z/OS 3.2 IBM Education Assistant

Solution Name: RSM – IARQUERY – PFTCADS protection

Solution Element(s): RSM, SMF

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Agenda

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  - None

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Objectives

- Improve system security by restricting non-authorized users view of how memory is used
- Enhance the IARQUERY macro to allow authorized invokers to obtain memory usage data

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Overview

- Who (Audience)
  - All users of z/OS 3.2
- What (Solution)
  - Introduce parmlib option to eliminate access to the PFTCADS
  - Introduce new options on IARQUERY to provide additional information about how memory is used
  - Introduce parmlib option to restrict usage of IARR2V to authorized users (or unauthorized users who have access to the storage)
  - Introduce a new SMF30 field to indicate unauthorized usage of IARR2V
- Wow (Benefit / Value, Need Addressed)
  - Enhanced security
  - Additional features on IARQUERY that ISVs requested
    - More accurate representation of how memory is used

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Usage & Invocation

- New IARQUERY macro options
- New iarquaa_RRImplicitlyFixed for REQINFO=REAL

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Usage & Invocation – details 1

- REQINFO=VIRTUAL
  - Provide information about a virtual range
  - Provides information about the backing real storage (if the virtual is backed) similar to what REQINFO=REAL would return
  - VIRTUALINFO=YES option will attempt to return additional information, even when the page is not backed in real
  - Possible applications:
    - Check the fix count of a page or check that a page is implicitly fixed
    - Check whether a page of storage has been shared
- REQINFO=DSFRAMECOUNT
  - Returns frame counts for either all the data spaces owned by an address space or just 1 data space
  - Also returns some additional attributes of the data spaces like the NAME, STOKEN, scope etc.
- REQINFO=LOCALCOUNTS
  - Returns address space level frame usage counts

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Usage & Invocation – details 2

- REQINFO=GLOBALCOUNTS
  - Provide system wide information about frame usage
- REQINFO=CONFIGCOUNTS
  - Returns the amount of online and offline real storage
- REQINFO=DIVCOUNTS
  - Returns DIV mapped (or USS mapped) pages backed in real

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Interactions & Dependencies

- Software Dependencies
  - None
- Hardware Dependencies
  - None
- Exploiters
  - ISVs will exploit IARQUERY

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Upgrade & Coexistence Considerations

- To exploit this solution, all systems in the Plex must be at the new z/OS level: No
- Unless the new parmlib options in IARPRMxx are used (set to YES), there are no changes 3.1 behavior

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Installation & Configuration

- IARPRMxx
  - RESTRICTPFTCADS=NO|YES
  - IARR2V_REQAUTH=NO|YES
- IBM recommends that you do not enable these settings without first getting assurances from your ISVs that they their products are not impacted.
- SMF30_UnauthCaller – can be used to determine whether there are any violations of the IARR2V restriction

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Summary

- New IARPRMxx statements are introduced to enhance security
  - Eliminate access to the PFTCADS
  - Restrict usage of IARR2V to authorized callers or callers who can access the storage
- IARQUERY is enhanced to allow users to obtain information about real storage usage that they would previously been able to obtain through direct access to the PFTCADS

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Appendix

- z/OS MVS Initialization and Tuning Reference
- z/OS MVS Authorized Assembler Services Reference volume 2
- z/OS MVS System Management Facilities (SMF)

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Appendix – IARQUERY macro syntax

```
IARQUERY  Ð  REQINFO=REAL                                          +
          |     ,INSTARTADDR=xinstartaddr                          +
          |     ,INCOUNT4K=xincount4k                              +
          |     ,OUTANSAREA=xoutansarea                            +
          |     ,INANSLEN=xinanslen                                +
          |    Ý,INSTOKEN=»xinstoken|0°                            +
          |       Ý,INCLUDEDS=»NO|YES°¨¨                           +
          Ô ,REQINFO=VIRTUAL                                       +
          |     ,INSTARTADDR=xinstartaddr                          +
          |     ,INCOUNT4K=xincount4k                              +
          |     ,OUTANSAREA=xoutansarea                            +
          |     ,INANSLEN=xinanslen                                +
          |   ÐÝ,VIRTUALINFO=NO                                    +
          |   |    Ý,INALET=»xinalet|0°¨                          +
          |   |    Ý,SERIALIZE=»YES|NO°¨¨                         +
          |   ¿Ý,VIRTUALINFO=YES                                   +
          |       Ý,INSTOKENPRIMARY                                +
          |                          =»xinstokenprimary|PR         +
          |                          IMARYSPACE°¨¨                 +
          Ô ,REQINFO=DSFRAMECOUNT                                  +
          |     ,OUTANSAREA=xoutansarea                            +
          |     ,INANSLEN=xinanslen                                +
          |    Ý,INSTOKENPRIMARY                                   +
          |                       =»xinstokenprimary|PRIMAR        +
          |                       YSPACE°¨                         +
          Ô ,REQINFO=LOCALCOUNTS                                   +
          |     ,OUTANSAREA=xoutansarea                            +
          |     ,INANSLEN=xinanslen                                +
          |    Ý,INSTOKENPRIMARY                                   +
          |                       =»xinstokenprimary|PRIMAR        +
          |                       YSPACE°¨                         +
          Ô ,REQINFO=GLOBALCOUNTS                                  +
          |     ,OUTANSAREA=xoutansarea                            +
          |     ,INANSLEN=xinanslen                                +
          Ô ,REQINFO=CONFIGCOUNTS                                  +
          |     ,OUTANSAREA=xoutansarea                            +
          |     ,INANSLEN=xinanslen                                +
          ¿ ,REQINFO=DIVCOUNTS                                     +
                ,OUTANSAREA=xoutansarea                            +
                ,INANSLEN=xinanslen                                +
               Ý,INSTOKENPRIMARY                                   +
                                 =»xinstokenprimary|PRIMAR         +
                                 YSPACE°¨                          +
           Ý,RETCODE=xretcode¨                                     +
           Ý,RSNCODE=xrsncode¨                                     +
           Ý,PLISTVER=»xplistver|IMPLIED_VERSION°¨                 +
```

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Appendix – IARQUERY output - VIRTUAL 1

```
*  Usage notes:
*   - For VIRTUALINFO=NO, if Iarquaa_VrValidInReal = 0 and
*     Iarquaa_VrIOInProgress = 0 then the only
*     valid fields are:
*       (1) Iarquaa_VrVsa
*       (2) Iarquaa_VrRangeSize
*     Iarquaa_VrVirtInfoFlags is never set regardless of the
*     value Iarquaa_VrValidInReal.
*
*   - For VIRTUALINFO=YES, if Iarquaa_VrValidInReal = 0 and
*     Iarquaa_VrIOInProgress = 0 then there is no frame
*     associated with this page and all frame related data is
*     not returned, except for FrameSize which is the set to
*     the expected size of the frame if it were in real. Also
*     note that virtual information may still be returned.
*
*
*
                        AIF   ('&DSECT' EQ 'YES').L001C
Iarquaa_VirtualRecord DS    0D
                        AGO   .L001D
.L001C                  ANOP
Iarquaa_VirtualRecord DSECT
.L001D                  ANOP
Iarquaa_VrStdHdr        DS    CL8     Standard record header
                        ORG   Iarquaa_VrStdHdr
Iarquaa_VrRecordType    DS    CL2
Iarquaa_VrVersion       DS    X       Version
                        DS    CL1     Unused
Iarquaa_VrLen           DS    H       Length of this record
Iarquaa_VrNextOffset    DS    H       Offset from the start of this    *
                                      record to the start of the next  *
                                      Iarquaa_VirtualRecord. Zero if no*
                                      next record.
Iarquaa_VrRSA           DS    AD      Real address associated with the *
                                      page. Set when                   *
                                      Iarquaa_VrValidInReal or         *
                                      Iarquaa_VrIOInProgress is set.   *
                                      Otherwise, there is no backing real
Iarquaa_VrVSA           DS    AD      VSA
Iarquaa_VrShareToken    DS    CL8     Set when either (1)              *
                                      IARQUAA_VrValidInReal (or        *
                                      Iarquaa_VrIOInProgress) is set and*
                                      Iarquaa_VrUsage=Iarquaa_kU       *
                                      sageSharedGroup or when          *
                                      Iarquaa_VrVirtualInfoObtained and*
                                      Iarquaa_VrShareGroup is on
Iarquaa_VrRangeSize     DS    FL8     Amount of virtual storage in 4k  *
                                      units that this record represents.*
                                      Each 4k unit has the same        *
                                      attributes except that the VSA (if*
                                      applicable) increases by 4k for  *
                                      each unit.
```

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Appendix – IARQUERY output - VIRTUAL 2

```
Iarquaa_VrFlags2        DS    B       Flag byte 2
*  Bit definitions:
Iarquaa_VrTransition    EQU   X'80'   Frame is in transition from one  *
                                      state to another
                        ORG   Iarquaa_VrFlags+2
Iarquaa_VrOwningAsid    DS    BL2     0 for common and shared. For 31  *
                                      share segments, contains the Asid *
                                      associated with the source data  *
                                      space. Set when either           *
                                      Iarquaa_VrValidInReal (or        *
                                      Iarquaa_VrIoInProgress) is set or *
                                      Iarquaa_VrVirtualInfoObtained is *
                                      set. Otherwise, value is unknown.
Iarquaa_VrRealStorageData1 DS CL8   Below fields only valid when     *
                                      Iarquaa_VrValidInReal (or        *
                                      Iarquaa_VrIoInProgress) is set.
                        ORG   Iarquaa_VrRealStorageData1
Iarquaa_VrFixCount      DS    F       Fix count.
Iarquaa_VrFrameType     DS    BL2     Frame type flags
                        ORG   Iarquaa_VrFrameType
Iarquaa_VrFrameType1    DS    B       Frame Type Flag 1
Iarquaa_VrFrameType2    DS    B       Frame Type Flag 2
Iarquaa_VrUsage         DS    H       Frame usage
Iarquaa_VrFrameSize     DS    X       Frame size or page size. Will be *
                                      zero if the frame size is unknown. *
                                      Set when Iarquaa_VrValidInReal (or *
                                      Iarquaa_VrIOInProgress) or       *
                                      (Iarquaa_VrVirtualInfoObtained &  *
                                      Iarquaa_VrAllocated). Possibly set *
                                      in other instances where         *
                                      Iarquaa_VrAllocated is not set, but *
                                      the frame size is still known.
Iarquaa_VrKeyFP         DS    B       Key and Fetch Protect status. Valid *
                                      when Iarquaa_VrKeyFpValid is set
*  Bit definitions:
Iarquaa_VrKey           EQU   X'F0'   Storage key
Iarquaa_VrFP            EQU   X'08'   Storage is fetch protected
Iarquaa_VrKeyFPValid    EQU   X'01'   Storage key and fetch protect      *
                                      status are valid (set when       *
                                      Iarquaa_VrValidInReal,           *
                                      Iarquaa_VrIoInProgress or        *
                                      (Iarquaa_VrVirtualInfoObtained and *
                                      either Iarquaa_VrAllocated is set *
                                      or Iarquaa_VrUsage=Iarq          *
                                      uaa_kUsageFreemained)
                        DS    CL2
                        DS    CL8
Iarquaa_VrVirtInfoFlags DS  CL8
                        ORG   Iarquaa_VrVirtInfoFlags
Iarquaa_VrVirtInfoFlags1 DS B       When VirtualInfo=YES,            *
                                      Iarquaa_VrVirtualInfoObtained is *
                                      not set in the following cases: (1) *
                                      Certain 31-bit private segment   *
                                      invalid cases (2) Certain dataspace *
                                      segment invalid cases
```

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Appendix – IARQUERY output – VIRTUAL 3

```
                                  status are valid (set when           *
                                  Iarquaa_VrValidInReal,               *
                                  Iarquaa_VrIoInProgress or            *
                                  (Iarquaa_VrVirtualInfoObtained and   *
                                  either Iarquaa_VrAllocated is set    *
                                  or Iarquaa_VrUsage=Iarq              *
                                  uaa_kUsageFreemained)
                        DS    CL2
                        DS    CL8
Iarquaa_VrVirtInfoFlags DS    CL8
                        ORG   Iarquaa_VrVirtInfoFlags
Iarquaa_VrVirtInfoFlags1 DS B       When VirtualInfo=YES,              *
                                  Iarquaa_VrVirtualInfoObtained is     *
                                  not set in the following cases: (1)  *
                                  Certain 31-bit private segment       *
                                  invalid cases (2) Certain dataspace  *
                                  segment invalid cases
*  Bit definitions:
Iarquaa_VrVirtualInfoObtained EQU X'80' Indicates that virtual         *
                                  information was obtained and the     *
                                  other bits in                        *
                                  Iarquaa_VrVirtInfoFlags were         *
                                  properly set.
Iarquaa_VrAllocated   EQU   X'40'  Page is in use. For 64 bit storage  *
                                  this indicates there is a memory     *
                                  object that contains the address.    *
                                  For data spaces this means the       *
                                  address is within the data space     *
                                  limits. For 24/31 bit storage it     *
                                  indicates that the page is either    *
                                  permanent (like the nucleus),        *
                                  storage obtained or system           *
                                  allocated for some other reason
Iarquaa_VrIEP         EQU   X'20'  Page is subject to IEP protection
Iarquaa_VrHiddenGuarded EQU X'10'  Page is hidden or guarded
Iarquaa_VrStoreProtected EQU X'04' Page is store protected
Iarquaa_VrVirtInfoFlags2 DS B
*  Bit definitions:
Iarquaa_VrOnDASD      EQU   X'80'  Page is on DASD AUX storage
Iarquaa_VrOnSCM       EQU   X'40'  Page is on SCM AUX storage
Iarquaa_VrSharedGroup EQU   X'20'  Page is in a Shared Group and      *
                                  Iarquaa_VrShareToken contains the    *
                                  share token
Iarquaa_VrOnDIV       EQU   X'10'  Page is on a DIV object or USS      *
                                  mapped file
Iarquaa_VrVIO         EQU   X'08'  Page is a VIO Page
Iarquaa_VrMapped      EQU   X'04'  Page is DIV or USS mapped
Iarquaa_VrOnVioDataset EQU  X'01'  Page is on a VIO dataset.
Iarquaa_VrVirtInfoFlags3 DS B
Iarquaa_VrVirtInfoFlags4 DS B
                        ORG   Iarquaa_VrVirtInfoFlags+8
                        DS    CL32   Reserved for future use.
Iarquaa_VrVersion1    EQU   1      HBB77F0
Iarquaa_VrVersionCurrent EQU 1     Current Version
Iarquaa_VirtualRecord_Len EQU *-Iarquaa_VirtualRecord
```

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Appendix – IARQUERY output - DSFRAMECOUNT

```
*  ********************************************************************
*
*    Local Data space count record
*
*    Returned by IARQUERY REQINFO=DsFrameCount
*
*  ********************************************************************
*
*
                        AIF   ('&DSECT' EQ 'YES').L0020
Iarquaa_DsCtrRecord     DS    0D
                        AGO   .L0021
.L0020                  ANOP
Iarquaa_DsCtrRecord     DSECT
.L0021                  ANOP
Iarquaa_DsCtrStdHdr     DS    CL8     Standard record header
                        ORG   Iarquaa_DsCtrStdHdr
Iarquaa_DsCtrRecordType DS    CL2
Iarquaa_DsCtrVersion    DS    X       Version
                        DS    CL1     Unused
Iarquaa_DsCtrLen        DS    H       Length of this record
Iarquaa_DsCtrNextOffset DS    H       Offset from the start of this       *
                                      record to the start of the next     *
                                      record. Zero if no next record.
Iarquaa_DsCtrOwnersStoken DS  CL8     STOKEN of the owning address space
Iarquaa_DsCtrFlags      DS    CL4
                        ORG   Iarquaa_DsCtrFlags
Iarquaa_DsCtrScope      DS    X
Iarquaa_DsCtrKeyFP      DS    B
Iarquaa_DsCtrFlags1     DS    CL1
*   Bit definitions:
Iarquaa_DsctrScrollHiperspace EQU X'80' Space is a scroll hiperspace
Iarquaa_DsctrCacheHiperspace EQU X'40' Space is a Cache Hiperspace
Iarquaa_DsctrCastoutNo EQU  X'20'  Space is not a CASTOUT=YES Cache     *
                                   hiperspace
Iarquaa_DsctrDref       EQU   X'10'  Pages for the space are DREF
Iarquaa_Dsctr1MPage     EQU   X'08'  Pages for the space may be           *
                                   formatted as 1M
                        ORG   Iarquaa_DsCtrFlags+4
Iarquaa_DsCtrDsname     DS    CL8     The name of the data space
Iarquaa_DsCtrDsStoken   DS    CL8     The STOKEN of the data space
Iarquaa_DsCtr4KFrameCount DS  F       Count of 4K frames backing data in  *
                                      the space, as well as DAT tables.
Iarquaa_DsCtr1MFrameCount DS  F       Count of 1M frames backing data in  *
                                      the space
Iarquaa_DsCtrMaxBlocks DS     F       Maximum size possible for this data *
                                      space (in units of blocks). the     *
                                      current size of the dataspace can   *
                                      never be extended.
Iarquaa_DsCtrMaxVsa     DS    F       Maximum virtual storage address for *
                                      this data space at its current      *
                                      size.
                        DS    CL36    Reserved for future use.
Iarquaa_DsCtrVersion1   EQU   1       HBB77F0
Iarquaa_DsCtrVersionCurrent EQU 1  Current Version
Iarquaa_DsCtrRecord_Len EQU *-Iarquaa_DsCtrRecord
```

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Appendix – IARQUERY output - LOCALCOUNTS

```
*
*   Local count record
*
*   Returned by IARQUERY REQINFO=LocalCounts
*
* ********************************************************************
*
*
                        AIF   ('&DSECT' EQ 'YES').L0024
Iarquaa_LCtrRecord      DS    0D
                        AGO   .L0025
.L0024                  ANOP
Iarquaa_LCtrRecord      DSECT
.L0025                  ANOP
Iarquaa_LCtrStdHdr      DS    CL8     Standard record header
                        ORG   Iarquaa_LCtrStdHdr
Iarquaa_LCtrRecordType DS   CL2
Iarquaa_LCtrVersion     DS    X       Version
                        DS    CL1     Unused
Iarquaa_LCtrLen         DS    H       Length of this record
Iarquaa_LCtrNextOffset DS   H       Offset from the start of this       *
                                    record to the start of the next     *
                                    record. Zero if no next record.
Iarquaa_LCtrOwnersStoken DS CL8     STOKEN of the owning address space
Iarquaa_LCtrFixedFrames DS  FL8     Number of frames in 4K units that   *
                                    are fixed in the address space
Iarquaa_LCtrFixed24Frames DS FL8    Number of frames in 4K units that   *
                                    are fixed below 16M
Iarquaa_LCtrFixedLSQAFrames DS FL8 Number of fixed LSQA frames owned    *
                                    by the address space
Iarquaa_LCtrDrefFrames DS   FL8     Number of DREF frames in real       *
                                    storage
Iarquaa_LCtrFixed31Frames DS FL8    Number of frames in 4k units        *
                                    between 16M and 2G that are fixed
Iarquaa_LCtr1MPagesBackedInReal DS FL8 Number of 1M pages backed in    *
                                    real
Iarquaa_LCtr2GPagesBackedInReal DS FL8 Number of 2G pages backed in    *
                                    real
                        DS    CL32    Reserved for future use.
Iarquaa_LCtrVersion1    EQU   1       HBB77F0
Iarquaa_LCtrVersionCurrent EQU 1    Current Version
Iarquaa_LCtrRecord_Len EQU  *-Iarquaa_LCtrRecord
.L0022                  ANOP
```

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Appendix – IARQUERY output - GLOBALCOUNTS

```
*********************************************************************
*
*   Global count record
*
*   Returned by IARQUERY REQINFO=GlobalCounts
*
*********************************************************************
*
*
                    AIF   ('&DSECT' EQ 'YES').L0028
Iarquaa_GctrRecord  DS    0D
                    AGO   .L0029
.L0028              ANOP
Iarquaa_GctrRecord  DSECT
.L0029              ANOP
Iarquaa_GctrStdHdr  DS    CL8     Standard record header
                    ORG   Iarquaa_GctrStdHdr
Iarquaa_GctrRecordType DS CL2
Iarquaa_GctrVersion DS    X       Version
                    DS    CL1     Unused
Iarquaa_GctrLen     DS    H       Length of this record
Iarquaa_GctrNextOffset DS H       Offset from the start of this *
                                  record to the start of the next *
                                  record. Zero if no next record.
Iarquaa_GctrCsaFrames DS  FL8     Count of 4k frames backing CSA
Iarquaa_GctrCsaFixedFrames DS FL8 Count of 4k fixed frames backing *
                                  CSA
Iarquaa_GctrPlpaFrames DS FL8     Number of PLPA frames backed in *
                                  real
Iarquaa_GctrPlpaFixedFrames DS FL8 Number of fixed PLPA frames
Iarquaa_GctrSqaFrames DS  FL8     Number of SQA frames backed in real
Iarquaa_GctrLsqaFrames DS FL8     Number of LSQA frames backed in *
                                  real
Iarquaa_GctrSqaDrefFrames DS FL8  Number of DREF SQA frames backed in *
                                  real
Iarquaa_GctrLsqaDrefFrames DS FL8 Total DREF real storage in use *
                                  across all address spaces
                    DS    CL32    Reserved for future use.
Iarquaa_GCtrVersion1 EQU  1       HBB77F0
Iarquaa_GCtrVersionCurrent EQU 1  Current Version
Iarquaa_GctrRecord_Len EQU *-Iarquaa_GctrRecord
.L0026              ANOP
```

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Appendix – IARQUERY output - CONFIGCOUNTS

```
*********************************************************************
*
*   Configuration Count record
*
*   Returned by IARQUERY REQINFO=CONFIGCOUNTS
*
*********************************************************************
*
*
                    AIF   ('&DSECT' EQ 'YES').L002C
Iarquaa_CctrRecord  DS    0D
                    AGO   .L002D
.L002C              ANOP
Iarquaa_CctrRecord  DSECT
.L002D              ANOP
Iarquaa_CCtrStdHdr  DS    CL8     Standard record header
                    ORG   Iarquaa_CCtrStdHdr
Iarquaa_CCtrRecordType DS CL2
Iarquaa_CCtrVersion DS    X       Version
                    DS    CL1     Unused
Iarquaa_CCtrLen     DS    H       Length of this record
Iarquaa_CCtrNextOffset DS H       Offset from the start of this       *
                                  record to the start of the next     *
                                  record. Zero if no next record.
Iarquaa_CCtrOnlineFrames DS FL8   Number of online frames in 4k       *
                                  units. This is for the entire       *
                                  system, including Dedicated Memory
Iarquaa_CCtrOfflineFrames DS FL8  Number of offline frames in 4k      *
                                  units. This is for the entire       *
                                  system, indluding Dedicated Memory
                    DS    CL32    Reserved for future use.
Iarquaa_CCtrVersion1  EQU   1     HBB77F0
Iarquaa_CCtrVersionCurrent EQU 1  Current Version
Iarquaa_CctrRecord_Len EQU  *-Iarquaa_CctrRecord
.L002A              ANOP
                    AIF   ('&Iarquaa_DivCtrRecord' EQ 'NO').L002E
                    AIF   ('&DSECT' EQ 'YES').L002E
```

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Appendix – IARQUERY output - DIVCOUNTS

```
*********************************************************************
*
*   DIV Count record
*
*   Returned by IARQUERY REQINFO=DIVCOUNTS
*
*********************************************************************
*
*
                      AIF   ('&DSECT' EQ 'YES').L0030
Iarquaa_DivCtrRecord  DS    0D
                      AGO   .L0031
.L0030                ANOP
Iarquaa_DivCtrRecord  DSECT
.L0031                ANOP
Iarquaa_DivCtrStdHdr  DS    CL8     Standard record header
                      ORG   Iarquaa_DivCtrStdHdr
Iarquaa_DivCtrRecordType DS CL2
Iarquaa_DivCtrVersion DS    X       Version
                      DS    CL1     Unused
Iarquaa_DIVCtrLen     DS    H       Length of record
Iarquaa_DivCtrNextOffset DS H       Offset from the start of this
                                    record to the start of the next
                                    record. Zero if no next record.
Iarquaa_DivCtrStoken  DS    CL8
Iarquaa_DivCtrFlags   DS    CL8
Iarquaa_DivCtrASFrames DS   FL8     Number of frames backing DIV mapped
                                    address space pages in 4k units
Iarquaa_DivCtrDSFrames DS   FL8     Number of frames backing DIV mapped
                                    data space pages in 4k units
                      DS    CL32    Reserved for future use.
Iarquaa_DivCtrVersion1 EQU  1       HBB77F0
Iarquaa_DivCtrVersionCurrent EQU 1 Current Version
Iarquaa_DivCtrRecord_Len EQU *-Iarquaa_DivCtrRecord
```

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