Performance Formula and Performance Reporting Fundamentals

z/OS Performance Education, Software, and Managed Service Providers

Creators of Pivotor®

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Performance Workshops Available

As of the date of the creation of this PDF file, our 2013 class schedule is not yet complete. Please keep an eye for our 2013 class schedule.


During these workshops you will be analyzing your own data!


- WLM Performance and Re-evaluating of Goals
  - Instructor: Peter Enrico
- Essential z/OS Performance Tuning
  - Instructor: Peter Enrico and Tom Beretvas
- Parallel Sysplex and z/OS Performance Tuning (Web / Internet Based!)
  - Instructor: Peter Enrico
- z/OS Capacity Planning and Performance Analysis
  - Instructor: Ray Wicks

Abstract and Reports Offer

- **Abstract**
  - During this session Peter Enrico will review z/OS performance formula fundamentals, and the fundamentals of performance reporting. This session will not only be informative and useful, but also will be a great back to basics reminder of the performance formulas and report structures that are used by z/OS performance analysts on a daily basis.

Preface to Lecture

- Please understand that performance measurements, performance formulas, and performance reporting are each enormous subjects
- The purpose of this presentation is to convey some of the basic concepts
- The subject matter covered in this lecture are the primary subject needed to conduct most basic performance analysis exercises for the z/OS environment
- This lecture is a simplified view of looking at measurements
- Note: Chart examples in this lecture were generated from www.pivotor.com

The Data – The Very Basics

Data 101

- Organization of Data
  - To do any sort of analysis, data must be grouped, organized, and summarized
  - The way the data are organized is based on how the report is to be used
  - So formulation of the question being asked of the data is very important
- First it is important to understand the types of data available
  - Data is the basic building blocks of any report used during an analysis
  - All data are logically broken up into the following 2 broad categories
    - Dimensional data
    - Measured (also known as metric) data

Dimensional Data

- Dimensional Data - Data that gives metrics context
  - One should think of dimensional data as any data that could be used compare metrics
- Examples of Dimensional data
  - **Time** based dimensional data – When data is used in context of '**When?'**
    - Examples: Date, Time, Hour, Year, etc.
  - **Placement** based dimensional data – When data is used in context of '**Where?'**
    - Examples: Sysplex name, System name, Volser, Coupling Facility, etc.
  - **Subject** based dimensional data – When data is used in context of '**What?'**
    - Examples: Transaction name, Service class name, Volser, Job name, etc.
  - **Adjective** based dimensional data – When data is used in context of '**Which?'**
    - Examples: Type of processor (CP, zIIP, zAAP, IFL, ICF), type of WLM class (Report Class o Service Class), etc.
- How the dimensional data is used is dependant upon the question being asked

Metrics – The measured data

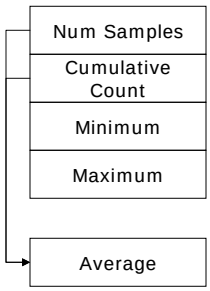
- Metrics Data
  - What is typically thought of as the measurement to gauge the relative value of during an analysis or study
  - One should think of metrics as any measured value that could be used to help gain an understanding needed to answer a question
  - Many times when reviewing measurements, metrics can be further defined
    - Cumulative / Interval
    - Snap shot
    - Sampled
    - Etc.
  - Examples of metrics (in a computer measurement environment)
    - Utilizations
    - Rates
    - Response times
    - Resource consumption
    - Number of ended transactions
    - Samples
    - Etc.

Types of Metrics Data

- Metrics – Cumulative and Interval data
  - For a fixed period of time, the measurement of a potentially continuous (ever increasing or decreasing) unit of measured data
  - Helps to answer the question of 'How much?' for a particular period of time
  - Examples:
    - Number of seconds of CPU consumed in 15 minutes
    - Number of transactions that completed in 15 minutes
    - Cumulative response time of all transactions in 15 minutes
    - Etc
- Metrics – Snap Shot end of interval sample
  - Any measurement's value at the end of a specific measurement interval
  - Value may increase / decrease / fluctuate
  - Usually not regularly sampled because too expensive or not useful as sampled
  - Examples:
    - Number of coupling facility cache structure directory entries in use
    - An on/off indicator
    - Amount of configured storage
    - Etc.

Types of Metrics Data

- Metrics – Sampled
  - Variation of snap shot data
  - Metric is sampled regularly during the measurement interval
    - Example: Once every second for 15 minutes (i.e. so 900 samples)
  - Usually, for every sampled measurement the following 4 values are recorded:
    - Number of samples
    - **Cumulative** value during the measurement interval
    - **Minimum** value during the measurement interval
    - **Maximum** value during the measurement interval
  - Naturally, given the number of samples and the cumulative value, the average value can be calculated
    - Average = (Cumulative Value) / (Number of samples)
  - Example Min / Max / Avg :
    - Number of unit of works on the dispatcher queue
    - High / Medium / Low impact frames
    - Etc.



Data Reporting 101 – Measurement Groupings

- Dimensional and Metric data are the basic building blocks for reporting
  - Whether a report is in a tabular or graphical format, the data on any report is actually categorized and organized into four groupings for that report.
- When creating any report, the selected data is segregated into one of 4 groupings to build the final report
  - Metric data
  - Row data
  - Column data
  - Filter data
- There is actually a forth category of data called 'ignored'
  - Ignored data is data that is not part of the subject report
  - In other words, the data is available, but was not needed to answer the question being asked of the data

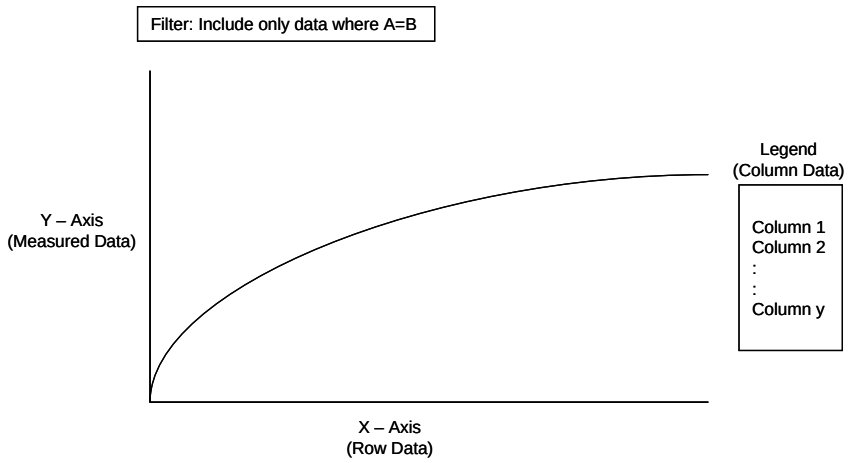
Data Reporting 101 – Groupings Explained

- Metric data
  - Data of study for the analyst of the report
  - Data values in this context could be the result of a collected value, complex formula, or could be nothing more than a Boolean indicator
- Row data
  - Group is data that provides context to measured data by separating summarized measured data into distinct groupings organized in row
- Column data
  - Grouping allows measured data to be logically grouped and summarized within a particular row
- Filter data
  - Grouping allows the data in any report to be narrowed down to a subset of data for reporting purposes

Data Reporting 101 – Report Types

- Data can be reported in an infinite number of ways, but in general, there are 3 broad categories of reports
- Graphical Reports
  - Allow the visualization of data into charts
- Tabular Reports
  - Allow the reading of the data values in a grid format
- Customer Designed Reports
  - Allow the summarization of varying and different types of data in a custom designed report
  - Example: RMF or CMF Post Processor reports

Graphical Report Example



Tabular Report Example

Filter: Include only data where A=B

	Column 1	Column 2	…	Column y
Row 1	Measurement 1,1	Measurement 1,2	…	Measurement 1,y
Row 2	Measurement 2,1	Measurement 2,2	…	Measurement 2,y
Row 3	Measurement 3,1	Measurement 3,2	…	Measurement 3,y
:	:	:	:	;
:	:	:	:	
Row x	Measurement x,1	Measurement x,2	…	Measurement x,y

Table report example:
Extract of LVs with worst QI instances

Filter:
- DASDplex
- QI > 200
- S > 1
- RT > 3

Row:
- Time
- Volser

Column:
- None (One super column with multiple measurements)

Metric:
- QI, S, RT IOSQ, PEND, DISC, CONN, RHR, CMR

Time	VolSer	QI	S	RT	IOSQ	PEND	DISC	CONN	RHR	CMR
23:45	U2O239	432	133.8	3.8	0.0	0.4	2.9	0.6	0.551	0.2
11:30	U1O796	400	37.8	11.1	0.1	7.6	3.0	0.5	0.618	6.8
11:15	U1O796	398	37.0	11.3	0.1	7.7	3.0	0.5	0.610	6.9
23:30	U1O954	381	68.7	6.3	0.0	0.4	5.1	0.7	0.452	0.3
12:15	U1O796	378	36.6	10.8	0.0	7.3	3.0	0.5	0.615	6.6
11:45	U1O796	375	37.9	10.4	0.0	7.0	2.9	0.5	0.630	6.4
11:00	U1O796	353	37.8	9.8	0.0	6.4	2.9	0.5	0.622	6.1
17:01	UKP252	350	46.5	15.0	0.0	0.5	7.1	7.4	0.445	0.3
19:15	U1O230	349	77.7	4.8	0.0	0.3	4.2	0.3	0.502	0.2
12:00	U1O796	347	36.0	10.2	0.0	6.6	3.0	0.5	0.630	6.1
17:01	U2O508	344	58.4	6.3	0.0	0.6	5.3	0.4	0.328	0.4
12:45	U1O796	344	34.6	10.4	0.0	7.1	2.8	0.5	0.644	6.3
10:30	U1O796	343	36.8	9.8	0.0	6.0	3.3	0.5	0.569	5.6
12:30	U1O796	343	34.9	10.3	0.0	6.8	3.0	0.5	0.634	6.4
11:15	U1O798	338	34.4	10.5	0.0	6.3	3.5	0.7	0.541	5.9
9:15	U1O798	337	111.5	3.4	0.0	1.6	1.4	0.4	0.833	1.4

Report Comments / Recommendations

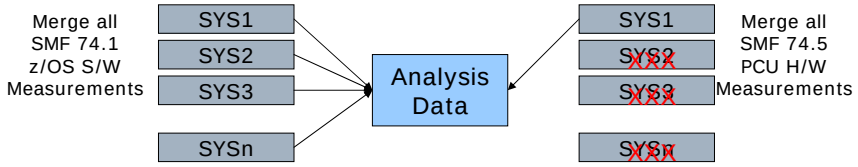
- Producing a report is not the same as conducting an analysis
  - Reports are only used to back up an analysis
  - Clear explanations of reports and analysis is still needed
- Choose metrics that fit into your analysis
- Clearly state the dimensions in both the reports and analysis and discussions
  - Dimensional analysis never assumes the reader is familiar with the dimensions
  - Example: TSO TSOPRD service class period 1 transactions per second
- Avoid metrics that are not very helpful
- Remember that rarely does one number or chart describe performance
- Always choose representative data
  - Avoid data outside the norm unless the study of that data is specific to the analysis
- Avoid too many reports
  - During an analysis it is OK to produce thousands of reports if you are the one who is going to examine them
  - In your final analysis you should only need a few reports to tell the story

Beyond the Very Basics

Now that the very basics have been covered, now let's talk the data

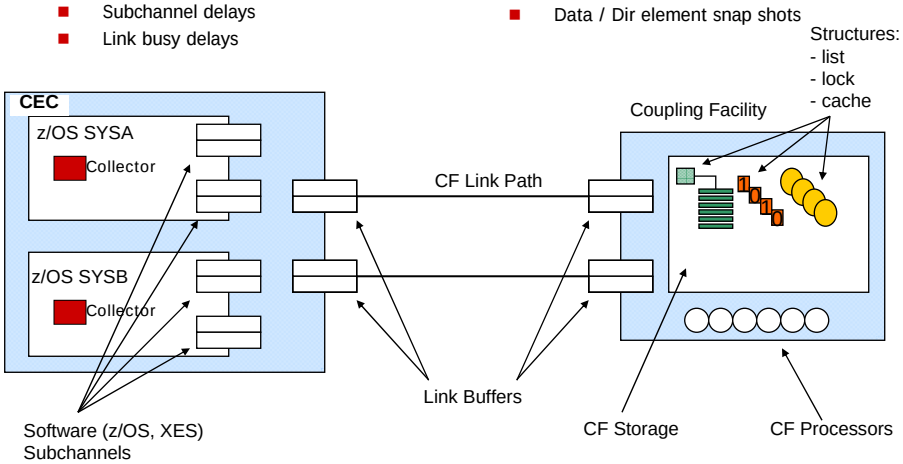
Understand measurement source to avoid duplicate measurements

- Internal resource or workload data
  - When measurement is collected where collector is running
  - Measurement can only be gotten from where the collector is running
    - So data is unique to the collector
    - Example: # of ended transactions and average response time of transactions on SYSA
- Hardware / peripheral measured data
  - When measurement is retrieved from someplace other than where the collector is running
  - If multiple collectors running on multiple systems, then each would get the same measurements from the peripheral device
    - Example: Control unit hardware data, Coupling facility hardware data, Processor data (such as PR/SM measurements via the Diag x'204' instruction)



Example – Coupling Facility S/W versus H/W

- CF z/OS S/W Measurements
  - Number of requests to each structure
  - Response time of each structure
  - True / False lock contention
  - Subchannel delays
  - Link busy delays
- CF H/W Measurements
  - CPU time
  - Storage used by each structure
  - Cache structure usage
  - Data / Dir element snap shots



Steps to Reporting Data

- Formulate the question
  - Is it a resource being measured?
  - Is it a workload being measured?
- Determine the dimensional data components
  - Time (When?), Placement (Where?), Subject (What?), Adjective (Which?)
- Determine the metric to be reported
  - Interval metric, Snap Shot metric, Sampled metric
  - Does a formula need to be applied to derive a metric based on other metrics?
  - Does the report need to contain multiple metrics?
- Report and interpret
- As a beginner, don't bog yourself down with lots of complicated formulas

Formulating the Question

- Selection of the dimensional data is key for summarization
- Report Separation (i.e. our filter data)
  - Many combinations possible. For example, say we want to summarize zIIP seconds
    - One report for each Sysplex
    - One report for each system for each Sysplex
    - One report for each service class for each system for each Sysplex
- Series Separation (i.e. our column data)
  - Many combinations available. For example, say we want to summarize zIIP seconds and want one report per system
    - One series for each importance level
    - One series for each service class
    - One series for each period by service class
- Row Separation (i.e. our row data)
  - Many combinations available. For example, say Row is time
    - Interval summary, Hourly summary, Shift summary
  - Say we want a row summary that is not time
    - By service class with series as the period, by logical volume, by system, etc.

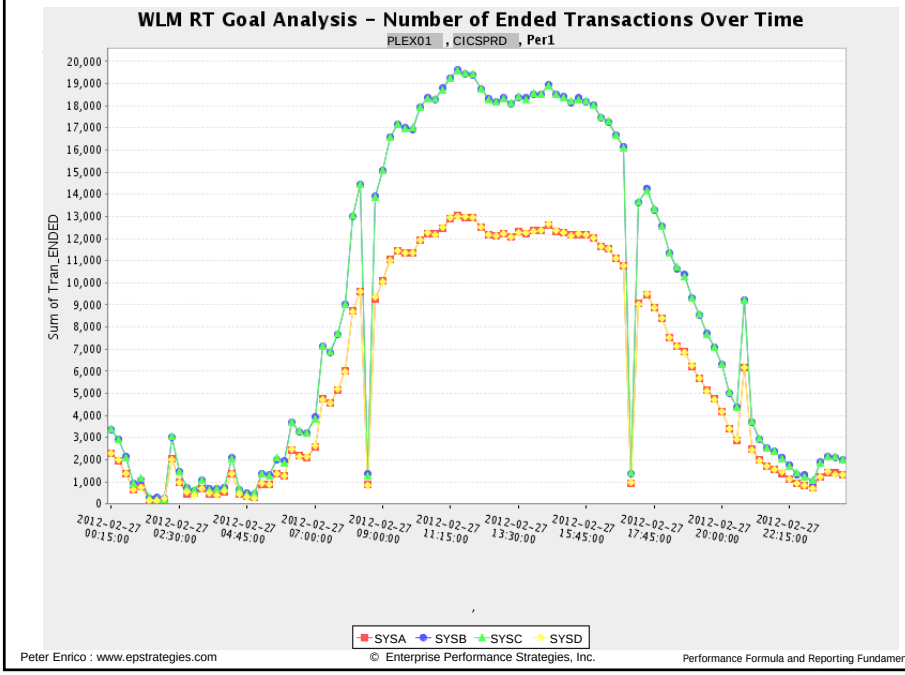
Basic Formulas

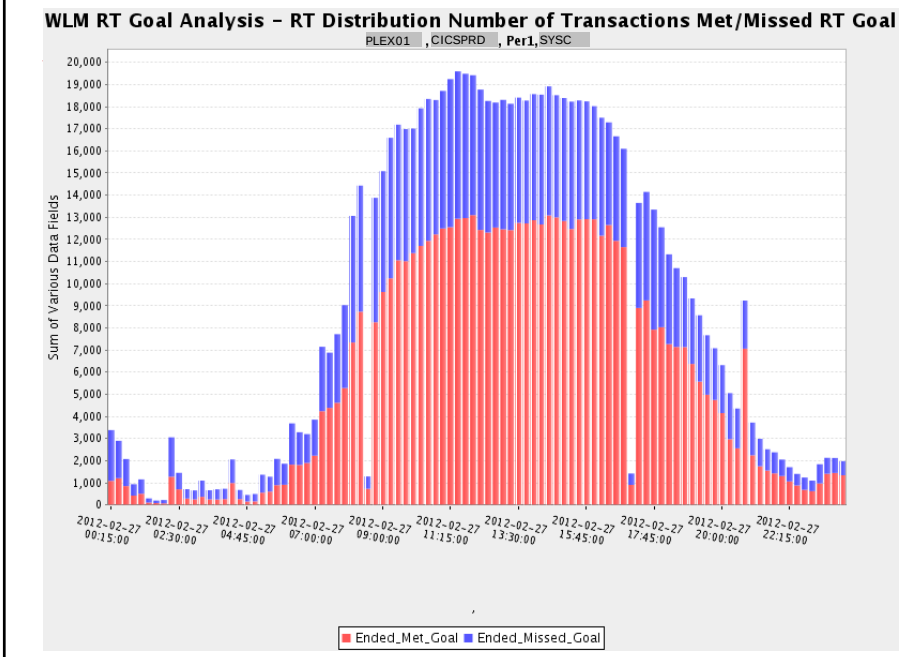
Basic Formulas for Performance Analysis

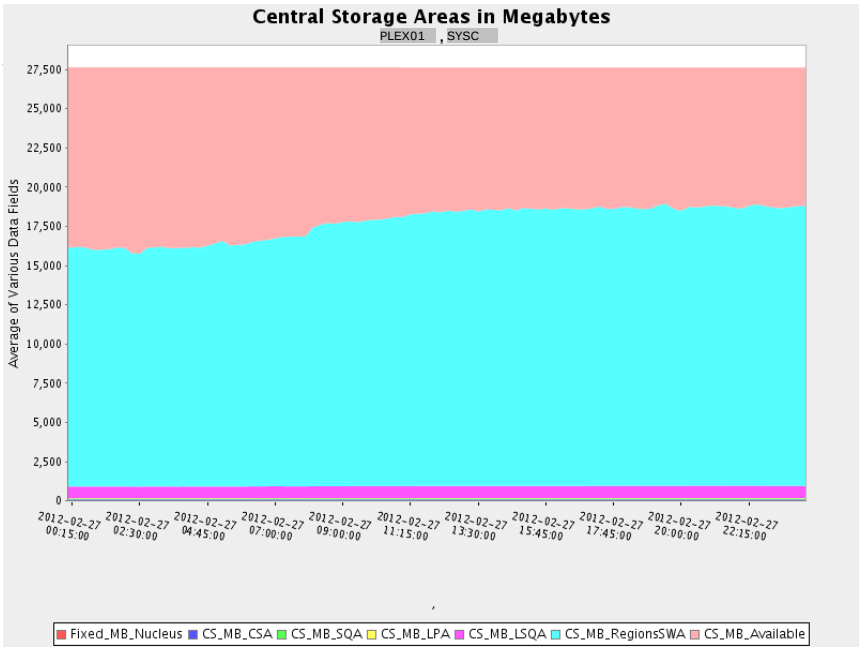
- When doing a performance analysis there are many metrics and formulas to choose from
- The following calculated values will enable any performance analyst to make significant progress in most any standard performance analysis
  - Count
  - Average
  - Utilization (or percentage used)
  - Percentage
  - Rate
  - Ratio
  - Intensity

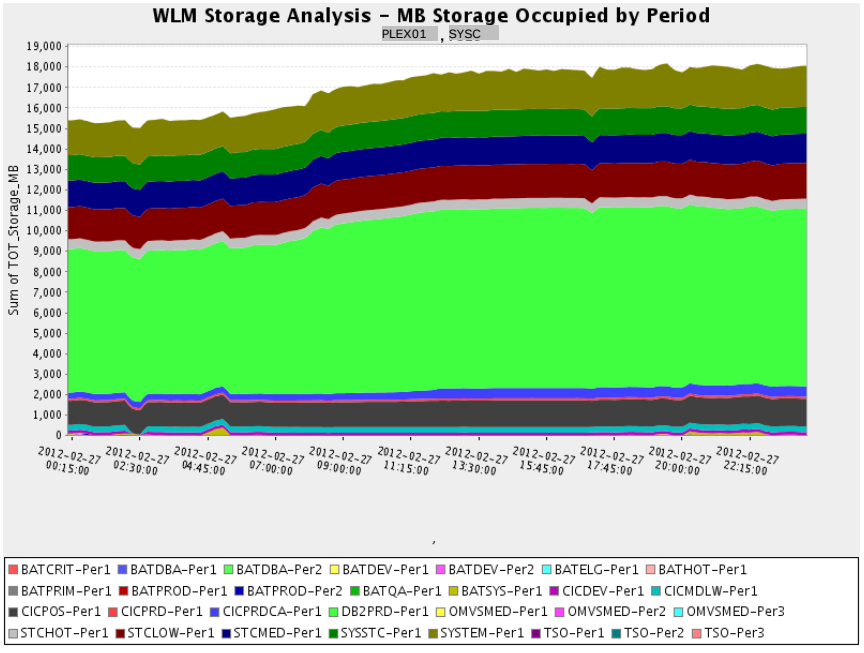
Count

- Count: A measure of selected items
- Basic Formula: *Count = (Metric_A)*
- Common use is when examining the relative quality of something
- Examples of use:
  - Showing load : Number of X over time
    - Where X = #transactions, #I/Os, #requests, etc..
  - Showing volume : X in size over time
    - Where X = MB of storage
  - Showing consumption: X seconds over time
    - Where X = CPU seconds
- Drawbacks
  - Could be difficult to draw conclusions without knowledge of what is normal


WLM RT Goal Analysis – Number of Ended Transactions Over Time
PLEX01 , CICSPRD , Per1
Sum of Tran_ENDED
SYSA SYSB SYSC SYSD


WLM RT Goal Analysis – RT Distribution Number of Transactions Met/Missed RT Goal
PLEX01 , CICSPRD , Per1, SYSC
Sum of Various Data Fields
Ended_Met_Goal Ended_Missed_Goal


Central Storage Areas in Megabytes
PLEX01 , SYSC
Average of Various Data Fields
27,500
25,000
22,500
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
2012-02-27 00:15:00
2012-02-27 02:30:00
2012-02-27 04:45:00
2012-02-27 07:00:00
2012-02-27 09:00:00
2012-02-27 11:15:00
2012-02-27 13:30:00
2012-02-27 15:45:00
2012-02-27 17:45:00
2012-02-27 20:00:00
2012-02-27 22:15:00
Fixed_MB_Nucleus
CS_MB_CSA
CS_MB_SQA
CS_MB_LPA
CS_MB_LSQA
CS_MB_RegionsSWA
CS_MB_Available


WLM Storage Analysis – MB Storage Occupied by Period
PLEX01 , SYSC
Sum of TOT_Storage_MB
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2012-02-27 00:15:00
2012-02-27 02:30:00
2012-02-27 04:45:00
2012-02-27 07:00:00
2012-02-27 09:00:00
2012-02-27 11:15:00
2012-02-27 13:30:00
2012-02-27 15:45:00
2012-02-27 17:45:00
2012-02-27 20:00:00
2012-02-27 22:15:00
BATCRIT-Per1
BATDBA-Per1
BATDBA-Per2
BATDEV-Per1
BATDEV-Per2
BATELG-Per1
BATHOT-Per1
BATPRIM-Per1
BATPROD-Per1
BATPROD-Per2
BATQA-Per1
BATSYS-Per1
CICDEV-Per1
CICMDLW-Per1
CICPOS-Per1
CICPRD-Per1
CICPRDCA-Per1
DB2PRD-Per1
OMVSMED-Per1
OMVSMED-Per2
OMVSMED-Per3
STCHOT-Per1
STCLOW-Per1
STCMED-Per1
SYSSTC-Per1
SYSTEM-Per1
TSO-Per1
TSO-Per2
TSO-Per3

Counts Valuable to Compare Relative Amounts

- Percentage of samples is helpful, but count of samples are more helpful

Sample Counts for BIGBATCH

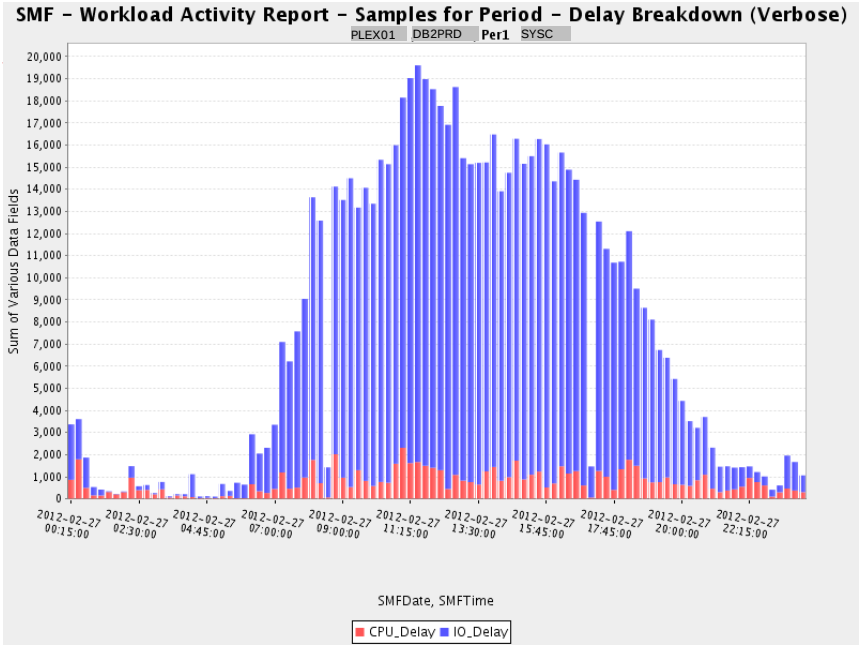
	Using		Non-Storage Delays						Storage Delays				
Number of Samples	100	25	255	30	0	0	0	100	0	0	0	0	0
State Sampled	CPU Using	I/O Using	CPU Delay	I/O Delay	CAP Delay	Swap In Delay	MPL Delay	QMPL Delay	Private Area Paging	Common Area Paging	Xmem Area Paging	VIO Area Paging	HSP Area Paging

Sample Counts for OMVSPROD

	Using		Non-Storage Delays						Storage Delays				
Number of Samples	10	5	2	5	0	0	0	0	0	0	0	0	0
State Sampled	CPU Using	I/O Using	CPU Delay	I/O Delay	CAP Delay	Swap In Delay	MPL Delay	QMPL Delay	Private Area Paging	Common Area Paging	Xmem Area Paging	VIO Area Paging	HSP Area Paging

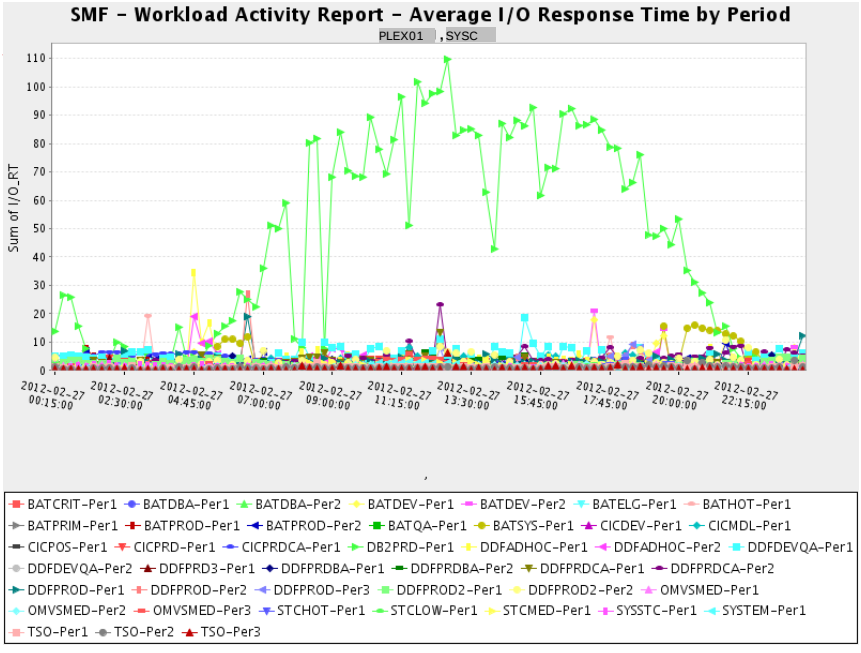
Sample Counts for IMSMPRS

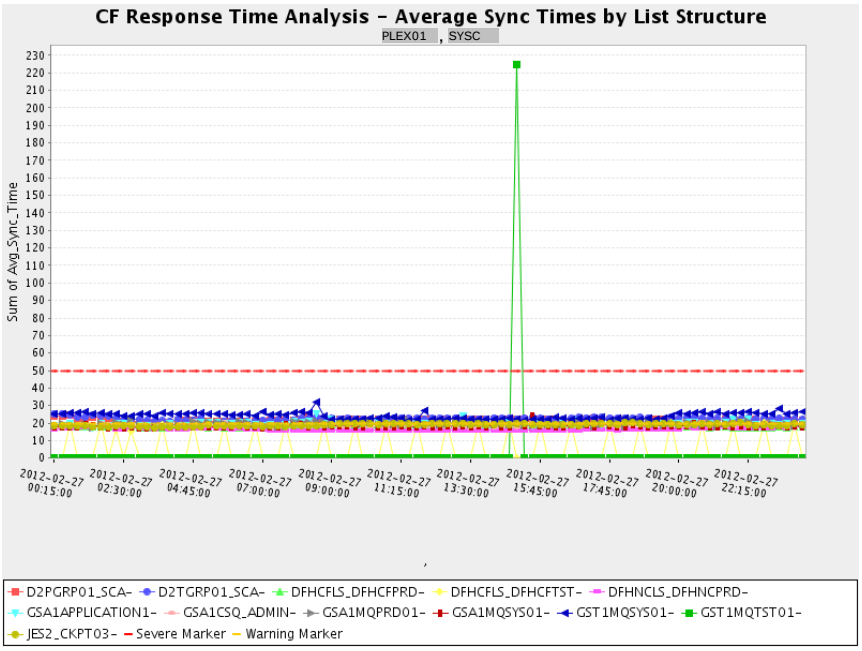
	Using		Non-Storage Delays						Storage Delays				
Number of Samples	10,000	2,500	25,500	13,000	0	0	0	0	0	0	0	0	0
State Sampled	CPU Using	I/O Using	CPU Delay	I/O Delay	CAP Delay	Swap In Delay	MPL Delay	QMPL Delay	Private Area Paging	Common Area Paging	Xmem Area Paging	VIO Area Paging	HSP Area Paging

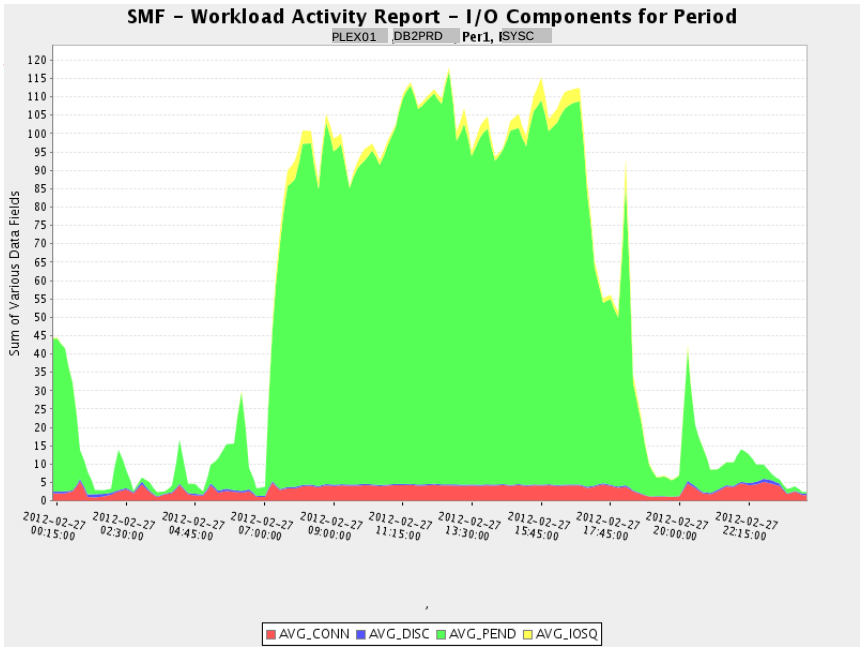


Averages

- Average : The measure of central tendency
  - That is, given a list of numbers, the average value of those numbers
- Basic Formula: *Average = (Sum All Counts) / (Number of Counts)*
- Common use is when examining the relative norm something
- Examples of use:
  - Showing load : Average number of X over time
    - Where X = #transactions, #I/Os, #requests, etc..
  - Showing consumption: X seconds per transaction
    - Where X = CPU time, service units, storage frames, etc.
  - Showing achieved time: Average X seconds per interval
    - Where X = transaction response time, queue time, etc




CF Response Time Analysis – Average Sync Times by List Structure
PLEX01 , SYSC
Sum of Avg_Sync_Time
D2PGRP01_SCA- D2TGRP01_SCA- DFHCFLS_DFHCFPRD- DFHCFLS_DFHCFTST- DFHNCLS_DFHNCPRD-
GSA1APPLICATION1- GSA1CSQ_ADMIN- GSA1MQPRD01- GSA1MQSYS01- GST1MQSYS01- GST1MQTST01-
JES2_CKPT03- Severe Marker Warning Marker


SMF – Workload Activity Report – I/O Components for Period
PLEX01 ,DB2PRD Per1, ISYSC
Sum of Various Data Fields
AVG_CONN AVG_DISC AVG_PEND AVG_IOSQ

Utilization

- Utilization: A measure of the usage of the installed capacity or fixed quantity
- Basic Formula : *Utilization(%) = ((Metric_A) / (Sum All))*100*
- Common use is when how much of a fixed resource is being consumed relative to the entire amount of the resource possible
- Examples of use:
  - Showing percentage of resource consumed : X% utilized
    - Where X = CPU, Storage, channel, etc.

Example: PR/SM Processor Utilizations

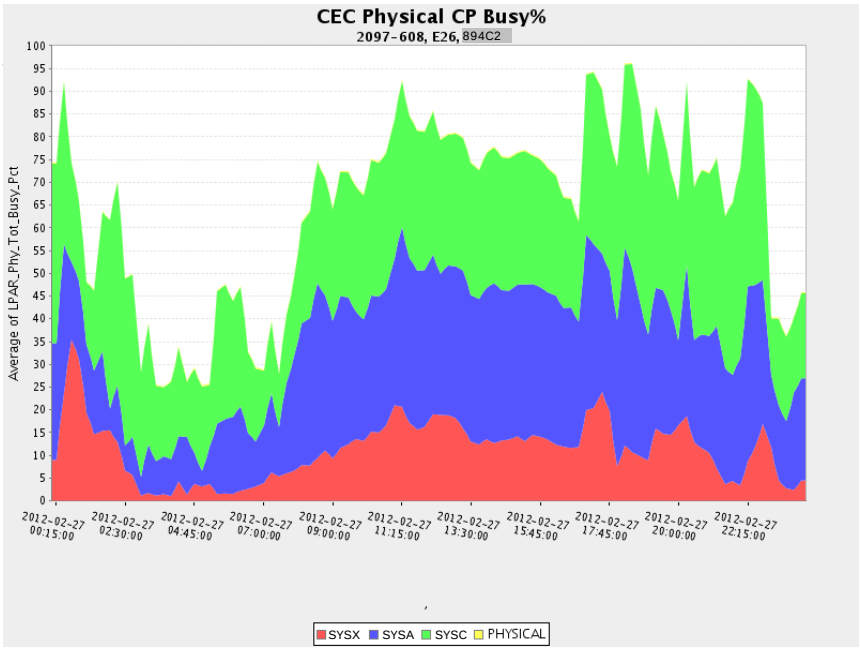
- Logical Processor Utilization Total
  - Percentage of the measurement interval that the partition was utilizing a logical processor on behalf of itself and for LPAR management time attributed to the partition

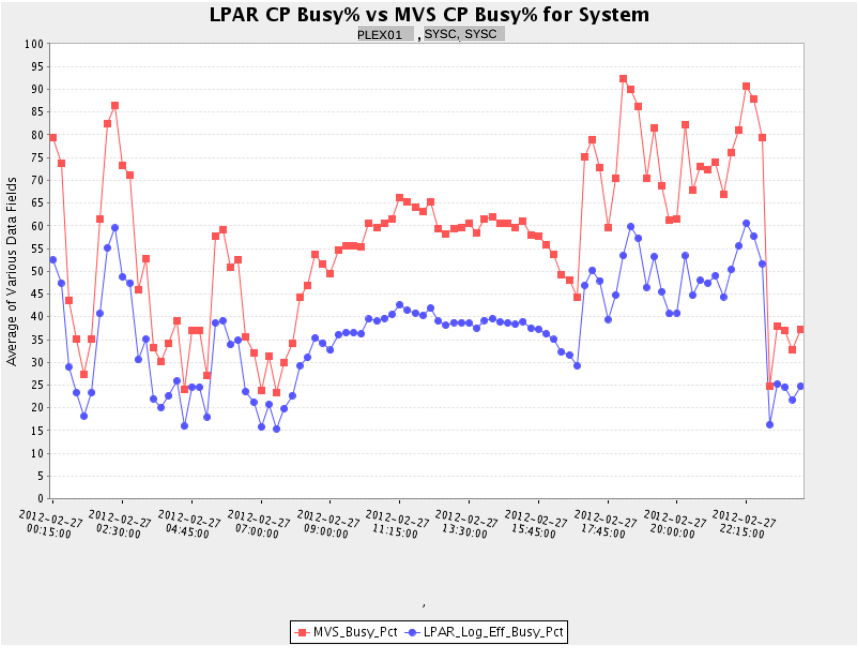
$$\frac{\sum \text{Partition Total Dispatch Times}}{\text{No of Logical Processors} * \text{Interval Time}} * 100$$

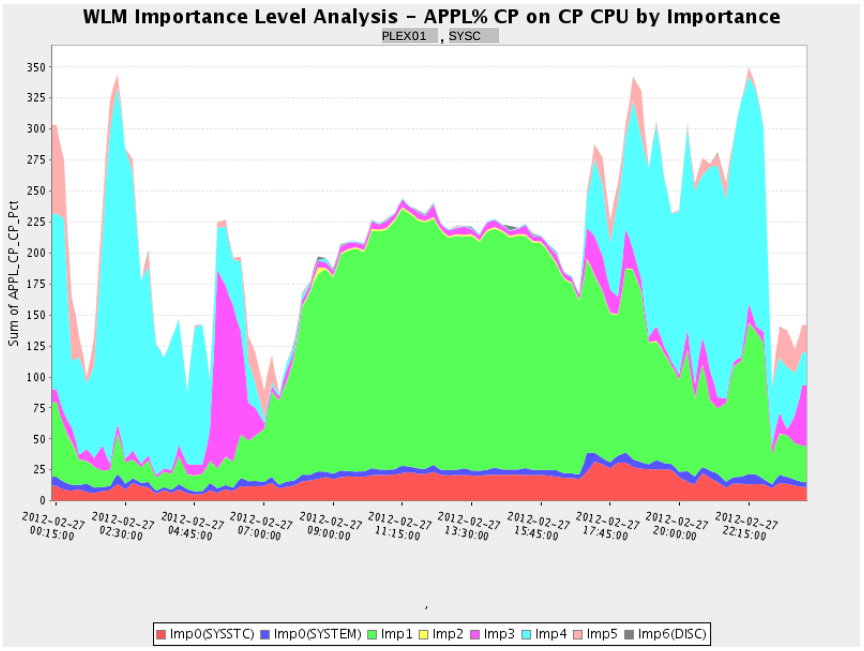
  - Numerator: PR/SM dispatch time of this partition
  - Denominator: Total dispatch time *possible* for LPAR

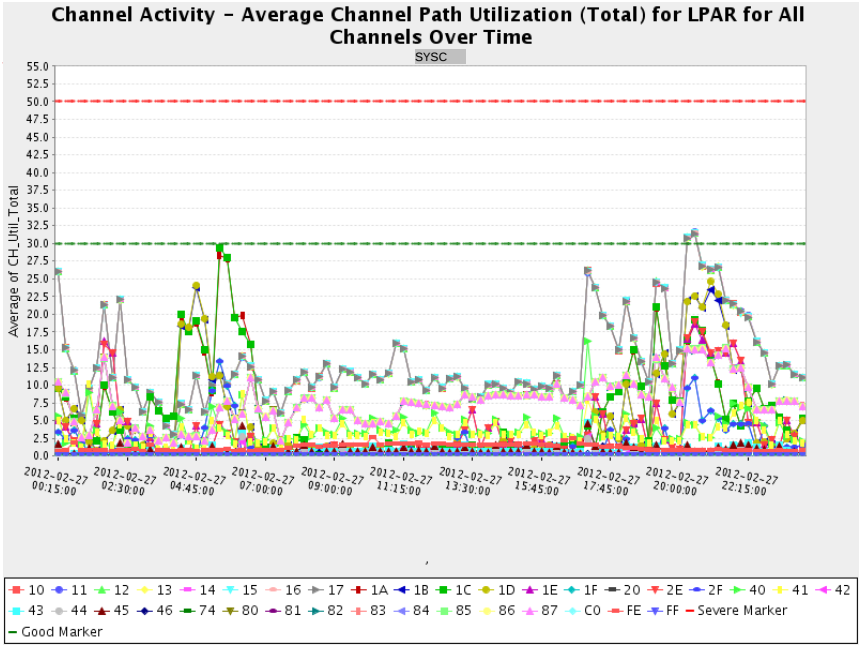
- Physical Processor Utilization Total
  - Percentage of the measurement interval that the partition was utilizing a physical processor on behalf of itself and for LPAR management time

$$\frac{\sum \text{Partition Total Dispatch Times}}{\text{No of Physical Processors} * \text{Interval Time}} * 100$$



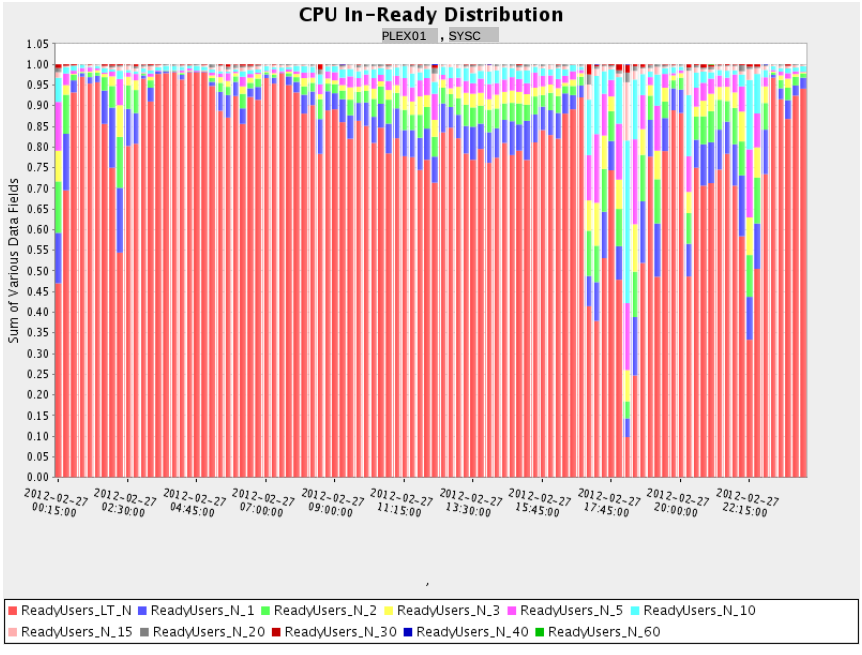


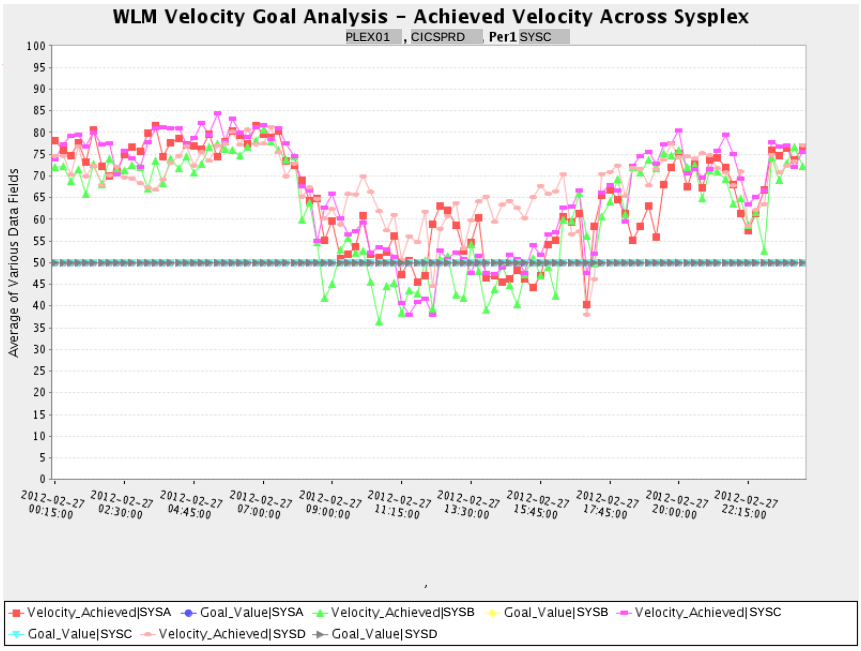

WLM Importance Level Analysis – APPL% CP on CP CPU by Importance
PLEX01 , SYSC
Sum of APPL_CP_CP_Pct
Imp0(SYSSTC) Imp0(SYSTEM) Imp1 Imp2 Imp3 Imp4 Imp5 Imp6(DISC)

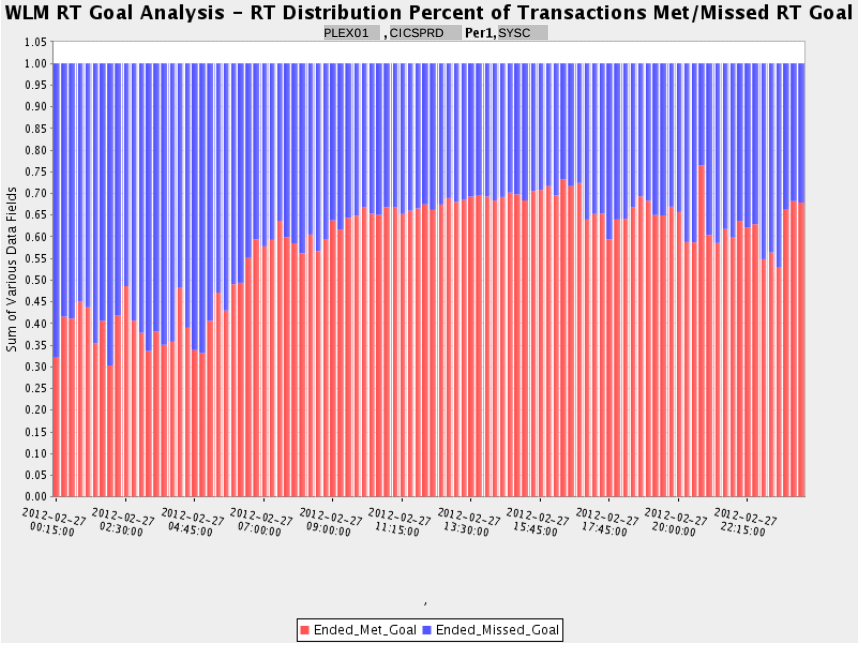

Channel Activity – Average Channel Path Utilization (Total) for LPAR for All Channels Over Time
SYSC
Average of CH_Util_Total
10 11 12 13 14 15 16 17 1A 1B 1C 1D 1E 1F 20 2E 2F 40 41 42
43 44 45 46 74 80 81 82 83 84 85 86 87 C0 FE FF Severe Marker
Good Marker

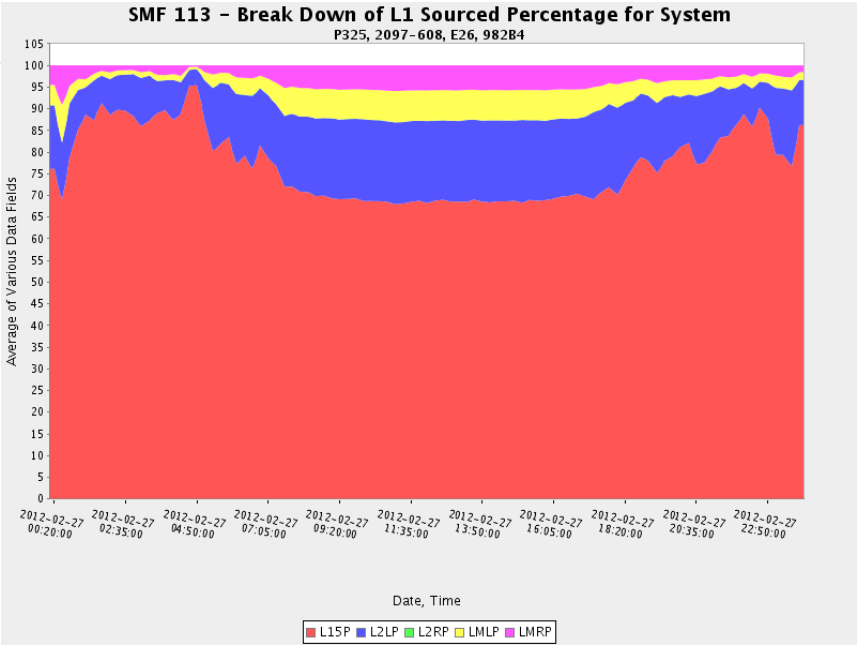
Percentage

- Percentage: A measure of the ratio of a metric as a fraction of 100
  - Similar to utilization, but percentage not based on a fixed quanity over time
- Basic Formula: *Percentage(%) = ((Metric_A) / (Sum_All)) * 100*
- Common use to understand the percentage breakdown of a particular quantity
- Examples of use:
  - Showing percentage breakdown of a distribution
    - Example: percentage of transactions or work units in each distribution bucket
  - Showing the percentage of using samples relative to known samples
    - Example: WLM achieved Velocity
  - Showing the percentage of transactions that missed goals
    - Example: Percentage of transactions that met the WLM response time goal
  - Etc..



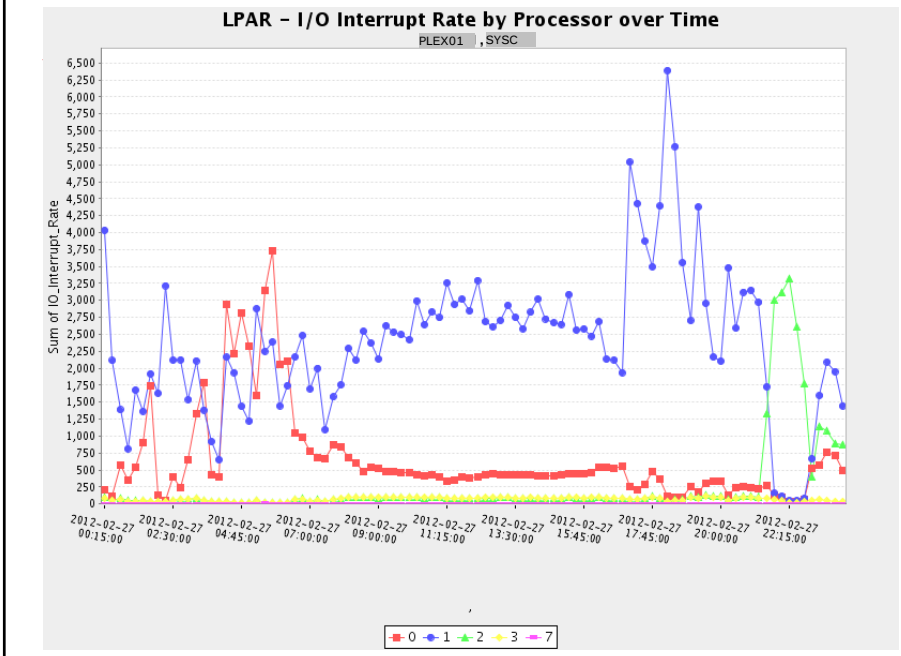


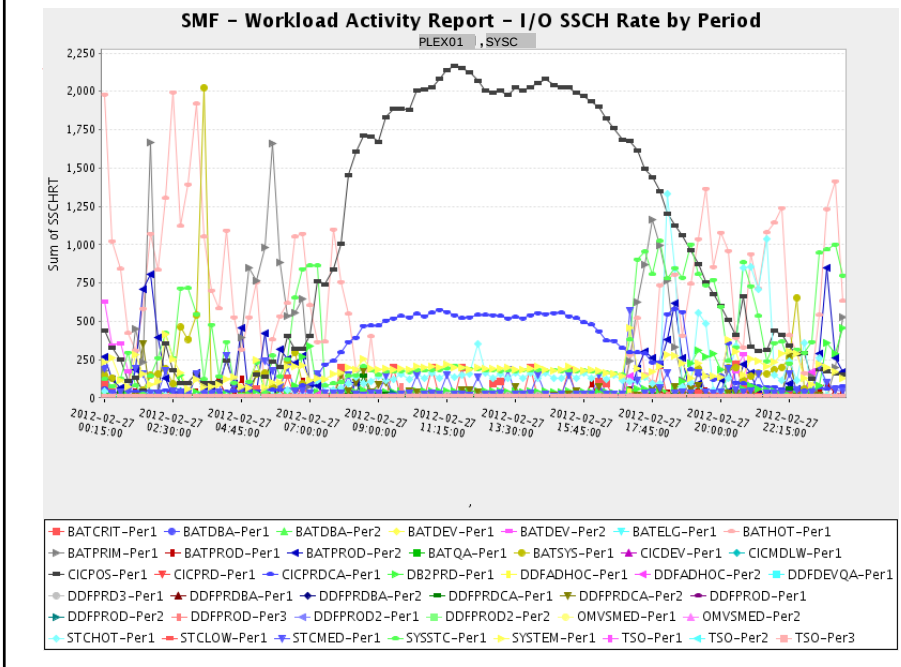




Rate

- Rate: A measure of frequency against some other measure
  - Many times the other measure is time (for per second rates)
- Basic Formula *Rate = (Metric_A) / (Interval Time)*
- Common use to understand the frequency of a unit of work
- Examples of use:
  - Showing the rate of work
    - Example: transactions per second, jobs per shift, etc.
  - Showing the rate of the usage of a resource
    - Example: I/Os per second, service units per second, etc.
  - Showing the rate of a task
    - Example: Coupling facility lock requests per second, etc.


LPAR – I/O Interrupt Rate by Processor over Time
PLEX01 , SYSC
Sum of IO_Interrupt_Rate
0 1 2 3 7


SMF – Workload Activity Report – I/O SSCH Rate by Period
PLEX01 , SYSC
Sum of SSCHRT
BATCRIT-Per1 BATDBA-Per1 BATDBA-Per2 BATDEV-Per1 BATDEV-Per2 BATELG-Per1 BATHOT-Per1
BATPRIM-Per1 BATPROD-Per1 BATPROD-Per2 BATQA-Per1 BATSYS-Per1 CICDEV-Per1 CICMDLW-Per1
CICPOS-Per1 CICPRD-Per1 CICPRDCA-Per1 DB2PRD-Per1 DDFADHOC-Per1 DDFADHOC-Per2 DDFDEVQA-Per1
DDFPRD3-Per1 DDFPRDBA-Per1 DDFPRDBA-Per2 DDFPRDCA-Per1 DDFPRDCA-Per2 DDFPROD-Per1
DDFPROD-Per2 DDFPROD-Per3 DDFPROD2-Per1 DDFPROD2-Per2 OMVSMED-Per1 OMVSMED-Per2
STCHOT-Per1 STCLOW-Per1 STCMED-Per1 SYSSTC-Per1 SYSTEM-Per1 TSO-Per1 TSO-Per2 TSO-Per3

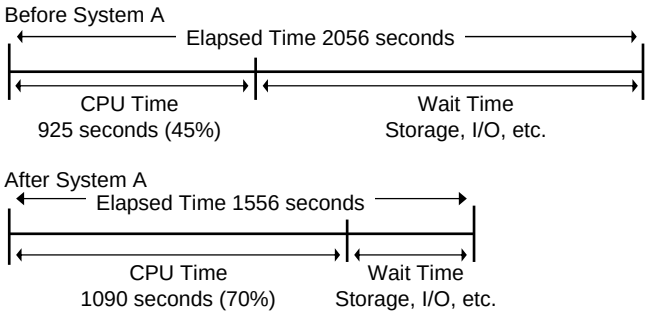
Rates to Understand a Workload

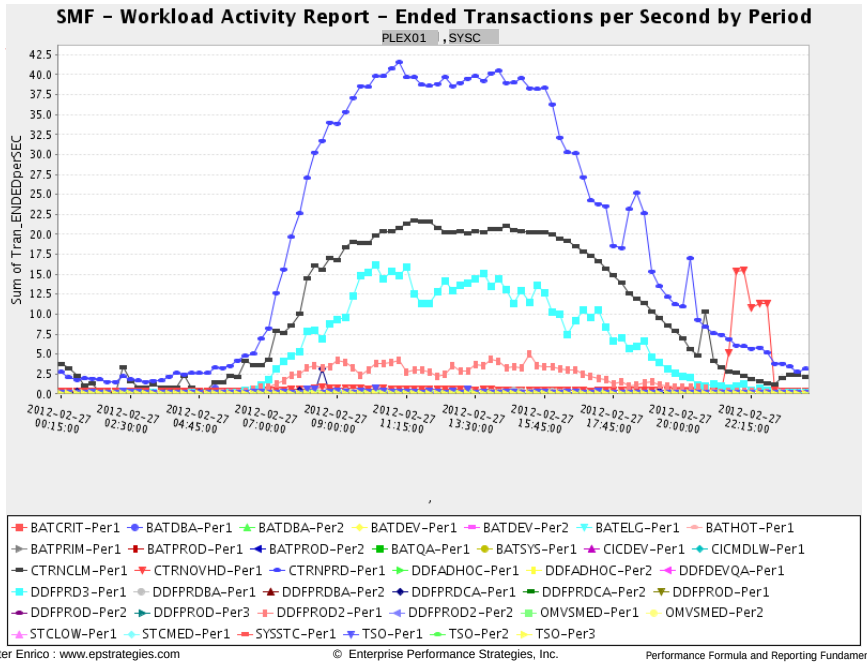
- Which is the better system to run the workload?

$$\text{ETR} = \frac{\text{Units of Work}}{\text{Elapsed Time}} = \frac{\text{Units of Work}}{\text{Second}}$$

- Which system has the better processor to run the workload?

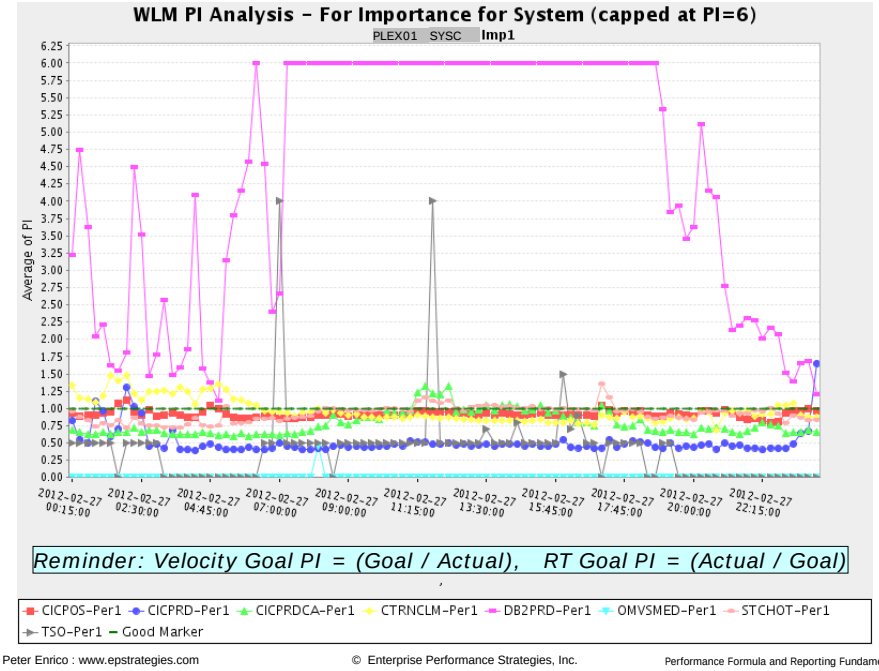
$$\text{ITR} = \frac{\text{Units of Work}}{\text{Processor Busy Time}} = \frac{\text{Units of Work}}{\text{CPU Second}} = \frac{\text{ETR}}{\text{Utilization}}$$

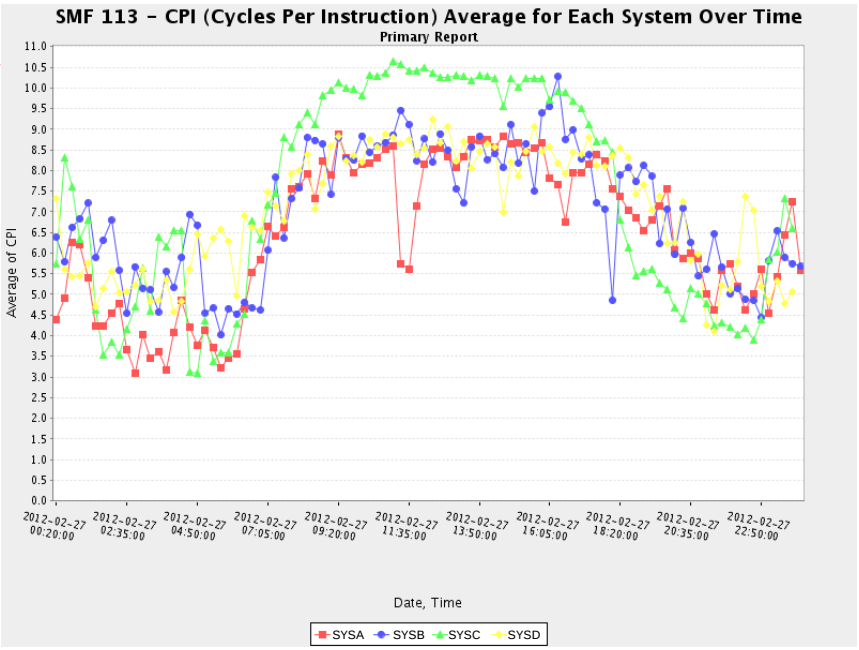


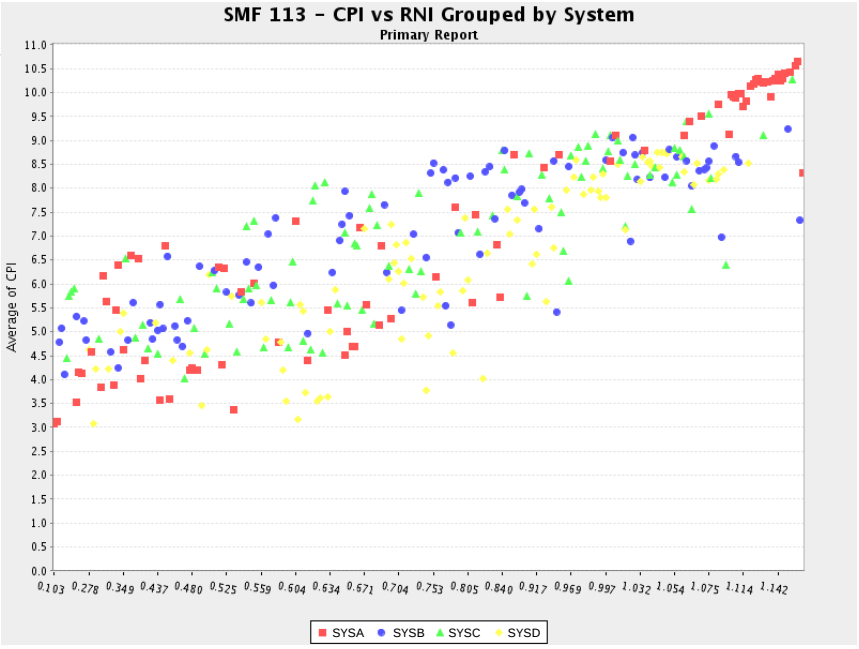


Ratio

- Ratio: A measure of frequency against some other measure
  - Similar to Rate, but this usage is not necessarily based on time
- Basic Formula: *Ratio = (Metric_A) / (Metric_B)*
- Common use to understand the relationship of two metrics
- Examples of use:
  - Showing X relative to Y
    - Example: Number of CPU cycles per instruction
  - Showing a before and after comparison
    - Example: ETR to ETR (i.e. before / after External Throughput Rate ratio)
    - Example: ITR to ITR (i.e. before / after Internal Throughput Rate ratio)
    - Example: IBM's LSPR (i.e. base processor ITR / subject processor ITR)







Example of Using ITR/ETR Relationship

$$ETR = \frac{\text{Units of Work}}{\text{Elapsed Time}} = \frac{\text{Units of Work}}{\text{Second}}$$

$$ITR = \frac{\text{Units of Work}}{\text{Processor Busy Time}} = \frac{\text{Units of Work}}{\text{CPU Second}} = \frac{\text{ETR}}{\text{Utilization}}$$

Below example: Was a 50% increase in CPU% and a 22% decrease in efficiency of the CPU by the workload worth an 18% improvement in throughput?

	Before Change	After Change	% Change
Elapsed Seconds	900	900 ↔	
Processor Seconds	540	810 ↑	
Transaction Count	1100	1300 ↑	18%
CPU Utilization (%)	60%	90% ↑	50%
ETR	1.22	1.44 ↑	18%
ITR	2.04	1.60 ↓	-22%

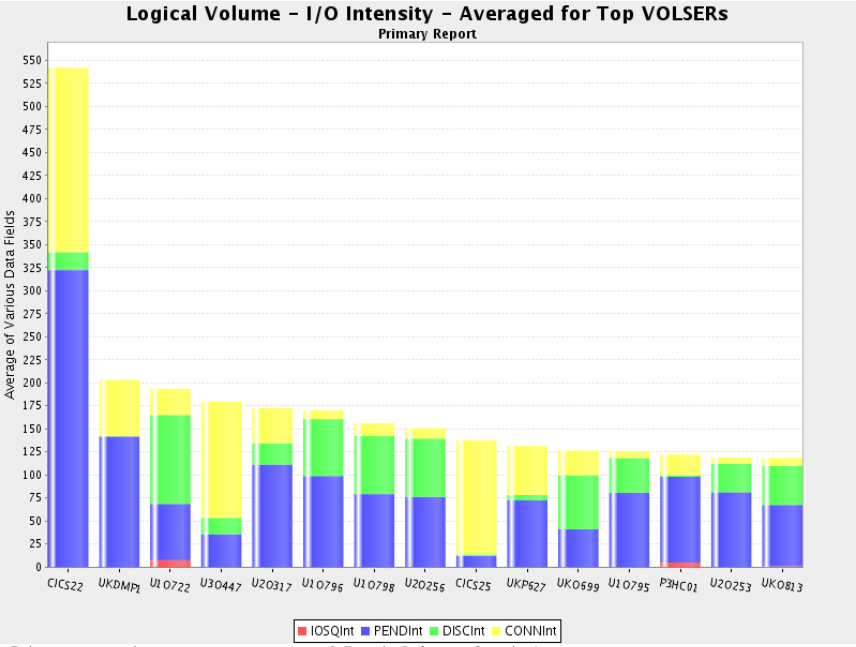
Installation must decide the value of the change.

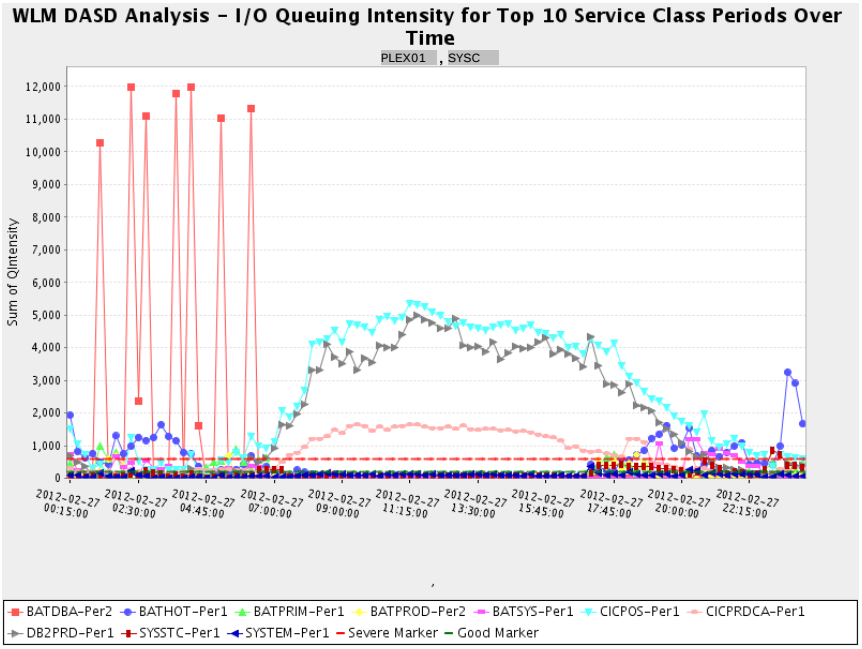
Intensity

- Intensity: A weight value that is a measurement to gain insight into what component / workload to concentrate an analysis on
  - The greater the intensity, the greater the impact and interest
- Basic Formula : *Intensity = (Rate) * (Average Time)*
- Common when there are many components being measured, but want to focus on the most interesting ones that are impacting performance the most
- Examples of use:
  - I/O intensities and Queuing intensities
    - Helps determine which logical volumes or LCUs or files are impacting I/O perfomrance the most
  - Coupling facility structure intensities
    - Helps determine the structures impacting performance the most
  - Batch job intensities
    - Finding which batch jobs are impacting performance of the stream
  - DB2 query intensities

Concept of Intensity

- When it comes to I/O many analysts make the mistake on concentrating on the following:
  - Poor I/O response times
  - Logical volumes with the most activity
- It is better to look at the calculated *Intensity* values
  - A great measurement to gain insight into what component / workload to concentrate your analysis on
  - The greater the intensity, the greater the impact
- Intensity = (I/O Rate) * (Average Response Time)
  - Example: I/O Intensity (Int) = (I/O Rate) * (CONN + DISC + PEND + IOSQ)
  - Example: Queuing Intensity (QI) = (I/O Rate) * (DISC + PEND + IOSQ)
    - *This value is particularly useful because it focuses on delays*
    - *In our analysis we usually use this value as a filter*





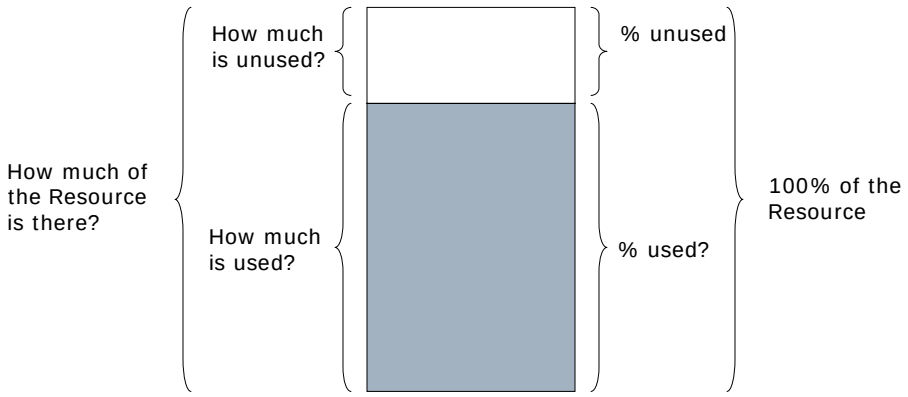
Measuring a Resource

Formulate the Question - Resource

- When formulating the question make sure it includes the following considerations:
  - What is the resource?
  - What units of measurement?
    - CPU : Usually in terms of utilization, seconds, etc.
    - Storage: Usually in terms of bytes (Mega, Giga, Terra, etc.), sometimes frames, etc.
    - I/O: Usually in terms of utilization, intensities, etc.
  - What is the time frame of the report?
    - Example: Daily report for every interval? Hourly report?
  - What is the grouping for summarization?
    - Example: By Machine? By Sysplex? By System?

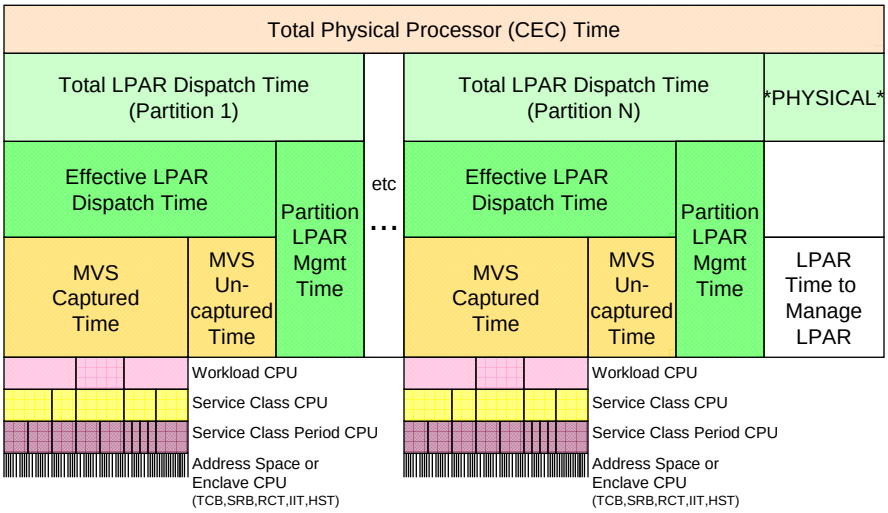
How much of the resource is in use?

- A resource can be thought of as a fixed volume container, and its contents are used by the workloads
- Based on the question, the data can be formulated many different ways



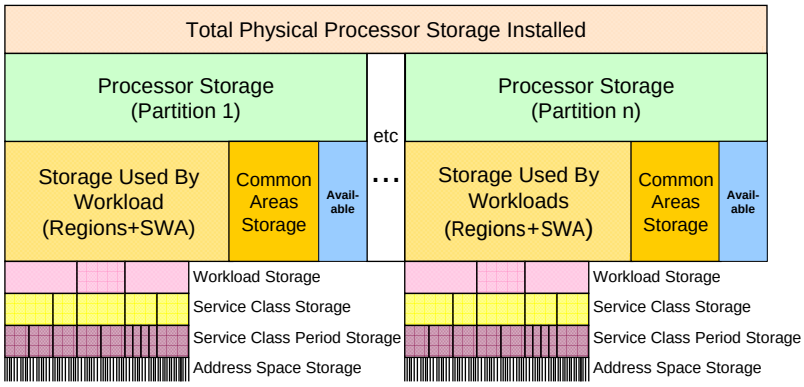
Breakdown of General Purpose Processor

- We always needed to understand the break down of CP CPU consumption



Processor Storage Analysis Overview

- During a performance health check, it is important to understand where, when, and by what the storage is being occupied



Measuring a Workload

Formulate the Question - Workload

- When formulating the question make sure it includes the following considerations:
  - What is the workload?
  - What is the time frame of the report?
    - Example: Daily report for every interval? Hourly report?
  - What is the grouping for summarization?
    - Example: By Sysplex? By System? By Service Class, By Address Space, etc.
  - What are the identification and dimensional details of the workloads?
  - What is the performance criteria of the workload?
  - What has the workload achieved?
  - What is the volume of the workload and rates of completion?
  - How active is the workload (in terms of rates of completion)?
  - How active is the workload (in terms of rates of consumption)?
  - What is the resource consumption of the workload?

Summary

- Producing a report is not the same as conducting an analysis
  - Reports are only used to back up an analysis
  - Clear explanations of reports and analysis is still needed
- Choose metrics that fit into your analysis
- Clearly state the dimensions in both the reports and analysis and discussions
  - Dimensional analysis never assumes the reader is familiar with the dimensions
  - Example: TSO TSOPRD service class period 1 transactions per second
- Avoid metrics that are not very helpful
- Remember that rarely does one number or chart describe performance
- Always choose representative data
  - Avoid data outside the norm unless the study of that data is specific to the analysis
- Avoid too many reports
  - During an analysis it is OK to produce thousands of reports if you are the one who is going to examine them
  - In your final analysis you should only need a few reports to tell the story