Contents

		r -	
ப	ro.	เล	ce

	Au	dience		liii
	Do	cumenta	ation Accessibility	liii
	Re	lated Do	ocuments	liv
	Co	nventior	ns	liv
Part		Basic	Database Administration	
L	Ge	etting	Started with Database Administration	
	1.1	Char	nges on Oracle Database Release 23ai for Oracle Database Administrator's Guide	1-1
		1.1.1	New Features in 23ai	1-2
		1.1.2	Deprecated Features	1-2
		1.1.3	Desupported Features	1-2
Part L	1.2	Type	s of Oracle Database Users	1-3
		1.2.1	Database Administrators	1-3
		1.2.2	Security Officers	1-4
		1.2.3	Network Administrators	1-4
		1.2.4	Application Developers	1-4
		1.2.5	Application Administrators	1-5
		1.2.6	Database Users	1-5
	1.3	Task	s of a Database Administrator	1-5
		1.3.1	Task 1: Evaluate the Database Server Hardware	1-6
		1.3.2	Task 2: Install the Oracle Database Software	1-6
		1.3.3	Task 3: Plan the Database	1-7
Part L		1.3.4	Task 4: Create and Open the Database	1-7
		1.3.5	Task 5: Back Up the Database	1-8
		1.3.6	Task 6: Enroll System Users	1-8
		1.3.7	Task 7: Implement the Database Design	1-8
		1.3.8	Task 8: Back Up the Fully Functional Database	1-8
		1.3.9	Task 9: Tune Database Performance	1-8
		1.3.10	Task 10: Download and Install Release Updates and Release Update Revisions	1-9



	1.3.11 Ta	sk 11: Roll Out to Additional Hosts	1-9
1.4	SQL Stat	ements	1-10
	1.4.1 Sul	omitting Commands and SQL to the Database	1-10
	1.4.2 Abo	out SQL*Plus	1-11
	1.4.3 Co	nnecting to the Database with SQL*Plus	1-11
	1.4.3.1	About Connecting to the Database with SQL*Plus	1-12
	1.4.3.2	Step 1: Open a Command Window	1-12
	1.4.3.3	Step 2: Set Operating System Environment Variables	1-12
	1.4.3.4	Step 3: Start SQL*Plus	1-13
	1.4.3.5	Step 4: Submit the SQL*Plus CONNECT Command	1-13
1.5	Identifyin	g Your Oracle Database Software Release	1-18
	1.5.1 Abo	out Oracle Database Release Numbers	1-18
	1.5.2 Ch	ecking Your Current Release Number	1-20
1.6	About Da	tabase Administrator Security and Privileges	1-21
	1.6.1 The	e Database Administrator's Operating System Account	1-21
	1.6.2 Adı	ministrative User Accounts	1-21
	1.6.2.1	About Administrative User Accounts	1-22
	1.6.2.2	SYS	1-23
	1.6.2.3	SYSTEM	1-23
	1.6.2.4	SYSBACKUP, SYSDG, SYSKM, and SYSRAC	1-23
	1.6.2.5	The DBA Role	1-24
1.7	Database	e Administrator Authentication	1-25
	1.7.1 Adı	ministrative Privileges	1-25
	1.7.2 Op	erations Authorized by Administrative Privileges	1-26
	1.7.3 Aut	hentication Methods for Database Administrators	1-29
	1.7.3.1	About Authentication Methods for Database Administrators	1-29
	1.7.3.2	Nonsecure Remote Connections	1-30
	1.7.3.3	Local Connections and Secure Remote Connections	1-31
	1.7.4 Usi	ng Operating System Authentication	1-31
	1.7.4.1	Operating System Groups	1-31
	1.7.4.2	Preparing to Use Operating System Authentication	1-33
	1.7.4.3	Connecting Using Operating System Authentication	1-33
	1.7.5 Usi	ng Password File Authentication	1-34
	1.7.5.1	Preparing to Use Password File Authentication	1-34
	1.7.5.2	Connecting Using Password File Authentication	1-36
1.8	Creating	and Maintaining a Database Password File	1-36
	1.8.1 OR	APWD Syntax and Command Line Argument Descriptions	1-37
		eating a Database Password File with ORAPWD	1-43
		aring and Disabling the Database Password File	1-45
		eping Administrator Passwords Synchronized with the Data Dictionary	1-45
		ding Users to a Database Password File	1-47
	1.8.6 Gra	anting and Revoking Administrative Privileges	1-47



· ·	e Password File Members abase Password File	1-49 1-49
Configuring Automat	ic Restart of an Oracle Database	
2.1 About Oracle Restart		2-1
2.1.1 Oracle Restart O	verview	2-2
2.1.2 About Startup De	ependencies	2-3
2.1.3 About Starting ar	nd Stopping Components with Oracle Restart	2-3
2.1.4 About Starting ar	nd Stopping Oracle Restart	2-4
2.1.5 Oracle Restart C	onfiguration	2-4
2.1.6 Oracle Restart In	itegration with Oracle Data Guard	2-6
2.1.7 Fast Application	Notification with Oracle Restart	2-7
2.1.7.1 Overview of	of Fast Application Notification	2-7
2.1.7.2 Application	High Availability with Services and FAN	2-8
2.2 Configuring Oracle Res	start	2-11
2.2.1 About Configurin	g Oracle Restart	2-13
2.2.2 Preparing to Run	SRVCTL	2-13
2.2.3 Obtaining Help for	or SRVCTL	2-14
2.2.4 Adding Compone	ents to the Oracle Restart Configuration	2-15
2.2.5 Removing Comp	onents from the Oracle Restart Configuration	2-16
2.2.6 Disabling and En	abling Oracle Restart Management for a Component	2-17
2.2.7 Viewing Compon	ent Status	2-18
2.2.8 Viewing the Orac	cle Restart Configuration for a Component	2-18
2.2.9 Modifying the Ora	acle Restart Configuration for a Component	2-19
2.2.10 Managing Envir	onment Variables in the Oracle Restart Configuration	2-20
2.2.10.1 About En	vironment Variables in the Oracle Restart Configuration	2-20
2.2.10.2 Setting ar	nd Unsetting Environment Variables	2-21
2.2.10.3 Viewing E	Environment Variables	2-21
2.2.11 Creating and De	eleting Database Services with SRVCTL	2-22
2.2.12 Enabling FAN E	events in an Oracle Restart Environment	2-23
2.2.13 Automating the Databases	Failover of Connections Between Primary and Standby	2-24
2.2.14 Enabling Clients	s for Fast Connection Failover	2-25
2.2.14.1 About Ena	abling Clients for Fast Connection Failover	2-25
2.2.14.2 Enabling	Fast Connection Failover for JDBC Clients	2-26
2.2.14.3 Enabling	Fast Connection Failover for Oracle Call Interface Clients	2-27
2.2.14.4 Enabling	Fast Connection Failover for ODP.NET Clients	2-28
2.3 Starting and Stopping	Components Managed by Oracle Restart	2-29
2.4 Stopping and Restartin	g Oracle Restart for Maintenance Operations	2-31
2.5 SRVCTL Command Re	eference for Oracle Restart	2-33



2.5.	1 add		2-35
	2.5.1.1	srvctl add asm	2-36
	2.5.1.2	srvctl add database	2-37
	2.5.1.3	srvctl add listener	2-39
	2.5.1.4	srvctl add ons	2-40
	2.5.1.5	srvctl add service	2-41
2.5.	2 conf	fig	2-45
	2.5.2.1	srvctl config asm	2-45
	2.5.2.2	srvctl config database	2-46
	2.5.2.3	srvctl config listener	2-47
	2.5.2.4	srvctl config ons	2-47
	2.5.2.5	srvctl config service	2-47
2.5.	3 disa	ble	2-48
	2.5.3.1	srvctl disable asm	2-49
	2.5.3.2	srvctl disable database	2-49
	2.5.3.3	srvctl disable diskgroup	2-50
	2.5.3.4	srvctl disable listener	2-50
	2.5.3.5	srvctl disable ons	2-51
	2.5.3.6	srvctl disable service	2-51
2.5.	4 dow	ngrade	2-52
	2.5.4.1	srvctl downgrade database	2-52
2.5.	5 enal	ble	2-53
	2.5.5.1	srvctl enable asm	2-53
	2.5.5.2	srvctl enable database	2-54
	2.5.5.3	srvctl enable diskgroup	2-54
	2.5.5.4	srvctl enable listener	2-55
	2.5.5.5	srvctl enable ons	2-55
	2.5.5.6	srvctl enable service	2-55
2.5.	6 gete	env	2-56
	2.5.6.1	srvctl getenv asm	2-57
	2.5.6.2	srvctl getenv database	2-57
	2.5.6.3	srvctl getenv listener	2-58
2.5.	7 mod	lify	2-58
	2.5.7.1	srvctl modify asm	2-59
	2.5.7.2	srvctl modify database	2-59
	2.5.7.3	srvctl modify listener	2-60
	2.5.7.4	srvctl modify ons	2-61
	2.5.7.5	srvctl modify service	2-62
2.5.	8 rem	ove	2-66
	2.5.8.1	srvctl remove asm	2-66
	2.5.8.2	srvctl remove database	2-67
	2.5.8.3	srvctl remove diskgroup	2-68



	2.5.8.4	srvctl remove listener	2-68
	2.5.8.5	srvctl remove ons	2-69
	2.5.8.6	srvctl remove service	2-69
	2.5.9 seter	าง	2-70
	2.5.9.1	srvctl setenv asm	2-71
	2.5.9.2	srvctl setenv database	2-71
	2.5.9.3	srvctl setenv listener	2-72
	2.5.10 star	t	2-73
	2.5.10.1	srvctl start asm	2-73
	2.5.10.2	srvctl start database	2-74
	2.5.10.3	srvctl start diskgroup	2-75
	2.5.10.4	srvctl start home	2-75
	2.5.10.5	srvctl start listener	2-76
	2.5.10.6	srvctl start ons	2-76
	2.5.10.7	srvctl start service	2-77
	2.5.11 state	us	2-78
	2.5.11.1	srvctl status asm	2-78
	2.5.11.2	srvctl status database	2-79
	2.5.11.3	srvctl status diskgroup	2-79
	2.5.11.4	srvctl status home	2-80
	2.5.11.5	srvctl status listener	2-80
	2.5.11.6	srvctl status ons	2-81
	2.5.11.7	srvctl status service	2-81
	2.5.12 stop	0	2-82
	2.5.12.1	srvctl stop asm	2-83
	2.5.12.2	srvctl stop database	2-83
	2.5.12.3	srvctl stop diskgroup	2-84
	2.5.12.4	srvctl stop home	2-85
	2.5.12.5	srvctl stop listener	2-86
	2.5.12.6	srvctl stop ons	2-86
	2.5.12.7	srvctl stop service	2-87
	2.5.13 uns	etenv	2-88
	2.5.13.1	srvctl unsetenv asm	2-89
	2.5.13.2	srvctl unsetenv database	2-89
	2.5.13.3	srvctl unsetenv listener	2-90
	2.5.14 upd	late	2-90
	2.5.14.1	srvctl update database	2-91
	2.5.15 upg	ırade	2-91
	2.5.15.1	srvctl upgrade database	2-91
2.6	CRSCTL C	Command Reference	2-92
	2.6.1 check	k	2-92
	2.6.2 config	g	2-93



2.6.3	disable	2-93
2.6.4	enable	2-93
2.6.5	start	2-93
2.6.6	stop	2-93
Managi	ng Processes	
3.1 Abou	ut Dedicated and Shared Server Processes	3-2
3.1.1	Dedicated Server Processes	3-2
3.1.2	Shared Server Processes	3-3
3.2 Abou	ut Database Resident Connection Pooling	3-5
3.2.1	Comparing DRCP to Dedicated Server and Shared Server	3-7
3.3 Abou	ut Proxy Resident Connection Pooling	3-8
3.4 Conf	figuring Oracle Database for Shared Server	3-9
3.4.1	Initialization Parameters for Shared Server	3-10
3.4.2	Memory Management for Shared Server	3-10
3.4.3	Enabling Shared Server	3-10
3.4	4.3.1 About Determining a Value for SHARED_SERVERS	3-12
3.4	1.3.2 Decreasing the Number of Shared Server Processes	3-12
3.4	1.3.3 Limiting the Number of Shared Server Processes	3-12
3.4	1.3.4 Limiting the Number of Shared Server Sessions	3-13
3.4	1.3.5 Protecting Shared Memory	3-13
3.4.4	Configuring Dispatchers	3-14
3.4	1.4.1 DISPATCHERS Initialization Parameter Attributes	3-15
3.4	1.4.2 Determining the Number of Dispatchers	3-16
3.4	1.4.3 Setting the Initial Number of Dispatchers	3-16
3.4	1.4.4 Altering the Number of Dispatchers	3-17
3.4	1.4.5 Shutting Down Specific Dispatcher Processes	3-19
3.4.5	Disabling Shared Server	3-19
3.4.6	Shared Server Data Dictionary Views	3-19
3.5 Conf	figuring Database Resident Connection Pooling	3-20
3.5.1	Database Resident Connection Pooling Initialization Parameters	3-22
3.5.2	Enabling Database Resident Connection Pooling	3-22
3.5.3	Configuring the Connection Pool for Database Resident Connection Pooling	3-23
3.5	5.3.1 Configuration Parameters for Database Resident Connection Pooling	3-24
3.5.4	Using Multi-Pool Database Resident Connection Pooling	3-26
3.5.5	Data Dictionary Views for Database Resident Connection Pooling	3-27
3.5.6	Determining the States of Connections in the Connection Pool	3-28
3.6 Abou	ut Oracle Database Background Processes	3-29
3.7 Man	aging Prespawned Processes	3-30
3.7.1	About Managing Prespawned Processes	3-30
3.7.2	Managing Pools for Prespawned Processes	3-31



	3.6 Managing Processes for Paraller SQL Execution	3-32
	3.8.1 About Parallel Execution Servers	3-33
	3.8.2 Altering Parallel Execution for a Session	3-33
	3.8.2.1 Disabling Parallel SQL Execution	3-34
	3.8.2.2 Enabling Parallel SQL Execution	3-34
	3.8.2.3 Forcing Parallel SQL Execution	3-34
	3.9 Managing Processes for External Procedures	3-35
	3.9.1 About External Procedures	3-35
1	3.9.2 DBA Tasks to Enable External Procedure Calls	3-36
	3.10 Terminating Sessions	3-37
	3.10.1 About Terminating Sessions	3-37
	3.10.2 Identifying Which Session to Terminate	3-38
	3.10.3 Terminating an Active Session	3-38
	3.10.4 Terminating an Inactive Session	3-39
	3.10.5 Cancelling a SQL Statement in a Session	3-40
	3.11 Process and Session Data Dictionary Views	3-41
4	Managing Memory	
	4.1 About Memory Management	4-2
	4.2 Memory Architecture Overview	4-3
	4.3 Using Unified Memory Management	4-5
	4.4 Using Automatic Memory Management	4-5
	4.4.1 About Automatic Memory Management	4-6
	4.4.2 Enabling Automatic Memory Management	4-6
	4.4.3 Monitoring and Tuning Automatic Memory Management	4-9
	4.5 Configuring Memory Manually	4-10
	4.5.1 About Manual Memory Management	4-10
	4.5.2 Using Automatic Shared Memory Management	4-11
	4.5.2.1 About Automatic Shared Memory Management	4-12
	4.5.2.2 Components and Granules in the SGA	4-12
	4.5.2.3 Setting Maximum SGA Size	4-13
	4.5.2.4 Setting SGA Target Size	4-13
	4.5.2.5 Enabling Automatic Shared Memory Management	4-15
	4.5.2.6 Setting Minimums for Automatically Sized SGA Components	4-17
	4.5.2.7 Dynamic Modification of SGA_TARGET	4-17
	4.5.2.8 Modifying Parameters for Automatically Sized Components	4-18
	4.5.2.9 Modifying Parameters for Manually Sized Components	4-19
	4.5.3 Using Manual Shared Memory Management	4-19
	4.5.3.1 About Manual Shared Memory Management	4-20
	4.5.3.2 Enabling Manual Shared Memory Management	4-20
	4.5.3.3 Setting the Buffer Cache Initialization Parameters	4-20



	4.5	5.3.4 Specifying the Shared Pool Size	4-23
	4.5	5.3.5 Specifying the Large Pool Size	4-24
	4.5	5.3.6 Specifying the Java Pool Size	4-24
	4.5	5.3.7 Specifying the Streams Pool Size	4-24
	4.5	5.3.8 Specifying the Vector Pool Size	4-24
	4.5	5.3.9 Specifying Miscellaneous SGA Initialization Parameters	4-24
4	4.5.4	Using Automatic PGA Memory Management	4-25
4	4.5.5	Using Manual PGA Memory Management	4-27
4.6	Usin	g Force Full Database Caching Mode	4-27
4	4.6.1	About Force Full Database Caching Mode	4-28
4	4.6.2	Before Enabling Force Full Database Caching Mode	4-29
4	4.6.3	Enabling Force Full Database Caching Mode	4-29
4	4.6.4	Disabling Force Full Database Caching Mode	4-30
4.7	Con	iguring Database Smart Flash Cache	4-30
4	4.7.1	When to Configure Database Smart Flash Cache	4-31
4	4.7.2	Sizing Database Smart Flash Cache	4-31
4	4.7.3	Tuning Memory for Database Smart Flash Cache	4-31
4	4.7.4	Database Smart Flash Cache Initialization Parameters	4-32
4	4.7.5	Database Smart Flash Cache in an Oracle Real Applications Clusters	
		Environment	4-33
4.8		oving Query Response Time with the Server Result Cache	4-34
	4.8.1	About the Server Result Cache	4-34
4	4.8.2	Using the Server Result Cache	4-34
	4.8.3	Specifying the Result Cache Maximum Size	4-35
4	4.8.4	Specifying the Use of Temporary Segments for Query Results	4-36
4.9	Impr	oving Query Performance with Oracle Database In-Memory	4-37
4.10	Ena	abling High Performance Data Streaming with the Memoptimized Rowstore	4-38
4.11	Me	mory Management Reference	4-39
4	4.11.1	Platforms That Support Automatic Memory Management	4-39
4	4.11.2	Memory Management Data Dictionary Views	4-39
4.12	Co	nfiguring and Using True Cache	4-40
Ма	nagi	ng Users and Securing the Database	
5.1	The	Importance of Establishing a Security Policy for Your Database	5-1
5.2	Man	aging Users and Resources	5-1
5.3	Usei	Privileges and Roles	5-2
5.4	Audi	ting Database Activity	5-2
5.5 Predefined User Accounts			



6 Monitoring the Database

6-1 6-1 6-1 6-1 6-1 6-1 6-1 6-1 6-1 7-1
6-6-6-6-6-6-16-16-16-16-16-17-6-17-6-17
6
6-6-6-6-16-16-16-16-17-6-17-6-17-7-7-7-7
6-6-6-6-6-6-6-10-6-10-6-10-6-10-6-10-6-
6-6 6-6 6-7 6-10 6-10 6-11 6-12 6-13 6-13 7-2
6-1 6-1 6-1 6-1 6-1 6-1 6-1 6-1
6-1 6-1 6-1 6-1 6-1 6-1 6-1 6-1 7-1
6-9 6-10 6-10 6-11 6-12 6-13 6-13
6-10 6-10 6-11 6-12 6-12 6-13 6-13
6-10 6-11 6-12 6-13 6-13 6-13
6-10 6-11 6-12 6-13 6-13 6-13
6-1: 6-1: 6-1: 6-1: 6-1:
6-1: 6-1: 6-1: 6-1: 7-:
6-1: 6-1: 6-1: 7-:
6-1: 6-1: 6-1: 7-:
6-1: 6-1: 7-:
6-1: 7-:
7-:
7-2
7-3
7-3
7-4
7-
7-!
7-0
7-
7-
7-8
7-9
7-10
7-1
7-10
7-12



7.2	About Inv	estigating, Reporting, and Resolving a Problem	7-15
	7.2.1 Roa	ndmap — Investigating, Reporting, and Resolving a Problem	7-16
	7.2.2 Tas	k 1: View Critical Error Alerts in Cloud Control	7-18
	7.2.3 Tas	k 2: View Problem Details	7-19
	7.2.4 Tas	k 3: (Optional) Gather Additional Diagnostic Information	7-19
	7.2.5 Tas	k 4: (Optional) Create a Service Request	7-20
	7.2.6 Tas	k 5: Package and Upload Diagnostic Data to Oracle Support	7-20
	7.2.7 Tas	k 6: Track the Service Request and Implement Any Repairs	7-21
7.3	Diagnosir	ng Problems	7-22
	7.3.1 Ider	ntifying Problems Reactively	7-23
	7.3.1.1	Viewing Problems with the Support Workbench	7-23
	7.3.1.2	Adding Problems Manually to the Automatic Diagnostic Repository	7-24
	7.3.1.3	Creating Incidents Manually	7-26
	7.3.1.4	Using DBMS_HCHECK to Identify Data Dictionary Inconsistencies	7-26
	7.3.2 Ider	ntifying Problems Proactively with Health Monitor	7-31
	7.3.2.1	About Health Monitor	7-32
	7.3.2.2	Running Health Checks Manually	7-33
	7.3.2.3	Viewing Checker Reports	7-35
	7.3.2.4	Health Monitor Views	7-38
	7.3.2.5	Health Check Parameters Reference	7-38
	7.3.3 Gat	hering Additional Diagnostic Data	7-39
	7.3.3.1	Viewing the Alert Log	7-40
	7.3.3.2	Finding Trace Files	7-40
	7.3.4 Cre	ating Test Cases with SQL Test Case Builder	7-41
	7.3.4.1	Purpose of SQL Test Case Builder	7-42
	7.3.4.2	Concepts for SQL Test Case Builder	7-42
	7.3.4.3	User Interfaces for SQL Test Case Builder	7-46
	7.3.4.4	Running SQL Test Case Builder	7-48
7.4	Reporting	Problems	7-51
	7.4.1 Inci	dent Packages	7-52
	7.4.1.1	About Incident Packages	7-52
	7.4.1.2	About Correlated Diagnostic Data in Incident Packages	7-53
	7.4.1.3	About Quick Packaging and Custom Packaging	7-54
	7.4.1.4	About Correlated Packages	7-55
	7.4.2 Pac	kaging and Uploading Problems with Custom Packaging	7-55
	7.4.3 Viev	wing and Modifying Incident Packages	7-59
	7.4.3.1	Viewing Package Details	7-60
	7.4.3.2	Accessing the Customize Package Page	7-60
	7.4.3.3	Editing Incident Package Files (Copying Out and In)	7-60
	7.4.3.4	Adding an External File to an Incident Package	7-61
	7.4.3.5	Removing Incident Package Files	7-62
	7.4.3.6	Viewing and Updating the Incident Package Activity Log	7-63



		7.4.4	Crea	ating, Editing, and Uploading Correlated Packages	7-63
		7.4.5	Dele	ting Correlated Packages	7-64
		7.4.6	Setti	ng Incident Packaging Preferences	7-65
	7.5	Res	olving	Problems	7-65
		7.5.1	Abou	ut Automatic Error Mitigation	7-66
		7.5.2	Repa	airing SQL Failures with the SQL Repair Advisor	7-70
		7.	5.2.1	About the SQL Repair Advisor	7-71
		7.	5.2.2	Running the SQL Repair Advisor Using Cloud Control	7-71
		7.	5.2.3	Running the SQL Repair Advisor Using the DBMS_SQLDIAG Package Subprograms	7-72
		7.	5.2.4	Viewing, Disabling, or Removing a SQL Patch Using Cloud Control	7-74
		7.	5.2.5	Disabling or Removing a SQL Patch Using DBMS_SQLDIAG Package Subprograms	7-75
		7.	5.2.6	Exporting and Importing a Patch Using DBMS_SQLDIAG Package Subprograms	7-76
		7.5.3	Repa	airing Data Corruptions with the Data Recovery Advisor	7-77
		7.5.4	-	rantine for Execution Plans for SQL Statements Consuming Excessive em Resources	7-78
		7.	5.4.1	About Quarantine for Execution Plans for SQL Statements	7-79
		7.	5.4.2	Creating a Quarantine Configuration for an Execution Plan of a SQL Statement	7-81
		7.	5.4.3	Specifying Quarantine Thresholds in a Quarantine Configuration	7-82
		7.	5.4.4	Enabling and Disabling a Quarantine Configuration	7-84
		7.	5.4.5	Viewing the Details of a Quarantine Configuration	7-84
		7.	5.4.6	Deleting a Quarantine Configuration	7-85
		7.	5.4.7	Viewing the Details of Quarantined Execution Plans of SQL Statements	7-86
		7.	5.4.8	Transferring Quarantine Configurations from One Database to Another Database	7-86
		7.	5.4.9	Example: Quarantine for an Execution Plan of a SQL Statement Consuming Excessive System Resources	7-88
		7.5.5	View	ving Attention Log Information	7-91
	7.6	Diag	nosis	and Tracing in a PDB Using Package DBMS_USERDIAG	7-91
		7.6.1		ut DBMS_USERDIAG	7-92
		7.6.2	Exar	mples of Using DBMS_USERDIAG	7-92
Part		Ora	acle I	Database Structure and Storage	
0	N // 4	anadi	na C	Control Files	
8	_				0.1
	8.1			Control File?	8-1
	8.2			s for Control Files	8-2
		8.2.1		ride File Names for the Control Files	8-2
		8.2.2	iviuiti	iplex Control Files on Different Disks	8-3



	8.2.3	Back Up Control Files	8-3
	8.2.4	Manage the Size of Control Files	8-3
	8.3 Crea	ating Control Files	8-4
	8.3.1	Creating Initial Control Files	8-4
	8.3.2	Creating Additional Copies, Renaming, and Relocating Control Files	8-5
	8.3.3	Creating New Control Files	8-5
	8.3	3.3.1 When to Create New Control Files	8-5
	8.3	3.3.2 The CREATE CONTROLFILE Statement	8-6
	8.3	3.3.3 Creating New Control Files	8-7
	8.4 Trou	bleshooting After Creating Control Files	8-8
	8.4.1	Checking for Missing or Extra Files	8-8
	8.4.2	Handling Errors During CREATE CONTROLFILE	8-9
	8.5 Back	king Up Control Files	8-9
	8.6 Reco	overing a Control File Using a Current Copy	8-9
	8.6.1	Recovering from Control File Corruption Using a Control File Copy	8-9
	8.6.2	Recovering from Permanent Media Failure Using a Control File Copy	8-10
	8.7 Drop	pping Control Files	8-10
	8.8 Cont	trol Files Data Dictionary Views	8-11
9	Managi	ng the Redo Log	
	0 1 Wha	t Is the Redo Log?	9-2
	9.1.1	Redo Threads	9-2
	9.1.2	Redo Log Contents	9-2
	9.1.3	How Oracle Database Writes to the Redo Log	9-3
		L.3.1 Active (Current) and Inactive Redo Log Files	9-4
		L.3.2 Log Switches and Log Sequence Numbers	9-4
	_	ning the Redo Log	9-5
	9.2.1	Multiplexing Redo Log Files	9-6
		2.1.1 Responding to Redo Log Failure	9-7
		2.1.2 Valid and Invalid Configurations	9-8
	9.2.2	Placing Redo Log Members on Different Disks	9-8
	9.2.3	Planning the Size of Redo Log Files	9-9
	9.2.4	Planning the Block Size of Redo Log Files	9-9
	9.2.5	Choosing the Number of Redo Log Files	9-10
	9.2.6	Controlling Archive Lag	9-11
	9.2	2.6.1 Setting the ARCHIVE LAG TARGET Initialization Parameter	9-11
	9.2	2.6.2 Factors Affecting the Setting of ARCHIVE_LAG_TARGET	9-12
	9.3 Crea	ating Redo Log Groups and Members	9-12
	9.3.1	Creating Redo Log Groups	9-13
	9.3.2	Creating Redo Log Members	9-13
	9.4 Relo	cating and Renaming Redo Log Members	9-14



	9.5 Dropping Redo Log Groups and Members	9-15
	9.5.1 Dropping Log Groups	9-16
	9.5.2 Dropping Redo Log Members	9-16
	9.6 Forcing Log Switches	9-17
	9.7 Verifying Blocks in Redo Log Files	9-17
	9.8 Clearing a Redo Log File	9-18
	9.9 Reduction of Redo Generation for Direct Path Operations	9-19
	9.10 Redo Log Data Dictionary Views	9-20
10	Managing Archived Redo Log Files	
	10.1 What Is the Archived Redo Log?	10-2
	10.2 Choosing Between NOARCHIVELOG and ARCHIVELOG Mode	10-2
	10.2.1 Running a Database in NOARCHIVELOG Mode	10-3
	10.2.2 Running a Database in ARCHIVELOG Mode	10-3
	10.3 Controlling Archiving	10-4
	10.3.1 Setting the Initial Database Archiving Mode	10-5
	10.3.2 Changing the Database Archiving Mode	10-5
	10.3.3 Performing Manual Archiving	10-6
	10.3.4 Adjusting the Number of Archiver Processes	10-7
	10.4 Specifying Archive Destinations	10-7
	10.4.1 Setting Initialization Parameters for Archive Destinations	10-7
	10.4.1.1 Method 1: Using the LOG_ARCHIVE_DEST_n Parameter	10-8
	10.4.1.2 Method 2: Using LOG_ARCHIVE_DEST and LOG_ARCHIVE_DUPLEX_DEST	10-10
	10.4.2 Expanding Alternate Destinations with Log Archive Destination Groups	10-11
	10.4.2.1 About Log Archive Destination Groups	10-11
	10.4.2.2 Specifying Log Archive Destination Groups	10-12
	10.4.3 Understanding Archive Destination Status	10-13
	10.4.4 Specifying Alternate Destinations	10-14
	10.5 About Log Transmission Modes	10-14
	10.5.1 Normal Transmission Mode	10-15
	10.5.2 Standby Transmission Mode	10-15
	10.6 Managing Archive Destination Failure	10-15
	10.6.1 Specifying the Minimum Number of Successful Destinations	10-16
	10.6.1.1 Specifying Mandatory and Optional Destinations	10-16
	10.6.1.2 Specifying the Number of Successful Destinations: Scenarios	10-17
	10.6.2 Rearchiving to a Failed Destination	10-18
	10.7 Controlling Trace Output Generated by the Archivelog Process	10-19
	10.8 Viewing Information About the Archived Redo Log	10-19
	10.8.1 Archived Redo Log Files Views	10-20



11 Managing Tablespaces

11.1	Guid	lelines	for Managing Tablespaces	11-2
1	1.1.1	Use	Multiple Tablespaces	11-2
1	1.1.2	Assi	gn Tablespace Quotas to Users	11-3
11.2	Crea	ating T	ablespaces	11-3
1	1.2.1	Abou	ut Creating Tablespaces	11-4
1	1.2.2	Loca	ally Managed Tablespaces	11-5
	11.2	2.2.1	About Locally Managed Tablespaces	11-5
	11.2	2.2.2	Creating a Locally Managed Tablespace	11-6
	11.2	2.2.3	Specifying Segment Space Management in Locally Managed Tablespaces	11-7
1	1.2.3	Bigfi	le Tablespaces	11-8
	11.2	2.3.1	About Bigfile Tablespaces	11-8
	11.2	2.3.2	Creating a Bigfile Tablespace	11-9
	11.2	2.3.3	Identifying a Bigfile Tablespace	11-10
1	1.2.4	Table	espaces with Default Compression Attributes	11-10
	11.2	2.4.1	About Tablespaces with Default Compression Attributes	11-10
	11.2	2.4.2	Creating Tablespaces with Default Compression Attributes	11-10
1	1.2.5	Encr	ypted Tablespaces	11-11
	11.2	2.5.1	About Encrypted Tablespaces	11-11
	11.2	2.5.2	Creating Encrypted Tablespaces	11-13
	11.2	2.5.3	Viewing Information About Encrypted Tablespaces	11-14
1	1.2.6	Tem	porary Tablespaces	11-14
	11.2	2.6.1	About Temporary Tablespaces	11-15
	11.2	2.6.2	Creating a Locally Managed Temporary Tablespace	11-17
	11.2	2.6.3	Creating a Bigfile Temporary Tablespace	11-18
	11.2	2.6.4	Viewing Space Usage for Temporary Tablespaces	11-18
1	1.2.7	Tem	porary Tablespace Groups	11-18
	11.2	2.7.1	Multiple Temporary Tablespaces: Using Tablespace Groups	11-18
	11.2	2.7.2	Creating a Tablespace Group	11-19
	11.2	2.7.3	Changing Members of a Tablespace Group	11-19
	11.2	2.7.4	Assigning a Tablespace Group as the Default Temporary Tablespace	11-20
11.3	Cons	sider S	Storing Tablespaces in the In-Memory Column Store	11-20
11.4	Spec	cifying	Nonstandard Block Sizes for Tablespaces	11-21
11.5	Conf	trolling	the Writing of Redo Records	11-21
11.6	Alter	ing Ta	blespace Availability	11-22
1	1.6.1	Takir	ng Tablespaces Offline	11-22
1	1.6.2	Bring	ging Tablespaces Online	11-24
11 7	Usin	n Rea	d-Only Tablespaces	11-24



11.7.1	About Read-Only Tablespaces	11-25
11.7.2	Making a Tablespace Read-Only	11-25
11.7.3	Making a Read-Only Tablespace Writable	11-27
11.7.4	Creating a Read-Only Tablespace on a WORM Device	11-28
11.7.5	Delaying the Opening of Data Files in Read-Only Tablespaces	11-28
11.7.6	Using Read-Only Tablespaces on Object Storage	11-29
11.	7.6.1 Enabling a Database for Using Object Storage	11-29
11.	7.6.2 Accessing Data in Object Storage	11-32
11.7	7.6.3 Dropping a Read-Only Tablespace and It's Data Files in Object Storage	11-35
11.8 Alter	ing and Maintaining Tablespaces	11-35
11.8.1	Increasing the Size of a Tablespace	11-36
11.8.2	Altering a Locally Managed Tablespace	11-36
11.8.3	Altering a Bigfile Tablespace	11-37
11.8.4	Shrinking a Tablespace	11-37
11.8.5	Altering a Locally Managed Temporary Tablespace	11-41
11.8.6	Shrinking a Locally Managed Temporary Tablespace	11-42
11.9 Ren	aming Tablespaces	11-42
11.10 Dro	opping Tablespaces	11-43
11.11 Ma	naging Lost Write Protection with Shadow Tablespaces	11-44
11.11.1	About Shadow Lost Write Protection	11-45
11.11.2	Creating Shadow Tablespaces for Shadow Lost Write Protection	11-47
11.11.3	Enabling Shadow Lost Write Protection for a Database	11-47
11.11.4	Enabling Shadow Lost Write Protection for Tablespaces and Data Files	11-49
11.11.5	Disabling Shadow Lost Write Protection for a Database	11-50
11.11.6	Removing or Suspending Shadow Lost Write Protection	11-51
11.11.7	Dropping a Shadow Tablespace	11-52
11.12 Ma	naging the SYSAUX Tablespace	11-52
11.12.1	Monitoring Occupants of the SYSAUX Tablespace	11-53
11.12.2	Moving Occupants Out Of or Into the SYSAUX Tablespace	11-53
11.12.3	Controlling the Size of the SYSAUX Tablespace	11-54
11.13 Co	recting Problems with Locally Managed Tablespaces	11-54
11.13.1	Diagnosing and Repairing Locally Managed Tablespace Problems	11-55
11.13.2	Scenario 1: Fixing Bitmap When Allocated Blocks are Marked Free (No Overlap)	11-56
11.13.3	Scenario 2: Dropping a Corrupted Segment	11-57
11.13.4	Scenario 3: Fixing Bitmap Where Overlap is Reported	11-57
11.13.5	Scenario 4: Correcting Media Corruption of Bitmap Blocks	11-57
11.13.6	Scenario 5: Migrating from a Dictionary-Managed to a Locally Managed Tablespace	11-57
11.14 Mig	rating the SYSTEM Tablespace to a Locally Managed Tablespace	11-58
11.15 Vie	wing Information About Tablespaces	11-59
11.15.1	Tablespace Data Dictionary Views	11-59



11.15.2	Example 1: Listing Tablespaces and Default Storage Parameters	11-60
11.15.3	Example 2: Listing the Data Files and Associated Tablespaces of a Database	11-60
11.15.4	Example 3: Displaying Statistics for Free Space (Extents) of Each Tablespace	11-62
Managin	g Data Files and Temp Files	
12.1 Guid	elines for Managing Data Files	12-2
12.1.1	About Data Files	12-2
12.1.2	Determine the Number of Data Files	12-3
12.1	.2.1 About Determining the Number of Data Files	12-3
12.1	.2.2 Determine a Value for the DB_FILES Initialization Parameter	12-4
12.1	.2.3 Consider Possible Limitations When Adding Data Files to a Tablespace	12-4
12.1	.2.4 Consider the Performance Impact of the Number of Data Files	12-4
12.1.3	Determine the Size of Data Files	12-5
12.1.4	Place Data Files Appropriately	12-5
12.1.5	Store Data Files Separate from Redo Log Files	12-5
12.2 Crea	ting Data Files and Adding Data Files to a Tablespace	12-5
12.3 Char	ging Data File Size	12-6
12.3.1	Enabling and Disabling Automatic Extension for a Data File	12-6
12.3.2	Manually Resizing a Data File	12-7
12.4 Alter	ng Data File Availability	12-8
12.4.1	About Altering Data File Availability	12-8
12.4.2	Bringing Data Files Online or Taking Offline in ARCHIVELOG Mode	12-9
12.4.3	Taking Data Files Offline in NOARCHIVELOG Mode	12-9
12.4.4	Altering the Availability of All Data Files or Temp Files in a Tablespace	12-10
12.5 Rena	ming and Relocating Data Files	12-10
12.5.1	Renaming and Relocating Online Data Files	12-11
12.5.2	Renaming and Relocating Offline Data Files	12-13
12.5	.2.1 Procedures for Renaming and Relocating Offline Data Files in a Single Tablespace	12-14
12.5	.2.2 Renaming and Relocating Offline Data Files in Multiple Tablespaces	12-16
12.6 Drop	ping Data Files	12-17
12.7 Verif	ring Data Blocks in Data Files	12-18
12.8 Copy	ing Files Using the Database Server	12-18
12.8.1	About Copying Files Using the Database Server	12-19
12.8.2	Copying a File on a Local File System	12-19
12.8.3	Third-Party File Transfer	12-20
12.8.4	Advanced File Transfer Mechanisms	12-21
12.8.5	File Transfer and the DBMS_SCHEDULER Package	12-21
12.9 Map _l	ping Files to Physical Devices	12-22
12.9.1	Overview of Oracle Database File Mapping Interface	12-23
12.9.2	How the Oracle Database File Mapping Interface Works	12-23



	12.9.2.	1 Components of File Mapping	12-23
	12.9.2.	2 Mapping Structures	12-25
	12.9.2.	3 Example of Mapping Structures	12-26
	12.9.2.	4 Configuration ID	12-27
	12.9.3 Us	sing the Oracle Database File Mapping Interface	12-27
	12.9.3.	1 Enabling File Mapping	12-28
	12.9.3.	2 Using the DBMS_STORAGE_MAP Package	12-29
	12.9.3.	3 Obtaining Information from the File Mapping Views	12-29
	12.9.4 Fi	le Mapping Examples	12-31
	12.9.4.	1 Example 1: Map All Database Files that Span a Device	12-31
	12.9.4.	2 Example 2: Map a File Into Its Corresponding Devices	12-32
	12.9.4.	3 Example 3: Map a Database Object	12-32
	12.10 Data F	iles Data Dictionary Views	12-33
13	Transportir	ng Data	
		ransporting Data	13-1
		urpose of Transporting Data	13-2
		ransporting Data: Scenarios	13-2
	13.1.2.	·	13-2
	13.1.2.	·	13-4
		ransporting Data Across Platforms	13-8
		eneral Limitations on Transporting Data	13-10
		ompatibility Considerations for Transporting Data	13-12
	•	orting Databases	13-13
		troduction to Full Transportable Export/Import	13-13
		mitations on Full Transportable Export/import	13-14
		ransporting a Database Using an Export Dump File	13-15
		ransporting a Database Over the Network	13-21
	•	orting Tablespaces Between Databases	13-26
		troduction to Transportable Tablespaces	13-27
		mitations on Transportable Tablespaces	13-27
		ransporting Tablespaces Between Databases	13-28
	13.3.3. 13.3.3.	·	13-30 13-31
	13.3.3.	·	13-33
	13.3.3.	·	13-33
		·	
	13.3.3.		13-34 13-34
	13.3.3.4 Transpo	·	13-34
	•	orting Tables, Partitions, or Subpartitions Between Databases	13-30
		troduction to Transportable Tables	
	13.4.2 Li	mitations on Transportable Tables	13-37



	13.4.3	Transporting Tables, Partitions, or Subpartitions Using an Export Dump File	13-38
	13.4.4	Transporting Tables, Partitions, or Subpartitions Over the Network	13-43
	13.5 Co	nverting Data Between Platforms	13-48
	13.5.1	Converting Data Between Platforms Using the DBMS_FILE_TRANSFER Package	13-48
	13.5.2	Converting Data Between Platforms Using RMAN	13-50
	13	.5.2.1 Converting Tablespaces on the Source System After Export	13-51
	13	.5.2.2 Converting Data Files on the Target System Before Import	13-52
	13.6 Gu	idelines for Transferring Data Files	13-53
14	Managi	ng Undo	
	14.1 Wh	at Is Undo?	14-2
	14.2 Intr	roduction to Automatic Undo Management	14-2
	14.2.1	Overview of Automatic Undo Management	14-2
	14.2.2	The Undo Retention Period	14-4
	14	.2.2.1 About the Undo Retention Period	14-4
	14	.2.2.2 Automatic Tuning of Undo Retention	14-5
	14	.2.2.3 Retention Guarantee	14-6
	14	.2.2.4 Undo Retention Tuning and Alert Thresholds	14-7
	14	.2.2.5 Tracking the Tuned Undo Retention Period	14-7
	14.3 Set	tting the Minimum Undo Retention Period	14-8
	14.4 Siz	ing a Fixed-Size Undo Tablespace	14-8
	14.4.1	Activating the Undo Advisor PL/SQL Interface	14-9
	14.5 Ma	naging Undo Tablespaces	14-10
	14.5.1	Creating an Undo Tablespace	14-10
	14	.5.1.1 About Creating an Undo Tablespace	14-11
	14	.5.1.2 Using CREATE DATABASE to Create an Undo Tablespace	14-11
	14	.5.1.3 Using the CREATE UNDO TABLESPACE Statement	14-12
	14.5.2	Altering an Undo Tablespace	14-12
	14.5.3	Dropping an Undo Tablespace	14-13
	14.5.4	Switching Undo Tablespaces	14-13
	14.5.5	Establishing User Quotas for Undo Space	14-14
	14.5.6	Managing Space Threshold Alerts for the Undo Tablespace	14-14
	14.6 Mig	grating to Automatic Undo Management	14-15
	14.7 Ma	naging Temporary Undo	14-15
	14.7.1	About Managing Temporary Undo	14-15
	14.7.2	Enabling and Disabling Temporary Undo	14-16
	14.8 Un	do Space Data Dictionary Views	14-17



15 Using Oracle Managed Files

15.1	Abou	t Orac	ele Managed Files	15-1
1	5.1.1	What	Is Oracle Managed Files?	15-2
1	5.1.2	Who	Can Use Oracle Managed Files?	15-2
1	5.1.3	What	Is a Logical Volume Manager?	15-3
1	5.1.4	What	Is a File System?	15-3
1	5.1.5	Bene	fits of Using Oracle Managed Files	15-3
1!	5.1.6	Oracl	le Managed Files and Existing Functionality	15-4
15.2	Enab	ling th	e Creation and Use of Oracle Managed Files	15-4
1!	5.2.1	Initial	ization Parameters That Enable Oracle Managed Files	15-5
1	5.2.2	Settir	ng the DB_CREATE_FILE_DEST Initialization Parameter	15-6
1	5.2.3	Settir	ng the DB_RECOVERY_FILE_DEST Parameter	15-6
1	5.2.4	Settir	ng the DB_CREATE_ONLINE_LOG_DEST_n Initialization Parameters	15-6
15.3	Creat	ting O	racle Managed Files	15-7
1	5.3.1	Wher	n Oracle Database Creates Oracle Managed Files	15-7
1!	5.3.2	How	Oracle Managed Files Are Named	15-8
1!	5.3.3	Creat	ting Oracle Managed Files at Database Creation	15-9
	15.3	.3.1	Specifying Control Files at Database Creation	15-10
	15.3	.3.2	Specifying Redo Log Files at Database Creation	15-11
	15.3	.3.3	Specifying the SYSTEM and SYSAUX Tablespace Data Files at	
			Database Creation	15-12
	15.3		Specifying the Undo Tablespace Data File at Database Creation	15-12
	15.3	.3.5	Specifying the Default Temporary Tablespace Temp File at Database Creation	15-13
	15.3	.3.6	CREATE DATABASE Statement Using Oracle Managed Files: Examples	15-13
1	5.3.4	Creat	ting Data Files for Tablespaces Using Oracle Managed Files	15-15
	15.3	.4.1	About Creating Data Files for Tablespaces Using Oracle Managed Files	15-15
	15.3	.4.2	CREATE TABLESPACE: Examples	15-16
	15.3	.4.3	CREATE UNDO TABLESPACE: Example	15-17
	15.3	.4.4	ALTER TABLESPACE: Example	15-18
1!	5.3.5	Creat	ting Temp Files for Temporary Tablespaces Using Oracle Managed Files	15-18
	15.3	15.3.5.1 About Creating Temp Files for Temporary Tablespaces Using Oracle Managed Files		15-18
	15.3	.5.2	CREATE TEMPORARY TABLESPACE: Example	15-19
	15.3	.5.3	ALTER TABLESPACE ADD TEMPFILE: Example	15-19
1	5.3.6	Creat	ting Control Files Using Oracle Managed Files	15-20
	15.3	.6.1	About Creating Control Files Using Oracle Managed Files	15-20
	15.3	.6.2	CREATE CONTROLFILE Using NORESETLOGS Keyword: Example	15-21
	15.3	.6.3	CREATE CONTROLFILE Using RESETLOGS Keyword: Example	15-21
1!	5.3.7	Creat	ting Redo Log Files Using Oracle Managed Files	15-22
	15.3		Using the ALTER DATABASE ADD LOGFILE Statement	15-22
	15.3	.7.2	Using the ALTER DATABASE OPEN RESETLOGS Statement	15-23



	15.3.8	Creating Archived Logs Using Oracle Managed Files	15-23
	15.4 Oper	ration of Oracle Managed Files	15-23
	15.4.1	Dropping Data Files and Temp Files	15-24
	15.4.2	Dropping Redo Log Files	15-24
	15.4.3	Renaming Files	15-24
	15.4.4	Managing Standby Databases	15-25
	15.5 Scer	narios for Using Oracle Managed Files	15-25
	15.5.1	Scenario 1: Create and Manage a Database with Multiplexed Redo Logs	15-25
	15.5.2	Scenario 2: Create and Manage a Database with Database and Fast Recovery Areas	15-29
	15.5.3	Scenario 3: Adding Oracle Managed Files to an Existing Database	15-30
16	Using Pe	ersistent Memory Database	
	16.1 Abou	ut Persistent Memory Database	16-1
	16.1.1	What Is Persistent Memory Database?	16-1
	16.1.2	What Is Oracle Persistent Memory Filestore?	16-1
	16.1.3	What Is Directly Mapped Buffer Cache?	16-2
	16.1.4	Benefits of Using Persistent Memory Database	16-2
	16.2 Setti	ng Initialization Parameters for Persistent Memory Database	16-2
	16.2.1	Persistent Memory Database Initialization Parameters	16-2
	16.3 Crea	ating a PMEM Filestore for an Oracle Database	16-3
	16.3.1	Creating a PMEM Filestore Before Creating the Database	16-3
	16.3.2	Creating a Database on PMEM Storage Using Oracle DBCA	16-4
	16.3.3	Creating an Oracle Database in the PMEM Filestore	16-5
	16.3.4	Migrating an Oracle Database to a PMEM Filestore	16-5
	16.4 Man	aging a PMEM Filestore	16-5
	16.4.1	Viewing Information About a PMEM Filestore	16-5
	16.4.2	Mounting a PMEM Filestore	16-6
	16.4.3	Dismounting a PMEM Filestore	16-6
	16.4.4	Changing the Attributes of a PMEM Filestore	16-6
	16.4.5	Dropping a PMEM Filestore	16-6
Part	III Sch	ema Objects	
17	Managın	g Schema Objects	
	17.1 Abou	ut Common and Local Objects	17-2
	17.2 Abou	ut the Container for Schema Objects	17-2
	17.3 Crea	ating Multiple Tables and Views in a Single Operation	17-2
	17.4 Anal	yzing Tables, Indexes, and Clusters	17-3
	17.4.1	About Analyzing Tables, Indexes, and Clusters	17-4



17.4	.2 Usin	g DBMS_STATS to Collect Table and Index Statistics	17-4
17.4	.3 Valid	lating Tables, Indexes, Clusters, and Materialized Views	17-5
17.4	.4 Cros	s Validation of a Table and an Index with a Query	17-6
17.4	.5 Listir	ng Chained Rows of Tables and Clusters	17-6
:	17.4.5.1	Creating a CHAINED_ROWS Table	17-7
:	17.4.5.2	Eliminating Migrated or Chained Rows in a Table	17-7
17.5 T	runcating	Tables and Clusters	17-8
17.5	.1 Usin	g DELETE to Truncate a Table	17-9
17.5	.2 Usin	g DROP and CREATE to Truncate a Table	17-9
17.5	.3 Usin	g TRUNCATE	17-9
17.6 E	Enabling a	nd Disabling Triggers	17-10
17.6	.1 Abou	ut Enabling and Disabling Triggers	17-11
17.6	.2 Enal	oling Triggers	17-12
17.6	.3 Disa	bling Triggers	17-12
17.7 N	/lanaging	Integrity Constraints	17-13
17.7	.1 Integ	grity Constraint States	17-13
:	17.7.1.1	About Integrity Constraint States	17-14
:	17.7.1.2	About Disabling Constraints	17-14
:	17.7.1.3	About Enabling Constraints	17-15
:	17.7.1.4	About the Enable Novalidate Constraint State	17-15
:	17.7.1.5	Efficient Use of Integrity Constraints: A Procedure	17-15
17.7	.2 Setti	ng Integrity Constraints Upon Definition	17-16
:	17.7.2.1	Disabling Constraints Upon Definition	17-17
:	17.7.2.2	Enabling Constraints Upon Definition	17-17
17.7	.3 Mod	ifying, Renaming, or Dropping Existing Integrity Constraints	17-18
:	17.7.3.1	Disabling and Enabling Constraints	17-18
:	17.7.3.2	Renaming Constraints	17-19
:	17.7.3.3	Dropping Constraints	17-19
17.7	.4 Defe	rring Constraint Checks	17-19
:	17.7.4.1	Set All Constraints Deferred	17-20
:	17.7.4.2	Check the Commit (Optional)	17-20
17.7	.5 Repo	orting Constraint Exceptions	17-20
17.7	.6 View	ring Constraint Information	17-22
17.8 F	Renaming	Schema Objects	17-22
17.9 N	/lanaging	Object Dependencies	17-23
17.9	.1 Abou	ut Object Dependencies and Object Invalidation	17-24
17.9	.2 Man	ually Recompiling Invalid Objects with DDL	17-25
17.9	.3 Man	ually Recompiling Invalid Objects with PL/SQL Package Procedures	17-25
17.10	Managin	g Object Name Resolution	17-26
17.11	Switching	to a Different Schema	17-28
17.12	Managin	g Editions	17-28
17.1	2.1 Abo	out Editions and Edition-Based Redefinition	17-29



17.12.2	DB	A Tasks for Edition-Based Redefinition	17-29
17.12.3	Set	tting the Database Default Edition	17-30
17.12.4	Qu	erying the Database Default Edition	17-30
17.12.5	Set	tting the Edition Attribute of a Database Service	17-30
17.	12.5.1	About Setting the Edition Attribute of a Database Service	17-31
17.	12.5.2	Setting the Edition Attribute During Database Service Creation	17-31
17.	12.5.3	Setting the Edition Attribute of an Existing Database Service	17-31
17.12.6	Usi	ing an Edition	17-32
17.12.7	Edi	itions Data Dictionary Views	17-32
17.13 Dis	splayin	g Information About Schema Objects	17-33
17.13.1	Usi	ing a PL/SQL Package to Display Information About Schema Objects	17-33
17.13.2	Sch	nema Objects Data Dictionary Views	17-34
17.	13.2.1	Example 1: Displaying Schema Objects By Type	17-34
17.	13.2.2	Example 2: Displaying Dependencies of Views and Synonyms	17-35
Managir	ng Sp	pace for Schema Objects	
18.1 Mar	aging	Tablespace Alerts	18-1
18.1.1	Abo	ut Managing Tablespace Alerts	18-2
18.1.2	Setti	ing Alert Thresholds	18-3
18.1.3	View	ving Alerts	18-5
18.1.4	Limit	tations	18-5
18.2 Mar	aging	Resumable Space Allocation	18-6
18.2.1	Resi	umable Space Allocation Overview	18-6
18.	2.1.1	How Resumable Space Allocation Works	18-7
18.	2.1.2	What Operations are Resumable?	18-8
18.	2.1.3	What Errors are Correctable?	18-8
18.	2.1.4	Resumable Space Allocation and Distributed Operations	18-9
18.	2.1.5	Parallel Execution and Resumable Space Allocation	18-9
18.2.2	Enal	bling and Disabling Resumable Space Allocation	18-9
18.	2.2.1	About Enabling and Disabling Resumable Space Allocation	18-10
18.	2.2.2	Setting the RESUMABLE_TIMEOUT Initialization Parameter	18-10
18.	2.2.3	Using ALTER SESSION to Enable and Disable Resumable Space Allocation	18-11
18.2.3	Usin	g a LOGON Trigger to Set Default Resumable Mode	18-12
18.2.4	Dete	ecting Suspended Statements	18-12
18.	2.4.1	Notifying Users: The AFTER SUSPEND System Event and Trigger	18-13
18.	2.4.2	Using Views to Obtain Information About Suspended Statements	18-13
18.	2.4.3	Using the DBMS_RESUMABLE Package	18-14
18.2.5	Ope	ration-Suspended Alert	18-14
18.2.6		umable Space Allocation Example: Registering an AFTER SUSPEND	18-15
18.3 Rec		g Unused Space	18-16



18.3.1	Abo	ut Reclaimable Unused Space	18-17
18.3.2	The	Segment Advisor	18-17
18.3	3.2.1	About the Segment Advisor	18-18
18.3	3.2.2	Using the Segment Advisor	18-18
18.3	3.2.3	Automatic Segment Advisor	18-18
18.3	3.2.4	Running the Segment Advisor Manually	18-19
18.3	3.2.5	Viewing Segment Advisor Results	18-24
18.3	3.2.6	Configuring the Automatic Segment Advisor	18-29
18.3	3.2.7	Viewing Automatic Segment Advisor Information	18-30
18.3.3	Shrii	nking Database Segments Online	18-31
18.3.4	Dea	llocating Unused Space	18-33
18.4 Drop	ping l	Jnused Object Storage	18-34
18.5 Unde	erstan	ding Space Usage of Data Types	18-35
18.6 Disp	laying	Information About Space Usage for Schema Objects	18-35
18.6.1		g PL/SQL Packages to Display Information About Schema Object Space	
	Usa		18-35
18.6.2		ema Objects Space Usage Data Dictionary Views	18-36
	5.2.1	Example 1: Displaying Segment Information	18-37
		Example 2: Displaying Extent Information	18-37
	5.2.3	Example 3: Displaying the Free Space (Extents) in a Tablespace	18-38
•	-	Planning for Database Objects	18-38
18.7.1		mating the Space Use of a Table	18-39
18.7.2		mating the Space Use of an Index	18-40
18.7.3	Obta	aining Object Growth Trends	18-40
Managin	g Ta	bles	
19.1 Abou	ut Tab	les	19-2
	lelines	s for Managing Tables	19-3
19.2.1		gn Tables Before Creating Them	19-5
19.2.2	Spe	cify the Type of Table to Create	19-5
19.2.3		cify the Location of Each Table	19-6
19.2.4	Con	sider Parallelizing Table Creation	19-6
19.2.5	Con	sider Using NOLOGGING When Creating Tables	19-7
19.2.6	Con	sider Using Table Compression	19-7
19.2	2.6.1	About Table Compression	19-8
19.2	2.6.2	Examples Related to Table Compression	19-11
19.2	2.6.3	Compression and Partitioned Tables	19-13
19.2	2.6.4	Determining If a Table Is Compressed	19-13
19.2	2.6.5	Determining Which Rows Are Compressed	19-13
19.2	2.6.6	Changing the Compression Level	19-14
19.2	2.6.7	Adding and Dropping Columns in Compressed Tables	19-15



	19.2.6.8	Exporting and Importing Hybrid Columnar Compression Tables	19-15
	19.2.6.9	Restoring a Hybrid Columnar Compression Table	19-16
	19.2.6.10	Notes and Restrictions for Compressed Tables	19-17
	19.2.6.11	. Packing Compressed Tables	19-17
	19.2.7 Mar	naging Table Compression Using Enterprise Manager Cloud Control	19-18
	19.2.7.1	Table Compression and Enterprise Manager Cloud Control	19-18
	19.2.7.2	Viewing the Compression Summary at the Database Level	19-19
	19.2.7.3	Viewing the Compression Summary at the Tablespace Level	19-19
	19.2.7.4	Estimating the Compression Ratio	19-20
	19.2.7.5	Compressing an Object	19-20
	19.2.7.6	Viewing Compression Advice	19-21
	19.2.7.7	Initiating Automatic Data Optimization on an Object	19-21
	19.2.8 Con	sider Using Segment-Level and Row-Level Compression Tiering	19-21
	19.2.9 Con	nsider Using Attribute-Clustered Tables	19-23
	19.2.10 Co	onsider Using Zone Maps	19-24
	19.2.11 Co	nsider Storing Tables in the In-Memory Column Store	19-25
	19.2.12 Co	onsider Using Invisible Columns	19-25
	19.2.12.1	Understand Invisible Columns	19-25
	19.2.12.2	2 Invisible Columns and Column Ordering	19-26
	19.2.13 Co	onsider Encrypting Columns That Contain Sensitive Data	19-28
	19.2.14 Un	nderstand Deferred Segment Creation	19-29
	19.2.15 Ma	aterializing Segments	19-32
	19.2.16 Es	timate Table Size and Plan Accordingly	19-32
	19.2.17 Re	estrictions to Consider When Creating Tables	19-32
19.	3 Creating 7	lables labeles	19-33
	19.3.1 Exa	mple: Creating a Table	19-34
	19.3.2 Crea	ating a Temporary Table	19-35
	19.3.2.1	Overview of Temporary Tables	19-35
	19.3.2.2	Considerations When Creating Temporary Tables	19-36
	19.3.2.3	Creating Global Temporary Tables	19-36
	19.3.2.4	Creating Private Temporary Tables	19-38
	19.3.3 Para	allelizing Table Creation	19-40
19.	4 Loading T	ables	19-41
	19.4.1 Met	hods for Loading Tables	19-41
	19.4.2 Imp	roving INSERT Performance with Direct-Path INSERT	19-43
	19.4.2.1	About Direct-Path INSERT	19-43
	19.4.2.2	How Direct-Path INSERT Works	19-44
	19.4.2.3	Loading Data with Direct-Path INSERT	19-45
	19.4.2.4	Logging Modes for Direct-Path INSERT	19-46
	19.4.2.5	Additional Considerations for Direct-Path INSERT	19-47
	19.4.3 Usir	ng Conventional Inserts to Load Tables	19-49
	19.4.4 Avo	iding Bulk INSERT Failures with DML Error Logging	19-49



	19.4	1.4.1	Inserting Data with DML Error Logging	19-50
	19.4	1.4.2	Error Logging Table Format	19-51
	19.4	1.4.3	Creating an Error Logging Table	19-52
	19.4	1.4.4	Error Logging Restrictions and Caveats	19-53
19.5	Optir	mizing	the Performance of Bulk Updates	19-54
19.6	Auto	matica	ally Collecting Statistics on Tables	19-55
19.7	Alter	ing Ta	bles	19-56
19	9.7.1	Reas	sons for Using the ALTER TABLE Statement	19-57
19	9.7.2	Alter	ing Physical Attributes of a Table	19-58
19	9.7.3	Movi	ng a Table to a New Segment or Tablespace	19-58
	19.7	7.3.1	About Moving a Table to a New Segment or Tablespace	19-58
	19.7	7.3.2	Moving a Table	19-59
	19.7	7.3.3	Moving a Table Partition or Subpartition Online	19-60
19	9.7.4	Manı	ually Allocating Storage for a Table	19-61
19	9.7.5	Modi	ifying an Existing Column Definition	19-61
19	9.7.6	Addi	ng Table Columns	19-62
19	9.7.7	Rena	aming Table Columns	19-63
19	9.7.8	Drop	ping Table Columns	19-63
	19.7	7.8.1	Removing Columns from Tables	19-64
	19.7	7.8.2	Marking Columns Unused	19-65
	19.7	7.8.3	Removing Unused Columns	19-65
	19.7	7.8.4	Dropping Columns in Compressed Tables	19-66
19	9.7.9	Placi	ing a Table in Read-Only Mode	19-66
19.8	Rede	efining	Tables Online	19-67
19	9.8.1	Abou	ut Redefining Tables Online	19-68
19	9.8.2	Feat	ures of Online Table Redefinition	19-69
19	9.8.3	Privil	eges Required for the DBMS_REDEFINITION Package	19-71
19	9.8.4	Rest	rictions for Online Redefinition of Tables	19-71
19	9.8.5	Perfo	orming Online Redefinition with the REDEF_TABLE Procedure	19-73
19	9.8.6	Rede	efining Tables Online with Multiple Procedures in DBMS_REDEFINITION	19-74
	19.8	3.6.1	Performing Online Redefinition with Multiple Procedures in DBMS_REDEFINITION	19-74
	19.8	3.6.2	Constructing a Column Mapping String	19-77
	19.8	3.6.3	Handling Virtual Private Database (VPD) Policies During Online Redefinition	19-78
	19.8	3.6.4	Creating Dependent Objects Automatically	19-79
	19.8	3.6.5	Creating Dependent Objects Manually	19-79
19	9.8.7	Resu	ults of the Redefinition Process	19-80
19	9.8.8	Perfo	orming Intermediate Synchronization	19-81
19	9.8.9	Refre	eshing Dependent Materialized Views During Online Table Redefinition	19-81
19	9.8.10	Mor	nitoring Online Table Redefinition Progress	19-85
19	9.8.11	Res	starting Online Table Redefinition After a Failure	19-88



19	.8.12	Rolli	ing Back Online Table Redefinition	19-91
	19.8.	12.1	About Online Table Redefinition Rollback	19-92
	19.8.	12.2	Performing Online Table Redefinition Rollback	19-92
19	.8.13	Term	ninating Online Table Redefinition and Cleaning Up After Errors	19-95
19	.8.14	Onlir	ne Redefinition of One or More Partitions	19-96
	19.8.	14.1	Rules for Online Redefinition of a Single Partition	19-97
19	.8.15	Onlir	ne Table Redefinition Examples	19-98
19.9	Resea	archin	g and Reversing Erroneous Table Changes	19-119
19.10	Reco	verin	g Tables Using Oracle Flashback Table	19-119
19.11	Drop	ping 1	Tables	19-120
19.12	Usin	g Flas	shback Drop and Managing the Recycle Bin	19-121
19	.12.1	Wha	at Is the Recycle Bin?	19-122
19	.12.2	Enal	bling and Disabling the Recycle Bin	19-123
19	.12.3	View	ving and Querying Objects in the Recycle Bin	19-124
19	.12.4	Purg	ging Objects in the Recycle Bin	19-124
19	.12.5	Rest	toring Tables from the Recycle Bin	19-125
19.13	Mana	aging	Index-Organized Tables	19-126
19	.13.1	Wha	at Are Index-Organized Tables?	19-127
19	.13.2	Crea	ating Index-Organized Tables	19-128
	19.13	3.2.1	About Creating Index-Organized Tables	19-128
	19.13	3.2.2	Example: Creating an Index-Organized Table	19-129
	19.13	3.2.3	Restrictions for Index-Organized Tables	19-129
	19.13	3.2.4	Creating Index-Organized Tables That Contain Object Types	19-130
	19.13	3.2.5	Choosing and Monitoring a Threshold Value	19-131
	19.13	3.2.6	Using the INCLUDING Clause	19-131
	19.13	3.2.7	Parallelizing Index-Organized Table Creation	19-132
	19.13	3.2.8	Using Prefix Compression	19-133
19	.13.3	Mair	ntaining Index-Organized Tables	19-134
	19.13	3.3.1	Altering Index-Organized Tables	19-134
	19.13	3.3.2	Moving (Rebuilding) Index-Organized Tables	19-134
19	.13.4	Crea	ating Secondary Indexes on Index-Organized Tables	19-135
	19.13	3.4.1	About Secondary Indexes on Index-Organized Tables	19-136
	19.13	3.4.2	Creating a Secondary Index on an Index-Organized Table	19-136
	19.13	3.4.3	Maintaining Physical Guesses in Logical Rowids	19-136
	19.13	3.4.4	Specifying Bitmap Indexes on Index-Organized Tables	19-137
19	.13.5	Anal	lyzing Index-Organized Tables	19-137
	19.13	3.5.1	Collecting Optimizer Statistics for Index-Organized Tables	19-137
	19.13	3.5.2	Validating the Structure of Index-Organized Tables	19-138
19	.13.6	Usin	ng the ORDER BY Clause with Index-Organized Tables	19-138
19	.13.7	Conv	verting Index-Organized Tables to Regular Tables	19-139
19.14	Mana	aging	Partitioned Tables	19-139
19.15	19.15 Managing External Tables			



1	.9.15.1	Abou	ut External Tables	19-140
1	9.15.2	Crea	ating External Tables	19-142
1	.9.15.3	Alter	ing External Tables	19-146
1	9.15.4	Prep	rocessing External Tables	19-147
1	9.15.5	Over	rriding Parameters for External Tables in a Query	19-149
1	9.15.6	Usin	g Inline External Tables	19-149
1	9.15.7	Parti	tioning External Tables	19-150
	19.15	.7.1	About Partitioning External Tables	19-150
	19.15	.7.2	Restrictions for Partitioned External Tables	19-152
	19.15	.7.3	Creating a Partitioned External Table	19-153
	19.15	.7.4	Altering a Partitioned External Table	19-157
1	9.15.8	Drop	pping External Tables	19-157
1	9.15.9	Syst	em and Object Privileges for External Tables	19-157
1	9.15.10	Usi	ng SQL*Loader for External Tables with Partition Values in File Paths	19-158
19.16	6 Mana	ging	Hybrid Partitioned Tables	19-158
19.17	7 Mana	ging	Immutable Tables	19-159
1	9.17.1	Abou	ut Immutable Tables	19-159
1	9.17.2	Guid	lelines for Managing Immutable Tables	19-160
	19.17	.2.1	Specify the Retention Period for the Immutable Table	19-160
	19.17	.2.2	Specify the Retention Period for Rows in the Immutable Table	19-161
	19.17	.2.3	Restrictions for Immutable Tables	19-161
1	9.17.3	Crea	ating Immutable Tables	19-162
1	9.17.4	Alter	ing Immutable Tables	19-163
1	.9.17.5	Addi	ng and Dropping User Columns in Immutable Tables	19-163
1	.9.17.6	Crea	ting Row Versions in Immutable Tables	19-164
1	9.17.7	Dele	ting Rows from Immutable Tables	19-164
1	.9.17.8	Drop	pping Immutable Tables	19-165
1	9.17.9	Imm	utable Tables Data Dictionary Views	19-165
19.18	3 Mana	ging	Blockchain Tables	19-166
1	9.18.1	Abou	ut Blockchain Tables	19-168
	19.18	.1.1	Benefits of Using Blockchain Tables	19-168
	19.18	.1.2	Chaining Rows in Blockchain Tables	19-170
	19.18	.1.3	Hidden Columns in Blockchain Tables	19-171
1	9.18.2	Guid	lelines for Managing Blockchain Tables	19-174
	19.18	.2.1	Specify the Retention Period for the Blockchain Table	19-174
	19.18	.2.2	Specify the Retention Period for Rows in the Blockchain Table	19-175
	19.18	.2.3	Exporting and Importing Blockchain Tables with Oracle Data Pump	19-175
	19.18	.2.4	Restrictions for Blockchain Tables	19-176
1	.9.18.3	Crea	ating Blockchain Tables	19-177
1	9.18.4	Addi	ng and Dropping User Columns in Blockchain Tables	19-179
1	.9.18.5	Crea	ating Row Versions in Blockchain Tables	19-179
1	9.18.6	Crea	ating User Chains in Blockchain Tables	19-180



19.1	3.7 Altering Blockchain Tables	19-181
19.1	3.8 Adding Certificates Used to Sign Blockchain Table Rows	19-181
19.1	3.9 Adding the Certificate of a Certificate Authority to the Database	19-182
19.1	3.10 Deleting Certificates in Blockchain Tables	19-183
19.1	3.11 Adding a User Signature to Blockchain Table Rows	19-183
19.1	3.12 Allowing a Delegate to Sign Blockchain Table Rows	19-185
19.1	3.13 Countersigning Blockchain Table Rows	19-186
19.1	3.14 Validating Data in Blockchain Tables	19-187
19.1	3.15 Verifying the Integrity of Blockchain Tables	19-188
-	9.18.15.1 Generating a Signed Digest for Blockchain Tables	19-189
-	9.18.15.2 Verifying Blockchain Table Rows Created in a Specified Time Period	19-190
19.1	3.16 Deleting Rows from Blockchain Tables	19-191
19.1	3.17 Dropping Blockchain Tables	19-192
19.1	3.18 Setting the Table Retention Threshold	19-193
19.1	3.19 Determining the Data Format for Row Content to Compute Row Hash	19-193
19.1	3.20 Determining the Data Format to Compute Row Signature	19-195
19.1	3.21 Displaying the Byte Values of Data in Blockchain Tables	19-195
19.1	3.22 Creating a Regular Table with Blockchain History Log	19-197
19.1	3.23 Blockchain Tables Data Dictionary Views	19-197
19.19	Tables Data Dictionary Views	19-198
Manao	ging Indexes	
		20.1
	bout Indexes	20-1
	uidelines for Managing Indexes	20-2 20-3
20.2 20.2	3	20-3
20.2		20-4
	4 Limit the Number of Indexes for Each Table	20-5
20.2		20-5
20.2		20-5
20.2	<u> </u>	20-6
20.2		20-7
20.2		20-7
20.2	C	20-7
20.2	-	20-8
20.2		20-9
20.2	•	20-10
20.2		20-10
20.2		20 11
20.2	Indexes	20-11
20.3 C	reating Indexes	20-12



	20.3.1	Prerequisites for Creating Indexes	20-13
:	20.3.2	Creating an Index Explicitly	20-13
:	20.3.3	Creating a Unique Index Explicitly	20-14
:	20.3.4	Creating an Index Associated with a Constraint	20-14
	20.3	3.4.1 About Creating an Index Associated with a Constraint	20-15
	20.3	3.4.2 Specifying Storage Options for an Index Associated with a Constraint	20-15
	20.3	3.4.3 Specifying the Index Associated with a Constraint	20-15
	20.3.5	Creating a Large Index	20-16
;	20.3.6	Creating an Index Online	20-17
;	20.3.7	Creating a Function-Based Index	20-17
;	20.3.8	Creating a Compressed Index	20-18
	20.3	8.8.1 Creating an Index Using Prefix Compression	20-19
	20.3	8.8.2 Creating an Index Using Advanced Index Compression	20-20
;	20.3.9	Creating an Unusable Index	20-21
;	20.3.10	Creating an Invisible Index	20-22
	20.3.11	Creating Multiple Indexes on the Same Set of Columns	20-23
	20.3.12	Creating a Vector Index	20-24
20.4	Alter	ing Indexes	20-24
;	20.4.1	About Altering Indexes	20-24
	20.4.2	Altering Storage Characteristics of an Index	20-25
;	20.4.3	Rebuilding an Existing Index	20-26
;	20.4.4	Making an Index Unusable	20-26
	20.4.5	Making an Index Invisible or Visible	20-28
	20.4.6	Renaming an Index	20-29
:	20.4.7	Monitoring Index Usage	20-29
20.5	Moni	toring Space Use of Indexes	20-30
20.6	Drop	ping Indexes	20-31
20.7	Mana	aging Automatic Indexes	20-31
:	20.7.1	About Automatic Indexing	20-32
:	20.7.2	How Automatic Indexing Works	20-33
:	20.7.3	Configuring Automatic Indexing in an Oracle Database	20-34
:	20.7.4	Generating Automatic Indexing Reports	20-38
:	20.7.5	Views Containing the Automatic Indexing Information	20-40
20.8	Index	xes Data Dictionary Views	20-41
Ма	nagin	g Clusters	
21.1	. Abou	ut Clusters	21-1
21.2	Guid	elines for Managing Clusters	21-3
:	21.2.1	Choose Appropriate Tables for the Cluster	21-3
:	21.2.2	Choose Appropriate Columns for the Cluster Key	21-4



	21.	2.3	Rows	21-4
	21.	2.4	Specify the Location of Each Cluster and Cluster Index Rows	21-4
	21.	2.5	Estimate Cluster Size and Set Storage Parameters	21-5
	21.3		ing Clusters and Objects That Use Them	21-5
			Creating Clusters	21-5
	21.		Creating Clustered Tables	21-6
	21.	3.3	Creating Cluster Indexes	21-7
	21.4	Alterii	ng Clusters and Objects That Use Them	21-7
	21.	4.1	Altering Clusters	21-7
	21.	4.2	Altering Clustered Tables	21-8
	21.	4.3	Altering Cluster Indexes	21-8
	21.5	Dropp	oing Clusters and Objects That Use Them	21-9
	21.	5.1	Dropping Clusters	21-9
	21.	5.2	Dropping Clustered Tables	21-10
	21.	5.3	Dropping Cluster Indexes	21-10
	21.6	Cluste	ers Data Dictionary Views	21-11
22	Mana	agino	g Hash Clusters	
			t Hash Clusters	22-1
			to Use Hash Clusters	22-2
			Situations Where Hashing Is Useful	22-2
			Situations Where Hashing Is Not Advantageous	22-3
			ing Different Types of Hash Clusters	22-3
			Creating Hash Clusters	22-4
			Creating a Sorted Hash Cluster	22-4
			Creating Single-Table Hash Clusters	22-7
	22.	3.4	Controlling Space Use Within a Hash Cluster	22-7
		22.3.	3	22-8
		22.3.	Ü	22-8
		22.3.		22-8
		22.3.	· · · · · · · · · · · · · · · · · · ·	22-9
		22.3.		22-9
			Estimating Size Required by Hash Clusters	22-10
			ng Hash Clusters	22-11
	22.5	Dropp	ping Hash Clusters	22-11
	22.6	Hash	Clusters Data Dictionary Views	22-11
23	Mana	agino	g Views, Sequences, and Synonyms	
	23.1	Mana	ging Views	23-1



23-2
23-2
23-3
23-4
23-4
23-5
23-5
23-6
23-7
23-7
23-9
23-10
23-13
23-14
23-15
23-15
23-16
23-16
23-17
23-17
23-18
23-19
23-20
23-23
23-25
23-25
23-26
23-26
23-27
23-27
23-28
24-1
24-2
24-2
24-3
24-3
24-3
24-4



	24	1.3.1.3	DB_VERIFY: Performing an Offline Database Check	24-4
	24	1.3.1.4	ANALYZE: Reporting Corruption	24-5
	24	1.3.1.5	DB_BLOCK_CHECKING Initialization Parameter	24-5
	24.3.2	. Task	2: Evaluate the Costs and Benefits of Using DBMS_REPAIR	24-6
	24.3.3	3 Task	3: Make Objects Usable	24-6
	24	1.3.3.1	Corruption Repair: Using the FIX_CORRUPT_BLOCKS and SKIP_CORRUPT_BLOCKS Procedures	24-7
	24	1.3.3.2	Implications When Skipping Corrupt Blocks	24-7
	24.3.4	Task	4: Repair Corruptions and Rebuild Lost Data	24-7
	24	1.3.4.1	Recover Data Using the DUMP_ORPHAN_KEYS Procedures	24-7
	24	1.3.4.2	Fix Segment Bitmaps Using the SEGMENT_FIX_STATUS Procedure	24-7
	24.4 DE	BMS_RE	EPAIR Examples	24-8
	24.4.1	. Exar	mples: Building a Repair Table or Orphan Key Table	24-8
	24	1.4.1.1	About Repair Tables or Orphan Key Tables	24-8
	24	1.4.1.2	Example: Creating a Repair Table	24-9
	24	1.4.1.3	Example: Creating an Orphan Key Table	24-9
	24.4.2	e Exar	mple: Detecting Corruption	24-10
	24.4.3	B Exar	mple: Fixing Corrupt Blocks	24-11
	24.4.4	Exar	mple: Finding Index Entries Pointing to Corrupt Data Blocks	24-11
	24.4.5	Exar	mple: Skipping Corrupt Blocks	24-12
Part 25			se Resource Management and Task Scheduling utomated Database Maintenance Tasks	
	25.1 Ab	out Auto	omated Maintenance Tasks	25-2
	25.2 Ab	out Mair	ntenance Windows	25-3
	25.3 Co	nfigurin	g Automated Maintenance Tasks	25-4
	25.3.1	. Enat	bling and Disabling Maintenance Tasks for all Maintenance Windows	25-4
	25.3.2	e Enak	bling and Disabling Maintenance Tasks for Specific Maintenance Windows	25-5
	25.4 Co	nfigurin	g Maintenance Windows	25-5
	25.4.1	. Modi	ifying a Maintenance Window	25-5
	25.4.2	. Crea	ating a New Maintenance Window	25-6
	25.4.3	Rem	noving a Maintenance Window	25-7
	25.5 Co	nfigurin	g Resource Allocations for Automated Maintenance Tasks	25-7
	25.5.1	. Abou	ut Resource Allocations for Automated Maintenance Tasks	25-8
	25.5.2	Char	nging Resource Allocations for Automated Maintenance Tasks	25-9
	25.6 Au	tomated	d Maintenance Tasks Reference	25-9
	25.6.1	. Pred	lefined Maintenance Windows	25-9

24.3.1.2 DBMS_REPAIR: Using the CHECK_OBJECT and ADMIN_TABLES Procedures



24-4

26 Managing Resources with Oracle Database Resource Manager

26.2	L Abo	ut Ora	cle Database Resource Manager	26-2
	26.1.1	CDE	B and PDB Resource Management	26-3
	26.1.2	Purp	pose of Resource Management	26-4
	26.3	1.2.1	Purpose of Resource Management for a CDB	26-4
	26.3	1.2.2	Purpose of Resource Management for PDBs	26-6
	26.1.3	Con	sumer Groups, Plans, and Plan Directives	26-7
	26.	1.3.1	About the Elements of Resource Manager	26-7
	26.	1.3.2	About Resource Consumer Groups	26-8
	26.	1.3.3	About Resource Plan Directives	26-9
	26.	1.3.4	About Resource Plans	26-20
	26.3	1.3.5	About Subplans	26-29
	26.1.4	Usei	r Interface for PDB Resource Management	26-30
	26.3	1.4.1	About Resource Manager Administration Privileges	26-31
	26.	1.4.2	DBMS_RESOURCE_MANAGER for CDBs and PDBs	26-32
	26.	1.4.3	Initialization Parameters for PDB-Level Resources	26-32
26.2	2 Enal	bling C	Dracle Database Resource Manager and Switching Plans	26-39
26.3	3 Assi	gning	Sessions to Resource Consumer Groups	26-42
	26.3.1	Ove	rview of Assigning Sessions to Resource Consumer Groups	26-42
	26.3.2	Assi	gning an Initial Resource Consumer Group	26-43
	26.3.3	Spec	cifying Session-to-Consumer Group Mapping Rules	26-43
	26.3	3.3.1	About Session-to-Consumer Group Mapping Rules	26-43
	26.3	3.3.2	Creating Consumer Group Mapping Rules	26-44
	26.3	3.3.3	Modifying and Deleting Consumer Group Mapping Rules	26-46
	26.3	3.3.4	Creating Mapping Rule Priorities	26-46
	26.3.4	Swit	ching Resource Consumer Groups	26-47
	26.3	3.4.1	Manually Switching Resource Consumer Groups	26-48
	26.3	3.4.2	Enabling Users or Applications to Manually Switch Consumer Groups	26-49
	26.3.5	Spe	cifying Automatic Consumer Group Switching	26-50
	26.3	3.5.1	Specifying Automatic Switching with Mapping Rules	26-50
	26.3	3.5.2	Specifying Automatic Switching by Setting Resource Limits	26-51
	26.3.6	Grar	nting and Revoking the Switch Privilege	26-54
	26.3	3.6.1	About Granting and Revoking the Switch Privilege	26-54
	26.3	3.6.2	Granting the Switch Privilege	26-55
	26.3.6.3		Revoking Switch Privileges	26-55
26.4	1 Man	aging	Resource Plans	26-56
	26.4.1	Man	aging CDB Resource Plans	26-56
	26.4	4.1.1	Creating a CDB Resource Plan for Managing PDBs	26-57
	26.4	4.1.2	Creating a CDB Resource Plan for Managing PDBs: Scenario	26-57



	26.	4.1.3	Creating a CDB Resource Plan with PDB Performance Profiles	26-60
	26.	4.1.4	Creating a CDB Resource Plan for PDB Performance Profiles: Scenario	26-61
	26.	4.1.5	Enabling a CDB Resource Plan	26-64
	26.	4.1.6	Modifying a CDB Resource Plan	26-64
	26.	4.1.7	Disabling a CDB Resource Plan	26-76
	26.	4.1.8	Viewing Information About Plans and Directives in a CDB	26-77
	26.4.2	Man	naging PDB Resource Plans	26-79
	26.	4.2.1	Creating a PDB Resource Plan	26-79
	26.	4.2.2	Enabling a PDB Resource Plan	26-80
	26.	4.2.3	Modifying a PDB Resource Plan	26-81
	26.	4.2.4	Disabling a PDB Resource Plan	26-82
	26.4.3	Crea	ating a Simple Resource Plan	26-82
	26.4.4	Crea	ating a Complex Resource Plan	26-84
	26.	4.4.1	About the Pending Area	26-85
	26.	4.4.2	Creating a Pending Area	26-86
	26.	4.4.3	Creating Resource Consumer Groups	26-86
	26.	4.4.4	Mapping Sessions to Consumer Groups	26-87
	26.	4.4.5	Creating a Resource Plan	26-88
	26.	4.4.6	Creating Resource Plan Directives	26-89
	26.	4.4.7	Validating the Pending Area	26-94
	26.	4.4.8	Submitting the Pending Area	26-95
	26.	4.4.9	Clearing the Pending Area	26-96
26.	5 Putt	ing It A	All Together: Oracle Database Resource Manager Examples	26-96
	26.5.1	Mult	tilevel Plan Example	26-97
	26.5.2	Exa	mples of Using the Utilization Limit Attribute	26-99
	26.5.3	Exa	mple of Using Several Resource Allocation Methods	26-104
	26.5.4	Exa	mple of Managing Parallel Statements Using Directive Attributes	26-104
	26.5.5	An C	Oracle-Supplied Mixed Workload Plan	26-107
26.	.6 Mar	naging	Multiple Database Instances on a Single Server	26-108
	26.6.1	Abo	ut Instance Caging	26-108
	26.6.2	Ena	bling Instance Caging	26-109
26.	7 Mai	ntainin	ng Consumer Groups, Plans, and Directives	26-109
	26.7.1	Upd	ating a Consumer Group	26-110
	26.7.2	Dele	eting a Consumer Group	26-110
	26.7.3	Upd	ating a Plan	26-111
	26.7.4	Dele	eting a Plan	26-111
	26.7.5	Upd	ating a Resource Plan Directive	26-112
	26.7.6	Dele	eting a Resource Plan Directive	26-113
26.	8 View	ving D	atabase Resource Manager Configuration and Status	26-113
	26.8.1	Abo	ut Resource Manager Views	26-114
	26.8.2	Viev	ving Consumer Groups Granted to Users or Roles	26-120
	26.8.3	Viev	ving Plan Information	26-120



	26.8.4 Viewing Current Consumer Groups for Sessions	26-121
	26.8.5 Viewing the Currently Active Plans	26-121
	26.8.6 Monitoring PDBs Managed by Oracle Database Resource Manager	26-121
	26.8.6.1 About Resource Manager Views for PDBs	26-122
	26.8.6.2 Monitoring CPU Usage for PDBs	26-123
	26.8.6.3 Monitoring Parallel Execution for PDBs	26-124
	26.8.6.4 Monitoring the I/O Generated by PDBs	26-125
	26.8.6.5 Monitoring Memory Usage for PDBs	26-126
	26.9 Interacting with Operating-System Resource Control	26-126
	26.9.1 Guidelines for Using Operating-System Resource Control	26-126
	26.10 Oracle Database Resource Manager Reference	26-127
	26.10.1 Predefined Resource Plans and Consumer Groups	26-127
	26.10.2 Predefined Consumer Group Mapping Rules	26-129
	26.10.3 Resource Manager Data Dictionary Views	26-130
	26.11 Operating System CPU Resource Management	26-131
27	Oracle Scheduler Concepts	
21	27.1 Overview of Oracle Scheduler	27-1
	27.2 Jobs and Supporting Scheduler Objects	27-3
	27.2.1 About Jobs and Supporting Scheduler Objects	27-4
	27.2.2 Programs	27-4
	27.2.3 Schedules	27-5
	27.2.4 Jobs	27-5
	27.2.4.1 About Jobs	27-6
	27.2.4.2 Specifying a Job Action	27-6
	27.2.4.3 Specifying a Job Schedule	27-6
	27.2.4.4 Specifying a Job Destination	27-7
	27.2.4.5 Specifying a Job Credential	27-7
	27.2.5 Destinations	27-8
	27.2.5.1 About Destinations	27-8
	27.2.5.2 About Destinations and Scheduler Agents	27-9
	27.2.6 File Watchers	27-10
	27.2.7 Credentials	27-10
	27.2.8 Chains	27-11
	27.2.9 Job Classes	27-12
	27.2.10 Windows	27-14
	27.2.10.1 About Windows	27-14
	27.2.10.2 Overlapping Windows	27-15
	27.2.11 Groups	27-18
	27.2.11.1 About Groups	27-18
	27.2.11.2 Destination Groups	27-18



	27.2.12	Incompatibilities	27-19
	27.3 More A	bout Jobs	27-19
	27.3.1 Job Categories		27-20
	27.3.1.1 Database Jobs		27-21
	27.3.1.	2 External Jobs	27-22
	27.3.1.	3 Multiple-Destination Jobs	27-24
	27.3.1.	4 Chain Jobs	27-26
	27.3.1.	5 Detached Jobs	27-26
	27.3.1.	.6 Lightweight Jobs	27-27
	27.3.1.7 In-Memory Jobs		27-28
	27.3.1.	.8 Script Jobs	27-28
	27.3.2 J	ob Instances	27-29
	27.3.3 J	ob Arguments	27-30
	27.3.4 H	low Programs, Jobs, and Schedules are Related	27-30
	27.4 Schedu	ıler Architecture	27-31
	27.4.1 S	cheduler Components	27-32
	27.4.2 T	he Job Table	27-32
	27.4.3 T	he Job Coordinator	27-32
	27.4.3	1 About The Job Coordinator	27-32
	27.4.3.	.2 Job Coordinator Actions	27-33
	27.4.3.	.3 Maximum Number of Scheduler Job Processes	27-33
	27.4.4 H	low Jobs Execute	27-34
	27.4.5 After Jobs Complete		27-35
	27.4.6 U	sing the Scheduler in Real Application Clusters Environments	27-35
	27.4.6	1 The Scheduler and Real Application Clusters	27-35
	27.4.6.2 Service Affinity when Using the Scheduler		27-36
	27.5 Process	ses to Close a PDB	27-37
	27.6 Schedu	ller Support for Oracle Data Guard	27-37
	0		
28	Scheduling Jobs with Oracle Scheduler		
	28.1 About S	Scheduler Objects and Their Naming	28-2
	28.2 Creatin	g, Running, and Managing Jobs	28-2
	28.2.1 J	ob Tasks and Their Procedures	28-3
	28.2.2 C	reating Jobs	28-4
	28.2.2.	1 Overview of Creating Jobs	28-4
	28.2.2.	.2 Specifying Job Actions, Schedules, Programs, and Styles	28-6
	28.2.2.	3 Specifying Scheduler Job Credentials	28-9
	28.2.2.	4 Specifying Destinations	28-10
	28.2.2.	5 Creating Multiple-Destination Jobs	28-13
	28.2.2.	6 Setting Job Arguments	28-14

27.2.11.3 Window Groups



27-18

	28.2	.2.7	Setting Additional Job Attributes	28-15
	28.2	.2.8	Creating Detached Jobs	28-15
	28.2	.2.9	Creating Multiple Jobs in a Single Transaction	28-16
	28.2	.2.10	Techniques for External Jobs	28-17
	28.2.3	Alter	ing Jobs	28-19
	28.2.4	Runr	ning Jobs	28-20
	28.2.5	Stop	ping Jobs	28-20
	28.2.6	Stop	ping External Jobs	28-21
	28.2.7	Stop	ping a Chain Job	28-22
	28.2.8	Drop	ping Jobs	28-22
	28.2.9	Drop	ping Running Jobs	28-22
	28.2.10	Dro	pping Multiple Jobs	28-22
	28.2.11	Disa	abling Jobs	28-23
	28.2.12	Ena	ubling Jobs	28-24
	28.2.13	Cop	oying Jobs	28-25
28.	.3 Creat	ting a	nd Managing Programs to Define Jobs	28-25
	28.3.1	Prog	ram Tasks and Their Procedures	28-25
	28.3.2	Crea	ting Programs with Scheduler	28-26
	28.3	.2.1	Creating Programs	28-26
	28.3	.2.2	Defining Program Arguments	28-26
	28.3.3	Alter	ing Programs	28-28
	28.3.4	Drop	ping Programs	28-28
	28.3.5	Disal	oling Programs	28-28
	28.3.6	Enab	oling Programs	28-29
28.	.4 Creat	ting a	nd Managing Schedules to Define Jobs	28-29
	28.4.1	Sche	dule Tasks and Their Procedures	28-30
	28.4.2	Crea	ting Schedules	28-30
	28.4.3	Alter	ing Schedules	28-31
	28.4.4	Drop	ping Schedules	28-31
	28.4.5	Setti	ng the Repeat Interval	28-31
	28.4	.5.1	About Setting the Repeat Interval	28-32
	28.4	.5.2	Using the Scheduler Calendaring Syntax	28-32
	28.4	.5.3	Using a PL/SQL Expression	28-35
	28.4	.5.4	Differences Between PL/SQL Expression and Calendaring Syntax Behavior	28-35
	28.4	.5.5	Repeat Intervals and Daylight Savings	28-36
28.	.5 Using	j Ever	nts to Start Jobs	28-36
	28.5.1		it Events	28-37
	28.5.2		ing Jobs with Events Raised by Your Application	28-37
	28.5		About Events Raised by Your Application	28-38
	28.5		Creating an Event-Based Job	28-39
	28.5		Altering an Event-Based Job	28-40
			-	



	28	.5.2.4	Creating an Event Schedule	28-40
	28	.5.2.5	Altering an Event Schedule	28-41
	28	.5.2.6	Passing Event Messages into an Event-Based Job	28-41
	28.5.3	Start	ing a Job When a File Arrives on a System	28-42
	28	.5.3.1	About File Watchers	28-43
	28	.5.3.2	Enabling File Arrival Events from Remote Systems	28-44
	28	.5.3.3	Creating File Watchers and File Watcher Jobs	28-44
	28	.5.3.4	File Arrival Example	28-47
	28	.5.3.5	Managing File Watchers	28-48
	28	.5.3.6	Viewing File Watcher Information	28-49
28.	6 Cre	eating a	nd Managing Job Chains	28-50
	28.6.1	Abou	ut Creating and Managing Job Chains	28-51
	28.6.2	Chai	n Tasks and Their Procedures	28-52
	28.6.3	Crea	iting Chains	28-53
	28.6.4	Defir	ning Chain Steps	28-53
	28.6.5	Addi	ng Rules to a Chain	28-55
	28.6.6	Setti	ng an Evaluation Interval for Chain Rules	28-58
	28.6.7	Enab	oling Chains	28-58
	28.6.8	Crea	ting Jobs for Chains	28-59
	28.6.9	Drop	ping Chains	28-60
	28.6.1	0 Rur	nning Chains	28-60
	28.6.1	1 Dro	pping Chain Rules	28-61
	28.6.1	2 Disa	abling Chains	28-61
	28.6.1	3 Dro	pping Chain Steps	28-61
	28.6.1	4 Sto	pping Chains	28-62
	28.6.1	5 Sto	pping Individual Chain Steps	28-62
	28.6.1	6 Pau	using Chains	28-62
	28.6.1	7 Skij	pping Chain Steps	28-63
	28.6.1	8 Rur	nning Part of a Chain	28-64
	28.6.1	9 Moi	nitoring Running Chains	28-64
	28.6.2	0 Har	ndling Stalled Chains	28-65
28.	7 Usi	ing Inco	mpatibility Definitions	28-65
	28.7.1	Crea	ting a Job or Program Incompatibility	28-66
	28.7.2	Addi	ng a Job or Program to an Incompatibility	28-66
	28.7.3	Rem	oving a Job or Program from an Incompatibility	28-67
	28.7.4	Drop	ping an Incompatibility	28-67
28.	8 Ma	naging .	Job Resources	28-68
	28.8.1	Crea	ting or Dropping a Resource	28-68
	28.8.2	Alter	ing a Resource	28-69
	28.8.3	Setti	ng a Resource Constraint for a Job	28-69
28.	9 Pri	oritizing	Jobs	28-70
	28.9.1	Mana	aging Job Priorities with Job Classes	28-71



	28.9	.1.1	Job Class Tasks and Their Procedures	28-71
	28.9	.1.2	Creating Job Classes	28-72
	28.9	.1.3	Altering Job Classes	28-72
	28.9	.1.4	Dropping Job Classes	28-72
28	.9.2	Settir	ng Relative Job Priorities Within a Job Class	28-73
28	.9.3	Mana	aging Job Scheduling and Job Priorities with Windows	28-73
	28.9	.3.1	About Job Scheduling and Job Priorities with Windows	28-74
	28.9	.3.2	Window Tasks and Their Procedures	28-75
	28.9	.3.3	Creating Windows	28-75
	28.9	.3.4	Altering Windows	28-76
	28.9	.3.5	Opening Windows	28-76
	28.9	.3.6	Closing Windows	28-77
	28.9	.3.7	Dropping Windows	28-78
	28.9	.3.8	Disabling Windows	28-78
	28.9	.3.9	Enabling Windows	28-79
28	.9.4	Mana	aging Job Scheduling and Job Priorities with Window Groups	28-79
	28.9	.4.1	Window Group Tasks and Their Procedures	28-80
	28.9	.4.2	Creating Window Groups	28-80
	28.9	.4.3	Dropping Window Groups	28-81
	28.9	.4.4	Adding a Member to a Window Group	28-81
	28.9	.4.5	Removing a Member from a Window Group	28-81
	28.9	.4.6	Enabling a Window Group	28-82
	28.9	.4.7	Disabling a Window Group	28-82
28	.9.5	Alloc	ating Resources Among Jobs Using Resource Manager	28-82
28	.9.6	Exan	nple of Resource Allocation for Jobs	28-83
28.10	Mor	nitorin	g Jobs	28-84
28	.10.1	Abo	out Monitoring Jobs	28-84
28	.10.2	The	Job Log	28-84
	28.1	0.2.1	Viewing the Job Log	28-85
	28.1	0.2.2	Run Details	28-86
	28.1	0.2.3	Precedence of Logging Levels in Jobs and Job Classes	28-86
28	.10.3	Mor	nitoring Multiple Destination Jobs	28-87
28	.10.4	Mor	nitoring Job State with Events Raised by the Scheduler	28-88
	28.1	0.4.1	About Job State Events	28-88
	28.1	0.4.2	Altering a Job to Raise Job State Events	28-90
	28.1	0.4.3	Consuming Job State Events with your Application	28-90
28	.10.5	Mor	nitoring Job State with E-mail Notifications	28-91
	28.10.5.1		About E-mail Notifications	28-91
	28.1	0.5.2	Adding E-mail Notifications for a Job	28-92
	28.1	0.5.3	Removing E-mail Notifications for a Job	28-93
	28.1	0.5.4	Viewing Information About E-mail Notifications	28-94



29 Administering Oracle Scheduler

29.1	Confi	gurin	g Oracle Scheduler	29-2
29	9.1.1	Setti	ng Oracle Scheduler Privileges	29-2
29	9.1.2	Setti	ing Scheduler Preferences	29-3
29	9.1.3	Usin	g the Oracle Scheduler Agent to Run Remote Jobs	29-5
	29.1	.3.1	Enabling and Disabling Databases for Remote Jobs	29-6
	29.1	.3.2	Installing and Configuring the Scheduler Agent on a Remote Host	29-9
	29.1	.3.3	Performing Tasks with the Scheduler Agent	29-10
29.2	Monit	toring	and Managing the Scheduler	29-13
29	9.2.1	View	ring the Currently Active Window and Resource Plan	29-13
29	9.2.2	Find	ing Information About Currently Running Jobs	29-13
29	9.2.3	Mon	itoring and Managing Window and Job Logs	29-1
	29.2	.3.1	Job Log	29-15
	29.2	.3.2	Window Log	29-16
	29.2	.3.3	Purging Logs	29-17
29	9.2.4	DBM	IS_SCHEDULER In-Memory Trace	29-18
29	9.2.5	Man	aging Scheduler Security	29-20
29.3	Impo	rt/Exp	port and the Scheduler	29-20
29.4	Trouk	olesh	ooting the Scheduler	29-22
29	9.4.1	A Jo	b Does Not Run	29-22
	29.4	.1.1	About Job States	29-22
	29.4	.1.2	Viewing the Job Log	29-22
	29.4	.1.3	Troubleshooting Remote Jobs	29-22
	29.4	.1.4	About Job Recovery After a Failure	29-23
29	9.4.2	A Pr	ogram Becomes Disabled	29-24
29	9.4.3	A W	indow Fails to Take Effect	29-24
29.5	Exan	nples	of Using the Scheduler	29-24
29	9.5.1	Exar	mples of Creating Job Classes	29-24
29	9.5.2	Exar	mples of Setting Attributes	29-25
29	9.5.3	Exar	mples of Creating Chains	29-27
29	9.5.4	Exar	mples of Creating Jobs and Schedules Based on Events	29-28
29	9.5.5	Exar	mple of Creating a Job In an Oracle Data Guard Environment	29-29
29.6	Sche	duler	Reference	29-30
29	9.6.1	Sche	eduler Privileges	29-30
29	9.6.2	Sche	eduler Data Dictionary Views	29-32
Man	agin	g Tr	ansactions	
30.1	Priori	ty Tra	ansactions	30-1
30	0.1.1	Usin	g Priority Transactions	30-2
	30.1	.1.1	Setting Transaction Priority	30-2



30

	30.1.	1.2 Setting System-Level Wait Targets	30-3				
	30.1.	1.3 Acknowledging the Automatic Rollback	30-4				
	30.1.	1.4 Setting Priority Transaction Mode	30-4				
	30.1.	1.5 Using Priority Transaction Mode to Determine System-Level Wait Targets	30-5				
	30.1.2	Monitoring Priority Transactions	30-6				
	30.1.	2.1 Statistics Incremented in ROLLBACK Mode	30-6				
	30.1.	2.2 Statistics Incremented in TRACK Mode	30-7				
	30.1.3	Priority Transaction Behavior	30-7				
	30.1.	3.1 Behavior of Priority Transactions for Distributed Transactions	30-7				
	30.1.	3.2 Behavior for XA Transactions	30-8				
	30.1.4	Priority Transaction Restrictions	30-8				
	30.2 Auton	natic Transaction Quarantine	30-8				
	30.2.1	Monitoring Quarantined Transactions	30-11				
	30.2.2	Resolving Quarantined Transactions	30-12				
	30.2.3	Dropping Quarantined Transactions	30-13				
	30.2.4	Transaction Quarantine Escalation	30-13				
Part	\/ Dietr	ibuted Database Management					
-	V DISTI	——————————————————————————————————————					
31	Distributed Database Concepts						
	31.1 Distrib	outed Database Architecture	31-1				
	31.1.1	Homogenous Distributed Database Systems	31-2				
	31.1.	1.1 About Homogenous Distributed Database Systems	31-2				
	31.1.	1.2 Distributed Databases Versus Distributed Processing	31-3				
	31.1.	1.3 Distributed Databases Versus Replicated Databases	31-4				
	31.1.2	Heterogeneous Distributed Database Systems	31-4				
	31.1.	2.1 About Heterogeneous Distributed Database Systems	31-5				
	31.1.	2.2 Heterogeneous Services	31-5				
	31.1.	2.3 Transparent Gateway Agents	31-5				
	31.1.	2.4 Generic Connectivity	31-6				
	31.1.3	Client/Server Database Architecture	31-6				
	31.2 Datab	pase Links	31-7				
	31.2.1	What Are Database Links?	31-8				
	31.2.2	What Are Shared Database Links?	31-9				
	31.2.3	Why Use Database Links?	31-10				
	31.2.4	Global Database Names in Database Links	31-10				
	31.2.5	Global Name as a Loopback Database Link	31-12				
	31.2.6	Names for Database Links	31-12				
	31.2.7	Types of Database Links	31-13				
	31.2.8	Users of Database Links	31-14				



31.2.8.1	Overview of Database Link Users	31-14
31.2.8.2	Connected User Database Links	31-15
31.2.8.3	Fixed User Database Links	31-16
31.2.8.4	Current User Database Links	31-16
31.2.9 Crea	ation of Database Links: Examples	31-17
31.2.10 Sch	nema Objects and Database Links	31-18
31.2.10.1	Naming of Schema Objects Using Database Links	31-19
31.2.10.2	Authorization for Accessing Remote Schema Objects	31-19
31.2.10.3	Synonyms for Schema Objects	31-19
31.2.10.4	Schema Object Name Resolution	31-20
31.2.11 Dat	abase Link Restrictions	31-20
31.3 Distributed	Database Administration	31-21
31.3.1 Site	Autonomy	31-22
31.3.2 Distr	ibuted Database Security	31-22
31.3.2.1	Authentication Through Database Links	31-23
31.3.2.2	Authentication Without Passwords	31-24
31.3.2.3	Supporting User Accounts and Roles	31-24
31.3.2.4	Centralized User and Privilege Management	31-25
31.3.2.5	Data Encryption	31-28
31.3.3 Audi	ting Database Links	31-29
31.3.4 Adm	inistration Tools	31-30
31.3.4.1	Cloud Control and Distributed Databases	31-30
31.3.4.2	Third-Party Administration Tools	31-30
31.3.4.3	SNMP Support	31-30
31.4 Transactio	n Processing in a Distributed System	31-31
31.4.1 Rem	ote SQL Statements	31-32
31.4.2 Distr	ibuted SQL Statements	31-32
31.4.3 Shar	red SQL for Remote and Distributed Statements	31-33
31.4.4 Rem	ote Transactions	31-33
31.4.5 Distr	ibuted Transactions	31-33
31.4.6 Two-	Phase Commit Mechanism	31-34
31.4.7 Data	base Link Name Resolution	31-34
31.4.7.1	About Database Link Name Resolution	31-35
31.4.7.2	Name Resolution When the Global Database Name Is Complete	31-35
31.4.7.3	Name Resolution When the Global Database Name Is Partial	31-35
31.4.7.4	Name Resolution When No Global Database Name Is Specified	31-36
31.4.7.5	Terminating the Search for Name Resolution	31-36
31.4.8 Sche	ema Object Name Resolution	31-37
31.4.8.1	About Schema Object Name Resolution	31-37
31.4.8.2	Example of Global Object Name Resolution: Complete Object Name	31-37
31.4.8.3	Example of Global Object Name Resolution: Partial Object Name	31-38
31.4.9 Glob	al Name Resolution in Views, Synonyms, and Procedures	31-39



31	.4.9.1	About Global Name Resolution in Views, Synonyms, and Procedures	31-39
31	.4.9.2	What Happens When Global Names Change	31-40
31	.4.9.3	Scenarios for Global Name Changes	31-40
31.5 Dis	tributed	Database Application Development	31-41
31.5.1	Tran	sparency in a Distributed Database System	31-42
31	.5.1.1	Location Transparency	31-42
31	.5.1.2	SQL and COMMIT Transparency	31-43
31.5.2	PL/S	SQL and Remote Procedure Calls (RPCs)	31-43
31.5.3	Distr	ributed Query Optimization	31-44
31.6 Ch	aracter	Set Support for Distributed Environments	31-44
31.6.1	Abo	ut Character Set Support for Distributed Environments	31-45
31.6.2	Clier	nt/Server Environment	31-45
31.6.3	Hom	nogeneous Distributed Environment	31-46
31.6.4	Hete	erogeneous Distributed Environment	31-46
		Distributed Database Global Names in a Distributed System	32-1
32.1.1		erstanding How Global Database Names Are Formed	32-2
32.1.2		ermining Whether Global Naming Is Enforced	32-2
32.1.3		ving a Global Database Name	32-3
32.1.4		nging the Domain in a Global Database Name	32-3
32.1.5		nging a Global Database Name: Scenario	32-4
		Patabase Links	32-6
32.2.1	_	aining Privileges Necessary for Creating Database Links	32-7
32.2.2		cifying Link Types	32-7
		Creating Private Database Links	32-8
		Creating Public Database Links	32-8
		Creating Global Database Links	32-9
32.2.3		cifying Link Users	32-9
	.2.3.1	Creating Fixed User Database Links	32-10
	.2.3.2	Creating Connected User and Current User Database Links	32-10
32.2.4		g Connection Qualifiers to Specify Service Names Within Link Names	32-11
32.3 Usi		red Database Links	32-12
32.3.1	Ü	ermining Whether to Use Shared Database Links	32-13
32.3.2	Crea	ating Shared Database Links	32-14
32.3.3		figuring Shared Database Links	32-14
	.3.3.1	Creating Shared Links to Dedicated Servers	32-14
32	.3.3.2	Creating Shared Links to Shared Servers	32-15
32.4 Ma	naging	Database Links	32-16
32.4.1		sing Database Links	32-17
32.4.2	Drop	oping Database Links	32-17



	32.4.2	2.1 Dropping a Private Database Link	32-17
	32.4.2	2.2 Dropping a Public Database Link	32-18
	32.4.3	Limiting the Number of Active Database Link Connections	32-18
	32.5 Viewir	ng Information About Database Links	32-19
	32.5.1	Determining Which Links Are in the Database	32-19
	32.5.2	Determining Which Link Connections Are Open	32-20
	32.5.3	Determining the Host of Outgoing Database Links	32-21
	32.5.4	Determining Information About Incoming Database Links	32-22
	32.5.5	Determining the Source of High SCN Activity for Incoming Database Links	32-23
	32.6 Creati	ing Location Transparency	32-24
	32.6.1	Using Views to Create Location Transparency	32-24
	32.6.2	Using Synonyms to Create Location Transparency	32-25
	32.6.2	2.1 Creating Synonyms	32-26
	32.6.2	2.2 Managing Privileges and Synonyms	32-27
	32.6.3	Using Procedures to Create Location Transparency	32-27
	32.6.3	3.1 Using Local Procedures to Reference Remote Data	32-28
	32.6.3	3.2 Using Local Procedures to Call Remote Procedures	32-28
	32.6.3	3.3 Using Local Synonyms to Reference Remote Procedures	32-29
	32.6.3	3.4 Managing Procedures and Privileges	32-29
	32.7 Manaç	ging Statement Transparency	32-29
	32.8 Manaç	ging a Distributed Database: Examples	32-31
	32.8.1	Example 1: Creating a Public Fixed User Database Link	32-31
	32.8.2	Example 2: Creating a Public Fixed User Shared Database Link	32-31
	32.8.3	Example 3: Creating a Public Connected User Database Link	32-32
	32.8.4	Example 4: Creating a Public Connected User Shared Database Link	32-32
	32.8.5	Example 5: Creating a Public Current User Database Link	32-33
33	Developin	ng Applications for a Distributed Database System	
	33.1 Mana(ging the Distribution of Application Data	33-1
	33.2 Contro	olling Connections Established by Database Links	33-2
	33.3 Mainta	aining Referential Integrity in a Distributed System	33-2
	33.4 Tuning	g Distributed Queries	33-3
	33.4.1	Using Collocated Inline Views	33-4
	33.4.2	Using Cost-Based Optimization	33-4
	33.4.2	2.1 How Does Cost-Based Optimization Work?	33-5
	33.4.2	2.2 Rewriting Queries for Cost-Based Optimization	33-5
	33.4.2	2.3 Setting Up Cost-Based Optimization	33-6
	33.4.3	Using Hints	33-7
	33.4.3	3.1 About Using Hints	33-7
	33.4.3	3.2 Using the NO_MERGE Hint	33-8
	33.4.3	3.3 Using the DRIVING_SITE Hint	33-8



	Analyzing the Execution Plan	33-8
33.4.	3	33-9
	4.2 Viewing the Execution Plan	33-9
33.5 Handl	ing Errors in Remote Procedures	33-10
Distribute	d Tarana di ang Orang da	
Distribute	d Transactions Concepts	
	Are Distributed Transactions?	34-1
34.1.1	DML and DDL Transactions	34-2
34.1.2	Transaction Control Statements	34-3
34.2 Session	on Trees for Distributed Transactions	34-3
34.2.1	About Session Trees for Distributed Transactions	34-3
34.2.2	Clients	34-4
34.2.3	Database Servers	34-5
34.2.4	Local Coordinators	34-5
34.2.5	Global Coordinator	34-5
34.2.6	Commit Point Site	34-5
34.2.	6.1 About the Commit Point Site	34-6
34.2.	6.2 How a Distributed Transaction Commits	34-7
34.2.	6.3 Commit Point Strength	34-7
34.3 Two-P	Phase Commit Mechanism	34-9
34.3.1	About the Two-Phase Commit Mechanism	34-9
34.3.2	Prepare Phase	34-10
34.3.	2.1 About Prepare Phase	34-10
34.3.	2.2 Types of Responses in the Prepare Phase	34-10
34.3.	2.3 Steps in the Prepare Phase	34-12
34.3.3	Commit Phase	34-12
34.3.	3.1 Steps in the Commit Phase	34-13
34.3.	3.2 Guaranteeing Global Database Consistency	34-13
34.3.4	Forget Phase	34-14
34.4 In-Dou	ubt Transactions	34-14
34.4.1	About In-Doubt Transactions	34-14
34.4.2	Automatic Resolution of In-Doubt Transactions	34-15
34.4.	2.1 Failure During the Prepare Phase	34-15
34.4.	·	34-16
34.4.3	Manual Resolution of In-Doubt Transactions	34-17
	Relevance of System Change Numbers for In-Doubt Transactions	34-17
	outed Transaction Processing: Case Study	34-18
	About the Distributed Transaction Processing Case Study	34-18
	Stage 1: Client Application Issues DML Statements	34-18
	Stage 2: Oracle Database Determines Commit Point Site	34-19
	Stage 3: Global Coordinator Sends Prepare Response	34-20
57.5.7	Caago C. Ciobal Coolamatol Condo i Toparo (Copondo	54.20



34.5.5	Stage 4: Commit Point Site Comm	nits	34-21
34.5.6	Stage 5: Commit Point Site Inform	s Global Coordinator of Commit	34-21
34.5.7	Stage 6: Global and Local Coordir	nators Tell All Nodes to Commit	34-21
34.5.8	Stage 7: Global Coordinator and C	Commit Point Site Complete the Commit	34-22
Managin	Distributed Transaction	S	
35.1 Spec	ring the Commit Point Strength of	a Node	35-2
35.2 Nam	g Transactions		35-2
35.3 View	g Information About Distributed T	ransactions	35-3
35.3.1	Determining the ID Number and S	tatus of Prepared Transactions	35-3
35.3.2	racing the Session Tree of In-Do	ubt Transactions	35-5
35.4 Deci	ng How to Handle In-Doubt Trans	actions	35-6
35.4.1	Discovering Problems with a Two-	Phase Commit	35-6
35.4.2	Determining Whether to Perform a	Manual Override	35-7
35.4.3	Analyzing the Transaction Data		35-7
35.4	1.1 Find a Node that Committed	or Rolled Back	35-8
35.4	Look for Transaction Comm	ents	35-8
35.4	3.3 Look for Transaction Advice		35-8
35.5 Man	lly Overriding In-Doubt Transaction	ons	35-9
35.5.1	Manually Committing an In-Doubt	Transaction	35-9
35.5	1 Privileges Required to Com	nit an In-Doubt Transaction	35-9
35.5	2 Committing Using Only the	Fransaction ID	35-9
35.5	3 Committing Using an SCN		35-10
35.5.2	Manually Rolling Back an In-Doub	t Transaction	35-10
35.6 Purg	g Pending Rows from the Data Di	ctionary	35-11
35.6.1	About Purging Pending Rows fron	ı the Data Dictionary	35-11
35.6.2	Executing the PURGE_LOST_DB	_ENTRY Procedure	35-12
35.6.3	Determining When to Use DBMS_	TRANSACTION	35-12
35.7 Man	lly Committing an In-Doubt Trans	action: Example	35-13
35.7.1	Step 1: Record User Feedback		35-14
35.7.2	Step 2: Query DBA_2PC_PENDIN	IG	35-14
35.7	.1 Determining the Global Tran	saction ID	35-15
35.7	2 Determining the State of the	Transaction	35-15
35.7	3 Looking for Comments or Ad	dvice	35-15
35.7.3	Step 3: Query DBA_2PC_NEIGHE	BORS on Local Node	35-16
35.7	3.1 Obtaining Database Role ar	nd Database Link Information	35-16
35.7	3.2 Determining the Commit Po	nt Site	35-17
35.7.4	Step 4: Querying Data Dictionary	views on All Nodes	35-17
35.7			35-17
35.7	•	rs and Commit Point Site at sales	35-18
35.7	· ·		35-19
	<u> </u>	-	



	35.7.5	Step 5: Commit the In-Doubt Transaction	35-19
	35.7.6	Step 6: Check for Mixed Outcome Using DBA_2PC_PENDING	35-20
	35.8 Data	a Access Failures Due to Locks	35-20
	35.8.1	Transaction Timeouts	35-20
	35.8.2	Locks from In-Doubt Transactions	35-21
	35.9 Sim	ulating Distributed Transaction Failure	35-21
	35.9.1	Forcing a Distributed Transaction to Fail	35-21
	35.9.2	Disabling and Enabling RECO	35-22
	35.10 Ma	anaging Read Consistency	35-23
	35.11 Enl	hancing Distributed Transaction Security	35-23
Part	VI Mai	naging Read-Only Materialized Views	
36	Read-O	nly Materialized View Concepts	
	36.1 Rep	lication Databases	36-1
	36.2 Rea	d-Only Materialized Views	36-2
	36.3 The	Uses of Materialized Views	36-3
	36.3.1	Ease Network Loads	36-3
	36.3.2	Enable Data Subsetting	36-3
	36.3.3	Enable Disconnected Computing	36-3
	36.4 Avai	ilable Materialized Views	36-4
	36.4.1	About the Available Materialized Views	36-4
	36.4.2	Primary Key Materialized Views	36-4
	36.4.3	Object Materialized Views	36-5
	36.4.4	ROWID Materialized Views	36-6
	36.4.5	Complex Materialized Views	36-6
	36.	4.5.1 About Complex Materialized Views	36-6
	36.4	4.5.2 A Comparison of Simple and Complex Materialized Views	36-8
	36.5 Use	rs and Privileges Related to Materialized Views	36-9
	36.5.1	Required Privileges for Materialized View Operations	36-10
	36.5.2	Creator Is Owner	36-11
	36.5.3	Creator Is Not Owner	36-11
	36.5.4	Refresher Is Owner	36-11
	36.5.5	Refresher Is Not Owner	36-12
	36.6 Data	a Subsetting with Materialized Views	36-12
	36.6.1	About Data Subsetting with Materialized Views	36-12
	36.6.2	Materialized Views with Subqueries	36-13
	36.	6.2.1 Many to One Subqueries	36-13
	36.	6.2.2 One to Many Subqueries	36-14
	36.	6.2.3 Many to Many Subqueries	36-15



	36.6.2.4 Materialized Views with Subqueries and Unions	36-16				
	36.6.3 Restrictions for Materialized Views with Subqueries	36-19				
	36.6.4 Restrictions for Materialized Views with Unions Containing Subqueries	36-20				
	36.6.4.1 Examples of Materialized Views with Unions Containing Subqueries					
	36.7 Materialized View Refresh					
	36.8 Refresh Groups					
	36.9 Materialized View Log	36-21				
	36.10 Materialized Views and User-Defined Data Types	36-22				
	36.10.1 How Materialized Views Work with Object Types and Collections	36-22				
	36.10.2 Type Agreement at Replication Databases	36-23				
	36.10.3 Column Subsetting of Masters with Column Objects	36-24				
	36.10.4 Materialized Views Based on Object Tables	36-25				
	36.10.4.1 About Materialized Views Based on Object Tables	36-25				
	36.10.4.2 Materialized Views Based on Object Tables Created Without Using the OF type Clause	36-25				
	36.10.4.3 OID Preservation in Object Materialized Views	36-26				
	36.10.5 Materialized Views with Collection Columns	36-26				
	36.10.5.1 Restrictions for Materialized Views with Collection Columns	36-28				
	36.10.6 Materialized Views with REF Columns	36-28				
	36.10.6.1 About Materialized Views with REF Columns	36-28				
	36.10.6.2 Scoped REF Columns	36-29				
	36.10.6.3 Unscoped REF Columns	36-30				
	36.10.6.4 Logging REF Columns in the Materialized View Log	36-30				
	36.10.6.5 REFs Created Using the WITH ROWID Clause	36-30				
	36.11 Materialized View Registration at a Master Database	36-30				
	36.11.1 Viewing Information about Registered Materialized Views	36-31				
	36.11.2 Internal Mechanisms	36-31				
	36.11.3 Manual Materialized View Registration	36-31				
37	Read-Only Materialized View Architecture					
	37.1 Master Database Mechanisms	37-1				
	37.1.1 Master Database Objects	37-1				
	37.1.2 Master Table	37-2				
	37.1.3 Internal Trigger for the Materialized View Log	37-2				
	37.1.4 Materialized View Logs	37-2				
	37.1.4.1 About Materialized View Logs	37-3				
	37.1.4.2 Columns Logged in the Materialized View Log	37-4				
	37.1.4.3 Restriction on Import of Materialized View Logs to a Different Schema	37-5				
	37.2 Materialized View Database Mechanisms	37-5				
	37.2.1 Indexes for Materialized Views	37-6				
	37.3 Organizational Mechanisms	37-6				



	37.3.1	Refresh Groups	37-6	
	37.3.2	Refresh Group Size	37-6	
	37.4 Refresh Process			
	37.4.1	About the Refresh Process	37-7	
	37.4.2	Refresh Types	37-7	
	37.4	1.2.1 Complete Refresh	37-8	
	37.4	1.2.2 Fast Refresh	37-8	
	37.4	1.2.3 Force Refresh	37-9	
	37.4.3	Initiating a Refresh	37-9	
	37.4	4.3.1 Scheduled Refresh	37-9	
	37.4	1.3.2 On-Demand Refresh	37-10	
	37.4.4	Constraints and Refresh	37-11	
38	Planning	for Read-Only Materialized Views		
	38.1 Cons	siderations for Master Tables	38-1	
	38.1.1	Primary Keys and Master Tables	38-1	
	38.1.2	Foreign Keys and Master Tables	38-1	
	38.1.3	Data Type Considerations for Master Tables	38-1	
	38.1.4	Unsupported Table Types	38-3	
	38.2 Plan	ning for Master Databases and Materialized View Databases	38-3	
	38.2.1	Characteristics of Master Databases and Materialized View Databases	38-4	
	38.2.2	Advantages of Master Databases	38-4	
	38.2.3	Advantages of Materialized View Databases	38-4	
	38.2.4	Preparing for Materialized Views	38-4	
	38.2	2.4.1 Required Schemas at Materialized View Database	38-5	
	38.2	2.4.2 Required Database Links for Materialized Views	38-5	
	38.2	2.4.3 Required Privileges	38-7	
	38.2	2.4.4 Sufficient Job Processes	38-7	
	38.2.5	Creating Materialized View Logs	38-8	
	38.2.6	Logging Columns in a Materialized View Log	38-9	
39	Creating and Managing Read-Only Materialized Views			
	39.1 Crea	ating Read-Only Materialized Views	39-1	
	39.2 Creating Refresh Groups			
	39.3 Refreshing Materialized Views		39-4	
	39.4 Determining the Fast Refresh Capabilities of a Materialized View			
	39.5 Adding a New Materialized View Database			
	39.6 Moni	itoring Materialized View Logs	39-7	
	39.6.1	Listing Information About the Materialized View Logs at a Master Database	39-7	
	39.6.2	Listing the Materialized Views that Use a Materialized View Log	39-8	



	39.7 Monitoring Materialized Views	39-9		
	39.7.1 Listing Information About Materialized Views	39-9		
	39.7.1.1 Listing Master Database Information For Materialized Views	39-9		
	39.7.1.2 Listing the Properties of Materialized Views	39-10		
	39.7.2 Listing Information About the Refresh Groups at a Materialized View Database	39-1		
	39.7.3 Determining the Job ID for Each Refresh Job at a Materialized View Database	39-12		
	39.7.4 Determining Which Materialized Views Are Currently Refreshing	39-12		
40	Troubleshooting Problems with Read-Only Materialized Views			
	40.1 Diagnosing Problems with Database Links	40-1		
	40.2 Problems Creating Materialized Views	40-2		
	40.3 Refresh Problems	40-2		
	40.3.1 Common Refresh Problems	40-2		
	40.3.2 Automatic Refresh Retries	40-3		
	40.3.3 Fast Refresh Errors at New Materialized View Databases	40-3		
	40.3.4 Materialized Views Continually Refreshing	40-4		
	40.3.5 Materialized View Logs Growing Too Large	40-4		
	40.4 Advanced Troubleshooting of Refresh Problems	40-4		
Part	t VII Appendixes			
Α	Support for DBMS_JOB			
	A.1 Oracle Scheduler Replaces DBMS_JOB			
	A.1.1 Configuring DBMS_JOB	A-2		
	A.1.2 Using Both DBMS_JOB and Oracle Scheduler	A-2		
	A.2 Moving from DBMS_JOB to Oracle Scheduler	A-2		
	A.2.1 Creating a Job	A-3		
	A.2.2 Altering a Job	A-3		
	A.2.3 Removing a Job from the Job Queue	A-4		
В	Blockchain Tables Reference			
	B.1 Blockchain Tables Column Content			
	B.2 Blockchain Tables Row Content			
	B.3 Format of the Signed Digest in Blockchain Tables			
	Index			

