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TC Platform培训 – 高级应用技术 (1)
—Teamcenter Performance

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Contents

- Performance Improvement Strategy
- Tuning Teamcenter System
- Optimizing Customization Code
- Implementing Applied Technologies
- Standards & Specifications

Description

Purpose

This lesson describes the approaches and processes to enhance Teamctner system performance.

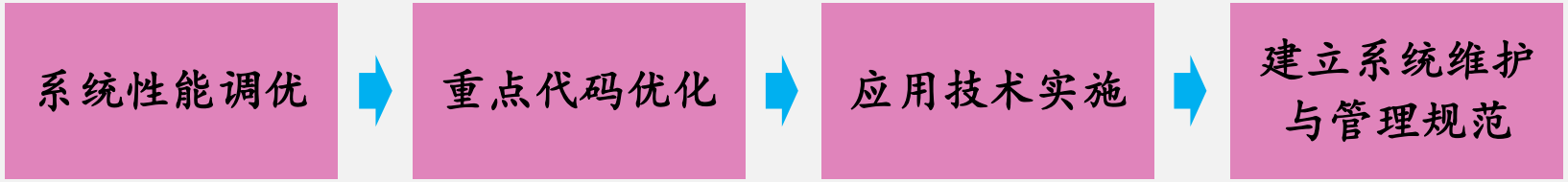
Objectives:

After this training, you should to:

- Understand the scope to enhance the Teamcenter performance
- Master the basic approaches and processes to identify the Teamcenter performance issues and to provide solutions to the issues.

Performance Improvement Strategy

- Strategy Overview
  - Traditional Approaches
    - 增加硬件资源。
    - 调整系统性能参数。
    - 采用技术手段抑制问题的恶化。
    - 其它解决方案(如调整系统架构)。
  - Improved Approaches



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Tuning Teamcenter System

- The scopes to tune Teamcenter system
  - Hardware Resources
  - System Architecture
  - OS & Network (AIX and TCP/IP)
  - Resource Tier (oracle)
  - Enterprise Tier (tcserver and pool manager)
  - Teamcenter Web Tier (WebLogic)
  - Client Tier (4-tier rich client)
  - FMS

Tuning Teamcenter System

- Hardware Resources
  - Initial Sizing for Teamcenter Systeme

    Using OOTB Teamcenter server sizing tool (SPLMInternal_TeamcenterServerSizingEstimator_v4.2.xlsx) to determine the resources required for Teamcenter system initial deployment.
  - 系统正常运行时，硬件资源有效利用率(经验值):

    数据库服务器：CPU利用率<80%; 内存占有率<80%

    TC服务器:　CPU利用率<70%，内存利用率<60%

    Web服务器:　CUP利用率<70%，内存利用率<70%

    FSC服务器：CUP利用率<70%，内存利用率<70%
  - 根据实际生产数据或压力测试数据，建立数据模型进行统计分析 (以TC服务器CPU利用率和在线用户数量的关系为例)，以确定或调整Teamcenter系统在正常运行时需要的硬件资源：

    1). 建立数据模型，例如线性模型：

    $$C = a + b * U \quad \ldots (1)$$

    其中，C为Corp服务器CPU利用率，U为在线用户数，a和b为统计常数

Tuning Teamcenter System

- Hardware Resources (2)

  2). 抽样测试并计算线性常量值

  3). 假设当前系统有n颗CPU提供100% CPU可利用率。那么，在线用户为U时所需的CPU实际数量N为：

  $$N = n * (a + b * U) / 100 \quad \ldots (2)$$

  4). 考虑到tcserver CPU利用率应该<70%，所以应该配置的CPU数量与在线用户的关系为：

  $$N = n * (a + b * U) / 70 \quad \ldots (3)$$

  - 调整硬件资源

    当在线用户数量变化时，根据式(3)调整TC服务器的CPU数量。

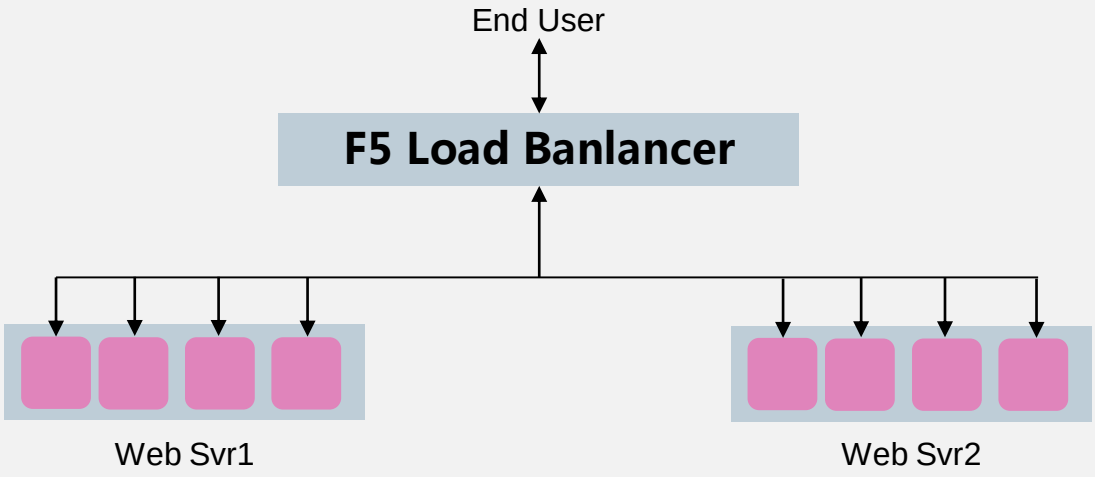
Tuning Teamcenter System

- System Architecture - System Infrastructure
  - Consult with IT expert to tune and optimize the infrastructure for Teamcenter environment.

Tuning Teamcenter System

- System Architecture - Teamcenter Architecture
  - 优化Teamcenter系统架构 (基本原则)
    - 分布式部署

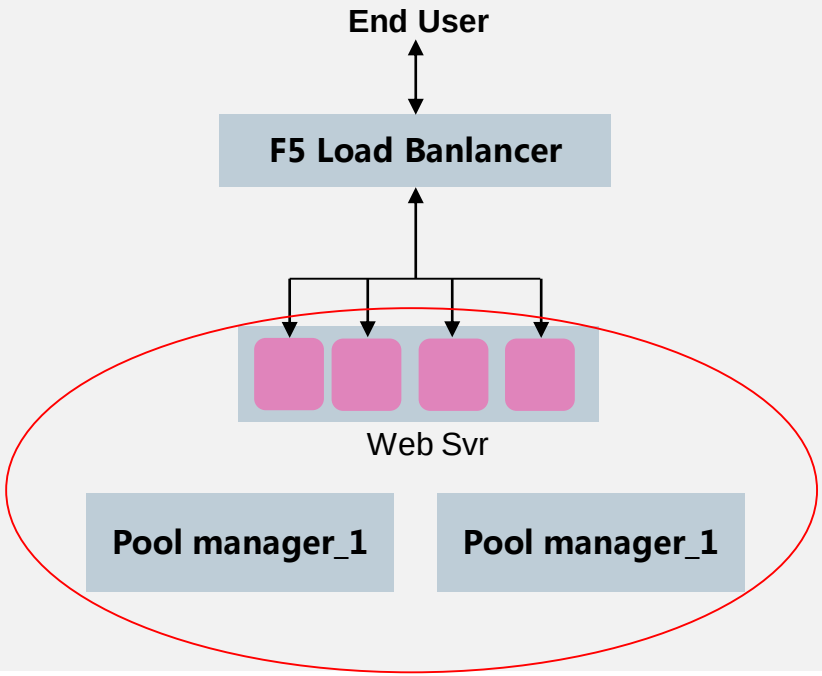
      在TC服务器层和TC Web层进行分布式布署，并尽量保证各个服务器的负载均衡。
    - 减少服务器之间的通信与交互
  - 采用硬件负载均衡器，如F5。按轮训策略或用户自定义策略，把end-user负载均匀地分配到Web-Tier的各个WebLogic节点。

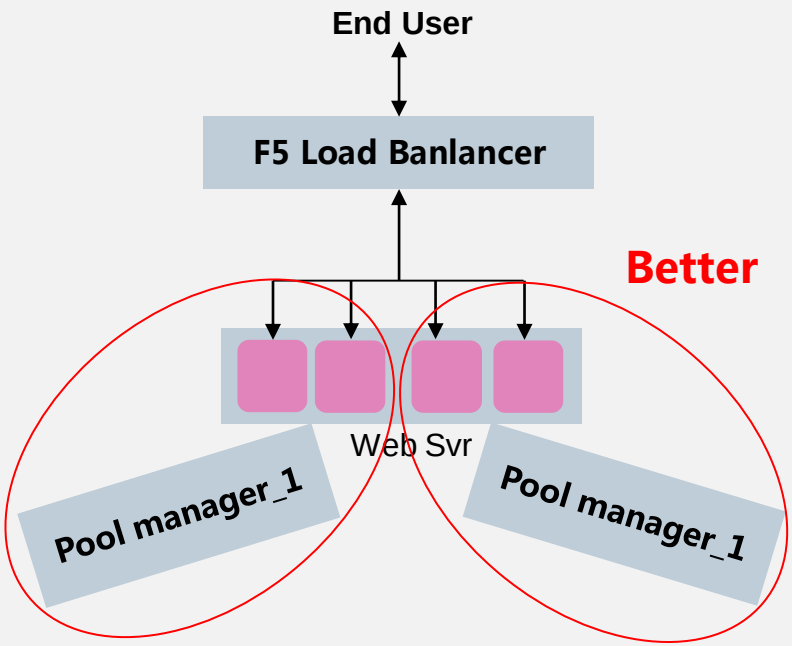


Tuning Teamcenter System

- System Architecture - Teamcenter Architecture (2)
  - 在Web-Tier，部署多个WebLogic 节点，即使是单台Web 服务器，以增加WEB层网络数据吞吐量。

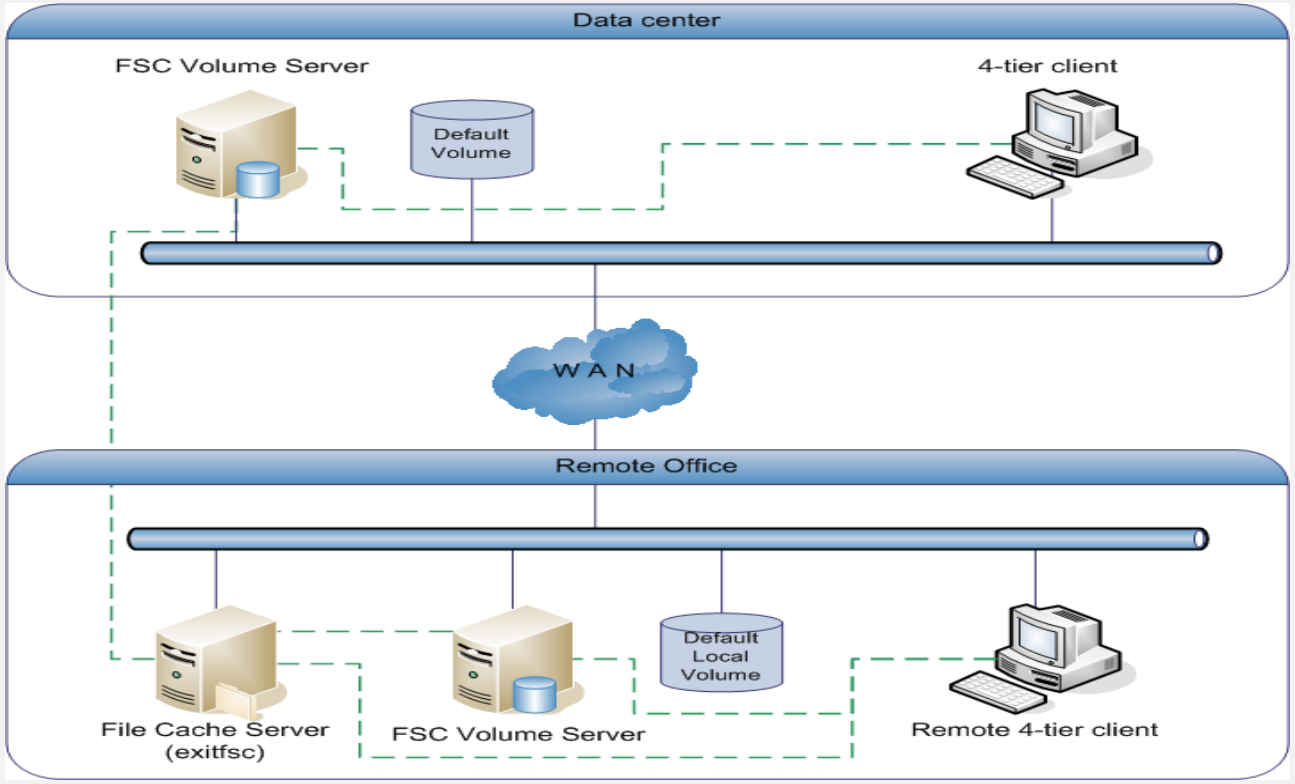
    根据经验，单个WebLogic节点适合服务100个左右的end-user。此值可以根据实际环境进行调整。
  - On the Enterprise tier, try to avoid the communication between pool managers. That means, in each pool it will be better to have only one pool manager.





Tuning Teamcenter System

- System Architecture - Teamcenter Architecture (3)
  - Setup and configure FSC Cache Server and Store and Forward Server to improve the performance of uploading and downloading files.



Tuning Teamcenter System

- OS and Network (AIX & TCP/IP)
  - Network performance check list
    - Physical Connections and NICs
      - ✓ Make sure connections are configured correctly preferably in auto configuration mode. Misconfiguration can cause lost data and degraded throughput. If any data loss is experienced this should be checked throughout the network between the server and the problematic client.
      - ✓ Check Network Interface Cards (NICs) and switch ports etc., for error logging. This can be a sign of performance issues.
      - ✓ Use NICs with TCP off-loading capabilities. It is a technology used in NIC to offload processing of the entire TCP/IP stack to the network controller, then free CPU processing.
      - ✓ Monitor switches and OS for packet loss.
      - ✓ If you are using GigE (Gigabit Ethernet) networks use Jumbo Frames if all connections support this. 10 /100 Mb/s devices do not support Jumbo frames and not all Ethernet switches support them.

      Note: Jumbo Frame 是默认情况下，以太网的MTU是1500字节；以太网帧是1522 字节，包含1500字节的负载、14字节的以太网头部、4字节的CRC、4字节的VLAN Tag。

Tuning Teamcenter System

- OS and Network (2)
  - Network performance check list - continued
    - Disable Nagle
      - ✓ Web Application Servers.
      - ✓ Teamcenter Enterprise Servers.
      - ✓ Teamcenter FSC Servers.
      - ✓ Oracle Servers.

Nagle Algorithm

```
if there is new data to send
  if the window size >= MSS and available data is >= MSS
    send complete MSS segment now
  else
    if there is data sent but not yet acknowledged
      queue data in the buffer until an acknowledge is received
    else
      send data immediately
    end if
  end if
end if
```

MSS: Maximum Segment Size

Tuning Teamcenter System

- OS and Network (3)
  - Network performance check list - continued
    - WAN/LAN

      Configure server operating systems to support the highest BDP in your network.

      On higher BDP, congested and poor networks consider using a WAN accelerator.

      Configure:

      - ✓ Clients
      - ✓ Web Application Servers
      - ✓ Teamcenter Enterprise Servers
      - ✓ FSC Servers
      - ✓ Oracle Servers

Tuning Teamcenter System

- OS and Network (4)
  - Network performance check list - continued
    - WAN/LAN - continued

      The following table shows suggested sizes for the tunable values to obtain optimal performance on a LAN or low-BDP network (Bandwidth Delay Product); based on the type of adapter and the MTU size (Maximum Transfer Unit).

      The TCP window is the maximum amount of data allowed to be sent out on the network before an acknowledgement is received. The size of window used is controlled by the receiver.

Device	Speed	MTU size	Send Space	Receive Space	Socket Buffer	Large window?
Ethernet	10 Mbit	1500	16384	16384	32768	N
Ethernet	100 Mbit	1500	16384	16384	65536	N
Ethernet	Gigabit	1500	131072	65536	131072	N
Ethernet	Gigabit	9000	131072	65535	262144	N
Ethernet	Gigabit	9000	262144	1310722	524288	Y
ATM	155 Mbit	1500	16384	16384	131072	N
ATM	155 Mbit	9180	65535	655353	131072	N
ATM	155 Mbit	65527	655360	6553604	1310720	Y
FDDI	100 Mbit	4352	45056	45056	90012	N
Fibre Channel	2 Gigabit	65280	655360	655360	1310720	Y

Tuning Teamcenter System

- OS and Network (5)
  - Network performance check list - continued
    - Tune Oracle Net (see section Resource Tier and Enterprise Tier).
      - ✓ Make sure Nagel is disabled (default is off)
      - ✓ Set the SDU size
      - ✓ Set the receive buffers
      - ✓ Set the send buffer
    - Losing Packets
      - ✓ Check port physical connections
      - ✓ Check MTU/ICMP: with netsh for Windows and ipconfig for UNIX/Linux.
      - ✓ Check losing package: with ping or/and tracert.

Tuning Teamcenter System

- OS and Network (6)
  - OS parameter check list (AIX and TCP/IP)
    - TCP_TIMEWAIT
    - file descriptor
    - TCP_KEEPIDLE
    - TCP_KEEPINTVL
    - TCP_KEEPINIT
    - TCP_NODELAY
    - TCP_SENDSPACE
    - TCP_RECVSPACE
    - SB_MAX

Tuning Teamcenter System

- OS and Network (7)
  - TCP_TIMEWAIT

    Determines the time that must elapse before TCP/IP can release a closed connection and reuse its resources. This interval between closure and release is known as the TIME_WAIT state.

    Adjust TCP_TIMEWAIT, if the running application requires rapid release or the creation of new connections, or if a low throughput occurs due to many connections sitting in the TIME_WAIT state.

    Recommended value: 15 seconds.

    usr/sbin/no –x tcp_timewait

    usr/sbin/no –o tcp_timewait =1 (set to 15 seconds)
  - file descriptors (ulimit)

    Default value: 2000

    Recommended value: unlimited.

    To display all the ulimit limits:

    ulimit -a

Tuning Teamcenter System

- OS and Network (8)
  - TCP_KEEPIDLE

    The keepAlive packet ensures that a connection stays in an active/ESTABLISHED state.

    Default value: 14400 half seconds (2 hours).

    Recommended value: 600 half seconds (5 minutes).

    ```
    no –x tcp_keepidle
    no -o tcp_keepidle=600
    ```

  - TCP_KEEPINTVL

    Specifies the interval between packets that are sent to validate the connection.

    Default value: 150 (1/2 seconds)

    Recommended value: 10 (1/2 seconds)

    ```
    no –x tcp_keepintval
    no -o tcp_keepintvl=10
    ```

Tuning Teamcenter System

- OS and Network (9)
  - TCP_KEEPINIT

    Specifies the initial timeout value for TCP connection.

    Default value: 150(1/2 seconds)

    Recommended value: 40 (1/2 seconds)

    no –x tcp_keepinit

    no -o tcp_keepinit=40
  - TCP_NODELAY

    Enable and disables the Nagel algorithm.

    Default value: 0

    Recommended value: 1

    no –x tcp_nodelay

    no -o tcp_nodelay=1

Tuning Teamcenter System

- OS and Network (10)
  - TCP_SENDSPACE

    Specifies the send buffer size for TCP connection.

    Default value: 16K

    Recommended value: see the suggested value

    no -x tcp_sendspace

    no -o tcp_sendspace=32768
  - TCP_RECVSPACE

    Specifies the receive buffer size for TCP connection.

    Default value: 16K

    Recommended value: see the suggested value

    no -x tcp_recvspace

    no -o tcp_recvspace=32678

Tuning Teamcenter System

- OS and Network (11)
  - SB_MAX

    Specifies the TCP window size for TCP connection.

    Default value: 1048576

    Recommended value: see the suggested value.

    no -x sb_max

    no -o sb_max= 1048576

Tuning Teamcenter System

- Resource Tier (Oracle)
  - Oracle performance tuning and configuration check list
    - Be certain Cost Based Optimizer (CBO) Initialization Parameters are set:
      - ✓ OPTIMIZER_MODE = ALL_ROWS
      - ✓ OPTIMIZER_INDEX_CACHING = 95
      - ✓ OPTIMIZER_INDEX_COST_ADJ = 10
    - Be certain Function Based Index (FBI) Initialization Parameters are set:
      - ✓ QUERY_REWRITE_ENABLED = TRUE
      - ✓ QUERY_REWRITE_INTEGRITY = TRUSTED
      - ✓ Compatible = <version of Oracle installed>

Tuning Teamcenter System

- Resource Tier (2)
  - Oracle performance tuning and configuration check list - continued
    - Check memory allocation parameters:

Auto Memory Management
sga_target = *appropriate_size*
sga_max_size = *appropriate_size*
workarea_size_policy = AUTO
pga_aggregate_target = 20% * sga_target

Manual Memory Management
db_cache_size = *appropriate_size*
large_pool_size = *appropriate_size*
shared_pool_size = *appropriate_size*
sort_area_size = 262,144 > 524,288
java_pool_size = 0

Either
db_block_size = 8192
db_file_multiblock_read_count = 16
undo_management = AUTO

Tuning Teamcenter System

- Resource Tier (3)
  - Oracle performance tuning and configuration check list - continued
    - Routinely update the CBO table and index statistics.
    - Check OS Kernel Parameters affecting memory utilization.

      For AIX:

      - ✓ mkdev -l aio0
      - ✓ smit aio
    - Check for high disk I/O, especially against single tables.
    - Check that Indexes were created for Saved Queries and Schema Extensions.
    - Disable slow SQL reporting except to diagnose performance issues, don't identify the slow SQL.

      - ✓ TC_SLOW_SQL=-1

Tuning Teamcenter System

- Resource Tier (4)
  - Tuning Tool
    - Oracle Enterprise Manager (OEM)

      The Oracle Enterprise Manager (OEM) is highly recommended to manage and tune Oracle performance for Teamcenter. OEM provides general management and maintenance capabilities as well as performance graphs and tools to assess workload, server utilization, top database activity, and performance alerts.

      Several automated features may be available including:

      - ✓ Automated Workload Repository (AWR)

        Automatically collects performance metrics for reporting or comparison at a later time

      - ✓ Automatic Database Diagnostic Monitor (ADDM)

        Monitors key metrics and generates alerts with configuration recommendations to improve performance

Tuning Teamcenter System

- Resource Tier (5)
  - OS Considerations

    In addition to the parameter OS parameters specified in installing Oracle in AIX, In addition to the required settings, the following kernel parameters may have an impact on Oracle performance:

    - Operating System Buffer Cache
    - Memory page scan rates/algorithms
    - Server I/O settings

      Enter the following command to verify whether asynchronous I/O services are running. If they are not, the command will start the services:

      - ✓ mkdev -l aio0
      - ✓ smit aio

Tuning Teamcenter System

- Resource Tier (6)
  - Oracle Indexes
    - Verifying Oracle Indexes Manually
      - ✓ verify if the indexes are exist:

```
select index_name, substr(column_name, 1, 32), column_position
from user_ind_columns
where table_name = '<tablename>'
order by index_name, column_position;
```

      - ✓ Verify indexes against columns:

```
select index_name, substr(column_name, 1, 32), column_position
from user_ind_columns
where table_name = '<tablename>'
order by index_name, column_position;
```

Tuning Teamcenter System

- Resource Tier (7)
  - Oracle Indexes - continued
    - Index Maintenance
      - ✓ Run the Index Verifier Routinely using tool: index_verifier
      - ✓ Update Table and Index Statistics, run the following oracle tool in a corn job or run OEM to automatically update table and index statistics:

        exec dbms_stats.gather_schema_stats(ownname =>'infodba', estimate_percent => 100, method_opt => 'FOR ALL COLUMNS SIZE AUTO', degree=>8, cascade=>true, no_invalidate=>FALSE);

      - ✓ Manually Creating and Analyzing Indexes, because of missing indexes, saved query and extended data model indexes, using tool: install -add index utility.

        If you create indexes manually using SQL, the index is not entered into the Teamcenter POM data dictionary. The index_verifier utility would then not be able to determine if the index ends up missing again.

Tuning Teamcenter System

- Resource Tier (8)
  - Oracle Indexes - continued
    - Function-Based Indexes

      To improve performance of a number of Teamcenter queries, Teamcenter uses Function-Based Indexes (FBI) for some tables. FBIs have been shown to improve Oracle performance for a number of customers with large databases that use case-insensitive searches or other functions. The installation and upgrade procedures automatically create Oracle FBIs for operations that have been shown to benefit from them.

      ```
      OPTIMIZER_MODE=ALL_ROWS
      QUERY_REWRITE_ENABLED=TRUE
      QUERY_REWRITE_INTEGRITY=TRUSTED
      ```

      OPTIMIZER_MODE=ALL_ROWS a cost-based optimizer mode that ensures that the overall query time is minimized. QUERY_REWRITE_ENABLED=TRUE allows the optimizer to rewrite the query, effectively removing the function from the SQL. QUERY_REWRITE_INTEGRITY=TRUSTED tells the optimizer to trust that code marked deterministic by the programmer is in fact deterministic. If the code is not deterministic (that is, it returns different output given the same inputs), the resulting rows from the index may be incorrect, but this is rare in Teamcenter. Without COMPATIBLE=10.2.0 Oracle does not use FBIs.

Tuning Teamcenter System

- Resource Tier (9)
  - Oracle Indexes - continued
    - Separate Index Tablespace

      If a particular tablespace has a significant amount of disk I/O, consider splitting out heavily used tables, along with their indexes in separate tablespaces.

    - Adding New Column in pom_backpointer Index

      The pipom_backpointer2 index defined on the to_uid column can be replaced with an index defined on the to_uid and from_uid columns on the pom_backpointer table to improve the performance and also to reduce the input/output cost of the query.

Tuning Teamcenter System

- Resource Tier (10)
  - Initialization Parameters
    - System Global Area (SGA)
      - ✓ It is recommended to set SGA automatically, set 80% free memory to sga_max, or 60% total memory, before oracle.
      - ✓ For The default Oracle initialization parameters supplied with Teamcenter are appropriate for typical customer deployments (100–250 users), referring to oracle installation with Teamcenter.

        For more than 250 users, the size of the System Global Area (SGA) will need to be increased to support the larger number of users, see below:

Number of Users	SGA Size
250–500	sga_target = 512 MB–1.0 GB, sga_max_size = 768 MB–1.5 GB)
500–1000	sga_target = 1.5 GB –3.0 GB, sga_max_size = 2.0 GB –4.0 GB)
> 1000	sga_target = 3.0GB or larger, sga_max_size = 4.0GB or larger)

Tuning Teamcenter System

- Resource Tier (11)
  - Initialization Parameters - continued
    - Program Global Area (PGA)

      It is recommended to automatically and dynamically to adjust PGA parameters by oracle, then set:

      - ✓ workarea_size_policy to AUTO
      - ✓ pga_aggregate_garget to 20% of free memory before oracle.

Tuning Teamcenter System

- Resource Tier (12)
  - Initialization Parameters - continued
    - shared _pool_size
      - ✓ Adjust shared_pool_size to ensure table buffer hit rate is more than 99% and dictionary buffer hit rate is more 90%.
      - ✓ Table buffer hit rate:

```
set linesize 128;
SELECT SUM (pinhits) / SUM (pins) * 100 "hit radio" FROM v$librarycache;
```

      - ✓ Directory buffer hit rate:

```
set linesize 128;
SELECT TO_CHAR (ROUND ((1 - SUM (getmisses) / SUM (gets)) * 100, 1)) || '%' "Dictionary Cache Hit Ratio"
FROM v$rowcache;
```

Tuning Teamcenter System

- Resource Tier (13)
  - Initialization Parameters - continued
    - db_cache_size
      - ✓ Adjust db_cache_size to ensure data buffer hit rate more than 95%.
      - ✓ Data buffer hit rate:

```
set linesize 128;
SELECT physical_reads, db_block_gets, consistent_gets, NAME,
    100 * ( 1 - ( physical_reads / (consistent_gets + db_block_gets))) "Data Buffer Hit Ratio"
FROM v$buffer_pool_statistics;
```

    - processes
      - ✓ Set the number of processes slightly above the number of users that are expected to be logged in concurrently, plus 12 (to cover Oracle processes), plus a few more for administration purposes.

Tuning Teamcenter System

- Resource Tier (14)
  - Initialization Parameters - continued
    - Cost-Based Optimization parameters

      Teamcenter recommendations for the following initialization parameters have changed and should be set as indicated:

      OPTIMIZER_MODE = ALL ROWS

      OPTIMIZER_INDEX_CACHING = 95

      OPTIMIZER_INDEX_COST_ADJ = 10

      The OPTIMIZER_MODE = ALL_ROWS parameter indicates that Oracle should choose a query plan that minimizes the overall time to retrieve all rows. In calculating the cost, Oracle considers the cost (in terms of logical and physical I/O) of reading indexes and the likelihood that needed index blocks are already in memory.

Tuning Teamcenter System

- Resource Tier (15)
  - Table & Tablespace maintenance
    - Free Tablespace

      The free tablespace should be more than 10%. To decide the free tablespace rate:

```
set linesize 128;
select dbf.tablespace_name,  dbf.totalspace "total_size(M)",  dbf.totalblocks as total_blocks,
       dfs.freespace "free_size(M)", dfs.freeblocks "free_blocks",
       (dfs.freespace / dbf.totalspace) * 100 "free_rate"
from (select t.tablespace_name,
             sum(t.bytes) / 1024 / 1024 totalspace, sum(t.blocks) totalblocks
      from dba_data_files t
      group by t.tablespace_name) dbf,
      (select tt.tablespace_name,
              sum(tt.bytes) / 1024 / 1024 freespace, sum(tt.blocks) freeblocks
              from dba_free_space tt
       group by tt.tablespace_name) dfs
       where trim(dbf.tablespace_name) = trim(dfs.tablespace_name);
```

Tuning Teamcenter System

- Resource Tier (16)
  - Table & Tablespace maintenance - continued
    - Free Temp tablespace

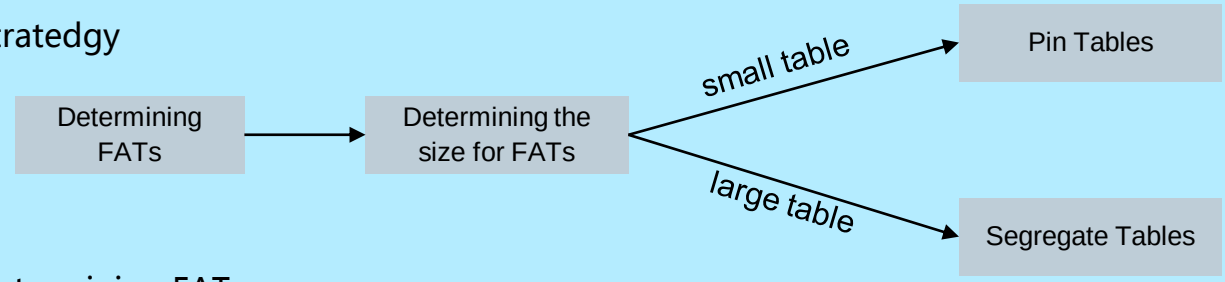
      The size of temp tablespace is recommended to be 4G.

      To decide the size of temp tablespace:

```
SELECT a.tablespace_name, a.BYTES total, a.bytes - nvl(b.bytes, 0) free
FROM  (SELECT   tablespace_name, SUM (bytes) bytes FROM dba_temp_files GROUP BY tablespace_name)
a, (SELECT   tablespace_name, SUM (bytes_cached) bytes FROM v$temp_extent_pool GROUP BY
tablespace_name) b
WHERE a.tablespace_name = b.tablespace_name(+);
```

Tuning Teamcenter System

- Resource Tier (17)
  - Table & Tablespace maintenance - continued
    - Deal with Frequently Accessed Tables (FATs)
      - ✓ Stratedgy



      - ✓ Determining FATs

        select DISK_READS, SQL_TEXT from v$sqlarea order by disk_reads;

      - ✓ Determing the table size

        select count(*) from *tablename*;

Tuning Teamcenter System

- Resource Tier (18)
  - Table & Tablespace maintenance - continued
    - Pining - Permanently Caching FATs
      - ✓ The following tables are recommended to be cached permanently:

PAM_ACE	PAM_ACL	PATTACHMENT_TYPES
PATTACHMENTS	PEPMTASK	PIMANTYPE
PITEMMASTER	PITEMVERSIONMASTER	POM_F_LOCK
POM_M_LOCK	POM_R_LOCK	PPOM_USER
PPSVIEWTYPE	PSIGNOFF	PUSER

      - ✓ Size required for cache

```
select sum(blocks) from dba_tables where table_name in( 'PAM_ACE', 'PAM_ACL', 'PATTACHMENT_TYPES',
'PATTACHMENTS', 'PEPMTASK', 'PIMANTYPE', 'PITEMMASTER', 'PITEMVERSIONMASTER', 'POM_F_LOCK',
'POM_M_LOCK', 'POM_R_LOCK', 'PPOM_USER', 'PPSVIEWTYPE', 'PSIGNOFF', 'PUSER' );
```

      - ✓ Parameters:

db_keep_cache_size = (*buffers:number*) (10g or later)

Tuning Teamcenter System

- Resource Tier (19)
  - Table & Tablespace maintenance - continued
    - Segregating FATs
      - ✓ Frequently accessed large tables may be candidates for their own tablespace on a separate disk.
      - ✓ Commonly segregated FATs

        POM_BACKPOINTER
        PPOM_OBJECT
        POM_M_LOCK, POM_R_LOCK, POM_F_LOCK
        PEPMTASK
      - ✓ Example to move the POM_BACKPOINTER table and its indexes to its own tablespace:

        ALTER TABLE POM_BACKPOINTER MOVE TABLESPACE IDATA2;

        ALTER INDEX PIPOM_BACKPOINTER REBUILD TABLESPACE IDATA2;

        ALTER INDEX PIPOM_BACKPOINTER2 REBUILD TABLESPACE IDATA2;

Tuning Teamcenter System

- Resource Tier (20)
  - Oracle NET Parameters
    - In both Oracle client and server side, set the following network parameters in sqlnet.ora:
      - ✓ TCP_NODELAY=YES
      - ✓ DEFAULT_SDU_SIZE=32767 (refer to section OS and Network for the real value)
      - ✓ RECV_BUF_SIZE=25000 (refer to section OS and Network for the real value)
      - ✓ SEND_BUF_SIZE=25000 (refer to section OS and Network for the real value)

Tuning Teamcenter System

- Resource Tier (21)
  - Other considerations
    - Finding Oracle System Bottlenecks (by OEM)
    - Oracle File System Optimization

Tuning Teamcenter System

- Enterprise Tier
  - 调试服务池
    - PROCESS_MAX
      - ✓ 按照可用的资源调节（主要是内存和CPU）
      - ✓ maxPoolMem – server池总共可使用的内存大小
      - ✓ memPerTcServer – 每个TC server平均使用的Memory
      - ✓ PROCESS_MAX = [maxPoolMem] / [memPerTcServer]
      - ✓ 默认值: 30

Tuning Teamcenter System

- Enterprise Tier (2)
  - PROCESS_TARGET
    - 考虑使用most-recently-used 缓存设置:
      - ✓ 更大的缓存设置可以增加命中率。
      - ✓ 太大的值将延迟对超时资源的回收。
    - 建议设为*PROCESS_MAX的1/3大小*

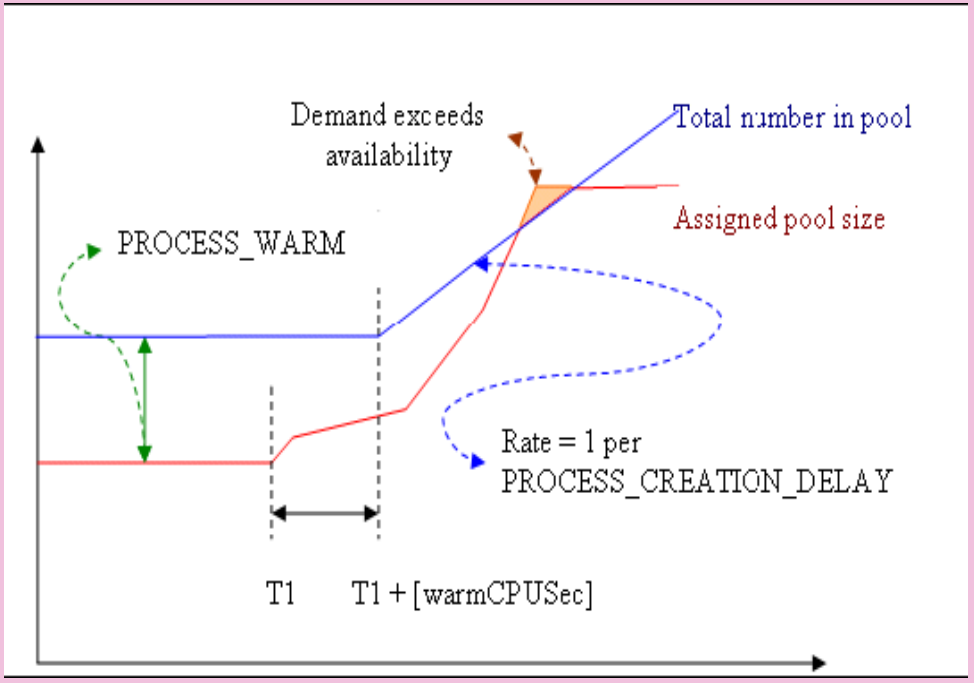
Tuning Teamcenter System

- Enterprise Tier (3)
  - PROCESS_CREATION_DELAY – 根据CPU的数量和速度进行调节。
    - 进程启动需要消耗比较多的资源(大概4-20秒)。
    - 延时列表(msecs) e.g. ‘2000 4000 8000 16000 30000’ .
    - 第一个值是启动的时间，后面的值是失败后的时间。
    - *warmSec*: 启动一个tcserver进程的时间。
    - *warmFraction*:分配给服务器启动tcserver的权重系数
      [initDelay] = ([warmSec] * 1000) / ([warmFraction] * [numCPUs])

启动一个WARMtcserver所需的CPU时间	CPU同时支持的线程数	延时时间最小值(设置warmFraction 为50%)
10 Sec	8	2500 mSec
5 Sec	2	5000 mSec
15 Sec	1	30000 mSec

Tuning Teamcenter System

- Enterprise Tier (4)
  - PROCESS_WARM
    - 可用的服务器数量最小值
    - 太小：来不及启动新的tcserver
    - 太大浪费内存
  - 先调节 PROCESS_TARGET 来提供一个好的profile
    - 默认值1
    - 考虑与PROCESS_CREATION_DELAY的关联
    - 另外建议： WARM + TARGET < MAX



Tuning Teamcenter System

- Enterprise Tier (5)
  - 超时类型
    - Soft – 当tcserver的数量超过target值时终止一些空闲的tcserver来将数量降低到target值。
    - Hard – 终止空闲的tcserver而不管池的状态。
    - 状态模式
      - ✓ Edit – 超时会由于数据丢失或者功能需求而具有高风险。
      - ✓ Read –对性能有影响。
      - ✓ Stateless – 低风险。

Tuning Teamcenter System

- Enterprise Tier (6)
  - 超时参数

参数	*服务器状态*	*服务器模式*	*池状态*	*默认值 (secs)*
SOFT_TIMEOUT_STATELESS	Idle	Stateless	Above Target	1200
SOFT_TIMEOUT_READ	Idle	Read	Above Target	28800
SOFT_TIMEOUT_EDIT	Idle	Edit	Above Target	28800
HARD_TIMEOUT_STATELESS	Idle	Stateless	Any	28800
HARD_TIMEOUT_READ	Idle	Read	Any	28800
HARD_TIMEOUT_EDIT	Idle	Edit	Any	28800
QUERY_TIMEOUT	Active	Any	Any	0 (unlimited)

Tuning Teamcenter System

- Enterprise Tier (7)
  - Oracle NET Parameters
    - In TC_DATA, set the following network parameters in sqlnet.ora:
      - ✓ TCP_NODELAY=YES
      - ✓ DEFAULT_SDU_SIZE=32767 (refer to section OS and Network for the real value)
      - ✓ RECV_BUF_SIZE=25000 (refer to section OS and Network for the real value)
      - ✓ SEND_BUF_SIZE=25000 (refer to section OS and Network for the real value)

Tuning Teamcenter System

- Web-Tier
  - Web Session Timeout

    The timeout is controlled by the ‘web-app -> session-config -> session-timeout’ element in the ‘WEB-INF/web.xml’ file. That file is packaged within the ‘tc.war’ file, which in turn is deployed within the ‘tc.ear’ file during the install process:

```
<web-app>
    …
    <session-config>
    <session-timeout>480</session-timeout>
    </session-config>
    …
</web-app>
```

Tuning Teamcenter System

- Web Tier (2)
  - Execute Pool Size (thread pool size)

    It is the execute pool size (or thread pool size) to serve client requests.

    WebLogic Server release 9 and higher uses a self-tuned thread-pool so this is not a configuration issue for this application server implementation. The administrator should occasionally review if that pool is configured large enough to support the number of assigned execution threads to prevent large execution queue delays.

    As with other Teamcenter components, more is not always best. Since each execution thread typically results in an independent JVM thread, too many may overwhelm the system, while too few may result in user requests waiting for an available thread. However, since most of the processing time resulting from a user request is consumed in the tcserver on the Enterprise tier (or lower application processes), the number of assigned execution threads does not translate directly to increased load on the J2EE Application Server.

Tuning Teamcenter System

- Web-Tier (3)
  - JAVA Heap Size

    When starting the WebLogic, the arguments for memory defines the JAVA Heap Size.

    For example,

    ```
    C:\apps\oracle\MIDDLE~1\JROCKI~1.0-1\bin\java -jrockit -Xms512m -Xmx512m Dweblogic.Name=AdminServer -
    Djava.security.policy=C:\apps\oracle\MIDDLE~1\WLSERV~1.1 \server\lib\weblogic.policy  -
    Dweblogic.ProductionModeEnabled=true  -Djava.endorsed.dirs=C:\apps\oracle\MIDDLE~1\JROCKI~1.0-
    1/jre/lib/endorsed;C:\apps\oracle\MIDDLE~1\WLSERV~1.1/endorsed  -da -
    Dplatform.home=C:\apps\oracle\MIDDLE~1\WLSERV~1.1 -
    Dwls.home=C:\apps\oracle\MIDDLE~1\WLSERV~1.1\server -
    Dweblogic.home=C:\apps\oracle\MIDDLE~1\WLSERV~1.1\server   -Dweblogic.management.discover=true  -
    Dwlw.iterativeDev=false -Dwlw.testConsole=false -Dwlw.logErrorsToConsole=false -
    Dweblogic.ext.dirs=C:\apps\oracle\MIDDLE~1\patch_wls1211\profiles\default\sysext_manifest_classpath;C:\apps\oracl
    e\MIDDLE~1\patch_ocp371\profiles\default\sysext_manifest_classpath  weblogic.Server
    ```

    Argument -Xms512m -Xmx512m defines the minimum and the maximum JAVA heap size when starting up the WebLogic instance.

    Adjust the java heap size according to the number change of users. If the number of users increase greatly, it is best to create another WebLogic instance not just to increase the Java heap size.

Tuning Teamcenter System

- Web Tier(4)
  - Garbage Collection
    - Two types of garbage collection
      - ✓ Full: dedicated thread to collect garbage and all other threads stop working.
      - ✓ Concurrent: A thread is to collect garbage when all other threads are still working.
    - Adjust JVM parameters to select the garbage collection.
    - JVM performance should be tuned by repeatedly adjust the parameter and testing to figure out a best configuration for the system.

Tuning Teamcenter System

- Client-Tier
  - 更新teamcenter.ini 文件
    - For 2 GB RAM
      - ✓ -Xverify:none
      - ✓ -Xms512m
      - ✓ -Xmx512m
      - ✓ -XX:PermSize=64m
      - ✓ -XX:MaxPermSize=128m
      - ✓ -Dsun.rmi.dgc.client.gcInterval=3600000
    - For 4 GB RAM or more
      - ✓ -Xverify:none
      - ✓ -Xms1024m
      - ✓ -Xmx1024m
      - ✓ -XX:PermSize=64m
      - ✓ -XX:MaxPermSize=128m
      - ✓ -Dsun.rmi.dgc.client.gcInterval=3600000

Tuning Teamcenter System

- Client-Tier (2)
  - 优化FMS设置
    - 针对广域网环境修改 fmsmaster_FSC_hostname_user.xml 文件:
      - ✓ Set maxpipes per group
  - 优化Teamcenter启动
    - 修改portal.bat:
      - ✓ 移除%path%环境变量中不必要的值。
      - ✓ 强制Teamcenter启动的时候打开“ Getting Started “ perspective.
      - ✓ 尽量不要在启动的时候检查更新。
      - ✓ 如果OTW安装，将OTW安装目录保持在最小。

Tuning Teamcenter System

- Client-Tier (3)
  - 优化 Teamcenter File Warmer
    - 将RAC文件夹加入到 File Warmer file list
      - ✓ plugins
      - ✓ features
      - ✓ registry
      - ✓ configuration
      - ✓ teamcenter.exe
      - ✓ teamcenter.ini
      - ✓ eclipseproduct
      - ✓ rt.jar
      - ✓ Foundation Viewer
    - 将RAC缓存添加到File Warmer

Tuning Teamcenter System

- Client-Tier (4)
  - Windows 磁盘优化
    - 使用Microsoft Disk Defragmenter整理磁盘碎片
      - ✓ 分析选择的磁盘
      - ✓ 整理选择的磁盘的碎片
      - ✓ 重复直到没有碎片
      - ✓ 配置磁盘碎片整理Schedule
  - 将Teamcenter设为病毒扫描例外
    - 設置病毒軟件不對下列目錄進行扫描
      - ✓ Teamcenter portal 安装目录和所有子目录
      - ✓ $HOME/Teamcenter/RAC 目录

Tuning Teamcenter System

- Tuning FMS
  - Main Considerations (see os and network)
    - The receive space
    - The send space
    - Large windows (RFC 1323)
    - Nagel (see section 3.2.3)
    - Socket buffer maximum size
    - Special network hardware for example checksum off load.
  - FSC Cache Size
    - Set cache size based on average data created daily and the age to keep in the cache
  - FCC Cache Size
    - Set cache size based on average data created daily and the age to keep in the cache

Tuning Teamcenter System

- Tuning FMS (2)
  - FSC Internal Buffer
    - Property file

      fsc.${FSC_ID}.properties files.

    - Configuration

```
# FSC internal buffer size.
# Default value is 64K.
# Value should be in 16K increments.
# Minimum is 16K.
#
#com.teamcenter.fms.servercache.FSCConstants.buffSize=64K
#
# Socket buffer size override.
# Default value is (com.teamcenter.fms.servercache.FSCConstants.buffSize * 2) + 1024.
# The value 0 disables setting the socket buffer sizes (uses system default).
# Minimum value is 8K (excluding the 0 case).
#
#com.teamcenter.fms.servercache.FSCConstants.sockBuffSize=128K
```

Tuning Teamcenter System

- Tuning FMS (3)
  - FCC Internal Buffer
    - Property file

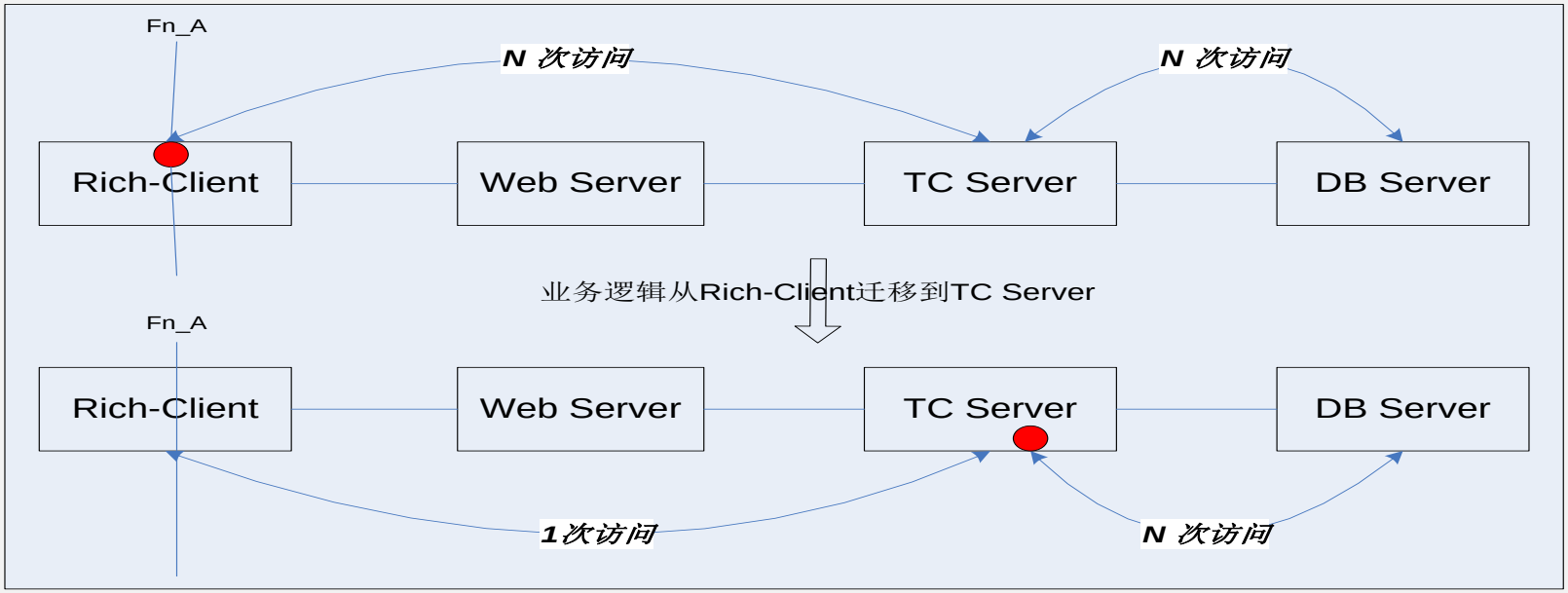
      fcc.properties

    - Configuration

      # FCC internal buffer size.
      # Default value is 64K.
      # Value should be in 16K increments.
      # Minimum is 16K.
      # (The setting name you see here is correct; this information is internally
      # associated with the FMS server cache (FSC) connections.)
      #
      #com.teamcenter.fms.servercache.FSCConstants.buffSize=64K

Optimizing Customization Code

- 迁移业务逻辑 (到服务器端)
  - 在四层架构中，某功能点Fn_A对数据库有N次访问,则实现Fn_A包括：



  - 迁移前： (N次Rich-Client对TC的访问) + (N次TC Server对DB的访问)
  - 迁移后： (1次Rich-Client对TC的访问) + (N次TC Server对DB的访问)

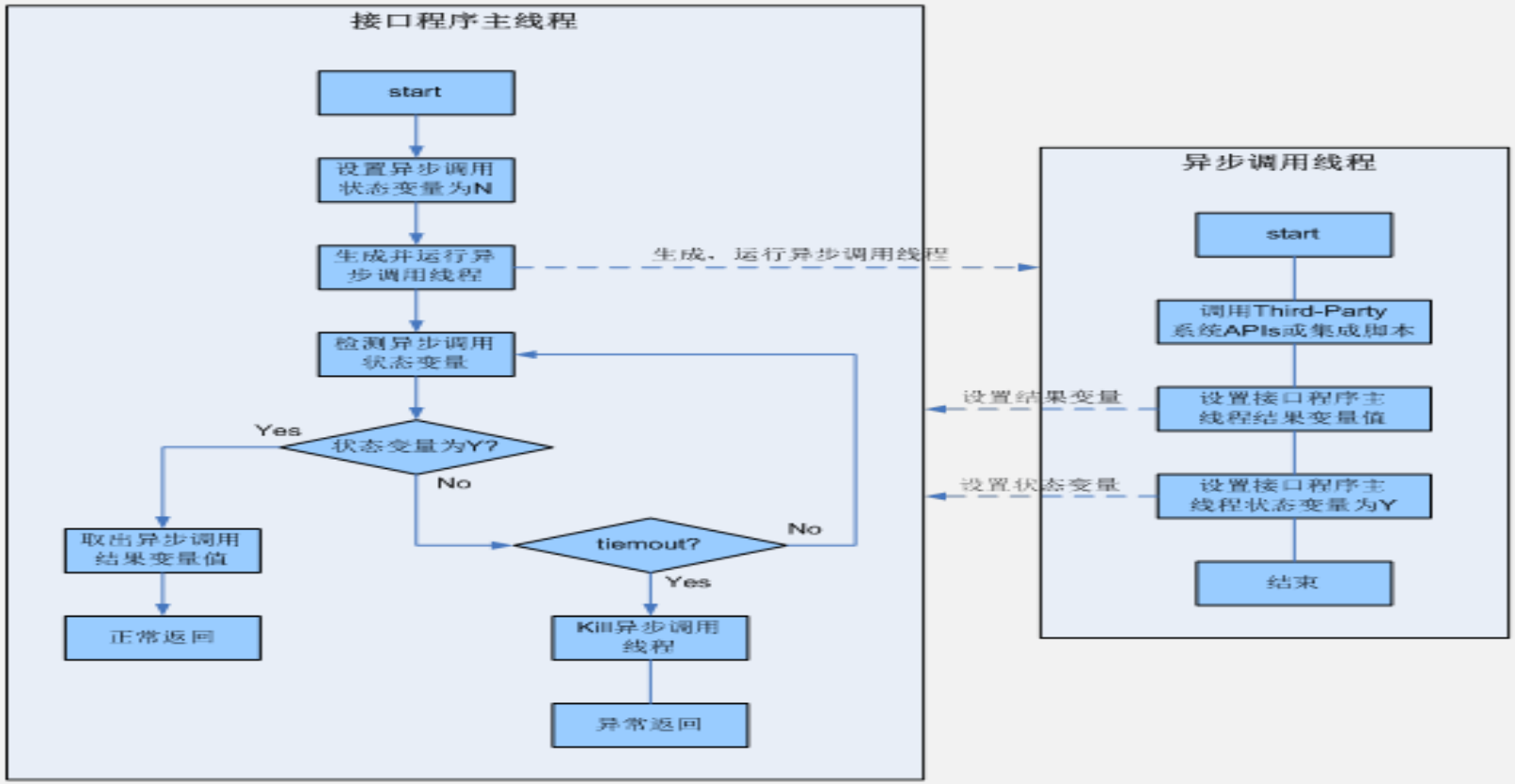
Optimizing Customization Code

- 净化错误内存代码 (以C/C++为例)
  - 局部变量未初始化

    在定义变量时，没有对其进行初始化赋值。这些变量的初始值不确定，导致程序运行存在一些潜在的、不可预知的情况。
  - 内存泄露。由于没有释放分配的内存，服务器进程消耗的内存资源越来越多，导致系统的性能变得越来越慢，最终系统因为内存资源耗竭而崩溃。
  - 内存溢出。由于分配的内存空间不足，在进行内存写操作时，经常破坏程序的其他数据，导致系统运行错误甚至紊乱或瘫痪。
  - 内存指针误用。把int标量数值误作指针类型引用，以及混淆字符串数组指针与数组中单个字符指针等错误，将会引起程序错误，并导致系统瘫痪。

Optimizing Customization Code

- 异步系统集成策略
  - Teamcenter系统与Third-Party系统之间的调用应该设计成异步调用，而不是同步调用，以减少系统之间的藕合。



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Optimizing Customization Code

- 优化数据库调用代码
  - 防止在数据库端出现Session死锁，并遵循：尽可能地避免扫描整个表；在可能的情况下，尽量使用读操作而不是加锁；避免使用逻辑操作符OR、!等　操作符；
  - 尽可能使用EXISTS来代替IN，使用NOT EXIS IS代替NOT IN；在字符串查询中尽可能少用通配符；等等。
- 解析多层次大循环代码
  - 解析多层次大循环代码，以减少总循环次数；要在内循环释放分配内存。
- 其他考虑
  - 避免代码递归调用；
  - 严格按照二次开发规范编制客户化代码；等等。

Implementing Applied Technologies

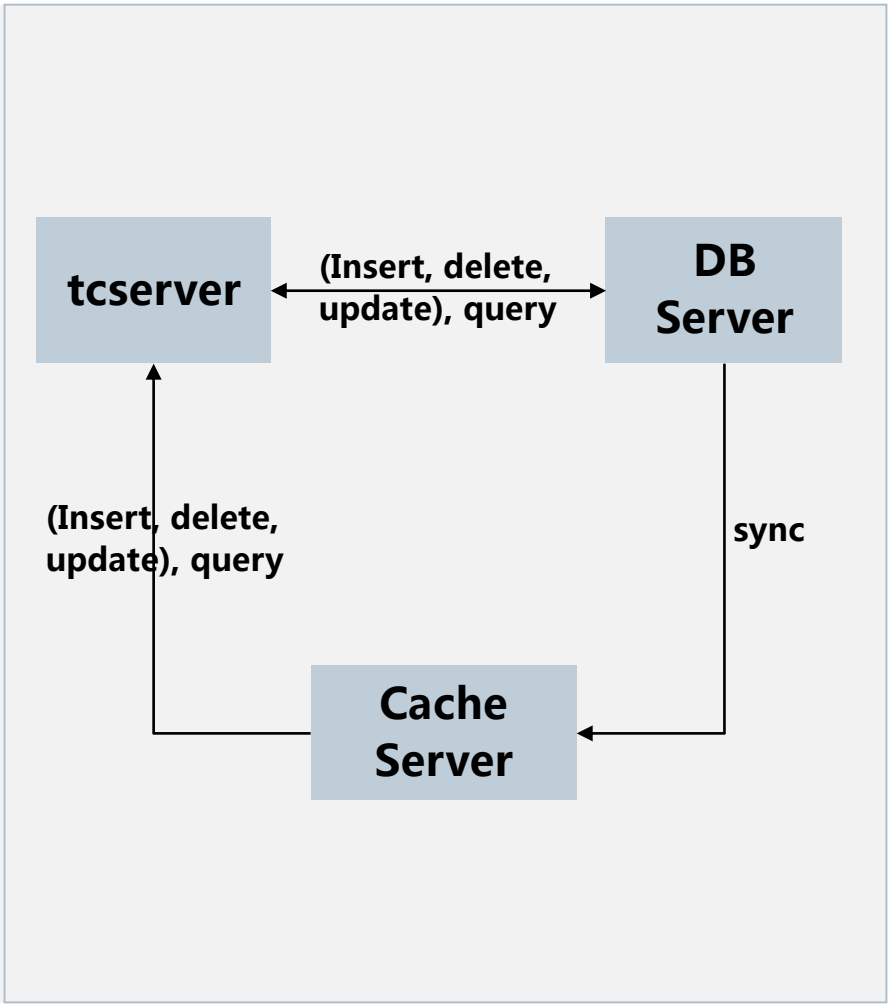
- 优化数据库Index
  - 对数据库表记录数量、搜索条件进行分析，并对Index进行优化。根据经验，可按如下原则进行优化：
    - 如果数据库表的记录数量大于20000，建立精确Index Index，即：对不同的搜索条件组合出建立相应的数据库表Index。
    - 如果数据库表的记录数量在5000到20000条之间，尽量建立精确Index；如果建立非精确Index，要求覆盖更多的搜索条件。
    - 如果数据库表的记录数量在5000到20000条之间，有条件地建立精确Index，其它则建立非精确Index。
    - 如果数据库表的记录数量小于5000，不新建数据库表Index。

Implementing Applied Technologies

- 建立数据库表Cache
  - 建立数据库表Cache的目，就是在数据库层面建立Cache，以增加对数据库表的搜索速度。主要考虑的因素包括：数据库表记录数量和对数据库表进搜索的频度，其原则为：
    - 对数据库表的搜索访问频繁；
    - 数据库表的内容基本稳定；
    - 数据库表的记录数量不超过5000行。
  - PLM系统的管理类表和记录数量稳定的Item对象类表适合建造Cache。

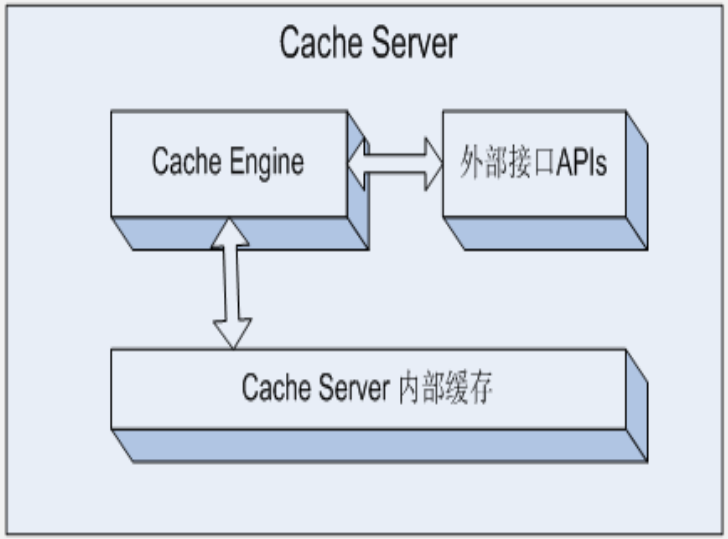
Implementing Applied Technologies

- 构造Cache Server
  - 以TC系统中，在本地构造Cache Server以快速存取复杂的计算数据和对象。
  - Ccache Server 与tcserver和DB Server的相互作用如右图所示。
    - 当tcserver对数据库进行(Insert, Delete,Update)操作时，tcserver首先访问数据库，如果成功，再对Cache Server 进行操作;如果失败，则tcserver执行数据库回退。
    - 当tcserver对数据库进行Query操作时，tcserver将直接访问Cache Server以获取信息。
    - Cache Server 将执行sync操作，从数据库中读取数据并重造内部Cache。



Implementing Applied Technologies

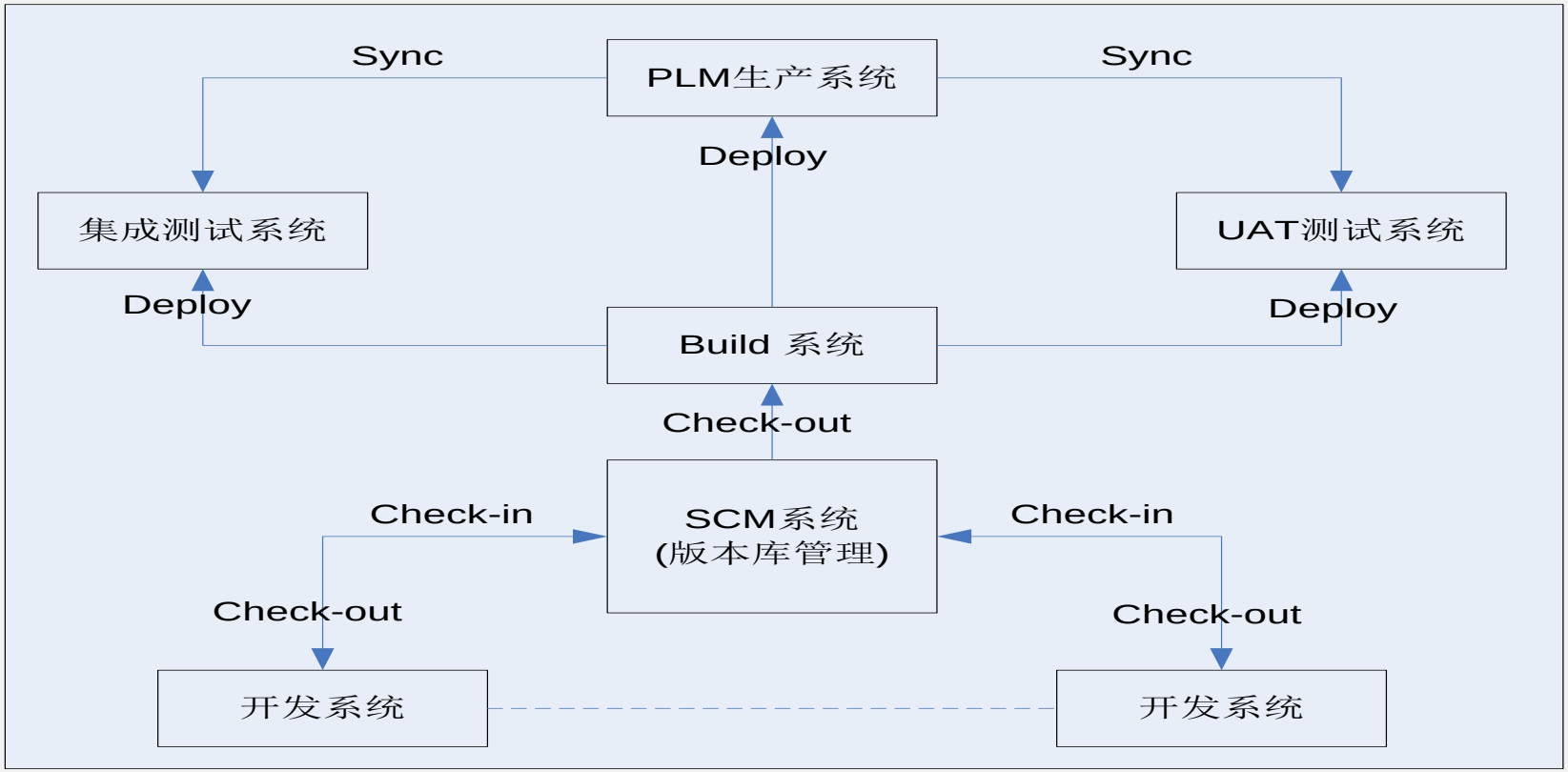
- 构造Cache Server (2)
  - Cache Server的系统结构如右图所示。
    - Cache Server内部缓存是一个动态Hash表，用于存储PLM系统的数据。Cache Engine是内部执行单元，其执行(insert，delete，update，query,sync)操作，并维护内部缓存。
    - 外部接口APIs是为主服务器程序提供的外部接口函数。主要包括：创建，清除，同步，插入数据，删除数据，修改数据，以及搜索Cache、等等。



Implementing Applied Technologies

- 应用Cache/Hash技术
  - 应用Cache/Hash技术策略，是指在客户化程序内部通过Cash/Hash技术，来缓存某些经常被访问的数据库表信息，以及某些功能点的结果信息，以减少主服务器对数据库的频繁访问和增加系统的整体性能。

- 环境管理规范
  - 建立以SCM (Source Control Management)为中心的Teamcenter环境。



Standards & Specifications

- 操作与应用规范
  - 从Teamcenter系统层面制定对Teamcenter系统进行操作与应用的规范。其主要内容包括：
    - Teamcenter系统操作及应用总则, 包括操作及应用责任人及职责。
    - 创建操作及应用工作区。
    - 系统启动/停止步骤、Re-cycle的策略、以及相关的脚本工具。
    - 维护PLM系统配置的准则、步骤、以及相应的脚本工具。
    - 其他专项运维规范，如重建数据库Index、校正数据一致性、CacheServer管理、日志管理、错误信息处理、等等。

Standards & Specifications

- 监控与维护规范
  - 从Teamcenter系统外部，制定对Teamcenter系统的运行状况进行监控与维护的规范。

    其包括：

    - 对各个服务器CPU利用率和Memory占用率进行监控的准则、步骤和工具；确定正常运行、黄色保警及红色保警策略与阀值。
    - 对系统负载进行监控与维护的准则、步骤和工具。
    - 对数据库服务器运行状态的监控，并确定报警策略与阀值。
    - 对tcserver and pool manage运行状态进行监控。
    - Web服务器的监控与维护。
    - 网络的监控与维护。
    - FSC服务器监控与维护 。

Standards & Specifications

- 二次开发规范
  - 制定PLM系统的二次开发规范，以确保客户化代码的质量。主要内容包括：
    - 服务端代码开发规范。
    - 客户端代码开发规范。
    - 应用工具脚本开发规范。
    - 参数配置文件定义规范。
    - 有关数据文件结构规范、等等。

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Thank you!

Learn and grow with our customers every day!