Oracle Real Application Testing - RAT

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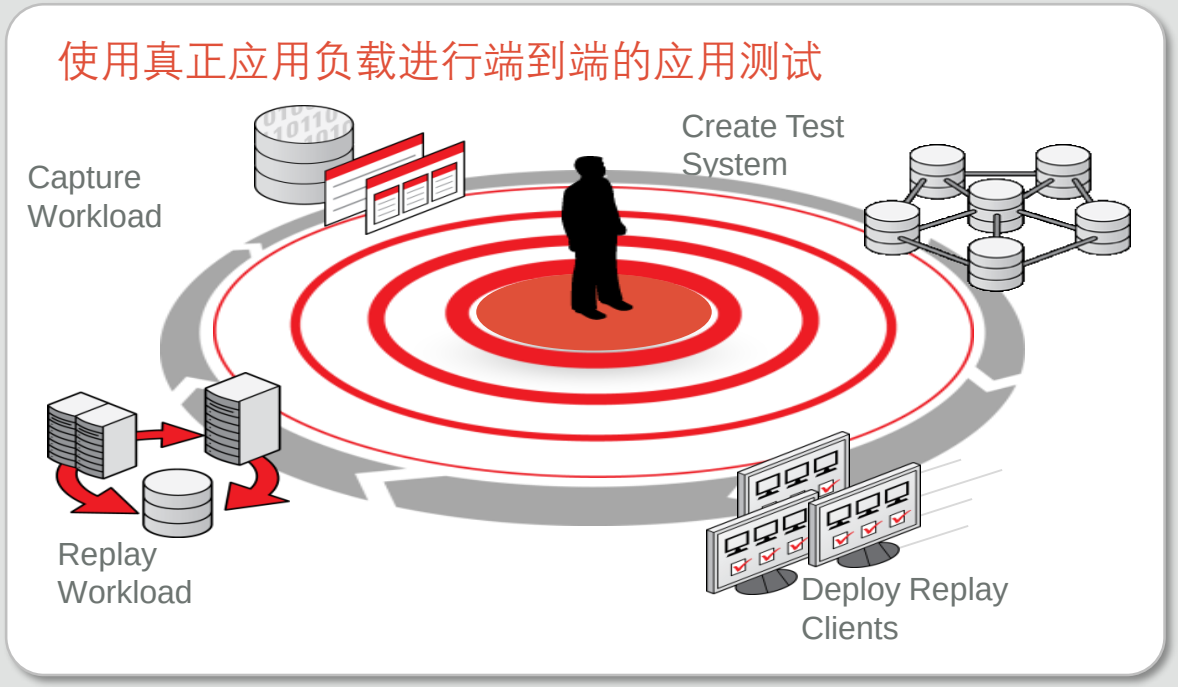
议程

- RAT介绍
- RAT的适用场景
- 使用方法详解及演示

议程

- **RAT介绍**
- RAT的适用场景
- 使用方法详解及演示

性能分析器与数据库重放



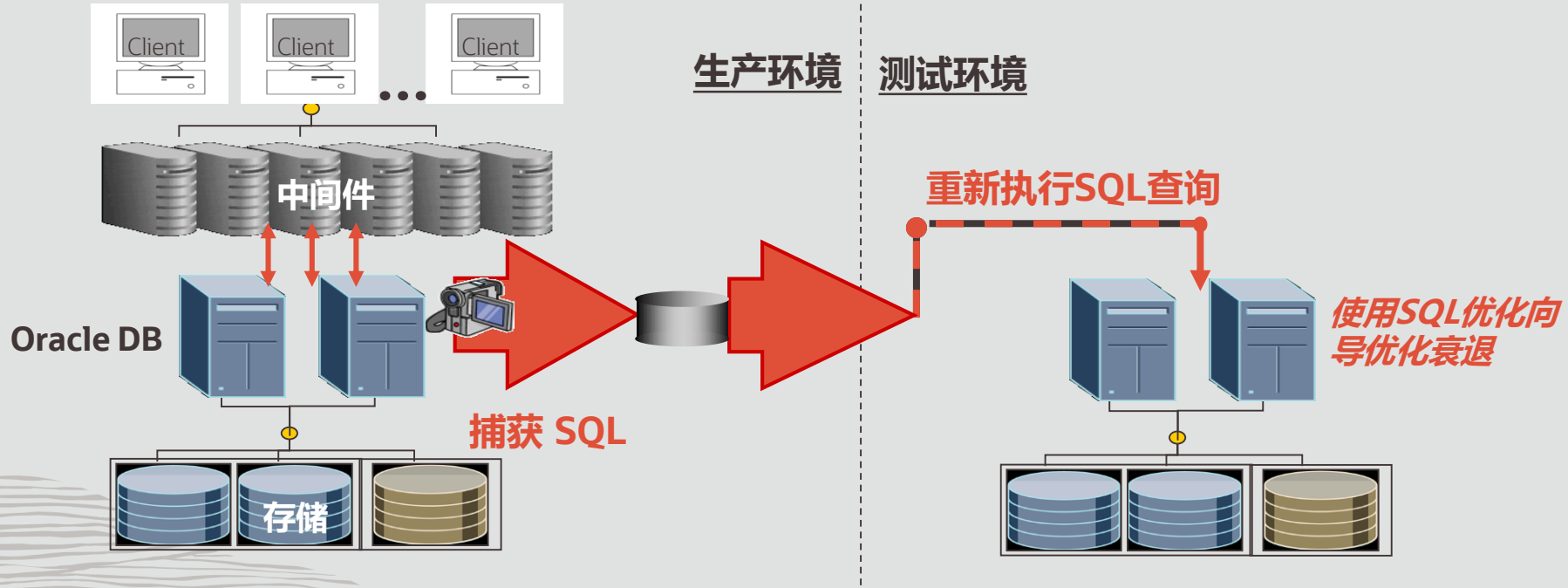
- SQL性能分析器（SPA）
  - SQL unit testing for response time
  - Identify and tune regressed SQL
  - Use SPA first
- 数据库重放（Database Replay）
  - Load, performance testing for throughput
  - Remediate application concurrency problems

- **SQL Performance Analyzer – SPA**

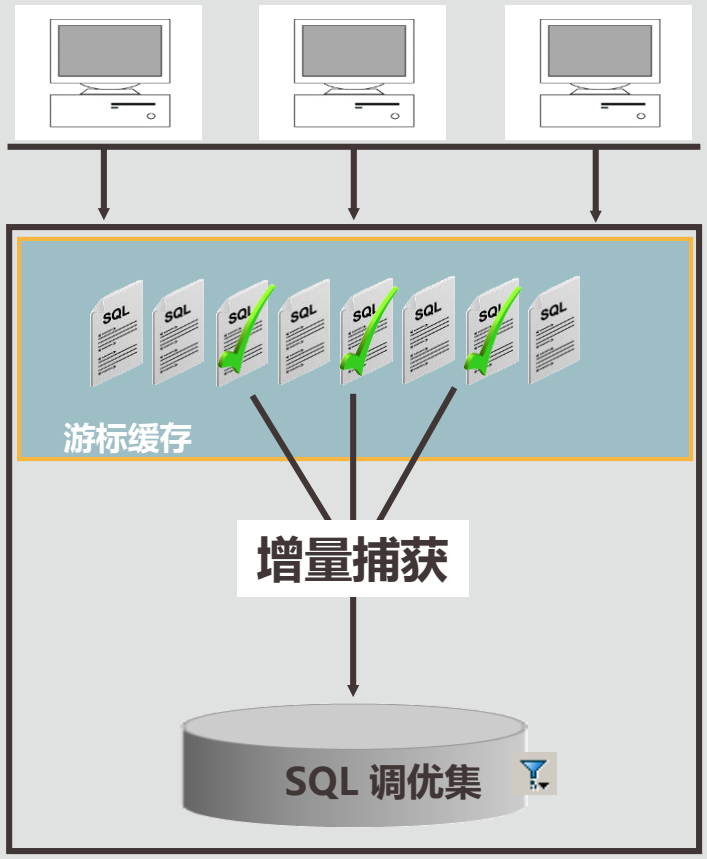
- DB Replay – 数据库重放

SQL 性能分析器 (SPA)

- 测试SQL查询性能方面改变的效果
- 在生产环境中捕获包括统计信息与绑定变量的SQL负载
- 在测试环境中重新执行SQL查询

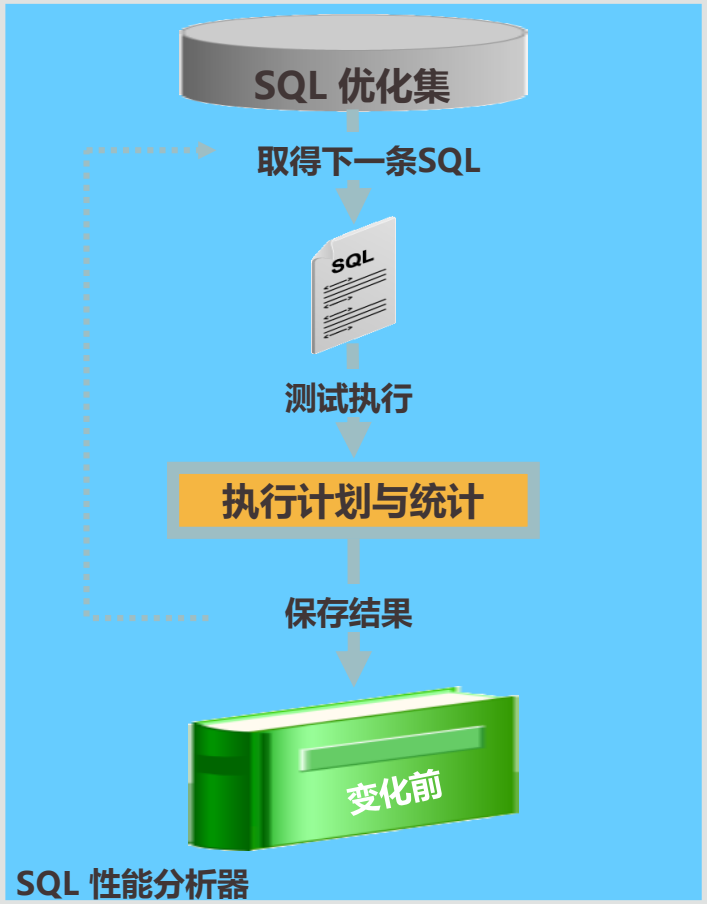


从生产环境中捕获SQL工作量负载



- SQL 调优集 (STS) 用于存储 SQL 工作负载
- STS 包括:
  - SQL 文本
  - 绑定变量
  - 执行计划
  - 执行统计
- 对一个时间段内的游标缓存进行增量捕获并放置于STS
- SQL 调优集过滤与排除不需要的SQL
- 可传输的STS用来将工作量负载移至测试系统

产生变化前执行SQL

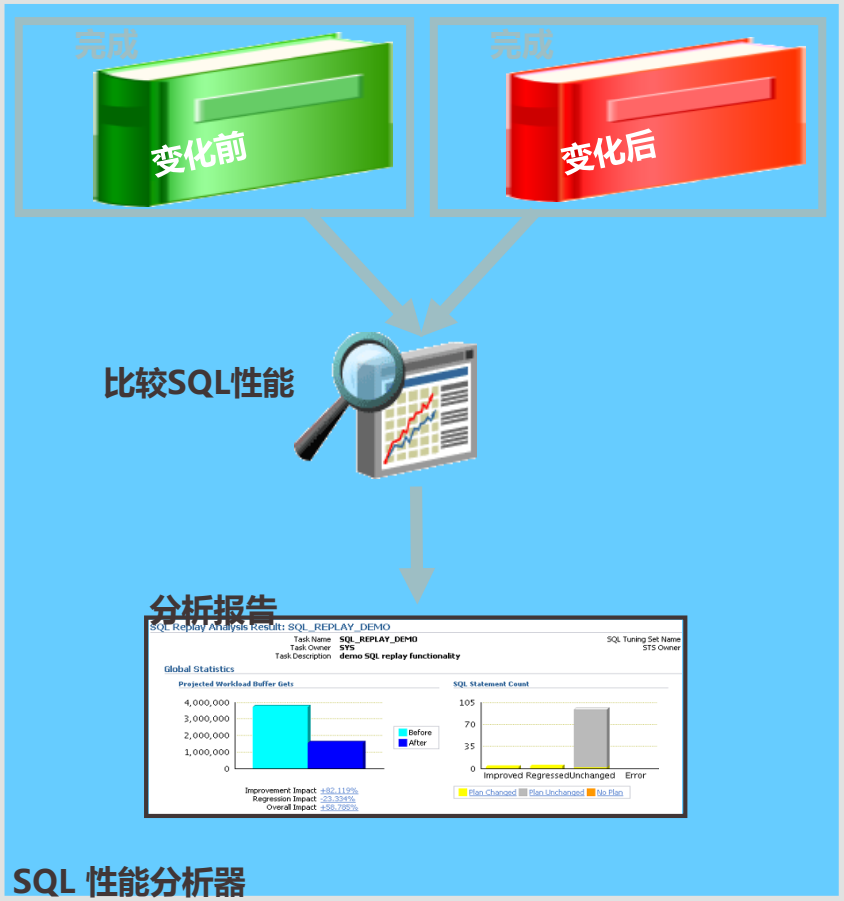


- 建立SQL工作负载性能基线
- 捕获SQL执行计划与统计信息
- 连续执行SQL (非并发)
- 每个SQL只执行一次
- 忽略DDL语句
- 可选择只做执行计划解析选项

产生变化后执行SQL

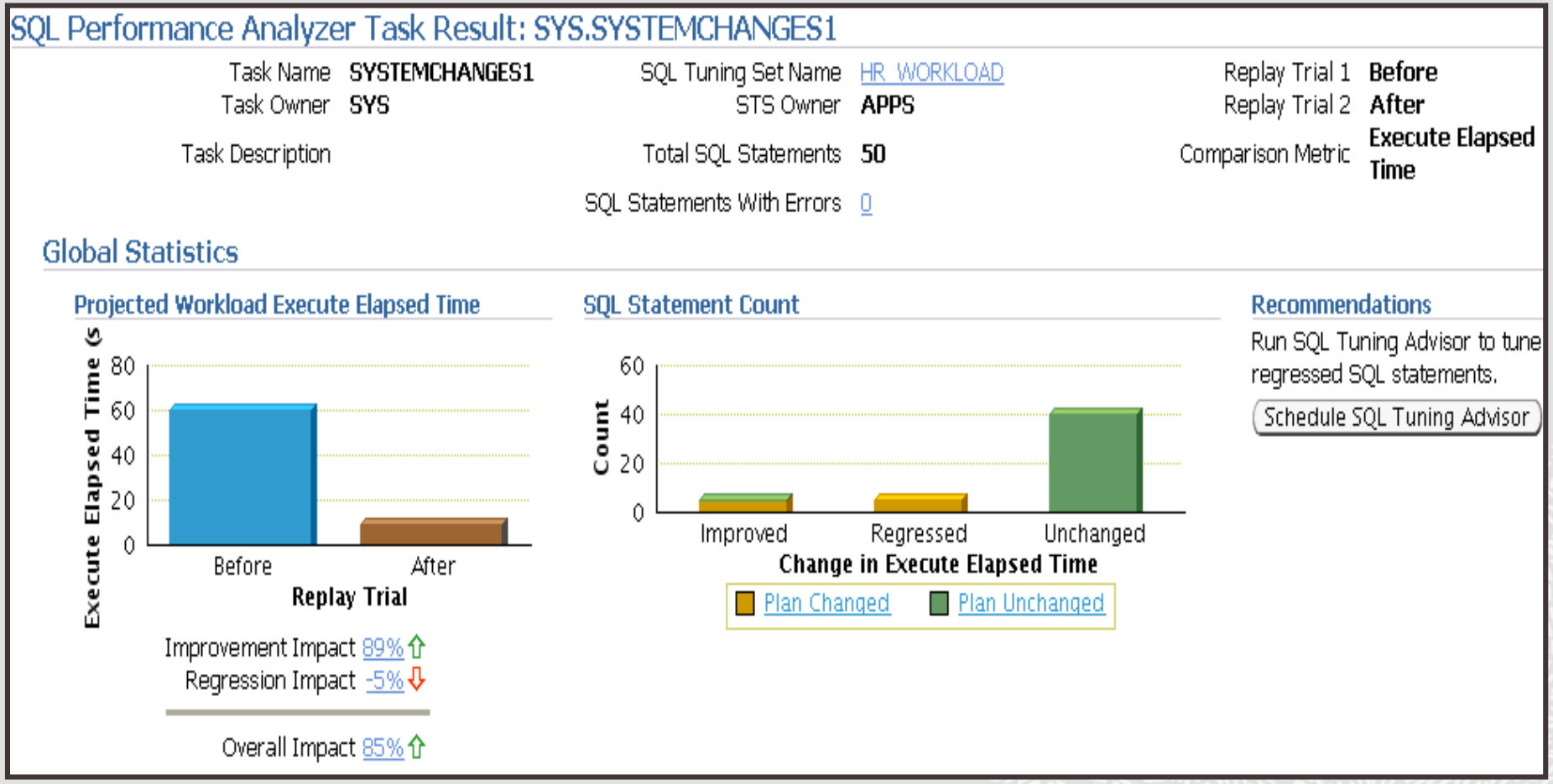
- 手工实施计划的改变:
  - 数据库升级，打补丁
  - 优化统计刷新
  - Schema变化
  - 数据库参数变化
  - 调优活动, 如建立SQL Profile
- 变化后重新执行SQL
  - 收集新的SQL执行计划与统计信息

对比与分析性能



- 使用不同指标对比性能,如:
  - 使用时间
  - CPU时间
  - 优化器成本
  - 缓存读
- SPA 报告会显示每一个SQL的变化的影响
  - 优化 SQL
  - 回退 SQL
  - 非变化 SQL
  - 带错误 SQL
- 使用SQL优化向导与SQL计划基线来修正回退的SQL

SPA 报告


SQL Performance Analyzer Task Result: SYS.SYSTEMCHANGES1
Task Name SYSTEMCHANGES1
Task Owner SYS
Task Description
SQL Tuning Set Name HR_WORKLOAD
STS Owner APPS
Total SQL Statements 50
SQL Statements With Errors 0
Replay Trial 1 Before
Replay Trial 2 After
Comparison Metric Execute Elapsed Time
Global Statistics
Projected Workload Execute Elapsed Time
Execute Elapsed Time (s
80
60
40
20
0
Before
After
Replay Trial
Improvement Impact 89%
Regression Impact -5%
Overall Impact 85%
SQL Statement Count
Count
60
40
20
0
Improved
Regressed
Unchanged
Change in Execute Elapsed Time
Plan Changed
Plan Unchanged
Recommendations
Run SQL Tuning Advisor to tune regressed SQL statements.
Schedule SQL Tuning Advisor

SPA 价值

- 在最终用户受到影响之前可以识别SQL性能的衰减
- SPA 可以对发生任何变化的SQL执行计划所引起的影响进行帮助
  - 数据库升级
  - 优化统计信息更新
  - 新建立的索引，物化视图，分区等
- 可以对成百上千的SQL声明自动进行跟踪-手工是不可能完成的
- 可以低系统影响下捕获SQL工作量负载
- 与修正衰减的SQL调优向导和SQL计划基线进行集成

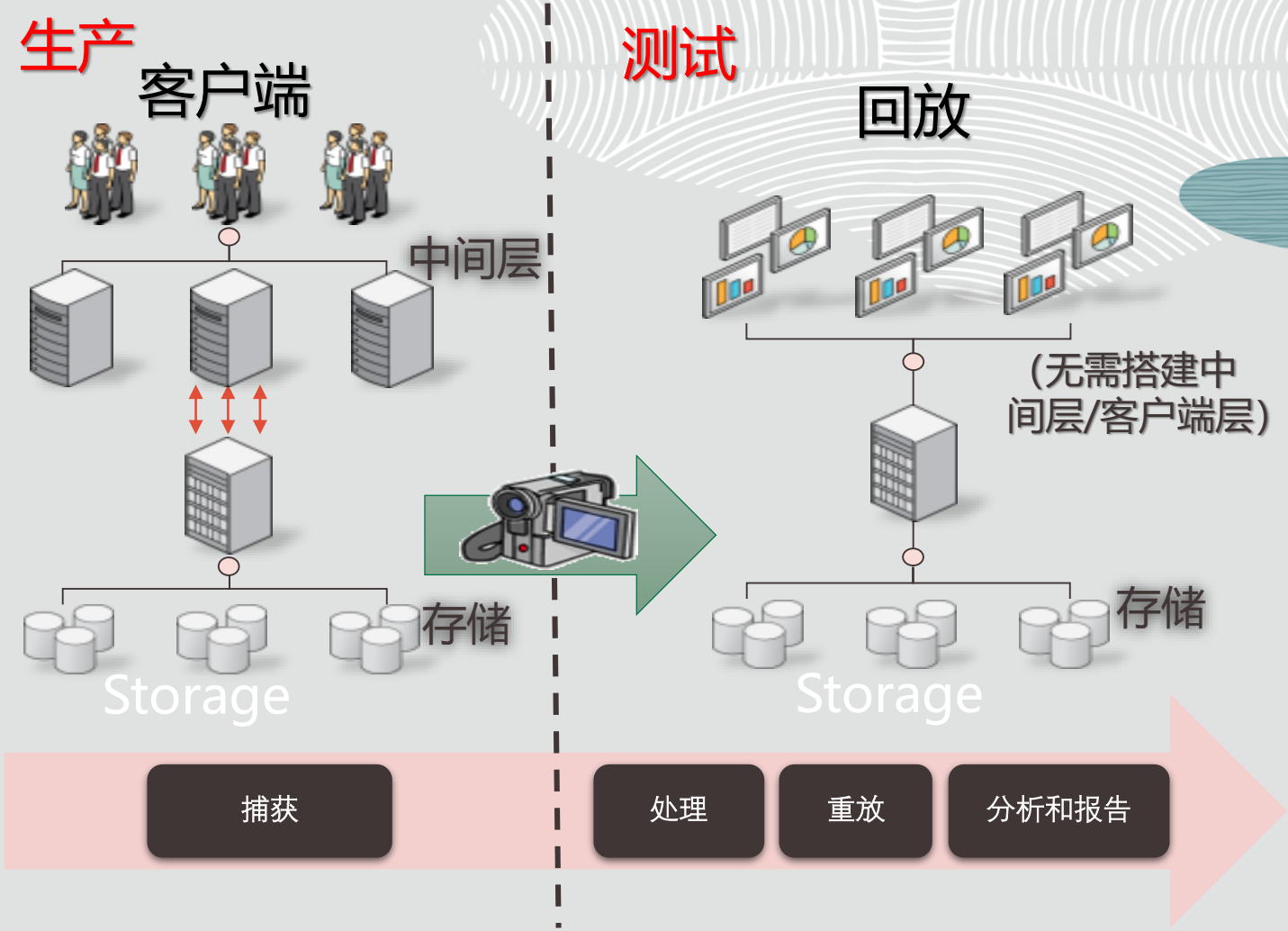
- SQL Performance Analyzer – SPA

- **DB Replay – 数据库重放**

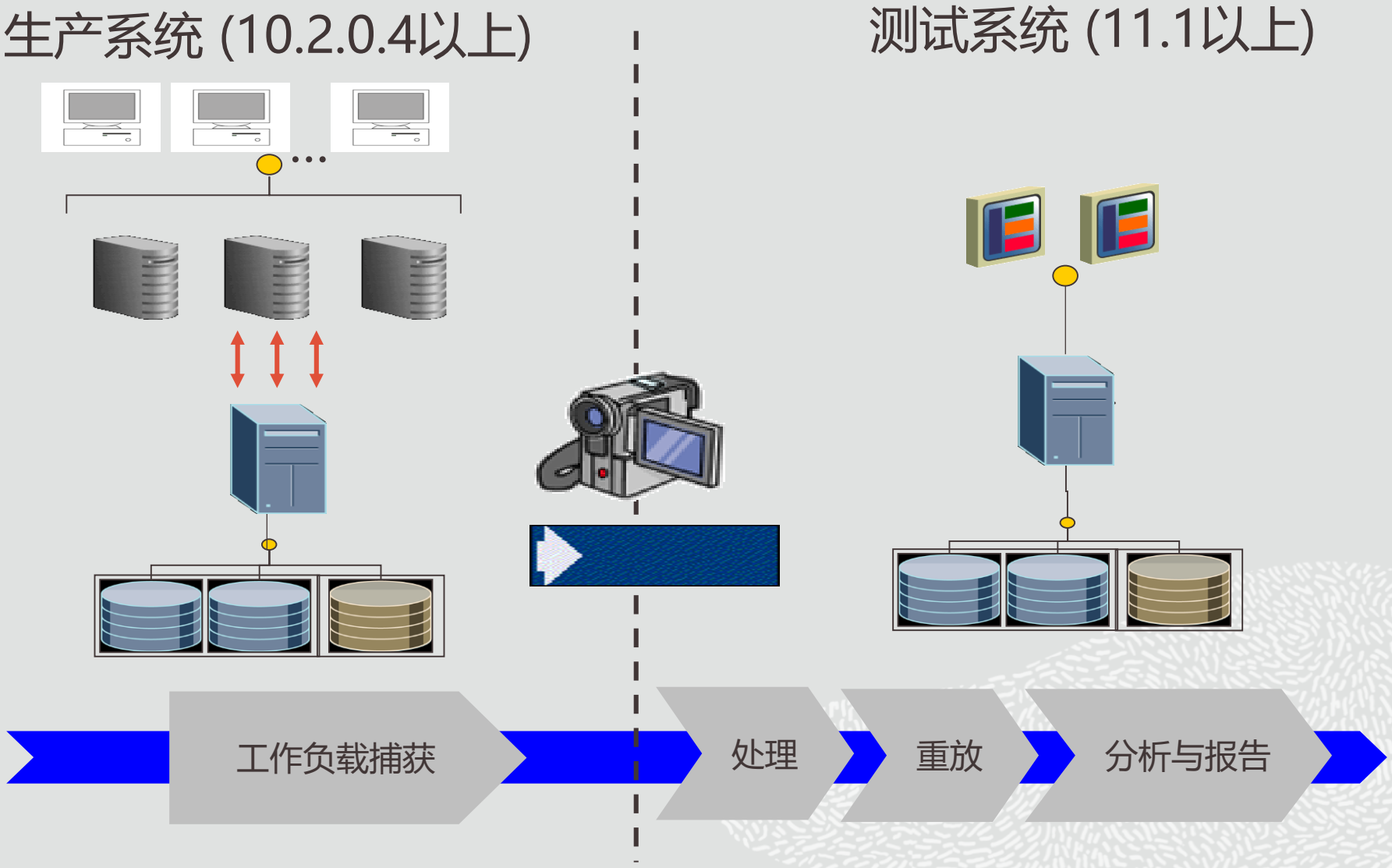
关注实例级性能

数据库重放

- 使用真实的生产环境工作负载来测试数据库负载和性能
  - 生产环境负载的特性：如时间，交易的依赖，维护需要等
  - 测试和度量事务吞吐量的改进
- 定位应用程序的可扩展性和并发性问题
- 在上线前修复问题以降低迁移的风险
- 11g以上版本可以做 Replay



数据库重放工作流

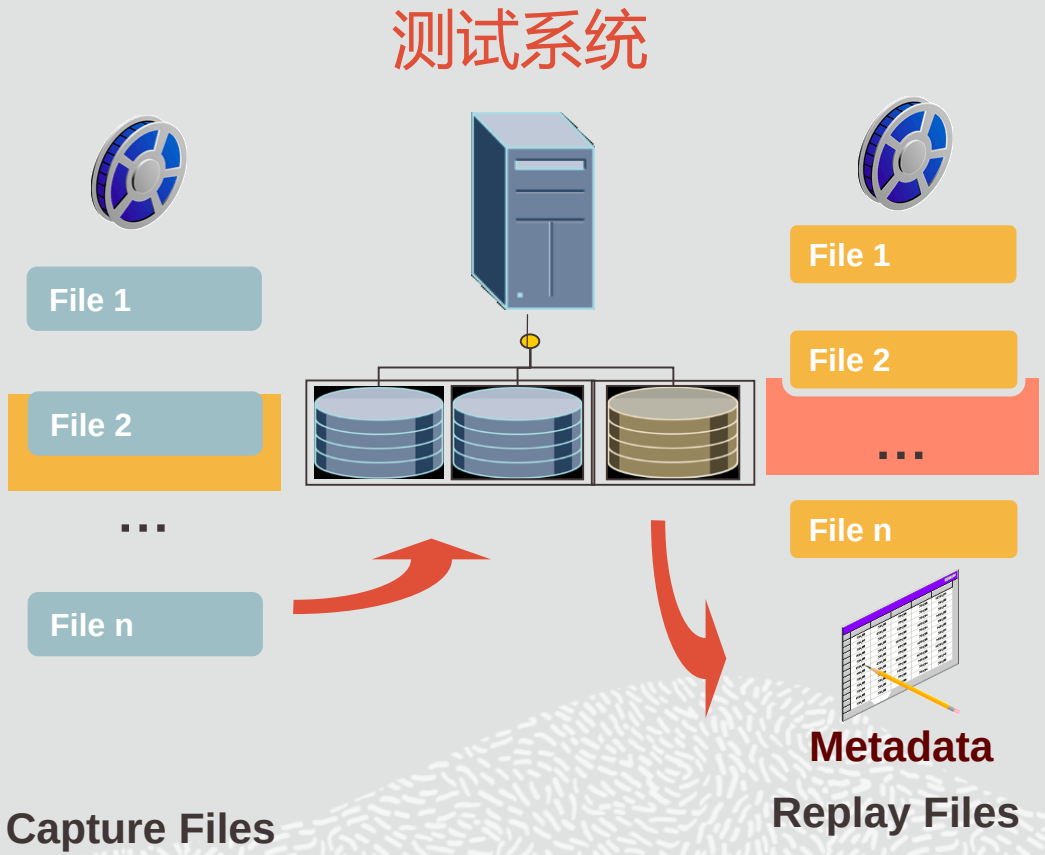


工作负载捕获

- 将所有外部客户端的请求捕获至二进制文件
- 排除系统后台与内部的活动
- 捕获时的最小性能影响
- 支持RAC,共享与本地文件系统
- 可以按感兴趣的时间段指定捕获，如峰值、月末处理期等

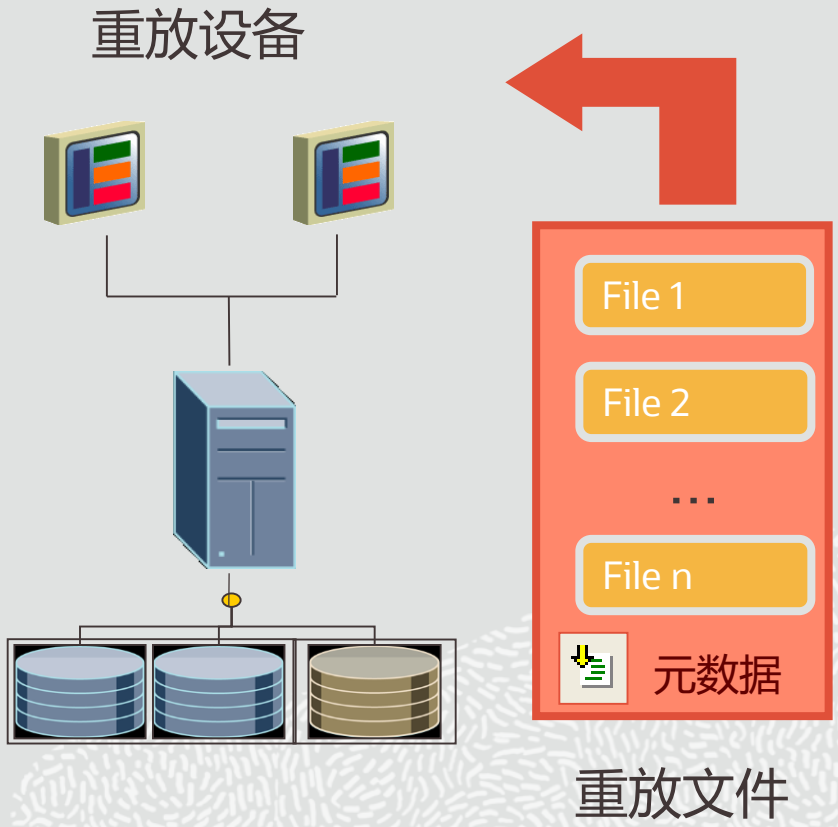
处理负载文件

- 测试数据库服务器上，将捕获的负载处理成可以重放的格式
- 只需要处理一次，可以多次重放
- 对于RAC数据库，捕获文件需要放到同一个位置进行处理
- 推荐采用共享文件系统



工作负载重放

- 工作负载重放保留捕获系统的时间段，并发与依赖关系
- 重放设备是一个消费进程工作负载和向重放系统发送请求的指定客户端程序
- 重放设备由一个或多个客户端组成，为了实现高并发性工作流，可能需要启动多个客户端去推动工作负载



重放分析和报告

- 重放过程中的进度和状态监控：

exec dbms_wrr_report.replay(<replay_id>);

- 提供了全面的报告以供分析
- 报告的差异有三种
  - 数据差异：对比每个调用返回的行数并报告差异
  - 错误差异：对每个调用，都会报告错误差异
    - 新错误：捕获过程中未出现而重放过程中出现的错误
    - 未找到：捕获过程中出现而在重放过程中未出现的错误
    - 变异：重放过程中出现但与捕获过程中不同的错误
  - 性能差异
    - 捕获和重放报告：提供高级别性能信息
    - ADDM 报告：提供深入的性能分析
    - AWR、ASH 报告：帮助进行比较分析或偏差分析

关于录制负载的开销

Database Replay captures the workload of external database clients at the database level and has negligible performance overhead. Capturing the production workload eliminates the need to develop simulation workloads or scripts, resulting in significant cost reduction and time savings. By using Database Replay, realistic testing of complex applications that previously took months using load simulation tools can now be completed in days. This enables you to rapidly test changes and adopt new technologies with a higher degree of confidence and at lower risk.

Oracle RAT负载采集对数据库的负载几乎可以忽略不计。

Determine the location and set up a directory where the captured workload will be stored. Before starting the workload capture, ensure that the directory is empty and has ample disk space to store the workload. If the directory runs out of disk space during a workload capture, the capture will stop. To estimate the amount of disk space that is required, you can run a test capture on your workload for a short duration (such as a few minutes) to extrapolate how much space you will need for a full capture. To avoid potential performance issues, you should also ensure that the target replay directory is mounted on a separate file system.

另外，请将RAT存储负载文件的目录放在单独的文件系统上

除此之外，可以使用EM同时监控整个负载采集过程，如果发现负载过高，可以随时停止采集作业。

关于重放负载时的负载调整

12.1.6.2 Controlling Session Connection Rate

The `connect_time_scale` parameter enables you to scale the elapsed time between the time when the workload capture began and each session connects. You can use this option to manipulate the session connect time during replay with a given percentage value. The default value is 100, which will attempt to connect all sessions as captured. Setting this parameter to 0 will attempt to connect all sessions immediately.

通过调整参数，可以控制负载重放时用户连接的速率，以调整并发数量。

12.1.6.3 Controlling Request Rate Within a Session

User think time is the elapsed time while the replayed user waits between issuing calls within a single session. To control replay speed, use the `think_time_scale` parameter to scale user think time during replay.

通过调整参数，可以控制负载重放时执行负载语句的间隔时间。以调整负载重放的执行速率。

12.1.7 Using Filters with Workload Replay

By default, all captured database calls are replayed during workload replay. You can use workload filters to specify which database calls to include in or exclude from the workload during workload replay.

通过使用过滤器，可以过滤不需要执行的负载，或者指定只执行哪些负载。

RAT的新特性 -12.1

DB Replay:

- 负载整合重放 (Consolidated Database Replay)
  - 将多个捕获的负载整合重放到一个CDB或non-CDB
  - 模拟多数据库迁移整合到统一平台的场景（Exadata），模拟整合后同时并发

- Database Replay 报告增强
  - 利用ASH数据，在报告中内置简要性能分析报告，具体性能差异建议使用ASH, AWR 等性能分析方法

RAT的新特性 -12.2 & 19c

12.2:

DB Replay:

- PL/SQL的捕获和重放的增强，（plsql_mode参数）

SPA:

- 增强支持使用EM Express调用SPA

19:

DB Replay:

- 支持PDB级别的负载捕获和重放

议程

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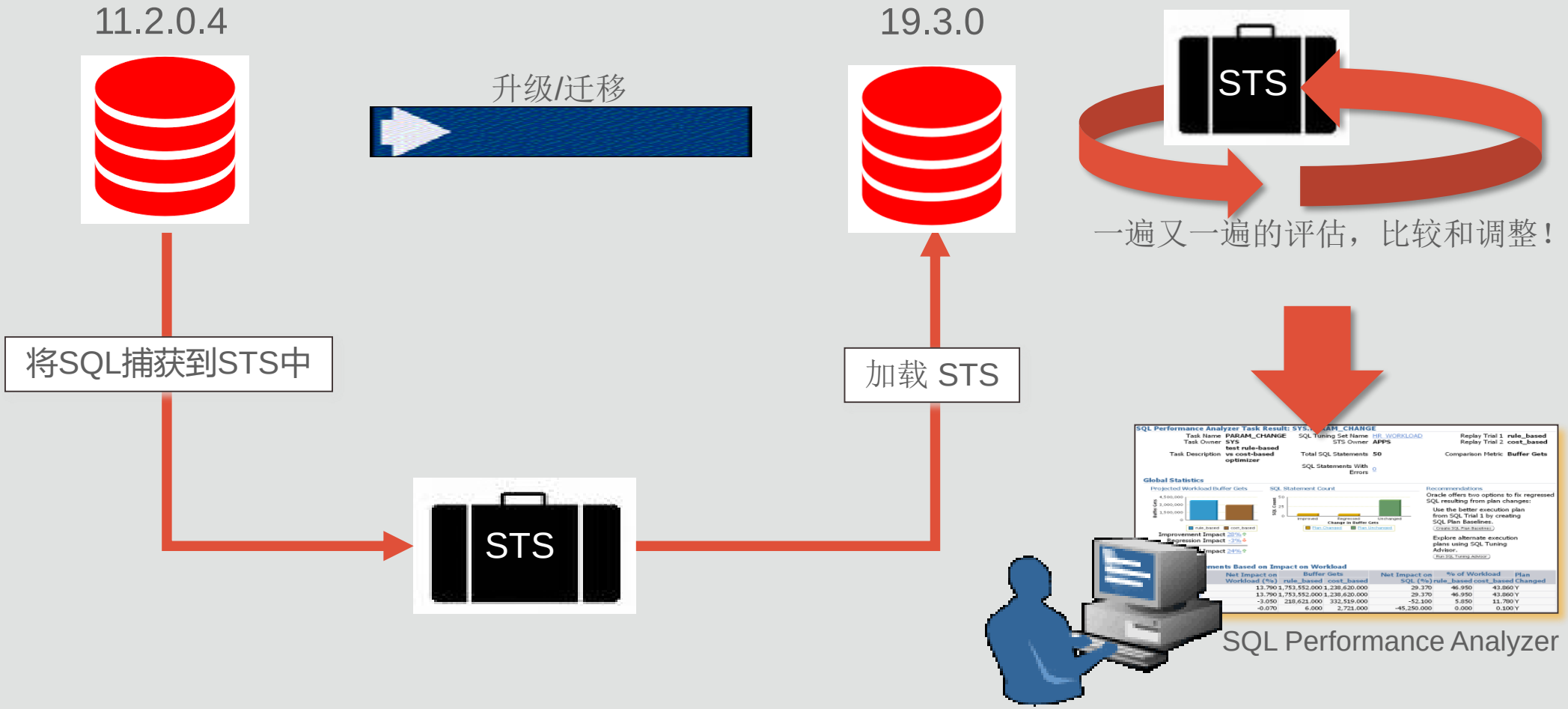
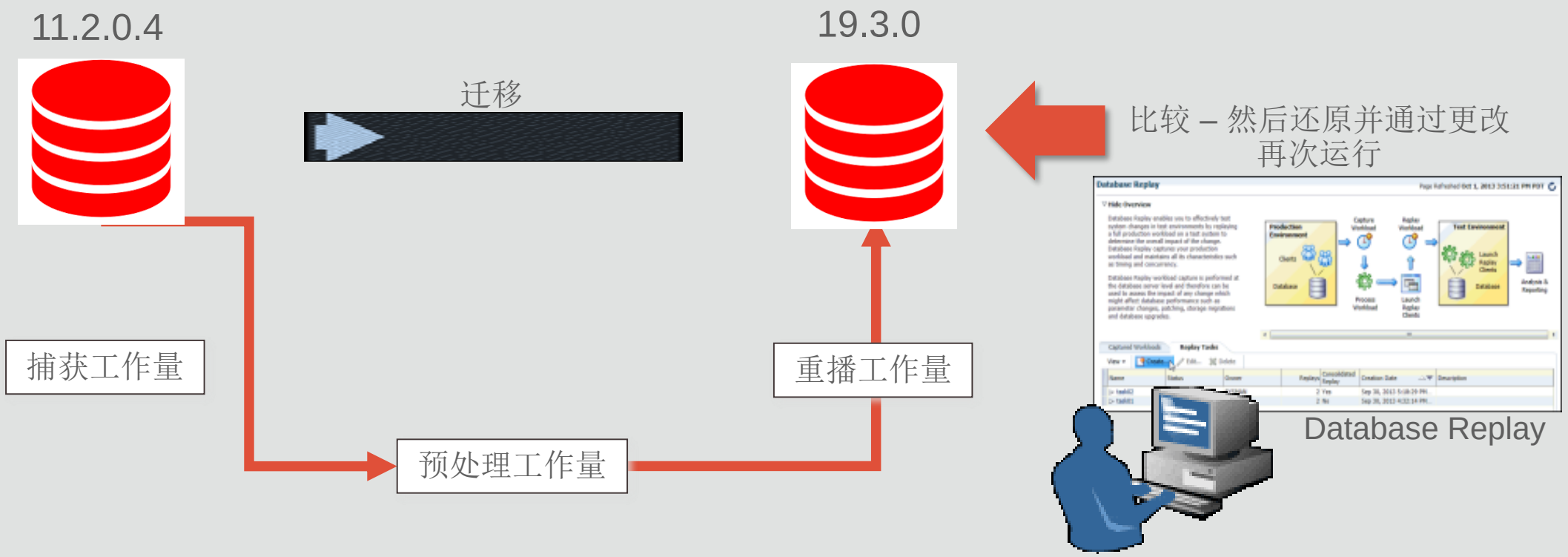
使用SPA还是数据库重放?

Change	Description	SPA	Query Only Replay	Database Replay	Concurrent Replay
SQL Profiles	Implement SQL profiles	✓	✓	✗	✗
Schema Tuning	Adding or droping indexes, Partitioning...	✓	✓	✓	✗
Optimizer Statistics	Refresh statistics on Table,schema or database level	✓	✓	✗	✗
Init.ora Optimizer	DB_FILE_MULTIBLOCK_READ_COUNT, OPTIMIZER_MODE...	✓	✓	✗	✗
Init.ora Memory	SGA_MAX_SIZE, PGA_AGGREGATE_TARGET (Concurrency related)	✗	✓	✓	✗
Features/Options	Compression, In-Memory...	✓	✓	✓	✗
Infra structure	Server, storage, Interconnect...	✓	✓	✓	✗
Upgrades	11g -> 12c, 12.1.0.1 -> 12.1.0.2...	✓	✓	✓	✗
Consolidation	Server Consolidation, Multitenant...	✓	✓	✓	✓
Capacity planning	Server Consolidation, Increasing user activity...	✓	✓	✓	✓
Reactive SQL Performance regression analysis	Find changes in plans and workloads between different days by using Baseline SQL tuning set.	✓	✗	✗	✗
Proactive Identification of high risk SQL statements	Find SQL statements whare SQL plans can change on increasing Data Volumes...	✓	✗	✗	✗

19c升级场景| SQL Performance Analyzer



19c升级场景|数据库重放（Database Replay）



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- DEMO1: SPA演示

- DEMO2: DB Replay演示

Q & A