Enhanced Logical Record Cache

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Logical record cache

Logical record cache (LRC) definition

- What is logical record cache (LRC)?
  - Set of APIs and infrastructure to keep data in memory on TPF
  - Can be used to:
    - Reduce I/O needs
    - Reduce processing overhead to access data
  - Provided in TPF 4.1

LRC characteristics

- Many logical record caches can exist
  - A logical record cache can exist for specific functions
  - Examples: File system / DNS
- Use of logical record cache is not transparent to applications
  - Requires use of logical record cache APIs
    - Update data (or put data) in cache
    - Read data from cache
- Data access in a logical record cache is done with a primary key
  - Optionally a secondary key can be used
  - Both primary and secondary keys can be up to 256 bytes in size

LRC characteristics

- Records up to 4 K in size can be used in LRC
- Records in a specific cache must be the same size
- Ability to set time out values for data in the cache
  - Use cast out value
  - Prevent use of stale data
- When TPF IPLs:
  - Data is lost
  - Responsibility of the application to recreate and re-populate the cache

LRC characteristics

- Processor unique or processor shared cache
- Coupling Facility is used for processor shared cache
  - Update to data on one processor results in the data being not valid on all other processors in the complex
  - A read for the data on other processors will return “not in cache”
  - Applications responsibility to re-populate data in cache
- Intended for records with high read to write ratio

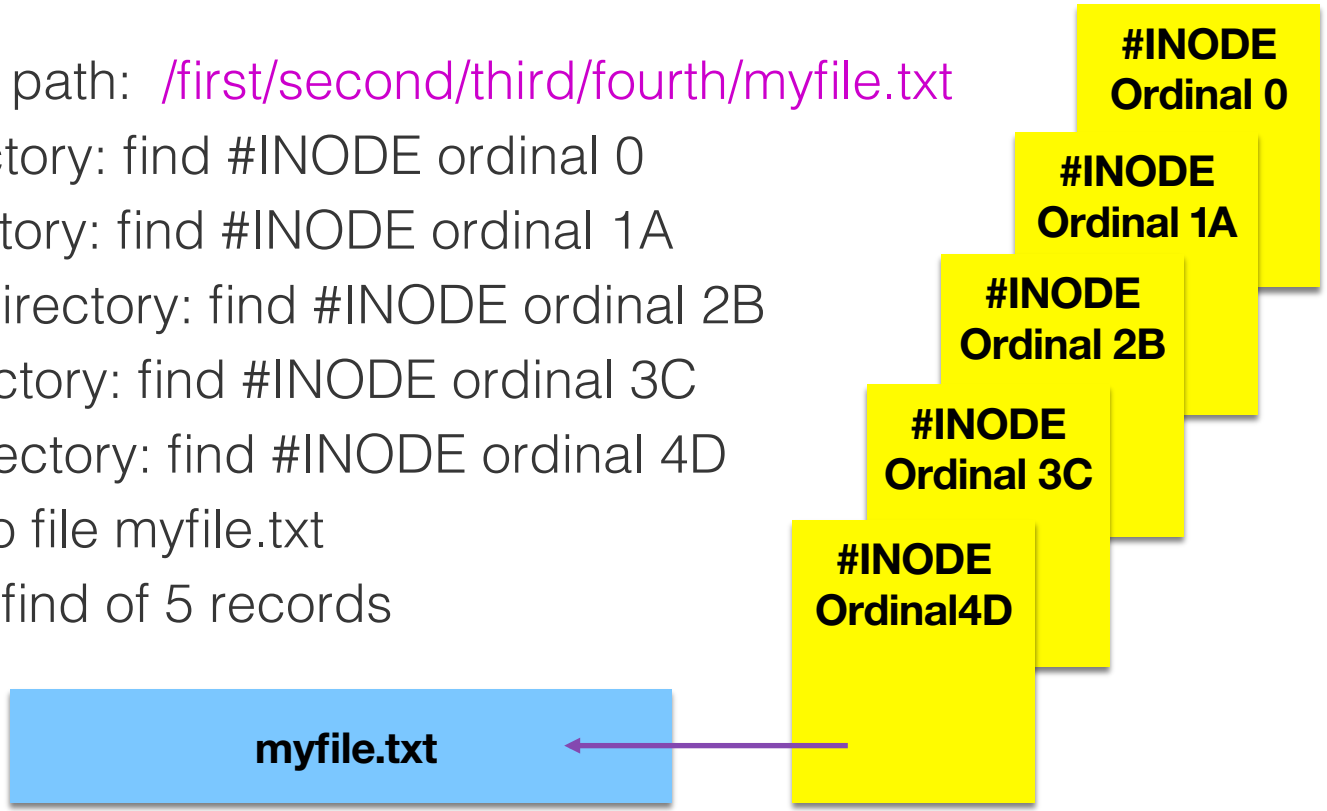
LRC vs VFA

- VFA is a cache for DASD records
  - Integrated into TPF find / file logic
  - No application changes requires to use VFA
  - One cache for all candidate records
- Why use logical record cache rather than VFA?
  - Use of keys in logical record cache can provide direct access to data compared to VFA

File system example without LRC

Open file using path: /first/second/third/fourth/myfile.txt

- For root directory: find #INODE ordinal 0
- For first directory: find #INODE ordinal 1A
- For second directory: find #INODE ordinal 2B
- For third directory: find #INODE ordinal 3C
- For fourth directory: find #INODE ordinal 4D
- Get access to file myfile.txt
- Requires the find of 5 records



File system example with LRC

Open file using path: /first/second/third/fourth/myfile.txt

- Initial access
  - Read all 5 records to get to #INODE ordinal 4D
  - #INODE ordinal 4D is put into logical record cache using primary key /first/second/third/fourth
- Subsequent accesses
  - Read primary key /first/second/third/fourth to get #INODE ordinal 4D
  - Get access to file myfile.txt
  - Requires the logical record cache access of 1 record
- If accessed frequently, significant savings can be realized

#INODE Ordinal 4D

LRC APIs

- Manage a cache
  - deleteCache()
  - flushCache()
  - newcache()
  - tpf_newcache_ext()
- Manage entries in a cache
  - deleteCacheEntry()
  - readCacheEntry()
  - tpf_updateCacheEntry_ext()
  - updateCacheEntry()

PJ42731 - Enhanced logical record cache

Problem

- Need ability to cache data entries that are larger than 4 K
- Need ability to cache data entries of different sizes

Enhancements

- PJ42731 is on PUT 13
- What is Enhanced logical record cache (ELRC)?
  - Same characteristics as LRC with the following enhancements
    - Individual entries in a cache can be larger than 4 K
    - Individual entries in a cache can be different sizes
  - Large data entries are managed as single entry
    - readCacheEntry() returns the entire entry
    - updateCacheEntry() writes the entire entry
    - If the entry is 16 K, read and update APIs treat entry as 16 K

Enhancements

- What is Enhanced logical record cache (ELRC)?
  - Same APIs as LRC
  - A cache is marked as ELRC when the cache is created
    - newCache() or tpf_newCache_ext()
    - ELRC is used when data_length parameter is greater than 4 K
  - ZCACH displays are updated
    - ZCACH DISPLAY ATTRIBUTES
    - ZCACH DISPLAY COUNTS
  - Updates to data collection / reduction
    - For both LRC and ELRC

ELRC usage

- Enhanced logical record cache (ELRC) is the underlying infrastructure for TPFDF cache
- Recommended use
  - High read to write ratio
  - Entries or objects that are greater than 4 K in size
    - readCacheEntry() will return a single entry
      - If the entry is 16 K in size, readCacheEntry() will return all 16 K
    - If a single entry is multiple 4 Ks, expect a savings over VFA due to reduced linkage costs

Example

```
==> ZCACH DISPLAY CTL
CSMP0097I 14.03.10 CPU-B SS-BSS  SSU-HPN  IS-01
CACH0002I 14.03.10 CACHE CONTROL AREA DISPLAY
NAME  IVFS_FS_DIR , ADDR  00000009F3892000
NAME  TPF_RECBUF  , ADDR  00000009F38F3000
NAME  IFFS_ICACHE , ADDR  00000009F3E42000
NAME  IPFS_ICACHE , ADDR  00000009F3E4D000  _
NAME  TPF_FS_DIR  , ADDR  00000009F3E58000
NAME  TPF_FS_INODE, ADDR  00000009F3EAC000
NAME  IPRCFF009490, ADDR  00000009F41F9000
NAME  ISYSFF005650, ADDR  00000009F5BAC000
NAME  ITPFDFFILES , ADDR  00000009F7C00000
NAME  ISYSFE01AE70, ADDR  00000009F9500000
NAME  IDNSHOSTADDR, ADDR  00000009FAEFE000  _
NAME  IDNSHOSTNAME, ADDR  00000009FC497000
DISPLAY COMPLETE+
```

Example

```
==> ZCACH DISPLAY ATTRIBUTES IVFS_FS_DIR
CSMP0097I 14.03.57 CPU-B SS-BSS  SSU-HPN  IS-01
CACH0035I 14.03.57 CACHE ATTRIBUTE DISPLAY
NAME  IVFS_FS_DIR , ADDR  00000009F3892000
CACHE ATTRIBUTES: TRADITIONAL, PROCESSOR UNIQUE, NOT CONNECTED TO CF,
                  CACHE CREATION/DELETION NOT SYNCHRONIZED
NUMBER CACHE ENTRIES DEFINED 1323 _
NUMBER HASH ENTRIES DEFINED  661
PRIMARY KEY SIZE  64  SECONDARY KEY SIZE  16
MAX ENTRY SIZE    88
CAST OUT TIME     3600
DISPLAY COMPLETE
```

Example

```
==> ZCACH DISPLAY ATTRIBUTES ITPFDFFILES
CSMP0097I 14.04.29 CPU-B SS-BSS  SSU-HPN  IS-01
CACH0035I 14.04.29 CACHE ATTRIBUTE DISPLAY
NAME  ITPFDFFILES , ADDR  00000009F7C00000
CACHE ATTRIBUTES: EXTENDED, PROCESSOR SHARED, CONNECTED TO CF,
                  CACHE CREATION/DELETION SYNCHRONIZED
NUMBER CACHE ENTRIES DEFINED 125002 _
NUMBER HASH ENTRIES DEFINED  62497
PRIMARY KEY SIZE  8  SECONDARY KEY SIZE  4
MAX ENTRY SIZE    512000000
CAST OUT TIME     0
EXTENDED CACHE INFORMATION FOR LARGE CACHES
TOTAL MEMORY USABLE BY CACHE ENTRIES     513032192
DISPLAY COMPLETE
```

Example

```
==> ZCACH DISPLAY COUNTS ITPFDFFILES
CSMP0097I 14.05.20 CPU-B SS-BSS  SSU-HPN  IS-01
CACH0036I 14.05.20 CACHE DATA COLLECTION COUNTER DISPLAY
NAME  ITPFDFFILES , ADDR  00000009F7C00000
NUMBER CACHE ENTRIES DEFINED 125002
NUMBER CACHE ENTRIES IN USE  6165
CAST OUT TIME                0
CALLS      579101445   MISSED     38521203    _
CASTOUTS   0   UPDATES    11595182   INVALIDATED    27171003
DUPLICATE HASH REFUSALS      0
EXTENDED CACHE INFORMATION FOR LARGE CACHES
TOTAL MEMORY USABLE BY CACHE ENTRIES     513032192
MEMORY ACTUALLY IN USE BY CACHE ENTRIES  124526592
AVERAGE CACHE ENTRY SIZE                 20198
DISPLAY COMPLETE
```

Summary

- Both LRC and ELRC
  - Provide ability to reduce I/Os
  - Provide ability to invalidate records in cache in loosely coupled complex using a CF
- ELRC
  - Provide ability to cache data entries that are larger than 4 K
  - Provide ability to cache data entries of different sizes
- Available for all customers (loosely coupled and non-loosely coupled)

Thank you!

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