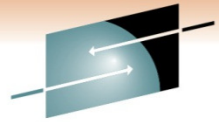

Understanding z/OS Communications Server Storage Usage

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Session: 8330
Friday, March 4, 2011: 9:30 AM-10:30 AM

Understanding z/OS Communications Server Storage Usage

Session number:	8330
Date and time:	Friday, March 4, 2011: 9:30 AM-10:30 AM
Location:	Room 212A (Anaheim Convention Center)
Program:	Communications Infrastructure
Project:	Communications Server
Track:	Network Support and Management
Classification:	Technical
Speaker:	Alfred B Christensen, IBM
Abstract:	If you have ever wondered how the z/OS Communications Server uses storage in your z/OS LPARs, this session is for you. The session will provide an overview and explanation of the z/OS Communications Server storage concepts and model - how TCP/IP and VTAM uses private storage, CSA, ECSA, CSM storage (ECSA, fixed, data spaces), 64-bit common, etc. The session will provide hints and tips about how to monitor Communications Server storage usage using display command and RMF reports.

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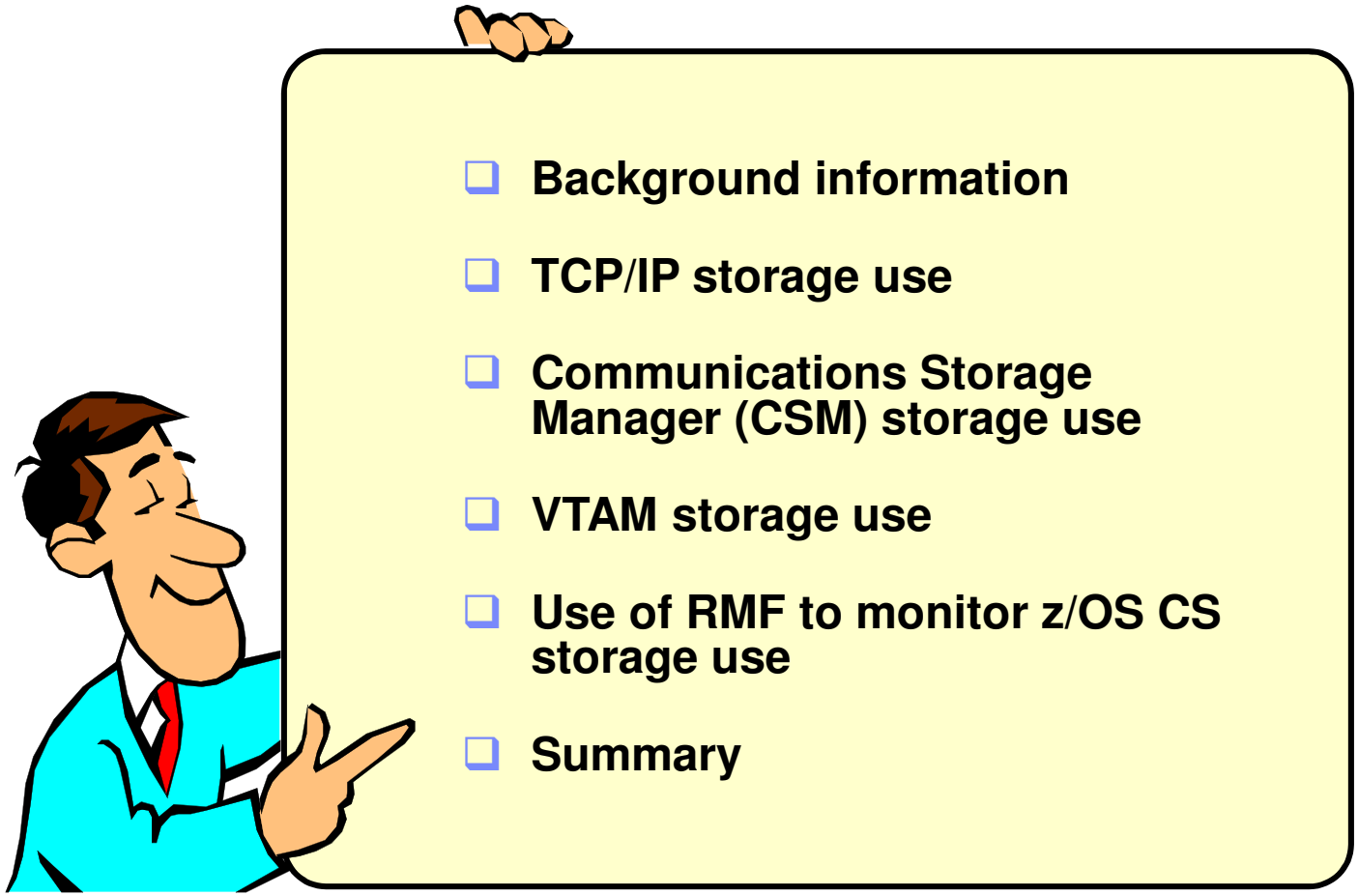
Agenda



- Background information
- TCP/IP storage use
- Communications Storage Manager (CSM) storage use
- VTAM storage use
- Use of RMF to monitor z/OS CS storage use
- Summary

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Background information

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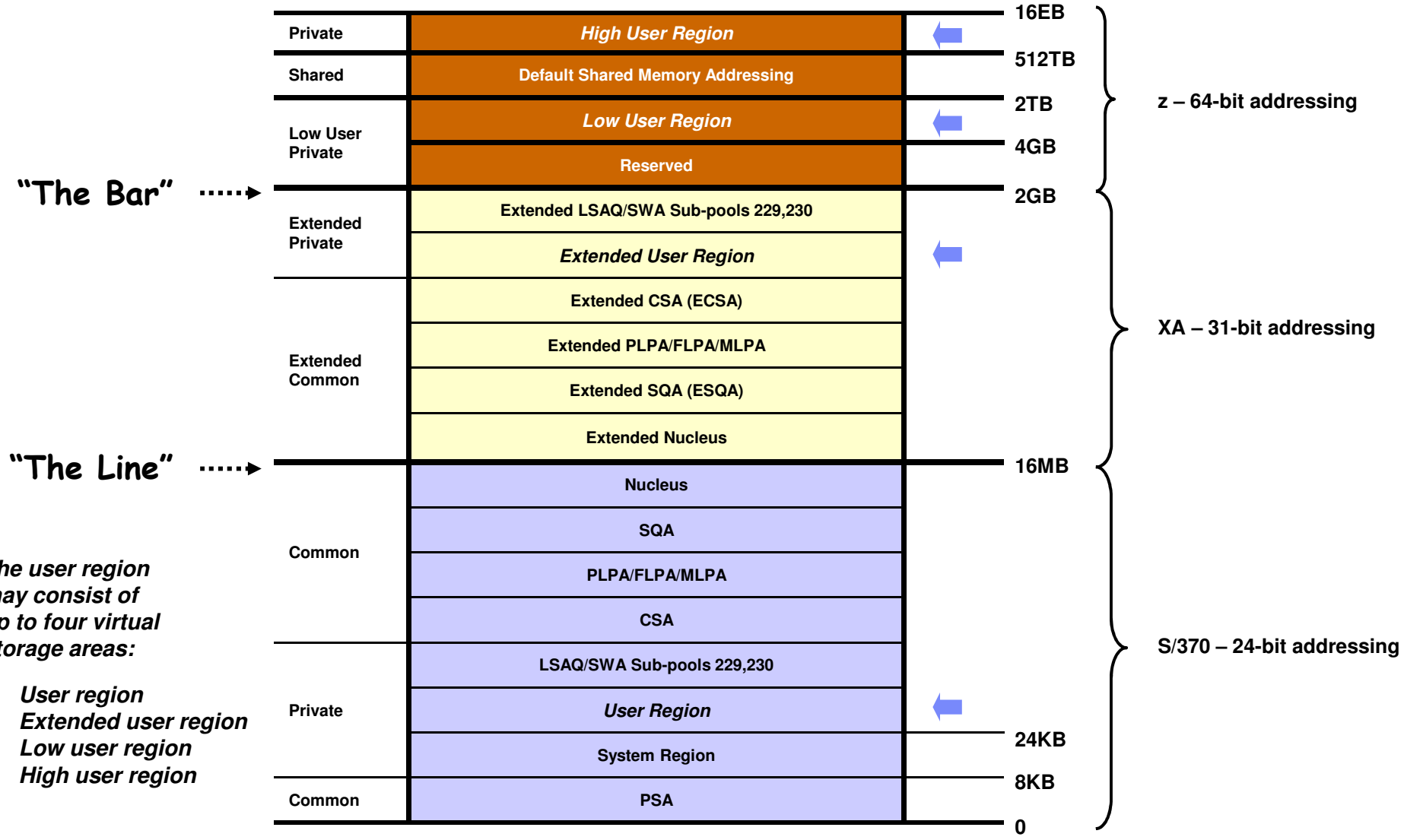
z/OS virtual storage map



The user region may consist of up to four virtual storage areas:

1. *User region*
2. *Extended user region*
3. *Low user region*
4. *High user region*

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KB, MB, GB, TB, PB, EB, ZB – and the lot ..

Name	Short	Size in bytes	2 to the order of
1 kilobyte	KB	1,024	10
1 megabyte	MB	1,048,576	20
1 gigabyte	GB	1,073,741,824	30
1 terabyte	TB	1,099,511,627,776	40
1 petabyte	PB	1,125,899,906,842,624	50
1 exabyte	EB	1,152,921,504,606,846,976	60
1 zettabyte	ZB	1,180,591,620,717,411,303,424	70
1 yottabyte	YB	1,208,925,819,614,629,174,706,176	80

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A perspective of address space size over time

- A 31-bit XA address space is 128 times larger than a 24-bit S/370 address space
- A 64-bit z/Architecture address space is 8 billion times larger than a 31-bit XA address space and 1024 billion times larger than a S/370 address space

Architecture	Size	Relative size	Comparison – metric	Comparison – non-metric
24-bit S/370 address space	16 MB	1	7 cm	2.8 inches
31-bit XA address space	2 GB	128	9 m	30 feet
64-bit z/Architecture address space	16 EB	1 099 511 627 776	Distance between Earth and Mars 78 341 212 Km	Distance between Earth and Mars 48 678 972 miles

Note: distance between earth and Mars varies between 66 million Km and 402 million Km. 78 341 212 Km is the average distance.

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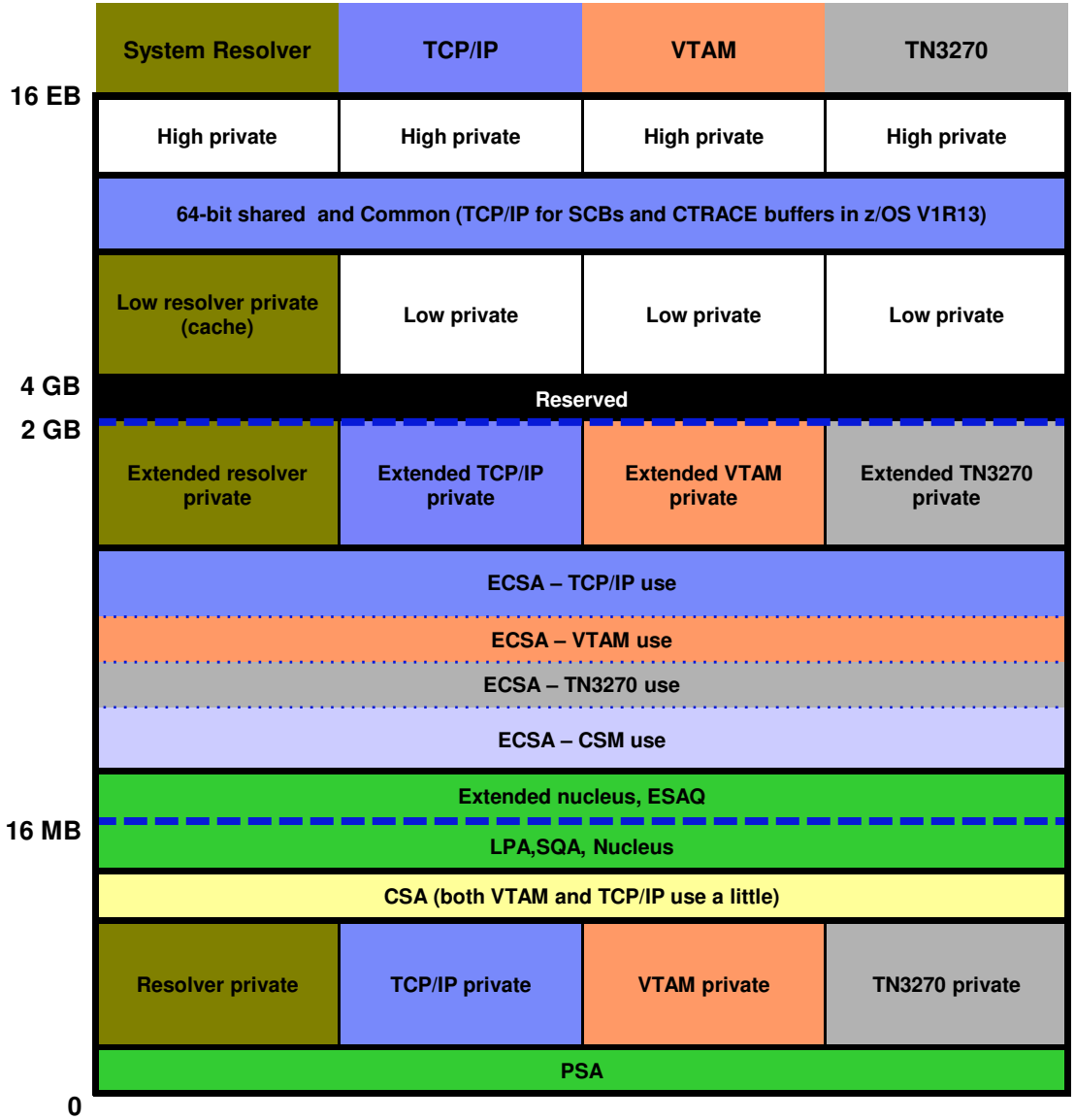
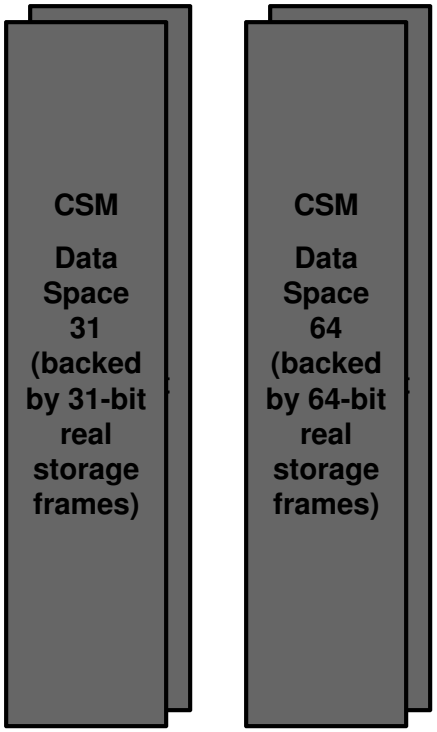
Communications Server virtual storage usage overview





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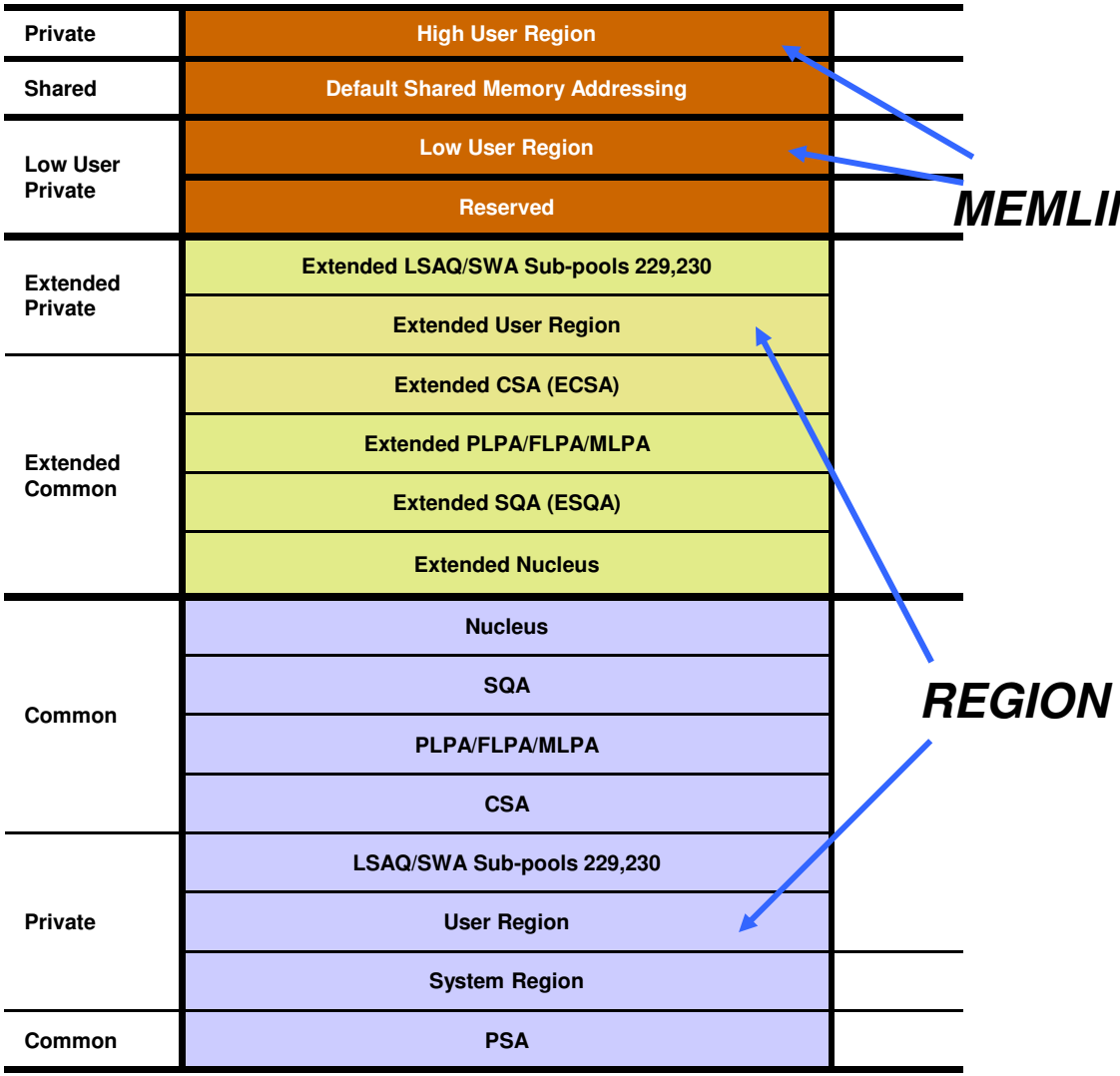
Limiting the amount of virtual storage in the user region(s)



- **The REGION JCL keyword limits amount of space in the user region and the extended user region**
  - Includes user region below the line and between the line and the bar, but not above the bar
  - Does not include space in any of the common areas
  - REGION=0M gives all available storage
- **The MEMLIMIT JCL keyword limits the amount of space in the low and high user regions**
  - Above the bar
- **Installation defaults can be defined in JES and SMF**
  - To be used as default when no REGION or MEMLIMIT keywords are specified in the JCL

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New 64-bit exploitation in z/OS V1R13 Communications Server

- Multiple trace buffers relocated to take advantage of 64 common storage
  - VTAM internal trace (VIT) is moved from ECSA to 64 bit common storage
    - Transparent to you if you use external VIT to obtain trace records
  - Multiple CTRACE components are moved from data-spaces to 64 bit common storage. The table below summarizes the changes.
    - These moves are transparent to you as long as you use the NMI interface to obtain trace data

CTRACE Component	*Current location*	*z/IOS V1R13 change*	*User*
SYSTCPIP	*TCPIPDS1 Dataspace*	*64 bit common*	*Stack*
SYSTCPDA	*TCPIPDS1 Dataspace*	*64 bit common*	*Stack (NMI)*
SYSTCPIS	*TCPIPDS1 Dataspace*	*64 bit common*	*Stack*
SYSTCPCN	*TCPIPDS1 Dataspace*	*64 bit common*	*Stack (NMI only)*
SYSTCPSM	*TCPIPDS1 Dataspace*	*64 bit common*	*Stack (NMI only)*
SYSTCPRE	*Private SP229*	*No Change*	*RESOLVER*
SYSTCPRT	*OMPROUTE Private storage*	*No Change*	*OMPROUTE*
SYSTCPIK	*IKE daemon Private storage*	*No Change*	*IKESMP*
SYSTCPOT	*TCPIPDS1 Dataspace*	*64 bit common*	*OSAENTA*
SYSTCPNS	*NSS daemon's private storage*	*No Change*	*Security Server*

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Installation exits may override JCL keywords

- **Installation exits can enforce installation standards – will override any specifications found in JCL**
  - **IEALIMIT**
    - Is no longer a recommended exit routine for this purpose
    - Can only enforce standards for user region below the 16 MB line and is linked into the MVS nucleus
  - **IEFUSI**
    - Is the preferred exit routine to enforce these limits
    - Resides in the LPA
    - Can enforce standards for:
      - The user region below the 16 MB line
      - The extended user region between the 16 MB line and the 2 GB bar
      - The user region above the 2 GB bar (MEMLIMIT JCL keyword)
    - PPT attribute NOHONORIEFUSIREGION can be used for selected programs to ignore IEFUSI standards – defined in the SCHEDxx SYS1.PARMLIB member

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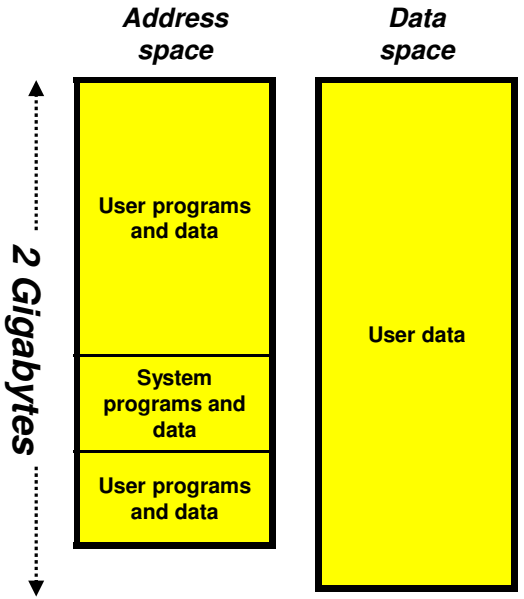
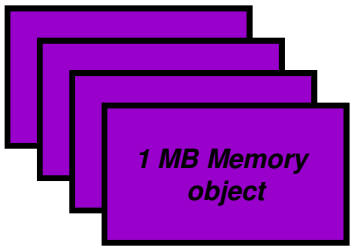
Data Spaces and memory objects

- **Data Space**
  - A data space is max 2 GB in size
  - 31-bit addressing is used to access data in a data space
  - A data space may be backed by 64-bit real storage frames (if the system has more than 2 GB of real storage)
    - What CSM means with the term 'DATA SPACE 64':
      - This is not 64-bit virtual storage, this is a normal 2 GB data space that is allowed to be backed by 64-bit real storage frames
  - CSM uses so-called common data spaces
    - System-wide number of common data spaces is limited by the MAXCAD keyword in IEASYSxx
      - Default is 50



- **Memory object**
  - Virtual storage above the bar may be allocated and made part of an address space's virtual storage addressing range
  - Obtained in multiples of 1 MB (a so-called memory object)
  - A memory object may be a common memory object or a shared memory object – residing in the area between 2 TB and 512 TB
  - A memory object may also be part of the private addressing range within an address space – part of the user region



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System wide storage-related definitions

- SYS1.PARMLIB – IEASYSnn member
  - **CSA=(a,b)**
    - ″a″ specifies the size of the CSA, located below 16MB
    - ″b″ specifies the size of the extended CSA, located above 16MB
      - Make sure this number is big enough to accommodate TCP/IP's, VTAM's, and CSM's ECSA requirements
      - Plus the requirements of whatever else you run on that system
    - Example:
      - CSA=(4M,256M)
        * 4MB CSA below the 16 MB line
        * 256MB ECSA above the 16 MB line
  - **HVCOMMON=a**
    - "a" specifies the size of the 64-bit common area (xxG or xxT)
      - The 64-bit common area will be placed below the 4T line.
      - The value you specify will be rounded up to a 2 gigabyte boundary
      - Default is 64 GB, minimum is 2 GB, maximum is 1 TB
  - **HVSHARE=a**
    - "a" specifies the size of the high virtual shared area.

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TCP/IP storage use

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TCP/IP storage use overview

- **TCP/IP user region**
  - Primarily extended user region
  - Very little, if any, in the user region below the line
  - Nothing in low and high user regions above the bar
  - TCP/IP refers to this storage as POOL storage

- **Extended Common Service Area (ECSA)**
  - The part of ECSA that is obtained and managed by TCP/IP
    - Not part of CSM storage
  - During TCP/IP initialization, a few modules are loaded into ECSA using dynamic LPA functions
    - Prior to z/OS V1R11 this was done by TCP/IP itself using directed load
    - Main module is EZBTIINI, which in the current z/OS V1R11 distribution is 7,117,424 bytes in size
  - Otherwise ECSA storage is primarily used for common control blocks
  - ECSA storage is obtained in either key 0 or key 6
    - Most workload-related storage is obtained in key 6
  - ECSA storage is obtained with TCP/IP or the “System” as owner
    - Almost all TCP/IP’s ECSA is obtained with the “System” as owner

- **Common 64-bit memory**
  - In z/OS V1R11, TCP/IP uses common 64-bit memory objects for Socket Control Blocks (SCBs)
  - In z/OS V1R13, both VTAM and TCP/IP use common 64-bit memory objects for various trace buffers

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D TCPIP,[stackname],STOR

- This does not include CSM storage
- Limits can optionally be configured in the TCP/IP Profile for POOL and ECSA storage

- **POOL** storage
  - The amount of storage TCP/IP uses in its user regions

- **ECSA** storage
  - In releases prior to z/OS V1R12, ECSA includes the size of load module EZBTIINI, which is loaded into ECSA during initialization (in z/OS V1R11 using dynamic LPA functions).
    - EZBTIINI resides in storage key 0.
    - The total size of this module is roughly 6,950K in z/OS V1R11, which is up about 660K from z/OS V1R10.
  - In z/OS V1R12, ECSA does not include any load modules that have been loaded into common storage
    - The size of load modules in ECSA is reported separately in the output from this command
  - Most of the ECSA storage is from an RMF perspective reported under the MVS master address space (RMF job name of %MVS).
    - The ECSA storage is obtained with OWNER(SYSTEM)
    - You cannot get an RMF Common Storage report to match the number above

- **64-BIT common**
  - This storage is obtained in 1 MB objects, but only backed by real storage or page data set space to the extend TCP/IP uses it

- **CSA Modules**
  - This is common storage used by TCP/IP load modules. Reported in z/OS V1R12.

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D TCPIP,[stackname],STOR

z/OS V1R11

```
13.59.24  d tcpip,tcpcs,stor
13.59.26  EZZ8453I TCPIP STORAGE
EZZ8454I TCPCS    STORAGE          CURRENT    MAXIMUM      LIMIT
EZZ8455I TCPCS    ECSA               9645K     10087K    NOLIMIT
EZZ8455I TCPCS    POOL              14017K     14171K    NOLIMIT
EZZ8455I TCPCS    64-BIT COMMON         1M         1M    NOLIMIT
EZZ8459I DISPLAY TCPIP STOR COMPLETED SUCCESSFULLY
```

z/OS V1R12

```
09.19.47  d tcpip,,stor
09.19.47  EZZ8453I TCPIP STORAGE
EZZ8454I TCPCS    STORAGE          CURRENT    MAXIMUM      LIMIT
EZZ8455I TCPCS    ECSA               2789K     3245K    NOLIMIT
EZZ8455I TCPCS    POOL              14212K     14212K    NOLIMIT
EZZ8455I TCPCS    64-BIT COMMON         1M         1M    NOLIMIT
EZZ8455I TCPCS    CSA MODULES        7423K     7423K    NOLIMIT
EZZ8459I DISPLAY TCPIP STOR COMPLETED SUCCESSFULLY
```

ECSA storage is now reported as workload-related storage use only. Load modules in ECSA are reported separately in the CSA Modules line.

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D TCPIP,TN-Server-Name,STOR

- **Each TN3270 server address space on your system also support the D TCPIP,,STOR command**
  - Output will reflect that TN3270 server address space's use of storage
    - Enter the command for each TN3270 server address space

```
13.30.24  d tcpip,tn3270a,stor
13.30.24  EZZ8453I TELNET STORAGE
EZZ8454I TN3270A  STORAGE          CURRENT   MAXIMUM     LIMIT
EZZ8455I TN3270A  ECSA                97K      117K   NOLIMIT
EZZ8455I TN3270A  POOL              6636K     7392K   NOLIMIT
EZZ8455I TN3270A  64-BIT COMMON        0M        0M   NOLIMIT
EZZ8455I TN3270A  CTRACE          262372K   262372K   262372K
EZZ8459I DISPLAY TELNET STOR COMPLETED SUCCESSFULLY
```

  - There are no limits that can be configured for a TN3270 server address space
  - The storage options include a CTRACE storage type
    - The CTRACE storage is in the TN3270 server's private area (not common and not data space), but is not included in the POOL storage type line
    - It is currently set to 256 MB
    - The limit here is not configurable
    - The size reflects how much storage is obtained for tracing, not what currently is being used for tracing

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How do you limit TCP/IP's storage use?

- **POOL storage**
  - Via the REGION keyword in TCP/IP's start up JCL
    - User and extended user region size
    - Can be overridden by installation exits
      - Primarily IEFUSI
    - If used, should be accompanied by limitations in TCP/IP's profile
  - TCP/IP Profile
    - GLOBALCONFIG POOLLIMIT xxK or xxM
      - 0 means no limit and is the default

- **ECSA storage**
  - TCP/IP Profile
    - GLOBALCONFIG ECSALIMIT xxK or xxM
      - 0 means no limit and is the default

- **The GLOBALCONFIG limits will be enforced by TCP/IP itself**
  - Warning messages at 80% (constrained), 90% (Critical), and 98% (Exhausted) utilization
    - EZZ4360I, EZZ4361I, and EZZ4362I for ECSA
    - EZZ4364I, EZZ4365I, and EZZ4366I for POOL
  - Storage relieved message issued when under 75% or 85% again
    - EZZ4363I for ECSA and EZZ4367I for POOL

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Considerations for choosing POOL and ECSA limits

- **Monitor TCP/IP storage use during your acceptable peak periods**

- **Add a reasonable fudge factor to the observed maximum usage values**
  - The ECSALIMIT ensures that TCP/IP does not overuse the z/OS system's common storage.
    - It is intended to improve system reliability by limiting TCP/IP's common storage usage.
  - Accommodate for temporary application "hang" conditions, where TCP/IP must buffer large amounts of inbound or outbound data.

- **If you choose to limit POOL storage, make sure you use a value that is lower than or equal to what your installation exit (IEFUSI) enforces**
  - The benefit of specifying POOL limit is that you will receive warning messages before storage obtain calls start failing with not enough storage available to satisfy the requests

- **The values can be changed via OBEYFILE command processing**

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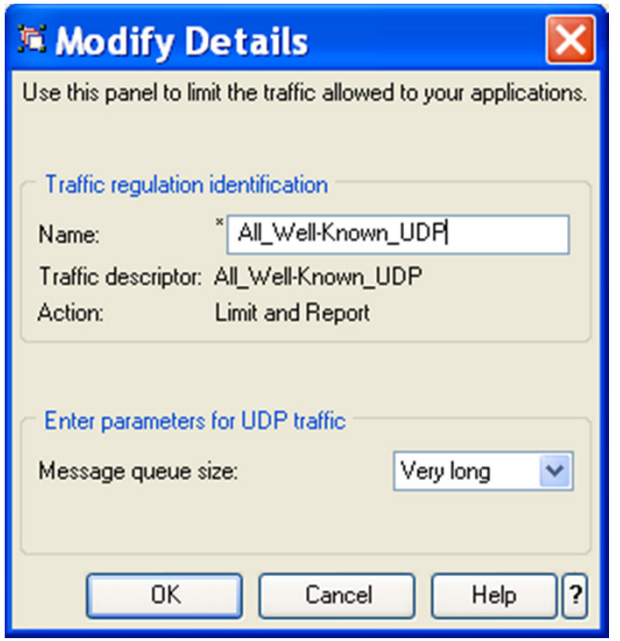
Other considerations for TCP/IP storage controls - UDP

- **UDP applications:**
  - Control queue size of UDP messages
  - UDPCONFIG UDPQUEUELIMIT
    - When UDPQUEUELIMIT is ON then receive queues for UDP ports are limited to 2000 messages or 2800K
  - To further control UDP queue sizes, enable IDS policies with traffic regulation and UDP message queue size limits per UDP application
  - Does not apply to EE UDP traffic !!



This will also benefit use of CSM storage

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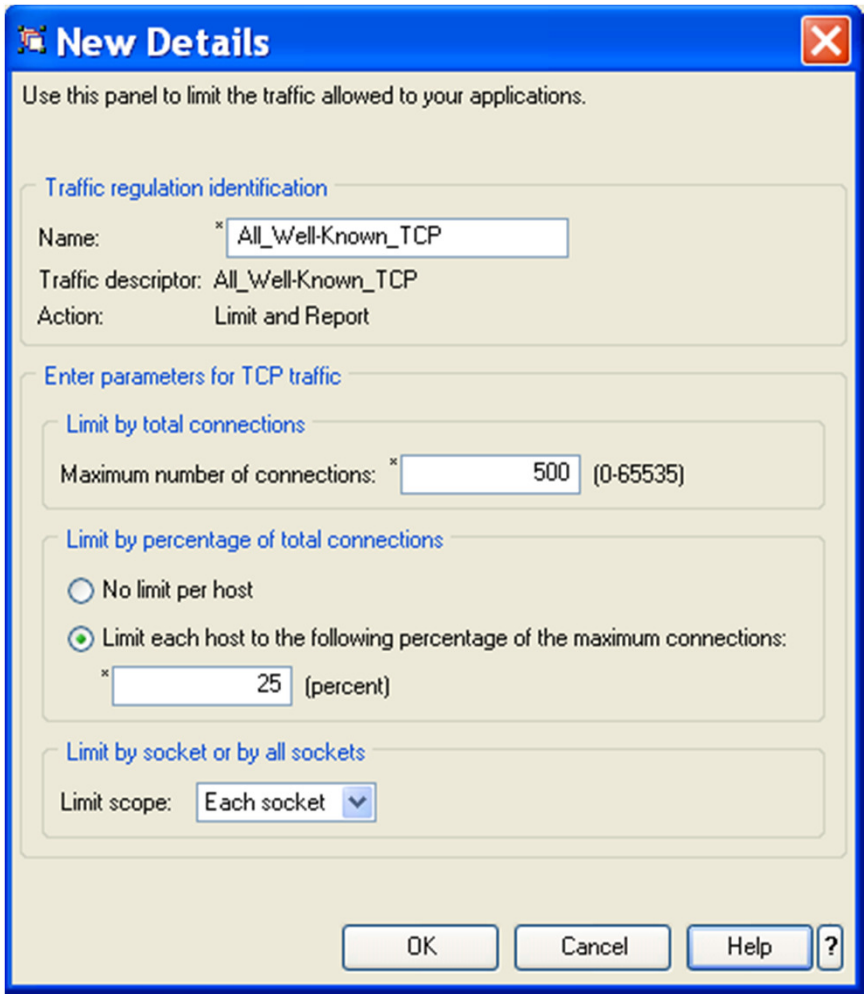
Other considerations for TCP/IP storage controls - TCP

- **TCP applications**
  - Control number of concurrent connections with TCP Listeners to reduce impacts of flooding attacks:
    - IDS policy with traffic regulation and connection limits
  - Monitor “misbehaving” applications that build up large send or receive buffers:
    - Monitor new z/OS V1R11 syslogd messages about applications with long send or receive queues
    - Watch for EZZ8661I to EZZ8664I messages
    - These messages will be logged through TRMD and syslogd even if you have no IDS policy enabled



This will also benefit use of CSM storage

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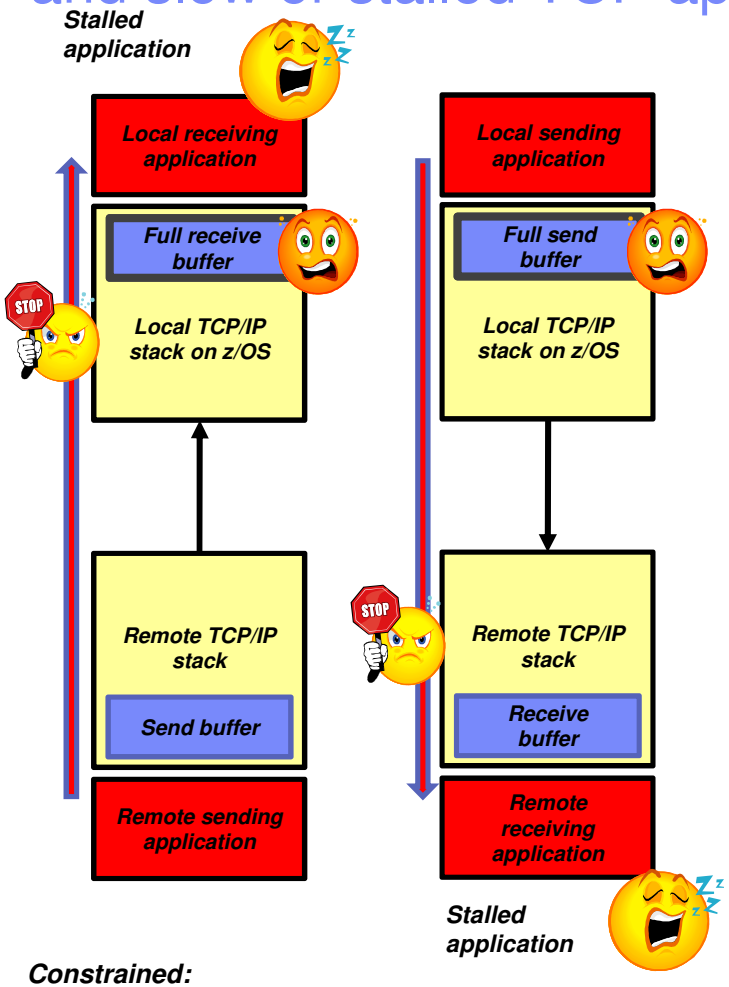
z/OS V1R11 storage improvements for storage shortages situations and slow or stalled TCP applications



Constrained:

- ***Queue full & data at least 30 sec old***
- ***Any data at least 60 sec old***

Entry alert when 90% of constrained threshold reached, exit alert when down at 80%

- Data in a send buffer is page fixed – awaiting IO operations to be initiated
  - When application is not making progress or fixed storage is constrained
    - All new data added to TCP send queue is marked as page-able
  - When storage becomes constrained, all unsent data on send queues for all non-local TCP connections is marked as page-able
  - Before data is sent to remote stack it is changed back to fixed, as required by the DLC
- It was very difficult to identify which local applications caused excessive amounts of space to be used on the send or receive queues
  - Alerts issued to indicate TCP queue in constrained state
    - Indicate old data on send or receive queue
    - Identify connection (connection id, job name, addresses, ports)
    - Constrained state entry and exit indicated
    - Issued to syslogd using TRMD
- z/OS V1R13 adds IDS policy control to this support

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Communications Storage Manager (CSM) storage use

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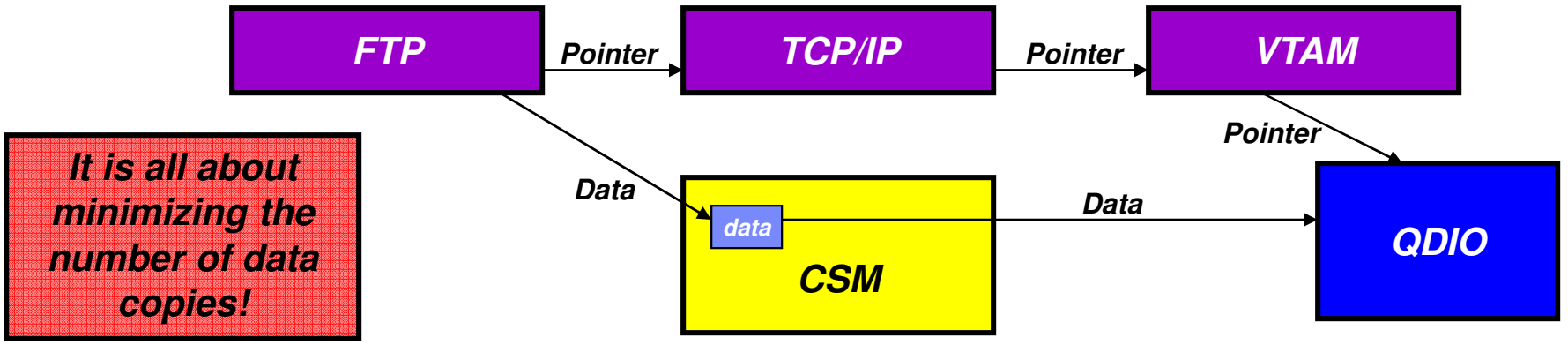
Communications Storage Manager (CSM)

- **The communications storage manager (CSM) is a VTAM component that allows authorized host applications to share data with VTAM, TCP/IP and other CSM users without the need to physically copy the data.**

- **CSM includes a public application programming interface (API) that provides a way to:**
  - Obtain and return CSM buffers
  - Change ownership of buffers
  - Copy buffers
  - Manage CSM buffers

- **The storage key for CSM buffers is key 6**
  - Most CSM storage is obtained with the “System” as owner



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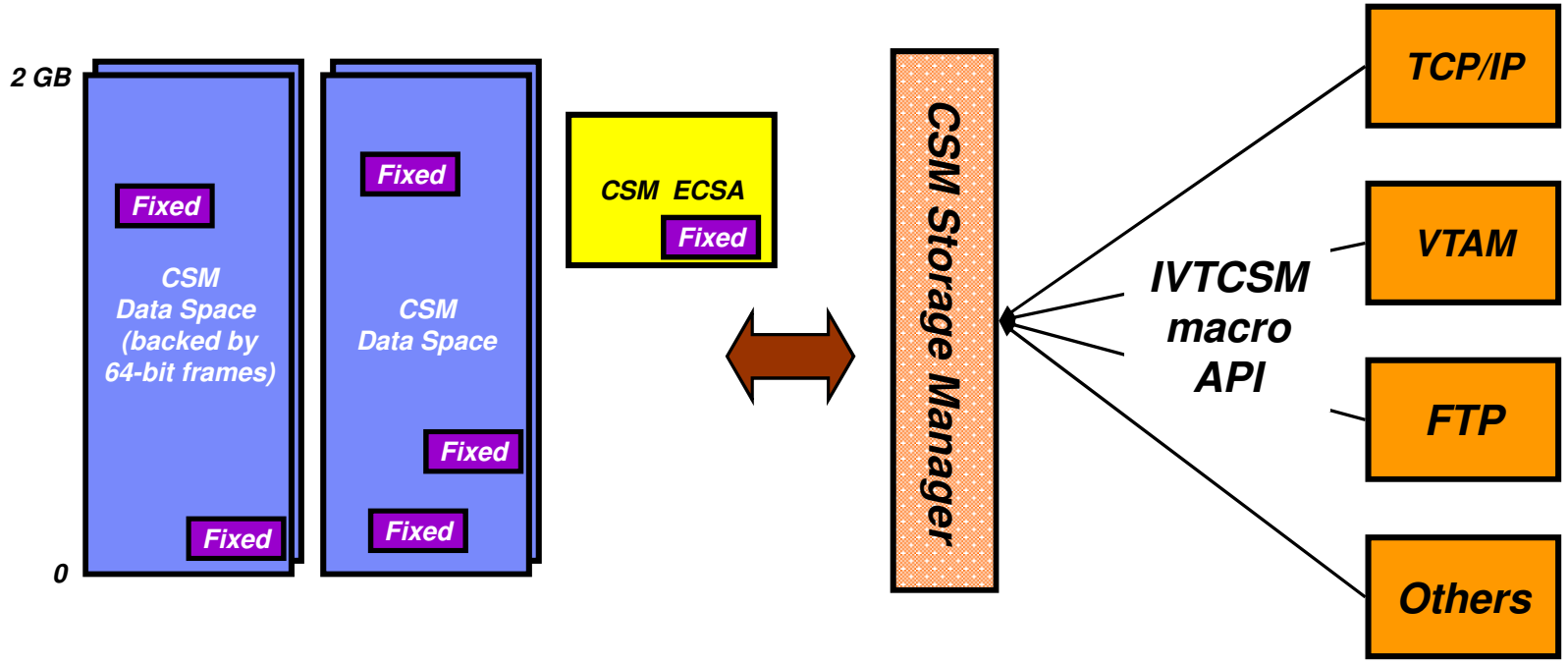
CSM virtual storage overview

- Users of CSM storage use the IVTCSM macro to interact with the CSM storage manager
- CSM storage is organized into buffer pools of fixed sizes (4K, 16K, 32K, 60K, and 180K)
- CSM storage is either ECSA or data space storage
  - CSM may create up to a total of five data spaces if needed
- CSM storage may be fixed or pageable
  - CSM storage may be page fixed in order to support an IO operation that requires fixed storage



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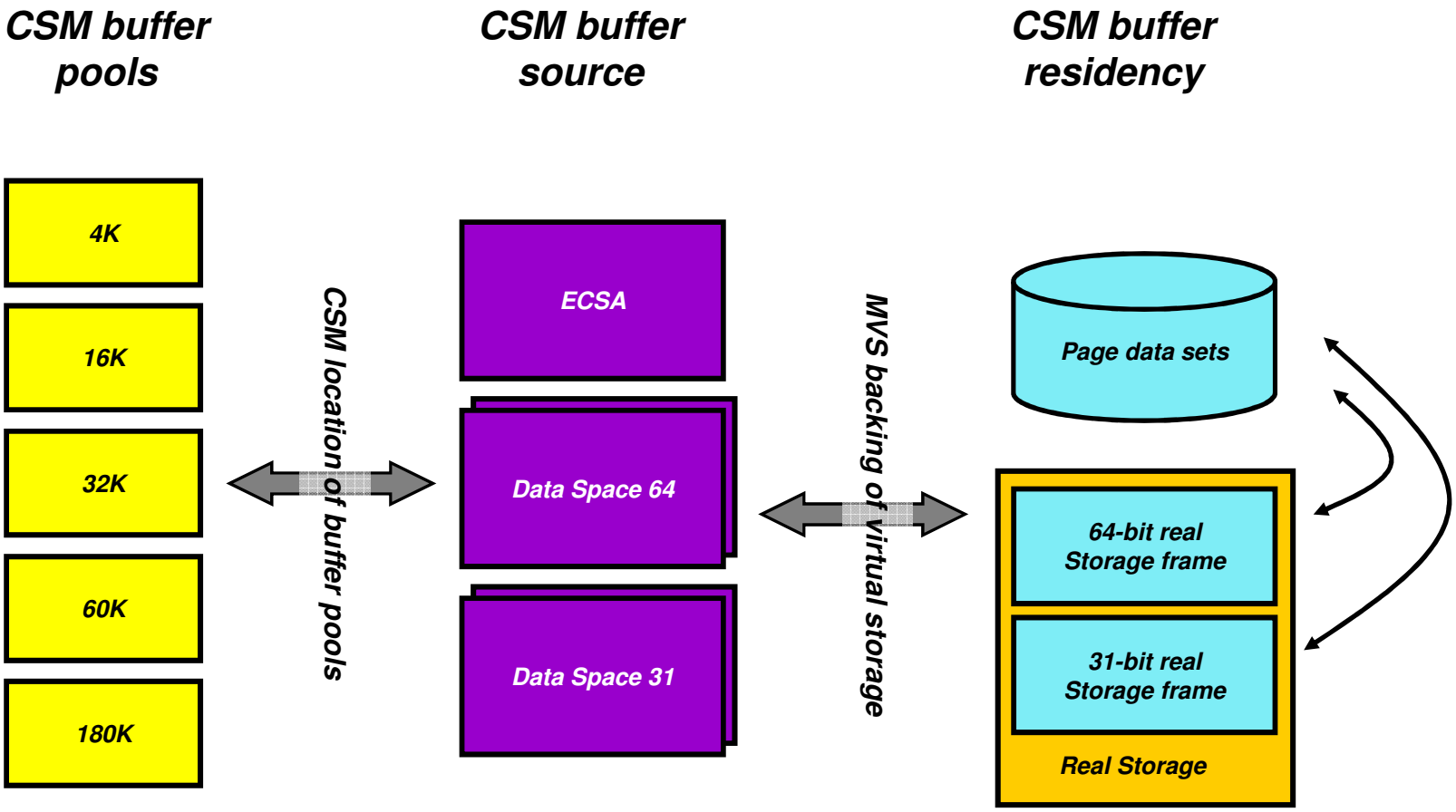
CSM buffer pools, source, and residency



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How to control CSM storage

- **IVTPRM00 member of SYS1.PARMLIB – Note: Only the 00 suffix is allowed – IVTPRM00.**
  - Read by VTAM during initialization
  - Can be modified and read via a MODIFY CSM without any parameters

- **You can control:**
  - The maximum amount of CSM storage that can be fixed at any point in time
    - Includes both ECSA and data space fixed storage
  - The maximum amount of ECSA storage, CSM can use at any point in time
  - How each of the five buffer pools is to be managed per buffer source
    - The default initial number of buffers to create the first time a user of CSM services request a pool to be created of a given size in one of the three CSM buffer sources
      - If initial number of buffers is set in IVTPRM00, it will always be used – otherwise the initial number of buffers depend on what the first requester asks for
    - The minimum number of free buffers in the pool before expansion must be done
    - The number of buffers the pool is to be expanded by when expansion occurs

- **Each of the data spaces CSM uses is 2 GB in size and no further controls are available for those**

Max fixed	100M
Max ECSA	100M

A health check suggests these two should be set to 120M as an initial value.

Buffer size	4K	16K	32K	60K	180K
Initial	64	16	16	16	2
Minimum free	8	4	2	2	1
Expansion units	16	8	4	4	2

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How to monitor overall CSM storage use

- A “D NET,CSM” command will provide a quick overview of how much storage has been allocated by CSM, and how much of it is in-use or free for use by a CSM user.
- Three main locations:
  - ECSA
  - Data Space 31
  - Data Space 64
- Sample IVTPRM00 for the system used for this D CSM command:
  - FIXED MAX(120M)
  - ECSA MAX(120M)

```
IVT5530I BUFFER BUFFER                                                  Comments
IVT5531I SIZE   SOURCE                  INUSE      FREE      TOTAL  #buf Exp?
IVT5532I ---------------------------------------------------------
IVT5533I    4K  ECSA                    200K       312K       512K  128 yes
IVT5533I   16K  ECSA                      0M       256K       256K   16  no
IVT5533I   32K  ECSA                      0M       512K       512K   16  no
IVT5533I   60K  ECSA                      0M         0M         0M    0
IVT5533I  180K  ECSA                      0M       360K       360K    2  no
IVT5535I TOTAL  ECSA                    200K      1440K      1640K
IVT5532I ---------------------------------------------------------
IVT5533I    4K  DATA SPACE 31             0M       256K       256K   64  no
IVT5533I   16K  DATA SPACE 31             0M         0M         0M    0
IVT5533I   32K  DATA SPACE 31             0M         0M         0M    0
IVT5533I   60K  DATA SPACE 31             0M         0M         0M    0
IVT5533I  180K  DATA SPACE 31             0M         0M         0M    0
IVT5535I TOTAL  DATA SPACE 31             0M       256K       256K
IVT5532I ---------------------------------------------------------
IVT5533I    4K  DATA SPACE 64          4372K       236K      4608K 1152 yes
IVT5533I   16K  DATA SPACE 64             0M       256K       256K   16  no
IVT5533I   32K  DATA SPACE 64           64K       448K       512K   16  no
IVT5533I   60K  DATA SPACE 64             0M         0M         0M    0
IVT5533I  180K  DATA SPACE 64             0M       360K       360K    2  no
IVT5535I TOTAL  DATA SPACE 64          4436K      1300K      5736K
IVT5532I ---------------------------------------------------------
IVT5535I TOTAL  DATA SPACE             4436K      1556K      5992K
IVT5532I ---------------------------------------------------------
IVT5536I TOTAL  ALL SOURCES            4636K      2996K      7632K
IVT5538I FIXED MAXIMUM =      120M    FIXED CURRENT =     7161K
IVT5541I FIXED MAXIMUM USED =     7161K SINCE LAST DISPLAY CSM
IVT5594I FIXED MAXIMUM USED =     7161K SINCE IPL
IVT5539I ECSA  MAXIMUM =      120M    ECSA  CURRENT =     1955K
IVT5541I ECSA  MAXIMUM USED =     1955K SINCE LAST DISPLAY CSM
IVT5594I ECSA  MAXIMUM USED =     1955K SINCE IPL
IVT5559I CSM DATA SPACE 1 NAME: CSM64001
IVT5559I CSM DATA SPACE 2 NAME: CSM31002
```


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CSM buffer pool usage for user of CSM storage

- To see how much CSM storage each of the CSM 'users' currently are using, issue a D NET,CSM,OWNERID=ALL command
  - This command can also be issued with a specific ownerID
- In this example, only VTAM (VTAMCS) and a TCP/IP stack (TCPCS) are using CSM storage

```
D NET,CSM,OWNERID=ALL command
IVT5508I DISPLAY ACCEPTED
IVT5549I PROCESSING DISPLAY CSM COMMAND - OWNERID SPECIFIED
IVT5530I BUFFER BUFFER
IVT5551I SIZE   SOURCE             STORAGE ALLOCATED TO OWNER
IVT5532I ----------------------------------------------------
IVT5553I    4K  ECSA                                  48K
IVT5553I   32K  ECSA                                  64K
IVT5554I TOTAL  ECSA                                 112K
IVT5532I ----------------------------------------------------
IVT5553I    4K  DATA SPACE 64                         20K
IVT5554I TOTAL  DATA SPACE 64                         20K
IVT5532I ----------------------------------------------------
IVT5554I TOTAL  DATA SPACE                            20K
IVT5532I ----------------------------------------------------
IVT5556I TOTAL  FOR OWNERID                          132K
IVT5557I OWNERID: ASID = 002A  JOBNAME = VTAMCS
IVT5532I ----------------------------------------------------
IVT5530I BUFFER BUFFER
IVT5551I SIZE   SOURCE             STORAGE ALLOCATED TO OWNER
IVT5532I ----------------------------------------------------
IVT5553I    4K  ECSA                                 128K
IVT5553I   32K  ECSA                                  64K
IVT5554I TOTAL  ECSA                                 192K
IVT5532I ----------------------------------------------------
IVT5553I    4K  DATA SPACE 64                       4324K
IVT5553I   16K  DATA SPACE 64                         16K
IVT5554I TOTAL  DATA SPACE 64                       4340K
IVT5532I ----------------------------------------------------
IVT5554I TOTAL  DATA SPACE                          4340K
IVT5532I ----------------------------------------------------
IVT5556I TOTAL  FOR OWNERID                         4532K
IVT5557I OWNERID: ASID = 004D  JOBNAME = TCPCS
IVT5599I END
```


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Detailed CSM buffer pool usage overview

- Per each of the 15 CSM buffer pools, a detailed usage display can be used
  - D NET,CSMUSE,POOL=pool-name

- The pool names are:
  - 4KECSA
  - 16KECSA
  - 32KECSA
  - 60KECSA
  - 180KECSA
  - 4KDS
  - 16KDS
  - 32KDS
  - 60KDS
  - 180KDS
  - 4KDS64
  - 16KDS64
  - 32KDS64
  - 60KDS64
  - 180KDS64

F NET,CSM,
- MONITOR=YES
- MONITOR=NO
- MONITOR=DYNAMIC
  - CSM dynamically activates CSM buffer monitoring when CSM storage usage approaches the constrained level

D NET,CSM,MONITOR

```
D NET,CSMUSE,POOL=4KECSA
IVT5508I DISPLAY ACCEPTED
IVT5574I PROCESSING DISPLAY CSMUSE COMMAND - POOL SPECIFIED 654
IVT5584I USAGE DETAILS - 4KECSA   POOL - POOL TOTAL =      164K
IVT5532I ----------------------------------------------------
IVT5576I    AMOUNT   MONITOR ID   OWNERID    JOBNAME
IVT5532I ----------------------------------------------------
IVT5577I       80K      21          003A      TCPCS
IVT5579I BUFFER USE FOR 21 :   USECNT  USERDATA   MONITOR HISTORY
IVT5580I                         20   F2C5F0F2       00000021
IVT5532I ----------------------------------------------------
IVT5577I       52K      21          002A      VTAMCS
IVT5579I BUFFER USE FOR 21 :   USECNT  USERDATA   MONITOR HISTORY
IVT5580I                          5   F0C4F0F0       00000021
IVT5580I                          4   F2C5F0F1       00000021
IVT5580I                          4   F2C5F0F0       00000021
IVT5585I DETAIL TOTAL FOR 4KECSA   POOL =      132K
IVT5599I END
```

Monitor IDs are documented in z/OS Communications Server: IP and SNA Codes Chapter 4

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CSM monitor IDs – lots of good hints about where CSM storage is being used

```
IVT5577I       80K      21          003A      TCPCS
IVT5579I BUFFER USE FOR 21 :    USECNT  USERDATA   MONITOR HISTORY
IVT5580I                          20   F2C5F0F2       00000021
IVT5532I ----------------------------------------------------
IVT5577I       52K      21          002A      VTAMCS
IVT5579I BUFFER USE FOR 21 :    USECNT  USERDATA   MONITOR HISTORY
IVT5580I                           5   F0C4F0F0       00000021
IVT5580I                           4   F2C5F0F1       00000021
IVT5580I                           4   F2C5F0F0       00000021
```

Range	Description
X'00' – X'1F'	CSM Monitor IDs
X'20' – X'2F'	DLC Monitor IDs
X'30' – X'8F'	VTAM Unique Monitor IDs
X'90' – X'97'	TCP/IP IF Layer Monitor IDs
X'98' – X'9F'	TCP/IP IP Layer Monitor IDs
X'A0' – X'AF'	TCP/IP Transport Layer Monitor IDs
X'B0' – X'FF'	TCP/IP Misc Monitor IDs

For monitor ID 21 (DLC Read Operation):

- **VTAM**
  - VTAM owns 52K of 4KECSA CSM buffers used for read operations at the DLC layer
  - The read operations are associated with devices 0D00 (CTC), 2E01 (QDIO write), and 2E00 (QDIO read)
- **TCP/IP**
  - TCP/IP owns 80K of 4KECSA CSM buffers used for read operations at the DLC layer
  - TCP/IP's read operation is associated with device 2E02 (QDIO data path)

- For monitor ID X'21', the user field will provide the EBCDIC sub-channel read device unit address associated with this device. Some devices can configure how much read storage is used (for example, QDIO devices).
- Other monitor IDs use the user data field for other types of information.

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VTAM storage use

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VTAM storage use overview

- **VTAM user region**
  - Primarily extended user region
  - Some in the user region below the line
- **Common Service Area (CSA) – referred to by VTAM as CSA24**
  - VTAM uses CSA below the line for a few modules and control blocks
- **Extended Common Service Area (ECSA)**
  - The part of ECSA that is obtained and managed by VTAM
    - Not part of CSM storage
  - VTAM has a few modules loaded into ECSA
  - Otherwise ECSA storage is primarily used for common control blocks
  - ECSA storage is obtained in either key 0 or key 6
    - Most of VTAM's ECSA storage is obtained in key 6
  - ECSA storage is obtained with VTAM or the "System" as owner
    - Workload related ECSA storage is generally obtained in key 6 with VTAM as owner

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How do you limit VTAM's storage use?

- **VTAM's private storage (VTAM's POOL storage)**
  - Via the REGION keyword in VTAM's start up JCL
    - Private and extended private region size
    - Can be overridden by installation exits - primarily by IEFUSI

- **CSA+ECSA storage**
  - Via the CSALIMIT VTAM start option (ATCSTRxx), which covers both CSA and ECSA
    - CSALIMIT=0 - Default, limit set to 90% of system limit (IEASYSnn CSA+ECSA limit)
    - CSALIMIT=nn - Warning when reached, but will continue until only 25% of system limit is available
    - CSALIMIT=(nn,F) - Will not go above the limit specified
  - Can be changed dynamically via a MODIFY VTAMOPTS or MODIFY CSALIMIT command

- **CSA storage below the line**
  - Via the CSA24 start option, which specifically covers 24-bit addressable CSA storage (CSA24 is a subset of the CSALIMIT value)
    - CSA24=a
      - CSA24=0 is the default and means no limit
      - Can be changed dynamically via a MODIFY VTAMOPTS or MODIFY CSALIMIT command

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How do you monitor VTAM's storage use?

- **Via a D NET,BFRUSE command**
  - Towards the end of the output from that command is a breakdown of VTAM's current storage use (limit, current, high-water mark)
    - CSA
    - CSA24
    - Private

In this example, this is the default limit: 90% of IEASYSnn CSA+ECSA

```
IST449I CSALIMIT = 240012K, CURRENT = 2562K, MAXIMUM = 2578K        CSA+ECSA
IST790I MAXIMUM CSA USED = 2578K
IST1667I SYSTEM CSA LIMIT = 266680K
IST1831I 91% OF SYSTEM CSA STORAGE REMAINING = 243320K
IST449I CSA24 LIMIT = NOLIMIT, CURRENT = 60K, MAXIMUM = 63K          CSA
IST790I MAXIMUM CSA24 USED = 63K
IST595I IRNLIMIT = NOLIMIT, CURRENT = 0K, MAXIMUM = 0K
IST981I VTAM PRIVATE: CURRENT = 1030K, MAXIMUM USED = 1183K          Private
IST924I -------------------------------------------------
IST1565I CSA MODULES = 1756K                                         Modules in CSA24
IST1565I CSA24 MODULES = 40K                                         and ECSA
IST1565I PRIVATE MODULES = 7497K
```


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Use of RMF to monitor z/OS CS storage use

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Communications Server storage is in Key 6

- The RMF Monitor II Virtual Storage Activity report reports the amount of Key 6 storage in CSA and ECSA
  - The Communications Server uses key 6 storage

```
                                V I R T U A L    S T O R A G E    A C T I V I T Y

          z/OS V1R11              SYSTEM ID 3090            DATE 06/16/2009           INTERVAL 09.44.920
                                  RPT VERSION V1R11 RMF     TIME 11.05.15             CYCLE 1.000 SECONDS

                                             COMMON STORAGE SUMMARY
NUMBER OF SAMPLES      50

      STATIC STORAGE MAP                                                ALLOCATED CSA/SQA
  AREA         ADDRESS   SIZE              ------------ BELOW 16M --------------  ------- EXTENDED (ABOVE 16M) --------
EPVT          16E00000  1682M                    MIN              MAX              AVG    MIN              MAX              AVG
ECSA           6D71000   257M          SQA   568K 11.05.16   568K 11.05.16   568K  14.5M 11.13.15  14.7M 11.08.55  14.6M
EMLPA          6D70000     4K          CSA   372K 11.05.16   372K 11.05.16   372K  23.0M 11.05.16  23.2M 11.06.15  23.1M
EFLPA          6D6D000    12K
EPLPA          2CD0000  64.6M          ALLOCATED CSA BY KEY
ESQA           1A0C000  18.8M           0    168K 11.05.16   168K 11.05.16   168K  12.5M 11.05.16  12.5M 11.05.16  12.5M
ENUC           1000000  10.0M           1     84K 11.05.16    84K 11.05.16    84K   832K 11.05.16   832K 11.05.16   832K
----- 16 MEG BOUNDARY ------           2     36K 11.05.16    36K 11.05.16    36K    16K 11.05.16    16K 11.05.16    16K
NUCLEUS         FD6000   168K          3      0K 11.05.16     0K              0K     0K 11.05.16     0K              0K
SQA             E5A000  1520K          4      0K 11.05.16     0K              0K     4K 11.05.16     4K 11.05.16     4K
PLPA            BF3000  2460K          5     4K 11.05.16     4K 11.05.16     4K   668K 11.05.16   668K 11.05.16   668K
FLPA            BF2000     4K          6     80K 11.05.16    80K 11.05.16    80K  8964K 11.05.16  9160K 11.06.15  9048K
MLPA            BE5000    52K          7      0K 11.05.16     0K              0K   228K 11.05.16   228K 11.05.16   228K
CSA             800000  3988K         8-F     0K 11.05.16     0K              0K     0K 11.05.16     0K              0K
PRIVATE           2000  8184K
PSA                  0     8K          SQA EXPANSION INTO CSA
                                              0K 11.05.16     0K              0K     0K 11.05.16     0K              0K
```


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RMF Monitor III Common Storage report

- Not too useful since most of the common storage that is obtained by the Communications Server components is obtained with the “SYSTEM” as owner (%MVS as jobname).

```
RMF V1R11  Common Storage                  Line 1 of 61
Command ===>                                          Scroll ===> CSR

Samples: 90      System: 3090  Date: 07/06/09  Time: 13.05.00  Range: 90    Sec

                                    ---- Percent ----   ------- Amount --------
System Information                  CSA ECSA SQA ESQA     CSA  ECSA   SQA  ESQA
 IPL Definitions                                        3980K  257M 1520K   19M
 Peak Allocation Values              16    9  80   69    639K   23M 1211K   13M
 Average CSA to SQA Conversion        0    0             0     0
 Average Use Summary                  8    9  35   69    324K   23M  531K   13M
 Available at End of Range           92   91  65   31   3656K  234M  989K 5903K

 Unalloc Common Area: 4564K

              Service        ELAP  -- Percent Used -   ----- Amount Used -----
Jobname  Act C Class    ASID  Time  CSA ECSA SQA ESQA     CSA  ECSA   SQA  ESQA
%MVS                          3     6  31   38    127K   15M  478K 7342K
%REMAIN                       0     0   0    0     424   105K   128  6240
VTAMCS       S SYSSTC   0041  3.0H   1     1   0    0   22032 2485K     0   696
TCPCS        S SYSSTC   0058  2.9H   0     0   0    0     136 47272     0   991
TN3270A      S SYSSTC   0061  2.9H   0     0   0    0     136 24432     0   632
ABCRESO      S SYSSTC   0040  2.9H   0     0   0    0       0   312     0  1280
OMPROUTE     S SYSSTC   0064  2.9H   0     0   0    0       0   952     0  1200
```

VTAM’s modules in ECSA, CSM’s, and TCP/IP’s ECSA storage is accounted for under %MVS

VTAM’s workload-related ECSA storage is accounted for under VTAM itself

TCP/IP components have minor ECSA amounts accounted under their own address spaces

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RMF Monitor III Storage Memory Objects (64-bit storage)

- Both the resolver address space and TCP/IP use 64-bit virtual storage since z/OS V1R11
  - Resolver uses 64-bit user region storage
  - TCP/IP uses 64-bit common storage

```
RMF V1R11  Storage Memory Objects          Line 1 of 8
Command ===>                                          Scroll ===> CSR

Samples: 90      System: 3090  Date: 07/06/09  Time: 13.05.00  Range: 90    Sec

------------------------------ System Summary -------------------------------
-- Memory Objects --   --------- Frames ----------    --- Area Used % ----
Common Shared  Large   Common  Fixed Shared   1 MB    Common Shared   1 MB
     6      0             800      0      0              0.0    0.0

-------------------------------------------------------------------------------
           Service           ---- Memory Objects ---  Frames  ----- Bytes -----
Jobname  C Class      ASID   Total  Comm   Shr Large   1 MB   Total  Comm   Shr

SMSPDSE  S SYSTEM     0008      12     0     0              76.0M     0     0
TRACE    S SYSTEM     0004       8     0     0              8192K     0     0
GRS      S SYSTEM     0007       4     0     0               140G     0     0
ABCRESO  S SYSSTC     0040       4     0     0              4096K     0     0
JESEAUX  S SYSSTC     0027       3     3     0              3072K 3072K     0
ZFS      S SYSSTC     0049       2     0     0              22.0M     0     0
*MASTER* S SYSTEM     0001       1     1     0              1024K 1024K     0
TCPCS    S SYSSTC     0058       1     1     0              1024K 1024K     0
```

Resolver uses 64-bit private for the DNS cache

TCP/IP uses 64-bit common memory for its sockets control blocks

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Understanding z/OS Communications Server Storage Usage

Summary

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Summary

- **Limiting CS common storage use should be done to protect other subsystem's access to common storage**
  - Severe network spikes (normal or the results of an attack) can require large amounts of common storage for a period of time
  - To avoid CS monopolizing all common storage on a system, limits should be enforced
    - There are no general values that will work for everyone
    - Monitor your system for a period of normal and acceptable peak workloads
    - Communications Server components have mechanisms built in to deal with storage constraints where the limits are approached
      - The intended objective of those mechanisms is to keep the system running in a controllable state, reducing the amount of network traffic to/from the system for a brief period of time
  - If other subsystems are unsuccessful in obtaining any more common storage, they may or may not be able to "survive"

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Summary

- **To get a complete picture of Communications Server common storage use, you need to add up the following items:**
  - ECSA use from the D TCPIP,,STOR command for all stacks
  - For z/OS V1R12: Also the CSA modules from D TCPIP,,STOR command
  - ECSA use from the D TCPIP,TN-Server,STOR command for all TN3270 server address spaces
  - CSM total ECSA use from the D NET,CSM command
  - VTAM total ECSA use from the D NET,BFRUSE command

- **For all items, you can collect**
  - Current use
  - High-water mark
  - Limit (if one has been configured)

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And as usual, a little REXX program can do wonders to bringing order into all that data ..

```
------------------------------------------------------------
System: MVS098 Sysplex: LOCAL Date: 18 Mar 2010 Time: 16:48:02
CPU: 002097-E56 LPAR/VM-name: MVS098
z/OS 01.12.00 5694-A01 CPU-id: FF01E15E2097

ASName   Stor-type      Current HighWater     Limit  In-use
-------- ------------ --------- --------- --------- -------
System   CSA             338432    654152      3968K   8.33%
System   ECSA            24067K    24916K   262720K   9.16%
System   SQA             540088     1216K     1520K  34.70%
System   ESQA            13673K    14360K    20240K  67.56%
TCPCS    ECSA             2752K     3243K         0     N/A
TCPCS    POOL             8892K     8925K         0     N/A
TCPCS    64-bit Commo     1024K     1024K         0     N/A
TCPCS    ECSA Modules     7428K     7428K         0     N/A
VTAMCS   ECSA             2838K     2844K   240019K   1.18%
VTAMCS   POOL             1034K     1172K         0     N/A
VTAMCS   ECSA Modules     1776K
VTAMCS   CSA Modules      40960
VTAMCS   PRIV Modules     7595K
TN3270A  ECSA            119808    119808         0     N/A
TN3270A  POOL             7826K     7827K         0     N/A
TN3270A  64-bit Commo        0         0         0     N/A
TN3270A  CTRACE         262372K   262372K   262372K 100.00%
CSM      ECSA             1554K         0   122880K   1.26%
CSM      Dataspace 31        0    262144     2048M   0.00%
CSM      Dataspace 64     8660K     9960K     2048M   0.41%
CSM      Fixed           11001K         0   122880K   8.95%
--------
(E)CSA   Workload         7261K
(E)CSA   Modules          9244K
```


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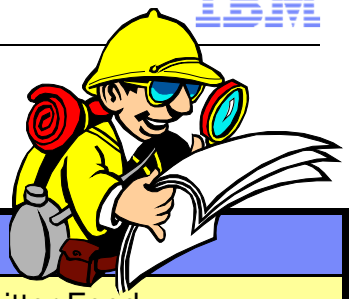
For more information



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http://www.redbooks.ibm.com	ITSO Redbooks
http://www.ibm.com/software/network/commserver/zos/support/	IBM z/OS Communications Server technical Support – including TechNotes from service
http://www.ibm.com/support/techdocs/atsmastr.nsf/Web/TechDocs	Technical support documentation from Washington Systems Center (techdocs, flashes, presentations, white papers, etc.)
http://www.rfc-editor.org/rfcsearch.html	Request For Comments (RFC)
http://www.ibm.com/systems/z/os/zos/bkserv/	IBM z/OS Internet library – PDF files of all z/OS manuals including Communications Server

For pleasant reading ….

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