The MLC Cost Reduction Cookbook

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Who is Scott Chapman? (Why can I talk about this?)

• Spent over 20 years at American Electric Power
  – Started out in applications, doing performance tuning for large CICS/DB2 application and technical support for other app programmers
  – Moved to z/OS systems performance and capacity
    • ~17 years in that role
    • Included hardware upgrade planning and MLC cost management

• In 2015 joined Peter Enrico at Enterprise Performance Strategies
  • We do z/OS Performance consulting, education, and reporting
  • Creators of Pivotor® - A reporting tool aimed primarily at z/OS performance reporting
z/OS Performance workshops available

During these workshops you will be analyzing your own data!

- **WLM Performance and Re-evaluating of Goals**
  - September 25-29 in Minneapolis, MN

- **Parallel Sysplex and z/OS Performance Tuning**
  - August 29-31, 2017 via the internet

- **Essential z/OS Performance Tuning Workshop**
  - Fall 2017, Columbus OH
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Note: page numbers illustrative, not accurate
Chapter 1

Understanding MLC
MLC Variable License Charges

• MLC cost based on peak Rolling 4-Hour Average (R4HA) MSU utilization in the month
  – Generally speaking, peak for each CEC, maybe summed across all
    • Example: CEC 1’s peak is 500 MSUs, CEC 2’s is 1000 MSUs, bill is for 1500 even though the peaks may not have been coincidental
    • Country Multiplex Pricing (CMP) changes this
    • Have to have sysplex aggregation for that summing to happen
  – Products charged by LPAR that they’re licensed in
    • Only license products where you need them
    • Note some products licensed by CEC regardless (e.g. some older compilers)

• Actual utilization will be higher at times than the R4HA
Sysplex aggregation rules (prior to CMP)

• In short, 50% of the workload on each CEC must be in the qualifying sysplex
  – Executing an “eligible systems enablement function”

• For aggregation purposes, a CEC can only belong to one sysplex

• Aggregation requires periodic validation

• No aggregation = higher MLC charges because each CEC starts over from “0”
  – First MSUs are the most expensive
Keep in mind…

• Enterprise License Agreements complicate matters
  – “True-up” may not be a dollar-for-dollar “true-up”
  – If you have an ELA, you need to understand the T&Cs
  – Before the ELA is agreed upon, plan carefully
    • Expected MSUs consumed month by month
  – Track your progress over the course of the year
    • Nice to know what to expect come true-up time!
    • Capacity groups can help you hit your target
  – Find out if you have an ELA and what the Ts&Cs are
Tracking your ELA progress is not simple, especially if you’re tightly managing your caps, but it’s a good idea!
Effect of reducing your R4HA

• Reducing the R4HA by 10% will not reduce your bill by 10%
  – Savings is off from incremental ("last") MSUs—the cheapest ones
  – Determine your incremental MSU cost
    • Complicated by things not licensed everywhere
    • But for the purposes of evaluating an R4HA reduction effort, being in the right ballpark is all that matters
MLC Price Curves – Cost to increase capacity

Reducing your R4HA by 20% won’t reduce your bill by 20%
Chapter 2

Tools of the trade
Sub-Capacity Reporting Tool

• To get sub-capacity pricing, you have to run SCRT once a month and send IBM the resulting output
  – Run on 2nd of month with data prior 2nd to 1st
    • Needs SMF 70 & 89

• Things to consider:
  – Keep a separate SMF file of just 70 & 89
  – You can run more than once a month and use the output yourself
    • Output is a CSV file
    • Handy for tracking over the course of the month to eliminate any surprises
Limiting your variability

• LPAR Defined Capacity and Capacity Groups can help guarantee you don’t exceed desired spends
  – Specify LPAR Defined Capacity (DC) and Group Capacity (GC) in MSUs
  – An LPAR can have a DC and belong to a Capacity Group
• When LPAR R4HA exceeds its DC, LPAR capped to its DC
• When Capacity Group R4HA exceeds the GC, group is capped to GC
• Bill is based on the DC / GC, not the R4HA value that exceeded those values
  – By making a group that covers all LPARs on the CEC, you can guarantee that your bill won’t exceed the GC
• Are you using DC and/or GC?
  – If not, consider using at least GC
MSU Averages Comparisons

CEC, 0BAC2, 0BAC2

Capacity Limit
1HA MSUs
Actual R4HA MSU
Billable R4HA MSU
Capping Issues

• If capping, usually some workloads will suffer—make sure they’re the right ones!
  – WLM policy should be periodically reviewed
  – If it hasn’t been done for a while, now would be a good time

• Test LPARs may drive up a group’s R4HA, enforcing the group cap on all LPARs in the group
  – Consider setting a defined capacity for the test LPARs as well as including them in the group with production

• Make sure your SLAs are based on business need, not just what is achievable
  – If you’re managing to SLAs that have little business value, you may end up spending too much
Resource Groups

- WLM Resource Groups can be used to limit workloads within an LPAR
  - Can have both min/max resource groups, for this purpose we're interested in max RGs
- May be handy for limiting things like dev/test workloads
  - Applied to an entire Service Class
  - Can keep something like looping test job from driving up your R4HA
- Three ways to define a limit
  - Un-weighted CPU SUs/second (sysplex scope)
  - Percent of LPAR (system scope)
  - CPs of Capacity (system scope)
- Do have to consider what is normal work patterns and set appropriately
  - May want different WLM policies for different time periods
How RG Maximums Work

- Cap Slicing used to enforce resource group maximums
- Each service class period in a resource group max has an awake / cap slice pattern
  - 1 cap slice = 1/64 of an SRM second (1/256 as of z/OS 2.1)
- Before work unit is dispatched onto a CPU, the current group slice is examined
  - If current slice is a *cap slice*, then unit of work is not dispatched and is moved to end of the queue of its current CPU dispatching priority
  - If current slice is an *awake slice*, then dispatched

Group 3

- Dispatched Work
  - Accumulates CPU Using Samples
- Queued Work
  - waiting at priority
- Accumulates CPU delay samples

Is slice awake or cap?

Capped: Accumulates CPU Cap Samples

Dispatcher Queue

Queued Work - waiting at priority
  - Accumulates CPU delay samples
Chapter 3

Reviewing your data
R4HA Patterns

• Most shops have some regularity to their R4HA peaks, such as:
  – Monthly processing on the first / last / something day of the month
  – Overnight batch maxes out the capacity limits every night
  – Weekday online activity peaking once or twice / day
    • Often with one day of the week being more intense than the others
  – Weekend database reorgs

• Remember that it’s a “Rolling 4-Hour Average”
  – Smaller interval utilization not important to this analysis
  – The peak utilization for the month may not be in the peak R4HA

• If you want to reduce your R4HA, you need to understand your R4HA patterns
Determine profile of the non-peak intervals

• Be aware of not just the peak, but also the profile of the top intervals
  – Peak R4HA value may exist across multiple intervals
  – Or the 2\textsuperscript{nd} through 50\textsuperscript{th} intervals highest may be only slightly less
  – SCRT report only shows top 2 intervals (at least by default)
  – Use your performance/capacity reporting tool to evaluate top \( n \) periods in the month
  – Get a copy of the SCRT for a few months
    • Validate your reported values for the top two periods

• Group/defined capacity may be limiting the impact of large consumers
  – If peaks are limited by GC/DC, then may need to reduce more than 10\% to get 10\% reduction in the actual billable MSUs

• If software inventory is not same across all LPARs, may need to track individual LPARs
ebMSU Peak/Top Interval over the month

Est Billable MSUs for All Hours

ebMSU = estimated billable MSUs
ebMSU Hot Spots over the MLC-Month

Hourly Estimated Billable R4HA Usage
Percent of Peak R4HA

CEC, 0BAC2, 0BAC2

2017-05-01
2017-04-30
2017-04-29
2017-04-28
2017-04-27
2017-04-26
2017-04-25
2017-04-24
2017-04-23
2017-04-22
2017-04-21
2017-04-20
2017-04-19
2017-04-18
2017-04-17
2017-04-16
2017-04-15
2017-04-14
2017-04-13
2017-04-12
2017-04-11
2017-04-10
2017-04-09
2017-04-08
2017-04-07
2017-04-06
2017-04-05
2017-04-04
2017-04-03
2017-04-02
How much can you reduce how easily?

• Effort required to reduce your R4HA depends on many things
  – How many intervals do you need to address?
  – What workloads are contributing to those intervals?
  – Are those workloads consistent across the top intervals?
  – Do you have room in your SLAs?

• It’s helpful to know when your peaks are occurring, but knowing what drove the peaks is also important

• Remember, the value is the Rolling 4-Hour Average
  – Work in the 6am hour impacts the average for the 9am hour!
  – Be aware of this situation with respect to capping too

• (Estimated) Billable MSUs <> Used MSUs/MIPS/CPU time
  – We convert CPU time to MSU (consumed MSUs)
  – Then we apportion the ebMSUs based on relative consumed MSUs
Chapter 4

Mitigation strategies
Eliminate

• Cheapest CPU second is the one not consumed

• Do you have old work that’s running that doesn’t need to run?
  – Old reports / jobs that you may not need anymore
  – Dev/test work scheduled repeatedly that maybe could be done only when needed
    • Database refresh
    • Test transactions to make sure regions are up
Reschedule

• Generally most applicable to batch-type of workloads

• Move jobs that don’t need to run during the peaks to out of the peaks
  – Filling in the valleys may or may not help
    • Remember, 4 hour average: \( \text{avg}(100, 40, 40, 100) = \text{avg}(70, 70, 70, 70) \)

• May have impact for things like testing / training efforts too
  – If your peak is the first week of the month, maybe don’t schedule that big training effort that week

• Don’t forget that some transactional type of workloads are driven by a schedule too
  – E.G. some DDF workloads, driven by an off-platform scheduler
Reduce

• Find the big applications during the peaks and spin up an application tuning effort
  – Because you’re impacting the R4HA, you can put a dollar benefit to this effort
  – For CICS/DB2 applications consider threadsafe!
  – For DB2 applications, is there SQL tuning or object tuning that could help?

• Subsystem tuning
  – Memory is more expansive these days: can you beneficially add some to CICS or DB2?
    • Reduce I/O = better performance = more opportunity for CPU delay not impacting SLAs
    • It takes CPU to do I/O

• System tuning / configuration
  – Choice of processor speed can impact your real capacity per MSU
  – Eliminate paging
  – Reduce I/O & optimize the I/O you are doing
  – Keep things like CF, XCF, Logger well-tuned
zIIPs

• If you have cross-over happening during your peaks, work to eliminate it
  – Consider IIPHONORPRIORITY(NO)
    • At least for certain service classes(!)
  – Add zIIPs if need be

• If you don’t have a zIIP (or two) consider adding
  – It seems like more and more things are going to the zIIPs
  – Upgrade software to latest version to take advantage of latest offload capability
    • Especially true for DB2

• Are there CPU-intensive processes that you can rewrite to run in the JVM?
  – Note that there are languages other than just Java that you can use for this
- Crossover = work that could have run on a zIIP ran on a GCP
- Appl % = Percentage of a GCP
- At peak here, 80% of a GCP is spent doing zIIP-eligible work

zIIP APPL% Crossover CPU - Service Class Period
(normalized to CP CPU speed)
Capping

• If you’re exceeding your SLAs...
  – A little bit of additional CPU delay may be fine
  – “As quick as physically possible” usually costs more than “just a little faster than we actually need”
  – Some resource groups for some batch work may well be in order

• Group Capacity and/or Defined Capacity can be very valuable tools

• Don’t forget: if you’re capping, some workloads will suffer—make sure they’re the right ones!
  – Make sure your WLM policy is correct
Multiple software products for R4HA management are available.

Products have different capabilities and methodologies:
- Some have capabilities beyond just R4HA management
- Some are designed for other primary purposes but can be used for R4HA management

Most appear to function as they say.

My suggestions are to:
- Know what you can do yourself first (consider doing group capping first)
- Know what the potential reasonably looks like
- Evaluate multiple options
- If you pick one, be sure to evaluate its effectiveness vs. what you were doing
## In summary… The main recipe

**MLC Cost Reduction**

1) Research your ELA status
2) Determine your incremental cost
3) Understand your capping tools
4) Review your utilization patterns
5) Identify your target times and workloads
6) Calculate your potential savings
7) Establish mitigation strategy
8) Execute

*Popular with those who have responsibility for the MLC budget!*
Don’t forget…

• 20% MSU reduction is less than 20% cost reduction

• Consider using DC/GC if you’re not already

• Make sure your SLAs are related to business need

Thanks!