TechU

IBM

A real customer experience in CPU sizing and CMP migration using SMF113, zPCR and LPARDesign tools

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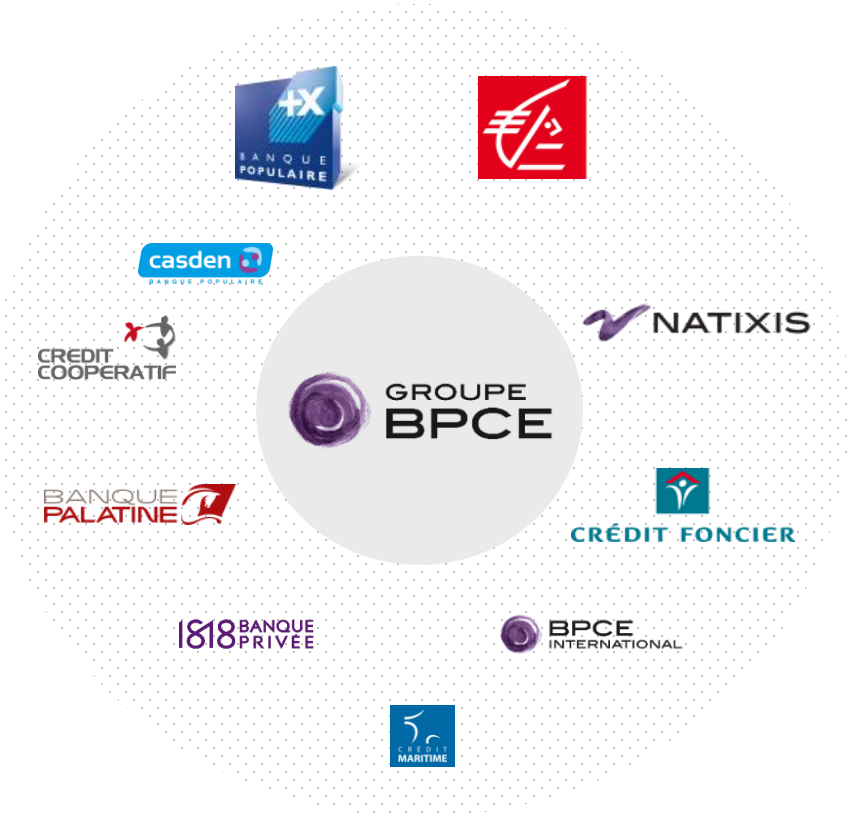
Agenda

1. Introduction
2. z13 Configuration Evaluation
3. z14 Configuration Selection
4. z14 Operations, Adjustment & Evaluation
5. Distribution of GCP, IIP & LPAR over the 4 z14
6. Conclusions

About BPCE



Second Bank Group in France

9 millions corporate members

31,2 millions customers

108 000 contributors

8 000 banking agencies

Présent in **48** countries

20 % of french economy financing

Objective

To present the methodology we retained to choose the right machine capacity for our z13 to z14 migration, how different tools have been helpful, and how we migrate from 2 active machines to 4 active machines and benefit of CMP.

November 2017…
Evaluate current z13 configuration

December 2017…
Select target z14 configuration

Christmas 2017…
Negociations & Deal with IBM…

June 2018…
Installation of the z14 servers and migration of LPARs

Summer 2018…
Evaluate current « **2 z14** » configuration

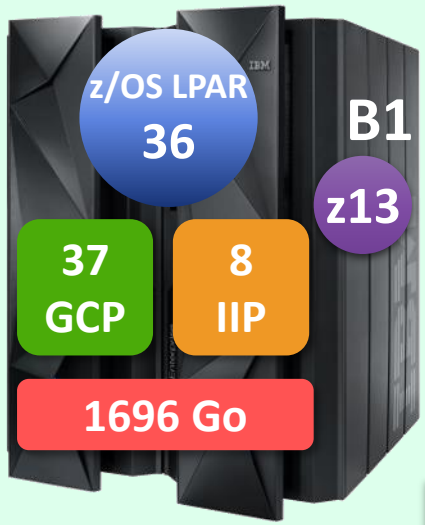
End of 2018…
Study distribution of GCP, IIP & LPAR over the 4 z14

January 2019…
Final « **4 z14** » configuration installation

z Servers Configuration – End of 2017

Site A

z13 2964-N63 737
38.840 Mips LSPR
36 z/OS LPAR
8 zIIP

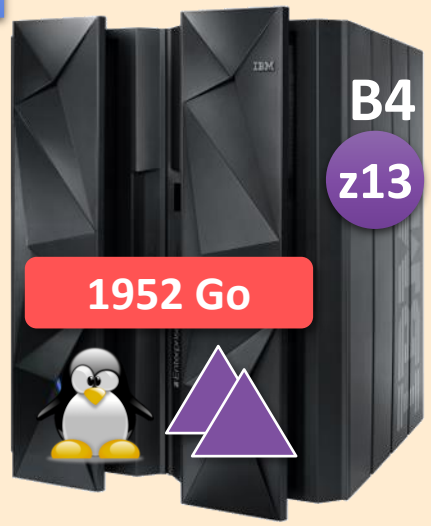


z13 2964-N96 401
11 ICF
5 IFL

Site B

z13 2964-N63 736
37.972 Mips LSPR
38 z/OS LPAR
8 zIIP

z13 2964-N96 401
11 ICF
5 IFL



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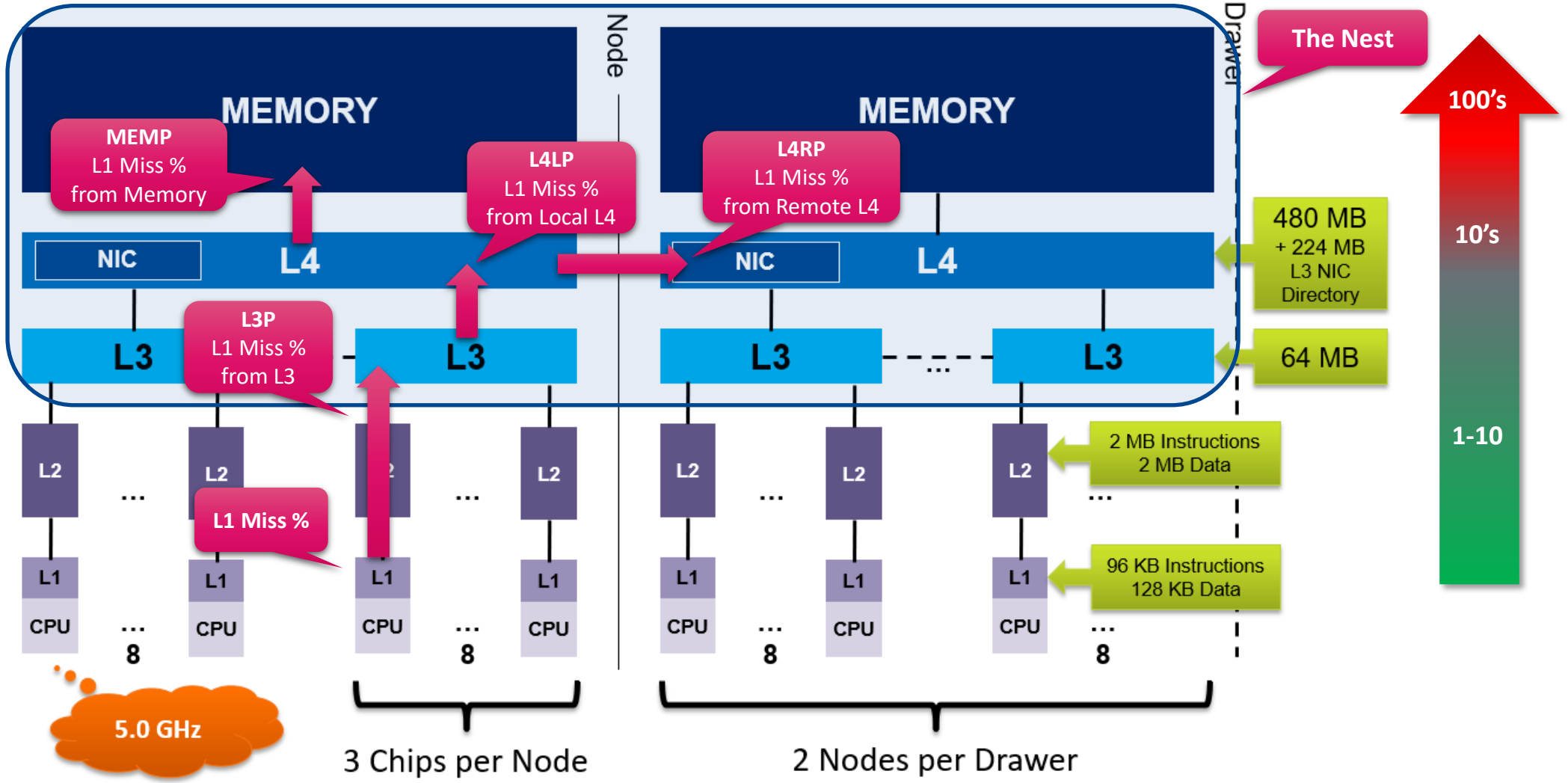
z13 Configuration Evaluation - Retained Method

Evaluate current configuration (i.e. z13)

- *Workload characterization*
  - *Select typical day and period for reference*
  - *Establish a Workload Characterization hint by LPAR*
- *PR/SM configuration*
- *Capacity Sizing*

Workload Characterization – Relative Nest Intensity (RNI) on z13

How deep into the shared cache and memory hierarchy (Nest) the processor must go to retrieve data.
➔ Access time increases significantly with each additional level (Increasing user wait time)



Workload Characterization – RNI Formulas & Table

System	Relative Nest Intensity (RNI)
z10	(1.0 x #L2LP + 2.4 x #L2RP + 7.5 x #MEMP) / 100
z196	1.67 x (0.4 x #L3P + 1.0 x #L4LP + 2.4 x #L4RP + 7.5 x #MEMP) / 100
zEC12	2.3 x (0.4 x #L3P + 1.2 x #L4LP + 2.7 x #L4RP + 8.2 x #MEMP) / 100
z13	**2.3 x (0.4 x #L3P + 1.6 x #L4LP + 3.5 x #L4RP + 7.5 x #MEMP) / 100**
z14	**2.4 x (0.4 x #L3P + 1.5 x #L4LP + 3.2 x #L4RP + 7.0 x #MEMP) / 100**

For z13 & z14 :

- **#L3P :** % of L1 misses sourced from the shared chip-level L3 cache
- **#L4LP :** % of L1 misses sourced from the local drawer L4 cache
- **#L4RP :** % of L1 misses sourced from the remote drawer L4 cache
- **#MEMP :** % of L1 misses sourced from Memory

*A same **Workload Characterization** could be issued by different combination of **L1 Miss %** and **Relative Nest Intensity***

__Workload Characterization__ is a function of __L1 Miss %__ and __Relative Nest Intensity__

L1 Miss %	Relative Nest Intensity (RNI)	Workload Characterization
< 3%	>= 0,75	Average
	< 0,75	Low
3% à 6%	> 1,0	High
	0,6 à 1,0	Average
	< 0,6	Low
> 6%	>= 0,75	High
	< 0,75	Average

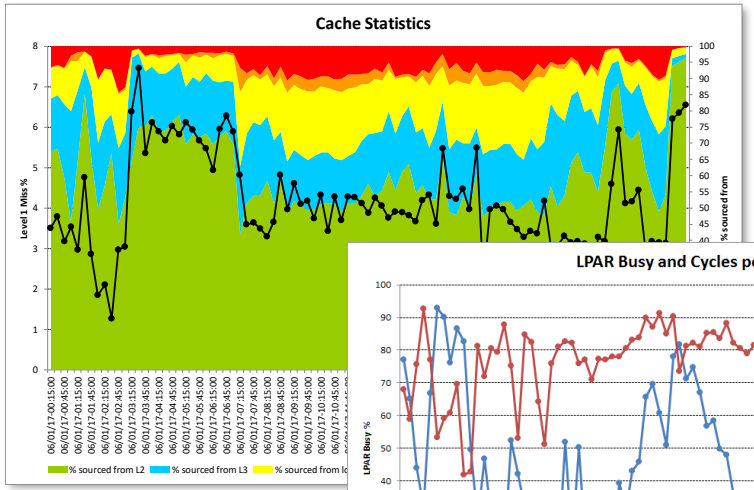
Apply to all processors from z10
Table may change based on feedback

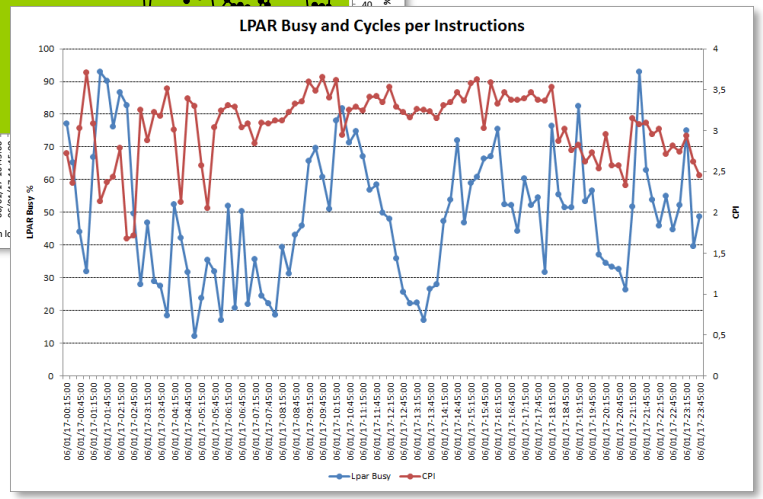
Workload Characterization from SMF 113

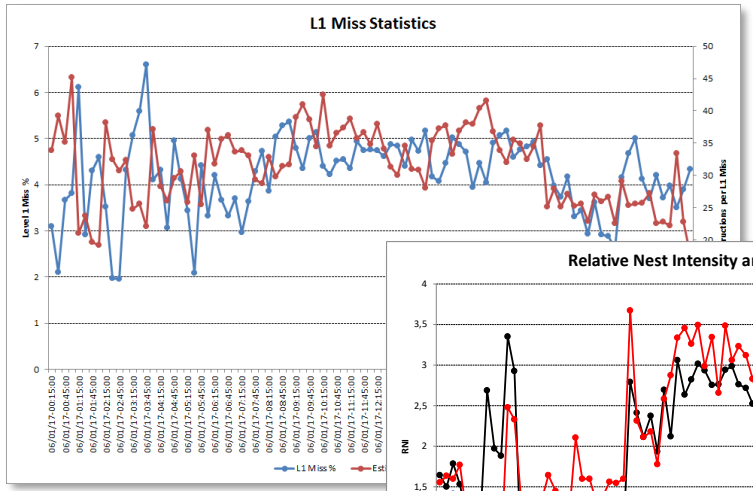
SMF113 Reporting Tool

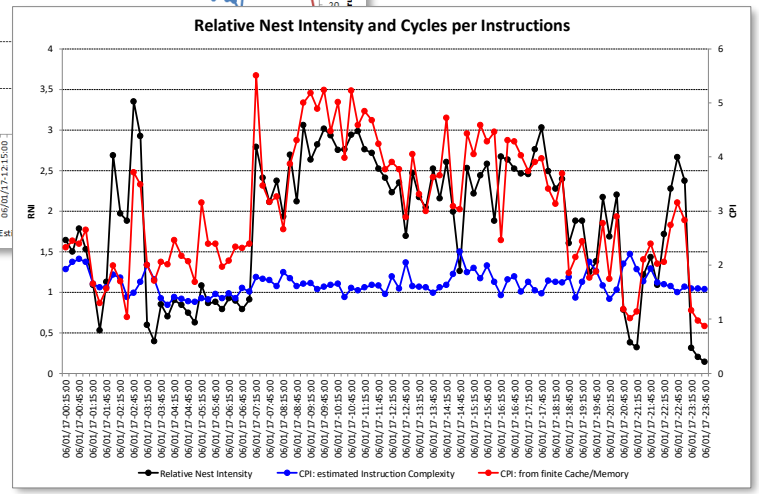
https://ibm.biz/BdZgeh

- SMF 113 records provide insight into the usage of hardware cache structures of your partitions.
- This reporting tool
  - Provides a set of REXX programs which process SMF 113 subtype 2 data from all processors types : z10, z196, zEC12, z13, z14
  - The output is a CSV file including the most common metrics which can be calculated from the SMF 113 counters
  - There is also a spreadsheet to display the most basic statistics for cache access and cycles per instructions thanks to pre defined chart sets

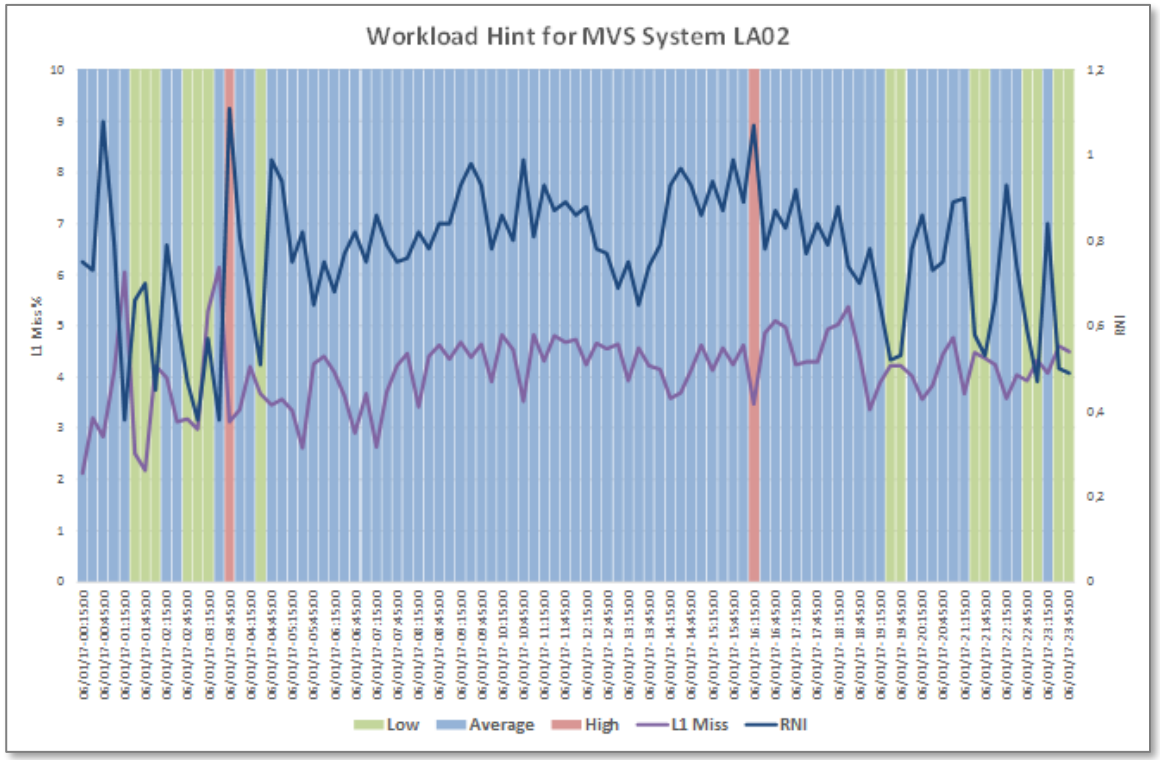








Workload Characterization – Analysis & Results



Based on the previous z13 **RNI** formula and the **L1 Miss %** we get for each LPAR it's **Workload Characterization** by interval of time for the retained day

Green ➔ Low workload characterization
Blue ➔ Average workload characterization
Red ➔ High workload characterization

Period selection criterias

- *Typical periods when our most important work is running*
  ➔ OLTP (8 am / 6 pm)
- *High CEC utilization and contention between LPARs*

In doubt, we use the « less favorable » characterization

As a result, we get for each LPAR a Workload characterization that we could use for the next steps of our CPU Sizing :

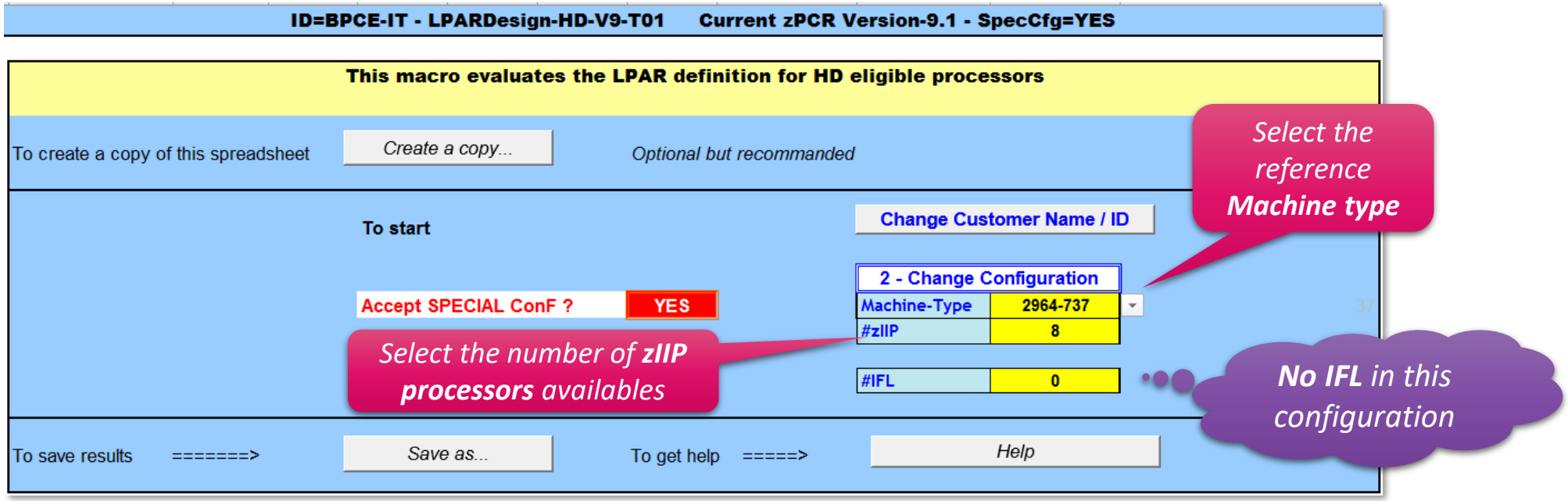
MVS Id	Workload Hint
LA01	High
LA02	Average
LA03	Average
LA04	Average
LA05	High
LA06	High
LA07	High
…	…

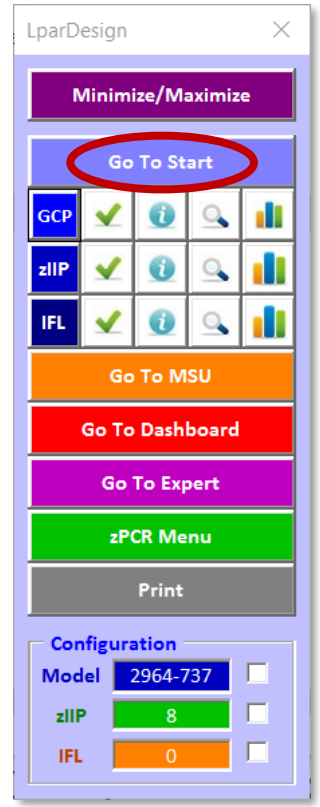
PR/SM Configuration – LPAR Design

LPAR Design

https://ibm.biz/BdZTVw

- The LPAR Design tool assists you in planning the LPAR layout of your Central Processor Complexes.
- The tool allows you to specify all partitions, the number of logical processors, their weights and their Workload Characterization hint.
- If you run your system in **Hiperdispatch** mode it also assists you in displaying the number of high, medium and low processors as a result of your definition.
- In addition zIIPs offload processors and IFL processors are also supported.
- You can upload or download the results from / to a zPCR study.





PR/SM Configuration – LPAR Design – GCP Configuration

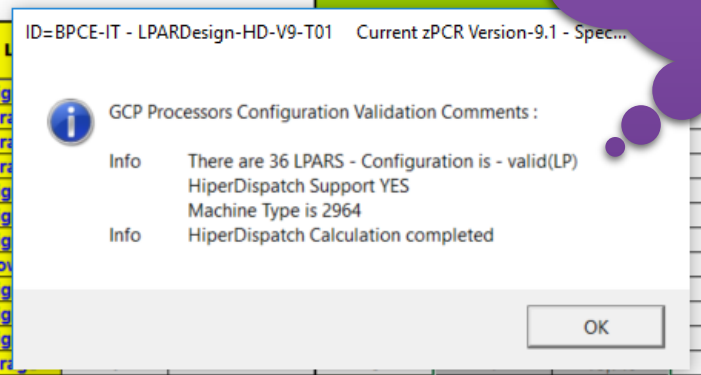
ID=BPCE-IT - LPARDesign-HD-V9-T01 Current zPCR Version-9.1 - SpecCfg=YES LPAR DEFINITION

			ψMachine	Shared-Pool
CFG-LP-VALID?	YES	#PhyProc	37	37
Machine-type	2964-737	#LPs (non-ICF, non-DED)	81	Ded-Pool
MSU	4 553	Ratio LP/PP (base)	2,19	0
Total Weight	3 536	LSPR-AVG-V2R2-MI	38 840	
Max LPAR	85	#LPARs	36	

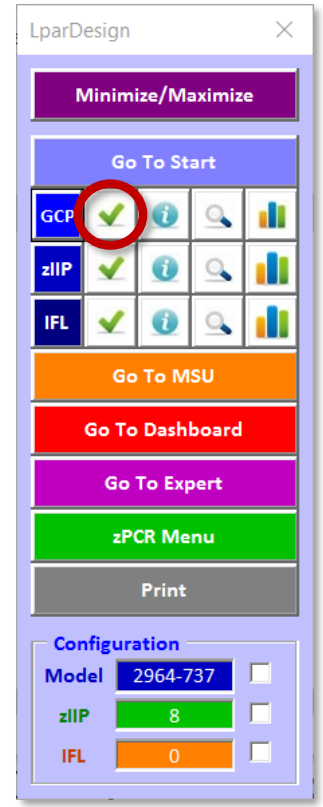
LPARNAME	WEIGHT	#LP	%SHARE (By Pool)	RESERVED	Guaranteed #PP	Wkld L
LA01	15	2	0,4%		0,16	Hig
LA02	219	5	6,2%		2,29	Avera
LA03	291	5	8,2%		3,04	Avera
LA04	457	7	12,9%		4,78	Avera
LA05	27	2	0,8%		0,28	Hig
LA06	28	2	0,8%		0,29	Hig
LA07	5	1				Hig
LB01						Lo
LB02						Hig
LB03						Hig
LB04						Hig
LB05						
						rage
						age
						age
						gh
						High
						High
						Average
LB13						High
LB14					2,25	Average
LB15					0,18	Low
LB16		2			0,78	High
LC01		3	4,8%	z13,z13s Rule	1,78	Average
LC02		2	2,0%		0,73	Average
LC03	7	1	0,2%		0,07	High
LC04	3	1	0,1%		0,03	High

9	OK	7	2	66,5%	1	9	9			
7	OK	6	1	86,4%	2	7	7			
2	OK	0	2	53,9%	0	2	2			
1	OK	0	1	54,4%	1	2	1			
1	OK	0	1	82,7%	1	2	1			
1	OK	0	1	13,6%	0	1	1			
1	OK	0	1		1	2	1			
1	OK	0	1	4,4%	0	1	1			
3	OK	1	2	62,5%	0	3	3			
1	OK	0	1	17,8%	0	1	1			
1	OK	0	1	78,5%	1	2	1			
2	OK	0	2	88,9%	1	2	2			
1	OK	0	1	73,2%	1	2	1			
1	OK	0	1	7,3%	0	1	1			
1	OK	0	1	3,1%		1	1			

Infos, Warnings, Errors after validation and HiperDispatch calculation of the GCP LPARs



For each LPAR using GCP processor specify its Weight, GCP LP count and retained Workload Characterization in the corresponding columns



PR/SM Configuration – LPAR Design – GCP Configuration

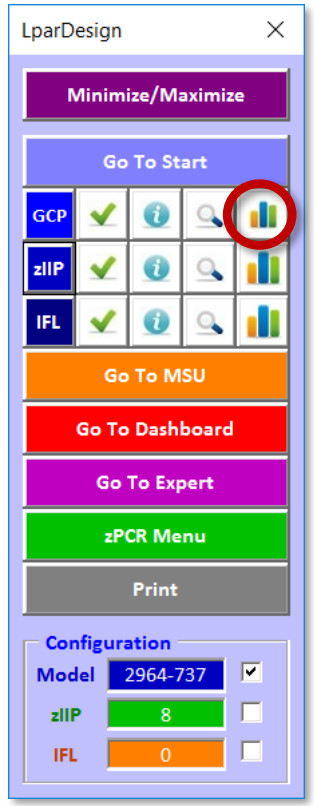
ID=BPCE-IT - LPARDesign-HD-V9-T01 Current zPCR Version-9.1 - SpecCfg=YES DASHBOARD For GCP Processors

GCP | zIIP | IFL

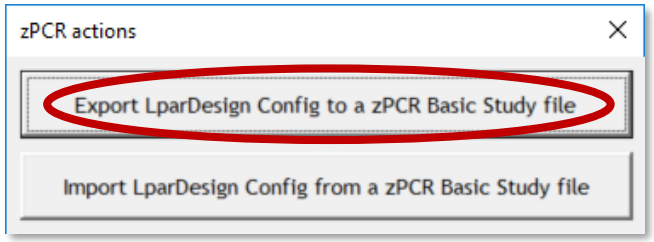
Legend : *LP High* x% *LP Medium with a Share of x%* *LP Low* x% *LP Low Always Unparked with a Share of x%*

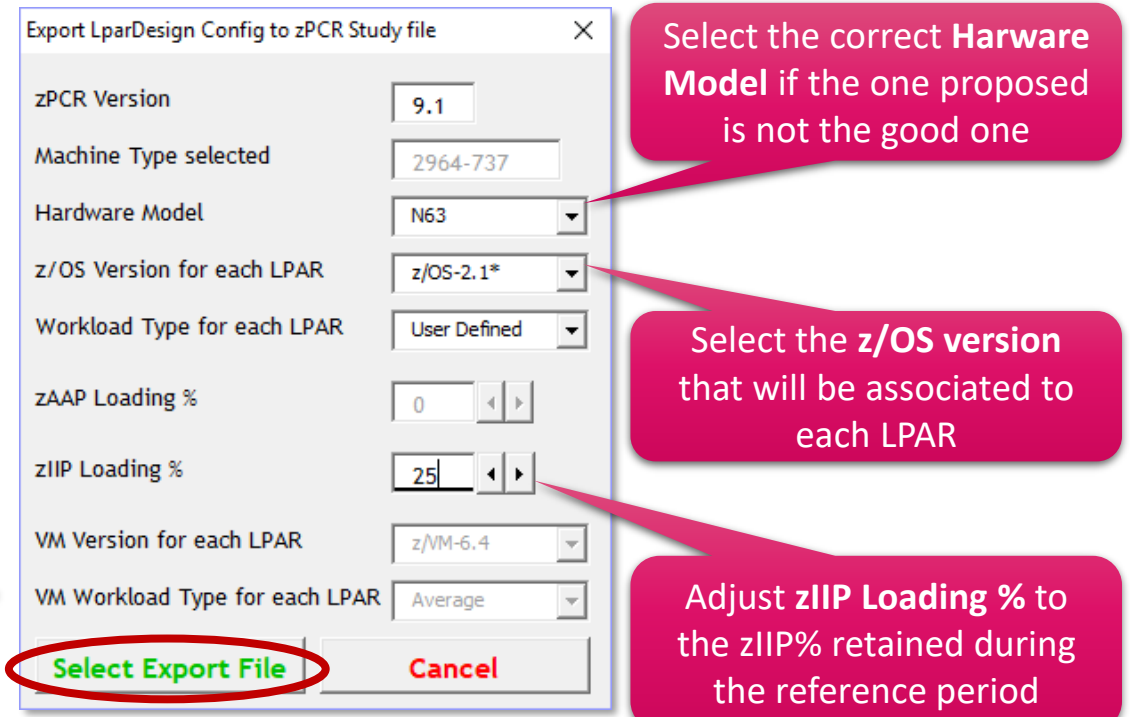
LPAR Name	% Share	Guarant #PP	LP0	LP1	LP2	LP3	LP4	LP5	LP6	LP7	LP8	LP9	LPA	LPB	LPC	LPD	LPE	LPF
LA01	0,4%	0,16	7,8%	7,8%														
LA02	6,2%	2,29		64,6%	64,6%													
LA03	8,2%	3,04			52,2%	52,2%												
LA04	12,9%	4,78					78,2%											
LA05	0,8%	0,28	14,1%	14,1%														
LA06	0,8%	0,29	14,6%	14,6%														
LA07	0,1%	0,05	5,2%															
LB01	0,3%	0,10	10,5%															
LB02	0,1%	0,02	2,1%															

DashBoard display of the HiperDispatch PR/SM configuration for the GCP pool LPAR



PR/SM Configuration – Export to zPCR





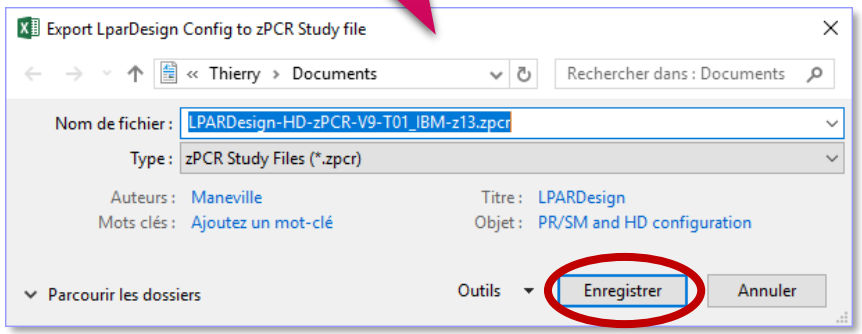
Select the correct **Harware Model** if the one proposed is not the good one

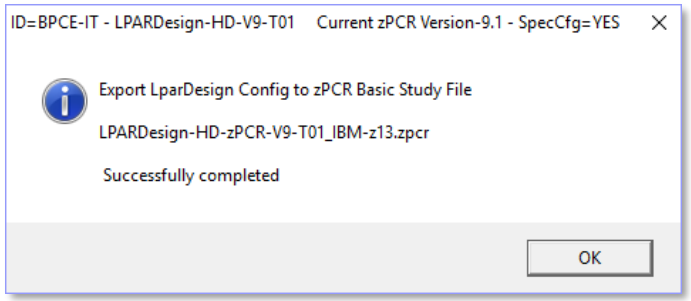
Select the **z/OS version** that will be associated to each LPAR

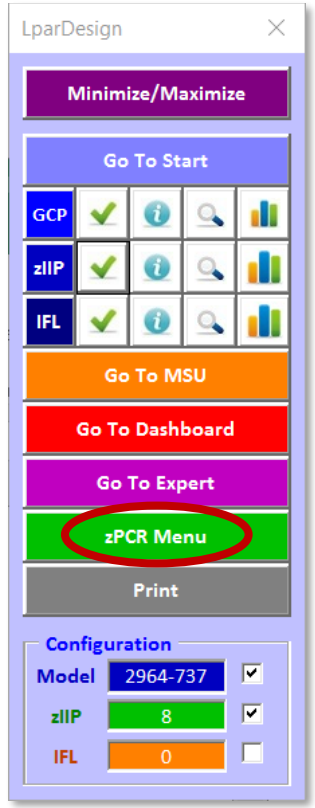
Adjust **zIIP Loading %** to the zIIP% retained during the reference period

Backup foil about the generated zPCR Study

Validate or modifiy the generated **zPCR file name**





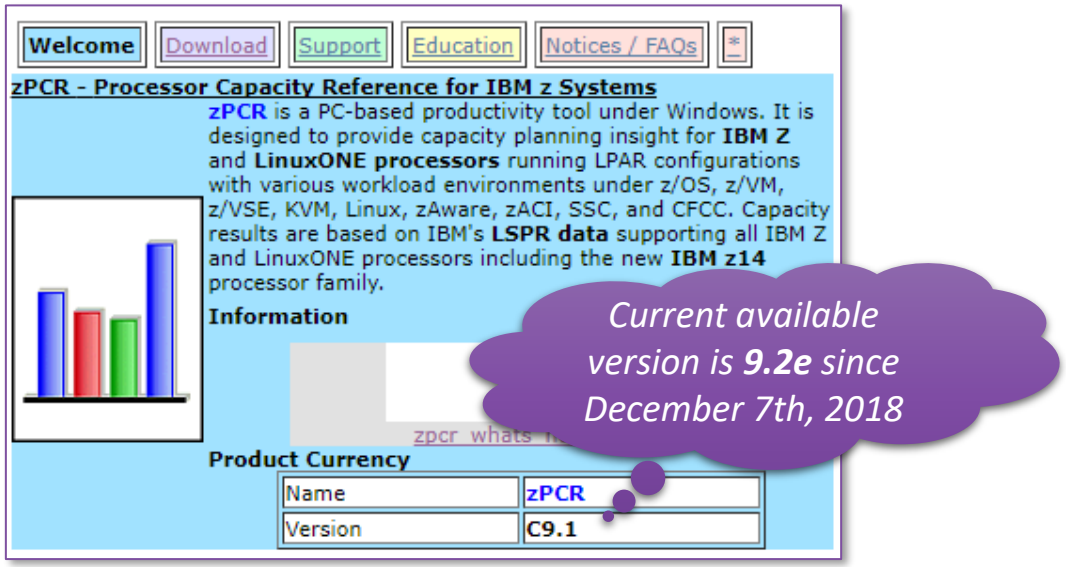


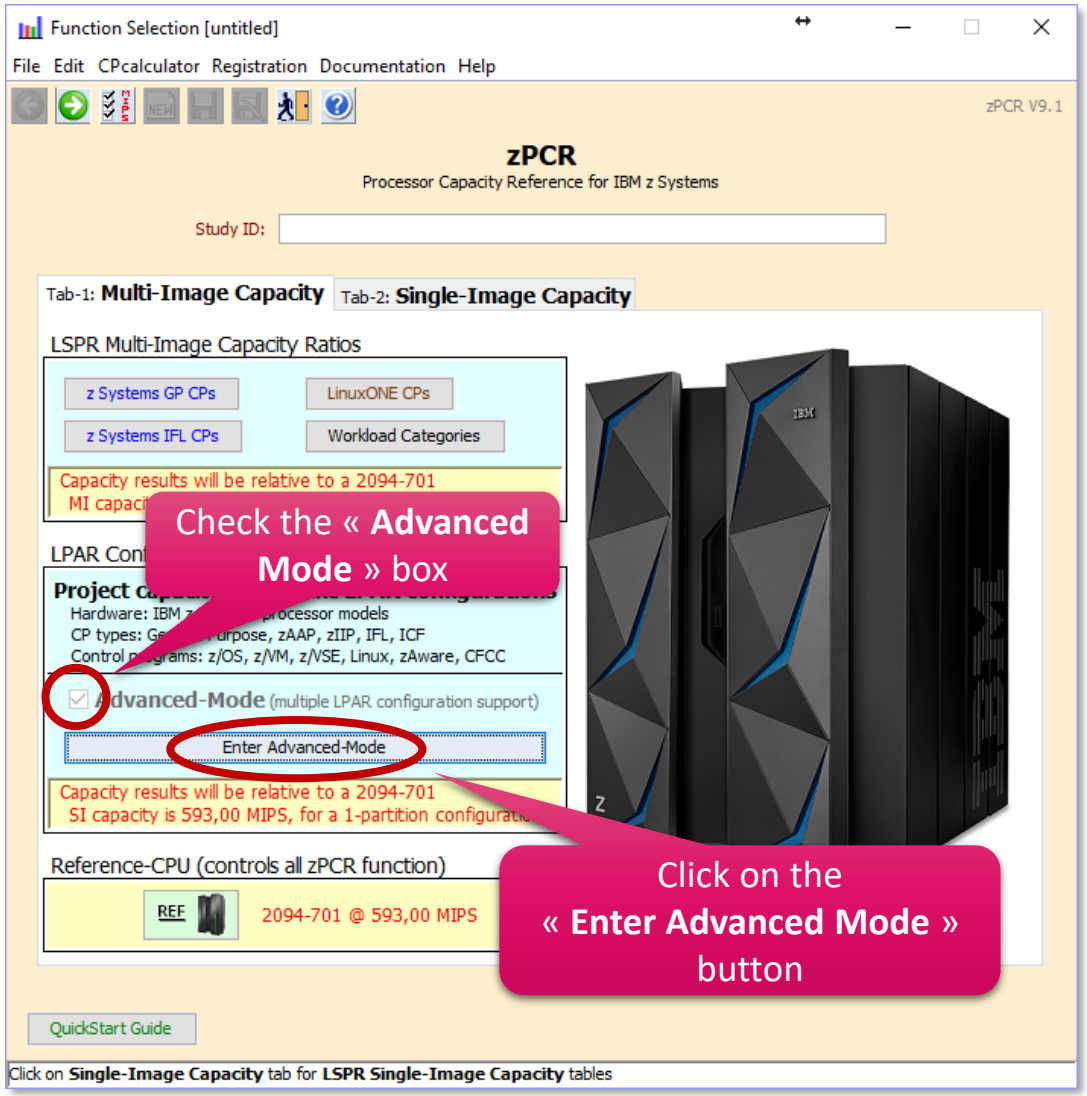
Capacity Sizing

IBM zPCR (z Processor Capacity Reference)

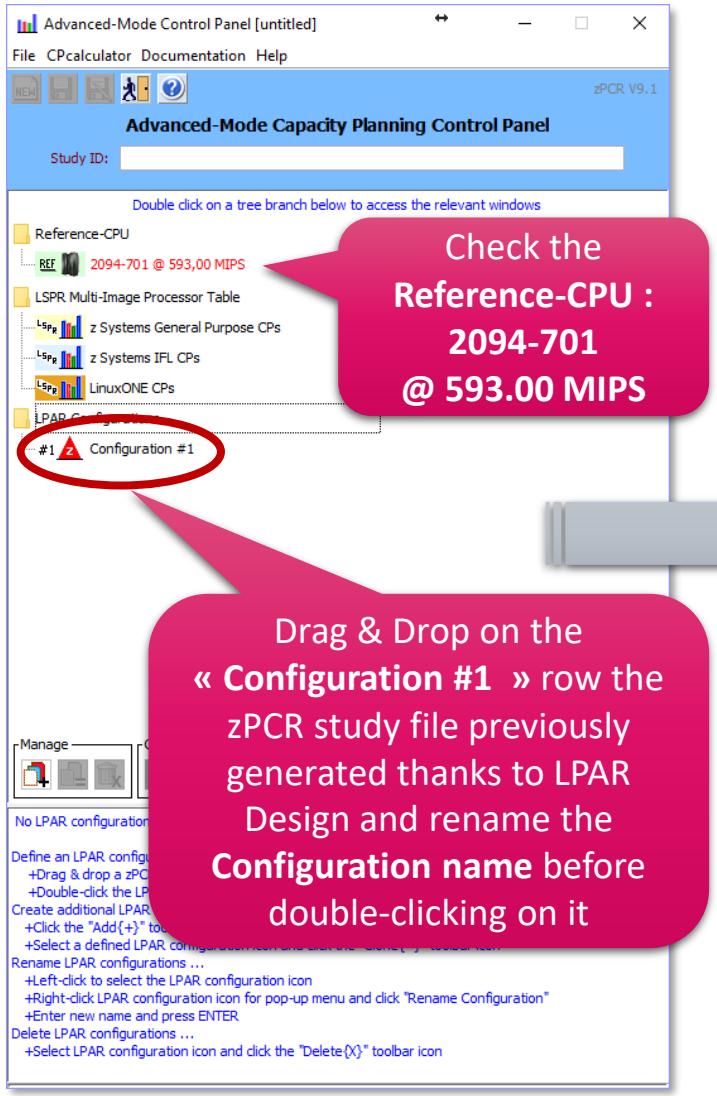
https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1381

- zPCR is a PC-based productivity tool under Windows.
- It is designed to provide capacity planning insight for IBM Z and LinuxONE processors running LPAR configurations with various workload environments under z/OS, z/VM, z/VSE, KVM, Linux, zAware, zACI, SSC, and CFCC.
- Capacity results are based on IBM's LSPR data supporting all IBM Z and Linux ONE processors including the new IBM **z14** processor family.



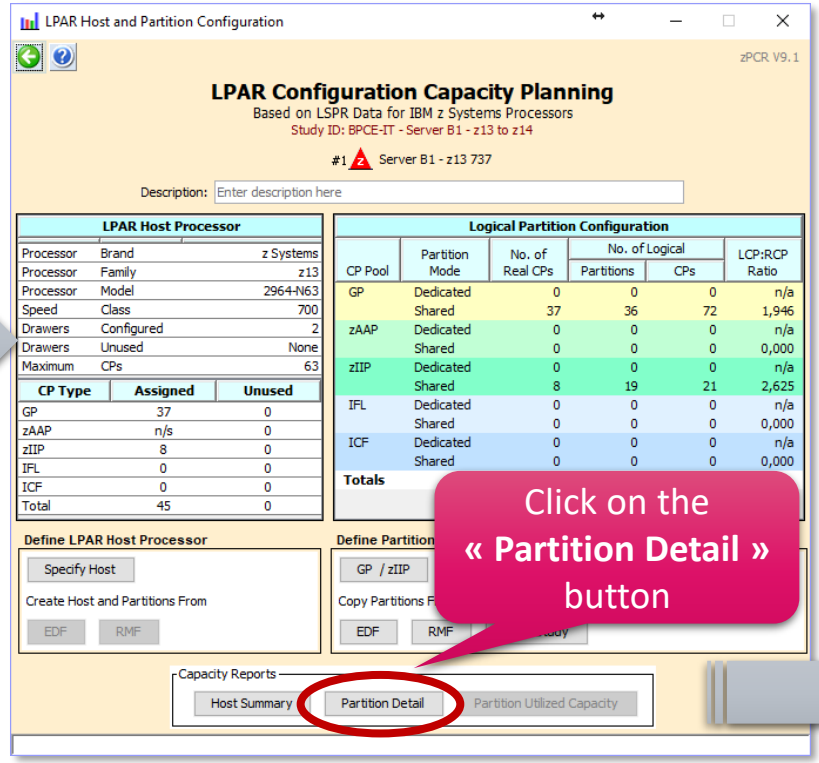


Capacity Sizing – Load & Results

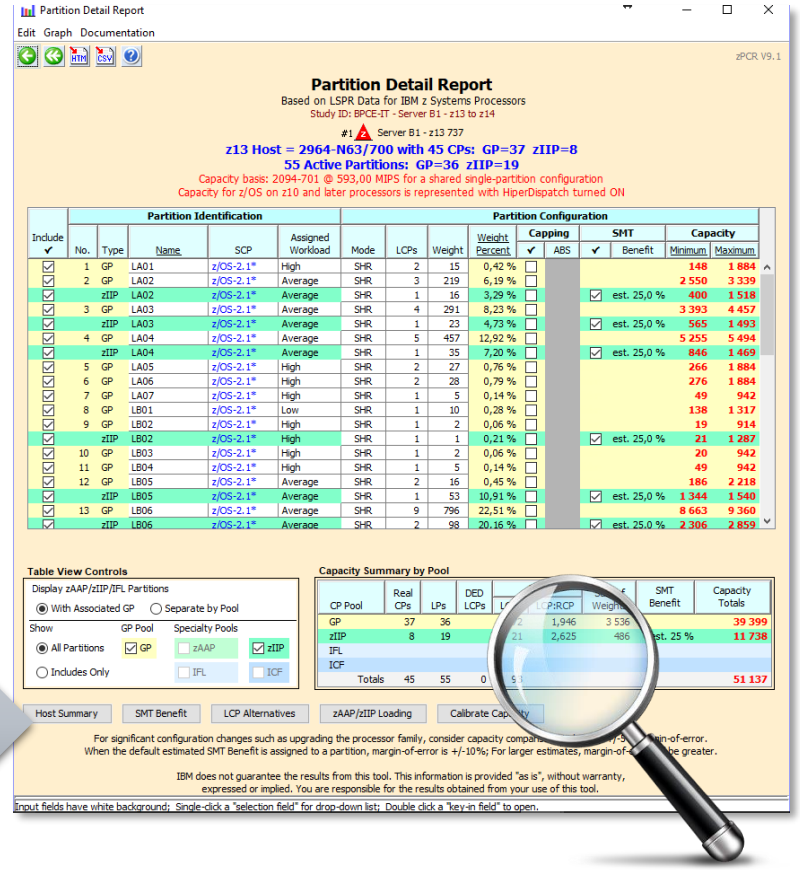


Check the **Reference-CPU : 2094-701 @ 593.00 MIPS**

Drag & Drop on the **« Configuration #1 »** row the zPCR study file previously generated thanks to LPAR Design and rename the **Configuration name** before double-clicking on it



Click on the **« Partition Detail »** button



Capacity Sizing – Results for one z13 Server

Capacity Summary by Pool

CP Pool	Real CPs	LPs	DED LCPs	SHR LCPs	SHR LCP:RCP	Sum of Weights	SMT Benefit	Capacity Totals
GP	37	36		72	1,946	3 536		39 399
zIIP	8	19		21	2,625	486	est. 25 %	11 738
IFL								
ICF								
Totals	45	55	0	93				51 137

Capacity Summary by pool for our current configuration i.e. « **the z13 one** »

B1 server with a **z13 2964-737** Configuration is valued by this zPCR study as having about **39 399 Mips** of usable capacity for it's **GCP** Pool…

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z14 Configuration Selection - Retained Method

Select a final configuration (i.e. z14)

- *Workload characterization*
  - *Adjustment of Workload Characterization hint for new architecture*
- *PR/SM configuration*
  - *Different z14 Model hypothesis*
  - *HiperDispatch comparison with current configuration*
- *Capacity Sizing*
  - *Different model hypothesis comparison*

*For each evaluated **z13** Server, select the **z14** Server required to guarantee at least the same current Capacity*

z14 Configuration Selection

Select an appropriate z14 Model
in which current Partitions and Workloads could fit…

Proposed Method

1. ***Adjust LPAR Workload characterization to z14 target***
2. *Select a z14 7xx starting model thanks to **zPCR***
3. *From the z13 configuration previously defined in **LPAR Design** make the z14 7xx model configuration*
   - *Adjust LPAR Workload characterization*
   - *Optimize HiperDispatch configuration*
   - *Export as a new zPCR study*
4. *Make a **zPCR** comparison study between the z13 configuration and the z14 7xx model one*

Workload Characterization adjustements for z14 architecture

Currently there's no available projection method to evaluate the Workload Characterization hint of an existing configuration on a new architecture…

Conservative approach

Proposition

*Thanks to the **SMF113 Reporting Tool** data extraction we could apply the z14 RNI formula onto the current configuration measured cache % data*

System	Relative Nest Intensity (RNI)
z13	2.3 x (0.4 x #L3P + 1.6 x #L4LP + 3.5 x #L4RP + 7.5 x #MEMP) / 100
z14	2.4 x (0.4 x #L3P + 1.5 x #L4LP + 3.2 x #L4RP + 7.0 x #MEMP) / 100

As a result we potentially get for each LPAR a **new Workload Characterization** that we could use for the next steps of the final configuration CPU Sizing…

No significative variations between z13 and z14 Workload characterization for our configuration

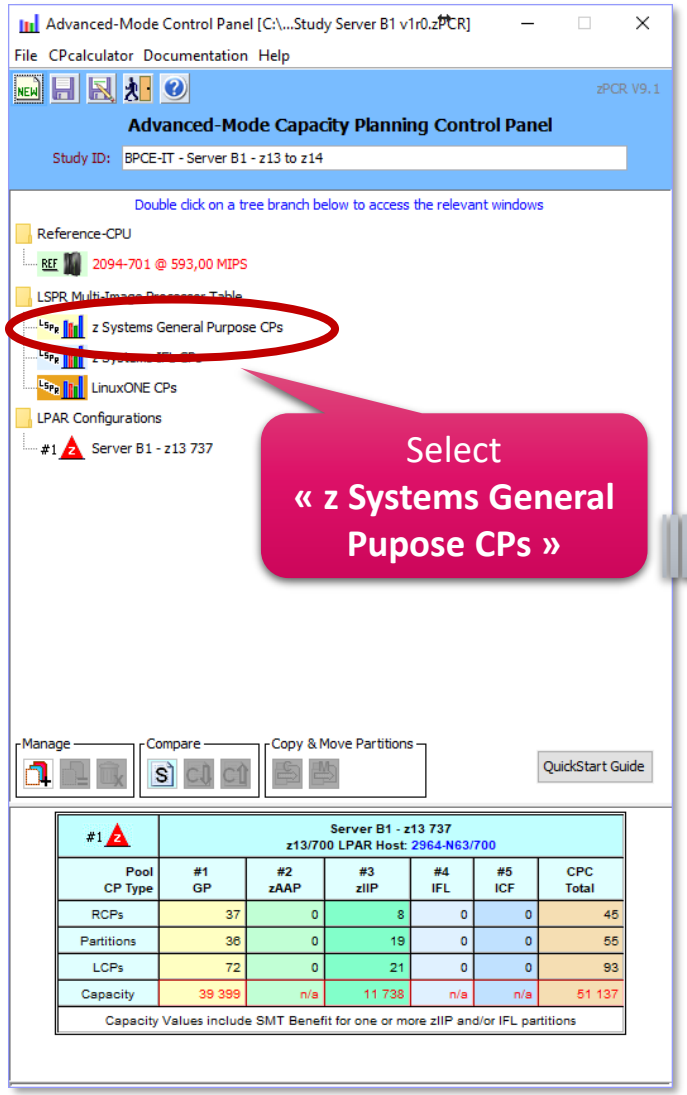
z14 Configuration Selection

Select an appropriate z14 Model
in which current Partitions and Workloads could fit…

Proposed Method

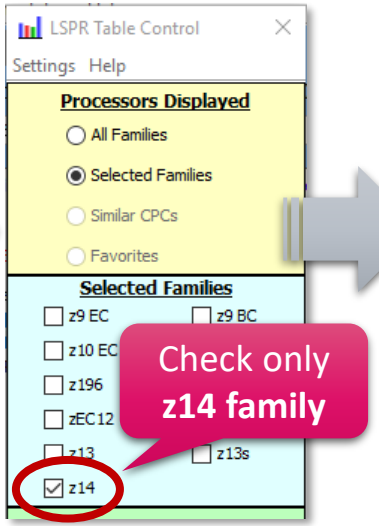
1. *Adjust LPAR Workload characterization to z14 target*
2. ***Select a z14 7xx starting model thanks to zPCR***
3. *From the z13 configuration previously defined in **LPAR Design** make the z14 7xx model configuration*
   - *Adjust LPAR Workload characterization*
   - *Optimize HiperDispatch configuration*
   - *Export as a new zPCR study*
4. *Make a **zPCR** comparison study between the z13 configuration and the z14 7xx model one*

z14 Starting Model - Selection

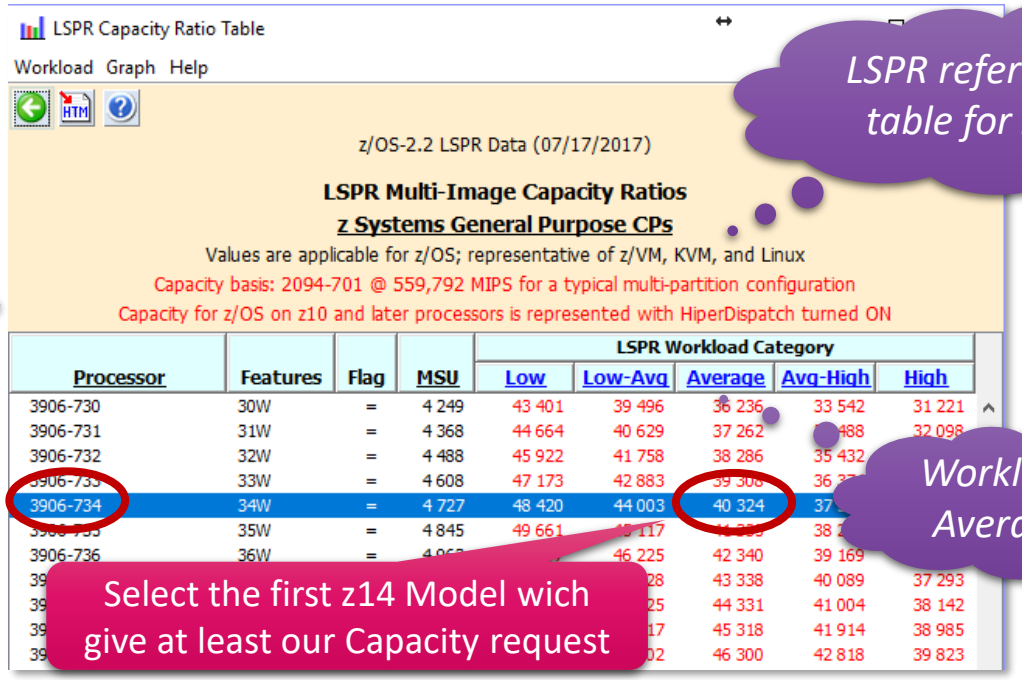


Select « z Systems General Pupose CPs »

*In the **z/OS-2.2 Multi-Image LSPR Capacity Ratios** table select the first **z14 3906-7xx** Model which gives at least our Capacity request of **39 399 Mips using the Average Workload***



Check only **z14 family**



LSPR reference table for z14

Workload Average

Select the first z14 Model wich give at least our Capacity request

z14 3906-734** with an estimate of **40 324 Mips** for **Average Workload

z14 Configuration Selection

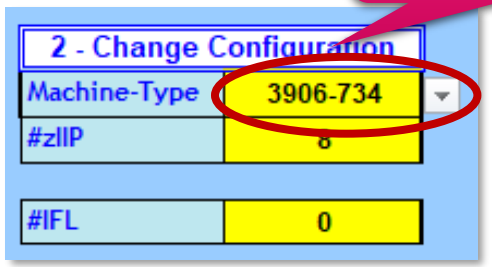
Select an appropriate z14 Model
in which current Partitions and Workloads could fit…

Proposed Method

1. *Adjust LPAR Workload characterization to z14 target*
2. *Select a z14 7xx starting model thanks to zPCR*
3. ***From the z13 configuration previously defined in LPAR Design make the z14 7xx model configuration***
   - ***Adjust LPAR Workload characterization***
   - ***Optimize HiperDispatch configuration***
   - ***Export as a new zPCR study***
4. *Make a **zPCR** comparison study between the z13 configuration and the z14 7xx model one*

z14 Starting Model – Configuration for z14 734

Select the retained z14 Model



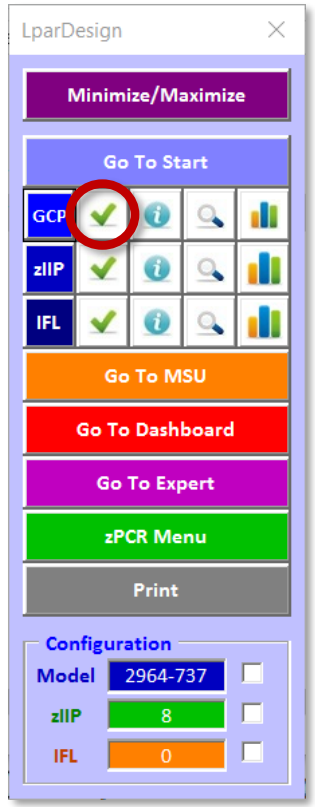
ID=BPCE-IT - LPARDesign-HD-V9-T01 Current zPCR Version-9

			ψMachine	Shared-Pool
CFG-LP-VALID?	NO	#PhyProc	34	34
Machine-type	3906-734	#LPs (non-ICF, non-DED)	81	Ded-Pool
MSU	4 727	Ratio LP/PP (base)	2,38	0
Total Weight	3 536	LSPR-AVG-V2R2-MI	40 324	
Max LPAR	85	#LPARs	36	

LPARNAME	WEIGHT	#LP	%SHARE (By Pool)	RESERVED	Guaranteed #PP	Wkld LSPR	MinReq#LP	Check#LP
LA01	15	2				High		
LA02	219	5				Average		
LA03	291	5				Average		
LA04	457	7				Average		
LA05	27	2				High		
LA06	28	2				High		
LA07	5	1				High		
LB01	10	1				Low		
LB02	2	1				High		
LB03	2	1				High		
LB04	5	1				High		
LB05	16	2				Average		

Adjust LPAR Workload characterization

Validate new z14 configuration



New HiperDispatch rule on z14…

*To get a **better colocation of Vertical High and Vertical Medium** Logical Processors on z14, the following rule has been reactivated for z14 :*

- *From 1.5 to 1.99 guaranteed CP we get 1 Vertical High and 1 Vertical Medium*
- *On z13 and z13s machines we had 2 Vertical Medium*

ID=IBM Corp. - LPARDesign-HD-V9-T02 Current zPCR Version-9.1 - SpecCfg=YES LPAR DEFINITION (CP)

			ψMachine	Shared-Pool
CFG-LP-VALID?	YES	#PhyProc	34	34
Machine-type	3906-734	#LPs (non-ICF, non-DED)	80	Ded-Pool
MSU	4 727	Ratio LP/PP (base)	2,35	0
Total Weight	3 536	LSPR-AVG-V2R2-MI	40 324	
Max LPAR	85	#LPARs	36	

Configuration Validation

Delete selected LPAR

									HD supported on 3906					
LPARNAME	WEIGHT	#LP	%SHARE (By Pool)	RESERVED	Guaranteed #PP	Wkld LSPR	MinReq#LP	Check#LP	HD-HIGH#	HD-MED#	HD-MED%	HD-LOW#	#Active LPs	#Report LPs
LA01	15	2	0,4%		0,14	High	1	OK	0	1	14,4%	1	2	1
LA02	219	5	6,2%		2,11	Average	3	OK	1	2	55,3%	2	3	3
LA03	291	5	8,2%		2,80	Average	3	OK	2	1	79,8%	2	3	3
LA04	457	7	12,9%		4,39	Average	5	OK	3	2	69,7%	2	5	5
LA05	27	2	0,8%		0,26	High	1	OK	0	1	26,0%	1	2	1
LA06	28	2	0,8%		0,27	High	1	OK	0	1	26,9%	1	2	1
LA07	5	1	0,1%		0,05	High	1	OK	0	1	4,8%	0	1	1
LB01	10	1	0,3%		0,10	Low	1	OK	0	1	9,6%	0	1	1
LB02	2	1	0,1%		0,02	High	1	OK	0	1	1,9%	0	1	1
LB03	2	1	0,1%		0,02	High	1	OK	0	1	1,9%	0	1	1
LB04	5	1	0,1%		0,05	High	1	OK	0	1	4,8%	0	1	1
LB05	16	2	0,5%		0,15	Average	1	OK	0	1	15,4%	1	2	1

z14 Starting Model – Expert notes for GCP

ID=IBM Corp. - LPARDesign-HD-V9-T02 Current zPCR Version-9.1 - SpecCfg=YES EXPERT

Click for EXPERT NOTES - GCP | Click for EXPERT NOTES - zIIP | Click for EXPERT NOTES - IFL

LPAR	Suggested Improvement Notes - GCP - Machine Type = 3906
LA01	(R5-GCP) - Due to the "at least 2 LP rule", the first VL will be always Unparked Your current Guaranteed#PP is 0,14 - you will have 2-VM with an entitlement of 7,2% and so 2 Active LP [+] NOTE - You have 1VM and 1VL When ALL Vls will be UnParked, each VM and VL will have an entitlement of 7,2%
LA02	No special Comment or Advice for this LPAR [+] NOTE - You have 2VM and 2VL When ALL Vls will be UnParked, each VM and VL will have an entitlement of 13,8
LA03	No special Comment or Advice for this LPAR [+] NOTE - You have 1VM and 2VL When ALL Vls will be UnParked, each VM and VL will have an entitlement of 26,(
LA04	No special Comment or Advice for this LPAR [+] NOTE - You have 2VM and 2VL When ALL Vls will be UnParked, each VM and VL will have an entitlement of 17,43%
LA05	(R5-GCP) - Due to the "at least 2 LP rule", the VL will be always Unparked Your current Guaranteed#PP is 0,26 - you will have VM with an entitlement of 13% and so 2 Active LP

ID=IBM Corp. - LPARDesign-HD-V9-T02 Current zPCR Version-9.1 - Spe...

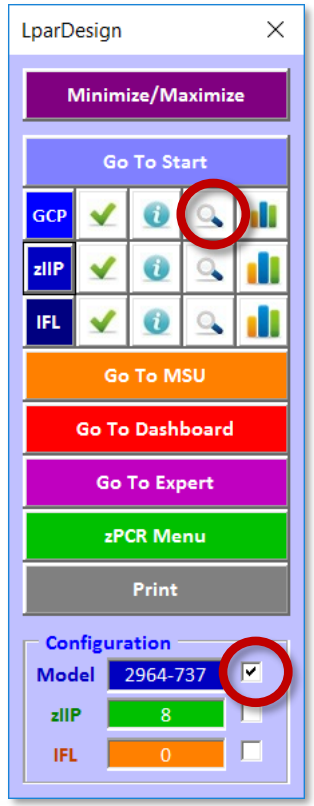
========== EXPERT Review GCP ==========

10 LPAR(s) have Suggested Improvement

========== End Of EXPERT Review ==========

Several HiperDispatch improvements suggested

Display **Expert Notes for GCP**



Example of a LPAR suggested improvement

LPAR	Suggested Improvement Notes - GCP - Machine Type = 3906
LB08	(R3-GCP) - You have 1-VM with an entitlement of 99%" Your current Guaranteed#PP is 0,99 - raising the Weight and removing 1-LP would give you 1-VH but with less fexibility" The New Weight should be : 104 - The current Weight is : 103 - So you must decrease another Lpar Weight by : 1 to keep Total Weight(3536) constant

z14 Starting Model – HiperDispatch adjustment

LPAR	Suggested Improvement Notes - GCP - Machine Type = 3906
LB08	(R3-GCP) - You have 1-VM with an entitlement of 99%" Your current Guaranteed#PP is 0,99 - raising the Weight and removing 1-LP would give you 1-VH but with less fexibility" The New Weight should be : 104 - The current Weight is : 103 - So you must decrease another Lpar Weight by : 1 to keep Total Weight(3536) constant

LPARNAME	WEIGHT	#LP	%SHARE (By Pool)	RESERVED	Guaranteed #PP	Wkld LSPR	MinReq#LP	Check#LP	HD-HIGH#	HD-MED#	HD-MED%	HD-LOW#
LB08	103	2	2,9%		0,99	Average	1	OK	0	1	99,0%	1

Implement suggestion

LPAR Name	% Share	Guarant #PP	LP0	LP1	LP2
LB08	2,9%	0,99	99,0%		

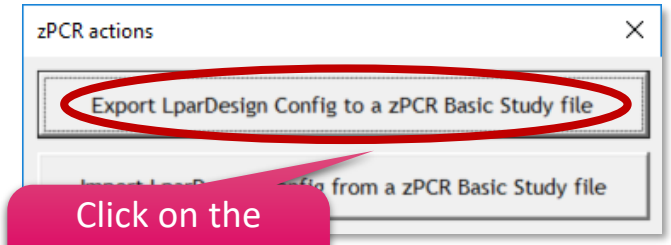
Get new HiperDispatch configuration

LPARNAME	WEIGHT	#LP	%SHARE (By Pool)	RESERVED	Guaranteed #PP	Wkld LSPR	MinReq#LP	Check#LP	HD-HIGH#	HD-MED#	HD-MED%	HD-LOW#
LB08	104	1	2,9%		1,00	Average	1	OK	1	0	N/A	0

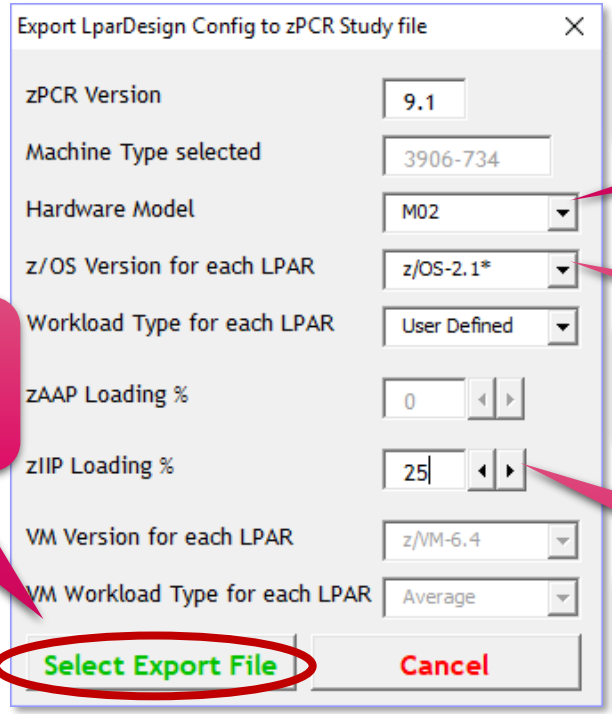
LPAR Name	% Share	Guarant #PP	LP0	LP1	LP2
LB08	2,9%	1,00			

Legend : LP High x% LP Medium with a Share of x%

z14 Starting Model – Export to zPCR



Click on the **« Export … »** button



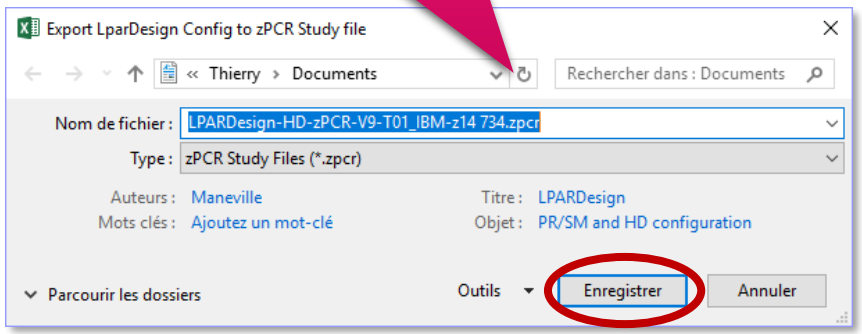
Select the correct **Harware Model** if the one proposed is not the good one

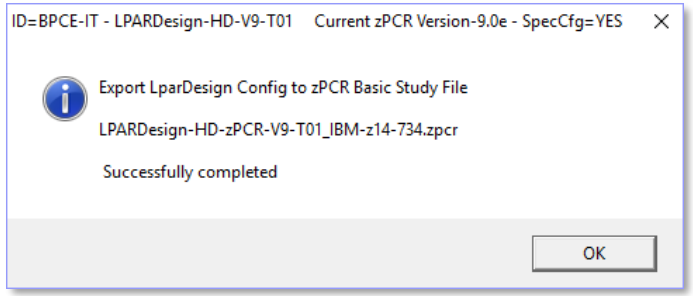
Select the **z/OS version** that will be associated to each LPAR

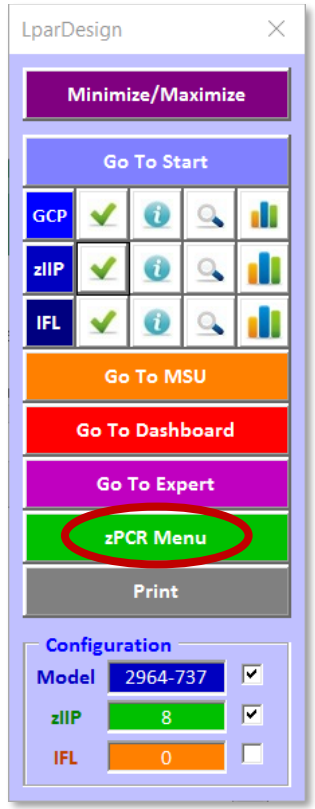
Adjust **zIIP Loading %** to the zIIP% retained during the reference period (zPCR default is 100%)

Click on the **« Select Export File »** button

Validate or modifiy the generated **zPCR file name** before clicking on the « **Save** » button







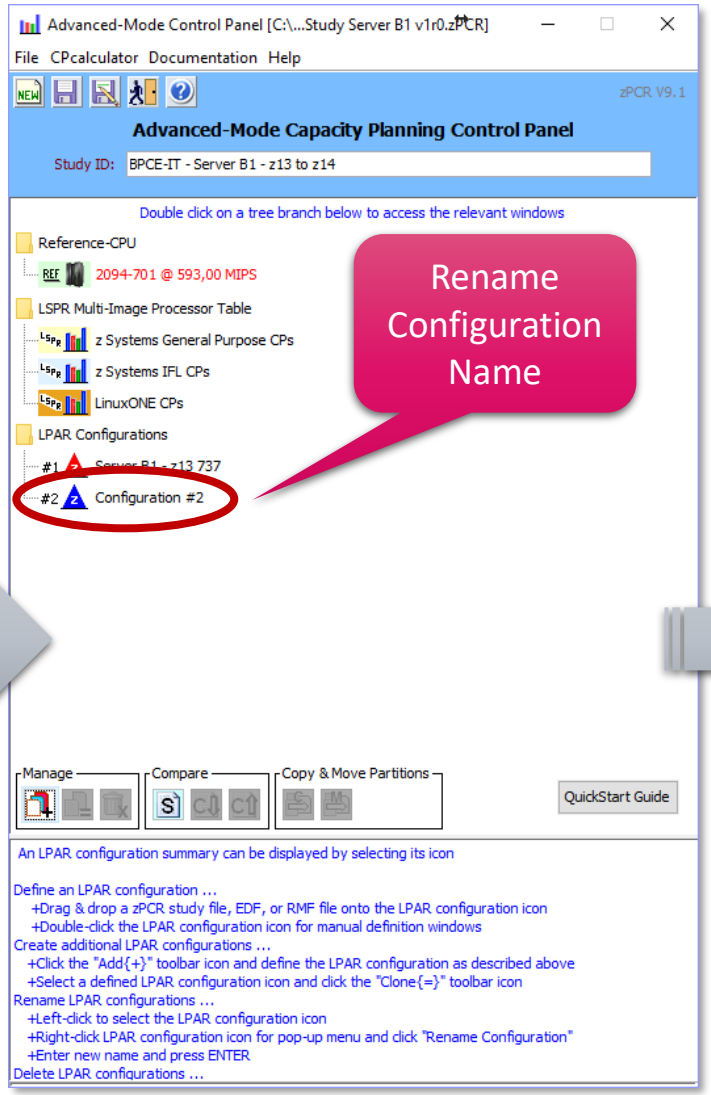
z14 Configuration Selection

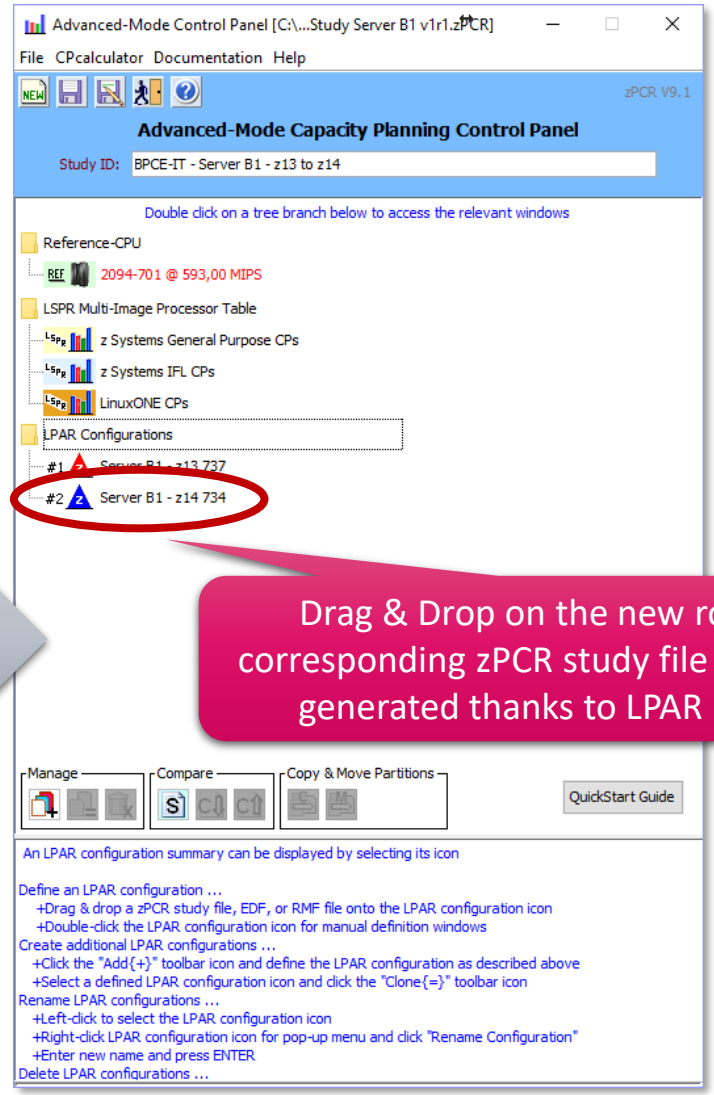
Select an appropriate z14 Model
in which current Partitions and Workloads could fit…

Proposed Method

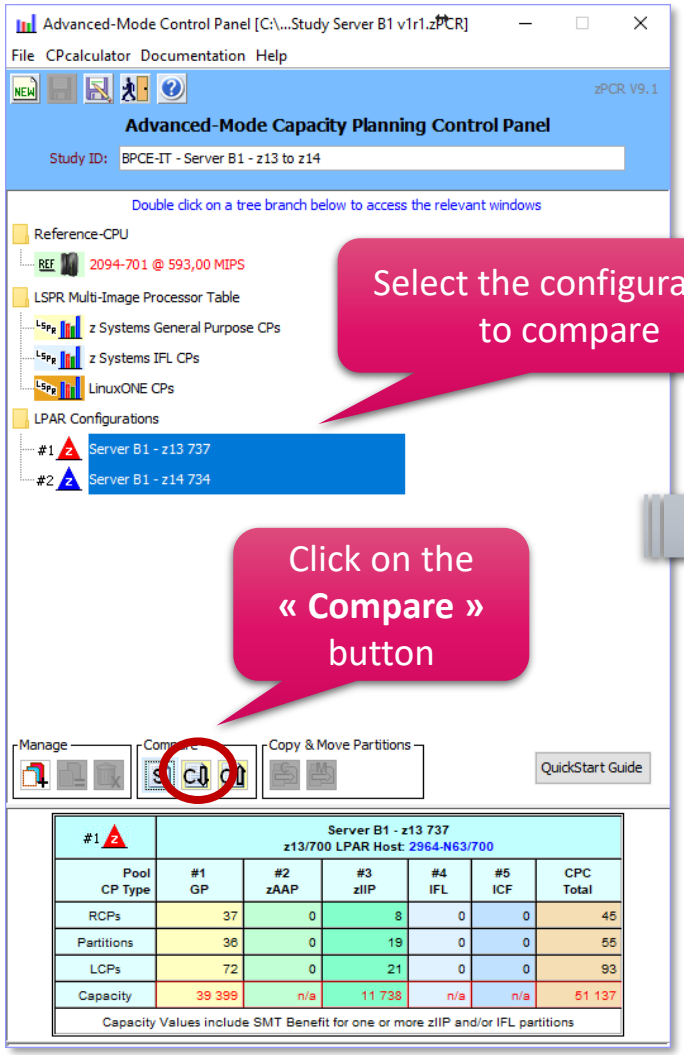
1. *Adjust LPAR Workload characterization to z14 target*
2. *Select a z14 7xx starting model thanks to zPCR*
3. *From the z13 configuration previously defined in LPAR Design make the z14 7xx model configuration*
   - *Adjust LPAR Workload characterization*
   - *Optimize HiperDispatch configuration*
   - *Export as a new zPCR study*
4. ***Make a zPCR comparison study between the z13 configuration and the z14 7xx model one***
   - ***If the z14 Model doesn't give at least the same projected Capacity than the z13 configuration (Minus the zPCR recommended 5% margin-of-error), repeat the process from step 3 with the next upper z14 7xx model***

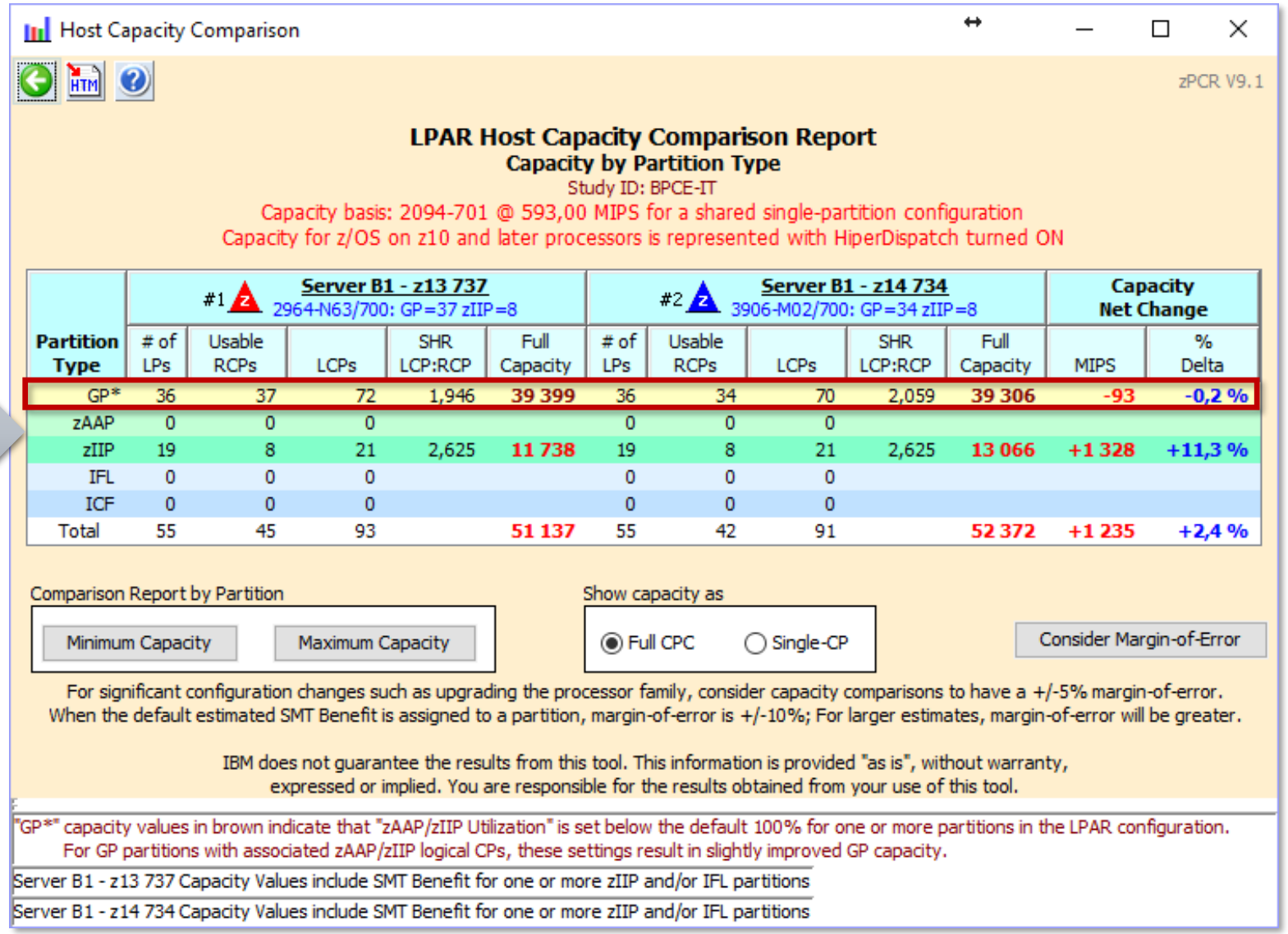
zPCR Comparison Study – z13 737 vs. z14 734





zPCR Comparison Study - z13 737 vs. z14 734





Partition Type	#1 Server B1 - z13 737 2964-N63/700: GP=37 zIIP=8 # of LPs	Usable RCPs	LCPs	SHR LCP:RCP	Full Capacity	#2 Server B1 - z14 734 3906-M02/700: GP=34 zIIP=8 # of LPs	Usable RCPs	LCPs	SHR LCP:RCP	Full Capacity	Capacity Net Change MIPS	% Delta
GP*	36	37	72	1,946	39 399	36	34	70	2,059	39 306	-93	-0,2 %
zAAP	0	0	0			0	0	0				
zIIP	19	8	21	2,625	11 738	19	8	21	2,625	13 066	+1 328	+11,3 %
IFL	0	0	0			0	0	0				
ICF	0	0	0			0	0	0				
Total	55	45	93		51 137	55	42	91		52 372	+1 235	+2,4 %

zPCR Comparison Study - z13 737 vs. z14 734

*% Delta of Minimum Capacity with Margin-of-Error Consideration between the z13 737 and the z14 734 configurations is **-5.2%** for GP processors : **The z14 734 Model doesn't give us enough capacity…***

Host Capacity Comparison

zPCR V9.1

LPAR Host Capacity Comparison Report
Capacity by Partition Type
Study ID: BPCE-IT
Capacity basis: 2094-701 @ 593,00 MIPS for a shared single-partition configuration
Capacity for z/OS on z10 and later processors is represented with HiperDispatch turned ON

Partition Type	#1 Server B1 - z13 737 2964-N63/700: GP=37 zIIP=8 # of LPs	Usable RCPs	LCPs	SHR LCP:RCP	Full Capacity	#2 Server B1 - z14 734 3906-M02/700: GP=34 zIIP=8 # of LPs	Usable RCPs	LCPs	SHR LCP:RCP	Full Capacity	Capacity Net Change MIPS	% Delta
GP*	36	37	72	1,946	**39 399**	36	34	70	2,059	**39 306**	-93	-0,2 %
zAAP	0	0	0									
zIIP	19	8	21							**13 066**	+1 328	+11,3 %
IFL	0	0	0									
ICF	0	0	0									
Total	55	45	93							**52 372**	+1 235	+2,4 %

Click on the « **Consider Margin-of-Error** » button

Comparison Report by Partition: Minimum Capacity | Maximum Capacity
Show capacity as: Multi-CPC | Single-CP
Consider Margin-of-Error

For significant configuration changes such as upgrading the processor family, consider capacity comparisons to have a +/-5% margin-of-error.
When the default estimated SMT Benefit is assigned to a partition, margin-of-error is +/-10%; For larger estimates, margin-of-error will be greater.

IBM does not guarantee the results from this tool. This information is provided "as is", without warranty, expressed or implied. You are responsible for the results obtained from your use of this tool.

"GP*" capacity values in brown indicate that "zAAP/zIIP Utilization" is set below the default 100% for one or more partitions in the LPAR configuration.
For GP partitions with associated zAAP/zIIP logical CPs, these settings result in slightly improved GP capacity.

Server B1 - z13 737 Capacity Values include SMT Benefit for one or more zIIP and/or IFL partitions

Server B1 - z14 734 Capacity Values include SMT Benefit for one or more zIIP and/or IFL partitions

Host Margin-of-Error

zPCR V9.1

Margin-of-Error Consideration
LPAR Host Capacity
Study ID: BPCE-IT
Capacity basis: 2094-701 @ 593,00 MIPS for a shared single-partition configuration
Capacity for z/OS on z10 and later processors is represented with HiperDispatch turned ON

Partition Type	#1 Server B1 - z13 737 Projected Capacity	#2 Server B1 - z14 734 Projected Capacity	Projected % Delta	Projected minus 5% Capacity	Projected minus 5% % Delta
GP*	**39 399**	**39 306**	-0,2 %	**37 341**	-5,2 %
zAAP					
zIIP	**11 738**	**13 066**	+11,3 %	**12 413**	+5,8 %
IFL					
ICF					
Total	**51 137**	**52 372**	+2,4 %	**49 754**	-2,7 %

For significant configuration changes such as upgrading the processor family, consider capacity comparisons to have a +/-5% margin-of-error.
When the default estimated SMT Benefit is assigned to a partition, margin-of-error is +/-10%; For larger estimates, margin-of-error will be greater.

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"GP*" capacity values in brown indicate that "zAAP/zIIP Utilization" is set below the default 100% for one or more partitions in the LPAR configuration.
For GP partitions with associated zAAP/zIIP logical CPs, these settings result in slightly improved GP capacity.

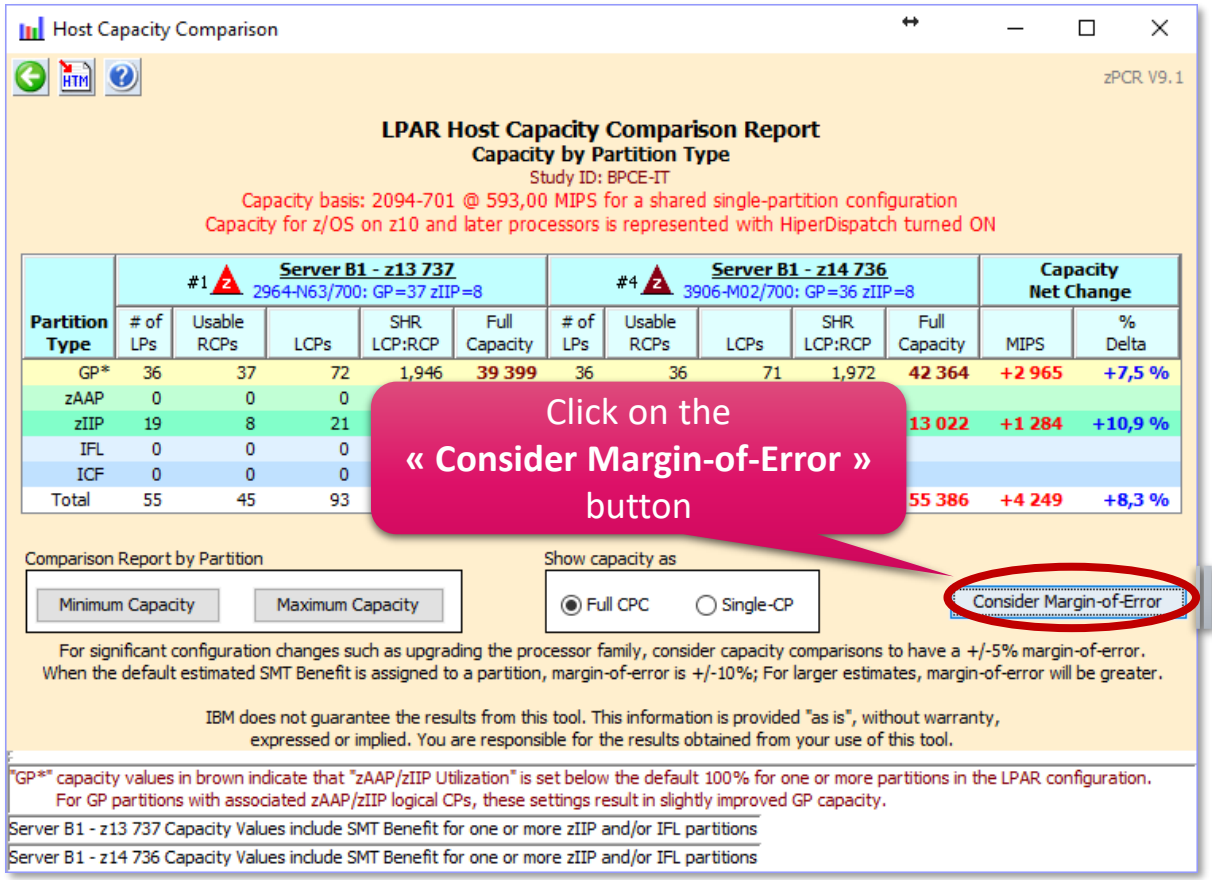
Server B1 - z13 737 Capacity Values include SMT Benefit for one or more zIIP and/or IFL partitions

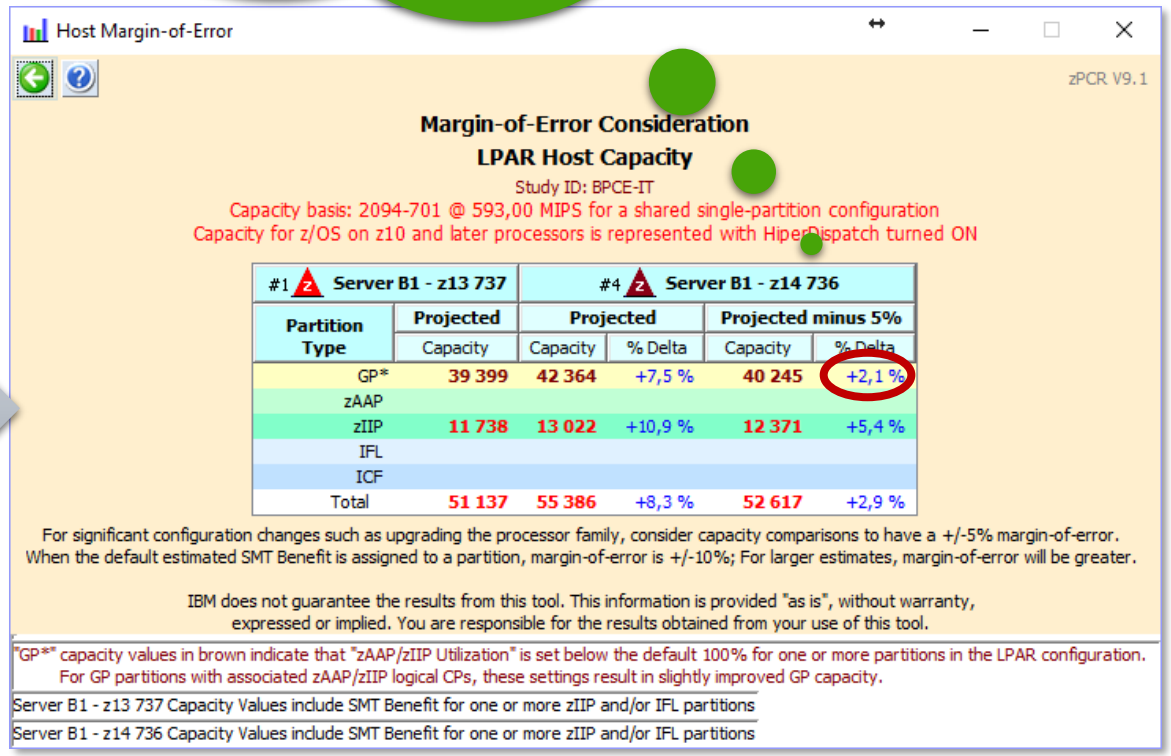
Server B1 - z14 734 Capacity Values include SMT Benefit for one or more zIIP and/or IFL partitions

For significant configuration changes such as upgrading the processor family, the zPCR recommandation is to consider capacity comparisons with a +/-5% margin-of-error.

zPCR Comparison Study - z13 737 vs. z14 736

*% Delta of Minimum Capacity with Margin-of-Error Consideration between the z13 737 and the z14 736 configurations is **+2.1%** for GP processors : **The z14 736 Model give us enough capacity !***





PR/SM Configuration – HiperDispatch Synthesis – GCP Pool

z13 737

HiperDispatch Effect - GCP			
	W/O HD		W/ HD
#LP (Shared Pool Only)	81		72
LP/PP ratio (Shared Pool Only)	2,19		1,95
Global Statistics			
LPAR Statistics			
#LPAR-TOTAL	36		
#LPAR w/HighShare LP (Total)	6		
#LPAR w/DED LP	0		
LP Statistics			
#HighShare LP (Total)	21		
#HighShare LP (DED)	0		
#MediumShare LP	42		
#LowShare LP	18		

z14 736

HiperDispatch Effect - GCP			
	W/O HD		W/ HD
#LP (Shared Pool Only)	81		71
LP/PP ratio (Shared Pool Only)	2,25		1,97
Global Statistics			
LPAR Statistics			
#LPAR-TOTAL	36		
#LPAR w/HighShare LP (Total)	7		
#LPAR w/DED LP	0		
LP Statistics			
#HighShare LP (Total)	22		
#HighShare LP (DED)	0		
#MediumShare LP	40		
#LowShare LP	19		

Even with less Physical Processors, we got more High Share Logical Processors applied to more LPAR on the z14 736 Configuration, thanks to the new HiperDispatch 3906 Rule

Migration from z13 to z14 – Final zPCR Study (December 25th 2017)

LPAR Host Capacity Comparison Report
Capacity by Partition Type
Study ID: Etude Migration z13 vers z14
Capacity basis: 2094-701 @ 593,00 MIPS for a shared single-partition configuration
Capacity for z/OS on z10 and later processors is represented with HiperDispatch turned ON

Partition Type	#1 z13 B1 2964-N63/700: GP=37 zIIP=8					#3 z14 S1 3906-M02/700: GP=37 zIIP=8					Capacity Net Change	
	# of LPs	Usable RCPs	Active LCPs	SHR LCP:RCP	Full Capacity	# of LPs	Usable RCPs	Active LCPs	SHR LCP:RCP	Full Capacity	MIPS	% Delta
GP*	36	37	76	2,054	**37 596**	36	37	71	1,919	**42 235**	**+4 639**	**+12,3 %**
zAAP	0	0	0			0	0	0				
zIIP	19	8	22	2,750	**10 862**	19	8	22	2,750	**12 221**	**+1 359**	**+12,5 %**
IFL	0	0	0			0	0	0				
ICF	0	0	0			0	0	0				
Total	55	45	98		**48 457**	55	45	93		**54 456**	**+5 999**	**+12,4 %**

Partition Type	#2 z13 B2 2964-N63/700: GP=36 zIIP=8					#4 z14 S2 3906-M02/700: GP=36 zIIP=8					Capacity Net Change	
	# of LPs	Usable RCPs	Active LCPs	SHR LCP:RCP	Full Capacity	# of LPs	Usable RCPs	Active LCPs	SHR LCP:RCP	Full Capacity	MIPS	% Delta
GP*	37	36	77	2,139	**36 488**	37	36	73	2,028	**41 135**	**+4 647**	**+12,7 %**
zAAP	0	0	0			0	0	0				
zIIP	19	8	22	2,750	**10 967**	21	8	24	3,000	**12 200**	**+1 233**	**+11,2 %**
IFL	0	0	0			0	0	0				
ICF	0	0	0			0	0	0				
Total	56	44	99		**47 455**	58	44	97		**53 335**	**+5 880**	**+12,4 %**

Total GP Full Capacity Server 1
« z14 » vs. « z13 »
+4.639 Mips / +12,3%
(+2.527 Mips / +6,7%
with 5% margin of error)

Total GP Full Capacity Server 2
« z14 » vs. « z13 »
+4.647 Mips / +12,7%
(+2.591 Mips / +7,1%
with 5% margin of error)

Migration from z13 to z14 – Final zPCR Study (December 25th 2017)

LPAR Host Capacity Comparison Report

Study ID: Etude Migration z13 vers z14

Capacity basis: 2094-701 @ 593,00 MIPS for a shared single-partition configuration

Capacity for z/OS on z10 and later processors is represented with HiperDispatch turned ON

LPAR Configuration			Full Capacity (based on usable RCP count)					
Identity	Hardware	SMT	GP*	zAAP	zIIP	IFL	ICF	Total
#1 z13 B1	2964-N63/700: GP=37 zIIP=8	✔	37 596	n/s	10 862			48 457
#2 z13 B2	2964-N63/700: GP=36 zIIP=8	✔	36 488	n/s	10 967			47 455
#3 z14 S1	3906-M02/700: GP=37 zIIP=8	✔	42 235	n/s	12 221			54 456
#4 z14 S2	3906-M02/700: GP=36 zIIP=8	✔	41 135	n/s	12 200			53 335

LPAR Configuration			Single-CP Capacity (based on usable RCP count)					
Identity	Hardware	SMT	GP*	zAAP	zIIP	IFL	ICF	Total
#1 z13 B1	2964-N63/700: GP=37 zIIP=8	✔	1 016	n/s	1 358			1 077
#2 z13 B2	2964-N63/700: GP=36 zIIP=8	✔	1 014	n/s	1 371			1 079
#3 z14 S1	3906-M02/700: GP=37 zIIP=8	✔	1 141	n/s	1 528			1 210
#4 z14 S2	3906-M02/700: GP=36 zIIP=8	✔	1 143	n/s	1 525			1 212

Total GP Full Capacity
« z14 » vs. « z13 »
+9.286 Mips / +12,5%
(+5.118 Mips / +6,9%
with 5% margin of error)

Average GP Single-CP Capacity
« z14 » vs. « z13 »
+127 Mips / +12,5%
(+70 Mips / +6,9%
with 5% margin of error)

Compare weighted Single-CP Capacity for GP to identify a **zPCR Expectation Ratio** for Old vs. New configuration

zPCR Expectation Ratio
2z14 vs. 2z13
Between 1.07 and 1.13

2 z13 to 2 z14 Migration – LSPR Expectation

Configuration	Model	# of CP	Relative Capacity Indicator		
			Low	Average	High
2 z13	2964-737	37	86,62	69,38	58,26
	2964-736	36	84,59	67,83	56,97
	Sum	**73**	**171,21**	**137,21**	**115,23**
2 z14	3906-737	37	93,12	77,42	66,62
	3906-736	36	90,92	75,63	65,10
	Sum	**73**	**184,04**	**153,05**	**131,72**
2 z14 vs. 2 z13	***Expectation Ratio***		**1,07**	**1,12**	**1,14**

LSPR Expectation Ratio
2z14 vs. 2z13
Between 1.07 and 1.14

Agenda

1. Introduction
2. z13 Configuration Evaluation
3. z14 Configuration Selection
4. **z14 Operations, Adjustment & Evaluation**
5. Distribution of GCP, IIP & LPAR over the 4 z14
6. Conclusions

z13 to z14 Operations – Start situation in June 2018

z14 Migration planned in February but delayed in June

Deal with IBM
➔
Loan of 10 more z13 GCP until z14 Migration

z13 to z14 Operations – June 4th 2018

z13 B3 replaced by z14 S3

z13 B1 z/OS LPARs went to z13 B4

z13 to z14 Operations – June 10th 2018

z13 B1 replaced by z14 S1

z13 B4 z/OS LPARs went back to z14 S1

z13 to z14 Operations – June 17th 2018

All z/OS LPAR on z14

z13 B2 z/OS LPARs went to z14 S3

z13 B4 replaced by z14 S4

z13 to z14 Operations – June 24th 2018

Full z14

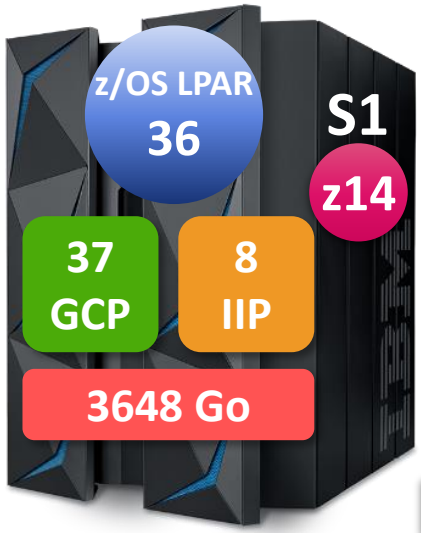
z13 B2 replaced by z14 S2

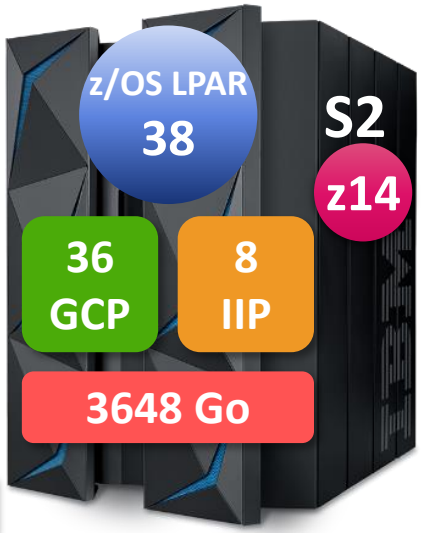
z14 S3 z/OS LPARs went to z14 S2

z Servers Configuration – June 24th 2018

And two times more Memory…

z14 3906-M02 737
43.338 Mips LSPR
36 z/OS LPAR
8 zIIP





z14 3906-M02 736
42.340 Mips LSPR
38 z/OS LPAR
8 zIIP

z14 3906-M03 401
16 ICF
5 IFL

z14 3906-M03 401
16 ICF
5 IFL

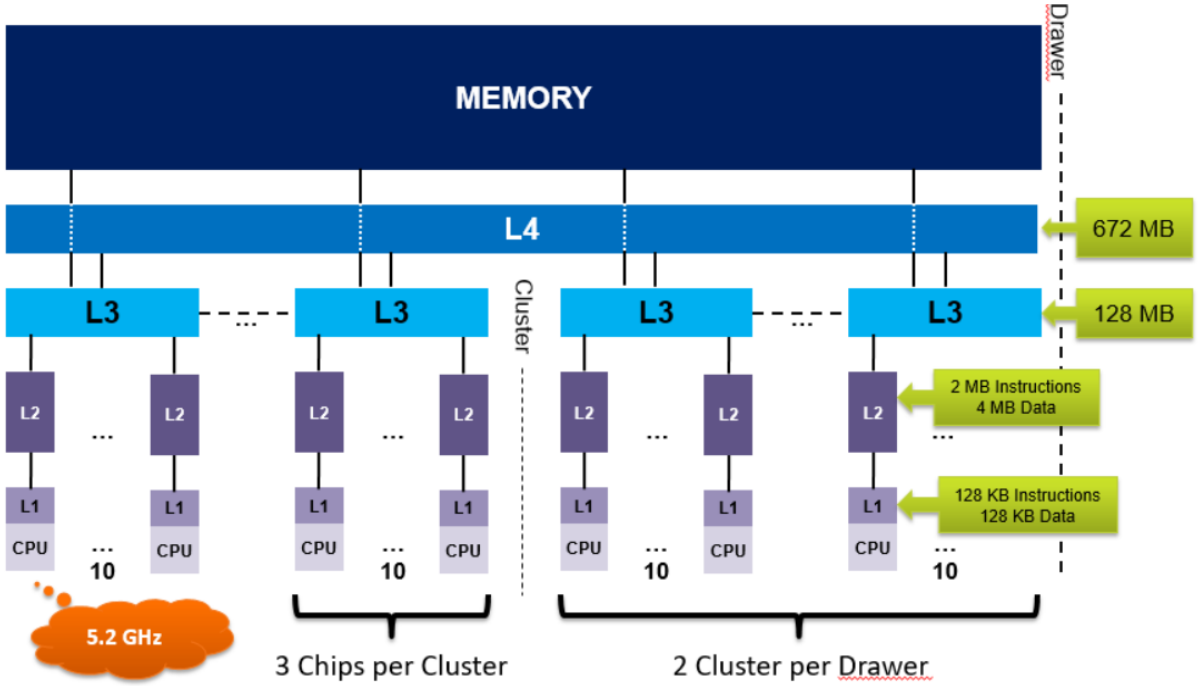
HiperDispatch Topology

WLM Topology Report

https://ibm.biz/BdZgeb

- The topology report displays the logical processor topology for systems running in Hiperdispatch mode. The Excel report on your workstation uses an input file (comma separated value) which must be first created on a z/OS system from **SMF 99 subtype 14 records**. The tool supports all IBM Z mainframe systems from z10 upwards for partitions running in Hiperdispatch mode.

- It displays :
  - the **association of logical processors to books, chips, drawers, and nodes**,
  - the **polarization of the processors** (high, medium, low),
  - the **processor type** (regular CP, zIIP, or zAAP),
  - and the **association to WLM nodes**.



Topology for 06/20/2018-13:03:06 ,System: PROD

Drawer_4			
Node_1			
	Chip_1	Chip_2	Chip_3
	PROD_01_LCPU008	PROD_01_HCPU000	PROD_05_HIIP011
	PROD_01_LCPU009	PROD_01_HCPU001	PROD_05_MIIP012
	PROD_01_LCPU010	PROD_02_HCPU002	
		PROD_02_HCPU003	
		PROD_03_HCPU004	
		PROD_03_HCPU005	
		PROD_01_MCPU006	
		PROD_01_MCPU007	

SSSS_nn_PTYPnnn

SSSS ➔ SMFId
nn ➔ Affinity Node
P ➔ Polarity (H / M / L)
TYP ➔ **CPU** / **IIP** / IFL / ICF
nnn ➔ Core Id

HiperDispatch configuration adjustment - Example

ID=BPCE-IT - LPARDesign V10-T01 Current zPCR Version-9.2a - SpecCfg=YES EXPERT

Click for EXPERT NOTES - GCP | Click for EXPERT NOTES - zIIP | Click for EXPERT NOTES - IFL

LPAR	Suggested Improvement Notes - GCP - Machine Type = 3906
LA10	(R1-GCP) - Due to the 0.5 rule, a small increase of the Weight could lead to have a Full VH Your current Guaranteed#PP is 1,49 - raising it to 1.5 would give you 1-VH and 1-VM@50%" The New Weight should be : 171 - The current Weight is : 170 - So you must decrease another Lpar Weight by : 1 to keep Total Weight(4231) constant[+] NOTE - You have 2VM and 2VL When ALL Vls will be UnParked, each VM and VL will have an entitlement of 18,62%

ID=BPCE-IT - LPARDesign V10-T01 Current zPCR Version-9.2a - SpecCfg=YES DASHBOARD For GCP Processors

GCP | zIIP | IFL

Legend : LP High x% | LP Medium with a Share of x% | LP Low x% | LP Low Always Unparked with a Share of x%

LPAR Name	% Share	Guarant #PP	LP0	LP1	LP2	LP3	LP4	LP5	LP6	LP7	LP8	LP9	LPA	LPB	LPC	LPD	LPE	LPF
LA10	4,0%	1,49	74,5%	74,5%														
LA32	7,0%	2,60			60,0%													

Decrease LA32 Weight by 1 and Increase LA10 Weight by 1…

ID=BPCE-IT - LPARDesign V10-T01 Current zPCR Version-9.2a - SpecCfg=YES DASHBOARD For GCP Processors

GCP | zIIP | IFL

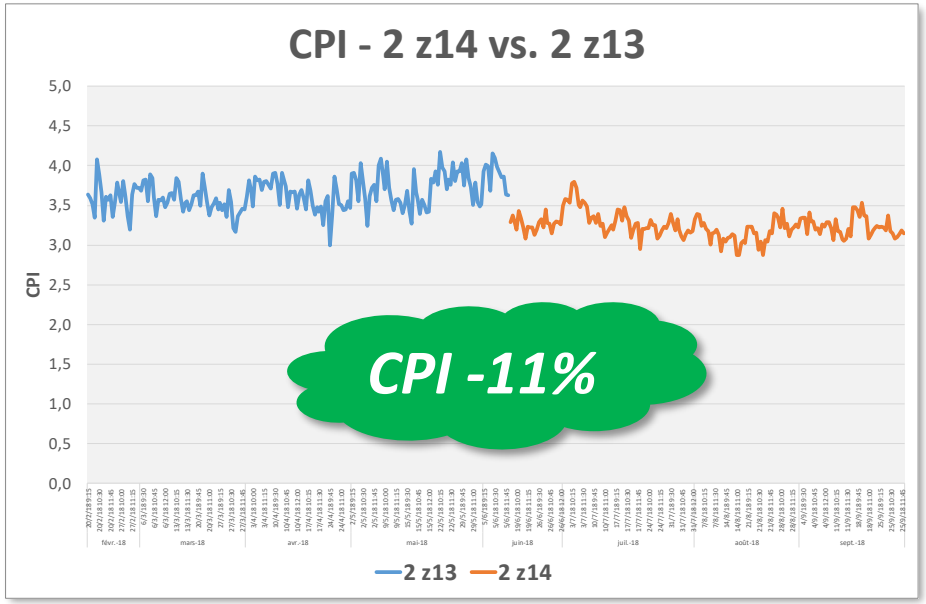
Legend : LP High x% | LP Medium with a Share of x% | LP Low x% | LP Low Always Unparked with a Share of x%

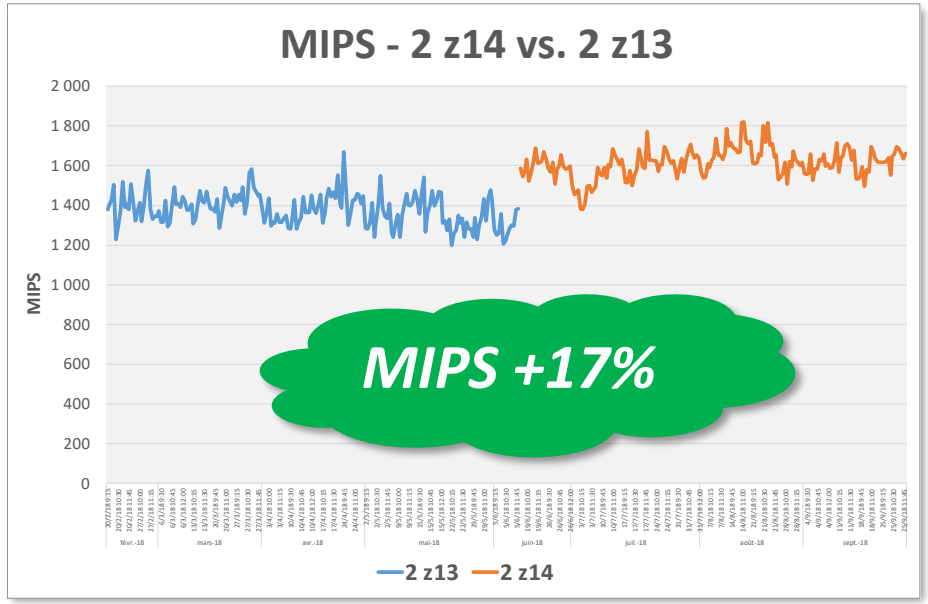
LPAR Name	% Share	Guarant #PP	LP0	LP1	LP2	LP3	LP4	LP5	LP6	LP7	LP8	LP9	LPA	LPB	LPC	LPD	LPE	LPF
LA10	4,0%	1,50		50,0%														
LA32	7,0%	2,59			59,0%													

*…Give us **one more VH** for LA10 with a very small impact on LA32 (VM 60% to VM 59%)*

z14 vs. z13 Evaluation from SMF 113 - GCP Processors

CPI
Number of Processor Cycles spend per completed Instruction

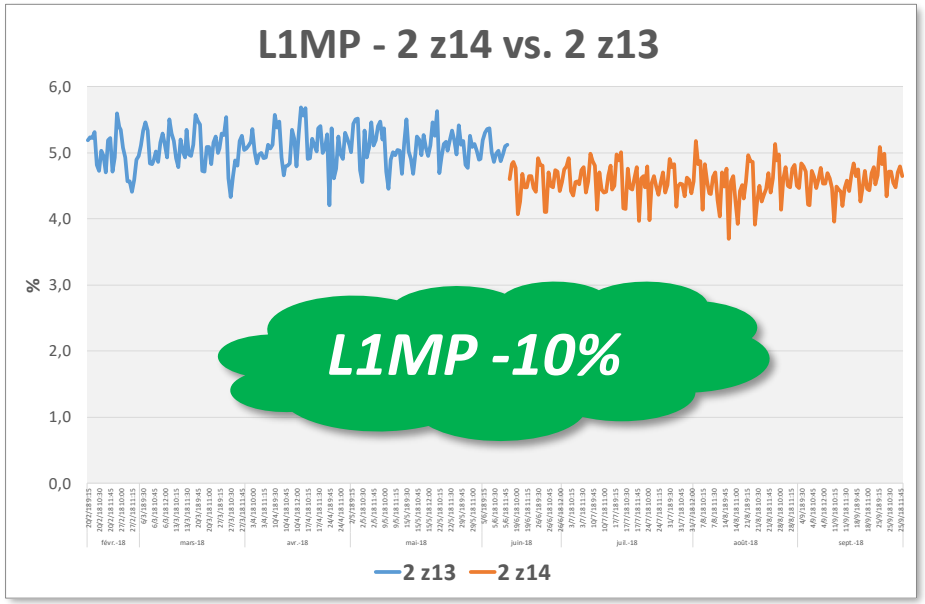


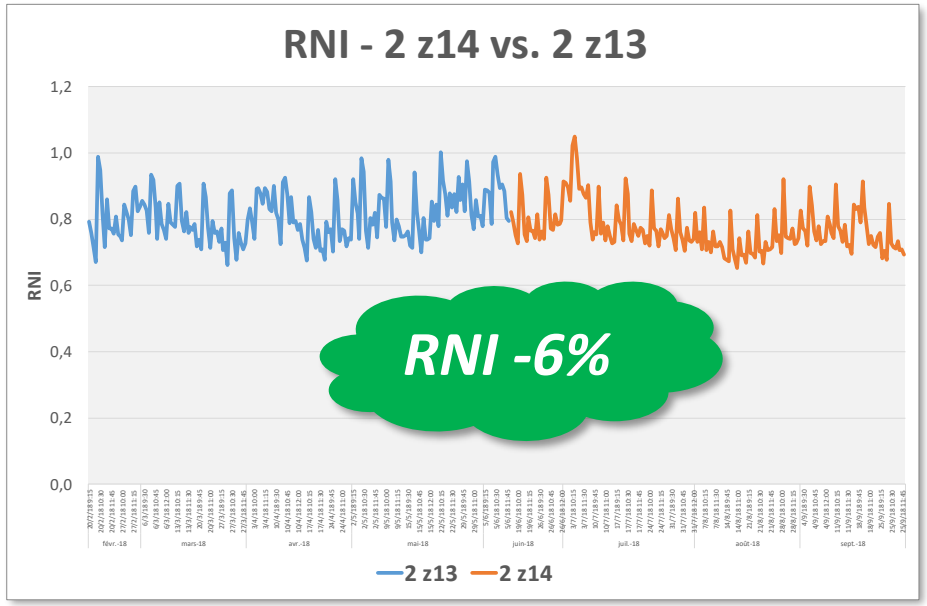


MIPS
Million Instructions per second and CP

(Rate of delivery not processor capacity)

L1MP
Level 1 Miss Per 100 instructions





RNI
Relative Nest Intensity

"RNI reflects the distribution and latency of sourcing from shared caches and memory"

z14 vs. z13 Evaluation from SMF 113 - GCP Processors

Data from comparable time periods (Open Tuesday from 9am to 12am) before and after operations when same workload executes (Mainly OLTP)

Date	Before Migration	After Migration	Comparison
Model	z13	z14	Migration 2 z14 vs. 2 z13
z/OS Server count	2	2	
GHz	5,0	5,2	**+4%**
Cycles per Instructions (CPI)	3,65	3,24	**-11%**
MIPS (Rate of delivery)	1379	1614	**+17%**
Level 1 Miss %	5,08	4,57	**-10%**
% Sourced from L2	70,30	71,46	**+2%**
% Sourced from L3	19,82	21,23	**+7%**
% Sourced from Local L4	7,09	4,83	**-32%**
% Sourced from Remote L4	1,09	0,20	**-81%**
% Sourced from Memory	1,67	2,25	**+35%**
Relative Nest Intensity (RNI)	0,82	0,77	**-6%**
CPI - Estimated Instruction Complexity	1,69	1,67	**-1%**
CPI - Estimated From Finite Cache/Memory	1,97	1,58	**-20%**
Estimated Sourcing Cycles per Level 1 Miss	38,78	34,59	**-11%**

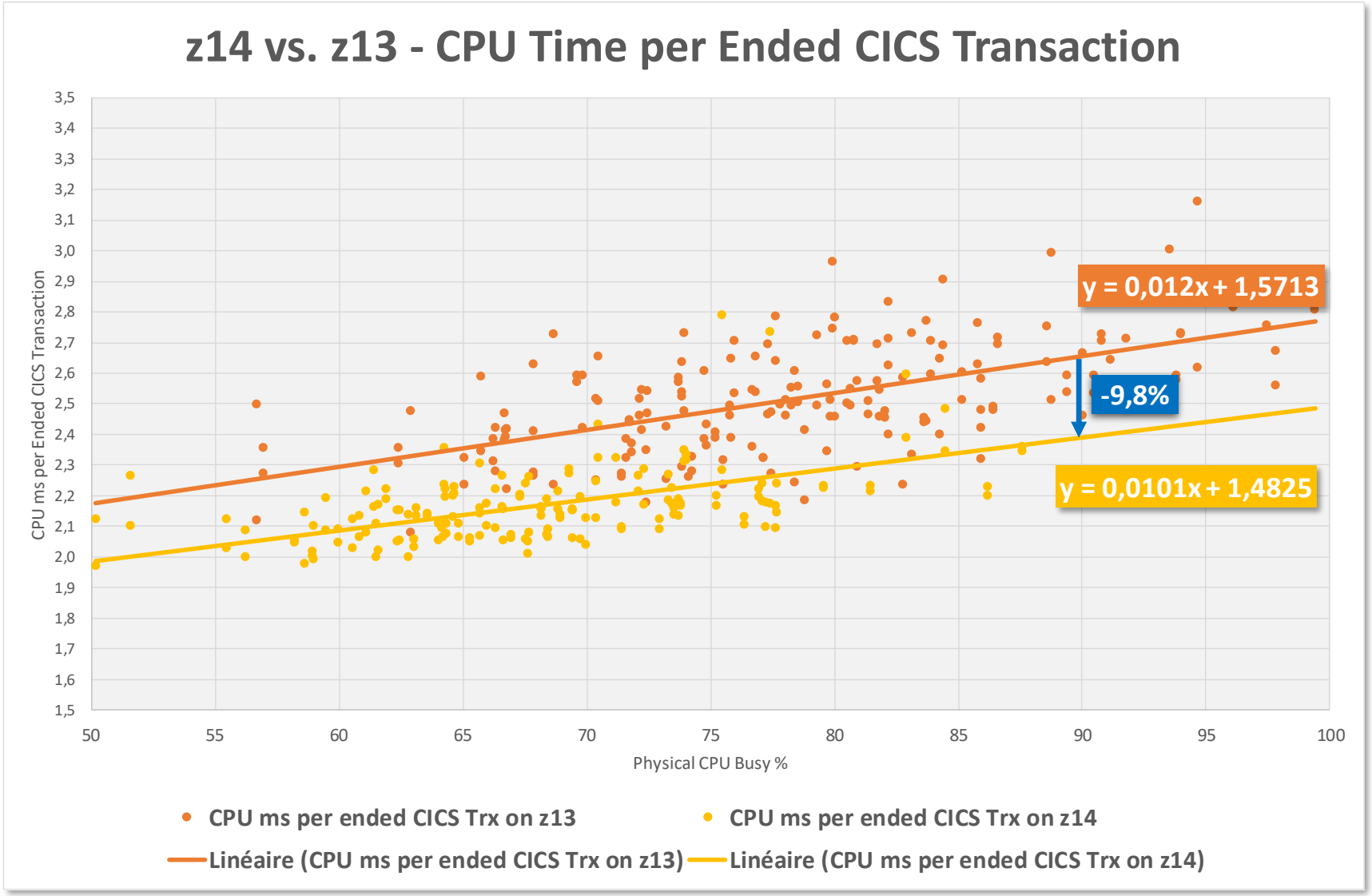
Compare CPI scaled by GHz to identify **Relative Capacity Ratio** for Old vs. New configuration

$$RCR = \frac{CPI(old) \times GHz(new)}{CPI(new) \times GHz(old)}$$

RCR 2z14 vs. 2z13
1.17

Processor Cycles are spent **Productively** (Executing instructions present in L1 cache) or **Unproductively** (Waiting for stage Data)

z14 vs. z13 Evaluation from SMF 70 & 72 – CPU Time per Transaction



CPU Time per Ended CICS Transaction against Physical CPU Busy%

The deviation of the two linear regression curves is the result CPU Time per Transaction improvement.

*Decrease in CPU Time per Transaction of about -**9,8%***

*This equates to a single-engine speedup of **1,11x***

Utilization Effect

Growth in CPU Time per Transaction as CPU Utilization increases

z14 vs. z13 Evaluation from SMF 110 & 30 – QoS CICS & Batch

Target		Response Time		
		z13	z14	Delta%
Mobile Transactions	TRM1	27,8	25,6	-8%
	TRM2	29,2	25,1	-14%
	TRM3	26,9	19,5	-27%
Work station Transactions	TRW1	62,4	56,9	-9%
	TRW2	63,5	55,0	-13%
	TRW3	65,5	49,4	-25%
Other Transaction		5,1	4,3	-17%

Week Day	Reference Batch Workload Average Elapsed Time		
	z13	z14	Delta%
Monday	06:59,7	06:19,3	-10%
Tuesday	07:15,3	04:23,7	-39%
Wednesday	05:16,1	04:28,3	-15%
Thursday	05:07,5	04:24,3	-14%
Total	06:09,6	04:53,9	-21%

z14 vs. z13 Evaluation – Workload Characterization revaluation

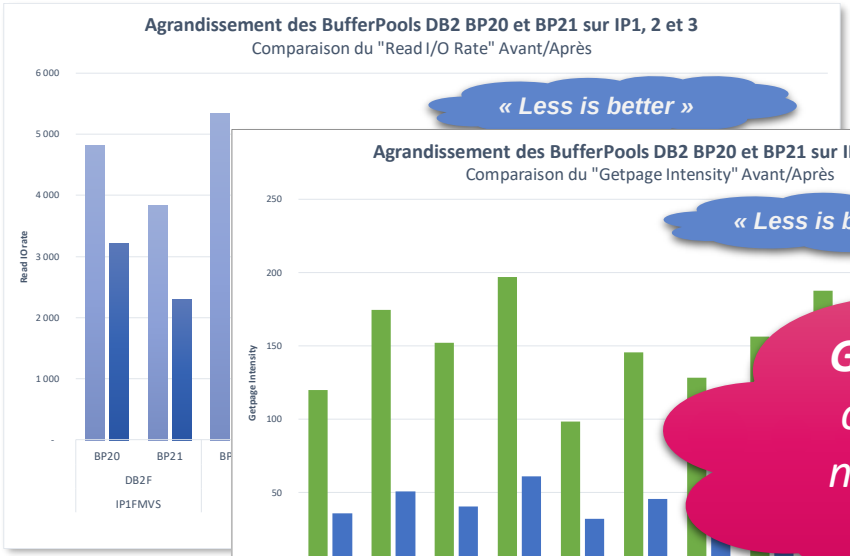
Change in Workload Characterization for some LPAR

*More « **Cache Friendly** »*

MVS Id	« Workload Hint on z13	Workload Hint on z14
LA01	High	Avg-High
LA02	Average	Average
LA03	Average	Average
LA04	Average	Low-Avg
LA05	High	Avg-High
LA06	High	High
LA07	High	Avg-High
…	…	…

DB2 BufferPools extension & 1Mb Large Memory Page utilization

Technical results
(i.e. DB2 Performance Metrics)



Goal : *Use of the large amount of Memory delivered with our new z14 (2 times more than on the previous z13)*

Contextual results
(i.e. Quality of Service Metrics)

READ I/O PER SEC	APPL HIT RATIO	SYSTEM HIT RATIO	GETPAGE INTENSITY	BUFFER I/O INTENSITY
-36%	+1%	+5%	-70%	-80%

Mobile Transaction RT	Desk Transaction RT
-13%	-13%

Agenda

1. Introduction
2. z13 Configuration Evaluation
3. z14 Configuration Selection
4. z14 Operations, Adjustment & Evaluation
5. **Distribution of GCP, IIP & LPAR over the 4 z14**
6. Conclusions

Country Multiplex Pricing (From Mario Bezzi & Frank Kyne's Workshop)

Primary objective** : Address customer issues with sysplex aggregation and provide customers with much more flexibility regarding how you configure your systems and sysplexes – **it aims to eliminate financial incentives to create configurations that make no technical sense.

After you switch to Country Multiplex Pricing, the R4HA for every LPAR across every CPC in a country is used to determine your incremental software cost, regardless of whether the systems are in the same sysplex (or ANY sysplex) or not.

No more financial encouragement to waste your time creating and maintaining shamplexes – YIPEE!

- ***Now you can spend your time exploiting technology to deliver real technical advantage to your business.***

With CMP, the number of CPCs that a sysplex is spread across has zero impact on MLC prices. So you could have 2 production CPCs and 2 test CPCs, or 4 production/test CPCs – the MLC SW cost would be the same.

- ***Now you can really configure for the optimum configuration without being constrained by financial considerations.***

With CMP, your peak R4HA is determined by summing every LPAR on every CPC, effectively working as if every LPAR was in the one CPC.

- ***The result is likely to be a lower peak R4HA number than would be calculated using pre-CMP rules.***

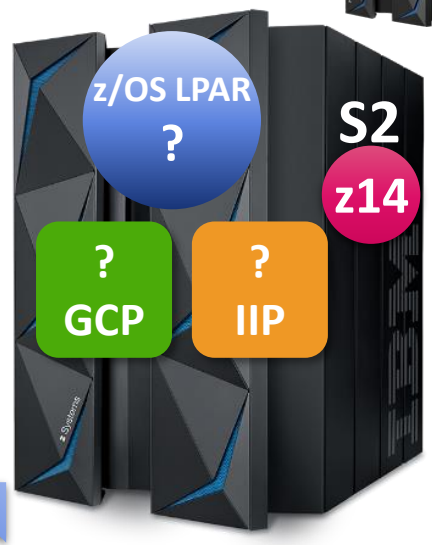
Distribution of the GCP, zIIP & z/OS LPAR over the 4 z14 - Start

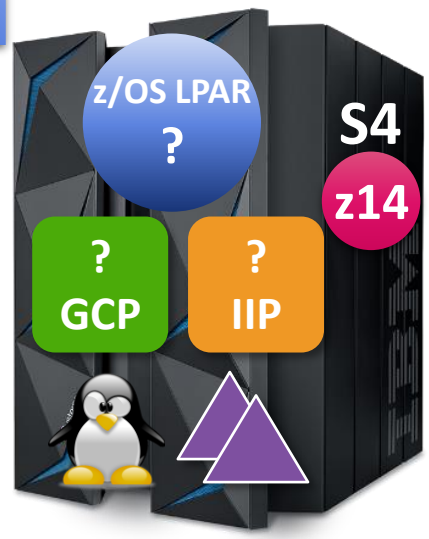
Redundancy principles

Same amount of GCP & zIIP

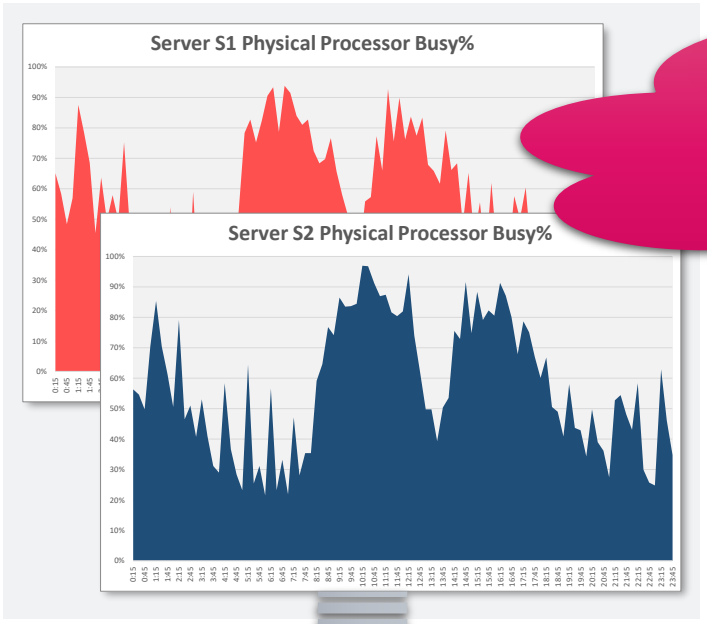
*Balanced distribution of **z/OS LPAR***

Sysplex requirements





Distribution of the GCP, zIIP & z/OS LPAR over the 4 z14 - Forecasting

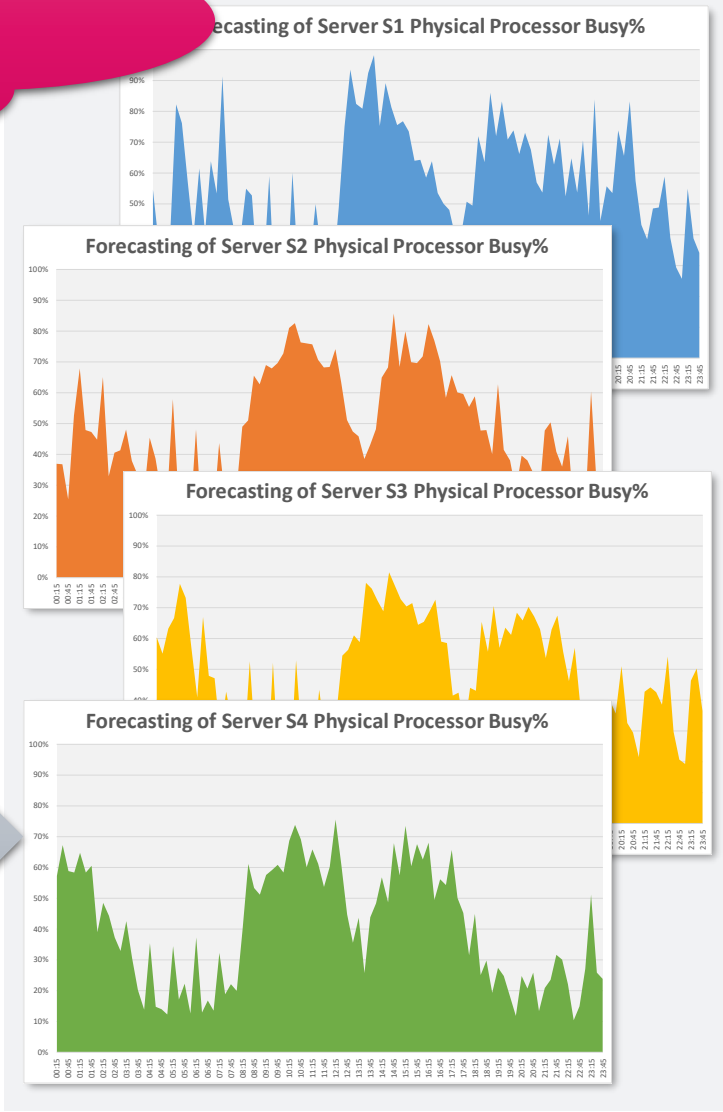


Balanced distribution over 4 z14
(∑ Mips) / CEC
(∑ Mips per Customer) / CEC
(∑ Mips per Production and Non Production LPAR) / CEC

LPAR Distribution Table
For each LPAR, build the "From Server" / "To Server" relation

Forecasting process

1. Target a significant day & period for reference
2. Extract CPU consumption per CEC & LPAR
3. Evaluate the **Utilization Effect%** per Interval and CEC
4. For each LPAR & Interval evaluate the **Reference BaseLine**
5. Project the LPAR CPU need by adjusting the Reference BaseLine with the projected **Utilization Effect%** on the retained z14 Model



Distribution of the GCP, zIIP & z/OS LPAR over the 4 z14 – zPCR Study

LPAR Host Capacity Comparison Report

Study ID: Etude répartition z14

Capacity basis: 2094-701 @ 593,00 MIPS for a shared single-partition configuration

Capacity for z/OS on z10 and later processors is represented with HiperDispatch turned ON

LPAR Configuration				Full CPC Capacity (based on usable RCP count)					
Identity	Hardware		SMT	GP*	zAAP	zIIP	IFL	ICF	Total
#1 S1 Actuel	3906-M02/700:	GP=37 zIIP=8	✓	43 348	n/s	12 293			55 641
#2 S2 Actuel	3906-M02/700:	GP=36 zIIP=8	✓	41 719	n/s	12 678			54 396
#3 S3 Actuel	3906-M03/400:	GP=1 IFL=5 ICF=16			n/s		1 826	15 060	16 886
#4 S4 Actuel	3906-M03/400:	GP=1 IFL=5 ICF=16			n/s		3 448	15 017	18 465
#5 S1 Cible	3906-M02/700:	GP=18 zIIP=4	✓	23 175	n/s	6 875			30 051
#6 S2 Cible	3906-M02/700:	GP=19 zIIP=4	✓	26 060	n/s	7 060			33 121
#7 S3 Cible	3906-M03/700:	GP=18 zIIP=4 IFL=5 ICF=16	✓	22 809	n/s	6 711	1 786	14 975	46 281
#8 S4 Cible	3906-M03/700:	GP=18 zIIP=4 IFL=5 ICF=16	✓	25 190	n/s	7 174	3 382	14 855	50 601

LPAR Configuration				Single-CP Capacity (based on usable RCP count)					
Identity	Hardware		SMT	GP*	zAAP	zIIP	IFL	ICF	Total
#1 S1 Actuel	3906-M02/700:	GP=37 zIIP=8	✓	1 172	n/s	1 537			1 236
#2 S2 Actuel	3906-M02/700:	GP=36 zIIP=8	✓	1 159	n/s	1 585			1 236
#3 S3 Actuel	3906-M03/400:	GP=1 IFL=5 ICF=16			n/s		1 826	941	993
#4 S4 Actuel	3906-M03/400:	GP=1 IFL=5 ICF=16			n/s		1 724	939	1 026
#5 S1 Cible	3906-M02/700:	GP=18 zIIP=4	✓	1 288	n/s	1 719			1 366
#6 S2 Cible	3906-M02/700:	GP=19 zIIP=4	✓	1 372	n/s	1 765			1 440
#7 S3 Cible	3906-M03/700:	GP=18 zIIP=4 IFL=5 ICF=16	✓	1 267	n/s	1 678	1 786	936	1 187
#8 S4 Cible	3906-M03/700:	GP=18 zIIP=4 IFL=5 ICF=16	✓	1 399	n/s	1 793	1 691	928	1 265

Total GP Full Capacity
« 4 z14 » vs. « 2 z14 »
+12.167 Mips / +14%

Balanced distribution of the GCP, zIIP & LPAR

Average GP Single-CP Capacity
« 4 z14 » vs. « 2 z14 »
+167 Mips / +14%

zPCR Expectation Ratio
4z14 vs. 2z14
1.14

Compare weighted Single-CP Capacity for GP to identify a **zPCR Expectation Ratio** for Old vs. New configuration

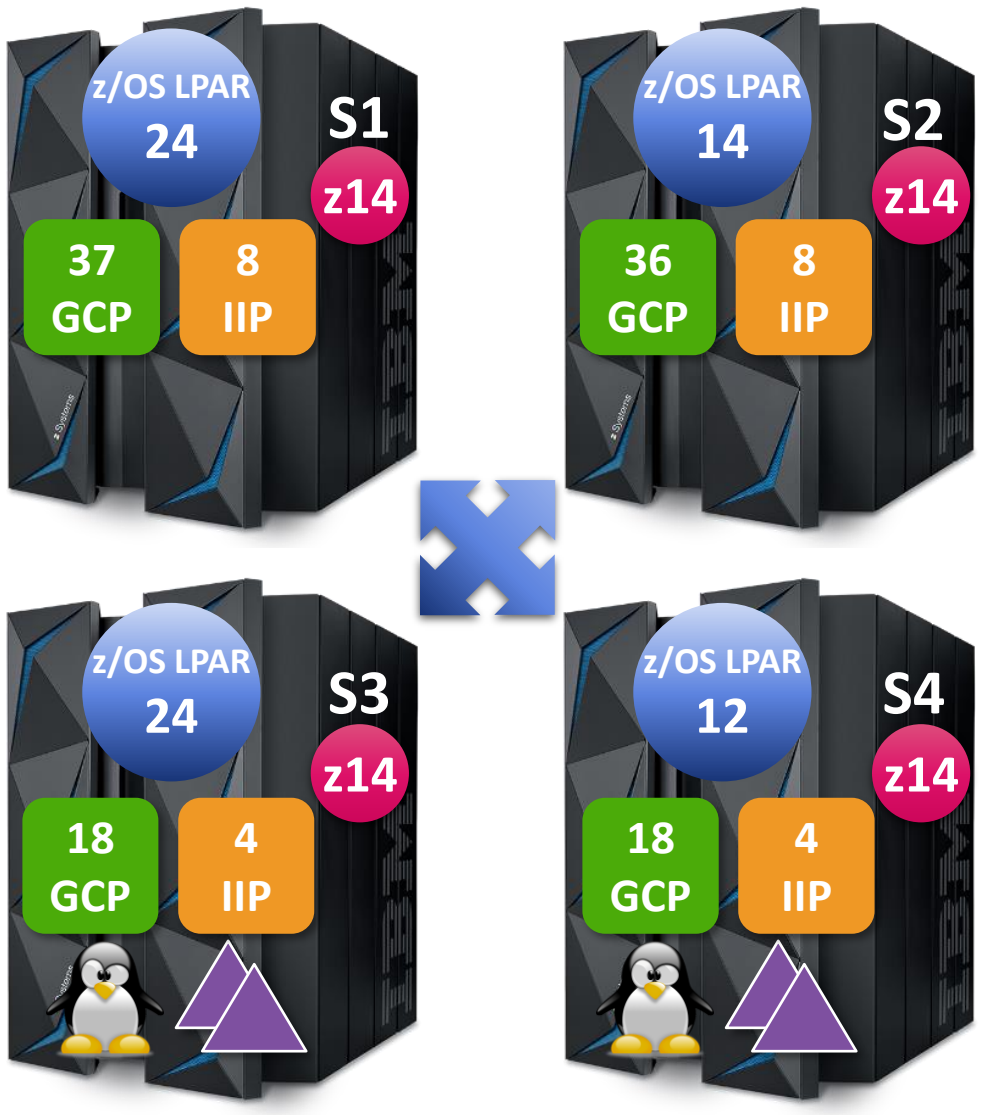
2 z14 to 4 z14 Distribution – LSPR Expectation

Configuration	Model	# of CP	Relative Capacity Indicator		
			Low	Average	High
2 z14	3906-737	37	93,12	77,42	66,62
	3906-736	36	90,92	75,63	65,10
	Sum	**73**	**184,04**	**153,05**	**131,72**
4 z14	3906-718	18	49,64	42,52	36,79
	3906-719	19	52,03	44,39	38,38
	3906-718	18	49,64	42,52	36,79
	3906-718	18	49,64	42,52	36,79
	Sum	**73**	**200,95**	**171,95**	**148,75**
4 z14 vs. 2 z14	***Expectation Ratio***		**1,09**	**1,12**	**1,13**

LSPR Expectation Ratio
4z14 vs. 2z14
Between 1.09 and 1.13

z14 Distribution of LPAR – Operations – Start Situation

z14 Distribution of LPAR – Operations – January 14th & 21st 2019



*Taking advantage of the **Business Continuity Architecture***

Activation of GCP & zIIP processors on S3

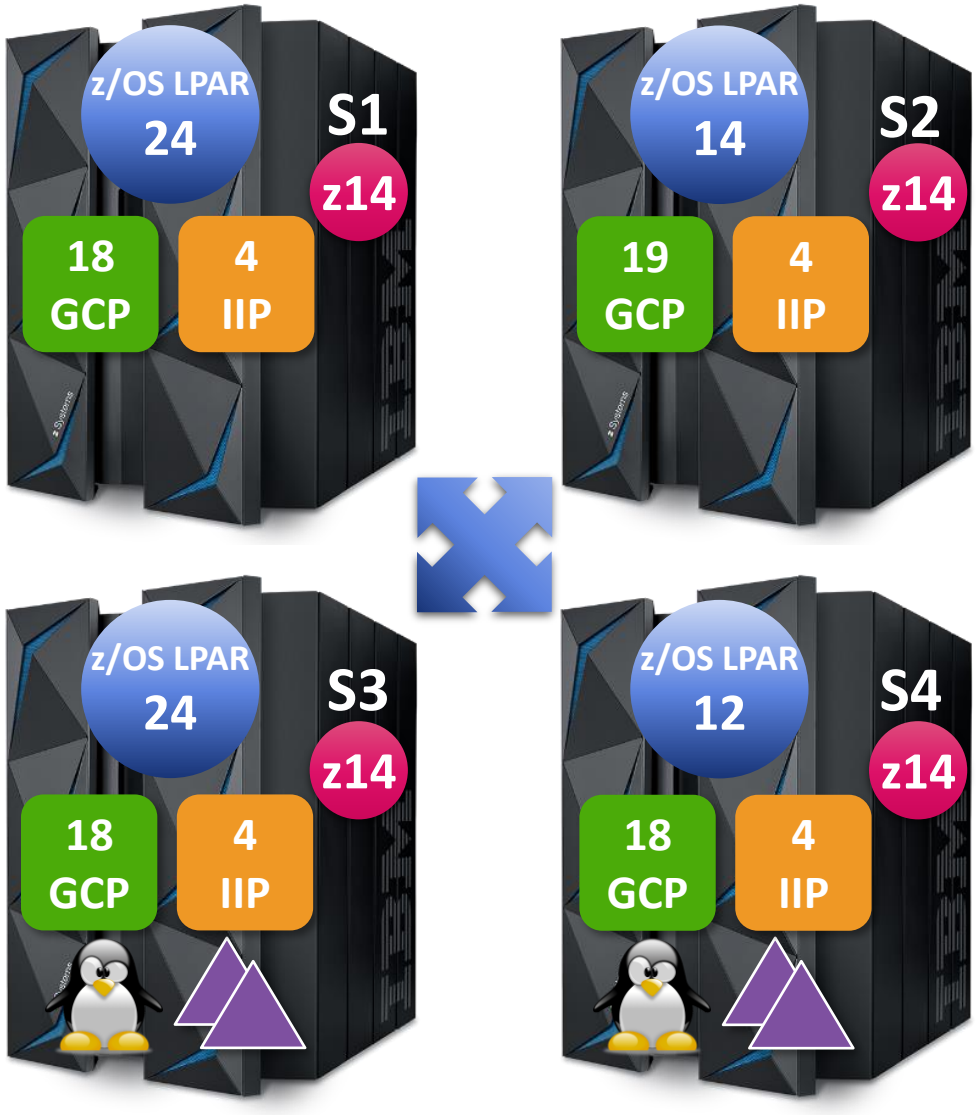
Distribution of z/OS LPAR from S1/S2 to S3/S4

Activation of GCP & zIIP processors on S4

Distribution of z/OS LPAR from S1/S2 to S3/S4

z14 Distribution of LPAR – Operations – January 27th 2019

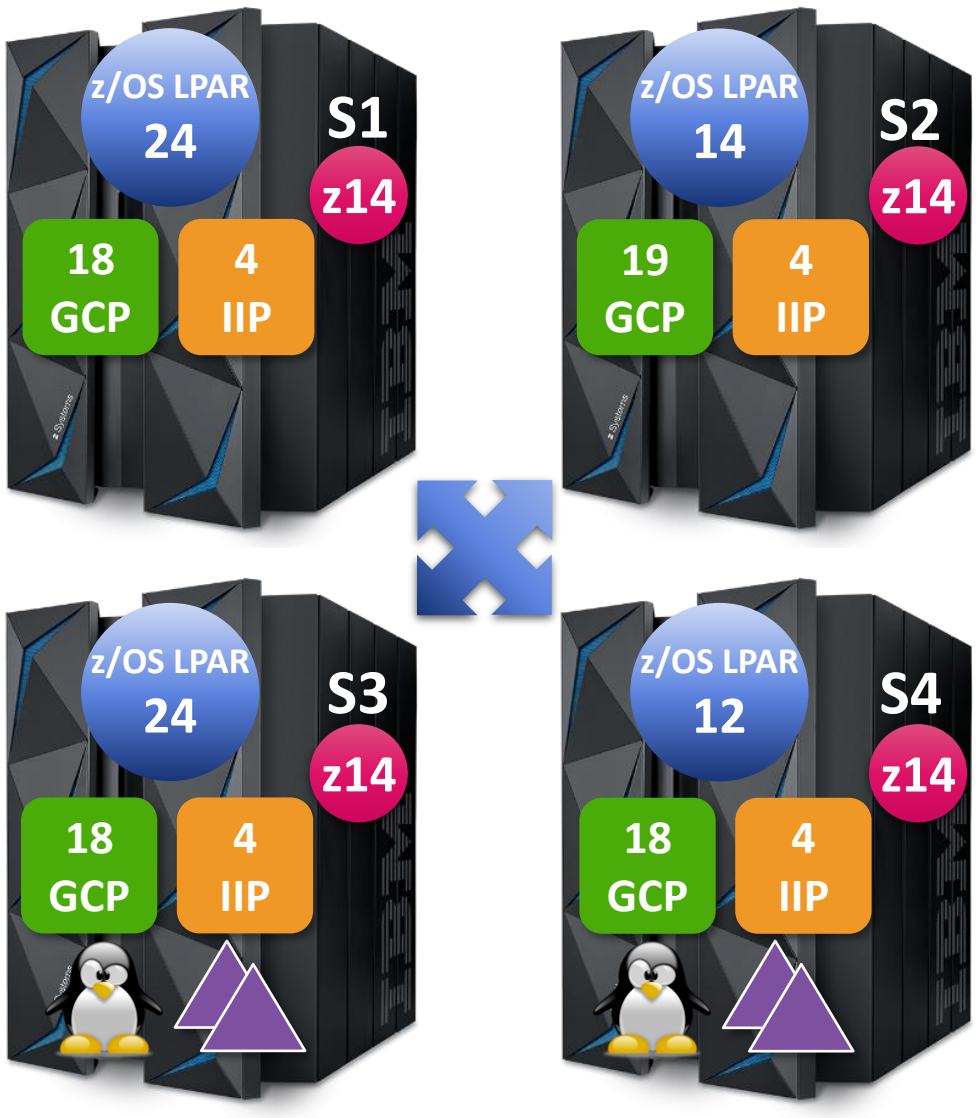
Adjustement of GCP & zIIP processors on S1



Adjustement of GCP & zIIP processors on S2

z Servers Configuration – January 27th 2019

z14 3906-M02 718
23.801 Mips LSPR
24 z/OS LPAR
4 zIIP



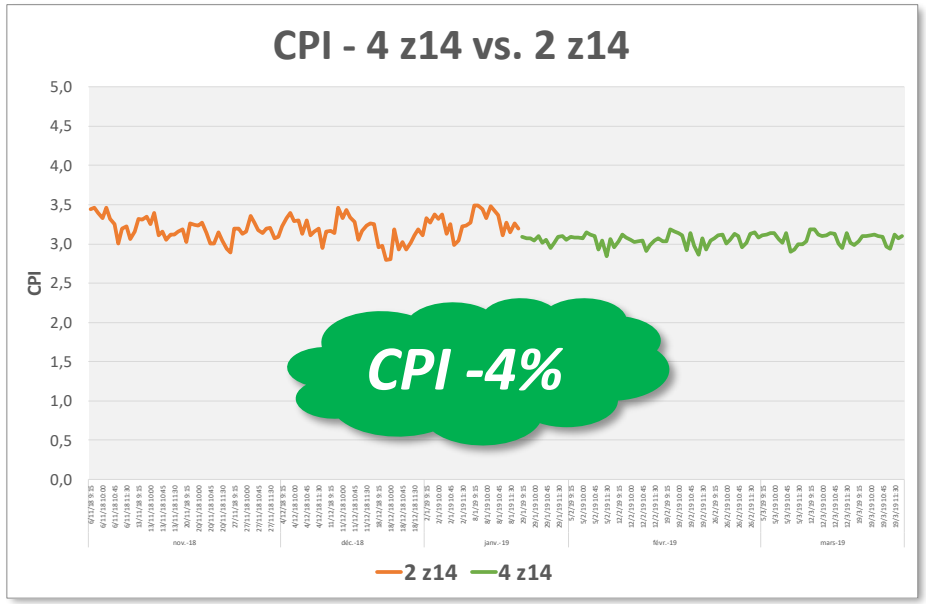
z14 3906-M02 719
24.846 Mips LSPR
14 z/OS LPAR
4 zIIP

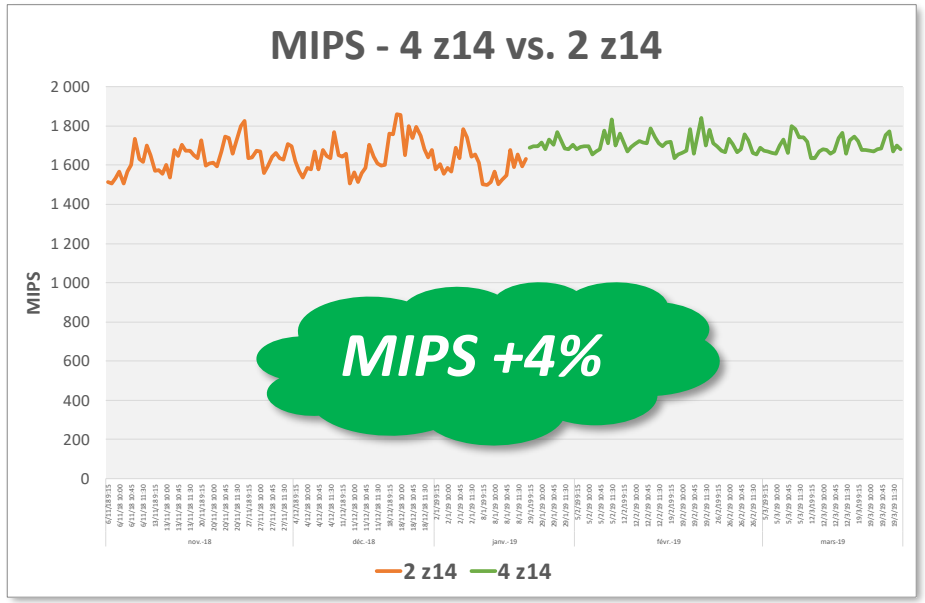
z14 3906-M03 718
23.801 Mips LSPR
24 z/OS LPAR
4 zIIP, 16 ICF, 5 IFL

z14 3906-M03 718
23.801 Mips LSPR
12 z/OS LPAR
4 zIIP, 16 ICF, 5 IFL

4 z14 vs. 2 z14 Evaluation from SMF 113 – GCP Processors

CPI
Number of Processor Cycles spend per completed Instruction

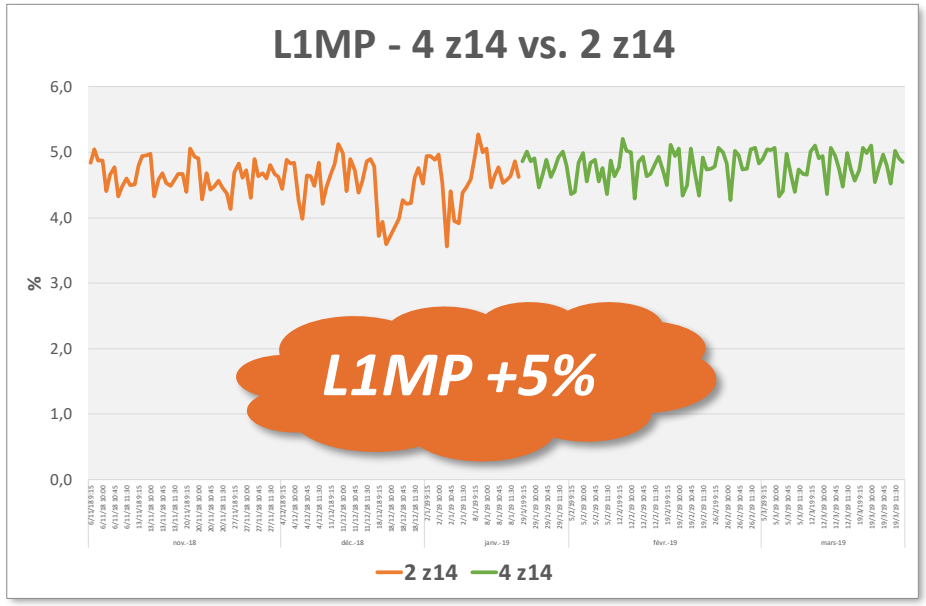


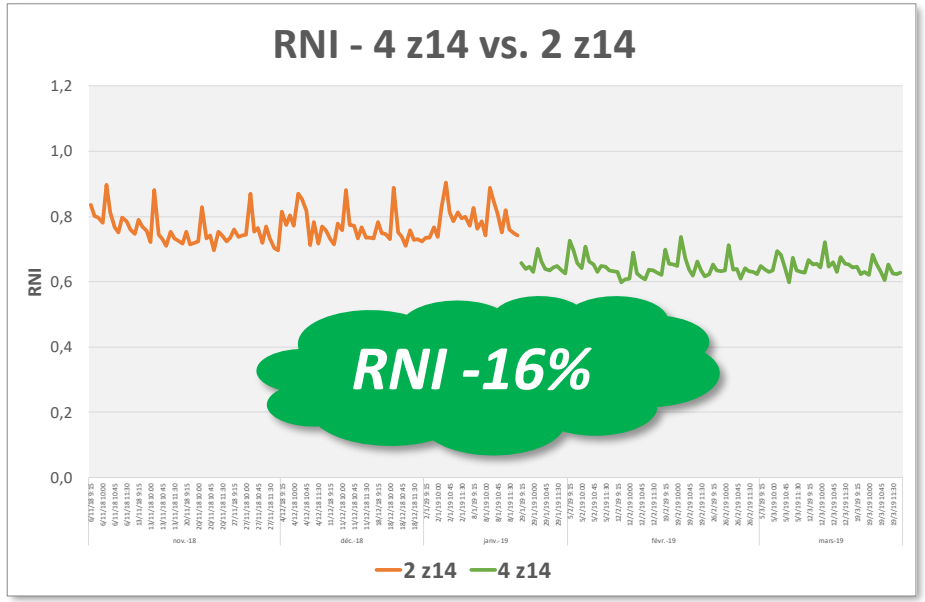


MIPS
Million Instructions per second and CP

(Rate of delivery not processor capacity)

L1MP
Level 1 Miss Per 100 instructions





RNI
Relative Nest Intensity

"RNI reflects the distribution and latency of sourcing from shared caches and memory"

4 z14 vs. 2 z14 Evaluation from SMF 113 – GCP Processors

Data from comparable time periods (Open Tuesday from 9am to 12am) before and after operations when same workload executes (Mainly OLTP)

Date	Before Distribution	After Distribution	Comparison
Model	2 z14	4 z14	Distribution 4 z14 vs. 2 z14
z/OS Server count	2	4	
GHz	5208	5208	**0%**
Cycles per Instructions (CPI)	3,20	3,06	**-4%**
MIPS (Rate of delivery)	1638	1705	**+4%**
Level 1 Miss %	4,58	4,79	**+5%**
% Sourced from L2	71,10	70,99	**0%**
% Sourced from L3	21,70	23,50	**+8%**
% Sourced from Local L4	4,71	3,76	**-20%**
% Sourced from Remote L4	0,25	0,05	**-81%**
% Sourced from Memory	2,21	1,67	**-24%**
Relative Nest Intensity (RNI)	0,77	0,65	**-16%**
CPI - Estimated Instruction Complexity	1,61	1,64	**+2%**
CPI - Estimated From Finite Cache/Memory	1,59	1,41	**-11%**
Estimated Sourcing Cycles per Level 1 Miss	34,62	29,57	**-15%**

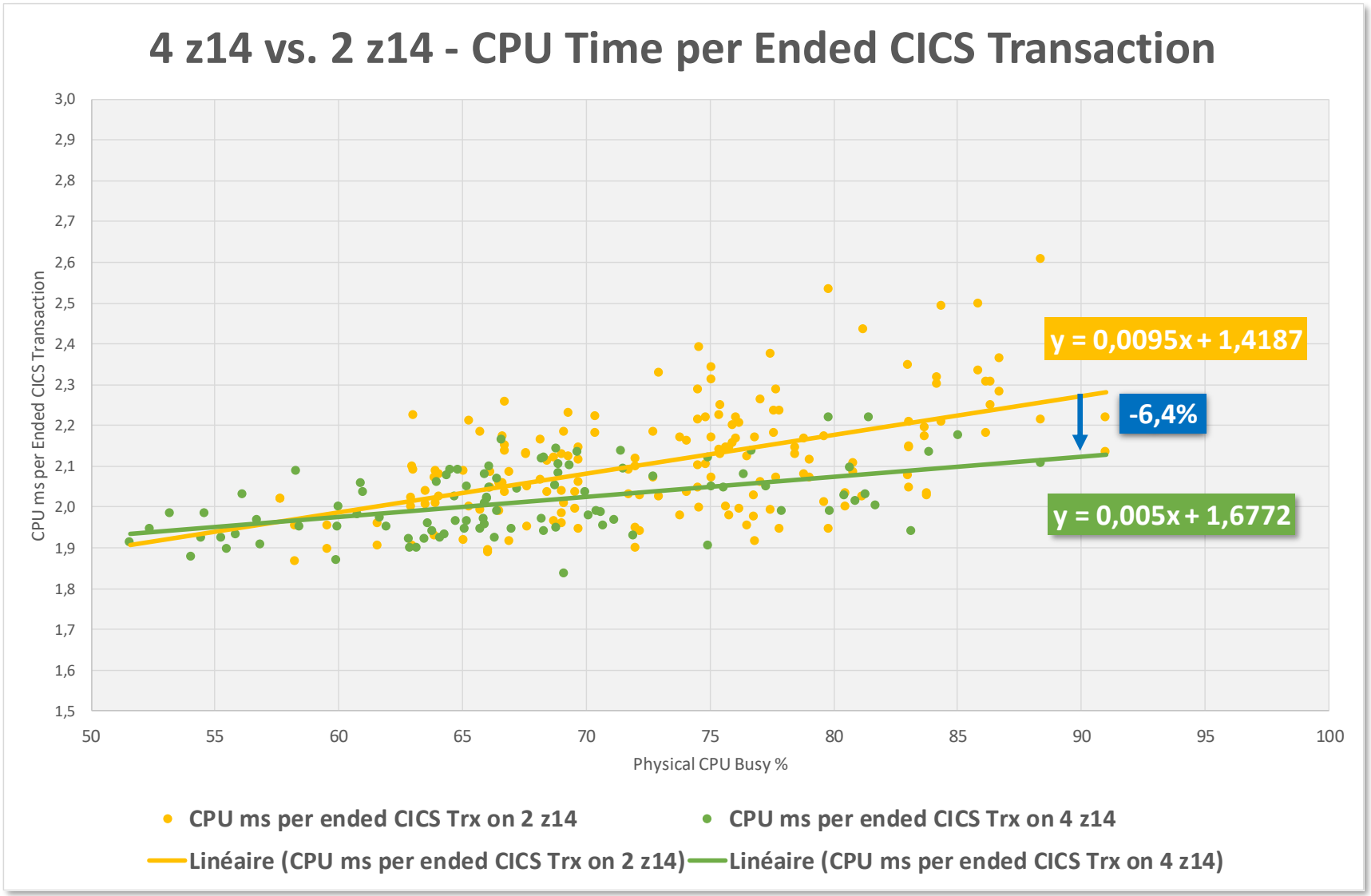
Compare CPI scaled by GHz to identify **Relative Capacity Ratio** for Old vs. New configuration

$$RCR = \frac{CPI(old) \times GHz(new)}{CPI(new) \times GHz(old)}$$

RCR 4z14 vs. 2z14
1.05

Processor Cycles are spent **Productively** (Executing instructions present in L1 cache) or **Unproductively** (Waiting for stage Data)

4 z14 vs. 2 z14 Evaluation from SMF 70 & 72 – CPU Time per Transaction



CPU Time per Ended CICS Transaction against Physical CPU Busy%

The deviation of the two linear regression curves is the result CPU Time per Transaction improvement.

*Decrease in CPU Time per Transaction of about -**6,4%***

*This equates to a single-engine speedup of **1,07x***

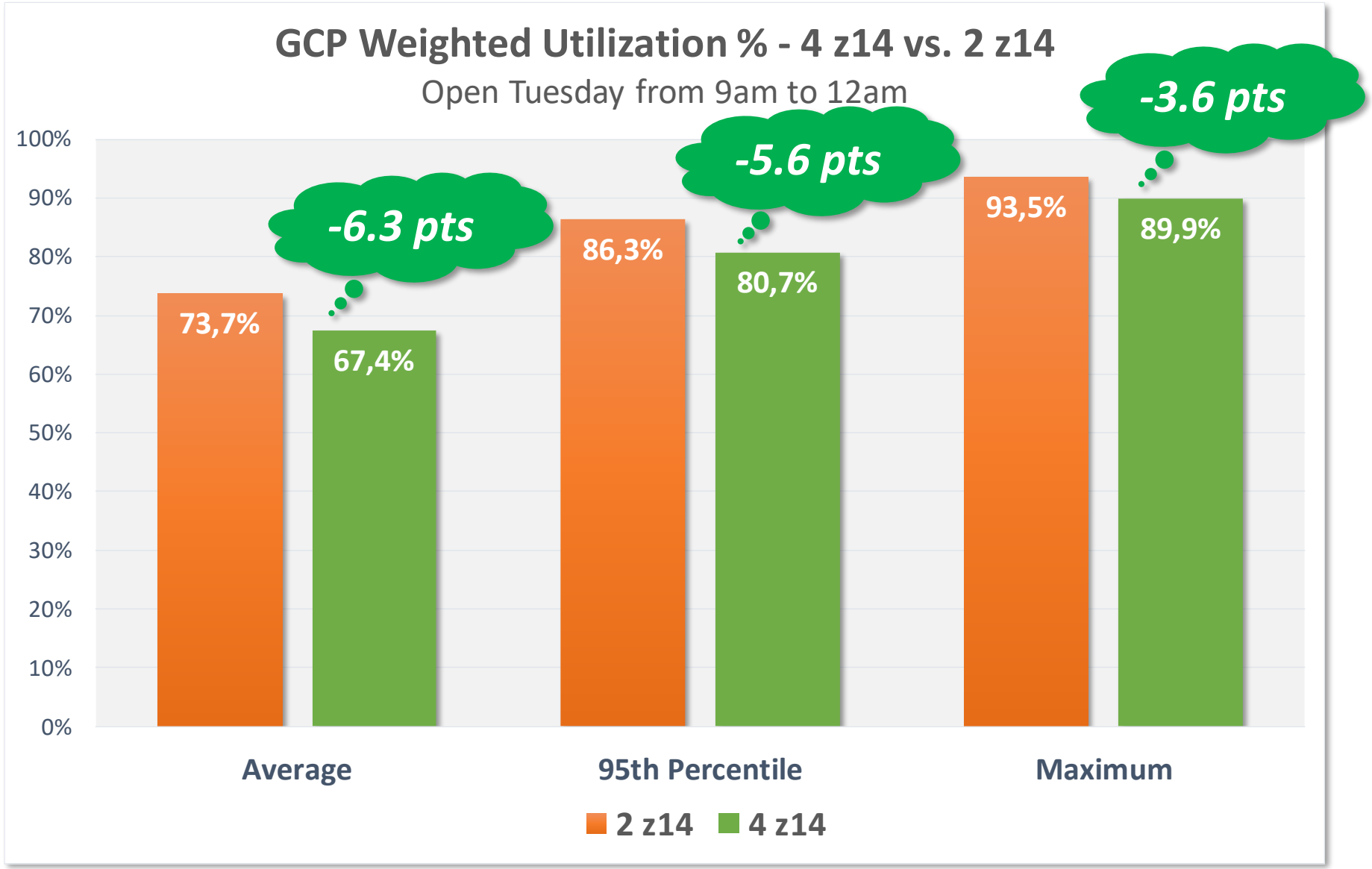
Utilization Effect

Growth in CPU Time per Transaction as CPU Utilization increases

4 z14 vs. 2 z14 Evaluation – GCP Utilization % Weighted by the amount of GCP

Data from comparable time periods (Open Tuesday from 9am to 12am) before and after operations when same workload executes (Mainly OLTP)

GCP Utilization % weighted over the sum of available GCP processors



Evaluations Synthesis - GCP Processors improvements

		Migration 2 z14 vs. 2 z13	Distribution 4 z14 vs. 2 z14	4 z14 vs. 2 z13
LSPR Expectation Ratio	Low	1,07	1,09	1,17
	Average	1,12	1,12	1,25
	High	1,14	1,13	1,29
zPCR Expectation Ratio		1,07 - 1,13	1,14	1,24 - 1,31
Relative Capacity Ratio (From CPI)		1,17	1,05	1,24
CPU Time per Transaction Ratio		1,11	1,07	1,25

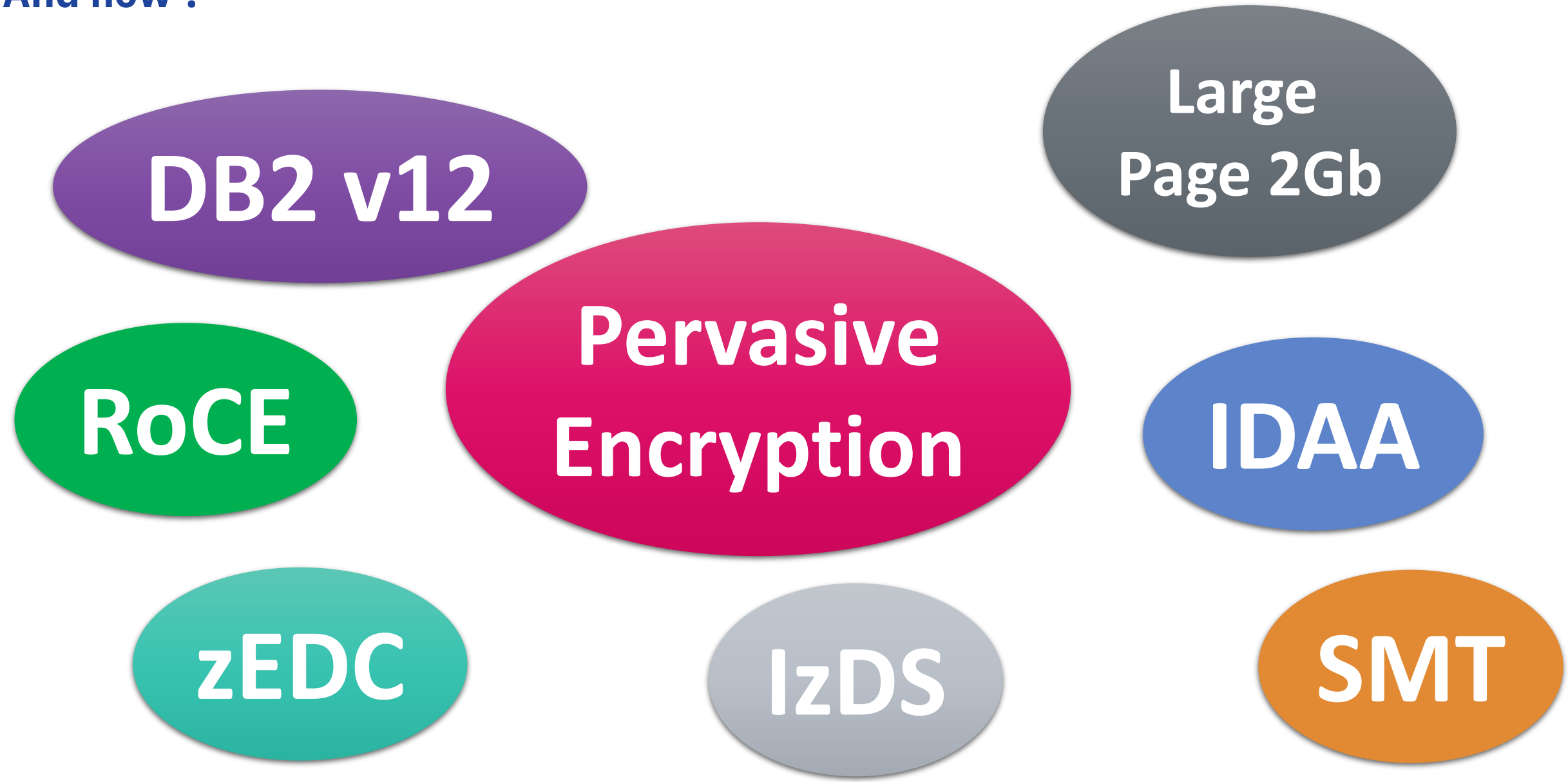
Agenda

1. Introduction
2. z13 Configuration Evaluation
3. z14 Configuration Selection
4. z14 Operations, Adjustment & Evaluation
5. Distribution of GCP, IIP & LPAR over the 4 z14
6. Conclusions

Conclusions

- The migration from 2 z13 to 2 z14 give us a better processor efficiency with **+17% Usable Mips Capability** and a **better Quality of Service**.
- The implementation of CMP gives us much more flexibility regarding how we can configure our Systems and Sysplexes to the optimum.
  - We move from PricePlex to **TRUE Sysplexes**
- As a result of this, the distribution of our z/OS LPARs over our 4 z14 gives us
  - **Estimated +14% Extra Capacity** that saves us time before upgrade
  - Some more benefits on our processor efficiency with **+4% more Mips**
  - Enhancement of our redundancy architecture
  - **Opportunity to implement high availability in our Sysplexes**

And now ?


DB2 v12
Large Page 2Gb
Pervasive Encryption
RoCE
IDAA
zEDC
IzDS
SMT

Session sources

- **“System z13 – First Experiences and Capacity Planning Considerations”** by Robert Vaupel
- **“z14 Performance Introduction”** by Robert Vaupel
- **“CPU MF Formulas and Updates - December 2017”** by John Burg
- **“zPCR Capacity Sizing”** by Brad D.Snyder & John Burg
- **“The RNI-based LSPR and the Latest z Systems Processors”** by David Hutton
- **“The Hitchhiker’s Guide to MIPS and Capacity Planning”** by David Hutton
- “**z/OS Performance Hot Topics”** by Kathy Walsh
- “**Achieving CPU (& MLC) savings through optimizing processor cache**” by Todd Havekost
- “**From Semi Conductor Technology Design to Compilers**” by Alain Maneville
- “**Caches, PR/SM and HiperDispatch – What’s new in z14**” by Alain Maneville
- “**The Watson and Walker zRoadShow**” by Cheryl Watson, Mario Bezzi & Frank Kyne
- “**Cheryl Watson’s Tuning Letters**” – Too much articles to mention…

Thank you!

Please complete the Session Evaluation!

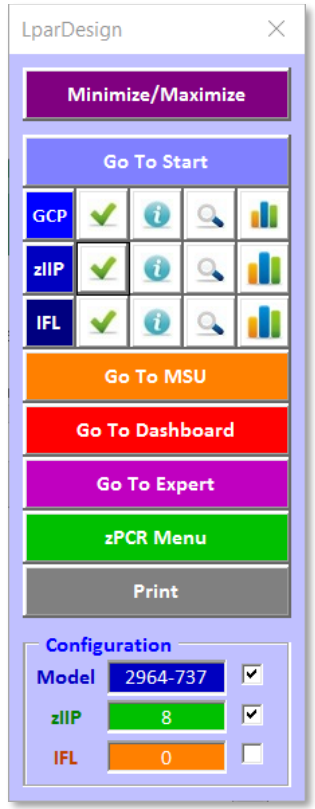
Backup foils

LparDesign – Export to zPCR - Remarks

About the generated zPCR Study…

- Only the **Active LP** of each LPAR are take into account as LP count
  - *From **zPCR User's Guide** :*
    - *"HiperDispatch can also improve z/OS performance by dynamically parking partition logical CPs that it considers to be excessive for the workloads competing for the shared CP resource. This aspect of HiperDispatch is not included in the LSPR data or algorithms used by zPCR. To fairly represent capacity for these configurations, parked logical CPs should not be considered when defining the number of shared LCPs for a partition."*
  - *This is equivalent to the zPCR "**Minimal Shared LCP Count Optimization**" where the weight percent determines the exact number of LCPs to be assigned*
- The proposed **Harware Model** is established thanks to the count of processors
- The selected **z/OS version** will be associated to each LPAR
- The selected **zIIP Loading %** will be associated to each zIIP LPAR
  - *It must be representative of the zIIP Processors % during the reference period (25% in our case)*
- The generally recommended **Reference-CPU** scaling factor/metric value is integrated
  - ***2094-701 rated at 593.00 MIPS***
  - *In our case (LSPR Multi-Image Capacity Ratios table purposes), the scaling-factor will be internally adjusted by zPCR to represent the capacity of a typical shared 5-partition configuration on the 1-way Reference-CPU model.*
- **SMT capability** is enabled for zIIP & IFL processors on z13, z13s & z14 with the following retained capacity benefit :
  - ***+25% on zIIP processors for z13, z13s and z14***
  - ***+20% on IFL processors for z13 and z13s, +25% for z14***

These parameters could be modified in the zPCR tool



Remark – Recommendations for Defining Logical Processors

Don't over allocate the number of Logical Processor !

New Best Practices for defining Logical Processors…

- *New best practices document for defining logical CPs and zIIPs to an LPAR*
  - *https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD106388*

- ***Define 1 or 2 more logicals than needed to meet CPs by weight***
- *Reasons :*
  - *Work runs mots efficiently if you run with defined weight using Vertical High and Vertical Medium*
  - *LPAR Busy value displayed on online monitors is relative to number of logicals*
  - *LPAR time slice is sensitive to number of logicals*
    - *Fewer logicals leads to longer timeslice*
  - *Reduce the impact of a CPU loop*
    - *Fewer logicals limits potential impact*
  - *z/OS operations like Quiesce need to be done even for parked logicals*
  - *Additional system ressources utilized for each logical processors*

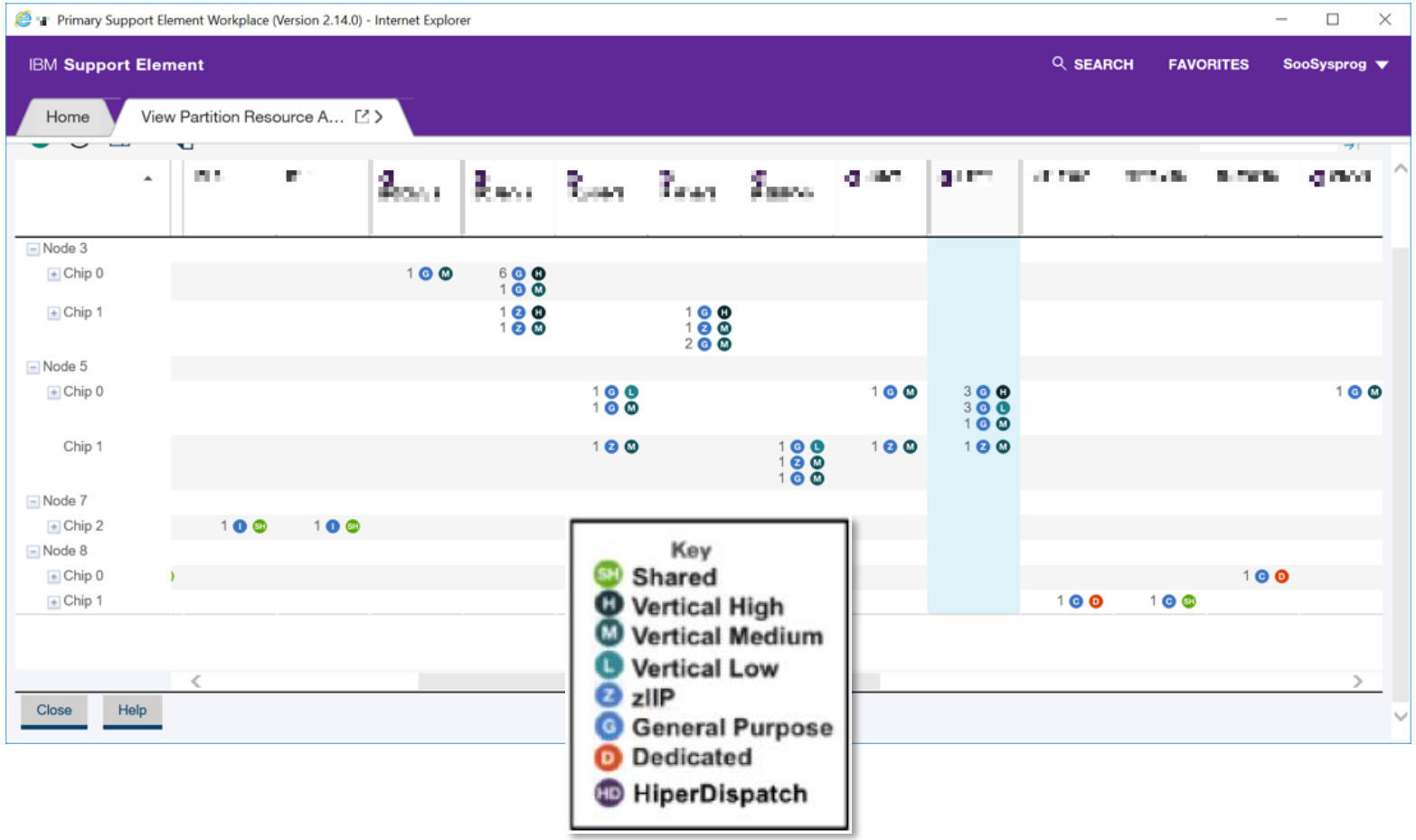
LPAR Design Tool *generates an exception if the number of Vertical Low engines exceeds this recommendation*

HMC LPAR Ressource Assignment Task

HMC LPAR Ressource Assignment Task

- The View Partition Resource Assignments task targets a z14 Family Processor and provides a snapshot of all active partitions and associated processor information. The information displayed for each partition includes the HiperDispatch setting and processor information (number, CPU type and polarity) displayed within the Node and Chip locations.

- Document with method available in TechDoc : https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102754

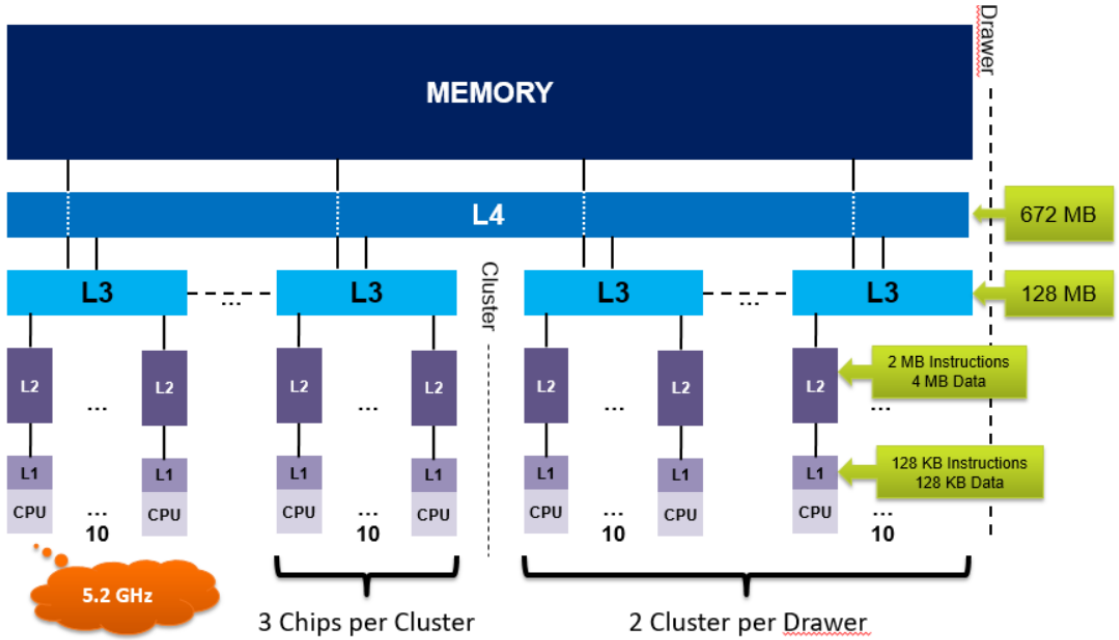


HiperDispatch Topology – ShowTopo

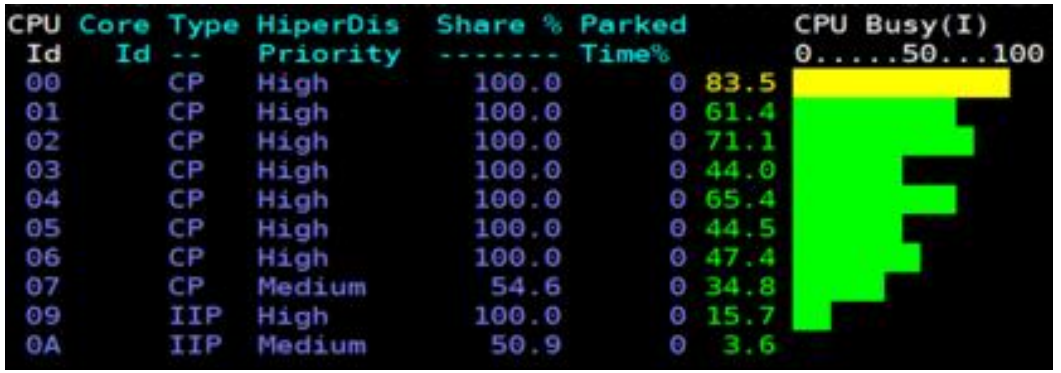
« ShowTopo »

https://watsonwalker.com/software/free-tools/

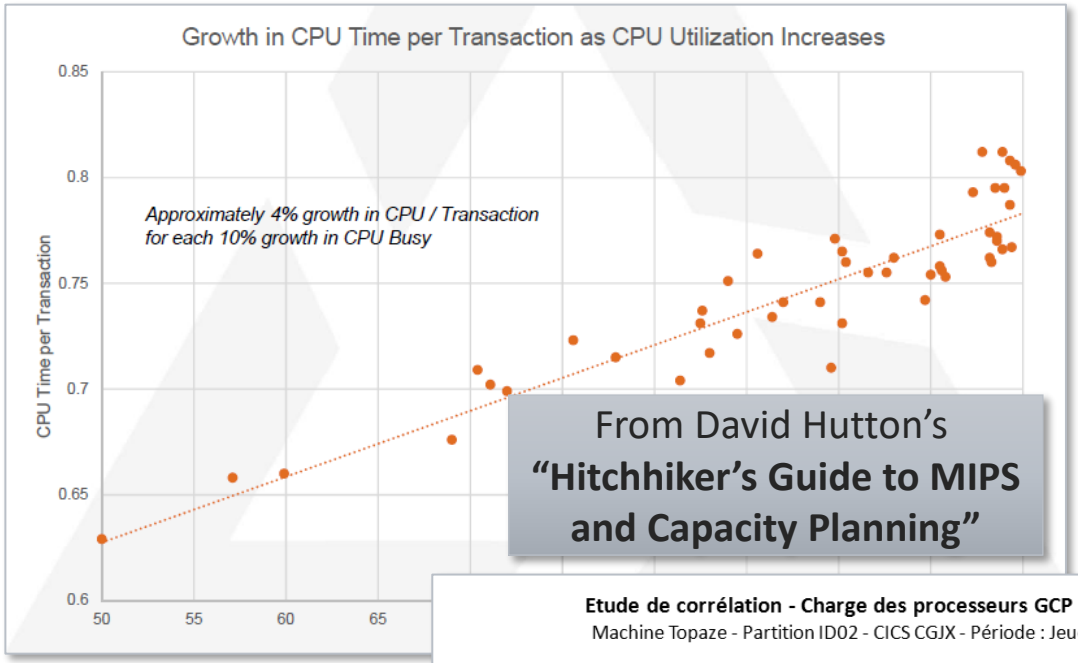
- Showtopo is an Assembler program by Mr. Rolf Bruner, SIX Group Services AG, & Mr. Klaus Wolf, IBM, that produces a quick and easy report showing the assignment and location of an LPAR's logical CPs and zIIPs.



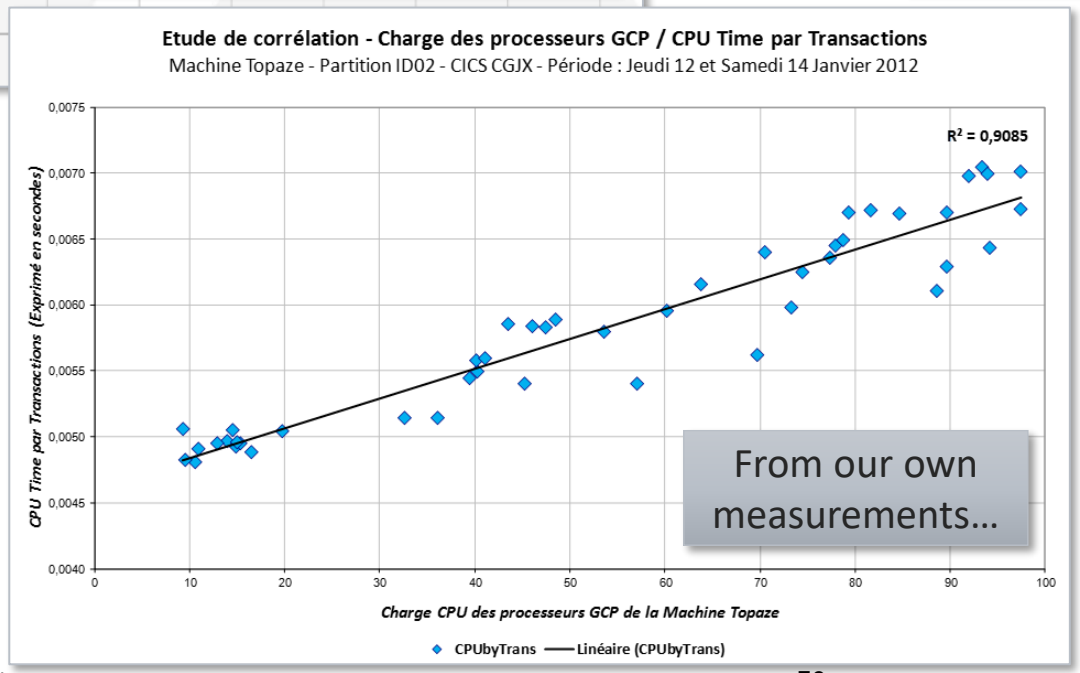

```
LPAR configuration data for system PROD: Date = 05/03/2019, Time = 13:45:10
System Information Block 15.1.2 processor topology (drawers/nodes/SCMs)

Server: IBM 3906-718 S1        capacity: curr=718 perm=718 temp=718
SYSIB_15.1.2: addr=x'023F1000' len=x'0070'
              lvl_6 to lvl_1:  00000402030A   max_nesting_lvl:  04

Drawer_no_04   node_no_01   processor_chip_no_01

   VCM_level: high    CP    CPU_mask: FE000000_00000000  CPU(00,01,02,03,04,..)
   VCM_level: medium  CP    CPU_mask: 01000000_00000000  CPU(07)

                            processor_chip_no_02

   VCM_level: high    zIIP  CPU_mask: 00400000_00000000  CPU(09)
   VCM_level: medium  zIIP  CPU_mask: 00200000_00000000  CPU(0A)
```



Distribution of the GCP, zIIP & z/OS LPAR over the 4 z14 – Utilization Effect



From David Hutton's
"Hitchhiker's Guide to MIPS and Capacity Planning"



From our own measurements…

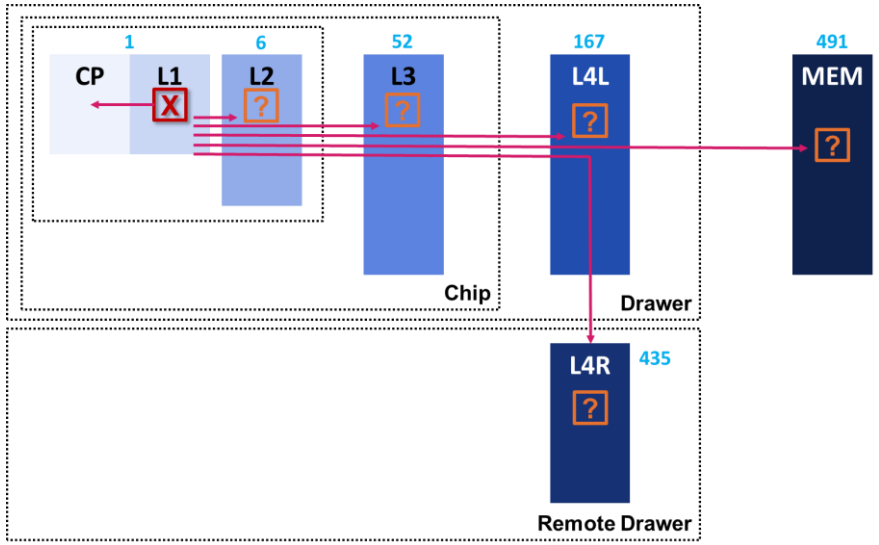
CPU Utilization : Impact to Capacity planning

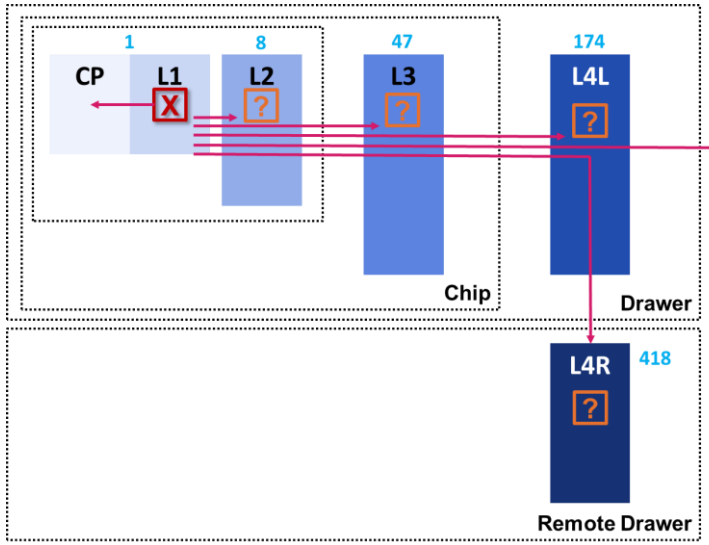
Estimating the impact - conservative approach :
For a change in utilization of 10%,
plan for the capacity effect to be :

3% for LOW RNI workloads
4% for AVERAGE RNI workloads
5% for HIGH RNI workloads

"IBM's zPCR tool does NOT factor in the knock-on benefits of reduced CPU utilization if you move to a larger CPC. And if you move to a SMALLER CPC, especially one with fewer CPs, don't forget to allow for the negative impact of higher utilization than you have today. "
The Watson and Walker zRoadshow, Mario Bezzi & Frank Kyne, Share Spring 2019

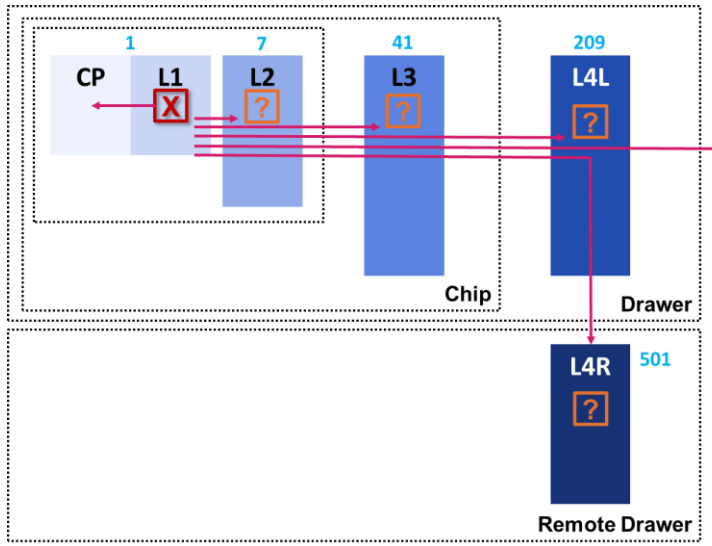
Estimated Sourcing Cycles per Level 1 Miss – Linear Regression





2 z13 to 2 z14

2 z14 to 4 z14



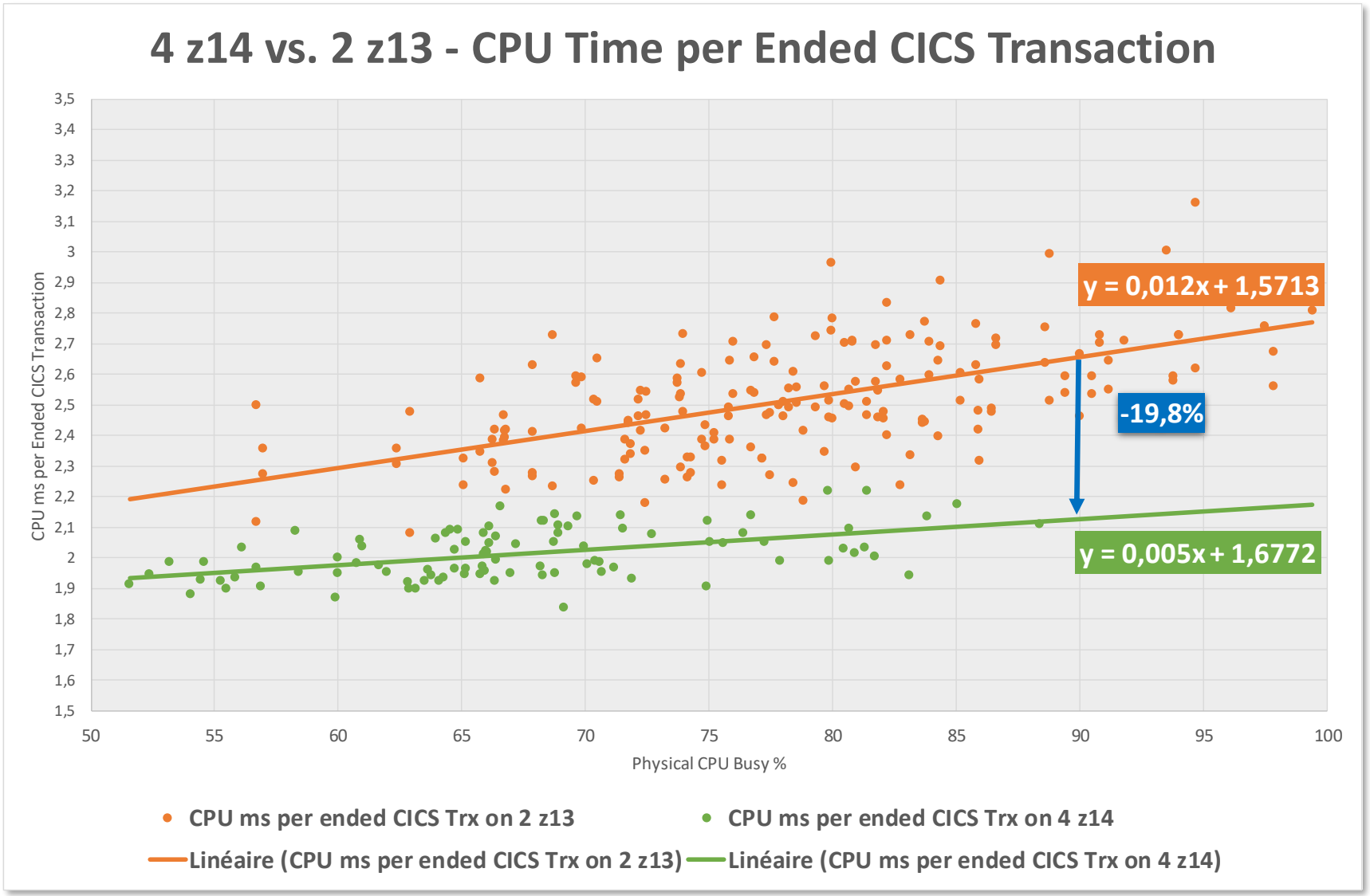
*Multi Linear Regression taking into account the main **%Lx** values*

	2 z13	2 z14	4 z14
L2%	6	8	7
L3%	52	47	41
L4L%	167	174	209
L4R%	435	418	501
MEM%	491	466	444

Evaluation from SMF 113 - GCP Processors - Synthesis

Date	Before Migration	After Migration	Before Distribution	After Distribution	Comparison		
Model	z13	z14		z14	Migration 2 z14 vs. 2 z13	Distribution 4 z14 vs. 2 z14	4 z14 vs. 2 z13
z/OS Server count	2	2		4			
GHz	5000	5208	5208	5208	**+4%**	**0%**	**+4%**
Cycles per Instructions (CPI)	3,65	3,24	3,20	3,06	**-11%**	**-4%**	**-16%**
MIPS (Rate of delivery)	1379	1614	1638	1705	**+17%**	**+4%**	**+24%**
Level 1 Miss %	5,08	4,57	4,58	4,79	**-10%**	**+5%**	**-6%**
% Sourced from L2	70,30	71,46	71,10	70,99	**+2%**	**0%**	**+1%**
% Sourced from L3	19,82	21,23	21,70	23,50	**+7%**	**+8%**	**+19%**
% Sourced from Local L4	7,09	4,83	4,71	3,76	**-32%**	**-20%**	**-47%**
% Sourced from Remote L4	1,09	0,20	0,25	0,05	**-81%**	**-81%**	**-96%**
% Sourced from Memory	1,67	2,25	2,21	1,67	**+35%**	**-24%**	**0%**
Relative Nest Intensity (RNI)	0,82	0,77	0,77	0,65	**-6%**	**-16%**	**-21%**
CPI - Estimated Instruction Complexity	1,69	1,67	1,61	1,64	**-1%**	**+2%**	**-2%**
CPI - Estimated From Finite Cache/Memory	1,97	1,58	1,59	1,41	**-20%**	**-11%**	**-28%**
Estimated Sourcing Cycles per Level 1 Miss	38,78	34,59	34,62	29,57	**-11%**	**-15%**	**-24%**

4 z14 vs. 2 z13 Evaluation from SMF 70 & 72 – CPU Time per Transaction



CPU Time per Ended CICS Transaction against Physical CPU Busy%

The deviation of the two linear regression curves is the result CPU Time per Transaction improvement.

Decrease in CPU Time per Transaction of about ***-19,8%***

This equates to a single-engine speedup of ***1,25x***

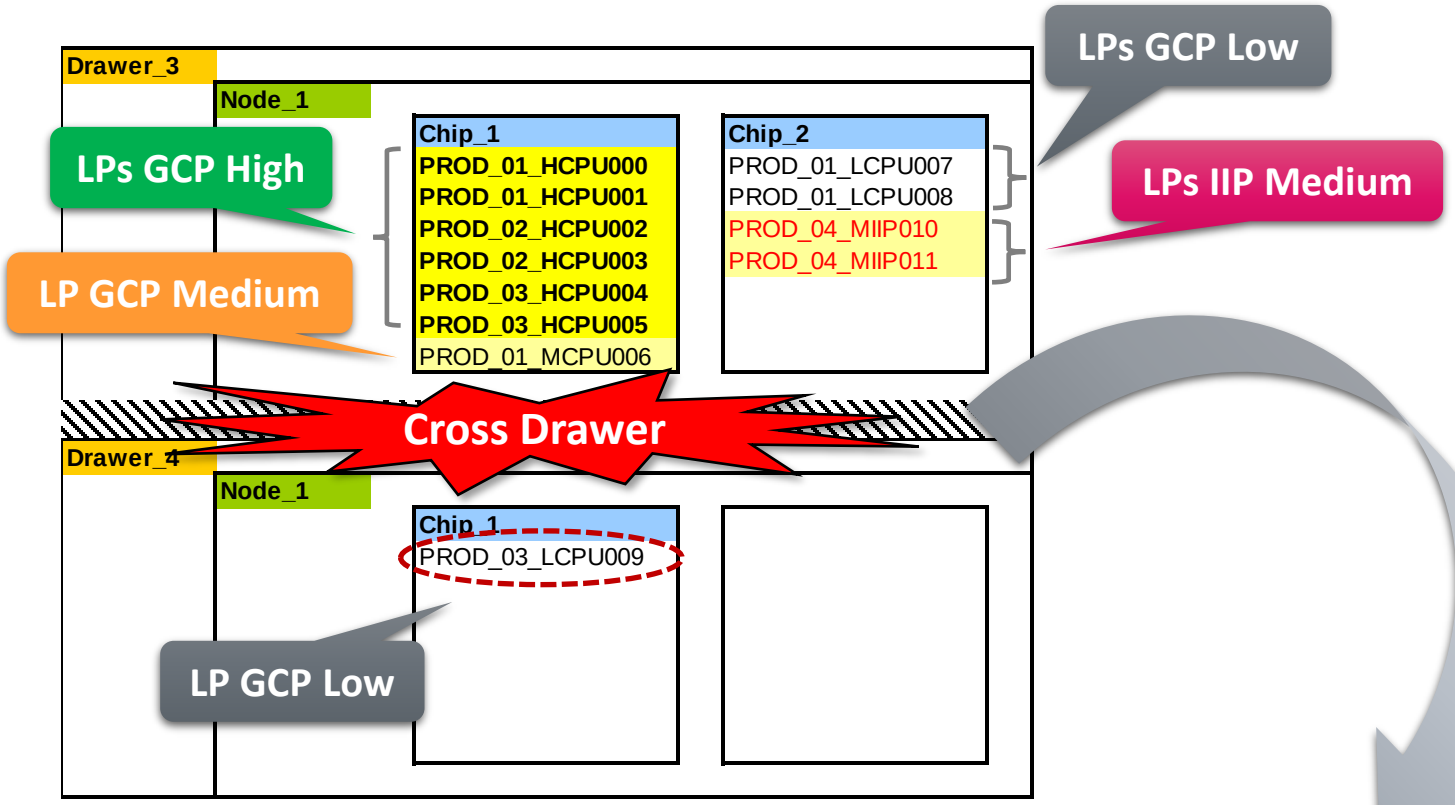
Utilization Effect

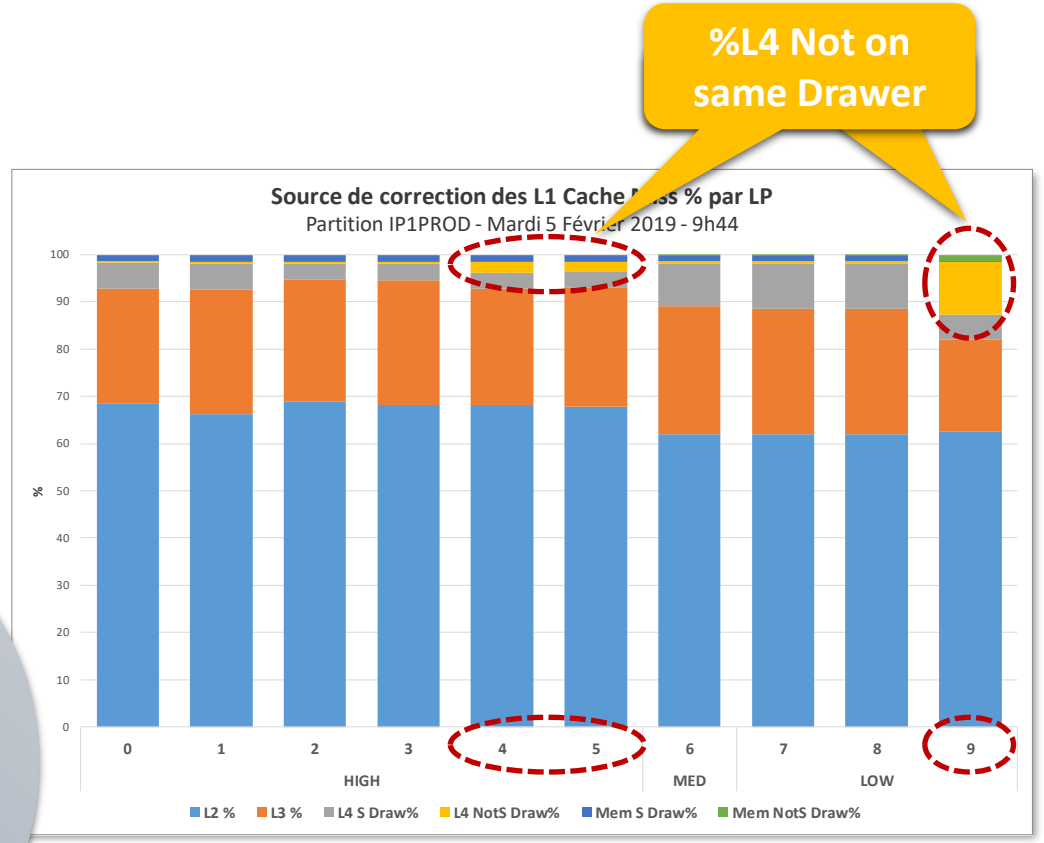
Growth in CPU Time per Transaction as CPU Utilization increases

2 z13 to 4 z14 Synthesis – LSPR Expectation

Configuration	Model	# of CP	Relative Capacity Indicator		
			Low	Average	High
2 z13	2964-737	37	86,62	69,38	58,26
	2964-736	36	84,59	67,83	56,97
	Sum	**73**	**171,21**	**137,21**	**115,23**
4 z14	3906-718	18	49,64	42,52	36,79
	3906-719	19	52,03	44,39	38,38
	3906-718	18	49,64	42,52	36,79
	3906-718	18	49,64	42,52	36,79
	Sum	**73**	**200,95**	**171,95**	**148,75**
4 z14 vs. 2 z13	***Expectation Ratio***		**1,17**	**1,25**	**1,29**

Topology Analysis - Example

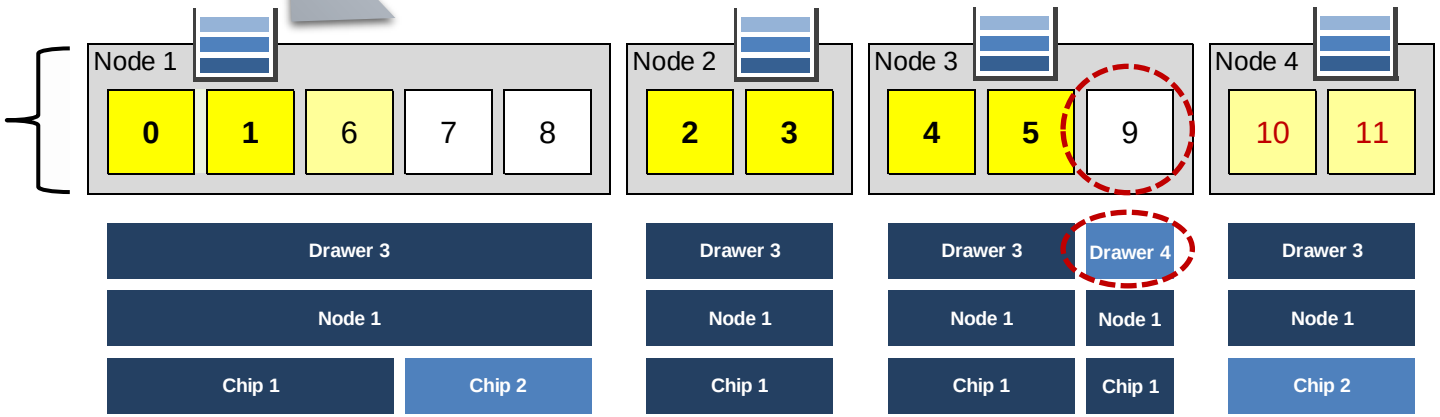




SSSS_nn_PTYPnnn

SSSS	➔	SMFId
nn	➔	Affinity Node
P	➔	Polarity (H / M / L)
TYP	➔	**CPU** / **IIP** / IFL / ICF
nnn	➔	Core Id

Corresponding WLM Affinity Nodes



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