

# Root Cause Analysis

for Customer:

**Fujitsu Services**

on

**SR No:** 3-1610271271: Receiver is waiting for a latch dumping latch state for receiver  
(LCK0 issues)

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## Executive Summary

Fujitsu Services are contracted with the Post Office to replace the current infrastructure used in 12000 branches across the UK. The project involves rolling out a (non Oracle) financial application using Oracle RAC database and tools products. Oracle Streams is used to provide a reporting database environment.

The migration onto the new platform started at the end of 2009 and is currently rolled out live to 600 branches.

Post Offices taking part in the pilot have been complaining about intermittent hangs which are having huge impact on over the counter services as the system hangs for 5 minutes or longer and users are unable to complete their financial transactions.

Fujitsu have been unable to reproduce the hangs in any test environment despite numerous attempts to inject the system with heavy load to simulate the production situation. The focus of this escalation is to resolve the system wide hangs.

This document outlines the investigations which have been carried out by Oracle support and development to establish the root cause for these hangs and make recommendations on how to resolve the issue as per Service Request 3-1610271271.

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## Root Cause Analysis

This issue is under investigation and a full root cause analysis cannot be completed until the problem is resolved. The information below is the current understanding of the issue and may change as further investigation continues.

Fujitsu's application uses ddl extensively to truncate database partitions. This usage does not follow Oracle best practise and causes heavy growth of the database's shared memory pool. The LCK issue is *believed* to be caused by excessive growth in the "mvobj part des" shared pool memory region.

This indicates the most likely root cause to be the truncation / application ddl but this cannot be confirmed until the recommendations are in place and all lines of investigation completed.

It is currently believed that over extended durations, the LIVE shared pool becomes fragmented by growth in "mvobj part des" and general queries using literals rather than bind variables. Eventually space pressure triggers housekeeping by LCK and the hang occurs. Fixes recently applied have reduced the workload of the LCK process but have not resolved the problem.

Further analysis after investigation of the incident on weekend of 22<sup>nd</sup>/23<sup>rd</sup> May led to investigation of memory usage at a sub pool level. Shared memory is divided into several sub pools, Oracle are currently investigating into whether there are memory issues with a specific sub pool. Initial investigation of customer data has indicated sub pool behaviour is correct but further data will be provided by Fujitsu to confirm.



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## Corrective Actions

The two bugs (5618049 and 8528171) attribute growth in this region to large amounts of partition DDL taking place. These have been applied on Thursday 20th May.

Improved shared memory usage after patch application has been observed through analysis of data, this has shown the average free memory improve and the "mvobj part des" allocations reduced to 750mb compared to 2GB prior to patch application but lck issue still occurred on Saturday 22<sup>nd</sup> May.

Bug 7306915 resolves a memory leakage issue, this is proved to be occurring in Fujitsu's environment after analysis by support. This is due to be applied 30<sup>th</sup> May.

Further application changes required to reduce ddl operations are scheduled for the 6<sup>th</sup> June by Fujitsu, these are critical and a key action to resolving the critical business impact of this issue. It is not possible to completely remove all ddl operations and we will be focused on continuing to resolve issues in this area to ensure long term stability of the service.

Due to the absence of a reproducible test case and the complexity of the environment Oracle are unable to 100% guarantee that no further issues will occur, however based on experience with hundreds of other customers and the diagnostic information gathered, we believe this is the correct technical plan to lead to resolution of the current hangs being experienced by the Post Office.

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## Mitigation

The problem is shown to be related to the time the database instances are running. Regular re-cycling of the database instances is a proven method to prevent shared memory fragmentation. Oracle will provide feedback by end of 27<sup>th</sup> May re: plan for continuing the recycling after the patch application on the weekend of 29<sup>th</sup> / 30<sup>th</sup> May.

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## Recommendations

By following the actions plan below we believe the issue will be significantly improved. This is a complex issue and ongoing investigation may lead to other recommendations.

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1. Set `_object_statistics=false`. This is to enable the fix for bug 6001617 which is a common LCK0 CPU/load fix. Overall LCK0 load will be reduced with this parameter setting. (Completed)
2. Set event 14532 at level 1 to enable the fix for bug 5618049. This fix frees up "mvobj part des" heaps faster. (Completed)
3. Apply fix for bug 8528171 (provided in patch 9668554). This fix specifically addresses over allocations of "mvobj part des" heaps and reduces the number of library cache handles that LCK0 would need to free. (Completed)
4. Shared pool/library cache tuning activity, being led by Adrian Turner from Oracle consulting (scheduled for 6<sup>th</sup> June)
5. Apply patch for bug 7306915. Delivered to customer on Friday 21st May as merge patch 9734573. This is aimed at further improving shared pool usage after reoccurrence of LCK issue on 22<sup>nd</sup> May.. This contains the following fixes:-  
9668554 (applied 20th May, as discussed in point 3 above) + 7306915 ( fix for 7445 [kgldgn()+1101] ).
6. Until points 4 & 5 are completed, Oracle recommend customer continues to regularly recycle database instances. Based upon current pattern of incidents, a daily recycle would be optimum but depends upon customer's business requirements.
7. Apply further tracing as documented in service request to investigate theory re: skewed sub pools. This has an impact and customer will do this out of hours. This may lead to further recommendations.

**Additional Recommendations:**

Following the changes outlined above a period of close monitoring is recommended. For other application related recommendations, see onsite report provided by Adrian Turner.

Oracle would also recommend that further investment is made into the Load Testing environment, so that we can be confident that the architecture will support the additional load of further branches being rolled out. Oracle have offered to be involved in reviewing the testing strategy in further detail to ensure adequate load testing is carried out.

Use of Oracle Real Application Testing (RAT) should be considered – which combines a workload capture and replay feature with an SQL performance analyzer to help you test changes against real-life workloads, and then helps you fine-tune the changes before putting them into production.

The database replay feature would require upgrade of the DB to 11g. RAT also includes SQL Performance Analyser which is available on 10.2 and allows you to analyse the entire SQL workload for performance degradation in a fraction of the time it would take to do manually

To mitigate the high CPU run queues it is recommended that Fujitsu implement Database Resource Manager. Resource Manager only steps in when the server is 100% busy and throttles sessions, making them wait on "RESMGR: CPU QUANTUM" event. Under CPU starvation this will have the added benefit of preventing the database from impacting Clusterware and operating system processes. There is a known bug which must be reviewed prior to implementation (bug 4147766).

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## Appendix: Bug descriptions

The following gives technical detail on the underlying bugs and what they are designed to fix:

### BUG 8528171

#### PROBLEM DESCRIPTION:

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Customer is doing thousands of add/exchange partition operations per day. These operations cause too much shared pool memory to be allocated for partition descriptor objects (mvobj part des). Because of this problem, customer is having several issues on shared pool related operations.

These objects should be cleaned up more quickly when they are no longer needed.

Typically in the AWR report, "mvobj part des" objects are the largest portion of the shared pool.

#### WORKAROUND:

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Restarting instance or flushing shared pool clears up the objects but these workarounds are not acceptable for the customer. Because they have a 24x7 system and flushing shared pool takes hours to complete.

#### FIX DESCRIPTION

This problem is addressed as follows:

- 1) Obsolete and invalid KGL objects are placed on the cold end of the KGH lru so they are freed faster.
- 2) Extent size for partition operations has been increased from 1k to 4k, this decreases fragmentation.
- 3) Multi-versioned objects now do not acquire any instance locks, obsolescence is instead done manually in kkpox. This allows for these objects to be freed more quickly in RAC as they can be freed immediately rather than being queued up by LCK0.

### BUG 6001617

#### PROBLEM DESCRIPTION:

LCK0 consumes CPU Spining on ksrwait reading an ever increasing list of messages in "obj stat del channel" and holding "channel operations parent latch". ORA-4031's are also possible as messages are stored in the shared pool.

#### FIX DESCRIPTION:

This fix is activated by setting STATISTICS\_LEVEL = BASIC (or by setting "\_object\_statistics"=false) in the init.ora. Setting this means the space advisory will not be available for use as there will be no statistics for it to measure.

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**BUG 5618049****PROBLEM DESCRIPTION:**

*Db Leaking memory allocated for "mvobj part description" -- the versioned partition descriptor. It seems that this happens for both ADD PARTITION and DROP PARTITION (probably for other PMOs as well), and is not IOT specific.*

kgh was unable to free memory because of a latching issue. In this case we had a number of versioned objects and were unable to free them.

*The basic problem is that kgl is sometimes unable to free handles when called from kgh. This happens when we free one handle, realize this allows us to free a new object (since the ref count is now zero), but find this new object is protected by a second latch. Since we already hold a latch (to free the first handle) we are unable to free the second one.*

**FIX DESCRIPTION:**

The fix tries to be proactive about freeing memory and will be enabled under an event 14532. The 10.2 fix tries to free memory proactively.

**BUG 7306915****PROBLEM DESCRIPTION**

**ORA-4031 / KGL HANDLES MEMORY LEAK OF MVOBIND / MVOBTBL FROM PARTITION DDL**

Repeated EXCHANGE PARTITION against a partitioned table with local partitioned indexes can cause a number of obsolete (OBS) unfreeable MVOBIND library cache handles in the library cache. ie: ALTER SYSTEM FLUSH SHARED POOL will not flush the library cache entries. For high numbers of exchanges this can lead to shared pool pressure and subsequent ORA-4031 errors.

**FIX DESCRIPTION**

Merge patch 9668554 has been provided to customer to resolve leaks. Workaround is to reduce the number of exchange partition operations.