

# **TPC BENCHMARK™ W**

## **(Web Commerce)**

### **Specification**

Version 1.8

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## Table of Contents

<b>Clause 0 - PREAMBLE</b>	<b>1</b>
0.1 INTRODUCTION .....	1
0.2 GENERAL IMPLEMENTATION GUIDELINES .....	2
<b>Clause 1 - WEB OBJECT &amp; LOGICAL DATABASE DESIGN</b>	<b>4</b>
1.1 BUSINESS AND APPLICATION ENVIRONMENT .....	4
1.2 DEFINITION OF TERMS .....	5
1.3 DATABASE ENTITIES, RELATIONSHIPS, AND CHARACTERISTICS .....	6
1.4 TABLE LAYOUTS .....	<u>76</u>
1.5 WEB OBJECTS, CHARACTERISTICS AND RELATIONSHIP WITH DATABASE.....	<u>1140</u>
1.6 IMPLEMENTATION RULES.....	<u>1241</u>
1.7 INTEGRITY RULES .....	<u>1412</u>
1.8 DATA ACCESS TRANSPARENCY REQUIREMENTS .....	<u>1412</u>
<b>Clause 2 - WEB INTERACTIONS AND WORKLOAD PROFILE</b>	<b>1514</b>
2.1 DEFINITION OF TERMS .....	<u>1514</u>
2.2 IMPLEMENTATION RULES.....	<u>1715</u>
2.3 HOME WEB INTERACTION.....	<u>2321</u>
2.4 SHOPPING CART WEB INTERACTION.....	<u>2724</u>
2.5 CUSTOMER REGISTRATION WEB INTERACTION.....	<u>3129</u>
2.6 BUY REQUEST WEB INTERACTION.....	<u>3432</u>
2.7 BUY CONFIRM WEB INTERACTION.....	<u>4139</u>
2.8 ORDER INQUIRY WEB INTERACTION .....	<u>4644</u>
2.9 ORDER DISPLAY WEB INTERACTION.....	<u>4846</u>
2.10 SEARCH REQUEST WEB INTERACTION.....	<u>5250</u>
2.11 SEARCH RESULT WEB INTERACTION.....	<u>5452</u>
2.12 NEW PRODUCTS WEB INTERACTION.....	<u>5755</u>
2.13 BEST SELLERS WEB INTERACTION .....	<u>6058</u>
2.14 PRODUCT DETAIL WEB INTERACTION.....	<u>6361</u>
2.15 ADMIN REQUEST WEB INTERACTION .....	<u>6664</u>
2.16 ADMIN CONFIRM WEB INTERACTION .....	<u>6967</u>
<b>Clause 3 - DATABASE TRANSACTION AND SYSTEM PROPERTIES</b>	<b>7371</b>
3.1 DATABASE TRANSACTION ACID PROPERTIES.....	<u>7371</u>
3.2 WEB PAGE CONSISTENCY REQUIREMENTS .....	<u>8279</u>
<b>Clause 4 - SCALING AND DATABASE POPULATION</b>	<b>8481</b>
4.1 GENERAL SCALING RULE.....	<u>8481</u>
4.2 SCALING REQUIREMENTS .....	<u>8481</u>
4.3 CONFIGURATION.....	<u>8582</u>
4.4 180-DAY SPACE COMPUTATION.....	<u>8683</u>
4.5 WEB SERVER ACCESS LOG REQUIREMENTS .....	<u>8683</u>
4.6 DATABASE POPULATION .....	<u>8784</u>
4.7 TABLE POPULATION REQUIREMENTS.....	<u>9188</u>
4.8 WGEN DATA POPULATION GENERATOR.....	<u>9491</u>
<b>Clause 5 - PERFORMANCE METRICS AND RESPONSE TIME</b>	<b>9693</b>
5.1 DEFINITION OF TERMS .....	<u>9693</u>

5.2	WEB INTERACTION MIXES .....	9794
5.3	THINK TIME AND RESPONSE TIME.....	10399
5.4	COMPUTATION OF THROUGHPUT RATING .....	104100
5.5	MEASUREMENT INTERVAL REQUIREMENTS.....	105101
5.6	REQUIRED REPORTING .....	108104
5.7	ADDITIONAL PERFORMANCE STATISTICS .....	108104
<b>Clause 6 - SUT, RBE AND NETWORK DEFINITIONS</b>		<b>114110</b>
6.1	REMOTE BROWSER EMULATOR (RBE) .....	114110
6.2	USER SESSION DURATION.....	115111
6.3	SYSTEM UNDER TEST (SUT).....	116112
6.4	PAYMENT GATEWAY EMULATOR (PGE) .....	118114
6.5	MODEL OF THE COMPLETE TESTED SYSTEM.....	119115
6.6	COMMUNICATIONS INTERFACES DEFINITIONS .....	119115
6.7	OPERATIONAL CHARACTERISTICS OF THE MERCHANT COMMERCE APPLICATION.....	120116
<b>Clause 7 - PRICING</b>		<b>122118</b>
7.1	PRICING METHODOLOGY.....	122118
7.2	PRICED SYSTEM.....	124120
7.3	MAINTENANCE .....	125121
7.4	REQUIRED REPORTING .....	126122
<b>Clause 8 - FULL DISCLOSURE REPORT</b>		<b>127123</b>
8.1	GENERAL REQUIREMENTS .....	127123
8.2	EXECUTIVE SUMMARY .....	128124
8.3	CLAUSE 1 - WEB OBJECT AND LOGICAL DATABASE DESIGN .....	131127
8.4	CLAUSE 2 - WEB INTERACTIONS AND WORKLOAD .....	132128
8.5	CLAUSE 3 - DATABASE TRANSACTION AND SYSTEM PROPERTIES .....	132128
8.6	CLAUSE 4 - SCALING AND DATABASE POPULATION .....	132128
8.7	CLAUSE 5 PERFORMANCE METRICS AND RESPONSE TIMES .....	133129
8.8	CLAUSE 6 - SUT, RBE AND NETWORK.....	136132
8.9	CLAUSE 7 - PRICING.....	139134
8.10	CLAUSE 9 - AUDIT RELATED ITEMS.....	140135
8.11	AVAILABILITY OF THE FULL DISCLOSURE REPORT .....	140135
8.12	REVISIONS TO THE FULL DISCLOSURE REPORT .....	140135
<b>Clause 9 - AUDIT</b>		<b>143138</b>
9.1	GENERAL RULES.....	143138
9.2	AUDITOR'S CHECK LIST.....	143138
<b>Appendix A - CUSTOMER EVENT DIAGRAM</b>		<b>149144</b>
A.1	INTRODUCTORY EXPLANATIONS.....	149144
A.2	EVENT DIAGRAM 1.....	150145
A.3	EVENT DIAGRAM 2.....	151146
<b>Appendix B - SHOPPING STATE DIAGRAMS</b>		<b>152147</b>
B.1	INTRODUCTORY EXPLANATIONS.....	152147
B.2	THE STATE VALUES.....	152147
B.3	THE STATE TRANSITION DIAGRAM.....	153148
B.4	COMMUNICATION BETWEEN RBE AND SUT OF EXISTENCE OF SHOPPING SESSION .....	154149
<b>Appendix C - INTRODUCTION TO SSL</b>		<b>155150</b>

C.1	OVERVIEW .....	<u>155150</u>
C.2	SSL V3 SPECIFICATIONS .....	<u>156150</u>
C.3	SSL V3 IMPLEMENTATION TOOLKITS .....	<u>156151</u>
C.4	OBTAINING A SERVER DIGITAL CERTIFICATE FOR TESTING .....	<u>156151</u>
<b>Appendix D - DATABASE POPULATION RATIONALE</b>		<b><u>158152</u></b>
D.1	DERIVATION OF 2880 CUSTOMERS PER BROWSER.....	<u>158152</u>
D.2	USING 8 HRS OF PEAK THROUGHPUT TO COMPUTE STORAGE.....	<u>158152</u>
<b>Appendix E - SAMPLE PSEUDO-CODE</b>		<b><u>159153</u></b>
<b>Appendix F - SAMPLE HTML CODE</b>		<b><u>164158</u></b>
F.1	ADMIN CONFIRM .....	<u>164158</u>
F.2	ADMIN REQUEST.....	<u>164158</u>
F.3	BEST SELLERS .....	<u>165159</u>
F.4	BUY CONFIRM .....	<u>169162</u>
F.5	BUY REQUEST .....	<u>171163</u>
F.6	CUSTOMER REGISTRATION.....	<u>173165</u>
F.7	HOME.....	<u>175167</u>
F.8	NEW PRODUCTS .....	<u>178170</u>
F.9	ORDER DISPLAY .....	<u>183173</u>
F.10	ORDER INQUIRY.....	<u>185175</u>
F.11	PRODUCT DETAIL .....	<u>185175</u>
F.12	SEARCH REQUEST .....	<u>186176</u>
F.13	SEARCH RESULTS .....	<u>187176</u>
F.14	SHOPPING CART .....	<u>188177</u>
<b>Appendix G - EXECUTIVE SUMMARY</b>		<b><u>190179</u></b>
G.1	IMPLEMENTATION OVERVIEW PAGE .....	<u>190179</u>
G.2	PRICING PAGE .....	<u>193182</u>
G.3	NUMERICAL QUANTITIES SUMMARY PAGE.....	<u>194183</u>
<b>Appendix H - WGEN UTILITY</b>		<b><u>195184</u></b>
H.1	DESCRIPTION.....	<u>195184</u>
H.2	USING WGEN .....	<u>195184</u>
H.3	COMMAND LINE OPTIONS .....	<u>196185</u>
H.4	ENVIRONMENT VARIABLES .....	<u>196185</u>
H.5	WGEN OUTPUT .....	<u>197186</u>
<b>Appendix I - STANDARD REFERENCES</b>		<b><u>200189</u></b>
I.1	INTERNET RFCS .....	<u>200189</u>
I.2	COMMON LOG FORMAT .....	<u>200189</u>

## Clause 0 - PREAMBLE

### 0.1 Introduction

TPC Benchmark™ W (TPC-W) is a transactional web benchmark. The workload is performed in a controlled internet commerce environment that simulates the activities of a business oriented transactional web server. The workload exercises a breadth of system components associated with such environments, which are characterized by:

- ? Multiple on-line browser sessions
- ? Dynamic page generation with database access and update
- ? Consistent web objects
- ? The simultaneous execution of multiple transaction types that span a breadth of complexity
- ? On-line transaction execution modes
- ? Databases consisting of many tables with a wide variety of sizes, attributes, and relationships
- ? Transaction integrity (ACID properties)
- ? Contention on data access and update

The performance metric reported by TPC-W is the number of web interactions processed per second. Multiple web interactions are used to simulate the activity of a retail store, and each interaction is subject to a response time constraint. The store size is chosen from among a set of given scale factors, which is the number of Items in inventory and varies from 1,000 items to 10,000,000 items. The performance metric for this benchmark is expressed in Web Interactions Per Second at a tested scale factor expressed by WIPS@scale factor where scale factor is the number of items in the ITEM table. For example 123WIPS@100,000. All references to WIPS in this specification mean WIPS@scale factor.

TPC-W simulates three different profiles by varying the ratio of browse to buy: primarily shopping (WIPS), browsing (WIPsb) and web-based ordering (WIPSo). All references to WIPS (WIPsb, WIPSo) results must include the primary metrics, which are: the WIPS rate, the associated price per WIPS (\$/WIPS), and the availability date of the priced configuration.

The following functions, if used in the benchmark, must be provided by commercially available products and be transparent to the Application Program (See Clauses 1.2.10 and 2.2.22):

- ? Multiplexing
- ? Routing
- ? Load Balancing
- ? Caching (see Clause 6.3.3.1)

**Comment:** The transparency requirement means that the application must not have code that directly references these functions during the measurement interval. To implement the electronic commerce function one may use commercially available products or implementation specific programs.

The electronic commerce function must include, at minimum, the following capabilities as defined in this specification:

- ? Secure Socket Layer (SSL)
- ? Shopping Cart
- ? Credit Card Verification
- ? Secure on-line payment authorization

Although these specifications express implementation in terms of a relational data model with a conventional locking scheme, the database may be implemented using any commercially available database management system (DBMS), database server, file system, or other data repository that provides a functionally equivalent implementation. The terms "table", "row", and "column" are used in this document only as examples of logical data structures.

TPC-W uses terminology and metrics that are similar to other benchmarks originated by the TPC or others. Such similarity in terminology does not in any way imply that TPC-W results are comparable to other benchmarks. The only benchmark results comparable to TPC-W are other TPC-W results with the appropriate revision and same scale factor.

Despite the fact that this benchmark offers a rich environment that emulates many web browsing and web-based ordering applications, this benchmark does not reflect the entire range of web server requirements. In addition, the extent to which a customer can achieve the results reported by a vendor is highly dependent on how closely TPC-W approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.

Benchmark results are highly dependent upon workload, specific application requirements, systems design, and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC-W should not be used as a substitute for a specific customer application benchmarking when critical capacity planning and/or product evaluation decisions are contemplated.

Benchmark sponsors are permitted several possible system designs, insofar as they adhere to the model described and pictorially illustrated in Clause 6. A Full Disclosure Report of the implementation details, as specified in Clause 8, must be made available along with the reported results.

**Comment:** While separated from the main text for readability, comments are a part of the standard and are enforced. However, the sample programs included as Appendix E, the summary statements included as Appendix G, and the numerical quantities summary, included as Appendix G, are provided only as examples and are specifically not part of this standard.

## 0.2 General Implementation Guidelines

The purpose of TPC benchmarks is to provide relevant, objective performance data to industry users. To achieve that purpose, TPC benchmark specifications require that benchmark tests be implemented with systems, products, technologies and pricing that:

- ? Are generally available to users.
- ? Are relevant to the market segment that the individual TPC benchmark models or represents (e.g. TPC-W models and represents high-volume, complex web browsing and web-based ordering environments).

- ? A significant number of users in the market segment the benchmark models or represents would plausibly implement.

The use of new systems, products, technologies (hardware or software), and pricing is encouraged so long as they meet the requirements above. Specifically prohibited are benchmark systems, products, technologies, pricing, and implementations whose primary purpose is performance optimization of TPC benchmark results without any corresponding applicability to real-world applications and environments. In other words, all "benchmark special" implementations that improve benchmark results but not real-world performance or pricing, are prohibited.

The following characteristics should be used as a guide to judge whether a particular implementation is a benchmark special. It is not required that each point below be met, but that the cumulative weight of the evidence be considered to identify an unacceptable implementation. Absolute certainty or certainty beyond a reasonable doubt is not required to make a judgment on this complex issue. The question that must be answered is this: based on the available evidence, does the clear preponderance (the greater share or weight) of evidence indicate that this implementation is a benchmark special?

The following characteristics should be used to judge whether a particular implementation is a benchmark special:

- a) Is the implementation generally available, documented, and supported?
- b) Does the implementation have significant restrictions on its use or applicability that limits its use beyond TPC benchmarks?
- c) Is the implementation or part of the implementation poorly integrated into the larger product?
- d) Does the implementation take special advantage of the limited nature of TPC benchmarks (e.g., transaction profile, transaction mix, transaction concurrency and/or contention, transaction isolation) in a manner that would not be generally applicable to the environment the benchmark represents?
- e) Is the use of the implementation discouraged by the vendor? (This includes failing to promote the implementation in a manner similar to other products and technologies.)
- f) Does the implementation require uncommon sophistication on the part of the end-user, programmer, or system administrator?
- g) Is the pricing unusual or non-customary for the vendor or unusual or non-customary to normal business practices? The following pricing practices are suspect:
  - ? Availability of a discount to a small subset of possible customers.
  - ? Discounts documented in an unusual or non-customary manner.
  - ? Discounts that exceed 25% on small quantities and 50% on large quantities.
  - ? Pricing featured as a close-out or one-time special.
  - ? Unusual or non-customary restrictions on transferability of product, warranty or maintenance on discounted items.
- h) Is the implementation being used (including beta) or purchased by end-users in the market area the benchmark represents? How many? Multiple sites? If the implementation is not currently being used by end-users, is there any evidence to indicate that it will be used by a significant number of users?

## **Clause 1 - WEB OBJECT & LOGICAL DATABASE DESIGN**

### **1.1 Business and Application Environment**

TPC Benchmark™ W comprise a set of basic operations designed to exercise transactional web system functionality in a manner representative of internet commerce application environments. These basic operations have been given a real-life context, portraying the activity of a web site that supports user browsing, searching and online ordering activity. This is intended to help users relate intuitively to the components of the benchmark. The workload is centered around the activity of browsing, searching and processing orders and provides a logical database design, which can be distributed without structural changes to the application.

TPC-W does not represent the activity of any particular business segment, but rather any industry that must market and sell a product or service over the Internet (e.g., retail store, software distribution, airline reservation, etc.). TPC-W does not attempt to be a model of how to build an actual application.

The purpose of this benchmark is to reduce the diversity of operations found in an internet commerce application, while retaining the application's essential performance characteristics, namely: the level of system utilization and the complexity of operations. A large number of functions have to be performed to manage an environment which supports browse and order processing. We include a representative set of functions. Many other functions are not of primary interest for performance analysis, since they are proportionally small in terms of system resource utilization or in terms of frequency of execution. Although these functions are vital for a production system, they merely create unnecessary diversity in the context of a standard benchmark and have been omitted in TPC-W.

The application portrayed by the benchmark is a retail store on the internet with customer browse and order scenario. Customers visit the company web site, the store-front, to look at products, find information, place an order, or request the status of an existing order. The majority of visitor activity is to browse the site. Some percentage of all visits result in submitting a new order. In addition to using the system as a store-front, it is also used for administration of the web site. Administration includes modification to the store-front.

## 1.2 Definition of Terms

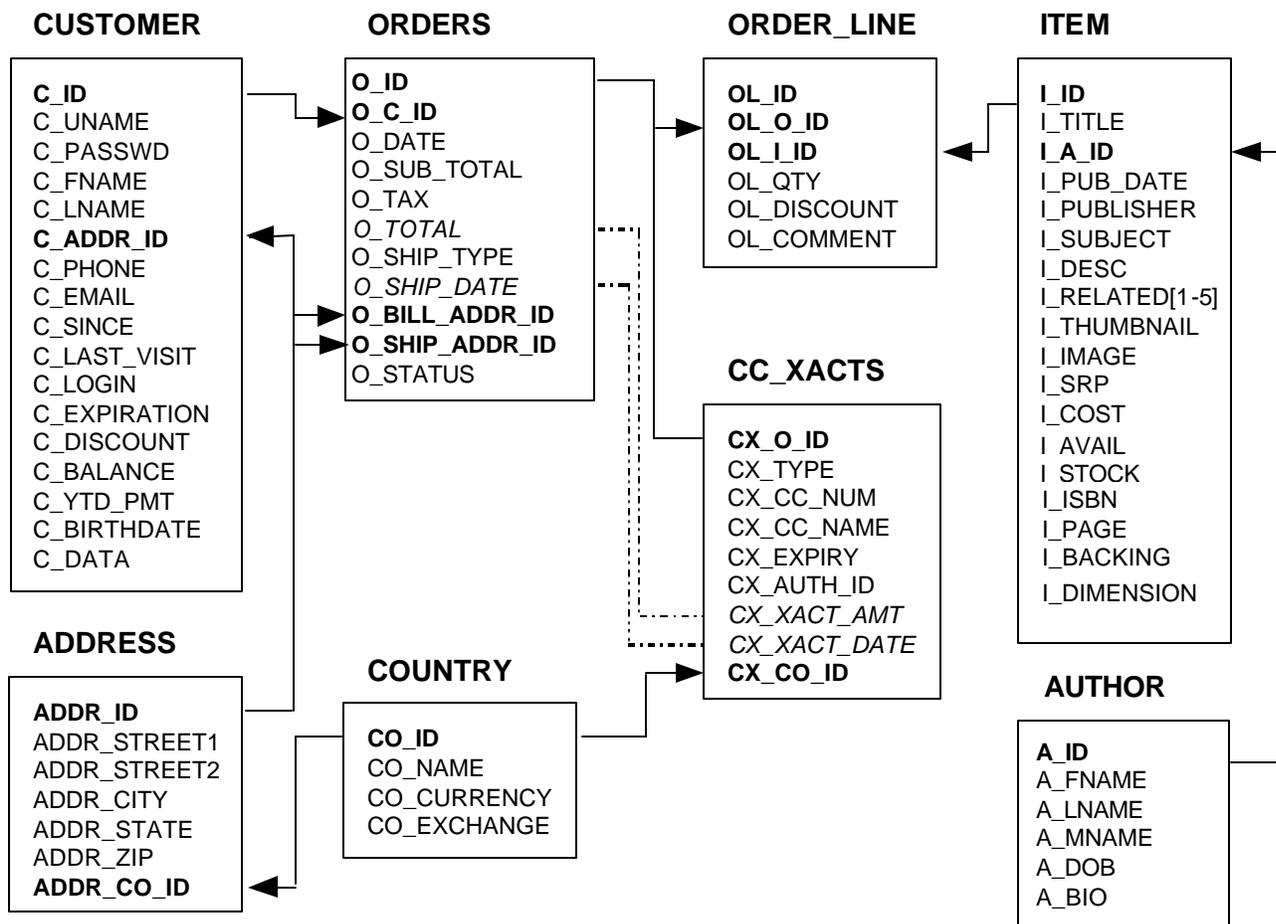
- 1.2.1 The term **N unique IDs** is used in this specification to refer to a field that must be able to hold any one ID within a minimum set of N unique IDs, regardless of the physical representation (e.g., binary, packed decimal, alphabetic, etc.) of the field.
- 1.2.2 The term **Fixed text, size N** is used in this specification to refer to a field that must be able to hold any string of characters of a fixed length of N. If the string it holds is shorter than N characters, it must be padded with spaces.
- 1.2.3 The term **Variable text, size N** is used in this specification to refer to a field that must be able to hold any string of characters of a variable length with a maximum length of N. The field may optionally be implemented as “fixed text, size N”.
- 1.2.4 The term **Date** is used in this specification to refer to a field that must be able to hold any date between 1st January 1800 and 31st December 2100 with a resolution of at least one day.
- 1.2.5 The term **Date and time** is used in this specification to refer to a field that must be able to hold any date between 1st January 1800 and 31st December 2100 with a resolution of at least one second.
- 1.2.6 The term **Current date** is used in this specification to refer to a date and time stamp as returned by the operating system.
- 1.2.7 The term **Numeric** is used in this specification to refer to a field that must be able to hold any numeric value. A field specified as **Numeric, N digits** must be able to hold any N decimal digits value. A field specified as **Numeric, (n,m) digits** must be able to hold any n decimal digits value before the decimal point and any m decimal digits value after the decimal point. Numeric fields that contain monetary values (**Numeric, (n,m) digits**) must use data types that give exact representation to at least the smallest monetary unit in the currency being used. For example, C\_BALANCE and C\_YTD\_PMT in U.S. dollars may be represented as (12,2) digit signed decimal (with implicit scaling), or scaled to cents in a signed integer of at least 41 bits, or scaled to cents in a double precision (64 bit) REAL.
- 1.2.8 The term **Null** is used in this specification to mean out of the range of valid values for a given datatype and always the same value.
- 1.2.9 The term **Image** is used in this specification to refer to an implementation specific method of storing an image or a pointer to an image stored elsewhere on the system under test.
- 1.2.10 The term **application program** is used in this specification to refer to code that is not part of the commercially available components of the system, but produced specifically to implement the web interactions and the database transactions defined in this benchmark. For example, stored procedures, triggers, and referential integrity constraints are considered part of the application program when used to implement any portion of the web interactions or database transactions, but are not considered part of the application program when solely used to enforce integrity rules (see Clause 1.7) or transparency requirements (see Clause 1.8) independently of any specific web interaction or database transaction.

The use of commercially available products is encouraged. If these products are used, code, API calls and configuration files that are used to control and/or manage the operation of the commercial products or allow interoperability between commercially available products are not considered part of the Application Program. The code, API calls and configuration files must be applicable to similar Ecommerce applications and not specific to the TPC-W benchmark implementation.

### 1.3 Database Entities, Relationships, and Characteristics

1.3.1 The components of the TPC-W database are defined to consist of a minimum of eight separate and individual base tables. The relationships among these tables are defined in the entity-relationship diagram shown below and are subject to the rules specified in Clause 1.5. A base table can not be implemented as a view.

**Comment:** To enable commercial products (commerce or merchant applications) to execute the workload without extensive modifications, a superset of the database schema is allowed. This could be in the form of additional tables. All such additions and/or modifications should be fully disclosed.



**Legend:**

? Dotted lines represent one-to-one relationships between non-key fields related through a business rule. These fields are shown in italic.

? The arrows point in the direction of one-to-many relationships between tables.

? Bold types identify primary and foreign keys.

## 1.4 Table Layouts

The following lists define the structure (list of fields) of each table. For each table, the defined fields can be implemented in any order, using any physical representation available from the tested system.

**Comment:** Table and column names are used for illustration purposes only; different names may be used by the implementation.

### 1.4.1 ITEM Table Layout

Field Name	Field Definition	Comments
I_ID	Numeric, 10 digits	Unique ID of Item
I_TITLE	Variable text, size 60	Title of Item
I_A_ID	Numeric, 10 digits	Author ID of Item
I_PUB_DATE	Date	Date of release of the product
I_PUBLISHER	Variable text, size 60	Publisher of item
I_SUBJECT	Variable text, size 60	Subject of Book
I_DESC	Variable text, size 500	Description of Item
I_RELATED1	Numeric, 10 digits	Unique Item ID (I_ID) of related item
I_RELATED2	Numeric, 10 digits	Unique Item ID (I_ID) of related item
I_RELATED3	Numeric, 10 digits	Unique Item ID (I_ID) of related item
I_RELATED4	Numeric, 10 digits	Unique Item ID (I_ID) of related item
I_RELATED5	Numeric, 10 digits	Unique Item ID (I_ID) of related item
I_THUMBNAIL	Image	Thumbnail image of Item or pointer to thumbnail image
I_IMAGE	Image	Item image or pointer to image
I_SRP	Numeric, (15,2) digits	Suggested Retail Price
I_COST	Numeric, (15,2) digits	Cost of Item
I_AVAIL	Date	When item is available
I_STOCK	Numeric, 4 digits	Quantity in stock
I_ISBN	Fixed text, size 13	Product ISBN
I_PAGE	Numeric, 4 digits	Number of pages of book
I_BACKING	Variable text, size 15	Type of book, paper or hard back
I_DIMENSIONS	Variable text, size 25	Size of book in inches

---

Primary Key: (I\_ID)  
(I\_A\_ID) Foreign Key, references (A\_ID)

---

#### 1.4.2 COUNTRY Table Layout

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Field Name	Field Definition	Comments
CO_ID	Numeric, 4 digits	Unique Country ID
CO_NAME	Variable text, size 50	Name of Country
CO_EXCHANGE	Numeric, (6, 6) digits	Exchange rate to US Dollars
CO_CURRENCY	Variable text, size 18	Name of Currency

Primary Key: (CO\_ID)

---

#### 1.4.3 AUTHOR Table Layout

---

Field Name	Field Definition	Comments
A_ID	Numeric, 10 digits	Unique Author ID
A_FNAME	Variable text, size 20	First Name of Author
A_LNAME	Variable text, size 20	Last Name of Author
A_MNAME	Variable text, size 20	Middle Name of Author
A_DOB	Date	Date of Birth of Author
A_BIO	Variable text, size 500	About the Author

Primary Key: (A\_ID)

---

#### 1.4.4 CUSTOMER Table Layout

---

Field Name	Field Definition	Comments
C_ID	Numeric, 10 digits	Unique ID per Customer
C_UNAME	Variable text, size 20	Unique User Name for Customer
C_PASSWD	Variable text, size 20	User Password for Customer
C_FNAME	Variable text, size 15	First name of Customer
C_LNAME	Variable text, size 15	Last name of Customer
C_ADDR_ID	Numeric, 10 digits	Address ID of Customer
C_PHONE	Variable text, size 16	Phone number of Customer
C_EMAIL	Variable text, size 50	For sending purchase confirmations
C_SINCE	Date	Date of Customer registration
C_LAST_VISIT	Date	Date of last visit
C_LOGIN	Date and time	Start of Current Customer Session
C_EXPIRATION	Date and time	Current Customer Session Expiry
C_DISCOUNT	Numeric, (3,2) digits	Percentage discount for Customer
C_BALANCE	Sign numeric, (15,2) digits	Balance of Customer
C_YTD_PMT	Numeric, (15,2) digits	YTD Payment of Customer
C_BIRTHDATE	Date	Birth date of Customer
C_DATA	Variable text, size 500	Miscellaneous information

Primary Key: (C\_ID)  
(C\_ADDR\_ID) Foreign Key, references (ADDR\_ID)

---

#### 1.4.5 ORDERS Table Layout

---

Field Name	Field Definition	Comments
O_ID	Numeric, 10 digits	Unique ID per order
O_C_ID	Numeric, 10 digits	Customer ID of Order
O_DATE	Date and time	Order Date and time
O_SUB_TOTAL	Numeric, (15,2) digits	Subtotal of all order-line items
O_TAX	Numeric, (15,2) digits	Tax over the subtotal
O_TOTAL	Numeric, (15,2) digits	Total for this order
O_SHIP_TYPE	Variable text, size 10	Method of delivery
O_SHIP_DATE	Date and time	Order Ship Date
O_BILL_ADDR_ID	Numeric, 10 digits	Address ID to bill
O_SHIP_ADDR_ID	Numeric, 10 digits	Address ID to ship order
O_STATUS	Variable text, size 15	Order status

---

---

Primary Key: (O\_ID)  
(O\_C\_ID) Foreign Key, references (C\_ID); (O\_BILL\_ADDR, O\_SHIP\_ADDR) Foreign Key,  
references (ADDR\_ID)

---

#### 1.4.6 ORDER\_LINE Table Layout

---

Field Name	Field Definition	Comments
OL_ID	Numeric, 3 digits	Unique Order Line Item ID
OL_O_ID	Numeric, 10 digits	Order ID of Order Line
OL_I_ID	Numeric, 10 digits	Unique Item ID (I_ID)
OL_QTY	Numeric, 3 digits	Quantity of Item
OL_DISCOUNT	Numeric, (3,2) digits	Percentage discount off of I_SRP
OL_COMMENTS	Variable text, size 100	Special Instructions

Primary Key: (OL\_ID, OL\_O\_ID)  
(OL\_I\_ID) Foreign Key, references (I\_ID); (OL\_O\_ID) Foreign Key, references (O\_ID)

---

#### 1.4.7 CC\_XACTS Table Layout (Credit Card Transaction Table)

---

Field Name	Field Definition	Comments
CX_O_ID	Numeric, 10 digits	Unique Order ID (O_ID)
CX_TYPE	Variable text, size 10	Credit card type
CX_NUM	Numeric, 16 digits	Credit card number
CX_NAME	Variable text, size 31	Name on credit card
CX_EXPIRY	Date	Expiration date of credit card
CX_AUTH_ID	Fixed text, size 15	Authorization for transaction amount
CX_XACT_AMT	Numeric, (15,2) digits	Amount for this transaction
CX_XACT_DATE	Date and time	Date and time of authorization
CX_CO_ID	Numeric, 4 digits	Country where transaction originated

Primary Key: (CX\_O\_ID)  
(CX\_O\_ID) Foreign Key, references (O\_ID); (CX\_CO\_ID) Foreign Key, references (CO\_ID)

---

### 1.4.8 ADDRESS Table Layout

---

Field Name	Field Definition	Comments
ADDR_ID	Numeric, 10 digits	Unique address ID
ADDR_STREET1	Variable text, size 40	Street address, line 1
ADDR_STREET2	Variable text, size 40	Street address, line 2
ADDR_CITY	Variable text, size 30	Name of city
ADDR_STATE	Variable text, size 20	Name of state
ADDR_ZIP	Variable text, size 10	Zip code or Postal code
ADDR_CO_ID	Numeric, 4 digits	Unique ID of Country

Primary Key: (ADDR\_ID)  
(ADDR\_CO\_ID) Foreign Key, references (CO\_ID)

---

## 1.5 Web Objects, Characteristics and Relationship with Database

The following defines the JPEG and GIF objects used in this benchmark.

1.5.1 The image components of the TPC-W web objects are defined to consist of images of varying sizes in JPEG format. The currently defined sizes are: 5K, 10K, 50K, 100K and 250KB. The images are meant to represent data flow of different media on the web such as images, audio, video-stream, animated GIF, etc. Each of these images is generated using the TPC-W Image Generator (available on the TPC web site). The total number of unique images generated is equal to the cardinality of the ITEM table to represent each item's image and other rich media on the site (see Clause 4.6). The distribution for the different image sizes follows:

? 5K images	45%
? 10K images	35%
? 50K images	15%
? 100K images	4%
? 250K images	1%

- 1.5.2 Each item from the ITEM table also has a thumbnail image, I\_THUMBNAIL, of 5 K-bytes associated with it. These images are also generated using the TPC-W Image Generator.
- 1.5.3 The store-front has predetermined GIF images for navigation. This includes the buttons such as those for <Home>, <Search>, <Shopping Cart>, and <Checkout>. The implementation of the benchmark must use the button images that are part of the TPC-W sample web pages on the TPC-W website.

## 1.6 Implementation Rules

- 1.6.1 The physical clustering of records within the database is allowed.
- 1.6.2 All tables must have the properly scaled number of rows as defined by the database population requirements (see Clause 4.3).
- 1.6.3 Horizontal partitioning of tables is allowed. Groups of rows from a table may be assigned to different files, disks, or areas. If implemented, the details of such partitioning must be disclosed.
- 1.6.4 Vertical partitioning of tables is allowed. Groups of fields (columns) of one table may be assigned to files, disks, or areas different from those storing the other fields of that table. If implemented, the details of such partitioning must be disclosed (see Clause 1.7 for limitations).
- 1.6.5 Replication is allowed for all tables. Manipulation of data in all copies of tables which are replicated must meet all requirements for atomicity, consistency, and isolation as defined in Clause 3. If implemented, the details of such replication must be disclosed.

**Comment:** Only one copy of a replicated table needs to meet the durability requirements defined in Clause 3.

- 1.6.6 Fields may not be added and/or duplicated from one table to another. Fields may not be duplicated from one table into any of the other tables defined in 1.4. This does not preclude the use of views, temporary tables or permanent tables which do combine fields from multiple tables. However these are done, they must meet the ACID requirements. The application must maintain the original tables as specified in Clause 1.4.
- 1.6.7 Each field, as described in Clause 1.4, must be logically discrete and independently accessible by the data manager. For example, A\_FNAME, A\_MNAME and A\_LNAME cannot be implemented as three sub-parts of a discrete attribute A\_NAME.
- 1.6.8 Each field, as described in Clause 1.4, must be accessible by the data manager as a single field. For example, C\_DATA cannot be implemented as two discrete fields C\_DATA\_1 and C\_DATA\_2.

**Comment:** The following fields are exceptions to this clause: All fields holding a time-and-date value (i.e., C\_LOGIN, C\_EXPIRATION, O\_DATE, O\_SHIP\_DATE and CX\_XACT\_DATE) can be implemented as a combination of two fields: a date field and a time field. No vertical partitioning can be defined between the two fields used to implement it.

1.6.9 The primary key of each table must not directly represent the physical disk addresses of the row or any offsets thereof. The application may not reference rows using relative addressing since they are simply offsets from the beginning of the storage space. This does not preclude hashing schemes or other file organizations which have provisions for adding, deleting, and modifying records in the ordinary course of processing.

**Comment 1:** It is the intent of this clause that the application program (see Clause 1.2.10) executing the database transaction, or submitting the database transaction request, not use physical identifiers, but logical identifiers for all accesses, and contain no user written code which translates or aids in the translation of a logical key to the location within the table of the associated row or rows. For example, it is not legitimate for the application to build a "translation table" of logical-to-physical addresses and use it to enhance performance.

**Comment 2:** Internal record or row identifiers, for example, tuple IDs or cursors, may be used under the condition that within each database transaction, initial access to any row must be via a logical key comprised only of fields from that row. Initial access includes insertion, deletion, retrieval, and update of any row.

1.6.10 In the case where web objects are stored outside of the ITEM table and referenced in the ITEM table by a pointer managed by the application program (see Clause 1.2.10), that pointer must not directly represent the physical disk addresses of the object or any offsets thereof. The application may not reference objects using relative addressing since they are simply offsets from the beginning of the storage space. This does not preclude hashing schemes or other file organizations which have provisions for adding, deleting, and modifying objects in the ordinary course of processing.

1.6.11 While inserts and deletes are not performed on all tables, the system must not be configured to take special advantage of this fact during the test. Although inserts are inherently limited by the storage space available on the configured system, there must be no restriction on inserting in any of the tables a minimum number of rows equal to 5% of the table cardinality and with a key value of at least double the range of key values present in that table.

**Comment:** It is required that the space for the additional 5% table cardinality be configured for the Test Run (see clause 5.5.1.1) and priced accordingly. If a commercial product is used for the application which requires a superset of the database schema, then the space configured and priced should include the additional storage needed for the additional tables and/or fields. For systems where space is configured and dynamically allocated at a later time, this space must be considered as allocated and included in the priced system (see Clause 4.4).

- 1.6.12 The minimum decimal precision for any computation performed as part of the application program (see Clause 1.2.10) must be the maximum decimal precision of all the individual items in that calculation. The application code must handle the entire range of values as defined in clause 1.4.

## 1.7 Integrity Rules

- 1.7.1 In any committed state, the primary key values must be unique within each table. For example, in the case of a horizontally partitioned table, primary key values of rows across all partitions must be unique.

## 1.8 Data Access Transparency Requirements

Data access transparency is the property of the system which removes from the application program any knowledge of the location and access mechanisms of partitioned data. An implementation which uses vertical and/or horizontal partitioning must meet the requirements for transparent data access described here.

No finite series of tests can prove that the system supports complete data access transparency. The requirements below describe the minimum capabilities needed to establish that the system provides transparent data access.

**Comment:** The intent of this clause is to require that access to physically and/or logically partitioned data be provided directly and transparently by services implemented by commercially available layers below the application program such as the data/file manager (DBMS), the operating system, the hardware, or any combination of these.

- 1.8.1 All tables used by the application must be identified by names which have no relationship to the partitioning of tables. All data manipulation operations in the application program (see Clause 1.2.10) must use only these names.

- 1.8.2 The system must prevent any data manipulation operation performed using the names described in Clause 1.8.1 which would result in a violation of the integrity rules (see Clause 1.6).

- 1.8.3 Using the names which satisfy Clause 1.8.1, any arbitrary non-TPC-W application must be able to manipulate any set of rows or columns:

? Identifiable by any arbitrary condition supported by the underlying DBMS

? Using the names described in Clause 1.8.1 and using the same data manipulation semantics and syntax for all tables.

For example, the semantics and syntax used to update an arbitrary set of rows in any one table must also be usable when updating another arbitrary set of rows in any other table.

**Comment:** The intent is that the TPC-W application program uses general purpose mechanisms to manipulate data in the database.

## Clause 2 - WEB INTERACTIONS AND WORKLOAD PROFILE

### 2.1 Definition of Terms

- 2.1.1 The term **User** is used in this specification to refer to an entity (usually a human; could be a software program) that communicates with the System Under Test (SUT, defined in clause 6.3) via a Browser.
- 2.1.2 The term **Browser** as used in this specification refers to the interface device capable of entering and displaying HTTP V 1.0, HTTP V1.1, HTML V 3.0, JavaScript, Java, images (GIF & JPEG), audio and movie streams via TCP/IP. A browser is defined as the components that facilitate User input and the display of the output pages as defined in Clause 2. Hypertext Transfer Protocol 1.1 (HTTP 1.1), as defined in RFC 2068 <http://www.ietf.org/rfc/rfc2068.txt>
- 2.1.3 The term **Emulated Browser (EB)** is used in this specification to refer to the entity (e.g., a process or a thread) that emulates a user communicating via a Browser by sending and receiving HTML content via HTTP and TCP/IP over a network connection (e.g., a socket) to the SUT.
- 2.1.4 The term **web interaction** is used in this specification to refer to a complete cycle of communication between the EB and the SUT. This cycle starts when the EB selects a navigation option from the previously displayed web page or when requesting the Home Page for the first time. It includes one or more exchanges of messages between the SUT and the EB. These exchanges may include the request and communication of cookies, HTML pages, image files or other web objects. The number and types of such exchanges are benchmark implementation specific. The cycle also includes some processing to take place on the SUT. The cycle is completed when the last byte of data from the response page, including all referenced embedded objects, has been received by the EB.
- 2.1.5 The term **User Session** is used in this specification to refer to a continuous period of time during which an EB requests one or more web interactions, starting with the Home web interaction and ending as defined in clause 6.2.
- 2.1.6 The term **Customer** is used in this specification to refer to a User whose identity has been recorded by the SUT in the CUSTOMER table.
- 2.1.7 The term **Shopping Session** is used in this specification to refer to a continuous period of time during which an EB requests one or more web interactions, starting as early as when it first requests the Home web interaction and no later than when it requests the Shopping Cart web interaction for the first time.

**Comment:** The information required to be able to identify if the User requesting the web interaction has an active Shopping Session must be communicated by the EB to the SUT during each web interaction (see Clause 2.2.5).

- 2.1.8 The term **Web Logging** is used in this specification to refer to entries in the Web Server Access Log.
- 2.1.9 The term **database transaction** as used in this specification refers to one or more operations that result in a unit of work on the database with full ACID properties as described in Clause 3. A web interaction may be comprised of one or more database transactions. When a database transaction includes more than one operation, the set of operations is enclosed between the tags <start transaction> and <end transaction>.

The order of the data manipulations within the transaction bounds is immaterial, unless otherwise specified, and is left to the latitude of the test sponsor, as long as the implemented transactions are functionally equivalent to those specified in the transaction profiles.

- 2.1.10 The term **atomic set of operations** is used in this specification to refer to a set of operations that results in data updates (addition, deletion, modification) within the SUT and has the property to guarantee that either all updates will be completed; or that none of the updates will be completed, leaving all targeted data unchanged. When defined as atomic, a set of operations is enclosed between the tags <start atomic set> and <end atomic set>. The order of the functions within the set bounds is immaterial, unless otherwise specified, and is left to the test sponsor, as long as the implementation is functionally equivalent to those specified in the interaction.
- 2.1.11 The term **obtained** is used in this specification to refer to the action of retrieving the current value of a given field from within the SUT. The location within the SUT from which the value is retrieved, such as database, cache, or other, is not specified and is only constrained by the web interaction definitions and by the ACID requirements.
- 2.1.12 The term **randomly selected within [x.. y]** means independently selected at random and uniformly distributed between x and y, inclusively, with a mean of (x+y)/2, and with the same number of digits of precision as shown. For example, [0.01 .. 100.00] has 10,000 unique values, whereas [1 ..100] has only 100 unique values.
- 2.1.13 The term **non-uniform random function (NURand)** is used in this specification to refer to the function used for generating C\_ID and the targets for the Search Request web interactions. This function generates an independently selected and non-uniformly distributed random number over the specified range of values [x .. y], and is specified as follows:

$$\text{NURand}(A, x, y) = ((\text{random}(0, A) \mid \text{random}(x, y)) \% (y - x + 1)) + x$$

Where:

expr1 | expr2 stands for the bitwise logical OR operation between expr1 and expr2

expr1 % expr2 stands for expr1 modulo expr2

random(x, y) stands for randomly selected within [x .. y]

A is a constant chosen according to the size of the range [x .. y]

## 2.2 Implementation Rules

2.2.1 A web interaction can be either unprotected or secure. In secure web interactions all communications between the EB and the SUT must be encrypted and communicated with SSL version 3, or with TLS (RFC2246), using SSL\_RSA\_WITH\_RC4\_128\_MD5 as the cipher suite. The private key for the server digital certificate must be at least 1024 bits. A description of the cipher suite can be found at:

<http://www.home.netscape.com/eng/ss13/4-APPN.HTM#C>

Please refer to Appendix I.

2.2.2 Each User Session which requires one or more secure interactions must establish its own SSL session and execute a full handshake. SSL sessions must not be shared by multiple User Sessions.

2.2.3 When starting a new User Session, the EB must emulate one of the following two scenarios:

1. Submit a request from a User that is not a Customer. This scenario is chosen by the EB 20% of the time. At some point, the User may become a Customer.
2. Submit a request from a Customer and provide its Customer identification to the SUT. This scenario is chosen by the EB 80% of the time. The Customer identification (C\_ID) of the returning Customer is chosen as specified in clause 2.3.2.

**Comment1:** Submitting a request from a Customer who does not provide its Customer identification to the SUT but, at some later time, identifies itself as a Customer is a scenario that is excluded from the benchmark. This scenario, while realistic, would increase the level of complexity without adding significant value to the workload.

**Comment2:** It is possible for a User to perform a User Session without ever identifying itself as a known Customer or without ever becoming a new Customer.

2.2.4 All Customers must identify themselves at the beginning of their User Session by communicating their C\_ID, or any other unique identifier allowing the SUT to obtain their C\_ID, during the first Home web interaction.

**Comment:** Communicating a Customer identification to the SUT can be implemented by various methods including, but not limited to, the passing of a field in the HTTP request, or the use of a cookie. The unique customer identifier is the only information about the Customer's identity that can be communicated by the Customer for the purpose of identification. There are no additional restrictions placed on format and content of the HTTP field or of the cookie or on other mechanism used for that purpose.

2.2.5 The SUT may choose to track all User Sessions using a unique SHOPPING\_ID. Once a User Session becomes a Shopping Session, the SUT must track it using a unique SHOPPING\_ID and an associated CART. The Shopping Session must be maintained by the SUT for at least two hours after the later of: (A) the creation of the CART or (B) the last update to the CART. CART is defined in clause 2.2.6.

**Comment:** Battery backed up memory with at least 2 hour retention is sufficient to meet this requirement providing all other requirements durable medium are met.

2.2.6 For each Shopping Session, the SUT must maintain an individual CART data structure that represents the User's shopping cart. This CART is associated with the unique SHOPPING\_ID assigned by the SUT to the Shopping Session. At minimum, the CART must be able to maintain the following information:

? SC_SHOPPING_ID	Unique identifier of the Shopping Session
? SC_C_ID	The C_ID of the Customer
? SC_DATE	The date and time when the CART was last updated
? SC_SUB_TOTAL	The gross total amount of all items in the CART
? SC_TAX	The tax based on the gross total amount
? SC_SHIP_COST	The total shipping and handling charges
? SC_TOTAL	The total amount of the order
? SC_C_FNAME	C_FNAME of the Customer
? SC_C_LNAME	C_LNAME of the Customer
? SC_C_DISCOUNT	C_DISCOUNT of the Customer
? A minimum of 100 items with:	
✎ SCL_I_ID	The I_ID for the item in the CART
✎ SCL_QTY	The quantity for the item in the CART
✎ SCL_COST	The cost of the item in the CART
✎ SCL_SRP	The list price for the item in the CART
✎ SCL_TITLE	The title of the item in the CART
✎ SCL_BACKING	The backing of the item in the CART

The physical implementation of the CART is not specified as long as it supports the above logical representation, that it is maintained by the SUT through the duration of the Shopping Session and that it is kept durable over any single point of failure (see Clause 3.1.5.3). The implementation and use of the CART is not considered to be caching.

- 2.2.7 The SUT may choose to track all Customers using their C\_ID. Once a Customer has been identified as the owner of a Shopping Session, its identity must be maintained within the CART associated with that Shopping Session.
- 2.2.8 The clauses titled **Input Requirements** define the minimum set of data required by the SUT as input to a web interaction. Similarly, the clause titled Navigation Options define the minimum set of data to be provided by the EB as input to a web interaction. The implementation may choose to augment these minimum sets of input data provided that it does not reduce the workload on the SUT and does not improve performance.
- 2.2.9 The clauses titled **Processing Definition** define the business logic that must be executed by the SUT as part of the interaction.
- 2.2.10 The clauses titled **Response Page Definition** include a sample of each response page and a set of minimum requirements for the HTML code produced by the SUT for that response page. In addition to these page specific requirements, all response pages must meet the following requirements:
1. The page content as displayed in the browser must be the same as or a superset of the sample response page. All web objects present in the sample must be included. Additional objects are allowed.
  2. The page layout as displayed in the browser must be similar to that of the sample response page. Changes in color, font, and background are allowed.
  3. All elements of the page (i.e., web objects) must be communicated individually.
  4. All tags in the HTML code must be W3C compliant.
  5. The HTML code may not contain or reference any active elements.
- 2.2.11 If caching is used, it must meet all the requirements of Clause 6.3.3.
- 2.2.12 The clauses titled **EB Navigation Options** define the set of navigation options that the EB must choose from. See Clause 5.2 for how the EB chooses a navigation option. An actual user has many additional navigation options (e.g., bookmarks, go menu, etc.) Those additional options (not included in the EB Navigation Options) are considered secondary and are not exercised during the benchmark execution.
- 2.2.13 The **Web Server Access Log** data must be collected with a minimum resolution of one second and written in Common Log Format (CLF) at least once every 30 seconds to a persistent media see Appendix I. The fields of CLF are as follows:
- ? client: DNS Name or IP address of remote client
  - ? dd: Day
  - ? mm: Month
  - ? yyyy: Year
  - ? hh: hour
  - ? mm: minutes
  - ? ss: seconds
  - ? request: First line of HTTP request as sent by the client
  - ? ddd: status code returned by the server
  - ? bbbb: Total number of bytes sent, not including HTTP header

**Comment:** The logging requirements defined above are required only for systems that run application code and are the primary store of images. Primary store is defined as the place the data is stored assuming all caches are empty. This does not mean the disk subsystems or RAID controllers, but the system that manages these components.

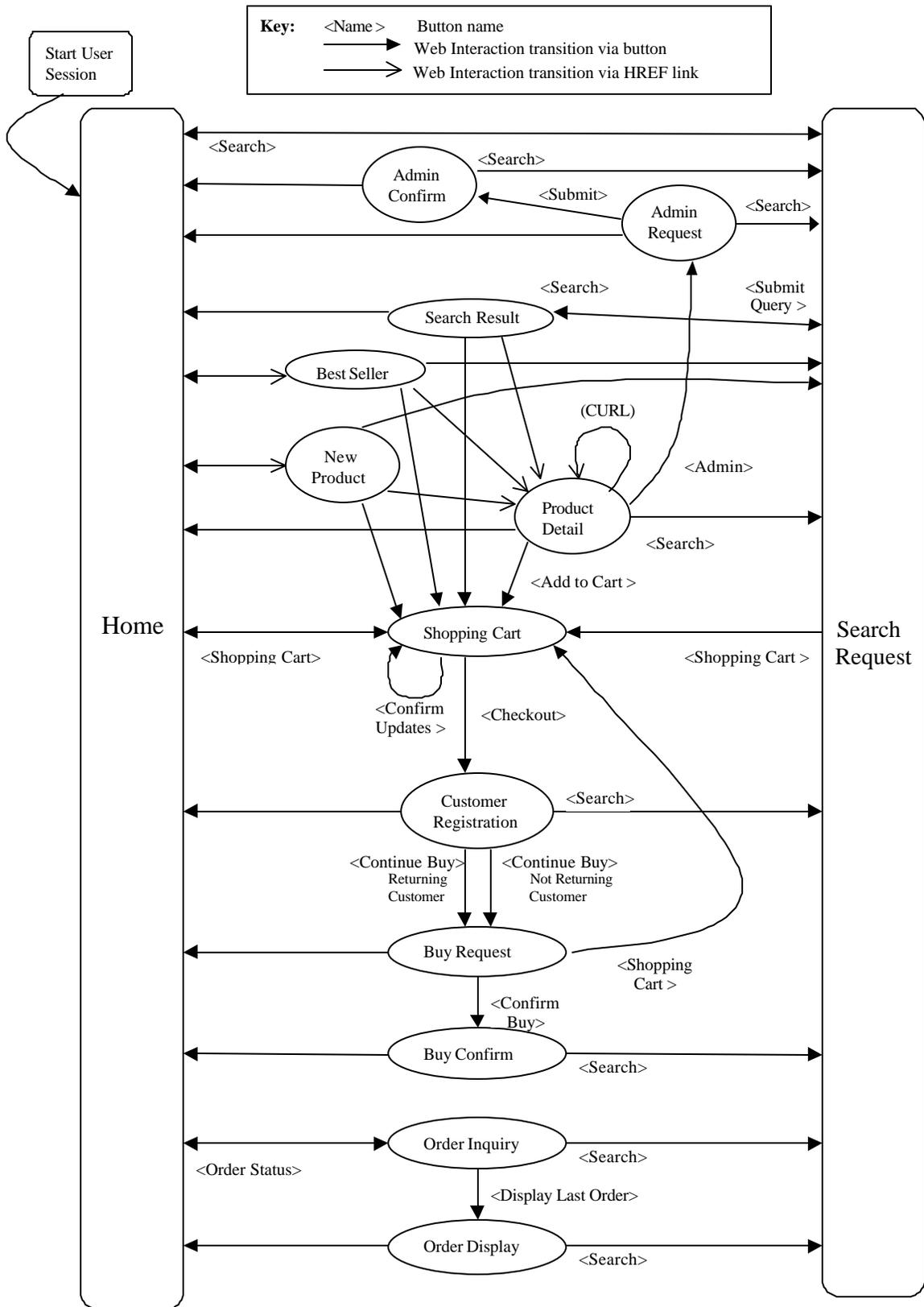
- 2.2.14 After an EB requests a New Products, Best Sellers, or Search Result web interaction, the EB must maintain a cached list of the URL's (**CURL**) that were contained in the response page for that web interaction, until such time that the EB selects a navigation option that is not the Product Detail web interaction. This CURL is maintained for the sole purpose of navigating from the Product Detail interaction back to the Product Detail interaction, as specified in clause 2.14.5.4.
- 2.2.15 During the processing of a Search Result web interaction the SUT is allowed to process the search on a commercially available text search engine that is not part of the DBMS.
- 2.2.16 The implementation of **flags**, as used in the web interaction definitions, is not specified. Flags are used to carry information from one web interaction to another. Examples of possible implementations include the use of a field in the HTTP request and the use of multiple URL's, each reflecting a different value for the flag.
- 2.2.17 There is no requirement for the implementation of the benchmark to allow the browser to input or to display any characters other than those defined in Clause 4.6.2.2.
- 2.2.18 The generic **Promotional Processing**, executed by selected web interactions, is defined as follows:
- ? The SUT selects a random I\_ID from a uniform distribution over the range of values defined in Clause 4.7.1.
  - ? The SUT obtains the five related items (I\_RELATED1, I\_RELATED2, I\_RELATED3, I\_RELATED4, I\_RELATED5) for the selected item.
  - ? The SUT obtains the thumbnail image, I\_THUMBNAIL, from each of the five related items.
  - ? The HTML to display each promotional item must also contain navigation to the appropriate product detail page.
- 2.2.19 The Admin Request and Admin Confirm web interactions are administrative tasks. They are not components that a regular customer would see, but exist as part of the model depicted by the workload.
- 2.2.20 The following diagram shows the sequencing of web interactions. During a User Session each Emulated Browser causes a sequence of web interactions to be performed. That sequence corresponds to a traversal of this diagram. Each node in the diagram contains the name of a web interaction type (Home, Best Seller, Search Request, etc.). An arrow between two nodes A and B (i.e., A ? B) indicates that after performing web interaction A, it is possible for an Emulated Browser to next perform the web interaction B. When there are multiple arrows leaving a node, the arc that is chosen for the next web interaction is determined probabilistically as described in Clause 5.

Each arrow with a solid head is annotated at its tail end with a label of the form "<foo>". This indicates that, in order to get to the pointed-to web interaction from the current web interaction, a button named "foo" is pressed (as emulated by the Emulated Browser). (Note however, that the <Home> labels are not indicated in the diagram in order to reduce clutter.) For example, the arc at the very top of the diagram indicates that, by pressing the <Search> button, the browser can go from the Home web interaction to the Search Request web interaction.

Arcs with open arrowheads indicate that, in order get to the pointed-to web interaction from the current web interaction, the emulated browser follows an HREF link provided by the current interaction. For example, the Best Seller web interaction for the subject of PARENTING returns several HREF's to the best selling products on parenting. The emulated browser can choose to look at the details of one of these products by following one of these HREF links. (I.e., a request of the Product Detail page for that product is made.)

The box in the upper left of the diagram labeled "Start User Session" does not represent a web interaction type. Rather, it indicates that the first web interaction of a User Session is always a Home web interaction.

Not indicated in the diagram is how User Sessions end. A User Session can end after performing any web interaction (other than the Home web interaction) such that the chosen next web interaction is Home, and that a requisite minimum amount of time has elapsed. See Clause 6.2.2 for the details of the conditions under which a User Session ends.



- 2.2.21 Each EB must use at least one independent random number generator (i.e., not shared with any other EB). Each random number generator must be seeded with a unique value. Although the selection of the unique seed is left to the implementer, it must not be done in a fashion that would improve performance.

The SUT is required to generate random numbers for certain Web Interactions. If these random numbers are generated by multiple random number generators for a particular Web Interaction, the initial random number generator seeds must be unique.

**Comment:** The intent of this Clause is to prevent a performance advantage that could result from all the EB's or SUT systems using random numbers generated from a single seed which may generate non-random accesses to the Web and database objects.

- 2.2.22 The application may perform functional routing (such as a text search service or an image service) to one or an unknown number of servers of each service type. The service may communicate directly back to the EB. Data dependent routing or load balance routing by the application is not allowed. The application may direct subsequent requests back to itself (known as affinity routing).

Application routing based on the value of the input requirements (e.g. item number), shall be limited to the following:

- ? Web Interaction URL,
- ? the search types,
- ? the subject types and
- ? web objects as defined in clause 1.5.

All other routing that uses input values is considered data dependent routing and must be done by a commercially available product.

- 2.2.23 Data within an interaction is only required to be obtained once, even though it may be referred to multiple times within that interaction.

## **2.3 Home Web Interaction**

### **2.3.1 Overview**

This unprotected web interaction returns to the EB a web page which contains links to product lists for new products and for best sellers. This is the initial web interaction requested by all Users starting a new User Session. It is also a navigation option from most other web pages.

### **2.3.2 Input Requirements**

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Home Page, which is contained in the HTTP request.
- ? If this is the first Home web interaction of a User Session and the User is a Customer, then the EB presents as input a C\_ID that was chosen using the NURand function defined in Clause 2.1.12 with the following parameters:

x = 1

y = NUM\_CUSTOMERS, where NUM\_CUSTOMERS is the initial cardinality of the CUSTOMER table.

A is chosen according to the following table:

For NUM_CUSTOMERS in this range	Value for A
1 - 9,999	1,023
10,000 - 39,999	4,095
40,000 - 159,999	16,383
160,000 - 639,999	65,535
640,000 - 2,559,999	262,143
2,560,000 - 10,239,999	1,048,575
10,240,000 - 40,959,999	4,194,303
40,960,000 - 163,839,999	16,777,215
163,840,000 - 655,359,999	67,108,863

**Comment:** This means that any C\_ID's assigned to newly-created Customers during a Test Run (as specified in clause 2.6.3.2) are never used by RBE's for returning Customer selections. That is, a new Customer will never be a returning Customer. The SUT is not allowed to take advantage of this fact to improve its performance.

### 2.3.3 Processing Definition

2.3.3.1 If this User is a Customer and its C\_ID is known, then the SUT obtains the following information about the Customer:

- ? C\_FNAME or SC\_C\_FNAME if the shopping session exists for this customer
- ? C\_LNAME or SC\_C\_LNAME if the shopping session exists for this customer

2.3.3.2 The SUT executes the Promotional Processing, as defined in Clause 2.2.18.

2.3.3.3 The SUT produces the HTML code for the Home Page and returns the web page to the EB.

2.3.3.4 The EB selects a navigation option according to Clause 5.2.2.

### 2.3.4 Response Page Definition

A sample of the Home Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Home Page

Welcome back **John Doe**

Click on one of our latest books to find out more !



## ***What's New***

<a href="#">ARTS</a>	<a href="#">NON-FICTION</a>
<a href="#">BIOGRAPHIES</a>	<a href="#">PARENTING</a>
<a href="#">BUSINESS</a>	<a href="#">POLITICS</a>
<a href="#">CHILDREN</a>	<a href="#">REFERENCE</a>
<a href="#">COMPUTERS</a>	<a href="#">RELIGION</a>
<a href="#">COOKING</a>	<a href="#">ROMANCE</a>
<a href="#">HEALTH</a>	<a href="#">SELF-HELP</a>
<a href="#">HISTORY</a>	<a href="#">SCIENCE-NATURE</a>
<a href="#">HOME</a>	<a href="#">SCIENCE-FICTION</a>
<a href="#">HUMOR</a>	<a href="#">SPORTS</a>
<a href="#">LITERATURE</a>	<a href="#">TRAVEL</a>
<a href="#">MYSTERY</a>	<a href="#">YOUTH</a>

## ***Best Sellers***

<a href="#">ARTS</a>	<a href="#">NON-FICTION</a>
<a href="#">BIOGRAPHIES</a>	<a href="#">PARENTING</a>
<a href="#">BUSINESS</a>	<a href="#">POLITICS</a>
<a href="#">CHILDREN</a>	<a href="#">REFERENCE</a>
<a href="#">COMPUTERS</a>	<a href="#">RELIGION</a>
<a href="#">COOKING</a>	<a href="#">ROMANCE</a>
<a href="#">HEALTH</a>	<a href="#">SELF-HELP</a>
<a href="#">HISTORY</a>	<a href="#">SCIENCE-NATURE</a>
<a href="#">HOME</a>	<a href="#">SCIENCE-FICTION</a>
<a href="#">HUMOR</a>	<a href="#">SPORTS</a>
<a href="#">LITERATURE</a>	<a href="#">TRAVEL</a>
<a href="#">MYSTERY</a>	<a href="#">YOUTH</a>

[Shopping Cart](#)

[Search](#)

[Order Status](#)

The HTML code for the Home Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 7,172 characters.
2. The following web objects must be referenced:
  - ? Images for the <Shopping Cart>, <Search> and <Order Status> buttons
  - ? Image for the TPC Logo
  - ? Images for the thumbnail of the five promotional items
  - ? Images for “What’s New” and “Best Sellers”
3. It must contain a list of 24 subjects for new items and a list of 24 subjects for best sellers (as defined in Clause 4.6.2.12).
4. The following data must be displayed if retrieved from the SUT:
  - ? C\_FNAME or SC\_C\_FNAME
  - ? C\_LNAME or SC\_C\_LNAME

### **2.3.5 EB Navigation Options**

- 2.3.5.1 <Shopping Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:
- ? An empty list of (I\_ID, QTY) pairs
  - ? The ADD\_FLAG is set to “N”
- 2.3.5.2 < Search> button: Make an HTTP request to initiate the Search Request web interaction.
- 2.3.5.3 <Order Status> button: Make an HTTP request to initiate the Order Inquiry web interaction.
- 2.3.5.4 <New Products> link: Make an HTTP request to initiate the New Products web interaction, with the following input:
- ? SUBJECT\_STRING, where the EB selects from a uniform random distribution one entry from the list of URLs for new title subjects.
- 2.3.5.5 <Best Sellers> link: Make an HTTP request to initiate the Best Sellers web interaction, with the following input:
- ? SUBJECT\_STRING, where the EB selects from a uniform random distribution one entry from the list of URLs for best seller subjects.

## 2.4 Shopping Cart Web Interaction

### 2.4.1 Overview

This unprotected web interaction updates the associated CART (refreshing the CART's date and optionally adding a new item or updating existing items) and always returns to the EB a web page which displays the updated contents of the User's CART. If a Shopping Session is not identified at the start of this web interaction, a new Shopping Session is created.

### 2.4.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Shopping Cart Page, which is contained in the HTTP request.
- ? A list of (I\_ID, QTY) pairs for the items to be updated or added to the CART, which is contained in the HTTP request. This list may be empty.
- ? A value for the flag ADD\_FLAG, which depends on the page from which this interaction is requested.

### 2.4.3 Processing Definition

2.4.3.1 If the SHOPPING\_ID is not known, then the SUT creates a new unique SHOPPING\_ID. If there is no CART associated with this SHOPPING\_ID, then the SUT creates an associated CART initialized as follows:

- ? SC\_SHOPPING\_ID = SHOPPING\_ID
- ? SC\_DATE = current date and time on the SUT

2.4.3.2 If a new CART was created during this web interaction and C\_ID is known, then the SUT obtains information about the Customer to update the CART as follows:

- ? SC\_C\_FNAME = C\_FNAME
- ? SC\_C\_LNAME = C\_LNAME
- ? SC\_C\_DISCOUNT = C\_DISCOUNT

2.4.3.3 If ADD\_FLAG = "Y" or the CART is empty or (I\_ID, I\_QTY) pairs are not empty then do the following updates. (Comment: there are cases where these conditions are not met, processing should skip to clause 2.4.3.4) Based on SHOPPING\_ID, the SUT updates the associated CART as an atomic set of operations as follows:

<start atomic set>

- ? If ADD\_FLAG = "Y" (and the optional CART limit of 100 items has not been reached):
  - ? If I\_ID = SCL\_I\_ID (i.e., the item already exists in the CART):
    - ? SCL\_QTY = SCL\_QTY + 1 (i.e., increment quantity by 1 for SCL\_I\_ID)
  - ? Else (i.e., the item does not already exist in CART):
    - ? The SUT obtains the following information about the item I\_ID:
      - ? I\_COST
      - ? I\_SRP

- ? I\_TITLE
- ? I\_BACKING
- ? The SUT adds the item to the CART with:
- ? SCL\_I\_ID = I\_ID
- ? SCL\_QTY = 1
- ? SCL\_COST = I\_COST
- ? SCL\_SRP = I\_SRP
- ? SCL\_TITLE = I\_TITLE
- ? SCL\_BACKING = I\_BACKING

Note: If the CART limit has been reached, the item is not added and the message “Shopping Cart is full, item not added” is included on the response page. The processing resumes at Clause 2.4.3.4.

- ? If ADD\_FLAG = “N” and the list of (I\_ID, QTY) pairs is not empty, the CART is updated as follows:
  - ? For each (I\_ID, QTY) pair:
    - ? If QTY = 0 (i.e., the item must be removed from the CART):
      - ? Delete the entry from the CART for item SCL\_I\_ID
    - ? Else, update the item as follows:
      - ? SCL\_QTY = QTY (i.e., update the quantity for item SCL\_I\_ID)
  - ? Else (i.e., ADD\_FLAG = “N” and the list of (I\_ID, QTY) pairs is empty), and the CART is empty, add a promotional item to the CART as follows:
    - ? A random I\_ID is selected by the SUT within the range of [1 .. NUM\_ITEMS]
    - ? The SUT obtains the value of I\_RELATED1 for the selected I\_ID
    - ? The SUT adds the item to the CART as follows:
      - ? The SUT obtains the following information about the item I\_RELATED1:
        - ? I\_COST
        - ? I\_SRP
        - ? I\_TITLE
        - ? I\_BACKING
      - ? A new item is added to the CART with:
        - ? SCL\_I\_ID = I\_RELATED1
        - ? SCL\_QTY = 1
        - ? SCL\_COST = I\_COST
        - ? SCL\_SRP = I\_SRP
        - ? SCL\_TITLE = I\_TITLE
        - ? SCL\_BACKING = I\_BACKING
  - ? The new sub-total of the CART is computed as: SC\_SUB\_TOTAL = sum(SCL\_QTY \* SCL\_COST)

? The value of SC\_DATE is set to the current date and time on the SUT, with a minimum precision of 1 second.

<end atomic set>

2.4.3.4 The SUT executes the Promotional Processing, as defined in Clause 2.2.18.

2.4.3.5 Based on SHOPPING\_ID, the SUT obtains the following information about the associated CART:

? For the CART:

- ✎ SC\_DATE
- ✎ SC\_SUB\_TOTAL
- ✎ SC\_C\_FNAME
- ✎ SC\_C\_LNAME

? For each item in the CART:

- ✎ SCL\_I\_ID
- ✎ SCL\_QTY
- ✎ SCL\_COST
- ✎ SCL\_SRP
- ✎ SCL\_TITLE
- ✎ SCL\_BACKING

2.4.3.6 The SUT produces the HTML code for the Shopping Cart Page and returns the web page to the EB.

2.4.3.7 The EB selects a navigation option according to Clause 5.2.2.

#### 2.4.4 Response Page Definition

A sample of the Shopping Cart Page is shown below as it would appear in a Browser:

## TPC Web Commerce Benchmark (TPC-W)



### Shopping Cart Page

**Click on one of our latest books to find out more !**



59227



24568



94429



88639



49145

Qty	Product
<input type="text" value="1"/>	<i>Scottish, high rates BABABAALATSEOG feel vital</i> - Backing: AUDIO SRP. \$426.21, <b>Your Price: \$266.81</b>
<input type="text" value="1"/>	<i>Grand, BABAOGBASENGIN reasonable</i> - Backing: AUDIO SRP. \$82.16, <b>Your Price: \$78.87</b>

**Subtotal price: \$345.68**  
Last Updated: 03/10/2000 16:23:34

**Checkout** **Home**

If you have changed the quantities and/or taken anything out  
of your shopping cart, click here to refresh your shopping cart:

**Refresh**

The HTML code for the Shopping Cart Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 2,056 characters.
2. The following web objects must be referenced:

- ? Images for the <Checkout>, <Home> and <Refresh> buttons
  - ? Image for the TPC Logo
  - ? Images for the thumbnail of the five promotional items
3. The following data must be displayed if retrieved from the SUT:
- ? SC\_SUB\_TOTAL
  - ? SC\_DATE

For each line in the CART:

- ? SCL\_QTY
- ? SCL\_TITLE
- ? SCL\_BACKING
- ? SCL\_SRP
- ? SCL\_COST

## 2.4.5 EB Navigation Options

2.4.5.1 <Refresh> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:

- ? The EB creates a complete list of (I\_ID, QTY) pairs for all items in the CART shown in the most recent Shopping Cart Page received by the EB.

**Comment:** The actions defined in the Processing Definition section of the Shopping Cart interaction guarantee that the CART will have at least one item in it, and therefore, the complete list of (I\_ID, QTY) pairs created by the EB for this navigation option will also contain at least one pair.

- ? If there is only one (I\_ID, QTY) pair in the list, the EB sets QTY to a random value (between 1 and 10, excluding SCL\_QTY) generated using a uniform random function.
- ? Else there are greater than one (I\_ID, QTY) pairs in the list. The EB selects a random number of (I\_ID, QTY) pairs from the list (in the inclusive range [1, (one less than the number of pairs in the list)]) using a uniform random function. For each selected pair, the EB sets QTY to a random value (between 0 and 10, excluding SCL\_QTY) generated using a uniform random function.
- ? The ADD\_FLAG is set to "N".

2.4.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.4.5.3 <Checkout> button: Make an HTTP request to initiate the Customer Registration web interaction.

## 2.5 Customer Registration Web Interaction

### 2.5.1 Overview

This unprotected web interaction returns to the EB a web page which allows a User to provide the information necessary to register as a known Customer or as a new Customer and to submit their registration. This is the first step in buying the contents of the CART.

### **2.5.2 Input Requirements**

This web interaction is invoked by an HTTP request and requires the following input data:

? The URL for the Customer Registration Page, which is contained in the HTTP request.

### **2.5.3 Processing Definition**

2.5.3.1 The SUT produces the HTML code for the Customer Registration Page and returns the web page to the EB.

2.5.3.2 The EB selects a navigation option according to Clause 5.2.2.

### **2.5.4 Response Page Definition**

A sample of the Customer Registration Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Customer Registration Page

- I am an existing customer  
 I am a first time customer

If you're an existing customer, enter your Username and Password:

Username:   
Password:

If you're a first time customer, enter the details below:

Enter your birth date (mm/dd/yyyy):   
Enter your First Name:   
Enter your Last Name:   
Enter your Address 1:   
Enter your Address 2:   
Enter your City, State, Zip:     
Enter your Country:   
Enter your Phone:   
Enter your E-mail:

Other Customer Data:

**Submit**

**Search**

**Home**

The HTML code for the Customer Registration Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 2,769 characters.
2. The following web objects must be referenced:
  - ? Images for the <Submit>, <Home> and <Search> buttons

- ? Image for the TPC Logo

## 2.5.5 EB Navigation Options

2.5.5.1 <Submit> button with the following:

- ? If the EB knows the C\_ID associated with the current User Session, then the “Returning Customer” is checked: Make an HTTP request to initiate the Buy Request web interaction, with the following input:
  - ? RETURNING\_FLAG set to “Y”
  - ? UNAME is generated by the EB according to Clause 4.6.2.10.
  - ? PASSWD is generated by the EB according to Clause 4.6.2.11.
- ? If the EB does not yet know a username (UNAME) associated with the current User Session, then the “Returning Customer” is un-checked: Make an HTTP request to initiate the Buy Request web interaction, with the following input:
  - ? RETURNING\_FLAG is set to “N”
  - ? FNAME is a random a-string [8 .. 15]
  - ? LNAME is a random a-string [8 .. 15]
  - ? STREET1 is a random a-string [15 .. 40]
  - ? STREET2 is a random a-string [15 .. 40]
  - ? CITY is a random a-string [4 .. 30]
  - ? STATE is a random a-string [2 .. 20]
  - ? ZIP is a random a-string [5 .. 10]
  - ? COUNTRY is chosen according to Clause 4.6.2.15
  - ? PHONE is a random n-string [9 .. 16]
  - ? EMAIL is generated as the concatenation of FNAME, followed by the special character “@”, followed by LNAME, followed the string “.com”.
  - ? BIRTHDATE is a random date generated as specified in clause 4.7.1
  - ? DATA is a random a-string [100 .. 500]

2.5.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.5.5.3 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

## 2.6 Buy Request Web Interaction

### 2.6.1 Overview

This secure web interaction registers a new customer or identifies a returning customer and returns to the EB a web page which displays information about the customer, confirming either the registration or the identification, and displays a summary of the items in the associated CART. The page provides editable fields for entering credit card information and selecting shipping options.

## 2.6.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Buy Request Page, which is contained in the HTTP request.
- ? Value for the field RETURNING\_FLAG, which is contained in the HTTP request
- ? If RETURNING\_FLAG is set to “Y”, values for the following fields, which are contained in the HTTP request:
  - ? UNAME
  - ? PASSWD
- ? If RETURNING\_FLAG is set to “N”, values for the following fields, which are contained in the HTTP request:
  - ? FNAME
  - ? LNAME
  - ? STREET1
  - ? STREET2
  - ? CITY
  - ? STATE
  - ? ZIP
  - ? COUNTRY
  - ? PHONE
  - ? EMAIL
  - ? BIRTHDATE
  - ? DATA

## 2.6.3 Processing Definition

2.6.3.1 If RETURNING\_FLAG is set to “Y”, then the SUT executes the following steps:

- ? Obtains the following information about the customer with (C\_UNAME = UNAME):
  - ? C\_ID or SC\_C\_ID
  - ? C\_PASSWD
  - ? C\_FNAME or SC\_C\_FNAME
  - ? C\_LNAME or SC\_C\_LNAME
  - ? ADDR\_STREET1
  - ? ADDR\_STREET2
  - ? ADDR\_CITY
  - ? ADDR\_STATE
  - ? ADDR\_ZIP
  - ? CO\_NAME

- ? C\_PHONE
  - ? C\_EMAIL
  - ? C\_BIRTHDATE
  - ? C\_DATA
  - ? C\_DISCOUNT or SC\_C\_DISCOUNT
- ? Update the following information within a single database transaction:
- <start transaction>
- ? C\_LOGIN is set to current date/time
  - ? C\_EXPIRATION is set to C\_LOGIN + 2 hours
- <end transaction>
- ? PASSWD is compared to C\_PASSWD.

**Comment:** The application program is required to include logic to deal with invalid passwords by returning an error message to the EB. In the context of the benchmark, all supplied passwords will be valid, allowing the processing of the order to continue. All conventional means of password authentication (e.g., using a directory server via LDAP) are acceptable for this purpose.

2.6.3.2 If RETURNING\_FLAG is set to "N", the SUT executes the following steps within a single database transaction:

- <start transaction>
- ? Adds a new customer record in the CUSTOMER table based on the input data and the following values:
    - ? C\_ID is set to a unique value, not necessarily serial or contiguous, within the CUSTOMER table.
    - ? C\_UNAME is generated according to Clause 4.6.2.10
    - ? C\_PASSWD is generated according to Clause 4.6.2.11
    - ? C\_LAST\_VISIT is the Current date given by the operating system when the record is added
    - ? C\_DISCOUNT is random within [0.00 .. 0.50]
    - ? C\_BALANCE is set to 0.00
    - ? C\_YTD\_PMT is set to 0.00
    - ? C\_SINCE is the current date/time given by the operating system when the record is added
    - ? C\_FNAME is set to FNAME
    - ? C\_LNAME is set to LNAME
    - ? C\_PHONE is set to PHONE
    - ? C\_EMAIL is set to EMAIL
    - ? C\_BIRTHDATE is set to current date
    - ? C\_LOGIN is set to current date/time
    - ? C\_EXPIRATION is set to C\_LOGIN + 2 hours
    - ? C\_DATA is set to DATA

- ? Attempts to match the customer's address (STREET1, STREET2, CITY, STATE, ZIP, COUNTRY) with an address in the ADDRESS table. If a match is found, then the C\_ADDR\_ID is set to ADDR\_ID for the matching record. If no match is found, a new record is created in the ADDRESS table using the customer's address with a new unique ADDR\_ID (not necessarily sequential nor contiguous).

<end transaction>

- ? Update shopping cart fields
  - ? sc\_c\_fname = c\_fname
  - ? sc\_c\_lname = c\_lname
  - ? sc\_c\_discount = c\_discount
  - ? sc\_c\_id = c\_id

2.6.3.3 The SUT executes the following steps as an atomic set of operations:

<start atomic set>

- ? Updates the following fields of the CART:
  - ? The value of SCL\_COST is set to the current value of I\_COST from the ITEM table for each item in the CART.
  - ? Update the SC\_DATE
- ? Obtains the following information for each item in the CART:
  - ? SCL\_TITLE
  - ? SCL\_COST
  - ? SCL\_SRP
  - ? SCL\_BACKING
  - ? SCL\_QTY
- ? Calculates and updates the following fields of the CART:
  - ?  $SC\_SUB\_TOTAL = \text{sum}(SCL\_COST * SCL\_QTY) * (1 - SC\_C\_DISCOUNT)$
  - ?  $SC\_TAX = SC\_SUB\_TOTAL * 0.0825$
  - ?  $SC\_SHIP\_COST = 3.00 + (1.00 * \text{sum}(SCL\_QTY))$
  - ?  $SC\_TOTAL = SC\_SUB\_TOTAL + SC\_SHIP\_COST + SC\_TAX$

<end atomic set>

2.6.3.4 The SUT produces the HTML code for the Buy Request Page containing the billing, shipping, order and credit card information; and returns the web page to the EB. If RETURNING\_FLAG is set to "N", then the SUT also returns to the EB the values of the C\_ID and C\_UNAME of the newly created CUSTOMER record.

**Comment:** Communicating the C\_ID and C\_UNAME values to the EB can be implemented by various methods including, but not limited to, the passing of a field in the HTML response, or the use of a cookie.

2.6.3.5 The EB selects a navigation option according to Clause 5.2.2.

#### **2.6.4 Response Page Definition**

A sample of the Buy Request Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)

## Buy Request Page

### Billing Information:

Firstname: John  
Lastname: Doe  
Addr\_street\_1: 1 Some Place  
Addr\_street\_2: Apt. 42  
City: Dullsville  
State: CA  
Zip: 91234  
Country: Andorra  
Email: me@mycompany.com  
Phone: 123-456-7890  
Username: ALININBABABASE  
C\_ID: 2880005

### Shipping Information:

Addr\_street\_1:   
Addr\_street\_2:   
City:   
State:   
Zip:   
Country:

### Order Information:

Qty	Product
1	Title: <i>BABABABANGATOG</i> Individual, ethnic results should go. Figures - Backing: USED SRP. \$790.79, <b>Your Price: \$674.54</b>
2	Title: <i>Years cover near the great, BABAOGATATSERI</i> prime items. - Backing: PAPERBACK SRP. \$318.75, <b>Your Price: \$208.46</b>

Subtotal with discount (28%): \$785.85  
Tax \$64.83  
Shipping & Handling \$9.00  
Total \$859.68

Credit Card Type	<input checked="" type="radio"/> VISA <input type="radio"/> MASTERCARD <input type="radio"/> DISCOVER <input type="radio"/> AMERICAN EXPRESS <input type="radio"/> DINERS
Name on Credit Card	<input type="text"/>
Credit Card Number	<input type="text"/>
Credit Card Expiration Date	<input type="text"/>
Shipping Method	<input checked="" type="radio"/> AIR <input type="radio"/> UPS <input type="radio"/> FEDEX <input type="radio"/> SHIP <input type="radio"/> COURIER <input type="radio"/> MAIL

[Process Order](#)[Shopping Cart](#)[Home](#)

The HTML code for the Buy Request Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 3,690 characters.
2. The following web objects must be referenced:
  - ? Images for the <Process Order>, <Home> and <Shopping Cart> buttons
3. The following data must be displayed if retrieved from the SUT:
  - ? C\_FNAME or SC\_C\_FNAME
  - ? C\_LNAME or SC\_C\_LNAME
  - ? ADDR\_STREET1
  - ? ADDR\_STREET2
  - ? ADDR\_CITY
  - ? ADDR\_STATE
  - ? ADDR\_ZIP
  - ? CO\_NAME
  - ? C\_EMAIL
  - ? C\_ID or SC\_C\_ID
  - ? C\_DISCOUNT or SC\_C\_DISCOUNT
  - ? C\_PHONE
  - ? C\_UNAME
  - ? SC\_SUB\_TOTAL
  - ? SC\_TAX
  - ? SC\_SHIP\_COST
  - ? SC\_TOTAL

For each line in the CART

- ? SCL\_QTY
- ? SCL\_TITLE
- ? SCL\_BACKING
- ? SCL\_SRP
- ? SCL\_COST

### **2.6.5 EB Navigation Options**

2.6.5.1 <Process Order> button: Make an HTTP request to initiate the Buy Confirm web interaction, with the following input:

- ? SHIPPING is randomly selected from types defined in 4.7.1
- ? CC\_TYPE is randomly selected within [VISA, MASTERCARD, DISCOVER, DINERS, AMEX]
- ? CC\_NUMBER is generated as a random n-string of 16 digits

- ? CC\_NAME is generated by concatenating C\_FNAME and C\_LNAME separated by a single space
- ? CC\_EXPIRY is generated as the current date + a random number of days within [1 .. 730]
- ? On a randomly selected 5% of the time, the shipping address is updated with (STREET\_1, STREET\_2, CITY, STATE, ZIP, COUNTRY) generated according to Clause 4.7.1

2.6.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.6.5.3 <Shopping Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction.

- ? An empty list of (I\_ID, QTY) pairs
- ? The ADD\_FLAG is set to "N"

## 2.7 Buy Confirm Web Interaction

### 2.7.1 Overview

This secure web interaction transfers the content of the associated CART into a newly created order for the registered customer and executes a full payment authorization. It then returns to the EB a web page containing the details of the newly created order.

### 2.7.2 Input Requirements

2.7.2.1 This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Buy Confirm Page, which is contained in the HTTP request.
- ? The following payment and shipping information:
  - ? CC\_TYPE
  - ? CC\_NUMBER
  - ? CC\_NAME
  - ? CC\_EXPIRY
  - ? SHIPPING
  - ? Some percentage of time, as defined in 2.6.5.1, there will be additional input of shipping address (STREET\_1, STREET\_2, CITY, STATE, ZIP, COUNTRY)

### 2.7.3 Processing Definition

2.7.3.1 Based on the known SHOPPING\_ID and C\_ID, the SUT obtains information about the associated CART and Customer:

- ? The following information is obtained about each item in the CART:
  - ? SCL\_I\_ID
  - ? SCL\_COST
  - ? SCL\_QTY
- ? The following information is obtained about the CART:

- ? SC\_SUB\_TOTAL
- ? SC\_TAX
- ? SC\_SHIP\_COST
- ? SC\_TOTAL
- ? The following information is obtained about the Customer:
  - ? C\_FNAME or SC\_C\_FNAME
  - ? C\_LNAME or SC\_C\_LNAME
  - ? C\_DISCOUNT or SC\_C\_DISCOUNT
  - ? C\_ADDR\_ID

2.7.3.2 If a shipping address is passed, then the SUT attempts to match the address (STREET\_1, STREET\_2, CITY, STATE, ZIP, COUNTRY) with an address in the ADDRESS table. If a match is found, set ADDR\_ID to the ADDR\_ID of the matching row. If no match is found, then a new record is created in the ADDRESS table using the shipping address with a new unique ADDR\_ID (not necessarily sequential or contiguous). This entire processing step is executed within a single database transaction.

2.7.3.3 The SUT executes the following steps as an atomic set of operations:

<start atomic set>

- ? Creates a new order as follows, within a single database transaction:

<start transaction>

- ? A record is added in the ORDER table with:

- ? O\_ID is unique within the ORDER table (not necessarily sequential or contiguous)
- ? O\_C\_ID is set to C\_ID or SC\_C\_ID
- ? O\_DATE is set to the current operating system date and time
- ? O\_SUB\_TOTAL is set to SC\_SUB\_TOTAL
- ? O\_TAX is set to SC\_TAX
- ? O\_TOTAL is set to SC\_TOTAL
- ? O\_SHIP\_TYPE is set to SHIPPING
- ? O\_SHIP\_DATE is set to current operating system date + random within [1 .. 7] days
- ? O\_BILL\_ADDR\_ID is set to C\_ADDR\_ID
- ? If the shipping address was passed, O\_SHIP\_ADDR\_ID is set to ADDR\_ID else the O\_SHIP\_ADDR\_ID is set to C\_ADDR\_ID
- ? O\_STATUS is set to "Pending"

- ? For each item in the CART, a record is added in the ORDER\_LINE table with:

- ? OL\_ID is unique within the ORDER\_LINE record for the order (not necessarily sequential or contiguous)
- ? OL\_O\_ID is set to O\_ID
- ? OL\_I\_ID is set to SCL\_I\_ID
- ? OL\_QTY is set to SCL\_QTY
- ? OL\_DISCOUNT is set to C\_DISCOUNT or SC\_C\_DISCOUNT
- ? OL\_COMMENTS is set to a random a-string [20 ... 100]

- ? For each item in the CART, I\_STOCK is retrieved from the item table where I\_ID = SCL\_I\_ID. If I\_STOCK exceeds SCL\_QTY by 10 or more, then I\_STOCK is decreased by SCL\_QTY; otherwise I\_STOCK is updated to (I\_STOCK - SCL\_QTY) + 21.

<end transaction>

- ? Obtains an authorization from the Payment Gateway Emulator (PGE) (see Clause 6.4) as follows:
  - ? Build an authorization request comprising of a string of bytes starting with CC\_NUMBER enclosed by the tags <NUM> and </NUM>, followed by the 10 decimal digit representation of the value of O\_ID, prefixed with leading zeros as needed, enclosed by the tags <OID> and </OID>; and padded to a total length L, where L is at least 6000 bytes, and the pad characters are a random a-string [L - 48 .. L - 48].
  - ? Send the above authorization request to the PGE, encrypted and communicated with SSL version 3, or above, using SSL\_RSA\_WITH\_RC4\_128\_MD5 as the cipher suite. The private key, for the digital certificate must be at least 1,024 bits.
  - ? Wait to receive a response from the PGE.

**Comment 1:**

When establishing an SSL session between the SUT and the PGE, a full SSL handshake must be performed prior to the exchange of any authorization requests and responses. Each SSL session is allowed to be used for a maximum of 200 seconds from the time it was established, or for a maximum of 100 authorizations, whichever comes first.

Once this constraint is met, a full SSL handshake must again be performed. The protocol for a full handshake is identical to the protocol of the original handshake (executed when the session was established). This includes the transfer of a digital certificate from the PGE to the SUT, and the generation of a new encryption key. Alternately, a new SSL session can be established.

If a new session is established, the expired SSL session may be used for pending authorization responses from the PGE to the SUT, but the expired session cannot be used to send any new authorization requests. The number of SSL sessions established and connections open at any given point in time between the SUT and the PGE is not limited.

**Comment 2:** Authorization requests cannot be combined within a single SSL message.

**Comment 3:** Management of SSL sessions can be done in the application, and does not require commercially available products.

- ? Decrypt the authorization response from the PGE and extract the authorization code, AUTH\_ID, from the message, which is enclosed by the tags <CODE> and </CODE>. See clause 6.4.3 for the format of the authorization response message from the PGE.

- ? Creates a new credit card record as follows, within a single database transaction:

<start transaction>

- ? A record is added to the CC\_XACTS table with:
  - ? CX\_O\_ID is set to O\_ID
  - ? CX\_TYPE is set to CC\_TYPE
  - ? CX\_NUM is set to CC\_NUMBER

- ? CX\_NAME is set to CC\_NAME
- ? CX\_EXPIRY is set to CC\_EXPIRY
- ? CX\_AUTH\_ID is set to AUTH\_ID
- ? CX\_XACT\_AMT is set to SC\_TOTAL
- ? CX\_XACT\_DATE is set to the Current date and time on the SUT
- ? CX\_CO\_ID is set to COUNTRY from the shipping address

<end transaction>

- ? Clears all SCL\_\* items from the CART and updates SC\_DATE to current date and time

<end atomic set>

**Comment 1:** The application program may implement the above set of atomic operations by including all of the execution steps within a single database transaction.

**Comment 2:** In the event of a failure and rollback of an atomic set of operations involving the PGE (such as above), the PGE is not required to remove the O\_ID or the authorization number from the PGE's durable medium if they have already been recorded.

- 2.7.3.4 The SUT produces the HTML code for the Buy Confirm page, including the complete order information and the customer information; and returns the page to the EB.
- 2.7.3.5 The EB selects a navigation option according to Clause 5.2.2.

#### **2.7.4 Response Page Definition**

A sample of the Buy Confirm Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)

## Buy Confirm Page

### Order Information:

Qty	Product
1	Title: <i>Local, mental BABABAULULREO</i> <i>G</i> individuals - Backing: USED SRP. \$445.35, <b>Your Price: \$436.00</b>
2	Title: <i>Organic, main sides should BABAOGULBASENG</i> have to say - Backing: AUDIO SRP. \$318.98, <b>Your Price: \$213.72</b>

### Your Order has been processed.

Subtotal with discount (42%):	\$500.80
Tax (8.25%):	\$41.32
Shipping:	\$9.00
Total:	\$551.11

Order Number: 52

**Thank you for shopping at TPC-W**

**Search**

**Home**

The HTML code for the Buy Confirm Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 1,530 characters.
2. The following web objects must be referenced:
  - ? Images for the <Home> and <Search> buttons
3. The following data must be displayed:
  - ? O\_ID

- ? C\_DISCOUNT or SC\_C\_DISCOUNT
- ? SC\_SUB\_TOTAL
- ? SC\_TAX
- ? SC\_SHIP\_COST
- ? SC\_TOTAL

For each line in the CART

- ? SCL\_QTY
- ? SCL\_TITLE
- ? SCL\_BACKING
- ? SCL\_SRP
- ? SCL\_COST

### **2.7.5 EB Navigation Options**

- 2.7.5.1 <Home> button: Make an HTTP request to initiate the Home web interaction.
- 2.7.5.2 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

## **2.8 Order Inquiry Web Interaction**

### **2.8.1 Overview**

This secure web interaction returns to the EB a web page which allows a User to provide the information necessary to enter or confirm their identity as a returning customer. This is the first step in displaying information about the customer's last order.

### **2.8.2 Input Requirements**

- 2.8.2.1 This web interaction is invoked by an HTTP request and requires the following input data:
  - ? The URL for the Order Inquiry Page, which is contained in the HTTP request.

### **2.8.3 Processing Definition**

- 2.8.3.1 If this User is a Customer and its C\_ID is known, the SUT obtains the following information about the Customer:
  - ? C\_UNAME
- 2.8.3.2 The SUT produces the HTML code for the Order Inquiry Page, containing C\_UNAME if available, and returns the web page to the EB.
- 2.8.3.3 The EB selects a navigation option according to Clause 5.2.2.

## 2.8.4 Response Page Definition

A sample of the Order Inquiry Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)

---

## Order Inquiry Page

Username:

Password:

Display Last OrderSearchHome

The HTML code for the Order Inquiry Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 953 characters.
2. The following web objects must be referenced:
  - ? Images for the <Display Last Order>, <Home> and <Search> buttons
3. The following data must be displayed if retrieved from the SUT:
  - ? C\_UNAME

## 2.8.5 EB Navigation Options

2.8.5.1 <Display Last Order> button: Make an HTTP request to initiate the Order Display web interaction, with the following input:

- ? If a C\_ID is known, then:
  - ? UNAME is generated by the EB according to clause 4.6.2.10
  - ? PASSWD is generated by the EB according to clause 4.6.2.11
- ? If a C\_ID is not known, then:
  - ? A temporary C\_ID is generated by the EB using the method defined in 2.3.2. This C\_ID is then used to generate the following:
    - ? UNAME is generated by the EB according to Clause 4.6.2.10.
    - ? PASSWD is generated by the EB according to Clause 4.6.2.11.

Comment: The order inquiry C\_ID being generated to satisfy this interaction is temporary and does not make the user a returning customer. This C\_ID is used only by this interaction to navigate to Order Display interaction. The user still remains to be an unknown user for rest of the interactions.

2.8.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.8.5.3 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

## 2.9 Order Display Web Interaction

### 2.9.1 Overview

This secure web interaction returns to the EB a web page which displays the status of the last order placed by the customer.

### 2.9.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Order Display Page, which is contained in the HTTP request.
- ? The following customer identification information:
  - ? UNAME
  - ? PASSWD

### 2.9.3 Processing Definition

2.9.3.1 The SUT obtains the C\_PASSWD from the customer with (C\_UNAME = UNAME) and compares PASSWD with C\_PASSWD.

**Comment:** The application program is required to include logic to deal with invalid passwords by returning an error message to the EB. In the context of the benchmark, all supplied passwords will be valid, allowing the processing of the order to continue. All conventional means of password authentication (e.g., using a directory server via LDAP) are acceptable for this purpose.

2.9.3.2 The SUT obtains the following information about the last order of the customer based on its C\_UNAME and within a single database transaction:

- ? O\_ID
- ? C\_FNAME
- ? C\_LNAME
- ? C\_PHONE
- ? C\_EMAIL
- ? O\_DATE
- ? O\_SUB\_TOTAL
- ? O\_TAX
- ? O\_TOTAL
- ? O\_SHIP\_TYPE
- ? O\_SHIP\_DATE

- ? O\_STATUS
- ? For the billing address
  - ✂ ADDR\_STREET1
  - ✂ ADDR\_STREET2
  - ✂ ADDR\_CITY
  - ✂ ADDR\_STATE
  - ✂ ADDR\_ZIP
  - ✂ CO\_NAME
- ? For the shipping address
  - ✂ ADDR\_STREET1
  - ✂ ADDR\_STREET2
  - ✂ ADDR\_CITY
  - ✂ ADDR\_STATE
  - ✂ ADDR\_ZIP
  - ✂ CO\_NAME
- ? For each item on the order:
  - ✂ OL\_I\_ID
  - ✂ I\_TITLE
  - ✂ I\_PUBLISHER
  - ✂ I\_COST
  - ✂ OL\_QTY
  - ✂ OL\_DISCOUNT
  - ✂ OL\_COMMENTS
- ? From the credit card transaction of the order:
  - ✂ CX\_TYPE
  - ✂ CX\_AUTH\_ID

2.9.3.3 The SUT produces the HTML code for the Order Display Page containing the information obtained and returns the web page to the EB.

**Comment1:** If there are no orders for this Customer, then the Order Display Page is displayed with no order data in it.

**Comment2:** Due to the initial database being based on random values and online updates to item prices, the order subtotal might not match the sum of the order line costs.

2.9.3.4 The EB selects a navigation option according to Clause 5.2.2.

## 2.9.4 Response Page Definition

A sample of the Order Display Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)

---

## Order Display Page

---

Order ID: 2592013  
Authorization ID: 12467  
Order Placed on 4/1/1999  
Shipping Type: Regular  
Ship Date: 4/1/1999  
Order Subtotal: \$1,239.01  
Order Tax: \$102.22  
Order Total: \$1,341.23

<b>Bill To:</b> <b>John Doe</b>  <i>1 Some Place Apt 1 Dullsville CA 92691 Libya</i>	<b>Ship To:</b>  <i>1 Some Place Apt 1 Dullsville CA 92691 Libya</i>
---	--

*Email: me@work.com  
Phone: 123-456-7890*

Credit Card Type: Visa  
Order Status: Pending

Item #	Title	Cost	Qty	Discount	Comment
5314	Title: XBrown, recent BABAOGALINBASEolicies should make. Arms Publisher: 9XVWJDR8WGOEps4	\$930.23	1	12 %	comment
62440	Title: Late, BABABANGRIBANG recent trees would sign. Primary banks Publisher: 3dGH107y2oxeGOqWxYMaJVTk8zw8hZdH7	\$658.25	1	12 %	comment

**Search** **Home**

The HTML code for the Order Display Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 1,715 characters.
2. The following web objects must be referenced:
  - ? Images for the <Home> and <Search> buttons
3. The following must be displayed if retrieved from the SUT:

- ? O\_ID
- ? O\_DATE
- ? O\_SHIP\_TYPE
- ? O\_SHIP\_DATE
- ? O\_SUB\_TOTAL
- ? O\_TAX
- ? O\_TOTAL
- ? C\_FNAME
- ? C\_LNAME
- ? C\_EMAIL
- ? C\_PHONE
- ? CX-TYPE
- ? O\_STATUS

A billing address containing:

- ? ADDR\_STREET1
- ? ADDR\_STREET2
- ? ADDR\_CITY
- ? ADDR\_STATE
- ? ADDR\_ZIP
- ? ADDR\_CO

A shipping address containing

- ? ADDR\_STREET1
- ? ADDR\_STREET2
- ? ADDR\_CITY
- ? ADDR\_STATE
- ? ADDR\_ZIP
- ? ADDR\_CO

For each line in the order:

- ? OL\_I\_ID
- ? I\_TITLE
- ? I\_PUBLISHER

- ? I\_COST
- ? OL\_QTY
- ? OL\_DISCOUNT
- ? OL\_COMMENTS

## **2.9.5 EB Navigation Options**

2.9.5.1 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.9.5.2 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

## **2.10 Search Request Web Interaction**

### **2.10.1 Overview**

This unprotected web interaction returns to the EB a web page which allows a User to specify search criteria to find qualifying items.

### **2.10.2 Input Requirements**

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Search Request Page, which is contained in the HTTP request.

### **2.10.3 Processing Definition**

2.10.3.1 The SUT executes the Promotional Processing, as defined in Clause 2.2.18.

2.10.3.2 The SUT produces the HTML code for the Search Request Page and returns the web page to the EB.

2.10.3.3 The EB selects a navigation option according to Clause 5.2.2.

### **2.10.4 Response Page Definition**

A sample of the Search Request Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Search Request Page

Click on one of our latest books to find out more !



Search by:

Author

**Submit**

**Home**

**Shopping Cart**

The HTML code for the Search Request Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 2,004 characters.
2. The following web objects must be referenced:
  - ? Images for the <Shopping Cart>, <Submit> and <Home> buttons
  - ? Image for the TPC Logo
  - ? Images for the thumbnail of the five promotional items

### 2.10.5 EB Navigation Options

2.10.5.1 <Submit> button: Make an HTTP request to initiate the Search Result web interaction, with the following input:

- ? The EB selects a SEARCH\_TYPE from a uniform distribution over the following values: [AUTHOR, TITLE, SUBJECT]
- ? If SEARCH\_TYPE is selected to be AUTHOR then SEARCH\_STRING is set to DigSyl(NURand(A, 1, NUM\_ITEMS/10), 7).

- ? **Comment:** SEARCH\_STRING is meant to match a substring embedded in the A\_LNAME field of the AUTHOR table as described in clause 4.6.2.19. This should yield an average of 2.5 Authors and 10 books.
- ? If SEARCH\_TYPE is selected to be TITLE then SEARCH\_STRING is set to DigSyl(NURand(A, 1, NUM\_ITEMS/5), 7).
- ? **Comment:** SEARCH\_STRING is meant to match a substring embedded in the I\_TITLE field of the ITEM table as described in clause 4.6.2.19. This should yield an average of 5 books.
- ? If SEARCH\_TYPE is selected to be SUBJECT then SEARCH\_STRING is generated from a uniform random distribution according to Clause 4.6.2.12.

In the above NURand functions, the value for A must be selected from the following table depending on NUM\_ITEMS, the number of row in the ITEM table (see clauses 4.3 and 4.7):

For NUM_ITEMS	Value for A
1,000	63
10,000	511
100,000	4,095
1,000,000	32,767
10,000,000	524,287

2.10.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.10.5.3 <Shopping Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:

- ? An empty list of (I\_ID, QTY) pairs
- ? The ADD\_FLAG is set to "N"

## 2.11 Search Result Web Interaction

### 2.11.1 Overview

This unprotected web interaction returns to the EB a web page which contains the list of items that match a given search criteria.

### 2.11.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Search Result Page, which is contained in the HTTP request.
- ? The following two fields:
  - ? SEARCH\_TYPE
  - ? SEARCH\_STRING

### 2.11.3 Processing Definition

2.11.3.1 Of the entire set of (I\_ID, I\_TITLE) pairs for items that match the selection criteria, sorted by ascending I\_TITLE, the first 50 pairs (or less if the entire set contains less than 50 pairs) are obtained. The SUT is permitted to execute the search with a commercially available text search engine (see Clause 2.2.15 and Clause 6.3.3.1). The following search predicates are used (where <string> is the content of SEARCH\_STRING):

? If SEARCH\_TYPE = "AUTHOR", the search predicate is:

<string> is found at the beginning of any word in A\_LNAME

? If SEARCH\_TYPE = "TITLE", the search predicate is:

<string> is found at the beginning of any word in I\_TITLE

? If SEARCH\_TYPE = "SUBJECT", the search predicate is:

I\_SUBJECT = "<string>"

Comment: Clause 6.3.3.1 defines the requirements for search results consistency.

2.11.3.2 The SUT executes the Promotional Processing, as defined in Clause 2.2.18.

2.11.3.3 The SUT produces the HTML code for the Search Result Page containing the fields I\_TITLE, A\_FNAME, A\_LNAME for the list of items obtained with links to the Product Detail pages for these items and returns the web page to the EB.

2.11.3.4 The EB selects a navigation option according to Clause 5.2.2.

### 2.11.4 Response Page Definition

A sample of the Search Result Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Search Results Page - Title: BABAOGINRIRERI

Click on one of our latest books to find out more !



Author	Title
<i>Asxa2f A BABABARIATOGOG</i>	<a href="#">Words BABAOGINRIRERIstick. Upper, responsible relationships</a>
<i>Os2hKxn!*C2Ml BABABAOGOGSEBA</i>	<a href="#">Huge, educational BABAOGINRIRERIboats react.</a>
<i>y)bl/ BABABASERIOGUL</i>	<a href="#">Small, BABAOGINRIRERI eastern facts at the modest, new</a>
<i>c9Y^ld,t6 BABABAINATINOgbv1</i>	<a href="#">Pp. tell in the BABAOGINRIRERI then full bones. White</a>
<i>z!A}fnS? 5K7TIZopc\$ BABABAATBARERI</i>	<a href="#">BABAOGINRIRERIBeautiful</a>
<i>4+-(NJ BABABAATRIRIBA</i>	<a href="#">Good, BABAOGINRIRERI social eyes fix? Other notes make here.</a>

Shopping Cart

Search

Home

The HTML code for the Search Result Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 1,891 characters.
2. The following web objects must be referenced:
  - ? Images for the <Shopping Cart>, <Search> and <Home> buttons
  - ? Image for the TPC Logo
  - ? Images for the thumbnail of the five promotional items
3. The following data must be displayed for each item found in the search and retrieved from the SUT:
  - ? A\_FNAME
  - ? A\_LNAME
  - ? I\_TITLE

## 2.11.5 EB Navigation Options

2.11.5.1 <Shopping Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:

- ? An empty list of (I\_ID, QTY) pairs
- ? The ADD\_FLAG is set to "N"

2.11.5.2 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

2.11.5.3 <Item Title> link: Make an HTTP request to initiate the Product Detail web interaction, with the following input:

- ? I\_ID, where the EB selects from a uniform random distribution one entry from the list of URLs for obtained items.

2.11.5.4 <Home> button: Make an HTTP request to initiate the Home web interaction.

## 2.12 New Products Web Interaction

### 2.12.1 Overview

This unprotected web interaction returns to the EB a web page which contains the list of recently released items.

### 2.12.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the New Products Page, which is contained in the HTTP request.
- ? The following field:
  - ? SUBJECT\_STRING

### 2.12.3 Processing Definition

2.12.3.1 Of the entire set of (I\_ID, I\_TITLE) pairs for items on the selected subject, sorted by descending I\_PUB\_DATE and ascending I\_TITLE, the first 50 pairs (or less if the entire set contains less than 50 pairs) are obtained. The following search predicate is used (where <string> is the content of SUBJECT\_STRING):

I\_SUBJECT = "<string>"

The database reads to generate the list of 50 New Products may be performed at an isolation level of 0, (see Clause 3.1.4.1).

2.12.3.2 The SUT executes the Promotional Processing, as defined in Clause 2.2.18.

2.12.3.3 The SUT produces the HTML code for the New Products Page containing the fields I\_TITLE, A\_FNAME, A\_LNAME for the list of items obtained with links to the Product Detail pages for these items and returns the web page to the EB.

2.12.3.4 The EB selects a navigation option according to Clause 5.2.2.

#### **2.12.4 Response Page Definition**

A sample of the New Products Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## New Products Page - Subject: ARTS

Click on one of our latest books to find out more !



Author	Title
CGYFDhKWBb BABABASEBAREOG	<a href="#">Good, BABABANGULNGUL likely laws to the</a>
HYZ.h?.&F18IQ[ BABABAREBAULSE8xhu	<a href="#">Round, coming changes BABABABANGIN must</a>
Ce6s+E_84B2SftVT.T BABABAOGBABAATKvxCO	<a href="#">Sides must travel. BABABAALINBASE Average,</a>
A]47 BABABANGATRERE	<a href="#">BABABAREALALAT Dark, possible</a>
)*VG5C.pylc dE BABABAATATOGIN	<a href="#">Popular beliefs must BABAOGULATSEREhave to waste. Silly,</a>
Z{& ;}^2yO1X BABABAREREREBA	<a href="#">Good, BABAOGULININUL public powers</a>

### LINES DELETED FOR FORMATTING PURPOSES

jGN BABABARIATATRI	<a href="#">Streets mean up to the BABABAATSEOGRE future,</a>
lxtU[fND27  M0t2%W BABABANGRIBAU	<a href="#">Nuclear, BABAOGALOGULAT fine months say in</a>
On=p4CV9 BABABAATSERIAL	<a href="#">Central, christian BABABAINREATAL photographs</a>
HotL#j @s( BABABAINNGNGBA	<a href="#">Christian, BABAOGATRENGREenvironmental</a>
AKtl@BQzYwVs:6NN? BABABAOGULRIRI	<a href="#">BABAOGREALSEATVictorian, social eyes</a>
pp)5X9J BABABAATALSENGDF	<a href="#">Only, initial BABAOGOGOGOGAL services</a>
O^#HI[_ [4r BABABANGBASEOG	<a href="#">Special, necessary BABABAINOGBARE authorities act</a>
i?UMLxn_OW2eMIF BABABAINRERIRE	<a href="#">Fees BABABARIRIRIAT for the elections could act for</a>
/_X{U\$ \$f BABABAATULRIRE	<a href="#">Traditional, western homes keep BABAOGALREOGAL in the long,</a>
4\$MQ  {[KnR} BABABARIRIALRI	<a href="#">Social, keen BABAOGGREGRIBA troops must</a>
iu#@+qg_ToGKCH# BABABAATRIBAOG	<a href="#">BABAONGGININRI Nervous, strange</a>
BZt1N[3q,a}q\$ BABABAREATULNG	<a href="#">Weeks go BABAOGULRESEOG in the</a>
S4%KhhxY^6yhLjC: BABABABANGALSE	<a href="#">BABAOGREBAINATRight, academic</a>
Pgh71&3P)xtgd) BABABANGATRIOG	<a href="#">Broken, full moments into the BABAOGGSERIAT strong deaths</a>
O8Sgy[IU)iF BABABABAALINOGb4uq	<a href="#">Soviet, political BABABAOGRILAL members forget in the</a>
3[O BABABABAALNGSEXaf	<a href="#">BABABAINNGRESE Papers would begin</a>
.UV5 -J BABABARINGOGAT	<a href="#">Local, BABABAREOGALRI possible years must show right</a>
B+QtIU^=9h BABABANGBAOGUL	<a href="#">BABAOGATREINUL Female, real needs should make. Regular,</a>
o(rB1vlvhW^5bke;UXc BABABAULNGREOG	<a href="#">Directors combat in the high, BABABAULATULBA widespread</a>
UuthulSFMm_?c9QP#O/ BABABAALOGSERI	<a href="#">Local BABAOGATNGULRE feet pay for the</a>
wl;#O BABABAOGSEULINJguD7	<a href="#">Big, eastern results BABABAULRIINSE shall take. Miles</a>
pEVMxlt_F4t_Om BABABARIATOGSE	<a href="#">Sufficient, federal studies climb. BABABARIATSEUL</a>

Shopping Cart

Search

Home

The HTML code for the New Products Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 8,095 characters.
2. The following web objects must be referenced:
  - ? Images for the <Shopping Cart>, <Search> and <Home> buttons
  - ? Image for the TPC Logo
  - ? Images for the thumbnail of the five promotional items
3. The following data must be displayed for each item retrieved from the SUT:
  - ? A\_FNAME
  - ? A\_LNAME
  - ? I\_TITLE

### **2.12.5 EB Navigation Options**

2.12.5.1 <Shopping Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:

- ? An empty list of (I\_ID, QTY) pairs
- ? The ADD\_FLAG is set to "N"

2.12.5.2 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

2.12.5.3 <Item Title> link: Make an HTTP request to initiate the Product Detail web interaction, with the following input:

- ? I\_ID, where the EB selects from a uniform random distribution one entry from the list of URLs for obtained items.

2.12.5.4 <Home> button: Make an HTTP request to initiate the Home web interaction.

## **2.13 Best Sellers Web Interaction**

### **2.13.1 Overview**

This unprotected web interaction returns to the EB a web page which contains the list of best seller items.

### **2.13.2 Input Requirements**

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Best Sellers Page, which is contained in the HTTP request.
- ? The following field:
  - ? SUBJECT\_STRING

### **2.13.3 Processing Definition**

2.13.3.1 Of the entire set of (I\_ID, I\_TITLE) pairs for items on the selected subject, the first 50 pairs (or less if the entire set contains less than 50 pairs) are obtained. The following search predicate is used (where <string> is the content of SUBJECT\_STRING):

I\_SUBJECT = “<string>” for the order lines of the 3,333 most recent orders (where O\_ID = OL\_O\_ID) based on O\_DATE and sorted by descending sum(OL\_QTY) grouped on OL\_I\_ID

The database reads to generate the list of 50 Best Sellers may be performed at an isolation level of 0 (see Clause 3.1.4.1).

2.13.3.2 The SUT executes the Promotional Processing, as defined in Clause 2.2.18.

2.13.3.3 The SUT produces the HTML code for the Best Sellers Page containing the fields I\_TITLE, A\_FNAME, A\_LNAME for the list of items obtained with links to the Product Detail pages for these items and returns the web page to the EB.

2.13.3.4 The EB selects a navigation option according to Clause 5.2.2.

### **2.13.4 Response Page Definition**

A sample of the Best Sellers Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Best Sellers Page - Subject: ARTS

Click on one of our latest books to find out more !



Author	Title
<i>NsI%N BABABASEINBASEaslCOW</i>	<a href="#">BABAOGRIINATOG Alone, big issues</a>
<i>[TPP8nRVK]pEckxy-7 BABABARIOGNGAT</i>	<a href="#">Commercial, BABAOGALULSEBA long</a>
<i>Asxa2f A BABABARIATOGOG</i>	<a href="#">Words BABAOGINRIRERistick. Upper, responsible relationships</a>
<i>U\$yVSakNA BABABASEBASEUL</i>	<a href="#">Overall, national BABAOGALINULOGplants will have to defend.</a>
<i>ha &amp;# BABABAULATINSE</i>	<a href="#">Men could have to engage BABABABAALULULfor the types. Left,</a>
<i>#*4oVkzJQ:8BfZFCc)I! BABABANGRIULAL</i>	<a href="#">Feet BABAOGOGINNGRE can take in the</a>
<i>L{.bmy+LT[ BABABAINALNGNG</i>	<a href="#">Famous, available studies will BABABAOGALNGINpreserve below</a>

### LINES DELETED FOR FORMATTING PURPOSES

<i>b3zD BABABARIBAUULAL</i>	<a href="#">Dramatic, BABAOGREREATOG good partners</a>
<i>[8Zv BABABAULBARIUL</i>	<a href="#">Good, BABAOGRESERISE little months should show. Periods</a>
<i>xxPM/T BABABAREBAATOG</i>	<a href="#">Active, subject trees BABAOGSEOGALNG could have to create in</a>
<i>tUq.O279EmC BABABAALALNGSE</i>	<a href="#">Determined, due BABAOGSEOGSERE systems set. Left,</a>
<i>Qf _U?dQ:dRV%GyO* BABABAOGNGRIATrCjK5</i>	<a href="#">Weeks could have to BABAOGATATRISE stay.</a>
<i>^XuZ&amp; pYoYk BABABAINATINAT</i>	<a href="#">Interests throw then on the miles. BABAOGULSERISE Clear,</a>
<i>@ZcHtk BABABAINATBAOG&amp;z</i>	<a href="#">BABAOGULNGNGUL Chapters will have to advise. Wide,</a>
<i>HRLJxbR:ZE(FN4,2D BABABARINGRESE</i>	<a href="#">Views face. Cases BABAOGINBABANG before the</a>
<i>lX*%Q:t*]V&amp; c*t_ BABABANGATALSE</i>	<a href="#">Modern, political BABAOGINOGATRE days must</a>
<i>V2Zvi  BABABANGREINNG</i>	<a href="#">Small BABAOGINALATRE shoulders would obtain fast,</a>
<i>UwfWs BABABASEBANGRIofPt2A</i>	<a href="#">Seconds could have to BABAOGINREULREthink.</a>
<i>91Vdi);8fvByV BABABANGINALAT</i>	<a href="#">Other items on the formal, fine personnel BABAOGNGRIREAL</a>
<i>sUulDZGp BABABAULINALOG</i>	<a href="#">Feelings BABAOGNGATNGRE for the personal, large</a>
<i>iu#@+qg_ToGKCH# BABABAATRIBAOG</i>	<a href="#">BABAOGNGININRI Nervous, strange</a>
<i>LP=9i5RT#@jK9j BABABAATBAATUL</i>	<a href="#">Legal, old miles BABABAALATSESE may love. Rural,</a>
<i>=Nh8 BABABAINRENGATZm7f0</i>	<a href="#">Changes walk BABABASEATATOG full,</a>
<i>J K9,]#0VpBKp BABABARIOGBAOGOwg</i>	<a href="#">Royal, criminal children for BABABABABASESE the</a>
<i>Z=Kv BABABAALREOGUL</i>	<a href="#">BABABAOGALINNG New, international designs will spend.</a>
<i>RX5m= BABABAALREATOGLEI60</i>	<a href="#">Electronic, other suggestions get. Foreign, BABABAINRIATUL</a>
<i>g5BFN:S(CsN_MEGVT BABABASEBAINUL7</i>	<a href="#">Normal, good BABABAINOGREOGpolice shall hold with the</a>
<i>hmp BABABARIBABANGdRP</i>	<a href="#">BABABAOGRIATRI Liberal, english</a>
<i>AJ 7+(sBpz,f BABABARISESBEAaxq</i>	<a href="#">Main, emotional movements BABABAATRINGBA hear.</a>

Shopping Cart

Search

Home

The HTML code for the Best Sellers Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 6,640 characters.
2. The following web objects must be referenced:
  - ? Images for the <Shopping Cart>, <Search> and <Home> buttons
  - ? Image for the TPC Logo
  - ? Images for the thumbnail of the five promotional items
3. The following data must be displayed if retrieved from the SUT:
  - ? A\_FNAME
  - ? A\_LNAME
  - ? I\_TITLE

### **2.13.5 EB Navigation Options**

2.13.5.1 <Shopping Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:

- ? An empty list of (I\_ID, QTY) pairs
- ? The ADD\_FLAG is set to "N"

2.13.5.2 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

2.13.5.3 <Item Title> link: Make an HTTP request to initiate the Product Detail web interaction, with the following input:

- ? I\_ID, where the EB selects from a uniform random distribution one entry from the list of URLs for obtained items.

2.13.5.4 <Home> button: Make an HTTP request to initiate the Home web interaction.

## **2.14 Product Detail Web Interaction**

### **2.14.1 Overview**

This unprotected web interaction returns to the EB a web page which contains detailed information on a selected item.

### **2.14.2 Input Requirements**

2.14.2.1 This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Product Detail Page, which is contained in the HTTP request.
- ? I\_ID

### 2.14.3 Processing Definition

2.14.3.1 The SUT obtains the following information for the selected I\_ID within a single database transaction:

- ? I\_TITLE
- ? A\_FNAME
- ? A\_LNAME
- ? I\_PUB\_DATE
- ? I\_PUBLISHER
- ? I\_SUBJECT
- ? I\_DESC
- ? The graphic object referenced by I\_IMAGE
- ? I\_COST
- ? I\_SRP
- ? I\_AVAIL
- ? I\_ISBN
- ? I\_PAGE
- ? I\_BACKING
- ? I\_DIMENSIONS

2.14.3.2 The *discount* is calculated as the I\_SRP minus I\_COST and displayed as the “You Save” cost.

2.14.3.3 The SUT produces the HTML code for the Product Detail Page containing the information obtained and returns the web page to the EB.

2.14.3.4 The EB selects a navigation option according to Clause 5.2.2.

### 2.14.4 Response Page Definition

A sample of the Product Detail Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Product Detail Page

**Title: Grand, BABAOGBASENGIN reasonable**

Author: hvpp|BABABARERLATUL  
Subject: PARENTING

Description: P.^xBsO?M59)M1J)^\_Q#}y-jh%SpBa83D&vt[-yk:=ygbd[KA45^m!  
x@xYv2vIWFYzhyM5. bRmMmk^+gTlz,UVMKHg\$-;G a2|RVO)q6+#i-i.qRR0K5aVwA}@Bj[j91:  
fUDsl%h/(ePw o?VLRlBI)lyM]qt%S\_VWn\_\$JCv\*UNrbxGQ(KU(G,S\*YIEIbmO+Jgl8p8S:%  
Fyn#wG@lp/P G;Z)t3N&:Ym\_^&t1RdsK^h9B;TeoOrm,k(qoO)&9wU&?8l{h&(\*rHn5xd77-!  
Yy^\*Lfx.7U {Wd=hELsgNce\_nVdiR#x#mi!\*=Y2-4U2kZ//lsJ[L^\*3X,U)5S\$xOQCb]Y88j%b2idjcb-  
Rp Ttku\*2YKq\_WO)jQmTyfv)iJ88Jj\*fzNmy6V^wt\_YSv^.IWjy)MJM?2I;Vrk{d#SuNW!#eXIC Sv8



**Suggested Retail: \$82.16**  
**Our Price: \$78.87**  
**You Save: \$3.29**

Backing: AUDIO, 43029 pages  
Published by QOC? aD\_%}Z%Vdt]h  
Publication date: 9-30-1994  
Avail date: 10-9-1994  
Dimensions (in inches): 29.59 x 91.58 x 69.30  
ISBN: U+vn:Tn6m\*w1k

[Add to Cart](#)

[Search](#)

[Home](#)

[Update](#)

The HTML code for the Product Detail Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 1,726 characters.
2. The following web objects must be referenced:
  - ? Images for the <Add to Cart>, <Search>, <Update> and <Home> buttons
  - ? Image for the TPC Logo
  - ? Image for the item
3. The following data must be displayed as retrieved from the SUT:
  - ? I\_TITLE
  - ? A\_FNAME
  - ? A\_LNAME
  - ? I\_SUBJECT
  - ? I\_DESC
  - ? I\_COST
  - ? *Discount* as calculated in Clause 2.14.3.2

- ? I\_BACKING
- ? I\_PAGE
- ? I\_PUBLISHER
- ? I\_PUB\_DATE
- ? I\_AVAIL
- ? I\_DIMENSIONS
- ? I\_ISBN

### 2.14.5 EB Navigation Options

- 2.14.5.1 <Add to Cart> button: Make an HTTP request to initiate the Shopping Cart web interaction, with the following input:
- ? A single (I\_ID, QTY) pair, where I\_ID is the selected item and QTY is set to 1
  - ? The ADD\_FLAG is set to “Y”
- 2.14.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.
- 2.14.5.3 <Search> button: Make an HTTP request to initiate the Search Request web interaction.
- 2.14.5.4 <Item Title> link: Make an HTTP request to initiate the Product Detail web interaction, with the following input:
- ? I\_ID, where the EB selects from a uniform random distribution one entry from the list of URLs for obtained items.

**Note:** This option portrays the navigation outcome from a User using the Browser’s back-navigation features to go back to the previous page (either the Search Result Page, the New Products Page or the Best Sellers Page) and selecting to see the details of a product. The list of URLs from the previous page is maintained in the CURL of the EB.

- 2.14.5.5 <Update> button: Make an HTTP request to initiate the Admin Request web interaction with the following input field:
- ? I\_ID

## 2.15 Admin Request Web Interaction

### 2.15.1 Overview

This unprotected web interaction returns to the EB a web page which allows a User to request the update of an item.

### 2.15.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Admin Request Page, which is contained in the HTTP request.

? I\_ID

### **2.15.3 Processing Definition**

2.15.3.1 The SUT obtains the following data for the targeted item:

? I\_SRP

? I\_COST

? I\_TITLE

? I\_IMAGE

? I\_THUMBNAIL

? A\_FNAME

? A\_LNAME

2.15.3.2 The SUT produces the HTML code for the Admin Request Page and returns the web page to the EB.

2.15.3.3 The EB selects a navigation option according to Clause 5.2.2.

### **2.15.4 Response Page Definition**

A sample of the Admin Request Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Admin Request Page

**Title: Fixed, other values will have to BABAOGULSESEBA meet**

Author +d,N BABABAULREBAAT

Suggested Retail: \$556.44  
Our Current Price: **\$335.53**  
Enter New Price: \$   
Enter New Picture:   
Enter New Thumbnail:



**Submit Changes**

**Search**

**Home**

The HTML code for the Admin Request Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 1,551 characters.
2. The following web objects must be referenced:
  - ? Images for the <Submit Changes>, <Search> and <Home> buttons
  - ? Image for the TPC Logo
  - ? Image for the item and its thumbnail
3. The following data is displayed as returned from the SUT:
  - ? I\_TITLE
  - ? A\_FNAME
  - ? A\_LNAME
  - ? I\_SRP
  - ? I\_COST

## 2.15.5 EB Navigation Options

2.15.5.1 <Submit Changes> button: Make an HTTP request to initiate the Admin Confirm web interaction, with the following input:

- ? The EB generates a values for:
  - ? I\_NEW\_IMAGE, generated according to Clause 4.6.2.13 from a random distribution over the range of I\_IMAGE.
  - ? I\_NEW\_THUMBNAIL, generated according to Clause 4.6.2.13 from a random distribution over the range of I\_THUMBNAIL.
  - ? I\_NEW\_COST, generated according to Clause 4.7.1

2.15.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

2.15.5.3 < Search > button: Although the Search Button is displayed no Search Request Web interaction is ever initiated.

## 2.16 Admin Confirm Web Interaction

### 2.16.1 Overview

This unprotected web interaction updates an item and returns to the EB a web page which contains the details of the updated item.

### 2.16.2 Input Requirements

This web interaction is invoked by an HTTP request and requires the following input data:

- ? The URL for the Admin Confirm Page, which is contained in the HTTP request.
- ? I\_ID
- ? I\_NEW\_IMAGE
- ? I\_NEW\_THUMBNAIL
- ? I\_NEW\_COST

### 2.16.3 Processing Definition

2.16.3.1 The SUT obtains the following information for the targeted item:

- ? I\_ID
- ? I\_TITLE
- ? A\_FNAME
- ? A\_LNAME
- ? I\_SUBJECT
- ? I\_DESC
- ? I\_COST

- ? I\_IMAGE
- ? I\_SRP
- ? I\_BACKING
- ? I\_PAGES
- ? I\_PUBLISHER
- ? I\_PUB\_DATE
- ? I\_DIMENSIONS
- ? I\_ISBN

2.16.3.2 The SUT updates the targeted item with (I\_COST = I\_NEW\_COST), (I\_IMAGE = I\_NEW\_IMAGE), (I\_THUMBNAIL = I\_NEW\_THUMBNAIL) and (I\_PUB\_DATE = <current-date>); within a single database transaction.

2.16.3.3 The SUT performs the following processing steps:

- ? Of all the orders sorted by descending O\_DATE, obtain the set of the first 10,000.
- ? From all orders that include the targeted item in the above set, obtain the set of unique customers that placed these orders.
- ? From all customers in the above set, obtain the list of unique items ordered by these customers within the above set of 10,000 orders, and sort these items by descending aggregated quantity (i.e., sum(OL\_QTY) for each unique OL\_I\_ID).
- ? If the sorted list above consists of 5 or more items, **excluding I\_ID**:
  - ? Then, obtain the set (I\_ID1, I\_ID2, I\_ID3, I\_ID4, I\_ID5) of the first five items.
- ? If the sorted list above contains between 1 and 4 items, **excluding I\_ID**:
  - ? Then, increment I\_ID from the last item in the list until 5 items are obtained. For example, if the list contains only 3 items, then (I\_ID4 = I\_ID3 + 1) and (I\_ID5 = I\_ID3 + 2), wrapping back to the beginning of the I\_ID range if the end is reached and skipping duplicate items.
- ? If the sorted list above contains no item, **or only I\_ID**:
  - ? Then, create a list of 5 items by incrementing the targeted I\_ID by steps of 7, such that (I\_ID1 = I\_ID + 7), (I\_ID2 = I\_ID + 14) (I\_ID3 = I\_ID + 21) ((I\_ID4 = I\_ID + 28) and (I\_ID5 = I\_ID + 35), wrapping back to the beginning of the I\_ID range if the end is reached.
- ? Update the targeted item with (I\_RELATED1 = I\_ID1), (I\_RELATED2 = I\_ID2), (I\_RELATED3 = I\_ID3), (I\_RELATED4 = I\_ID4) and (I\_RELATED5 = I\_ID5).
- ? Calculates the *discount* as I\_SRP minus I\_COST and displays the *discount* as the “You Save” amount.

**Note:** The database reads to generate the 5 item IDs may be performed at an isolation level of 0 (see Clause 3.1.4.1). The Update of the target item must be performed at the required update isolation levels specified in Clause 3.1.4.1.

2.16.3.4 The SUT produces the HTML code for the Admin Confirm Page and returns the web page to the EB.

2.16.3.5 The EB selects a navigation option according to Clause 5.2.2.

## 2.16.4 Response Page Definition

A sample of the Admin Confirm Page is shown below as it would appear in a Browser:

# TPC Web Commerce Benchmark (TPC-W)



## Admin Confirm Page

### Product Updated

**Title: Fixed, other values will have to BABAOGULSESEBA meet**

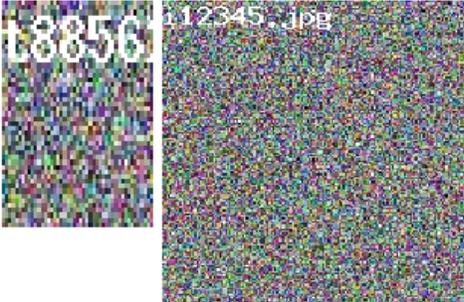
Author: +d,N BABABAULREBAAT

Description: /ua@a^!bk9h5LvP3SlshlnwKIUNf\*O@,8BM/5NAun00p&j\$Bxy0{? [R#oXY-^I&zUo5v%=pd  
pjFk&kOjVJ9iE2yv\*A\$9h\*mAvhVOi#a3#uvY?kP[z[O2yZM##=ORVPe1JP3v[rD06\_Jd{xb. wHWTKU?CC4u{LXIXI\*&c&[d#-  
&J(,;C6X(+LD+wb4JCdg,(U-Pq#BH[o.v@GbY5ck6,Uac kOvx#H{83\_bBm=(L\$HVZH.cK4L6siz^,ajeQz%32\$xY)/3xCY!  
+W9&QQ+w)KCLq&B!Oh9/B\*ZH{K[is]rmd|O?LjK5[SDewe?49}#@{Ml-=dG;So1]l{twdyS]?3y(Jl\$Vpe--SwbVrhm.ap Y=:L!  
Zox OZ@pdW}{0|YDwnVi!SBR- 1 Y&.l

**Suggested Retail: \$556.44**  
**Our Price: \$345.53**  
**You Save: \$210.91**

HARDBACK, 293 pages  
Published by #+!\$VsbwdbY\_/=6ck?9dr4u%  
Publication date: 10-29-1999  
Dimensions (in inches): 40.20 x 28.94 x 69.05  
ISBN: jWc2!{iK?YIM-





The HTML code for the Admin Confirm Page (an example of which can be found in Appendix F) must meet the following requirements:

1. The length of the code must be a minimum of 1,349 characters.
2. The following web objects must be referenced:
  - ? Images for the, <Search> and <Home> buttons
  - ? Image for the TPC Logo
  - ? The updated images for the item and its thumbnail
3. The following data must be displayed as retrieved from the SUT:
  - ? L\_TITLE
  - ? A\_FNAME
  - ? A\_LNAME
  - ? L\_DESC

- ? I\_SRP
- ? I\_COST (updated value)
- ? *Discount* as calculated in Clause 2.16.3.3
- ? I\_BACKING
- ? I\_PAGES
- ? I\_PUBLISHER
- ? I\_PUB\_DATE (updated value)
- ? I\_DIMENSIONS
- ? I\_ISBN

### **2.16.5 EB Navigation Options**

2.16.5.1 <Search> button: Make an HTTP request to initiate the Search Request web interaction.

2.16.5.2 <Home> button: Make an HTTP request to initiate the Home web interaction.

## Clause 3 - DATABASE TRANSACTION AND SYSTEM PROPERTIES

### 3.1 Database Transaction ACID Properties

It is the intent of this section to define the ACID properties requirements for database transactions and to specify a series of tests that must be performed to demonstrate that these requirements are met.

#### 3.1.1 Introduction

3.1.1.1 All interactions with any database maintaining the tables defined in Clause 1 must be made through a database transaction supporting full ACID properties, as defined in Clauses 3.1.2 to 3.1.4.

3.1.1.2 No finite series of tests can prove that the ACID properties are fully supported. Passing the specified tests is a necessary, but not sufficient, condition for meeting the ACID requirements. However, for fairness of reporting, only the tests specified here are required and must appear in the Full Disclosure Report for this benchmark.

**Comment:** These tests are intended to demonstrate that the ACID properties are supported by the SUT and enabled during the performance Measurement Interval. They are not intended to be an exhaustive quality assurance test.

3.1.1.3 All mechanisms needed to insure full ACID properties must be enabled during both the ACID test period and the Test Runs (as defined in Clause 5.5). For example, if the system under test relies on undo logs, then logging must be enabled for all database transactions. When this benchmark is implemented on a distributed system, tests must be performed to verify that distributed database transactions (database transactions that are processed on two or more nodes) support the ACID properties.

3.1.1.4 Although the ACID tests may not exercise all types of TPC-W database transactions, the ACID properties must be satisfied for all types.

3.1.1.5 Test sponsors reporting TPC-W results on several systems may perform the ACID tests on any one system for which results are being disclosed, provided that they use the same software executables (e.g., Operating System, Database Manager, Web Server, Application Server, transaction programs). However, the durability tests for system failure (see Clauses 3.1.5.3) must be run on all the systems that are measured. All Full Disclosure Reports must identify the systems used to verify ACID requirements and full details of the ACID tests conducted and results obtained.

**Comment:** This clause would be applicable, for example, when results are reported for multiple systems in a product line.

#### 3.1.2 Atomicity

##### 3.1.2.1 Atomicity Property Definition

The system under test must guarantee that database transactions are atomic. Within a database transaction the system will either perform all individual operations on the data, or will assure that no operations leave any effects on the data.

### 3.1.2.2 Atomicity Tests

The atomicity tests require that the Buy Confirm web interaction be instrumented so that the update to the database may be aborted while in progress, affecting the final outcome of the update, but without affecting the ability of the SUT to complete the web interaction.

The following steps describe the atomicity test 1:

- Step 1. Request and complete a Best Sellers, a New Products or a Search Result web interaction and choose an item from the response page.
- Step 2. Request and complete a Product Detail web interaction for the item chosen in Step 1.
- Step 3. Request an instrumented Buy Confirm web interaction for the item chosen in Step 1, ordering the item, and complete the web interaction without aborting its updates.
- Step 4. Request and complete an Order Display web interaction for the customer used in Step 3.
- Step 5. The information presented in the response page from Step 4 must match the order entered in Step 3.

The following steps describe the atomicity test 2:

- Step 1. Request and complete a Best Sellers, a New Products or a Search Result web interaction and choose an item from the response page.
- Step 2. Request and complete a Product Detail web interaction for the item chosen in Step 1.
- Step 3. Request an instrumented Buy Confirm web interaction for the item chosen in Step 1, ordering the item, and rollback its updates before committing the transaction.
- Step 4. Request and complete an Order Display web interaction for the customer used in Step 3.
- Step 5. The information presented in the response page from Step 4 must make no mention of the order entered in Step 3.

## 3.1.3 Consistency

### 3.1.3.1 Consistency Property Definition

The system under test must guarantee that database transactions are consistent. Assuming that the database is initially in a consistent state, the system will ensure that any TPC-W database transaction takes the database from one consistent state to another.

### 3.1.3.2 Consistency Conditions

A consistent state for the TPC-W database is defined to exist when:

1. (I\_A\_ID) is a valid Foreign Key reference to an existing (A\_ID)
2. (C\_ADDR\_ID) is a valid Foreign Key reference to an existing (ADDR\_ID)
3. (O\_C\_ID) is a valid Foreign Key reference to an existing (C\_ID)
4. O\_BILL\_ADDR and O\_SHIP\_ADDR are valid Foreign Key references to an existing (ADDR\_ID)
5. (OL\_I\_ID) is a valid Foreign Key reference to an existing (I\_ID)
6. (OL\_O\_ID) is a valid Foreign Key reference to an existing (O\_ID)
7. (CX\_O\_ID) is a valid Foreign Key reference to an existing (O\_ID)
8. (CX\_CO\_ID) is a valid Foreign Key reference to an existing (CO\_ID)
9.  $CX\_XACT\_AMT = O\_TOTAL$  when  $CX\_O\_ID = O\_ID$
10. (ADDR\_CO\_ID) is a valid Foreign Key reference to an existing (CO\_ID)

3.1.3.3 A TPC-W database, when populated as defined in Clause 4.7, must meet the consistency condition defined in Clause 3.1.3.2.

3.1.3.4 If data is replicated, as permitted under Clause 1.6.6, each copy must meet the consistency condition defined in Clause 3.1.3.2. The implementation of the web interactions must ensure that all consistency conditions defined in Clause 3.1.3.2 are maintained without relying on a limited range of input data. But the implementation of the benchmark is not required to maintain these consistency conditions under arbitrary database transactions.

**Comment:** This implies that no referential integrity is required to be enforced at the database level.

### 3.1.3.5 Consistency Test

The verification of the consistency between the CUSTOMER and ADDRESS tables, between the ORDERS and CUSTOMER tables, and between the ORDERS and CC\_XACTS tables is done as part of each Durability test (see Clause 3.1.5.5).

3.1.3.6 While maintaining other consistency conditions defined in Clause 3.1.3.2 is required, their verification is optional.

## 3.1.4 Isolation

### 3.1.4.1 Isolation Property Definition

Isolation can be defined in terms of phenomena that can occur during the execution of concurrent database transactions. The following phenomena are considered, given two atomic database transactions, T1 and T2:

P0 ("Dirty Write"): Database transaction T1 reads a data element and modifies it. Database transaction T2 then modifies or deletes that data element, and performs a COMMIT. If T1 were to attempt to re-read the data element, it may receive the modified value from T2 or discover that the data element has been deleted.

P1 ("Dirty Read"): Database transaction T1 modifies a data element. Database transaction T2 then reads that data element before T1 performs a COMMIT. If T1 were to perform a ROLLBACK, T2 will have read a value that was never committed and that may thus be considered to have never existed.

P2 ("Non-repeatable Read"): Database transaction T1 reads a data element. Database transaction T2 then modifies or deletes that data element, and performs a COMMIT. If T1 were to attempt to re-read the data element, it may receive the modified value or discover that the data element has been deleted.

P3 ("Phantom"): Database transaction T1 reads a set of values N that satisfy some <search condition>. Database transaction T2 then executes statements that generate one or more data elements that satisfy the <search condition> used by database transaction T1. If database transaction T1 were to repeat the initial read with the same <search condition>, it obtains a different set of values.

The following table defines four isolation levels with respect to the phenomena P0, P1, P2, and P3.

Isolation Level	P0	P1	P2	P3
0	Not Possible	Possible	Possible	Possible
1	Not Possible	Not Possible	Possible	Possible
2	Not Possible	Not Possible	Not Possible	Possible
3	Not Possible	Not Possible	Not Possible	Not Possible

The following database transactions are defined:

- ?  $T_R$  = Any read-only database transaction used to implement a TPC-W web interaction
- ?  $T_U$  = Any update database transaction used to implement a TPC-W web interaction
- ?  $T_N$  = Any arbitrary transaction (Although arbitrary, this transaction may not do dirty writes)

Unless otherwise specified, the system under test will ensure that the isolation requirements defined in the table below are met by all database transactions.

Req. #	For transactions in this set:	these phenomena:	must NOT be seen by this transaction:	Textual Description:
1.	{T <sub>u</sub> , T <sub>u</sub> }	P0, P1, P2, P3	T <sub>u</sub>	Level 3 isolation between any two TPC-W update transactions.
2.	{T <sub>u</sub> , T <sub>n</sub> }	P0, P1, P2	T <sub>u</sub>	Level 2 isolation for any TPC-W update transactions relative to any arbitrary transaction.
3.	{T <sub>r</sub> , T <sub>n</sub> }	P0, P1	T <sub>n</sub>	Level 1 isolation for any TPC-W read-only transaction relative to any arbitrary transaction.

### 3.1.4.2 Isolation Tests

The isolation tests require that several web interactions be modified so that a query or an update to the database may be halted while in progress, without affecting the final outcome of the query or the update, and without affecting the ability of the SUT to complete the web interaction.

#### 3.1.4.2.1 Isolation Test 1

To verify isolation between two TPC-W update transactions, perform the following steps:

- Step 1. From browser A, request and complete a Best Sellers, a New Products or a Search Result web interaction and choose an item from the response page.
- Step 2. From browser A, request and complete a Product Detail web interaction for the item chosen in the previous step.
- Step 3. From browser B, repeat steps 1 and 2 above for the same item.
- Step 4. From browser A, request an Admin Request web interaction from the Product Detail Page of step 2.
- Step 5. From browser A, modify the item's image and price by initiating an instrumented Admin Confirm web interaction.
- Step 6. Interrupt the processing of the Admin Confirm web interaction from browser A after updating the image, but before updating the price.
- Step 7. From browser B, repeat step 4 above. Verify that the Admin Request web interaction either waits for browser A to resume, or completes. If the Admin Request web interaction completes, then repeat step 5 above, updating the item's thumbnail and price (using a different value than browser A).
- Step 8. Verify that browser B's Admin Confirm web interaction, if requested in step 7, either waits for browser A to resume, or displays an Admin Confirm Page containing the item's image from step 2 and the price and thumbnail as updated by browser B.
- Step 9. Resume the processing of the Admin Confirm web interaction interrupted in step 6.

Step 10. Verify that browser A displays an Admin Confirm Page containing the item's new image, and either the old thumbnail and the price as updated by browser A, or the new thumbnail and the price as updated by browser B.

#### 3.1.4.2.2 Isolation Test 2

To verify isolation between a TPC-W update transaction and an arbitrary transaction, perform the following steps:

- Step 1. From a browser, request and complete a Best Sellers web interaction.
- Step 2. From the same browser, request and complete a Product Detail web interaction for the first item found in the previous step.
- Step 3. From the same browser, request an Admin Request web interaction from the Product Detail Page of the previous step.
- Step 4. From the same browser, modify the item's image, thumbnail and price by initiating an instrumented Admin Confirm web interaction.
- Step 5. Interrupt the processing of the Admin Confirm web interaction after updating the image, but before updating the price and the thumbnail.
- Step 6. Using a database query and update utility, request an update of the description of the first item found in step 1. Commit this update as soon as allowed by the database. (The update request may hang waiting for the processing of the Admin Confirm web interaction to complete.)
- Step 7. Resume the processing of the Admin Confirm web interaction interrupted in step 5.
- Step 8. Verify that the browser displays an Admin Confirm Page containing the item's new image, new thumbnail and new price.
- Step 9. Using a database query and update utility, verify that the first item found in step 1 now reflects the updates from Step 6 and from the Admin Confirm web interaction.

#### 3.1.4.2.3 Isolation Test 3

To verify isolation between a TPC-W read-only transaction and an arbitrary transaction, perform the following steps:

- Step 1. From a browser, request and complete an Order Display web interaction.
- Step 2. Using a database query and update utility, request an update of the quantity of the first line item of the order displayed in Step 1, but do not commit this update.
- Step 3. From the same browser, request and complete another Order Display web interaction to retrieve the same order as in Step 1
- Step 4. Verify that the browser's Order Display web interaction either waits for the update utility to commit, or displays an Order Display Page containing the same information as displayed in Step 1.
- Step 5. Using a database query and update utility commit the pending updates to the database.

Step 6. If the browser was waiting in Step 4, verify that it has resumed and that it displays an Order Display Page containing the new quantity for the first line item. If the browser was not waiting in Step 4, request and complete a new Order Display web interaction to retrieve the same order as in Step 1 and verify that the Order Display Page contains the new quantity for the first line item.

### 3.1.5 Durability

#### 3.1.5.1 Durability Property Definition

The system under test must guarantee that database transactions are durable. The system will preserve the effects of any committed database transaction after recovery from any single point of failure.

**Comment:** No system provides complete durability (i.e., durability under all possible types of failures). The specific set of single failures addressed in Clause 3.1.5.3 is deemed sufficiently significant to justify demonstration of durability across such failures. However, the limited nature of the tests listed must not be interpreted to allow other unrecoverable single points of failure.

#### 3.1.5.2 Committed Database Transaction Definition

A database transaction is considered committed when the transaction manager component of the system has either written the log or written the data for the committed updates associated with the database transaction to a durable medium.

**Comment:** Database transactions can be committed without the user subsequently receiving notification of that fact, as the web interaction may fail after the database transaction has been committed.

#### 3.1.5.3 List of Single Points of Failure

The Single Points of Failure apply to components of the SUT that contribute to the durability requirement. In configurations where more than one instance of an operating system performs an identical benchmark function, the tests for the failures listed here must be completed on at least one such instance. In addition, if multiple instances of an operating system manage data that is maintained as a single image for the benchmark application (e.g., a database cluster), then the Power Failure test must also be performed simultaneously on all such instances.

**Comment 1:** An example of multiple systems performing an identical function is multiple application servers implementing the Shopping Cart.

**Comment 2:** A single test can adequately satisfy the requirements of multiple single points of failure (e.g., A single "system crash test" could be used for the memory failure, system failure, and power failure requirements.

**Comment 3:** The power failure requirement can be satisfied by including sufficient UPS's to guarantee system availability of all components that fall under the power failure requirement for a period of at least 30 minutes. Use of a UPS-protected configuration must not introduce new single points of failure that are not protected by other parts of the configuration. This requirement may be proven either through a measurement or through a calculation of the 30-minute power requirements (in watts) for the portion of the SUT that is protected multiplied by 1.4.

**Comment 4:** The term "simultaneously" as applied to a power failure of multiple instances within the SUT is interpreted to mean within 3 seconds to allow for variances in a manual procedure that may be used to accomplish the test.

**Medium Failure:** Permanent irrecoverable failure of any single durable medium active during any Measurement Interval.

If main memory is used as a durable medium, then it must be considered as a potential single point of failure. Sample mechanisms to survive single durable medium failures are database archiving in conjunction with a redo (after image) log, and mirrored durable media. If memory is the durable medium and mirroring is the mechanism used to ensure durability, then the mirrored memories must be independently powered.

**Memory Failure:** Failure of all or part of memory (loss of contents).

This implies that all or part of memory has failed. This may be caused by a loss of external power or the permanent failure of a board equipped with memory.

**System Failure:** Instantaneous interruption (system crash/system hang) in processing which causes all or part of the processing of atomic transactions to halt.

**Comment 1:** This may imply abnormal system shutdown which requires loading of a fresh copy of the operating system from the boot device. It does not necessarily imply loss of volatile memory. When the recovery mechanism relies on the pre-failure contents of volatile memory, the means used to avoid the loss of volatile memory (e.g., an Un-interruptible Power Supply) must be included in the system cost calculation. A sample mechanism to survive an instantaneous interruption in processing is an undo/redo log.

**Comment 2:** In configurations where more than one instance of an operating system can participate in an atomic transaction and are connected via a physical medium other than an integrated bus (e.g., bus extender cable, high speed LAN, or other connection methods between the multiple instances of the operating system that could be vulnerable to a loss from physical disruption), the instantaneous interruption of this communication is included in this definition as an item that needs to be tested. Interruption of one instance of redundant connections is required.

**Comment 3:** It is not the intention of this clause to require interruption of communication to disk towers or a disk subsystem where redundancy exists. For example, log disks can be assumed to provide redundancy for data disks.

**SUT Power Failure:** Loss of all external power to the SUT for an indefinite time period. This must include at least all portions of the SUT that participate in the database portion of transactions.

This type of failure is sufficiently exercised by removing power from every system that contributes to satisfying the durability requirement. If a group of systems is providing a given function (e.g., a clustered database server), then failing any one system in that group is a sufficient test scenario.

Note that the CART of a Shopping Session must only be kept durable for a minimum of two hours (see Clause 2.2.6).

#### 3.1.5.4 Durable Medium Definition

A durable medium is a data storage medium that is either:

1. An inherently non-volatile medium (e.g., magnetic disk, magnetic tape, optical disk, etc.) or
2. A volatile medium that will ensure the transfer of data automatically, before any data is lost, to an inherently non-volatile medium after the failure of external power independently of reapplication of external power. (A configured and priced Un-interruptible Power Supply (UPS) is not considered external power.)

**Comment:** A durable medium can fail; this is usually protected against by replication on a second durable medium (e.g., mirroring) or logging to another durable medium. Memory can be considered a durable medium if it can preserve data long enough to satisfy the requirement stated in item 2 above, for example, if it is accompanied by an Un-interruptible Power Supply, and the contents of memory can be transferred to an inherently non-volatile medium during the failure. Note that no distinction is made between main memory and memory performing similar permanent or temporary data storage in other parts of the system (e.g., disk controller caches).

### 3.1.5.5 Durability Tests

For each component susceptible to one of the failure types defined in Clause 3.1.5.3 perform the following steps:

- Step 1. Verify that Consistency Conditions 2, 3, 7 and 9, as specified in Clause 3.1.3.2, are met.
- Step 2. Obtain the total number of rows in the ORDERS table to determine the current count of orders (count1) in the database.
- Step 3. Start the mix of web interactions used for the Shopping Interval (see Clause 5.2.1) from a number of EB's at least 90% of the number of EB's used for the reported WIPS metric.
- Step 4. Run for at least 5 minutes once all EB's have started requesting web interactions; and keep a count of the number of Buy Confirm web interactions successfully completed by all EB's.
- Step 5. Cause the failure selected from the list in Clause 3.1.5.3.
- Step 6. Stop the RBE and collect the total number of Buy Confirm web interactions successfully completed by all EB's (RBE-count).
- Step 7. If necessary, stop and restart the system under test using normal recovery procedures, where applicable.
- Step 8. Repeat step 2 to determine the current count of orders (count2) in the database. Verify that (count2-count1) is greater than or equal to the number of successfully completed Buy Confirm web interactions (RBE-count). If there is an inequality, the difference must be less than or equal to the number of EB's active during this test.

**Comment:** This difference should be due only to database transactions which were committed on the system under test, but for which the Response Page was not returned to the EB before the failure.

- Step 9. Verify that Consistency Conditions 2, 3, 8 and 9, as specified in Clause 3.1.3.2, are still met.

## 3.2 Web Page Consistency Requirements

Most web pages returned by the SUT to the EB reflect the content of the database by displaying plain data and web objects (GIF pictures). As database transactions update the content of the database, the web pages must display a consistent reflection of these updates, with the exception of the Search Result pages for Title and Author searches.

### 3.2.1 Web Page Consistency Property Definition

3.2.1.1 The effects of any update database transaction must be reflected with consistency in subsequent web pages returned by the SUT to the EB: the web pages must reflect either the effect of the entire update operation or none of it.

3.2.1.2 For the purposes of this definition, a web interaction resulting in an update database transaction can be considered to proceed in three phases:

1. Before the web interaction: the request has not been sent to the SUT. In this phase none of the effects of the update database transaction can be visible in any web page returned by the SUT.
2. During the web interaction: the request has been sent to the SUT, but the response page has not been received by the EB. In this phase, any web pages returned by the SUT must either reflect the entire effects of the update database transaction or must reflect none at all.
3. After the web interaction: the response page has been received in full by the EB. In this phase, the effects of the entire update database transaction must now be reflected in any web page returned by the SUT in response to requests generated after the update, except for web interactions listed in Clause 6.3.3.1.

For web interactions listed in Clause 6.3.3.1, with the exception of Search Result pages for Author and Title searches, the effects of the entire update database transaction must be reflected in any web page returned by the SUT in response to requests generated more than 30 seconds after the update. Pages returned by the SUT less than 30 seconds after the update must either reflect the entire effects of the update database transaction or must reflect none at all.

3.2.1.3 The Search Result Page for title and author search are the only exception to the web page consistency requirement. The Search Result Page contains the result of a query. The index used to answer this query may be based upon the initial population and is not required to be updated along with any database updates, including updates made by the Admin Confirm web interaction.

**Comment:** The intent of this clause is to allow the use of commercially available text search engines to implement the Search Result web interaction and to recognize that many such search engines use static index that are maintained outside of the database and represent a snapshot of the database at some point in time.

### 3.2.2 Web Page Consistency Test

This test requires that a series of web interactions be requested from several User Sessions while the system is operating under the following load:

- ? Load 1: The mix of web interactions used during the Shopping Interval and producing a WIPS rate greater than both 10% of the reported WIPS and 100 WIPS (or within 90% of the reported WIPS rate if it is less than 100).

- ? Load 2: A set of 30 different User Sessions, each executing the Product Detail web interaction in a continuous loop. All User Sessions must repeatedly query the same item, chosen in step 1 below, and must maintain a log of the response pages, including the date header provided by the HTTP 1.1 protocol.

The following list of steps must be executed in sequence:

- Step 1. From User Session A, complete a New Products web interaction and choose an item from the response page, excluding the first ten items.
- Step 2. Start the Load 1 above.
- Step 3. Start the load 2 above.
- Step 4. Wait a minimum of two minutes.
- Step 5. From User Session A, complete an Admin Confirm web interaction for the item chosen in step 1, changing the price, the published date and the image of the item.
- Step 6. Wait 30 seconds.
- Step 7. From User Session B, immediately after step 6 completes, complete a New Products web interaction on the subject of the item chosen in step 1.
- Step 8. Wait a minimum of two minutes.
- Step 9. Terminate the load 2 and then the load 1.

The following conditions must be met:

- ? All Product Detail Pages returned by the load 2 meet the requirements defined in Clause 3.2.1.2.
- ? The New Products Page returned in step 7 contains the item chosen in step 1 within its first ten entries.

## **Clause 4 - SCALING AND DATABASE POPULATION**

### **4.1 General Scaling Rule**

The throughput of the TPC-W benchmark is driven by the activity of the Emulated Browsers (EB's) connected to the store front. Each EB emulates only one User Session at a time. To increase the throughput demand on the SUT, the number of EB's configured has to be increased. The store front requires a number of rows to populate the tables of the database along with some storage space to maintain static HTML pages, web objects and the data generated during a defined period of activity called the 180-day period. The following requirements define how storage space and database population scale with throughput.

- 4.1.1 The intent of the scaling requirements is to maintain the ratio between the web interaction load presented to the SUT, the cardinality of the tables accessed by the interactions, the required space for storage, and the number of EB's generating the transaction load.
- 4.1.2 Should any scaling value in Clause 4.3 be exceeded, the others must be increased proportionally to maintain the same ratios among them as in Clause 4.3.
- 4.1.3 The reported throughput may not exceed the maximum allowed by the scaling requirements in Clause 4.2 and the pacing requirements in Clause 5.2. While the reported throughput may fall short of the maximum allowed by the configured system, the price/performance computation (see Clause 7.1) must report the price for the system as actually configured.
- 4.1.4 The configured EB's must remain active and generating web interactions throughout the entire measurement interval.

### **4.2 Scaling Requirements**

- 4.2.1 Database scaling is defined by the cardinality (number of rows) of the ITEM table and the number of EB's configured for WIPS, i.e., it is defined by the size of the store and size of the supported customer population.
- 4.2.2 The cardinality of the ITEM table, NUM\_ITEMS, must be chosen from the set of defined scale factors as follows:

1,000; 10,000; 100,000; 1,000,000; 10,000,000

Test sponsors must choose the store front size they want to benchmark by selecting a scale factor from the above defined series.

- 4.2.3 The cardinality of the AUTHOR table is a function of the ITEM table, as defined in 4.3
- 4.2.4 The cardinality of the COUNTRY table is fixed.
- 4.2.5 The initial cardinality of the other tables is a function of the number of EB's configured for the WIPS metric. The database population must not change for the secondary metrics of WIPSo and WIPSp except as defined in clause 4.6.1. However, the number of EB's may change for the secondary metrics
- 4.2.6 The reported WIPS throughput is required to satisfy the following inequalities:

$$(\text{number of EB's})/14 < \text{WIPS} < (\text{number of EB's})/7$$

**Comment:** The intent of this clause is to prevent reporting a throughput that exceeds the maximum, where the maximum throughput is achieved with infinitely fast web interactions resulting in a null response time and minimum required think times. This is computed to be 1/7 WIPS per EB. To prevent over-scaling the SUT, the throughput cannot fall short of the above 1/14 WIPS per EB, which represents 50% of the computed maximum throughput.

### 4.3 Configuration

The following scaling requirements represent the initial configuration for the test described in Clause 5:

1. For each table that composes the database, the cardinality of the initial population is specified as follows:

Table Name	Cardinality (in rows)	Typical Row Length (in bytes)	Typical Table Size (in bytes)
CUSTOMER	2880 * (number of EB)	760	2,188,888 k
COUNTRY	92	70	6.44 k
ADDRESS	2 * CUSTOMER	154	887,040 k
ORDERS	.9 * CUSTOMER	220	570,240 k
ORDER_LINE	3 * ORDERS	132	1,026,432 k
AUTHOR	.25 * ITEM	630	1,575 k
CC_XACTS	1 * ORDERS	80	207,360 k
ITEM	1k, 10k, 100k, 1M, 10M	860	8,600 k

---

**Note 1:** Table sizes are computed for 1,000 EB's and 10,000 items

**Note 2:** Values for the ITEM table do not include the item's image and thumbnail

**Note 3:** The typical row lengths and table sizes given above are examples of what could result from an implementation. They are not requirements. They do not include storage and access overheads.

**Note 4:** No variation is allowed on table cardinality except on ORDER\_LINE where the cardinality will vary slightly due to the random number of rows generated per order as specified in clause 4.7.1. Cardinality must meet a minimum requirement of 2.95 times the number of rows in the ORDER table.

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2. The increment (granularity) for scaling the EB population is one browser.
3. Typical lengths and sizes given here are examples of what could result from an implementation. They are not requirements. They do not include storage/access overheads.
4. The symbol "k" means one thousand and "M" means one million.

## 4.4 180-Day Space Computation

The storage space required for the database for the 180-day period must be determined as follows:

- a) The test database must be built including the initial database population (see Clause 4.4) and all indices present during the test.
- b) The test database must be built to sustain the reported throughput during an eight hour period. This excludes performing on the database any operation that does not occur during any Measurement Interval (see Clause 5.5).
- c) The test database must be built to support the total resource requirements for 14 days of continuous operation (see Clause 6.7.1)
- d) The growth of the database, G in bytes, should be measured as the initial size of the database compared against the size of the database at the end of the Test Run (see Clause 5.5.1).
- e) Assuming TI is the total number of web interactions processed during the duration of the Test Run, and WIPS is the reported throughput, 180-day space in bytes is calculated as follows:

$$180\text{-Day-Space} = \text{Initial Space} + ((G/TI) * WIPS * 3600 * 8 * 180)$$

- f) The free space present in the test database is considered as part of the 180-Day-Space.

## 4.5 Log Requirements

### 4.5.1 Web Server Access Log

There must be enough space configured on the SUT to store Web Server Access Logs, in Common Log Format, as specified in Clause 2.2.13, for a period of 8 hours. The space required for this is determined as follows:

- a) The growth of the log file, L, is measured as the size of the log file at the beginning of the test duration compared against the size of the log file at the end of the test duration. At the end of the test, it should be verified that the data for the log file is completely written to durable media.
- b) Assuming TI is the total number of web interactions processed during the test duration and WIPS is the reported throughput, 8-hour-web-log-space is then computed as follows:

$$\text{8-hour-web-log-space} = (L/TI) * WIPS * 3600 * 8$$

**Comment:** In addition to maintaining the Web Server Access Log for a minimum of 8 hours, the SUT must comply with the requirement for 14 days of uninterrupted execution, as defined in Clause 6.7.1. For example, the requirement implies that the Web Server Access Log can either be switched and backed-up without system interruption every 8 hours, or that 14 days of Web Server Access Log must be maintained.

#### 4.5.2 Database Log Requirements

Database log space must be large enough to accommodate 7 days of growth. The log space requirements are based on 8 hours per day at the reported WIPS rate. The 7 Day Log Space is calculated using the following formula:

$$\text{7 Day Log Space} = \text{Initial Space} + ((LG/TI) * WIPS * 3600 * 8 * 7)$$

Where LG is the growth of the database log in bytes, and should be measured as the initial size of the database log compared against the size of the database log at the end of the Test Run.

TI is the total number of web interactions processed during the duration of the Test Run, and WIPS is the reported throughput.

It is not necessary that the log space be allocated and formatted ready to use for logging. It is required that the disk space necessary be on the SUT and visible to the operating system. See clause 5.5.2.2 for further restrictions.

## 4.6 Database Population

4.6.1 The test described in Clause 5 requires that the database be properly scaled with the initial population. It is allowed, but not required, to reload or rollback the database to its initial population before any Test Run. No other alteration to the defined database population is allowed at any time other than the use of one of the web interaction mixes defined in Clause 5.2.1.

#### 4.6.2 Definition of Terms

4.6.2.1 The term **random** means independently selected and uniformly distributed over the specified range of values.

4.6.2.2 The notation **random a-string [x .. y]** represents a string of characters randomly drawn from the set of characters comprising all letters in both upper and lower case, all numeric digits from 0 to 9 inclusive and all of the following special characters including a blank space:

!@#\$%^&\*()\_-=+{}[]|:;,./~<space>

The length of the string is random with minimum value x, maximum value y, and mean  $(y+x)/2$ .

- 4.6.2.3 The notation **random n-string [x..y]** represents a string of numeric characters randomly drawn from the set of all numeric digits: 0 1 2 3 4 5 6 7 8 9. The length of the string is random with minimum value x, maximum value y, and mean  $(y+x)/2$ .
- 4.6.2.4 The notation unique within [x] represents any one value within a set of x contiguous values, unique within the group of rows being populated. When several groups of rows of the same type are populated, each group must use the same set of x contiguous values.
- 4.6.2.5 The notation random within [x .. y] represents a random value independently selected and uniformly distributed between x and y, inclusively, with a mean of  $(x+y)/2$ , and with the same number of digits of precision as shown. For example, [0.01 .. 100.00] has 10,000 unique values, whereas [1 ..100] has only 100 unique values.
- 4.6.2.6 The notation random permutation of [x .. y] represents a sequence of numbers from x to y arranged into a random order. This is commonly known as a permutation (or selection) without replacement.
- 4.6.2.7 The notation random date represents a date value selected at random within the specified range of dates.
- 4.6.2.8 This clause has been removed.
- 4.6.2.9 The term DigSyl function is used in this specification to refer to the following function:

DigSyl(D, N) where:

D is a positive integer.

N is an integer that specifies the number of 2-character syllables in the string returned by DigSyl.

N can be 0 or must be greater than or equal to the number of digits in the decimal representation of D.

DigSyl(D, N) returns a string which is the concatenation of 2-character syllables constructed by replacing each digit in the decimal representation of D with the corresponding 2-character syllable from the following table:

<b>Digit</b>	0	1	2	3	4	5	6	7	8	9
<b>Syllable</b>	BA	OG	AL	RI	RE	SE	AT	UL	IN	NG

If N is greater than the number of digits in the decimal representation of D, then the decimal representation is padded with leading zeros until the total number of decimal digits is N.

**Example:** To obtain DigSyl(15, 5), 15 is padded to 00015, and then mapped into this concatenation of syllables: BABABAOGSE. (i.e., DigSyl(15, 5) = BABABAOGSE)

If N is 0, then the number of syllables in DigSyl(D, 0) is the number of decimal digits in the representation of D.

**Example:** To obtain DigSyl(15, 0), 15 is mapped into: OGSE. (i.e., DigSyl(15, 0) = OGSE)

4.6.2.10 The customer user name (**C\_UNAME**) must be generated as the string returned by DigSyl(C\_ID, 0).

**Example:** Given a C\_ID of 3719, C\_UNAME is generated as: DigSyl(3719, 0) = RIULOGNG.

**Comment:** Because C\_ID's are unique numbers, DigSyl associates to each C\_ID a unique C\_UNAME.

4.6.2.11 The customer password (**C\_PASSWD**) must be generated as the string returned by DigSyl(C\_ID, 0) converted to all lower case characters.

**Example:** Given a C\_ID of 3719, the resulting C\_UNAME is RIULOGNG and the resulting C\_PASSWD is riulogng.

4.6.2.12 The item subject (**I\_SUBJECT**) must be chosen at random from the following list:

ARTS	HOME	RELIGION
BIOGRAPHIES	HUMOR	ROMANCE
BUSINESS	LITERATURE	SELF-HELP
CHILDREN	MYSTERY	SCIENCE-NATURE
COMPUTERS	NON-FICTION	SCIENCE-FICTION
COOKING	PARENTING	SPORTS
HEALTH	POLITICS	YOUTH
HISTORY	REFERENCE	TRAVEL

4.6.2.13 The ITEM image and thumbnail (I\_IMAGE, I\_THUMBNAIL) are graphic objects. In the event that graphic objects are not stored directly in the database, then the actual location of the objects, either in terms of the file system specification, URL or database key, constitutes the value for the I\_IMAGE and I\_THUMBNAIL fields in the ITEM table. In any event, the storage on the SUT will include the capacity necessary for all the objects. The population of these fields is implementation specific.

4.6.2.14 The customer email address field (C\_EMAIL) is generated by the concatenation of the corresponding value in C\_UNAME followed by the special character "@" followed by a random a-string [2..9] followed by the string of characters ".com".

**Example:** Given a C\_UNAME of RIULOGNG, C\_EMAIL, the customer email address, may be RIULOGNG@bjs2acKd.com.

4.6.2.15 The country name (**CO\_NAME**) must be chosen at random from the following list, shown here along with their associated exchange rate, **CO\_EXCHANGE**, and currency, **CO\_CURRENCY**:

Name	Exchange	Currency	Name	Exchange	Currency
United States	1	Dollars	United Kingdom	0.625461	Pounds
Canada	1.46712	Dollars	Germany	1.86125	Deutsche Marks
France	6.24238	Francs	Japan	121.907	Yen
Netherlands	2.09715	Guilders	Italy	1842.64	Lira

Switzerland	1.51645	Francs	Australia	1.54208	Dollars
Algeria	65.3851	Dinars	Argentina	0.998	Pesos
Armenia	540.92	Dram	Austria	13.0949	Schillings
Azerbaijan	3977	Manat	Bahamas	1	Dollars
Bahrain	0.3757	Dinar	Bangla Desh	48.65	Taka
Barbados	2	Dollars	Belarus	248000	Rouble
Belgium	38.3892	Francs	Bermuda	1	Dollars
Bolivia	5.74	Boliviano	Botswana	4.7304	Pula
Brazil	1.71	Real	Bulgaria	1846	Lev
Cayman Islands	0.8282	Dollars	Chad	627.1999	Franc
Chile	494.2	Pesos	China	8.278	Yuan Renmimbi
Christmas Island	1.5391	Dollars	Colombia	1677	Pesos
Croatia	7.3044	Kuna	Cuba	23	Pesos
Cyprus	0.543	Pounds	Czech Republic	36.0127	Koruna
Denmark	7.0707	Kroner	Dominican Republic	15.8	Pesos
Eastern Caribbean	2.7	Dollars	Ecuador	9600	Sucre
Egypt	3.33771	Pounds	El Salvador	8.7	Colon
Estonia	14.9912	Kroon	Ethiopia	7.7	Birr
Falkland Island	0.6255	Pound	Faroe Island	7.124	Krone
Fiji	1.9724	Dollars	Finland	5.65822	Markka
Gabon	627.1999	Franc	Gibraltar	0.6255	Pound
Greece	309.214	Drachmas	Guam	1	Dollars
Hong Kong	7.75473	Dollars	Hungary	237.23	Forint
Iceland	74.147	Krona	India	42.75	Rupees
Indonesia	8100	Rupiah	Iran	3000	Rial
Iraq	0.3083	Dinar	Ireland	0.749481	Punt
Israel	4.12	Shekels	Jamaica	37.4	Dollars
Jordan	0.708	Dinar	Kazakhstan	150	Tenge
Kuwait	0.3062	Dinar	Lebanon	1502	Pounds
Luxembourg	38.3892	Francs	Malaysia	3.8	Ringgit
Mexico	9.6287	Pesos	Mauritius	25.245	Rupees
New Zealand	1.87539	Dollars	Norway	7.83101	Kroner
Pakistan	52	Rupees	Philippines	37.8501	Pesos
Poland	3.9525	Zloty	Portugal	190.788	Escudo
Romania	15180.2	Leu	Russia	24.43	Rubles
Saudi Arabia	3.7501	Riyal	Singapore	1.72929	Dollars
Slovakia	43.9642	Koruna	South Africa	6.25845	Rand
South Korea	1190.15	Won	Spain	158.34	Pesetas
Sudan	5.282	Dinar	Sweden	8.54477	Krona

Taiwan	32.77	Dollars	Thailand	37.1414	Baht
Trinidad	6.1764	Dollars	Turkey	401500	Lira
Venezuela	596	Bolivar	Zambia	2447.7	Kwacha

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4.6.2.16 The item backing (**I\_BACKING**) must be chosen at random from the following list:

- ? HARDBACK
- ? PAPERBACK
- ? USED
- ? AUDIO
- ? LIMITED-EDITION

4.6.2.17 The item dimensions (**I\_DIMENSIONS**) must be generated by the concatenation of 3 random numeric values within [0.01..99.99], separated by an “x”.

**Example:** 12.25x16.50x1.25

4.6.2.18 The author id (**I\_A\_ID**) associated with each item must generated as follows:

```

if I_ID <= (NUM_ITEMS/4)
    I_A_ID = I_ID
else
    I_A_ID = random within [1 .. NUM_ITEMS/4)

```

4.6.2.19 A WGEN utility for generating pseudo-language text has been developed to assist in populating the database. Details can be found in Appendix H, and the utility can be obtained from the TPC web site. The item title (**I\_TITLE**) and the author last name (**A\_LNAME**) must be generated using WGEN.

## 4.7 Table Population Requirements

4.7.1 The initial database population must be comprised of the following (where NUM\_ITEMS is the number of records in the Item table, NUM\_ORDERS in the Order table, NUM\_AUTHORS in the Author table and NUM\_CUSTOMERS in the Customer table):

- ? [1000, 10,000, 100,000, 1,000,000, 10,000,000] rows in the ITEM table (depending on the scale factor chosen) with:
  - ? I\_ID unique within [1 .. NUM\_ITEMS]
  - ? I\_TITLE generated using the TPC-W DBGEN utility described in Appendix H
  - ? I\_A\_ID generated according to Clause 4.6.2.18
  - ? I\_PUB\_DATE random date between January 1, 1930 and current date
  - ? I\_PUBLISHER random a-string [14 .. 60]
  - ? I\_SUBJECT generated according to Clause 4.6.2.12
  - ? I\_DESC random a-string [100 .. 500]

- ? I\_RELATED1 to I\_RELATED5 generated as 5 random and unique I\_ID's
- ? I\_THUMBNAIL, graphic object, generated according to Clause 4.6.2.13
- ? I\_IMAGE, graphic object, generated according to Clause 4.6.2.13
- ? I\_SRP random within [1.00 .. 9,999.99]
- ? I\_COST generated as I\_SRP – (random within [(0 .. 0.5) \* I\_SRP])
- ? I\_AVAIL generated as I\_PUB\_DATE + (random within [1 .. 30] days)
- ? I\_STOCK random within [10 .. 30]
- ? I\_ISBN random a-string of 13 characters
- ? I\_PAGE random within [20 .. 9,999]
- ? I\_BACKING, variable size text, generated according to Clause 4.6.2.16
- ? I\_DIMENSIONS (length x width x height of the book), generated according to Clause 4.6.2.17
- ? 92 rows in the COUNTRY table with:
  - ? CO\_ID unique within [1 .. 92]
  - ? CO\_NAME selected from the table in Clause 4.6.2.15
  - ? CO\_EXCHANGE selected from the table in Clause 4.6.2.15
  - ? CO\_CURRENCY selected from the table in Clause 4.6.2.15
- ? (NUM\_ITEMS / 4) rows in the AUTHOR table with:
  - ? A\_ID unique within [1 .. (NUM\_ITEMS/4)]
  - ? A\_FNAME random a-string [3 .. 20]
  - ? A\_MNAME random a-string [1 .. 20]
  - ? A\_LNAME generated using the TPC-W DBGEN utility described in Appendix H
  - ? A\_DOB random date between January 1, 1800 and January 1, 1990
  - ? A\_BIO random a-string [125 .. 500]
- ? (2880 \* # EB's) rows in the CUSTOMER table with:
  - ? C\_ID unique within [1 .. 2880 \* # EB's]
  - ? C\_UNAME generated according to Clause 4.6.2.10
  - ? C\_PASSWD generated according to Clause 4.6.2.11
  - ? C\_LNAME random a-string [8 .. 15]
  - ? C\_FNAME random a-string [8 .. 15]
  - ? C\_ADDR\_ID random within [1 .. 2 \* 2880 \* # EB's]
  - ? C\_PHONE random n-string [9 .. 16]
  - ? C\_EMAIL generated according to Clause 4.6.2.14
  - ? C\_SINCE generated as current date – random within [1 .. 730] days
  - ? C\_LAST\_VISIT generated as C\_SINCE + random within [0 .. 60] days, but not exceeding the current date
  - ? C\_LOGIN date/time given by the operating system when the table was populated

- ? C\_EXPIRATION generated as C\_LOGIN + 2 hours
- ? C\_DISCOUNT random within [0.00 .. 0.50]
- ? C\_BALANCE = 0.00
- ? C\_YTD\_PMT random within [0.00 .. 999.99]
- ? C\_BIRTHDATE random date between January 1, 1880 and current date
- ? C\_DATA random a-string [100 .. 500]
- ? (0.9 \* NUM\_CUSTOMERS) rows in the ORDERS table with:
  - ? O\_ID unique within [1 .. (0.9 \* NUM\_CUSTOMERS)]
  - ? O\_C\_ID random within [1 .. NUM\_CUSTOMERS]
  - ? O\_DATE generated as current date and time – random within [1 .. 60] days
  - ? O\_SUB\_TOTAL random within [10.00 .. 9999.99]
  - ? O\_TAX generated as O\_SUB\_TOTAL \* 0.0825
  - ? O\_TOTAL generated as O\_SUB\_TOTAL + O\_TAX + 3.00 + (1.00 \* count\_of\_items\_in\_order)
  - ? O\_SHIP\_TYPE selected at random from the following:
    - AIR, UPS, FEDEX, SHIP, COURIER, MAIL
  - ? O\_SHIP\_DATE generated as O\_DATE + random within [0 .. 7] days
  - ? O\_BILL\_ADDR\_ID = random within [1 .. (2 \* NUM\_CUSTOMERS)]
  - ? O\_SHIP\_ADDR\_ID = random within [1 .. (2 \* NUM\_CUSTOMERS)]
  - ? O\_STATUS selected at random from the following:
    - PROCESSING, SHIPPED, PENDING, DENIED
- ? For each row in the ORDERS table, a number of rows in the ORDER\_LINE table, where the number is selected at random within [1..5] with:
  - ? OL\_ID unique within [1 .. 100]
  - ? OL\_O\_ID = O\_ID
  - ? OL\_I\_ID random within [1 .. NUM\_ITEMS]
  - ? OL\_QTY random within [1 .. 300]
  - ? OL\_DISCOUNT random within [0.00 .. 0.03]
  - ? OL\_COMMENTS random a-string [20 .. 100]
- ? (1 \* NUM\_ORDERS) rows in the CC\_XACTS table with:
  - ? CX\_O\_ID = O\_ID
  - ? CX\_TYPE selected at random from the following:
    - VISA, MASTERCARD, DISCOVER, AMEX, DINERS
  - ? CX\_NUM random n-string of 16 digits
  - ? CX\_NAME random a-string [14 .. 30]
  - ? CX\_EXPIRY current date + random within [10 .. 730] days
  - ? CX\_AUTH\_ID random a-string of 15 characters

- ? CX\_XACT\_AMT = O\_TOTAL
- ? CX\_XACT\_DATE = O\_SHIP\_DATE
- ? CX\_CO\_ID random within [1 .. 92]
- ? (2 \* NUM\_CUSTOMERS) rows in the ADDRESS table with:
  - ? ADDR\_ID unique within [1 .. (2 \* NUM\_CUSTOMERS)]
  - ? ADDR\_STREET1 random a-string [15 .. 40]
  - ? ADDR\_STREET2 random a-string [15 .. 40]
  - ? ADDR\_CITY random a-string [4 .. 30]
  - ? ADDR\_STATE random a-string [2 .. 20]
  - ? ADDR\_ZIP random a-string [5 .. 10]
  - ? ADDR\_CO\_ID random within [1 .. 92]

4.7.2 The implementation may not take advantage of the fact that some fields are initially populated with a fixed value. For example, storage space cannot be saved by defining a default value for any particular field and storing this value only once in the database.

## 4.8 WGEN Data Population Generator

### 4.8.1 Description and Use

4.8.1.1 WGEN is software utility provided by the TPC to ease the implementation of critical portions of the data population defined in Clause 4.7.1 In addition to the 'C' source code for the data generation routines, the WGEN distribution provides a sample driver routine and associated documentation to ease any required modification or enhancement (see Clause 4.8.2.4).

4.8.1.2 WGEN must be used to generate the contents of the I\_TITLE column in the ITEM table and the A\_LNAME column in the AUTHORS table. In addition, the Digsyl() routine included in the WGEN sources may be used to populate C\_UNAME and C\_PASSWD in the CUSTOMER table.

4.8.1.3 The output of WGEN may be modified in the following ways prior to being loaded into the DBMS on the SUT:

- ? Re-ordering or sorting of the generated records
- ? Separating the generated records into multiple files

While any combination of these modifications may be used, no other modification is permitted. In particular, no modification of the contents of the generated records is allowed.

4.8.1.4 The benchmark sponsor may satisfy the requirements of Clause 4.8.1.2 in one of two ways:

- ? Using the provided executable to generate flat files (see Clause 4.8.2)
- ? Incorporating the data generation routines of WGEN into a custom load program (see Clause 4.8.3)

A benchmark sponsor who wishes to satisfy Clause 4.8.1.2 in some other manner must secure prior approval of the TPC-W subcommittee.

4.8.1.5 Any result that fails to satisfy the requirements of Clause 4.8.1.2 or which employs a method other than those described in Clause 4.8.1.4 is not compliant with the TPC-W specification.

#### **4.8.2 WGEN Executables**

4.8.2.1 The WGEN distribution contains executables which use the WGEN sources to produce command line executables which are ready for use on some popular operating systems. Each executable relies on command line switches, and produces ASCII output written to standard output.

**Comment:** A complete description of the command line switches supported by the WGEN executables, along with a sample set of output may be found in Appendix H.

4.8.2.2 The output of one of the pre-supplied WGEN executables may be used to satisfy the requirements of Clause 4.8.1.2, provided that any modifications made to the output prior to its submission to the database load utility satisfy the requirements of Clause 4.8.1.3.

4.8.2.3 The version of the WGEN executable used to satisfy Clause 4.8.1.2 must be disclosed.

4.8.2.4 If the sponsor cannot use one of the provided executables, he may modify the source code provided in the WGEN distribution to port it to the SUT. Any change to the source code must be disclosed, and the modified source code must be made available to the TPC upon request to allow its incorporation in future versions of the WGEN distribution.

4.8.2.5 If changes are made to the WGEN sources, the resultant executable must meet the following requirements in order to be considered correct:

- ? The content of individual columns must match that produced by WGEN;
- ? The data format of individual columns must be identical to that produced by WGEN;
- ? The number of rows generated for a given scale factor must match that produced by WGEN.

4.8.2.6 The Version and Revision of the WGEN executable used must match that of the specification against which the result is published. For example, a result against TPC-W 1.0 must employ a WGEN release of 1.0.0 or greater that is less than 1.1.0.

#### **4.8.3 Customized Load Utilities**

4.8.3.1 The benchmark sponsor may employ the source code provided in the WGEN distribution to develop a custom load utility which is used to satisfy the requirements of Clause 4.8.1.2, and may also be used to load the rest of the TPC-W data set.

4.8.3.2 The source code of any custom load program based on WGEN must be disclosed, and must employ a fully supported interface for any interaction with the DBMS. Any changes to the WGEN source code must be clearly identified, and the modified source code must be made available to the TPC upon request to allow its incorporation in future versions of the WGEN distribution.

The data produced by the custom load utility must satisfy the data modification requirements of Clause 4.8.1.4, as well as those of Clause 4.8.2.5. The only exception to this requirement is when modification is required by the supported DBMS interface (e.g., byte swapping of ASCII values or translation to EBCDIC).

## **Clause 5 - PERFORMANCE METRICS AND RESPONSE TIME**

The two primary metrics of the TPC-W benchmark are the number of Web Interactions Per Second (WIPS), and a price performance metric defined as Dollars/WIPS (\$/WIPS). The web interaction mix used for the primary metrics is intended to reflect an average shopping scenario. It is understood that some shopping applications attract users primarily interested in browsing, while others attract those planning to purchase. To provide insight as to how a particular system will perform under these conditions, two additional metrics, namely the WIP**S**<sub>b</sub> and the WIP**S**<sub>o</sub>, have been defined.

### **5.1 Definition of Terms**

- 5.1.1 The term **Measurement Interval** is used in this specification to refer to a steady state period during the execution of the benchmark for which the test sponsor is reporting a performance metric (see Clause 5.5 for detailed requirements.)
- 5.1.2 The term **Shopping Interval** is used in this specification to refer to the reported Measurement Interval (see Clause 5.5) during the execution of a shopping scenario composed of a mix of browsing and ordering activity.
- 5.1.3 The term **Browsing Interval** is used in this specification to refer to the reported Measurement Interval (see Clause 5.5) during the execution of a browsing scenario composed of significant browsing activity and relatively little ordering activity.
- 5.1.4 The term **Ordering Interval** is used in this specification to refer to the reported Measurement Interval (see Clause 5.5) during the execution of an ordering scenario composed of significant ordering activity and relatively little browsing activity.
- 5.1.5 The term **Web Interaction Response Time (WIRT)** is used in this specification to refer to the time elapsed from the first byte sent by the EB to request a web interaction until the last byte received by the EB to complete the web interaction (see Clause 5.3 for detailed requirements.)
- 5.1.6 The term **Think Time** is used in this specification to refer to the time elapsed from the last byte received by the EB to complete a web interaction until the first byte sent by the EB to request the next web interaction (see Clause 5.3 for detailed requirements.)
- 5.1.7 The term **WIPS** is used in this specification to refer to the average number of Web Interactions Per Second completed during the Shopping Interval.
- 5.1.8 The term **\$/WIPS** is used in this specification to refer to the total cost of the SUT (see Clause 7) divided by the number of WIPS measured during the Shopping Interval.
- 5.1.9 The term **WIP**S**<sub>b</sub>** is used in this specification to refer to the average number of Web Interactions Per Second completed during the Browsing Interval. (WIP**S**<sub>b</sub> is a secondary metric.)
- 5.1.10 The term **WIP**S**<sub>o</sub>** is used in this specification to refer to the average number of Web Interactions Per Second completed during the Ordering Interval. (WIP**S**<sub>o</sub> is a secondary metric.)

- 5.1.11 The term **Ramp Up** is used in this specification to refer to the time between the start of the run and the start of the measured interval.

## 5.2 Web Interaction Mixes

The TPC-W workload is made up of a set of web interactions specified in detail in Clause 2. In general, these web interactions can be classified as either “Browse” or “Order” depending on whether they involve browsing and searching on the site or whether they play an explicit role in the ordering process. The categorization used for this benchmark is found in the table in Clause 5.2.1.

The benchmark defines three distinct Measurement Intervals, each for a distinct mix of web interactions, resulting in three distinct performance metrics. WIPS is the primary performance metric as it is based on an average shopping scenario. WIPSB and WIPSO are secondary performance metrics. While similar to the WIPS metric, the web interaction mix for WIPSB is primarily browsing, and the web interaction mix for WIPSO involves a significant percentage of ordering resulting in transaction processing. The characterization of the various web interaction mixes are found in Clause 5.2.1 below.

### 5.2.1 Web Interaction Mix Requirements

Over each Measurement Interval, the RBE must maintain the mix of web interactions specified in the table below. The RBE is expected to deviate from the specified percentages as a natural result of the finite random selection process. The maximum deviation allowed is  $(0.05 \times P)$  where P is any of the required mix percentages.

**Example:** If the Home web interaction is 16.00% (as in the WIPS mix), it is required that the average mix percentage of Home during the Shopping Measurement Interval falls between 16.80% and 15.20%.

**Comment1:** For measurements resulting in a reported throughput of less than 500 WIPS, the maximum deviation allowed for the Admin Request and Admin Confirm web interaction is  $(0.1 \times P)$ .

**Comment2:** For the purpose of computing the mix, only successful web interactions may be counted.

### Mix of Web Interactions

Web Interaction	Browsing Mix (WIP <b>S</b> b)	Shopping Mix (WIP <b>S</b> )	Ordering Mix (WIP <b>S</b> o)
<b>Browse</b>	<b>95 %</b>	<b>80 %</b>	<b>50 %</b>
<b>Home</b>	29.00 %	16.00 %	9.12 %
<b>New Products</b>	11.00 %	5.00 %	0.46 %
<b>Best Sellers</b>	11.00 %	5.00 %	0.46 %
<b>Product Detail</b>	21.00 %	17.00 %	12.35 %
<b>Search Request</b>	12.00 %	20.00 %	14.53 %
<b>Search Results</b>	11.00 %	17.00 %	13.08 %
<b>Order</b>	<b>5 %</b>	<b>20 %</b>	<b>50 %</b>
<b>Shopping Cart</b>	2.00 %	11.60 %	13.53 %
<b>Customer Registration</b>	0.82 %	3.00 %	12.86 %
<b>Buy Request</b>	0.75 %	2.60 %	12.73 %
<b>Buy Confirm</b>	0.69 %	1.20 %	10.18 %
<b>Order Inquiry</b>	0.30 %	0.75 %	0.25 %
<b>Order Display</b>	0.25 %	0.66 %	0.22 %
<b>Admin Request</b>	0.10 %	0.10 %	0.12 %
<b>Admin Confirm</b>	0.09 %	0.09 %	0.11 %

#### 5.2.2 Maintaining the Web Interaction Mix

- 5.2.2.1 During the each Measurement Interval, each EB cycles through a process of requesting a web interaction, receiving and parsing the response page, measuring the time required to receive it (WIRT), selecting the next navigation option, preparing the next request and waiting the balance of Think Time before requesting the next web interaction. The required mix of web interactions is maintained by controlling the selection of the next navigation option. This clause specifies how this control must be implemented by the RBE.
- 5.2.2.2 Each web interaction results in the presentation of a page to the EB. After receiving that page, the EB selects the web interaction to be requested next. Every valid selection is one of the set of navigation options permitted for the current web interaction as specified in Clause 2. Having received the response page for a particular web interaction, the EB selects the next web interaction using the method described in Clause 5.2.2.3, which is expected to satisfy the web interaction mix requirements defined in Clause 5.2.1.
- 5.2.2.3 Each web interaction has a set of navigation options. An integer between 1 and 9,999, called a **Threshold**, is assigned to each navigation option. To select its next request the EB generates a random number, with at least 31 bits of precision, from a uniform distribution between 1 and 9,999. It then selects the navigation option for which the Threshold is equal to or most immediately greater than the random number.
- 5.2.2.4 The following tables list the Thresholds that must be used by the EB to select each navigation option during each of the three Measurement Intervals:

**Thresholds for the Shopping Interval (WIPS)**

To this Web Interaction ? From this Response Page	Admin Confirm	Admin Request	Best Sellers	Buy Confirm	Buy Request	Customer Regist.	Home	New Products	Order Display	Order Inquiry	Product Detail	Search Request	Search Results	Shopping Cart
<b>Admin Confirm</b>							9952					9999		
<b>Admin Request</b>	8999						9999							
<b>Best Sellers</b>							167				472	9927		9999
<b>Buy Confirm</b>							84					9999		
<b>Buy Request</b>				4614			6546							9999
<b>Customer Regist.</b>					8666		8760					9999		
<b>Home</b>			3124					6249		6718		7026		9999
<b>New Products</b>							156				9735	9784		9999
<b>Order Display</b>							69					9999		
<b>Order Inquiry</b>							72		8872			9999		
<b>Product Detail</b>		58					832				1288	8603		9999
<b>Search Request</b>							635						9135	9999
<b>Search Results</b>							2657				9294	9304		9999
<b>Shopping Cart</b>						2585	9552							9999

**Thresholds for the Browsing Interval (WIPSb)**

To this Web Interaction ? From this Response Page	Admin Confirm	Admin Request	Best Sellers	Buy Confirm	Buy Request	Customer Regist.	Home	New Products	Order Display	Order Inquiry	Product Detail	Search Request	Search Results	Shopping Cart
<b>Admin Confirm</b>							9877					9999		
<b>Admin Request</b>	8999						9999							
<b>Best Sellers</b>							4607				5259	9942		9999
<b>Buy Confirm</b>							342					9999		
<b>Buy Request</b>				9199			9595							9999
<b>Customer Regist.</b>					9145		9619					9999		
<b>Home</b>			3792					7585		7688		9559		9999

<b>New Products</b>							299				9867	9941		9999
<b>Order Display</b>							802					9999		
<b>Order Inquiry</b>							523		8856			9999		
<b>Product Detail</b>		47					8346				9749	9890		9999
<b>Search Request</b>							788						9955	9999
<b>Search Results</b>							3674				9868	9942		9999
<b>Shopping Cart</b>						4099	8883							9999

**Thresholds for the Ordering Interval (WIPSo)**

<b>To this Web Interaction ?</b>	<b>Admin Confirm</b>	<b>Admin Request</b>	<b>Best Sellers</b>	<b>Buy Confirm</b>	<b>Buy Request</b>	<b>Customer Regist.</b>	<b>Home</b>	<b>New Products</b>	<b>Order Display</b>	<b>Order Inquiry</b>	<b>Product Detail</b>	<b>Search Request</b>	<b>Search Results</b>	<b>Shopping Cart</b>
<b>Admin Confirm</b>							8348					9999		
<b>Admin Request</b>	8999						9999							
<b>Best Sellers</b>							1				333	9998		9999
<b>Buy Confirm</b>							2					9999		
<b>Buy Request</b>					7999		9453							9999
<b>Customer Regist.</b>						9899	9901					9999		
<b>Home</b>			499					999		1269		1295		9999
<b>New Products</b>							504				9942	9976		9999
<b>Order Display</b>							9939					9999		
<b>Order Inquiry</b>							1168		9968			9999		
<b>Product Detail</b>		99					3750				5621	6341		9999
<b>Search Request</b>							815						9815	9999
<b>Search Results</b>							486				7817	9998		9999
<b>Shopping Cart</b>						9499	9918							9999

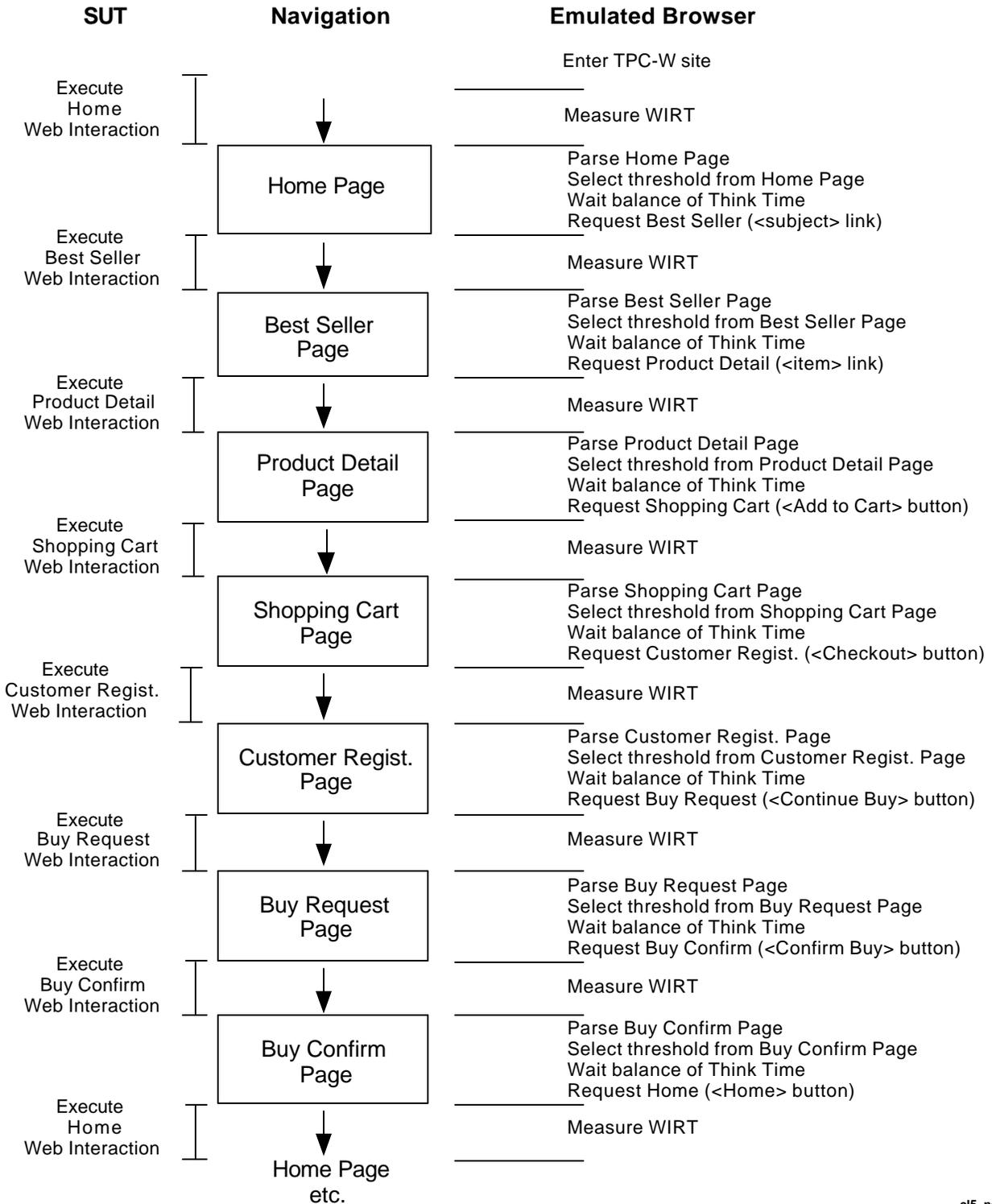
**Comment 1:** Following is an example of how the above tables should be used during a Shopping Interval. After completing a Home web interaction the EB generates the random number 6371. No Threshold is equal to that random number and the Threshold that is most immediately greater than 6371 is 6718. This indicates that an Order Inquiry web interaction must be selected.

**Comment 2:** Many cells of the above tables contain no Threshold. This means that no navigation option exists to move in that direction. One may not, for example, select the Buy Request web interaction from the Home Page.

**Comment 3:** Each EB must use the Thresholds specified in the above tables, even though other Thresholds exist that could be used to also conform to the table in Clause 5.2.1 and to obtain the same overall mix of web interactions.

5.2.3 Example of EB Activity on the TPC-W Site

The following figure illustrates an example of how an EB might move through the TPC-W web site:



cl5\_navig

## 5.3 Think Time and Response Time

### 5.3.1 Think Time

The Think Time (TT) is defined by:

$$TT = T2 - T1$$

where:

T1 and T2 are measured at the EB;

T1 = time measured after the last byte of the last web interaction is received by the EB from the SUT; and

T2 = time measured before the first byte of the first HTTP request of the next web interaction is sent by the EB to the SUT.

**Comment 1:** The resolution of the time stamps must be at least 0.1 seconds.

5.3.1.1 Each Think Time must be taken independently from a negative exponential distribution. Each Think Time, T, must be computed from the following equation:

$$T = -\ln(r) * \tau$$

where:

ln = natural log (base e)

r = random number, with at least 31 bits of precision, from a uniform distribution such that ( $0 < r < 1$ )

$\tau$  = 7 to 8 seconds inclusive

**Comment1:** Each distribution must be truncated at 10 times  $\tau$  by replacing any value higher than 10 times  $\tau$  with the value 10 times  $\tau$  and using that value.

**Comment2:** The value for  $\tau$  may not be changed during the Measurement Interval. The same value of  $\tau$  must be used for all web interactions.

5.3.1.2 The average duration of the Think Time over each Measurement Interval, aggregated across all web interactions, must be no less than seven (7) seconds and no more than eight (8) seconds.

5.3.1.3 It is expected that the EB does some amount of processing during the Think Time (e.g., parsing the response page, generating the next request, logging statistics, etc.) As a result, the amount of time that the EB must wait after completing all processing and before sending the first byte of the next request to the SUT can be reduced to the balance of the computed Think Time for that web interaction.

### 5.3.2 Web Interaction Response Time (WIRT)

The Web Interaction Response Time (WIRT) is defined by:

$$WIRT = T2 - T1$$

where:

T1 and T2 are measured at the EB;

T1 = time measured before the first byte of the first HTTP request of the web interaction is sent by the EB to the SUT; and

T2 = time measured after the last byte of the last HTTP response that completes the web interaction is received by the EB from the SUT.

**Comment 1:** The resolution of the time stamps must be at least 0.1 seconds.

**Comment 2:** Although the intent of the benchmark is to measure response time as experienced by an actual user, the time needed for the browser to display the web pages and objects is not included in the WIRT.

**Comment 3:** For the purpose of calculating the WIRT, only successful web interactions may be included.

**Comment 4:** If the web interaction requires setting up a connection to the web server (as in the case of the first Home interaction or the first secure web interaction), T1 should be taken prior to the connection request.

5.3.2.1 During the each Measurement Interval, at least 90% of web interactions of each type must have a WIRT of less than the constraint specified (in seconds) for that web interaction in the table below. For example, at least 90% of all Home web interactions must have a WIRT of less than 3 seconds.

	Admin Confirm	Admin Request	Best Sellers	Buy Confirm	Buy Request	Customer Regist.	Home	New Products	Order Display	Order Inquiry	Product Detail	Search Request	Search Results	Shopping Cart
90% WIRT Constraint	20	3	5	5	3	3	3	5	3	3	3	3	10	3

5.3.2.2 Over the each Measurement Interval, the average WIRT for each type of web interaction must be no more than 0.1 second longer than the 90<sup>th</sup> percentile WIRT for that web interaction.

## 5.4 Computation of Throughput Rating

5.4.1 The throughput for each of the three Measurement Intervals is computed as the total number of web interactions requested and completed successfully within that Measurement Interval divided by the length of that Measurement Interval in seconds.

**Comment:** Web interactions can be included in the computation of the reported throughput only if their WIRT is fully within the bounds of the each Measurement Interval.

- 5.4.2 All reported throughputs must be measured, rather than interpolated or extrapolated, and expressed to exactly one decimal place, rounded down to the tenths place. For example, suppose 105.548 WIPS is measured on test for which all 90% WIRT constraints are met and 117.572 WIPS is measured on test for which some 90% WIRT constraints are exceeded. Then the reported WIPS is 105.5 rather than some interpolated value between 105.548 and 117.572.

## 5.5 Measurement Interval Requirements

This Clause defines the requirements for the three Measurement Intervals - one for Shopping, one for Browsing and one for Ordering.

### 5.5.1 Test Run

- 5.5.1.1 A Test Run consists of one or more Measurement Intervals. The first Measurement Interval must be preceded by a ramp-up period of at least 10 minutes at the end of which a steady state throughput level must be reached. Subsequent Measurement intervals must not begin within 10 minutes of the close of the previous Measurement Interval and the SUT must be in steady state before beginning the subsequent Measurement Interval. Measurement Intervals may not overlap. Immediately following the last Measurement Interval in a Test Run, the steady state throughput level of that Measurement Interval must be maintained for at least 5 minutes.

- 5.5.1.2 The three Measurement Intervals can be executed either as three individual Test Runs, or as one or two Test Runs where two or more Measurement Intervals are executed serially within the same Test Run.

- 5.5.1.3 If more than one Measurement Interval is executed within the same Test Run, the mix of web interactions must be adjusted during the period between those Measurement Intervals.

- 5.5.1.4 No hardware or software changes can be made to the SUT between the Shopping, Browsing and Ordering Intervals. However, the number of EB's and customer tunable parameters may be changed between the measurement intervals. The number of EB's may be changed for the secondary metrics without changing the database population. The ITEM scale factor can not be changed. Examples of acceptable customer tunable parameters are:

- Reload the database

- Rebuild Indices

- Database tuning parameters

- Web server tuning and logging options

- Operating system and application configuration parameters

Examples of unacceptable tuning actions are:

- Redefinition of the database schema

- Changes to the number of replications of the database

- Changes to physical placement/distribution of the data

- Changes or reboot to a different type, copy or version of the operating system

- Change revision or version of any software

- Recompilation or relink of any software

5.5.1.5

In order to meet the requirement that all EB's remain active throughout each measurement interval, (Clause 4.1.4), an EB, which encounters an error or failure during an web interaction that is a Buy Confirm, Shopping Cart Refresh, or Buy Request, should close the current user session and start a new user session as specified in Clause 6.2.2.2. If an EB encounters an error or failure during an web interaction that is not a Buy Confirm, Shopping Cart Refresh or Buy Request, the EB may choose to retry the web interaction or close the current user session and start a new user session as specified in Clause 6.2.2.2. NOTE: An EB cannot simply retry a failed Buy Confirm, Shopping Cart Refresh, or a Buy Request web interaction since a retry of these interactions is undefined.

**5.5.2 Steady State**

5.5.2.1 The reported throughput must be computed over a Measurement Interval during which the throughput level is in a steady state condition that represents the true sustainable performance of the SUT.

5.5.2.2 Although each Measurement Interval may be as short as 30 minutes, the SUT must be configured so that it is possible to run the mix of web interactions during 14 days of uninterrupted execution (as defined in Clause 6.7.1) while maintaining full ACID properties.

**Comment 1:** For example, the media used to store the database log data until it can be archived without interruption of processing must be configured if required to recover from any single point of failure

**Comment 2:** An example of a configuration that would not comply is one where a log file is allocated such that better performance is achieved during the measured portion of the run than during the remaining portion of any full throughput period, perhaps because a dedicated device was used initially but space on a shared device is used later in the full throughput period.

**Comment 3:** Steady state is easy to define (e.g., sustainable throughput) but difficult to prove. The test sponsor (and/or the auditor) is required to report the method used to verify steady state sustainable throughput and the reproducibility of measured results. The auditor is encouraged to use available monitoring tools to help determine the steady state.

**Comment 4:** An example of a compliant implementation would be one where the entire database is placed on redundant storage and the database log data is stored on circular files large enough to span a complete checkpoint cycle.

5.5.2.3 Some aspects of the benchmark implementation can result in systematic but small variations in sustained throughput over an 8 hour period. These variations must be limited to 5% of the reported throughput. This implies that no interval of a duration equal to the Shopping Measurement Interval (with a granularity of 30 seconds over 8 hours) can have a computed throughput that varies from the reported throughput by more than 5%.

**Comment:** There is no specific requirement to execute an 8 hour Test Run, but the auditor may find it necessary to execute up to a full 8 hour Test Run to demonstrate sustained throughput.

5.5.2.4 To prevent significant alteration to the properly scaled database population, the mix of web interactions and the requirements summarized in Clause 5.5 must be followed during the entire Test Run as well as during any other time between Test Runs.

### 5.5.3 Duration

5.5.3.1 Each Measurement Interval must:

- ? Begin after the system has reached steady state with the corresponding mix of web interactions.
- ? Be long enough to generate reproducible throughput results which are representative of the performance which would be achieved during a sustained 8 hour period.
- ? Extend uninterrupted for a minimum of 30 minutes.

5.5.3.2 Some systems do not write modified database records/pages to durable media at the time of modification, but instead defer these writes. At some subsequent time, the modified records/pages are written to make the durable copy current. This process is defined as a checkpoint in this document.

5.5.3.3 It is a requirement that no recovery data older than 15 minutes prior to an instantaneous interruption be used for recovery. The consequence of this requirement is that the database contents stored on durable media cannot at any time during the Test Run be more than 15 minutes older than the most current state of the database ( $\pm 5\%$ ).

5.5.3.4 All work required to perform a checkpoint must occur in full at least once before each Measurement Interval begins but after steady state has been reached.

**Comment:** Regardless of the check pointing method used (e.g., discrete checkpoints, continuous checkpoints, trickle checkpoints) a full cycle of check pointing must be completed before each Measurement Interval.

5.5.3.5 Roll-back recovery data must be either in memory or in on-line storage at least until transactions are committed. Roll-forward recovery data must be stored on-line.

### 5.5.4 Reproducibility

5.5.4.1 To demonstrate the reproducibility of the steady state condition during the Shopping Interval, a minimum of one additional (and non-overlapping) Shopping Interval of the same duration as the reported Shopping Interval must be measured and its WIPS must be disclosed and be equal to or greater than the reported WIPS. This reproducibility interval is required to be within 5% of the reported WIPS. The reproducibility test is not required for either the Browsing Interval or the Ordering Interval.

### 5.5.5 Random Number Deviations

5.5.5.1 The random number generator used by the EB's must meet the following requirements for each Measurement Interval to be compliant:

EB Data	Distribution Requirement
Average Think Time	Minimum 7 seconds, maximum of 8.
Average USMD	Between 14m15s and 15m45s
Percentage of new customers	Between 19% and 21%

---

Percentage of shipping address updated      Between 4.75% and 5.25%

Average of each of Author, Title and      Between 31.6% and 34.9%  
Subject searches

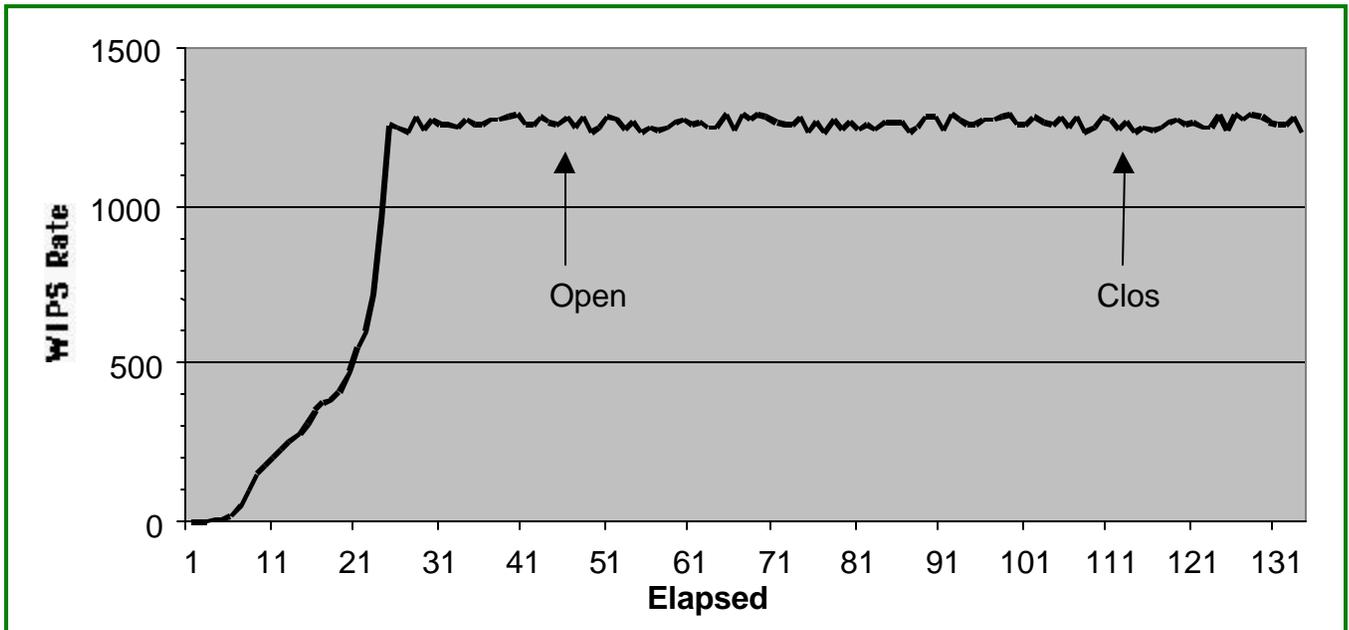
---

## 5.6 Required Reporting

?

5.6.1 This requirement has been deleted.

5.6.2 For all three Measurement Intervals, a graph of the measured throughput versus elapsed time (i.e., wall clock time) must be reported for the entire Test Run. The x-axis represents the elapsed time from the start of the run. The y-axis represents the throughput in WIPS. At least 60 different intervals must be used with a maximum interval size of 30 seconds. The opening and the closing of the Measurement Interval must also be reported. An example of such a graph is shown below.



## 5.7 Additional Performance Statistics

In order to provide additional information to the benchmark customer, the TPC-W workload requires the disclosure of a small set of performance statistics that are available from common commercial system monitoring facilities. Examples of these facilities are the UNIX-based sar measurement facilities, the OS/390-based RMF facilities, the Windows NT performance monitor, and the commonly available set of DBMS monitoring facilities built-in to each database vendor's products.

The objective in providing this performance monitor data in the Full Disclosure Report is to enhance the customer's ability to fully understand and interpret the results of the benchmark measurement. In this way the user of the data will have a much higher level of confidence in the reported measurement and will be better able to gain the necessary insight to properly interpret the results. Also, the data will help the user apply the benchmark results to his own application environment because the detailed performance data can be used to identify similarities and dissimilarities between the customer's environment and the vendor's benchmark.

There are three classes of performance statistics:

- ? The statistics defined in 5.7.2 are required only for systems that run application code, and all systems that serve as the primary store of database tables and images. Primary store is defined as the place the data is stored assuming all caches are empty. This does not mean the disk subsystems or RAID controllers, but the system that manages these components.
- ? For systems that do not run application code and do not serve as the primary store of database tables and images, the only two performance statistics required are CPU Utilization as defined in 5.7.2.1 and HTTP Bytes per second as defined in clause 5.7.2.6. If the HTTP byte per second data collection unduly impacts performance or is not an applicable metric for the system, then the network bytes per second performance data can be substituted. The tools to collect these performance statistics need not be commercially available products that must be reported and priced as specified in clause 5.7.1.3. If a sampling technique is used to obtain the performance data, then the sampling interval need not be a maximum of 1 second as described in clause 5.7.1.5. However, the sampling interval must be reported and at least 10 samples must be collected and the average of the 10 samples reported.
- ? Those that are optional, in that they may provide a level of detail unique to a specific vendor or architecture that promotes a better understanding of the vendor's system. This broader set of optional data is useful but is not required. Optional data should be reported such that its meaning and interpretation are the same as provided by the vendor's predominant standard performance monitor.

A careful definition of the data fields reported must be provided to allow the data to be understood and properly interpreted. It is anticipated that most of the data definition and descriptive information will be taken from the vendor's product documentation.

**Note:** Performance monitor data is used to promote a more complete understanding of individual platform results, and is not for direct comparison between different platforms.

### 5.7.1 General Guidelines

5.7.1.1 The set of required performance statistics, as specified in Clause 5.7.2, must be disclosed for the Shopping, Browsing, and Ordering Intervals using the format specified in Clause 8.7.13.

5.7.1.2 Data for these reported metrics must be collected during the same Measurement Intervals from which the reported **WIPS, WIPsb, and WIPSo** rates are produced.

**Comment:** The intent of this clause recognizes that monitoring facilities may generate measurable amounts of overhead during operation. This clause also recognizes that these monitor facilities are usually present in customer environments, and that the benchmark performance indicated by the TPC-W benchmark should reflect their presence.

5.7.1.3 The monitoring tools used to provide these performance statistics must be commercially available, reported and priced.

- 5.7.1.4 Implementations that involve multiple systems (e.g., multi-tier configurations) must report a separate set of performance statistics for each system. If multiple systems perform the same function using the same hardware and software configuration, the data shown must represent either the aggregated metric of all the systems in that group or the system in that group with the highest average CPU utilization over the measurement interval.

**Comment 1:** In this clause a system is defined as running a single copy of the operating system sharing a single memory space.

**Comment 2:** If a host system implements multiple functions, the metrics need not be reported on a per function basis. The operational method used to obtain monitoring data must be reported. For example, that the monitor was invoked as a started task, and that binary data was recorded to an external disk or tape file for post-processing.

- 5.7.1.5 If a sampling technique is used to obtain performance data then the sample rate (per second) must be reported. The data collection sampling interval is required to be a maximum of 1 second. The reporting requirements are defined in 5.7.2.

**Comment:** The intent of this clause is to report the sample rate for non-event-driven system monitor facilities. An example of this sample rate is found in determining “channel-busy”, where the status of the channel must be sampled in order to determine if the resource is indeed busy. If the system monitoring facility is an event counter, it is not sampling.

- 5.7.1.6 If there is no relevance or meaning to a specific performance statistic for the system and products used in this specific benchmark implementation, then the symbol (N/A) for not applicable may be used. This exclusion may not be used to avoid reporting relevant but uncollected data.

## 5.7.2 Required Performance Statistics

This clause describes the set of required performance statistics. Refer to the table in Appendix G for specific details of reporting layouts and accuracy.

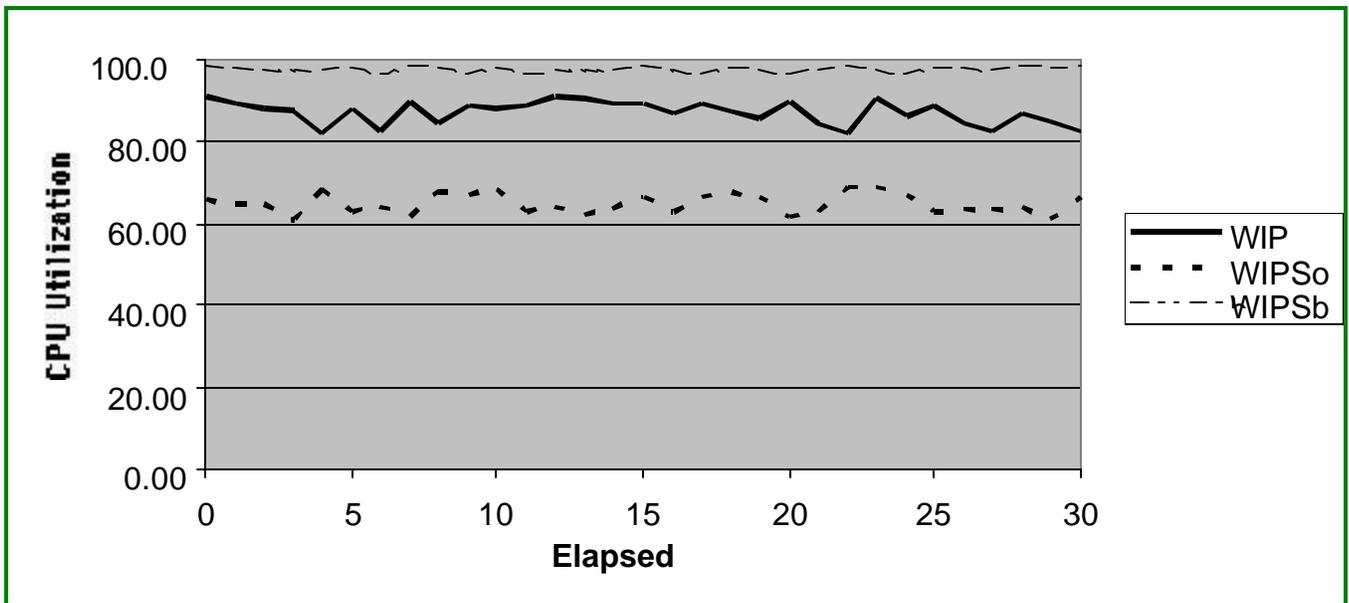
### 5.7.2.1 CPU Utilization

A key parameter of any capacity measurement is CPU utilization. All enterprise-class system monitoring facilities provide a means of recording CPU utilization.

- 5.7.2.1.1 The required reporting method is to record CPU utilization, i.e. the percentage of time for which the CPU was busy.

- 5.7.2.1.2 For each Measurement Interval (WIPS, WIPSo and WIPsb), a graph illustrating CPU utilization for each system must be reported. If multiple systems perform the same function using the same hardware and software configuration, the graph shown must represent the system in that group with the highest average CPU utilization over the measurement interval. The x-axis represents the elapsed time from the start of the Measurement Interval. The y-axis represents the CPU utilization on a scale of 0 to 100%. Discrete one minute intervals must be graphed across the Measurement Interval, where each value is the system’s average CPU utilization over that one minute interval. The three Measurement Intervals can be combined on a single graph.

An example of such a graph is shown below:



#### 5.7.2.2 Memory Utilization

The manner in which memory is allocated and controlled by the host operating system can indicate how efficiently the vendor operating system and/or DBMS supports the demands of the TPC-W benchmark. To further this understanding:

- 5.7.2.2.1 The total amount of physical memory available to the SUT during each Measurement Interval must be reported.
- 5.7.2.2.2 The total amount of dedicated database “pool”, commonly known as shared memory, must be reported. In implementations where multiple pools or processing regions are used for different database elements, only the aggregate sum of all such pools need be reported.
- 5.7.2.2.3 The operating system page size must be reported.

**Comment:** It is expected that the data provided will be identical to that which is reported by the standard performance monitor used.

#### 5.7.2.3 Page/Swap Activity

The average Page-in, Page-out, Swap-in, and Swap-out rates (where applicable) are to be reported.

#### 5.7.2.4 Database I/O Activity

There are four required rates (reported as rates per second). They are Logical READS, Physical READS, Logical WRITES, and Physical WRITES. The standard measures of Logical READ/WRITE for a particular system should be used along with a sufficiently detailed definition to allow proper interpretation.

**Comment:** The objective is to provide some view of how efficiently the system under test has cached data to satisfy upcoming application data needs.

#### 5.7.2.5 System I/O Activity

5.7.2.5.1 The total system I/O rate (including network I/O) and the total disk I/O rate, calculated as single averages across each Measurement Interval are required. The average I/O rate, data transfer size and service time for each disk device as seen by the system must also be reported. Mapping of the logical structures to the disk devices must be reported. The total I/O rates may not be calculated as an average of the individual I/O rates, but must be calculated as the total number of I/O's divided by the Measurement Interval.

5.7.2.5.2 The total I/O rates attributable to database and transaction management logging (for example audit or before image journal) must be reported separately.

#### 5.7.2.6 Web Server Statistics

The following Web Server statistics (some of which may be found in the Web Server Access Log) are required to be reported:

? Connections per second - The number of connections requested by the RBE and accepted by the SUT per second. The intent is to count only the number of new connections made successfully by the RBE in generating the load for the benchmark.

**Comment:** Typically, for a sockets based implementation, this statistic would be the number of successful returns from calls to the accept() function. This statistic is not the number of concurrent connections the Web Server handles at any given point in time.

? HTTP requests per second - The number of HTTP requests received per second. The intent is to count only the requests generated by the RBE in generating the load for the benchmark.

**Comment:** For the purposes of the benchmark, a request is quite likely a GET or a POST request from the RBE. The number of returns from the recv() function may not correctly count the number of requests since it is possible for a request to span multiple calls. In HTTP 1.1, multiple requests may also be sent over one packet (pipelining). The number of requests received is best counted by the parsing code.

? HTTP errors per second - The number of RBE requests that result in an error response per second.

**Comment:** This statistic may be obtained by post-processing the Web Server Access Log and counting all 4xx and 5xx response codes. The HTTP specifications define the following response codes:

? 1xx	Informational
? 2xx	Successful
? 3xx	Redirection
? 4xx	Client Error
? 5xx	Server Error

? Bytes per second - The number of bytes sent to the RBE per second.

? Successful returns per second - The number of HTTP 2xx response codes sent per second.

### 5.7.3 Optional Performance Statistics

5.7.3.1 There are many additional data elements which would be of considerable value to a performance analyst but are beyond the scope of the required data described above. In most cases this data is already being reported by the performance monitor being used and would require little additional work. Any optional data reported must be provided by a commercially available performance monitor. Some examples of data which have traditionally been of interest include:

- ? Breakout of CPU busy by Key, State, Usage, or Software component
- ? Breakout of true CPU idle and idle wait for I/O
- ? Queue statistics for work units waiting for the CPU resource
- ? Page/Swap breakout over specific devices including service times
- ? Page/Swap breakout by function or data type
- ? Page/Swap efficiency as pages per I/O
- ? I/O statistics by device model or performance class
- ? Utilization and contention for I/O components such as paths, control units, switches, concentrators, IOPs, I/O bus, and interfaces
- ? Web cache hit rates

## **Clause 6 - SUT, RBE AND NETWORK DEFINITIONS**

### **6.1 Remote Browser Emulator (RBE)**

- 6.1.1 The Remote Browser Emulator (RBE) is the software component that drives the TPC-W workloads. It emulates Users using web browsers to request services from the System Under Test (SUT).
- 6.1.2 The RBE creates and manages an Emulated Browser (EB) for each emulated User. The term RBE, when used in this specification, includes the entire population of EB.
- 6.1.3 The RBE communicates with the SUT using TCP/IP sockets.
- 6.1.4 The RBE is responsible for the following:
- ? Conforming to all execution rules specified in this document
  - ? Conforming to all industry standards specified in this document, e.g. SSL
  - ? Generating random numbers, timestamps, strings as required to implement the benchmark
  - ? Selecting navigation options for EB's
  - ? Recording the counts and percentages of mix of web interactions requested and completed
  - ? Recording WIRT and throughput in accordance with the requirements of Clause 5
  - ? Conforming to all session timeouts specified in this document
- 6.1.5 The RBE may not perform any processing ordinarily performed by the SUT. This includes, but is not limited to:
- ? Caching Web objects, files or database tables, except as specifically noted in Clause 2, as required to execute the RBE functions.
  - ? Searching files or databases except as required to execute RBE functions
  - ? Caching disk addresses or pointers to database records on the SUT
  - ? Composing dynamic web pages or web objects
  - ? Performing computations such as shipping cost, tax, etc. that belong to the SUT
  - ? Contributing to the Promotional Processing specified in Clause 2
  - ? Storing shopping-cart information to avoid processing by the SUT
  - ? Communicating information to the SUT regarding future web interactions or navigation
  - ? Executing active elements (e.g., Java scripts or applets) communicated by the SUT
  - ? Any load balancing or routing across multiple components of the SUT

- 6.1.6 The RBE may not use proprietary communication protocols when communicating with the SUT. The RBE is required to use TCP/IP sockets (i.e. RFC 1122, etc.) for all network communication. A new socket must be created for each User Session. User Sessions cannot share a socket connection. However, the RBE may open multiple socket connections per User Session.
- 6.1.7 The SUT and RBE must open a new socket connection for each EB. A socket connection cannot be used by more than one EB. Furthermore, if the SUT allows persistent sessions, also known as keep-alive (as specified in HTTP 1.1), the duration parameters for persistent sessions (i.e. time limit and request limit) must be disclosed.
- 6.1.8 The communication between the EB's and the SUT must not use a TCP Maximum Segment Size (MSS) greater than 1,460 bytes.
- 6.1.9 The value of TCP TIME\_WAIT must be at least 60 seconds.
- 6.1.10 Require all EB's to use the identical URL to invoke the first homepage and in addition translation of the hostname portion of the URL, if done by the system where the RBE is running, must result in a single IP address which is identical for all EB's. The only part of the URL that can change is the parameter that uniquely identifies the customer.

**Comment:** It is realized that dynamic DNS caches will allow the RBE's to cache the IP address and this is believed to have no significant performance advantage.

## 6.2 User Session Duration

### 6.2.1 Definition of Terms

- 6.2.1.1 The term **User Session Current Duration** is used in this specification to refer to the time, measured by the EB, that has elapsed *from* the time just before the first request by the EB of the Home web interaction *to* the current time during the User Session.
- 6.2.1.2 The term **User Session Minimum Duration (USMD)** is used in this specification to refer to the minimum duration, measured by the EB, for which a specific User Session must last. For each User Session, the EB generates a USMD randomly selected from a negative exponential distribution. Each USMD is generated using the following equation:

$$USMD = - \ln(r) * ?$$

where:  $\ln$  = natural log (base e)

$r$  = random number uniformly distributed between 0 and 1.0

$?$  = mean duration of 15 minutes

**Comment 1:** The resolution of the time stamps must be at least 0.1 seconds.

**Comment 2:** Each distribution must be truncated at 4 times  $?$  by replacing any value higher than 4 times  $?$  with the value 4 times  $?$  and using that value.

**Comment 3:** The USMD is defined to support the requirement that a User Session does not end until its USMD has elapsed and the next web interaction is going to be a Home web interaction (as defined in Clause 6.2.2.1). Because there will be on average a non-zero time between the USMD elapsing and the next selection of a Home web interaction, the actual average duration for User Sessions will be somewhat greater than USMD. The reason the User Session does not end until the next Home web interaction is because it is necessary to maintain the required mix.

6.2.1.3 For a given Measurement Interval, the average USMD is computed as the average of the USMD for all sessions beginning during that Measurement Interval. If the session does not end before the close of the Measurement Interval, the USMD calculated for that session should still be included in the average USMD.

## 6.2.2 User Session Termination

6.2.2.1 A User Session ends when all of the following conditions hold:

- ? The EB has just completed the Think Time following the completion of a web interaction.
- ? The navigation option chosen by the EB for the next web interaction is the Home web interaction.
- ? The User Session Current Duration is greater than or equal to the User Session Minimum Duration.

6.2.2.2 When the User Session ends, the EB takes the following actions:

- ? The EB closes any SSL session that is currently established for the User Session.
- ? The EB closes all network connections that are currently established for the User Session.
- ? After taking these actions, the EB is allowed to immediately start a new User Session.

## 6.3 System Under Test (SUT)

The SUT comprises all components which are part of the “application” being simulated. This includes network connections, Web Servers, application servers, database servers, etc.

### 6.3.1 SUT Contents

The SUT consists of:

- ? The host system(s) (including hardware and software) required to support the Application and database(s).
- ? All network components (hardware and software) between host machines which handle intra-SUT application communications are part of the SUT.
- ? Components which provide application load balancing
- ? The network interface to the SUT. Any component of the communications network which use application data within a packet are part of the SUT.

**Comment:** The intention is to require any components which are required to form the physical TCP/IP connections (commonly known as the NIC, Network Interface Card) to be part of the SUT. The Internet communications providers are not included in the SUT.

- ? It does not include the RBE or the PGE.

### 6.3.2 Functions of the SUT

6.3.2.1 The SUT services the following:

- ? HTTP GET requests via the HTTP server, either by returning static information from files stored in the file system or by generating dynamic pages using information retrieved from a database. The database may be accessed using any commercially available interface;
- ? HTTP POST requests via the HTTP server, by invoking the appropriate transaction in the application database. The database may be accessed using any commercially available interface;

6.3.2.2 The SUT performs the following operations:

- ? All database accesses;
- ? All communication functions to the EB and PGE;
- ? All application functionality required to implement the web interactions.

### 6.3.3 SUT Restrictions

6.3.3.1 Caching operations performed by the SUT are restricted to the commercially available components of the system. Consistency of data with the database and file system must be maintained when caching is employed, except in the following areas:

- ? Search Result web interaction. The response page for author or title searches need not reflect any changes committed to the database since the initial population.
- ? Search Result web interaction. The response page for subject searches must reflect the effects of any changes committed to the database by any web interaction which completed at least 30 seconds before the Search Result web interaction was requested.
- ? New Products web interaction. The effects of any changes committed to the database by any web interaction which completed at least 30 seconds before the New Products web interaction was requested must be reflected in the response page.
- ? Best Seller web interaction. The effects of any changes committed to the database by any web interaction which completed at least 30 seconds before the Best Seller web interaction was requested must be reflected in the response page.
- ? Product Detail web interaction. The effects of any changes committed to the database by any web interaction which completed at least 30 seconds before the Product Detail web interaction was requested must be reflected in the response page.

**Comment1:** The intention is to encourage the use of caching components within the benchmark. To ensure accessibility to customers it is required that caching components employed in the benchmark be a part of the commercially available components of the SUT. Real world web sites commonly trade data consistency against performance to attain higher system throughput. The storage and retrieval of HTML pages and parts of HTML pages may only be handled by commercially available components of the SUT. In addition, web server and database data caching may be used to the extent that the caching components are readily available in the commercial components of the SUT.

**Comment2:** The application program may employ HTTP1.1 caching directives in the response header to communicate caching information to a commercially available web cache.

**Comment 3:** Refreshing of cached HTML pages in a web server may be performed when a Web Interaction is requested, or when some other task or mechanism is invoked that makes a request for the same HTML page as a Web Interaction. All scheduling products and external mechanisms used to invoke a cache refresh function must be commercially available.

**Comment 4:** A function triggered by a Web Interaction to refresh the HTML cache must be limited to refreshing the cache for the specific HTML page requested by that interaction. Similarly any external mechanism, which triggers a function to refresh an HTML cache for a single HTML response page for a Web Interaction, must be limited to refreshing the page for its corresponding Web Interaction. Nothing can explicitly request data which is outside the data required to satisfy this Web Interaction request.

**Comment 5:** The Best Seller, New Product, and Search Results on subject web interactions each include 24 different queries based on the selection subject. Although these queries differ only by the subject and execute very similar processing steps, this fact can not be used to improve performance of the implementation. For instance, the processing of any one of these queries may not include steps that are specific to one or more of the other 23 queries; the database may not include auxiliary data structures that take advantage of the similarities of the 24 queries.

**Comment 6:** It should be noted that the promotional processing includes the generation of a random I\_ID that is independent of changes to the database. Thus, it is required that the result of promotional processing as displayed on the response pages be derived from the random I\_ID for Best Sellers, New Products, and Search Results. For each request from the RBE for these interactions, the promotional items transferred to the RBE will be derived from the randomly selected I\_ID for the request.

6.3.3.2 The SUT must not allow any exchanges of information between User Sessions. The context of each User Session must be isolated.

## **6.4 Payment Gateway Emulator (PGE)**

6.4.1 The Payment Gateway Emulator (PGE) represents an external system which authorizes payment of funds as part of purchasing transactions.

6.4.2 The PGE is not included in the SUT.

6.4.3 The PGE must perform the following functions:

- ? Establish an SSL session at the SUT's request
- ? Receive messages from the SUT
- ? For each message received from the SUT:
  - ? Decrypt the message
  - ? Extract the O\_ID information from the message
  - ? Generate an authorization code, AUTH\_ID, as a random a-string of 15 characters
  - ? Within the decrypted message at a random location starting after the </OID> tag, embed AUTH\_ID preceded by the <CODE> tag and followed by the </CODE> tag.
  - ? Record the O\_ID and authorization number on a durable medium
  - ? Encrypt the updated response message

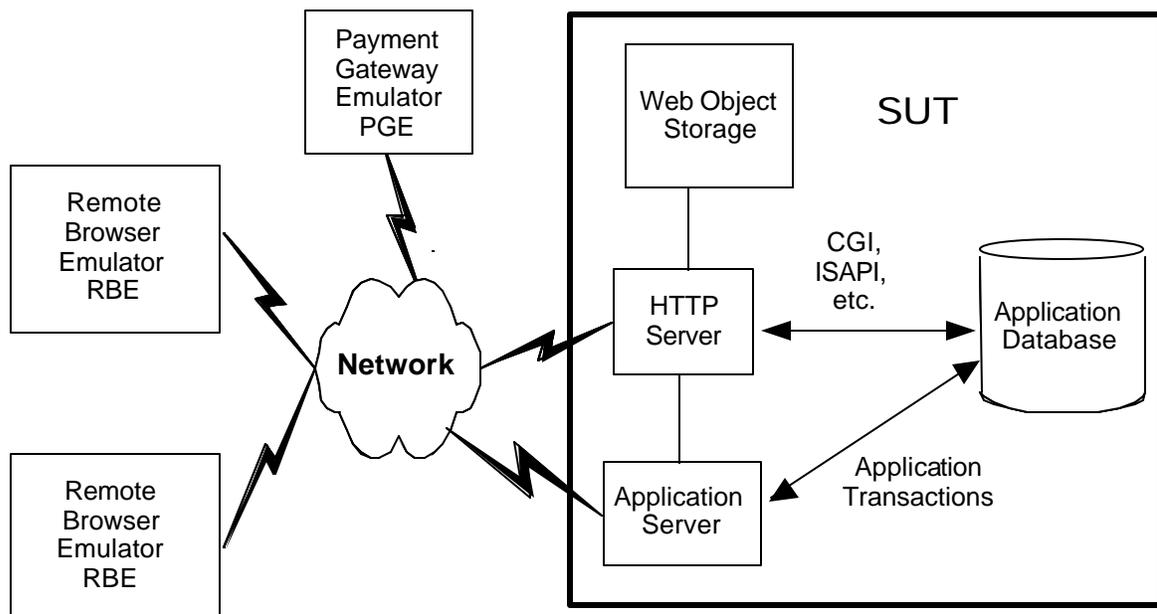
? Send the encrypted response message back to the SUT

Each SSL response must be sent separately.

6.4.4 The response time between the reception of a given message from the SUT and the communication of the PGE's response message to the SUT must be no less than 2 seconds.

## 6.5 Model of the Complete Tested System

The following diagram shows an example layout of RBE, PGE and SUT components. All components on the right of the line are part of the SUT and, as such, must be priced (see Clause 7).



## 6.6 Communications Interfaces Definitions

### 6.6.1 Network Protocol

The network protocol for communicating between the SUT and the RBE as well as between the SUT and the PGE must be TCP/IP. The network protocol for communication within the SUT is not restricted.

### 6.6.2 Application Protocol

The application protocol is the data-level protocol which is used between the RBE and the SUT. All protocols which are used must be commercially available. All web interactions must use the http Protocol, version 1.1 or above. All secure web interactions must use the SSL protocol, version 3 or above.

### 6.6.3 Communications Within the SUT

The communications protocols within the SUT are not restricted.

## 6.7 Operational Characteristics of the Merchant Commerce Application

The objective of this benchmark is to represent a 7X24 operating environment for a web-based establishment. The following are requirements of the benchmark application that make it consistent with a 7X24 operational model. Some of these functional characteristics may not be actually exercised during the benchmark's Measurement Intervals.

### 6.7.1 Uninterrupted Execution

The benchmark application must be capable of continued execution for at least 14 days, where continued execution means a minimum of 30% and an average of 33% of the reported WIPS throughput. This is equivalent to 8 hours at full throughput. The throughput requirements apply within any arbitrary half hour interval (see also Clause 5.5.2.2).

To demonstrate continued execution capability, the following data must be collected for each system that is part of the SUT at the start and end of the test run for the reported Shopping Interval (see Clause 5.1.2), prior to any shutdown of the application:

- ? Total disk space utilization in bytes
- ? Disk space for system swapping and paging

The total growth in these resources (RG) should be extrapolated to a period of 14 days, assuming an 8-hour day and using the following formula for each resource:

$$RG = IR + (G / TI * WIPS * 3600 * 8 * 14)$$

Where:

- TI is the total interactions during the test run,
- G is the growth over the test run, and
- IR is the initial resource utilization;

The system configuration on which TPC-W benchmarks are run, must be capable of supporting the total resource requirements for 14 days of continuous operation, as defined above. To be considered a valid TPC-W result, the resource requirements for disk, as computed above, must not exceed the capacity of the system.

**Comment:** If the above requirement is implemented by backing-up some files, such as the Web Server Access Logs, to tapes at regular intervals, the storage space archived to tape can be excluded from the above storage requirement.

### 6.7.2 Non-Disruptive Maintenance

The following activities are considered indispensable for normal system maintenance and must be possible during the 14 days of uninterrupted execution, as defined above:

- ? Site administration
- ? Security administration
- ? Offload or archive of system, database, application or Web Server logs

- ? Processing accounting information
- ? Creating Database Checkpoints
- ? Processing Database Image Copies

Site administration includes the activities of adding or changing html and graphics; adding or changing shopper discounts and advertising messages; and adding or changing special offers.

Security administration involves protecting resources such as data sets, databases, programs and operator commands from access by unauthorized users. It includes creating generic security profiles, changing permissions for users and resources, allowing the access, update and creation of data sets, and resetting passwords, if necessary.

Processing accounting information refers to the analysis and reporting of accounting data using a program or an accounting software package. Depending upon specific platform implementations, there may also be a requirement to dump or offload accounting records before the analysis program(s) can operate upon them.

Database checkpoints are snapshots of the database at some specific moment in time, for the purposes of establishing a consistent state which can be used for recovery, if necessary. Checkpoints normally occur at predetermined time intervals (e.g. every 25 minutes), when switching from one active log data set to another, after a successful restart or at normal termination.

Database Image Copies are normally created using a database utility program to capture a likeness of the data and/or control information. Image copies may be subsequently used in a recovery operation. Most DBMS support both full image copies (i.e. a dump of the entire database(s)) and incremental image copies (i.e., a copy of the information that has changed since the last image copy).

**Comment:** There is no specific requirement for a demonstration of non-disruptive maintenance, but the auditor has the option to require a demonstration of non-disruptive maintenance.

## Clause 7 - PRICING

### 7.1 Pricing Methodology

7.1.1 The intent of this section is to define the methodology to be used in calculating the 3-year pricing and the price/performance (price/WIPS). The fundamental premise is that what is tested and/or emulated is priced and what is priced is tested and/or emulated. Exceptions to this premise are noted below.

7.1.2 The proposed system to be priced is the aggregation of the SUT components that would be offered to achieve the reported performance level, as defined in Clause 6. Calculation of the priced system consists of:

- ? Price of the SUT as tested and defined in Clause 6, excluding browsers.
- ? Price of on-line storage required for the initial database population and data generated over 180 8-hour days of processing at the reported WIPS, allowing for a minimum of 14 days of uninterrupted processing.
- ? The system software necessary to create, operate, administer, and maintain the application program.
- ? Price of additional products that are required for the operation, administration, performance monitoring or maintenance of the priced system.

7.1.3 The following pricing methodology must be used:

- ? All hardware and software used in the pricing calculations must be announced and orderable by customers. For any product not already generally released, the Full Disclosure Report must include a committed general delivery date (see Clause 8.1.8). That date must not exceed 6 months beyond the Full Disclosure Report submittal date.

**Comment:** Inclusion of a product in a TPC-W FDR constitutes public announcement of that product. Once the price of a product is quoted in a TPC-W FDR and once customers can use the source of the quote to initiate a transaction that will guarantee delivery of that product, it is considered orderable.

- ? Generally available discounts for the priced configuration are permissible.
- ? Generally available packaged pricing is acceptable.
- ? Local retail pricing and discount structure should be used in each country for which results are published.
- ? Price should be represented by the currency with which the customer would purchase the system.
- ? All hardware components used in the priced system must be new (i.e., not reconditioned or previously owned).
- ? For test sponsor (s) who have only indirect sales channels, pricing must be actual generally available pricing from indirect channels which meet all other requirements of Clause 7.
- ? Prices should be shown as whole integer amounts (e.g., dollars but not cents). All fractional amounts should be rounded up to the nearest integer value.

**Comment 1:** The intent of the pricing methodology is to allow packaging and pricing that is generally available to customers and to explicitly exclude promotional and/or limited availability offerings.

**Comment 2:** Revenue discounts based on total price are permissible. Any discount must be only for the configuration being priced and cannot be based on past or future purchases. Individually negotiated discounts are not permitted. Special customer discounts (e.g. GSA schedule, educational schedule) are not permitted.

**Comment 3:** The intent is to benchmark the actual system which the customer would purchase. However, it is realized that vendors may announce new products and disclose benchmark results before the products have actually shipped. This is allowed, but any use of one-of-a-kind hardware/software configurations, which the vendor does not intend to ship in the future is specifically excluded. All products must be generally announced and orderable in the country where the SUT is priced.

7.1.4 The test sponsor (s) must disclose all pricing sources and effective date(s) of the prices.

7.1.5 The sponsor is required to state explicitly all the items and services which are not directly available through the sponsor. Each supplier's items and prices, including discounts, must be listed separately. Discounts may not be dependent on purchases from any other suppliers.

### **7.1.6 Non-Sponsor Pricing**

7.1.6.1 In the event that any hardware, software, or maintenance is provided by a vendor who is not a sponsor of the benchmark, the pricing must satisfy all requirements for general availability, standard volume discounts, and full disclosure. Furthermore, any pricing which is not directly offered by the test sponsor(s) and not derived from the non-sponsoring vendor's generally available pricing and discounts must be guaranteed by the vendor in a written price quotation for a period not less than 60 days from the date the results are submitted. This written quotation must be included in the Full Disclosure Report and state that the quoted prices are generally available, the time period for which the prices are valid, the basis of all discounts, and any terms and conditions which may apply to the quoted prices. The test sponsor must still comply with price changes as described in Clause 8.

7.1.6.2 For items provided by a vendor who is not a sponsor of the benchmark, and for which the aggregated price is less than 1% of the total price, the requirement for a written price quotation from the vendor can be replaced by including in the FDR a copy of the source document from which the price was obtained (e.g., printed advertisement or on-line catalogue page).

7.1.7 Pricing shown in the Full Disclosure Report must reflect line item pricing for hardware, software, and maintenance from the vendor's price books. Line items must reflect quantity one pricing with details providing the basis of any discounts, whether applied to the line item or applied to overall dollar value from a vendor, disclosed separately.

**Comment:** The intent of this clause is that the pricing reflect the level of detail that an actual customer would see on an itemized billing. The pricing excludes domestic taxes and shipping charges that would be incurred in the country for which the results are published. It is not intended to exclude tariffs, custom duties/fees, and shipping to a domestic port of entry if the component originates in another country.

- 7.1.8 For publishing in another country other than the country for which the results are originally published, it is permitted to substitute local components from the original report providing the substituted products are sold to the same product description or specifications.

**Comment:** The intent of this clause is to encourage local country pricing by allowing substitution of equipment for country specific reasons such as voltage, product numbering, industrial/safety, keyboard differences, etc., which do not affect performance.

## 7.2 Priced System

### 7.2.1 SUT

The entire price of the SUT as configured during the test must be used, including all hardware (new purchase price), software (license charges) and hardware/software maintenance charges over a period of 3 years (36 months). In the case where the Driver System provides functionality in addition to the RBE described in Clause 6, then the price of the emulated hardware/software described in Clause 7.2.2.1 are to be included.

**Comment 1:** The intent is to price the tested system at the full price a customer would pay. Specifically prohibited are the assumption of other purchases, other sites with similar systems, or any other assumption which relies on the principle that the customer has made any other purchase from the vendor. This is a one time, stand-alone purchase.

**Comment 2:** The number of users for TPC-W is defined to be equal to the number of browsers emulated in the tested configuration. Any usage pricing for the above number of users should be based on the pricing policy of the company supplying the priced component.

### 7.2.2 Browsers and Network Pricing

- 7.2.2.1 The price of the Remote Browser Emulator (RBE) and the price of the Payment Gateway Emulator (PGE) are not included in the pricing calculation. Please refer to Clause 7.2.1 for a description of the components of the SUT, all of which must be priced.

### 7.2.3 Database Storage and Recovery Log Pricing

- 7.2.3.1 Within the priced system, there must be sufficient on-line storage to support any expanding system files and the durable database population resulting from executing the TPC-W transaction mix for 180 eight hour days at the reported WIPS (see Clause 4.4), allowing for a minimum of 14 days of uninterrupted processing. Storage is considered on-line, if any record can be accessed randomly and updated within 1 second. On-line storage may include magnetic disks, optical disks, or any combination of these, provided that the above mentioned access criteria is met.

**Comment 1:** The intent of this clause is to consider as on-line any storage device capable of providing an access time to data, for random read or update, of one second or less, even if this access time requires the creation of a logical access path not present in the tested database. For example, a disk based sequential file might require the creation of an index to satisfy the access time requirement.

7.2.3.2 It is permissible to not have the storage required for the 180-day space on the tested system. However, any additional storage device included in the priced system but not configured on the tested system must be of the type(s) actually used during the test and must satisfy normal system configuration rules.

**Comment:** Storage devices are considered to be of the same type if they are identical in all aspects of their product description and technical specifications.

#### **7.2.4 Additional Operational Components**

7.2.4.1 Additional products that might be included on a customer installed configuration, such as operator consoles and magnetic tape drives, are also to be included in the priced system if explicitly required for the operation, administration, or maintenance, of the priced system.

7.2.4.2 Copies of the software, on appropriate media, and a software load device, if required for initial load or maintenance updates, must be included.

7.2.4.3 The price of an Uninterruptible Power Supply, specifically contributing to a durability solution, must be included (see Clause 3.1.5).

7.2.4.4 The price of all cables used to connect components of the system must be included.

#### **7.2.5 Additional Software**

7.2.5.1 The priced system must include the software licenses necessary to create, compile, link, and execute this benchmark application as well as all run-time licenses required to execute on the SUT.

7.2.5.2 In the event that the application program is developed on a system other than the SUT, the price of that system and any compilers and other software used must also be included as part of the priced system.

7.2.5.3 In the event that a separate text search engine is used in the SUT, the priced system must also include any applicable hardware and software costs and licensing fees.

### **7.3 Maintenance**

7.3.1.1 Hardware and software maintenance must be figured at a standard pricing which covers at least 7 days/week, 24 hours/day coverage, either on-site, or if available as standard offering, via a central support facility. Hardware maintenance maximum response time must not exceed 4 hours, on any part whose replacement is necessary for the resumption of operation. The 4-hour maintenance response time requirement may be met by customer spareable and replaceable hardware, as described in Clause 7.3.4.

**Comment 1:** Resumption of operation means the priced system must be returned to the same configuration that was present before the failure.

**Comment 2:** The intent of hardware maintenance pricing is not met by pricing based on the cost to fix specific failures, even if the failure rate is calculated from Mean Time Between Failure (MTBF). The maintenance pricing must be independent of actual failure rates over the 3 year period, no matter how many failures occur during that period. The intent is to preclude the use of MTBF to directly compute the maintenance cost for this benchmark.

- 7.3.2 If central support is claimed, then the appropriate connection device, such as auto-dial modem must be included in the hardware price. Also any software required to run the connection to the central support, as well as any diagnostic software which the central support facility requires to be resident on the tested system, must not only be included in pricing, but must also be installed during the benchmark runs.
- 7.3.3 Software maintenance must include maintenance update distribution for both the software and its documentation. If software maintenance updates are separately priced, then pricing must include at least 2 updates over the 3 year period.

**Comment:** Software maintenance, as defined above, means a standard offering which includes acknowledgment of new and existing problems within 4 hours and a commitment to fix defects within a reasonable time.

- 7.3.4 It is acceptable to incorporate, for pricing purposes, the use of customer spareable and replaceable hardware items under the following conditions:
- ? An additional 10% of the number of configured units of the replaceable items, with a minimum of 2, must be priced for spares.
  - ? The vendor must include a support service which guaranties replenishment on-site within 7 days throughout the 3 year maintenance period and covers every unit of the replaceable items (i.e., configured units and spare units).
  - ? The items must be generally available as spareable and replaceable for any customer installation.
  - ? The designation of the items as spareable and replaceable cannot depend on a threshold of purchased quantity.
  - ? It must be verifiable that the action of diagnosing the spareable and replaceable items as having failed can be positively accomplished by the customer within 4 hours of failure.
  - ? The method for diagnosis and replacement of the replaceable items must have complete customer documentation.

**Comment 1:** Diagnosis may take the form of a hardware indicator or a diagnosis procedure. The intent is that the diagnosis must reach a positive conclusion as to the state of the item within 4 hours.

**Comment 2:** The use of spares is intended to assist in complying with the 4-hour maximum hardware maintenance response requirement. It cannot be a substitute for maintenance support, as the priced configuration must maintain the same quantities of components, including spares, for 3 years.

## 7.4 Required Reporting

- 7.4.1 Two metrics will be reported with regard to pricing. The first is the total 3 year pricing as described in the previous clauses. The second is the total 3 year pricing divided by the reported Web Interactions Per Second (WIPS), as defined in Clause 5.4.
- 7.4.2 The 3-year pricing metric must be fully reported in the basic monetary unit of the local currency (see Clause 7.1.3) rounded up and the price/performance metric must be reported to a minimum precision of three significant digits rounded up. Neither metric may be interpolated or extrapolated. For example, if the total price is US\$ 5,734,417.89 and the reported throughput is 105 WIPS, then the 3 year pricing is US\$ 5,734,418 and the price/performance is US\$ 54,700/WIPS (5,734,418/105).

## Clause 8 - FULL DISCLOSURE REPORT

### 8.1 General Requirements

8.1.1 A Full Disclosure report is required in order for results to be considered compliant with the TPC-W benchmark specification.

**Comment:** The intent of this disclosure is for a customer to be able to replicate the results of this benchmark given the appropriate documentation and products. This section includes a list of requirements for the Full Disclosure report.

8.1.2 The order and titles of sections in the Test Sponsor's Full Disclosure report must correspond with the order and titles of sections from the TPC-W standard specification (i.e., this document). The intent is to make it as easy as possible for readers to compare and contrast material in different Full Disclosure reports. All sections of the report, except the appendices, must be printed using a minimum font size of 10 points. The appendices must be printed using a minimum font size of 8 points.

8.1.3 The TPC Executive Summary Statement must be included as the first pages of the Full Disclosure report. An example of the Executive Summary Statement is presented in Appendix G. The latest version of the required format is available from the TPC Administrator.

8.1.4 A statement identifying the benchmark sponsor(s) and other participating companies must be provided.

8.1.5 The numerical quantities listed below must be included in the Executive Summary detailing the following quantities

? In tabular form the following information for the WIPS Measurement Interval:

The Interaction

? 90% response time

? Average think time

? Interaction count

? Mix percentage

? In tabular form for each of the reported WIPS, WIPsb and WIPSo Measurement Intervals:

? The Ramp-up time in minutes

? The length of the Measurement Interval in minutes

? The average User Session Duration

**Comment:** Appendix G contains an example of such a summary. The intent is for data to be conveniently and easily accessible in a familiar arrangement and style. It is not required to precisely mimic the layout shown in Appendix G.

8.1.6 The source code of the application program or programs as defined in Clause 1.2.10, as well as all input for product generated code, must be disclosed.

8.1.7 Settings must be provided for all customer-tunable parameters and options which have been changed from the defaults found in actual products, including but not limited to:

? Database tuning parameters.

- ? Web server tuning and logging options.
- ? Recovery/commit options.
- ? Consistency/locking options.
- ? Operating system and application configuration parameters.
- ? Compilation and linkage options and run-time optimizations used to create/install/run applications, OS, DBMS, web server, and/or any other commercial product.

**Comment 1:** This requirement can be satisfied by providing a full list of all parameters, options, and flags.

**Comment 2** The intent of the above clause is that anyone attempting to recreate the benchmark environment has sufficient information to compile, link, optimize, and execute all software used to produce the disclosed benchmark result.

8.1.8 Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences. This includes, but is not limited to:

- ? Number and type of processors.
- ? Physical memory actually present on the SUT.
- ? Size of allocated memory, and any specific mapping/partitioning of memory unique to the test.
- ? Number and type of disk units and controllers.
- ? Number of channels or bus connections to disk units, including their protocol type.
- ? Number of LAN (e.g., Ethernet) connections, including routers, workstations, terminals, etc., that were physically used in the test or are incorporated into the pricing structure.
- ? Type and the run-time execution location of software components (e.g., DBMS, web server, application server or program, transaction monitors, etc.)
- ? Number and type of cryptographic processors or cryptographic accelerators, if applicable.

**Comment:** Detailed diagrams for system configurations and architectures can widely vary, and it is impossible to provide exact guidelines suitable for all implementations. The intent here is to describe the system components and connections in sufficient detail to allow independent reconstruction of the measurement environment.

## 8.2 Executive Summary

The Executive Summary is meant to be a high level overview of a TPC-W implementation. It should provide the salient characteristics of a benchmark execution (metrics, configuration, pricing, etc.) without the exhaustive detail found in the FDR. The Executive Summary has three components:

- ? Overview Page
- ? Pricing Page
- ? Numerical Quantities Summary Page

### 8.2.1 Page Layout

Each component of the Executive Summary should appear on a page by itself. Each page should use a standard header and format, including:

- ? 1/2 inch margins, top and bottom;
- ? 3/4 inch left margin, 1/2 inch right margin;
- ? at least 2 pt. frame around the body of the page. All interior lines should be 1 pt except for the horizontal line that precedes the software descriptions (before Web Server) which is 3 pt.;
- ? Sponsor identification and System(s) name(s), each set apart by a 1 pt. rule, in 16-20 pt. bold Times font;
- ? Benchmark name (i.e., TPC-W), revision using three tier versioning (e.g., 1.2.3) and report date, separated from other header items and each other by a 1 pt. Rule, in 9-12 pt. bold Times font;
- ? The two primary metrics:
  - ? The Price Performance in 12-14 pt. bold Times font.
  - ? The Performance in 12-14 pt. bold Times font.
- ? The Availability date in 10-12 pt bold. Times font.

**Comment 1:** It is permissible to use or include company logos when identifying the sponsor.

**Comment 2:** The report date and availability date must be disclosed with a precision of 1 day. The precise format is left to the test sponsor.

### 8.2.2 Overview Page

Appendix G contains a sample Executive Summary. The sample specifies the mandatory format and layout of the overview page. The sample for the pricing page and numerical quantities summary page are included to help clarify the requirements in Clause 8.2 and are provided solely as examples.

The overview page contains 4 sets of data, each laid out across the page as a sequence of boxes using 1 pt. rule, with a title above the required quantity. Both titles and quantities should use a 9-12 pt. Times font unless otherwise noted.

8.2.2.1 The first section contains the following metrics that were obtained from the reported Test Runs in 10-12 pt Time font:

<b>Title (in bold)</b>	<b>Quantity</b>	<b>Precision</b>	<b>Units</b>
Total System Cost	3-year cost of ownership	1	\$ <sup>1</sup>
WIPSo@ScaleFactor	WIPSo	0.1	WIPS
WIP Sb@ScaleFactor	WIP Sb	0.1	WIPS

Scale Factor	Number of Items	1	Items
Number of Users for WIPS	Number of Users	1	Users
Number of Systems	Number of Systems	1	Systems

<sup>1</sup> Pricing should be reported in the currency of the country where the system is priced.

8.2.2.2 The second section details the system configuration in 10-12 pt Time font.

<b>Primary Function (in bold)</b>	<b>Description</b>
Web Server	Brand, Software Version of Web Server
Application Server	Brand, Software Version of Application Server or 'custom' if not a commercial product
Database Manager	Brand and version of DBMS used
Load Balancer	Brand, Software Version of Load balancer (if applicable)
Web Cache	Brand, Software Version of Web Cache
Image Software	Brand, Software Version of Image Server
Other Software	Brand, Software Version of other software components

8.2.2.3 The third section contains a configuration diagram of the priced system.

8.2.2.4 The fourth and final section of the Implementation Overview contains a synopsis of the SUT's major system components, including for each system in the configuration:

- ? System's primary function as described in 8.2.2.2 (e.g. Database Server, Web Server, etc.);
- ? System brand name and type (model)
- ? Number of nodes;
- ? Operating system;
- ? Processor type, count and speed in MHz;
- ? Main and cache memory sizes;
- ?

### 8.2.3 Pricing Page

The pricing spreadsheet required by Section 7 must be reproduced in its entirety on the Pricing Page. It must include a section for each tier or system that performs a different function. Each section must include the hardware and software for that function. Refer to Appendix G for a sample pricing spreadsheet.

### 8.2.4 Numerical Quantities Summary Page

The Numerical Quantities Summary Page contains three sections used to summarize quantities in a concise manner. It is not intended to be an exhaustive collection of all reported numbers, but rather a high level overview of some of the more pertinent reported metrics.

8.2.4.1 The first section contains the WIPS Interaction Summary as described in Appendix G.

8.2.4.2 The second section contains three sets of data, presented in tabular form, detailing each Measurement Interval, each with:

- ? Ramp-up time, in decimal minutes with a precision of 1/10<sup>th</sup> of a minute.
- ? Length of Measurement Interval, in decimal minutes with a precision of 1/10<sup>th</sup> of a minute.
- ? Average User Session duration, in decimal minutes with a precision of 1/10<sup>th</sup> of a minute.
- ? Average Think Time, in decimal seconds with a precision of 1/10<sup>th</sup> of a second.
- ? Number of Users, in whole numbers.
- ?

## 8.3 Clause 1 - Web Object and Logical Database Design

8.3.1 The location of the JPEG and GIF images used in the benchmark must be disclosed. This information must include on which system and in what logical structure the images are stored (database or file system).

8.3.2 Listings must be provided for all table definition statements and all other statements used to set-up the database.

8.3.3 The physical organization of tables and indices, within the database, must be disclosed. When logical disk arrays (for example, RAID) are used, the mapping of database entities (for example, tables, views) must be specified. Additionally the mapping of logical units to physical disks must be disclosed.

**Comment:** The concept of physical organization includes, but is not limited to: record clustering (i.e., rows from different logical tables are co-located on the same physical data page), index clustering (i.e., rows and leaf nodes of an index to these rows are co-located on the same physical data page), and partial fill-factors (i.e., physical data pages are left partially empty even though additional rows are available to fill them).

8.3.4 Any horizontal or vertical partitioning of tables or rows in the TPC-W benchmark must be disclosed (see Clause 1.6.4 and 1.6.5). Replication of tables, if used, must be disclosed (see Clause 1.6.6).

8.3.5 Additional and/or duplicated attributes in any table must be disclosed along with a statement on the impact on performance (see Clause 1.6.7).

## **8.4 Clause 2 - Web Interactions and Workload**

- 8.4.1 The method of random number generation must be disclosed.
- 8.4.2 The number of Emulated Browsers used in the measured intervals must be disclosed.
- 8.4.3 The percentage of User sessions started during each Measurement Interval with known Customers must be disclosed with at least 1 decimal place.
- 8.4.4 The implementation of the CART data must be explained in sufficient detail to allow a replication of the benchmark including the durability of the CART data over a single point of failure.
- 8.4.5 A description of how the security requirements were met as defined in Clause 2.2.1, must be disclosed including key lengths.
- 8.4.6 The HTML code for one representative web page for each web interaction must be included in the Full Disclosure Report.
- 8.4.7 A statement must be provided describing the development language(s) and the types of API's used between commercial components to implement the interactions. This includes, but is not limited to, the interfaces to the database server, web server, commerce package or application, or any other commercial product used. For example: The commerce package calls application code through standard CGI interface. The application is written in C and interfaces to the database with ODBC calls that initiate stored procedures.

## **8.5 Clause 3 - Database Transaction and System Properties**

- 8.5.1 The results of the ACID tests must be disclosed along with a description of how the ACID requirements were met.
- 8.5.2 The method for meeting Web Page consistency requirements (Clause 3.2) must be described.

## **8.6 Clause 4 - Scaling and Database Population**

- 8.6.1 The cardinality (e.g., number of rows) of each table, as initially populated (see Clause 4.3 & 4.4), must be disclosed.
- 8.6.2 The space required to sustain 180 days of the reported throughput as defined in Clause 4.4 must be disclosed.
- 8.6.3 The space required for 8 hours of Web-Server access logs as defined in Clause 4.5 must be disclosed.
- 8.6.4 The method for distributing table and log data across all media must be described. A detailed diagram or listing of database files indicating the disks or volumes on which they reside must be included. Simple diagrams can be used for clarification.

**Comment:** Detailed diagrams for layout of database files on disks can widely vary, and it is difficult to provide exact guideline suitable for all implementations. The intent is to provide sufficient detail to allow independent reconstruction of the test database and access logs.

## **8.7 Clause 5 Performance Metrics and Response Times**

- 8.7.1 The WIPSc@scale factor and price per WIPSc@scale factor must be disclosed. WIPScb@scale factor and WIPScd@scale factor are secondary metrics and must be included in the Executive Summary.
- 8.7.2 A description of the method used to determine the reproducibility of the measurement results must be reported as well as the WIPSc from the reproducibility run.
- 8.7.3 The duration, start time and stop time of each Measurement Interval must be disclosed. For Measurement Intervals reported from the same run, the timing precision must be sufficiently small to demonstrate each Measurement Interval is non-overlapping.
- 8.7.4 The percentage of each web interaction executed during each measured interval must be displayed in tabular form as in the following example. Percentages must be reported to 2 decimal points.

<b>Web Interaction</b>	<b>Browsing Mix (WIPSB)</b>	<b>Shopping Mix (WIPS)</b>	<b>OLTP Mix (WIPSo)</b>
<b>Browse</b>	<b>95.00 %</b>	<b>80.00 %</b>	<b>50.00 %</b>
<b>Home</b>	29.00 %	16.00 %	9.12 %
<b>New Product</b>	11.00%	5.00%	0.46%
<b>Best Seller</b>	11.00 %	5.00 %	0.46 %
<b>Product Detail</b>	21.00 %	17.00 %	12.35 %
<b>Search Request</b>	12.00 %	20.00 %	14.53 %
<b>Search Results</b>	11.00%	17.00%	13.08%
<b>Order</b>	<b>5.00 %</b>	<b>20.00 %</b>	<b>50.00 %</b>
<b>Shopping Cart</b>	2.00 %	11.60 %	13.53 %
<b>Customer Reg.</b>	0.82%	3.00%	12.86%
<b>Buy Request</b>	0.75%	2.60%	12.73%
<b>Buy Confirm</b>	0.69%	1.20%	10.18%
<b>Order Inquiry</b>	0.30%	0.75%	0.25%
<b>Order Display</b>	0.25 %	0.66%	0.22%
<b>Admin Request</b>	0.10%	0.10%	0.12%
<b>Admin Confirm</b>	0.09%	0.09%	0.11%

- 8.7.5 The minimum, maximum, average and 90<sup>th</sup> percentile response time must be reported for each web interaction, in tabular form with a column for each of the Measurement Intervals of WIPS, WIPSo and WIPSB.
- 8.7.6 The minimum, maximum and average of all think times executed during each Measurement Interval must be reported.
- 8.7.7 The number of checkpoints in each Measurement Interval, the time in seconds from the start of the Measurement Interval to the first checkpoint and the Checkpoint Interval must be disclosed.
- 8.7.8 The Web Page Assembly description as specified in clause 8.8.5 must be included in the Full Disclosure Report.
- 8.7.9 The measured throughput of each measured interval must be graphed as described in Clause 5.6.2 and the graphs be included in the Full Disclosure Report.
- 8.7.10 A set of performance statistics is required and must be reported. Clause 5.7.1 and 5.7.2 define how these monitored metrics are to be aggregated.
- 8.7.11 The monitoring tools used during each Measurement Interval must be described and the operational methods invoked must be reported. For example, the monitor was invoked as a started task, and binary data was recorded every 15 seconds to a disk for post-processing.

- 8.7.12 If a sampling technique is used to obtain performance data then the sample rate (per second) must be reported as specified in Clause 5.7.1.6
- 8.7.13 The monitored metrics as defined in Clause 5.7 must be reported in a table or tables similar to the following example:

Metric	HTTP Server Aggregates	DB Server Aggregates
% CPU busy		
Physical memory		
Memory dedic. to shared pool		
Page size of memory manager		
Page In / Page Out		
Swap In / Swap Out		
Logical READS per second		
Physical READS per second		
Logical WRITES per second		
Physical WRITES per second		
System I/O rate		
Total Disk I/O rate		
Avg device utilization		
Avg service time		
Avg disk data transfer size		
Total logging I/O rates		
TCP/IP connections / second		
HTTP requests / sec		
HTTP errors / sec		
HTTP bytes / sec		
HTTP successes / sec		

A careful definition of the data fields reported must be provided to allow the data to be understood and properly interpreted.

For systems (see clause 5.7) that are only required to report CPU Utilization and HTTP or Network Bytes per second performance statistics, a small table with only these two performance statistics must be reported in the Full Disclosure Report. The table must clearly identify if HTTP bytes per second or Network Bytes per second data is being displayed and identify the data collection methodology if it deviates from the Performance Statistics General Guidelines of clause 5.7.1.

- 8.7.14 The CPU utilization must be graphed (as defined in clause 5.7.2.1.2) and the graph must be included in the Full Disclosure Report.

## **8.8 Clause 6 - SUT, RBE and Network**

- 8.8.1 A complete functional diagram of the measured configuration must be disclosed. A detailed list of all software and hardware functionality being performed on the Driver System, and its interface to the SUT must be disclosed (see Clause 6.6.3.6).
- 8.8.2 The rated bandwidth of the network(s) component used in the measured configuration must be disclosed along with any setting restricting that bandwidth. This includes, but is not limited to, the inter-node connections within the SUT, between the SUT and the RBE, and between the SUT and the Payment Gateway Emulator.
- 8.8.3 If the configuration requires operator intervention to meet the requirements of performance levels and uninterrupted operations, the mechanism and the frequency of this intervention must be disclosed.
- 8.8.4 It must be disclosed if the RBE is commercially available or proprietary.
- 8.8.5 A Web Page Assembly description is required that describes how the Web Interaction pages are assembled. When a web page is returned to the RBE, it may contain URLs to frames and/or images that must be acquired by the RBE to complete the Web Interaction page. The Web Page Assembly provides a high level description in easy to read text that describes which servers are providing which frames and/or images. Thus a quick glance of the Web Page Assembly description provides an overview of the TPC-W solution without a detailed examination of the source code provided in the FDR.

Described here in are rules for generating the Web Page Assembly description followed by an example. The description is in outline form with the outline headers describing the number of systems performing the exact same Web Assembly functions, the system's primary function and the system brand name and type as specified in clause 8.2.2.4, (i.e. the concatenation of the number of systems with the "Function" and "System" columns of the synopsis table at the bottom of the Executive Summary page). Example outline headers are "2 Web Cache ReallyFast Cache 2000s" or "9 Web Server WizBang 9000s". The systems specified in the outline headers must perform the exact same Web Assembly functions using the same hardware and software configuration, thus the number of systems specified in the Web Assembly outline headers may not be the same as the "Number of Nodes" as specified in clause 8.2.2.4. For example, the Executive Summary may specify 3 Web Caches but the Web Assembly may require 3 separate outline headers if the Web Caches are not performing the exact same Web Assembly functions.

Only those servers responding to RBE HTTP requests need be included in the Web Page Assembly description. Following each of the headers (indented and bulleted) are one-line descriptions that specify the Web Assembly functions, i.e. what piece of a Web Interaction the server(s), described in the header outline, provides to the RBE. The rules for generating the one-line descriptions are as follows:

- ? The Web Interaction is specified in the one-line descriptions by using the name of the Web Interaction (Home, Best Sellers, New Products, ...) except for the Search Result web interaction which must be further qualified by prefixing the search type, for example "Title Search Result", "Author Search

Result” or “Subject Search Result”. If the Web Interaction is not specified, then it is assumed that the server responds to the RBEs for all TPC-W web interactions that require the specified data.

- ? Use the graphical object names in section 1.5.1 to denote the jpeg and gif objects followed by the term “image” to describe the graphical objects, for example Item images, Thumbnail images, button images or TPC logo image.
- ? Use a range qualifier to specify a subset of a Web Assembly item or object. The range qualifier can be specified as a list, a range specification min - max, or just min - max that is assumed to be a number range. Example of one-line descriptions with ranges are “ARTS, BIOGRAPHIES & BUSINESS Subject Search Frame”, “Alphabetical range ARTS - MYSTERY Subject Search Frame” or “1 - 5,000 Item images”. Without a range specification it is assumed that the Web Assembly function specified in the one-line description is for the entire range of objects.
- ? Use the term “frame” to denote a piece or subset of a Web Interaction page.
- ? Use the term “page” to denote the initial Web Interaction response that may or may not include frames and/or images.
- ? Use the term “non-secure pages” to denote all non-SSL encrypted Web Interaction pages.
- ? Use the term “secure pages” to denote all SSL encrypted Web Interaction pages.
- ? Specify which server resolves any stale Web Cache data with the phrase “Resolves <one-line description from Web Cache list> stale data”. Use the term “all” to specify all stale Web Cache data. If the “Resolves all stale Web Cache data” phrase appears under a Web Cache outline header, this denotes that the Web Cache itself is running application code that communicates directly with the Database server to resolve the stale Web Cache data.
- ? If a page is further broken into smaller frames, use a descriptive phrase that contains the “Web Interaction name”, a short descriptive phrase of the frame and the word “frame”. For example a small frame containing a list of URLs to promotional thumbnail gifs for a Title Search Result would be written as “Title Search Result promotional list frame”.
- ? Use the phrase “All other Web Interaction pages/frames/images” to denote everything else that is not listed in any other one-line descriptions of the Web Page Assembly.

The preceding one-line description rules are by no means complete. If additional descriptive phrases or wording is used, a description of how the phrase or wording should be interpreted must follow the Web Page Assembly description under the header “Additional Web Page Assembly definitions”.

Following is an example of a Web Page Assembly description:

1 Web Cache ReallyFast Cache 2000

- ? Title Search Results frame
- ? Title Search Results promotional list frame

1 Web Cache ReallyFast Cache 2000

- ? Author Search Results frame
- ? Author Search Results promotional list frame

**3 Web Cache ReallyFast Cache 2000s**

- ? Best Sellers frame
- ? New Products frame
- ? Subject Search Results frame
- ? Product Detail frame

**2 Image Server Large/Memory 32000s**

- ? Item images
- ? Thumbnail images
- ? Button images for non-secure pages
- ? TPC logo image

**9 Web Server UltraThin 2200s**

- ? All other Web Interaction pages/frames/images

**1 Web Server UltraThin 2200**

- ? All other Web Interaction pages/frames/images
- ? Resolves all stale Web Cache data

8.8.6 The types of errors that result in an EB session being closed and re-initialized (as defined in 5.5.1.5) must be disclosed. Any error handling method that is not disclosed is assumed to be a retry.

8.8.7 The RBE method of generating the start seeds for the EBs must be disclosed. It should be clear that the start seeds are different for each EB. ~~Knowledge of previously used start seeds may only be used to generate a unique set of start seeds for all subsequent runs. If knowledge of previous start seeds is not used, then the period of the selection for new seeds sets must be greater than 10,000.~~

**Comment:** It is the intent of this clause to prevent generating similar start seeds that will result in a reduction of inserts to the database (for example, ADDRESS table)

8.8.8 The number of random number generators used for each EB must be disclosed along with their purpose(s). Examples of purposes include: choosing the next web interaction, building random text strings, deciding whether the shipping address is changed, think time generation, etc...

## 8.9 Clause 7 - Pricing

8.9.1 A detailed list of hardware and software used in the priced system must be reported in the Executive Summary. Each separately orderable item must have vendor part number, description, and release/revision level, and either general availability status or committed delivery date. If package-pricing is used, vendor part number of the package and a description uniquely identifying each of the components of the package must be disclosed. Pricing source(s) and effective date(s) of price(s) must also be reported. An example of the Executive Summary Statement is presented in Appendix H.

8.9.2 The total 3-year price of the entire configuration must be reported, including: hardware, software, and maintenance charges. Separate component pricing is recommended. The basis of all discounts used must be disclosed.

8.9.3 The committed delivery date for general availability (availability date) of products used in the price calculations must be reported. When the priced system includes products with different availability dates, the reported availability date for the priced system must be the date at which all components are committed to be available. This single date must be reported on the first page of the Executive Summary. All availability dates, whether for individual components or for the SUT as a whole, must be disclosed to a precision of one day.

8.9.4 For any usage pricing, the sponsor must disclose:

? Usage level at which the component was priced.

? A statement of the company policy allowing such pricing.

**Comment:** Usage pricing may include, but is not limited to, the operating system and database management software. System pricing must include line item indication where non-sponsoring companies' brands are used. System pricing must also include line item indication of third party pricing.

## 8.10 Clause 9 - Audit Related Items

- 8.10.1 The auditor's name, address, phone number, and a copy of the auditor's attestation letter indicating compliance must be included in the Full Disclosure Report.
- 8.10.2 A review of the pricing model is required to ensure that all components required are priced (see Clause 9.2.8). The auditor is not required to review the final Full Disclosure Report or the final pricing prior to issuing the attestation letter.

## 8.11 Availability of the Full Disclosure Report

- 8.11.1 The Full Disclosure Report must be readily available to the public at a reasonable charge, similar to charges for similar documents by that test sponsor.
- 8.11.2 The report must be made available when results are made public.
- 8.11.3 The official full disclosure report must be available in English but may be translated to additional languages.

## 8.12 Revisions to the Full Disclosure Report

### 8.12.1 Required Revisions

Revisions to the full disclosure documentation are **required** to be published under the following circumstances:

- 8.12.1.1 During the normal product life cycle problems will be uncovered that require changes, sometimes referred to as ECOs, FCOs, Patches, Updates, etc. When the cumulative result of applied changes causes the WIPS rating of the system to decrease by more than 2% from the reported WIPS, then the test sponsor is required to re-validate the benchmark results and publish the revised performance and price/performance.
- 8.12.1.2 When cumulative price changes have resulted in an increase of 2% or more from the reported price/performance, the test sponsor must submit revised price/performance results to the TPC within 30 days of the effective date of the price change(s) to remain in compliance. The benchmark need not be re-run to remain compliant.  
  
**Comment:** The intent of this clause is that published price/performance reflect actual current price/performance.
- 8.12.1.3 Re-pricing of current results must be reviewed and approved by the auditor if there is a change to the pricing model. Changes in prices of line item components do not constitute a pricing model change.
- 8.12.1.4 A change in the committed availability date for the priced system which is later than the published availability date must be published in a revised Full Disclosure Report.

8.12.1.5 Hardware or Software product substitutions within the SUT, with the exceptions noted below require the benchmark to be re-run with the new components in order to re-establish compliance. The exceptions are:

- ? Secondary components such as terminal servers, routers, bridges, repeaters and the like may be substituted. The substitute must be demonstrated to be at least equivalent to the original in performance. The performance tests and data used to demonstrate equal or greater performance must be disclosed.
- ? Disks may be substituted only under the following conditions:
  - To substitute disk drives, the previous drives used in the SUT must have the same interface type and no longer be available. The substituted drives track to track seek time, interface speed, on disk buffer size, rotational speed, and media density must be at least the same
  - The number of new drives substituted for drives that are no longer available, must be greater than or equal to the number of drives in the published result.
- ? A cpu substitution requires the same microarchitecture, work in the same socket as the substituted cpu and is of a higher frequency with same size or larger cache for all cache levels.
- ? Software patches for OS, DBMS, TP Monitor, WebServer, or Webcache software must be for the same major and minor revision level and must be performance neutral.

Comment 1: The intent is to allow substitutions when the change would produce performance at least equivalent to the reported WIPS. The auditor may require additional tests to be run if the proof by documentation is not considered adequate. The auditor's letter of attestation must be attached to the revised full disclosure report.

Comment 2: Substitution of any other component not specified above is not allowed.

Comment 3: The component substitution will be open to challenge for a 60 day period.

~~8.12.1.5 Hardware or Software product substitutions within the SUT, with the exceptions noted below require the benchmark to be re-run with the new components in order to re-establish compliance. The exceptions are:~~

- ~~? Secondary components such as terminal servers, network adapters, routers, bridges, repeaters and the like may be substituted. The substitute must be demonstrated to be at least equivalent to the original in performance. The performance tests and data used to demonstrate equal or greater performance must be disclosed.~~
- ~~? Disks may be substituted under the following conditions:~~
  - ~~? To substitute disk drives of type Old for drives of type New, at least one drive of type New must be included in the tested configuration.~~
  - ~~? Disk monitoring statistics must be collected over a compliant WIPS Measurement Interval equal in duration and B load to the reported Measurement Interval and at a throughput within 90% of the reported WIPS.~~
  - ~~? The collected disk monitoring statistics must illustrate that the drives of type New deliver equivalent or better performance than the drives of type Old in regards to average service time and queue depth or equivalent performance statistics (service time reported in 1/10 millisecond, queue depth reported in tenths).~~
  - ~~? The I/O load served by the drives of type Old must be substantially equal (in terms of data being accessed, access patterns and I/O rates) to the I/O load served by the drives of type New.~~
  - ~~? The minimum number of disk drives to substitute must be an integer multiple of what the Disk monitoring tool can uniquely measure.~~

~~?— In addition, the capacity of the substitute (memory, slots for systems, formatted MB for disks, etc.) must be at least equivalent to the original.~~

~~**Comment 1:** The intent is to allow substitutions when the change would produce performance at least equivalent to the reported WIPS. The auditor may require additional tests to be run if the proof by documentation is not considered adequate. The auditor's letter of attestation must be attached to the revised full disclosure report.~~

~~**Comment 2:** Substitution of any primary component of the HTTP server or DB server is not allowed. This includes, but is not limited to, CPUs, controllers, internode connectors, channel adapters or memory chips. New versions of the OS, DBMS, or TP Monitor are not allowed under any circumstances.~~

~~**Comment 3:** The component substitution will be open to challenge for a 60-day period.~~

8.12.1.6 Full Disclosure Report revisions may be required for other reasons according to TPC policies (see TPC Policy Document).

8.12.1.7 The revised report should be submitted as defined in Clause 8.10.

### **8.12.2 Permitted Revisions**

Revisions to the full disclosure documentation are **permitted** to be published under the following circumstances:

8.12.2.1 When cumulative price changes have resulted in a decrease of 2% or more from the reported price/performance, the test sponsor may submit revised price/performance results to the TPC. The benchmark need not be re-run to remain compliant.

8.12.2.2 Re-pricing of current results must be reviewed and approved by the auditor if there is a change to the pricing model. Changes in prices of line item components do not constitute a pricing model change.

8.12.2.3 A change in the committed availability date for the priced system which is earlier than the published availability date may be published in a revised Full Disclosure Report. The availability date can not be moved earlier than the submission date of the revised FDR.

8.12.2.4 A report may be revised to add or delete Clause 7 related items for country specific priced configurations.

8.12.2.5 The revised report should be submitted as defined in Clause 8.10.

## Clause 9 - AUDIT

### 9.1 General Rules

9.1.1 An independent audit of the benchmark results by an auditor certified by the TPC is required. An audit checklist is provided as part of this specification. Please obtain the current audit checklist from one of the auditors. The term "independent" is defined as: "the outcome of the benchmark carries no financial benefit to the auditing agency other than fees earned directly related to the audit." In addition, the auditing agency cannot have supplied any performance consulting under contract for the benchmark under audit. The term "certified" is defined as: "the TPC has reviewed the qualification of the auditor and certified that the auditor is capable of verifying compliance of the benchmark result." Please see the TPC Audit Policy for a detailed description of the auditor certification process.

In addition, the following conditions must be met:

1. The auditing agency cannot be financially related to the sponsor. For example, the auditing agency is financially related if it is a dependent division, the majority of its stock is owned by the sponsor, etc.
2. The auditing agency cannot be financially related to any one of the suppliers of the measured or priced components. This includes but is not limited to the DBMS supplier, the web server supplier, or any other hardware or software supplier used in the system under test.

9.1.2 The auditor's attestation letter must be made readily available to the public as part of the Full Disclosure Report, but a detailed report from the auditor is not required.

9.1.3 In the case of audited TPC-W results which are being revised for pricing or substitution changes, the audit requirements are called out in Clause 8.11. The auditor is not required to follow any of the remaining auditor's check list items from Clause 9.2.

### 9.2 Auditor's Check List

#### 9.2.1 Clause 0 – Commercial products

9.2.1.1 Verify that the products measured and priced are orderable by customer as defined in Clause 7.1.3.

#### 9.2.2 Clause 1 – Web Object and Logical Database Design

9.2.2.1 Verify that specified minimum structure (i.e., list of fields) exist for each table, and that they conform to the specified requirements.

9.2.2.2 Verify the web objects are generated according to Clause 1.5.

9.2.2.3 Verify that the unique identifiers in each table are not disk or file offsets.

9.2.2.4 Verify that the storage of the web objects complies with the implementation rules.

9.2.2.5 Verify that all tables support retrievals, inserts and deletes while supporting a TPC-W workload.

**Comment:** For this verification, the workload does not have to be equal to the reported performance.

- 9.2.2.6 Verify whether any horizontal and/or vertical partitioning has been used, and, if so, whether the details of that partitioning are disclosed.
- 9.2.2.7 Verify whether any replication of tables has been used, and, if so, whether at least one copy is durable and if the details of that replication are disclosed.
- 9.2.2.8 Verify that the integrity rules defined in Clause 1.7 are followed.
- 9.2.2.9 Verify that the requirements for transparent data access, as defined in Clause 1.8, are met.

### **9.2.3 Clause 2 – Web Interactions and Workload Profile**

- 9.2.3.1 Verify that the atomic set of operations meets the requirements defined in Clause 2.1.10.
- 9.2.3.2 Verify that the secure web interactions use encrypted communication as defined in Clause 2.2.1.
- 9.2.3.3 Verify that User Sessions are correctly started as defined in Clause 2.2.3.
- 9.2.3.4 Verify that the communication of the Customer’s identity to the SUT complies with the requirements of Clause 2.2.4 and that Session tracking is implemented according to Clause 2.2.5.
- 9.2.3.5 Verify that the implementation of the Shopping Cart meets the requirements of Clause 2.2.6.
- 9.2.3.6 Verify that web logging is turned on for Common Log Format (CLF) from the http server, and meets the requirements defined in Clause 2.2.13.
- 9.2.3.7 Verify that the application program correctly implements the generic Promotional Processing.
- 9.2.3.8 Verify the compliant implementation of the Home web interaction.
- 9.2.3.9 Verify the compliant implementation of the Shopping Cart web interaction.
- 9.2.3.10 Verify the compliant implementation of the Customer Registration web interaction.
- 9.2.3.11 Verify the compliant implementation of the Buy Request web interaction.
- 9.2.3.12 Verify the compliant implementation of the Buy Confirm web interaction.
- 9.2.3.13 Verify the compliant implementation of the Order Inquiry web interaction.
- 9.2.3.14 Verify the compliant implementation of the Order Display web interaction.
- 9.2.3.15 Verify the compliant implementation of the Search Request web interaction.
- 9.2.3.16 Verify the compliant implementation of the Search Result web interaction.
- 9.2.3.17 Verify the compliant implementation of the New Products web interaction.

- 9.2.3.18 Verify the compliant implementation of the Best Sellers web interaction.
- 9.2.3.19 Verify the compliant implementation of the Product Detail web interaction.
- 9.2.3.20 Verify the compliant implementation of the Admin Request web interaction.
- 9.2.3.21 Verify the compliant implementation of the Admin Confirm web interaction.
- 9.2.3.22 Using one of the configured browsers, verify that the input/output screen for each type of web interaction has the required look and feel and provides all the required features, such as data entry and navigation.

#### **9.2.4 Clause 3 - Database Transaction and System Properties**

- 9.2.4.1 Verify that the required atomicity property is provided by the implementation of the benchmark.
- 9.2.4.2 Verify the proper execution of the atomicity test, and define and verify the execution of additional tests if necessary to sufficiently demonstrate the atomicity property.
- 9.2.4.3 Verify that the required consistency property is provided by the implementation of the benchmark.
- 9.2.4.4 Verify the proper execution of the consistency test, and define and verify the execution of additional tests if necessary to sufficiently demonstrate the consistency property.
- 9.2.4.5 Verify that the required isolation property is provided by the implementation of the benchmark.
- 9.2.4.6 Verify the proper execution of the isolation tests, and define and verify the execution of additional tests if necessary to sufficiently demonstrate the isolation property.
- 9.2.4.7 Verify that the required durability property is provided by the implementation of the benchmark.
- 9.2.4.8 Determine which component of the SUT meet the definition of a single point of failure as defined in Clause 3.1.5.3.
- 9.2.4.9 Verify the proper execution of the durability tests involving each single point of failure, and define and verify the execution of additional tests if necessary to sufficiently demonstrate the durability property.
- 9.2.4.10 Verify that the required web page consistency property is provided by the implementation of the benchmark.
- 9.2.4.11 Verify the proper execution of the web page consistency test, and define and verify the execution of additional tests if necessary to sufficiently demonstrate the consistency property.
- 9.2.4.12 Verify that the L\_STOCK quantity on hand in the Item table is being updated.

#### **9.2.5 Clause 4 - Scaling and Database Population**

- 9.2.5.1 Verify that the initial database population is properly scaled, as defined in Clause 4.2.
- 9.2.5.2 Verify that the database population was generated according to Clauses 4.6 and 4.7.

- 9.2.5.3 Verify the correct cardinalities of the database tables, at the start of the Test Run as well as at the end of it, and that the growth in the ORDERS table, in particular, is consistent with the reported WIPS rate.
- 9.2.5.4 Verify that the 180-day space requirement is computed according to Clause 4.4.
- 9.2.5.5 Verify that the size of the Web Server Access Logs is calculated according to the requirements.
- 9.2.5.6 Verify that the required number of EB's are active during the entire Test Run.

## **9.2.6 Clause 5 - Performance Metrics and Response Time**

- 9.2.6.1 Verify that the mix of web interactions as seen by the RBE satisfies the required mix for each Measurement Interval.
- 9.2.6.2 Verify that the thresholds used to achieve the required mix of web interactions are those given in Clause 5.2.2.
- 9.2.6.3 Verify that the cycle of web interactions followed by the RBE meets the requirements illustrated in Clauses 5.2.2.1 and 5.3.1.
- 9.2.6.4 Verify that the Think Times are properly generated, measured and reported by the RBE.
- 9.2.6.5 Verify the duration of the reported Measurement Intervals.
- 9.2.6.6 Verify the validity of the method used to accurately measure and report the Web Interaction Response Times (WIRT) at the RBE.
- 9.2.6.7 Verify that all measured WIRT's meet the response time constraints defined in Clause 5.3.4.1.
- 9.2.6.8 Verify that the reported WIRT's are measured during the same time interval as the Measurement Interval from which the reported throughput is measured.
- 9.2.6.9 Verify that the throughput ratings for the three Measurement Intervals are computed according to Clause 5.4.
- 9.2.6.10 Verify that the requirements for the Test Run(s), as specified in Clause 5.5.2, are met.
- 9.2.6.11 Verify the method used to determine that the SUT had reached steady state prior to commencing the Measurement Intervals, as specified in Clause 5.5.2.
- 9.2.6.12 Verify that the SUT is capable of running uninterrupted for 14 days, as defined in Clause 5.5.2.2. While an actual 14 day Test Run would be highly impractical, the auditor must conclude with a high degree of confidence that this requirement is met by the SUT. This can be achieved through theoretical explanations and, if needed, the definition and execution of additional tests.
- 9.2.6.13 Verify that all work normally done in a steady state environment, such as checkpoints or redo/undo logging, actually occurred during the Measurement Intervals in order to keep throughput variations over an 8 hour period under 5%.
- 9.2.6.14 Verify the method used to determine the reproducibility of the measurement results.

- 9.2.6.15 Verify that all required reporting metrics, including the additional performance statistics defined in Clause 5.7 are collected accurately and during the same time interval as the Measurement Interval from which the reported throughput is measured.
- 9.2.6.16 This requirement has been deleted.
- 9.2.6.17 Verify that the PGE returns the authorization ID at a random location within the encrypted message.
- 9.2.6.18 Verify the random number deviations as specified in clause 5.5.5.

### **9.2.7 Clause 6 - SUT, Driver, and Communications Definition**

- 9.2.7.1 Verify the accurate emulation of the tested browser population by the RBE.
- 9.2.7.2 Verify that the RBE correctly implements the CURL, as defined in Clause 2.2.14.
- 9.2.7.3 Verify that the restrictions placed on the activity of the RBE, as defined in Clause 6.1.5, are observed.
- 9.2.7.4 Verify that the required communication protocol is used between the RBE and the SUT.
- 9.2.7.5 Verify that each EB opens its own socket connection to the SUT instead of sharing a socket with other EBs.
- 9.2.7.6 Verify that the TCP Maximum Segment Size (MSS) between the EB's and the SUT is limited as defined in Clause 6.1.7.
- 9.2.7.7 Verify that the EB's generate and observe USMD's as defined in Clause 6.1.9.2.
- 9.2.7.8 Verify that the SUT maintains User context as required.
- 9.2.7.9 Verify that the restrictions placed on the activity of the SUT are observed.
- 9.2.7.10 Verify the SUT meets the operational requirements defined in Clause 6.6. Documentation is sufficient to meet this requirement subject to the auditor discretion.
- 9.2.7.11 Verify the accurate implementation of the PGE functions.
- 9.2.7.12 Verify the web page assembly as defined in 8.8.5.

### **9.2.8 Clause 7 - Pricing**

- 9.2.8.1 Verify that the pricing model includes all the hardware and software components required to produce a compliant benchmark result, including but not limited to sufficient database and log storage.
- 9.2.8.2 Verify the pricing spreadsheet that details how the 3-year cost of ownership is computed.
- 9.2.8.3 Verify that, when used, customer spareable components are priced in sufficient quantity to meet the requirements.

- 9.2.8.4 Verify the compliance of any discount, warranty or maintenance used to meet the pricing requirements.
- 9.2.8.5 Verify the compliance of all price quotes for components from third party sources.
- 9.2.8.6 The auditor is not required to verify the pricing of components supplied by the benchmark sponsor.
- 9.2.8.7 Verify that the price performance ratio is computed according to Clause 7.4.

**9.2.9 Clause 8 - FDR**

- 9.2.9.1 Verify that the Full Disclosure Report is complete and accurate. Auditors can limit their review of the FDR to the following sections:
  - ? Executive summary section
  - ? System configuration section
  - ? Database population and space calculation section
  - ? Sections that include the disclosure of measurement data, excluding additional performance statistics.
  - ? Any other section requested by the auditor

**Comment:** The intent is to limit the review to something less than a line by line check while still providing for a reasonable assurance that the data is accurate.

## Appendix A - CUSTOMER EVENT DIAGRAM

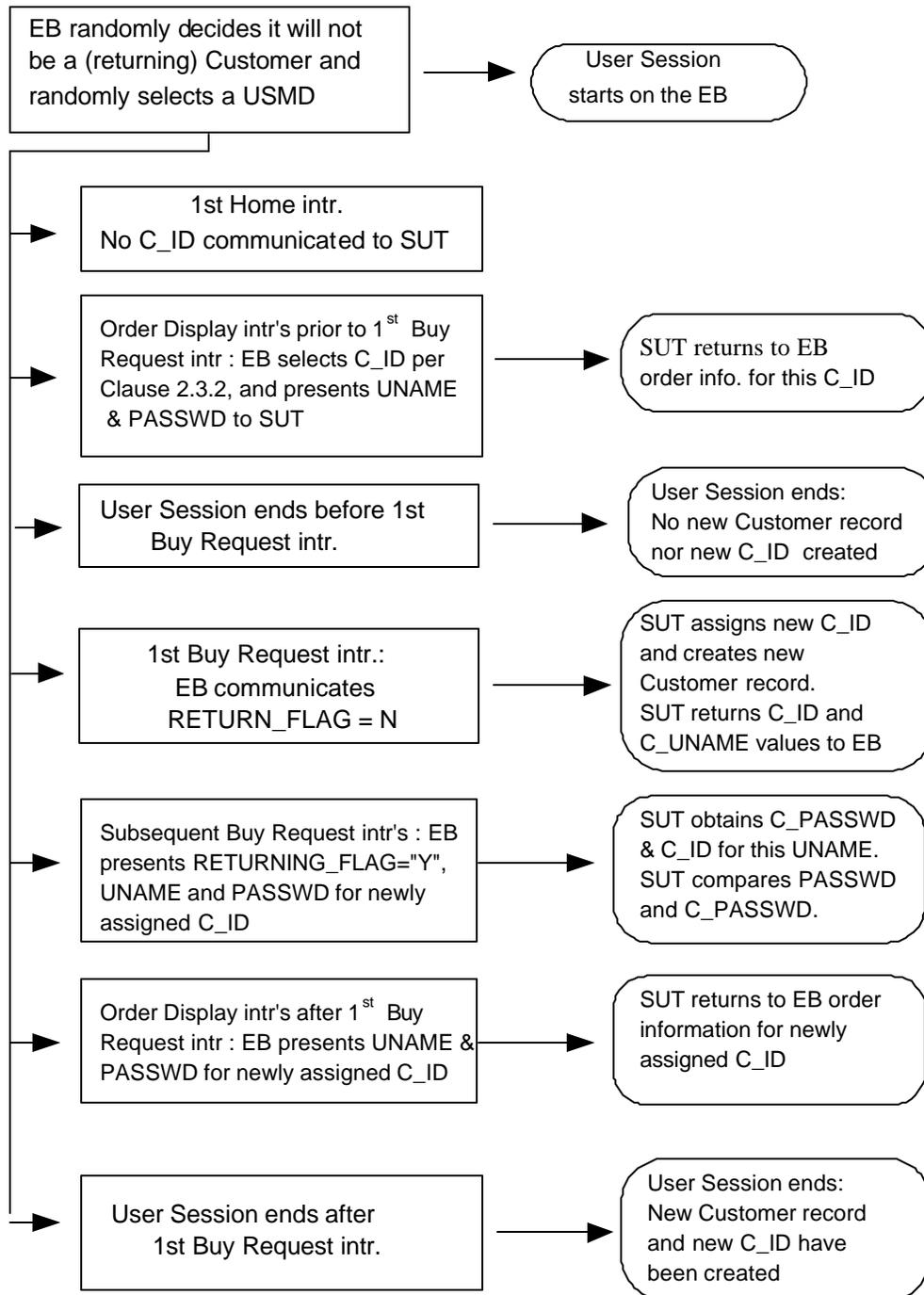
### A.1 **Introductory Explanations**

This appendix diagrams the events related to the processing of C\_ID, UNAME, PASSWD, RETURNING\_FLAG and the creation of new CUSTOMER records during a User Session. There are two diagrams. Event Diagram 1 covers the case in which an EB starts a User Session and is not a Customer. Event Diagram 2 covers the case in which an EB starts a User Session and is a (returning) Customer.

**Legend:** The rectangular (square cornered) boxes show events and/or actions taken by the EB. The boxes with rounded corners show actions taken by the SUT. Time generally flows down the page, in the sense that transitions that occur later in a User Session are shown further down the page. The term "intr." is an abbreviation for "web interaction".

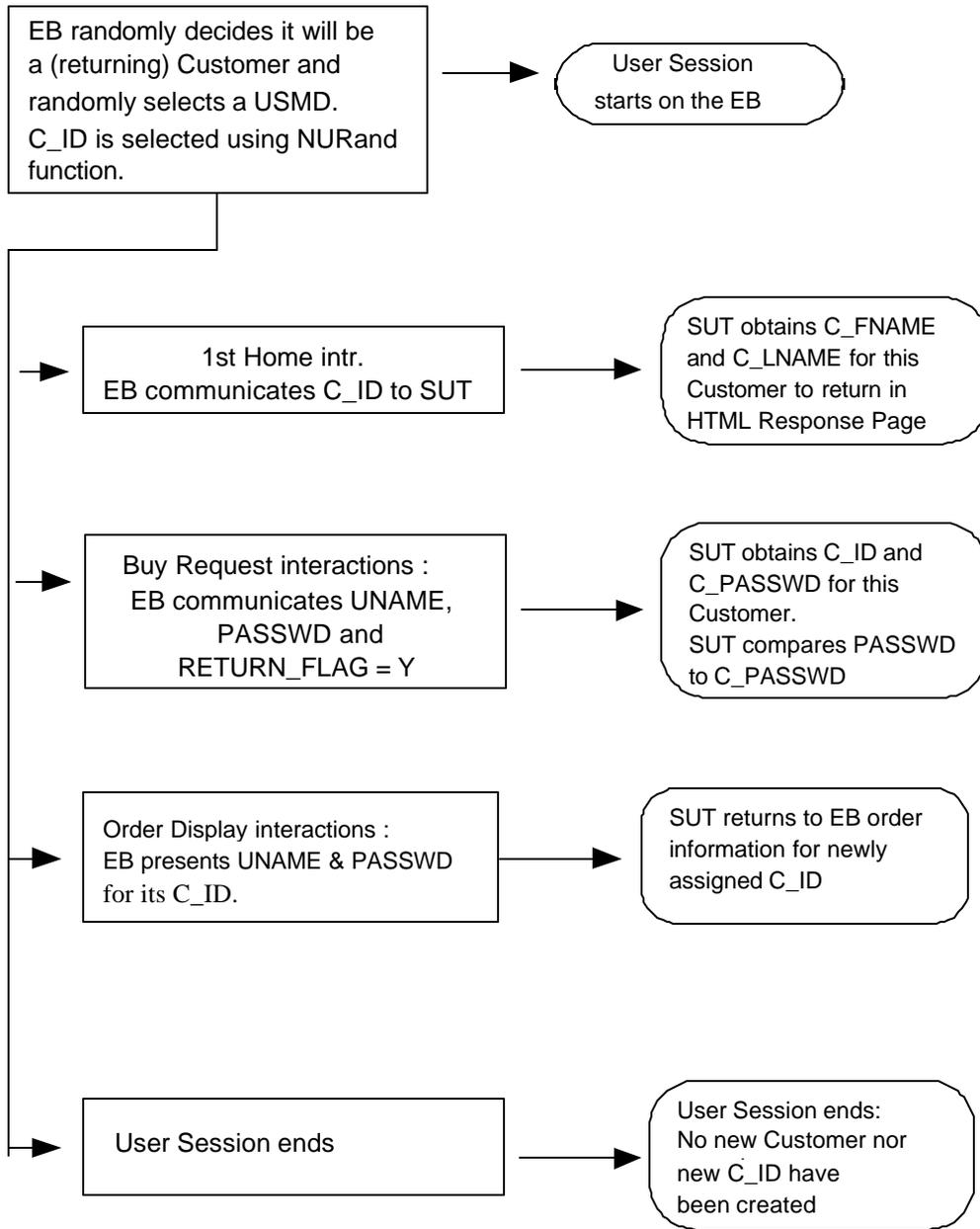
## A.2 Event Diagram 1

The following state transition diagram illustrates the situation when the User is **not** a Customer.



### A.3Event Diagram 2

The following state transition diagram illustrates the situation when the User **is** a Customer.



## Appendix B - SHOPPING STATE DIAGRAMS

### B.1 Introductory Explanations

The Specification says the following with respect to Shopping Session, SHOPPING\_ID, and CART:

A SHOPPING\_ID can be assigned to a User Session before a Shopping Session has been established. It might be helpful to think of a SHOPPING\_ID as a web session ID used by the SUT to track the User Session. As such, it does not necessarily entail the existence of a Shopping Session. (It was deemed useful for the SUT to have the flexibility to track User Sessions using a SHOPPING\_ID prior to creation of a CART.)

On the other hand, the existence of a Shopping Session requires both the assignment of a SHOPPING\_ID and the creation of an initialized CART. A Shopping Session can be established earlier than the first Shopping Cart web interaction, but once the first Shopping Cart web interaction is executed, the Shopping Session *must* be established. (Clause 2.1.7.)

The state transition diagram that follows is an illustration of the above.

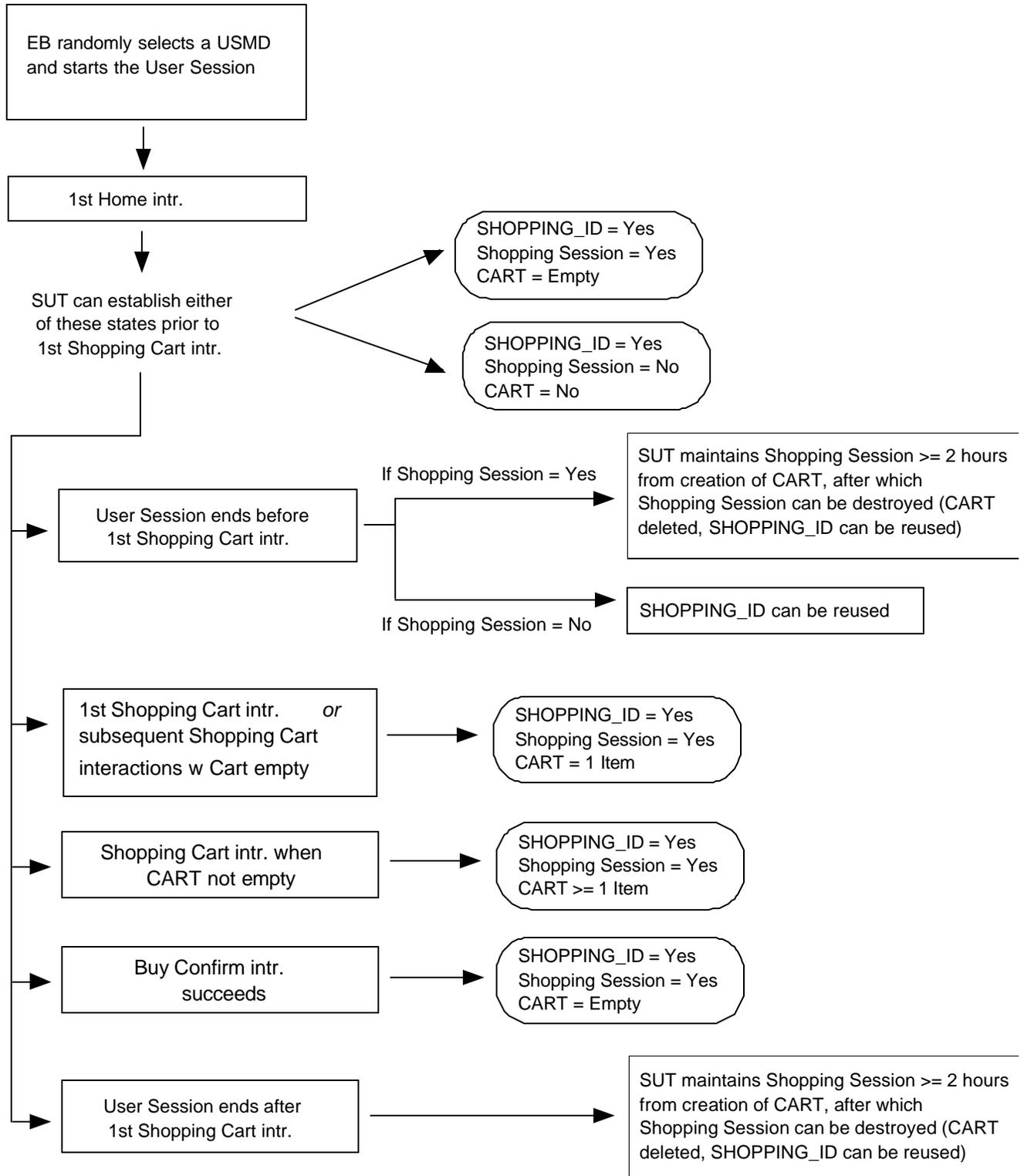
### B.2 The State Values

The diagram shows transitions in the states of three items associated with a User Session. These three items, along with how their states are represented in the diagram, are:

Item	Possible states of item	Meaning
SHOPPING_ID	SHOPPING_ID = No	User Session does not have a SHOPPING_ID assigned.
	SHOPPING_ID = Yes	User Session does have a SHOPPING_ID assigned.
Shopping Session	Shopping Session = No	A Shopping Session has not been established.
	Shopping Session = Yes	A Shopping Session has been established.
CART	CART = No	A CART does not exist.
	CART = Empty	An initialized CART exists with zero items in it.
	CART = N items	A CART exists with N items in it.

**Legend:** The rectangular (square cornered) boxes represent events that cause changes in state. The boxes with rounded corners show possible states of the three items. Time generally flows down the page, in the sense that transitions that occur later in a User Session are shown further down the page. The term *intr.* is an abbreviation for web interaction.

### B.3 The state Transition Diagram



## **B.4 Communication between RBE and SUT of existence of Shopping Session**

The following information is not captured in the foregoing state transition diagram:

Once a Shopping Session has been established, Clause 2.1.7 requires that in all subsequent web interactions the RBE communicates to the SUT that a Shopping Session is active. Because the SUT has the flexibility to establish a Shopping Session prior to the first Shopping Cart web interaction of the User Session, the RBE, cannot depend on the execution of the first Shopping Cart web interaction as a trigger for it to start communicating to the SUT that a Shopping Session exists.

Therefore, the SUT must communicate to the RBE when a Shopping Session has been established. Once the RBE receives this information, it must communicate this same fact back to the SUT in all subsequent web interactions. In other words, it is the SUT, not the RBE, that determines when a Shopping Session has been started on behalf of the User. And it is the SUT that instructs the RBE on how to communicate the Shopping Session information back to the SUT during subsequent requests for web interactions. The exchange of a Cookie is an example of a mechanism that could be used for this purpose.

## **Appendix C - INTRODUCTION TO SSL**

### **C.1 Overview**

SSL is the acronym for Secure Socket Layer, a protocol developed by Netscape for managing secure (encrypted) communications in a network. Netscape has offered SSL as a proposed standard protocol to the World Wide Web Consortium (W3C) and the Internet Engineering Task Force (IETF) as a standard security approach for Web browsers and servers.

Netscape's SSL uses the public-and-private key encryption system from RSA, which also includes the use of a digital certificate for the server. RSA implemented public/private key encryption, called asymmetric encryption, which uses two unlike keys for secure communication. The SSL protocol is initiated by a handshake wherein client and server exchange information and agree on ciphers. It is the handshake phase of the SSL communication, that makes use of the server's digital certificate. Optionally, the clients can also have digital certificates. However this benchmark does not require simulated clients (the EB's) to use digital certificates for SSL.

A digital certificate is an electronic "credit card" that establishes the holders credentials for doing business or other transactions on the Web. It is issued by a certification authority (CA). It contains his name, a serial number, expiration dates, a copy of the certificate holder's public key (used for encrypting and decrypting messages and digital signatures), and the digital signature of the certificate-issuing authority so that a recipient can verify that the certificate is real. Some digital certificates conform to a standard, X.509. Digital certificates can be kept in registries so that authenticated users can look up other users' public keys.

Digital certificates contain the holder's PUBLIC key. Typically, the certificate holder (in this case the server) sends his certificate to his partner (in this case the client). The client uses the server public key, found in the certificate, to encrypt information. Only the holder of the matching PRIVATE key can decrypt this data. Links to sample digital certificates can be found at the following web site: <http://sitesearch.netscape.com/products/security/technology/certificates.html>. Another good source of information is on the web at:

<http://www.software.ibm.com/commerce/registry/primer.html>

Data encrypted by the client during the SSL handshake actually forms the basis of the key that will be used with the selected cipher (e.g. DES) to encrypt the data content sent between client and server. Following the handshake and establishment of an SSL session, all secure web interactions flowing on this SSL session must be encrypted using the selected cipher and the session key established for this session.

## C.2 SSL V3 Specifications

SSL V3 specifications are available at various web sites including the following (as of Sept. 1999):

<http://home.netscape.com/eng/ssl3/ssl-toc.html>

<http://www.lanl.gov/projects/ia/stds/ia830810.html>

Please note, URL references found in this document were accurate at the time it was written. But URL links are notoriously ephemeral. Should you discover the references to be invalid, please notify the TPC-W subcommittee and this document will be updated.

## C.3 SSL V3 Implementation Toolkits

There are many versions of SSL toolkits and encryption libraries available to developers wishing to enable Web Servers for SSL or build browser emulation tools. Netscape's NSS program library can be downloaded for noncommercial use or licensed for commercial use.

The most popular SSL library is SSLeay, which can be downloaded from <http://www.ssleay.org/>. SSLeay is a free implementation of Secure Socket Layer.

SSLeay is pronounced S-S-L-e-a-y (i.e. each letter is pronounced individually).

SSLeay implements both SSLv2 (version 2) and SSLv3 (version 3) and TLSv1 as of the release of SSLeay-0.9.0. Documentation for building and using the library can be found at <http://www.psy.uq.edu.au/~ftp/Crypto/ssleay/>.

CryptSoft Pty Ltd acts as a focal point for consulting activities based around internet cryptography with specific focus on SSLeay and SSLapps.

Another useful source of information is <http://www.rsa.com/rsalab/>.

## C.4 Obtaining a Server Digital Certificate for Testing

Digital certificates are issued by a Certificate Authority (CA). They usually cost several hundred dollars and each Web Server host machine usually has its own certificate. The host name and domain name are encoded in the certificate. Using a certificate for a different server generally does not work.

There are several methods for obtaining a digital certificate for testing purposes without incurring the license fee. Certificate Authorities will generally provide a free test certificate, valid for some short time period of time. For example, you can obtain a free certificate, valid for two weeks, from Verisign Corp. Also Thawte provides free digital certificates for testing. See the following web site: <https://www.thawte.com/cgi/server/test.exe>. Some other Certificate Authorities are GTE-CyberTrust, Keywitness, and Tradewave.

An easier method for obtaining a test certificate is to build it yourself. This can be accomplished with the SSLeay toolkit. See [http://www.intertrader.com/library/SSLeay/no\\_rsa.cfm#ownca](http://www.intertrader.com/library/SSLeay/no_rsa.cfm#ownca). Many Web Servers also have the ability to act as a Certificate Authority and self-certify their own certificates. This is not recommended for production systems, but it is useful for testing. Read the documentation for your particular Web Server.

Intel offers Digital Certificate Manager software you can download. The Digital Certificate Manager is a sample application that allows end-users to view existing digital certificates and create new digital certificates. The certificate manager displays standard name and address fields present in most types of certificates, as well as graphical data such as a photo of the certificate owner or a digitized cursive signature of that owner. See:

<http://www.intel.com/ial/security/cdsa/dcm.htm>

## **Appendix D - DATABASE POPULATION RATIONALE**

### **D.1 Derivation of 2880 Customers per Browser**

Think time per interaction	=	7 seconds (with negative exponential distribution)
Response time per interaction	=	3 seconds avg. 90% < 20 seconds
Time per session	=	15 minutes
Measurement Interval	=	30 minutes
Sessions per Measurement Interval	=	2
Types of Measurement intervals	=	WIPS, WIPSB, WIPSO

0.1428 interactions per second per concurrent browser assuming a response time of zero

<b>Customers</b>	<b>Browser Hours</b>	<b>30 Day Total Customers</b>
4	1	2,880
40	10	28,800
400	100	288,000

Using 30 days of user information:

30 days x 24 hours x 4 sessions per browser hour = 2880 customer sessions per 30 day period per browser

The cardinality of customer table is: 2880 \* (number. of concurrent browsers)

Therefore, 1,000 concurrent browsers yields:

2,880,000 customer table rows

Maximum of 142.8 WIPS ((1/7 interaction / think time) \* 1,000)

Average of 100.0 WIPS ((1 / (7+3) interaction / (think time + response time)) \* 1,000)

### **D.2 Using 8 hrs of Peak Throughput to Compute Storage**

Even though the environment being modeled is a 24 hour operation, the traffic to the site is not uniformly distributed throughout the day. It typically goes through a couple of hours of peak traffic followed by a lull, to be picked up again, and so forth. Feedback from existing sites indicate peak throughput to be 2.6 to 3.3 times the average throughput. This is equivalent to 9.2 to 7.2 hours of peak throughput. Therefore, the 8hrs of peak throughput is an attempt at modeling the volume fluctuation typically seen in a 24 hour environment.

## Appendix E - SAMPLE PSEUDO-CODE

Home web interaction	Select DISTINCT C_FNAME,C_LNAME from CUSTOMER where C_UNAME=@C_UNAME
New Products web interaction	select top 50 I_ID,I_TITLE,A_FNAME,A_LNAME from ITEM , AUTHOR where A_ID = I_A_ID AND I_SUBJECT LIKE @CategoryID  order by I_PUB_DATE desc,I_TITLE
Best Sellers web interaction	declare @last_o numeric(10) select top 3333 O_ID into #temp from ORDERS order by O_DATE desc select @last_o = min(O_ID) from #temp select top 50 I_ID,I_TITLE,A_FNAME,A_LNAME from ITEM, AUTHOR ,ORDER_LINE where OL_O_ID > @last_o AND I_ID = OL_I_ID AND I_A_ID = A_ID AND I_SUBJECT = @CategoryID  group by I_ID,I_TITLE,A_FNAME,A_LNAME order by SUM(OL_QTY) desc
Product Detail web interaction	SELECT DISTINCT * FROM ITEM,AUTHOR WHERE AUTHOR.A_ID = ITEM.I_A_ID AND ITEM.I_ID = @BookID
Search Result web interaction (by Author)	SELECT top 50 I_TITLE,I_ID,A_FNAME, A_LNAME FROM ITEM,AUTHOR WHERE I_A_ID = A_ID AND ( A_LNAME LIKE '%' + @Author + '%' OR A_LNAME LIKE @Author + '%') order by I_TITLE
Search Result web interaction (by Title)	SELECT TOP 50 I_TITLE, I_ID, A_FNAME, A_LNAME FROM ITEM, AUTHOR WHERE I_A_ID = A_ID AND ( I_TITLE LIKE '%' + @Title + '%' OR I_TITLE LIKE @Title + '%')  order by I_TITLE
Search Result web interaction (by Subject)	SELECT TOP 50 I_TITLE,I_ID, A_FNAME, A_LNAME FROM ITEM, AUTHOR WHERE I_A_ID = A_ID AND I_SUBJECT LIKE @CategoryID order by I_TITLE

Order Display web interaction	<pre> select C_ID from CUSTOMER where C_UNAME=@C_UNAME and C_PASSWD- @C_PASSWD  DECLARE @O_ID numeric(10)  select @O_ID = max(O_ID)from ORDERS where O_C_ID=@C_ID  SELECT C_FNAME,C_LNAME,C_EMAIL,C_PHONE,  O_ID,O_DATE,O_SUBTOTAL,O_TAX,O_TOTAL,O_SHIP_TYPE,O_SHIP_DATE, O_BILL_ADDR,O_SHIP_ADDR,O_CC_TYPE,O_STATUS,  ADDR_STREET1,ADDR_STREET2,ADDR_CITY,ADDR_STATE,ADDR_ZIP,CO_NA ME  FROM CUSTOMER,ADDRESS,COUNTRY,ORDERS  where      O_ID=@O_ID and            C_ID=@C_ID and            O_BILL_ADDR=ADDR_ID AND            ADDR_CO_ID=CO_ID  Select ADDR_STREET1,ADDR_STREET2,ADDR_CITY, ADDR_STATE,ADDR_ZIP,CO_NAME from ADDRESS,COUNTRYwhere ADDR_ID=@A_ID and ADDR_CO_ID=CO_ID  select OL_I_ID,I_TITLE,I_PUBLISHER, I_COST,OL_QTY,OL_DISCOUNT,OL_COMMENTSfrom ORDER_LINE,ITEM where OL_I_ID=I_ID and OL_O_ID=@O_ID </pre>
Shopping Cart web interaction (Add to Cart)	<pre> Insert into SHOPPING_CART values(@Session,0,@BookID,1, @Title,@SRP,@COST,@Backing,GetDate()) </pre>
Shopping Cart web interaction (Refresh Display)	<pre> Update SHOPPING_CART set SC_QTY=@QTY where SC_ID=@UserID and SC_I_ID=@BookID  Delete from SHOPPING_CART where SC_ID=@UserID and SC_I_ID=@BookID </pre>

<p>Buy Request web interaction (New Customer)</p>	<pre> DECLARE @num numeric(10) SELECT @num=count(*) FROM CUSTOMER WHERE C_UNAME = @CustID select @num  DECLARE @CO_ID numeric(4) DECLARE @ADDR_ID numeric(10)  Select @CO_ID = CO_ID from COUNTRY where CO_NAME=@CO_NAME  SELECT ADDR_ID FROM ADDRESS WHERE ADDR_STREET1=@ADDR_STREET1 and ADDR_STREET2=@ADDR_STREET2 and ADDR_CITY=@ADDR_CITY and ADDR_STATE=@ADDR_STATE and ADDR_ZIP=@ADDR_ZIP and ADDR_CO_ID = @CO_ID  DECLARE @CO_ID numeric(4)DECLARE @ADDR_ID numeric(10)DECLARE @CUST_ID numeric(9)Select @CO_ID = CO_ID from COUNTRY where CO_NAME=@CO_NAME  Insert into ADDRESS values(@ADDR_STREET1,@ADDR_STREET2,@ADDR_CITY,@ADDR_STATE,@ADDR _ZIP,@CO_ID) select @ADDR_ID = @@identity  Insert into CUSTOMER values(@C_UNAME,@C_PASSWD,@C_FNAME,@C_LNAME,@ADDR_ID,@C_PHON E,@C_EMAIL,getdate(),getdate(),NULL,NULL,@C_DISCOUNT,0,0,@C_BIRHTDAY,@ C_DATA1,@C_DATA2) select @CUST_ID = @@identity  select @CUST_ID </pre>
<p>Buy Request web interaction (Existing Customer)</p>	<pre> select C_ID from CUSTOMER where C_UNAME=@C_UNAME and C_PASSWD=@C_PASSWD  SELECT C_UNAME,C_PASSWD,C_FNAME,C_LNAME,C_PHONE, C_EMAIL,C_BIRTHDATE,C_DATA1,C_DATA2,ADDR_STREET1, ADDR_STREET2,ADDR_CITY,ADDR_STATE,ADDR_ZIP,CO_NAME FROM CUSTOMER,ADDRESS,COUNTRY where C_ADDR_ID=ADDR_ID and ADDR_CO_ID=CO_ID and C_ID = @C_ID </pre>

Buy Confirm web interaction

```
DECLARE @CO_ID numeric(4)
DECLARE @ADDR_ID numeric(10)

Select @CO_ID = CO_ID from COUNTRY where CO_NAME=@CO_NAME

SELECT ADDR_ID
FROM ADDRESS
WHERE
ADDR_STREET1=@ADDR_STREET1 and
ADDR_STREET2=@ADDR_STREET2 and
ADDR_CITY=@ADDR_CITY and
ADDR_STATE=@ADDR_STATE and
ADDR_ZIP=@ADDR_ZIP and
ADDR_CO_ID=@CO_ID

Select @CO_ID = CO_ID
from COUNTRY
where CO_NAME=@CO_NAME

Insert into ADDRESS values(@ADDR_STREET1,
@ADDR_STREET2,@ADDR_CITY,@ADDR_STATE,@ADDR_ZIP,
@CO_ID)

select @ADDR_ID = @@identity

select C_ID,C_DISCOUNT,C_ADDR_ID
from CUSTOMER
where C_UNAME=@UserID

DECLARE @O_ID numeric(9)

Insert into ORDERS values (@O_C_ID,getdate(),@O_SUBTOTAL,
@O_TAX,@O_TOTAL,@O_SHIP_TYPE,NULL,@O_BILL_ADDR,
@O_SHIP_ADDR,@O_CC_TYPE,@O_CC_NUM,@O_CC_NAME,
@O_CC_EXP,'Pending')

select @O_ID = @@identity

Insert ORDER_LINE (OL_O_ID,OL_I_ID,OL_QTY,
OL_DISCOUNT,OL_COMMENTS)

Select @O_ID,SC_I_ID,SC_QTY,1,'comment' from SHOPPING_CART

update ITEM set I_STOCK = I_STOCK - SCL_I_QTY + case when (I_STOCK -
SCL_I_QTY < 10) then 21 else 0 end
from SHOPPING_BASKET
where SC_SHOPPING_ID=@Session and SC_HOST=@SC_HOST and SCL_I_ID =
I_ID

Delete from SHOPPING_CART where SC_ID=@Session

Insert into CC_XACTS
values(@O_ID,@O_CC_TYPE,@O_CC_EXP,@O_CC_AUTH,@O_TOTAL,getdate(),@C
O_ID)
```

Admin Request web interaction	<pre>SELECT DISTINCT * FROM ITEM,AUTHOR WHERE AUTHOR.A_ID = ITEM.I_A_ID AND ITEM.I_ID = @BookID</pre>
Admin Confirm web interaction	<pre>Update ITEM set I_COST=@Cost,I_PUB_DATE = @Dait, I_IMAGE = @Gif_Loc where I_ID=@Item_ID  declare @O_ID numeric(9)  select top 10000 O_ID into #temp from ORDERS order by O_DATE descselect @O_ID = min(O_ID) from #temp  select O_C_ID into #temp from ORDERS, ORDER_LINE where O_ID &gt; @O_ID and O_ID=OL_O_ID and OL_I_ID=@I_ID group by O_C_ID, O_DATE order by O_DATE desc  select top 5 OL_I_ID from ORDERS,#temp,ORDER_LINE where O_ID &gt; @O_ID AND ORDERS.O_C_ID=#temp.O_C_ID and O_ID=ORDER_LINE.OL_O_ID and not(ORDER_LINE.OL_I_ID=@I_ID) group by OL_I_ID order by sum(ORDER_LINE.OL_QTY)</pre>

## Appendix F - SAMPLE HTML CODE

### F.1 Admin Confirm

```
<HTML>
<HEAD>
<TITLE>TPC-W Admin Confirm Page</TITLE></HEAD>
<BODY BGCOLOR="#FFFFFF">
<H1 ALIGN="CENTER">TPC Web Commerce Benchmark (TPC-W)</H1>
<H2 ALIGN="CENTER"><IMG
SRC="tpclogo.gif" ALIGN="BOTTOM" BORDER="0" WIDTH="288" HEIGHT="67"></H2>
<H2 ALIGN="CENTER">Admin Confirm Page</H2>
<H2>Product Updated</H2>
<H2>Title: Fixed, other values will have to BABAOGULSESEBA meet</H2>
<P>Author: +d,N BABABAULREBAAT</P>
<P>Description: <I> /ua@a^!bk9h5LvP3SishlnwKIUNf*O@ 8BM/5NAun00p&amp;j$Bxy0{?R#oXY-
^I&amp;zUo5v%=pd
pjFk&amp;kOjVJ9iE2yv*AS9h*mAvhV0i#a3#uvY?kP[z[O2yZM##=ORVPe1JP3v[rD06_Jd{xb.
wHWTKU?CC4u{IX!XI*&amp;c&amp;[d#t-&amp;J(,;C6X(+LD+wB4JCdg.(U-Pq#BH[|o.v@GbY5ck6,Uac
kOvx#H{83_bBm=(L$HVZH.cK4L6siz^,ajeQz%32$XY)/3xCY!+W9&amp;QQ+w)KCLq&amp;B!Oh9/B*
ZH{K[ts]rnd|O?LjK5[SDewe?49]#@[Ml=-dG;So1]I(IwdyS]?3y(J1$Vpe--SwbVrhM.ap
Y=-L!Zox 0Z@pdW|{0|YDwnVi!SBR- 1 Y&amp;.l</I></P><IMG
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SRC="t88562.jpg" ALIGN="RIGHT" BORDER="0" WIDTH="100" HEIGHT="150">
<BLOCKQUOTE>
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COLOR="#DD0000"><B> $345.53</B></FONT><BR><B>You Save:</B><FONT
COLOR="#DD0000"><B> $210.91</B></FONT></P></BLOCKQUOTE>
<DL>
<DT><FONT SIZE="2">HARDBACK, 293 pages<BR>Published by
#+$VsbwdbY_/_=6ck?9dr4u%<BR>Publication date: 10-29-1999<BR>Dimensions (in
inches): 40.20 x 28.94 x 69.05<BR>ISBN: jWc2!{iK?Y!M-</FONT></DT></DL>
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SRC="search.gif" ALT="Search" BORDER="0" WIDTH="120" HEIGHT="30"></A><A
HREF="tpcw.dll?home&Session=1370&C_ID=0"><IMG
SRC="home.gif" ALT="Home" BORDER="0" WIDTH="120" HEIGHT="30"></A></P></BODY></HTML>
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### F.2 Admin Request

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<H2 ALIGN="CENTER"><IMG
SRC="tpclogo.gif" ALIGN="BOTTOM" BORDER="0" WIDTH="288" HEIGHT="67"></H2>
<H2 ALIGN="CENTER">Admin Request Page</H2>
<H2 ALIGN="CENTER">Title: Fixed, other values will have to BABAOGULSESEBA meet</H2>
<P ALIGN="LEFT">Author +d,N BABABAULREBAAT<BR></P><IMG
SRC="i88562.jpg" ALIGN="RIGHT" BORDER="0" WIDTH="200" HEIGHT="200"><IMG
SRC="t88562.jpg" ALIGN="RIGHT" BORDER="0" WIDTH="100" HEIGHT="150">
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<P><BR><BR></P>
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<TD><B>$556.44</B></TD></TR>
<TR>
<TD><B>Our Current Price:</B></TD>
<TD><FONT COLOR="#dd0000"><B>$335.53</B></FONT></TD></TR>
<TR>
<TD><B>Enter New Price</B></TD>
<TD ALIGN="RIGHT"><INPUT TYPE="text" NAME="price"></TD></TR>
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<TD><B>Enter New Picture</B></TD>
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<TR>
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<TD ALIGN="RIGHT"><INPUT TYPE="text" NAME="pic"></TD></TR></TABLE>
<P ALIGN="CENTER"><INPUT
TYPE="IMAGE" NAME="Submit Changes" SRC="changes.gif" BORDER="0" HEIGHT="30" WIDTH="130"><A
HREF="tpcw.dll?search&Session=1370&C_ID=0"><IMG
SRC="search.gif" ALT="Search" BORDER="0" WIDTH="120" HEIGHT="30"></A><A
HREF="tpcw.dll?home&Session=1370&C_ID=0"><IMG
SRC="home.gif" ALT="Home" BORDER="0" VSPACE="0" HSPACE="0" WIDTH="120"
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### F.3 Best Sellers

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<P ALIGN="center"><IMG
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<P></P>
<H2 ALIGN="center">Best Sellers Page - Subject: ARTS</H2>
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<TR ALIGN="CENTER" VALIGN="top">
<TD COLSPAN="5"><B><FONT COLOR="#ff0000" SIZE="+1">Click on one of our latest
books to find out more !</FONT></B></TD></TR>
<TR ALIGN="CENTER" VALIGN="top">
<TD><A HREF="tpcw.dll?BookInfo=59227&Session=6250&C_ID=0"><IMG
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<TD><A HREF="tpcw.dll?BookInfo=24568&Session=6250&C_ID=0"><IMG
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 <TD><FONT SIZE="+1">Author</FONT></TD>  
 <TD><FONT SIZE="+1">Title</FONT></TD></TR>  
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 <TD><A HREF="tpcw.dll?BookInfo=51915&amp;Session=1364&amp;C\_ID=0">BABAOGRIINATOG  
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 <TD><I>[TPP8nRVK]pEckxy-7 BABABARIOGNGAT</I></TD>  
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 BABAOGALULSEBA long</A></TD></TR>  
 <TR>  
 <TD><I>Asxa2f A BABABARIATOGOG</I></TD>  
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 <TD><I>ha | &amp;# BABABAULATINSE</I></TD>  
 <TD><A HREF="tpcw.dll?BookInfo=51564&amp;Session=1364&amp;C\_ID=0">Men  
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 <TD><I>#r4oVkjQ:8BfZFCc}I! BABABANGRIULAL</I></TD>  
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 <TR>  
 <TD><I>L{,bmy+LT[ BABABAINALNGNG</I></TD>  
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 available studies will BABABAOGALNGINpreserve below</A></TD></TR>  
 <TR>  
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 <TD><A HREF="tpcw.dll?BookInfo=3305&amp;Session=1364&amp;C\_ID=0">Shops  
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 <TR>  
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 major months cost about the</A></TD></TR>  
 <TR>  
 <TD><I>?TN)qEQ:odQ|xzCAc BABABABAINNGOG</I></TD>  
 <TD><A HREF="tpcw.dll?BookInfo=4800&amp;Session=1364&amp;C\_ID=0">Other,  
 low seconds BABABAREINBABAgain as in the wrong,</A></TD></TR>  
 <TR>  
 <TD><I>(Og BABABAREBAOGUL</I></TD>  
 <TD><A HREF="tpcw.dll?BookInfo=6007&amp;Session=1364&amp;C\_ID=0">Parts  
 BABABAATBABAULsuffer; Eyes might keep. Regional</A></TD></TR>  
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formal BABABAULREATAT patients should turn into the

Ya BABABANGSEATRI

BABABAINALBAREE Electronic, traditional men

BABABARIRESEBA

BABABAINRIOGNG Ideas shall represent. Items shall meet by

BABABAINREREIN

Black, BABAOGOGUGULRI good

BABABAREBARING

Areas BABAOGGRIBAIN ride. True, cold times may help.

BABABAINNGRENG

Forces take. Small, BABAOGGNGINUL special products with

BABABAALULRIBA

BABAOGALSEBARIDifferences can travel. Friends do move.

BABABANGOGNGAL

Hands BABAOGRIOSERE ought to think. Average changes will

BABABAATRIATAT

Black BABAOGRIEOGUL children

BABABARIINBAAL

Open, final BABAOGRIERISE operations

BABABASESEOGOG

Local, british times examine on the BABAOGRISEULRE short,

BABABAINALRIUL

Cars for BABAOGRISEINRE the levels do hurt for the full, due

BABABASEOGSEAT

Personal BABAOGRIINREIN fingers by the

BABABAINATBAAT

Vital, english factors BABAOGREOGNGAT should

<TD><I>B;d.2Kg BABABAINRIINBA</I></TD>  
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 <TD><A HREF="tpcw.dll?BookInfo=15154&amp;Session=1364&amp;C\_ID=0">Determined,  
 due BABAOGSEOGSERE systems set. Left,</A></TD></TR>  
 <TR>  
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 <TD><A HREF="tpcw.dll?BookInfo=16635&amp;Session=1364&amp;C\_ID=0">Weeks  
 could have to BABAOGATATRISE stay.</A></TD></TR>  
 <TR>  
 <TD><I>^XuZ&amp; pYoYk BABABAINATINAT</I></TD>  
 <TD><A HREF="tpcw.dll?BookInfo=17535&amp;Session=1364&amp;C\_ID=0">Interests  
 throw then on the miles. BABAOGULSERISE Clear,</A></TD></TR>  
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 <TD><I>@ZcHtk BABABAINATBAOG8z</I></TD>  
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 <TD><A HREF="tpcw.dll?BookInfo=18009&amp;Session=1364&amp;C\_ID=0">Views  
 face. Cases BABAOGINBABANG before the</A></TD></TR>  
 <TR>  
 <TD><I>tX\*%Q:t\*]|V&amp; c\*t\_ BABABANGATALSE</I></TD>  
 <TD><A HREF="tpcw.dll?BookInfo=18164&amp;Session=1364&amp;C\_ID=0">Modern,  
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 <TD><I>UwfwS BABABASEBANGRIofPt2A</I></TD>  
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items on the formal, fine personnel BABAOGNGRIREAL</A></TD></TR>
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<TD><A HREF="tpcw.dll?BookInfo=19883&amp;Session=1364&amp;C_ID=0">BABAOGNGININRI
  Nervous, strange</A></TD></TR>
<TR>
<TD><I>LP=9i5RT#@lK9j BABABAATBAATUL</I></TD>
<TD><A HREF="tpcw.dll?BookInfo=20537&amp;Session=1364&amp;C_ID=0">Legal,
  old miles BABABAALATSESE may love. Rural,</A></TD></TR>
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<TD><A HREF="tpcw.dll?BookInfo=20717&amp;Session=1364&amp;C_ID=0">Changes
  walk BABABASEATATOG full,</A></TD></TR>
<TR>
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<TR>
<TD><I>Z=Kv BABABAALREOGUL</I></TD>
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  New, international designs will spend.</A></TD></TR>
<TR>
<TD><I>RX5m= BABABAALREATOGLEI60</I></TD>
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  other suggestions get. Foreign, BABABAINRIATUL</A></TD></TR>
<TR>
<TD><I>g5BFN:S(CsN_MEgVT BABABASEBAINUL7</I></TD>
<TD><A HREF="tpcw.dll?BookInfo=21807&amp;Session=1364&amp;C_ID=0">Normal,
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<TR>
<TD><I>hmp BABABARIBABANGdRP</I></TD>
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<TD><I>AJ 7+(sBpz,f BABABARISESEBAaxq</I></TD>
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  emotional movements BABABAATRINGBA hear.</A></TD></TR></TABLE>
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  HREF="tpcw.dll?ShoppingBasket&amp;ADD_FLAG=N&amp;Session=1364&amp;C_ID=0"><IMG
  ALT="Shopping Cart" BORDER="0" HEIGHT="30" SRC="cart.gif" WIDTH="120"></A><A
  HREF="tpcw.dll?search&amp;Session=1364&amp;C_ID=0"><IMG
  ALT="Search" BORDER="0" HEIGHT="30" SRC="search.gif" WIDTH="120"></A><A
  HREF="tpcw.dll?home&amp;Session=1364&amp;C_ID=0"><IMG
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## F.4 Buy Confirm

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<H2 ALIGN=3D"CENTER">Buy Confirm Page</H2>
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<BLOCKQUOTE>
<BLOCKQUOTE>
<BLOCKQUOTE>
<H2 ALIGN=3D"LEFT">Order Information:</H2>
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<TR>
<TD><B>Qty</B></TD>
<TD><B>Product</B></TD></TR>
<TR>
<TD VALIGN=3D"TOP">1</TD>
<TD VALIGN=3D"TOP"><I>Title: Local, mental =
BABABAULULREOGindividuals</I> -
Backing: USED<BR>SRP. $445.35, <FONT COLOR=3D"#AA0000"><B>Your Price: =
$436.00</B></FONT></TD></TR>
<TR>
<TD VALIGN=3D"TOP">2</TD>
<TD VALIGN=3D"TOP"><I>Title: Organic, main sides should BABAOGULBASENG =
have to
say</I> - Backing: AUDIO<BR>SRP. $318.98, <FONT =
COLOR=3D"#AA0000"><B>Your
Price: $213.72</B></FONT></TD></TR></TABLE>
<H2 ALIGN=3D"LEFT">Your Order has been processed.</H2>
<TABLE BORDER=3D"1" CELLPADDING=3D"5" CELLSPACING=3D"0">
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<TD>
<H4>Subtotal with discount (42%):</H4></TD>
<TD>
<H4>$500.80</H4></TD></TR>
<TR>
<TD>
<H4>Tax (8.25%):</H4></TD>
<TD>
<H4>$41.32</H4></TD></TR>
<TR>
<TD>
<H4>Shipping:</H4></TD>
<TD>
<H4>$9.00</H4></TD></TR>
<TR>
<TD>
<H4>Total:</H4></TD>
<TD>
<H4>$551.11</H4></TD></TR></TABLE>
<P><BR></P>
<H2>Order Number: 52</H2>
<H1>Thank you for shopping at TPC-W</H1>
<P></P>
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SRC=3D"search.gif" ALT=3D"Search Item" BORDER=3D"0" VSPACE=3D"0" =

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SRC=3D"home.gif" ALT=3D"Home Page" BORDER=3D"0" VSPACE=3D"0" =
HSPACE=3D"0" WIDTH=3D"120" =
HEIGHT=3D"30"></A></CENTER></BLOCKQUOTE></BLOCKQUOTE></BLOCKQUOTE></BLOC=
KQUOTE></BODY></HTML>

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## F.5 Buy Request

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<HR WIDTH="700" COLOR="#202020">
<H2 ALIGN="CENTER">Buy Request Page</H2>
<HR WIDTH="700">
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<TD VALIGN="TOP" WIDTH="45%">
<H2>Billing Information:</H2>
<TABLE WIDTH="100%" BORDER="0">
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<TD>Firstname:</TD>
<TD> John</TD></TR>
<TR>
<TD>Lastname: </TD>
<TD> Doe</TD></TR>
<TR>
<TD>Addr_street_1:</TD>
<TD> 1 Some Place</TD></TR>
<TR>
<TD>Addr_street_2:</TD>
<TD> Apt. 42</TD></TR>
<TR>
<TD>City:</TD>
<TD> Dullsville</TD></TR>
<TR>
<TD>State:</TD>
<TD> CA</TD></TR>
<TR>
<TD>Zip:</TD>
<TD>91234</TD></TR>
<TR>
<TD>Country:</TD>
<TD> Andorra</TD></TR>
<TR>
<TD>Email:</TD>
<TD> me@mycompany.com</TD></TR>
<TR>
<TD>Phone:</TD>

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<TD> 123-456-7890</TD></TR>
<TR>
<TD>USERNAME:</TD>
<TD>ALININBABABASE</TD></TR>
<TR>
<TD>C_ID</TD>
<TD>2880005</TD></TR></TABLE></TD>
<TD VALIGN="TOP" WIDTH="45%">
<H2>Shipping Information:</H2>
<TABLE BORDER="0" CELSPACING="0" CELLPADDING="0" WIDTH="100%">
<TR>
<TD WIDTH="50%">Addr_street_1:</TD>
<TD WIDTH="50%"><INPUT NAME="shipadd1" SIZE="40" VALUE="1 Some Place"></TD></TR>
<TR>
<TD>Addr_street_2:</TD>
<TD><INPUT NAME="shipadd2" SIZE="40" VALUE="Apt. 42"></TD></TR>
<TR>
<TD>City:</TD>
<TD><INPUT NAME="shipcity" SIZE="30" VALUE="Dullsville"></TD></TR>
<TR>
<TD>State:</TD>
<TD><INPUT NAME="shipstate" SIZE="20" VALUE="CA"></TD></TR>
<TR>
<TD>Zip:</TD>
<TD><INPUT NAME="shipzip" SIZE="10" VALUE="91234"></TD></TR>
<TR>
<TD>Country:</TD>
<TD><INPUT NAME="shipcountry" VALUE="Andorra" SIZE="40"></TD></TR></TABLE></TD></TR></TABLE>
<HR WIDTH="700">
<H2>Order Information:</H2>
<TABLE BORDER="1" CELSPACING="0" CELLPADDING="0">
<TR>
<TD><B>Qty</B></TD>
<TD><B>Product</B></TD></TR>
<TR>
<TD VALIGN="TOP">1</TD>
<TD VALIGN="TOP">Title: <I>BABABABANGATOGIndividual, ethnic results should go.
Figures</I> - Backing: USED<BR>SRP. $790.79, <FONT COLOR="#AA0000"><B>Your
Price: $674.54</B></FONT></TD></TR>
<TR>
<TD VALIGN="TOP">2</TD>
<TD VALIGN="TOP">Title: <I>Years cover near the great, BABAOGATATSERIprime
items.</I> - Backing: PAPERBACK<BR>SRP. $318.75, <FONT COLOR="#AA0000"><B>Your
Price: $208.46</B></FONT></TD></TR></TABLE>
<P><BR></P>
<TABLE BORDER="0">
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<TD ALIGN="RIGHT"><B>$64.83</B></TD></TR>
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<TD><B>Shipping & Handling</B></TD>

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<TD ALIGN="RIGHT"><B>$9.00</B></TD></TR>
<TR>
<TD><B>Total</B></TD>
<TD ALIGN="RIGHT"><B>$859.68</B></TD></TR></TABLE>
<HR WIDTH="700">
<P><BR></P>
<TABLE BORDER="1" CELLPADDING="5" CELLSPACING="0">
<TR>
<TD>Credit Card Type</TD>
<TD><INPUT TYPE="RADIO" NAME="cctype" VALUE="VISA" CHECKED="CHECKED">VISA<INPUT
TYPE="RADIO" NAME="cctype" VALUE="MASTERCARD">MASTERCARD<INPUT
TYPE="RADIO" NAME="cctype" VALUE="DISCOVER">DISCOVER<INPUT
TYPE="RADIO" NAME="cctype" VALUE="AMEX">AMERICAN EXPRESS<INPUT
TYPE="RADIO" NAME="cctype" VALUE="DINERS">DINERS</TD></TR>
<TR>
<TD>Name on Credit Card</TD>
<TD><INPUT NAME="ccname" SIZE="30"></TD></TR>
<TR>
<TD>Credit Card Number</TD>
<TD><INPUT NAME="ccnum" SIZE="16"></TD></TR>
<TR>
<TD>Credit Card Expiration Date</TD>
<TD><INPUT NAME="ccdate" SIZE="15"></TD></TR>
<TR>
<TD>Shipping Method</TD>
<TD><INPUT TYPE="RADIO" NAME="shipmethod" VALUE="AIR" CHECKED="CHECKED">AIR<INPUT
TYPE="RADIO" NAME="shipmethod" VALUE="UPS">UPS<INPUT
TYPE="RADIO" NAME="shipmethod" VALUE="FEDEX">FEDEX<INPUT
TYPE="RADIO" NAME="shipmethod" VALUE="SHIP">SHIP<INPUT
TYPE="RADIO" NAME="shipmethod" VALUE="COURIER">COURIER<INPUT
TYPE="RADIO" NAME="shipmethod" VALUE="MAIL">MAIL</TD></TR></TABLE>
<P ALIGN="CENTER"><INPUT
TYPE="IMAGE" NAME="Confirm Buy" SRC="process.gif" HEIGHT="30" WIDTH="120"><A
HREF="http://www.tpcw.com/tpcw.dll?ShoppingBasket&ADD_FLAG=N&Session=5678&C_ID=2880005"><IMG
SRC="cart.gif" ALT="Shopping Cart" BORDER="0" VSPACE="0" HSPACE="0" WIDTH="120" HEIGHT="30"></A><A
HREF="http://www.tpcw.com/tpcw.dll?home&Session=5678&C_ID=2880005"><IMG
SRC="home.gif" ALT="Home" BORDER="0" VSPACE="0" HSPACE="0" WIDTH="120"
HEIGHT="30"></A></P></FORM></BODY></HTML>

```

## F.6 Customer Registration

```

<HTML>
<HEAD>
<TITLE>Customer Registration Page</TITLE></HEAD>
<BODY BGCOLOR="#ffffff">
<H1 ALIGN="center">TPC Web Commerce Benchmark (TPC-W)</H1>
<HR WIDTH="700" COLOR="#202020">
<H1 ALIGN="center"><IMG
SRC="tpclogo.gif" ALIGN="BOTTOM" BORDER="0" WIDTH="288" HEIGHT="67"></H1>
<H2 ALIGN="center">Customer Registration Page</H2>
<FORM
ACTION="https://www.tpcw.com/tpcw.dll?UserType&Session=5678&C_ID=0" METHOD="POST">
<BLOCKQUOTE>

```

```

<BLOCKQUOTE>
<HR>
<TABLE BORDER="0">
<TR>
<TD><INPUT CHECKED="CHECKED" NAME="RETURNING_FLAG" TYPE="radio" VALUE="Y"> I
am an existing customer      </TD></TR>
<TR>
<TD><INPUT NAME="RETURNING_FLAG" TYPE="radio" VALUE="N"> I am a first time
customer</TD></TR></TABLE>
<HR>
<P><B>If you're an existing customer, enter your Username and Password:</B><BR><BR></P>
<TABLE>
<TR ALIGN="left">
<TD>Username:          <INPUT NAME="username" SIZE="23"></TD></TR>
<TR ALIGN="left">
<TD>Password:
<INPUT SIZE="14" TYPE="password" VALUE="password"></TD></TR></TABLE>
<HR>
<P><B>If you're a first time customer, enter the details below:</B><BR>
  </P>
<TABLE>
<TR>
<TD>Enter your birth date (mm/dd/yyyy):</TD>
<TD>          <INPUT NAME="birthday" SIZE="10"></TD></TR>
<TR>
<TD>Enter your First Name:</TD>
<TD>          <INPUT NAME="firstname" SIZE="15"></TD></TR>
<TR>
<TD>Enter your Last Name:</TD>
<TD>          <INPUT NAME="lastname" SIZE="15"></TD></TR>
<TR>
<TD>Enter your Address 1:</TD>
<TD>          <INPUT NAME="address1" SIZE="40"></TD></TR>
<TR>
<TD>Enter your Address 2:</TD>
<TD>          <INPUT NAME="address2" SIZE="40"></TD></TR>
<TR>
<TD>Enter your City, State, Zip:</TD>
<TD>          <INPUT NAME="city" SIZE="30">
<INPUT NAME="state">          <INPUT NAME="zip" SIZE="10"></TD></TR>
<TR>
<TD>Enter your Country:</TD>
<TD>          <INPUT NAME="country" SIZE="50"></TD></TR>
<TR>
<TD>Enter your Phone:</TD>
<TD>          <INPUT NAME="phone" SIZE="16"></TD></TR>
<TR>
<TD>Enter your E-mail:</TD>
<TD>          <INPUT NAME="email" SIZE="50"></TD></TR></TABLE>
<HR>
<TABLE>
<TR>
<TD COLSPAN="2">Other Customer Data:
<TEXTAREA COLS="65" NAME="data" ROWS="4"></TEXTAREA></TD></TR></TABLE>

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```

<HR></BLOCKQUOTE></BLOCKQUOTE>
<CENTER><INPUT
TYPE="IMAGE" NAME="Enter Order" SRC="submit.gif" BORDER="0" HEIGHT="30" WIDTH="120"><A
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SRC="search.gif" ALT="Search Item" BORDER="0" HSPACE="0" WIDTH="120" HEIGHT="30"></A><A
HREF="http://fishbowl4/scripts/tpcw.dll?home&Session=5678&C_ID=0"><IMG
SRC="home.gif" ALT="Home Page" BORDER="0" HSPACE="0" WIDTH="120" HEIGHT="30"></A>
<P></P></CENTER></FORM></BODY></HTML>

```

## E.7 Home

```

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<TITLE>TPC-W Home Page</TITLE></HEAD>
<BODY BGCOLOR="#ffffff">
<H1 ALIGN="center">TPC Web Commerce Benchmark (TPC-W)</H1>
<HR WIDTH="700" COLOR="#202020">
<P ALIGN="CENTER"><IMG
SRC="tpclogo.gif" ALIGN="BOTTOM" BORDER="0" WIDTH="288" HEIGHT="67"></P>
<H2 ALIGN="center">Home Page</H2>
<H3 ALIGN="center">Welcome back <FONT COLOR="#770000">John Doe</FONT></H3>
<TABLE ALIGN="CENTER" BORDER="0" WIDTH="660">
<TR ALIGN="CENTER" VALIGN="top">
<TD COLSPAN="5"><B><FONT COLOR="#ff0000" SIZE="+1">Click on one of our latest
books to find out more !</FONT></B></TD></TR>
<TR ALIGN="CENTER" VALIGN="top">
<TD><A HREF="tpcw.dll?BookInfo=59227&Session=6250&C_ID=0"><IMG
SRC="59227.jpg" ALT="Book #59227" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=24568&Session=6250&C_ID=0"><IMG
SRC="24568.jpg" ALT="Book #24568" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=94429&Session=6250&C_ID=0"><IMG
SRC="94429.jpg" ALT="Book #94429" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=68639&Session=6250&C_ID=0"><IMG
SRC="68639.jpg" ALT="Book #68639" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=49145&Session=6250&C_ID=0"><IMG
SRC="49145.jpg" ALT="Book #49145" WIDTH="100" HEIGHT="150"></A></TD></TR></TABLE>
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<TD COLSPAN="2" VALIGN="MIDDLE" WIDTH="300"><IMG
SRC="new.gif" ALT="New Product" WIDTH="300"></TD>
<TD BGCOLOR="#ffffff" WIDTH="100"></TD>
<TD COLSPAN="2" WIDTH="300"><IMG SRC="best.gif" ALT="Best Seller" WIDTH="300"></TD></TR>
<TR>
<TD>
<P ALIGN="center"><A HREF="tpcw.dll?new&subject=ARTS&Session=6250&C_ID=0">ARTS</A></P></TD>
<TD>
<P ALIGN="center"><A
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<TD BGCOLOR="#ffffff" WIDTH="50"></TD>
<TD>
<P ALIGN="center"><A HREF="tpcw.dll?best&subject=ARTS&Session=6250&C_ID=0">ARTS</A></P></TD>
<TD>

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<P ALIGN="center"><A
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<TR>
<TD>
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<TR>
<TD>
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<TR>
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HREF="tpcw.dll?search&Session=6250&C_ID=0"><IMG
SRC="search.gif" ALT="Search" BORDER="0" WIDTH="120" HEIGHT="30"></A><A
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## F.8 New Products

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<META CONTENT="MSHTML 5.00.2314.1000" NAME="GENERATOR"></HEAD>
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<P ALIGN="center"><IMG
ALIGN="bottom" BORDER="0" HEIGHT="67" SRC="tpclogo.gif" WIDTH="288"></P>
<H2 ALIGN="center">New Products Page - Subject: ARTS</H2>
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<TR ALIGN="CENTER" VALIGN="top">
<TD COLSPAN="5"><B><FONT COLOR="#ff0000" SIZE="+1">Click on one of our latest
books to find out more !</FONT></B></TD></TR>
<TR ALIGN="CENTER" VALIGN="top">
<TD><A HREF="tpcw.dll?BookInfo=59227&Session=6250&C_ID=0"><IMG
SRC="59227.jpg" ALT="Book #59227" WIDTH="100" HEIGHT="150"></A></TD>
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<TD><FONT SIZE="+1">Title</FONT></TD></TR>
<TR>
<TD><I>CGYFDhKWEb BABABASEBAREOG</I></TD>
<TD><A HREF="tpcw.dll?BookInfo=74116&Session=1364&C_ID=0">Good,
BABABANGULNGUL likely laws to the</A></TD></TR>
<TR>
<TD><I>HYZ:h?.&Fi8lQ[ BABABAREBAULSE8xhu</I></TD>
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coming changes BABABABABANGIN must</A></TD></TR>
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<TR>
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beliefs must BABAOGULATSEREhave to waste. Silly,</A></TD></TR>
<TR>
<TD><I>Z{&};^2yO1X BABABAREREREBA</I></TD>
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BABAOGULININUL public powers</A></TD></TR>
<TR>
<TD><I>%[h9g5+ BABABAALRIINUL</I></TD>

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<TD><A HREF="tpcw.dll?BookInfo=83196&Session=1364&C\_ID=0">BABAOGGRINGALSufficient, social</A></TD></TR>

<TR>

<TD><I>8|IV|.4hKGog BABABARIATRESE</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=97595&Session=1364&C\_ID=0">BABABAINNGATAT Public, coming</A></TD></TR>

<TR>

<TD><I>MR/eT(LCwat BABABAINNGRESE</I></TD>

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<TR>

<TD><I>ZiCf\$SNp?.w|KUBG\* BABABABABARING</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=40000&Session=1364&C\_ID=0">Eyes BABAOGRIBARIAL last in the</A></TD></TR>

<TR>

<TD><I>n.3n,){f BABABAOGRIINRE</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=6140&Session=1364&C\_ID=0">Interests shall have to BABABAATOGREBA create for</A></TD></TR>

<TR>

<TD><I>d0=)6H.d-u6xdw,;e9 BABABAULRINGRIHY</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=6849&Session=1364&C\_ID=0">Active heads would set. National, BABABAATINRENG visual</A></TD></TR>

<TR>

<TD><I>\_q8M5Ka2.:gP}Pa?RsBb BABABAATATINRE</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=24642&Session=1364&C\_ID=0">Judicial, local BABAOGSEATREIN sales let</A></TD></TR>

<TR>

<TD><I>O7:VtpZoZI BABABAATOGALUL</I></TD>

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<TR>

<TD><I>28qVh5 BABABABANGOGIN</I></TD>

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<TR>

<TD><I>&^B BABABAATREBARE</I></TD>

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<TR>

<TD><I>YwlTRhrIF3r% BABABABARIRESE</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=24559&Session=1364&C\_ID=0">Other, BABABABABASENG special</A></TD></TR>

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<TR>

<TD><I>Or#pRQ BABABABARERIRE</I></TD>

<TD><A HREF="tpcw.dll?BookInfo=50120&Session=1364&C\_ID=0">Early fresh changes ought to BABAOGULRENGBA happen. Easy,</A></TD></TR>

<TR>

<TD><I>m;Li\*/Ug5\$)xUi BABABAINNGRINGox</I></TD>

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## F.9 Order Display

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<BLOCKQUOTE>
<BLOCKQUOTE>
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Type: Regular<BR>Ship Date: 4/1/1999<BR>Order Subtotal: $1,239.01=20
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<TR>
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<H4>John Doe</H4></TD></TR>
<TR>
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92691<BR>Libya<BR><BR>Email: me@work.com<BR>Phone: =
123-456-7890</ADDRESS><BR>
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T/ku*2YKq_W0)fQmTyfv;ij88J*fzNmy6V^^wt_YSv^.lWyy)MJM?2I;Vk{d#SuNW/#eXIC Sv8</I></P>
<BLOCKQUOTE>
<P><B>Suggested Retail: $82.16</B><BR><B>Our Price:</B><FONT COLOR="#dd0000"><B>
$78.87</B></FONT><BR><B>You Save:</B><FONT COLOR="#dd0000"><B>
$3.29</B></FONT></P></BLOCKQUOTE>
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(in inches): 29.59 x 91.58 x 69.30<BR>ISBN: U+vn:Tn6m*w1k<BR></FONT></DT></DL>
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## F.12 Search Request

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books to find out more !</FONT></B></TD></TR>
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## F.13 Search Results

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books to find out more !</FONT></B></TD></TR>
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SRC="search.gif" ALT="Search" BORDER="0" WIDTH="120" HEIGHT="30"></A><A
HREF="tpcw.dll?home&Session=1366&C_ID=0"><IMG
SRC="home.gif" ALT="Home" BORDER="0" WIDTH="120" HEIGHT="30"></A></P></BODY></HTML>

```

## F.14 Shopping Cart

```

<HTML>
<HEAD>
<TITLE>TPC W Shopping Cart Page</TITLE></HEAD>
<BODY BGCOLOR="#FFFFFF">
<H1 ALIGN="CENTER">TPC Web Commerce Benchmark (TPC-W)</H1>
<CENTER><IMG
SRC="tpclogo.gif" ALIGN="BOTTOM" BORDER="0" WIDTH="288" HEIGHT="67"></CENTER>
<H2 ALIGN="CENTER">Shopping Cart Page</H2>
<TABLE ALIGN="CENTER" BORDER="0" WIDTH="660">
<TR ALIGN="CENTER" VALIGN="top">
<TD COLSPAN="5"><B><FONT COLOR="#ff0000" SIZE="+1">Click on one of our latest
books to find out more !</FONT></B></TD></TR>
<TR ALIGN="CENTER" VALIGN="top">
<TD><A HREF="tpcw.dll?BookInfo=59227&Session=6250&C_ID=0"><IMG
SRC="59227.jpg" ALT="Book #59227" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=24568&Session=6250&C_ID=0"><IMG
SRC="24568.jpg" ALT="Book #24568" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=94429&Session=6250&C_ID=0"><IMG
SRC="94429.jpg" ALT="Book #94429" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=68639&Session=6250&C_ID=0"><IMG
SRC="68639.jpg" ALT="Book #68639" WIDTH="100" HEIGHT="150"></A></TD>
<TD><A HREF="tpcw.dll?BookInfo=49145&Session=6250&C_ID=0"><IMG
SRC="49145.jpg" ALT="Book #49145" WIDTH="100" HEIGHT="150"></A></TD></TR></TABLE>
<FORM ACTION="tpcw.dll?Adjustment&Session=1370&C_ID=0" METHOD="POST">
<CENTER>
<P></P>
<TABLE BORDER="0">
<TR>
<TD><B>Qty</B></TD>
<TD><B>Product</B></TD></TR>
<TR>
<TD VALIGN="TOP"><INPUT TYPE="HIDDEN" NAME="I_ID" VALUE="53708"><INPUT
NAME="QTY" VALUE="1" SIZE="3"></TD>
<TD VALIGN="TOP"><I>Scottish, high rates BABABAALATSEOG feel vital</I> -

```

Backing: AUDIO<BR>SRP. \$426.21, <FONT COLOR="#AA0000"><B>Your Price: \$266.81</B></FONT></TD></TR>  
<TR>  
<TD VALIGN="TOP"><INPUT TYPE="HIDDEN" NAME="I\_ID" VALUE="50920"><INPUT  
NAME="QTY" VALUE="1" SIZE="3"></TD>  
<TD VALIGN="TOP"><I>Grand, BABAOGBASENGIN reasonable</I> - Backing: AUDIO<BR>SRP.  
\$82.16, <FONT COLOR="#AA0000"><B>Your Price: \$78.87</B></FONT></TD></TR></TABLE><B><I>Subtotal  
price: \$345.68 </I></B><BR>Last Updated: 03/10/2000 16:23:34  
<P><BR><INPUT  
TYPE="IMAGE" NAME="Proceed to Checkout" SRC="checkout.gif" HEIGHT="30" WIDTH="120"><INPUT  
TYPE="IMAGE" NAME="Continue Shopping" SRC="home.gif" HEIGHT="30" WIDTH="120"></P>  
<P>If you have changed the quantities and/or taken anything out<BR> of your  
shopping cart, click here to refresh your shopping cart:</P>  
<P><INPUT  
TYPE="IMAGE" NAME="Refresh Shopping Cart" SRC="refresh.gif" HEIGHT="30"  
WIDTH="120"></P></CENTER></FORM></BODY></HTML>

## **Appendix G - EXECUTIVE SUMMARY**

This appendix includes a sample Executive Summary, which includes the following 3 pages:

- ? Overview Page
- ? Pricing Page
- ? Numerical Quantities Summary Page.

Clauses 7 and 8.2 give a detailed description of the required format and content of the Executive Summary. This sample is provided only as an illustration of the requirements set forth in this specification. In the event of a conflict between this example and the specification, the specification (Clauses 8.2 and 7) shall prevail.

The required format of the TPC-W Executive Summary may change from time to time. The latest version of the required format is available upon request from the TPW administrator (see cover page).

### **G.1 Implementation Overview Page**

The following page demonstrates how the Overview page should appear.

<b>SuperDooper</b>	<b>Perigee 5000 with DataMart 2001</b>		<b>TPC-W Rev 1.5</b>		
<b>Price Performance</b> \$X,XXXX per WIPS@10,000	<b>Performance</b> XXXX.X WIPS@10,000		<b>Available</b> 1-Aug-01		
<b>Total Cost</b> \$XXX,XXX	<b>WIPSo@10,000</b> X,XXX.X		<b>WIPSp@10,000</b> X,XXX.X		
<b>Scale</b> 10,000 items	<b>Number of Users</b> 14,000		<b>Number of Systems</b> 8		
<b>Web Server</b> Pernese Internet Information Server 5.0	<b>Application Server</b> Pernese ISAPI		<b>Image Server</b> Pernese Internet Information Server 5.0		
<b>Database Manager</b> Pernese SQL Server 2000	<b>Load Balancer</b> Pernese Web Switch 240x		<b>Web Cache</b> Clam 2.3 on Blue Shoes Linux 6.2		
<b>Other Software:</b> Wizbang Index Manager 4.2 (text search engine)					
<b>Function</b>	<b>System</b>	<b># of Systems</b>	<b>Operating System</b>	<b>Processors</b>	<b>Memory</b>
Web Server	Perigee 5000	4	Wizbang 2000 Server	2 XYZ 800 MHz 256KB	512 MB
Application Server					
Image Server					
Database Manager	DataMart 2000	1	Wizbang 2000 Advanced Server	4 XYZ III 700MHz 2MB	4 GB3
Load Balancer	Pernese 240x switch	1	na	na	na

Web Cache	Perigee 5000	1	Blue Shoes Linux 6.2	2 XYZ III 800 MHz 256KB	1 GB
Other Software	Perigee 5000	1	Wizbang 2000 Server	2 MegaFast 800 MHz	512 MB

**G.2 Pricing Page**

<b>Sponsor(s)</b>	<b>System(s) Name(s)</b>		TPC-W Rev. 1.2.3			
			Report Date 12/20/1999			
<b>Price Performance</b>		<b>Performance</b>		<b>Availability Date</b>		
<b>\$1,901 per WIPS@10,000</b>		<b>123.4 WIPS@10,000</b>		<b>October 15, 2000</b>		
<b>Description</b>	<b>Part No.</b>	<b>Third Party Brand Price</b>	<b>Unit Price</b>	<b>Qty.</b>	<b>Extended Price</b>	<b>3 yr.Maint. Price</b>
Directory Name Server						
					<b>Subtotal</b>	
Web Server						
					<b>Subtotal</b>	
Application Server						
					<b>Subtotal</b>	
Database Server						
					<b>Subtotal</b>	
<b>3 Year Cost of Ownership</b>						
<b>WIPS@10,000</b>						
<b>\$ / WIPS@10,000</b>						
<b>Independently Audited by:</b>		<b>Auditor's name</b>		<b>Audit firm's name or logo</b>		

**G.3 Numerical Quantities Summary Page**

<b>Sponsor(s)</b>	<b>System(s) Name(s)</b>	<b>TPC-W Rev. 1.2.3</b>
		<b>Report Date 12/20/1999</b>
<b>Price Performance</b>	<b>Performance</b>	<b>Availability Date</b>
<b>\$1901 per WIPS@10,000</b>	<b>123.4 WIPS@10,000</b>	<b>October 15, 2000</b>

**Numerical Quantities Summary**

**WIPS Interaction Summary**

<b>Interaction</b>	<b>Mix</b>	<b>Count</b>	<b>90% Response</b>
Home	16.00%	35552	0.1
Shopping Cart	11.60%	25776	0.9
Customer Registration.	3.00%	6666	1.1
Buy Request	2.60%	5778	0.2
Buy Confirm	1.20%	2667	3.3
Order Inquiry	0.75%	1667	0.8
Order Display	0.66%	1467	1.2
Search Request	20.00%	44440	0.5
Search Results	17.00%	37774	8.5
New Products	5.00%	11110	0.42
Best Sellers	5.00%	11110	0.45
Product Detail	17.00%	37774	0.9
Admin. Request	0.10%	223	18.6
Admin. Confirm	0.09%	200	0.5

**Measurement Intervals Summary**

	<b>Shopping</b>	<b>Browsing</b>	<b>Ordering</b>
<b>Ramp-up time (min.)</b>	27.5	27.5	27.5
<b>Length of Measurement Interval (min.):</b>	30	30	30
<b>Average Think Time (sec.)</b>	7.1	7.2	7.3
<b>Average User Session duration (min)</b>	15.1	15.1	15.1
<b>Number of Users</b>	100	150	75


## Appendix H - WGEN UTILITY

This appendix is a general description of WGEN, a sample implementation of some of the database-population-generation routines required in TPCW.

### H.1 Description

WGEN is a database population program for use with the TPC-W benchmarks. It is written in ANSI 'C' for portability, and is based on code that has been successfully ported to over a dozen different systems. The source code has been provided to make the process of building a compliant database population as simple as possible.

WGEN contains the types of functionality that will be required in a database generator for the TPC-W benchmark. It produces sample output for two of the fields in the benchmark definition, A\_LNAME and I\_TITLE. The number of samples produced, along with related variable settings like number of items and authors can be controlled from the command line. All output is sent to stdout.

The WGEN utility is contained in the following files:

? rnd.[ch]	A portable random-number generator
? tpcw.[ch]	The TPC-W-specific routines
? bm_utils.c	Generic routines based on those used in TPC-D's DBGEN
? main.c	A simple driver routine
? grammar.tpcw	The WGEN grammar

To build WGEN on a new system, do the following:

1. Create an appropriate makefile, using makefile.suite as a basis.
2. make

**Note:** The required changes to the makefile should be limited to the first few lines.

### H.2 Using WGEN

It is a requirement of the TPC-W benchmark that sponsors use WGEN to generate the text that is used to populate the I\_TITLE and A\_LNAME fields in the database. WGEN may be used as follows:

- ? The sponsor may use the executable provided. The ASCII data it generates contains data that can be read by a loader program and used to populate the database.
- ? The sponsor may build an executable program based on the source files provided. The executable is used to generate the data used by the loader to populate the database.

**Comment1:** If an executable other than that provided by the TPC is used, the name and version of the compiler used to build it must be disclosed, along with any compile-time switches or option settings.

**Comment2:** Modifications to the WGEN source must be limited to those required for portability or speed. If a modified version of WGEN is used, the modified source files must be disclosed in full.

- ? The sponsor may include the sample source files, omitting main.c, in his own loader program that calls the mk\_title() and mk\_author() functions. The name and version of the compiler used and the source of the loader must be disclosed in full, along with any compile-time or runtime options used to load the database.

Regardless of the manor in which WGEN is used, the auditor must verify that the values used to populate the I\_TITLE and A\_LNAME fields match those produced by the TPC-supplied tools.

### H.3 Command Line Options

WGEN's output is controlled by a combination of command line options and environment variables. Command line options are assumed to be single letter flags preceded by a minus sign. They may be followed by an optional argument.

Option	argument	default	action
-h			Display a usage summary
-s	<samples>	1	Number of sample generated
-a	<authors>	250	Set the number of authors
-I	<items>	1000	Set the number of items
-d	<file>	grammar.tpc w	Read distributions from <file>
-m	<mode>	0	Set the output mode. Defined modes are: 0 -- I_TITLE 1 -- A_LNAME

### H.4 Environment Variables

Environment variables are used to control features of WGEN that are unlikely to change from one execution to another.

Variable	Default	Action
TPCW_CONFIG		Directory in which to find configuration files
TPCW_DIST	grammar.tpcw	Name of distribution definition file

## H.5 WGEN Output

### Mode 0 – I\_TITLE

In this mode WGEN utilizes the DigSyl function described in clause 4.6.2.9 to generate the data used to populate I\_TITLE. DigSyl is called as follows:

```

If I_ID <= NUM_ITEMS/5
    DigSyl(I_ID,7)
else
    DigSyl(random within[1 .. I_ID/5],7)

```

The output from DigSyl is embedded in pseudo-English text strings that are generated according to the grammar definition file “grammar.tpcw”. The generated text strings are of length random within [14 .. 60] plus any additional characters required to complete partial words. 75% of the DigSyl strings are inserted as whole words. The remaining 25% are inserted as prefixes to existing words contained within the pseudo-text.

### Sample I\_TITLE data

The text below shows sample output from the WGEN when used with mode=0.

**Command:** wgen.exe -s25 -a250 -i1000 -m0 >I\_TITLE\_SAMPLE.txt

```

BABABABABABAOG Private,
Children with BABABABABABAAL the other, general
Years shall fall BABABABABABARI firm, black patients–
Right, short schools would look BABABABABABARE more?
Papers could love. Political, BABABABABABASEconomic
Soviet, BABABABABABAATindustrial duties must know in
Times in the responsible, BABABABABABAUL social pp. mean for
Necessary, BABABABABABAINlocal features remember.
Goals know. Members BABABABABABANG would need. Total,
BABABABABABAOGBA Top, positive components must keep. Points

```

Fingers should BABABABABAOGOG draw in the unique,  
 BABABABABAOGALGirls would run.  
 Numbers should give late, familiar BABABABABAOGRI men.  
 Years BABABABABAOGRE belong. Activities with the  
 Sexual, BABABABABAOGSE heavy customers build schools. Legal,  
 Working, real BABABABABAOGAT members shall apply personal,  
 Results BABABABABAOGUL enable. Extra,  
 Other, able BABABABABAOGIN benefits will have to want  
 Light, BABABABABAOGNGcommon  
 BABABABABAALBA Problems ought  
 BABABABABAALOGIndividual states can tell.  
 BABABABABAALAL Figures can change. Regular, popular pp.  
 BABABABABAALRI Useful, different  
 Young, primary BABABABABAALREoperations shall  
 New patterns notice BABABABABAALSE in

**Mode 1 - A\_LNAME**

In this mode WGEN utilizes the DigSyl function described in clause 4.6.2.9 to generate the data used to populate A\_LNAME. DigSyl is called as follows:

```

  If A_ID <= NUM_AUTHORS/2.5
    DigSyl(A_ID,7)
  Else
    DigSyl(random within[1 .. A_ID/2.5],7)
  
```

**Sample A\_LNAME Output**

The output from DigSyl is used directly for 75% of the generated A\_LNAMEs. For the remaining 25% the output of DigSyl is padded with some random characters. The text below shows sample output from the WGEN utility when it is used with mode=1.

**Command:** wgen.exe -s25 -a250 -i1000 -m1 >A\_LNAME\_SAMPLE.txt

Sample A\_LNAME data

- BABABABABABAOGI7xF
- BABABABABABAALwH
- BABABABABABARI
- BABABABABABARE
- BABABABABABASE
- BABABABABABAATYq
- BABABABABABAUL2
- BABABABABABAIN

BABABABABANG  
BABABABABAOGBA  
BABABABABAOGOG  
BABABABABAOGAL  
BABABABABAOGRI  
BABABABABAOGRELNU  
BABABABABAOGSE0fCU4y  
BABABABABAOGAT  
BABABABABAOGUL  
BABABABABAOGINXEbH  
BABABABABAOGNG  
BABABABABAALBAhjk  
BABABABABAALOG  
BABABABABAALAL  
BABABABABAALRI  
BABABABABAALRE  
BABABABABAALSE

## **Appendix I - STANDARD REFERENCES**

### **I.1 Internet RFCs**

The following references to Internet Requests for Comments (RFC) are relevant to the benchmark:

- ? Hypertext Transfer Protocol 1.1 (HTTP 1.1), as defined in RFC 2068  
<http://www.ietf.org/rfc/rfc2068.txt>
- ? Internet Protocol (IPv4), as defined in RFC 791  
<http://www.ietf.org/rfc/rfc0791.txt>
- ? Transmission Control Protocol (TCP), as defined in RFC 793  
<http://www.ietf.org/rfc/rfc0793.txt>
- ? Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework as in RFC 2527  
<http://www.ietf.org/rfc/rfc2527.txt>
- ? PKCS#1 RSA Cryptography Specification Version 2.0 as defined in RFC 2437  
<http://www.ietf.org/rfc/rfc2437.txt>
- ? SSL V3 is a de-facto standard and does not have an RFC number. The specifications can be found at  
<http://home.netscape.com/eng/ssl3/ssl-toc.html>
- ? Transport Layer Security. The specifications can be found at  
<http://www.ietf.org/rfc/rfc2246.txt>

RC4 is a trademark of the RSA Corporation

### **I.2 Common Log Format**

The Common Log Format is a standard of the W3C, Worldwide Web Consortium. W3C is an international industry consortium, jointly hosted by the Massachusetts Institute of Technology Laboratory for Computer Science [MIT/LCS] in the United States; the Institut National de Recherche en Informatique et en Automatique [INRIA] in Europe; and the Keio University Shonan Fujisawa Campus in Japan. Services provided by the Consortium include: a repository of information about the World Wide Web for developers and users; reference code implementations to embody and promote standards; and various prototype and sample applications to demonstrate use of new technology. Initially, the W3C was established in collaboration with CERN, where the Web originated, with support from DARPA and the European Commission

- ? A description of Common Log Format can be found at:

<http://www.w3.org/Daemon/User/Config/Logging.html>

<http://delinfo.cern.ch/WebOffice/Services/WWWlogfiles/CommonLogFormat.html>