IBM® TS7700 Virtualization Engine

LOGICAL WRITE-ONCE, READ-MANY (LWORM) RETENTION FUNCTION USER'S GUIDE

A TS7700 LWORM retention function user's guide

Document Version 1.01
April 16, 2021

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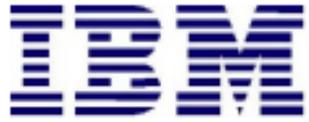*TS7700 Development Tokyo, Japan*
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Summary of Change

Version	Change Date	Description
1.0	04/01/2021	Initial version of this document
1.01	04/16/2021	Fix typo in Appendix A checklists

1 Introduction

This paper describes IBM TS7700 Logical Write-Once, Read-Many (LWORM) Retention function concepts. TS7700 LWORM was first introduced in microcode release 8.6.x.x and provides the capability of the software-emulated WORM (Write-Once, Read-Many) available on physical tape media.

TS7700 LWORM Retention function was introduced in microcode release 8.51.1.x and provides the capability to include TS7700 enforced retention as part of the LWORM function. The retention duration is based off of the expiration dates encoded in the HDR1 data set labels of the logical volume, fixed durations or a combination of both. This paper can be used as a guide to understand and configure an environment to apply the LWORM Retention function to your TS7700s.

1.1 Standard LWORM (since 8.6.x.x)

The LWORM function was introduced in 8.6.x.x to emulate the behavior of physical WORM. LWORM attributes provide the following functions:

LWORM attributes provides the following functions:
- Assigns a data class constructs property to volumes assigned as LWORM-compliant, either upon the first write from BOT mount or during reuse from scratch
- Generates a unique World Wide Identifier (WWID) that is sent to the host and also bound to the volume
- Generates a write mount count for each LWORM volume that is maintained persistently and synchronized with the tape management system (for example, DFSMSrmm).
- Permits appends to LWORM volumes using only physical WORM append guidelines

LWORM attributes cannot be applied to previously written standard read/write volumes. For a volume to be LWORM-compliant, it must be assigned before data is written to it, either upon the first write from BOT mount or during reuse from scratch.

Please refer to the following site to check what LWORM function is in detail:
https://www.ibm.com/support/knowledgecenter/STFS69_5.1.1/ts7740_grid_configurations_data_access_availability_lworm.html

1.2 LWORM Retention (since 8.51.1.x)

LWORM Retention inherits all LWORM functions, plus it provides additional capabilities related to retention which are not achieved by the LWORM function alone.

The tape volumes and the data sets written on the tape volumes are managed by a tape management systems such as DFSMSrmm. The tape management system manages which tape volumes contain data and specific retention rules for those volumes.

One of the major functions of the tape management system is to manage how long the data sets on the tape volumes need to be retained.   IBM Z tape management systems and IBM Z applications work together in order to determine when a volume has expired and can be returned to scratch. Any return to scratch is honored by the TS7700, independent of the LWORM function alone. With the introduction of TS7700 LWORM retention, an unexpected or early return to scratch can be either denied or allowed to continue with hold. The TS7700 utilizes dates encoded in the IBM standard label HDR1 of each dataset on tape, configured durations or a combination of both when determining if any attempt to return a volume to scratch is too early.

1.3   Standard LWORM (8.6.x.x) versus LWORM Retention (8.51.1.x) volume

The table below summarizes the differences in volume behavior between standard LWORM and LWORM Retention for a volume whose retention date has not yet expired:

	LWORM volume (8.6.x.x)	LWORM Retention volume (not yet expired) (8.51.1.x)
Return To Scratch	Allowed	Rejected (*1)
Scratch Mount	Allowed	Rejected
Delete Expire Processing	Allowed	Rejected
Eject Volume	Allowed	Rejected
Scratch Volume Inventory Count	Included	Excludes those in scratch still under a hold or retained state
Copy Audit BVIR	Scratch volumes are excluded from the audit check	Scratch volumes in a retained hold state are included in the audit check (*2)
LI REQ, SETTING, COPY, SCRATCH behavior	Scratch volumes may skip replication based on the setting.	Scratch volumes in a retained hold state are treated as private and always replicated

Table 1 LWORM vs LWORM Retention volume

(*1) The behavior can change based off of the LWORM Retention options configured.
(*2) Under certain circumstances, with special IBM support, the retained scratch volumes can be excluded as part of an official cluster removal MES operation if requested.

Once an LWORM Retention date has passed on an LWORM retained volume, the volume is treated as a standard LWORM volume, unless the retention period is again extended which is based on the options configured. If extended, it will then honor the new retention rule.

2   Code Level/Configuration Requirements

The LWORM Retention function is enabled only when all clusters in the same Grid have a code level of 8.51.1.x or above. Mixed code level configuration with pre-8.51.1.x code level is not supported.

The new LWORM retention function is supported on all cluster models which support 8.51.1.x code level or above.

No feature code is required to enable the function on TS7700.

No additional host APAR is required to enable the function.

An iRPQ/SCORE is required to set up and enable the function. At 8.51.1.x, the function is enabled with IBM support. As of the 8.51.1.x code level, LWORM Retention attributes are applied to each logical volume using customer inaccessible settings configured only by an IBM support team. Changes to these settings will require IBM support.

Note: On a cluster join/merge MES as well as GGM (Grid to Grid Migration), the settings are not automatically copied. The settings will need to be configured or adjusted by IBM support in the following cases:
- Existing cluster(s) have the LWORM Retention settings and they need to be copied to the joining/merging cluster(s).
- Merging cluster(s) have the LWORM Retention settings and they need to be copied to the existing cluster(s).
- Existing and joining/merging cluster(s) both have the LWORM Retention settings and they need to be adjusted on either side.
- GGM copy source Grid has the LWORM Retention settings and they need to be inherited to the GGM copy target Grid.

Note: In a future release, LWORM Retention attributes will likely be customer configurable through the Data Class settings within the Management Interface GUI without IBM support (i.e. no iRPQ/SCORE is required).

3 How to Enable LWORM Retention Function

LWORM Retention function can be enabled with IBM support through the iRPQ/SCORE process. The 3 primary steps required to enable LWORM Retention function are as follows:

1. Determine how to set up LWORM Retention function
   - Determine if the LWORM Retention settings should have unique behaviors per Data Class or if the settings should be global.
   - Determine how the LWORM Retention function options and behaviors should be configured. Though a few different options exist, some combinations may not be supported without additional verification as part of the iRPQ/SCORE process.
2. Work with IBM support to set up the required settings.

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- IBM support needs to be involved to set up LWORM Retention function
3. Start using LWORM Retention function
   - Once the setup is complete, the LWORM Retention function is enabled and the LWORM Retention attributes are applied to the target logical volume on the next write from beginning of tape (BOT).

The following sections describe the details of each step.

3.1 Determine how to set up LWORM Retention function

The granularity of LWORM Retention function is global or per data class. The user can set up the LWORM Retention function with the following data class name granularity:
- Specific Data Class Name
  - When there is a requirement to apply LWORM Retention attributes to the target logical volumes using a specific data class, provide IBM the target data class names used for the target logical volumes. The logical volumes that are assigned to the provided data class names during a write to BOT will then honor the configured retention rules.
  - Other logical volumes that are not assigned to the provided data class names do not apply LWORM Retention attributes.
- Default Data Class Name
  - This is similar to "Specific Data Class Name", but allows a method to configure the behavior when the DEFAULT data class is used.
- All Data Class
  - When all logical volumes require LWORM Retention attributes, the TS7700 can be configured to apply these settings to all volumes that receive a write to BOT, independent of what data class is used.
  - If this option is chosen, the above two methods (specific/default data class) are ignored.

The specific data class names must be already defined in the Management Interface (MI) GUI beforehand when one or more specific data class names are configured. All existing data class attributes are honored such as "Virtual Volume Size", "Compression Method" and "3490 Counters Handling." The exception is the "Logical WORM" attribute. Independent of whether it's set or not within the MI for the target data class, the volumes will become LWORM volumes if the special LWORM Retention settings are configured globally or for that specific data class as well.

Note: If "All Data Class" is chosen, all data classes defined in the MI, including the DEFAULT, have the "Logical WORM = Yes" attribute implied.

Once the target data class name (specific, default or all) is determined, the next step is to determine what LWORM Retention options need to be set to the target data class name or names if more than one needs to be defined. There are three primary options which determine how the LWORM Retention function works:

1. Retention Type option
2. Retention Duration options
3. Retention Return-To-Scratch option

1. **Retention Type option**
   These options determine if a fixed duration or the contents of HDR1 records should be used to determine the duration of retention.
   - **FIXED**
     The retention date is calculated and set based on a fixed duration from the last time when data was written to the logical volume. Any dates encoded in IBM standard label HDR1 records are ignored. The exact retention date for the logical volume is set to a future date based on the time when a Z host initiates the last write after a mount to the logical volume + (A Configured Fixed Duration) + 1 day". The configured "Fixed Duration" is described in more detail later.
   - **HDR1**
     The retention is based on any date or lack of date contained within the one or more IBM standard label HDR1 records written to the logical tape. Since special dates can be provided and different sequences can occur, additional sub-options are available to control how to handle the various scenarios. The following sub-options (Yes or No) must be defined when the HDR1 type is chosen:
     - **APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE**
       If a first IBM standard label HDR1 has "No date" (described later):
       - Yes: Use the "Fixed Duration" value to calculate the retention date. The method the duration is calculated matches what is described in the "FIXED" duration section above. If an existing retention date is set, the retention date is set to the later of the two.
       - No: No recalculation of the retention date occurs and any existing retention date is not modified.
     - **NO_FIRST_HDR1_TREAT_AS_NO_DATE**
       If data is written to a logical volume from BOT, but no IBM standard label HDR1 is written before demount, should a fixed duration be used:
       - Yes: Use the "Fixed Duration" value to calculate the retention date. The method the duration is calculated matches what is described in the "FIXED" duration section above. If an existing retention date is set, the retention date is set to the later of the two.
       - No: No retention date is set for the mount with write to BOT.
     - **HONOR_ALL_SUBSEQUENT_HDR1S**
       If two or more IBM standard label HDR1 records are written during the combined first mount and any subsequent mount, determine if the second and later written HDR1 records should be honored:
       - Yes: A new retention date may be set based on the additional HDR1's contents and the settings below. If an existing retention date is set, the retention date is set to the later of the two.
       - No: Any second and later HDR1 records are ignored and any existing retention date is not modified.

> ➢ **NO_HDR1_MOD_USE_FIXED**
>   (Applicable only if HONOR_ALL_SUBSEQUENT_HDR1S is Yes)
> If a private mount with MOD (data append) occurs and no IBM standard label HDR1 is written during the private mount with one or more writes, should a fixed duration be used instead:
>   - Yes: Use the "Fixed Duration" value to calculate the retention date. The method the duration is calculated matches what is described in the "FIXED" duration section above. If an existing retention date is set, the retention date is set to the later of the two.
>   - No: No recalculation of the retention date occurs and any existing retention date is not modified.
> ➢ **SUBSEQUENT_HDR1_HONOR_NO_DATE**
>   (Applicable only if HONOR_ALL_SUBSEQUENT_HDR1S is Yes AND
>   APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE is Yes)
> If a second or more IBM standard label HDR1 is written during the first mount and all subsequent mounts and contains "No date" (described below), should it use fixed duration:
>   - Yes: Use the "Fixed Duration" value to calculate the retention date. The method the duration is calculated matches what is described in the "FIXED" duration section above. If an existing retention date is set, the retention date is set to the later of the two.
>   - No: Any second and later HDR1 records with "No date" are ignored and will not result in a modification of any existing retention date .
> ➢ **SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE**
>   (Applicable only if HONOR_ALL_SUBSEQUENT_HDR1S is Yes)
> If a second or more IBM standard label HDR1 is written during the first mount and all subsequent mounts and contains an "Application Managed Date" (described below), should it use fixed duration:
>   - Yes: Use the "Fixed Duration" value to calculate the retention date. The method the duration is calculated matches what is described in the "FIXED" duration section above. If an existing retention date is set, the retention date is set to the later of the two.
>   - No: Any second and later HDR1 records with an "Application Managed Date" are ignored and will not result in a modification of any existing retention date .

2. **Retention Duration options**
   This is the duration (N days) if any rule mentions to calculate the retention date by using either of the durations:
   - **Fixed Duration**
     When any retention option rule mentions to use the "Fixed Duration," this duration is used to calculate the retention date.
   - **Application Managed Duration**
     When the expiration date in the IBM standard label HDR1 is an "Application Managed Date" (described later), this duration is used to calculate the retention date.

The above two durations can be one of the following values:
- FOREVER
  This is used to retain LWORM volume forever.
- NONE
  This is used when no retention date adjustment is required (i.e. no LWORM Retention adjustment is made)
- N DAYS
  Retention period is set to "the time when Z host writes the data to the logical volume + (N DAYS) + 1 day". Up to 8000 years (2928000 days) can be set (the highest supported resulting retention date is a date in the year 9999).

3. **Retention Return-To-Scratch option**
   This option determines behaviors related to a return to scratch.
   - **HONOR_RETURN_TO_SCRATCH**
     If the private volume is still in a retention period and the Z host attempts a return-to-scratch operation to the logical volume, should it be honored.
     - Yes: The operation is allowed, but the volume remains in an expire hold retention state until the retention period passes. Once the retention period passes, any category based expire-hold state that was configured would be honored if it results in a continuation of the hold state. Basically, the greater of the two determines when the expire hold state ends.
     - No: The operation is denied
   - **USE_FIXED_DUR_ON_RETURN_TO_SCRATCH**
     When a logical volume is successfully returned to scratch, should a retention adjustment be made using fixed duration:
     - Yes: The retention date is updated to "current time + (Fixed Duration) + 1 day". If an existing retention date exists and HONOR_RETURN_TO_SCRATCH is Yes, the later of the two dates is used to determine how long the volume remains in an expire hold state. Once the retention period passes, any category based expire-hold state that was configured would be honored if it results in a continuation of the hold state. Basically, the greater of the two determines when the expire hold state ends.
     - No: No adjustments are made to the retention date.

HDR1 Date Formats

The expiration date written in the IBM standard label HDR1 by Z host can be categorized as follows:
- Valid future date
  A valid future data in the format "cYYddd" (century/year/Julian date). Please refer to https://www.ibm.com/support/knowledgecenter/SSLTBW_2.4.0/com.ibm.zos.v2r4.idam300/formds2.htm for details.
- No date

"cYYddd" is either of the following values " 00000"/" 97000"/" 98000"/" 99000" (c is blank) or "000000" (all null), or the date which was passed is a valid date in the past. The tape management system associates these with "No Retention", but retention rules can still be applied by the TS7700 based on the LWORM Retention settings mentioned above.

• Application Managed date
"cYYddd" is either of the values " 99365" or " 99366" (c is blank). They are considered "Application Managed" since the tape management system will hold the volumes indefinitely until given permission by the application to expire the volume. Or, the tape management system may use an external method, such as whether the volume is catalogued, to determine when the volume can be expired.

In 8.51.1.x, only two sets of LWORM Retention options are formally approved and tested:
1. **Fixed Set #1**
   ● Retention Type option:
     HDR1
       HDR1 sub-options:
         - NO_FIRST_HDR1_TREAT_AS_NO_DATE: No
         - HONOR_ALL_SUBSEQUENT_HDR1S: Yes
         - NO_HDR1_MOD_USE_FIXED: No
         - SUBSEQUENT_HDR1_HONOR_NO_DATE: No
         - SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE: No
         - APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE: Yes

   ● Retention Duration option:
     - Fixed Duration: Forever
     - Application Managed Data: Forever

   ● Retention Return-To-Scratch option:
     - HONOR_RETURN_TO_SCRATCH: No
     - USE_FIXED_DUR_ON_RETURN_TO_SCRATCH: No

2. **Fixed Set #2**
   ● Retention Type option:
     HDR1
       HDR1 sub-options:
         - NO_FIRST_HDR1_TREAT_AS_NO_DATE: No
         - HONOR_ALL_SUBSEQUENT_HDR1S: Yes
         - NO_HDR1_MOD_USE_FIXED: No
         - SUBSEQUENT_HDR1_HONOR_NO_DATE: No
         - SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE: No
         - APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE: Yes

   ● Retention Duration option:
     - Fixed Duration: N days

- Application Managed Data: None

- Retention Return-To-Scratch option:
    - HONOR_RETURN_TO_SCRATCH: No
    - USE_FIXED_DUR_ON_RETURN_TO_SCRATCH: Yes

Please refer to chapter 6 to understand how the LWORM Retention volume behaves with above two Fixed Set of options.

Once the target data class name and its LWORM Retention options are determined, it needs to be determined which TS7700(s) in the Grid should enable the LWORM Retention function. Most likely, this is all clusters in the grid. In 8.5.1.x, the function is controlled by customer inaccessible settings configured on each cluster by IBM support. The logical volume applies the LWORM Retention attributes only when the TS7700 that receives the first write from BOT mount has such settings configured.

Once it's determined which data class names (or all) require LWORM Retention enablement, please complete the checklist in Appendix A and provide it to your IBM representative or IBM support team.

3.2   Work with IBM support to setup the LWORM Retention settings

In 8.51.1.x, LWORM Retention function can be enabled through iRPQ/SCORE process. And to enable LWORM Retention function, IBM support needs to be involved to setup the configuration values on each TS7700.

Once the check list sheet in Appendix A is completed, your IBM representative or support team needs to be involved in applying the requested settings.

IBM support needs to login remotely and setup the required settings on all necessary TS7700s. Once all the required settings are configured within all TS7700s in a grid, future volumes written from BOT with an applicable data class will begin to honor the new settings.

3.3   Start using LWORM Retention function

Once the required special settings are configured by IBM support on the target TS7700(s), the LWORM Retention function is ready to use.

- The LWORM Retention attributes are applied to logical volumes only when a write to BOT occurs (new output tape).
- The LWORM Retention attributes are applied to the logical volume only when the TS7700 supporting the mount has the special settings configured.
- The LWORM Retention attributes are applied to logical volumes that utilize a data class that matches one of the LWORM Retention configured settings by data class. If "all data

class" is used, all logical volumes apply the LWORM Retention rules regardless of the data class.

● When a matching LWORM Retention rule is found by data class or when "all data class" is defined, the target logical volume is treated as an LWORM volume independent of whether the corresponding data class setting in the MI has LWORM configured.

● Once a set of LWORM Retention rules are applied to a volume, they cannot be modified. Any changes to the special configuration settings will not be retroactive to existing LWORM Retained volumes. Only volumes created from that point forward will honor the new settings.

● Once a retention period passes for a retained LWORM volume and the VOLSER is selected during a future scratch mount, the logical volume can be reused as a standard read/write tape, a new occurrence of a standard LWORM tape or a new occurrence of a retained LWORM tape. Any previously defined retention states or rules bound to a logical volume are cleared during any post-retention reuse from BOT.

● For clarity, independent of any configured rules or settings, a volume's retention date will never be made sooner. Any configured or applicable setting will either leave an existing retention date unchanged or move it out further into the future. If adjusted further into the future for any reason, it again can never be reduced and only pushed out further.

● Once a retention date has passed (if not forever), the logical volume remains an LWORM volume with LWORM rules. It's simply allowed to be reused. This of course is only true if another event hasn't occurred which extends the retention date further into the future before the reuse is attempted. Therefore, a volume can exit a retention and then re-enter a retention state based on the sequence of events and the configured settings.

● Other than additional retention concepts, all other LWORM rules still apply for LWORM Retained volumes.

The overall LWORM Retention attributes (LWORM retention options/state/date) are bound to the logical volume token when the logical volume is demounted after a write to BOT. When a MOD (append) occurs, any adjustments to the retention date are bound to the token during demount. During any mount, with or without write, the token is verified to be in synch with the internal LWORM attributes bound to the logical volume.

The possible LWORM Retention state and date are:

Retention State	Retention Date	Meaning
None	NA	The logical volume is not retained. It may still be a LWORM volume, but was not setup for retention or no events occurred which were true based on the bound configured retention rules for the logical volume.
Forever	-	The logical volume is being retained forever.
Date Based retention	Valid Date	The logical volume is being retained until the displayed retention date passes and no additional

		adjustments to the date occur between now and then.

Table 2 LWORM Retention state/date

When the "Date Based retention" is applied, the date uses a 24 hour granularity. The hour:minute:second of the date will be always 00:00:00. For example, a single dataset is written to the logical volume and its IBM standard format label HDR1 has 2021/307 (Julian date) which is Nov 3rd in UTC. The retention date is set to 2021-11-03 **00:00:00**, then once TS7700 internal time (in UTC) passes that date/time, the logical volume is no longer retained. For example, past midnight of the following day.

While the logical volume is retained, the logical volume follows the behavior described in the section 1.3 or chapter 7. Once the logical volume exits the retention date, it's no longer retained but it's still a LWORM volume.

4 Library Request change for LWORM Retention function

There are two changes to the Library Request commands regarding the LWORM Retention function:
1. Provide LWORM Retention state/date in LVOL output
2. A new keyword "LWORMR" to display LWORM Retention special settings are supported

4.1 LVOL output change

LVOL, <volser>, INFO provides the current LWORM Retention state and date. The sample output is as follows:

```
LOGICAL VOLUME INFO V3 .0
 LOGICAL VOLUME              : Z10000
 MEDIA, FMT, MAX(MB), CWRAP   : ECST, 6,    800, N
 SIZE(MB) COMP, CHAN, RATIO   : 14, 95,  6.38:1(FICON)
 CURRENT OWNER, TVC LIB      : Arabian, Lipizzan
 MOUNTED LIB/DV, MNT STATE    : -/-, -
 CACHE PREFERENCE, CATEGORY   : PG1, 0001 (SCRATCH)
 LAST MOUNTED (UTC)          : 2018-08-28 03:34:31
 LAST MODIFIED LIB/DV, UTC(UTC): Lipizzan/0000, 2018-08-28 03:34:25
 KNOWN CPYS, REQ, REMOVED     : 1, 1, 0 (N)
 DEL EXP, WHEN (UTC)         : N, -
 HOT, FLASH COPY             : N, ACTIVE
 LWORM RET STATE, TIME(UTC)   : D, 2020-11-03 00:00:00
----------------------------------------------------------------
  LIBRARY RQ CA P-PVOL S-PVOL CPS CPQ CPP RM CP CD CC
 Lipizzan  N  Y ------ ------ CMP   - DEF   N  2  0   C
  Arabian  N  N ------ ------ NOR   - NOC   N  0  0   A
```

```
cluster2  N  N ------ ------ NOR   - NOC  N  0  0  N
Palomino  N  N ------ ------ NOR   - NOC  N  1  0  N
```

Line 13 includes the LWORM Retention state and time. It's provided only when the entire Grid is at 8.51.1.x or above. The format is as follows. Please refer to Library request Command white paper for the entire output format.

Line	Bytes	Name	Description
13	0	Blank	
	1:32	Header Info	`'LWORM RET STATE, TIME(UTC)     : '`
	33	Retention state	LWORM retention state. The possible values are: 'N': The volume is not LWORM-retained. 'D': The volume is date based LWORM-retained. 'F': The volume is forever LWORM-retained. This line is provided only when the Grid is at 8.51.1.x or above.
	34:35	Header Info (Comma separator)	`', '`
	36:54	Retention time	LWORM retention time. The timestamp in UTC until when the volume is LWORM-retained. The timestamp is formatted as follows: YYYY-MM-DD HH:MM:SS for example: 2020-11-03 00:00:00 If the volume is not LWORM-retained (i.e. the retention state is 'N'), 'NA' is provided. If the volume is forever LWORM-retained (i.e. the retention state is 'F'), '-' is provided. This line is provided only when the Grid is at 8.51.1.x or above.
	55:69	Blanks	

Table 3 LI REQ, LVOL output format for LWORM Retention state/date

4.2 New LWORMR keyword support

The new 1st keyword of LWORMR is supported when the entire Grid is at 8.51.1.x or above and it provides what LWORM Retention special settings are configured on the target TS7700. This can be used to verify and audit the retention settings. The keywords are as follows:

Keyword 1	Keyword 2	Keyword 3	Keyword 4	Comp	Dist	7700D	7740	7700T	7700C
LWORMR	SHOW	<index>		N/A	Y	Y	N/A	Y	Y

Table 4 LI REQ, LWORMR keyword

Note: The valid index is 1, 2,3. If no index or index 0 is specified, it's converted to 1 automatically.

- Index 1 provides the first 92 setting file contents if exist.

- Index 2 provides the next 92 setting file contents if exist.

- Index 3 provides the last 72 setting file contents if exist.

This is a sample output of the command:
```
LWORMR SHOW V1 .0
 INDEX:1
  ID:DTCLASS ,FIXDUR,APPDUR,FLG      ID:DTCLASS ,FIXDUR,APPDUR,FLG
   1: DCLASS1 ,-1    ,-1    ,8A       2:DEFAULT ,10    ,0     ,208A
```

It provides the ID (just sequence number) and LWORM Retention options for each data class name which should be in sync with the contents provided in Appendix A check list.

The options are Fixed Duration, Application Managed Duration and Retention Type/Retention Return-To-Scratch options. The column "FLG" shows the Retention Type/Retention Return-To-Scratch options and it's the ORed mask values of the options described in the following table. The following table details the format of the data reported:

Line	Bytes	Name	Description
1	0:13	Header Info	`'LWORMR SHOW V'`
	14:15	Version	The version number for the response. The number is left justified and padded with blanks. Starts with 1 at 8.51.1.x
	16	Dot	'.'
	17:18	Revision	The revision number for the response. The number is left justified and padded with blanks. Starts with 0.
	19:69	Blanks	
2	0:6	Header Info	`' INDEX:'`
	7	Index	Index number (1-3) specified by the request
	8:69	Blanks	
3	0:65	Header Info	`'  ID:DTCLASS ,FIXDUR,APPDUR,FLG    ID:DTCLASS ,FIXDUR,APPDUR,FLG'`
	66:69	Blanks	
The following output may vary based off of the number of the setting files			
4:49	0	Blank	

	1:3	Index	File index (1-256) of each setting file
	4	Delimiter	`':'`
	5:12	Data Class name	The data class name which the contents of the setting file are applied. The name is left justified and padded with blanks (up to 8 characters).
	13	Delimiter	`','`
	14:19	Fixed Duration value	The fixed duration value for the data class name. The unit is "day". The value is left justified and padded with blanks.
			-1: Forever
			0: No retention adjustment (default value)
			N: 1-2928000 (up to 8000 years)
	20	Delimiter	`','`
	21:26	Application Managed Duration value	The application ma nagged duration value for the data class name. The unit is "day". The value is left justified and padded with blanks.
			-1: Forever
			0: No retention adjustment (default value)
			N: 1-2928000 (up to 8000 years)
	27	Delimiter	`','`
	28:33	LWORM retention options	The LWORM retention options value (hexadecimal) for the data class name. The value is left justified and padded with blanks. The value is ORed of the following setting values used internally:
			`--- Retention Type ---`
			`0x00000000 – No retention`
			`0x00000001 – FIXED`
			`0x00000002 – HDR1`
			`--- HDR1 sub-options ---`
			`0x00000004 – NO_FIRST_HDR1_TREAT_AS_NO_DATE`
			`0x00000008 – HONOR_ALL_SUBSEQUENT_HDR1S`
			`0x00000010 – NO_HDR1_MOD_USE_FIXED`
			`0x00000020 – SUBSEQUENT_HDR1_HONOR_NO_DATE`
			`0x00000040 – SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE`
			`0x00000080 – APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE`
			`--- return-to-scratch option ---`
			`0x00001000– HONOR_RETURN_TO_SCRATCH`
			`0x00002000– USE_FIXED_DUR_ON_RETURN_TO_SCRATCH`

	34:35	Blanks	
	36:38	Index	File index
	39	Delimiter	`':'`
	40:47	Data Class name	The data class name which the contents of the setting file are applied.
	48	Delimiter	`','`
	49-54	Fixed Duration value	The fixed duration value for the data class name.
	55	Delimiter	`','`
	56:61	Application Managed Duration value	The application ma nagged duration value for the data class name.
	62	Delimiter	`','`
	63:68	LWORM retention options	The LWORM retention options value (hexadecimal) for the data class name.
	69	Blank	
When more than 92/184 setting files exist and the index 0/1 is specified, the following message is provided at the last line:			
50	0:24		`' MORE SETTING FILES EXIST'`
	25:69	Blanks	
When more than 256 setting files exist (unexpected situation) and the index 2 is specified, the following message is provided at the last line:			
40	0:33		`' MORE THAN 256 SETTING FILES EXIST'`
	34:69	Blanks	

Table 5 LI REQ, LWORMR FLG output format

If no setting file exists, the following text is returned:

```
NO LWORMR SETTING FILE EXISTS
```

If an invalid index (other than 0-3) is specified, the following error text is returned:

```
INVALID INDEX X WAS SPECIFIED
```

If any unexpected error occurs, the following error text is returned:

```
AN ERROR OCCURED PROCESSING THE HOST REQUEST. RETURN CODE = X
```

When the fixed set #1 or #2 is used (refer to the section 3.1), the "FLG" should have the following values;

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- **Fixed Set #1:** `FIXDUR=-1, APPDUR=-1, FLG='A'`

`HDR1(0x00000002)+HONOR_ALL_SUBSEQUENT_HDR1S(0x00000008)+APPLY_FIXED_DURATION_`
`FOR_HDR1_NO_DATE(0x00000080)=0x0000008A('8A')`

- **Fixed Set#2:** `FIXDUR=N (user specified value), APPDUR=0, FLG='200A'`

`HDR1(0x00000002)+HONOR_ALL_SUBSEQUENT_HDR1S(0x00000008)+`
`APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE(0x00000080)+`
`USE_FIXED_DUR_ON_RETURN_TO_SCRATCH(0x00002000)= 0x0000208A`

5 Bulk Volume Information Retrieval (BVIR) change for LWORM Retention

VOLUME STATUS as well as CLOUD VOLUME MAP includes the LWORM Retention attributes for the logical volume.

5.1 VOLUME STATUS

5 new fields related to LWORM Retention attributes are added in the VOLUME STATUS output. The format is as follows. Please refer to BVIR white paper for the entire output format.

Field Name	Description

lworm retention flag	This field represents the currently bound LWORM retention flag assigned to the logical volume which is supported in 8.51PGA1 or above.
	
	The value is ORed of the following setting values used internally:
	`--- Retention Type ---`
	`0x00000000 – No retention`
	`0x00000001 – FIXED`
	`0x00000002 – HDR1`
	`--- HDR1 sub-options ---`
	`0x00000004 – NO_FIRST_HDR1_TREAT_AS_NO_DATE`
	`0x00000008 – HONOR_ALL_SUBSEQUENT_HDR1S`
	`0x00000010 – NO_HDR1_MOD_USE_FIXED`
	`0x00000020 – SUBSEQUENT_HDR1_HONOR_NO_DATE`
	`0x00000040 – SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE`
	`0x00000080 – APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE`
	`--- return-to-scratch option ---`
	`0x00001000– HONOR_RETURN_TO_SCRATCH`
	`0x00002000– USE_FIXED_DUR_ON_RETURN_TO_SCRATCH`
	
	This field is new to VOLUME STATUS version 11.

	The field is a numeric, unsigned integer (hexadecimal) field. Max length (3).

lworm retention fixed duration	This field represents the currently bound LWORM retention fixed duration assigned to the logical volume which is supported in 8.51PGA1 or above. The unit is "day" and the possible values are:
	
	`-1: Forever`
	
	`0: No retention adjustment (default value)`
	
	`N: 1-2928000 (up to 8000 years)`
	
	This field is new to VOLUME STATUS version 11.
	The field is a numeric field. Max length (6).

lworm retention application managed duration	This field represents the currently bound LWORM retention application managed duration assigned to the logical volume which is supported in 8.51PGA1 or above. The unit is "day" and the possible values are:
	
	`-1: Forever`
	
	`0: No retention adjustment (default value)`
	
	`N: 1-2928000 (up to 8000 years)`
	
	This field is new to VOLUME STATUS version 11.
	The field is a numeric field. Max length (6).

lworm retention time	The ending retention timestamp currently bound to the logical volume. in 8.51PGA1 or above. This field is applicable only if "lworm retention state" is set to "D" for date based retention. The format of the timestamp is: Year-Month-Day-Hour.Minute.Second.Microsecond for example: `2021-04-13-00.00.00.000000` If the volume is not LWORM-retained (i.e. the retention state is 'N'), 'NULL' is provided. If the volume is forever LWORM-retained (i.e. the retention state is 'F'), `'1970-01-01-00.00.00.000000'` (EPOC timestamp) is provided. This field is new to VOLUME STATUS version 11. The field is a timestamp field. Max length (26).

lworm retention state	This field represents the current LWORM retention state assigned of the logical volume which is supported in 8.51PGA1 or above. The possible values are:
	
	`'N': The volume is not LWORM-retained.`
	
	`'D': The volume is date based LWORM-retained.`
	
	`'F': The volume is forever LWORM-retained.`
	
	This field is new to VOLUME STATUS version 11.
	The field is a character field. Max length (1).

Table 6 BVIR VOLUME STATUS output format for LWORM Retention attributes

5.2 CLOUD VOLUME MAP

4 new fields related to LWORM Retention attributes are added in the CLOUD VOLUME MAP output. The format is as follows. Please refer to BVIR white paper for the entire output format.

Bytes	Name	Description
1139-1164	LWORM_RETENTION_TIME	The ending retention timestamp currently bound to the logical volume. The format of the timestamp is: Year-Month-Day-Hour.Minute.Second.Microsecond for example: `2021-04-13-00.00.00.000000` If the volume is not LWORM-retained (i.e. the retention state is 'N'), 'NULL' is provided. If the volume is forever LWORM-retained (i.e. the retention state is 'F'), '`1970-01-01-00.00.00.000000`' (EPOC timestamp) is provided.
1165	Field Delimiter	Blank character

1166	LWORM_RETENTION_FLAGS	The currently bound flag assigned to the logical volume when LWORM retention was applied. The value is ORed of the following setting values used internally:
		`--- Retention Type ---`
		`0x00000000 – No retention`
		`0x00000001 – FIXED`
		`0x00000002 – HDR1`
		`--- HDR1 sub-options ---`
		`0x00000004 – NO_FIRST_HDR1_TREAT_AS_NO_DATE`
		`0x00000008 – HONOR_ALL_SUBSEQUENT_HDR1S`
		`0x00000010 – NO_HDR1_MOD_USE_FIXED`
		`0x00000020 – SUBSEQUENT_HDR1_HONOR_NO_DATE`
		`0x00000040 – SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE`
		`0x00000080 – APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE`
		`--- return-to-scratch option ---`
		`0x00001000– HONOR_RETURN_TO_SCRATCH`
		`0x00002000– USE_FIXED_DUR_ON_RETURN_TO_SCRATCH`

1167-1187	Field Delimiter	Blank character

1188-1212	LWORM_RETENTION_FIXED_DUR	The currently bound fixed duration assigned to the logical volume when LWORM retention is applied. The unit is "day" and the possible values are:
		`-1: Forever`
		`0: No retention adjustment (default value)`

		N: 1-2928000 (up to 8000 years)
1213	Field Delimiter	Blank character
1214-1237	LWORM_RETENTION_APPL_DUR	The currently bound application managed duration assigned to the logical volume when LWORM retention is applied. The unit is "day" and the possible values are: -1: Forever 0: No retention adjustment (default value) N: 1-2928000 (up to 8000 years)
1238	Field Delimiter	Blank character

Table 7 BVIR CLOUD VOLUME MAP output format for LWORM Retention attributes

6 LWORM Retention logical volume example scenarios

This chapter gives some example scenarios when the fixed set of LWORM Retention options (#1 and #2) is applied.

Please refer to the following page to check IBM standard labels of the tape volume format: `https://www.ibm.com/support/knowledgecenter/SSLTBW_2.4.0/com.ibm.zos.v2r4.idam300/stan.htm`

6.1 Fixed Set #1

This section describes how the retention state/date are set on the target logical volume if the fixed set #1 of LWORM Retention options are applied.

6.1.1 Single Data Set Volume

Only a single dataset with a valid IBM standard format label HDR1 expiration date is written on a logical volume. The retention date is bound to the logical volume when the logical volume is demounted after a write to BOT:

Case	HDR1 expiration date (cYYddd)	Logical Volume Retention state/date
1	"021307" (valid future date)	D/2021-11-03-00.00.00.000000
2	" 97000" (no date)	F/-
3	" 99365" (application managed date)	F/-
4	No IBM standard format label HDR1 is written	N/NA

Table 8 Retention state/date on a single data set volume with #1 options

- Case 1: The logical volume is retained until 2021/11/03.
- Case 2: The logical volume is retained "forever" because the expiration date is "no date" and the fixed duration is set to forever. The retention date is calculated as "last host

write time + fixed duration (forever) + 1 day" with the option
APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE (Yes).
- Case 3: The logical volume is retained "forever" because the expiration date is
  "application managed date" and the application managed duration is set to forever with
  the option APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE (Yes).
- Case 4: The logical volume is not retained because there's no IBM standard format label
  HDR1 and HDR1 sub-option NO_FIRST_HDR1_TREAT_AS_NO_DATE is No.

6.1.2   Multiple Data Sets Volume

Multiple data sets with valid IBM standard format label HDR1 expiration dates are written
on a logical volume (example is three data sets). The retention date is set on the logical
volume when the volume is written on the write from BOT mount:

Case	HDR1 expiration date (cYYddd)			Logical Volume Retention state/date
	DS1	DS2	DS3	
1	"021307"	"022110"	"022030"	D/2022-04-20-00.00.00.000000
2	"021307"	" 00000"	"022030"	D/2022-01-30-00.00.00.000000
3	"021307"	"022110"	" 99366	D/2022-04-20-00.00.00.000000
4	" 98000"	"022110"	"022030"	F/-
5	No IBM standard format label HDR1 is written	"022110"	" 99000"	D/2022-04-20-00.00.00.000000

Table 9 Retention state/date on multiple (3) data sets volume with #1 options

- Case 1: The 2nd DS has the furthest expiration date (2022/110) among three dates,
  then it's honored.
- Case 2: The 2nd DS has "no date" but the HD1 sub-option
  SUBSEQUENT_HDR1_HONOR_NO_DATE is "No", then it's ignored. The 3rd DS has
  further expiration date (022030) than the 1st DS (021307), then it's honored.
- Case 3: The 3rd DS has "application managed date" but the HD1 sub-option
  SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE is "No", so it's ignored. The 2nd DS
  has a further expiration date (022110) than the 1st DS (021307), so it's honored.
- Case 4: The 1st DS has "no date" and the fixed duration is set to forever. The volume is
  retained "forever" and the other two expiration date are not considered.
- Case 5: The 1st DS has no IBM standard label HDR1 and sub-option
  NO_FIRST_HDR1_TREAT_AS_NO_DATE is No, so it's ignored. But
  HONOR_ALL_SUBSEQUENT_HDR1S is Yes so the 2nd DS expiration date is considered.
  The 3rd DS expiration date is ignored because SUBSEQUENT_HDR1_HONOR_NO_DATE
  is No. Therefore, the 2nd DS expiration date is honored.

6.1.3   Return to Scratch operation

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With this fixed set of LWORM Retention options, it is prohibited to return the target logical volume to scratch category until the retention date is expired because the option HONOR_RETURN_TO_SCRATCH is No. Once the retention date is expired, the logical volume can be returned to scratch. If it's moved back to private and modified, it may re-enter a retention state if the events apply to one or more configured rules.

Note: Once any logical volume is retained "forever", it can never be returned to scratch from that point forward.

6.2   Fixed Set #2

This section describes how the retention state/date are set on the target logical volume if the fixed set #2 of LWORM Retention options are applied.

As an example, the fixed duration = 10 days is used. Also, the data is written on Jan 10, 2021 (UTC).

6.2.1   Single Data Set Volume

Only a single dataset with a valid IBM standard format label HDR1 expiration date is written on a logical volume. The retention date is set on the logical volume:

Case	HDR1 expiration date (cYYddd)	Logical Volume Retention state/date
1	"021307" (valid future date)	D/2021-11-03-00.00.00.000000
2	" 97000" (no date)	D/2021-01-21-00.00.00.000000
3	" 99365" (application managed date)	N/NA
4	No IBM standard format label HDR1 is written	N/NA

Table 10 Retention state/date on a single data set volume with #2 options

- Case 1: The logical volume is retained until 2021/11/03.
- Case 2: The option APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE is Yes and "no date" is written. The retention date is calculated as "last host write time (Jan 10, 2021) + fixed duration (10 days) + 1 day".
- Case 3: The logical volume is not retained because the expiration date is "application managed date" and the application managed duration is 0 (none)
- Case 4: The logical volume is not retained because there's no IBM standard format label HDR1 and HDR1 sub-option NO_FIRST_HDR1_TREAT_AS_NO_DATE is No.

The retention state/date of the case 2 and 3 when using the "**Fixed Set #2**" options are the only differences from the results of using the "**Fixed set #1**" options.

6.2.2 Multiple Dataset Volume

Multiple datasets with valid IBM standard format label HDR1 expiration dates are written on a logical volume (example is three datasets). The resulting retention date set on the logical volume is displayed:

Case	HDR1 expiration date (cYYddd)			Logical Volume Retention state/date
	DS1	DS2	DS3	
1	"021307"	"022110"	"022030"	D/2022-04-20-00.00.00.000000
2	"021307"	" 00000"	"022030"	D/2022-01-30-00.00.00.000000
3	"021307"	"022110"	" 99366	D/2022-04-20-00.00.00.000000
4	" 98000"	"022110"	"022030"	D/2022-04-20-00.00.00.000000
5	No IBM standard format label HDR1 is written	"022110"	" 99000"	D/2022-04-20-00.00.00.000000

Table 11 Retention state/date on multiple (3) data sets volume with #2 options

- Case 1: The 2nd DS has the furthest expiration date (2022/110) among three dates, then it's honored.
- Case 2: The 2nd DS has "no date" but the HD1 sub-option SUBSEQUENT_HDR1_HONOR_NO_DATE is "No", so it's ignored. The 3rd DS has a further expiration date (022030) than the 1st DS (021307), so the 3rd DS is honored.
- Case 3: The 3rd DS has "application managed date" but the HDR1 sub-option SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE is "No", so it's ignored. The 2nd DS has a further expiration date (022110) than the 1st DS (021307), so the 2nd is DS is honored.
- Case 4: The 1st DS has "no date" and the fixed duration is 10 days. The retention date from 1st DS is "last host write time (Jan 10, 2021) + fixed duration (10 days) + 1 day" = Jan 21, 2021. The 2nd DS has the furthest expiration date among the three dates, so the 2nd DS date is honored.
- Case 5: The 1st DS has no IBM standard label HDR1 and sub-option NO_FIRST_HDR1_TREAT_AS_NO_DATE is No, so it's ignored. But HONOR_ALL_SUBSEQUENT_HDR1S is Yes, so the 2nd DS expiration date is considered. The 3rd DS expiration date is ignored because SUBSEQUENT_HDR1_HONOR_NO_DATE is No. Therefore, the 2nd DS expiration date is honored.

The retention state/date of the case 4 when using the "**Fixed Set #2**" is the only difference from the results of using the "**Fixed set #1**" options.

6.2.3 Return to Scratch operation

With the "Fixed Set #2" LWORM Retention options, it is prohibited to return the target logical volume to a scratch category until the retention date is expired because the option

HONOR_RETURN_TO_SCRATCH is No. Once the retention date is expired, the logical volume can be returned to scratch. If it's moved back to private and modified, it may re-enter a retention state if the events apply to one or more configured rules.

Note: Once any logical volume is retained "forever", it can never be returned to scratch from that point forward.

One difference between the Fixed #2 and #1 options is that the return to scratch option (USE_FIXED_DUR_ON_RETURN_TO_SCRATCH) is Yes on Fixed #2. With this option, the retention date is updated when the logical volume is returned to scratch. This provides a way to provide a more granular expire-hold state.

Given the logical volume in the example in 6.2.1 are returned to scratch on Nov 10, 2021, the retention date is updated as follows:

Case	HDR1 expiration date (cYYddd)	Logical Volume Retention state/date	Logical Volume Retention state/date after return-to-scratch
1	"021307" (valid future date)	D/2021-11-03-00.00.00.000000	D/2021-11-21-00.00.00.000000
2	" 97000" (no date)	D/2021-01-21-00.00.00.000000	D/2021-11-21-00.00.00.000000
3	" 99365" (application managed date)	N/NA	D/2021-11-21-00.00.00.000000
4	No IBM standard format label HDR1 is written	N/NA	D/2021-11-21-00.00.00.000000

Table 12 Retention state/date on multiple (3) data sets volume with #1 options

The fixed set #2 option can be used in the following use-case:
- No LWORM Retention is required while the target logical volume is in the private category.
- Z host writes the application managed date to IBM standard label HDR1 expiration date, then the volume is just LWORM capable (only append is allowed).
- It can be returned to scratch because LWORM Retention attributes are not applied. But, once the volume is returned to scratch, it becomes an LWORM Retention volume for N days (Fixed Duration).
- As a result, the volume data will be protected for N days from return to scratch.

This mechanism works similar to the existing scratch category expire-hold setting but per Data Class (not scratch category) granularity.

7 Logical Volume behavior while it's retained

The section 1.3 provides the summary of the difference between LWORM (8.6.x.x) and LWORM Retention (8.51.1.x) volume. This chapter provides LWORM Retention volume behavior while it's retained in comparison with LWORM volume. In the following sections, "LWORM volume" means a LWORM volume (8.6.x.x) and "LWORM Retention volume" means a LWORM volume in the retention state (8.51.1.x).

7.1 Return To Scratch

A standard LWORM volume can be returned to scratch at any time, so the data on the volume can be overwritten from BOT if no expire-hold applies.

A LWORM Retention volume can't be returned to scratch (until the retention date is expired) if its option HONOR_RETURN_TO_SCRATCH is No (8.51.1.x fixed set #1 and #2 both set No). If the option is Yes, LWORM Retention volume can be returned to scratch, but will enter a retained hold state until the retention date or any configured expire-hold date passes (greater of the two).

7.2 Scratch Mount

A standard LWORM volume may be selected for a scratch mount once it's returned to scratch and any configured category based expire-hold has passed.

A LWORM Retention volume does not support scratch mounts (fail with Error Recovery Action (ERA) 29 (write protect or read only)). Although an LWORM Retention volume can be returned to scratch with HONOR_RETURN_TO_SCRATCH=Yes option. If allowed to be returned to scratch, it will enter a retained hold state until the retention date or any configured expire-hold date passes (greater of the two). Only then will it be a candidate for scratch selection.

7.3 Delete-Expire processing

A standard LWORM volume can be auto-deleted by the scratch category delete-expire process after it's returned to scratch and delete-expire is enabled on the target scratch category.

A LWORM Retention volume is excluded from the scratch category delete-expire process. Therefore, it remains in an extended retained hold state until the retention period passes. Only then will any applicable delete-expire rule be applicable.

7.4 Volume Eject

A standard LWORM volume allows a volume eject once it's returned to scratch.

A LWORM Retention volume does not allow a volume to be ejected while still under retention. Since an LWORM Retention volume can be returned to scratch with HONOR_RETURN_TO_SCRATCH=Yes, it can still be scratched but will enter a retained hold state until the retention date or any configured expire-hold date passes (greater of the two). Only then can it be ejected.

7.5 Scratch Volume Inventory Count

A standard LWORM volume is included in the scratch volume inventory count request (such as /d sms,lib(xxxx), detail), unless it's in an expire-hold state.

A LWORM Retention volume is never included in the count until any retention period has passed and any expire-hold state has passed (greater of the two).

7.6 Copy Audit BVIR

An inconsistent standard LWORM volume is not reported in the Copy Audit BVIR if it's already in a scratch category.

An inconsistent LWORM Retention volume is still reported in the Copy Audit BVIR if it's already in a scratch category. When a cluster removal MES is attempted, it fails if any inconsistent LWORM Retention volumes are left although they're already returned to a scratch category. Once the retention period passes, it's excluded from the Copy Audit BVIR checks and no longer reported unless it again enters a retention state.

7.7 LI REQ, SETTING, COPY, SCRATCH

LI REQ, SETTING, COPY, SCRATCH setting controls the replication behavior of scratch volumes within a Grid.

A scratch standard LWORM volume follows always honors this setting. For example, if it's set to "NEVER", the scratch LWORM volume is never copied once in scratch.

A scratch LWORM Retention volume does not follow this setting. Although it's set to "NEVER", the scratch LWORM retention volumes under retention are always copied. Once the retention period passes, the LI REQ setting is honored unless it again enters a retention state.

8   Appendix A LWORM Retention options checklists

This sheet can be used as a check list to help record the following:
- What data class name or names are used to enable LWORM Retention function
  - ➢ The second page of the checklist helps accommodate multiple data classes.
- What LWORM Retention options should be set for the data class name
- Which cluster needs to enable LWORM Retention function for the data class name

<table>
<tr><td colspan="3">Data Class Name
ALL / Default / (   )</td><td colspan="2">Target cluster(s)?
All / C0 C1 C2 C3 C4 C5 C6 C7</td></tr>
<tr><td>☐</td><td>Fixed Set #1 (Refer to 3.1)</td><td>Retention Type (HDR1 or FIXED)</td><td></td><td>HDR1</td></tr>
<tr><td></td><td></td><td>HDR1 sub-options (Y or N)</td><td>NO_FIRST_HDR1_TREAT_AS_NO_DATE
HONOR_ALL_SUBSEQUENT_HDR1S
NO_HDR1_MOD_USE_FIXED
SUBSEQUENT_HDR1_HONOR_NO_DATE
SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE
APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE</td><td>N
Y
N
N
N
Y</td></tr>
<tr><td></td><td></td><td>Retention Duration (Forever/None/X days)</td><td>Fixed Duration
Application Managed Duration</td><td>F
F</td></tr>
<tr><td></td><td></td><td>Retention Return-To-Scratch (Y or N)</td><td>HONOR_RETURN_TO_SCRATCH
USE_FIXED_DUR_ON_RETURN_TO_SCRATCH</td><td>N
N</td></tr>
<tr><td>☐</td><td>Fixed Set #2 (Refer to 3.1)</td><td>Retention Type (HDR1 or FIXED)</td><td></td><td>HDR1</td></tr>
<tr><td></td><td></td><td>HDR1 sub-options (Y or N)</td><td>NO_FIRST_HDR1_TREAT_AS_NO_DATE
HONOR_ALL_SUBSEQUENT_HDR1S
NO_HDR1_MOD_USE_FIXED
SUBSEQUENT_HDR1_HONOR_NO_DATE
SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE
APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE</td><td>N
Y
N
N
N
Y</td></tr>
<tr><td></td><td></td><td>Retention Duration (Forever/None/X days)</td><td>Fixed Duration
Application Managed Duration</td><td>(   )
N</td></tr>
<tr><td></td><td></td><td>Retention Return-To-Scratch (Y or N)</td><td>HONOR_RETURN_TO_SCRATCH
USE_FIXED_DUR_ON_RETURN_TO_SCRATCH</td><td>N
Y</td></tr>
<tr><td>☐</td><td>Others (   )</td><td>Retention Type (HDR1 or FIXED)</td><td></td><td>(   )</td></tr>
<tr><td></td><td></td><td>HDR1 sub-options (Y or N)</td><td>NO_FIRST_HDR1_TREAT_AS_NO_DATE
HONOR_ALL_SUBSEQUENT_HDR1S
NO_HDR1_MOD_USE_FIXED
SUBSEQUENT_HDR1_HONOR_NO_DATE
SUBSEQUENT_HDR1_HONOR_APP_MANAGED_DATE
APPLY_FIXED_DURATION_FOR_HDR1_NO_DATE</td><td>(   )
(   )
(   )
(   )
(   )
(   )</td></tr>
<tr><td></td><td></td><td>Retention Duration (Forever/None/X days)</td><td>Fixed Duration
Application Managed Duration</td><td>(   )
(   )</td></tr>
<tr><td></td><td></td><td>Retention Return-To-Scratch (Y or N)</td><td>HONOR_RETURN_TO_SCRATCH
USE_FIXED_DUR_ON_RETURN_TO_SCRATCH</td><td>(   )
(   )</td></tr>
</table>

If multiple data class names need to be configured, this sheet can be used to summarize them. DEFAULT is considered a unique data class. If "All" is requested on the previous page, this page can be ignored.

LWORM Retention options	Data Class Name	Target Clusters
Fixed Set #1		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
Fixed Set #2		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
Others		
1. ( )		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
2. ( )		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7
		All / C0 C1 C2 C3 C4 C5 C6 C7

Table 2 Cloud Export Status Messages

You can copy and use these sheets when multiple data class names need to be set up. IBM support team will use this list to setup the special settings on each target cluster.

9 Appendix B Sample JCL to set the expiration date and some references to the expiration parameters

This is a sample JCL to set the expiration date to the target data set:

```
000100 //GENER2   JOB  MSGLEVEL=(1,1),MSGCLASS=A,CLASS=A,NOTIFY=&SYSUID
000200 //STEP1     EXEC PGM=IEBGENER
000300 //SYSPRINT  DD SYSOUT=*
000400 //*YSUT1    DD DSN=USER.PARMLIB(JES2PHM),DISP=SHR
000410 //SYSUT1    DD *
000420 TEST DATA
000430 /*
000500 //SYSUT2    DD UNIT=GRIDLIB3,DISP=(,KEEP),
000509 //          RETPD=1,
000510 //          DSN=TESTDS.TAPE.TEST
000511 //SYSIN     DD DUMMY
000520 /*
```

References to JCL DD statement RETPD/EXPDT parameters:
    RETPD parameter
    EXPDT parameter

Reference to data class attribute of Retpd/Expdt:
    Defining record and space attributes for data class

Reference to management class expiration attributes:
    Defining management class expiration attributes
    The use of expiration attributes and retention limit

Reference to OAM SETOAM statements for object tape storage (TAPEEXPIRATION):
    SETOAM statements for object tape storage