Oracle® Rdb for OpenVMS

Release Notes

Release 7.1.4.1

August 2005

Oracle Rdb Release Notes, Release 7.1.4.1 for OpenVMS

Contents

5 Known Problems and Restrictions

Preface

Purpose of This Manual

This manual contains release notes for Oracle Rdb Release 7.1.4.1. The notes describe changed and enhanced features; upgrade and compatibility information; new and existing software problems and restrictions; and software and documentation corrections.

Intended Audience

This manual is intended for use by all Oracle Rdb users. Read this manual before you install, upgrade, or use Oracle Rdb Release 7.1.4.1.

Document Structure

This manual consists of the following chapters:

Chapter 1	Describes how to install Oracle Rdb Release 7.1.4.1.
Chapter 2	Describes software errors corrected in Oracle Rdb Release 7.1.4.1.
Chapter 3	Describes enhancements introduced in Oracle Rdb Release 7.1.4.1.
Chapter 4	Provides information not currently available in the Oracle Rdb documentation set.
Chapter 5	Describes problems, restrictions, and workarounds known to exist in Oracle Rdb Release 7.1.4.1.

1 Installing Oracle Rdb Release 7.1.4.1

This software update is installed using the standard OpenVMS Install Utility.

NOTE

All Oracle Rdb Release 7.1 kits are full kits. There is no requirement to install any prior release of Oracle Rdb when installing new Rdb Release 7.1 kits.

1.1 Alpha EV7 Processor Support

For this release of Oracle Rdb, the Alpha EV7 (also known as the Alpha 21364) processor is the newest processor supported.

1.2 Oracle Rdb V7.1 Version Numbering Enhancement

Previously, the Oracle Rdb version number was specified as 4 digits (for example, version “7.1.0.2”). Starting with Oracle Rdb Release 7.1.1, an additional, fifth, digit has been added to the kit version number. This new digit is intended to indicate an optimization level of the Rdb software. The use of this new digit is to indicate a “generic” kit (final digit of zero) for all Alpha processors or a “performance” kit that will run on a subset of the supported platforms (final digit of 1). In the future, additional values may be specified to indicate other performance or platform options.

For Oracle Rdb Release 7.1.4.1, the two kits are 7.1.4.1.0 (compiled for all Alpha processor types) and 7.1.4.1.1 (compiled for EV56 and later Alpha processors). These kits offer identical functionality and differ only in a potential performance difference.

1.3 Requirements

The following conditions must be met in order to install this software:

- Oracle Rdb must be shutdown before you install this update kit. That is, the command file SYS$STARTUP:RMONSTOP71.COM should be executed before proceeding with this installation. If you have an OpenVMS cluster, you must shutdown the Rdb 7.1 monitor on all nodes in the cluster before proceeding.
- The installation requires approximately 280,000 blocks for OpenVMS Alpha systems.
- If you are running Hot Standby and you are upgrading from a version of Oracle Rdb 7.1 prior to 7.1.1, you must install this kit on both the master and the standby systems prior to restarting Hot Standby. This requirement

is necessary due to changes to the message format used to transmit journal state information from the master to the standby system.

1.4 Invoking VMSINSTAL

To start the installation procedure, invoke the VMSINSTAL command procedure as in the following examples.

To install the Oracle Rdb for OpenVMS Alpha kit that is compiled to run on all Alpha platforms:

```
@SYS$UPDATE:VMSINSTAL RDBV71410AM device-name OPTIONS N
```

To install the Oracle Rdb for OpenVMS Alpha kit that is performance targeted for Alpha EV56 and later platforms:

```
@SYS$UPDATE:VMSINSTAL RDBV71411AM device-name OPTIONS N
```

device-name

Use the name of the device on which the media is mounted. If the device is a disk drive, you also need to specify a directory. For example: `DKA400:[RDB.KIT]`

OPTIONS N

This parameter prints the release notes.

The full Oracle Rdb Release 7.1 Installation Guide is also available on MetaLink in Adobe Acrobat PDF format:

```
Top Tech Docs\Oracle Rdb\Documentation\Rdb 7.1 Installation and Configuration
Guide
```

1.5 Stopping the Installation

To stop the installation procedure at any time, press Ctrl/Y. When you press Ctrl/Y, the installation procedure deletes all files it has created up to that point and exits. You can then start the installation again.

If VMSINSTAL detects any problems during the installation, it notifies you and a prompt asks if you want to continue. You might want to continue the installation to see if any additional problems occur. However, the copy of Oracle Rdb installed will probably not be usable.

1.6 After Installing Oracle Rdb

This update provides a new Oracle Rdb Oracle TRACE facility definition. Any Oracle TRACE selections that reference Oracle Rdb will need to be redefined to reflect the new facility version number for the updated Oracle Rdb facility definition, “RDBVMSV7.1”.

If you have Oracle TRACE installed on your system and you would like to collect for Oracle Rdb, you must insert the new Oracle Rdb facility definition included with this update kit.

The installation procedure inserts the Oracle Rdb facility definition into a library file called EPC$FACILITY.TLB. To be able to collect Oracle Rdb event-data using Oracle TRACE, you must move this facility definition into the Oracle TRACE administration database. Perform the following steps:

1. Extract the definition from the facility library to a file (in this case, RDBVMS.EPC$DEF).

```
$ LIBRARY /TEXT /EXTRACT=RDBVMSV7.1 -
_$ /OUT=RDBVMS.EPC$DEF SYS$SHARE:EPC$FACILITY.TLB
```

2. Insert the facility definition into the Oracle TRACE administration database.

   ```
   $ COLLECT INSERT DEFINITION RDBVMS.EPC$DEF /REPLACE
   ```

Note that the process executing the INSERT DEFINITION command must use the version of Oracle Rdb that matches the version used to create the Oracle TRACE administration database or the INSERT DEFINITION command will fail.

1.7 Spurious SYSVERDIF Message During Installation

When installing Oracle Rdb on an OpenVMS V8.2 Alpha system, depending on the previous version of Oracle Rdb installed and how Oracle Rdb was shut down prior to the installation, a message similar to the following may be displayed during the installation procedure:

```
%INSTALL-E-FAIL, failed to REPLACE entry for
DISK$VMS82:<SYS0.SYSCOMMON.SYSLIB>RDMXSMP71.EXE
-INSTALL-E-SYSVERDIF, system version mismatch - please relink
```

This message may be safely ignored. Using the RMONSTOP.COM (for standard installations) or RMONSTOP71.COM (for multi-version installations) procedure to shut down Oracle Rdb prior to the installation may help avoid the message.

1.8 Patches for OpenVMS V7.3-1

Several problems that affect installations using Oracle Rdb on OpenVMS V7.3-1 are corrected in patch kits available from HP OpenVMS support. Oracle recommends that you consult with Hewlett-Packard and install these patch kits (or their replacements) to correct or avoid the following problems:

- VMS731_SYS-V0400 corrects the following problems seen with Oracle Rdb:
  - When using Oracle Rdb Galaxy support, or memory-resident global sections, processes enter a permanent RWAST state at image exit. The system must be rebooted to remove the process and continue normal operations. Note that when using Oracle Rdb Release 7.1.2 databases with SHARED MEMORY IS PROCESS RESIDENT attribute, the Row Cache feature and caches with the SHARED MEMORY IS SYSTEM, LARGE MEMORY IS ENABLED, or RESIDENT attributes, or in an OpenVMS Galaxy configuration with Oracle Rdb Galaxy support enabled, you are at an elevated risk of experiencing this problem.

    Configurations that do not have this patch, or it's future replacement, applied will not be supported by Oracle if the SHARED MEMORY IS PROCESS RESIDENT, the Row Cache, or Galaxy support features are in use. If you are not using these features, then the patch or it's replacement is not mandatory. However, Oracle still strongly recommends that it be used.
  - Applications using the Oracle Rdb Row Cache or AIJ Log Server (ALS) features would sometimes have their server processes hang in HIB (hibernate) state.
- VMS731_SYSLOA-V0100 corrects the following problem seen with Oracle Rdb:
  - In an OpenVMS cluster environment, unreported deadlocks and hangs can occur. This problem is sometimes characterized by an Oracle Rdb

blocking lock incorrectly being shown as owned by the system (in other words, with a zero PID).

1.9 Oracle Rdb Release 7.1.4.1.1 Optimized for Alpha EV56 (21164A Processor Chip) and Later Platforms

Oracle will be releasing Oracle Rdb 7.1 and later kits in parallel build streams - a “generic” kit that will run on all certified and supported Alpha platforms as well as a “performance” kit that will run on a subset of the supported platforms. The performance kit is intended for those customers with “newer” Alpha processor chips who need higher levels of performance than are offered by the generic kits. The performance kits are otherwise functionally identical to the generic kits.

Oracle will continue to release both types of kits for Oracle Rdb Release 7.1 as long as there is significant customer interest in the generic kit.

For improved performance on current generation Alpha processors, Oracle Rdb Release 7.1.4.1.1 is compiled explicitly for Alpha EV56 and later systems. This version of Oracle Rdb requires a system with a minimum Alpha processor chip of EV56 and a maximum processor chip of Alpha EV7 (known as the Alpha 21364).

Oracle Rdb Release 7.1.4.1.1 is functionally equivalent to Oracle Rdb Release 7.1.4.1.0 and was built from the same source code. The only difference is a potentially improved level of performance. Oracle Rdb Releases 7.1.4.1.0 and 7.1.4.1.1 are certified on all supported Alpha processor types (up to and including the Alpha EV7 processor).

In Release 7.1.4.1.1, Oracle Rdb is explicitly compiled for EV56 and later Alpha processors such that the generated instruction stream can utilize the byte/word extension (BWX) of the Alpha architecture. Additionally, this kit is compiled with instruction tuning biased for performance of Alpha EV6 and later systems that support quad-issue instruction scheduling.

Note that you should not install Release 7.1.4.1.1 of Oracle Rdb on Alpha EV4, EV45 or EV5 systems. These processor types do not support the required byte /word extension (BWX) of the Alpha architecture. Also ensure that all systems in a cluster sharing the system disk are using a minimum of the Alpha EV56 processor.

To easily determine the processor type of a running OpenVMS Alpha system, use the CLUE CONFIG command of the OpenVMS System Dump Analyzer utility (accessed with the ANALYZE/SYSTEM command). The “CPU TYPE” field indicates the processor type as demonstrated in the following example from an HP AlphaServer GS140 6/525 system with an EV6 (21264) processor:

```
$ ANALYZE/SYSTEM
SDA> CLUE CONFIG
System Configuration:
    .
    .
    .
Per-CPU Slot Processor Information:
CPU ID    00                CPU State    rc,pa,pp,cv,pv,pmv,pl
CPU Type  EV6  Pass 2.3 (21264)
PAL Code  1.96-1            Halt PC      00000000.20000000
    .
    .
    .
```

1.9.1 AlphaServer 4000 EV56 299Mhz Not Supported by Oracle Rdb Release Optimized for Alpha EV56 Processor

Oracle Rdb releases that are optimized for the Alpha EV56 and later processors are not able to run on the AlphaServer 4000 with the 299Mhz EV56 processor. Though this CPU claims to be an EV56, it does not, in fact, implement the byte /word instruction set as required.

According to information on the HP web site, this problem may be present in the AlphaServer 4000 or 4100 systems with a processor module of KN304-FA or KN304-FB. The systems effected appear to include the AlphaServer 4x00 5/300 pedestal, cabinet and rackmount systems: DA-51FAB-ED/-FD/-GB or DA-53GEB-CA/-EA/-FA/-GA.

The indicated CPU is not able to run Oracle Rdb releases that are optimized for the Alpha EV56 and later processors. This effects Oracle Rdb Releases optimized for the Alpha EV56 and later processors.

Possible workarounds include updating the system to an EV56 module for the AlphaServer 4x00 that is later than the KN304-FA or FB (ie a clock speed greater than 300Mhz). Some of the possible modules would include: KN304-AA 400mhz, KN304-DA 466mhz, B3005-CA 533mhz, B3006-EB 600mhz.

Otherwise, an Oracle Rdb release that is not optimized for the Alpha EV56 and later processors must be used (such as Oracle Rdb Releases 7.1.4.1.0)

Please contact your HP AlphaServer hardware vendor for additional information.

1.10 Maximum OpenVMS Version Check Added

As of Oracle Rdb7 Release 7.0.1.5, a maximum OpenVMS version check has been added to the product. Oracle Rdb has always had a minimum OpenVMS version requirement. With 7.0.1.5 and for all future Oracle Rdb releases, we have expanded this concept to include a maximum VMS version check and a maximum supported processor hardware check. The reason for this check is to improve product quality.

OpenVMS Version 8.2-x is the maximum supported version of OpenVMS.

The check for the OpenVMS operating system version and supported hardware platforms is performed both at installation time and at runtime. If either a non-certified version of OpenVMS or hardware platform is detected during installation, the installation will abort. If a non-certified version of OpenVMS or hardware platform is detected at runtime, Oracle Rdb will not start.

1.11 VMS$MEM_RESIDENT_USER Rights Identifier Required

Oracle Rdb Version 7.1 introduced additional privilege enforcement for the database or row cache attributes RESIDENT, SHARED MEMORY IS SYSTEM and LARGE MEMORY IS ENABLED. If a database utilizes any of these features, then the user account that opens the database must be granted the VMS$MEM_ RESIDENT_USER rights identifier.

Oracle recommends that the RMU/OPEN command be used when utilizing these features.

2
Software Errors Fixed in Oracle Rdb Release 7.1.4.1

This chapter describes software errors that are fixed by Oracle Rdb Release 7.1.4.1.

2.1 Software Errors Fixed That Apply to All Interfaces

2.1.1 Memory Leak With RMU /OPEN /STATISTICS=IMPORT

Starting with Oracle Rdb Release 7.1.2, when using the persistant statistics functionality, the Oracle Rdb monitor process (RDMMON71) would “leak” memory every 30 minutes. The monitor process could eventually run out of P0 virtual address space and could stop accepting new database open requests.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The monitor process no longer leaks memory when it performs periodic statistics checkpoint operations.

2.1.2 Query With Two ORDER BY Clauses Returns Wrong Result

Bugs 4086431, 2882908 and 1329838

The following query, which contains two ORDER BY clauses, returns results in the wrong order.

```
SELECT TMP.LOT_NO, TMP.CID, TMP.TIME FROM
    (SELECT CLOT.LOT_NO,
           CAS.CID,
           T2.TIME
     FROM CLOT AS T1,HLOT AS T2, CAS AS T3,
          (SELECT LOT_NO, MAX(TIME) FROM HLOT GROUP BY LOT_NO)
           AS TMP1 (LOT_NO, TIME)
     WHERE (T1.LOT_STATUS = 'CMP')  AND
          T1.LOT_NO = T2.LOT_NO AND
          T1.CID=CAS.CID AND
          T2.LOT_NO = TMP1.LOT_NO AND
          T2.TIME = TMP1.TIME
        ORDER BY T2.LOT_NO) AS TMP
ORDER BY TMP.LOT_NO;
Tables:
  0 = CLOT
  1 = HLOT
  2 = CAS
  3 = HLOT
Merge of 1 entries
  Merge block entry 1
  Cross block of 3 entries
    Cross block entry 1
      Conjunct: 0.CID = 2.CID
      Match
        Outer loop      (zig-zag)
          Index only retrieval of relation 2:CAS
```

```
            Index name  CASI1 [0:0]
        Inner loop      (zig-zag)
          Conjunct: 0.LOT_STATUS = 'CMP'
          Get     Retrieval by index of relation 0:CLOT
            Index name  CLOTI2 [0:0]
    Cross block entry 2
      Index only retrieval of relation 1:HLOT
        Index name  HLOTI1 [1:1]
          Keys: 0.LOT_NO = 1.LOT_NO
    Cross block entry 3
      Conjunct: (1.LOT_NO = 3.LOT_NO) AND (1.TIME = <mapped field>)
      Merge of 1 entries
        Merge block entry 1
        Aggregate: 0:MAX (3.TIME)
        Index only retrieval of relation 3:HLOT
          Index name  HLOTI1 [1:1]
            Keys: 3.LOT_NO = 0.LOT_NO
 LOT_NO            CID           TIME
 HK1L100152        SH011004      21-DEC-2000 16:23:56.00
 HK4L200099        SH011020       1-JUN-2001 11:36:44.00
 HK1L100343        SH015004      21-DEC-2000 16:34:21.00
 CIMP402051        SK025017       1-DEC-2004 02:45:59.00
 MR6NZ6N027        SM091027      18-NOV-2003 10:43:21.00
5 rows selected
```

The query works if the outermost ORDER BY clause is removed.

```
SELECT TMP.LOT_NO, TMP.CID, TMP.TIME FROM
    (SELECT T1.LOT_NO,
            CAS.CID,
            T2.TIME
     FROM CLOT AS T1,HLOT AS T2, CAS AS T3,
          (SELECT LOT_NO, MAX(TIME) FROM HLOT GROUP BY LOT_NO)
           AS TMP1 (LOT_NO, TIME)
     WHERE (T1.LOT_STATUS = 'CMP')  AND
          T1.LOT_NO = T2.LOT_NO AND
          T1.CID=CAS.CID AND
          T2.LOT_NO = TMP1.LOT_NO AND
          T2.TIME = TMP1.TIME
        ORDER BY T2.LOT_NO) AS TMP
!ORDER BY TMP.LOT_NO                    <== Commented out
;
Tables:
  0 = CLOT
  1 = HLOT
  2 = CAS
  3 = HLOT
Merge of 1 entries
  Merge block entry 1
  Cross block of 4 entries
    Cross block entry 1
      Conjunct: 0.LOT_STATUS = 'CMP'
      Get     Retrieval by index of relation 0:CLOT
        Index name  CLOTI1 [0:0]
    Cross block entry 2
      Index only retrieval of relation 2:CAS
        Index name  CASI1 [1:1]       Direct lookup
          Keys: 0.CID = 2.CID
    Cross block entry 3
      Index only retrieval of relation 1:HLOT
        Index name  HLOTI1 [1:1]
          Keys: 0.LOT_NO = 1.LOT_NO
    Cross block entry 4
      Conjunct: (1.LOT_NO = 3.LOT_NO) AND (1.TIME = <mapped field>)
      Merge of 1 entries
        Merge block entry 1
        Aggregate: 0:MAX (3.TIME)
        Index only retrieval of relation 3:HLOT
          Index name  HLOTI1 [1:1]
            Keys: 3.LOT_NO = 0.LOT_NO
 LOT_NO              CID            TIME
 CIMP402051          SK025017        1-DEC-2004 02:45:59.00
 HK1L100152          SH011004       21-DEC-2000 16:23:56.00
 HK1L100343          SH015004       21-DEC-2000 16:34:21.00
 HK4L200099          SH011020        1-JUN-2001 11:36:44.00
 MR6NZ6N027          SM091027       18-NOV-2003 10:43:21.00
5 rows selected
```

Notice that the problem query applies the index CASI1 with the column 2.CID at the outermost cross block while the good query applies the index CLOTI1 with the column 0.LOT_NO, which is the correct one referenced by the ORDER BY clause.

The key parts of this cursor query which contributed to the situation leading to the error are these:

1. The cursor query contains the outer SELECT statement as a derived table wrapped around the inner SELECT statment joining three tables and an aggregate query with MAX and GROUP BY clause.
2. The inner SELECT statement contains a WHERE clause with four equality predicates and a filter predicate, followed by an ORDER BY clause, referencing the same column as the GROUP BY clause.
3. The outer SELECT statement contains an ORDER BY clause referencing the same column as the inner ORDER BY clause via the derived table.

As a workaround, the query works if the outermost ORDER BY clause is removed, as shown in the example above.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.3 Database Shutdown Interruped by Re-attach May Cause Lost ALS Process

Bug 2668892

When the database open mode and the ALS are AUTOMATIC, if a new process attaches to the database at about the same time as the last process is detaching and closing the database, then it is possible, in some rare cases, that the ALS will be stopped by the detaching process and not restarted by the attaching process.

As a workaround, you can start the ALS manually when the database is open and the ALS is missing with the following command:

```
$ RMU/SERVER AFTER_JOURNAL START <root-file-spec>
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.4 Query With BETWEEN Clause Slows Down Using Index Full Scan

Bug 3835253

A customer found that the following query runs much slower as compared to the previous version of Rdb.

```
SELECT COUNT(*)
 FROM T1 V, T2 L, T3 P, T4 A
  WHERE
    V.LID  = L.LID AND
    L.PID = P.PID AND
    P.AID  = A.AID AND
    PSTAT = 'FF' AND
    PNUM = '123456' AND
    V.TX_DATE BETWEEN DATE ANSI '2003-01-01' AND DATE ANSI '2003-01-05' AND
    A.FLAG = 'T';
Tables:
  0 = T1
  1 = T2
  2 = T3
  3 = T4
Aggregate: 0:COUNT (*)
Conjunct: 0.LID = 1.LID
Match
  Outer loop
    Sort: 1.LID(a)
    Cross block of 3 entries
      Cross block entry 1
        Leaf#01 BgrOnly 3:T4 Card=21
          Bool: 3.FLAG = 'T'
          BgrNdx1 T4_NDX [0:0] Fan=21
      Cross block entry 2
        Conjunct: 2.AID = 3.AID
        Get     Retrieval sequentially of relation 2:T3
      Cross block entry 3
        Conjunct: 1.PID = 2.PID
        Index only retrieval of relation 1:T2
          Index name  T2_nDX [0:0]
  Inner loop      (zig-zag)
    Conjunct: 0.PSTAT = 'FF'
    Conjunct: 0.PNUM = '123456'
    Conjunct: 0.TX_DATE >= DATE '2003-01-01'
    Conjunct: 0.TX_DATE <= DATE '2003-01-05'
    Get     Retrieval by index of relation 0:T1
      Index name  I_VIOL_TX_SD2 [0:0]
        Bool: (0.TX_DATE >= DATE '2003-01-01') AND (0.TX_DATE <= DATE
              '2003-01-05')

           0
1 row selected
```

This problem started showing up in Oracle Rdb Release 7.1.2.1 where the fix for Bug 3144382 was included. For Rdb 7.0, the problem started in Rdb Release 7.0.7.1.

This type of performance problem could likely occur in a query with a predicate of either GTR, GEQ, LSS, LEQ, NEQ, CONTAINING or STARTS operator as the leading segment of the index retrieval.

As a workaround, the query correctly applies [2:2] index retrieval if the SQL flag 'selectivity' is set.

```
set flags 'selectivity';
```

```
! run the same query from above
!
Tables:
  0 = T1
  1 = T2
  2 = T3
  3 = T4
Aggregate: 0:COUNT (*)
Cross block of 4 entries
  Cross block entry 1
    Leaf#01 BgrOnly 3:T4 Card=21
      Bool: 3.FLAG = 'T'
      BgrNdx1 T4_NDX [0:0] Fan=21
  Cross block entry 2
    Conjunct: 2.AID = 3.AID
    Get     Retrieval sequentially of relation 2:T3
  Cross block entry 3
    Conjunct: 1.PID = 2.PID
    Index only retrieval of relation 1:T2
      Index name  T2_nDX [0:0]
  Cross block entry 4
    Leaf#02 BgrOnly 0:T1 Card=19098133
      Bool: (0.LID = 1.LID) AND (0.PSTAT = 'FF') AND (
            0.PNUM = '123456') AND (0.TX_DATE >= DATE '2003-01-01') AND
            (0.TX_DATE <= DATE '2003-01-05')
      BgrNdx1 I_VIOL_TX_SD2 [2:2] Fan=10
        Keys: (0.LID = 1.LID) AND (0.TX_DATE >= DATE '2003-01-01') AND (
              0.TX_DATE <= DATE '2003-01-05')

           0
1 row selected
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.5 Database Recovery Process May Fail When AIJs are Full

Bug 4122574

When AIJs were full, it was possible for the database recovery process to fail when trying to recover processes with active read write transactions. The failure occurred when trying to undo the current uncommitted transaction. The DBR log file would show the following:

```
<timestamp> - Starting transaction UNDO for TSN 0:128
<timestamp> - UNDO TSN 0:128 starts at RUJ JFA (2:0)
<timestamp> - Scanning AIJ for optimistic commit
<timestamp> - Starting AIJ scan at 1:513
%RDMS-I-BUGCHKDMP, generating bugcheck dump file SYS$SYSROOT:[SYSEXE]
RDMDBRBUG.DMP
```

Note that the AIJ scan started at 1:513 while the AIJ file is only 512 blocks.

```
The exception in the dump is:
***** Exception at 001B3418 : UTIO$READ_BLOCK + 00000208
%RDMS-F-FILACCERR, error reading disk file
-SYSTEM-W-ENDOFFILE, end of file
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.6 Count Distinct(fld) May Fail When Sorted Ranked Indexes are Used

Bug 4160534

In Oracle Rdb Release 7.1.0, an optimization enhancement was added to Rdb to handle "count distinct" type queries if a ranked index could be used to scan the distinct values. This optimization may return incorrect results if the field that the distinct value is based on is a leading segment in a multisegment sorted ranked index.

Count scan can only be used to determine distinct counts if the value expression of count distinct is covered by the entire key of the index, not just the leading segments.

A workaround is to disable COUNT SCAN optimization using the SET Flag statement:

```
SET FLAGS 'NOCOUNT_SCAN'
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.7 Left Outer Join View Query With Constant Columns Returns Wrong Result

Bugs 1752645 and 4155086

A customer gets the wrong result with the following query which selects from a left outer join view with constant columns.

```
create view test_vw1 as
select
cast(cast('ABCD' as char(4)) as char(4)) as fld_1,
cast('ABCD' as char(5)) as fld_2,
cast(case when 1=1 then 'YYY' else 'NNN' end as char(3)) as fld_3,
cast('NNN' as char(3)) as fld_4
    from rdb$database t1
    left outer join rdb$database t2 on t2.rdb$file_name = 'asdfasdf'
;
sel  * from test_vw1;
Tables:
  0 = RDB$DATABASE
  1 = RDB$DATABASE
Cross block of 2 entries        (Left Outer Join)
  Cross block entry 1
    Retrieval sequentially of relation 0:RDB$DATABASE
  Cross block entry 2
    Conjunct: 1.RDB$FILE_NAME = 'asdfasdf'
    Get     Retrieval sequentially of relation 1:RDB$DATABASE
 FLD_1   FLD_2   FLD_3   FLD_4
 NULL    NULL    YYY     NULL
1 row selected
```

The result should display the constant columns instead of NULL. Without the view, the query returns the correct result.

```
select
cast(cast('ABCD' as char(4)) as char(4)) as fld_1,
cast('ABCD' as char(5)) as fld_2,
cast(case when 1=1 then 'YYY' else 'NNN' end as char(3)) as fld_3,
cast('NNN' as char(3)) as fld_4
    from rdb$database t1
    left outer join rdb$database t2 on t2.rdb$file_name = 'asdfasdf'
;
Tables:
  0 = RDB$DATABASE
  1 = RDB$DATABASE
Cross block of 2 entries        (Left Outer Join)
  Cross block entry 1
    Retrieval sequentially of relation 0:RDB$DATABASE
  Cross block entry 2
    Conjunct: 1.RDB$FILE_NAME = 'asdfasdf'
    Get     Retrieval sequentially of relation 1:RDB$DATABASE
 FLD_1   FLD_2   FLD_3   FLD_4
 ABCD    ABCD    YYY     NNN
1 row selected
```

The original design for Bug 1752645, which allows a constant column in a view definition for an outer join, caused all types of problems in the optimizer because it could not associate the constant column to the view. With this fix, the wrong result is produced by the simple query (like the one above) which selects constant columns of nested expressions from a view query with left outer join on two tables.

The fix for Bug 1752645 has been withdrawn from all Rdb releases to fix this current problem.

There is no known workaround for this problem.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.8 Bugchecks at DIOMARK$NEW_SNAP_PAGE + 000000D0 When Area Added Online

Bug 3818408

If a database was currently open on multiple nodes, and a storage area was added on one node, attempts to reference that area on other nodes could result in a bugcheck containing an exception similar to the following:

```
***** Exception at 011F4500 : DIOMARK$NEW_SNAP_PAGE + 000000D0
%SYSTEM-F-ACCVIO, access violation, reason mask=00, virtual address=
0000000000000008, PC=00000000011F4500, PS=0000000B
```

This problem can be demonstrated with the following commands.

Session on Node 1:

```
$ SQL$
SQL> CREATE DATABASE FILENAME TEST OPEN IS MANUAL
SQL>   RESERVE 10 STORAGE AREAS
SQL>
SQL>   CREATE STORAGE AREA RDB$SYSTEM FILENAME TEST;
SQL> EXIT
```

Session on Node 2:

```
$ RMU/OPEN/WAIT TEST
```

Session on Node 1:

```
$ RMU/OPEN/WAIT TEST
$
$ SQL$
SQL> ALTER DATABASE FILENAME TEST
SQL>   ADD STORAGE AREA AREA1 FILENAME AREA1;
SQL>
SQL> ATTACH 'FILENAME TEST';
SQL> CREATE TABLE T1 (F1 INTEGER);
SQL> CREATE STORAGE MAP M1 FOR T1 STORE IN AREA1;
SQL> COMMIT;
SQL> EXIT
```

Session on Node 2:

```
SQL> ATTACH 'FILENAME TEST';
SQL> INSERT INTO T1 VALUES (1);
%RDMS-I-BUGCHKDMP, generating bugcheck dump file dev:[dir]RDSBUGCHK.DMP;
%RDMS-I-BUGCHKDMP, generating bugcheck dump file dev:[dir]SQLBUGCHK.DMP;
%SYSTEM-F-ACCVIO, access violation, reason mask=00, virtual address=
0000000000000008, PC=000000000027F20C, PS=0000001B
SQL> ROLLBACK;
SQL> EXIT;
```

The bugcheck would only occur if a specific sequence of actions occurred the first time the new storage area was accessed on a node that did not create the area. Under certain conditions, the data structure describing the new storage area was not being read from disk prior to being accessed.

The problem can be avoided by closing the database on all nodes prior to adding a new storage area.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.9 Query with GROUP BY and ORDER BY Returned Rows in the Wrong Order

Bug 4239808

The following query with GROUP BY and ORDER BY clauses returned rows in the wrong order. The detailed query strategy appears after the select statement and before the resulting data rows. If you compare the order of the keys in the ORDER BY clause of the SELECT statement with the order of those same keys in the Sort: line of the detailed query strategy, you will see that they are not the same. This pinpoints the cause of the error.

```
set flags 'detail,strategy';
select
   T2.ITYPE,
   T3.UNLY,
   SUM(T1.AMT) as AMOUNT
from
   (select CLRH, SCTRY, SMRKT,
           SIG, SCMD,
           ETYPE, CNO, DSNAME, AMT
    from EDS
    where BID = 1 and
          ETYPE = 1 and
          CNO IN (24,25) ) as T1
join
   EINTR as T2 on
   T2.SCTRY = T1.SCTRY AND
   T2.SMRKT  = T1.SMRKT  AND
   T2.SIG = T1.SIG
join
   ENT_UND as T3 on
   T3.SCMD = T1.SCMD
group by
   T1.CLRH,
   T2.ITYPE,
   T3.UNLY,
   T1.ETYPE,
   T1.CNO,
   T1.DSNAME
order by
   T1.CLRH,
   T1.DSNAME,
   T1.ETYPE,
   T1.CNO,
   T2.ITYPE,
   T3.UNLY;
 T2.ITYPE   T3.UNLY           AMOUNT
 HSIC       HSI               6.660000000000000E+002
 HSIP       HSI               7.140000000000000E+002
 SFU2       JSE               5.684000000000002E+002
 MHIC       MHI               2.000000000000000E+002
 MHIF       MHI               1.840000000000000E+001
 MHIP       MHI               4.000000000000000E+001

    ... etc. ...

12 rows selected
```

The results appear in the correct order when the query is run under Rdb Release 7.0.6.2. The value SFU2 in column T2.ITYPE would correctly appear in row 6 (as shown in the example that follows). In the example above, that value is sorted incorrectly and appears in row 3.

As a workaround, the query works if the columns of the GROUP BY clause are rearranged to be in the same order as in the ORDER BY clause.

```
select
   T2.ITYPE,
   T3.UNLY,
   SUM(T1.AMT) as AMOUNT
from
   (select CLRH, SCTRY, SMRKT,
           SIG, SCMD,
           ETYPE, CNO, DSNAME, AMT
    from EDS
    where BID = 1 and
          ETYPE = 1 and
          CNO IN (24,25) ) as T1
join
   EINTR as INST on
   T2.SCTRY = T1.SCTRY AND
   T2.SMRKT  = T1.SMRKT  AND
   T2.SIG = T1.SIG
join
   ENT_UND as UND on
   T3.SCMD = T1.SCMD
group by
   T1.CLRH,
   T1.DSNAME,
   T1.ETYPE,
   T1.CNO,
   T2.ITYPE,
   T3.UNLY
order by
   T1.CLRH,
   T1.DSNAME,
   T1.ETYPE,
   T1.CNO,
   T2.ITYPE,
   T3.UNLY;
 T2.ITYPE   T3.UNLY           AMOUNT
 HSIC       HSI               6.660000000000000E+002
 HSIP       HSI               7.140000000000000E+002
 MHIC       MHI               2.000000000000000E+002
 MHIF       MHI               1.840000000000001E+001
 MHIP       MHI               4.000000000000000E+001
 SFU2       JSE               5.684000000000001E+002

    ... etc. ...

12 rows selected
```

The key parts of this cursor query which contributed to the situation leading to the error are these:

1. The select query contains GROUP BY and ORDER BY clauses where the columns of the ORDER BY clause have a different order from that of the GROUP BY clause.
2. One item of the select list is an aggregate of some sort, for example SUM.
3. The query applies the cross strategy rather than a match strategy.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.10 Query with GROUP BY, ORDER BY Returned Rows in the Wrong Order

Bugs 4239808 and 3197004

A query with a GROUP BY and an ORDER BY clause presented its rows sorted in the wrong order. Below is an example query on the standard Rdb PERSONNEL database. The example first shows the SQL query, followed by a detailed diagnostic output of the Rdb optimizer's query strategy, followed by the rows returned as the result of the query. Certain lines in the example have been annotated with numerals towards the right margin so that reference can be made to those lines in the explanation that follows the example.

```
set flags 'detail,strategy';

select employee_id as emp_id,
       manager_id as mgr_id,
       last_name as last_name
 from employees inner join departments
 on (employee_id = manager_id)                               1
 group by employee_id, last_name, manager_id                 2
 order by employee_id desc, manager_id desc;                 3
Tables:
  0 = EMPLOYEES
  1 = DEPARTMENTS
Reduce: 0.LAST_NAME, 0.EMPLOYEE_ID, 1.MANAGER_ID
Sort: 0.LAST_NAME(a), 0.EMPLOYEE_ID(d), 1.MANAGER_ID(a)      4
Cross block of 2 entries
  Cross block entry 1
    Get Retrieval sequentially of relation 1:DEPARTMENTS
  Cross block entry 2
    Get Retrieval by index of relation 0:EMPLOYEES
      Index name  EMP_EMPLOYEE_ID [1:1] Direct lookup
        Keys: 0.EMPLOYEE_ID = 1.MANAGER_ID
 EMP_ID   MGR_ID   LAST_NAME
 00374    00374    Andriola
 00207    00207    Babbin
 00205    00205    Bartlett
 00173    00173    Bartlett

 ...

26 rows selected
```

The query strategy, in this case, showed but a single Sort: line (the line marked 4). The order of the sort keys was different from the order in the query's ORDER BY clause (line 3). The query contains a GROUP BY clause (line 2), which implies that sorting must be done to perform the grouping operation. As a rule, the Rdb optimizer tries to rearrange keys in a GROUP BY sort using the order of the keys in an outer ORDER BY sort. If it can do so, Rdb eliminates one of the two sorts by combining them. In this example, Rdb did so incorrectly, resulting in the wrong order of sort keys in the remaining sort operation of the original two. This explains why the rows were sorted incorrectly.

In the examples, the EMPLOYEE_ID and MANAGER_ID columns are used in an ON clause (line 1) as the condition for joining two tables, EMPLOYEES and DEPARTMENTS. The EMPLOYEE_ID and MANAGER_ID columns appear in the ORDER BY clause (line 3) and those sort keys are considered to be equivalent. One can sort on the one key or sort on the other to achieve the same results. In certain cases (the preceding example showing one of them), the fact that the ORDER BY clause contained two or more equivalent sort keys was one of the conditions that caused the incorrect behavior in Rdb.

The following example shows the corrected behavior.

```
set flags 'detail,strategy';

select employee_id as emp_id,
       manager_id as mgr_id,
       last_name as last_name
 from employees inner join departments
 on (employee_id = manager_id)                                      1
 group by employee_id, last_name, manager_id                        2
 order by employee_id desc, manager_id desc;                        3
Tables:
  0 = EMPLOYEES
  1 = DEPARTMENTS
Sort: 0.EMPLOYEE_ID(d), 1.MANAGER_ID(d)                             5
Reduce: 0.EMPLOYEE_ID, 0.LAST_NAME, 1.MANAGER_ID
Sort: 0.EMPLOYEE_ID(a), 0.LAST_NAME(a), 1.MANAGER_ID(a)             4
Cross block of 2 entries
  Cross block entry 1
    Get Retrieval sequentially of relation 1:DEPARTMENTS
  Cross block entry 2
    Get Retrieval by index of relation 0:EMPLOYEES
      Index name  EMP_EMPLOYEE_ID [1:1] Direct lookup
        Keys: 0.EMPLOYEE_ID = 1.MANAGER_ID
 EMP_ID   MGR_ID   LAST_NAME
 00471    00471    Herbener
 00418    00418    Blount
 00405    00405    Dement
 00374    00374    Andriola

 ...

26 rows selected
```

This second example, above, shows the query results returned in the desired order. The query strategy now has two sorts performed (one at line 4 for the GROUP BY clause and one at line 5 for the ORDER BY clause).

A third example, below, shows a variation of the previous query. In this next example, the columns in the GROUP BY and the ORDER BY clauses are the same, and the order sorts first in descending order on the first key and in ascending order on the second key. See the line marked 1 in the right margin for the sort order that Rdb used. Sorting first on MANAGER_ID and then on EMPLOYEE_ID is accceptable because the two columns are equivalent as explained earlier in this note. The problem was that the sorting was done in ascending order.

```
set flags 'detail,strategy';
```

```
select employee_id as emp_id,
       manager_id as mgr_id
  from employees inner join departments
  on (employee_id = manager_id)
  group by employee_id, manager_id
  order by employee_id desc, manager_id asc;
Tables:
  0 = EMPLOYEES
  1 = DEPARTMENTS
Reduce: 1.MANAGER_ID, 0.EMPLOYEE_ID
Sort: 1.MANAGER_ID(a), 0.EMPLOYEE_ID(a)                              1
Cross block of 2 entries
  Cross block entry 1
    Get Retrieval sequentially of relation 1:DEPARTMENTS
  Cross block entry 2
    Index only retrieval of relation 0:EMPLOYEES
      Index name  EMP_EMPLOYEE_ID [1:1] Direct lookup
        Keys: 0.EMPLOYEE_ID = 1.MANAGER_ID
 EMP_ID   MGR_ID
 00164    00164
 00166    00166
 00168    00168
 00173    00173

 ...
26 rows selected
```

The following example shows the corrected behavior. Again, the positions of MANAGER_ID and EMPLOYEE_ID are swapped in the sort order, which is permissible given that the two columns are equivalent in this query. The first key is sorted in descending order and the second key is sorted in ascending order, as they should be.

```
set flags 'detail,strategy';

select employee_id as emp_id,
       manager_id as mgr_id
  from employees inner join departments
  on (employee_id = manager_id)
  group by employee_id, manager_id
  order by employee_id desc, manager_id asc;
Tables:
  0 = EMPLOYEES
  1 = DEPARTMENTS
Reduce: 1.MANAGER_ID, 0.EMPLOYEE_ID
Sort: 1.MANAGER_ID(d), 0.EMPLOYEE_ID(a)                              1
Cross block of 2 entries
  Cross block entry 1
    Get Retrieval sequentially of relation 1:DEPARTMENTS
  Cross block entry 2
    Index only retrieval of relation 0:EMPLOYEES
      Index name  EMP_EMPLOYEE_ID [1:1] Direct lookup
        Keys: 0.EMPLOYEE_ID = 1.MANAGER_ID
 EMP_ID   MGR_ID
 00471    00471
 00418    00418
 00405    00405
 00374    00374

 ...
26 rows selected
```

There is no known workaround for this problem.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.11 Truncating Empty Table Leaves Uncommited Transaction in Journal

Bug 4245771

If an empty table was truncated, an after-image journal (AIJ) entry would be made for the truncate operation but no commit entry would be entered in the journal for the committed transaction. Thus the transaction would appear uncommitted when a recover operation was done with the journal.

For example, the following message could be displayed by a RMU/RECOVER command when recovering a journal that has missing COMMIT entries:

```
%RMU-I-LOGRECSTAT, transaction with TSN nn:nn is active
```

This message can be safely ignored. To prevent this from occurring, some other kind of update operation would need to be done in the same transaction as the TRUNCATE command. For example, if a row was added to the table prior to the TRUNCATE command then that would prevent this problem from occurring.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.12 Bugchecks in AIJUTL$FREE_DIRTY_ARBS When Journals Full

Bug 4088221

Various processes could fail with bugchecks in AIJUTL$FREE_DIRTY_ARBS if all journals became full, a user process was terminated, a journal was backed up, and further journaling activity in the database occurred.

The bugcheck exception was similar to the following:

```
***** Exception at 011E9E94 : AIJUTL$FREE_DIRTY_ARBS + 000005F4
%COSI-F-BUGCHECK, internal consistency failure
```

This problem was introduced in Oracle Rdb Release 7.1.2.4.

The following demonstrates how this problem could occur.

Create a simple database with two minimum sized journals:

```
$ SQL$
CREATE DATABASE FILENAME TEST
  CREATE STORAGE AREA AREA1
    FILENAME AREA1 ;
CREATE TABLE TABLE1 (COLUMN1 INTEGER, COLUMN2 CHAR (900));
CREATE STORAGE MAP MAP1 FOR TABLE1
  DISABLE COMPRESSION
  STORE IN AREA1;
COMMIT;
DISCONNECT ALL;

ALTER DATABASE FILE TEST
  JOURNAL IS ENABLED
  (FAST COMMIT IS ENABLED,
   SHUTDOWN TIME IS 1 MINUTE)
  RESERVE 1 JOURNAL
  ADD JOURNAL JOURNAL1 FILENAME 'JOURNAL1'
  ADD JOURNAL JOURNAL2 FILENAME 'JOURNAL2';
EXIT;
```

Fill the journals:

```
$ RMU/OPEN TEST
$ SQL$
ATTACH 'FILENAME TEST';

INSERT INTO TABLE1 VALUES (1, 'Text');
COMMIT;
EXIT;
$ RMU/SET AFTER_JOURNAL /SWITCH TEST
$ SQL$
ATTACH 'FILENAME TEST$DATABASE:TEST';
BEGIN
DECLARE :I INT;
FOR :I IN 2 TO 100000
DO
  INSERT INTO TABLE1 VALUES (:I, 'Text');
END FOR;
COMMIT;
END;
```

After the journals fill, the insert process will hang. Kill it, backup the journals, and then attempt to insert more data into the table:

```
$ RMU/BACKUP/AFTER/NOLOG TEST NL:
$ SQL$
ATTACH 'FILENAME TEST';

INSERT INTO TABLE1 VALUES (1, 'Text');
%RDMS-I-BUGCHKDMP, generating bugcheck dump file dev:[dir]RDSBUGCHK.DMP;
%COSI-F-BUGCHECK, internal consistency failure
```

This problem can be avoided by ensuring that journals are backed up prior to all journals becoming full.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.13 Query With Shared Expressions in OR Predicates Returns Wrong Result

Bugs 4300529 and 3918278

The following query with shared expressions in the OR predicate returns the wrong result.

```
select * from
  (SELECT T1.SEM, T1.PAL, T1.VUO, T1.KK, T1.PV
     FROM T1, T2
     WHERE (T2.SEM = T1.SEM)
          AND
          ((NOT EXISTS (SELECT T3.SEM FROM T3
                        WHERE T3.SEM = T1.SEM))
           OR
           (T1.SEM = 'JOVK'))
           AND
          ((NOT EXISTS (SELECT T3.SEM FROM T3
                        WHERE T3.PAL = T1.PAL))
           OR
           (T1.SEM = 'JOVK'))
    ) as DTAB (SEM, PAL, VUO, KK, PV)
where VUO = '2005' and KK = '03' and PV = '29';
Tables:
  0 = T1
  1 = T2
  2 = T3
  3 = T3
Merge of 1 entries
  Merge block entry 1
  Cross block of 4 entries
    Cross block entry 1
      Conjunct: (0.VUO = '2005') AND (0.KK = '03') AND (0.PV = '29')
      Index only retrieval of relation 0:T1
        Index name  T1_INDEX [3:3]
          Keys: (0.VUO = '2005') AND (0.KK = '03') AND (0.Pv = '29')
    Cross block entry 2
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Aggregate-F1: 0:COUNT-ANY (<subselect>)
      Conjunct: (2.SEM = 0.SEM)
      Index only retrieval of relation 2:T3
        Index name  T3_INDEX [0:0]
    Cross block entry 3
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: 0.SEM = 'JOVK'                   <== See NOTE
      Conjunct: ((<agg0> = 0) OR (0.SEM = 'JOVK')) AND
     ((<agg1> = 0) OR (0.SEM = 'JOVK'))
      Aggregate-F1: 1:COUNT-ANY (<subselect>)
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: (3.PAL = 0.PAL)
      Index only retrieval of relation 3:T3
        Index name  T3_INDEX [0:0]
    Cross block entry 4
      Conjunct: ((<agg0> = 0) OR (0.SEM = 'JOVK')) AND
     ((<agg1> = 0) OR (0.SEM = 'JOVK'))
      Index only retrieval of relation 1:T2
        Index name  T2_INDEX [1:1]     Direct lookup
          Keys: 1.SEM = 0.SEM
 SEM    PAL          VUO    KK     PV
 JOVK   TV2          2005   03     29
 JOVK   TV2          2005   03     29
2 rows selected
```

NOTE:: The conjunct "(0.SEM = 'JOVK')" is separated from its parent OR predicate with the other left operand "(<agg0> = 0)".

The following cross entry 3 contains the incorrect conjunct "(0.SEM = ’JOVK’)" which is separated from the other left operand "(<agg0> = 0)" of the OR predicate.

```
    Cross block entry 3
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: 0.SEM = 'JOVK'                    <== Incorrect
      Conjunct: ((<agg0> = 0) OR (0.SEM = 'JOVK')) AND
     ((<agg1> = 0) OR (0.SEM = 'JOVK'))
      Aggregate-F1: 1:COUNT-ANY (<subselect>)
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: (<agg0> = 0) OR (0.SEM = 'JOVK')
      Conjunct: (3.PAL = 0.PAL)
      Index only retrieval of relation 3:T3
        Index name  T3_INDEX [0:0]
```

There is no known workaround for this problem.

The key parts of this query which contributed to the situation leading to the error are these:

1. The main query selects from a derived table joining two tables with the filtering predicates in the outer WHERE clause.
2. The inner WHERE clause of the query selecting the derived table contains a join equality predicate and two similar OR predicates with a shared expression "(T1.SEM = ’JOVK’)" as the right side operand.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.14 Failed Users Not Recovered if DBR Startup Fails

Failed users would not always be recovered if a database shutdown was forced due to an error when the database monitor attempted to create a database recovery (DBR) process.

For example, if there were insufficient process slots available on the system to create another process and the database monitor could not create a DBR then the database would be shutdown. The forced shutdown would leave behind user entries in the database for all the processes that were accessing the database from that node. However, the monitor would incorrectly clear the entry in the data structure used to determine if a node recovery was needed. This would prevent the failed users from being recovered the next time that the database was accessed.

Since the failed users were not recovered, it is possible that database corruption could be introduced since changes made by the failed users were not rolled back before other users accessed the data. It is possible that logical inconsistencies could have been introduced in the database that cannot be detected by RMU/VERIFY. If this problem is encountered, it is advised that the database be restored from the last backup and after-image journals be applied to recover the database up to the point of failure. Recovery past the point of failure may be possible but could re-introduce corruption.

This problem can be avoided by ensuring that there are sufficient system resources available to start DBR processes when needed.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.15 Various Errors or Corruption of Ranked Indexes

Bug 4216643

If a series of updates occurred on an index node of `type is sorted ranked` in the same transaction, it was possible that the index node could be corrupted.

Several different results could occur depending on subsequent operations in the transaction.

- If there were no further operations on the index node in the same transaction and the transaction committed, the index will be left corrupt.
- If a subsequent update attempted certain operations on the index node, various bugchecks could result. In this case, the transaction would be rolled back and the index node would not be corrupt.
- If a subsequent update attempted to update the same index node, the update could fail with the error message "RDB-E-NO_RECORD, access by dbkey failed because dbkey is no longer associated with a record". In this case, the index may or may not be left corrupt depending on the precise sequence of operations and also on the application's response to the error. If the application commits the transaction, the index may be left corrupt. If the application rolls back the transaction, the index will not be left corrupt.

In the reported case, a RDB-E-NO_RECORD error was reported and the failed update was automatically rolled back. This is termed a *verb rollback*. The following example shows the reported error.

```
SQL> delete from some_table where some_key < 20050225;
%RDB-E-NO_RECORD, access by dbkey failed because dbkey is no longer
associated with a record
-RDMS-F-NODBK, 98:770:1 does not point to a data record
```

In this case, a subsequent RMU/VERIFY reported no errors and the index was not corrupt.

To produce this problem, a precise sequence of operations needed to occur within the same transaction.

- A row is deleted where the key value is not the first key value in the index node and that key value has many duplicates causing the duplicates chain to overflow into several overflow index nodes.
- The dbkey for the deleted row must be in the first overflow node for the key value.
- A row is deleted that is the last remaining row with a key value in the same index node and that key value appeared in the index node before the previously deleted row.
- Another row is deleted with the first key value and the deleted dbkey is the last remaining dbkey in the first overflow node.

When the last dbkey is deleted from the first overflow node, that node is deleted and the overflow pointer in the index node must be modified to point to the second overflow node. In the sequence above, the deletion of the unique key values caused the location of the second ikey to be moved in the index node but the third delete used a stale pointer to update the overflow dbkey.

The problem can be avoided by performing the sequence of operations in a different order or in separate transactions. The problem only affects indexes of `type is sorted ranked`.

If index corruption occurs, the index must be dropped and recreated to eliminate the corruption.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.16 Wrong Results Generated by Query With Common Boolean Elements

Bug 4332115

In prior releases of Oracle Rdb, an optimization was applied to WHERE clauses and other Boolean expressions to reformat those queries to gain possible advantages in the query execution phase. However, in the reported problem, this optimization leads to a query strategy that does not return the correct results. In some cases, the common expression in an OR expression was lifted too high in the expression and so distorted the results.

While this problem is possible in older versions of Rdb, it may occur more frequently in Oracle Rdb V7.0 and later versions because of a more aggressive restructuring algorithm employed by these recent versions.

For example, this query against the EMPLOYEES table should produce four result rows.

```
SQL> set flags 'strategy,detail';
SQL>
SQL> select last_name, first_name
cont> from employees
cont> where
cont>     (
cont>      (
cont>       (last_name = 'Watters' and first_name = 'Christine')
cont>       or
cont>       (last_name = 'Watters' and first_name = 'Cora')
cont>      )
cont>      and
cont>      (
cont>       (last_name = 'Watters' and first_name = 'Christine')
cont>       or
cont>       (last_name = 'Watters' and first_name = 'Cora')
cont>      )
cont>     )
cont>     or
cont>     (last_name = 'Smith')
cont> order by 1, 2
cont> ;
Tables:
  0 = EMPLOYEES
Sort: 0.LAST_NAME(a), 0.FIRST_NAME(a)
Leaf#01 BgrOnly 0:EMPLOYEES Card=100
  Bool: ((((0.FIRST_NAME = 'Christine') OR (0.FIRST_NAME = 'Cora')) AND ((
        0.FIRST_NAME = 'Christine') OR (0.FIRST_NAME = 'Cora'))) OR (0.LAST_NAME
         = 'Smith')) AND (0.LAST_NAME = 'Watters')
  BgrNdx1 EMP_LAST_NAME [1:1] Fan=12
    Keys: 0.LAST_NAME = 'Watters'
 LAST_NAME        FIRST_NAME
 Watters          Christine
 Watters          Cora
2 rows selected
SQL> -- expecting 4 rows
```

The detailed strategy output shows that the expression `AND (0.LAST_NAME = 'Watters')` has been raised to the outer most part of the query and thus erroneously eliminates two of the rows matching 'Smith'.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The query optimizer now correctly handles the case where a trailing OR term does not match a common Boolean with the query.

2.1.17 Wrong Result From Query With Common Join Booleans in OR

Bugs 4332115 and 1329838

The following query with common join booleans in the OR predicate returns the wrong result (should be 5 rows) after the common boolean optimization is manually disabled (by commenting out the code).

```
sel  e.employee_id, e.last_name, j.job_start
  from employees e, job_history j
  where
        e.employee_id = j.employee_id and e.employee_id = '00222'
              or
        e.employee_id = j.employee_id and e.employee_id = '00234'
              or
        e.employee_id = j.employee_id and e.employee_id = '00345'
;
Tables:
  0 = EMPLOYEES
  1 = JOB_HISTORY
Cross block of 2 entries
  Cross block entry 1
    Get     Retrieval by index of relation 0:EMPLOYEES
      Index name  EMP_EMPLOYEE_ID [0:0]
  Cross block entry 2
    Conjunct:
    ((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00222'))
              OR
    ((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00234'))
              OR
    ((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00345'))
    OR index retrieval
      Conjunct:
      ((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00222'))
                OR
      ((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00234'))
      OR index retrieval
        Conjunct:
        (0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00222')
        Get     Retrieval by index of relation 1:JOB_HISTORY
          Index name  JOB_HISTORY_HASH [1:1]
            Keys: 0.EMPLOYEE_ID = 1.EMPLOYEE_ID
        Conjunct:
        NOT ((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00222'))
                AND
        (0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00234')
        Get     Retrieval by index of relation 1:JOB_HISTORY
          Index name  JOB_HISTORY_HASH [1:1]
            Keys: 0.EMPLOYEE_ID = 1.EMPLOYEE_ID
      Conjunct:
      NOT (((0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00222'))
                OR
           (0.EMPLOYEE_ID = 1.EMPLOYEE_ID) )   ! Note :: <== missing '00234'
      AND (0.EMPLOYEE_ID = 1.EMPLOYEE_ID) AND (0.EMPLOYEE_ID = '00345')
      Get     Retrieval by index of relation 1:JOB_HISTORY
        Index name  JOB_HISTORY_HASH [1:1]
          Keys: 0.EMPLOYEE_ID = 1.EMPLOYEE_ID
 E.EMPLOYEE_ID   E.LAST_NAME      J.JOB_START
 00222           Lasch            28-Dec-1979
 00222           Lasch            18-Aug-1976
 00234           Robinson         20-May-1980
 00234          Robinson         5-Mar-1978
4 rows selected
```

Note that the boolean '0.EMPLOYEE_ID = '00234' is missing in the NOT predicate of the 2nd leg of the outer OR index retrieval.

There is no known workaround for this problem.

The key parts of this query which contributed to the situation leading to the error are these:

1. The main query joins EMPLOYEES and JOB_HISTORY tables using EMPLOYEE_ID.
2. The WHERE clause of the query contains two OR predicates with three operands where E.EMPLOYEE_ID = J.EMPLOYEE_ID is a common join boolean in each operand.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.18 Wrong Result Selecting From a Derived Table of UNION Clause

Bug 4327112

The following query selects the wrong result (should be 3 rows) from a derived table of a union clause.

```
set flags 'strategy,detail';
SEL * FROM
    (SELECT FLD1, A.FLD2,
       NVL((SELECT FLD3 FROM TAB_B B WHERE B.FLD2 = A.FLD2), 'Z')
     FROM TAB_A A
     UNION
     SELECT F1, F2, F3 FROM TAB_C
     ) AS DT (F1, F2, F3)
WHERE DT.F3 = 'Z';
Tables:
  0 = TAB_A
  1 = TAB_B
  2 = TAB_C
Merge of 1 entries
  Merge block entry 1
  Reduce: <mapped field>, <mapped field>, <mapped field>
  Sort: <mapped field>(a), <mapped field>(a), <mapped field>(a)
  Merge of 2 entries
    Merge block entry 1
    Cross block of 2 entries
      Cross block entry 1
        Get Retrieval sequentially of relation 0:TAB_A
      Cross block entry 2
        Aggregate: 0:VIA (1.FLD3)
        Conjunct: 1.FLD2 = 0.FLD2
        Get     Retrieval sequentially of relation 1:TAB_B
    Merge block entry 2
    Conjunct: 2.F3 = 'Z'
    Get     Retrieval sequentially of relation 2:TAB_C
 F1     F2     F3
 1      A      Z
 2      A      Z
 3      B      1      <== should not have returned this row
 4      C      Z
4 rows selected
```

In the problem query, the conjunct "DT.F3 = 'Z'" appears only in the second UNION leg but not in the first UNION leg. Without an additional conjunct at the outside of the union query, the query returns the wrong result.

As a workaround, the query works if the union legs are swapped.

```
SEL * FROM
    (
    SELECT F1, F2, F3 FROM TAB_C ! <== second leg is swapped here as first leg
    UNION
    SELECT
        FLD1, A.FLD2,
        NVL((SELECT FLD3 FROM TAB_B B WHERE B.FLD2 = A.FLD2), 'Z')
        FROM TAB_A A
        ) AS DT (F1, F2, F3)
WHERE DT.F3 = 'Z';
Tables:
  0 = TAB_C
  1 = TAB_A
  2 = TAB_B
  3 = TAB_B
Conjunct: <mapped field> = 'Z'                <== See note
Merge of 1 entries
  Merge block entry 1
  Reduce: <mapped field>, <mapped field>, <mapped field>
  Sort: <mapped field>(a), <mapped field>(a), <mapped field>(a)
  Merge of 2 entries
    Merge block entry 1
    Conjunct: 0.F3 = 'Z'
    Get     Retrieval sequentially of relation 0:TAB_C
    Merge block entry 2
    Cross block of 3 entries
      Cross block entry 1
        Get     Retrieval sequentially of relation 1:TAB_A
      Cross block entry 2
        Aggregate: 0:VIA (2.FLD3)
        Conjunct: 2.FLD2 = 1.FLD2
        Get     Retrieval sequentially of relation 2:TAB_B
      Cross block entry 3
        Aggregate: 1:VIA (3.FLD3)
        Conjunct: 3.FLD2 = 1.FLD2
        Get     Retrieval sequentially of relation 3:TAB_B
 F1     F2     F3
 1      A      Z
 2      A      Z
 4      C      Z
3 rows selected
```

Note:: There is an additional conjunct "<mapped field> = 'Z'" at the top of the union query.

The key parts of this query which contributed to the situation leading to the error are these:

1. The main query selects from the derived table of a union clause with a filter predicate.
2. The first leg of the union clause contains a select query with a NVL function on a subselect query.
3. The second leg of the union clause contains a select query from a table.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.19 Incorrect Foreign Key Constraint Behavior on Update

Bug 4157145

A certain class of foreign key constraint would fail to detect a violation when an update was performed. Under the following conditions, an update statement that modified a primary/unique key would not result in a constraint violation if one were to exist:

- The constraint must have been defined by the SQL REFERENCES clause (making it a foreign key constraint).
- The constraint must be self-referencing. A self-referencing constraint is one in which the columns of the foreign key and the columns of the primary/unique key are in the same table.
- The update statement must have referenced one or more of the columns that make up the primary/unique key.

The following is an example of a self-referencing, foreign key constraint.

```
SQL$

create database filename test;

create table t (pk char (3), fk char (3),
                constraint pk_constraint
                  primary key (pk) not deferrable);

insert into t(pk)    values ('1');
1 row inserted
insert into t(pk,fk) values ('2','2');
1 row inserted
insert into t(pk,fk) values ('3','1');
1 row inserted
commit;

alter table t
  add constraint
    constraint fk_constraint
      foreign key (fk) references t(pk) not deferrable;
commit;

select * from t order by pk;
 PK     FK
 1      NULL
 2      2
 3      1
3 rows selected
rollback;

update t set pk='9' where pk='1';
%RDB-E-INTEG_FAIL, violation of constraint FK_CONSTRAINT caused
operation to fail
-RDB-F-ON_DB, on database DISK:[DIR]TEST.RDB;
```

The third row, with values (3,1), shows a foreign key value that matches a primary key value in the first row. The update statement, which attempts to change the primary key value in that first row from 1 to 9 violates the foreign key constraint that a primary key with value 1 exist in the table.

The example shows the error message that is now reported by Oracle Rdb Release 7.1.4.1. In some prior releases, the constraint violation was not detected, no error message was reported, and the update was allowed.

For self-referencing, foreign key constraint definitions created using SQL and the REFERENCES clause and created using Oracle Rdb 7.1.4.1, the correct behavior will appear. For such constraints created by certain earlier releases of Oracle Rdb, the problem will continue to appear. To determine if a table contains erroneous data, data that should cause a constraint violation, execute the statement RMU/VERIFY/CONSTRAINT. If there is an error in the data, you should see an error message such as the one in the following example. In the example, the database file specification has been abbreviated to the word DBASE to shorten the text.

```
$ rmu/verify/constraint test.rdb
%RMU-I-BGNROOVER, beginning root verification
%RMU-I-ENDROOVER, completed root verification
%RMU-I-BGNVCONST, beginning verification of constraints for database DBASE
%RMU-W-CONSTFAIL, Verification of constraint "FK_CONSTRAINT" has failed.
%RMU-I-ENDVCONST, completed verification of constraints for database DBASE
...
```

Oracle recommends the regular use of RMU Verify to monitor the integrity of your databases.

To correct the problem in constraint definitions created using earlier releases of Oracle Rdb, first fix the database files, either by dropping and recreating the offending constraint definitions or by recreating the database files from EXPORT /IMPORT interchange files. Then, recreate any Oracle Rdb backup files for the databases (files with filename extensions of .RBF).

- For an existing Rdb database, alter the table definition to drop the foreign key constraint. Then, alter the table definition to recreate the constraint using Oracle Rdb 7.1.4.1.
- For an existing database backup file, make a new backup file from a database file in which the constraint definition has been recreated as explained in the preceding bulleted item.

There is no known workaround for this problem.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.20 Bugchecks Accessing a REAL or DOUBLE PRECISION Column

Bug 4349150

If an application inserted invalid floating point data in a REAL or DOUBLE PRECISION column, Rdb would bugcheck in various ways when that data was accessed. Inserting invalid floating point data is an application bug and can happen, for example, when uninitialized host language variables are used as a source for column data in an insert.

For example, suppose a table T was defined with a REAL column named R. If an F-Float format Not-a-number (NaN) value was stored in column R, the following SQL statements demonstrate the kinds of bugcheck failures that were occurring.

```
Simple select:
SQL> select R from T;
 R
%RDMS-I-BUGCHKDMP, generating bugcheck dump file XXXXX:[XXXX]SQLBUGCHK.DMP;
%SQL-F-BUGCHK, There has been a fatal error. Please contact your Oracle
support representative. SQL$EEP - 4

Type conversion:
SQL> select cast(R as varchar(15)) FROM T;
%RDMS-I-BUGCHKDMP, generating bugcheck dump file XXXXX:[XXXX]RDSBUGCHK.DMP;
%COSI-F-UNEXPERR, unexpected system error
-SYSTEM-E-ACCVIO, access violation, reason mask=00, virtual address=
0000000000000000, PC=0000000000000000, PS=00000000

Arithmetic:
SQL> select (R + 1.0) from T
%RDMS-I-BUGCHKDMP, generating bugcheck dump file XXXXX:[XXXX]RDSBUGCHK.DMP;
%COSI-F-UNEXPERR, unexpected system error
-SYSTEM-E-ACCVIO, access violation, reason mask=00, virtual address=
0000000000000000, PC=0000000000000000, PS=00000000
```

As a workaround for this problem, update the rows to put valid floating point data in the problem columns.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. In the case of a simple select (like the first example above), the output field in the display is filled with asterisks ("*"). In the other examples where Rdb tries to convert datatypes or do arithmetic, an %RDB-E-ARITH_EXCEPT error is returned.

2.1.21 Connection Name Longer than 31 Octets Mishandled

Bug 4380993

Starting in Oracle Rdb Release 7.1.4, the 31 octet name limit for connection names began to be enforced. Unfortunately, if a connection name was submitted which had greater than the allowed length of 31 octets, the name would be silently truncated. This has been corrected so that the CONNECT statement is rejected with a %SQL-E-NAMTOOBIG error.

In addition, if a SET CONNECT or DISCONNECT statement were submitted with a name larger than 31 octets, the error text associated with the returned %SQL-E-NOSUCHCON error sometimes contained non-printing characters. This has been fixed so that these extraneous characters will no longer appear.

As a workaround, use a connection name of 31 octets or less.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.22 Loss of NULL Setting for Imported LIST OF BYTE VARYING Columns

Bug 4384906

In prior versions of Oracle Rdb V7.1, the IMPORT command would loose the NULL attribute for LIST OF BYTE VARYING columns. Instead these columns would be imported as empty lists.

The following example shows the difference before and after an IMPORT.

```
SQL> attach 'filename PERSONNEL';
SQL> insert into resumes values ('00167', null);
1 row inserted
SQL> select * from resumes;
 EMPLOYEE_ID   RESUME
 00167         NULL
1 row selected
SQL> commit;
SQL> export database alias RDB$DBHANDLE into PERS.RBR;
SQL> disconnect all;
SQL> drop database filename PERSONNEL;
SQL> import database from PERS.RBR filename PERSONNEL.RDB;
SQL> select * from resumes;
 EMPLOYEE_ID   RESUME
 00167                         0:0:0
1 row selected
SQL> commit;
```

This problem affects all LIST OF BYTE varying columns in user defined tables.

The column's NULL attribute is lost and the segmented string id appears as 0:0:0 when displayed by Interactive SQL. If a cursor is opened on such LIST OF BYTE VARYING columns then it will act like an empty list and return no data, just as it would if the NULL attribute was on. However, applications that test a LIST column using IS NULL or IS NOT NULL will possibly match a different set of rows.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.23 Bugchecks in PSII2SPLITNODE When Using Ranked Indexes

Bug 4324725

When inserting rows into a table with indexes of `TYPE IS SORTED RANKED`, it was possible that a bugcheck could occur in the routine PSII2SPLITNODE.

The exception occurred when the 65535th row was added to a particular key value, and the dbkey was inserted into an overflow node and the level one node contained exactly one key value and had two or fewer free bytes.

The following example shows the bugcheck footprint for an index that only contains one key value.

```
COSI-F-BUGCHECK, internal consistency failure
Exception occurred at PSII2SPLITNODE + 00000390
Called from PSII2CASETOPM1 + 000006C8
Called from PSII2INSERTTREE + 000001FC
Called from RDMS$$KOD_INSERT_TREE + 00002954
```

For indexes with more than one key value, the bugcheck footprint would be slightly different.

```
COSI-F-BUGCHECK, internal consistency failure
Exception occurred at PSII2SPLITNODE + 00000390
Called from PSII2BALANCE + 00000DEC
Called from PSII2INSERTT + 00000548
Called from PSII2INSERTT + 0000042C
```

The index is not corrupt but repeated attempts to insert such a record will fail with the same exception. If the index is dropped, the row may be inserted, and the index can be rebuilt correctly. A rebuild of the index would likely eliminate the bugcheck.

The problem can be avoided by either using alternate index types or adding fields to the key value to make the index more unique.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.24 Wrong Result from UNION Query with Outer Join Leg

Bug 4392374

The following query should find one row:

```
set flags 'strategy,detail';
SELECT sec_id, busdate, tc_code
FROM (SELECT
        SP_sec_id,
        SP_busdate,
        SP_tc_code,
        SP_rlc_code,
        SP_stc_id,
        SP_part_id
FROM
    (SELECT
    SEC.sec_id,
    SEC.sec_sub_id,
    ABD.busdate,
    STD.tc_code,
    STD.rlc_code,
    STD.stc_id,
    OPA.part_id
    FROM    STD    STD,
            ABD    ABD,
            OPA    OPA,
            RLC    RLC,
            STC    STC,
            SEC    SEC
    WHERE   SEC.es_date   <=  ABD.busdate
    AND     SEC.ee_date   >=  ABD.busdate
    AND     SEC.inst_code =   1
    AND     STD.es_date   <=  ABD.busdate
    AND     STD.ee_date   >=  ABD.busdate
    AND     STD.sec_id    =   SEC.sec_id
    AND     OPA.sec_id    =   SEC.sec_id
    AND     STD.rlc_code  =   RLC.rlc_code
    AND     RLC.es_date   <=  ABD.busdate
    AND     RLC.ee_date   >=  ABD.busdate
    AND     STD.stc_id    =   STC.stc_id
    AND     STC.es_date   <=  ABD.busdate
    AND     STC.ee_date   >=  ABD.busdate
    ) AS    SP
        (SP_sec_id,
        SP_sec_sub_id,
        SP_busdate,
        SP_tc_code,
        SP_rlc_code,
        SP_stc_id,
        SP_part_id
        )
                                                  LEFT OUTER JOIN
    (SELECT
     DIV1.shr_id,
     DIV1.ex_div_date,
     DIV1.div_cur_code,
     SUM(DIV1.div_value)
     FROM
     DIV    DIV1,
     ABD    ABD1,
     SEC    SEC1,
     STD    STD1
     WHERE  DIV1.ex_div_date   =  ABD1.busdate
     AND    DIV1.div_cur_code  =  STD1.tc_code
     AND    STD1.es_date       <= ABD1.busdate
     AND    STD1.ee_date       >= ABD1.busdate
     AND    SEC1.sec_sub_id    =  DIV1.shr_id
     AND    STD1.sec_id        =  SEC1.sec_id
     AND    SEC1.es_date       <= ABD1.busdate
     AND    SEC1.ee_date       >= ABD1.busdate
     AND    SEC1.inst_code     =  1
     GROUP BY
     DIV1.shr_id,
     DIV1.ex_div_date,
     DIV1.div_cur_code
    ) AS    DIVSEC
            (DIVSEC_shr_id,
             DIVSEC_ex_div_date,
             DIVSEC_div_cur_code,
             DIVSEC_div_value)
    ON      SP_sec_sub_id         =   DIVSEC_shr_id AND
            DIVSEC_div_cur_code   =   SP_tc_code AND
            DIVSEC_ex_div_date    =   SP_busdate
UNION ALL
    SELECT
            SEC.sec_id,
            ABD.busdate,
            STD.tc_code,
            STD.rlc_code,
            STD.stc_id,
            OPA.part_id
    FROM    STD    STD,
            SEC    SEC,
            OPA    OPA,
            ABD    ABD,
            RLC    RLC,
            STC    STC
    WHERE   SEC.es_date   <=  ABD.busdate
    AND     SEC.ee_date   >=  ABD.busdate
    AND     SEC.inst_code <>  1
    AND     STD.es_date   <=  ABD.busdate
    AND     STD.ee_date   >=  ABD.busdate
    AND     STD.sec_id    =   SEC.sec_id
    AND     OPA.sec_id    =   SEC.sec_id
    AND     STD.rlc_code  =   RLC.rlc_code
    AND     RLC.es_date   <=  ABD.busdate
    AND     RLC.ee_date   >=  ABD.busdate
    AND     STD.stc_id    =   STC.stc_id
    AND     STC.es_date   <=  ABD.busdate
    AND     STC.ee_date   >=  ABD.busdate
    )
    as OM_STATIC_VIEW (
    sec_id,
    busdate,
    tc_code,
    rlc_code,
    stc_id,
    part_id
    )
WHERE sec_id = 32978 AND busdate = '24-MAY-2005';
Tables:
  0 = STD
  1 = ABD
  2 = OPA
  3 = RLC
  4 = STC
  5 = SEC
  6 = DIV
  7 = ABD
  8 = SEC
  9 = STD
  10 = STD
  11 = SEC
  12 = OPA
  13 = ABD
  14 = RLC
  15 = STC
Conjunct: (<mapped field> = 32978) AND (<mapped field> = '24-MAY-2005')
Merge of 1 entries
  Merge block entry 1
  Merge of 2 entries
    Merge block entry 1
    Conjunct: 5.sec_id = 32978
    Conjunct: 1.busdate = '24-MAY-2005'
    Conjunct: 5.sec_id = 32978          <== See Note1
    Conjunct: 1.busdate = '24-MAY-2005'
    Match    (Left Outer Join)                 <== See Note2
      Outer loop
        Sort: 1.busdate(a), 0.tc_code(a),
              5.sec_sub_id(a)          <== See Note3
        Merge of 1 entries
          Merge block entry 1
          Cross block of 6 entries
            Cross block entry 1
              Conjunct: 1.busdate = '24-MAY-2005'
              Index only retrieval of relation 1:ABD
                Index name  ABD_U_PRM [1:1]    Direct lookup
                  Keys: <mapped field> = '24-MAY-2005'
            Cross block entry 2
              Conjunct: 4.es_date <= 1.busdate
              Conjunct: 4.ee_date >= 1.busdate
              Get     Retrieval by index of relation 4:STC
                Index name  STC_U_PRM [0:0]
            Cross block entry 3
              Conjunct: 0.es_date <= 1.busdate
              Conjunct: 0.ee_date >= 1.busdate
              Get
              Retrieval by index of relation 0:STD
                Index name  STD_U_FRG_7 [1:1]
                  Keys: 0.stc_id = 4.stc_id
            Cross block entry 4
              Conjunct: 5.ee_date >= 1.busdate
              Get     Retrieval by index of relation 5:SEC   <== See Note2
                Index name  SEC_U_FRG_7 [2:3]
                  Keys: (5.inst_code = 1) AND (0.sec_id =
                        5.sec_id) AND (5.es_date <=
                        1.busdate)
                  Bool: 5.sec_id = 32978
            Cross block entry 5
              Conjunct: 3.ee_date >= 1.busdate
              Get     Retrieval by index of relation 3:RLC
                Index name  RLC_U_PRM [1:2]
                  Keys: (0.rlc_code = 3.rlc_code)
                         AND (3.es_date <= 1.busdate)
            Cross block entry 6
              Get     Retrieval by index of relation 2:OPA
                Index name  OPA_U_PRM [1:1]    Direct lookup
                  Keys: 2.sec_id = 5.sec_id
      Inner loop
        Temporary relation
        Sort: 6.ex_div_date(a), 6.div_cur_code(a), 6.shr_id(a)
        Merge of 1 entries
          Merge block entry 1
```

```
              Aggregate: 0:SUM (6.div_value)
              Sort: 6.shr_id(a), 6.ex_div_date(a), 6.div_cur_code
                    (a)
              Cross block of 4 entries
                Cross block entry 1
                  Index only retrieval of relation 7:ABD
                    Index name  ABD_U_PRM [0:0]
                Cross block entry 2
                  Get     Retrieval by index of relation 6:DIV
                    Index name  DIV_U_ALT_1 [1:1]
                      Keys: 6.ex_div_date = 7.busdate
                Cross block entry 3
                  Conjunct: 8.ee_date >= 7.busdate
                  Conjunct: 8.inst_code = 1
                  Get     Retrieval by index of relation 8:SEC
                    Index name  SEC_U_FRG_8 [1:2]
                      Keys: (8.sec_sub_id = 6.shr_id) AND (
                            8.es_date <= 7.busdate)
                Cross block entry 4
                  Conjunct: (6.div_cur_code = 9.tc_code)
                             AND (9.ee_date >= 7.busdate)
                  Get
                  Retrieval by index of relation 9:STD
                    Index name  STD_U_PRM [1:2]
                      Keys: (9.sec_id = 8.sec_id) AND (
                            9.es_date <= 7.busdate)
        Merge block entry 2
        Cross block of 6 entries
          Cross block entry 1
            Conjunct: 13.busdate = '24-MAY-2005'
            Index only retrieval of relation 13:ABD
              Index name  ABD_U_PRM [1:1]    Direct lookup
                Keys: <mapped field> = '24-MAY-2005'
          Cross block entry 2
            Conjunct: 15.es_date <= 13.busdate
            Conjunct: 15.ee_date >= 13.busdate
            Get     Retrieval by index of relation 15:STC
              Index name  STC_U_PRM [0:0]
          Cross block entry 3
            Conjunct: 10.es_date <= 13.busdate
            Conjunct: 10.ee_date >= 13.busdate
            Get     Retrieval by index of relation 10:STD
              Index name  STD_U_FRG_7 [1:1]
                Keys: 10.stc_id = 15.stc_id
          Cross block entry 4
            Conjunct: 14.ee_date >= 13.busdate
            Get     Retrieval by index of relation 14:RLC
              Index name  RLC_U_PRM [1:2]
                Keys: (10.rlc_code = 14.rlc_code) AND
                      (14.es_date <= 13.busdate)
          Cross block entry 5
            Conjunct: (11.ee_date >= 13.busdate) AND (
                      11.inst_code <> 1)
            Get     Retrieval by index of relation 11:SEC
              Index name  SEC_U_PRM [1:2]
                Keys: (10.sec_id = 11.sec_id) AND (11.es_date
                       <= 13.busdate)
                Bool: 11.sec_id = 32978
          Cross block entry 6
            Get     Retrieval by index of relation 12:OPA
              Index name  OPA_U_PRM [1:1]    Direct lookup
                Keys: 12.sec_id = 11.sec_id
0 rows selected
```

```
Note1:: The conjunct "5.sec_id = 32978" is generated from the predicate
       "sec_id = 32978" since sec_id is a mapped column from the
       OM_STATIC_VIEW (a derived table) which contains the UNION query with
       the first leg as a left outer join and the second leg as a regular
       join subquery.

Note2:: The match strategy is used for the left outer join operation and
        thus it requires a sort node. The sort operation in Rdb always
        pre-loaded the records from the table into the sort buffer before
        the actual record retrieval.

Note3:: When the conjunct "5.sec_id = 32978" is evaluated, the column
       "5.sec_id" contains a stale value from the table 5:SEC
       instead of the updated value from the sort buffer. This causes the
       query to return FALSE even though the correct record is found.
```

As a workaround, the query works if the index SEC_U_FRG_7 for SEC table is dropped since the query now switches from match to cross strategy for the left outer join operation without the sort node. This could also happen if SQL flags is set to ’index_column_group’ or ’old_cost_model’.

The following is the strategy output of the same query after the index SEC_U_FRG_7 is dropped.

```
Conjunct: (<mapped field> = 32978) AND (<mapped field> = ’24-MAY-2005’)
Merge of 1 entries
  Merge block entry 1
  Merge of 2 entries
    Merge block entry 1
    Conjunct: 5.sec_id = 32978                    <== See Note4
    Conjunct: 1.busdate = ’24-MAY-2005’
    Cross block of 2 entries        (Left Outer Join)  <== See Note4
      Cross block entry 1
        Merge of 1 entries
          Merge block entry 1
          Cross block of 6 entries
            Cross block entry 1
              Conjunct: 1.busdate = ’24-MAY-2005’
              Index only retrieval of relation 1:ABD
                Index name  ABD_U_PRM [1:1]    Direct lookup
                  Keys: <mapped field> = ’24-MAY-2005’
            Cross block entry 2
              Conjunct: (5.ee_date >= 1.busdate) AND (
                        5.inst_code = 1)
              Get     Retrieval by index of relation 5:SEC  <== See Note4
                Index name  SEC_U_PRM [1:2]
                  Keys: (<mapped field> = 32978) AND (5.es_date <=
                        1.busdate)
            Cross block entry 3
              Conjunct: 4.es_date <= 1.busdate
              Conjunct: 4.ee_date >= 1.busdate
              Get     Retrieval by index of relation 4:STC
                Index name  STC_U_PRM [0:0]
            Cross block entry 4
              Conjunct: 0.ee_date >= 1.busdate
              Conjunct: 0.stc_id = 4.stc_id
              Get
              Retrieval by index of relation 0:STD
                Index name  STD_U_PRM [1:2]
                  Keys: (0.sec_id = 5.sec_id) AND (
                        0.es_date <= 1.busdate)
            Cross block entry 5
              Get     Retrieval by index of relation 2:OPA
                Index name  OPA_U_PRM [1:1]    Direct lookup
                  Keys: 2.sec_id = 5.sec_id
            Cross block entry 6
              Conjunct: 3.ee_date >= 1.busdate
              Get     Retrieval by index of relation 3:RLC
                Index name  RLC_U_PRM [1:2]
                  Keys: (0.rlc_code = 3.rlc_code)
                         AND (3.es_date <= 1.busdate)
      Cross block entry 2
        Conjunct: (5.sec_sub_id = 6.shr_id) AND (
                  6.div_cur_code = 0.tc_code) AND (
                  6.ex_div_date = 1.busdate)
        Merge of 1 entries
          Merge block entry 1
          Aggregate: 0:SUM (6.div_value)
          Sort: 6.shr_id(a), 6.ex_div_date(a), 6.div_cur_code
                (a)
          Cross block of 4 entries
            Cross block entry 1
              Index only retrieval of relation 7:ABD
                Index name  ABD_U_PRM [0:0]
            Cross block entry 2
              Conjunct: (5.sec_sub_id = 6.shr_id) AND (
                        6.div_cur_code = 0.tc_code) AND
                        (6.ex_div_date = 1.busdate)
              Conjunct: 6.ex_div_date = 7.busdate
              Get     Retrieval by index of relation 6:DIV
                Index name  DIV_U_ALT_1 [2:2]
                  Keys: (6.ex_div_date = 7.busdate) AND (
                        5.sec_sub_id = 6.shr_id)
            Cross block entry 3
              Conjunct: 8.ee_date >= 7.busdate
              Conjunct: 8.inst_code = 1
              Get     Retrieval by index of relation 8:SEC
                Index name  SEC_U_FRG_8 [1:2]
                  Keys: (8.sec_sub_id = 6.shr_id) AND (
                        8.es_date <= 7.busdate)
            Cross block entry 4
              Conjunct: (6.div_cur_code = 9.tc_code)
                         AND (9.ee_date >= 7.busdate)
              Get
              Retrieval by index of relation 9:STD
                Index name  STD_U_PRM [1:2]
                  Keys: (9.sec_id = 8.sec_id) AND (
                        9.es_date <= 7.busdate)
    Merge block entry 2
    Cross block of 6 entries
      Cross block entry 1
        Conjunct: 13.busdate = '24-MAY-2005'
        Index only retrieval of relation 13:ABD
          Index name  ABD_U_PRM [1:1]    Direct lookup
            Keys: <mapped field> = '24-MAY-2005'
      Cross block entry 2
        Conjunct: 15.es_date <= 13.busdate
        Conjunct: 15.ee_date >= 13.busdate
        Get     Retrieval by index of relation 15:STC
          Index name  STC_U_PRM [0:0]
      Cross block entry 3
        Conjunct: 10.es_date <= 13.busdate
        Conjunct: 10.ee_date >= 13.busdate
        Get     Retrieval by index of relation 10:STD
          Index name  STD_U_FRG_7 [1:1]
            Keys: 10.stc_id = 15.stc_id
      Cross block entry 4
        Conjunct: 14.ee_date >= 13.busdate
        Get     Retrieval by index of relation 14:RLC
          Index name  RLC_U_PRM [1:2]
            Keys: (10.rlc_code = 14.rlc_code) AND
```

```
                  (14.es_date <= 13.busdate)
      Cross block entry 5
        Conjunct: (11.ee_date >= 13.busdate) AND (
                  11.inst_code <> 1)
        Get     Retrieval by index of relation 11:SEC
          Index name  SEC_U_PRM [1:2]
            Keys: (10.sec_id = 11.sec_id) AND (11.es_date
                   <= 13.busdate)
            Bool: 11.sec_id = 32978
      Cross block entry 6
        Get     Retrieval by index of relation 12:OPA
          Index name  OPA_U_PRM [1:1]    Direct lookup
            Keys: 12.sec_id = 11.sec_id
 sec_id   busdate                  tc_code
  32978   24-MAY-2005 00:00:00.00   CHF
1 row selected
```

```
Note4:: The cross strategy is used for the left outer join operation instead
        of a match strategy. Since no sort is required and the column
        5.sec_id in the conjunct "5.sec_id = 32978" did not get
        pre-loaded, as in the case of a sort operation, it was correctly
 retrieved from the table on the fly during the cross operation.
```

The key parts of this query which contributed to the situation leading to the error are these:

1. The main query selects a particular row from either a view or derived table of a union query where the first leg is a left outer join subquery and the second leg is a regular join subquery.
2. The column of the equality predicate is mapped via the view or derived table to the same base table which is included in both legs of the left outer join subquery and the second UNION leg.
3. The query applies a match strategy for the left outer join operation with a sort node at the outer loop and another sort node at the inner loop.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.25 COSI_MEM_FREE_VMLIST Bugcheck with Vertical Partitioning

Bug 4460398

With vertical partitioning in use, the following bugcheck was possible:

```
***** Exception at 0091B704 : COSI_MEM_FREE_VMLIST + 00000094
%SYSTEM-F-ACCVIO, access violation, reason mask=04,
  virtual address=000000000008308D, PC=000000000091B704, PS=0000001B
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.26 Bugcheck from INSERT With Partition Index

Bug 4477862

The following query bugchecks:

```
SQL>INSERT INTO TBL1 VALUES (1,2,3);
%DEBUG-I-DYNMODSET, setting module RDMS$PREEXEMSC
%SYSTEM-F-ACCVIO, access violation, reason mask=00, virtual address=000000000000
0060, PC=00000000006A2358, PS=00000018
1816:                         IF .CXPR [CXPR$L_OPERATOR] NEQU BLR$K_MISSING
```

```
where the tables are defined as follows:
```

```
CREATE TABLE TBL1 (TBL1_P1 INT, TBL1_P2 INT, TBL1_P3 INT, CONSTRAINT TBL1_PRIM
PRIMARY KEY (TBL1_P1, TBL1_P2) DEFER);
```

```
CREATE TABLE TBL2 (TBL2_P1 INT, TBL2_P2 INT, TBL2_P3 INT, CONSTRAINT TBL2_FOR
FOREIGN KEY (TBL2_P1, TBL2_P2) REFERENCES TBL1 (TBL1_P1, TBL1_P2) DEFER);

CREATE INDEX IDX1 ON TBL1 (TBL1_P1 DESC, TBL1_P2 DESC) STORE USING (TBL1_P1)
IN A1 WITH LIMIT OF (2)
IN A2 WITH LIMIT OF (1)
OTHERWISE IN A3;
CREATE INDEX IDX2 ON TBL2 (TBL2_P1, TBL2_P2) ;
COMMIT;

UPDATE RDB$RELATIONS SET RDB$CARDINALITY = 306
WHERE RDB$RELATION_NAME='TBL2';
COMMIT;
```

As a workaround, the query works if the cardinality of table TBL2 is updated to a number below 306 rows.

```
UPDATE RDB$RELATIONS SET RDB$CARDINALITY = 305
WHERE RDB$RELATION_NAME='TBL2';
COMMIT;
```

This problem with the INSERT statement occurs when the following conditions are met:

1. The table TBL1 contains a primary constraint and the table TBL2 contains a foreign key constraint referencing the primary keys of TBL1.
2. The index for the table TBL1 is a partition index keying on the leading primary keys.
3. The cardinality of the table TBL2 is updated to a number such that the optimizer chooses a match strategy over cross. In this case, the cardinality number is 306.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.27 Journals Not Initialized After Backup if Backing Up to Tape Device

Bug 2808539

If after image journal backups were being done to tape and the AIJs being backed up were circular AIJs, the backed up journal would not get properly initialized. This could lead to various issues such as journaling being shutdown with a “journal is not empty” error. When that occurred, the journal state displayed by RMU/DUMP/HEADER=JOURNAL would show the following lines of output:

```
          File is inaccessible
            journal has been made inaccessible by system
            journal is not empty
```

Other symptoms were also possible. The database recovery process (DBR) could fail with a bugcheck in DBR$RECOVER_ALL. Attempts to recover a database using an existing journal that was not properly re-initialized could fail with AIJCORRUPT errors. For example:

```
%RMU-W-AIJCORRUPT, journal entry 1451795/3364123 contains a new AIJBL that
doesn't have the start flag set
```

This problem was introduced in Oracle Rdb Release 7.1.2.3.

The problem can be avoided by backing up the journals to a disk destination.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.28 Constant Snapshot File Growth

With Oracle Rdb Release 7.1.4, it was possible for snapshot files to continually extend. This would occur after an abnormal user termination was handled by a database recovery (DBR) process. The problem was seen after installing Oracle Rdb Release 7.1.4.

There are two data structures in the database root (.RDB) file that are used to represent the state of a database user:

1. The RTUPB list
2. The TSNBLKs

In Release 7.1.4, when the DBR process would clear the failed user's entries in the root file, it would neglect to clear the TSNBLK entry. That would cause Oracle Rdb to include the old user's last transaction sequence number (TSN) when determining what TSN should be granted to new snapshot (read only) transactions. Typically, the TSNBLK entry would soon get reused by another user and no symptoms of the problem would be seen. Occasionally, it was possible for the old TSNBLK entry to linger for quite some time. As long as the old TSN was still in the TSNBLK, pages in the snapshot files with TSNs greater than the old user's TSN could not be reclaimed. This would cause the snapshot files to grow since pages in the file could not be reused.

To determine if this problem is affecting a database, the following steps can be done:

1. Determine the TSN being granted to all snapshot transactions:

   ```
   $ RMU/DUMP/HEADER/OPTION=DEBUG/OUTPUT=TEMP.TXT DB
   $ SEARCH TEMP.TXT /WINDOW=(0,3) "Snapshot transaction in progress"
       Snapshot transaction in progress
       Last Process quiet-point was AIJ sequence 0
       Transaction sequence number is 0:3392
   ```

   Note that in the above example the TSN is 3392.

2. See if there is a TSNBLK entry showing an active transaction with that TSN:

   ```
   $ SEARCH TEMP.TXT 3392
       Transaction sequence number is 0:3392
     SLOT[1.] SIP TSN = 0:3392, COMMIT_TSN = 0:0.
     SLOT[2.] WIP TSN = 0:3392, COMMIT_TSN = 0:3390.
   ```

   Note that in the above example there is a line that contains "WIP TSN = 0:3392". This indicates that there should be a user with a read write transaction with sequence number 3392.

3. Confirm that there are no read-write transactions active with that TSN:

   ```
   $ PIPE SEARCH /WINDOW=(0,3) TEMP.TXT "Read/write transaction in progress" | -
     SEARCH SYS$INPUT "0:3392"
   %SEARCH-I-NOMATCHES, no strings matched
   ```

   No read write transactions exist with that TSN, thus the TSNBLK contains an invalid entry.

This problem can be corrected by forcing the TSNBLK entry to get reused. That can be done by adding multiple concurrent attaches to the database until the TSNBLK entry is reclaimed by one of the new users. For example:

```
SQL> ATTACH 'ALIAS A1 FILENAME DB';
SQL> ATTACH 'ALIAS A2 FILENAME DB';
SQL> ATTACH 'ALIAS A3 FILENAME DB';
SQL> ATTACH 'ALIAS A4 FILENAME DB';
...
```

Since each TSNBLK can only be used by one node in the cluster, it may be necessary to do attaches from each node that currently has the database open. Continue to add attaches to the database until the "WIP TSN =" string noted above is no longer found in the RMU/DUMP/HEADER output.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The TSNBLK is now properly cleared by the DBR when recovering a failed user.

2.1.29 Select Count Query with Host Variable Returns Wrong Result

Bug 4208119

The following select count query, which contains a WHERE clause with a host variable, returns the wrong result.

```
declare :x integer;
begin
set :x = 1;
set :x = 1;
end;

sel count(*) from employees where :x = 2;
Tables:
  0 = EMPLOYEES
Aggregate: 0:COUNT (*)
Index only retrieval of relation 0:EMPLOYEES
  Index name  EMP_EMPLOYEE_ID [0:0]

         100
1 row selected
```

The query works if the host variable is removed, as in the following example.

```
sel count(*) from employees where 1 = 2;
Tables:
  0 = EMPLOYEES
Aggregate: 0:COUNT (*)
Conjunct: 1 = 2
Index only retrieval of relation 0:EMPLOYEES
  Index name  EMP_EMPLOYEE_ID [0:0]

           0
1 row selected
```

The query also works if the count is removed, as in the following example.

```
sel * from employees where :x = 2;
Tables:
  0 = EMPLOYEES
Leaf#01 FFirst 0:EMPLOYEES Card=10000
  Bool: <var0> = 2
  BgrNdx1 EMP_EMPLOYEE_ID [0:0] Fan=17
    Bool: <var0> = 2
0 rows selected
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.30 UNION Join Query with Host Variable in the Predicate Returns Wrong Result

Bug 4208119

The following UNION join query with host variable in the predicate returns the wrong result.

```
DECLARE  :H_BID INTEGER;
DECLARE  :H_CUST VARCHAR(5);
BEGIN
SET :H_BID = 1;
SET :H_CUST = 'USCC';
END;

SELECT T1.BID, T1.CTY
FROM T1 INNER JOIN (
        SELECT  CTY, MRK FROM T2
        WHERE MRK IN (2, 20)
        UNION
        SELECT  CTY, MRK FROM T2
        WHERE MRK NOT IN (2, 20)
        ) AS T2
        ON T1.CTY = S.CTY AND T1.MRK = S.MRK
WHERE   T1.BID = :H_BID
        AND (T1.CUSTOMER = :H_CUST
             OR :H_CUST = '') ;         <== see Note
Tables:
  0 = T1
  1 = T2
  2 = T2
Cross block of 2 entries
  Cross block entry 1
    Leaf#01 FFirst 0:T1 Card=1
      Bool: (0.BID = <var0>) AND ((0.CUSTOMER = <var1>) OR (<var2> =
            ''))
      BgrNdx1 T1_IDX01 [1:1] Fan=15
        Keys: 0.BID = <var0>
  Cross block entry 2
    Conjunct: (0.CTY = <mapped field>) AND (0.MRK =
              <mapped field>)
    Merge of 1 entries
      Merge block entry 1
      Reduce: <mapped field>, <mapped field>
      Sort: <mapped field>(a), <mapped field>(a)
      Merge of 2 entries
        Merge block entry 1
        Conjunct: (1.MRK = 2) OR (1.MRK = 20)
        Index only retrieval of relation 1:T2
          Index name  T2_IDX01 [0:0]
        Merge block entry 2
        Conjunct: <var2> = ''                  <== see Note
        Conjunct: 0.BID = <var0>
        Conjunct: (2.MRK <> 2) AND (2.MRK <> 20)
        Index only retrieval of relation 2:T2
          Index name  T2_IDX01 [0:0]
0 rows selected
```

Note:: The conjunct ":H_CUST = ”" is pushed down to the second leg of the UNION clause. Since this is the right side operand of the OR predicate it cannot be stripped out and pushed down without the other operand.

The query works if the host variable in one of the predicates is replaced by the text literal 'USCC', as in the following example.

```
SELECT T1.BID, T1.CTY
FROM T1 INNER JOIN (
        SELECT  CTY, MRK FROM T2
        WHERE MRK IN (2, 20)
        UNION
        SELECT  CTY, MRK FROM T2
        WHERE MRK NOT IN (2, 20)
        ) AS T2
        ON T1.CTY = S.CTY AND T1.MRK = S.MRK
WHERE   T1.BID = :H_BID
        AND (T1.CUSTOMER = :H_CUST
             OR 'USCC' = ''                     ! <== replaced with 'USCC'
             ) ;
Tables:
  0 = T1
  1 = T2
  2 = T2
Cross block of 2 entries
  Cross block entry 1
    Leaf#01 FFirst 0:T1 Card=1
      Bool: (0.BID = <var0>) AND ((0.CUSTOMER = <var1>) OR ('USCC' =
            ''))
      BgrNdx1 T1_IDX01 [1:1] Fan=15
        Keys: 0.BID = <var0>
  Cross block entry 2
    Conjunct: (0.CTY = <mapped field>) AND (0.MRK =
              <mapped field>)
    Merge of 1 entries
      Merge block entry 1
      Reduce: <mapped field>, <mapped field>
      Sort: <mapped field>(a), <mapped field>(a)
      Merge of 2 entries
        Merge block entry 1
        Conjunct: (1.MRK = 2) OR (1.MRK = 20)
        Index only retrieval of relation 1:T2
          Index name  T2_IDX01 [0:0]
        Merge block entry 2
        Conjunct: 0.BID = <var0>                <== see Note1
        Conjunct: (2.MRK <> 2) AND (2.MRK <> 20)
        Index only retrieval of relation 2:T2
          Index name  T2_IDX01 [0:0]
  T1.BID   T1.CTY
       1   12
1 row selected
```

Note1:: Note that the conjunct "'USCC' = ''" does not appear in the second leg of the UNION clause.

The key parts of this cursor query which contributed to the situation leading to the error are these:

1. The main query selects from inner-joining a table with a UNION of two sub-select queries.
2. The WHERE clause contains an OR predicate referencing a host variable twice in the equality filters.

There is no known workaround for this problem.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.31 Bugcheck in COSI_MEM_FREE_VMLIST After Update of Ranked Index

Bug 4191015

During updates on indexes of TYPE IS SORTED RANKED, it was possible that memory could be overwritten and memory queues become corrupt. When the memory queue was subsequently processed, a bugcheck would result.

In the following example, the update statement left a memory queue in this corrupt state. During exit from SQL, while detaching from the database, the memory queue was processed to free up the memory and a bugcheck resulted.

```
SQL> update some_table set some_key=626 where another_key=624;
32419 rows updated
SQL> commit;
SQL> exit
%RDMS-I-BUGCHKDMP, generating bugcheck dump file MBRADLEY_USR:[BRADLEY]
RDSBUGCHK.DMP;
```

The following example shows the exception and the first few calls from the bugcheck.

```
%SYSTEM-F-ACCVIO, access violation, reason mask=04, virtual
address=0000000050000004, PC=00000000011D68E4, PS=0000000B

Saved PC = 0115C214 : RDMS$$RDMSCHEMA_UNLOAD_META + 00000434
Saved PC = 0115CB5C : RDMS$$RDMSCHEMA_UNLOAD_TABLE + 0000024C
Saved PC = 0117FCD4 : RDMS$$DETACH_DATABASE + 000002F4
Saved PC = 0117F944 : RDMS$TOP_DETACH_DATABASE + 00000424
```

In the reported case, the update completed sucessfully and the index was not corrupt in any way.

There is no known workaround for this problem.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.1.32 ILLPAGCNT Exception Reading Large Table with a Dynamic Tactic

Bug 3194130

When the dynamic optimizer was chosen for a query and more than 268,435,455 dbkeys were read from a single index scan, the query would fail with an illegal page count parameter exception.

The same problem also produced a bugcheck dump in versions prior to 7.1.

An example of this is shown below.

```
SQL> select * from t1 where f1>1 and f2>1 optimize for total time;
Leaf#01 BgrOnly T1 Card=300000000
  BgrNdx1 I1 [1:0] Fan=308
  BgrNdx2 I2 [1:0] Fan=308
%COSI-F-VASFULL, virtual address space full
-SYSTEM-F-ILLPAGCNT, illegal page count parameter
SQL>
```

The problem can be avoided by disabling the dynamic optimizer by either using a query outline with EXECUTION OPTIONS NONE or using the MAX_STABILITY flag.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.2 SQL Errors Fixed

2.2.1 SQL Precompiler (Pascal) Generates Incorrect Definition for SQL_TINYINT Type

Bug 4121870

In Oracle Rdb Release 7.1.3, the Pascal support in the SQL Precompiler was modified to make better use of recent OpenVMS Pascal compiler enhancements. Unfortunately, the SQL_TINYINT definition is now no longer sharable when using multiple SQL Precompiler modules in a Pascal Environment file.

The following example shows the error that is generated.

```
$ SQL$PRE /PASCAL PRE_COMP_TEST_MAIN

 SQL_TINYINT = SQL_BYTE;
.^
%PASCAL-E-REDECL, A declaration of SQL_TINYINT already exists in environment
TEST$:PRE_COMP_TEST_MODULE.PEN
at line number 28 in file DISK12:[TESTER.SQL$PRE]PRE_COMP_TEST_MAIN.PAS;1
%PASCAL-E-ENDDIAGS, PASCAL completed with 1 diagnostic
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The Pascal [HIDDEN] attribute is now applied to SQL_TINYINT.

2.2.2 LOCK TABLE May Bugcheck if DROP TABLE Appears in Same Transaction

Bug 4134139

In prior versions of Oracle Rdb, a SET TRANSACTION ... RESERVING of a table followed by a DROP of the table referenced by the RESERVING clause and then a LOCK TABLE of any table in this same transaction might generate a bugcheck dump. The following example shows the problem.

```
SQL> set transaction read write wait reserving TAB1 for shared write;
SQL> lock table TAB1 for shared write mode wait;
SQL> rollback;
SQL> --
SQL> set transaction read write wait reserving TAB1 for shared write;
SQL> drop table TAB1;
SQL> create table TAB2 (col1 integer, col2 integer);
SQL> lock table TAB2 for shared write mode wait;
%RDMS-I-BUGCHKDMP, generating bugcheck dump file USER2:[TESTER]RDSBUGCHK.DMP;
%RDB-F-BUG_CHECK, internal consistency check failed
SQL> rollback;
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. LOCK TABLE now correctly processes the reserving list of the transaction.

2.2.3 CREATE VIEW May Fail With a "Deadlock on Client" Error

Bug 4101404

In prior versions of Oracle Rdb, it was possible in rare cases for the CREATE VIEW statement to fail with a DEADLOCK error. This could occur under the following circumstances:

- The database is active with views created and dropped often. Over a long period, this will result in the unique identifier for the view growing to the maximum supported by Rdb.

- Subsequent CREATE VIEW statements must scan the RDB$RELATIONS system table looking for unused ID’s, that is, those that are freed by a DROP VIEW.
- The view being defined references a view or table with COMPUTED BY columns that also include table references (subselects).

The following example shows the problem.

```
SQL> create view DEPT_STATS as
cont>  select DEPARTMENT_NAME, EMPTY_DEPARTMENT
cont>   from DEPARTMENTS;
%RDB-E-DEADLOCK, request failed due to resource deadlock
-RDB-E-NO_META_UPDATE, metadata update failed
-RDMS-F-DEADLOCK, deadlock on client ’.....0..’ 0000300B0000000400000055
SQL>
```

In this example, the computed column EMPTY_DEPARTMENT references another COMPUTED BY column in DEPARTMENTS that references a different table.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. Rdb now correctly handles the inner references to other tables during the locking of the view ID.

2.2.4 TRUNCATE TABLE Did Not Release Strong Lock on Table Until DISCONNECT

Bug 3627324

The TRUNCATE TABLE statement did not correctly queue a commit/rollback action to release locks for the target table in all cases. However, if the table had SORTED or SORTED RANKED indices then this action was queued. Otherwise, the lock on the table was retained until DISCONNECT time and prevented access to the truncated table.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. COMMIT and ROLLBACK following a TRUNCATE table now release the strong metadata lock on the table to allow sharing of the table with other applications. Please note that TRUNCATE TABLE requires exclusive access to the table while it changes metadata and data in the table and indices.

2.2.5 COMMENT ON COLUMN Failed When Applied to a View Definition

In prior versions of Oracle Rdb 7.1, the COMMENT ON TABLE statement would apply a comment to a view and was equivalent to the COMMENT ON VIEW statement. However, similar table related COMMENT ON statements would fail with RDMS-F-NOCHGVW errors if the target was a view instead of a table.

The following example shows the errors reported by these commands.

```
SQL> comment on column current_job.JOB_START is ’’;
%RDB-E-NO_META_UPDATE, metadata update failed
-RDMS-F-NOCHGVW, the definition of a view may not be changed
SQL> comment on current_job
cont>     (LAST_NAME is ’last name’,
cont>      FIRST_NAME is ’first name’,
cont>      JOB_START is ’job start’);
%RDB-E-NO_META_UPDATE, metadata update failed
-RDMS-F-NOCHGVW, the definition of a view may not be changed
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. COMMENT ON COLUMN and COMMENT ON with a list of column names can be used for a table or a view definition.

2.2.6 Unexpected SQL-F-CURALROPE Following Compound Statement or CALL Statement

Bug 4301488

In Oracle Rdb Release 7.1.4, a problem was introduced that could cause SQL to believe a cursor was still open after a COMMIT or ROLLBACK was executed in a stored procedure (activated by the CALL statement) or in a compound statement (BEGIN ... END).

The following example shows the unexpected error.

```
SQL> declare cursor2 read only table cursor for
cont>     select college_name from colleges where college_code = 'BATE';
SQL> open cursor2;
SQL> begin commit; end;
SQL> open cursor2;
SQL> begin commit; end;
SQL> open cursor2;
%SQL-F-CURALROPE, Cursor CURSOR2 was already open
```

Clearly the COMMIT statement closed the cursor but SQL did not detect that change of state. This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.2.7 Unexpected Results When Using Host Variables in Subselects

Bug 2316744

In prior versions of Oracle Rdb, assignments to host variables might not be used when subselects use these host variables inside conditional or control statements (IF statement, CASE statement or FOR cursor loop).

Host variables are those declared in C, COBOL, FORTRAN, etc in a SQL$PRE source module or in Interactive and Dynamic SQL using the DECLARE Variable statement.

The following example shows the problem. The query should return the LAST_NAME matching the EMPLOYEE_ID assigned to the host variable :OUT_VAL. However, Oracle Rdb does not detect that the subselect uses a variable modified within the scope of the IF statement and promotes the subselect into the query for the IF statement. That is, Rdb evaluates the WHERE clause prior to the assignment of the value in the IF body. The result is no matching rows found and a NULL (shows as -1 for the indicator variable) result.

```
SQL> declare :out_val char(5) = '';
SQL> declare :out_name varchar(40) = '';
SQL> declare :out_name_ind integer = 0;
SQL>
SQL> begin
cont> if exists (select count(*)
cont>            from employees
cont>            where employee_id = '00164')
cont> then
cont>     set :out_val = '00164';
cont>     set :out_name indicator :out_name_ind =
cont>         (select trim(last_name)
cont>          from employees
cont>          where employee_id = :out_val);
cont> end if;
cont> end;
SQL>
SQL> print :out_val, :out_name, :out_name_ind;
 OUT_VAL   OUT_NAME                                  OUT_NAME_IND
 00164                                                         -1
SQL>
```

Workarounds include: assigning the values prior to the conditional statement; assigning to local variables (the DECLARE appears inside the compound statement); and possibly assigning the results to the host variable after the conditional statement.

Note

This problem does not exist for locally declared variables or parameters to stored procedures and stored functions.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. Oracle Rdb now detects the update of the host variable and correctly processes the subselect.

2.2.8 Unexpected Bugcheck Reported When LIST OF BYTE VARYING Column has NOT NULL Constraint

Bug 4354994

In prior versions or Oracle Rdb, defining a column of LIST OF BYTE VARYING, LONG or LONG RAW with a NOT NULL constraint would cause both DROP TABLE and TRUNCATE TABLE to fail with a bugcheck. In addition, if an UPDATE statement assigned NULL to a column of these types, a similar bugcheck was generated.

The following example shows the problem.

```
SQL> create table TEST_A
cont>     (col_a integer
cont>     ,col_b long raw
cont>         not null deferrable);
SQL>
SQL> drop table TEST_A;
%RDMS-I-BUGCHKDMP, generating bugcheck dump file USER2:[TESTER]RDSBUGCHK.DMP;
%RDB-F-BUG_CHECK, internal consistency check failed
SQL>
```

The bugcheck dump summary is similar to this example:

COSI-F-BUGCHECK, internal consistency failure
Exception occurred at RDMS$$DTYPE_BLR + 00000D74

```
Called from RDMS$$VERIFY_TABLE_CONSTRAINTS + 00002294
Called from RDMS$$CREATE_ECON + 00000618
Called from RDMS$$CREATE_EMOD + 000019F4
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The NOT NULL constraint is now correctly handled by UPDATE, DROP TABLE and TRUNCATE TABLE.

2.2.9 DEFAULT Expression Fails for Declared Temporary Tables

Bug 4390079

In prior releases of Oracle Rdb V7.1, the use of the DEFAULT clause in an INSERT or an UPDATE of a declared local temporary table might result in an error message or in the assignment of an incorrect default value.

- If no created table or view exists with the same name as the declared temporary table, then an error will be reported during the INSERT or UPDATE statement:

  ```
  %RDB-E-OBSOLETE_METADA, request references metadata objects that no longer exist
  -RDMS-F-RELNOEXI, relation LOCAL_TABLE0 does not exist in this database
  ```

- If a created table or view exists with the same name as the declared temporary table but with no matching column, then an error will be reported during the INSERT or UPDATE statement:

  ```
  %RDB-E-OBSOLETE_METADA, request references metadata objects that no longer exist
  -RDMS-F-BAD_SYM, unknown field symbol - MCOL2
  ```

- If a created table or view exists with the same name as the declared temporary table and with a matching column name, then an error may be reported during the INSERT or UPDATE statement if the data type of the DEFAULT is incompatible with the column in the temporary table.

  ```
  %RDB-E-ARITH_EXCEPT, truncation of a numeric value at runtime
  -COSI-F-INPCONERR, input conversion error
  ```

  If the types are compatible, then the wrong DEFAULT may be assigned to the temporary table.

The following example shows the reported error:

```
SQL> declare local temporary table module.local_table0
cont>    (mcol1 char(7) default 'o--0--o'
cont>    ,mcol2 integer default 4044
cont>    );
SQL>
SQL> insert into module.local_table0 values ('qqq', default);
%RDB-E-OBSOLETE_METADA, request references metadata objects that no longer exist
-RDMS-F-RELNOEXI, relation LOCAL_TABLE0 does not exist in this database
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.2.10 DEFAULT Inherited from Domain now Displayed by SHOW TABLE

Bug 4424589

In prior releases of Oracle Rdb, the SHOW TABLE (COLUMN) output did not display the DEFAULT inherited from domains used for the column definition.

If the domain DEFAULT is overridden by a column level definition, then it is this DEFAULT that is used by Oracle Rdb and shown by the SHOW TABLE command. However, if no local definition is used then the domain's DEFAULT is inherited by the column. This value is now displayed by the SHOW TABLE command.

```
SQL> create domain MONEY integer(2) default 0.00;
SQL>
SQL> create table EXPENSES
cont>     (descr        varchar(40)
cont>     ,amt  MONEY
cont>     ,amt2 MONEY default 1.11
cont>     );
SQL>
SQL> show table (column) EXPENSES
Information for table EXPENSES

Columns for table EXPENSES:
Column Name                     Data Type        Domain
-----------                     ---------        ------
DESCR                           VARCHAR(40)
AMT                             INTEGER(2)       MONEY
 Oracle Rdb default: 0
AMT2                            INTEGER(2)       MONEY
 Oracle Rdb default: 1.11

SQL>
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.2.11 Dynamic SQL Rounds Results from Division Operator

Bug 4165206

In previous versions of Oracle Rdb, the Dynamic SQL interface would determine the result data type using the type and scale of the dividend. This lead to rounded results if the dividend was a fixed point value. With this release of Oracle Rdb, all numeric division computations return a REAL or DOUBLE PRECISION value.

The following example shows the behavior in prior versions.

```
$ r test$tools:tester
Enter statement:
attach 'filename sql$database';
Enter statement:
select 1/2 from rdb$database;
 0/: 1
Enter statement:
```

In this example the result (0.5) is rounded to the target type of INTEGER to yield a - possibly unexpected - value 1. Now Dynamic SQL uses a floating result and gives the expected result.

```
$ r test$tools:tester
Enter statement:
attach 'filename sql$database';
Enter statement:
select 1/2 from rdb$database;
 0/: 0.500000
Enter statement:
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.2.12 SQL Incorrectly Truncated Multi-octet Characters when Using GB18030 and UTF8 Character Sets

Bug 4319811

In previous versions of Oracle Rdb, SQL would incorrectly determine that multi-octet characters from the GB18030 or UTF8 character sets were truncated on text copies when they were not actually truncated. As a result of this incorrect determination, SQL would replace the last 2 or 3 octets of a multi-octet character with underscore characters ("_").

In the following example, the value in hexadecimal is a valid 4 octet GB18030 character. However when a substring of the first character is extracted by SQL, the character is incorrectly truncated and the last two octets of the character are replaced with underscores.

```
SQL> set character length 'characters';
SQL> select substring (_GB18030 X'8139D531' from 1 for 1 ) from rdb$database;

 9__
1 row selected
```

The correct output should have been:

```
SQL> select substring (_GB18030 X'8139D531' from 1 for 1 ) from rdb$database;

 9Õ1
1 row selected
```

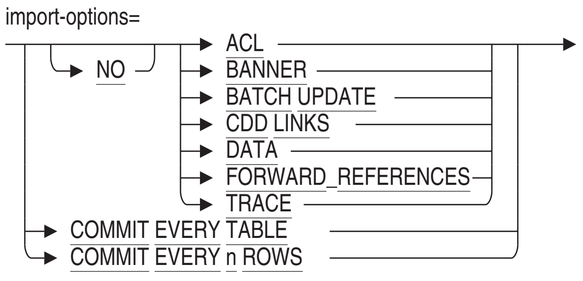
This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.2.13 New COMMIT EVERY Clause Added to IMPORT DATABASE Command

Bug 4001638

In previous versions of Oracle Rdb, the IMPORT DATABASE statement would import and load data rows in a single transaction. If the table was very large, the recovery unit journal (RUJ) file might become quite large. To help reduce the RUJ file usage during IMPORT, a new COMMIT EVERY n ROWS clause has been added. This clause instructs SQL IMPORT to commit at regular intervals. If the IMPORT should subsequently fail, then the table will be left with a partial set of rows. The default is COMMIT EVERY TABLE.

Format



The following example shows the use of this clause.

```
SQL> import database
cont>     from 'TEST$DB_SOURCE:MF_PERSONNEL'
cont>     filename 'MF_PERSONNEL'
cont>
cont>     commit every 10 rows
cont>
cont>     create storage area DEPARTMENTS
cont>         filename 'DEPARTMENTS'
cont>         page format is mixed
cont>         snapshot filename 'DEPARTMENTS'
cont>     create storage area EMPIDS_LOW
cont>         filename 'EMPIDS_LOW'
cont>         page format is mixed
cont>         snapshot filename 'EMPIDS_LOW'
cont>     create storage area EMPIDS_MID
cont>         filename 'EMPIDS_MID'
cont>         page format is mixed
cont>         snapshot filename 'EMPIDS_MID'
cont>     create storage area EMPIDS_OVER
cont>         filename 'EMPIDS_OVER'
cont>         page format is mixed
cont>         snapshot filename 'EMPIDS_OVER'
 . . .
cont> ; ! end of import
Definition of STORAGE AREA RDB$SYSTEM overridden
Definition of STORAGE AREA MF_PERS_SEGSTR overridden
Definition of STORAGE AREA EMPIDS_LOW overridden
Definition of STORAGE AREA EMPIDS_MID overridden
Definition of STORAGE AREA EMPIDS_OVER overridden
Definition of STORAGE AREA DEPARTMENTS overridden
Definition of STORAGE AREA SALARY_HISTORY overridden
Definition of STORAGE AREA JOBS overridden
Definition of STORAGE AREA EMP_INFO overridden
COMMIT EVERY ignored for table EMPLOYEES due to PLACEMENT VIA INDEX processing
COMMIT EVERY ignored for table JOB_HISTORY due to PLACEMENT VIA INDEX processing
SQL>
```

Note

If the table being imported includes a storage map with the "PLACEMENT VIA INDEX" clause, then the COMMIT EVERY clause is ignored for that table. This restriction will be removed in a future release of Oracle Rdb. A message will be displayed informing the database administrator of the tables that did not have COMMIT EVERY applied. See the example in this release note which shows the message reported for the EMPLOYEES and JOB_HISTORY tables.

2.2.14 Unexpected SQL-F-BADBLOB Reported by SQL IMPORT

Bug 4001638

In prior releases of Oracle Rdb, it was possible to receive the following errors when importing large tables (multi-million rows) that contained one or more LIST OF BYTE VARYING columns.

```
 . . .
IMPORTing table LARGE_TABLE
%SQL-F-BADBLOB, unable to import a list
%COSI-F-EXQUOTA, exceeded quota
-SYSTEM-F-EXQUOTA, process quota exceeded
%SQL-F-BADBLOB, unable to import a list
%RDB-E-BAD_SEGSTR_HAND, invalid segmented string handle
%RDB-E-BAD_SEGSTR_HAND, invalid segmented string handle
 . . .
IMPORTing table LARGE_TABLE
%SQL-F-BADBLOB, unable to import a list
%COSI-F-UNEXPERR, unexpected system error
-SYSTEM-F-ILLPAGCNT, illegal page count parameter
%SQL-F-BADBLOB, unable to import a list
%RDB-E-BAD_SEGSTR_HAND, invalid segmented string handle
%RDB-E-BAD_SEGSTR_HAND, invalid segmented string handle
```

This error occurs due to the growth of a data structure that is sized to contain references to all created LIST OF BYTE VARYING columns. This data structure is used to provide the full generality of the LIST cursor model, however, during IMPORT this functionality is never used.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. Oracle Rdb now releases this data structure after the row INSERT during an IMPORT operation to prevent this error and also reduce page faulting during a successful IMPORT.

A possible workaround is to define the logical name RDMS$BIND_SEGMENTED_STRING_COUNT to a value that is calculated using this formula: row-count * list-columns + 100. The data structure is normally created small and grows as more LIST OF BYTE VARYING data is inserted. This logical name allows the structure to be pre-created and therefore use less virtual memory. However, this pre-allocated size might still exhaust the page file quota for the process.

2.3 RDO and RDML Errors Fixed

2.3.1 Unexpected NOT_LARDY Following LOCK_CONFLICT Exception

Bug 2274845

In prior releases of Oracle Rdb, when using the RDO or RDBPRE interfaces, it was possible to receive a RDMS-F-NOT_LARDY after a RDB-F-LOCK_CONFLICT occurred. This error would repeat for all access to the table which caused the LOCK_CONFLICT error. A ROLLBACK or COMMIT was required to clear this error state.

The following example shows this behavior.

```
INVOKE DATABASE FILENAME TEST_DATABAS

START_TRANSACTION READ_WRITE CONCURRENCY NOWAIT

FOR CLI IN CLI_DNI WITH CLI.DNI_CLI = 'DNI37'
  PRINT CLI.COD_IDI,CLI.FE_ULT_CON
  MODIFY CLI USING
    CLI.COD_IDI='CAS'
  END_MODIFY
END_FOR
%RDB-E-LOCK_CONFLICT, request failed due to locked resource
-RDMS-F-LCKCNFLCT, lock conflict on logical area 57
```

```
FOR CLI IN CLI_DNI WITH CLI.DNI_CLI = 'DNI37'
  PRINT CLI.COD_IDI,CLI.FE_ULT_CON
  MODIFY CLI
    USING CLI.COD_IDI='CAS'
  END_MODIFY
END_FOR
%RDMS-F-NOT_LARDY, area for 57:1257:4 not in proper ready mode
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.4 RMU Errors Fixed

2.4.1 RMU Extract Might Extract Incomplete Routine Definition

Bug 4142629

In Oracle Rdb Release 7.1.3 and 7.1.4, RMU Extract could possibly extract stored procedures and functions incorrectly. This occurred when the original definition included a quoted string (such as in the COMMENT IS clause) that started in the first column of the source. The result was that the first statement in the routine would not be extracted.

A workaround is to start all string literals in the routine header after the first column.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.4.2 Unexpected ACCVIO and BUGCHECK from RMU Extract

Bug 4205822

In prior versions of Oracle Rdb, attempts to use RMU Extract to format a view, trigger or constraint definition that contained a dbkey literal (for example _ DBKEY'-1:-1:-1') would fail with errors similar to those shown below.

```
$ rmu/extract/item=view/option=(filename_only,noheader,match=myv%) sql$database
set verify;
set language ENGLISH;
set default date format 'SQL92';
set quoting rules 'SQL92';
set date format DATE 001, TIME 001;
attach 'filename MF_PERSONNEL';
create view MYV
    (JRN,
     FMUB) as
%SYSTEM-F-ACCVIO, access violation, reason mask=00,
virtual address=0000000000000000, PC=FFFFFFFF81096B64, PS=0000001B
%RMU-F-FATALOSI, Fatal error from the Operating System Interface.
%RMU-I-BUGCHKDMP, generating bugcheck dump file USER2:[TESTER]RMUEXTBUGCHK.DMP;
%RMU-F-FTL_RMU, Fatal error for RMU operation at 26-FEB-2005 03:31:09.78
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The following example shows the corrected output from RMU Extract. Please note that SQL converts _ROWID into _DBKEY literals so that this is what will be extracted by RMU.

```
$ rmu/extract/item=view/option=(filename_only,noheader,match=myv%) sql$database
set verify;
set language ENGLISH;
set default date format 'SQL92';
set quoting rules 'SQL92';
set date format DATE 001, TIME 001;
attach 'filename MF_PERSONNEL';
create view MYV
    (JRN,
     FMUB) as
    (select
        case C1.DBKEY
             when _DBKEY'-1:-1:-1' then 'D'
             else 'I'
        end,
        C1.MY_UB
    from MYONE C1);

commit work;
```

2.4.3 RMU Load Did Not Handle UNSPECIFIED Character Set in RRD File

Bug 4242736

In prior releases of Oracle Rdb, the special character set UNSPECIFIED was not correctly supported by RMU Load. This character set informs Rdb that this data can be assigned to and from a character string of any other character set. It is the default character set for the USER, CURRENT_USER, SESSION_USER and SYSTEM_USER builtin functions to allow assignment in any database.

The following example shows the error previously reported by RMU when it checks for compatible character sets between the source data file and the target column.

```
$ RMU /LOAD/RECORD_DEFINITION=(FILE=1.RRD,FORMAT=DELIMITED_TEXT,NULL="*") -
/TRANSACTION_TYPE=EXCLUSIVE/BUFFERS=400 MF_PERSONNEL DUMMY_COPY DUMMY.UNL
  DEFINE FIELD F1 DATATYPE IS TEXT SIZE IS 31 CHARACTERS CHARACTER SET IS
    UNSPECIFIED.
  DEFINE RECORD DUMMY.
     F1 .
  END DUMMY RECORD.
%RMU-F-FLDMUSMAT, Specified fields must match in number and datatype with the
unloaded data
%RMU-I-DATRECSTO,   0 data records stored.
%RMU-F-FTL_LOAD, Fatal error for LOAD operation at 16-MAR-2005 14:54:20.21
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. This problem has been corrected so that RMU Load allows assignment from this data to any character column.

2.4.4 RMU/CONVERT Ignored Storage Maps Defined for Optional System Tables

Bug 4274119

RMU/CONVERT did not check to see if storage maps were defined for optional system tables. This caused an access violation since an invalid logical area ID of zero was retrieved from the system table RDB$RELATIONS record for the optional table when the correct logical area ID was defined in the storage map. Also, it was assumed that optional system tables were stored compressed when the storage map could specify that compression was disabled. In addition, optional system tables with storage maps were not converted if the record format had changed and therefore were not put in a new logical area by RMU/CONVERT.

These problems have been fixed. Note that these problems only happened for optional system tables that used storage maps.

The following example shows that an access violation occurred because a storage map was defined for the optional system table RDB$WORKLOAD. This caused RMU/CONVERT to use an invalid logical area ID of zero.

```
RYEROX>RMU/CONVERT TEST_DB.RDB
%RMU-I-RMUTXT_000, Executing RMU for Oracle Rdb V7.1-401
Are you satisfied with your backup of DEVICE:[DIRECTORY]TEST_DB.RDB;1
 and your backup of any associated .aij files [N]? y
%RMU-I-LOGCONVRT, database root converted to current structure level
%RMU-S-CVTDBSUC, database DEVICE:[DIRECTORY]TEST_DB.RDB;1
 successfully converted from version V7.0 to V7.1
%SYSTEM-F-ACCVIO, access violation, reason mask=00, virtual address=
 0000000000000168, PC=00000000003D5DA0, PS=0000001B
%RMU-F-FATALOSI, Fatal error from the Operating System Interface.
%RMU-I-BUGCHKDMP, generating bugcheck dump file
 DEVICE:[DIRECTORY]RMUBUGCHK.DMP;
%RMU-F-FTL_CNV, Fatal error for CONVERT operation at 22-APR-2005 10:11:57.83
```

As a workaround, do not define storage maps for optional system tables.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.4.5 RMU /UNLOAD From Remote Database Specification

Previously, the RMU /UNLOAD command to unload records from a database table did not allow the database specification to include a remote file specification. A RMU-F-NONODE fatal error would be returned when attempting to use a remote database specification, as in the following example.

```
$ DEFINE DB$ REMNOD::DUA0:[DB]DB.RDB
$ RMU/UNLOAD DB$ C1 C1
%RMU-W-BADDBNAME, can't find database root REMNOD::DUA0:[DB]DB.RDB;1
-RMU-F-NONODE, no node name is allowed in the file specification
%RMU-F-CANTOPNROO, cannot open root file "REMNOD::DUA0:[DB]DB.RDB;1"
%RMU-F-FTL_UNL, Fatal error for UNLOAD operation at 13-MAY-2005 02:18:26.61
```

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The remote node operation is now allowed. Note, however, that the database root file may be accessed by both FAL and the Rdb database server (because not all of the RMU operations are strictly database user attaches).

2.4.6 RMU/SHOW AFTER/BACKUP May Stall When AIJs Are Full

Bug 4347617

In previous releases of Oracle Rdb, when using multiple circular journals which have a state of Full, the RMU/SHOW AFTER/BACKUP command may stall on "waiting for AIJ journal lock 0 (PW)".

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.4.7 Problem with LITERAL Character Set and Embedded Quotes in RMU EXTRACT

Bug 4469731

In prior releases of Oracle Rdb, it was possible that RMU/EXTRACT might generate incorrect code for the session LITERAL character set definition if the database had a default character set other than DEC_MCS.

```
$ rmu/extract/item=(tables) test/out=test.sql
$ sql @test.sql;
SQL> set language ENGLISH;
SQL> set default date format 'SQL92';
SQL> set quoting rules 'SQL92';
SQL> set date format DATE 001, TIME 001;
SQL> attach 'filename device:[directory]TEST.RDB';
SQL> set default character set 'DEC_HANYU';
SQL> set literals character set 'DEC_HANYU';
%SQL-I-SPELLCORR, identifier LITERALS replaced with LITERAL
```

In addition, if the database default character was not DEC_MCS, embedded single quotation marks were not correctly doubled in object comments.

```
 . . .
SQL> create table T (
cont>     F
cont>         INTEGER)
cont>     comment is
cont>       'This relation will be used in testing 'store' statments';
      'This relation will be used in testing 'store' statments';
                                             ^
%SQL-W-LOOK_FOR_STT, Syntax error, looking for:
%SQL-W-LOOK_FOR_CON,            /, ENABLE, STORAGE, LOGGING, COMMENT,
DISABLE, PCTFREE, PCTUSED, INITRANS, MAXTRANS,
%SQL-W-LOOK_FOR_CON,            NOLOGGING, TABLESPACE, ;,
%SQL-F-LOOK_FOR_FIN,    found STORE instead
SQL>
```

These problems have been corrected in Oracle Rdb Release 7.1.4.1.

2.5 LogMiner Errors Fixed

2.5.1 Incorrect Elimination of AIJ When Using RMU /UNLOAD /AFTER_JOURNAL /ORDER_AIJ_FILES /RESTART

Bug 4121598

In previous versions of Oracle Rdb, it was possible for the specified input after-image journal file to be skipped when using the /RESTART and /ORDER_AIJ_FILES qualifiers and only a single input AIJ file. The single after-image journal file would be incorrectly eliminated from processing in this case.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The after-image journal file will not be eliminated when using the /RESTART and /ORDER_AIJ_FILES qualifiers and only a single input AIJ file.

2.5.2 RMU /UNLOAD /AFTER_JOURNAL /[NO]SYMBOLS

Previously, it was possible for a large number of DCL symbols to be created by the RMU /UNLOAD /AFTER_JOURNAL command. If enough tables were being unloaded, the CLI symbol table space could become exhausted. The error message "LIB-F-INSCLIMEM, insufficient CLI memory" would be returned in this case.

As a possible workaround, increasing the system parameter CLISYMTBL will provide more space for the CLI symbol table.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. A qualifier "/[NO]SYMBOLS" has been added to the RMU /UNLOAD /AFTER_JOURNAL command. The default is "/SYMBOLS" to cause the symbols to be created. Specifying "/NOSYMBOLS" prevents the symbols being created.

2.5.3 RMU /UNLOAD /AFTER_JOURNAL Incorrect Settings in Null Bit Vector

With some combinations of table definition modifications with adding and removing fields, it was possible for a table's maximum null bit vector length to be incorrectly calculated by the Oracle Rdb LogMiner(tm). The incorrect length would be used internally by the RMU /UNLOAD /AFTER_JOURNAL command and could result in an incorrect null bit vector content being generated for the output stream.

As a possible workaround, unloading the table data from the database, dropping and recreating the table and then reloading the content would cause the table's maximum field identification to be reset and the RMU /UNLOAD /AFTER_JOURNAL command would then work correctly.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The RMU /UNLOAD /AFTER_JOURNAL command now correctly determines the maximum field ID and the null bit vector length.

2.5.4 RMU /UNLOAD /AFTER_JOURNAL Field Order Clarification

Unlike SQL and RMU /UNLOAD, the Oracle Rdb LogMiner (tm) RMU /UNLOAD /AFTER_JOURNAL command outputs fields in the database on-disk field order. This difference can become apparant when a table definition has been modified. For example, when adding a new column to appear in a positon other than at the end of the record.

The following example shows one way that the Oracle Rdb LogMiner (tm) RMU /UNLOAD /AFTER_JOURNAL command outputs fields in the database on-disk field order.

```
$!
$ SQL$
    CREATE DATA FILE FOO LOGMINER SUPPORT ENA;

    -- Create table then insert another column between COL1 & COL2.

    CREATE TABLE T1 (COL1 INT, COL2 INT);
    ALTER TABLE T1 ADD COLUMN COL3 INT BEFORE COLUMN COL2;
    SHOW TABLE (COLUMN) T1;
Information for table T1

Columns for table T1:
Column Name                     Data Type        Domain
-----------                     ---------        ------
COL1                            INTEGER
COL3                            INTEGER
COL2                            INTEGER

    COMMIT;
    DISCONNECT ALL;
    ALTER DATA FILE FOO JOU ENA ADD JOU J1 FILE J1;
    EXIT;
$!
$ RMU/BACKUP/NOLOG FOO NLA0:FOO
$ RMU/BACKUP/AFTER/NOLOG FOO NLA0:B1
$!
$ SQL$
    ATTACH 'FILE FOO';
    INSERT INTO T1 VALUES (NULL,2,3); -- COL1=NULL, COL3=2, COL2=3
1 row inserted
    INSERT INTO T1 VALUES (1,NULL,3); -- COL1=1, COL3=NULL, COL2=3
1 row inserted
    INSERT INTO T1 VALUES (1,2,NULL); -- COL1=1, COL3=2, COL2=NULL
1 row inserted
    COMMIT;
    SELECT * FROM T1; -- Show data content
        COL1          COL3          COL2
        NULL             2             3
           1          NULL             3
           1             2          NULL
3 rows selected
    EXIT;
$!
$ RMU/BACKUP/AFTER/NOLOG FOO B1
$!
$ RMU/UNL/RECORD=FILE=T1.RRD1 FOO T1 NLA0:T1
%RMU-I-DATRECUNL,   3 data records unloaded.
$ RMU/UNL/AFTER/NOLOG/FORMAT=DUMP FOO B1 -
    /TABLE=(NAME=T1,OUTPUT=T1.DAT,RECORD=T1.RRD2)
$!
$ SEARCH T1.RRD1 COL ! Show field order - RMU/UNLOAD
DEFINE FIELD COL1 DATATYPE IS SIGNED LONGWORD.
DEFINE FIELD COL3 DATATYPE IS SIGNED LONGWORD.
DEFINE FIELD COL2 DATATYPE IS SIGNED LONGWORD.
   COL1 .
   COL3 .
   COL2 .
$ SEARCH T1.RRD2 COL ! Show field order - RMU/UNLOAD/AFTER_JOURNAL
DEFINE FIELD COL1 DATATYPE IS SIGNED LONGWORD.
DEFINE FIELD COL2 DATATYPE IS SIGNED LONGWORD.
DEFINE FIELD COL3 DATATYPE IS SIGNED LONGWORD.
   COL1.
   COL2.
   COL3.
$ SEARCH T1.DAT RDB$LM_RELATION_NAME, COL ! Show data content
RDB$LM_RELATION_NAME            : T1
COL1                            : NULL
COL2                            : 3
COL3                            : 2
RDB$LM_RELATION_NAME            : T1
COL1                            : 1
COL2                            : 3
COL3                            : NULL
RDB$LM_RELATION_NAME            : T1
COL1                            : 1
COL2                            : NULL
COL3                            : 2
$!
```

2.6 Row Cache Errors Fixed

2.6.1 RMU /CLOSE /ABORT=DELPRC /WAIT Hang

Bug 4304166

Starting with Oracle Rdb V7.1, it is possible that when using the Row Cache feature, closing a database with the /ABORT=DELPRC and /WAIT qualifiers may hang. The problem results in the database recovery processes and the record cache server process becoming deadlocked. To actually close the database may require manual intervention to explicitly STOP/ID the database recovery processes.

With this combination of command line qualifiers, the Oracle Rdb monitor process was incorrectly issuing a $DELPRC to the record cache server process. The /ABORT=DELPRC and /ABORT=FORCEX qualifiers are intended to apply only to database user processes and not to database servers when /WAIT is not specified.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The Oracle Rdb monitor process no longer attempts to issue a $DELPRC to the record cache server process when /WAIT is specified.

2.6.2 Long Running Transaction Hangs After RMU/CHECKPOINT

Bug 4290880

When row caching was enabled, after an RMU/CHECKPOINT command was issued, it was possible for long running update transactions to hang waiting for the global checkpoint lock. The RMU/SHOW STATISTICS “Stall Messages” screen would show output similar to the following:

```
Process.ID  Since...... T Stall.reason............................Lock.ID.
2360128C:2  05:42:54.38 W waiting for global checkpoint (CR)       1B00783D
23601292:1u 05:42:54.39 - waiting for RCS synch. request 1:23601291 (EX)
23601291:1s 05:42:54.72 - waiting for record 97:12875:0 (PR)       5600322C
23601291:1s 05:42:54.72 - waiting for record 97:12875:0 (PR)       5600322C
```

This problem would occur because under the old checkpointing mechanisms a process had to obtain the global checkpoint lock prior to making any further updates to the database. Thus a long running update transaction would stall waiting for the RMU process to release the global checkpoint lock. The RMU process would not release the global checkpoint lock until the Row Cache Server (RCS) process completed its checkpoint. The RCS could not complete its checkpoint until the long running transaction released its row locks. Thus all processes would stall in a deadlock.

This problem has been resolved by changing the checkpoint mechanism to use an asynchronous lock request to obtain the global checkpoint lock. That is, processes no longer stall waiting to obtain the lock but instead queue a lock request and then continue processing. This prevents processes from stalling for the global checkpoint lock.

This problem can be avoided by not using the RMU/CHECKPOINT command. If a checkpoint timeout interval is declared for the database, then forcing checkpoints should not be necessary. The “CHECKPOINT TIMED EVERY <n> SECONDS” clause can be used to enable checkpoint timers. This problem can also be avoided by disabling row cache.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

2.7 Hot Standby Errors Fixed

2.7.1 Excessive CPU Consumed by LRS Process

Bug 4268610

When using the Hot Standby feature, the AIJ Log Recovery Server (LRS) process would sometimes consume inordinate amounts of CPU. This would especially be true when the following conditions were true:

- Many short duration transactions were being generated by the application.
- Many journal slots were allocated in the database.
- The current journal sequence number was relatively large, for example, in the tens of thousands.

When the above conditions were true, it exposed a problem in the recovery code statistics collection. The recovery code was attempting to determine how many blocks of journal were spanned in each committed transaction. However, the recovery code did not record the journal starting point for the transaction, thus it would appear that the transaction started in journal sequence number 0. The statistics code would then first attempt to find journal sequence 0. When it didn't find sequence 0 it would then try to find sequence 1 so that it could approximate the number of blocks in the transaction. That journal would not be found so it would continue searching for journals until it tried all possible journal sequence numbers up to the current journal. This could consume huge amounts of CPU time.

There is no workaround for this problem.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The recovery code will no longer attempt to gather statistics on the number of journal blocks per transaction since the number is not useful in the context of database recovery.

2.7.2 LRS Bugchecks in DIOLAREA$SCAN_ABM_CHAIN

Bug 4429420

The Hot Standby Log Recovery Server (LRS) process could fail with a bugcheck exception similar to the following when replication is first started for a restored standby database.

```
***** Exception at 00225AC4 : DIOLAREA$SCAN_ABM_CHAIN + 000003E4
%COSI-F-BUGCHECK, internal consistency failure
```

This problem would occur when the current journals for the master database contained entries for a DROP TABLE or DROP INDEX operation, but the database backup used to create the standby database did not contain the table or index that was dropped. That is, the database backup was done after the table or index were dropped.

This problem can be demonstrated with the following sequence of commands:

```
$ ! Create master database.
$
$ SQL$
CREATE DATABASE FILENAME TEST_MASTER
  CREATE STORAGE AREA RDB$SYSTEM FILENAME TEST_MASTER;
DISCONNECT ALL;
ALTER DATABASE FILENAME TEST_MASTER RESERVE 2 JOURNALS
  OPEN IS MANUAL;
%RDMS-W-DOFULLBCK, full database backup should be done to ensure future recovery
ALTER DATABASE FILENAME TEST_MASTER JOURNAL IS ENABLED
  (FAST COMMIT IS ENABLED,
   LOG SERVER IS AUTOMATIC)
  ADD JOURNAL AIJ_1 FILENAME 'SYS$DISK:[]TEST_MASTER_JOURNAL1'
  ADD JOURNAL AIJ_2 FILENAME 'SYS$DISK:[]TEST_MASTER_JOURNAL2'
  ADD JOURNAL AIJ_3 FILENAME 'SYS$DISK:[]TEST_MASTER_JOURNAL3';
%RDMS-W-DOFULLBCK, full database backup should be done to ensure future recovery
EXIT;
$
$ RMU/OPEN TEST_MASTER
$
$ ! Create a table
$
$ SQL$
ATTACH 'FILENAME TEST_MASTER';
CREATE TABLE T1 (C1 INT);
INSERT INTO T1 VALUES (1);
1 row inserted
COMMIT;
EXIT;
$
$ ! Dispose of the journal entries reflecting the CREATE TABLE.
$
$ RMU/BACKUP/AFTER/NOLOG TEST_MASTER NL:
%RMU-W-DATACMIT, unjournaled changes made; database may not be recoverable
$
$ ! Drop the table.  The journal will contain the DROP TABLE but will not
$ ! contain the original CREATE TABLE.
$
$ SQL$
ATTACH 'FILENAME TEST_MASTER';
DROP TABLE T1;
COMMIT;
EXIT;
$
$ ! Now that the table is gone, backup the database and use the backup to
$ ! create the standby database.  The standby database will not contain an
$ ! ABM page for the table that was CREATEd/DROPped, but the journal will
$ ! contain the DROP TABLE entries.  The LRS will process the DROP TABLE
$ ! journal entries for the non-existent table.
$
$ RMU/BACKUP/NOLOG/ONLINE TEST_MASTER TEST_MASTER
$ RMU/SHOW AFTER_JOURNAL/OUTPUT=TEST_AIJ.OPT TEST_MASTER
$ RMU/RESTORE/NOLOG/NOCDD/NEW/DIR=SYS$DISK:[]-
    /ROOT=SYS$DISK:[]TEST_STANDBY -
    /AIJ_OPT=TEST_AIJ.OPT TEST_MASTER
  JOURNAL IS ENABLED -
      RESERVE 3 -
      ALLOCATION IS 512 -
      EXTENT IS 512 -
      OVERWRITE IS DISABLED -
      SHUTDOWN_TIMEOUT IS 60 -
      NOTIFY IS DISABLED -
      BACKUPS ARE MANUAL -
      CACHE IS DISABLED
  ADD JOURNAL AIJ_1 -
  ! FILE SYS$DISK:[]TEST_MASTER_JOURNAL1.AIJ;1
      FILE SYS$DISK:[]TEST_MASTER_JOURNAL1
  ADD JOURNAL AIJ_2 -
  ! FILE SYS$DISK:[]TEST_MASTER_JOURNAL2.AIJ;1
      FILE SYS$DISK:[]TEST_MASTER_JOURNAL2
  ADD JOURNAL AIJ_3 -
  ! FILE SYS$DISK:[]TEST_MASTER_JOURNAL3.AIJ;1
      FILE SYS$DISK:[]TEST_MASTER_JOURNAL3
$ RMU/OPEN TEST_STANDBY
$ RMU/REPLICATE AFTER_JOURNAL START TEST_STANDBY -
    /MASTER_ROOT=TEST_MASTER -
    /OUTPUT=TEST_LRS.LOG
%RMU-I-HOTOFFLINE, standby database opened for exclusive access
$
$ ! Start replication.  The LRS will attempt to apply the REL_CLUMP entry.
$ ! Part of processing the REL_CLUMP is to update the ABM pages, but they
$ ! don't exist.  As reported in BUG 4429420, the LRS would bugcheck at
$ ! DIOLAREA$SCAN_ABM_CHAIN + 000003E4.  In this test the following REPLICATE
$ ! START command would return an RDMS-F-TIMEOUT error when the LRS crashed.
$ ! The LCS timed out waiting for the LRS to respond.
$
$ RMU/REPLICATE AFTER_JOURNAL START TEST_MASTER /STANDBY_ROOT=TEST_STANDBY
%RDMS-F-TIMEOUT, timeout on
```

This problem can be avoided by backing up the journals and the database in sequence without doing any intervening metadata operations.

This problem has been corrected in Oracle Rdb Release 7.1.4.1.

3
Enhancements Provided in Oracle Rdb Release 7.1.4.1

3.1 Enhancements Provided in Oracle Rdb Release 7.1.4.1

3.1.1 Support Added for ANSI C Comments

For several years, the ANSI C standard has included the "//" style comment in addition to the traditional "/* */" style comment. Until now, SQL$PRE/CC has only supported the later style. Support for the "//" style comment has been added.

The following example shows comments in the old and in the newly supported style.

```
/*
 * Traditional C style comments
 */
i0 += 1;             /* add one to i0 */

//
// Comments using the // style
//
i0 += 1;             // add one to i0
```

3.1.2 New Rdb Character Set GB18030

Oracle Rdb has introduced a new Chinese character set, GB18030, which is defined by the GB18030-2000 standard as used by the People's Republic of China. GB18030 encodes characters in sequences of one, two, or four octets. The following are valid octet sequences:

```
§       Single-octet: %X'00'-%X'7F '
§       Two-octet: %X'81'-%X'FE' + %X'40-%X'7E' %X'80-%X'FE';
§       Four-octet: %X'81'-%X'FE' + %X'30'-%X'39' %X'81'-%X'FE' +%X'30'-%X'39'
```

The single-octet characters comply with the standard GB 11383 (iISO 4873:1986). GB18030 has 1.6 million valid octet sequences.

As GB18030 contains single-octet ASCII characters, it may be used as an Identifier Character Set.

3.1.3 New GET DIAGNOSTICS Keyword

The following new keyword has been added to GET DIAGNOSTICS:

– TRACE_ENABLED

  Returns an INTEGER value to indicate if the TRACE flag has been enabled using the statement SET FLAGS 'TRACE' or by either of the logical names RDMS$SET_FLAGS or RDMS$DEBUG_FLAGS. A zero (0) is returned if the flag is disabled, otherwise a one (1) is returned to indicate that tracing is enabled.

The following example shows usage of this keyword in a compound statement.

```
SQL> declare :x integer;
SQL> begin
cont> get diagnostics :x = TRACE_ENABLED;
cont> end;
SQL> print :x;
           X
           0
SQL> set flags 'trace';
SQL> begin
cont> get diagnostics :x = TRACE_ENABLED;
cont> end;
SQL> print :x;
           X
           1
```

3.1.4 Buffer Memory Now Exported/Imported

Bug 4213762

The Recovery Journal setting for Buffer Memory is now EXPORTed/IMPORTed.

An example of the syntax follows:

```
create data file rujmem;
export data file rujmem into rujmem;
drop data file rujmem;
import data from rujmem file rujmem recovery journal (buffer memory is local);
```

This feature has been added in Oracle Rdb Release 7.1.4.1.

3.1.5 RMU /UNLOAD Qualifier /REOPEN_COUNT

Bug 4246050

Previously, RMU /UNLOAD would write a single output file for all records in the table/view being unloaded. In some cases, this single output file would become difficult to manipulate.

This problem has been corrected in Oracle Rdb Release 7.1.4.1. The "/REOPEN_COUNT=n" qualifier allows specifying how many records will be written to an output file. The output file will be re-created (ie, a new version of the file created) when the record count reaches the specified value. The "/REOPEN_COUNT=n" qualifier is only valid when used with the "/RECORD_DEFINITION" or "/RMS_RECORD_DEF" qualifiers.

3.1.6 New DEFAULTS Qualifier Added to RMU Extract

This release of Oracle Rdb, Release 7.1.4.1, adds a new DEFAULTS qualifier to RMU Extract.

- Defaults=defaults-list

  This qualifier is used to change the output of the RMU Extract command. The following defaults can be modified with the Defaults qualifier:

  – Allocation
    NoAllocation

    When creating a test database using the RMU Extract generated script, the allocation from the source database may not be appropriate. The ALLOCATION keyword can be used to specify an alternate value to be used by all storage areas, or the NOALLOCATION keyword can be used to cause the clause to be omitted from the CREATE STORAGE MAP syntax. The default behavior, that is when neither keyword is used, is to use the allocation recorded in the database for each storage area. See also the SNAPSHOT_ALLOCATION keyword.

- Date_format
  NoDate_format

  By default, RMU Extract assumes that DATE types will be SQL standard compliant (that is DATE ANSI) and that the builtin function CURRENT_TIMESTAMP will return a TIMESTAMP(2) value. If your environment uses DATE VMS exclusively, then you can modify the default by specifying the default DATE_FORMAT=VMS. The legal values are described in the Oracle Rdb SQL Reference Manual in the SET DEFAULT DATE FORMAT section. The default is DATE_FORMAT=SQL92.

  Use NODATE_FORMAT to omit the setting of this session attribute from the script.

- Dialect
  NoDialect

  For some extracted SQL scripts, the language dialect is required to be specified. The DIALECT keyword can be used to supply a specified dialect for the script. The legal values for this option can be found in the Oracle Rdb SQL Reference Manual in the SET DIALECT section. The default is NODIALECT.

- Language
  NoLanguage

  RMU Extract uses the process language, that is the translated value of SYS$LANGUAGE or ENGLISH, for the SET LANGUAGE command. However, if the script is used on a different system then this language might not be appropriate. The LANGUAGE keyword can be used to supply a specified language for the script. Legal language names are defined by the OpenVMS system logical name table. Examine the logical name SYS$LANGUAGES for a current set. Use NOLANGUAGE to omit this command from the script.

- Quoting_rules
  NoQuoting_rules

  The QUOTING_RULES keyword can be used to supply a specified setting for the script. The legal values for this option can be found in the Oracle Rdb SQL Reference Manual in the SET QUOTING RULES section. The default is QUOTING_RULES=SQL92. Please note that RMU Extract assumes that SQL keywords and names containing non-ASCII character set values will be quoted.

- Snapshot_allocation
  NoSnapshot_allocation

  When creating a test database from the RMU Extract output, the snapshot file allocation from the source database may not be appropriate. The SNAPSHOT_ALLOCATION keyword can be used to specify an alternate value to be used by all snapshot areas, or the NOALLOCATION keyword can be used to cause the "snapshot allocation is" clause to be omitted. The default behavior, that is when neither keyword is used, is to use the snapshot allocation stored in the database for each snapshot area. See also the ALLOCATION keyword.

3.1.7 New RESTART WITH Clause for ALTER SEQUENCE

This release of Oracle Rdb, 7.1.4.1, includes support for the ALTER SEQUENCE ... RESTART WITH clause. RESTART WITH allows the database administrator to reset the sequence to a specified value. The value must be within the range of MINVALUE and MAXVALUE. This command requires exclusive access to the sequence. Once the ALTER SEQUENCE statement is successfully committed, applications using the sequence will start with a value based on the restarted value.

Note

TRUNCATE TABLE for a table with an IDENTITY column implicitly executed an ALTER SEQUENCE ... RESTART WITH on the sequence. Specify the MINVALUE if it is an ascending sequence or MAXVALUE if it is a descending sequence.

The following example shows the new RESTART WITH clause.

```
SQL> show sequence NEW_EMPLOYEE_ID
     NEW_EMPLOYEE_ID
 Sequence Id: 1
 Initial Value: 472
 . . .
SQL>
SQL> alter sequence NEW_EMPLOYEE_ID
cont> restart with 500;
SQL>
SQL> show sequence NEW_EMPLOYEE_ID
     NEW_EMPLOYEE_ID
 Sequence Id: 1
 Initial Value: 500
 . . .
SQL>
```

3.1.8 ALTER VIEW Statement

Description

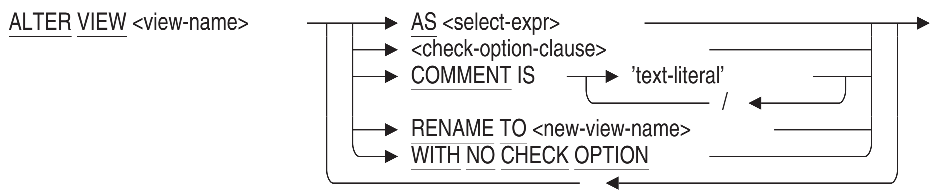
This statement allows the named view to be modified.

Environment

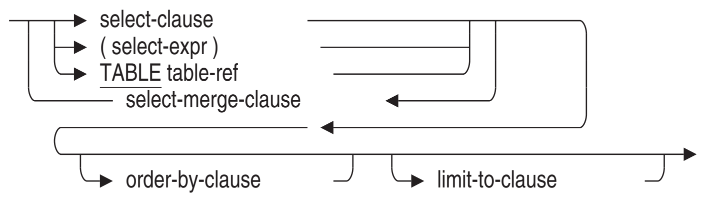
You can use the ALTER VIEW statement:

- In interactive SQL
- Embedded in host language programs
- As part of a procedure in a SQL module
- In dynamic SQL as a statement to be dynamically executed

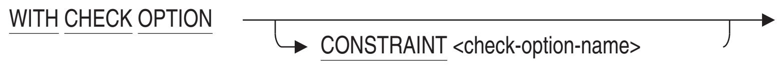
Format



select-expr =



check-option-clause =



Arguments

- AS

  Replaces the view select expression and the definitions of the columns. The number of expressions in the select list must match the original CREATE VIEW column list.

- CONSTRAINT check-option-name

  Specify a name for the WITH CHECK OPTION constraint. If you omit the name, SQL creates a name. However, Oracle Rdb recommends that you always name constraints. If you supply a name for the WITH CHECK OPTION constraint, the name must be unique in the schema.

  The name for the WITH CHECK OPTION constraint is used by the INTEG_FAIL error message when an INSERT or UPDATE statement violates the constraint.

- COMMENT IS

  Replaces the comment currently defined for the view (if any). The comment will be displayed by the SHOW VIEW statement in Interactive SQL.

- RENAME TO

  Renames the current view. The new view name must not exist as the name of an existing view, table, sequence or synonym.

- WITH CHECK OPTION

A constraint that places restrictions on update operations made to a view. The check option clause ensures that any rows that are inserted or updated in a view conform to the definition of the view. Do not specify the WITH CHECK OPTION clause with views that are read-only. (The Usage Notes describe which views SQL considers read-only.)

- WITH NO CHECK OPTION

  Removes any check option constraint currently defined for the view.

Usage Notes

- You require ALTER privilege on the referenced view.
- The ALTER VIEW statement causes the RDB$LAST_ALTERED column of the RDB$RELATIONS table for the named view to be updated with the transaction's timestamp.
- Neither the column names nor their position may be modified using ALTER VIEW. Nor can columns be added or dropped for a view. These changes require both a DROP VIEW and CREATE VIEW statement to replace the existing definition.
- RENAME TO allows the name of the view to be changed. This clause requires that synonyms are enabled in the database. Use ALTER DATABASE ... SYNONYMS ARE ENABLED.

  The old name will be used to create a synonym for the new name of this view. This synonym can be dropped if the name is no longer used by database definitions or applications.

  This clause is equivalent to the RENAME VIEW statement.
- The COMMENT IS clause changes the existing comment on the view. This clause is equivalent to the COMMENT ON VIEW statement.
- Changes to the column expression may change the column to read-only and prevent referencing routines, triggers and applications from performing INSERT and UPDATE operations on those columns. Such changes will be reported at runtime.

  Similarly, if the view select table expression becomes read-only, referencing queries may fail.

  SQL considers as read-only views those with select expressions that:

  - Use the DISTINCT argument to eliminate duplicate rows from the result table
  - Name more than one table or view in the FROM clause
  - Use a derived table in the FROM clause
  - Include a statistical function in the select list
  - Contain a UNION, EXCEPT DISTINCT (MINUS), INTERSECT DISTINCT, GROUP BY, or HAVING clause
- If the AS clause changes the view to read-only, or includes a LIMIT TO ... ROWS clause on the main query then the check option constraint is implicitly removed.

Example 3–1 Changing the comment on a view

```
SQL> show view (comment) current_job
Information for table CURRENT_JOB

SQL> alter view CURRENT_JOB
cont>   comment is 'Select the most recent job for the employee';
SQL> show view (comment) current_job
Information for table CURRENT_JOB

Comment on table CURRENT_JOB:
Select the most recent job for the employee
SQL>
```

Examples

A comment can be added or changed on a view using the COMMENT IS clause as shown in this example.

The following view uses a derived table and join to collect the count of employees in each department. The view is used in several reporting programs used by the department and company managers.

Example 3–2 Changing the columns results of a view definition

```
SQL> create view DEPARTMENTS_SUMMARY
cont> as
cont> select department_code, d.department_name,
cont>        d.manager_id, jh.employee_count
cont> from departments d inner join
cont>      (select department_code, count (*)
cont>         from job_history
cont>         where job_end is null
cont>         group by department_code)
cont>           as jh (department_code, employee_count)
cont>      using (department_code);
SQL>
SQL> show view DEPARTMENTS_SUMMARY;
Information for table DEPARTMENTS_SUMMARY

Columns for view DEPARTMENTS_SUMMARY:
Column Name                     Data Type        Domain
-----------                     ---------        ------
DEPARTMENT_CODE                 CHAR(4)
DEPARTMENT_NAME                 CHAR(30)
 Missing Value: None
MANAGER_ID                      CHAR(5)
 Missing Value:
EMPLOYEE_COUNT                  INTEGER
 Source:
select department_code, d.department_name,
       d.manager_id, jh.employee_count
from departments d inner join
     (select department_code, count (*)
        from job_history
        where job_end is null
        group by department_code) as jh (department_code, employee_count)
     using (department_code)

SQL>
```

The database administrator decides to create a column in the DEPARTMENTS table to hold the count of employees (rather than using a query to gather the total) and to maintain the value through triggers on EMPLOYEES and JOB_HISTORY (not shown here). Now the view can be simplified without resorting to a DROP VIEW and CREATE VIEW. Alter view will preserve the dependencies on the view from other views, triggers and routines and so minimize the work required to implement such a change.

```
SQL> alter table DEPARTMENTS
cont>     add column EMPLOYEE_COUNT integer;
SQL>
SQL> alter view DEPARTMENTS_SUMMARY
cont> as
cont> select department_code, d.department_name,
cont>        d.manager_id, d.employee_count
cont> from departments d;
SQL>
SQL> show view DEPARTMENTS_SUMMARY;
Information for table DEPARTMENTS_SUMMARY
```

(continued on next page)

Example 3–2 (Cont.) Changing the columns results of a view definition

```
Columns for view DEPARTMENTS_SUMMARY:
Column Name                     Data Type        Domain
-----------                     ---------        ------
DEPARTMENT_CODE                 CHAR(4)
 Missing Value: None
DEPARTMENT_NAME                 CHAR(30)
 Missing Value: None
MANAGER_ID                      CHAR(5)
 Missing Value:
EMPLOYEE_COUNT                  INTEGER
 Source:
select department_code, d.department_name,
       d.manager_id, d.employee_count
from departments d

SQL>
```

This example shows that a WITH CHECK OPTION constraint restricts the inserted data to the view's WHERE clause. Once the constraint is removed, the INSERT is no longer constrained.

Example 3–3 Changing the WITH CHECK OPTION constraint of a view definition

```
SQL> create view TOLIVER_EMPLOYEE
cont> as select * from EMPLOYEES where employee_id = '00164'
cont> with check option;
SQL> insert into TOLIVER_EMPLOYEE (employee_id) value ('00000');
%RDB-E-INTEG_FAIL, violation of constraint TOLIVER_EMPLOYEE_CHECKOPT1 caused
operation to fail
-RDB-F-ON_DB, on database DISK1:[DATABASES]MF_PERSONNEL.RDB;1
SQL>
SQL> alter view TOLIVER_EMPLOYEE with no check option;
SQL>
SQL> insert into TOLIVER_EMPLOYEE (employee_id) value ('00000');
1 row inserted
SQL>
```

4 Documentation Corrections, Additions and Changes

This chapter provides corrections for documentation errors and omissions.

4.1 Documentation Corrections

4.1.1 Incorrect Example Under RMU Unload Command

Bug 4430799

The Oracle RMU Reference Manual, Version 7.1, contains a misleading example. Example 14 in the RMU Unload Command describes a mechanism for reloading AUTOMATIC column data into the database. It should be replaced by this revised example:

AUTOMATIC columns are evaluated during INSERT and UPDATE operations for a table; for instance, they may record the timestamp for the last operation. If the table is being reorganized, it may be necessary to unload the data and reload it after the storage map and indexes for the table are re-created, yet the old auditing data must remain the same.

Normally, RMU Unload does not unload columns marked as AUTOMATIC. You must use the /VIRTUAL_FIELD qualifier with the keyword AUTOMATIC to request this action.

```
$ rmu/unload/virtual_fields=(automatic) payroll_db people people.unl
```

Following the restructure of the database, the data can be reloaded. If the target columns are also defined as AUTOMATIC, then RMU Load will not write to those columns, therefore, you must use the /VIRTUAL_FIELD qualifier with the keyword AUTOMATIC to request this action.

```
$ rmu/load/virtual_fields=(automatic) payroll_db people people.unl
```

4.1.2 RDM$BIND_MAX_DBR_COUNT Documentation Clarification

Bugs 1495227 and 3916606

The Rdb7 Guide to Database Performance and Tuning Manual, Volume 2, page A-18, incorrectly describes the use of the RDM$BIND_MAX_DBR_COUNT logical.

Following is an updated description. Note that the difference in actual behavior between what is in the existing documentation and software is that the logical name only controls the number of database recovery processes created at once during “node failure” recovery (that is, after a system or monitor crash or other abnormal shutdown) for each database.

When an entire database is abnormally shut down (due, for example, to a system failure), the database will have to be recovered in a “node failure” recovery mode. This recovery will be performed by another monitor in the cluster if the database is opened on another node or will be performed the next time the database is opened.

The RDM$BIND_MAX_DBR_COUNT logical name and the RDB_BIND_MAX_DBR_COUNT configuration parameter define the maximum number of database recovery (DBR) processes to be simultaneously invoked by the database monitor for each database during a “node failure” recovery.

This logical name and configuration parameter apply only to databases that do not have global buffers enabled. Databases that utilize global buffers have only one recovery process started at a time during a “node failure” recovery.

In a node failure recovery situation with the Row Cache feature enabled (regardless of the global buffer state), the database monitor will start a single database recovery (DBR) process to recover the Row Cache Server (RCS) process and all user processes from the oldest active checkpoint in the database.

Per-Database Value

The RDM$BIND_MAX_DBR_COUNT logical name specifies the maximum number of database recovery processes to run at once for each database. For example, if there are 10 databases being recovered and the value for the RDM$BIND_MAX_DBR_COUNT logical name is 8, up to 80 database recovery processes would be started by the monitor after a node failure.

The RDM$BIND_MAX_DBR_COUNT logical name is translated when the monitor process opens a database. Databases should be closed and reopened for a new value of the logical to become effective.

4.1.3 Database Server Process Priority Clarification

By default, the database servers (ABS, ALS, DBR, LCS, LRS, RCS) created by the Rdb monitor inherit their VMS process scheduling base priority from the Rdb monitor process. The default priority for the Rdb monitor process is 15.

Individual server priorities can be explicitly controlled via system-wide logical names as described in Table 4–1.

Table 4–1 Server Process Priority Logical Names

Logical Name	Use
RDM$BIND_ABS_PRIORITY	Base Priority for the ABS Server process
RDM$BIND_ALS_PRIORITY	Base Priority for the ALS Server process
RDM$BIND_DBR_PRIORITY	Base Priority for the DBR Server process
RDM$BIND_LCS_PRIORITY	Base Priority for the LCS Server process
RDM$BIND_LRS_PRIORITY	Base Priority for the LRS Server process
RDM$BIND_RCS_PRIORITY	Base Priority for the RCS Server process

When the Hot Standby feature is installed, the RDMAIJSERVER account is created specifying an account priority of 15. The priority of AIJ server processes on your system can be restricted with the system-wide logical name RDM$BIND_

AIJSRV_PRIORITY. If this logical name is defined to a value less than 15, an AIJ server process will adjust its base priority to the value specified when the AIJ server process starts. Values from 0 to 31 are allowed for RDM$BIND_AIJSRV_PRIORITY, but the process is not able to raise its priority above the RDMAIJSERVER account value.

For most applications and systems, Oracle discourages changing the server process priorities.

4.1.4 Explanation of SQL$INT in a SQL Multiversion Environment and How to Redefine SQL$INT

Bug 2500594

In an environment running multiple versions of Oracle Rdb, for instance Rdb V7.0 and Rdb V7.1, there are now several varianted SQL images, such as SQL$70.EXE and SQL$71.EXE. However, SQL$INT.EXE is not varianted but acts as a dispatcher using the translation of the logical name RDMS$VERSION_VARIANT to activate the correct SQL runtime environment. This image is replaced when a higher version of Oracle Rdb is installed. Thus, using the example above, when Rdb V7.1 is installed, SQL$INT.EXE will be replaced with the V7.1 SQL$INT.EXE.

If an application is linked in this environment (using V7.1 SQL$INT) and the corresponding executable deployed to a system running Oracle Rdb V7.0 multiversion only, the execution of the application may result in the following error:

```
%IMGACT-F-SYMVECMIS, shareable image's symbol vector table mismatch
```

In order to avoid such a problem, the following alternative is suggested:

In the multiversion environment running both Oracle Rdb V7.0 and Oracle Rdb V7.1, run Oracle Rdb V7.0 multiversion by running the command procedures RDB$SETVER.COM 70 and RDB$SETVER RESET. This will set up the necessary logical names and symbols that establish the Oracle Rdb V7.0 environment.

For example:

```
$ @SYS$LIBRARY:RDB$SETVER 70

Current PROCESS Oracle Rdb environment is version V7.0-63 (MULTIVERSION)
Current PROCESS SQL environment is version V7.0-63 (MULTIVERSION)
Current PROCESS Rdb/Dispatch environment is version V7.0-63 (MULTIVERSION)

$ @SYS$LIBRARY:RDB$SERVER RESET
```

Now run SQL and verify that the version is correct:

```
$ sql$
SQL> show version
Current version of SQL is: Oracle Rdb SQL V7.0-63
```

Define SQL$INT to point to the varianted SQL$SHR.EXE. Then, create an options file directing the linker to link with this newly defined SQL$INT. An example follows:

```
$ DEFINE SQL$INT SYS$SHARE:SQL$SHR'RDMS$VERSION_VARIANT'.EXE
$ LINK TEST_APPL,SQL$USER/LIB,SYS$INPUT/option
SQL$INT/SHARE
^Z
```

The executable is now ready to be deployed to the Oracle Rdb V7.0 multiversion environment and should run successfully.

Please note that with each release of Oracle Rdb, new entry points are added to the SQL$INT shareable image. This allows the implementation of new functionality. Therefore, applications linked with SQL$INT from Oracle Rdb V7.1 cannot be run on systems with only Oracle Rdb V7.0 installed. This is because the shareable image does not contain sufficient entry points.

The workaround presented here allows an application to explicitly link with the Oracle Rdb V7.0 version of the image. Such applications are upward compatible and will run on Oracle Rdb V7.0 and Oracle Rdb V7.1. The applications should be compiled and linked under the lowest version.

In environments where Oracle Rdb V7.1 is installed, this workaround is not required because the SQL$INT image will dynamically activate the appropriate SQL$SHRxx image as expected.

4.1.5 Documentation Omitted Several Reserved Words

Bug 2319321

The following keywords are considered reserved words in Oracle Rdb Release 7.1.

- UID
- CURRENT_UID
- SYSTEM_UID
- SESSION_UID
- RAW
- LONG
- DBKEY
- ROWID
- SYSDATE

In particular, any column which has these names will be occluded by the keyword. i.e. selecting from column UID will be interpreted as referencing the built in function UID and so return a different result.

The correction to this problem is to enable keyword quoting using SET QUOTING RULES 'SQL92' (or 'SQL99') and enclose the column name in quotations.

In addition, SQL will now generate a warning if these reserved words are used (unquoted) in CREATE and ALTER operations.

4.1.6 Using Databases from Releases Earlier Than V6.0

Bug 2383967

You cannot convert or restore databases earlier than V6.0 directly to V7.1. The RMU Convert command for V7.1 supports conversions from V6.0 through V7.0 only. If you have a V3.0 through V5.1 database, you must convert it to at least V6.0 and then convert it to V7.1. For example, if you have a V4.2 database, convert it first to at least V6.0, then convert the resulting database to V7.1.

If you attempt to convert a database created prior to V6.0 directly to V7.1, Oracle RMU generates an error.

4.1.7 New RMU/BACKUP Storage Area Assignment With Thread Pools

This is to clarify how storage areas are assigned to disk and tape devices using the new RMU/BACKUP THREAD POOL and BACKUP TO MULTIPLE DISK DEVICES features introduced in Oracle Rdb Release 7.1.

For the case of backup to multiple disk devices using thread pools, the algorithm used by RMU/BACKUP to assign threads is to calculate the size of each area as the product of the page length in bytes times the highest page number used (maximum page number) for that area. The area sizes are then sorted by descending size and ascending device name. For internal processing reasons, the system area is placed as the first area in the first thread. Each of the remaining areas is added to whichever thread has the lowest byte count. In this way, the calculated area sizes are balanced between the threads.

For tape devices, the same algorithm is used but the areas are partitioned among writer threads, not disk devices.

The partitioning for backup to multiple disk devices is done by disk device, not by output thread, because there will typically be more disk devices than output threads, and an area can not span a device.

4.1.8 RDM$BIND_LOCK_TIMEOUT_INTERVAL Overrides the Database Parameter

Bug 2203700

When starting a transaction, there are three different values that are used to determine the lock timeout interval for that transaction. Those values are:

1. The value specified in the SET TRANSACTION statement
2. The value stored in the database as specified in CREATE or ALTER DATABASE
3. The value of the logical name RDM$BIND_LOCK_TIMEOUT_INTERVAL

The timeout interval for a transaction is the smaller of the value specified in the SET TRANSACTION statement and the value specified in CREATE DATABASE. However, if the logical name RDM$BIND_LOCK_TIMEOUT_INTERVAL is defined, the value of this logical name overrides the value specified in CREATE DATABASE.

The description of how these three values interact, found in several different parts of the Rdb documentation set, is incorrect and will be replaced by the description above.

The lock timeout value in the database can be dynamically modified from the Locking Dashboard in RMU/SHOW STATISTICS. The Per-Process Locking Dashboard can be used to dynamically override the logical name RDM$BIND_LOCK_TIMEOUT_INTERVAL for one or more processes.

4.1.9 New Request Options for RDO, RDBPRE and RDB$INTERPRET

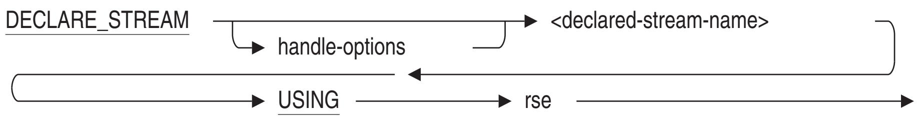
This release note was included in the V70A Release Notes but had gotten dropped somewhere along the line.

For this release of Rdb, two new keywords have been added to the handle-options for the DECLARE_STREAM, the START_STREAM (undeclared format) and FOR loop statements. These changes have been made to RDBPRE, RDO and RDB$INTERPRET at the request of several RDO customers.

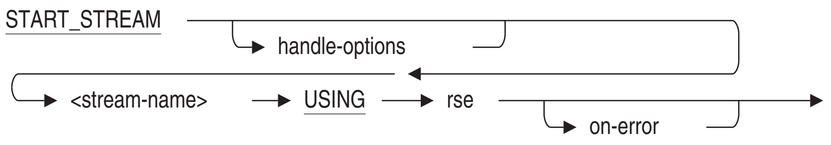
In prior releases, the handle-options could not be specified in interactive RDO or RDB$INTERPRET. This has changed in Rdb7 but these allowed options will be limited to MODIFY and PROTECTED keywords. For RDBPRE, all options listed will be supported. These option names were chosen to be existing keywords to avoid adding any new keywords to the RDO language.

The altered statements are shown in Example 5-1, Example 5-2 and Example 5-3.

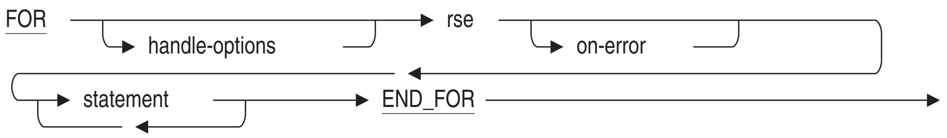
Example 5-1 DECLARE_STREAM Format



Example 5-2 START_STREAM Format

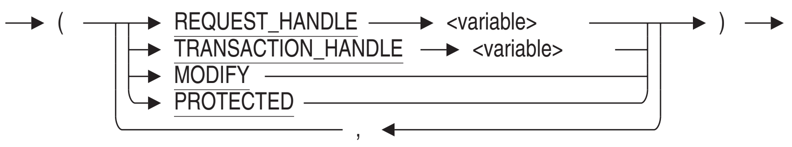


Example 5-3 FOR Format



Each of these statements references the syntax for the HANDLE-OPTIONS which has been revised and is shown below.

handle-options =



The following options are available for HANDLE-OPTIONS:

- REQUEST_HANDLE specifies the request handle for this request. This option is only valid for RDBPRE and RDML applications. It cannot be used with RDB$INTERPRET, nor interactive RDO.
- TRANSACTION_HANDLE specifies the transaction handle under which this request executes. This option is only valid for RDBPRE and RDML applications. It cannot be used with RDB$INTERPRET, nor interactive RDO.
- MODIFY specifies that the application will modify all (or most) records fetched from the stream or for loop. This option can be used to improve application performance by avoiding lock promotion from SHARED READ for the FETCH to PROTECTED WRITE access for the nested MODIFY or ERASE statement. It can also reduce DEADLOCK occurrence because lock promotions are avoided.

  This option is valid for RDBPRE, RDB$INTERPRET, and interactive RDO. This option is not currently available for RDML.

For example:

```
RDO>   FOR (MODIFY) E IN EMPLOYEES WITH E.EMPLOYEE_ID = "00164"
cont>    MODIFY E USING E.MIDDLE_INITIAL = "M"
cont>    END_MODIFY
cont>  END_FOR
```

This FOR loop uses the MODIFY option to indicate that the nested MODIFY is an unconditional statement and so aggressive locking can be undertaken during the fetch of the record in the FOR loop.

- PROTECTED specifies that the application may modify records fetched by this stream by a separate and independent MODIFY statement. Therefore, this stream should be protected from interference (aka Halloween affect). The optimizer will select a snapshot of the rows and store them in a temporary relation for processing, rather than traversing indexes at the time of the FETCH statement. In some cases this may result in poorer performance when the temporary relation is large and overflows from virtual memory to a temporary disk file, but the record stream will be protected from interference. The programmer is directed to the documentation for the Oracle Rdb logical names RDMS$BIND_WORK_VM and RDMS$BIND_WORK_FILE.

  This option is valid for RDBPRE, RDB$INTERPRET, and interactive RDO. This option is not currently available for RDML.

  The following example creates a record stream in a BASIC program using Callable RDO:

```
RDMS_STATUS = RDB$INTERPRET ('INVOKE DATABASE PATHNAME "PERSONNEL"')

RDMS_STATUS = RDB$INTERPRET ('START_STREAM (PROTECTED) EMP USING ' + &
                             'E IN EMPLOYEES')

RDMS_STATUS = RDB$INTERPRET ('FETCH EMP')

DML_STRING = 'GET ' +                                           &
                 '!VAL = E.EMPLOYEE_ID;' +                      &
                 '!VAL = E.LAST_NAME;' +                        &
                 '!VAL = E.FIRST_NAME' +                        &
             'END_GET'

RDMS_STATUS = RDB$INTERPRET (DML_STRING, EMP_ID, LAST_NAME, FIRST_NAME)
```

  In this case the FETCH needs to be protected against MODIFY statements which execute in other parts of the application.

4.2 Address and Phone Number Correction for Documentation

In release 7.0 or earlier documentation, the address and fax phone number listed on the Send Us Your Comments page are incorrect. The correct information is:

```
FAX -- 603.897.3825
Oracle Corporation
One Oracle Drive
Nashua, NH 03062-2804
USA
```

4.3 Online Document Format and Ordering Information

You can view the documentation in Adobe Acrobat format using the Acrobat Reader, which allows anyone to view, navigate, and print documents in the Adobe Portable Document Format (PDF). See http://www.adobe.com for information about obtaining a free copy of Acrobat Reader and for information on supported platforms.

The Oracle Rdb documentation in Adobe Acrobat format is available on MetaLink:

```
Top Tech Docs\Oracle Rdb\Documentation\<bookname>
```

Customers should contact their Oracle representative to purchase printed documentation.

4.4 New and Changed Features in Oracle Rdb Release 7.1

This section provides information about late-breaking new features or information that is missing or changed since the Oracle Rdb New and Changed Features for Oracle Rdb manual was published.

4.4.1 PERSONA is Supported in Oracle SQL/Services

In the "New and Changed Features for Oracle Rdb" Manual under the section "ALTER DATABASE Statement" is a note stating that impersonation is not supported in Oracle SQL/Services. This is incorrect. There was a problem in the first release of Oracle Rdb 7.1 (7.1.0) whereby impersonation through Oracle SQL/Services failed. This problem is resolved in Oracle Rdb Release 7.1.0.1.

4.4.2 NEXTVAL and CURRVAL Pseudocolumns Can Be Delimited Identifiers

The New and Changed Features for Oracle Rdb manual describes SEQUENCES but does not mention that the special pseudocolumns NEXTVAL and CURRVAL can be delimited. All uppercase and lowercase variations of these keywords are accepted and assumed to be equivalent to these uppercase keywords.

The following example shows that any case is accepted:

```
SQL> set dialect 'sql92';
SQL> create sequence dept_id;
SQL> select dept_id.nextval from rdb$database;
                    1
1 row selected
SQL> select "DEPT_ID".currval from rdb$database;
                    1
1 row selected
SQL> select "DEPT_ID"."CURRVAL" from rdb$database;
                    1
1 row selected
SQL> select "DEPT_ID"."nextval" from rdb$database;
                    2
1 row selected
SQL> select "DEPT_ID"."CuRrVaL" from rdb$database;
                    2
1 row selected
```

4.4.3 Only=select_list Qualifier for the RMU Dump After_Journal Command

The Oracle Rdb New and Changed Features for Oracle Rdb manual documents the First=select_list and Last=select_list qualifiers for the RMU Dump After_Journal command. Inadvertently missed was the Only=select_list qualifier.

The First, Last, and Only qualifiers have been added because the Start and End qualifiers are difficult to use since users seldom know, nor can they determine, the AIJ record number in advance of using the RMU Dump After_Journal command.

The select_list clause of these qualifiers consists of a list of one or more of the following keywords:

- TSN=tsn

  Specifies the first, last, or specific TSN in the AIJ journal using the standard [n:]m TSN format.
- TID=tid

  Specifies the first, last or specific TID in the AIJ journal.
- RECORD=record

  Specifies the first or last record in the AIJ journal. This is the same as the existing Start and End qualifiers (which are still supported, but deprecated). This keyword cannot be used with the Only qualifier.
- BLOCK=block#

  Specifies the first or last block in the AIJ journal. This keyword cannot be used with the Only qualifier.
- TIME=date_time

  Specifies the first or last date/time in the AIJ journal using the standard date/time format. This keyword cannot be used with the Only qualifier.

The First, Last, and Only qualifiers are optional. You may specify any or none of them.

The keywords specified for the First qualifier can differ from the keywords specified for the other qualifiers.

For example, to start the dump from the fifth block of the AIJ journal, you would use the following command:

```
RMU/DUMP/AFTER_JOURNAL /FIRST=(BLOCK=5) MF_PERSONNEL.AIJ
```

To start the dump from block 100 or TSN 52, whichever occurs first, you would use the following command:

```
RMU/DUMP/AFTER_JOURNAL /FIRST=(BLOCK=100,TSN=0:52) MF_PERSONNEL.AIJ
```

When multiple keywords are specified for a qualifier, the first condition being encountered activates the qualifier. In the preceding example, the dump starts when either block 100 or TSN 52 is encountered.

Be careful when searching for TSNs or TIDs as they are not ordered in the AIJ journal. For example, if you want to search for a specific TSN, use the Only qualifier and not the First and Last qualifiers. For example, assume the AIJ journal contains records for TSN 150, 170, and 160 (in that order). If you specify the First=TSN=160 and Last=TSN=160 qualifiers, nothing will be dumped because TSN 170 will match the Last=TSN=160 criteria.

4.5 Oracle Rdb7 and Oracle CODASYL DBMS Guide to Hot Standby Databases

This section provides information that is missing from or changed in V7.0 of the Oracle Rdb7 and Oracle CODASYL DBMS Guide to Hot Standby Databases.

4.5.1 Restrictions Lifted on After-Image Journal Files

The Hot Standby software has been enhanced regarding how it handles after-image journal files. Section 4.2.4 in the Oracle Rdb and Oracle CODASYL DBMS Guide to Hot Standby Databases states the following information:

```
If an after-image journal switchover operation is suspended when
replication operations are occurring, you must back up one or more of
the modified after-image journals to add a new journal file.
```

This restriction has been removed. Now, you can add journal files or use the emergency AIJ feature of Oracle Rdb release 7.0 to automatically add a new journal file. Note the following distinctions between adding an AIJ file and adding an emergency AIJ file:

- You can add an AIJ file to the master database and it will be replicated on the standby database. If replication operations are active, the AIJ file is created on the standby database immediately. If replication operations are not active, the AIJ file is created on the standby database when replication operations are restarted.
- You can add emergency AIJ files anytime. If replication operations are active, the emergency AIJ file is created on the standby database immediately. However, because emergency AIJ files are not journaled, starting replication after you create an emergency AIJ will fail. You cannot start replication operations because the Hot Standby software detects a mismatch in the number of after-image journal files on the master compared to the standby database.

  If an emergency AIJ file is created on the master database when replication operations are not active, you must perform a master database backup and then restore the backup on the standby database. Otherwise, an AIJSIGNATURE error results.

4.5.2 Changes to RMU Replicate After_Journal ... Buffer Command

The behavior of the RMU Replicate After_Journal ... Buffers command has been changed. The Buffers qualifier may be used with either the Configure option or the Start option.

When using local buffers, the AIJ Log Roll-forward Server will use a minimum of 4096 buffers. The value provided to the Buffers qualifier will be accepted but ignored if it is less than 4096. In addition, further parameters will be checked and the number of buffers may be increased if the resulting calculations are greater than the number of buffers specified by the Buffers qualifier. If the database is configured to use more than 4096 AIJ Request Blocks (ARBs), then the number of buffers may be increased to the number of ARBs configured for the database. The LRS ensures that there are at least 10 buffers for every possible storage area in the database. Thus if the total number of storage areas (both used and reserved) multiplied by 10 results in a greater number of buffers, then that number will be used.

When global buffers are used, the number of buffers used by the AIJ Log Roll-forward Server is determined as follows:

- If the Buffers qualifier is omitted and the Online qualifier is specified, then the number of buffers will default to the previously configured value, if any, or 256, whichever is larger.
- If the Buffers qualifier is omitted and the Online qualifier is not specified or the Noonline qualifier is specified, then the number of buffers will default to the maximum number of global buffers allowed per user ("USER LIMIT"), or 256, whichever is larger.
- If the Buffers qualifier is specified then that value must be at least 256, and it may not be greater than the maximum number of global buffers allowed per user ("USER LIMIT").

The Buffer qualifier now enforces a minimum of 256 buffers for the AIJ Log Roll-forward Server. The maximum number of buffers allowed is still 524288 buffers.

4.5.3 Unnecessary Command in the Hot Standby Documentation

There is an unnecessary command documented in the Oracle Rdb and Oracle CODASYL DBMS Guide to Hot Standby Databases manual. The documentation (in Section 2.12 "Step 10: Specify the Network Transport Protocol") says that to use TCP/IP as the network protocol, you must issue the following commands:

```
$ CONFIG UCX AIJSERVER OBJECT
$ UCX SET SERVICE RDMAIJSRV
/PORT=n
/USER_NAME=RDMAIJSERVER
/PROCESS_NAME=RDMAIJSERVER
/FILE=SYS$SYSTEM:rdmaijserver_ucx.com
/LIMIT=nn
```

The first of these commands ($ CONFIG UCX AIJSERVER OBJECT) is unnecessary. You can safely disregard the first line when setting up to use TCP/IP with Hot Standby.

The documentation will be corrected in a future release of Oracle Rdb.

4.5.4 Change in the Way RDMAIJ Server is Set Up in UCX

Starting with Oracle Rdb Release 7.0.2.1, the RDMAIJ image became a varianted image. Therefore, the information in Section 2.12, "Step 10: Specify the Network Transport Protocol," of the Oracle Rdb7 and Oracle CODASYL DBMS Guide to Hot Standby Databases has become outdated with regard to setting up the RDMAIJSERVER object when using UCX as the network transport protocol. The UCX SET SERVICE command is now similar to the following:

```
$ UCX SET SERVICE RDMAIJ -
      /PORT=port_number -
      /USER_NAME=RDMAIJ -
      /PROCESS_NAME=RDMAIJ -
      /FILE=SYS$SYSTEM:RDMAIJSERVER.com -
      /LIMIT=limit
```

For Oracle Rdb multiversion, the UCX SET SERVICE command is similar to the following:

```
$ UCX SET SERVICE RDMAIJ70 -
      /PORT=port_number -
      /USER_NAME=RDMAIJ70 -
      /PROCESS_NAME=RDMAIJ70 -
      /FILE=SYS$SYSTEM:RDMAIJSERVER70.com -
      /LIMIT=limit
```

The installation procedure for Oracle Rdb creates a user named RDMAIJ(nn) and places a file called RDMAIJSERVER(nn).COM in SYS$SYSTEM. The RMONSTART(nn).COM command procedure will try to enable a service called RDMAIJ(nn) if UCX is installed and running.

Changing the RDMAIJ server to a varianted image does not impact installations using DECNet since the correct DECNet object is created during the Oracle Rdb installation.

4.5.5 CREATE INDEX Operation Supported for Hot Standby

On Page 1-13 of the Oracle Rdb7 and Oracle CODASYL DBMS Guide to Hot Standby Databases, the add new index operation is incorrectly listed as an offline operation not supported by Hot Standby. The CREATE INDEX operation is now fully supported by Hot Standby, as long as the transaction does not span all available AIJ journals, including emergency AIJ journals.

4.6 Oracle Rdb7 for OpenVMS Installation and Configuration Guide

This section provides information that is missing from or changed in V7.0 of the Oracle Rdb7 for OpenVMS Installation and Configuration Guide.

4.6.1 Suggestion to Increase GH_RSRVPGCNT Removed

The Oracle Rdb7 for OpenVMS Installation and Configuration Guide contains a section titled "Installing Oracle Rdb Images as Resident on OpenVMS Alpha". This section includes information about increasing the value of the OpenVMS system parameter GH_RSRVPGCNT when you modify the RMONSTART.COM or SQL$STARTUP.COM procedures to install Oracle Rdb images with the Resident qualifier.

Note that modifying the parameter GH_RSRVPGCNT is only required if the RMONSTART.COM or SQL$STARTUP.COM procedures have been manually modified to install Oracle Rdb images with the Resident qualifier. Furthermore, if the RMONSTART.COM and SQL$STARTUP.COM procedures are executed during the system startup procedure (directly from SYSTARTUP_VMS.COM, for example), there is no need to modify the GH_RSRVPGCNT parameter.

Oracle Corporation recommends that you do not modify the value of the GH_RSRVPGCNT system parameter unless it is absolutely required. Some versions of OpenVMS on some hardware platforms require GH_RSRVPGCNT to be a value of zero in order to ensure the highest level of system performance.

4.6.2 Prerequisite Software

In addition to the software listed in the Oracle Rdb Installation and Configuration Guide and at the url http://www.oracle.com/rdb/product_info/index.html, note that the MACRO-32 compiler and the OpenVMS linker are required OpenVMS components in order to install Oracle Rdb on your OpenVMS Alpha system.

The MACRO-32 Compiler for OpenVMS Alpha is a standard component of the OpenVMS Operating System. It is used to compile VAX MACRO assembly language source files into native OpenVMS Alpha object code. During the Oracle Rdb installation procedure, and portions of the installation verification procedure (such as the test for RDBPRE), the MACRO-32 compiler is required.

The OpenVMS linker is a standard component of the OpenVMS Operating System. It is used to link one or more input files into a program image and defines the execution characteristics of the image. The linker will be required for application development and is likewise used by the Oracle Rdb installation procedure and the installation verification procedure.

4.6.3 Defining the RDBSERVER Logical Name

Sections 4.3.7.1 and 4.3.7.2 in the Oracle Rdb7 for OpenVMS Installation and Configuration Guide provide the following examples for defining the RDBSERVER logical name: `$ DEFINE RDBSERVER SYS$SYSTEM:RDBSERVER70.EXE`

and `$ DEFINE RDBSERVER SYS$SYSTEM:RDBSERVER61.EXE`

These definitions are inconsistent with other command procedures that attempt to reference the RDBSERVERxx.EXE image. Below is one example where the RDBSERVER.COM procedure references SYS$COMMON:<SYSEXE> and SYS$COMMON:[SYSEXE] rather than SYS$SYSTEM.

```
$   if .not. -
       ((f$locate ("SYS$COMMON:<SYSEXE>",rdbserver_image) .ne. log_len) .or. -
        (f$locate ("SYS$COMMON:[SYSEXE]",rdbserver_image) .ne. log_len))
$   then
$       say "''rdbserver_image' is not found in SYS$COMMON:<SYSEXE>"
$       say "RDBSERVER logical is ''rdbserver_image'"
$       exit
$   endif
```

In this case, if the logical name were defined as instructed in the Oracle Rdb7 for OpenVMS Installation and Configuration Guide, the image would not be found.

The correct definition of the logical name is as follows: `DEFINE RDBSERVER SYS$COMMON:<SYSEXE>RDBSERVER70.EXE`

and `DEFINE RDBSERVER SYS$COMMON:<SYSEXE>RDBSERVER61.EXE`

4.7 Guide to Database Design and Definition

This section provides information that is missing from or changed in release 7.0 of the Oracle Rdb7 Guide to Database Design and Definition.

4.7.1 Lock Timeout Interval Logical Incorrect

On Page 7-31 of Section 7.4.8 in the Oracle Rdb7 Guide to Database Design and Definition, the RDM$BIND_LOCK_TIMEOUT logical name is referenced incorrectly. The correct logical name is RDM$BIND_LOCK_TIMEOUT_INTERVAL.

The Oracle Rdb7 Guide to Database Design and Definition will be corrected in a future release.

4.7.2 Example 4-13 and Example 4-14 Are Incorrect

Example 4-13 showing vertical partitioning, and Example 4-14, showing vertical and horizontal partitioning, are incorrect. They should appear as follows:

Example 4-13:

```
SQL> CREATE STORAGE MAP EMPLOYEES_1_MAP
cont>    FOR EMPLOYEES
cont>    ENABLE COMPRESSION
cont>    STORE COLUMNS (EMPLOYEE_ID, LAST_NAME, FIRST_NAME,
cont>                   MIDDLE_INITIAL, STATUS_CODE)
cont>                   DISABLE COMPRESSION
cont>                   IN ACTIVE_AREA
cont>    STORE COLUMNS (ADDRESS_DATA_1, ADDRESS_DATA_2, CITY,
cont>                   STATE, POSTAL_CODE)
cont>                   IN INACTIVE_AREA
cont>    STORE IN OTHER_AREA;
```

Example 4-14:

```
SQL>  CREATE STORAGE MAP EMPLOYEES_1_MAP2
cont>       FOR EMP2
cont>       STORE COLUMNS (EMPLOYEE_ID, LAST_NAME, FIRST_NAME,
cont>                      MIDDLE_INITIAL, STATUS_CODE)
cont>             USING (EMPLOYEE_ID)
cont>             IN ACTIVE_AREA_A WITH LIMIT OF ('00399')
cont>             IN ACTIVE_AREA_B WITH LIMIT OF ('00699')
cont>             OTHERWISE IN ACTIVE_AREA_C
cont>       STORE COLUMNS (ADDRESS_DATA_1, ADDRESS_DATA_2, CITY,
cont>                     STATE, POSTAL_CODE)
cont>             USING (EMPLOYEE_ID)
cont>             IN INACTIVE_AREA_A WITH LIMIT OF ('00399')
cont>             IN INACTIVE_AREA_B WITH LIMIT OF ('00699')
cont>             OTHERWISE IN INACTIVE_AREA_C
cont>       STORE IN OTHER_AREA;
```

4.8 Oracle RMU Reference Manual, Release 7.0

This section provides information that is missing from or changed in V7.0 of the Oracle RMU Reference Manual.

4.8.1 RMU Unload After_Journal Null Bit Vector Clarification

Each output record from the RMU /UNLOAD /AFTER_JOURNAL command includes a vector (array) of bits. There is one bit for each field in the data record. If a null bit value is 1, the corresponding field is NULL; if a null bit value is 0, the corresponding field is not NULL and contains an actual data value. The contents of a data field that is NULL are not initialized and are not predictable.

The null bit vector begins on a byte boundary. The field RDB$LM_NBV_LEN indicates the number of valid bits (and thus, the number of columns in the table). Any extra bits in the final byte of the vector after the final null bit are unused and the contents are unpredictable.

The following example C program demonstrates one possible way of reading and parsing a binary output file (including the null bit vector) from the RMU /UNLOAD /AFTER_JOURNAL command. This sample program has been tested using Oracle Rdb V7.0.5 and higher and HP C V6.2-009 on OpenVMS Alpha V7.2-1. It is meant to be used as a template for writing your own program.

```
/* DATATYPES.C */

#include <stdio.h>
#include <descrip.h>
#include <starlet.h>
#include <string.h>

#pragma member_alignment __save
#pragma nomember_alignment

struct { /* Database key structure */
    unsigned short      lno;    /* line number */
    unsigned int        pno;    /* page number */
    unsigned short      dbid;   /* area number */
    } dbkey;

typedef struct { /* Null bit vector with one bit for each column */
    unsigned            n_tinyint   :1;
    unsigned            n_smallint  :1;
    unsigned            n_integer   :1;
    unsigned            n_bigint    :1;
    unsigned            n_double    :1;
    unsigned            n_real      :1;
    unsigned            n_fixstr    :1;
    unsigned            n_varstr    :1;
    } nbv_t;

struct { /* LogMiner output record structure for table DATATYPES */
    char                rdb$lm_action;
    char                rdb$lm_relation_name [31];
    int                 rdb$lm_record_type;
    short               rdb$lm_data_len;
    short               rdb$lm_nbv_len;
    __int64             rdb$lm_dbk;
    __int64             rdb$lm_start_tad;
    __int64             rdb$lm_commit_tad;
    __int64             rdb$lm_tsn;
    short               rdb$lm_record_version;
    char                f_tinyint;
    short               f_smallint;
    int                 f_integer;
    __int64             f_bigint;
    double              f_double;
    float               f_real;
    char                f_fixstr[10];
    short               f_varstr_len;   /* length of varchar */
    char                f_varstr[10];   /* data of varchar */
    nbv_t               nbv;
    } lm;

#pragma member_alignment __restore

main ()
{   char timbuf [24];
    struct dsc$descriptor_s dsc = {
        23, DSC$K_DTYPE_T, DSC$K_CLASS_S, timbuf};
    FILE *fp = fopen ("datatypes.dat", "r", "ctx=bin");

    memset (&timbuf, 0, sizeof(timbuf));

    while (fread (&lm, sizeof(lm), 1, fp) != 0)
    {
        printf ("Action     = %c\n",     lm.rdb$lm_action);
        printf ("Table      = %.*s\n",   sizeof(lm.rdb$lm_relation_name),
                                         lm.rdb$lm_relation_name);
        printf ("Type       = %d\n",     lm.rdb$lm_record_type);
        printf ("Data Len   = %d\n",     lm.rdb$lm_data_len);
        printf ("Null Bits  = %d\n",     lm.rdb$lm_nbv_len);
        memcpy (&dbkey, &lm.rdb$lm_dbk, sizeof(lm.rdb$lm_dbk));
        printf ("DBKEY      = %d:%d:%d\n", dbkey.dbid,
                                dbkey.pno,
                                dbkey.lno);

        sys$asctim (0, &dsc, &lm.rdb$lm_start_tad, 0);
        printf ("Start TAD  = %s\n", timbuf);

        sys$asctim (0, &dsc, &lm.rdb$lm_commit_tad, 0);
        printf ("Commit TAD = %s\n", timbuf);

        printf ("TSN        = %Ld\n",    lm.rdb$lm_tsn);
        printf ("Version    = %d\n",     lm.rdb$lm_record_version);

        if (lm.nbv.n_tinyint == 0)
                printf ("f_tinyint  = %d\n", lm.f_tinyint);
        else    printf ("f_tinyint  = NULL\n");

        if (lm.nbv.n_smallint == 0)
                printf ("f_smallint = %d\n", lm.f_smallint);
        else    printf ("f_smallint = NULL\n");

        if (lm.nbv.n_integer == 0)
                printf ("f_integer  = %d\n", lm.f_integer);
        else    printf ("f_integer  = NULL\n");

        if (lm.nbv.n_bigint == 0)
                printf ("f_bigint   = %Ld\n", lm.f_bigint);
        else    printf ("f_bigint   = NULL\n");

        if (lm.nbv.n_double == 0)
                printf ("f_double   = %f\n", lm.f_double);
        else    printf ("f_double   = NULL\n");

        if (lm.nbv.n_real == 0)
                printf ("f_real     = %f\n", lm.f_real);
        else    printf ("f_real     = NULL\n");

        if (lm.nbv.n_fixstr == 0)
                printf ("f_fixstr   = %.*s\n", sizeof (lm.f_fixstr),
                                               lm.f_fixstr);
        else    printf ("f_fixstr   = NULL\n");

        if (lm.nbv.n_varstr == 0)
                printf ("f_varstr   = %.*s\n", lm.f_varstr_len, lm.f_varstr);
        else    printf ("f_varstr   = NULL\n");

        printf ("\n");
    }
}
```

Example sequence of commands to create a table, unload the data and display the contents with this program:

```
SQL> ATTACH 'FILE MF_PERSONNEL';
SQL> CREATE TABLE DATATYPES (
       F_TINYINT TINYINT
      ,F_SMALLINT SMALLINT
      ,F_INTEGER INTEGER
      ,F_BIGINT BIGINT
      ,F_DOUBLE DOUBLE PRECISION
      ,F_REAL REAL
      ,F_FIXSTR CHAR (10)
      ,F_VARSTR VARCHAR (10));
SQL> COMMIT;
SQL> INSERT INTO DATATYPES VALUES (1, NULL, 2, NULL, 3, NULL, 'THIS', NULL);
SQL> INSERT INTO DATATYPES VALUES (NULL, 4, NULL, 5, NULL, 6, NULL, 'THAT');
SQL> COMMIT;
SQL> EXIT;
$ RMU /BACKUP /AFTER_JOURNAL MF_PERSONNEL AIJBCK.AIJ
$ RMU /UNLOAD /AFTER_JOURNAL MF_PERSONNEL AIJBCK.AIJ -
     /TABLE = (NAME=DATATYPES, OUTPUT=DATATYPES.DAT)
$ CC DATATYPES.C
$ LINK DATATYPES.OBJ
$ RUN DATATYPES.EXE
```

4.8.2 New Transaction_Mode Qualifier for Oracle RMU Commands

A new qualifier, Transaction_Mode, has been added to the RMU Copy, Move_Area, Restore, and Restore Only_Root commands. You can use this qualifier to set the allowable transaction modes for the database root file created by these commands. If you are not creating a root file as part of one of these commands, for example, you are restoring an area, attempting to use this qualifier returns a CONFLSWIT error. This qualifier is similar to the SET TRANSACTION MODE clause of the CREATE DATABASE command in interactive SQL.

The primary use of this qualifier is when you restore a backup file (of the master database) to create a Hot Standby database. Include the Transaction_Mode qualifier on the RMU Restore command when you create the standby database (prior to starting replication operations). Because only read-only transactions are allowed on the standby database, you should use the Transaction_Mode=Read_Only qualifier setting. This setting prevents modifications to the standby database at all times, even when replication operations are not active.

You can specify the following transaction modes for the Transaction_Mode qualifier:

```
All
Current
None
[No]Batch_Update
[No]Read_Only
[No]Exclusive
[No]Exclusive_Read
[No]Exclusive_Write
[No]Protected
[No]Protected_Read
[No]Protected_Write
[No]Shared
[No]Shared_Read
[No]Shared_Write
```

Note that [No] indicates that the value can be negated. For example, the NoExclusive_Write option indicates that exclusive write is not an allowable access mode for this database. If you specify the Shared, Exclusive, or Protected option, Oracle RMU assumes you are referring to both reading and writing in these modes. For example, the Transaction_Mode=Shared option indicates that you want both Shared_Read and Shared_Write as transaction modes. No mode is enabled unless you add that mode to the list or you use the ALL option to enable all modes.

You cannot negate the following three options: All, which enables all transaction modes; None, which disables all transaction modes; and Current, which enables all transaction modes that are set for the source database. If you do not specify the Transaction_Mode qualifier, Oracle RMU uses the transaction modes enabled for the source database.

You can list one qualifier that enables or disables a particular mode followed by another that does the opposite. For example, Transaction_Mode=(NoShared_Write, Shared) is ambiguous because the first value disables Shared_Write access while the second value enables Shared_Write access. Oracle RMU resolves the ambiguities by first enabling all modes that are enabled by the items in the Transaction_Mode list and then disabling those modes that are disabled by items in the Transaction_Mode list. The order of items in the list is irrelevant. In the example discussed, Shared_Read is enabled and Shared_Write is disabled.

The following example shows how to set a newly restored database to allow read-only transactions only. After Oracle RMU executes the command, the database is ready for you to start Hot Standby replication operations.

```
$ RMU/RESTORE/TRANSACTION_MODE=READ_ONLY MF_PERSONNEL.RBF
```

4.8.3 RMU Server After_Journal Stop Command

If database replication is active and you attempt to stop the database AIJ Log Server, Oracle Rdb returns an error. You must stop database replication before attempting to stop the server.

In addition, a new qualifier, Output=filename, has been added to the RMU Server After_Journal Stop command. This optional qualifier allows you to specify the file where the operational log is to be created. The operational log records the transmission and receipt of network messages.

If you do not include a directory specification with the file name, the log file is created in the database root file directory. It is invalid to include a node name as part of the file name specification.

Note that all Hot Standby bugcheck dumps are written to the corresponding bugcheck dump file; bugcheck dumps are not written to the file you specify with the Output qualifier.

4.8.4 Incomplete Description of Protection Qualifier for RMU Backup After_Journal Command

The description of the Protection Qualifier for the RMU Backup After_Journal command is incomplete in the Oracle RMU Reference Manual for Digital UNIX. The complete description is as follows:

The Protection qualifier specifies the system file protection for the backup file produced by the RMU Backup After_Journal command. If you do not specify the Protection qualifier, the default access permissions are -rw-r—— for backups to disk or tape.

Tapes do not allow delete or execute access and the superuser account always has both read and write access to tapes. In addition, a more restrictive class accumulates the access rights of the less restrictive classes.

If you specify the Protection qualifier explicitly, the differences in access permissions applied for backups to tape or disk as noted in the preceding paragraph are applied. Thus, if you specify Protection=(S,O,G:W,W:R), the access permissions on tape becomes rw-rw-r-.

4.8.5 RMU Extract Command Options Qualifier

A documentation error exists in the description of the Options=options-list qualifier of the RMU Extract command. Currently, the documentation states that this qualifier is not applied to output created by the Items=Volume qualifier. This is incorrect. Beginning with 6.1 of Oracle Rdb, the behavior of the Options=options-list qualifier is applied to output created by the Items=Volume qualifier.

4.8.6 RDM$SNAP_QUIET_POINT Logical is Incorrect

On page 2-72 of the Oracle RMU Reference Manual, the reference to the RDM$SNAP_QUIET_POINT logical is incorrect. The correct logical name is RDM$BIND_SNAP_QUIET_POINT.

4.8.7 Using Delta Time with RMU Show Statistics Command

Oracle RMU does not support the use of delta time. However, because the OpenVMS platform does, there is a workaround. You can specify delta time using the following syntax with the RMU Show Statistics command:

```
$ RMU/SHOW STATISTICS/OUTPUT=file-spec/UNTIL=" ' ' f$cvtime ("+7:00") ' "
```

The +7:00 adds 7 hours to the current time.

You can also use "TOMORROW" and "TODAY+n".

This information will be added to the description of the Until qualifier of the RMU Show Statistics command in a future release of the Oracle RMU Reference Manual.

4.9 Oracle Rdb7 Guide to Database Performance and Tuning

The following section provides corrected, clarified, or omitted information for the Oracle Rdb7 Guide to Database Performance and Tuning manual.

4.9.1 Dynamic OR Optimization Formats

In Table C-2 on Page C-7 of the Oracle Rdb7 Guide to Database Performance and Tuning, the dynamic OR optimization format is incorrectly documented as [l:h...]n. The correct formats for Oracle Rdb Release 7.0 and later are [(l:h)n] and [l:h,l2:h2].

4.9.2 Oracle Rdb Logical Names

The Oracle Rdb7 Guide to Database Performance and Tuning contains a table in Chapter 2 summarizing the Oracle Rdb logical names. The information in the following table supersedes the entries for the RDM$BIND_RUJ_ALLOC_ BLKCNT and RDM$BIND_RUJ_EXTEND_BLKCNT logical names.

RDM$BIND_RUJ_ALLOC_BLKCNT Allows you to override the default value of the .ruj file. The block count value can be defined between 0 and 2 billion with a default of 127.

RDM$BIND_RUJ_EXTEND_BLKCNT Allows you to pre-extend the .ruj files for each process using a database. The block count value can be defined between 0 and 65535 with a default of 127.

4.9.3 Waiting for Client Lock Message

The Oracle Rdb7 Guide to Database Performance and Tuning contains a section in Chapter 3 that describes the Performance Monitor Stall Messages screen. The section contains a list describing the "Waiting for" messages. The description of the "waiting for client lock" message was missing from the list.

A client lock indicates that an Rdb metadata lock is in use. The term client indicates that Rdb is a client of the Rdb locking services. The metadata locks are used to guarantee memory copies of the metadata (table, index and column definitions) are consistent with the on-disk versions.

The "waiting for client lock" message means the database user is requesting an incompatible locking mode. For example, when trying to drop a table which is in use, the drop operation requests a PROTECTED WRITE lock on the metadata object (such as a table) which is incompatible with the existing PROTECTED READ lock currently used by other users of the table.

The lock name for these special locks consist of an encoded 16 byte name. The first 4 bytes contains the leading four bytes of the user name (for system objects the RDB$ prefix is skipped) followed by three longwords. The lock is displayed in text format first - here will be seen the prefix for the table, routine, or module name; followed by its hexadecimal representation. The text version masks out non-printable characters with a dot (.).

```
waiting for client '...."...EMPL' 4C504D450000002200000004000000055
```

The leftmost value seen in the hexadecimal output contains the name prefix which is easier read in the text field. Then comes a hex number (00000022) which is the id of the object. The id is described below for tables, views, functions, procedures, modules, and sequences.

- For tables and views, the id represents the unique value found in the RDB$RELATION_ID column of the RDB$RELATIONS system relation for the given table.
- For routines (that is functions and procedures), the id represents the unique value found in the RDB$ROUTINE_ID column of the RDB$ROUTINES system relation for the given routine.
- For modules, the id represents the unique value found in the RDB$MODULE_ID column of the RDB$MODULES system relation for the given module.
- For sequences, the id represents the unique value found in the RDB$SEQUENCE_ID column of the RDB$SEQUENCES system relation for the given sequence.

The next value displayed signifies the object type. The following table describes objects and their hexadecimal type values.

Table 4–2 Objects and Their Hexadecimal Type Value

Object	Hexadecimal Value
Tables or views	00000004
Modules	00000015
Routines	00000016
Sequences	00000019

The last value in the hexadecimal output represents the lock type. The hexadecimal value 55 indicates this is a client lock and distinct from page and other data structure locks.

The following example shows a "waiting for client lock" message from a Stall Messages screen while the application was processing the EMPLOYEES table from MF_PERSONNEL. The terminal should be set to 132 characters wide to view the full client lock string.

```
Process.ID  Since.................. T Stall.reason............................Lock.ID.
27800643:1                            waiting for logical area 79 (CW)        16004833
27800507:1  31-OCT-2002 16:05:15.71 W waiting for client '...."...EMPL' 4C504D45000000220000000400000055 (PW)
```

To determine the name of the referenced object given the lock ID, the following queries can be used based on the object type:

```
SQL> select RDB$RELATION_NAME from RDB$RELATIONS where RDB$RELATION_ID = 25;
SQL> select RDB$MODULE_NAME from RDB$MODULES where RDB$MODULE_ID = 12;
SQL> select RDB$ROUTINE_NAME from RDB$ROUTINES where RDB$ROUTINE_ID = 7;
SQL> select RDB$SEQUENCE_NAME from RDB$SEQUENCES where RDB$SEQUENCE_ID = 2;
```

For more detailed lock information, perform the following steps:

- Press the L option from the horizontal menu to display a menu of lock IDs.
- Select the desired lock ID.

4.9.4 RDMS$TTB_HASH_SIZE Logical Name

The logical name RDMS$TTB_HASH_SIZE sets the size of the hash table used for temporary tables. If the logical name is not defined, Oracle Rdb uses a default value of 1249.

If you expect that temporary tables will be large (that is, 10K or more rows), use this logical name to adjust the hash table size to avoid long hash chains. Set the value to approximately 1/4 of the expected maximum number of rows for each temporary table. For example, if a temporary table will be populated with 100,000 rows, define this logical name to be 25000. If there are memory constraints on your system, you should define the logical name to be no higher than this value (1/4 of the expected maximum number of rows).

4.9.5 Error in Updating and Retrieving a Row by Dbkey Example 3-22

Example 3-22 in Section 3.8.3 that shows how to update and retrieve a row by dbkey is incorrect. The example should appear as follows:

```
SQL> ATTACH 'FILENAME MF_PERSONNEL.RDB';
SQL> --
SQL> -- Declare host variables
SQL> --
SQL> DECLARE :hv_row INTEGER;              -- Row counter
SQL> DECLARE :hv_employee_id ID_DOM;       -- EMPLOYEE_ID field
SQL> DECLARE :hv_employee_id_ind SMALLINT; -- Null indicator variable
SQL> --
SQL> DECLARE :hv_dbkey CHAR(8);            -- DBKEY storage
SQL> DECLARE :hv_dbkey_ind SMALLINT;       -- Null indicator variable
SQL> --
SQL> DECLARE :hv_last_name LAST_NAME_DOM;
SQL> DECLARE :hv_new_address_data_1 ADDRESS_DATA_1_DOM;
SQL> --
SQL> SET TRANSACTION READ WRITE;
SQL> BEGIN
cont> --
cont> -- Set the search value for SELECT
cont> --
cont>  SET :hv_last_name = 'Ames';
cont> --
cont> -- Set the NEW_ADDRESS_DATA_1 value
cont> --
cont> SET :hv_new_address_data_1 = '100 Broadway Ave.';
cont> END;
SQL> COMMIT;
SQL> --
SQL> SET TRANSACTION READ ONLY;
SQL> BEGIN
cont> SELECT E.EMPLOYEE_ID, E.DBKEY
cont>   INTO :hv_employee_id INDICATOR :hv_employee_id_ind,
cont>        :hv_dbkey INDICATOR :hv_dbkey_ind
cont>   FROM EMPLOYEES E
cont> WHERE E.LAST_NAME = :hv_last_name
cont> LIMIT TO 1 ROW;
cont> --
cont> GET DIAGNOSTICS :hv_row = ROW_COUNT;
cont> END;
SQL> COMMIT;
SQL> --
SQL> SET TRANSACTION READ WRITE RESERVING EMPLOYEES FOR SHARED WRITE;
SQL> BEGIN
cont> IF (:hv_row = 1) THEN
cont>    BEGIN
cont>    UPDATE EMPLOYEES E
cont>      SET E.ADDRESS_DATA_1 = :hv_new_address_data_1
cont>    WHERE E.DBKEY = :hv_dbkey;
cont>    END;
cont> END IF;
cont> END;
SQL> COMMIT;
SQL> --
SQL> -- Display result of change
SQL> --
SQL> SET TRANSACTION READ ONLY;
SQL> SELECT E.*
cont> FROM EMPLOYEES E
cont> WHERE E.DBKEY = :hv_dbkey;
 EMPLOYEE_ID   LAST_NAME       FIRST_NAME   MIDDLE_INITIAL
   ADDRESS_DATA_1              ADDRESS_DATA_2         CITY
      STATE   POSTAL_CODE   SEX    BIRTHDAY      STATUS_CODE
 00416         Ames            Louie        A
   100 Broadway Ave.                                  Alton
      NH      03809         M      13-Apr-1941   1
```

```
1 row selected
SQL>
```

The new example will appear in a future publication of the Oracle Rdb7 Guide to Database Performance and Tuning manual.

4.9.6 Error in Calculation of Sorted Index in Example 3-46

Example 3-46 in Section 3.9.5.1 shows the output when you use the RMU Analyze Indexes command and specify the Option=Debug qualifier and the DEPARTMENTS_INDEX sorted index.

The description of the example did not include the 8 byte dbkey in the calculation of the sorted index. The complete description is as follows:

The entire index (26 records) is located on pages 2 and 3 in logical area 72 and uses 188 bytes of a possible 430 bytes or the node record is 47 percent full. Note that due to index compression, the node size has decreased in size from 422 bytes to 188 bytes and the percent fullness of the node records has dropped from 98 to 47 percent. Also note that the used/avail value in the summary information at the end of the output does not include the index header and trailer information, which accounts for 32 bytes. This value is shown for each node record in the detailed part of the output. The number of bytes used by the index is calculated as follows: the sort key is 4 bytes plus a null byte for a total of 5 bytes. The prefix is 1 byte and the suffix is 1 byte. The prefix indicates the number of bytes in the preceding key that are the same and the suffix indicates the number of bytes that are different from the preceding key. The dbkey pointer to the row is 8 bytes. There are 26 data rows multiplied by 15 bytes for a total of 390 bytes. The 15 bytes include:

- 7 bytes for the sort key: length + null byte + prefix + suffix
- 8 bytes for the dbkey pointer to the row

Add 32 bytes for index header and trailer information for the index node to the 390 bytes for a total of 422 bytes used. Index compression reduces the number of bytes used to 188 bytes used.

The revised description will appear in a future publication of the Oracle Rdb7 Guide to Database Performance and Tuning manual.

4.9.7 Documentation Error in Section C.7

The Oracle Rdb Guide to Database Performance And Tuning, Volume 2 contains an error in Section C.7 titled Displaying Sort Statistics with the R Flag.

When describing the output from this debugging flag, bullet 9 states:

- Work File Alloc indicates how many work files were used in the sort operation. A zero (0) value indicates that the sort was accomplished completely in memory.

This is incorrect, the statistics should be described as show below:

- Work File Alloc indicates how much space (in blocks) was allocated in the work files for this sort operation. A zero (0) value indicates that the sort was accomplished completely in memory.

This error will be corrected in a future release of Oracle Rdb Guide to Database Performance And Tuning.

4.9.8 Missing Tables Descriptions for the RDBEXPERT Collection Class

Appendix B in the Oracle Rdb7 Guide to Database Performance and Tuning describes the event-based data tables in the formatted database for the Oracle Rdb PERFORMANCE and RDBEXPERT collection classes. This section describes the missing tables for the RDBEXPERT collection class.

Table 4–3 shows the TRANS_TPB table.

Table 4–3 Columns for Table EPC$1_221_TRANS_TPB

Column Name	Data Type	Domain
COLLECTION_RECORD_ID	SMALLINT	COLLECTION_RECORD_ID_ DOMAIN
IMAGE_RECORD_ID	INTEGER	IMAGE_RECORD_ID_DOMAIN
CONTEXT_NUMBER	INTEGER	CONTEXT_NUMBER_DOMAIN
TIMESTAMP_POINT	DATE VMS	
CLIENT_PC	INTEGER	
STREAM_ID	INTEGER	
TRANS_ID	VARCHAR(16)	
TRANS_ID_STR_ID	INTEGER	STR_ID_DOMAIN
TPB	VARCHAR(127)	
TPB_STR_ID	INTEGER	STR_ID_DOMAIN

Table 4–4 shows the TRANS_TPB_ST table. An index is provided for this table. It is defined with column STR_ID, duplicates are allowed, and the type is sorted.

Table 4–4 Columns for Table EPC$1_221_TRANS_TPB_ST

Column Name	Data Type	Domain
STR_ID	INTEGER	STR_ID_DOMAIN
SEGMENT_NUMBER	SMALLINT	SEGMENT_NUMBER_DOMAIN
STR_SEGMENT	VARCHAR(128)	

4.9.9 Missing Columns Descriptions for Tables in the Formatted Database

Some of the columns were missing from the tables in Appendix B in the Oracle Rdb7 Guide to Database Performance and Tuning. The complete table definitions are described in this section.

Table 4–5 shows the DATABASE table.

Table 4–5 Columns for Table EPC$1_221_DATABASE

Column Name	Data Type	Domain
COLLECTION_RECORD_ID	SMALLINT	COLLECTION_RECORD_ID_ DOMAIN

(continued on next page)

Table 4–5 (Cont.) Columns for Table EPC$1_221_DATABASE

Column Name	Data Type	Domain
IMAGE_RECORD_ID	INTEGER	IMAGE_RECORD_ID_DOMAIN
CONTEXT_NUMBER	INTEGER	CONTEXT_NUMBER_DOMAIN
TIMESTAMP_POINT	DATE VMS	
CLIENT_PC	INTEGER	
STREAM_ID	INTEGER	
DB_NAME	VARCHAR(255)	
DB_NAME_STR_ID	INTEGER	STR_ID_DOMAIN
IMAGE_FILE_NAME	VARCHAR(255)	
IMAGE_FILE_NAME_STR_ID	INTEGER	STR_ID_DOMAIN

Table 4–6 shows the REQUEST_ACTUAL table.

Table 4–6 Columns for Table EPC$1_221_REQUEST_ACTUAL

Column Name	Data Type	Domain
COLLECTION_RECORD_ID	SMALLINT	COLLECTION_RECORD_ID_ DOMAIN
IMAGE_RECORD_ID	INTEGER	IMAGE_RECORD_ID_DOMAIN
CONTEXT_NUMBER	INTEGER	CONTEXT_NUMBER_DOMAIN
TIMESTAMP_START	DATE VMS	
TIMESTAMP_END	DATE VMS	
DBS_READS_START	INTEGER	
DBS_WRITES_START	INTEGER	
RUJ_READS_START	INTEGER	
RUJ_WRITES_START	INTEGER	
AIJ_WRITES_START	INTEGER	
ROOT_READS_START	INTEGER	
ROOT_WRITES_START	INTEGER	
BUFFER_READS_START	INTEGER	
GET_VM_BYTES_START	INTEGER	
FREE_VM_BYTES_START	INTEGER	
LOCK_REQS_START	INTEGER	
REQ_NOT_QUEUED_START	INTEGER	
REQ_STALLS_START	INTEGER	
REQ_DEADLOCKS_START	INTEGER	
PROM_DEADLOCKS_START	INTEGER	
LOCK_RELS_START	INTEGER	
LOCK_STALL_TIME_START	INTEGER	
D_FETCH_RET_START	INTEGER	

(continued on next page)

Table 4–6 (Cont.) Columns for Table EPC$1_221_REQUEST_ACTUAL

Column Name	Data Type	Domain
D_FETCH_UPD_START	INTEGER	
D_LB_ALLOK_START	INTEGER	
D_LB_GBNEEDLOCK_START	INTEGER	
D_LB_NEEDLOCK_START	INTEGER	
D_LB_OLDVER_START	INTEGER	
D_GB_NEEDLOCK_START	INTEGER	
D_GB_OLDVER_START	INTEGER	
D_NOTFOUND_IO_START	INTEGER	
D_NOTFOUND_SYN_START	INTEGER	
S_FETCH_RET_START	INTEGER	
S_FETCH_UPD_START	INTEGER	
S_LB_ALLOK_START	INTEGER	
S_LB_GBNEEDLOCK_START	INTEGER	
S_LB_NEEDLOCK_START	INTEGER	
S_LB_OLDVER_START	INTEGER	
S_GB_NEEDLOCK_START	INTEGER	
S_GB_OLDVER_START	INTEGER	
S_NOTFOUND_IO_START	INTEGER	
S_NOTFOUND_SYN_START	INTEGER	
D_ASYNC_FETCH_START	INTEGER	
S_ASYNC_FETCH_START	INTEGER	
D_ASYNC_READIO_START	INTEGER	
S_ASYNC_READIO_START	INTEGER	
AS_READ_STALL_START	INTEGER	
AS_BATCH_WRITE_START	INTEGER	
AS_WRITE_STALL_START	INTEGER	
BIO_START	INTEGER	
DIO_START	INTEGER	
PAGEFAULTS_START	INTEGER	
PAGEFAULT_IO_START	INTEGER	
CPU_START	INTEGER	
CURRENT_PRIO_START	SMALLINT	
VIRTUAL_SIZE_START	INTEGER	
WS_SIZE_START	INTEGER	
WS_PRIVATE_START	INTEGER	
WS_GLOBAL_START	INTEGER	
CLIENT_PC_END	INTEGER	
STREAM_ID_END	INTEGER	

(continued on next page)

Table 4–6 (Cont.) Columns for Table EPC$1_221_REQUEST_ACTUAL

Column Name	Data Type	Domain
REQ_ID_END	INTEGER	
COMP_STATUS_END	INTEGER	
REQUEST_OPER_END	INTEGER	
TRANS_ID_END	VARCHAR(16)	
TRANS_ID_END_STR_ID	INTEGER	STR_ID_DOMAIN
DBS_READS_END	INTEGER	
DBS_WRITES_END	INTEGER	
RUJ_READS_END	INTEGER	
RUJ_WRITES_END	INTEGER	
AIJ_WRITES_END	INTEGER	
ROOT_READS_END	INTEGER	
ROOT_WRITES_END	INTEGER	
BUFFER_READS_END	INTEGER	
GET_VM_BYTES_END	INTEGER	
FREE_VM_BYTES_END	INTEGER	
LOCK_REQS_END	INTEGER	
REQ_NOT_QUEUED_END	INTEGER	
REQ_STALLS_END	INTEGER	
REQ_DEADLOCKS_END	INTEGER	
PROM_DEADLOCKS_END	INTEGER	
LOCK_RELS_END	INTEGER	
LOCK_STALL_TIME_END	INTEGER	
D_FETCH_RET_END	INTEGER	
D_FETCH_UPD_END	INTEGER	
D_LB_ALLOK_END	INTEGER	
D_LB_GBNEEDLOCK_END	INTEGER	
D_LB_NEEDLOCK_END	INTEGER	
D_LB_OLDVER_END	INTEGER	
D_GB_NEEDLOCK_END	INTEGER	
D_GB_OLDVER_END	INTEGER	
D_NOTFOUND_IO_END	INTEGER	
D_NOTFOUND_SYN_END	INTEGER	
S_FETCH_RET_END	INTEGER	
S_FETCH_UPD_END	INTEGER	
S_LB_ALLOK_END	INTEGER	
S_LB_GBNEEDLOCK_END	INTEGER	
S_LB_NEEDLOCK_END	INTEGER	
S_LB_OLDVER_END	INTEGER	

(continued on next page)

Table 4–6 (Cont.) Columns for Table EPC$1_221_REQUEST_ACTUAL

Column Name	Data Type	Domain
S_GB_NEEDLOCK_END	INTEGER	
S_GB_OLDVER_END	INTEGER	
S_NOTFOUND_IO_END	INTEGER	
S_NOTFOUND_SYN_END	INTEGER	
D_ASYNC_FETCH_END	INTEGER	
S_ASYNC_FETCH_END	INTEGER	
D_ASYNC_READIO_END	INTEGER	
S_ASYNC_READIO_END	INTEGER	
AS_READ_STALL_END	INTEGER	
AS_BATCH_WRITE_END	INTEGER	
AS_WRITE_STALL_END	INTEGER	
BIO_END	INTEGER	
DIO_END	INTEGER	
PAGEFAULTS_END	INTEGER	
PAGEFAULT_IO_END	INTEGER	
CPU_END	INTEGER	
CURRENT_PRIO_END	SMALLINT	
VIRTUAL_SIZE_END	INTEGER	
WS_SIZE_END	INTEGER	
WS_PRIVATE_END	INTEGER	
WS_GLOBAL_END	INTEGER	

Table 4–7 shows the TRANSACTION table.

Table 4–7 Columns for Table EPC$1_221_TRANSACTION

Column Name	Data Type	Domain
COLLECTION_RECORD_ID	SMALLINT	COLLECTION_RECORD_ID_ DOMAIN
IMAGE_RECORD_ID	INTEGER	IMAGE_RECORD_ID_DOMAIN
CONTEXT_NUMBER	INTEGER	CONTEXT_NUMBER_DOMAIN
TIMESTAMP_START	DATE VMS	
TIMESTAMP_END	DATE VMS	
CLIENT_PC_START	INTEGER	
STREAM_ID_START	INTEGER	
LOCK_MODE_START	INTEGER	
TRANS_ID_START	VARCHAR(16)	
TRANS_ID_START_STR_ID	INTEGER	STR_ID_DOMAIN
GLOBAL_TID_START	VARCHAR(16)	

(continued on next page)

Table 4–7 (Cont.) Columns for Table EPC$1_221_TRANSACTION

Column Name	Data Type	Domain
GLOBAL_TID_START_STR_ID	INTEGER	STR_ID_DOMAIN
DBS_READS_START	INTEGER	
DBS_WRITES_START	INTEGER	
RUJ_READS_START	INTEGER	
RUJ_WRITES_START	INTEGER	
AIJ_WRITES_START	INTEGER	
ROOT_READS_START	INTEGER	
ROOT_WRITES_START	INTEGER	
BUFFER_READS_START	INTEGER	
GET_VM_BYTES_START	INTEGER	
FREE_VM_BYTES_START	INTEGER	
LOCK_REQS_START	INTEGER	
REQ_NOT_QUEUED_START	INTEGER	
REQ_STALLS_START	INTEGER	
REQ_DEADLOCKS_START	INTEGER	
PROM_DEADLOCKS_START	INTEGER	
LOCK_RELS_START	INTEGER	
LOCK_STALL_TIME_START	INTEGER	
D_FETCH_RET_START	INTEGER	
D_FETCH_UPD_START	INTEGER	
D_LB_ALLOK_START	INTEGER	
D_LB_GBNEEDLOCK_START	INTEGER	
D_LB_NEEDLOCK_START	INTEGER	
D_LB_OLDVER_START	INTEGER	
D_GB_NEEDLOCK_START	INTEGER	
D_GB_OLDVER_START	INTEGER	
D_NOTFOUND_IO_START	INTEGER	
D_NOTFOUND_SYN_START	INTEGER	
S_FETCH_RET_START	INTEGER	
S_FETCH_UPD_START	INTEGER	
S_LB_ALLOK_START	INTEGER	
S_LB_GBNEEDLOCK_START	INTEGER	
S_LB_NEEDLOCK_START	INTEGER	
S_LB_OLDVER_START	INTEGER	
S_GB_NEEDLOCK_START	INTEGER	
S_GB_OLDVER_START	INTEGER	
S_NOTFOUND_IO_START	INTEGER	
S_NOTFOUND_SYN_START	INTEGER	

(continued on next page)

Table 4–7 (Cont.) Columns for Table EPC$1_221_TRANSACTION

Column Name	Data Type	Domain
D_ASYNC_FETCH_START	INTEGER	
S_ASYNC_FETCH_START	INTEGER	
D_ASYNC_READIO_START	INTEGER	
S_ASYNC_READIO_START	INTEGER	
AS_READ_STALL_START	INTEGER	
AS_BATCH_WRITE_START	INTEGER	
AS_WRITE_STALL_START	INTEGER	
AREA_ITEMS_START	VARCHAR(128)	
AREA_ITEMS_START_STR_ID	INTEGER	STR_ID_DOMAIN
BIO_START	INTEGER	
DIO_START	INTEGER	
PAGEFAULTS_START	INTEGER	
PAGEFAULT_IO_START	INTEGER	
CPU_START	INTEGER	
CURRENT_PRIO_START	SMALLINT	
VIRTUAL_SIZE_START	INTEGER	
WS_SIZE_START	INTEGER	
WS_PRIVATE_START	INTEGER	
WS_GLOBAL_START	INTEGER	
CROSS_FAC_2_START	INTEGER	
CROSS_FAC_3_START	INTEGER	
CROSS_FAC_7_START	INTEGER	
CROSS_FAC_14_START	INTEGER	
DBS_READS_END	INTEGER	
DBS_WRITES_END	INTEGER	
RUJ_READS_END	INTEGER	
RUJ_WRITES_END	INTEGER	
AIJ_WRITES_END	INTEGER	
ROOT_READS_END	INTEGER	
ROOT_WRITES_END	INTEGER	
BUFFER_READS_END	INTEGER	
GET_VM_BYTES_END	INTEGER	
FREE_VM_BYTES_END	INTEGER	
LOCK_REQS_END	INTEGER	
REQ_NOT_QUEUED_END	INTEGER	
REQ_STALLS_END	INTEGER	
REQ_DEADLOCKS_END	INTEGER	
PROM_DEADLOCKS_END	INTEGER	

(continued on next page)

Table 4–7 (Cont.) Columns for Table EPC$1_221_TRANSACTION

Column Name	Data Type	Domain
LOCK_RELS_END	INTEGER	
LOCK_STALL_TIME_END	INTEGER	
D_FETCH_RET_END	INTEGER	
D_FETCH_UPD_END	INTEGER	
D_LB_ALLOK_END	INTEGER	
D_LB_GBNEEDLOCK_END	INTEGER	
D_LB_NEEDLOCK_END	INTEGER	
D_LB_OLDVER_END	INTEGER	
D_GB_NEEDLOCK_END	INTEGER	
D_GB_OLDVER_END	INTEGER	
D_NOTFOUND_IO_END	INTEGER	
D_NOTFOUND_SYN_END	INTEGER	
S_FETCH_RET_END	INTEGER	
S_FETCH_UPD_END	INTEGER	
S_LB_ALLOK_END	INTEGER	
S_LB_GBNEEDLOCK_END	INTEGER	
S_LB_NEEDLOCK_END	INTEGER	
S_LB_OLDVER_END	INTEGER	
S_GB_NEEDLOCK_END	INTEGER	
S_GB_OLDVER_END	INTEGER	
S_NOTFOUND_IO_END	INTEGER	
S_NOTFOUND_SYN_END	INTEGER	
D_ASYNC_FETCH_END	INTEGER	
S_ASYNC_FETCH_END	INTEGER	
D_ASYNC_READIO_END	INTEGER	
S_ASYNC_READIO_END	INTEGER	
AS_READ_STALL_END	INTEGER	
AS_BATCH_WRITE_END	INTEGER	
AS_WRITE_STALL_END	INTEGER	
AREA_ITEMS_END	VARCHAR(128)	
AREA_ITEMS_END_STR_ID	INTEGER	STR_ID_DOMAIN
BIO_END	INTEGER	
DIO_END	INTEGER	
PAGEFAULTS_END	INTEGER	
PAGEFAULT_IO_END	INTEGER	
CPU_END	INTEGER	
CURRENT_PRIO_END	SMALLINT	
VIRTUAL_SIZE_END	INTEGER	

(continued on next page)

Table 4–7 (Cont.) Columns for Table EPC$1_221_TRANSACTION

Column Name	Data Type	Domain
WS_SIZE_END	INTEGER	
WS_PRIVATE_END	INTEGER	
WS_GLOBAL_END	INTEGER	
CROSS_FAC_2_END	INTEGER	
CROSS_FAC_3_END	INTEGER	
CROSS_FAC_7_END	INTEGER	
CROSS_FAC_14_END	INTEGER	

Table 4–8 shows the REQUEST_BLR table.

Table 4–8 Columns for Table EPC$1_221_REQUEST_BLR

Column Name	Data Type	Domain
COLLECTION_RECORD_ID	SMALLINT	COLLECTION_RECORD_ID_DOMAIN
IMAGE_RECORD_ID	INTEGER	IMAGE_RECORD_ID_DOMAIN
CONTEXT_NUMBER	INTEGER	CONTEXT_NUMBER_DOMAIN
TIMESTAMP_POINT	DATE VMS	
CLIENT_PC	INTEGER	
STREAM_ID	INTEGER	
REQ_ID	INTEGER	
TRANS_ID	VARCHAR(16)	
TRANS_ID_STR_ID	INTEGER	STR_ID_DOMAIN
REQUEST_NAME	VARCHAR(31)	
REQUEST_NAME_STR_ID	INTEGER	STR_ID_DOMAIN
REQUEST_TYPE	INTEGER	
BLR	VARCHAR(127)	
BLR_STR_ID	INTEGER	STR_ID_DOMAIN

4.9.10 A Way to Find the Transaction Type of a Particular Transaction Within the Trace Database

The table EPC$1_221_TRANSACTION in the formatted Oracle Trace database has a column LOCK_MODE_START of longword datatype. The values of this column indicate the type of transaction a particular transaction was.

```
Value          Transaction type
-----          ----------------
8              Read only
9              Read write
14             Batch update
```

4.9.11 Using Oracle TRACE Collected Data

The following example shows how the OPTIMIZE AS clause is reflected in the Oracle TRACE database. When a trace collection is started the following SQL commands will record the request names.

```
SQL> attach 'file personnel';
SQL> select last_name, first_name
cont> from employees
cont> optimize as request_one;
.
.
.
SQL> select employee_id
cont> from employees
cont> optimize as request_two;
.
.
.
SQL> select employee_id, city, state
cont> from employees
cont> optimize as request_three;
.
.
.
SQL> select last_name, first_name, employee_id, city, state
cont> from employees
cont> optimize as request_four;
.
.
.
```

Once an Oracle TRACE database has been populated from the collection, a query such as the following can be used to display the request names and types. The type values are described in Table 3-10. The unnamed queries in this example correspond to the queries executed by interactive SQL to validate the names of the tables an columns referenced in the user supplied queries.

```
SQL> select REQUEST_NAME, REQUEST_TYPE, TIMESTAMP_POINT
cont> from EPC$1_221_REQUEST_BLR;
REQUEST_NAME                     REQUEST_TYPE   TIMESTAMP_POINT
                                            1   15-JAN-1997 13:23:27.18
                                            1   15-JAN-1997 13:23:27.77
REQUEST_ONE                                 1   15-JAN-1997 13:23:28.21
REQUEST_TWO                                 1   15-JAN-1997 13:23:56.55
REQUEST_THREE                               1   15-JAN-1997 13:24:57.27
REQUEST_FOUR                                1   15-JAN-1997 13:25:25.44
6 rows selected
```

The next example shows the internal query format (BLR) converted to SQL strings after EPC$EXAMPLES:EPC_BLR_TOSQL_CONVERTER.COM has been run.

```
SQL> SELECT A.REQUEST_NAME, B.SQL_STRING FROM
cont> EPC$1_221_REQUEST_BLR A,
cont> EPC$SQL_QUERIES B
cont> WHERE A.CLIENT_PC = 0 AND A.SQL_ID = B.SQL_ID;
A.REQUEST_NAME
  B.SQL_STRING
REQUEST_ONE
      SELECT C1.LAST_NAME, C1.FIRST_NAME.       FROM EMPLOYEES C1
. . .
REQUEST_TWO
      SELECT C1.EMPLOYEE_ID.       FROM EMPLOYEES C1
. . .
REQUEST_THREE
SELECT C1.EMPLOYEE_ID, C1.CITY, C1.STATE.       FROM EMPLOYEES C1
  .
  .
  .
4 rows selected
```

Table 4-17 shows the Request Types.

Table 4–9 Request Types

Symbolic Name	Value	Comment
RDB_K_REQTYPE_OTHER	0	A query executed internally by Oracle Rdb
RDB_K_REQTYPE_USER_ REQUEST	1	A non-stored SQL statement, which includes compound statements
RDB_K_REQTYPE_PROCEDURE	2	A stored procedure
RDB_K_REQTYPE_FUNCTION	3	A stored function
RDB_K_REQTYPE_TRIGGER	4	A trigger action
RDB_K_REQTYPE_ CONSTRAINT	5	A table or column constraint

4.9.12 AIP Length Problems in Indexes that Allow Duplicates

When an index allows duplicates, the length stored in the AIP will be 215 bytes, regardless of the actual index node size. Because an index with duplicates can have variable node sizes, the 215-byte size is used as a median length to represent the length of rows in the index's logical area.

When the row size in the AIP is less than the actual row length, it is highly likely that SPAM entries will show space is available on pages when they have insufficient space to store another full size row. This is the most common cause of insert performance problems.

For example, consider a case where an index node size of 430 bytes (a common default value) is used; the page size for the storage area where the index is stored is 2 blocks. After deducting page overhead, the available space on a 2-block page is 982 bytes. Assume that the page in this example is initially empty.

1. A full size (430-byte) index node is stored. As 8 bytes of overhead are associated with each row stored on a page, that leaves 982-430-8 = 544 free bytes remaining on the page.

2. A duplicate key entry is made in that index node and thus a duplicate node is created on the same page. An initial duplicate node is 112 bytes long (duplicate nodes can have a variety of sizes depending on when they are created, but for this particular example, 112 bytes is used). Therefore, 544-112-8 = 424 free bytes remain on the page.

At this point, 424 bytes are left on the page. That is greater than the 215 bytes that the AIP shows as the row length for the logical area, so the SPAM page shows that the page has space available. However, an attempt to store a full size index node on the page will fail, because the remaining free space (424 bytes) is not enough to store a 430-byte node.

In this case, another candidate page must be selected via the SPAM page, and the process repeats until a page that truly has sufficient free space available is found. In a logical area that contains many duplicate nodes, a significant percentage of the pages in the logical area may fit the scenario just described. When that is the case, and a new full size index node needs to be stored, many pages may need to be read and checked before one is found that can be used to store the row.

It is possible to avoid the preceding scenario by using logical area thresholds. The goal is to set a threshold such that the SPAM page will show a page is full when space is insufficient to store a full size index node.

Using the previous example, here is how to properly set logical area thresholds to prevent excessive pages checked on an index with a 430-byte node size that is stored on a 2-block page. To calculate the proper threshold value to use, you must first determine how full the page can get before no more full size nodes will fit on the page. In this example, a database page can have up to 982-430-8 = 544 bytes in use before the page is too full. Therefore, if 544 or fewer bytes are in use, then enough space remains to store another full size node. The threshold is then 544 / 982 = .553971, or 55%.

In addition, you can determine how full a page must be before a duplicate node of size 112 will no longer fit. In this example, a database page can have up to 982-112-8 = 862 bytes in use before the page is too full. Therefore, if 862 or fewer bytes are in use, then enough space remains to store another small duplicates node. The threshold is then 862 / 982 = .8778, or 88%.

Here is an example of creating an index with the above characteristics:

```
SQL> CREATE INDEX TEST_INDEX ON EMPLOYEES (LAST_NAME)
cont>     STORE IN RDB$SYSTEM
cont>     (THRESHOLD IS (55, 55, 88));
```

These settings mean that any page at over 55% full will not be fetched when inserting a full index node, however, it may be fetched when inserting the smaller duplicates node. When the page is over 88% full then neither a full node nor a duplicate node can be stored, so the page is set as FULL. The lowest setting is not used and so can be set to any value less than or equal to the lowest used threshold.

Note that the compression algorithm used on regular tables that have compression enabled does not apply to index nodes. Index nodes are not compressed like data rows and will always utilize the number of bytes that is specified in the node size. Do not attempt to take into account a compression factor when calculating thresholds for indexes.

4.9.13 RDM$BIND_MAX_DBR_COUNT Documentation Clarification

Appendix A in Oracle Rdb7 Guide to Database Performance and Tuning incorrectly describes the use of the RDM$BIND_MAX_DBR_COUNT logical name.

Following is an updated description. Note that the difference in actual behavior between what is in the existing documentation and the software is that the logical name only controls the number of database recovery processes created at once during "node failure" recovery (that is, after a system or monitor crash or other abnormal shutdown).

When an entire database is abnormally shut down (due, for example, to a system failure), the database will have to be recovered in a "node failure" recovery mode. This recovery will be performed by another monitor in the cluster if the database is opened on another node or will be performed the next time the database is opened.

The RDM$BIND_MAX_DBR_COUNT logical name and the RDB_BIND_MAX_DBR_COUNT configuration parameter define the maximum number of database recovery (DBR) processes to be simultaneously invoked by the database monitor during a "node failure" recovery.

This logical name and configuration parameter apply only to databases that do not have global buffers enabled. Databases that utilize global buffers have only one recovery process started at a time during a "node failure" recovery.

In a node failure recovery situation with the Row Cache feature enabled (regardless of the global buffer state), the database monitor will start a single database recovery (DBR) process to recover the Row Cache Server (RCS) process and all user processes from the oldest active checkpoint in the database.

4.10 Oracle Rdb7 Guide to SQL Programming

This section provides information that is missing or changed in the Oracle Rdb7 Guide to SQL Programming.

4.10.1 Location of Host Source File Generated by the SQL Precompiler

When the SQL precompiler generates host source files (for example, .c, .pas, or .for) from the precompiler source files, it locates these files based on the Object qualifier in the command given to the SQL precompiler.

The following examples show the location where the host source file is generated.

When the Object qualifier is not specified on the command line, the object and the host source file take the name of the SQL precompiler with the extensions of .obj and .c, respectively. For example:

```
$ sqlpre/cc scc_try_mli_successful.sc
$ dir scc_try_mli_successful.*

Directory MYDISK:[LUND]

SCC_TRY_MLI_SUCCESSFUL.C;1          SCC_TRY_MLI_SUCCESSFUL.OBJ;2
SCC_TRY_MLI_SUCCESSFUL.SC;2

Total of 3 files.
```

When the Object qualifier is specified on the command line, the object and the host source take the name given on the qualifier switch. It uses the default of the SQL precompiler source if a filespec is not specified. It uses the defaults of .obj and .c if the extension is not specified. If the host language is a language other than C, it uses the appropriate host source extension (for example, .pas or .for). The files also default to the current directory if a directory specification is not specified. For example:

```
$ sqlpre/cc/obj=myobj scc_try_mli_successful.sc
$ dir scc_try_mli_successful.*

Directory MYDISK:[LUND]

SCC_TRY_MLI_SUCCESSFUL.SC;2

Total of 1 file.
$ dir myobj.*

Directory MYDISK:[LUND]

MYOBJ.C;1           MYOBJ.OBJ;2

Total of 2 files.

$ sqlpre/cc/obj=MYDISK:[lund.tmp] scc_try_mli_successful.sc
$ dir scc_try_mli_successful.*

Directory MYDISK:[LUND]

SCC_TRY_MLI_SUCCESSFUL.SC;2

Total of 1 file.
$ dir MYDISK:[lund.tmp]scc_try_mli_successful.*

Directory MYDISK:[LUND.TMP]

SCC_TRY_MLI_SUCCESSFUL.C;1              SCC_TRY_MLI_SUCCESSFUL.OBJ;2

Total of 2 files.
```

4.10.2 Remote User Authentication

In the Oracle Rdb7 Guide to SQL Programming, Table 15-1 indicates that implicit authorization works from an OpenVMS platform to another OpenVMS platform using TCP/IP. This table is incorrect. Implicit authorization only works using DECnet in this situation.

The Oracle Rdb7 Guide to SQL Programming will be fixed in a future release.

4.10.3 Additional Information About Detached Processes

Oracle Rdb documentation omits necessary detail on running Oracle Rdb from a detached process.

Applications run from detached processes must ensure that the OpenVMS environment is established correctly before running Oracle Rdb, otherwise Oracle Rdb will not execute.

Attempts to attach to a database and execute an Oracle Rdb query from applications running as detached processes will result in an error similar to the following:

```
%RDB-F-SYS_REQUEST, error from system services request
-SORT-E-OPENOUT, error opening [file] as output
-RMS-F-DEV, error in device name or inappropriate device type for operation
```

The problem occurs because a detached process does not normally have the logical names SYS$LOGIN or SYS$SCRATCH defined.

There are two methods that can be used to correct this:

- Solution 1:

  Use the DCL command procedure RUN_PROCEDURE to run the ACCOUNTS application:

  RUN_PROCEDURE.COM includes the single line:

  $ RUN ACCOUNTS_REPORT

  Then execute this procedure using this command:

  $ RUN/DETACH/AUTHORIZE SYS$SYSTEM:LOGINOUT/INPUT=RUN_PROCEDURE

  This solution executes SYS$SYSTEM:LOGINOUT so that the command language interface (DCL) is activated. This causes the logical names SYS$LOGIN and SYS$SCRATCH to be defined for the detached process. The /AUTHORIZE qualifier also ensures that the users' process quota limits (PQLs) are used from the system authorization file rather than relying on the default PQL system parameters, which are often insufficient to run Oracle Rdb.

- Solution 2:

  If DCL is not desired, and SYS$LOGIN and SYS$SCRATCH are not defined, then prior to executing any Oracle Rdb statement, you should define the following logical names:

  - RDMS$BIND_WORK_FILE

    Define this logical name to allow you to reduce the overhead of disk I/O operations for matching operations when used in conjunction with the RDMS$BIND_WORK_VM logical name. If the virtual memory file is too small then overflow to disk will occur at the disk and directory location specified by RDMS$BIND_WORK_FILE.

    For more information on RDMS$BIND_WORK_FILE and RDMS$BIND_WORK_VM, see the Oracle Rdb Guide to Database Performance and Tuning.

  - SORTWORK0, SORTWORK1, and so on

    The OpenVMS Sort/Merge utility (SORT/MERGE) attempts to create sort work files in SYS$SCRATCH. If the SORTWORK logical names exist, the utility will not require the SYS$SCRATCH logical. However, note that not all queries will require sorting, and that some sorts will be completed in memory and so will not necessarily require disk space.

    If you use the logical RDMS$BIND_SORT_WORKFILES, you will need to define further SORTWORK logical names as described in the Oracle Rdb Guide to Database Performance and Tuning.

    You should also verify that sufficient process quotas are specified on the RUN/DETACH command line, or defined as system PQL parameters to allow Oracle Rdb to execute.

4.11 Guide to Using Oracle SQL/Services Client APIs

The following information describes Oracle SQL/Services documentation errors or omissions.

- The Guide to Using Oracle SQL/Services Client APIs does not describe changes to size and format of integer and floating-point data types

  Beginning with Oracle SQL/Services V5.1, the size and format of some integer and floating-point data types is changed as follows:

  - Trailing zeros occur in fixed-point numeric data types with SCALE FACTOR.

    Trailing zeros are now included after the decimal point up to the number of digits specified by the SCALE FACTOR. In versions of Oracle SQL/Services previous to V5.1, at most one trailing zero was included where the value was a whole number.

    The following examples illustrate the changes using a field defined as INTEGER(3):

    ```
    V5.1 and     Versions previous
    higher       to V5.1
    --------     -----------------
      1.000         1.0
     23.400        23.4
    567.890       567.89
    ```

  - Trailing zeros occur in floating-point data types. Trailing zeros are now included in the fraction, and leading zeros are included in the exponent, up to the maximum precision available, for fields assigned the REAL and DOUBLE PRECISION data types.

    ```
                                                    Versions previous
    Data Type           V5.1 and higher             to V5.1
    ----------------    -----------------------     -----------------
    REAL                1.2340000E+01               1.234E+1
    DOUBLE PRECISION    5.6789000000000000E+001     5.6789E+1
    ```

  - Size of TINYINT and REAL data types is changed.

    The maximum size of the TINYINT and REAL data types is changed to correctly reflect the precision of the respective data types.

    The following table shows the maximum lengths of the data types now and in previous versions:

    ```
                        V5.1 and    Versions previous
    Data type           higher      to V5.1
    ----------          --------    -----------------
    TINYINT              4           6
    REAL                15          24
    ```

- The Guide to Using Oracle SQL/Services Client APIs does not describe that the sqlsrv_associate( ) service returns SQL error code -1028 when connecting to a database service if the user has not been granted the right to attach to the database.

  When a user connects to a database service, the sqlsrv_associate( ) service completes with the SQL error code -1028, SQL_NO_PRIV, if the user has been granted access to the Oracle SQL/Services service, but has not been granted the right to attach to the database. A record of the failure is written to the executor process's log file. Note that the sqlsrv_associate( ) service completes with the Oracle SQL/Services error code -2034, SQLSRV_GETACCINF if the user has not been granted access to the Oracle SQL/Services service.

5
Known Problems and Restrictions

This chapter describes problems and restrictions relating to Oracle Rdb Release 7.1.4, and includes workarounds where appropriate.

5.1 Known Problems and Restrictions in All Interfaces

This section describes known problems and restrictions that affect all interfaces for Release 7.1.

5.1.1 RDO IMPORT Does Not Support FORWARD_REFERENCES Created by SQL EXPORT

Recent versions of SQL EXPORT have included support for new features as they are added to Oracle Rdb. In particular, SQL now generates forward references for routines to allow references in the metadata prior to those routines being created. No such enhancements will be made to RDO IMPORT.

Due to changes in the CREATE STORAGE MAP statement for this release, the RDO IMPORT command is no longer able to process interchange (.RBR) files created by SQL EXPORT due to forward references to new storage mapping routines. See the Oracle Rdb 7.1.4 Release Notes, Enhancement Chapter for details.

Note

The RDO IMPORT command has been deprecated since the release of Oracle Rdb V7.0. Oracle recommends that users change all scripts to use the SQL IMPORT command in the future.

The following example shows the reported error:

```
$ RDO
IMPORT 'thresh_alter_sql' INTO 'thresh' DICTIONARY IS NOT USED.
%RDO-W-UNSIMPORT, RDO IMPORT does not support all Oracle Rdb features, please
use SQL IMPORT
Exported by Oracle Rdb V7.1-301 Import/Export utility
A component of Oracle Rdb SQL V7.1-301
   .
   .
   .
IMPORTing STORAGE AREA: RDB$SYSTEM
IMPORTing STORAGE AREA: AREA1
IMPORTing STORAGE AREA: AREA2
IMPORTing STORAGE AREA: DEFAULT_AREA
%RDO-E-EXTRADATA, unexpected data at the end of the RBR file
```

With the current release, you can work around this problem in one of the following ways:

1. Change the command to execute the SQL IMPORT command. This is the recommended and long term solution to this problem.
2. Change the SQL EXPORT command to include the NO FORWARD_REFERENCES clause. This will eliminate the definitions which currently cause errors in RDO IMPORT. However, this interchange file may then not contain sufficient information to fully import the database.
3. The RMU/LOAD command can also be used to extract the data for individual tables. You must use the /MATCH_NAME qualifier for Load.

5.1.2 New Attributes Saved by RMU/LOAD Incompatible With Prior Versions

Bug 2676851

To improve the behavior of unloading views, Oracle Rdb Release 7.1.2 changed the way view columns were unloaded so that attributes for view computed columns, COMPUTED BY and AUTOMATIC columns were saved. These new attributes are not accepted by prior releases of Oracle Rdb.

The following example shows the reported error trying to load a file from V7.1.2 under V7.1.0.4.

```
%RMU-F-NOTUNLFIL, Input file was not created by RMU UNLOAD
%RMU-I-DATRECSTO,   0 data records stored.
%RMU-F-FTL_LOAD, Fatal error for LOAD operation at 21-OCT-2003 16:34:54.20
```

You can workaround this problem by using the /RECORD_DEFINITION qualifier and specifying the FORMAT=DELIMITED option. However, this technique does not support LIST OF BYTE VARYING column unloading.

5.1.3 RDMS-E-RTNSBC_INITERR, Cannot init. external routine server site executor

Execution of an external function or procudure with server site binding may unexpectedly fail.

The following example shows this problem.

```
%RDB-E-EXTFUN_FAIL, external routine failed to compile or execute successfully
-RDMS-E-EXTABORT, routine NNNNNNNNN execution has been aborted
-RDMS-E-RTNSBC_INITERR, Cannot init. external routine server site executor;
reason XX
```

In this example, NNNNNNNNN is the function name and XX is a decimal value such as 41.

While such errors are possible they are very unlikely to be seen, especially on systems that have had Rdb successfully installed. These errors usually indicate a problem with the environment. For instance, ensure that images RDMXSMvv.EXE, RDMXSRvv.EXE and RDMXSMPvv.EXE (where vv is the Rdb version) are installed and have the correct protections, as in the following example.

```
Directory DISK$:<SYS6.SYSCOMMON.SYSLIB>

RDMXSM70.EXE;3          183   8-APR-2004 09:37:31.36  (RWED,RWED,RWED,RE)
RDMXSMP70.EXE;3         159   8-APR-2004 09:37:31.54  (RWED,RWED,RWED,RE)
RDMXSR70.EXE;3           67   8-APR-2004 09:37:31.74  (RWED,RWED,RWED,RE)

Total of 3 files, 409 blocks.
```

```
DISK$:<SYS6.SYSCOMMON.SYSLIB>.EXE
   RDMXSM70;3       Open Hdr Shared            Lnkbl
DISK$:<SYS6.SYSCOMMON.SYSLIB>.EXE
   RDMXSMP70;3      Open Hdr Shared       Prot Lnkbl  Safe
DISK$:<SYS6.SYSCOMMON.SYSLIB>.EXE
   RDMXSR70;3       Open Hdr Shared            Lnkbl
```

5.1.4 SYSTEM-F-INSFMEM Fatal Error With SHARED MEMORY IS SYSTEM or LARGE MEMORY IS ENABLED in Galaxy Environment

When using the GALAXY SUPPORT IS ENABLED feature in an OpenVMS Galaxy environment, a `%SYSTEM-F-INSFMEM, insufficient dynamic memory error` may be returned when mapping record caches or opening the database. One source of this problem specific to a Galaxy configuration is running out of Galaxy Shared Memory regions. For Galaxy systems, GLX_SHM_REG is the number of shared memory region structures configured into the Galaxy Management Database (GMDB).

While the default value (for OpenVMS versions through at least V7.3-1) of 64 regions might be adequate for some installations, sites using a larger number of databases or row caches when the SHARED MEMORY IS SYSTEM or LARGE MEMORY IS ENABLED features are enabled may find the default insufficient.

If a `%SYSTEM-F-INSFMEM, insufficient dynamic memory` error is returned when mapping record caches or opening databases, Oracle Corporation recommends that you increase the GLX_SHM_REG parameter by 2 times the sum of the number of row caches and number of databases that might be accessed in the Galaxy at one time. As the Galaxy shared memory region structures are not very large, setting this parameter to a higher than required value does not consume a significant amount of physical memory. It also may avoid a later reboot of the Galaxy environment. This parameter must be set on all nodes in the Galaxy.

Galaxy Reboot Required

Changing the GLX_SHM_REG system parameter requires that the OpenVMS Galaxy environment be booted from scratch. That is, all nodes in the Galaxy must be shut down and then the Galaxy reformed by starting each instance.

5.1.5 Oracle Rdb and OpenVMS ODS-5 Volumes

The OpenVMS Version 7.2 release introduced an Extended File Specifications feature, which consists of two major components:

- A new, optional, volume structure, ODS-5, which provides support for file names that are longer and have a greater range of legal characters than in previous versions of OpenVMS.
- Support for “deep” directory trees.

ODS-5 was introduced primarily to provide enhanced file sharing capabilities for users of Advanced Server for OpenVMS 7.2 (formerly known as PATHWORKS for OpenVMS), as well as DCOM and JAVA applications.

In some cases, Oracle Rdb performs its own file and directory name parsing and explicitly requires ODS-2 (the traditional OpenVMS volume structure) file and directory name conventions to be followed. Because of this knowledge, Oracle does not support any Oracle Rdb database file components (including root files, storage area files, after image journal files, record cache backing store files, database backup files, after image journal backup files, etc.) that utilize any non-ODS-2 file naming features. For this reason, Oracle recommends that Oracle Rdb database components not be located on ODS-5 volumes.

Oracle does support Oracle Rdb database file components on ODS-5 volumes provided that all of these files and directories used by Oracle Rdb strictly follow the ODS-2 file and directory name conventions. In particular, all file names must be specified entirely in uppercase and “special” characters in file or directory names are forbidden.

5.1.6 Optimization of Check Constraints

Bug 1448422

When phrasing constraints using the "CHECK" syntax, a poorer strategy can be chosen by the optimizer than when the same or similar constraint is phrased using referential integrity (PRIMARY and FOREIGN KEY) constraints.

For example, I have two tables T1 and T2, both with one column, and I wish to ensure that all values in table T1 exist in T2. Both tables have an index on the referenced field. I could use a PRIMARY KEY constraint on T2 and a FOREIGN KEY constraint on T1.

```
SQL> alter table t2
cont>   alter column f2 primary key not deferrable;
SQL> alter table t1
cont>   alter column f1 references t2 not deferrable;
```

When deleting from the PRIMARY KEY table, Rdb will only check for rows in the FOREIGN KEY table where the FOREIGN KEY has the deleted value. This can be seen as an index lookup on T1 in the retrieval strategy.

```
SQL> delete from t2 where f2=1;
Get     Temporary relation      Retrieval by index of relation T2
  Index name  I2 [1:1]
Index only retrieval of relation T1
  Index name  I1 [1:1]
%RDB-E-INTEG_FAIL, violation of constraint T1_FOREIGN1 caused operation to fail
```

The failure of the constraint is not important. What is important is that Rdb efficiently detects that only those rows in T1 with the same values as the deleted row in T2 can be affected.

It is necessary sometimes to define this type of relationship using CHECK constraints. This could be necessary because the presence of NULL values in the table T2 precludes the definition of a primary key on that table. This could be done with a CHECK constraint of the form:

```
SQL> alter table t1
cont>   alter column f1
cont>   check (f1 in (select * from t2)) not deferrable;
SQL> delete from t2 where f2=1;
Get     Temporary relation      Retrieval by index of relation T2
  Index name  I2 [1:1]
Cross block of 2 entries
  Cross block entry 1
    Index only retrieval of relation T1
      Index name  I1 [0:0]
  Cross block entry 2
    Conjunct        Aggregate-F1    Conjunct
    Index only retrieval of relation T2
      Index name  I2 [0:0]
%RDB-E-INTEG_FAIL, violation of constraint T1_CHECK1 caused operation to fail
```

The cross block is for the constraint evaluation. This retrieval strategy indicates that to evaluate the constraint, the entire index on table T1 is being scanned and for each key, the entire index in table T2 is being scanned. The behavior can be improved somewhat by using an equality join condition in the select clause of the constraint:

```
SQL> alter table t1
cont>   alter column f1
cont>   check (f1 in (select * from t2 where f2=f1))
cont>      not deferrable;
```

or:

```
SQL> alter table t1
cont>   alter column f1
cont>   check (f1=(select * from t2 where f2=f1))
cont>      not deferrable;
```

In both cases the retrieval strategy will look like this:

```
SQL> delete from t2 where f2=1;
Get     Temporary relation      Retrieval by index of relation T2
  Index name  I2 [1:1]
Cross block of 2 entries
  Cross block entry 1
    Index only retrieval of relation T1
      Index name  I1 [0:0]
  Cross block entry 2
    Conjunct        Aggregate-F1    Conjunct
    Index only retrieval of relation T2
      Index name  I2 [1:1]
%RDB-E-INTEG_FAIL, violation of constraint T1_CHECK1 caused operation to fail
```

While the entire T1 index is scanned, at least the value from T1 is used to perform an index lookup on T2.

These restrictions result from semantic differences in the behavior of the "IN" and "EXISTS" operators with respect to null handling, and the complexity of dealing with non-equality join conditions.

To improve the performance of this type of integrity check on larger tables, it is possible to use a series of triggers to perform the constraint check. The following triggers perform a similar check to the constraints above.

```
SQL> create trigger t1_insert
cont>  after insert on t1
cont>  when (not exists (select * from t2 where f2=f1))
cont>    (error) for each row;
SQL> create trigger t1_update
cont>  after update on t1
cont>  when (not exists (select * from t2 where f2=f1))
cont>    (error) for each row;
SQL> ! A delete trigger is not needed on T1.
SQL> create trigger t2_delete
cont>  before delete on t2
cont>  when (exists (select * from t1 where f1=f2))
cont>    (error) for each row;
SQL> create trigger t2_modify
cont>  after update on t2
cont>  referencing old as t2o new as t2n
cont>  when (exists (select * from t1 where f1=t2o.f2))
cont>    (error) for each row;
SQL> ! An insert trigger is not needed on T2.
```

The strategy for a delete on T2 is now:

```
SQL> delete from t2 where f2=1;
Aggregate-F1    Index only retrieval of relation T1
  Index name  I1 [1:1]
Temporary relation      Get     Retrieval by index of relation T2
  Index name  I2 [1:1]
%RDB-E-TRIG_INV_UPD, invalid update; encountered error condition defined for
trigger
-RDMS-E-TRIG_ERROR, trigger T2_DELETE forced an error
```

The trigger strategy is the index only retrieval displayed first. You will note that the index on T1 is used to examine only those rows that may be affected by the delete.

Care must be taken when using this workaround as there are semantic differences in the operation of the triggers, the use of "IN" and "EXISTS", and the use of referential integrity constraints.

This workaround is useful where the form of the constraint is more complex, and cannot be phrased using referential integrity constraints. For example, if the application is such that the value in table T1 may be spaces or NULL to indicate the absence of a value, the above triggers could easily be modified to allow for these semantics.

5.1.7 Using Databases from Releases Earlier Than V6.0

You cannot convert or restore databases earlier than V6.0 directly to V7.1. The RMU Convert command for V7.1 supports conversions from V6.0 through V7.0 only. If you have a V3.0 through V5.1 database, you must convert it to at least V6.0 and then convert it to V7.1. For example, if you have a V4.2 database, convert it first to at least V6.0, then convert the resulting database to V7.1.

If you attempt to convert a database created prior to V6.0 directly to V7.1, Oracle RMU generates an error.

5.1.8 Carryover Locks and NOWAIT Transaction Clarification

In NOWAIT transactions, the BLAST (Blocking AST) mechanism cannot be used. For the blocking user to receive the BLAST signal, the requesting user must request the locked resource with WAIT (which a NOWAIT transaction does not do). Oracle Rdb defines a resource called NOWAIT, which is used to indicate that a NOWAIT transaction has been started. When a NOWAIT transaction starts, the user requests the NOWAIT resource. All other database users hold a lock on the NOWAIT resource so that when the NOWAIT transaction starts, all other users are notified with a NOWAIT BLAST. The BLAST causes blocking users to release any carryover locks. There can be a delay before the transactions with carryover locks detect the presence of the NOWAIT transaction and release their carryover locks. You can detect this condition by examining the stall messages. If the "Waiting for NOWAIT signal (CW)" stall message appears frequently, the application is probably experiencing a decrease in performance, and you should consider disabling the carryover lock behavior.

5.1.9 Unexpected Results Occur During Read-Only Transactions on a Hot Standby Database

When using Hot Standby, it is typical to use the standby database for reporting, simple queries, and other read-only transactions. If you are performing these types of read-only transactions on a standby database, be sure you can tolerate a READ COMMIT level of isolation. This is because the Hot Standby database might be updated by another transaction before the read-only transaction finishes, and the data retrieved might not be what you expected.

Because Hot Standby does not write to the snapshot files, the isolation level achieved on the standby database for any read-only transaction is a READ COMMITED transaction. This means that nonrepeatable reads and phantom reads are allowed during the read-only transaction:

- Nonrepeatable read operations: Allows the return of different results within a single transaction when an SQL operation reads the same row in a table twice. Nonrepeatable reads can occur when another transaction modifies and commits a change to the row between transactions. Because the standby database will update the data when it confirms a transaction has been committed, it is very possible to see an SQL operation on a standby database return different results.
- Phantom read operations: Allows the return of different results within a single transaction when an SQL operation retrieves a range of data values (or similar data existence check) twice. Phantoms can occur if another transaction inserted a new record and committed the insertion between executions of the range retrieval. Again, because the standby database may do this, phantom reads are possible.

Thus, you cannot rely on any data read from the standby database to remain unchanged. Be sure your read-only transactions can tolerate a READ COMMIT level of isolation before you implement procedures that read and use data from a standby database.

5.1.10 Both Application and Oracle Rdb Using SYS$HIBER

In application processes that use Oracle Rdb and the $HIBER system service (possibly through RTL routines such as LIB$WAIT), the application must ensure that the event being waited for has actually occurred. Oracle Rdb uses $HIBER /$WAKE sequences for interprocess communications particularly when the ALS (AIJ Log Server) feature is enabled.

The use of the $WAKE system service by Oracle Rdb can interfere with other users of $HIBER (such as the routine LIB$WAIT) that do not check for event completion, possibly causing a $HIBER to be unexpectedly resumed without waiting at all.

To avoid these situations, consider altering the application to use a code sequence that avoids continuing without a check for the operation (such as a delay or a timer firing) being complete.

The following pseudo-code shows how a flag can be used to indicate that a timed-wait has completed correctly. The wait does not complete until the timer has actually fired and set TIMER_FLAG to TRUE. This code relies on ASTs being enabled.

```
ROUTINE TIMER_WAIT:
    BEGIN
    ! Clear the timer flag
    TIMER_FLAG = FALSE
    ! Schedule an AST for sometime in the future
    STAT = SYS$SETIMR (TIMADR = DELTATIME, ASTRTN = TIMER_AST)
    IF STAT <> SS$_NORMAL
    THEN BEGIN
         LIB$SIGNAL (STAT)
         END
    ! Hibernate.  When the $HIBER completes, check to make
    ! sure that TIMER_FLAG is set indicating that the wait
    ! has finished.
    WHILE TIMER_FLAG = FALSE
    DO  BEGIN
        SYS$HIBER()
        END
    END
ROUTINE TIMER_AST:
    BEGIN
    ! Set the flag indicating that the timer has expired
    TIMER_FLAG = TRUE
    ! Wake the main-line code
    STAT = SYS$WAKE ()
    IF STAT <> SS$_NORMAL
    THEN BEGIN
         LIB$SIGNAL (STAT)
         END
    END
```

The LIB$K_NOWAKE flag can be specified when using the OpenVMS LIB$WAIT routine to allow an alternate wait scheme (using the $SYNCH system service) that can avoid potential problems with multiple code sequences using the $HIBER system service.

5.1.11 Bugcheck Dump Files with Exceptions at COSI_CHF_SIGNAL

In certain situations, Oracle Rdb bugcheck dump files indicate an exception at COSI_CHF_SIGNAL. This location is, however, not the address of the actual exception. The actual exception occurred at the previous call frame on the stack (the one listed as the next Saved PC after the exception).

For example, consider the following bugcheck file stack information:

```
$ SEARCH RDSBUGCHK.DMP "EXCEPTION","SAVED PC","-F-","-E-"

***** Exception at 00EFA828 : COSI_CHF_SIGNAL + 00000140
%COSI-F-BUGCHECK, internal consistency failure
Saved PC = 00C386F0 : PSIINDEX2JOINSCR + 00000318
Saved PC = 00C0BE6C : PSII2BALANCE + 0000105C
Saved PC = 00C0F4D4 : PSII2INSERTT + 000005CC
Saved PC = 00C10640 : PSII2INSERTTREE + 000001A0
      .
      .
      .
```

In this example, the exception actually occurred at PSIINDEX2JOINSCR offset 00000318. If you have a bugcheck dump with an exception at COSI_CHF_SIGNAL, it is important to note the next "Saved PC" because it is needed when working with Oracle Rdb Worldwide Support.

5.1.12 Read-only Transactions Fetch AIP Pages Too Often

Oracle Rdb read-only transactions fetch Area Inventory Pages (AIP) to ensure that the logical area has not been modified by an exclusive read-write transaction. This check is needed because an exclusive read-write transaction does not write snapshot pages and these pages may be needed by the read-only transaction.

Because AIPs are always stored in the RDB$SYSTEM area, reading the AIP pages could represent a significant amount of I/O to the RDB$SYSTEM area for some applications. Setting the RDB$SYSTEM area to read-only can avoid this problem, but it also prevents other online operations that might be required by the application so it is not a viable workaround in all cases.

This problem has been reduced in Oracle Rdb release 7.0. The AIP entries are now read once and then are not read again unless they need to be. This optimization requires that the carry-over locks feature be enabled (this is the default setting). If carry over locks are not enabled, this optimization is not enabled and the behavior is the same as in previous releases.

5.1.13 Row Cache Not Allowed While Hot Standby Replication is Active

The row cache feature may not be enabled on a hot standby database while replication is active. The hot standby feature will not start if row cache is enabled.

This restriction exists because rows in the row cache are accessed via logical dbkeys. However, information transferred to the standby database via the after image journal facility only contains physical dbkeys. Because there is no way to maintain rows in the cache via the hot standby processing, the row cache must be disabled when the standby database is open and replication is active.

A new command qualifier, ROW_CACHE=DISABLED, has been added to the RMU Open command. To open the hot standby database prior to starting replication, use the ROW_CACHE=DISABLED qualifier on the RMU Open command.

5.1.14 Excessive Process Page Faults and other Performance Considerations During Oracle Rdb Sorts

Excessive hard or soft page faulting can be a limiting factor of process performance. One factor contributing to Oracle Rdb process page faulting is sorting operations. Common causes of sorts include the SQL GROUP BY, ORDER BY, UNION, and DISTINCT clauses specified for a query, and index creation operations. Defining the logical name RDMS$DEBUG_FLAGS to "RS" can help determine when Oracle Rdb sort operations are occurring and to display the sort keys and statistics.

Oracle Rdb includes its own copy of the OpenVMS SORT32 code within the Oracle Rdb images and does not generally call the routines in the OpenVMS run-time library. A copy of the SORT32 code is used to provide stability between versions of Oracle Rdb and OpenVMS and because Oracle Rdb calls the sort routines from executive processor mode which is difficult to do using the SORT32 shareable image. SQL IMPORT and RMU Load operations do, however, call the OpenVMS SORT run-time library.

At the beginning of a sort operation, the SORT code allocates some memory for working space. The SORT code uses this space for buffers, in-memory copies of the data, and sorting trees.

SORT does not directly consider the processes quotas or parameters when allocating memory. The effects of WSQUOTA and WSEXTENT are indirect. At the beginning of each sort operation, the SORT code attempts to adjust the process working set to the maximum possible size using the $ADJWSL system service specifying a requested working set limit of %X7FFFFFFF pages (the maximum possible). SORT then uses a value of 75% of the returned working set for virtual memory scratch space. The scratch space is then initialized and the sort begins.

The initialization of the scratch space generally causes page faults to access the pages newly added to the working set. Pages that were in the working set already may be faulted out as the new pages are faulted in. Once the sort operation completes and SORT returns back to Oracle Rdb, the pages that may have been faulted out of the working set are likely to be faulted back into the working set.

When a process working set is limited by the working set quota (WSQUOTA) parameter and the working set extent (WSEXTENT) parameter is a much larger value, the first call to the sort routines can cause many page faults as the working set grows. Using a value of WSEXTENT that is closer to WSQUOTA can help reduce the impact of this case.

With some OpenVMS versions, AUTOGEN sets the SYSGEN parameter PQL_MWSEXTENT equal to the WSMAX parameter. This means that all processes on the system end up with WSEXTENT the same as WSMAX. Since that might be quite high, sorting might result in excessive page faulting. You may want to explicitly set PQL_MWSEXTENT to a lower value if this is the case on your system.

Sort work files are another factor to consider when tuning for Oracle Rdb sort operations. When the operation can not be done in the available memory, SORT uses temporary disk files to hold the data as it is being sorted. The Oracle Rdb7 Guide to Database Performance and Tuning contains more detailed information about sort work files.

The logical name RDMS$BIND_SORT_WORKFILES specifies how many work files sort is to use if work files are required. The default is 2 and the maximum number is 10. The work files can be individually controlled by the SORTWORKn logical names (where n is from 0 through 9). You can increase the efficiency of sort operations by assigning the location of the temporary sort work files to different disks. These assignments are made by using up to ten logical names, SORTWORK0 through SORTWORK9.

Normally, SORT places work files in the your SYS$SCRATCH directory. By default, SYS$SCRATCH is the same device and directory as the SYS$LOGIN location. Spreading the I/O load over many disks improves efficiency as well as performance by taking advantage of the system resources and helps prevent disk I/O bottlenecks. Specifying that a your work files reside on separate disks permits overlap of the SORT read/write cycle. You may also encounter cases where insufficient space exists on the SYS$SCRATCH disk device (for example, while Oracle Rdb builds indexes for a very large table). Using the SORTWORK0 through SORTWORK9 logical names can help you avoid this problem.

Note that SORT uses the work files for different sorted runs, and then merges the sorted runs into larger groups. If the source data is mostly sorted, then not every sort work file may need to be accessed. This is a possible source of confusion because even with 10 sort work files, it is possible to exceed the capacity of the first SORT file and the sort operation fails never having accessed the remaining 9 sort work files.

Note that the logical names RDMS$BIND_WORK_VM and RDMS$BIND_WORK_FILE do not affect or control the operation of sort. These logical names are used to control other temporary space allocation within Oracle Rdb.

5.1.15 Control of Sort Work Memory Allocation

Oracle Rdb uses a built-in SORT32 package to perform many sort operations. Sometimes, these sorts exhibit a significant performance problem when initializing work memory to be used for the sort. This behavior can be experienced, for example, when a very large sort cardinality is estimated, but the actual sort cardinality is small.

In rare cases, it may be desirable to artificially limit the sort package's use of work memory. Two logicals have been created to allow this control. In general, there should be no need to use either of these logicals and misuse of them can significantly impact sort performance. Oracle recommends that these logicals be used carefully and sparingly.

The logical names are:

Table 5–1 Sort Memory Logicals

Logical	Definition
RDMS$BIND_SORT_MEMORY_WS_FACTOR	Specifies a percentage of the process's working set limit to be used when allocating sort memory for the built-in SORT32 package. If not defined, the default value is 75 (representing 75%), the maximum value is 75 (representing 75%), and the minimum value is 2 (representing 2%). Processes with vary large working set limits can sometimes experience significant page faulting and CPU consumption while initializing sort memory. This logical name can restrict the sort work memory to a percentage of the processes maximum working set.
RDMS$BIND_SORT_MEMORY_MAX_BYTES	Specifies an absolute limit to be used when allocating sort memory for the built-in SORT32 package. If not defined, the default value is unlimited (up to 1GB), the maximum value is 2,147,483,647 and the minimum value is 32,768.

5.1.16 The Halloween Problem

When a cursor is processing rows selected from a table, it is possible that another separate query can interfere with the retrieval of the cursor by modifying the index columns key values used by the cursor.

For instance, if a cursor selects all EMPLOYEES with LAST_NAME >= 'M', it is likely that the query will use the sorted index on LAST_NAME to retrieve the rows for the cursor. If an update occurs during the processing of the cursor which changes the LAST_NAME of an employee from "Mason" to "Rickard", then it is possible that that employee row will be processed twice. First when it is fetched with name "Mason", and then later when it is accessed by the new name "Rickard".

The Halloween problem is a well known problem in relational databases. Access strategies which optimize the I/O requirements, such as Index Retrieval, can be subject to this problem. Interference from queries by other sessions are avoided by locking and are controlled by the ISOLATION LEVEL options in SQL, or the CONCURRENCY/CONSISTENCY options in RDO/RDML.

Oracle Rdb avoids this problem if it knows that the cursors subject table will be updated. For example, if the SQL syntax UPDATE ... WHERE CURRENT OF is used to perform updates of target rows, or the RDO/RDML MODIFY statement uses the context variable for the stream. Then the optimizer will choose an alternate access strategy if an update can occur which may cause the Halloween problem. This can be seen in the access strategy in Example 2-2 as a "Temporary relation" being created to hold the result of the cursor query.

When you use interactive or dynamic SQL, the UPDATE ... WHERE CURRENT OF or DELETE ... WHERE CURRENT OF statements will not be seen until after the cursor is declared and opened. In these environments, you must use the FOR UPDATE clause to specify that columns selected by the cursor will be updated during cursor processing. This is an indication to the Rdb optimizer so that it protects against the Halloween problem in this case. This is shown in Example 2-1 and Example 2-2.

The following example shows that the EMP_LAST_NAME index is used for retrieval. Any update performed will possibly be subject to the Halloween problem.

```
SQL> set flags 'strategy';
SQL> declare emp  cursor for
cont> select * from employees where last_name >= 'M'
cont> order by last_name;
SQL> open emp;
Conjunct        Get     Retrieval by index of relation EMPLOYEES
  Index name  EMP_LAST_NAME [1:0]
SQL> close emp;
```

The following example shows that the query specifies that the column LAST_NAME will be updated by some later query. Now the optimizer protects the EMP_LAST_NAME index used for retrieval by using a "Temporary Relation" to hold the query result set. Any update performed on LAST_NAME will now avoid the Halloween problem.

```
SQL> set flags 'strategy';
SQL> declare emp2 cursor for
cont> select * from employees where last_name >= 'M'
cont> order by last_name
cont> for update of last_name;
SQL> open emp2;
Temporary relation      Conjunct        Get
Retrieval by index of relation EMPLOYEES
  Index name  EMP_LAST_NAME [1:0]
SQL> close emp2;
```

When you use the SQL precompiler, or the SQL module language compiler it can be determined from usage that the cursor context will possibly be updated during the processing of the cursor because all cursor related statements are present within the module. This is also true for the RDML/RDBPRE precompilers when you use the DECLARE_STREAM and START_STREAM statements and use the same stream context to perform all MODIFY and ERASE statements.

The point to note here is that the protection takes place during the open of the SQL cursor (or RDO stream), not during the subsequent UPDATE or DELETE.

If you execute a separate UPDATE query which modifies rows being fetched from the cursor then the actual rows fetched will depend upon the access strategy chosen by the Rdb optimizer. As the query is separate from the cursors query (i.e. doesn't reference the cursor context), then the optimizer does not know that the cursor selected rows are potentially updated and so cannot perform the normal protection against the Halloween problem.

5.2 SQL Known Problems and Restrictions

This section describes known problems and restrictions for the SQL interface for release 7.1.

5.2.1 Interchange File (RBR) Created by Oracle Rdb Release 7.1 Not Compatible With Previous Releases

To support the large number of new database attributes and objects, the protocol used by SQL EXPORT and SQL IMPORT has been enhanced to support more protocol types. Therefore, this format of the Oracle Rdb release 7.1 interchange files can no longer be read by older versions of Oracle Rdb.

Oracle Rdb continues to provide upward compatibility for interchange files generated by older versions.

Oracle Rdb has never supported backward compatibility, however, it was sometimes possible to use an interchange file with an older version of IMPORT. However, this protocol change will no longer permit this usage.

5.2.2 System Relation Change for International Database Users

Due to an error in creating the RDB$FIELD_VERSIONS system relation, another system relation, RDB$STORAGE_MAP_AREAS, cannot be accessed if the session character sets are not set to DEC_MCS.

This problem prevents the new Oracle Rdb GUIs, specifically the Oracle Rdb Schema Manager, from viewing indexes and storage maps from existing Oracle Rdb databases.

The problem can be easily corrected by executing the following SQL statement after attaching to the database:

```
SQL> UPDATE RDB$FIELD_VERSIONS SET RDB$FIELD_SUB_TYPE = 32767
cont> WHERE RDB$FIELD_NAME = 'RDB$AREA_NAME';
```

5.2.3 Single Statement LOCK TABLE is Not Supported for SQL Module Language and SQL Precompiler

The new LOCK TABLE statement is not currently supported as a single statement within the module language or embedded SQL language compiler.

Instead you must enclose the statement in a compound statement. That is, use BEGIN... END around the statement as shown in the following example. This format provides all the syntax and flexibility of LOCK TABLE.

This restriction does not apply to interactive or dynamic SQL.

The following extract from the module language listing file shows the reported error if you use LOCK TABLE as a single statement procedure. The other procedure in the same module is acceptable because it uses a compound statement that contains the LOCK TABLE statement.

```
MODULE sample_test
LANGUAGE C
PARAMETER COLONS

DECLARE ALIAS FILENAME 'mf_personnel'

PROCEDURE a (SQLCODE);
LOCK TABLE employees FOR EXCLUSIVE WRITE MODE;
%SQL-F-WISH_LIST, (1) Feature not yet implemented - LOCK TABLE requires compound
statement

PROCEDURE b (SQLCODE);
BEGIN
LOCK TABLE employees FOR EXCLUSIVE WRITE MODE;
END;
```

To workaround this problem of using LOCK TABLE for SQL module language or embedded SQL application, use a compound statement in an EXEC SQL statement.

5.2.4 Multistatement or Stored Procedures May Cause Hangs

Long-running multistatement or stored procedures can cause other users in the database to hang if the procedures obtain resources needed by those other users. Some resources obtained by the execution of a multistatement or stored procedure are not released until the multistatement or stored procedure finishes. Thus, any-long running multistatement or stored procedure can cause other processes to hang. This problem can be encountered even if the statement contains SQL COMMIT or ROLLBACK statements.

The following example demonstrates the problem. The first session enters an endless loop; the second session attempts to backup the database but hangs forever.

```
Session 1:

SQL> attach 'filename MF_PERSONNEL';
SQL> create function LIB$WAIT (in real by reference)
cont> returns integer;
cont> external name LIB$WAIT location 'SYS$SHARE:LIBRTL.EXE'
cont> language general general parameter style variant;
SQL> commit;
        .
        .
        .
$ SQL
SQL> attach 'filename MF_PERSONNEL';
SQL> begin
cont> declare :LAST_NAME LAST_NAME_DOM;
cont> declare :WAIT_STATUS integer;
cont> loop
cont> select LAST_NAME into :LAST_NAME
cont> from EMPLOYEES where EMPLOYEE_ID = '00164';
cont> rollback;
cont> set :WAIT_STATUS = LIBWAIT (5.0);
cont> set transaction read only;
cont> end loop;
cont> end;

Session 2:

$ RMU/BACKUP/LOG/ONLINE MF_PERSONNEL MF_PERSONNEL

From a third session, you can see that the backup process is waiting
for a lock held in the first session:

$ RMU/SHOW LOCKS /MODE=BLOCKING MF_PERSONNEL
    .
    .
    .
Resource: nowait signal

ProcessID Process Name        Lock ID   System ID Requested Granted
--------- ---------------     --------- -------- --------- -------
20204383  RMU BACKUP.....     5600A476  00010001 CW        NL
2020437B  SQL...........      3B00A35C  00010001 PR        PR
```

There is no workaround for this restriction. When the multistatement or stored procedure finishes execution, the resources needed by other processes are released.

5.2.5 Use of Oracle Rdb from Shareable Images

If code in the image initialization routine of a shareable image makes any calls into Oracle Rdb, through SQL or any other means, access violations or other unexpected behavior may occur if Oracle Rdb images have not had a chance to do their own initialization.

To avoid this problem, applications must take one of the following steps:

- Do not make Oracle Rdb calls from the initialization routines of shareable images.
- Link in such a way that the RDBSHR.EXE image initializes first. You can do this by placing the reference to RDBSHR.EXE and any other Oracle Rdb shareable images last in the linker options file.

This is not a bug; it is a restriction resulting from the way OpenVMS image activation works.

5.3 Oracle RMU Known Problems and Restrictions

This section describes known problems and restrictions for the RMU interface for release 7.1.

5.3.1 RMU/BACKUP MAX_FILE_SIZE Option Has Been Disabled

The MAX_FILE_SIZE option of the RMU/BACKUP/DISK_FILE qualifier for backup to multiple disk files has been temporarily disabled since it creates corrupt RBF files if the maximum file size in megabytes is exceeded and a new RBF file is created. It also does not give a unique name to the new RBF file but creates an RBF file with the same name but a new version number in the same disk directory. This will cause an RMU-F-BACFILCOR error on the restore and the restore will not complete.

The multi-file disk backup and restore will succeed if this option is not used. If this option is specified, a warning message is now output that this qualifier will be ignored.

The following example shows that the MAX_FILE_SIZE option, when used with the /DISK_FILE qualifier on an RMU/BACKUP, will be ignored and a warning message will be output.

```
$ RMU/BACKUP /ONLINE                    -
             /NOCRC                     -
             /NOLOG                     -
             /NOINCREMENTAL             -
             /QUIET_POINT               -
             TEST_DB_DIR:TEST_DB
  -
BACKUP_DIR_1:TEST_DB/DISK_FILE=(WRITER_THREADS=3,MAX_FILE_SIZE=10) ,-
BACKUP_DIR_2:/DISK_FILE=(WRITER_THREADS=3,MAX_FILE_SIZE=10) ,-
BACKUP_DIR_3:/DISK_FILE=(WRITER_THREADS=3,MAX_FILE_SIZE=10)

%RMU-W-DISABLEDOPTION, The MAX_FILE_SIZE option is temporarily disabled
        and will be ignored
```

As a workaround to avoid this problem, do not specify the MAX_FILE_SIZE option with the /DISK_FILE qualifier.

5.3.2 RMU Convert Fails When Maximum Relation ID is Exceeded

If, when relation IDs are assigned to new system tables during an RMU Convert of an Oracle Rdb V7.0 database to a V7.1 database, the maximum relation ID of 8192 allowed by Oracle Rdb is exceeded, the fatal error %RMU-F-RELMAXIDBAD is displayed and the database is rolled back to V70. Contact your Oracle support representative if you get this error. Note that when the database is rolled back, the fatal error %RMU-F-CVTROLSUC is displayed to indicate that the rollback was successful but caused by the detection of a fatal error and not requested by the user.

This condition only occurs if there are an extremely large number of tables defined in the database or if a large number of tables were defined but have subsequently been deleted.

The following example shows both the %RMU-F-RELMAXIDBAD error message if the allowed database relation ID maximum of 8192 is exceeded and the %RMU-F-CVTROLSUC error message when the database has been rolled back to V7.0 since it cannot be converted to V7.1:

```
$rmu/convert mf_personnel
%RMU-I-RMUTXT_000, Executing RMU for Oracle Rdb V7.1-00
Are you satisfied with your backup of
 DEVICE:[DIRECTORY]MF_PERSONNEL.RDB;1 and your backup of
 any associated .aij files [N]? Y
 %RMU-I-LOGCONVRT, database root converted to current structure level
 %RMU-F-RELMAXIDBAD, ROLLING BACK CONVERSION - Relation ID exceeds maximum
  8192 for system table RDB$RELATIONS
 %RMU-F-CVTROLSUC, CONVERT rolled-back for
  DEVICE:[DIRECTORY]MF_PERSONNEL.RDB;1 to version V7.0
```

The following example shows the normal case when the maximum allowed relation ID is not exceeded:

```
$rmu/convert mf_personnel
%RMU-I-RMUTXT_000, Executing RMU for Oracle Rdb V7.1-00
Are you satisfied with your backup of
 DEVICE:[DIRECTORY]MF_PERSONNEL.RDB;1 and your backup of
 any associated .aij files [N]? Y
%RMU-I-LOGCONVRT, database root converted to current structure level
%RMU-S-CVTDBSUC, database DEVICE:[DIRECTORY]MF_PERSONNEL.RDB;1
 successfully converted from version V7.0 to V7.1
%RMU-I-CVTCOMSUC, CONVERT committed for
 DEVICE:[DIRECTORY]MF_PERSONNEL.RDB;1 to version V7.1
```

5.3.3 RMU Unload /After_Journal Requires Accurate AIP Logical Area Information

The RMU Unload /After_Journal command uses the on-disk area inventory pages (AIPs) to determine the appropriate type of each logical area when reconstructing logical dbkeys for records stored in mixed-format storage areas. However, the logical area type information in the AIP is generally unknown for logical areas created prior to Oracle Rdb release 7.0.1. If the RMU Unload /After_Journal command cannot determine the logical area type for one or more AIP entries, a warning message is displayed for each such area and may ultimately return logical dbkeys with a 0 (zero) area number for records stored in mixed-format storage areas.

In order to update the on-disk logical area type in the AIP, the RMU Repair utility must be used. The INITIALIZE=LAREA_PARAMETERS=optionfile qualifier option file can be used with the TYPE qualifier. For example, to repair the EMPLOYEES table of the MF_PERSONNEL database, you would create an options file that contains the following line:

EMPLOYEES /TYPE=TABLE

For partitioned logical areas, the AREA=name qualifier can be used to identify the specific storage areas that are to be updated. For example, to repair the EMPLOYEES table of the MF_PERSONNEL database for the EMPID_OVER storage area only, you would create an options file that contains the following line:

EMPLOYEES /AREA=EMPID_OVER /TYPE=TABLE

The TYPE qualifier specifies the type of a logical area. The following keywords are allowed:

- TABLE

  Specifies that the logical area is a data table. This would be a table created using the SQL CREATE TABLE syntax.

- B-TREE

Specifies that the logical area is a B-tree index. This would be an index created using the SQL CREATE INDEX TYPE IS SORTED syntax.

- HASH

  Specifies that the logical area is a hash index. This would be an index created using the SQL CREATE INDEX TYPE IS HASHED syntax.

- SYSTEM

  Specifies that the logical area is a system record that is used to identify hash buckets. Users cannot explicitly create these types of logical areas.

  Note

  This type should NOT be used for the RDB$SYSTEM logical areas. This type does NOT identify system relations.

- BLOB

  Specifies that the logical area is a BLOB repository.

There is no explicit error checking of the type specified for a logical area. However, an incorrect type may cause the RMU Unload /After_Journal command to be unable to correctly return valid, logical dbkeys.

5.3.4 Do Not Use HYPERSORT with RMU Optimize After_Journal Command

The OpenVMS Alpha V7.1 operating system introduced the high-performance Sort/Merge utility (also known as HYPERSORT). This utility takes advantage of the OpenVMS Alpha architecture to provide better performance for most sort and merge operations.

The high-performance Sort/Merge utility supports a subset of the SOR routines. Unfortunately, the high-performance Sort/Merge utility does not support several of the interfaces used by the RMU Optimize After_Journal command. In addition, the high-performance Sort/Merge utility reports no error or warning when being called with the unsupported options used by the RMU Optimize After_Journal command.

Because of this, the use of the high-performance Sort/Merge utility is not supported for the RMU Optimize After_Journal command. Do not define the logical name SORTSHR to reference HYPERSORT.EXE.

5.3.5 Changes in EXCLUDE and INCLUDE Qualifiers for RMU Backup

The RMU Backup command no longer accepts both the Include and Exclude qualifiers in the same command. This change removes the confusion over exactly what gets backed up when Include and Exclude are specified on the same line, but does not diminish the capabilities of the RMU Backup command.

To explicitly exclude some storage areas from a backup, use the Exclude qualifier to name the storage areas to be excluded. This causes all storage areas to be backed up except for those named by the Exclude qualifier.

Similarly, the Include qualifier causes only those storage areas named by the qualifier to be backed up. Any storage area not named by the Include qualifier is not backed up. The Noread_only and Noworm qualifiers continue to cause read-only storage areas and WORM storage areas to be omitted from the backup even if these areas are explicitly listed by the Include qualifier.

Another related change is in the behavior of EXCLUDE=*. In previous versions, EXCLUDE=* caused all storage areas to be backed up. Beginning with V7.1, EXCLUDE=* causes only a root backup to be done. A backup created by using EXCLUDE=* can be used only by the RMU Restore Only_Root command.

5.3.6 RMU Backup Operations Should Use Only One Type of Tape Drive

When using more than one tape drive for an RMU Backup command, all of the tape drives must be of the same type (for example, all the tape drives must be TA90s or TZ87s or TK50s). Using different tape drive types (for example, one TK50 and one TA90) for a single database backup operation may make database restoration difficult or impossible.

Oracle RMU attempts to prevent using different tape drive densities during a backup operation, but is not able to detect all invalid cases and expects that all tape drives for a backup are of the same type.

As long as all of the tapes used during a backup operation can be read by the same type of tape drive during a restore operation, the backup is likely valid. This may be the case, for example, when using a TA90 and a TA90E.

Oracle Corporation recommends that, on a regular basis, you test your backup and recovery procedures and environment using a test system. You should restore the database and then recover using AIJs to simulate failure recovery of the production system.

Consult the Oracle Rdb7 Guide to Database Maintenance, the Oracle Rdb7 Guide to Database Design and Definition, and the Oracle RMU Reference Manual for additional information about Oracle Rdb backup and restore operations.

5.3.7 RMU/VERIFY Reports PGSPAMENT or PGSPMCLST Errors

RMU/VERIFY may sometimes report PGSPAMENT or PGSPMCLST errors when verifying storage areas. These errors indicate that the Space Area Management (SPAM) page fullness threshold for a particular data page does not match the actual space usage on the data page. For a further discussion of SPAM pages, consult the Oracle Rdb7 Guide to Database Maintenance.

In general, these errors will not cause any adverse affect on the operation of the database. There is potential for space on the data page to not be totally utilized, or for a small amount of extra I/O to be expended when searching for space in which to store new rows. But unless there are many of these errors then the impact should be negligible.

It is possible for these inconsistencies to be introduced by errors in Oracle Rdb. When those cases are discovered, Oracle Rdb is corrected to prevent the introduction of the inconsistencies. It is also possible for these errors to be introduced during the normal operation of Oracle Rdb. The following scenario can leave the SPAM pages inconsistent:

1. A process inserts a row on a page, and updates the threshold entry on the corresponding SPAM page to reflect the new space utilization of the data page. The data page and SPAM pages are not flushed to disk.
2. Another process notifies the first process that it would like to access the SPAM page being held by the process. The first process flushes the SPAM page changes to disk and releases the page. Note that it has not flushed the data page.

3. The first process then terminates abnormally (for example, from the DCL STOP/IDENTIFICATION command). Since that process never flushed the data page to disk, it never wrote the changes to the Recovery Unit Journal (RUJ) file. Since there were no changes in the RUJ file for that data page then the Database Recovery (DBR) process did not need to roll back any changes to the page. The SPAM page retains the threshold update change made above even though the data page was never flushed to disk.

While it would be possible to create mechanisms to ensure that SPAM pages do not become out of synch with their corresponding data pages, the performance impact would not be trivial. Since these errors are relatively rare and the impact is not significant, then the introduction of these errors is considered to be part of the normal operation of Oracle Rdb. If it can be proven that the errors are not due to the scenario above, then Oracle Product Support should be contacted.

PGSPAMENT and PGSPMCLST errors may be corrected by doing any one of the following operations:

- Recreate the database by performing:
    1. SQL EXPORT
    2. SQL DROP DATABASE
    3. SQL IMPORT
- Recreate the database by performing:
    1. RMU/BACKUP
    2. SQL DROP DATABASE
    3. RMU/RESTORE
- Repair the SPAM pages by using the RMU/REPAIR command. Note that the RMU/REPAIR command does not write its changes to an after-image journal (AIJ) file. Therefore, Oracle recommends that a full database backup be performed immediately after using the RMU/REPAIR command.

5.4 Known Problems and Restrictions in All Interfaces for Release 7.0 and Earlier

The following problems and restrictions from release 7.0 and earlier still exist.

5.4.1 Converting Single-File Databases

Because of a substantial increase in the database root file information for V7.0, you should ensure that you have adequate disk space before you use the RMU Convert command with single-file databases and V7.0 or higher.

The size of the database root file of any given database increases a minimum of 13 blocks and a maximum of 597 blocks. The actual increase depends mostly on the maximum number of users specified for the database.

5.4.2 Row Caches and Exclusive Access

If a table has a row-level cache defined for it, the Row Cache Server (RCS) may acquire a shared lock on the table and prevent any other user from acquiring a Protective or Exclusive lock on that table.

5.4.3 Exclusive Access Transactions May Deadlock with RCS Process

If a table is frequently accessed by long running transactions that request READ /WRITE access reserving the table for EXCLUSIVE WRITE and if the table has one or more indexes, you may experience deadlocks between the user process and the Row Cache Server (RCS) process.

There are at least three suggested workarounds to this problem:

- Reserve the table for SHARED WRITE
- Close the database and disable row cache for the duration of the exclusive transaction
- Change the checkpoint interval for the RCS process to a time longer than the time required to complete the batch job and then trigger a checkpoint just before the batch job starts. Set the interval back to a smaller interval after the checkpoint completes.

5.4.4 Strict Partitioning May Scan Extra Partitions

When you use a WHERE clause with the less than (<) or greater than (>) operator and a value that is the same as the boundary value of a storage map, Oracle Rdb scans extra partitions. A boundary value is a value specified in the WITH LIMIT OF clause. The following example, executed while the logical name RDMS$DEBUG_FLAGS is defined as "S", illustrates the behavior:

```
ATTACH 'FILENAME MF_PERSONNEL';
CREATE TABLE T1 (ID INTEGER, LAST_NAME CHAR(12), FIRST_NAME CHAR(12));
CREATE STORAGE MAP M FOR T1 PARTITIONING NOT UPDATABLE
 STORE USING (ID)
 IN EMPIDS_LOW WITH LIMIT OF (200)
 IN EMPIDS_MID WITH LIMIT OF (400)
 OTHERWISE IN EMPIDS_OVER;
INSERT INTO T1 VALUES (150,'Boney','MaryJean');
INSERT INTO T1 VALUES (350,'Morley','Steven');
INSERT INTO T1 VALUES (300,'Martinez','Nancy');
INSERT INTO T1 VALUES (450,'Gentile','Russ');
SELECT * FROM T1 WHERE ID > 400;
Conjunct Get Retrieval sequentially of relation T1
Strict Partitioning: part 2 3
ID LAST_NAME FIRST_NAME
450 Gentile Russ
1 row selected
```

In the previous example, partition 2 does not need to be scanned. This does not affect the correctness of the result. Users can avoid the extra scan by using values other than the boundary values.

5.4.5 Restriction When Adding Storage Areas with Users Attached to Database

If you try to interactively add a new storage area where the page size is less than the existing page size and the database has been manually opened or users are active, the add operation fails with the following error:

```
%RDB-F-SYS_REQUEST, error from system services request
-RDMS-F-FILACCERR, error opening database root DKA0:[RDB]TEST.RDB;1
-SYSTEM-W-ACCONFLICT, file access conflict
```

You can make this change only when no users are attached to the database and, if the database is set to OPEN IS MANUAL, the database is closed. Several internal Oracle Rdb data structures are based on the minimum page size and these structures cannot be resized if users are attached to the database.

Furthermore, because this particular change is not recorded in the AIJ, any recovery scenario fails. Note also that if you use .aij files, you must backup the database and restart after-image journaling because this change invalidates the current AIJ recovery.

5.4.6 Support for Single-File Databases to Be Dropped in a Future Release

Oracle Rdb currently supports both single-file and multifile databases on all platforms. However, single-file databases will not be supported in a future release of Oracle Rdb. At that time, Oracle Rdb will provide the means to easily convert single-file databases to multifile databases.

Oracle Rdb recommends that users with single-file databases perform the following actions:

- Use the Oracle RMU commands, such as Backup and Restore, to make copies, backup, or move single-file databases. Do not use operating system commands to copy, back up, or move databases.
- Create new databases as multifile databases even though single-file databases are supported.

5.4.7 Multiblock Page Writes May Require Restore Operation

If a node fails while a multiblock page is being written to disk, the page in the disk becomes inconsistent, and is detected immediately during failover. (Failover is the recovery of an application by restarting it on another computer.) The problem is rare, and occurs because only single-block I/O operations are guaranteed by OpenVMS to be written atomically. This problem has never been reported by any customer and was detected only during stress tests in our labs.

Correct the page by an area-level restore operation. Database integrity is not compromised, but the affected area is not available until the restore operation completes.

A future release of Oracle Rdb will provide a solution that guarantees multiblock atomic write operations. Cluster failovers will automatically cause the recovery of multiblock pages, and no manual intervention will be required.

5.4.8 Replication Option Copy Processes Do Not Process Database Pages Ahead of an Application

When a group of copy processes initiated by the Replication Option (formerly Data Distributor) begins running after an application has begun modifying the database, the copy processes catch up to the application and are not able to process database pages that are logically ahead of the application in the RDB$CHANGES system relation. The copy processes all align waiting for the same database page and do not move on until the application has released it. The performance of each copy process degrades because it is being paced by the application.

When a copy process completes updates to its respective remote database, it updates the RDB$TRANSFERS system relation and then tries to delete any RDB$CHANGES rows not needed by any transfers. During this process, the RDB$CHANGES table cannot be updated by any application process, holding up any database updates until the deletion process is complete. The application stalls while waiting for the RDB$CHANGES table. The resulting contention for RDB$CHANGES SPAM pages and data pages severely impacts performance throughput, requiring user intervention with normal processing.

This is a known restriction in V4.0 and higher. Oracle Rdb uses page locks as latches. These latches are held only for the duration of an action on the page and not to the end of transaction. The page locks also have blocking asynchronous system traps (ASTs) associated with them. Therefore, whenever a process requests a page lock, the process holding that page lock is sent a blocking AST (BLAST) by OpenVMS. The process that receives such a blocking AST queues the fact that the page lock should be released as soon as possible. However, the page lock cannot be released immediately.

Such work requests to release page locks are handled at verb commit time. An Oracle Rdb verb is an Oracle Rdb query that executes atomically, within a transaction. Therefore, verbs that require the scan of a large table, for example, can be quite long. An updating application does not release page locks until its verb has completed.

The reasons for holding on to the page locks until the end of the verb are fundamental to the database management system.

5.5 SQL Known Problems and Restrictions for Oracle Rdb Release 7.0 and Earlier

The following problems and restrictions from Oracle Rdb Release 7.0 and earlier still exist.

5.5.1 SQL Does Not Display Storage Map Definition After Cascading Delete of Storage Area

When you drop a storage area using the CASCADE keyword and that storage area is not the only area to which the storage map refers, the SHOW STORAGE MAP statement no longer shows the placement definition for that storage map.

The following example demonstrates this restriction:

```
SQL> SHOW STORAGE MAP DEGREES_MAP1
     DEGREES_MAP1
 For Table:             DEGREES1
 Compression is:        ENABLED
 Partitioning is:       NOT UPDATABLE
 Store clause:          STORE USING (EMPLOYEE_ID)
            IN DEG_AREA WITH LIMIT OF ('00250')
             OTHERWISE IN DEG_AREA2

SQL> DISCONNECT DEFAULT;
SQL> -- Drop the storage area, using the CASCADE keyword.
SQL> ALTER DATABASE FILENAME MF_PERSONNEL
cont> DROP STORAGE AREA DEG_AREA CASCADE;
SQL> -- Display the storage map definition.
SQL> ATTACH 'FILENAME MF_PERSONNEL';
SQL> SHOW STORAGE MAP DEGREES_MAP1
DEGREES_MAP1 For Table: DEGREES1
Compression is: ENABLED
Partitioning is: NOT UPDATABLE
```

The other storage area, DEG_AREA2, still exists, even though the SHOW STORAGE MAP statement does not display it.

A workaround is to use the RMU Extract command with the Items=Storage_Map qualifier to see the mapping.

5.5.2 ARITH_EXCEPT or Incorrect Results Using LIKE IGNORE CASE

When you use LIKE...IGNORE CASE, programs linked under Oracle Rdb V4.2 and V5.1, but run under higher versions of Oracle Rdb, may result in incorrect results or %RDB-E-ARITH_EXCEPT exceptions.

To work around the problem, avoid using IGNORE CASE with LIKE or recompile and relink under a higher version (V6.0 or higher.)

5.5.3 Different Methods of Limiting Returned Rows from Queries

You can establish the query governor for rows returned from a query by using either the SQL SET QUERY LIMIT statement or a logical name. This note describes the differences between the two mechanisms.

If you define the RDMS$BIND_QG_REC_LIMIT logical name to a small value, the query often fails with no rows returned regardless of the value assigned to the logical. The following example demonstrates setting the limit to 10 rows and the resulting failure:

```
$ DEFINE RDMS$BIND_QG_REC_LIMIT 10
$ SQL$
SQL> ATTACH 'FILENAME MF_PERSONNEL';
SQL> SELECT EMPLOYEE_ID FROM EMPLOYEES;
%RDB-F-EXQUOTA, Oracle Rdb runtime quota exceeded
-RDMS-E-MAXRECLIM, query governor maximum limit of rows has been reached
```

Interactive SQL must load its metadata cache for the table before it can process the SELECT statement. In this example, interactive SQL loads its metadata cache to allow it to check that the column EMPLOYEE_ID really exists for the table. The queries on the Oracle Rdb system relations RDB$RELATIONS and RDB$RELATION_FIELDS exceed the limit of rows.

Oracle Rdb does not prepare the SELECT statement, let alone execute it. Raising the limit to a number less than 100 (the cardinality of EMPLOYEES) but more than the number of columns in EMPLOYEES (that is, the number of rows to read from the RDB$RELATION_FIELDS system relation) is sufficient to read each column definition.

To see an indication of the queries executed against the system relations, define the RDMS$DEBUG_FLAGS logical name as "S" or "B".

If you set the row limit using the SQL SET QUERY statement and run the same query, it returns the number of rows specified by the SQL SET QUERY statement before failing:

```
 SQL> ATTACH 'FILENAME MF_PERSONNEL';
 SQL> SET QUERY LIMIT ROWS 10;
 SQL> SELECT EMPLOYEE_ID FROM EMPLOYEES;
 EMPLOYEE_ID
 00164
 00165
    .
    .
    .
 00173
 %RDB-E-EXQUOTA, Oracle Rdb runtime quota exceeded
 -RDMS-E-MAXRECLIM, query governor maximum limit of rows has been reached
```

The SET QUERY LIMIT specifies that only user queries be limited to 10 rows. Therefore, the queries used to load the metadata cache are not restricted in any way.

Like the SET QUERY LIMIT statement, the SQL precompiler and module processor command line qualifiers (QUERY_MAX_ROWS and SQLOPTIONS=QUERY_MAX_ROWS) only limit user queries.

Keep the differences in mind when limiting returned rows using the logical name RDMS$BIND_QG_REC_LIMIT. They may limit more queries than are obvious. This is important when using 4GL tools, the SQL precompiler, the SQL module processor, and other interfaces that read the Oracle Rdb system relations as part of query processing.

5.5.4 Suggestions for Optimal Use of SHARED DATA DEFINITION Clause for Parallel Index Creation

The CREATE INDEX process involves the following steps:

1. Process the metadata.
2. Lock the index name.

   Because new metadata (which includes the index name) is not written to disk until the end of the index process, Oracle Rdb must ensure index name uniqueness across the database during this time by taking a special lock on the provided index name.
3. Read the table for sorting by selected index columns and ordering.
4. Sort the key data.
5. Build the index (includes partitioning across storage areas).
6. Write new metadata to disk.

Step 6 is the point of conflict with other index definers because the system relation and indexes are locked like any other updated table.

Multiple users can create indexes on the same table by using the RESERVING table_name FOR SHARED DATA DEFINITION clause of the SET TRANSACTION statement. For optimal usage of this capability, Oracle Rdb suggests the following guidelines:

- You should commit the transaction immediately after the CREATE INDEX statement so that locks on the table are released. This avoids lock conflicts with other index definers and improves overall concurrency.
- By assigning the location of the temporary sort work files SORTWORK0, SORTWORK1, ... , SORTWORK9 to different disks for each parallel process that issues the SHARED DATA DEFINITION statement, you can increase the efficiency of sort operations. This minimizes any possible disk I/O bottlenecks and allows overlap of the SORT read/write cycle.
- If possible, enable global buffers and specify a buffer number large enough to hold a sufficient amount of table data. However, do not define global buffers larger than the available system physical memory. Global buffers allow sharing of database pages and thus result in disk I/O savings. That is, pages are read from disk by one of the processes and then shared by the other index definers for the same table, reducing the I/O load on the table.

- If global buffers are not used, ensure that enough local buffers exist to keep much of the index cached (use the RDM$BIND_BUFFERS logical name or the NUMBER OF BUFFERS IS clause in SQL to change the number of buffers).
- To distribute the disk I/O load, store the storage areas for the indexes on separate disk drives. Note that using the same storage area for multiple indexes results in contention during the index creation (Step 5) for SPAM pages.
- Consider placing the .ruj file for each parallel definer on its own disk or an infrequently used disk.
- Even though snapshot I/O should be minimal, consider disabling snapshots during parallel index creation.
- Refer to the Oracle Rdb7 Guide to Database Performance and Tuning to determine the appropriate working set values for each process to minimize excessive paging activity. In particular, avoid using working set parameters where the difference between WSQUOTA and WSEXTENT is large. The SORT utility uses the difference between these two values to allocate scratch virtual memory. A large difference (that is, the requested virtual memory grossly exceeds the available physical memory) may lead to excessive page faulting.
- The performance benefits of using SHARED DATA DEFINITION can best be observed when creating many indexes in parallel. The benefit is in the average elapsed time, not in CPU or I/O usage. For example, when two indexes are created in parallel using the SHARED DATA DEFINITION clause, the database must be attached twice, and the two attaches each use separate system resources.
- Using the SHARED DATA DEFINITION clause on a single-file database or for indexes defined in the RDB$SYSTEM storage area is not recommended.

The following table displays the elapsed time benefit when creating multiple indexes in parallel with the SHARED DATA DEFINITION clause. The table shows the elapsed time for ten parallel process index creations (Index1, Index2, ... Index10) and one process with ten sequential index creations (All10). In this example, global buffers are enabled and the number of buffers is 500. The longest time for a parallel index creation is Index7 with an elapsed time of 00:02:34.64, compared to creating ten indexes sequentially with an elapsed time of 00:03:26.66. The longest single parallel create index elapsed time is shorter than the elapsed time of creating all ten of the indexes serially.

Table 5–2 Elapsed Time for Index Creations

Index Create Job	Elapsed Time
Index1	00:02:22.50
Index2	00:01:57.94
Index3	00:02:06.27
Index4	00:01:34.53
Index5	00:01:51.96
Index6	00:01:27.57

(continued on next page)

Table 5–2 (Cont.) Elapsed Time for Index Creations

Index Create Job	Elapsed Time
Index7	00:02:34.64
Index8	00:01:40.56
Index9	00:01:34.43
Index10	00:01:47.44
All10	00:03:26.66

5.5.5 Side Effect When Calling Stored Routines

When calling a stored routine, you must not use the same routine to calculate argument values by a stored function. For example, if the routine being called is also called by a stored function during the calculation of an argument value, passed arguments to the routine may be incorrect.

The following example shows a stored procedure P being called during the calculation of the arguments for another invocation of the stored procedure P:

```
SQL> create module M
cont>     language SQL
cont>
cont>     procedure P (in :a integer, in :b integer, out :c integer);
cont>     begin
cont>     set :c = :a + :b;
cont>     end;
cont>
cont>     function F () returns integer
cont>     comment is 'expect F to always return 2';
cont>     begin
cont>     declare :b integer;
cont>     call P (1, 1, :b);
cont>     trace 'returning ', :b;
cont>     return :b;
cont>     end;
cont> end module;
SQL>
SQL> set flags 'TRACE';
SQL> begin
cont> declare :cc integer;
cont> call P (2, F(), :cc);
cont> trace 'Expected 4, got ', :cc;
cont> end;
~Xt: returning 2
~Xt: Expected 4, got 3
```

The result as shown above is incorrect. The routine argument values are written to the called routine's parameter area before complex expression values are calculated. These calculations may (as in the example) overwrite previously copied data.

The workaround is to assign the argument expression (in this example calling the stored function F) to a temporary variable and pass this variable as the input for the routine. The following example shows the workaround:

```
SQL> begin
cont> declare :bb, :cc integer;
cont> set :bb = F();
cont> call P (2, :bb, :cc);
cont> trace 'Expected 4, got ', :cc;
cont> end;
~Xt: returning 2
~Xt: Expected 4, got 4
```

This problem will be corrected in a future version of Oracle Rdb.

5.5.6 Considerations When Using Holdable Cursors

If your applications use holdable cursors, be aware that after a COMMIT or ROLLBACK statement is executed, the result set selected by the cursor may not remain stable. That is, rows may be inserted, updated, and deleted by other users because no locks are held on the rows selected by the holdable cursor after a commit or rollback occurs. Moreover, depending on the access strategy, rows not yet fetched may change before Oracle Rdb actually fetches them.

As a result, you may see the following anomalies when using holdable cursors in a concurrent user environment:

- If the access strategy forces Oracle Rdb to take a data snapshot, the data read and cached may be stale by the time the cursor fetches the data.

  For example, user 1 opens a cursor and commits the transaction. User 2 deletes rows read by user 1 (this is possible because the read locks are released). It is possible for user 1 to report data now deleted and committed.

- If the access strategy uses indexes that allow duplicates, updates to the duplicates chain may cause rows to be skipped, or even revisited.

  Oracle Rdb keeps track of the dbkey in the duplicate chain pointing to the data that was fetched. However, the duplicates chain could be revised by the time Oracle Rdb returns to using it.

Holdable cursors are a very powerful feature for read-only or predominantly read-only environments. However, in concurrent update environments, the instability of the cursor may not be acceptable. The stability of holdable cursors for update environments will be addressed in future versions of Oracle Rdb.

You can define the logical name RDMS$BIND_HOLD_CURSOR_SNAP to the value 1 to force all hold cursors to fetch the result set into a cached data area. (The cached data area appears as a "Temporary Relation" in the optimizer strategy displayed by the SET FLAGS 'STRATEGY' statement or the RDMS$DEBUG_FLAGS "S" flag.) This logical name helps to stabilize the cursor to some degree.

5.5.7 AIJSERVER Privileges

For security reasons, the AIJSERVER account ("RDMAIJSERVER") is created with only NETMBX and TMPMBX privileges. These privileges are sufficient to start Hot Standby, in most cases.

However, for production Hot Standby systems, these privileges are not adequate to ensure continued replication in all environments and workload situations. Therefore, Oracle recommends that the DBA provide the following additional privileges for the AIJSERVER account:

- ALTPRI

This privilege allows the AIJSERVER to adjust its own priority to ensure adequate quorum (CPU utilization) to prompt message processing.

- PSWAPM

  This privilege allows the AIJSERVER to enable and disable process swapping, also necessary to ensure prompt message processing.

- SETPRV

  This privilege allows the AIJSERVER to temporarily set any additional privileges it may need to access the standby database or its server processes.

- SYSPRV

  This privilege allows the AIJSERVER to access the standby database rootfile, if necessary.

- WORLD

  This privilege allows the AIJSERVER to more accurately detect standby database server process failure and handle network failure more reliably.