WLM SYSTEM & SYSSTC Primer

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Abstract

- **WLM SYSTEM / SYSSTC**

  - Ah… the SYSTEM and SYSSTC service class. These are two foundational service classes that all installations have defined, regularly use, and are in need of evaluation. During this webinar, Peter Enrico will give a primer of the SYSTEM and SYSSTC service classes and provide some general performance guidelines.

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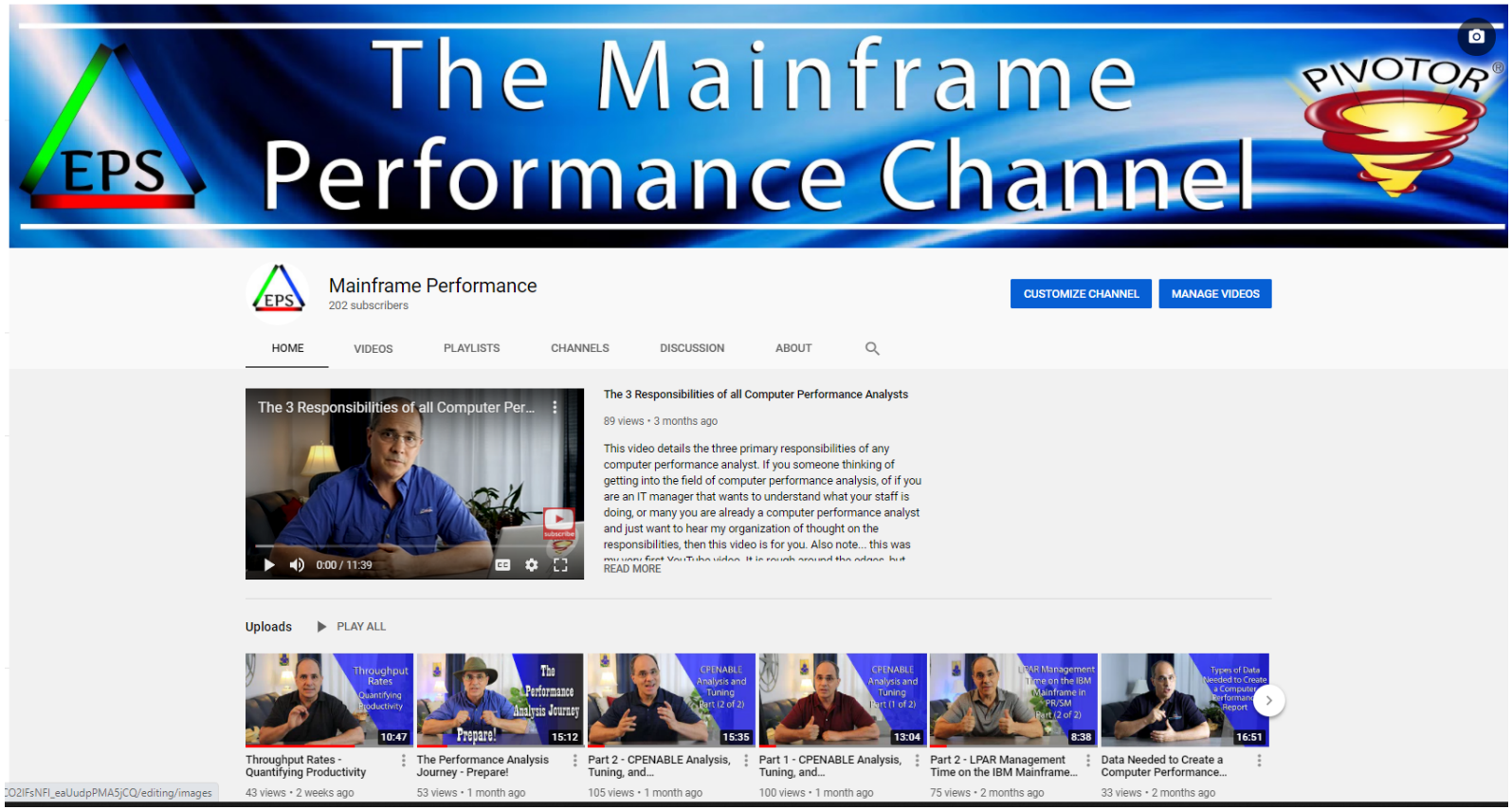

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Introduction to SYSTEM and SYSSTC Service Classes

Overview of SYSTEM & SYSSTC Service Classes

- SYSTEM Service Class
  - WLM defined service class
  - Has no goal, but is considered importance 0 (higher than importance 1)
    - Address spaces in SYSTEM are not managed by WLM (except for XMEM delays)
  - Address spaces in SYSTEM get the highest CPU & I/O dispatching priority in the system
    - x'FF' or 255
  - Examples of address spaces in SYSTEM include
    - MASTER, GRS, DUMPSRV, CATALOG, RASP, XCFAS, SMXC, CONSOLE, IOSAS, others

- SYSSTC Service Class
  - WLM defined service class
  - Has no goal, but is considered importance 0 (higher than importance 1)
    - Address spaces in SYSSTC not usually managed by WLM (except for XMEM delays and Servers)
  - Address spaces in SYSSTC get the second highest CPU & I/O dispatching priority
    - x'FE' or 254
  - Contains started tasks not explicitly classified to another service class
  - Work of the following subsystem types may go into SYSSTC
    - ASCH, JES, OMVS, STC, TSO

Why SYSTEM and SYSSTC?

- SYSTEM and SYSSTC are statically defined service classes available on all systems
  - They provide a service class grouping for certain WLM and installation recognized work
  - WLM then manages SYSTEM and SYSSTC work according to a fixed set of controls
- The design assumption:
  - Allow WLM to recognize a certain set of address spaces that are to be 'treated well', but not managed by any specific goal
  - By always providing these address spaces first access to resources, such as CPU, WLM can then spend its time managing less important work (address spaces and enclaves) towards their response time and velocity goals
- The downside:
  - Are not managed towards any goal
  - Address spaces running in SYSTEM and SYSSTC do not get proactive storage isolation

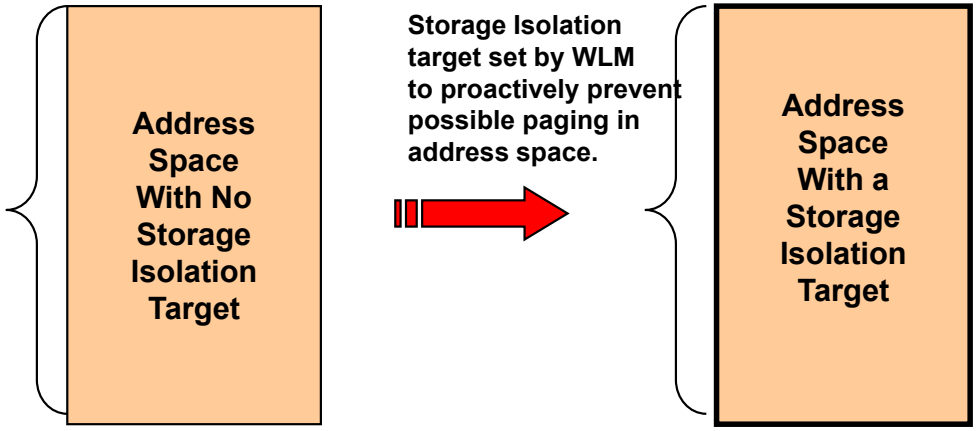
Review of WLM Storage Controls

- Currently WLM policy adjustment algorithms exist to alleviate or prevent paging, and to manage access to processor storage
  - Storage isolation targets are the most common way:
    - Individual storage targets (placed on individual address spaces)
    - Period wide storage targets (placed on all address spaces in a period)
    - Common area storage targets (placed on common areas such as CSA)

- Types of storage targets include:
  - Protective processor
    - Storage target to protect some number of frames in processor storage
    - A way to ensure an address space has the storage it needs to avoid paging
    - Protective targets are especially useful for server subsystems like CICS, IMS, DB2, Server address spaces
  - Restrictive processor
    - Storage target to preferentially migrate number of frames down to the target
    - A way to limit the amount of processor storage an address space occupies to prevent other address spaces from paging
    - Restrictive targets are useful for large batch workloads that want to consume more storage than is available

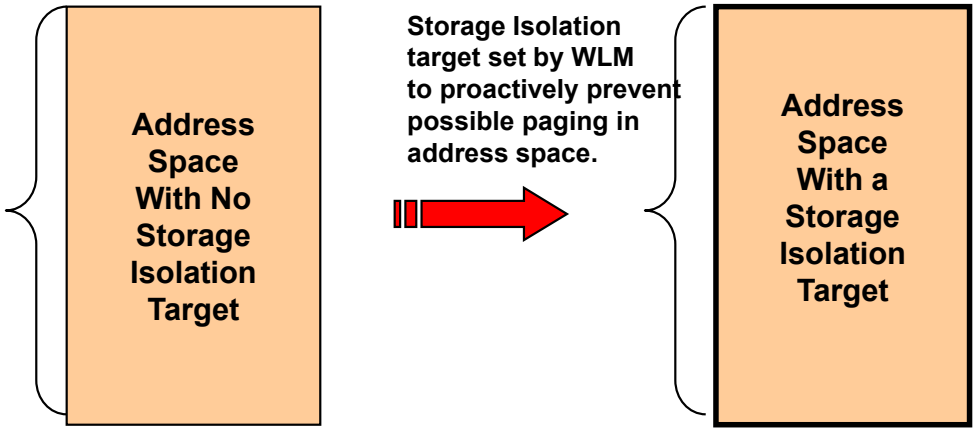
Review of Proactive Storage Isolation

- Proactive storage targets are used to help WLM prevent possible paging problems
  - On a system with little or no paging, WLM will inventory the 'large' address spaces
  - WLM may then decide to proactively storage protect some of the large important address spaces even though they may not be missing their goals
    - And even if there is not currently a paging problem
  - These address spaces are now proactively protected in case a storage shortage occurs



SYSTEM & SYSSTC
Ineligible for Proactive Storage Isolation

- SYSTEM and SYSSTC work is not eligible for proactive storage isolation algorithms
  - This means that if an address space grows to a significant storage size, WLM will not proactively storage isolate the address space to prevent it from paging in case of a storage problem
- SYSTEM and SYSSTC also not storage managed based on any goal
  - May still get storage isolated for other reasons (such as XMEM), but not due the address space's goal
- Less of a problem in today's large processor storage environments



Classifying Work to SYSTEM & SYSSTC

Classification Rules for STC

- STC rules are used to classify address spaces initiated by the START or MOUNT
  - You can explicitly classify work to SYSTEM and SYSSTC
  - Note: If your service definition has 'blank' service class specified for a classification rule then it is an old service definition that needs to be updated

```
 Subsystem-Type  Xref  Notes  Options  Help
------------------------------------------------------------------------------
                Modify Rules for the Subsystem Type     Row 9 to 16 of 47
Command ===> ____________________________________________ SCROLL ===> PAGE

Subsystem Type . : STC         Fold qualifier names?   Y  (Y or N)
Description  . . . started Tasks

Action codes:   A=After     C=Copy        M=Move     I=Insert rule
                B=Before    D=Delete row  R=Repeat   IS=Insert Sub-rule
                                                        More ===>
          --------Qualifier--------               -------Class--------
Action    Type       Name     Start                Service     Report
                                          DEFAULTS: STCLO       ________
 ____  1  TN         IMWEBSRV ___                  STCHI       WEBSERVR
 ____  1  TN         IMWIWM   ___                  STCHI       WEBQM
 ____  1  TN         DLF      ___                  SYSSTC      ________
 ____  1  TN         WLA*     ___                  STCHI       WLA
 ____  1  TN         ESCM     ___                  STCLO       ________
 ____  1  TN         GDMMSTR  ___                  STCMD       ________
 ____  1  TN         GDMSLAVE ___                  STCMD       ________
 ____  1  TN         IXFP     ___                  STCHI       ________
```

SYSTEM and SYSSTC Defaults

- Explicit classification of work to a service class is always optional
  - For subsystem types other than STC (such as JES, TSO, CB, etc.) work that is not explicitly classified gets classified to the default service class

- STC address spaces not explicitly classified get classified a little differently
  - May get classified to the default service class
  - While other address spaces get classified to the SYSTEM service class
  - Still other address spaces get classified to the SYSSTC service class

SYSTEM and SYSSTC Defaults

- For system spaces and started tasks, certain attributes determine the default system defined service class
- High level process for STC default classification:
  - Some address spaces will be forced to SYSTEM no matter what the classification rules are
  - HIPRI address spaces not classified will go to SYSTEM
  - If address space is still not classified
    - WLM then determines if an address space is Privileged. If so, WLM classifies it to SYSSTC
  - If address space is still not classified
    - WLM classifies it to the STC default service class

	Privileged	Not Privileged
ASCRE Attribute HIPRI	Goal: • SC = 'SYSTEM' • DP = x'FF'	Goal: • SC='SYSTEM' • DP = x'FF'
ASCRE Attribute NONURG	Goal: • SC = 'SYSSTC' • DP = x'FE'	Goal: • SC=default for STC • DP = WLM managed

SYSTEM and SYSSTC Defaults

- Is the SYSTEM service class the best service class for HIPRI address space?
  - In nearly every case the answer is YES
  - In some cases, such as *MASTER* and WLM, you do not even have a choice.
  - Most of these address spaces will be forced to SYSTEM regardless of classification rule

- Is the SYSSTC service class the best service class for privileged address spaces?
  - In many cases the answer is YES
  - In many cases the answer is NO
  - What cases do you think are YES and NO?

- Is the SYSSTC the best service class for address spaces that are not privileged?
  - In many cases the answer is YES
  - In many cases the answer is NO
  - What cases do you think are YES and NO?

When is SYSSTC right for an Address Space?

- When is SYSSTC the right or wrong service class for an address space?
  - Regardless if it is privileged or not.

- Rules of thumb for when SYSSTC is a good service class for an address space:
  - SYSSTC is usually a good service class for the following address spaces:
    - Most critical system oriented started tasks
    - High importance system addresses that are predictable and don't use up lots of CPU
    - High important started tasks with 'bursty' activity or sporadic CPU consumption
    - DB2 IRLM or any lock manager that should run above its associated subsystem address spaces
    - Most monitors (but within reason)
    - When the workload utilization of SYSSTC is less than 50% of a single CPU. Less in smaller environments

When is SYSSTC ***not*** right for an Address Space?

- Rules of thumb for when SYSSTC is NOT a good service class for an address space:
  - SYSSTC is usually not a good service class for the following address spaces:
    - Storage intensive or storage critical address spaces
    - Address spaces prone to WLM server management
      - Example: Those address spaces in SDSF that are listed as SERVER=YES
  - Most subsystem address spaces for subsystem work managers such as CICS, IMS, DB2, WebSphere, ADABAS, IDMS, and many others
  - Address spaces whose CPU consumption is not predicable and could be very high

Classification of work to SYSTEM and SYSSTC

SPM Classification Rule

- Subsystem Parameter (SPM) rule for STC subsystem
  - Indicates that the system provided service class of SYSTEM or SYSSTC will be assigned if a started task with high dispatching priority, privileged, or system task attribute but is not assigned to a regular service class with goal

```
Subsystem-Type  Xref  Notes  Options  Help
------------------------------------------------------------------------------
                 Modify Rules for the Subsystem Type       Row 1 to 8 of 47
Command ===> _____________________________________________ SCROLL ===> PAGE

Subsystem Type . : STC          Fold qualifier names?   Y   (Y or N)
Description  . . . Started Tasks

Action codes:   A=After      C=Copy        M=Move      I=Insert rule
                B=Before     D=Delete row  R=Repeat    IS=Insert Sub-rule
                                                          More ===>
          --------Qualifier---------                -------Class--------
Action    Type       Name     Start                  Service     Report
                                              DEFAULTS: STCLO       DEFSTC
  ____  1 TN         ASCH     ___                    SYSSTC      ________
  ____  1 TN         DFSMSHSM ___                    STCHI       ________
  ____  1 TN         %%%%IRLM ___                    SYSSTC      DB2

(all other STC rules are here, and then last rule is as follows:

____  1 SPM        SYSTEM   ___                    SYSTEM      DEFSYSTM
____  1 SPM        SYSSTC   ___                    SYSSTC      DEFSYSTC
```

If your STC classification rules do not have these SPM rules specified, the rules will be implied.

So having these SPM rules as the last rules or not having them at all as the same result.

However, having the SPM rule gives you the ability to specify report classes

Revisit the Assignment to SYSTEM and SYSSTC

- It is important to verify that SYSTEM and SYSTC are used effectively
  - It is recommended that you inventory all your high DP and privileged address spaces
- Recommendation - Inventory all your HIPRI and privileged address spaces
  - Group all STC address spaces into the following categories:

    1. Work that is HIPRI (to ensure they run in SYSTEM)
    2. Work that is privileged and truly should be in SYSSTC
    3. Work that is privileged but does not belong SYSSTC
    4. Work that is not privileged but should be in SYSSTC
    5. Work that is neither HIPRI nor privileged should not go to either SYSTEM or SYSSTC
       - Note: These will go to the STC a service class other than SYSTEM or SYSSTC
- Then make sure the work is classified accordingly
  - Best to use the SPM classification rules to do this

Typical SYSTEM Address Spaces

- The following is a list of typical SYSTEM address spaces
  - Some are forced there regardless of classification rules
  - Others are HIPRI, so will go to SYSTEM with either the SPM rule or when not classified

JOBNAME	JOBNAME	JOBNAME
MASTER	DUMPSRV	PCAUTH
ALLOCAS	GRS	RASP
ANTMAIN	IEFSCHAS	SMF
BPXOINIT	IOSAS	SMSPDSE
CATALOG	IXGLOGR	SMSPDSE1
CEA	JES2MON	TRACE
CONSOLE	JESXCF	WLM
DEVMAN	OMVS	XCFAS

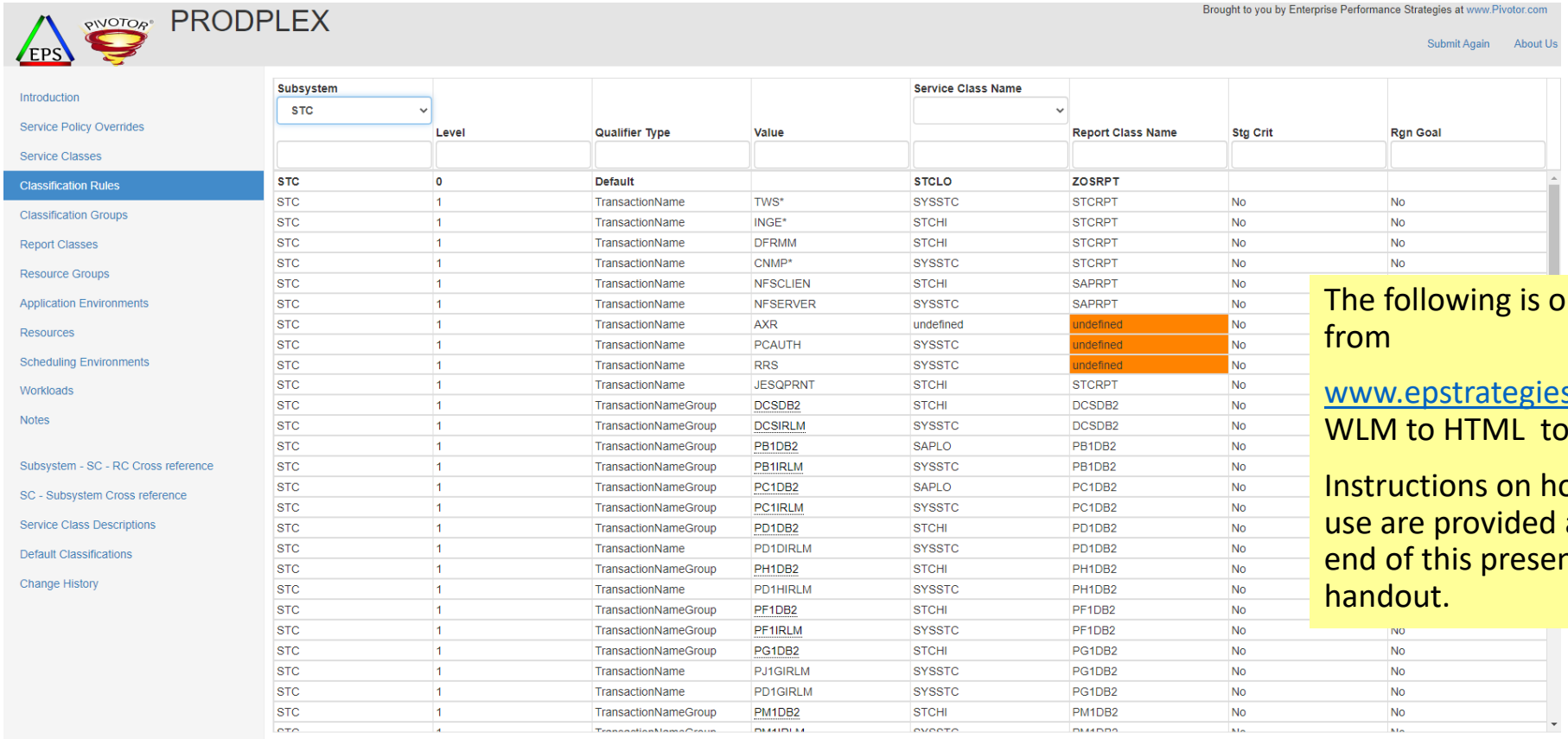
Typical Privileged and SYSSTC Address Spaces

- Privileged address spaces not classified or classified via SPM
  - Most listed below are typical privileged SYSSTC address spaces and are system facilities that do work on behalf of the entire system
  - ***Warning!*** There are many privileged address spaces that if not classified elsewhere can get stuck classified to SYSSTC. This needs to be avoided
    - Example: DB2 MSTR, DBM1, and DIST address spaces are privileged, but should not be in SYSSTC

JOBNAME	JOBNAME	JOBNAME
ANTAS000	JES2AUX	PSF52
SMS	TSS	PAGENT
RESOLVER	VMCF	OMPROUTE
LLA02	NET	TN3270
VLF	RMF	RMFGAT
RRS	TNF	G201IRLM
OAM	TSO	G201MSTR
JES2	TCPIP	G201DBM1
		G201DIST

- Do not want DB2 in SYSSTC

Review your STC Classification Rules



The following is output from

www.epstrategies.com
WLM to HTML tool

Instructions on how to use are provided at the end of this presentation handout.

Inventory all SYSTEM Address Spaces

SYSPLEX	Job_Name	AS_Type	SC_Name	RC_Name	SYSK CPU Secs	SYSL CPU Secs
PRODPLEX	ALLOCAS	SYS	SYSTEM	ZOSRPT	3.11	0.16
PRODPLEX	ANTMAIN	SYS	SYSTEM	ZOSRPT	0.57	0.79
PRODPLEX	BPXOINIT	SYS	SYSTEM	ZOSRPT	4.65	1.49
PRODPLEX	CAMASTER	SYS	SYSTEM	ZOSRPT	0.01	0.01
PRODPLEX	CATALOG	SYS	SYSTEM	ZOSRPT	171	656.87
PRODPLEX	CEA	SYS	SYSTEM	ZOSRPT	0.02	0.02
PRODPLEX	CONSOLE	SYS	SYSTEM	ZOSRPT	140.58	40.2104
PRODPLEX	DEVMAN	SYS	SYSTEM	ZOSRPT	0.05	0.03
PRODPLEX	DUMPSRV	SYS	SYSTEM	ZOSRPT	0.01	0
PRODPLEX	EYUX320	SYS	SYSTEM	ZOSRPT	0	
PRODPLEX	FPGHWAM	SYS	SYSTEM	ZOSRPT	0.01	0.01
PRODPLEX	GRS	SYS	SYSTEM	ZOSRPT	237.91	947.19
PRODPLEX	IEFSCHAS	SYS	SYSTEM	ZOSRPT	0.15	16.05
PRODPLEX	IOSAS	SYS	SYSTEM	ZOSRPT	4.36	3.05
PRODPLEX	IXGLOGR	SYS	SYSTEM	ZOSRPT	26.25	44.32
PRODPLEX	JES2MON	SYS	SYSTEM	ZOSRPT	26.99	19.05
PRODPLEX	JESXCF	SYS	SYSTEM	ZOSRPT	6.72	6.14
PRODPLEX	MSTJCL00	SYS	SYSTEM	ZOSRPT	97.43	146.59
PRODPLEX	OMVS	SYS	SYSTEM	ZOSRPT	9086.4	127.15
PRODPLEX	PCIE	SYS	SYSTEM	ZOSRPT	0.01	0
PRODPLEX	RACFDS	SYS	SYSTEM	ZOSRPT	0.2	0.96
PRODPLEX	RASP	SYS	SYSTEM	ZOSRPT	1.81	3.13
PRODPLEX	SMF	SYS	SYSTEM	ZOSRPT	12.73	69.34
PRODPLEX	SMSPDSE	SYS	SYSTEM	ZOSRPT	2.42	1.95
PRODPLEX	SMSPDSE1	SYS	SYSTEM	ZOSRPT	23.37	2.96
PRODPLEX	TRACE	SYS	SYSTEM	ZOSRPT	0	0
PRODPLEX	WLM	SYS	SYSTEM	ZOSRPT	274.9	1029.21
PRODPLEX	XCFAS	SYS	SYSTEM	ZOSRPT	648.7	396.09

Inventory all your SYSTEM address spaces

- Take note to make sure any address space in SYSTEM is truly a system address space
- Consider classifying address spaces of most interest to their own report class

Inventory all SYSSTC Address Spaces

SYSPLEX	Job_Name	AS_Type	SC_Name	RC_Name	SYSK CPU Secs	SYSL CPU Secs
PRODPLEX	AXR	SYS	SYSSTC	ZOSRPT	0.01	0.03
PRODPLEX	CICPKMA1	STC	SYSSTC	CPSM	137.42	
PRODPLEX	CICPWUI1	STC	SYSSTC	MONITORS		
PRODPLEX	HZR	SYS	SYSSTC	ZOSRPT		
PRODPLEX	IZUANG1	STC	SYSSTC	ZOSRPT		
PRODPLEX	JES2	SYS	SYSSTC	ZOSRPT		
PRODPLEX	LLA	SYS	SYSSTC	ZOSRPT		
PRODPLEX	NET	STC	SYSSTC	NETWK		
PRODPLEX	NFSERVER	STC	SYSSTC	SAPRPT		
PRODPLEX	OAM	STC	SYSSTC	ZOSRPT		
PRODPLEX	PCAUTH	SYS	SYSSTC	ZOSRPT		
PRODPLEX	PD0AIRLM	STC	SYSSTC	DCSDB2		
PRODPLEX	PD0BIRLM	STC	SYSSTC	P11DB2		
PRODPLEX	PD1CIRLM	STC	SYSSTC	KC9DJ7		
PRODPLEX	PD1FIRLM	STC	SYSSTC	PF1DB2		
PRODPLEX	PD1GIRLM	STC	SYSSTC	PG1DB2		
PRODPLEX	PD1HIRLM	STC	SYSSTC	PH1DB2		
PRODPLEX	PD1RIRLM	STC	SYSSTC	PR1DB2		
PRODPLEX	PD1SIRLM	STC	SYSSTC	PS1DB2		
PRODPLEX	PD1WIRLM	STC	SYSSTC	PB1DB2		
PRODPLEX	PE1CIRLM	STC	SYSSTC	KC9DJ7		
PRODPLEX	PE1FIRLM	STC	SYSSTC	VD6LF6		
PRODPLEX	RACF	SYS	SYSSTC	ZOSRPT		
PRODPLEX	RIO	STC	SYSSTC	ZOSRPT		
PRODPLEX	RMF	STC	SYSSTC	ZOSRPT		
PRODPLEX	RMFGAT	STC	SYSSTC	ZOSRPT		

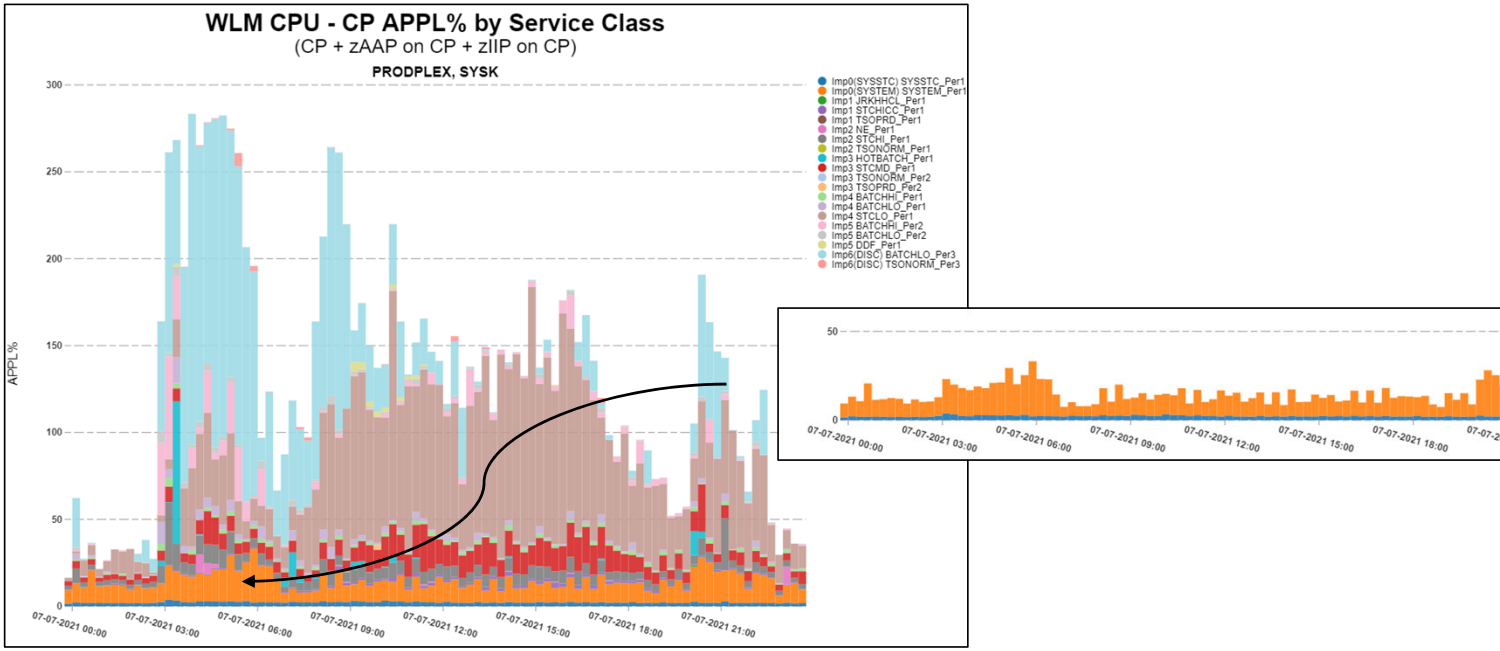
SYSPLEX	Job_Name	AS_Type	SC_Name	RC_Name	SYSK CPU Secs	SYSL CPU Secs
PRODPLEX	RRS	SYS	SYSSTC	ZOSRPT	8.26	5.09
PRODPLEX	TCP3270	STC	SYSSTC	NETWK	37.19	27.46
	TCPIP	STC	SYSSTC	NETWK	228.53	6579.82
	TCPRSLVR	SYS	SYSSTC	NETWK	0.07	0.04
	TMONDB2	STC	SYSSTC	MONITORS		221.77
	TMONDLFS	STC	SYSSTC	MONITORS		0.37
	TMONHUBP	STC	SYSSTC	MONITORS	9.66	0.04
	TMONHUBR	STC	SYSSTC	MONITORS	0.32	0.27
	TMONMQS	STC	SYSSTC	MONITORS	316.26	
	TMONQLFS	STC	SYSSTC	MONITORS	1.4	
	TMONTCP	STC	SYSSTC	MONITORS		2.42
	TMONTLFS	STC	SYSSTC	MONITORS		0.22
	TMONULFS	STC	SYSSTC	MONITORS	0.14	
	TMONUSS	STC	SYSSTC	MONITORS	0.01	
	TNF	SYS	SYSSTC	ZOSRPT	0	0
	TSO	STC	SYSSTC	ZOSRPT	0.06	0
	TWSC	STC	SYSSTC	STCRPT		6.42
	TWSD	STC	SYSSTC	STCRPT		21.75
	TWST	STC	SYSSTC	STCRPT		0.69
	VLF	SYS	SYSSTC	ZOSRPT	0.38	0.38
	VMCF	SYS	SYSSTC	ZOSRPT	0.12	0.09
	XMANAGER	STC	SYSSTC	MONITORS	5.18	4.06
	ZFS	SYS	SYSSTC	ZOSRPT	197.74	192.7

Inventory all your SYSSTC address spaces

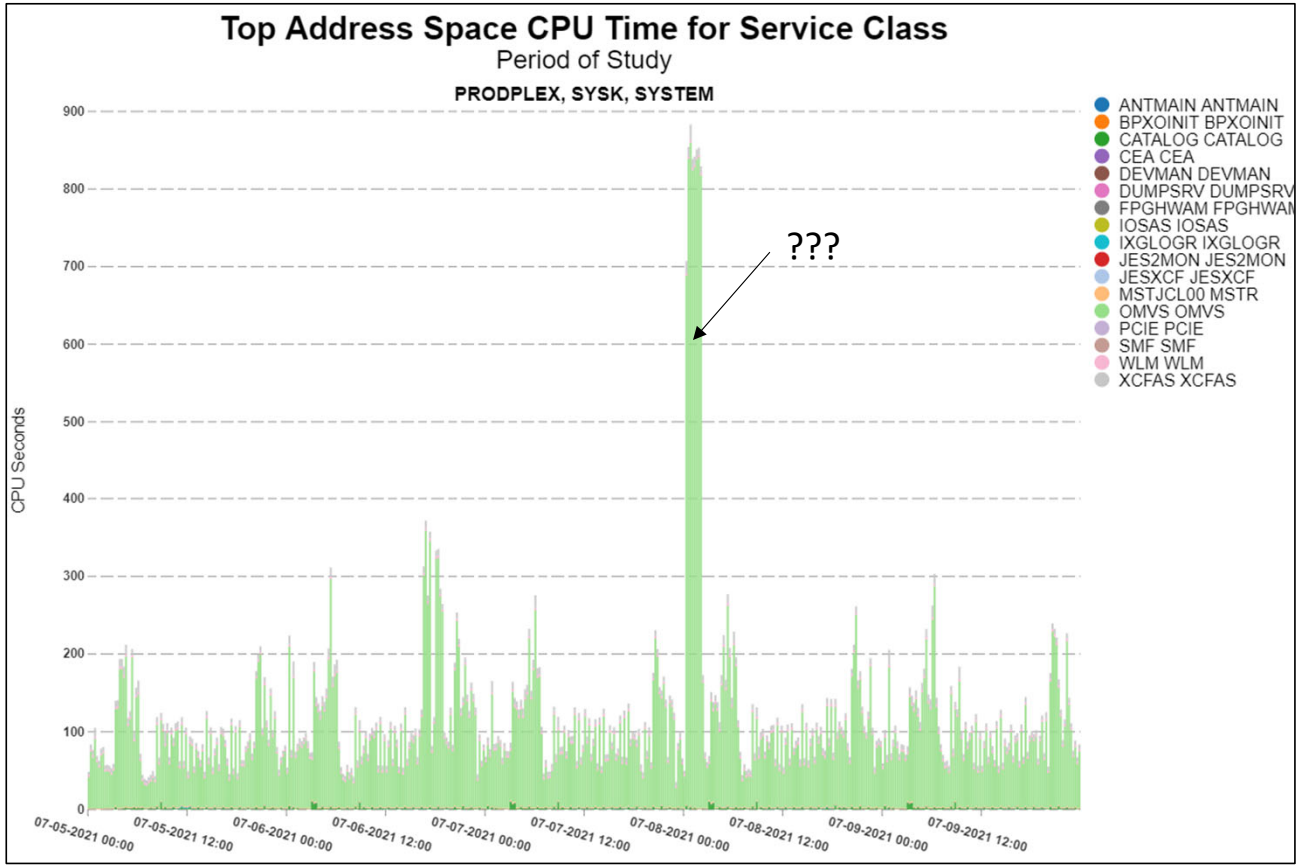
- Take note to make sure any address space in SYSSTC are not storage sensitive
- Monitors are OK so long as collectively they do not use too much CPU
- Strongly recommended to put IRLMs here
- Do not put DB2, CICS, or IMS server address spaces
- No SERVER=Y address spaces.
- Make good use of report classes

Monitor CPU Usage by SYSEM and SYSSTC

- Monitor the CPU consumption of SYSTEM and SYSSTC
  - CPU consumption should be predictable and not excessive
    - Remember anything running in SYSTEM and SYSSTC run at a higher CPU DP than all other work



Monitor Top consuming SYSTEM address spaces

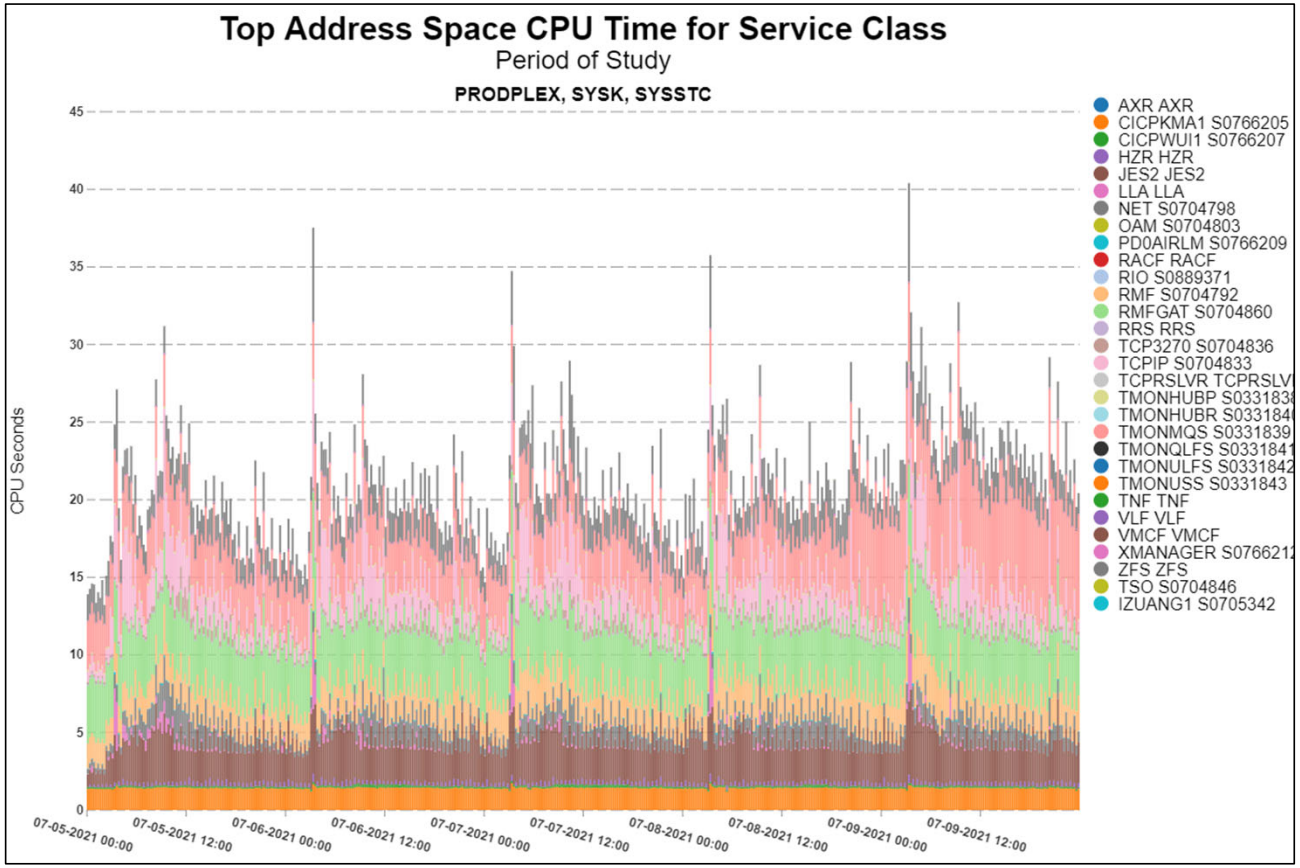


Take note of the largest consuming address spaces in the SYSTEM service class

In this example we are looking at 5 days (Monday through Friday) of the SYSTEM service class address spaces that consumed the most CPU seconds.

What happened in the early morning hours of July 8th?

Monitor Top consuming SYSSTC address spaces



Take note of the largest consuming address spaces in the SYSSTC service class

In this example we are looking at 5 days (Monday through Friday) of the SYSSTC service class address spaces that consumed the most CPU seconds.

Notice the predictable usage of CPU.

SYSTEM and SYSSTC Conclusion

- Remember, SYSTEM and SYSSTC work is not eligible for proactive storage isolation
  - So don't put spaces that are storage sensitive into SYSTEM and SYSSTC
- Do not putting too much work into SYSTEM and SYSSTC
  - If too much were in SYSTEM and SYSSTC you may starve lower importance work and you tie WLM's hands by making less resources available for it to make trade-offs with
- Do not put into SYSSTC
  - Work managers such as CICS or IMS address spaces
  - Database managers such as DB2 address spaces
    - But IRLM is OK for SYSSTC
  - Server=YES address spaces such as WebSphere Servant regions or WLM stored procedure address spaces

Comments from Jamie…
and then
Q & A

Questions about content of webinar?

Of maybe general performance questions?

Quick Reminder: Convert your WLM Service Definition to HTLM for Easy Reading

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  - We're always happy to process a day's worth of data and show you the results
  - See also: http://pivotor.com/cursoryReview.html

Format your WLM Service Definition in HTML

- Today, it is recommended to save the WLM service definition in XML format
  - The ISPF tables are automatically updated when they are touched by new APARs or z/OS releases. This then makes then ineligible to be updated if the APARs or z/OS releases are rolled back, or if an older release needs to edit or access.

- Select
  - File
  - -> Save as

  Use Save as to save the currently displayed service definition in a PDS as ISPF tables or in a PS as XML

```
File  Utilities  Notes  Options  Help
------------------------------------------------------------------------------
Functionality LEVEL025 Definition Menu WLM Appl LEVEL025
Command ===> ____________________________________________________________

Definition data set . . : none

Definition name . . . . . ________ (Required)
Description . . . . . . . ________________________________

Select one of the following options.
___ 1. Policies                          12. Tenant Resource Groups
    2. Workloads                         13. Tenant Report Classes
    3. Resource Groups
    4. Service Classes
    5. Classification Groups
    6. Classification Rules
    7. Report Classes
    8. Service Coefficients/Options
    9. Application Environments
   10. Scheduling Environments
   11. Guest Platform Management Provider
```

Convert it to HTML via our website!

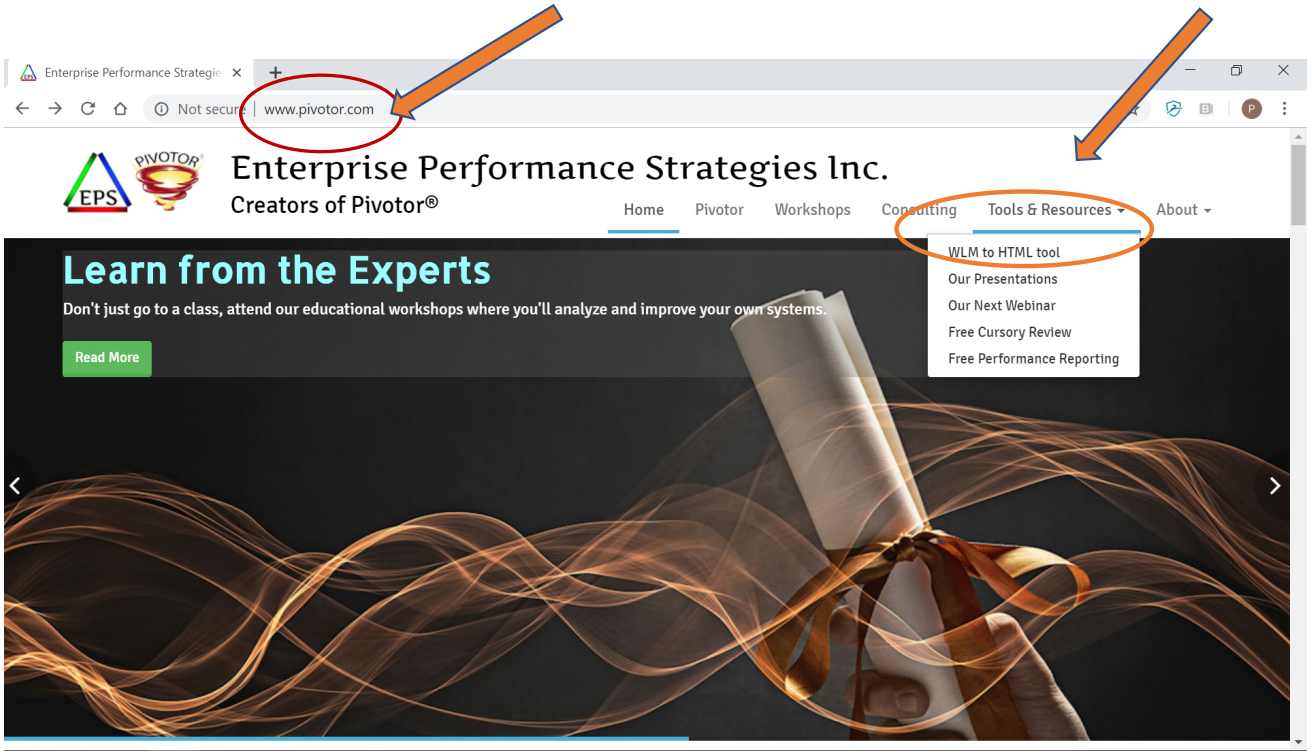
- Once saved as XML, a tool is available to nicely format the XML file into a easy to read format to assist during your WLM analysis

- Visit www.pivotor.com or www.epstrategies.com

- Select 'Tools & Resources' option

- Select WLM TO HTML

- Provide your XML file and email address
  - HTML formatted WLM service definition emailed to you in seconds!



Example of HTML Formatted Service Definition

- Not only is the XML file nicely formatted

  But there is some analysis built into the file to help you with your service definition cleanup.