

Are You Using the Right 4-Hour Rolling Average?



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Abstract

One of the biggest part of mainframe budgeting is the Monthly License Charging (**MLC**) for software. The MLC for software covers the license and support cost for the majority of IBM software's like z/OS, CICS, DB2, IMS. Earlier this chargeback was done relative to the full capacity of the machine. In 2000 IBM introduced the Sub-capacity pricing option and most organizations quickly adopted to this usage metric of billing. The usage is calculated based on the Rolling 4-Hour Average (R4HA). It is important to keep a track of 4-Hour Average to gain an insight on what is driving your monthly software bills. The Sub-Capacity Reporting Tool is an IBM tool which generates a monthly licensing cost report for sub capacity eligible products by analyzing a month worth of data for IBM Z environment. Tivoli Decision Support for Z/OS leverages the performance data to generate insightful reports for different components of System Z. One of the reports which can be produced is the monthly 4Hour Rolling Average report to understand what drives the monthly licensing costs. The focus of this paper would be to establish a reporting technique that will align with the SCRT report using Tivoli Decision Support for Z/OS.

Keywords: MLC, R4HA, SCRT, Tivoli Decision Support

Introduction

How 4 Hour Rolling Average is Calculated?

WLM is responsible for sampling the MSU Utilization for each LPAR every 10 seconds. Every 5 minutes, WLM documents the highest observed MSU utilization sample from the 10 second bucket. This process keeps a track of the past 48 updates sampled for each LPAR. When the 49th observation is recorded, the 1st observation is discarded, and so on. These 48 observations of 5 minutes each represent a total of 5 minutes * 48 = 240 minutes or the past 4 hours rolling average (R4HA). WLM stores the average of these 48 values in the WLM control block RCT.RCTLACS. Every time RMF creates a Type 70 record, the current 4 hour rolling average from RCT.RCTLACS is populated in the SMF70LAC field representing the 4hour rolling average at the time of cut. This way we have the “4 Hour Rolling Average” being recorded as SMF70LAC for every Type70 record.

The below example shows how 4HRA is calculated. In this example the 4HRA at 04:00 is 271 MSUs which is average of all the 48 intervals of 5 minutes each from 00:00-4:00.

OBS	TIME	MSU/HR
1	0:00	220
2	0:05	259
3	0:10	278
4	0:15	262
5	0:20	312
6	0:25	225
7	0:30	234
8	0:35	289
9	0:40	285
10	0:45	262
11	0:50	283
12	0:55	310
13	1:00	302
14	1:05	289
15	1:10	263
16	1:15	213
17	1:20	241
18	1:25	173
19	1:30	169
20	1:35	233
21	1:40	279
22	1:45	303
23	1:50	328
24	1:55	313
25	2:00	319
26	2:05	319
27	2:10	280
28	2:15	280
29	2:20	307
30	2:25	293
31	2:30	289
32	2:35	301
33	2:40	249
34	2:45	304
35	2:50	273
36	2:55	277
37	3:00	301
38	3:05	249
39	3:10	211
40	3:15	234
41	3:20	241
42	3:25	278
43	3:30	304
44	3:35	273
45	3:40	277
46	3:45	307
47	3:50	229
48	3:55	304
4HRA AT 04:00	4:00	271



How SCRT Reports the 4 Hour Rolling Average?

The Detail LPAR Data (N5) section of the SCRT report shows the interval (date and hour) during the month for each LPAR on a CPC when the LPAR reached a maximum rolling 4-hour average utilization value (in MSUs). It also shows the interval in which the sum of all the LPARs reached a maximum rolling 4-hour average value. The SMF Recording interval varies from site to site based on the installation needs. The SCRT algorithm calculates 4HRA values at the hourly interval by taking an hourly average of 4HRA values at each of the LPAR SMF intervals. In the below example the SMF recording interval for LPAR A is 15 minutes and the peak reported in SCRT occurred at 20:00, so SCRT here has taken the mean of all the 4 intervals of 20th hour.

LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL SMF70LAC VALUES	SCRT VALUE REPORTED IN N5 SECTION AT 20th HOUR
A	20.00.00		53
A	20.15.00		53
A	20.30.00		52
A	20.45.00		50
CALCULATED VALUE : AVG(20:00,20:15,20:30,20:45) = 52 MSUs			

Tivoli Decision Support for Z/OS

Tivoli Decision Support for Z/OS leverages the SMF data to provide a variety of reports for various components of System Z. TDS maintains a database for different SMF record types which can be queried using QMF to provide reports on the fly. One such report is the monthly 4 hour rolling average report for each LPAR in the CEC. TDS provides 'MVSPM_SYSTEM_H' and 'MVSPM_LPAR_H' tables which contains the 'MSU_4HRA' (SMF70LAC) for each LPAR in the CEC. The below section of this paper establishes a reporting technique which will align with the SCRT report.

USING MVSPM_LPAR_H

'MVSPM_LPAR_H' provides hourly statistics on logical partitions and processor activity in a PR/SM environment. It contains data from SMF type 70. The 'MSU_4HRA' column contains the 4-hour rolling average for each logical partition. This value 'MSU_4HRA' in table 'MVSPM_LPAR_H' is **the last effective 4 hour rolling average** for the hourly interval (. **MSU_4HRA = LAST (V_MSU_4HRA)**).

For example, if your recording interval is 15 minutes then the 'MSU_4HRA' value reported for 20th hour in TDS will be the value which occurred at 20:45(the last effective 4HRA value for that hour). This is the reason your 'MSU_4HRA' value would not match with your SCRT value.

LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL MSU 4HRA	1 HOUR INTERVAL DATA IN MVSPM_LPAR_H AT 01:00:00
A	01.00.00		35
A	01.15.00		35
A	01.30.00		36
A	01.45.00		35 TDS VALUE : 35 (LAST EFFECTIVE 4HRA)
LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL MSU 4HRA	1 HOUR INTERVAL DATA IN MVSPM_LPAR_H AT 03:00:00
A	03.00.00		33
A	03.15.00		33
A	03.30.00		34
A	03.45.00		34 TDS VALUE : 34 (LAST EFFECTIVE 4HRA)
LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL MSU 4HRA	1 HOUR INTERVAL DATA IN MVSPM_LPAR_H AT 20:00:00
A	20.00.00		53
A	20.15.00		53
A	20.30.00		52
A	20.45.00		50 TDS VALUE : 50 (LAST EFFECTIVE 4HRA)

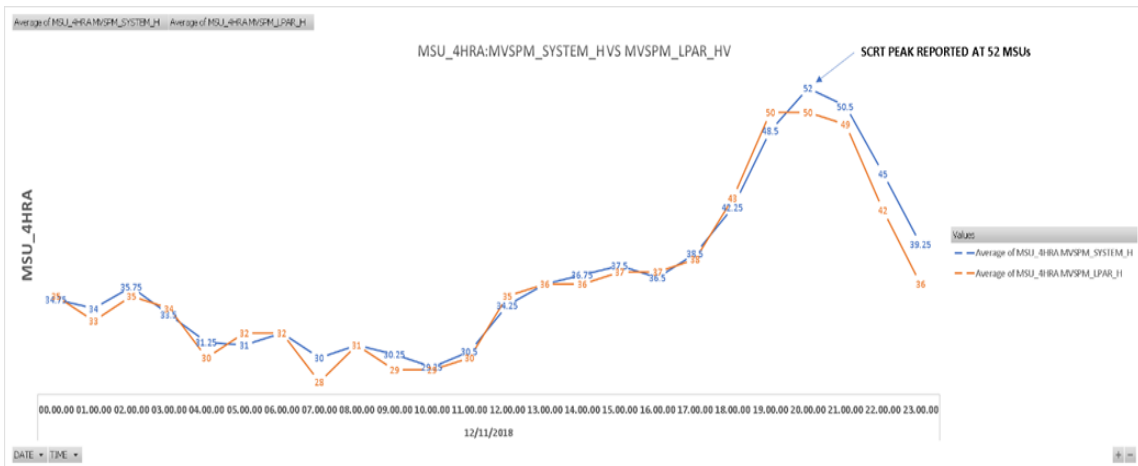
USING MVSPM_SYSTEM_H

MVSPM_SYSTEM_H also contains the 'MSU_4HRA' (SMF70LAC) for each LPAR. However, the value of MSU_4HRA reported in this table is **the average (MSU_4RHA = Avg (SMF70LAC, INPUT_RECORDS) of SMF70LAC SMF interval records**. The MSU_4HRA values reported in this table always matches your SCRT report because SCRT uses the mean of SMF interval records to aggregate an hourly record. For example, if your SMF recording interval is 15 minutes then the MSU_4HRA value reported for 20th hour will be the average of SMF interval records (In this case **AVG (20:00,20:15,20:30,20:45)**).

LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL MSU 4HRA	1 HOUR INTERVAL DATA IN MVSPM_SYSTEM_H AT 01:00:00
A	01.00.00		35
A	01.15.00		35
A	01.30.00		36
A	01.45.00		35 TDS VALUE : 35.25 (AVERAGE 4HRA)
LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL MSU 4HRA	1 HOUR INTERVAL DATA IN MVSPM_SYSTEM_H AT 03:00:00
A	03.00.00		33
A	03.15.00		33
A	03.30.00		34
A	03.45.00		34 TDS VALUE : 33.5 (AVERAGE 4HRA)
LPARNAME	SMF INTERVAL	15 MINUTES INTERVAL MSU 4HRA	1 HOUR INTERVAL DATA IN MVSPM_SYSTEM_H AT 20:00:00
A	20.00.00		53
A	20.15.00		53
A	20.30.00		52
A	20.45.00		50 TDS VALUE : 52 (AVERAGE 4HRA)

‘MVSPM_LPAR_H VS MVSPM_SYSTEM_H

The graph below shows how the MSU_4HRA values in MVSPM_LPAR_H and MVSPM_SYSTEM_H varies with time. This example shows how MVSPM_LPAR_H might be misleading when compared to the SCRT Report.



Group capacity and Defined capacity.

Whenever SCRT finds out that LPAR usage is exceeding the individual defined capacity or LPARs within the same group are exceeding the group capacity limit, it replaces the LPAR usage with the capping value. It first checks for individual LPAR defined capacity before taking into consideration the group capacity limit.

Conclusion

Tivoli Decision Support for Z/OS provides the functionality to track the last effective 4 Hour Rolling Average and Mean 4 Hour Rolling Average. It is very important to understand the context of each of these values while reporting. The 'MVSPM_SYSTEM_H' should be used as a baseline while comparing your results with SCRT. However, to keep track of the last effective 4 HRA in an hour 'MVSPM_LPAR_H' becomes an ideal choice.