

Performance Assurance for IT Systems

Brian King



CONTENTS

WHAT THIS BOOK IS ABOUT	xvii
--------------------------------------	-------------

ACKNOWLEDGMENTS	xxv
------------------------------	------------

PART 1: INDIVIDUAL AREAS OF INTEREST

1. Preparing for the Challenge	3
1.1 Abstract	3
1.2 Introduction	4
1.3 In The Beginning.....	4
1.4 The Need to Address New Applications	5
1.5 Definition of Performance	5
1.6 The Required Skills	7
1.6.1 Understanding Hardware and Software Technologies	7
1.6.2 Application Design	9
1.6.3 Vendors	9
1.6.4 Tools and Techniques	11
1.7 Performance Assurance Within a Project Lifecycle.....	12
1.7.1 Requirements/Functional Specification Stage.....	13
1.7.2 Design Stage	13
1.7.3 Code and Test.....	14
1.7.4 Performance Acceptance Testing	15
1.7.5 The All-Phases Stage	16
1.7.6 Post-Implementation	16
1.8 Summary	16
2. Caveat Emptor (Let the Buyer Beware).....	19
2.1 Abstract	19
2.2 Software Product Lifecycle	19
2.3 Hardware Product Lifecycle	20
2.4 Marketing.....	21

2.5	Technical Reviews of Products	22
2.5.1	Preparation	24
2.5.2	Reading Vendor Literature	25
2.5.3	Vendor Meetings	26
2.5.4	Technical Review Checklist	27
2.5.4.1	Architecture	27
2.5.4.2	Scalability	28
2.5.4.3	Resilience	29
2.5.4.4	Performance	30
2.5.4.5	Other Elements	31
2.5.5	Custom Software Versus Product	32
2.5.6	Drawing Conclusions	32
3.	Lies, Damned Lies, and Benchmarks	35
3.1	Abstract	35
3.2	Introduction	36
3.3	Industry Benchmarks	36
3.4	Vendor Benchmarks	38
3.5	Independent Benchmarking	39
3.6	In-House Benchmarking	39
3.7	Tricks of the Trade	40
3.7.1	Simplifying the Problem	40
3.7.2	Improving Disk Performance	41
3.7.3	Unrepresentative Deployment	42
3.7.4	Minimizing Overheads	43
3.7.5	Reporting	44
3.8	Using Benchmarks	45
3.8.1	Using Published Benchmarks	45
3.8.2	Requesting Benchmarks	46
3.8.3	In-House Benchmarks	47
3.8.4	Drawing Conclusions from Benchmarks	48
4.	Nonfunctional Requirements and Solutions	51
4.1	Abstract	51
4.2	Introduction	52
4.3	The Problems	52
4.3.1	Authors of Requirements	53
4.3.2	Poor Quality Requirements	53
4.3.2.1	Poorly Written Requirements	54
4.3.2.2	Introducing Risk by Requesting Bleeding-Edge Technology	54
4.3.2.3	Technically Unrealistic Requirements	54
4.3.2.4	Requirements That Bear No Resemblance to the Available Budget	54
4.3.2.5	No Explanation of Any Ground Rules	55

4.3.2.6	Inadequate Sizing Information	55
4.3.2.7	Ambiguous and Even Contradictory Requirements	55
4.3.3	What Do They Want?	55
4.3.4	And Now for Something Completely Different	57
4.4	Sizing Information	57
4.5	Performance Requirements	59
4.6	Hardware Sizing	62
4.7	Hardware Deployment and Scalability	63
4.7.1	Deployment Approaches	63
4.7.2	Software Scalability	64
4.8	Availability	65
4.8.1	General Observations	65
4.8.2	Building in Resilience	67
4.9	The Need for Business Continuity	68
4.10	Summary	70
5.	Hardware Sizing: The Crystal Ball Gazing Act	73
5.1	Abstract	73
5.2	The Challenge	74
5.3	Summary of Hardware Sizing Approaches	75
5.3.1	By Simple Analogy	75
5.3.2	Vendor Sizing	75
5.3.3	Using Benchmarks	76
5.3.4	Detailed Transaction-Level Hardware Sizing	77
5.3.5	High-Level Sizing	77
5.4	High-Level Sizing Method	78
5.4.1	Step 1: Information Gathering	78
5.4.1.1	Raw Data Volumes	79
5.4.1.2	Peak Period	79
5.4.1.3	Identify Workloads and Users	79
5.4.1.4	Transaction Rates	81
5.4.2	Step 2: Assess the Credibility of the Available Information	82
5.4.3	Step 3: Establish the Resource Profiles	84
5.4.3.1	Magic Numbers	84
5.4.3.2	Use of Benchmark Figures	84
5.4.3.3	New Software Technology	85
5.4.3.4	Adjusting Resource Profiles	86
5.4.4	Step 4: Sizing Calculations	86
5.4.4.1	The System to Be Sized	86
5.4.4.2	Disk Capacity: Stage 1	87
5.4.4.3	Resource Profiles: Stage 2	89
5.4.4.4	Main Calculations: Stage 3	91

5.4.5	Step 5: Consider Deployment Options	96
5.4.5.1	Issues	96
5.4.5.2	Other Environments	97
5.5	Batch Processing Considerations	97
5.5.1	Simple Background Batch	99
5.5.2	Overnight Batch	99
5.6	Sizing Software Products	100
5.7	Sizing Reviews	101
5.7.1	The Battleground	101
5.7.2	Productive Approach	101
5.7.3	Unproductive Approaches	102
5.8	Deliverables	104
5.9	Hardware Sizing Revisited	104
5.10	Change	105
5.11	Summary	106
6.	Bid Logistics	107
6.1	Abstract	107
6.2	The Challenge	107
6.3	Bid Qualification	108
6.4	The Political Dimension	109
6.5	Teaming	109
6.6	Dealing with Hardware and Software Vendors	110
6.7	Iterative Sizing	112
6.8	Bid Reviews	113
6.9	Prototypes	113
6.10	BAFO	114
6.11	Documentation	114
6.12	Summary	115
7.	Designing for Performance, Scalability, and Resilience . . .	117
7.1	Abstract	117
7.2	Initial Observations	117
7.2.1	Understanding the Work Done in Previous Stages . .	117
7.2.2	Nirvana	118
7.2.3	Does It Cost More?	119
7.2.4	QA	119
7.2.5	In-House Benchmarks	120
7.2.6	Change	120
7.3	Basic Design Principles	120
7.3.1	Understanding Resource Usage Costs	120
7.3.2	Balanced Hardware Configurations	121
7.3.3	Partitioning	122
7.3.4	Resilience	125

7.4	General Thoughts and Guidelines	126
7.4.1	Threads	126
7.4.2	Communication Between Software Components . . .	127
7.4.3	Minimizing Overheads	128
7.4.4	Going with the Flow	129
7.4.5	The Only Transaction in the World	130
7.4.6	Under the Covers	130
7.4.7	Relational Databases	130
7.4.8	Database Transactions	131
7.4.9	File Handling	132
7.4.10	Network Performance	133
7.4.11	Publish and Subscribe	133
7.4.12	Gluings Software	134
7.4.13	Data Replication	135
7.4.14	Partitioning the Problem	135
7.4.15	Some Basic Hardware Considerations	137
7.4.16	Server-Side Batch Processing	138
7.4.17	Application Resilience	139
7.4.18	Security Implications	139
7.4.19	Evaluating Design Approaches	139
7.4.20	Something for the Back Pocket	140
7.4.21	Data Migration	141
7.4.22	Backup and Recovery	142
7.4.23	Archiving	143
7.5	Coding and Testing	143
7.6	Summary	144
8.	Awareness of Queues	145
8.1	Abstract	145
8.2	Queues	145
8.3	Locks	147
8.4	Tackling Delays	148
8.5	Analytic and Simulation Modeling Tools	148
8.6	Alternative Approaches	149
8.7	Summary	150
9.	Nonfunctional Acceptance	151
9.1	Abstract	151
9.2	The Issues	151
9.3	Stress Testing	152
9.3.1	Scope and Logistics	152
9.3.2	Planning	153
9.3.3	Tools	153
9.3.4	Workloads	155

9.3.5	Data	156
9.3.6	Test Environment.	157
9.3.7	Preparation	157
9.3.8	Test Logistics	158
9.3.9	Analyzing Results.	159
9.4	Soak Testing	159
9.5	Operational-Readiness Testing	160
9.6	Summary	160
10.	Post-Production	161
10.1	Abstract	161
10.2	Introduction	161
10.3	Classic Capacity Management	162
10.3.1	Performance Monitoring/Reporting	162
10.3.2	Workload Management	164
10.3.3	Capacity Planning	165
10.3.4	Service Level Management.	165
10.3.5	Cost Management	166
10.4	A Minimalist Approach to Capacity Management	167
11.	Softer Issues	169
11.1	Abstract	169
11.2	Introduction	169
11.3	Devil's Advocate and Seductive Technology	171
11.4	Communication	171
11.4.1	Meetings	172
11.4.2	Communication Within the Project Team.	172
11.4.3	Communication Across the Organization	173
11.4.4	Communication Between Organizations.	173
11.5	Awareness of Cost	175
11.6	Awareness of Time.	175
11.7	Overengineering.	176
11.8	Smoke-Filled Rooms.	176
11.9	Team Balance	177
11.10	Multi-Tasking	177
11.11	Client Responsibilities.	178
11.12	Technical Postmortem	179
11.13	All-Rounders	179
12.	So What?	181
12.1	"My Way".	181
12.2	Informed Approach	183

PART 2: TECHNICAL FOUNDATION

13. Introduction to Technology Tasters	187
14. Operating Systems.....	189
14.1 Basic Terminology	189
14.2 Technology Outline	189
14.2.1 Processes and Threads	190
14.2.2 Memory Management	191
14.2.3 Scheduling	192
14.2.4 Device Management	192
14.3 Performance.....	192
14.4 General Observations.....	194
14.5 Further Reading	194
15. CPU Basics	195
15.1 Basic Terminology	195
15.2 Technology Outline	195
15.2.1 Data and Instruction Caching	196
15.2.2 Bit Width	196
15.2.3 Pipelining Instructions.....	197
15.2.4 Branch Prediction	198
15.2.5 Parallelism.....	198
15.3 Performance.....	199
15.4 General Observations.....	199
15.5 Further Reading	200
16. Memory	201
16.1 Basic Terminology	201
16.2 Technology Outline	201
16.2.1 SRAM (Static Random Access Memory)	203
16.2.2 DRAM (Dynamic Random Access Memory)	203
16.3 Performance.....	205
16.4 General Observations.....	206
16.5 Further Reading	206
17. Hard Disk Basics	207
17.1 Basic Terminology	207
17.2 Technology Outline	207
17.2.1 Basic Disk Accessing.....	208
17.2.2 Logical Volumes	212
17.2.3 RAID.....	212
17.3 Performance.....	214
17.4 General Observations.....	216
17.5 Further Reading	216

18. Server Infrastructure.....	217
18.1 Basic Terminology	217
18.2 Technology Outline	217
18.2.1 System Bus	217
18.2.2 CPUs.....	218
18.2.3 Memory Controller	219
18.2.4 IO Bus Bridge.....	219
18.2.5 SMP Implementation	219
18.3 Performance.....	221
18.4 General Observations.....	222
18.5 Further Reading	222
19. Multiprocessors (Shared Memory)	225
19.1 Basic Terminology	225
19.2 Technology Outline	225
19.2.1 SMP (or UMA)	226
19.2.2 ccNUMA	227
19.2.3 S-COMA	228
19.2.4 R-NUMA	229
19.2.5 Vendor Implementations	229
19.3 Performance.....	229
19.4 General Observations.....	230
19.5 Further Reading	231
20. Hard Disk: Fibre Channel, SAN, and NAS.....	233
20.1 Basic Terminology	233
20.2 Technology Outline	233
20.2.1 Fibre Channel	233
20.2.2 SAN	236
20.2.3 Top-of-the-Range Disk Subsystems	237
20.2.4 NAS (Network Attached Storage).....	238
20.3 Performance.....	240
20.4 General Observations.....	240
20.5 Further Reading	241
21. File Access Basics	243
21.1 Basic Terminology	243
21.2 Technology Outline	243
21.2.1 UNIX File System Basics	243
21.2.2 UNIX File System Refinements.....	245
21.2.3 NTFS.....	246
21.2.4 Network File System	247
21.2.5 Cache-Coherent Shared File System.....	249

21.2.6	Shared File System — Direct Connections via SAN.	249
21.3	Performance.	250
21.4	General Observations.	251
21.5	Further Reading	251
22.	Relational Database Basics	253
22.1	Basic Terminology	253
22.2	Technology Outline	253
22.2.1	Network Communication.	255
22.2.2	SQL Processing	256
22.2.3	Data Access	260
22.2.4	Transactions	261
22.2.5	Parallel SQL Processing	262
22.3	Performance.	263
22.4	General Observations.	264
22.5	Further Reading	265
23.	Back-End Server Clusters	267
23.1	Basic Terminology	267
23.2	Technology Outline	268
23.2.1	Background.	268
23.2.2	High Availability	268
23.2.3	Shared Resources	272
23.2.4	Scalability	273
	23.2.4.1 Multiple Server Shared File System . . .	273
	23.2.4.2 Multiple Node Database.	273
23.3	Performance.	275
23.3.1	Heartbeat Checking.	275
23.3.2	Speed of Service Fail-Over	276
23.3.3	Full Site Fail-Over	276
23.3.4	Clusterwide Disk Sharing.	276
23.4	General Observations.	277
23.5	Further Reading	278
24.	Network Basics	279
24.1	Basic Terminology	279
24.2	Technology Outline	279
24.2.1	The Seven Layers	279
24.2.2	IP	280
24.2.3	Brief Overview of WAN Technologies	281
24.2.4	Basic LAN Topologies	283
24.2.5	Hubs and Switches	284

24.2.6	Inter-Ethernet LAN Connectivity	284
24.2.7	Inter-Data Center Communication	288
24.2.8	Scalable Networks	288
24.2.9	Citrix and Microsoft Terminal Servers	288
24.3	Performance	290
24.4	General Observations	292
24.5	Further Reading	293
25.	Firewalls	295
25.1	Basic Terminology	295
25.2	Technology Outline	295
25.2.1	Functionality	295
25.2.2	High Availability (HA)	297
25.2.3	Scalability	297
25.3	Performance	297
25.4	General Observations	298
25.5	Further Reading	299
26.	Server Load Balancing	301
26.1	Basic Terminology	301
26.2	Technology Outline	302
26.2.1	Load Balancing Approaches	302
26.2.2	Software Load Balancing	302
26.2.3	Hardware Approach	303
26.2.4	Resilience	304
26.2.5	The Implications of State	305
26.3	Performance	307
26.4	General Observations	308
26.5	Further Reading	309
27.	Web Server and	
	Cache Server	311
27.1	Basic Terminology	311
27.2	Technology Outline	312
27.2.1	Web Server	312
27.2.1.1	Static Content	312
27.2.1.2	Dynamic Content	314
27.2.2	Cache Server	315
27.3	Performance	319
27.4	General Observations	320
27.5	Further Reading	320
28.	LDAP Server	321
28.1	Basic Terminology	321

28.2	Technology Outline	321
28.2.1	Client/Server Communication.	322
28.2.2	Replication	322
28.2.3	Deployment	323
28.3	Performance.	323
28.4	General Observations.	324
28.5	Further Reading	324
29.	Modern Server-Side Development Technologies	327
29.1	Basic Terminology	327
29.2	Technology Outline	328
29.2.1	Background.	328
29.2.2	Architecture.	329
29.2.2.1	Presentation.	329
29.2.2.2	Business Logic.	329
29.2.2.3	Connectivity	329
29.2.2.4	Execution	330
29.2.2.5	Services.	330
29.2.3	Programming Languages	330
29.2.4	Memory	330
29.2.5	Hardware Deployment Options.	331
29.3	Performance.	331
29.3.1	Threading	331
29.3.2	Run-Time Environment	332
29.3.3	Garbage Collection	332
29.3.4	Intercomponent Communication	333
29.3.5	Mixing Technologies	333
29.3.6	Reusing Objects	334
29.3.7	General Design Issues.	334
29.3.8	Session State	334
29.3.9	Data Access	335
29.3.10	Transactions	335
29.3.11	XML and Web Services	335
29.3.12	Programming Language.	336
29.4	General Observations.	336
29.5	Further Reading	337
Index		339