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Pro Oracle Database 11g RAC on Linux

Oracle Database 11g Real Application Clusters (RAC) on Linux has established itself as a powerhouse solution for enterprises seeking high availability, scalability, and robust performance. Implementing Oracle RAC on Linux offers a cost-effective and reliable platform for critical business applications, ensuring minimal downtime and optimized resource utilization. This article explores the key benefits, architecture, setup considerations, and best practices for deploying and managing Oracle Database 11g RAC on Linux, providing comprehensive insights for database administrators and IT professionals.

Understanding Oracle Database 11g RAC on Linux

Oracle Database 11g RAC is a clustering solution that allows multiple servers (nodes) to operate as a single database system. When deployed on Linux, it leverages open-source flexibility and cost advantages while maintaining enterprise-grade performance.

What is Oracle RAC?

- A clustered database architecture that enables multiple servers to access a shared database.
- Provides high availability by eliminating single points of failure.
- Supports load balancing across nodes to optimize performance.
- Facilitates scalability by adding or removing nodes without downtime.

Why Choose Linux for Oracle RAC?

- Cost-effectiveness: Linux is open-source and reduces licensing costs.
- Flexibility: Wide hardware and software compatibility.
- Community Support: Extensive developer and user community.
- Stability and Security: Mature Linux distributions like Oracle Linux are optimized for enterprise workloads.

Benefits of Deploying Oracle Database 11g RAC on Linux

Deploying Oracle RAC on Linux offers numerous advantages that make it an attractive choice for large-scale, mission-critical applications.

High Availability and Reliability

- Continuous operation even if one or more nodes fail.
- Automatic failover mechanisms ensure minimal service disruption.
- Data integrity is maintained through Oracle's cache fusion technology.

Scalability and Performance

- Linear scalability by adding nodes to accommodate growth.
- Load balancing distributes user requests efficiently.
- Improved query performance due to parallel processing.

Cost-Effective Infrastructure

- Eliminates the need for expensive proprietary hardware.
- Utilizes commodity hardware with Linux operating systems.
- Reduces total cost of ownership over traditional RDBMS solutions.

Ease of Management and Maintenance

- Centralized database management simplifies administrative tasks.
- Rolling upgrades and patches without downtime.
- Robust monitoring tools enhance operational oversight.

Architecture and Components of Oracle RAC on Linux

Understanding the architecture is essential for deploying and managing Oracle RAC effectively.

Clusterware

- Oracle Clusterware manages node membership and resources.
- Provides high availability services and failover support.
- Handles node communication and cluster health monitoring.

Database Instances

- Each node runs an Oracle database instance.
- Instances access a common database stored on shared storage.
- Instances coordinate via cache fusion technology.

Shared Storage

- Essential for RAC; typically SAN or NAS solutions.
- Supports data files, control files, and redo logs.
- Ensures data consistency across nodes.

Networking

- Private interconnects for cluster communication.
- Public network interfaces for client connections.
- Proper network configuration is critical for performance.

Prerequisites and Setup Considerations

Successful deployment requires careful planning and adherence to prerequisites.

Hardware Requirements

- Multiple servers with compatible CPU architectures.
- Shared storage solutions such as SAN or NAS.
- Reliable network interfaces for cluster communication.
- Minimum RAM and CPU specifications as per Oracle guidelines.

Operating System and Software

- Oracle Linux or other certified Linux distributions.
- Latest patches and kernel updates installed.
- Oracle Grid Infrastructure software for cluster management.
- Oracle Database 11g Enterprise Edition.

Configuration Steps Overview

- Install and configure Linux on all nodes.
- Set up shared storage and verify accessibility.
- Configure network interfaces and private interconnects.
- Install Oracle Clusterware and validate cluster health.
- Create and configure the RAC database instances.
- Test failover, load balancing, and recovery procedures.

Best Practices for Managing Oracle RAC on Linux

Efficient management ensures optimal performance and availability of the RAC environment.

Monitoring and Performance Tuning

- Utilize Oracle Enterprise Manager and other monitoring tools.
- Regularly check cluster and database logs for anomalies.
- Tune network settings, cache sizes, and storage configurations for optimal throughput.

Backup and Recovery Strategies

- Implement RMAN (Recovery Manager) backups for data protection.
- Schedule regular backups and validate recovery procedures.
- Use Data Guard for disaster recovery if applicable.

Security Considerations

- Harden the Linux OS by disabling unnecessary services.
- Use strong authentication and encryption protocols.
- Regularly update software patches to mitigate vulnerabilities.

High Availability Configurations

- Configure automatic failover with Oracle Data Guard or other tools.
- Set up monitoring for node health and network status.
- Design for redundancy in storage, networking, and power supplies.

Common Challenges and Troubleshooting Tips

While Oracle RAC on Linux offers many benefits, it also presents unique challenges.

Network Issues

- Ensure private interconnects are low latency and dedicated.
- Verify network configurations and firewall settings.

Storage Problems

- Confirm shared storage is properly configured and accessible.
- Monitor storage performance and resolve bottlenecks promptly.

Cluster Failures

- Regularly update and patch clusterware components.
- Use diagnostic tools like Oracle Cluster Verification Utility (CVU).

Performance Bottlenecks

- Analyze wait events and system metrics.
- Optimize SQL queries and resource allocations.

Conclusion

Implementing Oracle Database 11g RAC on Linux is a strategic move for organizations aiming for high availability, scalability, and cost efficiency. By leveraging the flexibility and robustness of Linux, combined with Oracle's powerful clustering technologies, enterprises can build resilient database environments capable of supporting mission-critical applications. Proper planning, adherence to best practices, and ongoing management are key to harnessing the full potential of Oracle RAC on Linux. Whether deploying a new database infrastructure or upgrading existing systems, understanding the architecture and operational nuances of Oracle RAC ensures a reliable and high-performing environment that can adapt to evolving business needs.

Pro Oracle Database 11g RAC on Linux: A Comprehensive Analysis

In the rapidly evolving landscape of enterprise data management, Oracle Database 11g Real Application Clusters (RAC) on Linux has established itself as a formidable solution for organizations

seeking high availability, scalability, and robust performance. This article provides an in-depth exploration of Oracle 11g RAC on Linux, examining its architecture, benefits, deployment considerations, and best practices for maximizing its potential.

Introduction to Oracle Database 11g RAC

Oracle Database 11g Release 2 (11.2) introduced significant enhancements to its RAC capabilities, solidifying its position as a preferred choice for mission-critical applications. RAC enables multiple servers (nodes) to access a single database simultaneously, providing fault tolerance, load balancing, and continuous availability.

What is Oracle RAC?

Oracle RAC is a clustered database solution that allows multiple interconnected servers to work as a single system. Each node runs its own Oracle instance but shares a common database stored on shared storage. This architecture ensures that if one node fails, others can seamlessly take over, minimizing downtime.

Why Linux?

Linux, being open-source, cost-effective, and highly customizable, has become a preferred operating system for deploying Oracle RAC environments. Its stability, support for enterprise-grade hardware, and widespread adoption make it ideal for high-availability database solutions.

Architecture and Components of Oracle 11g RAC on Linux

Understanding the architecture of Oracle RAC on Linux is crucial for effective deployment and management. The architecture comprises several interconnected components working in harmony to deliver high availability and scalability.

- Clusterware Layer

- Oracle Clusterware: The foundational layer that manages cluster resources, node membership, and failure handling.

- Voting Disk: Maintains information about cluster node membership; critical for cluster integrity.

- CRS (Cluster Ready Services): Manages resources such as database instances, listeners, and services.

- Database Layer

- Multiple instances (one per node) that access the shared database.
- Uses Oracle Automatic Storage Management (ASM) for efficient shared storage management.

- Shared Storage Infrastructure

- Typically implemented via SAN or NAS solutions.
- Utilizes ASM for managing shared disk resources, ensuring data consistency and high performance.

- Network Layer

- Private interconnects for cluster communication, crucial for data consistency and cache fusion.
- Public network interfaces for client connections.

Advantages of Deploying Oracle 11g RAC on Linux

Implementing Oracle RAC on Linux offers numerous benefits that can significantly impact an enterprise's database operations.

- High Availability and Fault Tolerance

- Ensures minimal downtime with automatic failover capabilities.
- Protects against hardware failures, network issues, or software crashes.

- Scalability and Performance

- Horizontal scaling by adding nodes to the cluster.
- Load balancing across nodes to optimize resource utilization.
- Cache fusion technology reduces disk I/O by sharing data cache among nodes.

- Cost-Effectiveness

- Linux's open-source nature reduces licensing costs.
- Flexible hardware options enable tailored infrastructure investments.

- Flexibility and Compatibility

- Compatible with various Linux distributions such as Oracle Linux, Red Hat Enterprise Linux, and CentOS.

- Supports a wide range of enterprise applications.

- Manageability and Monitoring

- Oracle Enterprise Manager provides comprehensive tools for monitoring, managing, and tuning RAC environments.

- Automation features simplify routine operations.

Deployment Considerations and Best Practices

While Oracle RAC on Linux offers substantial advantages, deploying it effectively requires careful planning and adherence to best practices.

- Hardware and Storage Planning

- Node Configuration: Ensure uniform hardware specifications across nodes to prevent bottlenecks.

- Network Setup: Use dedicated private interconnects for cluster communication, preferably with high-speed Ethernet or InfiniBand.

- Shared Storage: Implement reliable SAN/NAS solutions with redundant paths and backups.

- Disk Layout: Follow Oracle's recommended disk layouts for datafiles, redo logs, and archive logs.

- Linux Environment Optimization

- Kernel Tuning: Adjust kernel parameters like shared memory (`shmmax`, `shmmni`), semaphore settings, and network parameters for optimal RAC performance.
- User and Group Management: Properly configure user accounts and permissions for Oracle software and operating system users.
- Package Dependencies: Install required OS packages, libraries, and patches aligned with Oracle's certification matrix.

- Software Installation and Configuration

- Clusterware Installation: Use Oracle Grid Infrastructure for cluster management.
- Database Software: Install Oracle Database 11g Release 2 with RAC options.
- Network Configuration: Set up Virtual IPs (VIPs), public and private network interfaces, and listener configurations.
- Database Creation: Use Oracle Database Configuration Assistant (DBCA) with RAC options enabled.

- High Availability and Disaster Recovery Planning

- Implement Data Guard or other replication solutions for disaster recovery.
- Configure failover policies and monitoring tools to detect and respond to failures promptly.

- Regular Maintenance and Patching

- Keep the system updated with the latest patches and upgrades.
- Monitor system logs, performance metrics, and resource utilization continuously.

Challenges and Limitations of Oracle RAC on Linux

Despite its advantages, deploying Oracle RAC on Linux presents certain challenges:

- Complexity: Setting up and managing RAC environments requires specialized skills and experience.
- Cost: While Linux reduces licensing costs, the hardware and administrative overhead can be significant.

- Network Dependency: Performance heavily depends on network latency and bandwidth, especially for cache fusion.
- Resource Intensive: RAC environments demand substantial CPU, memory, and storage resources.
- Compatibility Constraints: Not all Linux distributions or hardware are certified for Oracle RAC.

Performance Tuning and Optimization Strategies

Achieving optimal performance in Oracle RAC on Linux involves multi-layered tuning:

- Hardware Optimization

- Use high-speed, low-latency interconnects.
- Ensure balanced CPU, memory, and storage resources across nodes.

- Network Tuning

- Configure private interconnects with dedicated bandwidth.
- Enable TCP offloading features where available.
- Adjust network stack parameters for latency reduction.

- Database Tuning

- Optimize SQL queries and indexing strategies.
- Configure proper redo log sizes and archive log settings.
- Use Automatic Workload Repository (AWR) reports for performance diagnostics.

- Clusterware and OS Tuning

- Regularly update clusterware components.
- Monitor and tune kernel parameters as per Oracle guidelines.
- Implement resource management policies to prevent bottlenecks.

Future Perspectives and Evolving Trends

While Oracle 11g RAC remains a robust solution, newer versions and alternative architectures are shaping the future of high-availability databases:

- Oracle 19c and 21c: Offer enhanced features like autonomous management and cloud integration.
- Cloud Deployments: Increasing migration towards Oracle Cloud Infrastructure (OCI) and other cloud platforms for RAC-like services.
- Containerization: Emerging trends involve deploying RAC components within containers or using Oracle RAC on Kubernetes for greater agility.
- Hybrid Cloud Strategies: Combining on-premises RAC with cloud-based disaster recovery and data sharing solutions.

Conclusion

Oracle Database 11g RAC on Linux epitomizes a mature, scalable, and reliable enterprise database solution that addresses the highest demands for availability and performance. Its architecture leverages the strengths of Linux—cost-efficiency, stability, and flexibility—while delivering advanced clustering capabilities. Successful deployment hinges on meticulous planning, hardware and network optimization, and continuous management.

As enterprises increasingly seek resilient data infrastructures, mastering Oracle RAC on Linux remains a strategic asset, paving the way for resilient, scalable, and high-performance database environments capable of supporting critical business operations into the future.

Question What are the key benefits of deploying Oracle Database 11g RAC on Linux? Deploying Oracle Database 11g RAC on Linux provides high availability, scalability, workload balancing, and cost-effectiveness, enabling organizations to ensure continuous service and optimal resource utilization. What are the hardware and software prerequisites for installing Oracle 11g RAC on Linux? Prerequisites include compatible Linux distributions (like Oracle Linux or Red Hat), shared storage configured with Oracle Clusterware, sufficient network interfaces for interconnect and public access, and supported hardware components such as servers with appropriate CPU, memory, and disk configurations as specified in Oracle documentation. How do I configure Oracle Clusterware for Oracle 11g RAC on Linux? Configuring Oracle Clusterware involves setting up shared storage, configuring public and private interconnects, installing the Oracle Grid Infrastructure, and verifying cluster health using utility tools like `crsctl` and `olsnodes`, following Oracle's detailed installation guidelines. What are best practices for tuning performance of Oracle 11g RAC on Linux? Best practices include optimizing network configurations, using appropriate interconnect hardware, tuning database parameters, managing cache efficiently, and regularly monitoring system performance.

with Oracle Enterprise Manager or other monitoring tools. How do I perform patching and maintenance on Oracle 11g RAC on Linux? Patching involves using Oracle OPatch, applying patches in rolling fashion to minimize downtime, and following Oracle's recommended procedures for patching RAC environments, including backing up data and testing patches in staging environments first. What are common challenges faced during Oracle 11g RAC on Linux deployment and their solutions? Common challenges include network misconfigurations, storage issues, and clusterware failures. Solutions involve thorough planning, adhering to Oracle installation best practices, ensuring proper network setup, and utilizing Oracle support resources for troubleshooting. How does Oracle 11g RAC on Linux support high availability and disaster recovery? Oracle RAC provides high availability through active-active clustering, automatic failover, and load balancing. For disaster recovery, it integrates with Data Guard and other backup solutions to ensure data integrity and minimal downtime in case of site failures. Is it possible to migrate existing single-instance Oracle databases to RAC on Linux? Yes, migrating to RAC involves using Data Pump or RMAN for data transfer, configuring the cluster environment, and performing a careful upgrade or migration plan to ensure minimal downtime and data consistency, following Oracle's migration best practices.

Related keywords: Oracle Database 11g RAC, Linux RAC installation, Oracle RAC clustering, Oracle 11g RAC configuration, Oracle Real Application Clusters, Linux Oracle database setup, RAC high availability, Oracle 11g RAC tuning, Oracle RAC networking, Linux database clustering

ORACLE 12C NEW FEATURES

Understanding Oracle 12c New Features: A Comprehensive Overview

oracle 12c new features have significantly transformed the landscape of database management systems, offering enhanced performance, scalability, security, and ease of use. Released by Oracle Corporation, Oracle 12c (where 'c' stands for 'Cloud') introduces a suite of innovations designed to meet the evolving needs of modern enterprise environments. This article delves into the most notable features of Oracle 12c, exploring how they empower organizations to optimize their database operations and streamline their cloud initiatives.

Introduction to Oracle 12c

Oracle 12c, launched in 2013, marked a pivotal shift in Oracle's database technology, emphasizing cloud computing and multi-tenancy. The platform's architecture was fundamentally redesigned to support cloud deployment models, making it more flexible and scalable than its predecessors. The new features in Oracle 12c aim to simplify database management, improve performance, bolster

security, and facilitate easier migration to the cloud.

Key New Features of Oracle 12c

The most prominent enhancements introduced in Oracle 12c can be categorized into several core areas:

- Multitenant Architecture
- Enhanced Performance Features
- Improved Security Capabilities
- Advanced Data Management
- Better Cloud Integration and Management
- Simplified Administration and Development

Let's explore each of these categories in detail.

Multitenant Architecture

One of the flagship features of Oracle 12c is the introduction of the Multitenant architecture, which allows a single database to host multiple pluggable databases (PDBs). This innovation simplifies database consolidation, provisioning, and management.

What is Multitenant Architecture?

The multitenant architecture enables a container database (CDB) to hold multiple user-created pluggable databases. Each PDB appears as a separate database but shares the same memory and background processes of the CDB. This setup offers:

- Easier database consolidation
- Rapid provisioning of new databases
- Simplified patching and upgrades
- Improved resource utilization

Benefits of Multitenant Architecture

Implementing multitenancy provides several advantages:

- Cost Savings: Reduced hardware and licensing costs by consolidating multiple databases.

- Operational Efficiency: Simplified backup, recovery, and patching processes.
- Enhanced Security: Isolation between PDBs ensures security and data separation.
- Cloud Readiness: Facilitates cloud deployment models smoothly.

Enhanced Performance Features

Oracle 12c introduces multiple performance-oriented enhancements to improve database responsiveness and throughput.

In-Memory Column Store

This feature allows data to be stored in memory in a columnar format, significantly accelerating analytical queries.

- Benefits:
- Faster query response times
- Real-time analytics
- Reduced CPU and I/O bottlenecks

Adaptive Query Optimization

Oracle 12c enhances the optimizer with adaptive features, enabling it to adjust execution plans dynamically based on runtime statistics.

- Features include:
- Adaptive plans that change during execution
- Improved cardinality estimation
- Better handling of complex queries

Automatic Data Optimization (ADO)

ADO automates data management by dynamically compressing and moving data based on usage patterns.

- Advantages:
- Space savings
- Improved performance
- Reduced administrative overhead

Improved Security Capabilities

Security features are vital for safeguarding sensitive data. Oracle 12c introduces several security enhancements.

Enhanced Transparent Data Encryption (TDE)

TDE now supports tablespaces and pluggable databases, providing stronger encryption options.

Data Redaction

This feature allows masking sensitive data in query results, useful in development, testing, or reporting environments.

Unified Audit Framework

Oracle 12c consolidates audit records into a centralized repository, simplifying compliance and security monitoring.

Oracle Database Vault

Provides fine-grained access control, enabling administrators to restrict privileged user activities effectively.

Advanced Data Management Features

Oracle 12c introduces functionalities that enhance data handling and processing.

JSON Support

Native JSON data type and functions allow seamless storage and retrieval of JSON documents.

- Use Cases:
- Web applications
- NoSQL-like data storage
- Flexible schema management

Enhanced Partitioning

Partitioning strategies are expanded, including interval and reference partitioning, to manage large

datasets efficiently.

Data Movement and Data Guard Enhancements

Features like Active Data Guard support enable real-time disaster recovery, data replication, and offloading queries to standby databases.

Better Cloud Integration and Management

Oracle 12c is designed for cloud environments, providing tools and features that simplify cloud deployment and management.

Cloud-Friendly Features

- Multitenant architecture simplifies database provisioning in cloud environments.
- Integration with Oracle Cloud Infrastructure (OCI) for seamless deployment.
- Support for Oracle's Database Cloud Service offerings.

Enterprise Manager Enhancements

Oracle Enterprise Manager 12c offers improved dashboarding, automation, and monitoring tools tailored for cloud and hybrid environments.

Simplified Administration and Development

Ease of use and developer productivity are prioritized through new tools and features.

SQL Developer and PL/SQL Enhancements

Enhanced IDE features streamline development, debugging, and deployment.

Automatic Indexing

Oracle 12c can automatically create, rebuild, or drop indexes based on workload patterns, optimizing performance without manual intervention.

Online Operations

Many administrative tasks, such as patching, upgrading, or reorganization, can now be performed online, minimizing downtime.

Summary of Key Oracle 12c New Features

Feature	Description	Benefits
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| Multitenant Architecture | Multiple PDBs within a CDB | Simplifies consolidation, management, and cloud readiness |

| In-Memory Column Store | Accelerates analytics | Faster query performance |

| Adaptive Query Optimization | Dynamic execution plans | Improved query efficiency |

| JSON Support | Native JSON data handling | Flexibility for web and NoSQL applications |

| Data Redaction & Security | Masking and encryption | Enhanced data security and compliance |

| Advanced Partitioning | Better data organization | Improved manageability and performance |

| Cloud Integration | Seamless deployment | Simplifies cloud adoption |

| Online Maintenance | Zero-downtime operations | Increased system availability |

Conclusion

Oracle 12c's new features mark a significant advancement in database technology, focusing on cloud computing, security, performance, and ease of management. The multitenant architecture alone addresses many enterprise needs for consolidation and agility, while enhancements like in-memory processing and JSON support open new avenues for application development and data analysis. Organizations leveraging Oracle 12c can expect not only improved operational efficiency but also a robust foundation for future growth and innovation. As the database landscape continues to evolve, Oracle 12c's comprehensive suite of features ensures that enterprises are well-equipped to meet emerging challenges and opportunities.

Final Thoughts

Adopting Oracle 12c's new features requires careful planning and understanding of your specific business needs. Whether it's consolidating multiple databases into a multitenant architecture, enhancing security protocols, or leveraging in-memory capabilities for analytics, organizations should evaluate these features' strategic value. Training and skill development for DBAs and developers will further maximize the benefits derived from Oracle 12c innovations. Staying ahead in

the competitive landscape involves embracing such technological advances, and Oracle 12c provides a powerful toolkit to do just that.

Oracle 12c New Features have significantly transformed the landscape of database management, offering enhanced performance, increased scalability, and innovative tools that streamline operations. As organizations increasingly rely on data-driven insights, Oracle 12c has positioned itself as a robust platform capable of meeting modern enterprise demands. This comprehensive review delves into the key new features introduced in Oracle 12c, exploring their functionalities, benefits, and potential drawbacks to provide a clear understanding of how this release elevates database management.

Introduction to Oracle 12c

Oracle Database 12c, released in 2013, marked a pivotal shift in Oracle's database architecture with its emphasis on cloud computing and multitenant architecture. The "c" in 12c signifies "cloud," highlighting Oracle's strategic move towards cloud-ready solutions. The core philosophy behind 12c is to simplify database consolidation, improve resource utilization, and offer flexible deployment options. The introduction of new features aims to provide database administrators and developers with more powerful tools to optimize performance, manage large datasets efficiently, and enhance security.

Key New Features in Oracle 12c

1. Multitenant Architecture (Container and Pluggable Databases)

One of the most groundbreaking features in Oracle 12c is the Multitenant Architecture, which introduces the concept of a Container Database (CDB) containing multiple Pluggable Databases (PDBs).

Features & Benefits:

- Simplifies database consolidation, allowing multiple databases to run within a single container environment.
- Eases provisioning and management of databases.
- Facilitates rapid cloning, backup, and recovery operations at the container level.
- Improves resource utilization and reduces hardware costs.

Pros:

- Streamlines database administration across multiple databases.
- Enhances agility in deploying new databases.
- Supports cloud migration strategies effectively.

Cons:

- Adds complexity to database management for organizations unfamiliar with multitenant architecture.
- Potential performance overhead if not properly managed.

Use Cases:

- Data centers hosting multiple applications.
- Software as a Service (SaaS) providers managing numerous customer databases.

2. Enhanced Partitioning Capabilities

Oracle 12c introduces advanced partitioning features that improve data management and query performance.

Features & Benefits:

- Interval Partitioning: Automates the creation of new partitions based on specified interval values, reducing manual intervention.
- In-Database Archiving: Enables archiving data within partitions, improving data lifecycle management.
- Hybrid Partitioning: Combines different partitioning methods for optimized data distribution.

Pros:

- Simplifies management of large tables.
- Enhances query performance through partition pruning.
- Facilitates easier data archiving and purging.

Cons:

- Requires careful planning to maximize benefits.
- Increased complexity might pose a learning curve for new DBAs.

Use Cases:

- Managing large transactional datasets.
- Data warehousing scenarios requiring efficient data retrieval.

3. Automatic Data Optimization (ADO)

Oracle 12c emphasizes intelligent data management through Automatic Data Optimization, a feature that automates data movement and compression based on usage patterns.

Features & Benefits:

- Uses Heat Map and Automatic Data Optimization policies to identify infrequently accessed data.
- Moves cold data to cheaper, compressed storage tiers.
- Implements advanced compression techniques to reduce storage costs.

Pros:

- Optimizes storage utilization.
- Improves overall database performance.
- Minimizes manual intervention in data maintenance.

Cons:

- Requires initial setup and tuning.
- Potential impact on performance if policies are misconfigured.

Use Cases:

- Data warehouses with historical data.
- Organizations looking to reduce storage costs without sacrificing performance.

4. Enhanced Security Features

Security enhancements in Oracle 12c focus on protecting sensitive data and ensuring compliance.

Features & Benefits:

- Data Redaction: Allows masking sensitive data dynamically in query results to prevent unauthorized access.
- Real Application Security (RAS): Provides fine-grained access control and auditing capabilities.
- Enhanced Transparent Data Encryption (TDE): Supports column-level encryption.

Pros:

- Strengthens data security and compliance.
- Reduces risk of data breaches.
- Provides flexible security policies.

Cons:

- Additional configuration complexity.
- Slight performance overhead due to encryption and redaction processes.

Use Cases:

- Financial institutions handling sensitive customer data.
- Enterprises subject to strict data privacy regulations.

5. Improved In-Memory Capabilities

Oracle 12c introduces significant enhancements to its In-Memory feature, designed for real-time analytics.

Features & Benefits:

- In-Memory Column Store integrated into the database.
- Supports hybrid columnar compression.
- Seamless integration with existing OLTP workloads.

Pros:

- Accelerates analytic queries by orders of magnitude.
- Enables real-time business insights.
- Reduces the need for separate data warehousing solutions.

Cons:

- Additional licensing costs.
- Increased memory requirements.

Use Cases:

- Business intelligence and reporting.
- Real-time analytics for operational dashboards.

6. Enhanced XML and JSON Support

Oracle 12c expands its capabilities for handling semi-structured data formats like XML and JSON.

Features & Benefits:

- Native support for JSON data types and functions.
- Improved XML indexing and querying.
- Support for RESTful web services directly within the database.

Pros:

- Simplifies application development involving web data.
- Improves performance for XML/JSON data processing.
- Facilitates integration with modern web applications.

Cons:

- Slightly increased complexity in schema management.

- Requires familiarity with new data types and functions.

Use Cases:

- Web and mobile applications leveraging JSON APIs.
- Data integration scenarios involving semi-structured data.

7. Improved Data Pump and Backup Features

Data migration and backup are critical aspects of database administration, and Oracle 12c enhances these functionalities.

Features & Benefits:

- Data Pump Enhancements: Faster data export/import with parallel processing.
- Online Datafile Move: Enables moving datafiles while the database remains operational.
- Backup Compression: Reduces storage of backup files.

Pros:

- Faster data migration and recovery.
- Reduced downtime during maintenance.
- Cost savings on storage.

Cons:

- Increased resource usage during parallel operations.
- Need for careful planning to avoid performance bottlenecks.

Use Cases:

- Large-scale database upgrades.
- High availability requirements requiring minimal downtime.

Conclusion

Oracle 12c's new features represent a significant leap forward in database technology, emphasizing cloud readiness, automation, security, and performance optimization. The multitenant architecture alone revolutionizes how organizations manage multiple databases, providing a scalable and cost-effective solution. Enhanced partitioning, data optimization, and in-memory capabilities further empower enterprises to handle vast datasets efficiently and extract real-time insights. Security enhancements ensure data integrity and compliance, which are crucial in today's regulatory landscape. Meanwhile, improved support for semi-structured data formats and backup operations streamline development and administrative tasks.

While these features offer numerous advantages, they also introduce complexity that organizations must manage carefully. Proper planning, training, and tuning are essential to harness the full potential of Oracle 12c's innovations. Overall, Oracle 12c's new features position it as a versatile, powerful platform suitable for a wide range of enterprise applications, from traditional OLTP systems to modern data analytics and cloud solutions. As businesses continue to evolve in the digital age, Oracle 12c's capabilities make it a compelling choice for organizations aiming to stay ahead in data management and innovation.

Question What are the key new features introduced in Oracle 12c? Oracle 12c introduced features such as Multitenant Architecture, In-Memory Column Store, Automatic Data Optimization, Enhanced Partitioning, and Advanced Security options, among others. **Answer** How does the Multitenant Architecture in Oracle 12c improve database management? The Multitenant Architecture allows a single container database (CDB) to host multiple pluggable databases (PDBs), simplifying consolidation, management, and provisioning of databases. What is Oracle 12c's In-Memory Column Store, and how does it boost performance? The In-Memory Column Store enables real-time analytics by storing data in a columnar format in memory, significantly accelerating query performance for analytical workloads. Can you explain the new Automatic Data Optimization feature in Oracle 12c? Automatic Data Optimization automatically compresses and moves data based on usage patterns, optimizing storage and performance without manual intervention. What improvements have been made to partitioning in Oracle 12c? Oracle 12c offers advanced partitioning options such as interval partitioning, reference partitioning, and global partitioning, allowing for easier management and improved query performance. How does Oracle 12c enhance security features compared to previous versions? Oracle 12c introduces features like Unified Auditing, Data Redaction, and enhanced Transparent Data Encryption (TDE) to provide stronger security and compliance capabilities. What is the significance of the new JSON support in Oracle 12c? Oracle 12c provides native JSON data type support, enabling efficient storage, indexing, and querying of JSON documents within the database. How does Oracle 12c improve high availability and disaster recovery? Features like Data Guard enhancements, Flashback Data Archive, and Real Application Clusters (RAC) improvements help ensure high availability and easier disaster recovery strategies. Are there any enhancements in Oracle 12c related to SQL and PL/SQL performance? Yes, Oracle 12c introduces performance improvements such as enhanced optimizer features, new SQL functions, and support for in-memory analytics, leading to faster query execution and better

PL/SQL performance.

Related keywords: Oracle 12c new features, Oracle 12c release notes, Oracle 12c architecture, Oracle Multitenant, Oracle In-Memory, Oracle 12c security enhancements, Oracle 12c performance improvements, Oracle 12c SQL features, Oracle 12c partitioning, Oracle 12c automation

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ORACLE SQL DEVELOPER

Oracle SQL Developer: The Ultimate Guide for Database Professionals

Oracle SQL Developer is a powerful and versatile integrated development environment (IDE) designed specifically for working with Oracle databases. Whether you're a database administrator, developer, or data analyst, mastering Oracle SQL Developer can significantly streamline your workflow, enhance productivity, and improve your understanding of Oracle databases. In this comprehensive guide, we'll explore the core features, benefits, best practices, and tips for maximizing your use of Oracle SQL Developer.

What is Oracle SQL Developer?

Oracle SQL Developer is a free graphical tool provided by Oracle Corporation that simplifies database development and management tasks. It offers an intuitive interface for working with SQL and PL/SQL, running queries, designing database schemas, and managing database objects?all from a single platform. Since its inception, SQL Developer has become the go-to tool for Oracle professionals due to its robust features, ease of use, and extensive support for Oracle database versions.

Key Features of Oracle SQL Developer

Understanding the core features of Oracle SQL Developer is essential to leveraging its full potential. Here are some of its most notable capabilities:

1. SQL and PL/SQL Development

- Write, execute, and debug SQL queries with syntax highlighting and code completion.
- Develop, test, and debug PL/SQL procedures, functions, and packages.

- Support for SQL Worksheet for quick query execution.

2. Database Object Management

- Create, alter, and drop tables, views, indexes, sequences, and other objects.
- Design and visualize database schemas through diagramming tools.
- Manage constraints, triggers, and stored procedures efficiently.

3. Data Migration and Import/Export

- Import data from various formats like CSV, Excel, and XML.
- Export data and database objects for backup or migration purposes.
- Assist in migrating databases from other platforms to Oracle.

4. Performance Monitoring and Tuning

- Access real-time performance metrics of Oracle databases.
- Analyze query execution plans to optimize performance.
- Utilize tuning advisors and diagnostic tools integrated into the IDE.

5. Version Control Integration

- Connect with popular version control systems like Git, Subversion, and CVS.
- Manage database scripts and object changes within version control workflows.

6. Reports and Data Visualization

- Create custom reports on database objects, performance, and user activity.
- Use built-in charting tools for visual data analysis.

Benefits of Using Oracle SQL Developer

Adopting Oracle SQL Developer offers numerous advantages for database professionals:

1. Cost-Free and Cross-Platform

As a free tool provided by Oracle, SQL Developer runs on Windows, macOS, and Linux, making it accessible to a broad user base without licensing costs.

2. User-Friendly Interface

Its intuitive GUI simplifies complex database tasks, reducing the learning curve for new users and increasing efficiency for experienced professionals.

3. Integrated Environment

Consolidates multiple tasks?such as writing queries, managing objects, and performance tuning?within a single environment, eliminating the need for multiple tools.

4. Extensible and Customizable

Supports plugins and custom extensions, allowing users to tailor the IDE to their specific workflows and requirements.

5. Strong Community and Support

Numerous online resources, tutorials, and forums are available to assist users in troubleshooting and learning advanced features.

Getting Started with Oracle SQL Developer

To begin using Oracle SQL Developer effectively, follow these steps:

1. Download and Install

- Visit the official Oracle SQL Developer download page.
- Choose the version compatible with your operating system.
- Follow the installation instructions provided.

2. Connect to Your Oracle Database

- Open SQL Developer and click the "New Connection" button.
- Enter your database credentials: username, password, and connection details.
- Test the connection to ensure correctness, then save it for future use.

3. Explore the Interface

Familiarize yourself with key panels such as the Connections navigator, SQL Worksheet, and Reports tab.

Best Practices for Using Oracle SQL Developer

Maximizing your efficiency with SQL Developer involves adopting some best practices:

1. Organize Your Workspaces

- Group related connections in folders.
- Use projects to group scripts, reports, and other resources.

2. Use Snippets and Templates

- Create reusable code snippets for common queries or procedures.
- Leverage template features to generate boilerplate code quickly.

3. Automate Routine Tasks

- Schedule scripts or reports using built-in scheduling tools or external schedulers.
- Use command-line interfaces for batch operations.

4. Regularly Backup and Version Control

- Export scripts and object definitions periodically.
- Integrate with version control systems to track changes over time.

5. Leverage Performance Tools

- Use Explain Plan and SQL Tuning Advisor to optimize queries.
- Monitor active sessions and wait events to identify bottlenecks.

Advanced Tips for Power Users

For experienced users looking to deepen their mastery of Oracle SQL Developer, consider these advanced tips:

1. Customizing the IDE

- Adjust color schemes and fonts for better readability.
- Install plugins for additional functionality, such as data modeling or data import utilities.

2. Scripting and Automation

- Write complex scripts using SQLPlus scripts integrated within SQL Developer.
- Automate repetitive tasks with scripting tools and external schedulers.

3. Data Modeling and Design

- Use the Data Modeler feature to create ER diagrams and visualize database schemas.
- Generate DDL scripts from models for deployment.

4. Security and User Management

- Create and manage user accounts and roles within SQL Developer.
- Set privileges and audit user activities for compliance.

Common Challenges and Troubleshooting

While Oracle SQL Developer is a robust tool, users may encounter some challenges:

1. Connection Issues

- Verify network configurations and firewall settings.
- Ensure the correct Oracle client version is installed.

2. Performance Problems

- Optimize queries using execution plans.

- Monitor system resources and adjust configurations accordingly.

3. Compatibility and Updates

- Keep SQL Developer updated to the latest version for compatibility and security patches.
- Check for known issues with specific Oracle database versions.

Conclusion

Oracle SQL Developer stands out as an indispensable tool for anyone working with Oracle databases. Its comprehensive features, user-friendly interface, and powerful capabilities make it ideal for database development, management, and performance tuning. By understanding its core features, adopting best practices, and exploring advanced functionalities, users can significantly enhance their productivity and ensure their Oracle databases operate efficiently. Whether you're just starting or an experienced database professional, mastering Oracle SQL Developer will undoubtedly be a valuable investment in your career.

Remember, continuous learning and exploration are key. Take advantage of online resources, tutorials, and community forums to deepen your understanding and stay updated with the latest features and best practices in Oracle SQL Developer.

Oracle SQL Developer: A Comprehensive Guide to the Essential Tool for Database Professionals

Introduction

Oracle SQL Developer has established itself as an indispensable tool for database administrators, developers, and analysts working with Oracle databases. As a free integrated development environment (IDE) provided by Oracle Corporation, SQL Developer streamlines the process of database development, management, and troubleshooting. Its intuitive interface, robust features, and versatility make it a go-to solution for both novice and experienced users who require efficient access to their Oracle data environments. In this article, we delve into the core functionalities, features, and practical applications of Oracle SQL Developer, providing a detailed overview for those seeking to harness its full potential.

What is Oracle SQL Developer?

Oracle SQL Developer is a graphical user interface (GUI) tool designed to simplify and accelerate database development and management tasks. Released by Oracle Corporation, it replaces traditional command-line interfaces like SQLPlus with a modern, user-friendly environment that caters to a range of database activities.

Key Characteristics:

- Free and Open: No licensing costs, making it accessible to individual developers and organizations.
- Cross-Platform Compatibility: Runs on Windows, Linux, and macOS.
- Extensible: Supports plugins to enhance functionality.
- Integrated: Combines multiple tools such as SQL querying, PL/SQL development, data modeling, and database administration within a single platform.

Core Features of Oracle SQL Developer

- SQL Querying and Data Manipulation

At its heart, SQL Developer provides a powerful SQL worksheet that enables users to write, execute, and analyze SQL queries with ease. Features include:

- Syntax highlighting and code completion for faster coding.
- Query result grids with sorting, filtering, and export options.
- Support for executing multiple queries in a single script.
- Visual Query Builder for drag-and-drop query creation without extensive SQL knowledge.

- PL/SQL Development Environment

PL/SQL, Oracle's procedural extension to SQL, is vital for complex database logic. SQL Developer offers:

- PL/SQL editors with debugging capabilities.
- Breakpoints, step-through debugging, and variable inspection.
- Code snippets and templates for rapid development.
- Version control integration for collaborative development.

- Database Administration and Management

Beyond development, SQL Developer provides tools for database administration, including:

- User and privilege management.
 - Monitoring of database health and performance metrics.
 - Session management to view and control active connections.
 - Backup and recovery options, often through integration with RMAN (Recovery Manager).
-
- Data Modeling and Design

Data modeling aids in the visual representation of database structures. SQL Developer includes:

- Data Modeler tool for creating, editing, and visualizing logical and physical data models.
 - Forward and reverse engineering capabilities.
 - Support for various modeling standards like ER diagrams.
 - Schema comparison and synchronization.
-
- Data Migration and Connectivity

Migrating data from other databases or versions is simplified via:

- Migration wizard supporting heterogeneous sources (e.g., MySQL, Microsoft SQL Server).
- Data import/export features supporting formats like CSV, Excel, XML.
- Connectivity options including JDBC, ODBC, and Oracle Net.

Practical Applications of Oracle SQL Developer

Development and Testing

Developers leverage SQL Developer to write and test SQL and PL/SQL code efficiently. Its debugging tools help troubleshoot complex scripts, optimize performance, and ensure code quality.

Database Administration

DBAs utilize SQL Developer for routine administrative tasks?monitoring sessions, managing user privileges, and performing schema changes?all within a consolidated environment.

Data Analysis

Analysts can query and visualize data directly within SQL Developer, export results for further

analysis, or generate reports that support business decision-making.

Data Migration Projects

Organizations undertaking database upgrades or migrations benefit from SQL Developer's migration tools, reducing downtime and minimizing errors.

Advanced Features and Customization

Automation and Scripting

While SQL Developer is primarily GUI-based, it supports automation through scripting and command-line options, enabling scheduled tasks and batch operations.

Extensibility

The platform supports plugins, allowing users to customize and augment its capabilities. Popular plugins include:

- Version control integrations (e.g., Git, Subversion).
- Additional data visualization tools.
- Performance tuning utilities.

Workspace and User Preferences

Personalization options allow users to tailor the workspace, including themes, keyboard shortcuts, and window layouts, enhancing productivity.

Comparing SQL Developer with Other Tools

While tools like TOAD, SQLPlus, or Oracle Enterprise Manager are also prevalent, SQL Developer offers a unique blend of accessibility, comprehensive features, and cost-effectiveness. Its open-source nature and continuous updates from Oracle ensure it remains relevant and aligned with current database management trends.

Strengths:

- Free and regularly updated.
- User-friendly interface.

- Rich feature set covering development, administration, and modeling.

Limitations:

- May lack some advanced performance tuning features available in commercial tools.
- Performance can be impacted with very large databases or complex schemas.

Getting Started with Oracle SQL Developer

Installation

Installing SQL Developer is straightforward:

- Download the latest version from Oracle's official website.
- Ensure Java Development Kit (JDK) is installed, as SQL Developer depends on it.
- Follow the setup instructions; no complex configuration is typically required.

Connecting to an Oracle Database

- Launch SQL Developer.
- Create a new connection by providing:
 - Connection name.
 - Username and password.
 - Hostname and port.
 - Service name or SID.
- Test the connection and save.

Once connected, users can start executing queries, managing schemas, or exploring data.

Best Practices for Using SQL Developer

- Organize your connections using folders for different environments (development, testing, production).

- Utilize version control integrations to manage code changes.
- Regularly update to benefit from new features and security patches.
- Backup scripts and models regularly to prevent data loss.
- Leverage snippets and templates to accelerate repetitive tasks.

The Future of Oracle SQL Developer

As Oracle continues to evolve its database ecosystem, SQL Developer is poised to incorporate more advanced features such as:

- Enhanced support for cloud-based Oracle Autonomous Database.
- Improved performance tuning and monitoring tools.
- Better integration with DevOps workflows.
- AI-powered insights for query optimization and anomaly detection.

Conclusion

Oracle SQL Developer stands out as a versatile, powerful, and user-friendly platform that caters to the full spectrum of database tasks—from development and testing to administration and modeling. Its rich feature set, combined with ease of use and free availability, makes it an essential tool in any Oracle database professional's toolkit. As data environments grow more complex and demand more agility, SQL Developer's continued development promises to keep it at the forefront of Oracle database management solutions, empowering users to work more efficiently and effectively.

Whether you are just starting your journey with Oracle databases or are a seasoned expert, mastering SQL Developer can significantly enhance your productivity and deepen your understanding of database systems.

Question What are the key features of Oracle SQL Developer? Oracle SQL Developer offers features such as a user-friendly interface for database management, SQL and PL/SQL development, data modeling, debugging tools, query optimization, database migration, and reporting capabilities, making it a comprehensive tool for Oracle database administrators and developers. **Answer** How do I connect Oracle SQL Developer to a remote database? To connect to a remote database, open SQL Developer, click on the 'Connections' pane, select 'New Connection,' enter the connection details such as hostname, port, service name or SID, username, and password, then test the connection and save it for future use. Can I use Oracle SQL Developer with non-Oracle databases? While primarily designed for Oracle databases, Oracle SQL Developer does support connections to some non-Oracle databases such as MySQL, SQL Server, and PostgreSQL through JDBC drivers, but functionality may be limited compared to Oracle databases. What are some common troubleshooting tips for Oracle SQL Developer connection issues? Common tips include verifying

network connectivity, checking that the database listener is running, ensuring correct connection details (hostname, port, service/SID), updating JDBC drivers, and reviewing firewall settings to allow database access. How can I install plugins or extensions in Oracle SQL Developer? Plugins can be installed via the 'Help' menu by selecting 'Check for Updates' or 'Install Additional Components.' You can also manually add third-party plugins by downloading their zip files and installing through the 'Help' > 'About' > 'Plugins' menu. Is Oracle SQL Developer suitable for database version control? Yes, Oracle SQL Developer supports version control integrations with systems like Git and Subversion, allowing developers to manage database scripts, track changes, and collaborate effectively during development. What are the best practices for writing efficient SQL queries in Oracle SQL Developer? Best practices include using proper indexing, avoiding unnecessary data retrieval, writing clear and concise queries, utilizing explain plans to analyze query performance, and leveraging built-in tools like SQL Tuning Advisor for optimization.

Related keywords: Oracle SQL Developer, SQL, Database, PL/SQL, Data Modeling, Query Builder, Data Migration, SQL Optimization, Database Management, Schema Design

Read the full article online: [ORACLE SQL DEVELOPER](#)

Oracle Database Appliance Migration Strategies

oracle database appliance migration strategies are critical for organizations seeking to optimize their database infrastructure, ensure minimal downtime, and maintain data integrity during transitions. Migration processes can be complex, involving multiple technical considerations such as data transfer methods, compatibility issues, and downtime planning. Properly planning and executing an Oracle Database Appliance (ODA) migration can significantly improve performance, reduce operational risks, and extend the lifespan of existing hardware while leveraging newer technologies or cloud environments. This article explores comprehensive strategies, best practices, and key considerations to ensure a smooth and efficient migration of Oracle Database Appliances.

Understanding Oracle Database Appliance (ODA) and Its Significance

What is Oracle Database Appliance?

Oracle Database Appliance (ODA) is a pre-configured, integrated hardware and software system optimized for running Oracle databases. It simplifies deployment, management, and maintenance of database environments, offering high availability, scalability, and security features out-of-the-box.

Why Migrate an ODA?

Organizations may choose to migrate their ODA due to:

- Hardware End-of-Life or Decommissioning
- Upgrading to Newer Oracle Database Versions
- Moving to Cloud Platforms
- Consolidating Data Centers
- Improving Performance and Scalability
- Cost Optimization

Key Considerations Before Starting an ODA Migration

Assessment and Planning

- Inventory of Existing Environment: Document current hardware, software versions, database configurations, and workloads.
- Compatibility Checks: Verify compatibility between source and target systems, Oracle versions, and OS platforms.
- Downtime Planning: Estimate acceptable downtime window and communicate with stakeholders.
- Data Size and Transfer Methods: Assess data volume to select suitable migration tools and strategies.
- Resource Allocation: Ensure skilled personnel, hardware resources, and backup solutions are in place.

Backup and Risk Management

- Take comprehensive backups before migration.
- Establish rollback procedures in case of failure.
- Test backups to ensure data recoverability.

Choosing the Right Migration Strategy

Factors influencing strategy choice include data size, downtime tolerance, technical complexity, and available tools.

Common Oracle Database Appliance Migration Strategies

1. Data Pump Export/Import

This method involves exporting the database from the source system and importing it into the target system.

Advantages:

- Suitable for smaller databases.
- Ensures data consistency.
- Can be used for schema-only migrations.

Disadvantages:

- Downtime required during export/import.
- Not ideal for very large databases.

Steps:

- Export the database using `Data Pump Export (expdp)`.
- Transfer dump files to the target system.
- Import the database using `Data Pump Import (impdp)`.
- Reconfigure network and service endpoints.

2. RMAN (Recovery Manager) Duplicate

RMAN duplication creates a copy of the database using backup sets or active database cloning.

Advantages:

- Efficient for large databases.
- Supports incremental backups.
- Minimal downtime when using active duplication.

Disadvantages:

- Requires careful configuration.
- Needs proper backup management.

Steps:

- Take a backup of the source database.
- Use RMAN duplicate command to clone the database on the target.
- Adjust network configurations and listener settings.
- Validate the migration.

3. Oracle Data Guard

Data Guard provides disaster recovery and data replication features, facilitating near-zero downtime migration.

Advantages:

- Minimal downtime.
- Maintains a synchronized standby database.
- Supports rolling migrations.

Disadvantages:

- Complex setup.
- Additional licensing costs.

Steps:

- Set up Data Guard configuration between primary and standby.
- Perform a switchover or failover at the appropriate time.
- Redirect applications to the new environment.
- Decommission old system if needed.

4. GoldenGate Replication

Oracle GoldenGate offers real-time data replication, enabling live migration with minimal impact.

Advantages:

- Very low downtime.
- Supports heterogeneous environments.
- Continuous replication during migration.

Disadvantages:

- Licensing and setup complexity.
- Additional hardware and software requirements.

Steps:

- Install GoldenGate on source and target.
- Configure initial data synchronization.
- Enable real-time replication.
- Cut over once data is synchronized.

Migration Process Workflow

Step 1: Pre-Migration Preparation

- Perform thorough assessment.
- Establish migration timeline.
- Backup all data.
- Test migration procedures in a staging environment.

Step 2: Data Transfer and Synchronization

- Choose appropriate method based on data size and downtime constraints.
- Conduct initial data copy.
- Synchronize ongoing transactions if needed.

Step 3: Cutover and Validation

- Schedule downtime for final switch.
- Redirect applications to the new appliance.
- Validate data integrity and system functionality.

- Monitor system performance.

Step 4: Post-Migration Activities

- Decommission old hardware if applicable.
- Document the migration process.
- Optimize the new environment.
- Conduct performance tuning and security assessments.

Best Practices for Successful ODA Migration

- Comprehensive Testing: Always test migration procedures in a non-production environment.
- Clear Communication: Keep stakeholders informed about plans, timelines, and potential impacts.
- Incremental Approach: When possible, migrate in phases to reduce risk.
- Automation Tools: Utilize Oracle Enterprise Manager or third-party tools to streamline migration.
- Monitoring: Post-migration monitoring ensures stability and performance.

Challenges and How to Mitigate Them

- Data Loss: Ensure reliable backups and test recovery procedures.
- Downtime Overruns: Plan for contingencies and set realistic expectations.
- Compatibility Issues: Conduct thorough compatibility checks beforehand.
- Performance Bottlenecks: Perform performance testing and tuning post-migration.
- Security Risks: Update security configurations and audit access controls.

Conclusion

Oracle Database Appliance migration requires meticulous planning, suitable strategy selection, and careful execution to ensure minimal disruption and data integrity. Whether employing Data Pump, RMAN, Data Guard, GoldenGate, or hybrid approaches, organizations must align their migration plans with business needs, technical capabilities, and resource availability. Adhering to best practices and leveraging automation tools can significantly enhance success rates. Ultimately, a well-executed migration can unlock new performance levels, enable infrastructure modernization, and support future growth.

Additional Resources

- Oracle Official Documentation on ODA Migration
- Best Practices for Oracle Data Guard and GoldenGate
- Oracle Support and Community Forums
- Third-party Tools for Oracle Migration Assistance

Optimizing your Oracle Database Appliance migration strategies ensures a seamless transition, safeguarding your data, and providing a foundation for future scalability. Planning, testing, and executing with precision are the keys to success.

Oracle Database Appliance Migration Strategies: Navigating the Path to Modernization

Oracle Database Appliance migration strategies are critical considerations for organizations seeking to enhance their database infrastructure, improve performance, and reduce operational costs. As enterprises increasingly adopt cloud solutions, upgrade legacy systems, or consolidate data centers, understanding the nuances of migrating Oracle Database Appliances (ODA) becomes paramount. This article delves into comprehensive migration strategies, exploring best practices, challenges, and practical steps to ensure a smooth transition to newer, more efficient Oracle database environments.

Introduction to Oracle Database Appliance and Migration Needs

Oracle Database Appliance (ODA) is an integrated, pre-configured hardware and software platform designed for simplifying database deployment and management. It offers a turnkey solution that combines hardware, storage, and Oracle Database software optimized for high availability and performance.

However, as organizations evolve—whether by upgrading hardware, migrating to cloud, or consolidating databases—migration becomes inevitable. The reasons for migration include:

- End-of-life hardware or software support
- Performance improvements through newer Oracle versions
- Cost reduction via consolidation or cloud migration
- Enhanced security and compliance requirements
- Business continuity and disaster recovery enhancements

Successfully migrating an Oracle Database Appliance requires a well-thought-out strategy, encompassing technical planning, risk management, and minimal downtime. The following sections outline the primary approaches and best practices.

Key Migration Strategies for Oracle Database Appliances

- Lift-and-Shift (Rehost) Migration

Overview:

The simplest approach involves moving the existing database environment from the current ODA to a new infrastructure with minimal changes. This method is often favored for its speed and simplicity, especially during data center consolidations or hardware refreshes.

Process Steps:

- Backup and Prepare: Full database backups and validation.
- Provision New Hardware: Set up the target environment?could be another ODA, cloud infrastructure, or a different hardware platform.
- Data Transfer: Use tools like Data Pump, RMAN, or Oracle GoldenGate for data migration.
- Validation: Ensure data integrity post-migration.
- Switch Over: Redirect applications to the new environment.

Advantages:

- Minimal application changes.
- Faster migration timelines.
- Lower initial planning complexity.

Challenges:

- Limited optimization for newer environments.
- Potential performance discrepancies if hardware differences are significant.
- No immediate benefit from new features or architecture improvements.

- Database Upgrade and Migration

Overview:

This approach combines migrating the database environment with an upgrade to a newer Oracle Database version. It's suitable when organizations want to leverage new features, improved performance, or enhanced security.

Process Steps:

- Assessment: Compatibility checks for the target Oracle Database version.
- Planning: Decide between in-place upgrade or migration to a new server.
- Testing: Perform test upgrades in a non-production environment.
- Migration Execution: Use tools like Data Pump, RMAN, or Data Guard for data transfer.
- Post-migration Validation: Confirm application compatibility and performance benchmarks.

Advantages:

- Access to new features and improvements.
- Better performance and security.
- Reduced downtime with well-planned upgrade windows.

Challenges:

- Compatibility issues with applications or custom code.
 - Potential for unforeseen bugs or issues during upgrade.
 - Need for comprehensive testing.
-
- Data Guard and Replication-Based Migration

Overview:

Utilizing Oracle Data Guard or replication technologies allows for near-zero downtime migrations, especially critical for mission-critical systems.

Process Steps:

- Configure Data Guard: Set up a standby database on the target environment.
- Synchronization: Keep the standby synchronized with the primary during migration.
- Switchover: Transition to the standby as the primary.
- Validation and Cutover: Final checks before directing applications.

Advantages:

- Minimal or zero downtime.
- Continuous data availability.
- Ease of rollback if needed.

Challenges:

- Complexity in setup and configuration.
- Requires additional infrastructure.
- Potential data lag during synchronization.

- Cloud-Based Migration

Overview:

Moving Oracle databases from on-premises ODAs to cloud platforms (Oracle Cloud, AWS, Azure) is increasingly common, offering scalability, cost savings, and flexibility.

Process Steps:

- Assessment and Planning: Identify suitable cloud services and migration tools.
- Replatforming or Rehosting: Decide whether to lift-and-shift or replatform with optimizations.
- Data Transfer: Use Oracle Data Pump, GoldenGate, or cloud-native services.
- Configuration and Tuning: Optimize cloud environment for performance.
- Validation: Ensure data integrity and application compatibility.

Advantages:

- Scalability and flexibility.
- Reduced hardware management overhead.
- Access to cloud-native services like automated backups, disaster recovery, and analytics.

Challenges:

- Data security and compliance considerations.
- Network bandwidth limitations.
- Potential latency issues.

Best Practices for Successful ODA Migration

Implementing an effective migration plan involves meticulous planning and execution. The following best practices can mitigate risks and ensure a successful transition:

Conduct Thorough Assessment and Discovery

- Understand the existing environment: Hardware specifications, database sizes, custom configurations.
- Identify dependencies: Applications, integrations, network considerations.
- Evaluate compatibility: Oracle versions, patch levels, operating systems.

Develop a Clear Migration Roadmap

- Define objectives: Downtime windows, success criteria.
- Prioritize phases: Pilot testing, validation, full cutover.
- Allocate resources: Skilled personnel, testing environments.

Perform Comprehensive Testing

- Functional testing: Application behavior post-migration.
- Performance testing: Benchmark before and after.
- Recovery testing: Backup and restore processes.

Backup and Rollback Planning

- Always maintain current backups before migration.
- Prepare rollback procedures in case of failure.
- Document rollback steps thoroughly.

Minimize Downtime

- Use replication technologies or Data Guard for near-zero downtime.
- Schedule migrations during low-traffic periods.
- Communicate clearly with stakeholders.

Post-Migration Optimization

- Tune database parameters for the new environment.
- Re-assess storage and networking configurations.
- Monitor performance metrics closely.

Challenges and Risks in ODA Migration

While migration strategies are well-established, several challenges can arise, requiring careful mitigation:

- Data Loss: Inadequate backups or errors during transfer.
- Application Downtime: Underestimating migration duration.
- Compatibility Issues: Custom scripts or applications not compatible with newer versions.
- Performance Degradation: Hardware differences or improper tuning.
- Security Concerns: Data exposure during transfer or in new environments.

Mitigating these risks involves rigorous testing, documentation, and contingency planning.

Future Trends in Oracle Database Migration

The landscape of database migration is evolving with technological advancements:

- Automation Tools: Increased use of orchestration and automation for seamless migrations.
- Hybrid Cloud Strategies: Combining on-premises and cloud environments.
- Containerization: Using Docker and Kubernetes for portable database deployments.
- AI and Machine Learning: Predictive analytics for performance tuning during migration.
- Oracle Autonomous Database: Moving towards self-managing databases reducing migration complexity.

Organizations adopting these trends can expect more streamlined, less risky migration processes in the future.

Conclusion

Navigating the complex terrain of Oracle Database Appliance migration requires a strategic approach tailored to organizational needs. Whether opting for lift-and-shift, upgrade, replication, or cloud migration, success hinges on thorough planning, testing, and execution. By understanding the

strengths and limitations of each strategy and adhering to best practices, organizations can ensure minimal disruption, optimized performance, and a solid foundation for future growth.

In an era of rapid technological change, mastering migration strategies is not just about moving data; it's about transforming IT infrastructure to meet evolving business demands efficiently and securely.

Question What are the key considerations when planning an Oracle Database Appliance migration? Key considerations include assessing current database configurations, ensuring compatibility with the new appliance, planning downtime windows, evaluating network and storage dependencies, and preparing detailed migration procedures to minimize disruption. Which migration strategies are recommended for minimizing downtime during an Oracle Database Appliance upgrade? Strategies such as Data Guard replication, Oracle GoldenGate, or Active Data Guard are recommended for minimal downtime migrations, allowing data synchronization while the source database remains operational before switchover. How does Oracle Data Pump assist in migrating databases to an Oracle Database Appliance? Oracle Data Pump enables fast and efficient export/import of database data and metadata, making it suitable for large database migrations with minimal downtime, especially when combined with parallel processing and network optimization. What role does Oracle RMAN play in migrating to an Oracle Database Appliance? Oracle RMAN provides reliable backup and restore capabilities, allowing databases to be backed up from the source environment and restored onto the appliance, facilitating a streamlined and consistent migration process. Are there any best practices for testing the migration process before executing it on production systems? Yes, best practices include performing test migrations in a staging environment, validating data integrity and performance, rehearsing failover procedures, and documenting rollback plans to ensure a smooth production migration. What are common challenges faced during an Oracle Database Appliance migration and how can they be mitigated? Common challenges include data inconsistency, configuration mismatches, and unexpected downtime. These can be mitigated through thorough planning, comprehensive testing, detailed documentation, and employing reliable migration tools like Data Guard or RMAN.

Related keywords: Oracle database appliance migration, database upgrade strategies, appliance migration planning, data transfer techniques, downtime minimization, performance optimization, backup and recovery, compatibility considerations, migration tools, deployment best practices

Read the full article online: [Oracle Database Appliance Migration Strategies](#)

Oracle database 12c new features oracle press

oracle database 12c new features oracle press has become a pivotal topic for database administrators, developers, and IT professionals aiming to leverage the latest advancements in Oracle's flagship database platform. Oracle Database 12c, released in 2013, introduced numerous innovative features designed to enhance performance, scalability, security, and manageability. This article explores these new features comprehensively, providing insights into how they can transform enterprise database environments.

Introduction to Oracle Database 12c

Oracle Database 12c, where "c" stands for "Cloud," marks a significant shift towards cloud computing and multi-tenant architecture. It provides a robust platform for deploying, managing, and scaling databases efficiently in both on-premises and cloud environments. The key focus of this release is on simplifying database management, improving resource utilization, and increasing flexibility for modern applications.

Key New Features in Oracle Database 12c

Oracle Database 12c encompasses several groundbreaking features. These can be broadly categorized into architecture enhancements, performance improvements, security enhancements, and management tools.

Multitenant Architecture (Container and Pluggable Databases)

One of the most revolutionary features of Oracle Database 12c is the introduction of the multitenant architecture, which allows multiple pluggable databases (PDBs) within a single container database (CDB).

- **Container Database (CDB):** Serves as a root system container managing common metadata and resources.
- **Pluggable Databases (PDBs):** Self-contained databases that can be plugged into or unplugged from a CDB, facilitating easier database consolidation, provisioning, and upgrade processes.

Benefits:

- Simplified management of multiple databases.
- Reduced resource consumption.
- Easier application provisioning and migration.
- Enhanced security through isolation.

Enhanced Performance Features

Oracle 12c introduces various performance optimizations:

- **In-Memory Column Store:** Allows data to be stored in memory in a columnar format, accelerating analytical queries significantly.
- **Adaptive Query Optimization:** Uses runtime statistics to better optimize query execution plans dynamically.
- **Real-Time Materialized Views:** Enables fast refreshes, making data warehousing and reporting more efficient.
- **Improved Indexing:** Introduction of invisible indexes and automatic index management to optimize query performance without impacting DML operations.

Security Enhancements

Security remains a critical aspect of database management. Oracle 12c introduces several features to strengthen data protection:

- **Data Redaction:** Masks sensitive data in query results to prevent unauthorized access.
- **Enhanced Transparent Data Encryption (TDE):** Facilitates easier encryption management for data-at-rest.
- **Unified Auditing:** Consolidates audit data for simplified compliance and analysis.
- **Privilege Analysis:** Identifies unused privileges, reducing attack surfaces.

Management and Automation Features

To streamline database administration, Oracle 12c offers advanced management tools:

- **Automatic Data Optimization (ADO):** Automates data lifecycle management, including compression and movement based on usage patterns.
- **Cloud Control and Enterprise Manager Enhancements:** Provides centralized monitoring, diagnostics, and automation capabilities.
- **Online Migration and Patching:** Enables database upgrades and patches with minimal downtime.

Oracle Database 12c New Features in Detail

Multitenant Architecture: A Game-Changer

The multitenant architecture fundamentally changes how databases are deployed and maintained. It simplifies consolidation strategies by allowing multiple PDBs to run within a single CDB, sharing common memory and background processes.

Advantages:

- Rapid provisioning of new databases.
- Easier upgrades and patches across multiple databases.
- Reduced hardware footprint and licensing costs.
- Seamless migration and cloning of databases.

Implementation Considerations:

- Compatibility with existing applications.
- Licensing implications, as multitenant is an additional feature.
- Management tools and best practices to handle multi-tenant environments.

In-Memory Column Store for Accelerated Analytics

This feature leverages in-memory technology to store data in a columnar format, drastically improving query response times for analytical workloads.

Key Benefits:

- Real-time analytics.
- Reduced CPU and I/O consumption.
- Compatibility with existing SQL queries, minimizing application changes.

Implementation Tips:

- Identify high-demand tables for in-memory optimization.
- Balance in-memory size with available hardware resources.
- Monitor in-memory statistics to optimize performance.

Advanced Security Features

Security enhancements in Oracle 12c address the increasing need for data privacy and compliance:

- Data Redaction: Provides dynamic data masking, which is crucial in scenarios where sensitive data should not be exposed, such as in reporting or third-party access.
- Unified Auditing: Simplifies audit trail management by consolidating audit data across the database.
- Enhanced TDE: Supports transparent encryption of data files, backups, and network communications.

Best Practices:

- Regularly review audit logs.
- Implement data redaction policies for sensitive columns.
- Keep encryption keys secure and compliant with organizational policies.

Managing Oracle Database 12c

Effective management is vital for maximizing the benefits of new features:

Oracle Enterprise Manager (OEM) Enhancements

OEM provides a centralized platform for managing Oracle databases, and in 12c, it includes:

- Automated performance diagnostics.
- Cloud management features for provisioning and patching.
- Advanced monitoring capabilities for multi-tenant environments.

Automation with Oracle Data Guard and RMAN

Oracle 12c enhances disaster recovery and backup management with:

- Simplified Data Guard configurations.
- Fast incremental backups.
- Automated maintenance tasks.

Conclusion: Embracing the Future with Oracle Database 12c

Oracle Database 12c's new features mark a significant evolution in database technology, emphasizing cloud readiness, security, performance, and manageability. The multitenant architecture alone revolutionizes database consolidation and provisioning, enabling organizations to

reduce costs and increase agility. The in-memory column store accelerates analytics, supporting modern data-driven decision-making.

Security features like data redaction and unified auditing help organizations meet compliance requirements with ease. Meanwhile, management tools and automation capabilities reduce administrative burdens, allowing DBAs to focus on strategic initiatives.

For organizations seeking to stay ahead in the competitive landscape, understanding and adopting Oracle Database 12c's new features is essential. Whether deploying on-premises or in the cloud, these enhancements provide a robust foundation for modern enterprise applications.

Further Reading and Resources:

- Oracle Press Publications on Oracle Database 12c.
- Official Oracle Documentation.
- Oracle Learning Library tutorials and webinars.
- Community forums and user groups for shared experiences and best practices.

By leveraging these new features effectively, businesses can achieve higher performance, enhanced security, and greater operational efficiency, ensuring their database infrastructure is prepared for future challenges.

oracle database 12c new features oracle press

Oracle Database 12c marked a significant milestone in the evolution of Oracle's flagship database management system, introducing a host of innovative features designed to enhance performance, scalability, security, and manageability. As organizations increasingly adopt cloud computing and big data strategies, Oracle 12c's new capabilities aim to streamline database operations while empowering developers and administrators with advanced tools. This article explores the most notable features of Oracle Database 12c as highlighted by Oracle Press, providing a comprehensive yet accessible overview for IT professionals, database administrators, and technology enthusiasts eager to understand what sets this version apart.

Introduction to Oracle Database 12c

Oracle Database 12c, released in 2013, stands for "Cloud," reflecting Oracle's strategic shift toward cloud-native architectures and multi-tenant environments. It builds upon the robust foundation of previous Oracle databases while introducing features tailored to meet the demands of modern data workloads. The "c" in 12c emphasizes its focus on cloud computing, enabling organizations to deploy, manage, and scale databases more efficiently in the cloud or on-premises.

The overarching goal of Oracle 12c is to provide a flexible, scalable, and secure platform capable of supporting diverse applications, ranging from transactional systems to data warehouses. Its new features facilitate better resource utilization, simplified management, and enhanced data security—all critical in today's fast-paced digital landscape.

Key New Features of Oracle Database 12c

Oracle Press emphasizes several core areas where 12c introduces groundbreaking features. These include the multitenant architecture, enhancements in performance, security improvements, and advanced data management capabilities.

Multitenant Architecture: The Core Innovation

What is Multitenant Architecture?

One of the most transformative features introduced in Oracle 12c is the multitenant architecture. This architecture allows a single container database (CDB) to host multiple pluggable databases (PDBs), effectively enabling a multi-tenant environment within a single database instance.

Benefits of Multitenant Architecture

- **Simplified Consolidation:** Multiple databases can coexist within a single container, reducing hardware costs and simplifying management.
- **Improved Resource Utilization:** PDBs share the same memory and background processes, optimizing resource use.
- **Rapid Provisioning:** New databases can be created quickly by plugging in pre-configured PDBs.
- **Enhanced Manageability:** PDBs can be unplugged, plugged, or cloned independently, streamlining database operations.

Practical Implications

For organizations managing numerous databases—such as SaaS providers or large enterprises—the multitenant architecture significantly reduces administrative overhead. It facilitates easier patching, upgrades, and backups at the container level rather than individual databases.

Performance and Scalability Enhancements

In-Memory Column Store

Oracle 12c introduces the Database In-Memory option, which enables the database to store data in

a columnar format alongside traditional row-based storage. This dual-format approach accelerates analytical queries and mixed workloads.

Key features include:

- Real-time analytics: Data is available in-memory for rapid query execution.
- Selective column caching: Administrators can specify which tables or columns are stored in-memory.
- Compatibility: Works seamlessly with existing applications without requiring significant changes.

Adaptive Query Optimization

Oracle 12c enhances its optimizer with adaptive capabilities that adjust execution plans during runtime based on real-time statistics. This results in:

- More efficient query plans
- Reduced need for manual tuning
- Improved performance for complex queries

Partitioning Enhancements

Partitioning in Oracle 12c is more flexible, allowing:

- Interval Partitioning: Automates the creation of new partitions based on time or other ranges, ideal for data warehouses.
- Reference Partitioning: Maintains data integrity across related tables.
- Partition Maintenance: Simplifies operations like moving or dropping partitions without affecting the entire database.

Security Improvements

Security remains paramount, especially with the increase in cyber threats. Oracle 12c introduces several features to bolster data protection:

Transparent Data Encryption (TDE)

Enhanced in 12c, TDE allows encryption of data at rest, protecting sensitive information from unauthorized access. Improvements include:

- Key Management: Integration with Oracle Wallet and hardware security modules (HSMs).
- Tablespace Encryption: Encrypt entire tablespaces effortlessly.
- Column Encryption: Fine-grained encryption for specific columns.

Privilege and Role Management

Oracle 12c simplifies privilege management with:

- Role Hierarchies: Create nested roles for better access control.
- Unified Auditing: Centralized auditing system for tracking database activities, aiding compliance.

Data Redaction

Dynamic data redaction enables sensitive data to be masked in query results, reducing the risk of exposure during user interactions or application development.

Data Management and Integration Features

JSON Support

With the rise of web and mobile applications, Oracle 12c introduces native support for JSON data types, enabling:

- Efficient storage and retrieval of JSON documents.
- SQL functions for querying JSON data.
- Integration with existing relational data.

Enhanced Data Pump and Recovery

Oracle 12c improves data export/import tools, making data movement more efficient. Features include:

- Partition-wise Data Pump: Allows parallel processing of individual partitions.
- Online Data Movement: Enables data operations without downtime.

In-Memory Analytics

Coupled with the in-memory column store, Oracle 12c enhances analytics by allowing:

- Real-time data analysis
- Complex aggregations and joins executed swiftly

Cloud and Deployment Features

Cloud-Ready Architecture

Oracle 12c is optimized for deployment in cloud environments, supporting:

- Private, public, and hybrid clouds
- Oracle Cloud Infrastructure integration
- Containerization and virtualization support

Flexibility in Deployment

- Automatic Storage Management (ASM): Simplifies storage provisioning.
- Data Guard and Recovery Options: Enable high availability and disaster recovery.
- In-Memory Cloud Service: Provides on-demand in-memory capabilities in the cloud.

Management and Monitoring Tools

Oracle 12c introduces advanced tools to simplify database administration:

- Oracle Management Cloud: A comprehensive suite for monitoring, analytics, and automation.
- Automatic Indexing: The database automatically creates, drops, or modifies indexes based on workload patterns, reducing manual intervention.
- Enhanced Diagnostics: Improved diagnostics and health checks facilitate proactive maintenance.

Conclusion: Embracing the Future with Oracle 12c

Oracle Database 12c's new features, as highlighted by Oracle Press, demonstrate Oracle's commitment to addressing the complex needs of modern data management. From its innovative multitenant architecture to advanced security and performance enhancements, 12c equips organizations with a versatile, scalable, and secure platform. As enterprises navigate an increasingly cloud-centric world, Oracle 12c's capabilities enable them to innovate faster, manage data more efficiently, and ensure security and compliance.

Adopting Oracle 12c requires careful planning and understanding of its features, but the benefits—cost savings, agility, and robust performance—make it a compelling upgrade. Whether deployed on-premises or in the cloud, Oracle Database 12c stands as a powerful tool in the data-driven era, paving the way for smarter, more resilient enterprise systems.

Final Thoughts

The evolution of Oracle Database through version 12c underscores the shifting landscape of data management technology. Its focus on cloud readiness, security, and performance optimization reflects industry trends and organizational needs. For IT professionals and decision-makers, mastering these new features opens opportunities to leverage the full potential of Oracle's database solutions, driving innovation and competitive advantage in their respective fields.

Question What are the key new features introduced in Oracle Database 12c as highlighted by Oracle Press? Oracle Database 12c introduces features like multitenant architecture, enhanced security with data masking and redaction, improved performance with in-memory capabilities, and advanced automation tools, all detailed extensively in Oracle Press publications. **How does the multitenant architecture in Oracle 12c benefit database management?** The multitenant architecture allows you to manage multiple pluggable databases within a single container database, simplifying consolidation, provisioning, and maintenance, which is comprehensively covered in Oracle Press resources. **What new security features are available in Oracle Database 12c?** Oracle 12c introduces advanced security features such as data redaction, privilege analysis, and enhanced encryption options, enabling better data protection and compliance, as detailed in Oracle Press guides. **Can you explain the in-memory capabilities of Oracle Database 12c?** Yes, Oracle 12c's in-memory feature accelerates analytics and transactional processing by allowing data to be stored in a columnar format in memory, significantly boosting performance, with detailed implementation steps available in Oracle Press publications. **What automation features does Oracle Database 12c provide for DBAs?** Oracle 12c offers automated maintenance tasks, such as automated data patching, tuning, and health checks, reducing manual effort and errors, with comprehensive guidance provided by Oracle Press. **How does Oracle Press cover the new features of Oracle Database 12c for learners and professionals?** Oracle Press provides detailed books, tutorials, and best practice guides that cover all new features of Oracle 12c, including practical examples and deployment strategies for both beginners and experienced professionals. **Are there any enhancements in Oracle Data Pump and SQL Developer in Oracle 12c?** Yes, Oracle 12c includes improvements in Data Pump for faster data export/import and new features in SQL Developer for better database management and development, as documented in Oracle Press publications.

Related keywords: Oracle Database 12c, new features, Oracle Press, pluggable databases, multitenant architecture, data redaction, online table redefinition, invisible columns, JSON support, edition-based redefinition, security enhancements

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