Non-Reusable Address Space IDs

The number of address space IDs is a fixed number in the system and remains fixed for the duration of an IPL. Parameter in IEASYSxx in PARMLIB specifies a value that the system uses to limit the number of address spaces that can run concurrently during a given IPL. This number includes time sharing jobs, batch jobs, started tasks, system tasks, and the master scheduler, JES2 or JES3.

In z/OS a terminated address space that owned a system LX becomes permanently non-reusable. If a cross memory binding is made to any other address spaces, they also become permanently non-reusable.

An address space which owns a non-system LX may be temporarily non-reusable. When an address space terminates (call this one ASID_X) for which there is a cross memory binding from some other address space (call this one ASID_Y) into the just terminated address space ASID_X, this ASID is not usable until the cross memory binding is terminated. This normally occurs when the address space which has the binding (ASID_Y in our example) terminates. When an address space is terminated that has latent bindings you will see messages on the console and the syslog that look like:

```
 C P5SRV1C.P5SRV1C,A=004A
STC06881 00000010  IEF450I P5SRV1C P5SRV1C - ABEND=S222 U0000 REASON=00000000
STC06881 00000010  IEF352I ADDRESS SPACE UNAVAILABLE
STC06881 00000010  $HASP395 P5SRV1C  ENDED
```

Therefore, the address space with ASID=004A associated with Started Task P5SRV1C is not reusable. This could be a temporary or permanent situation but cannot be determined from message IEF352I. Please note, it does not matter whether you cancel or stop the ASID, you will get the same behavior.

z/OS monitors the number of address spaces in use on a two minutes interval and issues various messages:

```
IEA059E ASID SHORTAGE HAS BEEN DETECTED
IEA060I ASID SHORTAGE HAS BEEN RELIEVED
IEA061E REPLACEMENT ASID SHORTAGE HAS BEEN DETECTED
IEA062I REPLACEMENT ASID SHORTAGE HAS BEEN RELIEVED
```

It is considered to be ASID shortage condition when the number of ASIDs in **active use** being >= 95% of the IEASYSxx MAXUSER specification (RSVSTRT usage is not monitored, since started tasks will spill over into MAXUSER). The shortage will be considered relieved when the usage value is <= 90%.

The number of replacement ASIDs in use being >= 95% of the IEASYSxx RSVNONR specification. The shortage will be considered relieved when the usage value is <= 90%.

When a shortage condition is detected an action message is issued. When the shortage is relieved the prior message will be DOMed and a new message will be issued.

The following displays are from **MXI**, the freeware tool available at http://www.mximvs.com or http://www.rocketsoftware.com

ASID option of MXI displays the following:

```
MXI - ASID - SYSC - HOME ----- CPU   5 UIC  254 PAG  0 ------Row 1 of 12
Command ===>                                             Scroll ===> CSR
```

Address Space Definitions

```
Maximum Defined              750
Reserved Non-Reusable        200
Reserved Start Commands        5

Address Space Type          Number  Percentage
Available For Use            849          88
Marked Not-Reusable           15           1
Started Tasks Active          69           7
TSO Users Active               2           0
Batch Jobs Active              0           0
Initiators Active             20           2
```

The display shows the **total** number of ASIDs that are defined, the MAXUSER and the RSVNONR values. More importantly15 ASIDs are marked not re-usable. This includes some active address spaces and some that are marked non-reusable.

MXI provides two options, **XM** *(ASIDs with current cross memory bindings)* and **MDQ** *(non-reusable ASIDs with system LX or latent bindings)* which will help in determining non-reusable ASIDs. First let's look at the XM display.

From the XM display we see the following:

```
MXI - XM --- SYSC - HOME ----- CPU   4 UIC  254 PAG  0 -------Row 1 of 66
Command ===>                                              Scroll ===> CSR

Jobname  ASID     To    From XMSE     ASCB     Type CJOB   CAID   Status
PCAUTH   0002      *     * 7FFD4E20 00FB3400 <==> *        *    System LX
RASP     0003      *     * 7FFD3BE0 00FB3280 <==> *        *    System LX
TRACE    0004      *     * 7FFD37C0 00FB3100 <==> *        *    System LX
XCFAS    0006      *     * 7FFD33A0 00F3DD00 <==> *        *    System LX
GRS      0007      *     * 7FFD3A00 00F3DB80 <==> *        *    System LX
SMSPDSE  0008      *     * 7FFD3E20 00FB3A80 <==> *        *    System LX
SMSVSAM  0009      *     * 7F849E20 00FB3900 <==> *        *    System LX
CONSOLE  000A      *     * 7FFD4C40 00F3DA00 <==> *        *    System LX
WLM      000B      *     * 7FFCFA58 00F3D080 <==> *        *    System LX
ANTMAIN  000C      *     * 7F84CE20 00FA5680 <==> *        *    System LX
ANTAS000 000D      *     * 7F84BC40 00FA5500 <==> *        *    System LX
OMVS     000E      *     * 7FFCF638 00F24A80 <==> *        *    System LX
IEFSCHAS 0010      *     * 7FFCF878 00F3E700 <==> *        *    System LX
JESXCF   0011      *     * 7F84C438 00FB3700 <==> *        *    System LX
```

```
 ALLOCAS  0012      *     * 7FFCFC98 00F3CE80 <==> *        *    System LX
 IOSAS    0013      *     * 7FFD4100 00F3CD00 <==> *        *    System LX
 IXGLOGR  0014      *     * 7FFD51A0 00F3CB80 <==> *        *    System LX
 SMF      0015      *     * 7FFD4A60 00F24780 <==> *        *    System LX
 VLF      0016      *     * 7F84B650 00F24600 <==> *        *    System LX
 LLA      0017      *     * 7F84CC40 00F24480 <==> *        *    System LX
 ATRRRS   001A      *     * 7F84BE20 00F8EA80 <==> *        *    System LX
 NET      001B      *     * 7F847BE0 00F8E900 <==> *        *    System LX
 RMF      001C      *     * 7F849220 00F8E780 <==> *        *    System LX
 ASCH     0020      *     * 7F84C678 00F8E180 <==> *        *    System LX
 APPC     0021      *     * 7F84B410 00F89E80 <==> *        *    System LX
 SDSF     0022      *     * 7F849A60 00F89D00 <==> *        *    System LX
 RACFDS   0024      *     * 7FFD4880 00F88200 <==> *        *    System LX
 SMS      0025      *     * 7F84CA60 00F88080 <==> *        *    System LX
 RACF     0026      *     * 7FFD35E0 00F89500 <==> *        *    System LX
 TNF      0027      *     * 7FFD46A0 00F89380 <==> *        *    System LX
 VMCF     0028      *     * 7FFD44C0 00F89200 <==> *        *    System LX
 CATALOG  0029      *     * 7FFD42E0 00FAB900 <==> *        *    System LX
 RESOLVER 002A      *     * 7F849820 00FA8600 <==> *        *    System LX
 TCPIPC   0043      *     * 7F84BA60 00FA6280 <==> *        *    System LX
 RMFGAT   0046      *     * 7F847608 00F9DB80 <==> *        *    System LX
 ICSF     0048      *     * 7F847428 00F9D880 <==> *        *    System LX
 DBP3MSTR 0049      3     5 7F845A60 00FAA280 <=== DBP3MSTR 0049 Active
                                              ===> DBP3MSTR 0049 Active
                                              <=== DBP3DBM1 02F8 Active
                                              <=== DBP3DIST 004D Active
                                              ===> DBP3DBM1 02F8 Active
                                              ===> DBP3DIST 004D Active
                                              <=== ATRRRS   001A Active
                                              <=== DBP3SPAS 02F6 Active
DBP3DIST 004D      3      4 7F843A00 00FAAD00 ===> DBP3MSTR 0049 Active
                                              <=== DBP3DIST 004D Active
                                              ===> DBP3DIST 004D Active
                                              <=== DBP3MSTR 0049 Active
                                              <=== DBP3DBM1 02F8 Active
                                              ===> DBP3DBM1 02F8 Active
                                              <=== DBP3SPAS 02F6 Active
 DBP3IRLM 004E      *      * 7F843580 00FAA100 <==> *        *    System LX
 P5DMN    005B      *      * 7F84B880 00FAC580 <==> *        *    System LX
 DBP3SPAS 02F6      3      0 7F843820 00FAAB80 ===> DBP3DBM1 02F8 Active
                                               ===> DBP3DIST 004D Active
                                               ===> DBP3MSTR 0049 Active
 DBP3DBM1 02F8      3      4 7F843BE0 00FAAE80 ===> DBP3MSTR 0049 Active
                                               <=== DBP3DBM1 02F8 Active
                                               ===> DBP3DBM1 02F8 Active
                                               <=== DBP3MSTR 0049 Active
                                               ===> DBP3DIST 004D Active
                                               <=== DBP3DIST 004D Active
                                               <=== DBP3SPAS 02F6 Active
 P5AGNTC  02FD      1      2 7FFD5E20 00FAF880 <=== P5AGNTC  02FD Active
                                               ===> P5AGNTC  02FD Active
                                               <=== ATRRRS   001A Active
                                               <=== ATRRRS   0342 Active
 P5DMGR   0067      1      3 7F835178 00F93880 <=== P5DMGR   0067 Active
                                               ===> P5DMGR   0067 Active
                                               <=== ATRRRS   0342 Active
                                               <=== P5DMGRS  0068 Active
 P5DMGRS  0068      1      0 7F837100 00F93700 ===> P5DMGR   0067 Active
 T5SRV1   0300      1      3 7F829A60 00FA6580 <=== T5SRV1   0300 Active
                                               ===> T5SRV1   0300 Active
                                               <=== ATRRRS   0342 Active
                                               <=== T5SRV1S  033F Active
 T5SRV1S  033F      1      0 7F829E20 00F95880 ===> T5SRV1   0300 Active
```

The bottom of this display shows how address spaces have cross memory bindings to each other. In particular the WAS Version 5 Control Region for the node agent (P5AGNTC). Notice that ATRRRS has a cross memory binding to this address space. Unfortunately there is not a full Network Deployment configuration up on this system using DB2, CICS etc, but you can get the idea.

Basically, all the WebSphere Application Server’s Control Regions, except for the daemon, will have a binding from ATRRRS to them. They also have a cross memory binding to themselves. Each of the Server Regions will have a cross memory bindings to its Control Region. When you have other resource managers, it can get even more complicated. Now let’s look at the MDQ display.

From the MDQ display of MXI we see the following:

```
MXI - MDQ—SYSC - SYSC ----- CPU   5 UIC  254 PAG    0 ----------- Row 1 of 9
Command ===>                                                  Scroll ===> CSR

Jobname  ASID      To    From XMSE     ASCB     Type CJOB     CAID Status
P5DMNX   02FA       *       * 7F847180 00FAF580 Both *        *    System LX
P5SRV1C  004A       0       1 7F847E20          From ATRRRS   001A Active
P5SRV1C  0051       0       1 7F846E20          From ATRRRS   001A Active
P5AGNTC  02F7       0       1 7F845C40          From ATRRRS   001A Active
P5AGNTC  02F5       0       1 7F845768          From ATRRRS   001A Active
P5AGNTC  02F4       0       1 7F845190          From ATRRRS   001A Active
P5AGNTC  02F1       0       1 7F846380          From ATRRRS   001A Active
P5SRV1C  004B       0       1 7F846A00          From ATRRRS   001A Active
P5AGNTB  0042       0       1 7F846190          From ATRRRS   001A Active
```

The address apace P5SRV1C from ASID 004A is in the list of currently non-reusable ASIDs, which cannot be reused until ATRRRS is terminated.

If you were to issue the ***SETRRS CANCEL*** command to terminate ATRRRS and then re-display using MDQ, you would see the following:

```
MXI - MDQ—SYSC - SYSC ----- CPU   5 UIC  254 PAG    0 ---------- Row 1 of 9
Command ===>                                                  Scroll ===> CSR

Jobname  ASID      To    From XMSE     ASCB     Type CJOB      CAID Status
P5DMNX   02FA       *       * 7F847180 00FAF580 Both *         *    System LX
```

Now if you look at the ASID display you will see those ASIDs marked non-reusable has decreased by eight, and the number of available increased by 8. However, you will not see any console messages unless there was a shortage of ASIDs or LXs.

If you start canceling WebSphere Application Server (WAS) Control Regions, you will see ASIDs accumulate again.

Summary

The number of unavailable ASIDs changes whenever an ASID goes through memory termination (MEMTERM). The situation can get better or worse depending on whether the latent bindings are removed. Some ASIDs can never be reclaimed.

Sometimes the impact of terminating all the components which are causing ASIDs to become non-reusable will require an IPL. If you have access to MXI, then you can easily determine the number of address spaces that are not available and which address space is preventing the reuse. So in the above example, where ATRRRS is the root cause, you can make a decision of whether or not to recycle ATRRRS and the subsystems dependent on it at your convenience as opposed to an unscheduled IPL.

On systems where there is a lot of starting and stopping of address spaces which get latent bindings, you need to manage the number of ASIDs and LXs.

The monitoring function of z/OS, which runs every 2 minutes, monitors the available ASIDs and LXs. It will issues action message when there is shortage and DOMs them when the shortage is relieved.

An installation running WebSphere test servers, where many Control Region restarts will occur, should consider increasing their **IEASYSxx** specifications for **MAXUSER, RSVSTRT, and RSVNONR**.

We recommend that you specify larger than necessary values for MAXUSER, RSVSTRT, and RSVNONR. The MAXUSER value must be large enough to include all the active address spaces. Therefore, the value you specify for MAXUSER must take into account the number of initiators, TSO/E USERMAX, and any other factors that contribute to the number of active address spaces.

However, do not over-specify the MAXUSER value by too great of an amount. The console control block area allocates CSA storage based on the sum of MAXUSER and RSVSTRT, available. So, if the system is not configured to have a lot of storage below 16MB, a large combined value of these two fields can result in a shortage of CSA storage. For each allowed user specified by the MAXUSER parameter, 50 bytes of CSA storage is allocated below 16MB. For example, if you specify a value of 2000 for MAXUSER, 100,000 bytes of CSA storage will be allocated below 16MB. This storage is allocated after system initialization, reducing the amount of available CSA storage below 16MB. This could result in an ABEND 878 reason code 08 when applications are started after IPL. A large MAXUSER value could also cause a wait state 040 to occur at IPL time.

When the system is heavily used, it can use the value specified on the RSVSTRT system parameter to allow more concurrent jobs and started tasks than the number specified by MAXUSER.

When there are non-reusable ASIDs, it can use the value specified on the RSVNONR systems parameter to allow the MAXUSER value to be honored until the number of non-reusable ASIDs exceeds the value of RSVNONR. When this happens, the number of jobs and started tasks that can run concurrently will be reduced by the difference between the number of non-reusable ASIDs and the value of RSVNONR.

As an example, suppose that MAXUSER in IEASYSxx specifies 500 and RSVSTRT specifies 5. If there is an attempt to start an address space via the START command, and none of the 500 address space entries defined by the MAXUSER parameter is available (meaning heavy system use), but an entry defined by the RSVSTRT parameter is available, the system will use that entry. Thus, when the system is heavily used, there can be more concurrent jobs and started tasks in the system than the number defined by MAXUSER. The absolute limit to the number of concurrent jobs and started tasks is the **sum** of the values specified for the MAXUSER and RSVSTRT system parameters. The maximum ASID value is the sum of the values specified for the MAXUSER, RSVSTRT, and RSVNONR system parameters.

If started tasks or batch jobs that create non-reusable ASIDs end enough times, they will exhaust all available ASIDs and an IPL will be required. When IPLing is not an acceptable option, determine which ASIDs caused the problems and fix them using the method outlined above. Please note that the **sum** of the values specified for the MAXUSER, RSVSTRT, and RSVNONR system parameters cannot exceed 32767.