Capacity Planning: Where the Mistakes Are
Session: 11598

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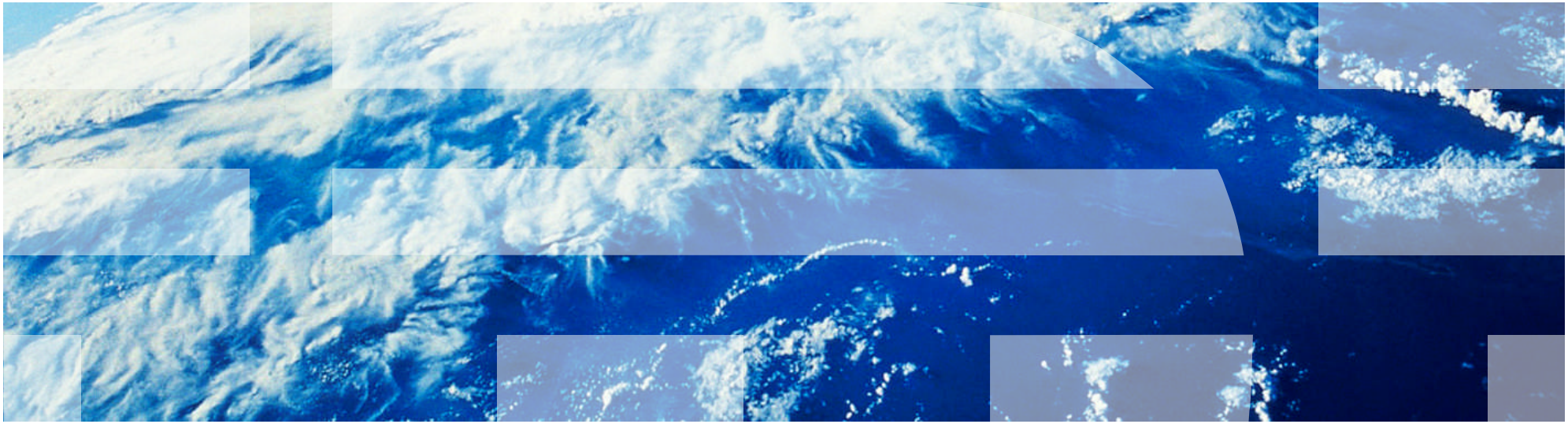

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Agenda

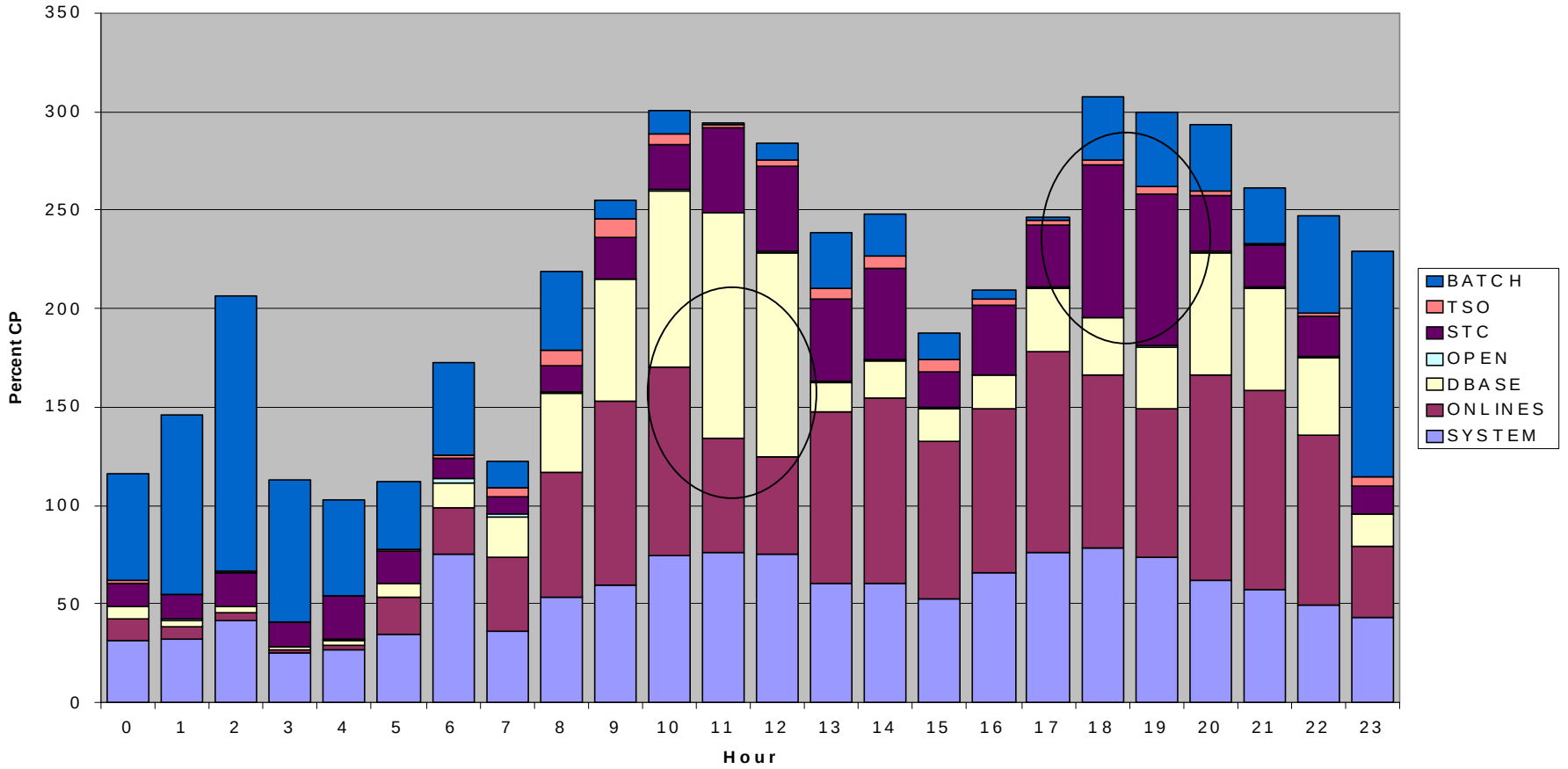
- Measurement Intervals
- LSPR
- Service Units vs MIPS vs MSU vs zPCR
- Hiperdispatch and IRD
- Low Utilization
- Specialty Engines

Evaluate Current Performance Data

- Capacity Planning ASSUMES the system is well tuned
- Generally SMF Records 70:78, 30 are used for Analysis
- A good planning process will still make some rudimentary checks to evaluate the performance of the system
  - Good z/OS capture ratio
  - Latent demand in an LPAR
  - Latent demand in a CP (single TCB architectures)
  - Latent demand in Job queues
  - Consistently high utilization
  - Well-running I/O subsystem
  - No processor storage contention
- Evaluate the WLM setup to ensure the workloads have enough granularity to get a reasonable view of the system
  - Need to look at the report class granularity

Picking the Timeframe for Analysis

- Pick the period which drives your capacity
- Understand the business cycle
- Know when there are software problems which distort the “typical” capacity
- Review capacity based on importance



Intervals, Amount of Data, and Confidence

- Don’t use a single period to do capacity planning
  - Review multiple days, month end, other peak periods
- When using tooling ensure you look across time to ensure the period being fed to the tool is representative
  - Must ensure the period represents valid data
- Order the capacity charts based on WLM importance
  - Make sure the correct workloads “disappear” when the CEC becomes busy
  - If not, examine the WLM policy

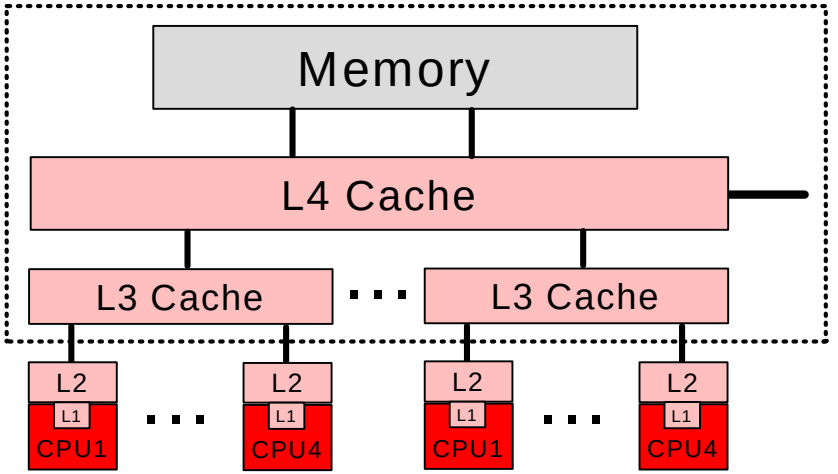
LSPR: The heart of the data

LSPR

- Old/new processors measured at high utilization with same workload
- Workloads and environments updated to stay current
- Presents capacity ratios among processors
- Source for Single Number Metrics
  - MIPS, MSU, SU/SEC
- Based on:
  - Average Workload
  - Median LPAR Config

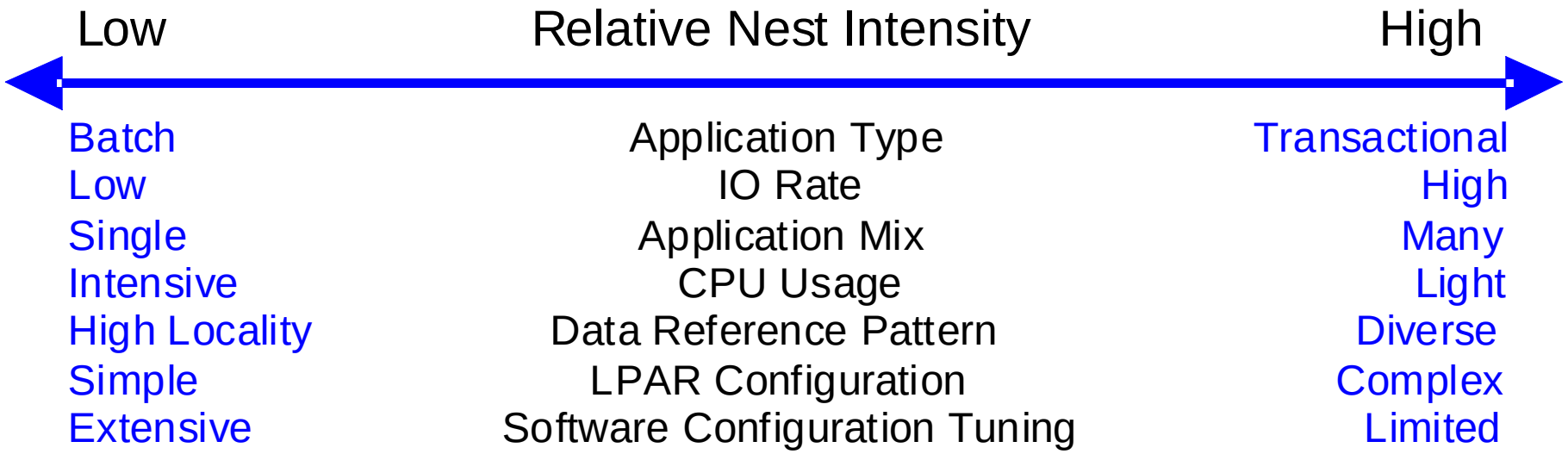
LSPR 1.11 Table

z196	LOW RNI	AVERAGE RNI	HIGH RNI
701	---	---	---
702	---	---	---
703	---	---	---
704	---	---	---
705	---	---	---
706	---	---	---
707	---	---	---



Picking a Workload's Capacity Curve

- Many factors influence a workload's capacity curve
  - What they are actually affecting is the workload's Relative Nest Intensity
- The net effect of the interaction of all these factors determines the capacity curve
- The chart below indicates the trend of the effect of each factor but is not absolute
  - Some batch will have high RNI while some transactional workloads will have low
  - Some low IO rate workloads will have high RNI, while some high IO rates will have low



Using MIPS Tables – Don't Get Crossed Up

- MUST know which LSPR table version the values are derived from
- **NEVER** mix MIPS values from different LSPR tables
- Mistakes happen when processors are in one LSPR table but not the other
  - Contact IBM and ask for help zpcr@us.ibm.com
- MIPS tables are only valid for general positioning NOT for capacity planning

z114	zPCR	zPCR
CPs	CPs	R11mlt
A01	1	26
A02	2	47
A03	3	67
A04	4	86
A05	5	104
B01	1	29
B02	2	53
B03	3	75
B04	4	96
B05	5	116

Z9-BC		zPCR	zPCR
R07	CPs	R9mlt	R6mlt
A01	1	26	26
A02	2	51	51
A03	3	76	74
B01	1	38	38
B02	2	75	74
B03	3	110	109

Service Units Overview

- Unitless number, used by z/OS (SRM) to determine amount of service a transaction is receiving
- Service units are accumulated for CPU consumed (TCB and SRB), I/O activity (IO), and processor storage (MSO)
  - Recommend MSO values be set to 0.0000
- SU/SEC is used to set the MSU value which is used to give a single price for software
- System z or z/OS can change performance of processor via the service stream and the SU/SEC value is not updated
- Does not include the impacts of:
  - Actual LPAR Configuration
  - Actual Workloads
  - HiperDispatch Park/UnPark of Logical CPs
  - Specialty CPs
- **SU/SEC or MSU values should not be used to determine the relative capacity of processors**

Calculating MSUs

- CPU Factor – Provided by hardware vendor
- CPU Service Definition Coefficient – Provided by Installation
  - Typically CPU = 1.0, SRB=1.0
- Service units are derived from CPU seconds
  - CPU SU = (TCB seconds + SRB Seconds * CPU Factor) * CPU SDC
- MSU – Million Service Units
  - CPU Factor * # of GCPs * 3600 secs / 1,000,000

	CALC	PUBLISH
	MSU	MSU
2094-721	1505	1177
2097-713	1600	1076
	1.06	0.91
	CALC	PUBLISH
	MSU	MSU
2097-713	1600	1076
2817-710	1794	1191
	1.12	1.11

Calculating MSUs

- MSU values are single number metrics which are the same regardless of LPAR configuration, workload, or operating system
- In certain environments like the z9 and the z10 the published MSU values contained a technology dividend to provide reduced software prices
- With LSPR v1.11 the MSU value is set by the Average RNI workload using the LSPR Multi-Image table

z9 vs z10

	CALC	PUBLISH	LOW	AVERAGE	HIGH
	MSU	MSU	MIPS	MIPS	MIPS
2094-721	1505	1177	9803	8729	8057
2097-713	1600	1076	10129	8809	7679
	1.06	0.91	1.03	1.01	0.95

z10 vs z196

	CALC	PUBLISH	LOW	AVERAGE	HIGH
	MSU	MSU	MIPS	MIPS	MIPS
2097-713	1600	1076	10129	8809	7679
2817-710	1794	1191	10590	9788	8892
	1.12	1.11	1.05	1.11	1.16

Processors are not single speeds

- Example
  - Three different LPAR configurations and their impact on capacity

z9 vs z10

			ZPCR	ZPCR	ZPCR	ZPCR
	CALC	PUBLISH	AVERAGE	3 LPAR	6 LPAR	12 LPAR
	MSU	MSU	MIPS	MIPS	MIPS	MIPS
2094-721	1505	1177	8729	9574	9632	9529
2097-713	1600	1076	8809	9630	9564	9182
	1.06	0.91	1.01	1.01	0.99	0.96

z10 vs z196

			ZPCR	ZPCR	ZPCR	ZPCR
	CALC	PUBLISH	AVERAGE	3 LPAR	6 LPAR	12 LPAR
	MSU	MSU	MIPS	MIPS	MIPS	MIPS
2097-713	1600	1076	8809	9630	9564	9182
2817-710	1794	1191	9788	10525	10405	9908
	1.12	1.11	1.11	1.09	1.09	1.08

Capacity Planning Needs to be aware of Actual Capacity

- Example
  - Take two z10 713 processors with different LPAR configurations and consolidate to a single larger z196
  - Compare using LSPR Multi Image Average Workload Table vs zPCR Info

			ZPCR	ZPCR	ZPCR	ZPCR
	CALC	PUBLISH	AVERAGE	3 LPAR	6 LPAR	12 LPAR
	MSU	MSU	MIPS	MIPS	MIPS	MIPS
2097-713	1600	1076	8809	9630	9564	9182

  - SCP (System Control Program) is operating system level
    - z/OS 1.10* - indicates 1.11 LSPR tables are being used, z/OS 1.10 software constraints

	Partition Identification					Partition Configuration					Partition Capacity	
Include	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	LP-01	z/OS-1.11	Average	SHR	5	230	23.23%	☐	4,693	4,810
☑	2	GP	LP-04	z/OS-1.11	Average	SHR	5	230	23.23%	☐	4,693	4,810
☑	3	GP	LP-05	z/OS-1.11	Average	SHR	2	50	5.05%	☐	1,028	1,939
☑	4	GP	LP-06	z/OS-1.10*	Average	SHR	4	150	15.15%	☐	3,087	3,881
☑	5	GP	LP-07	z/OS-1.10*	Average	SHR	4	150	15.15%	☐	3,087	3,881
☑	6	GP	LP-08	z/OS-1.10*	Average	SHR	3	120	12.12%	☐	2,469	2,909
☑	7	GP	LP-09	z/OS-1.10*	Average	SHR	2	20	2.02%	☐	411	1,939
☑	8	GP	LP-10	z/OS-1.10*	Average	SHR	2	20	2.02%	☐	411	1,939
☑	9	GP	LP-11	z/OS-1.10*	Average	SHR	2	20	2.02%	☐	411	1,939

Capacity Planning Needs to Be Aware of Actual Capacity

- Guideline: The new CEC should be around 90% busy

	AVG		ORIGINAL	zPCR	NEW CEC	
Weight	MIPS	LPAR	WEIGHT	MIPS	Weight	LCP
0.23	3964	1	45	4334	0.23	5
0.23	3964	2	45	4334	0.23	5
0.05	881	3	10	963	0.05	2
0.15	2643	1	30	2869	0.15	4
0.15	2643	2	30	2869	0.15	4
0.12	2202	3	25	2391	0.12	3
0.02	440	4	5	478	0.02	2
0.02	440	5	5	478	0.02	2
0.02	440	6	5	478	0.02	2
	17617		200	19194		

Z10 713 #1
8809 / 9630

Z10 713 #2
8809 / 9564

		AVG	AVG	zPCR	zPCR
	MSU	MIPS	MIPS %	MIPS	MIPS %
2817-721	2144	17862	99	20163	95
2817-722	2224	18550	95	21069	91
2817-723	2306	19234	92	21975	87
2817-724	2388	19915	88	22881	84

1 PCP too Big

Server Consolidations

- The capacity estimates need to be made using the same LSPR tables
- Capacity needs to be measured at end points, not intermediate stages
  - Example: 9 LPARs from 2 different CEC need to migrate to new footprint
  - Measure all 9 LPARs at one point in time (BEFORE) and project capacity (AFTER)
  - Migrate 3 LPARs to new CEC – can't measure at this point and compare to AFTER
    - AFTER expectation was set for 9 LPARs not 3
  - Migrate 3 of 6 LPARs on CEC2 to new CEC – can't measure at this point
    - AFTER expectation was set for 9 LPARs
    - Can't use current utilization of remaining 3 LPARs on old CEC and project forward since the MIPS rating of old has changed
- Need to use zPCR to do System z Capacity Planning

Hiperdispatch

- z/OS exclusive:
  - Parks and unparks logical CPs based on capacity demands
  - Works to (re)dispatch work to same set of physical CPs
  - Heuristic
- Sensitivities
  - Processor cache technology
  - Number of physical processors
  - Size of the z/OS partition
  - Logical : Physical processor ratio
  - Memory reference pattern
  - Exploitation of IRD Vary CPU Management
- LSPR data for z10 and z196 assumes Hiperdispatch=YES

Hiperdispatch Capacity Guidelines

z10

1-2% for a 1 book environment - less than 12 purchased CPs/zIIPs/zAAPs
2-4% for a 2 book environment - less than 26 purchased CPs/zIIPs/zAAPs
4-7% for a 3 book environment - less than 40 purchased CPs/zIIPs/zAAPs
7-10% for a 4 book environment - less than 64 purchased CPs/zIIPs/zAAPs

z196

Share of the partition - assumes 1.5 logical to physical ratio	Number of Physical CPs + zIIPs + zAAPs			
	<=16	17-32	33-64	65-80
0 <= share in processors < 1.5	0%	0%	0%	0%
1.5 <= share in processors < 3	2-5%	3-6%	3-6%	3-6%
3 <= share in processors < 6	4-8%	5-9%	6-10%	6-10%
6 <= share in processors < 12	5-11%	7-13%	8-14%	8-16%
12 <= share in processors < 24	-	8-16%	10-18%	11-21%
24 <= share in processors < 48	-	-	11-21%	12-24%
48 <= share in processors <= 80	-	-	-	14-26%

Latent Demand: LPAR Busy vs MVS Busy

CPU 2097 CPC CAPACITY 1451
MODEL 719 CHANGE REASON=N/A **HIPERDISPATCH=YES**

---CPU--- NUM	TYPE	ONLINE	TIME % LPAR BUSY	MVS BUSY	**PARKED**	LOG PROC SHARE %	
0	CP	100.00	96.77	96.80	0.00	100.0	HIGH
1	CP	100.00	94.91	94.95	0.00	100.0	HIGH
2	CP	100.00	96.72	96.74	0.00	100.0	HIGH
3	CP	100.00	95.07	95.10	0.00	100.0	HIGH
4	CP	100.00	**50.18**	**93.55**	0.00	66.0	MED
5	CP	100.00	50.15	93.56	0.00	66.0	MED
6	CP	100.00	**20.30**	**89.09**	**56.00**	0.0	LOW
7	CP	100.00	11.40	90.19	72.00	0.0	LOW
8	CP	100.00	22.12	88.49	50.79	0.0	LOW
9	CP	100.00	**46.12**	**87.87**	**0.00**	0.0	LOW
A	CP	100.00	45.37	86.74	0.00	0.0	LOW
B	CP	100.00	38.46	86.76	11.21	0.0	LOW
C	CP	100.00	35.08	86.96	19.43	0.0	LOW
D	CP	100.00	19.29	84.13	57.66	0.0	LOW
E	CP	100.00	0.00	-----	100.00	0.0	LOW
F	CP	100.00	0.00	-----	100.00	0.0	LOW
10	CP	100.00	0.00	-----	100.00	0.0	LOW
TOTAL/AVERAGE			**42.47**	**91.45**		**532.0**	

CEC Busy = 98.85

.0115 * 19 CP = .22 CPs available

Weight: 5.32 CPs

Using: 42.47/100 * 17 LCP = 7.22 CPs

Understanding the Numbers

CEC is 98.85% busy

			LCP	LOG PROC		POLARITY	UNPARKED	LPAR	UNPARKED
	ONLINE	LPAR BUSY	MVS BUSY	PARKED	SHARE %		CPs	MVS BUSY	EFF
1	100	96.77	96.80	0.00	100	HIGH	100	96.80	96.77
2	100	94.91	94.95	0.00	100	HIGH	100	94.95	94.91
3	100	96.72	96.74	0.00	100	HIGH	100	96.74	96.72
4	100	95.07	95.10	0.00	100	HIGH	100	95.10	95.07
5	100	50.18	93.55	0.00	66	MED	100	93.55	50.18
6	100	50.15	93.56	0.00	66	MED	100	93.56	50.15
7	100	20.30	89.09	56.00	0	LOW	44.00	39.20	46.14
8	100	11.40	90.19	72.00	0	LOW	28.00	25.25	40.71
9	100	22.12	88.49	50.79	0	LOW	49.21	43.55	44.95
10	100	46.12	87.87	0	0	LOW	100	87.87	46.12
11	100	45.37	86.74	0	0	LOW	100	86.74	45.37
12	100	38.46	86.76	11.21	0	LOW	88.79	77.03	43.32
13	100	35.08	86.96	19.43	0	LOW	80.57	70.06	43.54
14	100	19.29	84.13	57.66	0	LOW	42.34	35.62	45.56
15	100	0.00	0.00	100	0	LOW	0		
16	100	0.00	0.00	100	0	LOW	0		
17	100	0.00	0.00	100	0	LOW	0		
	17	42.47		5.67	5.32		11.33	1036.03	
		7.22						91.45	

Unparked Effective – Percent of time dispatched by LPAR when not parked

$$\frac{(\text{LPAR Busy} / 100)}{100 - \text{Parked Time} / 100}$$

CPU to Dispatch Ratio

Interval	CP 0	CP 1	CP 2	CP 3
1 CICS,STC,Batch,Batch	CICS L=P	BATCH L=P	STC L=P	BATCH L=P
2 CICS,STC,Batch	CICS L	BATCH L=P	STC L=P	0
3 CICS,Batch,Batch,Batch	CICS L=P	BATCH L=P	BATCH L=P	BATCH L=P
4 CICS	CICS L	0	0	0

```
CICS Active          4:4   = 100%
CICS Dispatched      2:4   =  50%
LPAR BUSY           10:16  =  63%
MVS BUSY            12:16  =  75%
```

Understanding the Numbers – Next Interval

CEC is 97.85% busy

			LCP		LOG PROC	POLARITY	UNPARKED	LPAR	UNPARKED
	ONLINE	LPAR BUSY	MVS BUSY	PARKED	SHARE %		CPs	MVS BUSY	EFF
1	100	96.15	96.15	0	100	HIGH	100	96.15	96.15
2	100	93.72	93.75	0	100	HIGH	100	93.75	93.72
3	100	96.03	96.02	0	100	HIGH	100	96.02	96.03
4	100	94.06	94.06	0	100	HIGH	100	94.06	94.06
5	100	60.87	93.23	0	66	MED	100	93.23	60.87
6	100	60.85	93.19	0	66	MED	100	93.19	60.85
7	100	32.59	88.61	40.88	0	LOW	59.12	52.39	55.13
8	100	5.16	84.41	90.54	0	LOW	9.46	7.99	54.55
9	100	0	0	100	0	LOW	0	0	
10	100	36.29	88.05	32	0	LOW	68	59.96	53.29
11	100	40.58	86.46	23	0	LOW	77	66.19	53.01
12	100	54.02	84.87	0.00	0	LOW	100	84.87	54.02
13	100	53.13	83.78	0.00	0	LOW	100	83.78	53.13
14	100	53.83	84.59	0.00	0	LOW	100	84.59	53.83
15	100	0	0	100	0	LOW	0		
16	100	0	0	100	0	LOW	0		
17	100	0	0	100	0	LOW	0		
	17	45.72		5.87	5.32		11.13	1006.16	
		7.77						90.38	

$$\text{MVS Busy: } \frac{\text{Online Time - (Wait Time + Parked Time)}}{\text{Online Time - Parked Time}}$$

$$\text{LPAR MVS Busy: } \frac{\text{Unparked Time * (LCP MVS BUSY)}}{\Sigma\,\text{(Unparked CPs)}}$$

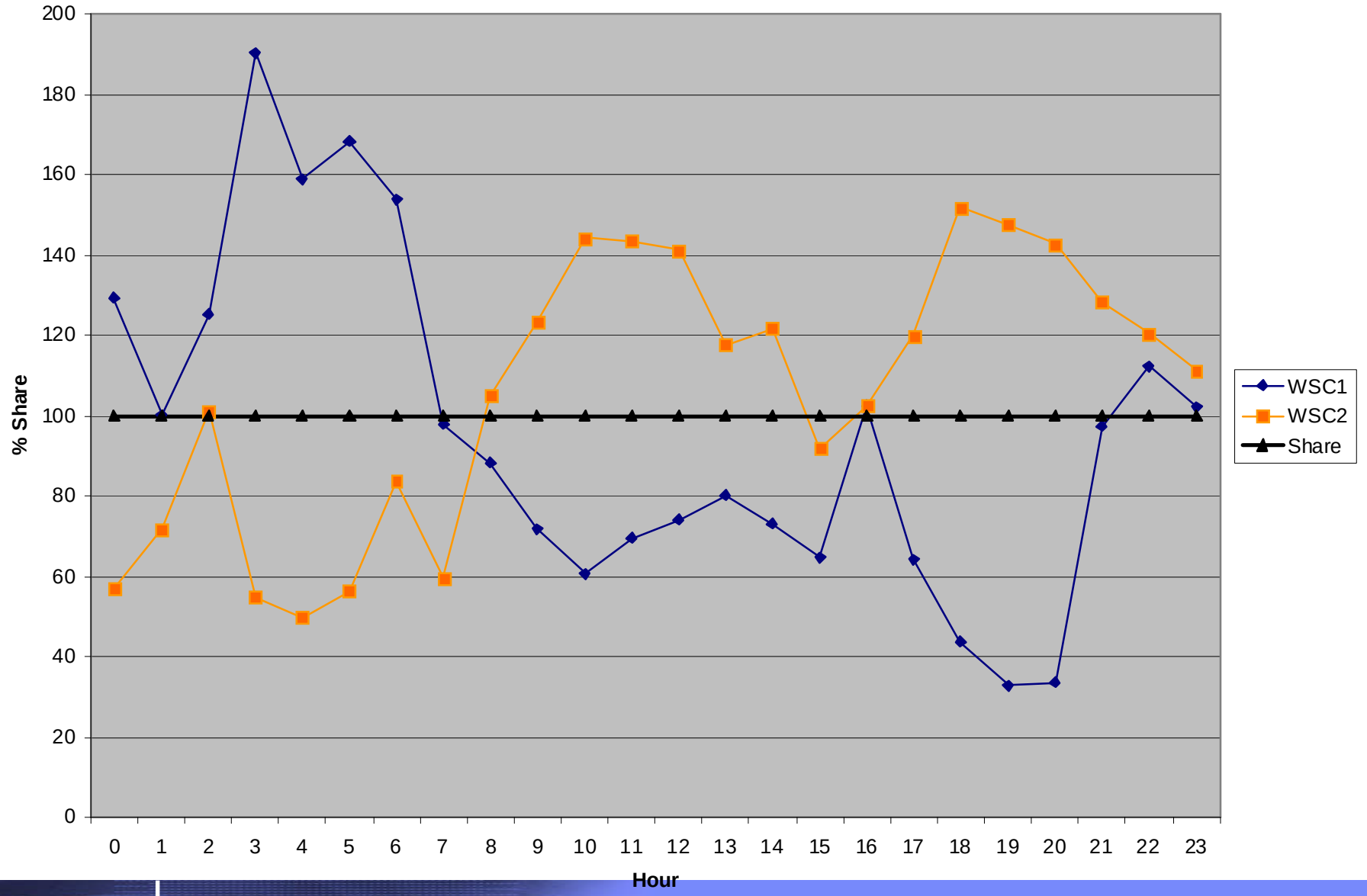
Hiperdispatch Summary

- Important to ensure LPAR weights are close to actual LPAR usage
  - Drives better allocation of Vertical Highs
- Still be realistic in number of logical CPs assigned to an LPAR
  - e.g. if using 7.7 LCPs at max specify 9-11 not 17
  - LPAR MVS Busy is key metric driving unparking
- Calculate Unparked Effectiveness and evaluate workload delays
  - Impacts are very workload specific
  - Check CPU to Dispatch ratios
- Latent Demand indicators now need to include knowledge of:
  - Parked CPs over time
  - Unparked Effectiveness
- Watch LPAR weights for small LPARs with low utilization
  - Weight = 1.98 CPs then 1 VH, 1 VM (2 LCPs)
  - Change Weight to: 2.01 then 1 VH, 2 VM (3 LCPs)

Don’t get Button Happy in zPCR

- zPCR provides a lot of productivity enhancements
  - Automatically reading in your RMF data
  - Adjusting logical CPs
- Make sure the changes requested are representative of the environment
- If not, then need to adjust the zPCR study
- Example:
  - RMF partition data report shows the intended LPAR configuration but actual usage can differ from intended
    - IRD, Hiperdispatch
    - Use of Whitespace

LPAR Share



Typical Partition Data Report Used in zPCR

--------- PARTITION DATA ----------							-- LOGICAL P		-- AVERAGE PROCESSOR UTILIZATION PERCENTAGES --				
			----MSU----		-CAPPING--		PROCESSOR-		LOGICAL PROCESSORS		--- PHYSICAL PROCESSORS ---		
NAME	S	WGT	DEF	ACT	DEF	WLM%	NUM	TYPE	EFFECTIVE	TOTAL	LPAR MGMT	EFFECTIVE	TOTAL
WSC1	A	550	56	47	NO	0.0	10	CP	83.55	83.57	0.02	83.54	83.56
WSC2	A	300	56	7	NO	0.0	10	CP	13.08	13.12	0.04	13.08	13.12
WSC3	A	120	11	0	NO	0.0	10	CP	0.00	0.00	0.00	0.00	0.00
WSC4	A	30	5	0	NO	0.0	10	CP	0.00	0.00	0.00	0.00	0.00
PHYSICAL											0.12		0.12
											-----	-----	-----
TOTAL											0.19	96.62	96.80

- LPAR definitions state the WSC1 LPAR gets 55% of the environment
- Overachieving the weight – this needs to be reflected in zPCR

Get the right capacity relationships

Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	WSC1	z/OS-1.11	Average	SHR	10	550	55.00%	☐	5,356	9,739
☑	2	GP	WSC2	z/OS-1.11	Average	SHR	10	300	30.00%	☐	2,922	9,739
☑	3	GP	WSC3	z/OS-1.11	Average	SHR	10	120	12.00%	☐	1,169	9,739
☑	4	GP	WSC4	z/OS-1.11	Average	SHR	10	30	3.00%	☐	292	9,739
☑	5	ICF	ICF	CFCC	CFCC	DED	1	n/a		☐	1,141	1,141

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	10	4	40	4.000	9,739
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	1	1	1	All DED	1,141
Totals	11	5	41		10,879

Unused LPARs should be unchecked

Change causes the Partitions Weight in zPCR to change

Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	WSC1	z/OS-1.11	Average	SHR	10	550	64.71%	☐	6,597	10,195
☑	2	GP	WSC2	z/OS-1.11	Average	SHR	10	300	35.29%	☐	3,598	10,195
☐		GP	WSC3	z/OS-1.11	Average	SHR	10	120		☐		
☐		GP	WSC4	z/OS-1.11	Average	SHR	10	30		☐		
☑	3	ICF	ICF	CFCC	CFCC	DED	1	n/a		☐	1,140	1,140

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	10	2	20	2.000	10,195
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	1	1	1	All DED	1,140
Totals	11	3	21		11,335

This indicates WSC1 gets 64.71% of the CEC

Get the right capacity relationships

Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	WSC1	z/OS-1.11	Average	SHR	10	550	64.71%	☐	6,597	10,195
☑	2	GP	WSC2	z/OS-1.11	Average	SHR	10	300	35.29%	☐	3,598	10,195
☐		GP	WSC3	z/OS-1.11	Average	SHR	10	120		☐		
☐		GP	WSC4	z/OS-1.11	Average	SHR	10	30		☐		
☑	3	ICF	ICF	CFCC	CFCC	DED	1	n/a		☐	1,140	1,140

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	10	2	20	2.000	10,195
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	1	1	1	All DED	1,140
Totals	11	3	21		11,335

With Hiperdispatch the logicals in RMF PDR report don't match what is really running

This LPAR gets .6471 * 10 = 6.47 CPs or

5 VH, 2 VM, 3 VL

Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	WSC1	z/OS-1.11	Average	SHR	7	550	64.71%	☐	6,813	7,370
☑	2	GP	WSC2	z/OS-1.11	Average	SHR	4	300	35.29%	☐	3,795	4,301
☐		GP	WSC3	z/OS-1.11	Average	SHR	10	120		☐		
☐		GP	WSC4	z/OS-1.11	Average	SHR	10	30		☐		
☑	3	ICF	ICF	CFCC	CFCC	DED	1	n/a		☐	1,139	1,139

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	10	2	11	1.100	10,608
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	1	1	1	All DED	1,139
Totals	11	3	12		11,748

At capacity the LPAR would run with 7 LCPs, not 10

Get the right capacity relationships

Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	WSC1	z/OS-1.11	Average	SHR	7	550	64.71%	☐	6,813	7,370
☑	2	GP	WSC2	z/OS-1.11	Average	SHR	4	300	35.29%	☐	3,795	4,301
☐		GP	WSC3	z/OS-1.11	Average	SHR	10	120		☐		
☐		GP	WSC4	z/OS-1.11	Average	SHR	10	30		☐		
☑	3	ICF	ICF	CFCC	CFCC	DED	1	n/a		☐	1,139	1,139

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	10	2	11	1.100	10,608
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	1	1	1	All DED	1,139
Totals	11	3	12		11,748

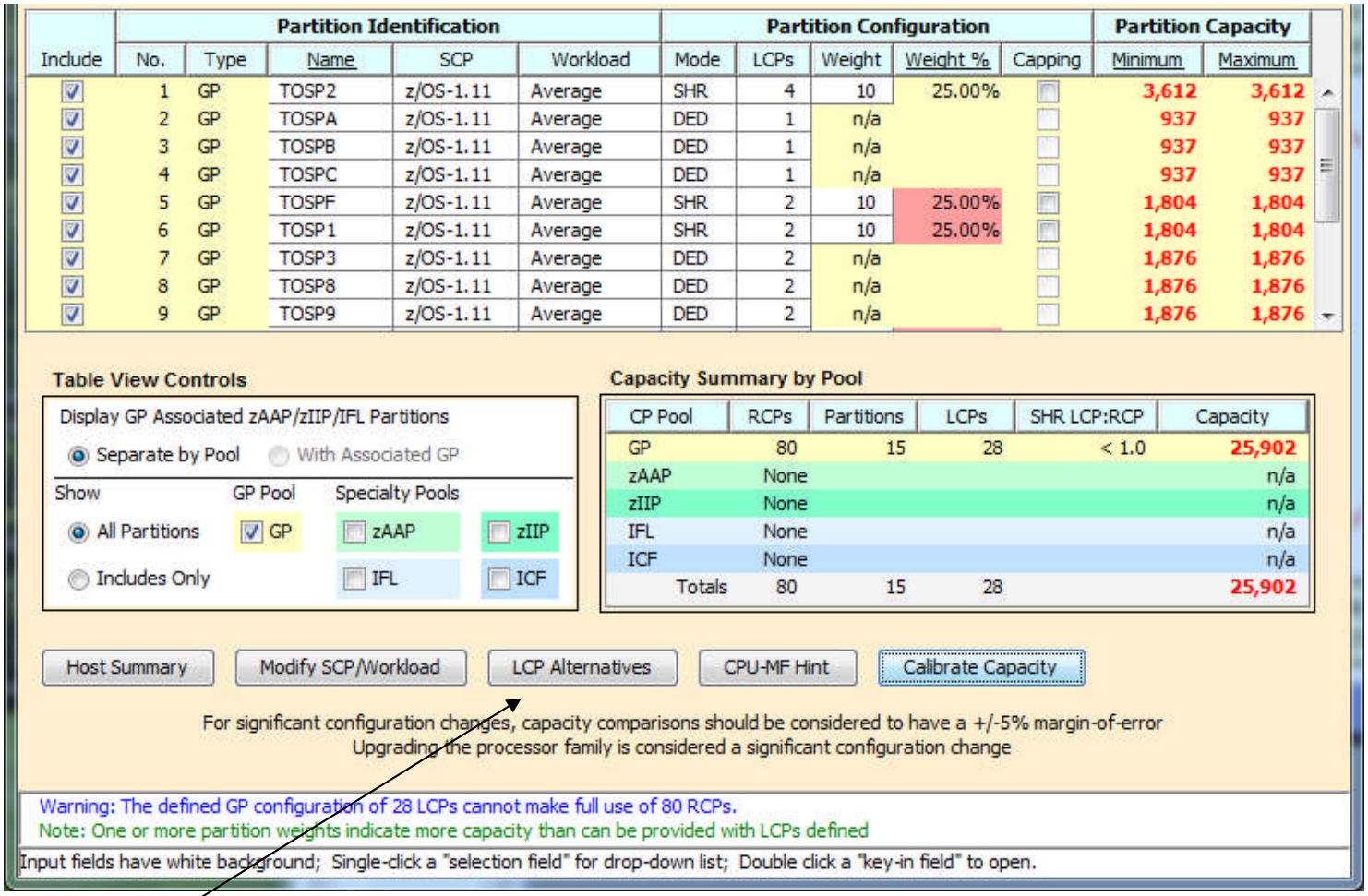
But it is really using 83% of the environment so it has more LCPs running

Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	WSC1	z/OS-1.11	Average	SHR	9	850	85.00%	☐	8,841	9,361
☑	2	GP	WSC2	z/OS-1.11	Average	SHR	2	150	15.00%	☐	1,612	2,149
☐		GP	WSC3	z/OS-1.11	Average	SHR	10	120		☐		
☐		GP	WSC4	z/OS-1.11	Average	SHR	10	30		☐		
☑	3	ICF	ICF	CFCC	CFCC	DED	1	n/a		☐	1,139	1,139

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	10	2	11	1.100	10,452
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	1	1	1	All DED	1,139
Totals	11	3	12		11,592

RMF report would give 9739 MIPS but actual configuration gives 10,452 MIPS

New Version of zPCR will Provide Assistance



Include	Partition Identification					Partition Configuration					Partition Capacity	
	No.	Type	Name	SCP	Workload	Mode	LCPs	Weight	Weight %	Capping	Minimum	Maximum
☑	1	GP	TOSP2	z/OS-1.11	Average	SHR	4	10	25.00%	☐	3,612	3,612
☑	2	GP	TOSPA	z/OS-1.11	Average	DED	1	n/a		☐	937	937
☑	3	GP	TOSPB	z/OS-1.11	Average	DED	1	n/a		☐	937	937
☑	4	GP	TOSPC	z/OS-1.11	Average	DED	1	n/a		☐	937	937
☑	5	GP	TOSPF	z/OS-1.11	Average	SHR	2	10	25.00%	☐	1,804	1,804
☑	6	GP	TOSP1	z/OS-1.11	Average	SHR	2	10	25.00%	☐	1,804	1,804
☑	7	GP	TOSP3	z/OS-1.11	Average	DED	2	n/a		☐	1,876	1,876
☑	8	GP	TOSP8	z/OS-1.11	Average	DED	2	n/a		☐	1,876	1,876
☑	9	GP	TOSP9	z/OS-1.11	Average	DED	2	n/a		☐	1,876	1,876

Table View Controls

Display GP Associated zAAP/zIIP/IFL Partitions

◉ Separate by Pool ○ With Associated GP

Show	GP Pool	Specialty Pools	
◉ All Partitions	☑ GP	☐ zAAP	☐ zIIP
○ Includes Only		☐ IFL	☐ ICF

Capacity Summary by Pool

CP Pool	RCPs	Partitions	LCPs	SHR LCP:RCP	Capacity
GP	80	15	28	< 1.0	25,902
zAAP	None				n/a
zIIP	None				n/a
IFL	None				n/a
ICF	None				n/a
Totals	80	15	28		25,902

Host Summary | Modify SCP/Workload | LCP Alternatives | CPU-MF Hint | Calibrate Capacity

For significant configuration changes, capacity comparisons should be considered to have a +/-5% margin-of-error
Upgrading the processor family is considered a significant configuration change

Warning: The defined GP configuration of 28 LCPs cannot make full use of 80 RCPs.
Note: One or more partition weights indicate more capacity than can be provided with LCPs defined

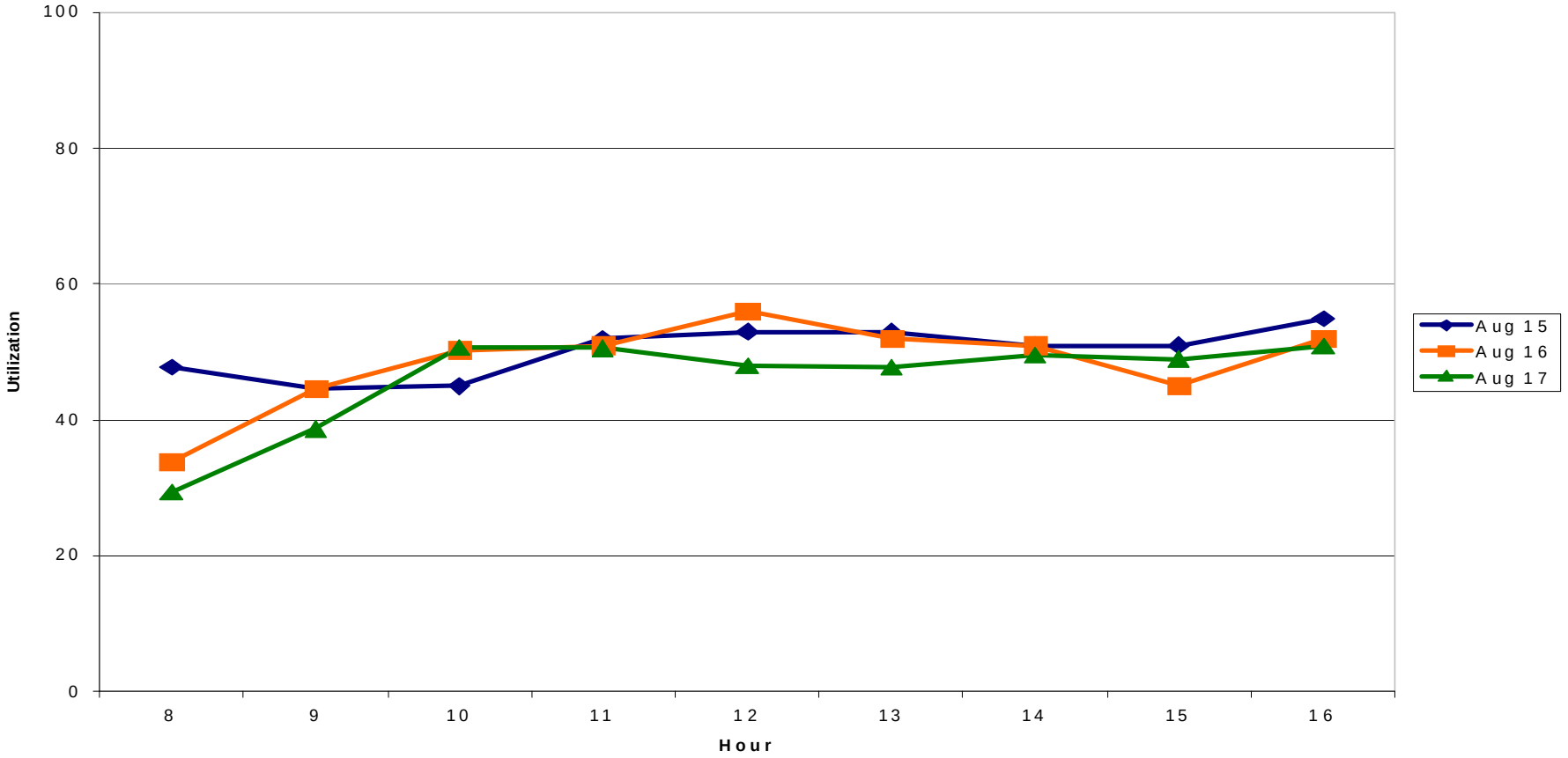
Input fields have white background; Single-click a "selection field" for drop-down list; Double click a "key-in field" to open.

When Determining Capacity

- When using automated input be sure to adjust zPCR weights and number of logical CPs to reflect actual capacity
- Want to designate a zPCR model which gives the best view of typical peak capacity
  - Want to see the capacity available at contention given “most likely” conditions

CPU Utilization

- Processor is a 2817-720 with 3 LPARs but is running only 50% busy
  - zPCR Multi-Image Table places this at 17,171 MIPS, or 859 MIPS per CP
- Processor is actually running faster than this



CPU Utilization

- Impact to capacity planning comes in two flavors
  - May have less headroom on processor than expected
  - When moving a workload, it may not fit in the new container
- Example
  - Assume a workload is running at 50% busy on a 2000 MIPS box without factoring in utilization effect, it will be called a 1000 MIPS workload in fact, it may be an 1100 MIPS workload when running at the efficiency of a 90% busy box
  - Caution #1: There is NOT room to double this workload on the current box
  - Caution #2: If moved to a new box or LPAR, it will likely need a 1100 MIPS container (not 1000 MIPS) to fit
- ROT:
  - CPU per tran will vary 3-5% for every 10% change in utilization

How to Handle

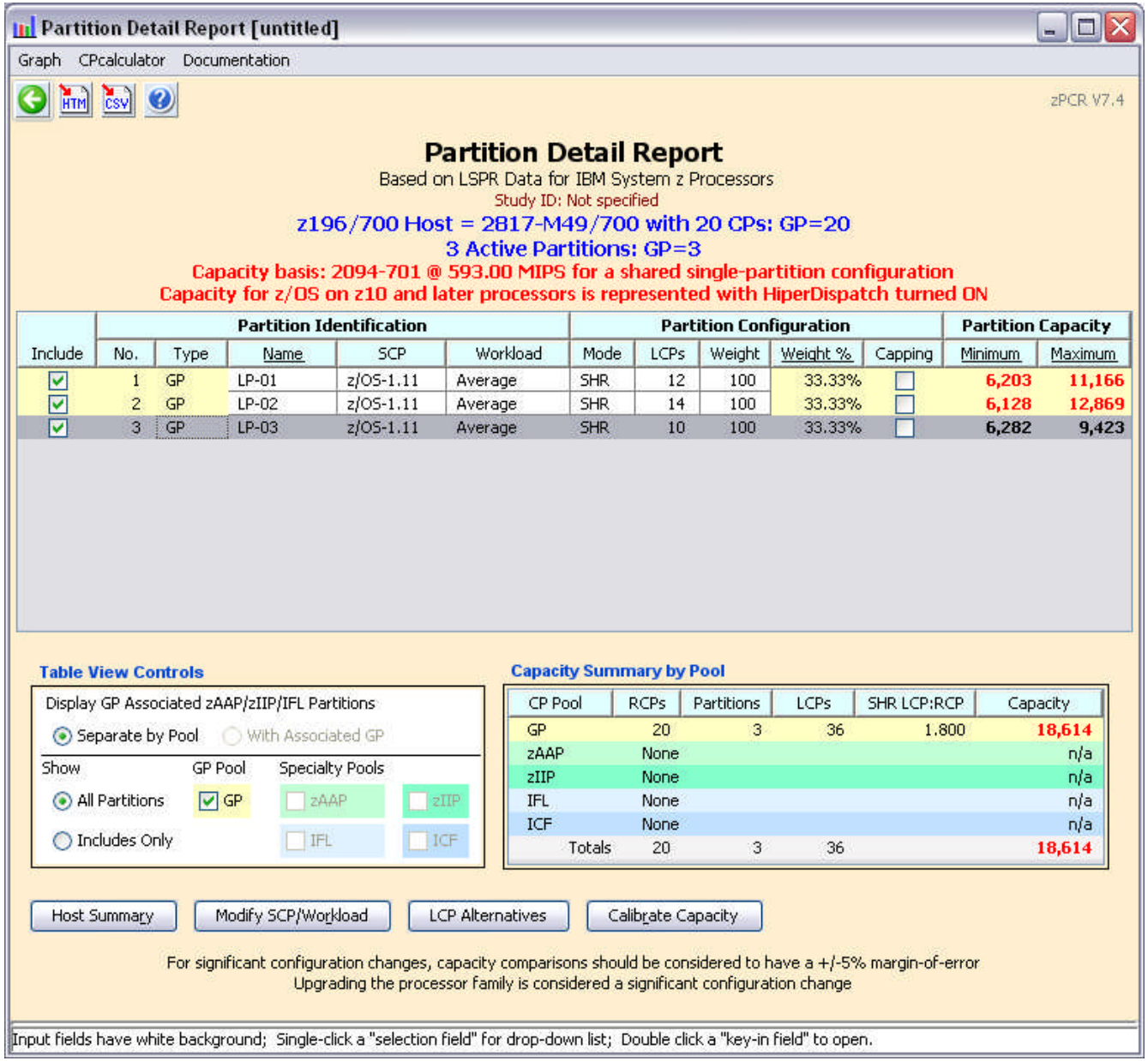
Build zPCR model for current processor, e.g. z196-720

Per CP speed is:

18614 / 20 = 931 MIPS

But running 50% busy the CEC really looks like

.5 * 20 = 10 CPs / .9 = 11 CPs

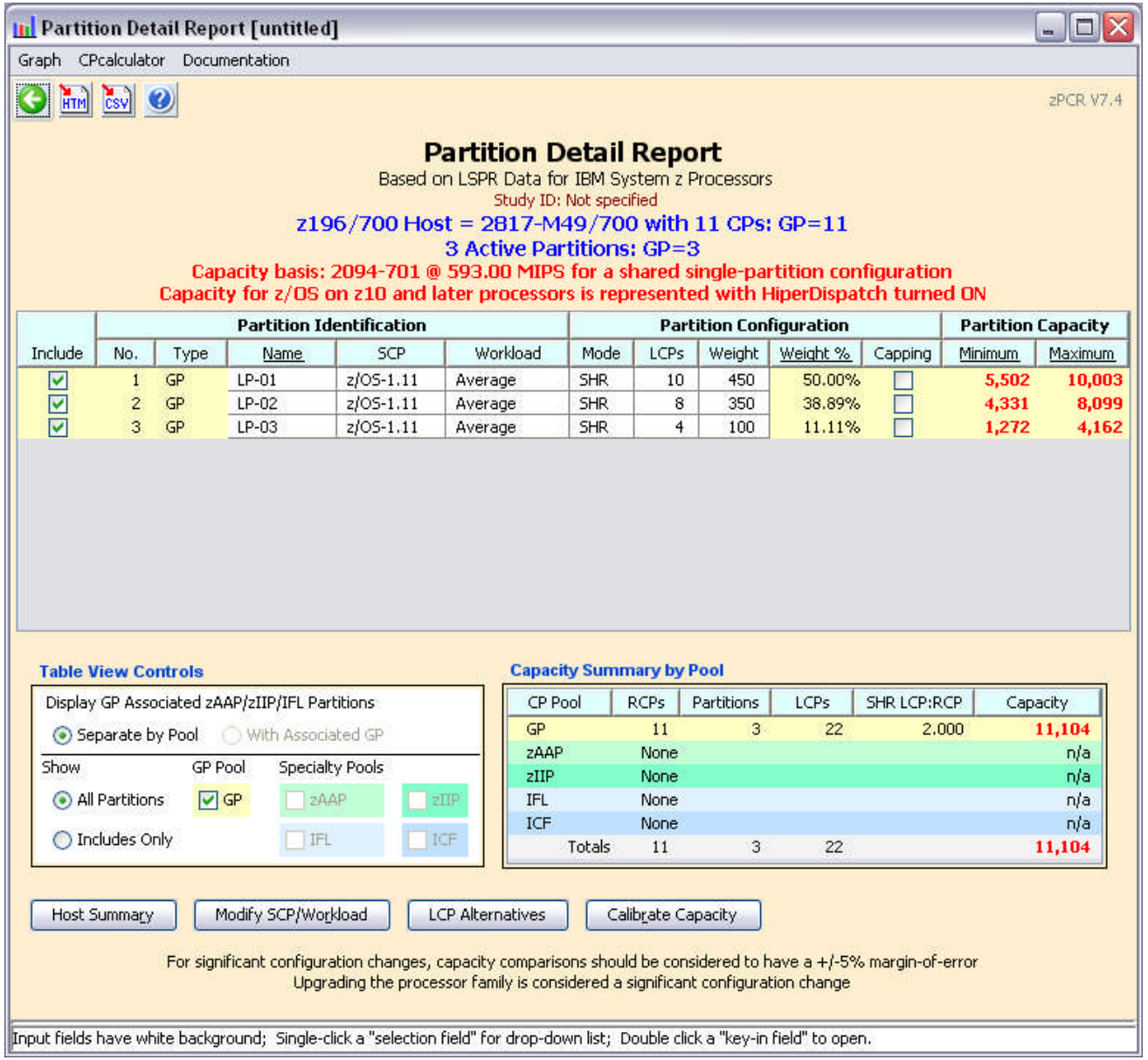


How to Handle

Change the host to be a z196-711 adjusting the CPs as needed for the smaller n-way

711 delivers 11,104 MIPS / 11 = 1009 MIPS

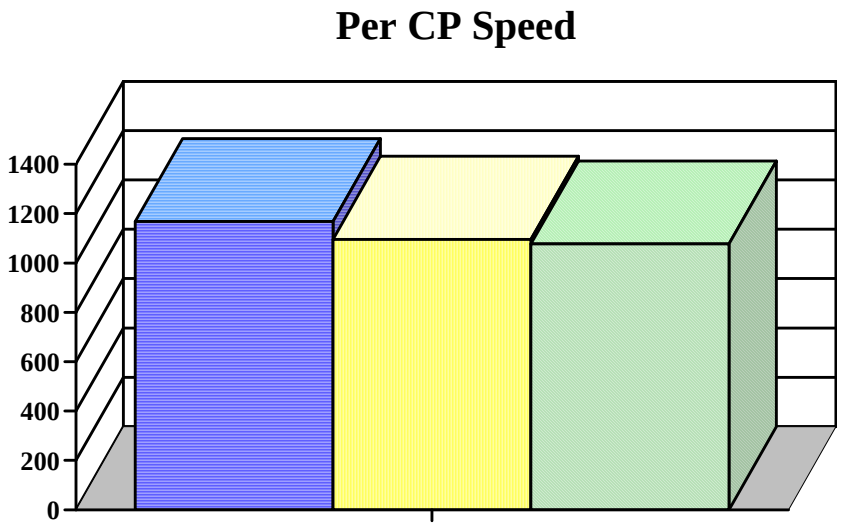
Actual capacity being delivered is more like 1009 MIPS CPs not 931 MIPS per CP

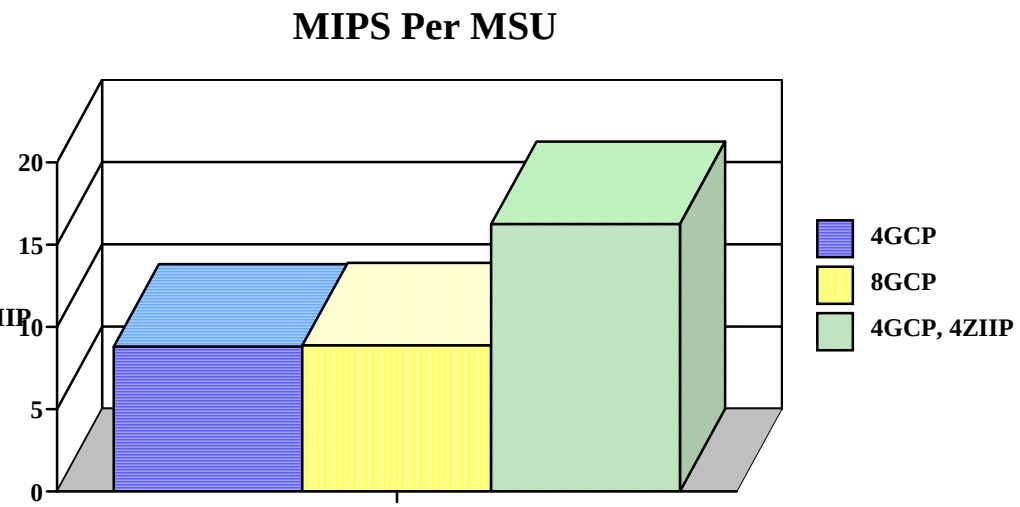


Impact of Specialty CPs on GCP Capacity

- Slight impact on capacity when running multiple books and specialty CPs
- Busy of the specialty CPs will govern the extent of the impact
- zPCR assumes the specialty CPs are fully utilized (90%) and so gives a conservative view of capacity ****

Environment	MSU	GCP MIPS	PER CP	zIIP MIPS	TOTAL
2817 M15 with 4 GCPs	531	4670	1168	0	4670
2817 M15 with 8 GCPs	988	8769	1096	0	8769
2817 M15 with 4 GCPs, 4 zIIPs	531	4311	1078	4311	8622





zIIP Busy Impacts on Capacity

- zPCR estimate assumes the zIIP is 90% busy
  - Impacts of IIPHONORPRIORITY limits zIIP busy
  - Workload eligibility requirements limits zIIP busy

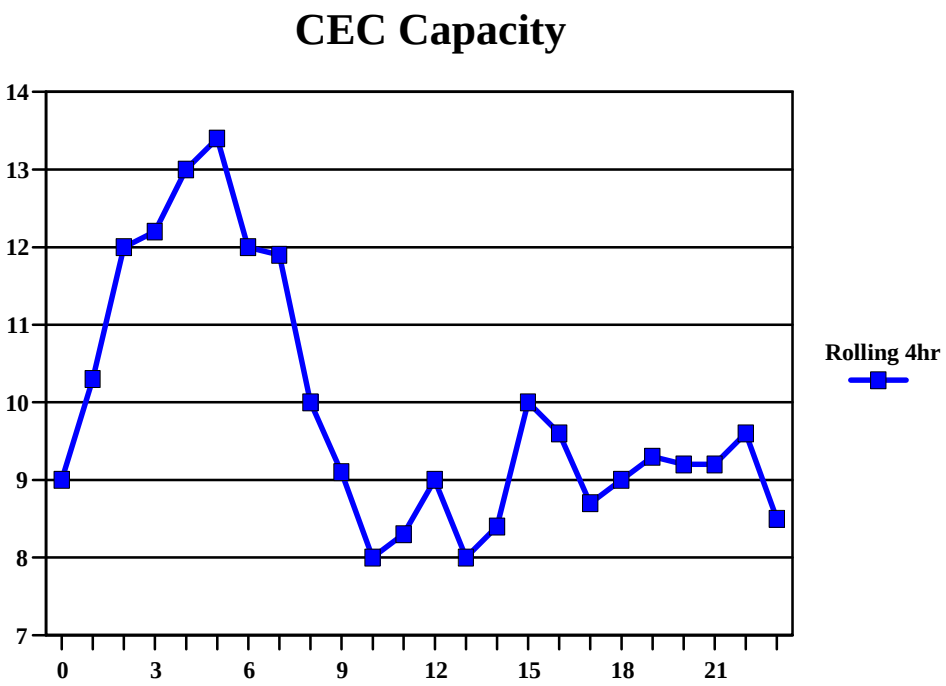
Environment	MSU	GCP MIPS	PER CP	zIIP MIPS	TOTAL
2817 M15 with 4 GCPs	531	4670	1168	0	4670
2817 M15 with 8 GCPs	988	8769	1096	0	8769
2097 E12 with 4 GCPs, 4 zIIPs	531	4311	1078	4311	8622

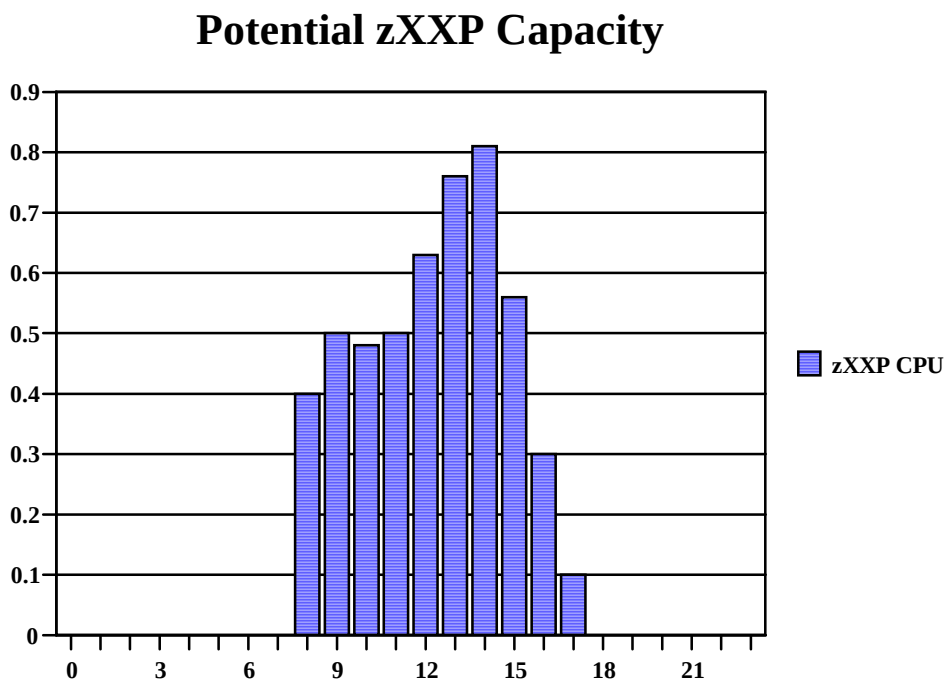
Difference between 4 GCP + 0 zIIP and 4 GCP + 4 zIIP is 359 MIPS
zIIP is 30% busy, true impact to GCP is 359 * .3 = 108 MIPS

So GCP MIPS are 4670 - 108 = 4562 MIPS

Specialty CP Capacity Planning Mistake

- Need to look across time for zXXP eligible work, and understand interval which drives need for processor capacity
- Make sure the peak which drives capacity can use the zXXP CPs to reduce costs





Summary

- Ensure period used for capacity analysis reflects representative time periods
  - Ensure WLM policy is prioritizing work correctly
  - Eliminate events which impact hardware or software capacity
- Use LSPR (zPCR) when calculating capacity relationships
  - Don’t use MSUs, or Service Units
  - Always ensure a single LSPR table is used when building capacity
- Understand Hiperdispatch latent demand indicators
  - Unparked Effectiveness and Number of Parked CPs over time
  - Check CPU:Dispatch ratios and adjust weights or config off logicals if there are delays
- Understand the capacity aspects of parallel sysplex
- Understand impacts of Low Utilization on CPU per tran
- Ensure zPCR models reflect actual capacity and not defined capacity
- Understand impacts of Specialty CPs on GCP capacity

z/OS Capture Ratio

- CPU time used by the system to do processing which cannot be related to a specific user
  - Capture ratios in z/OS have improved over time
  - 88-95% capture ratios are "common"
  - Indicator of overall system health

- Calculation

$$\textbf{Capture Ratio} = \frac{(\Sigma\ \textbf{Service Class APPL\%}) / \#\ \textbf{Logical CPs}}{\textbf{LPAR Busy}}$$

- Should be a concern if capture ratio varies widely across time

Capture Ratio Data Sources

```
------------------------------------------------------------------------------------------------------------ SERVICE POLICY
-TRANSACTIONS-  TRANS-TIME HHH.MM.SS.TTT  --DASD I/O--  ---SERVICE---   SERVICE TIME  ---APPL %---  --PROMOTED--  ----STORAGE----
AVG     287.47  ACTUAL            17.054  SSCHRT  8208  IOC     38141K  CPU 8257.462  CP     738.41  BLK     0.000  AVG    23729.95
MPL     287.42  EXECUTION         13.090  RESP     8.8  CPU    186346K  SRB  943.551  AAPCP    0.00  ENQ     0.527  TOTAL   3701667
ENDED    10357  QUEUED               867  CONN     6.4  MSO          0  RCT    1.011  IIPCP  13.49  CRM     0.000  SHARED   877.88
END/S    11.51  R/S AFFIN          2.897  DISC     0.1  SRB     21293K  IIT   59.980                LCK     0.000
#SWAPS    2796  INELIGIBLE           198  Q+PEND   2.3  TOT    245781K  HST    0.179  AAP      N/A                  -PAGE-IN RATES-
EXCTD        0  CONVERSION             1  IOSQ     0.0  /SEC   273191  AAP      N/A  IIP     0.00                  SINGLE      0.0
AVG ENC 131.43  STD DEV         2.28.422                               IIP    0.000                                BLOCK       0.0
REM ENC   0.00                                          ABSRPTN   950                                            SHARED      0.0
MS ENC    0.00                                          TRX SERV  950                                            HSP         0.0
```

```
CPU         2094   CPC CAPACITY   N/A
MODEL       712    CHANGE REASON=N/A
H/W MODEL   S38
---CPU---     ---------------- TIME % -----
NUM  TYPE     ONLINE     LPAR BUSY     MVS BU
 0    CP      100.00     64.37         99.82
 1    CP      100.00     64.37         99.83
 2    CP      100.00     64.36         99.84
 3    CP      100.00     64.37         99.84
 4    CP      100.00     64.38         99.84
 5    CP      100.00     64.37         99.83
 6    CP      100.00     64.37         99.82
 7    CP      100.00     64.36         99.82
 8    CP      100.00     64.38         99.81
 9    CP      100.00     64.36         99.82
 A    CP      100.00     64.33         99.81
 B    CP      100.00     64.35         99.80
TOTAL/AVERAGE            64.36         99.82
```

- RMF Monitor 1
  - RMF CPU Activity Report and use LPAR Busy from CPU Activity
  - Use RMF Workload Activity with control card SYSRPTS(WLMGL(POLICY)) and get a single report per interval

738.41 /100 = 7.38 CPs
64.36 /100 * 12 CPs = 7.72 CPs

Capture Ratio = 7.38 / 7.72 = 96%

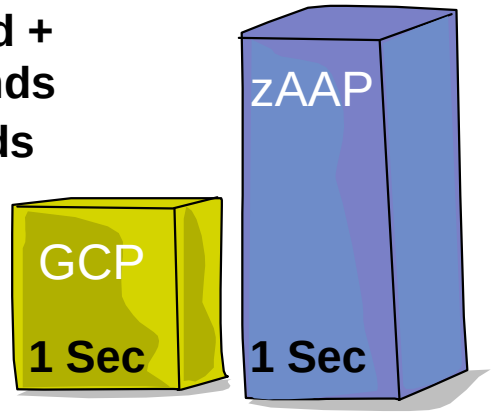
Subcapacity GCPs and Specialty CPs

- Specialty CPs always run at full speed of processor model
- Same z/OS image has CPs running at different speeds
- Requires CPU seconds to be normalized

Example: zAAP is 8 times the speed of the GCP

Execution Time = GCP seconds + (zAAP seconds * normalization factor)

Execution Time = 1 second + (1 second * (8)) = 8 seconds
= 9 seconds



- **Normalization factor used is in RMF 72 subtype 3 record, R723NFFI (zAAP) or R791NFFS (zIIP)**
- **Normalization factor used is in the SMF 30 record, SMF30ZNF (zAAP) or SMF30SNF (zIIP)**
- **When zAAP/zIIP and GCP are the same speed the normalization factor resolves to 1**