zSeries, Sub-Capacity Workload License Charges, Soft-Caps, and WLM

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With the advent of zSeries processors and z/OS, IBM decided to offer a new software cost structure. The new pricing structure, Sub-Capacity Workload License Charges, attempts to reduce the cost of key IBM software in the z/OS environment. This paper discusses the author’s experiences with Sub-Capacity License Charges, the tools available to help manage the LPARs running sub-capacity WLC, results, and benefits.

Introduction

In an effort to provide assistance with software pricing, IBM has provided a potential software price reduction through the use of Sub-Capacity Workload License Charges. Sub-Capacity Workload License Charges (referred to in the IBM literature as Sub-Capacity WLC or VWLC) allow a datacenter to pay for qualified IBM software on a monthly usage basis. All charges are on an MSU (millions of Service Units per Hour) basis. The software charges are based on the sum of the LPAR utilizations in MSUs in a 4-hour rolling average. Sub-Capacity WLC only applies to zSeries running 64-bit z/OS. The data center pays for software based upon the highest 4-hour rolling average MSU consumption identified during the billing month or the sum of the predefined LPAR soft-caps, whichever is lower.

Almost every data center, running zSeries and z/OS, can financially benefit from Sub-Capacity Workload License charges. The savings range from a few thousand to tens of thousands of dollars per month.

To use Sub Capacity Workload License Charges, a new software license contract must be made with IBM. The contract only impacts software that is eligible for VWLC licensing. If multiple CPCs (Central Processor Complex, mainframe) are involved there may be an additional benefit to aggregate license charges which means that all CPCs in the contract are treated as one entity for software charge calculations. All the CPCs in a Sysplex must participate in VWLC. This economy of scale is a great benefit because the more MSUs used, the lower the incremental price per MSU.

When using Sub-Capacity Workload License Charges, each LPAR must have a defined capacity limit (soft-cap) set through the Hardware Management Console (HMC). This limit is based on the software MSU rating for the CPC. Setting the soft-cap below the CPC’s rated limit potentially lowers the LPAR’s overall performance when under stress, and thus lowers the software charges. The trick is to balance the soft-cap and the high stress workload periods.

Tools

There are a few tools available to help manage LPAR Defined Capacity. These tools analyze and report on existing performance data to help determine where to set the LPAR Defined Capacity (soft-cap) and whether it is a viable solution for the data center. On an on-going basis these tools can be used to monitor system performance and determine where and when to change the LPAR Defined Capacity (soft-cap).

Sub-Capacity Planning Tool

The Sub-Capacity Planning Tool is a free tool from IBM that reviews RMF type 70 data to determine the MSU 4-hour rolling average and MSUs used. This tool uses data from any MVS LPAR (including 32-bit MVS), so it can be used to provide a quick analysis to indicate if Sub-Capacity Workload License Charges has the potential to reduce software charges. The URL for the tool can be found in the reference section of this paper. The tool analyzes one CPC at a time, so a separate run is required for each CPC. When running the report, select a principle LPAR on the CPC. Any amount of data can be used, however, 24 hours is good time period. The output is a CSV file that can be downloaded, viewed and analyzed with any spreadsheet software. See attachment 1 for a sample output.
This tool identifies the maximum MSUs used, the 4-hour rolling average for the LPARs and the CPC for each SMF interval. It will not show the maximum usage for separately licensed software (CICS, DB2, etc.). However, this is not a bad tool for a place to start and a quick analysis.

**Sub-Capacity Reporting Tool**

The Sub-Capacity Reporting Tool (SCRT) is used to report the monthly usage to IBM for billing. The URL for the tool can be found in the reference section of this paper. It uses a month’s worth of type 70 and 89 (software product usage) records. The output from this tool is a PDS containing CSV a member for each CPC. The data in each member is a CSV file for use in a spreadsheet. The individual members of the output PDS are then downloaded, reviewed, potentially amended, then emailed to IBM for each month’s billing cycle. The billing cycle is from the 2nd of the month to the 1st of the next month. SCRT reports must be sent to IBM by the 9th day of the month. For example, the billing period for August 2004 is August 2, 2004 through September 1, 2004. The SCRT reports must be sent to IBM by September 9, 2004. If the reports are not sent in, the software charge will be at the full installed capacity.

For software that is not tracked by type 89 records, the tool identifies the software as used on par with z/OS. This may not be the case. For instance, the COBOL compiler, 5648-A25, may not be used during your peak 4-hour rolling average. If it can be proven that the compiler is not used during the peak average period, the report can be amended to reflect this and the software charge will also be changed. You must be able to identify when the software’s peak usage did occur and what the LPAR’s 4-hour rolling average MSU consumption was at that time. This requires developing your own usage analysis software or the use of an independent vendor tool such as LCS (LPAR Capacity and Software Usage Analysis). SCRT can be run at any time during the month to acquire a month-to-date view of MSU usage if desired.

The individual SCRT spreadsheets can be amended/updated/corrected in selected cells only. There is a checksum value that will change and invalidate the spreadsheet if other cells are changed. The user will probably need to update the pricing aggregation cell with “YES” so that the CPC’s MSU usage will be summed across all CPCs for aggregate billing. See attachment 2 for a sample report after amendments.

A few days after sending in the SCRT spreadsheets, IBM will respond with a spreadsheet detailing the billing charges for that month’s usage. The spreadsheet will identify the software cost with and without VWLC. The actual software savings can then be tracked. The actual billing month is 2 months following the SCRT reporting month.

Since this tool uses the type 70 and 89 records, the daily, weekly, monthly SMF management process could be modified to extract and accumulate these records into a separate file structure. This job runs in minutes when it only has to read the type 70 and 89 records. It runs for hours when scanning larger sets of SMF data. The type 70 and 89 records from all z/OS LPARs are required.

Proper care and feeding of SMF/RMF is mandatory. The SCRT reports require that 95% of the type 70 and 89 records be available for processing. This also requires that you stay on top of software changes and update the SCRT parameter files as software licenses change (such as upgrading COBOL from 5648-A25 to 5655-G53).

Communication with the IBM Software Customer Support Organization is critical. Anomalies, such as an inability to send the reports by the deadline or missing data can be resolved.

Downloading this tool automatically enrolls the user in an SCRT listserv, which informs the user about new releases and announcements. Installation of new SCRT releases within the deadline is mandatory.

**LCS**

LPAR Capacity and Software Usage Analysis Software (LCS) by I/S Management Strategies, Ltd. does a more comprehensive analysis of hardware and software usage than the IBM tools. LCS reads several files from an MXG PDB daily and builds its own LCS PDB for Sub-Capacity Workload Charge (VWLC) analysis. LCS does a more comprehensive tracking of software (such as the COBOL and PL/I compilers) that do not have type 89 records. LCS provides a comprehensive set of reports that analyze CPC, LPAR and software usage. These reports may be used to determine where to set the LPAR soft-caps. LCS also has modeling spreadsheets to help determine where to set the LPAR soft-caps and to estimate monthly software charges.
In order to perform a more in depth analysis than the Sub-Capacity Reporting Tool, LCS reads the type 70, type 89, type 30 subtypes 2, 3 and 4 records (MXG TYPE70, TYPE70PR, SMFINTRV and STEPS) and Thruput Manager data, if available. It identifies which software ran on what LPAR and when. Thruput Manager data is used to distinguish different versions of software (such as multiple versions of COBOL), so that only the VWLC versions are tracked for VWLC.

The output from monthly LCS reports can be used to override the SCRT reports for billing with IBM. So far, discrepancies and corrections identified by LCS have been accepted without question when placed in the SCRT spreadsheets. Attachments 3 and 4 show some samples of LCS reports.

**RMF Monitor III Facility**

RMF Monitor III data can be used to monitor and report on LPAR MSU consumption under TSO.

IBM provides an interactive RMF monitor available through TSO. To use this monitor, perform the following steps:

1. Enter: TSO RMF
2. Select option 3 – MONITOR III
3. Select option 1 – Overview
4. Select option 3 – CPC

The LPAR name, time interval and range (in seconds) can be selected. The range defaults to 120 seconds and the minimum it can be set to is 10. PF keys 10 and 11 navigate backward and forward in time by the range amount. Not only is the output displayed on the screen, but it is also written to JES in a non-held output file. The JES output can be saved to a dataset and post processed. The amount of data (time period viewable) is determined by the size of the RMF III VSAM datasets and when they were last dumped or wrapped. Figure 1 shows a sample of the output from the Interactive RMFIII Monitor.

This display (figure 1) shows many useful pieces of information. The current 4-hour rolling average MSU consumption (4h MSU Average), percent of time during the interval the LPAR was capped (WLM Capping %), The LPAR soft-cap (MSU Def) and actual MSU consumption (MSU Act) are displayed along with other valuable information.

The display was modified to add the CPCHRMSU field (RT Until CAP). This value is calculated at display time and estimates the remaining time (in seconds) until the soft-cap is imposed on the LPAR. A value of 0 indicates the LPAR is already capped, 14400 indicates the value cannot currently be determined or that capping may not take effect for the next 4 hours (14400 is 4 hours in seconds), and any other value is the estimated time until capping takes effect. The instructions for making this modification were found in the RMF Programmers Guide, Chapter 5, Adding Monitor III User Exits, section: The Monitor III Utility. This author’s experience indicates that the calculated remaining time until capped is of marginal value. It tends to over estimate the remaining time and it is first calculated much later than expected.
The RMF III VSAM datasets can also be accessed with MXG. Module ASMRMFV reads and decompresses the Monitor III VSAM clusters and VMACRMFV builds the PD8 files. The CPU data is in file PDB.ZRBCPU. At the time of this writing, MXG does not decode all the data in the records making the VSAM clusters of marginal value for this data. The pertinent record is the CPUG3 record, the data not decoded by MXG is the CPCT3 table in the record. If VMACRMFV is upgraded to include the CPCT3 table, MXG would provide value by reading and decoding the VSAM cluster data, which is significantly faster than the manual scroll effort through TSO to record the data to a JES spool file.

**RMF PM**

RMF Performance Monitoring (RMFPM) is a workstation-based interface to RMF Monitor III data. It provides graphical views of RMF data in simple histogram or bar chart format. See the URL in references to download this tool. RMF PM provides real time graphical monitoring of LPAR soft-cap MSU usage as well as other system performance metrics. Figure 2 shows a display with MSU consumption metrics of 4 LPARs. This display is currently showing the percent of time WLM capped the LPAR, the actual MSU usage, the 4 hour rolling average MSU usage, and the LPAR Defined Capacity (image capacity). Almost all the RMF Monitor III values can be viewed with RMF PM.

For visual monitoring of MSU usage, this tool is far superior to the TSO RMF Monitor III Facility. The windows are updated automatically and multiple LPARs can be viewed at the same time. Each graphic window is scrollable through the time duration that RMF PM is running.

IBM’s RMF User’s Guide, chapter 19, discusses how to install, setup and use RMF PM.

![Figure 2](image-url)
In-house reporting and analysis
With the use of MICS or MXG and SAS, (and the ability to use SAS) it is relatively easy to build a group of reports and graphs that assist in decision making for VWLC pricing and monitoring the soft-caps. The graphs shown in this paper are all part of the author’s developed tool-set for monitoring the systems and making soft-cap decisions.

The data relating to LPAR soft-capping is found in PDB.TYPE70, PDB.TYPE70PR, PDB.ASUM70PR and PDB.ASUMCEC records in MXG and DETAIL.HARCPUnn and DETAIL.HARLPCnn in MICS.

Spreadsheet software is also valuable for adhoc graphs of data when downloaded to the PC. For instance, the output from the Sub-Capacity Planning Tool is designed for use with a spreadsheet.

A software pricing model spreadsheet can be built from the information available on the IBM zSeries Software Pricing web-site (see the references). This spreadsheet model can then be used to predict software pricing on different processors at different defined capacities.

Workload Manager (WLM)
WLM plays a critical role with Sub-Capacity License Charges. It controls the usage of CPU resources in relationship to the LPAR Defined Capacity (soft-cap). When the 4-hour rolling average MSU consumption exceeds the soft-cap, WLM activates the soft-cap preventing the LPAR from using more CPU resource than the LPAR Defined Capacity. WLM determines whether the soft-cap should be activated approximately every 10 seconds, along with all other WLM policy decisions.

A well defined and working WLM policy is mandatory to ensure that the important workloads (CICS, DB2, etc.) acquire the CPU resources they need to meet their objectives. Discretionary and lower priority work will be the first to suffer when WLM activates the soft-cap.

Observations/Behaviors
Free Software MSUs
Figure 3 displays a typical system behavior with soft-capping enabled. Prior to 9:00 AM the system uses CPU as needed and meets short term bursts with no problem. At approximately 9:00 AM, the workloads on the LPAR demand the use of all CPU resources. For approximately 2 hours the LPAR uses all available CPU resources. Finally, the 4-hour rolling MSU average reaches the LPAR Defined Capacity (soft-cap) and WLM (Workload Manager) imposes the soft-cap on the LPAR. Observations indicate that the LPAR actually runs a few MSUs (2-3%) above the soft-capped MSU limit until the workloads no longer require the CPU resource.

Figure 3 shows the MSU consumption over time. The graph indicates that the system is running close to the soft-cap limit but is able to meet the necessary CPU requirements. During the ‘capped’ time, WLM manages the workloads according to its policy just as it always does. The preferred (‘loved ones’) workloads are given priority and discretionary work is processed when CPU resource is available. With a properly established WLM policy, all work can meet desired performance criteria. All response times for online systems were met during the capped period in the chart. As will be shown in a later chart, when the 4 hour rolling average exceeded the LPAR Defined Capacity and soft-capping was placed in effect, the MSUs consumed were slightly higher than the cap (2-3%). Al Sherkow queried several of his clients and determined the same phenomenon exists on their machines.

Figure 3
The beauty of this phenomenon is the opportunity to reduce software costs and still meet performance requirements. In the old performance model, there was no control over how much of the CPU resource could be consumed except through the number of CPs assigned to the LPAR, this allowed work to use resources it didn’t need to meet performance requirements and typically these requirements were exceeded.

The CPC, in figure 3, has 14 CPs (a 2064-114 providing 410 MSUs) and is soft-capped at the MSU power of 13 CPs (410/14x13=381, the LPAR is actually capped at 382). Depending upon the CPU model and 3rd party software costs, many scenarios are possible for providing software cost reduction and performance enhancements.

In figure 3, notice that the 4-hour rolling average MSU consumption continued to rise for a while after the soft-cap took effect. This is a typical statistical behavior. Even though the 4-hour rolling average exceeded the LPAR Defined Capacity, the software charge was based upon the soft-cap. The end result of this is “Free Software MSUs.”

Figure 4 shows daily LPAR MSU consumption for an entire billing month. The highest 4-hour rolling average MSU consumption is shown along with the average and lowest consumption for each day. This chart demonstrates the fact that MSU usage consistently exceeded the LPAR Defined Capacity (soft-cap) for the month. The lowest 4-hour average MSU consumption shows the breadth or span of CPU usage. By looking at the daily charts, the low points can be identified. If it is possible to move work to the low points (typically evenings, weekends and holidays), the potential exists to lower the LPAR Defined Capacity even further.

A month-to-date variation (Figure 5) of this same chart is valuable for monitoring the soft-cap throughout the month. The increase in Available MSUs on August 15, indicates a hardware upgrade. Notice that the LPAR Defined Capacity was defined at the same level, which keeps the VWLC charges the same despite the upgrade. This particular chart allows for tracking MSU usage in relation to the LPAR Defined Capacity on a daily basis.
Hardware vs. Software MSUs
Software MSU and service unit per second values are reported and tracked in the type 70 records. Hardware service unit per second values are reported in the type 72 records. TCB and SRB service units as collected in the type 72 and type 30 (job & step) records, are hardware service units not software service units. Because software and hardware service units per second are different, they cannot be mixed and matched. This means the service units in type 72 or type 30 records cannot be summed and compared against consumed service units (or MSU x 1000000) from the type 70 records. Doing so will overstate the usage of the CPU resource.

The main reason why hardware and software MSUs are different is because IBM chose to provide an approximate 10% software price reduction with z/990 and z/890 processors. Since the LPAR Defined Capacity is based upon software MSUs and is tracked in the type 70 records, it is different than the data tracked in the type 72 and 30 records.

The formula for calculating MSUs is: \[ MSU = INT\left(\frac{SUSEC \times \#CP \times 3600}{1000000}\right) \]

The type 70 record contains the software service units per second value (SUSEC for the equation). This value is 15180.27 for a 2084-309, which is a 9 way (9 CPs) z990. Therefore the software MSUs are:

\[ 492 = INT\left(15180.27 \times 9 \times 3600 \div 1000000\right) \]

The type 72 record contains the hardware service units per second value (SUSEC for the equation). The value is 17353.5792 for the same 2084-309. Therefore the hardware MSUs are:

\[ 562 = INT\left(17353.5792 \times 9 \times 3600 \div 1000000\right) \]

The IBM published value for hardware MSUs for a 2084-309 is 551. IBM has slightly understated the MSU value.

IBM was queried about this difference in hardware MSU values. The response returned from the Washington System Center was that this author was being too precise in his MSU calculation. The difference tends to be within 2%.

Soft-Capping Behaviors
Figures 6, and 7 were generated by Microsoft Excel using the data manually collected from the TSO RMF Monitor III Facility and processed by SAS to create the CSV files for spreadsheet software.

Figure 6 shows the behavior of a different LPAR when the 4-hour rolling average MSU consumption reached the LPAR Defined Capacity, resulting in the soft-cap being applied. Notice that the actual MSU consumption is not constant. The RMF III data showed that in general the capping was 100%. Notice that the 4-hour rolling average MSU consumption was a few MSUs above the soft-cap. This, again, was free software MSUs! As stated before, this phenomenon has been confirmed by Al Sherkow. This can be easily exploited. Statistically this error is within 2-3 % of the LPAR Defined Capacity (soft-cap). This, again, indicates that users of VWLC get 2-3 % more MSUs of CPU resource than they are paying for.
Note that there was a brief 10 or 11 minute period (on the left of the chart, at approximately 8:45) where the 4 hour average MSU consumption was at or below the LPAR Defined Capacity. During that time the system used all available MSUs!

Even though the LPAR was not able to use all the power of the CPC, all WLM service class objectives were met and online system response times met service level objectives. Low priority discretionary test batch work was slowed down while the system was capped.

Figure 7 shows yet another LPAR and its behavior when the 4-hour rolling average MSU consumption reached the LPAR Defined Capacity. In this case, the data is in 2 minute increments. However, notice that there is no variation in the MSU consumption from interval to interval. The RMF III data showed 100% soft-capping for each interval.

Figure 7 shows yet another LPAR and its behavior when the 4-hour rolling average MSU consumption reached the LPAR Defined Capacity. In this case, the data is in 2 minute increments. However, notice that there is no variation in the MSU consumption from interval to interval. The RMF III data showed 100% soft-capping for each interval.

Figures 6 and 7 show different behaviors when the 4 hour rolling average MSU consumption reached the LPAR Defined Capacity. Each one of these LPARs is the principle LPAR on 2 separate CPCs.

This author suspects that since the actual (mathematically calculated) hardware MSUs are slightly higher than the stated hardware MSUs, that the actual software MSUs used during the soft-capped periods reflect that same slightly higher MSU specification.

At the present time, this author has only theories about the different behaviors. The SMF type99 subtype 8 records have proven to be of no value for determining the causes of these behaviors. The type 99 subtype 8 records contain less data than the RMF III VSAM cluster records. The current theory is that the more committed to work the LPAR is (high latent demand or very high In and Ready queues), the smaller the MSU consumption swings and the greater the CPU MSU capping is in effect. The LPAR in figure 6 runs a large CICS/DB2 workload providing a lot of variability. The LPAR in figure 7 is almost exclusively SAS batch.
Figure 8 shows the workload characteristics of an LPAR throughout the day. From midnight to 7 AM the work was well below the LPAR Defined Capacity. Sometime after 8 AM, the total workload climbed above the LPAR Defined Capacity. The total workload used the CPC’s CPU resources until the 4 hour rolling MSU average exceeded the LPAR Defined Capacity (approximately 11AM) and the soft-cap was imposed. The CPC MSU Capacity and LPAR Defined Capacity were converted to hardware MSUs for this chart because the service units reported in the type 30 and 72 records are hardware service units not software service units. Basically the service units were summed for each hour and divided by 1,000,000 to provide MSUs.

Managing the LPAR Defined Capacity (Soft-Cap)

Using the tools to determine the LPAR Defined Capacity (Soft-Cap).

All of the tools mentioned previously can assist in managing the soft-cap and determining where to set it. Each tool reports on MSU consumption. If your current average consumption is under 100%, the Sub Capacity Planning Tool is a good place to start. Over time, use of the various tools will provide a history of MSU consumption. This history can be used to further fine tune the soft-caps.

SAS and MICS or MXG can be used to acquire the requisite MSU consumption data. Using at least 30 days of data, an appropriate starting point for soft-capping can be determined. Daily, weekly and monthly graphs (similar to those used in this paper) can be used to monitor and determine adjustments to the LPAR Defined Capacity (soft-cap). Transaction volumes, response times and WLM performance data are also useful indicators for determining when to raise the LPAR Defined Capacity (soft-cap).

LCS is an excellent tool for analyzing MSU consumption. One of the reports identifies expendable MSUs (discretionary and low priority work, identified by the user of the tool) executed during the time intervals. This author has used this report to fine tune the soft-cap to meet the critical requirements of month-end processing. During the peak hours of month-end processing there are less than 5 MSUs of expendable work for many RMF intervals. This author reviews the reports from LCS on a weekly basis.

Since it appears that WLM will always provide a few more MSUs than the soft-cap allows, this can be exploited. Analyzing the data to determine the actual above the soft-cap usage will allow the capacity planner to set the LPAR Defined Capacity 2-3 percent lower.

This author’s organization has a significant month-end workload when compared to the rest of the month. The LPAR Defined Capacities are set to handle the critical month-end workload with some stress to test workloads (expendable work). During the rest of the month, there is resource to spare for the test workloads. Deliberate use of the available tools over a few months made this a functional reality. It took just a few hours per month to reach this state.
For an organization that does not have SAS and MXG, the Sub-Capacity Planning Tool can be used in conjunction with a spreadsheet to analyze and report on LPAR MSU consumption. Graphs can be generated and decisions for setting the LPAR Defined Capacity (soft-cap) can be made.

As is true for much of capacity planning, there are hard statistics and reporting to document the past. The actual values used for setting the LPAR Defined Capacity may come from the capacity planner’s art.

**How to set the LPAR Defined Capacity**
The LPAR Defined Capacity (soft-cap) is set at the Hardware Management Console. The process described works on HMC50: Hardware Management Console Workplace version 1.7.3 and 1.8.2, which implies it is consistent with most versions.

1. Make sure you are logged on the HMC as SYSPROG
2. In the Views pane (top left) select the Groups icon
3. In the bottom left pane select the Defined CPC’s icon
4. Highlight the desired CPC. Note: Only one CPC can be highlighted at a time to correctly change LPAR settings.
5. Rotate the right panel to the CPC Operational Customization panel
6. In the right panel select the Change LPAR Controls icon
7. Change the desired settings, specifically the soft-cap values
8. Select the Save and Change button to place the new soft-cap in effect
9. Unhighlight the CPC in the lower left pane
10. Repeat steps 4 through 9 for each CPC

**When to Set the LPAR Defined Capacity**
Every time the LPAR Defined Capacity (soft-cap) is raised during the billing month, the potential exists to raise the software charge for that month. Therefore the soft-cap should be raised judiciously and with forethought. Once raised, lowering it will probably not reduce the software charge for the month, unless the soft-cap was not reached. Raising the soft-cap to meet a peak load condition will impact the software bill for the entire month.

Once the soft-cap is reached during the month, lowering the LPAR Defined Capacity has no effect on the software bill for the month. The best time to lower the LPAR Defined Capacity is late (before midnight) on the 1st day of the month (last day of the monthly billing cycle). The new, lower cap will then be in effect for the next month. It can always be raised, but lowering the soft-cap probably won’t change the software charge until the next month if the LPAR Defined Capacity has been reached.

The best time to raise the LPAR Defined Capacity is early on the 2nd of the month (after midnight), so that the previous month’s bill will not be impacted.

**Getting Started**
It is relatively easy to setup and use. The time involved to get started is minimal. The following steps should be followed.

1. Download and install the Sub-Capacity Planning Tool.
2. Run the tool against several days of RMF data.
3. Determine that the actual system usage is typically below the CPC capacity.
4. Identify the LPAR Defined Capacity values for your LPARs. Initially, these values only need to be 2-3% below the CPC capacity
5. Follow the steps identified above to set the LPAR Defined capacities.
6. Monitor LPAR and workload behaviors, back out and quit if there is a problem at this low level of implementation.
7. Discuss the opportunity to use Sub-Capacity Workload License Charges with IBM and determine that it is a better license option than your current contract. If so, specify a time to convert to VWLC and change your contracts accordingly.
8. Monitor and adjust the LPAR Defined Capacities to maximize the benefit.
Benefits

There are two basic benefits to Sub-Capacity License Charges. The first benefit is the obvious software cost reduction. The second is the ability to better manage system growth.

Cost Savings

Since implementing Sub-Capacity License Charges, this author’s organization has observed noticeable savings.

The actual software cost reduction is dependent upon many factors, the size and number of CPC’s, the VWLC software mix, the 4-hour rolling averages of MSU consumption, and the depth of the soft-capping. The larger the machine(s) and the lower the defined capacity is set, the greater the IBM software savings.

A data center with 1919 software MSUs over a few CPCs running z/OS, DB2, COBOL, C++, MQSeries, CICS, HSM, DFSORT, GDDM, RMF, SDSF, RACF and Netview could be expected to pay $777,321 per month for the software with PSLC licensing. If the license is converted to VWLC the maximum per month would be $606,145. However, if the aggregate sum of the MSU usage and or soft-caps was 1866 MSUs the data center would only pay $595,450 for the month, which is a savings of $181,871 per month or an annual savings of $2,182,452. And for short burst of work the full capacity of the machines is still available, at no additional cost!

As previously mentioned, observations indicate that when the LPAR Defined Capacity is implemented the actual used MSUs are slightly higher than the LPAR Defined Capacity. Taking this into account, if the same data center implemented Sub-Capacity License Charges (VWLC) and set the LPAR Defined Capacities 2% below the CPC maximums (1880 MSUs) the monthly cost would be $593,927, saving $12,218 per month. That is $146,616 per year with no noticeable change in system performance and capacity. This is saving $146,616 with just a few hours of work!

Even small data centers can benefit from Sub-Capacity License Charges. This author assisted a small datacenter running a z800 (60 MSUs) with their implementation. If they run the same software as described in the previous examples, their monthly cost would be $109,848. If they set the LPAR Defined Capacity to 54 MSUs (90%) the cost is $105,996, saving $3,852 per month.

There is one downside to the cost savings. Decisions to raise the LPAR Defined Capacity cost money and therefore require some form of justification and approval. Even though the cost may only increase by 1 or 2 thousand dollars per month, it comes out of a budget and directly impacts the corporate bottom line.

Managing System Growth

The second benefit is managed growth. Through aggressive use of WLM and the LPAR Defined Capacity, growth can be slowed down extending the life of the processors. Raising the LPAR Defined Capacity in small increments corresponding to growth in workloads will extend the life of the CPCs and reduce upgrades and replacements. When a CPU upgrade is finally required, the bonanza spurt in usage can be managed with an incremental or no increase in the LPAR Defined Capacity. This also provides an opportunity to manage boom/bust behaviors in CPU usage.

In order to accomplish this, WLM policies must be carefully scrutinized, monitored and adjusted to provide performance where required. There is a cost, usually to low priority work during peak load periods. But, if this can be tolerated, growth can be slowed down. It is similar to running a CPU at full capacity and not having the opportunity to upgrade the CPU. However, the opportunity exists to add a few additional MSUs (smaller increments of growth) to meet the needs.

Conclusions

Since implementing VWLC, the author’s organization has experienced significant software cost reduction. At the present rate, the annual salaries of two performance and capacity analysts will be provided by the one year software savings.

As experience was gained, the rampant growth and upgrade schedule averaging one CP per month was reduced with no upgrades occurring for 5 months in a row.
The recommendations to raise the LPAR defined capacities have now become part of the capacity planning function and the decisions have become part of the political landscape. Raising the defined capacity costs real money, which requires managerial approval.

Sub-Capacity License Charges provide the rare opportunity for performance and capacity analysts to directly show real cost savings, which in turn demonstrates their value to the organization.

All of the tools mentioned in this paper have been used. LCS provides monthly corrections to the SCRT billing reports sent to IBM. LCS and in house developed reports and graphs track MSU usage and have been instrumental in establishing LPAR Defined Capacity (soft-cap) values.

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- Planning for Subcapacity Pricing, SA22-7999-00, September, 2004
- Planning for Workload License Charges, SA22-7506-06, December 2003
- Using the Sub-Capacity Reporting Tool SCRT Version 9.1, SG24-6522-11, September, 2004

Other web sites

Other Documents
- Alan Sherkow, LPAR Capacity and Software Usage Analysis Software (LCS) User’s Guide Version 02.02, March, 2004
### SUB-CAPACITY PLANNING TOOL

**Release Date**: 6/2/2004  
**Customer Name**: ACME Coyote Tricks  
**System Name**: CPC1  
**Serial Number**: 12345  
**Machine Description**: 2084-309  
**Capacity (MSUs)**: 492

**Excluded LPARs**: LPR2, LPR3

If you had a product only running in QAS1, it would require 4 MSUs.  
If you had a product only running in SYSD, it would require 427 MSUs.  
If you had a product running in ALL LPARs, it would require 431 MSUs.

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<th>Avg MSUs/Interval CFPA - Util</th>
<th>Rolling 4-Hr Avg CFPA - Util</th>
<th>Avg MSUs/Interval CFTZ - Util</th>
<th>Rolling 4-Hr Avg CFTZ - Util</th>
<th>Avg MSUs/Interval TST1 - Util</th>
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<th>Avg MSUs/Interval LPR1 - Util</th>
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**LPAR Name** | **Weight** | **CP Processors**
--- | --- | ---
CFPA | 0 | 0
CFTZ | 10 | 1
TST1 | 15 | 2
LPR1 | 95 | 9
This report is prepared by the zSeries customer identified above ("Customer") or its authorized designee, and such Customer is solely responsible for the contents and accuracy of this report. Specifically, IBM makes no representations or warranties regarding the contents or accuracy of this report. Any questions concerning this report should be directed to the Customer.
### Attachment 3 – LCS SCRT1B Report

**PRODUCT SUMMARY INFORMATION WITH MSUS AND SYSPLEX/SYSTEM COMBINATIONS**

**Machine Identifier**: 2064#1234, A 2064-113 with announced capacity of 392

**Reporting Period**: 02JUN2004. Is z/OS the only operating system? Yes

**Maximum Simultaneous 4 Hour Rolling Average** is 384 MSUs which is 94% of the announced capacity

#### This Group is SCRT Products

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<tr>
<th>PRODUCT TYPE</th>
<th>PRODUCT NAME</th>
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<th>TOOL</th>
<th>MSUS</th>
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**Added w/LCS**

| CA-IDMS | CA-IDMS | 392  | PLEX1_LPR1          |      |                  |
| CA-7    | CA-7    | 392  | PLEX1_LPR1          |      |                  |
| IBM COBOL FOR MVS & VM | 5688-197 |      |                  |      |

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### Attachment 4 – LCS SCRT1C Report

**SCRT: TOP 25 SIMULTANEOUS 4 HOUR ROLLING AVERAGES, COMPARE WITH THE SCRT ‘DETAIL LPAR DATA SECTION’**

**Machine Identifier**: 2064#1234, REPORTING PERIOD IS 02JUN2004.

#### This Page is for LPARs PLEX1_LPR1

**SCRT Reports Hourly Data in the Two Left Columns, LCS Adds Interval Level MSUs in the Three Right Columns**

**Your IBM Bill Will Be Based on the First Number in the First Column**: 382.0

**Bonus MSUs That Will Not Appear on Your Bill**: 0.0

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