AV2.11 to AV2.16 Stitcher/Session Memory Use - QAM markets
Charter Internal Note.
Draft Version 1.0.0

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May 2020

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1 Introduction

Session Size analysis was performed in AV2.11, which showed memory usage to be significantly higher than was expected. AV2.16 brings changes to webkit, which are expected to bring the largest sessions down in size due to improvements to the garbage collector which de-allocates memory which is no longer in use. Further improvements are expected with the delivery of changes to SGUI's NNS project. With these performance improvements underway, this document serves as a look into the performance provided by the switch to Webkit-V3 bundled in the deployment of AV2.16 in QAM markets (Portland and Slidel) which have to date been deployed.

2 RSS vs. SIZE

The Resident Set Size(RSS) of a process in Linux is a measure of memory used, but does not include memory which is swapped out, or memory which is being used in shared memory libraries. Virtual Memory Size (VMS) aka SIZE includes all memory the process can access, including swap memory and memory which has been allocated but not used. This means that RSS under-reports memory used, while VMS over-reports memory used. In AV2.16 VMS has become unusable for capacity planning because of how memory is allocated in webkit-V3. RSS in AV2.16. Linux reports that RSS used by a webkit process may be 380 MB, while the VMS is allocating 100GB per session on stitchers that only have 128 GB or 256 GB of memory. There are three usual causes for large virtual memory utilization which don't materialize into real memory usage as we are seeing. Those are extensive use of swap memory, use of large shared libraries, and memory which is allocated to the buffer/cache but is not used. A 'free -m' command reveals no use of swap memory, some use of shared memory, but does show up as a significant allocation to buffer/cache memory. The use of buffer/cache memory was also present in AV2.11, but did not show in the VMS SIZE reporting. Some shared memory libraries are being used, but not at the level to explain the VMS reported size of each process. A better understanding of how webkit manages its memory allocations and shared memory will be necessary going forward to ensure accurate capacity planning can be accomplished in AV2.16+ environments.

3 Memory Consumption AV2.11

The memory utilization of the html5client process on the Portland stitchers in AV2.11 is summarized in table 1. Here we can see the difference between RSS and VMS reported by Linux. The average AV2.11 session is using 815MB of memory when reported by RSS, and 1175 MB (over 1 GB) of memory when reported by SIZE (VMS). This difference comes down to buffer/cache memory and shared memory utilization in the webkit-V2 environment. It is worth noting that the largest session in Portland at the time of measurement was 6.7GB RSS which corresponds to 8.7GB VMS.

pldcor	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	389	389.000000	389.000000	389.00000
mean	1 days 05:24:52.033419	11.805141	815.620380	1175.33370
std	5 days 16:38:37.442890	24.115209	733.513476	1041.47454
min	0 days 00:00:01	0.000000	125.612000	211.30800
25%	0 days 00:01:08	0.300000	330.576000	576.40000
50%	0 days 00:14:33	2.300000	636.780000	919.36800
75%	0 days 01:38:37	8.500000	1054.984000	1405.63200
max	37 days 14:45:31	99.900000	6727.340000	8748.13200

Table 1: Size of the html5client in AV2.11 from PLDCOR.

4 Memory Consumption AV2.16

The one html5client process from AV2.11 has been split up into three processes in AV2.16. Those three processes are html5client-v3, WebKitWebProces, and WebKitNetworkProcess. Use metrics for html5client-v3 can be seen in table 2. Use metrics for WebKitWebProces can be seen in table 3. Use metrics for WebKitNetworkProcess can be seen in table 4. All three of these processes contribute to session memory utilization.

pldcor	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	506	506.000000	506.000000	506.000000
mean	0 days 00:41:26.021739	0.424704	43.621684	93895.408292
std	0 days 01:00:50.166777	0.688435	8.362421	8273.868427
min	0 days 00:00:00	0.000000	23.972000	84016.300000
25%	0 days 00:03:48	0.000000	38.061000	84088.565000
50%	0 days 00:22:18	0.100000	42.394000	100841.268000
75%	0 days 00:53:06.250000	0.600000	48.441000	100863.709000
max	0 days 10:35:26	4.400000	79.672000	100896.780000

Table 2: Size of the html5client-v3 in AV2.16 from PLDCOR on 05/20.

pldcor	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	512	512.000000	512.000000	512.000000
mean	0 days 00:41:04.878906	4.576562	286.127617	94585.646141
std	0 days 01:00:37.965294	10.453799	85.498982	8323.576927
min	0 days 00:00:00	0.000000	22.768000	84667.332000
25%	0 days 00:03:41.500000	0.400000	221.208000	85188.249000
50%	0 days 00:21:39	1.000000	267.196000	101659.494000
75%	0 days 00:52:43.750000	4.025000	339.199000	101932.089000
max	0 days 10:34:47	92.000000	689.492000	102392.896000

Table 3: Size of the WebKitWebProces in AV2.16 from PLDCOR on 05/20.

pldcor	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	505	505.000000	505.00000	505.000000
mean	0 days 00:41:47.299009	0.343960	32.72484	92755.409030
std	0 days 01:00:56.538316	1.194003	1.81726	8393.817497
min	0 days 00:00:01	0.000000	30.59600	84149.036000
25%	0 days 00:03:59	0.000000	31.34000	84584.300000
50%	0 days 00:23:41	0.000000	31.86800	84771.688000
75%	0 days 00:53:35	0.100000	33.57200	101360.492000
max	0 days 10:35:07	13.500000	40.42800	101614.444000

Table 4: Size of the WebKitNetworkProcess in AV2.16 from PLDCOR on 05/20.

By taking these three processes and combining them we can get a comparable result for session memory utilization. Each process's average utilization can be added, and their standard deviations can be added in quadrature to yield a meaningful result. The html5 process has RSS of 43±8 MB, WebkitWeb 286±85 MB, and WebKitNet 32 ± 2 MB. This gives an overall session RSS of 361 ± 85 MB. Because of the overallocation of memory by webkit-v3 a result for the VMS SIZE is not meaningful. This RSS measurement, by the nature of how RSS is reported, under-represents the actual memory used. The use of 'free -m revealed approx 1-3 GB of shared libraries loaded into memory in pldcor which is not included in the RSS session size reporting. Shared memory increased in bodcma (a docsis market) from AV2.11 to AV2.16, from between 2-5GB in AV2.11 up to 7-10GB in AV2.16 per stitcher. Further measurements of shared memory use will be required to fully assess capacity on a per market basis. Session size, however, will be the majority contributer to capacity, using approx. 10x more memory than shared memory allocations even with the increases in shared memory seen in bodcma.

5 Impacts on Capacity Modeling

Since the core processes of how SGUI is delivered, changes to the capacity model are required. The old capacity model is

$$Capacity_{AV2.11} = \frac{Mem * 0.8 * 1000}{SesSize + 2.32 * SesVar}$$

which is described in the stitcher capacity document. Since that was based on one process the $SesSize$ and $SesVar$ were more easily measurable. With three processes the $Size$ and Var for each of the three processes are needed. Sizes can be measured in the same way for each process, and then added for a total average session size. The Var needs to be measured for each process, and then added in quadrature. This means $SesVar = \sqrt{Var_{html}^2 + Var_{WebKitWeb}^2 + Var_{WebKitNet}^2}$. Because the use of RSS is required shared memory use also must be included in order to get accurate memory use. This means that an allocation for shared memory use must be subtracted from the total available memory. This means the new capacity model adjusted for changes in AV2.16 is

$$Capacity_{AV2.16} = \frac{Mem * 0.8 * 1000 - (SharedMem + 2.32 * SharedMemVar)}{SesSize + 2.32 * SesVar}$$

where $SharedMem$ is the average shared memory for stitchers on the market, $SharedMemVar$ is the standard deviation of shared memory for stitchers on the market, $SesSize$ and $SesVar$ have been adjusted to account for all three processes as described above, and an allocation of 2.32 standard deviations has been made to account for stitchers using above average shared memroy. The 2.32 factor is the statistical Z-Score corresponding to 99% coverage for this allocation.

6 Conclusion

In AV2.11 average session size in Portland was reported as RSS 815 ± 733 MB and SIZE 1175 ± 1041 MB. This is in contrast to AV2.16 which is using RSS 361 ± 85 MB. RSS size has come down by 56%, with a corresponding 89% reduction in the standard deviation. Similar gains were realized in Slidel with a reduction in session size from 680 ± 384 MB RSS down to 382 ± 85 MB RSS, which is a reduction of 45% in average session size and a reduction in the standard deviation of 78%. This means in both these markets we are no longer seeing sessions growing to 5, 10, even 20GB of RAM usage which require supporting as we saw in AV2.11. This gives us a remarkable increase in capacity as we deploy AV2.16 and further assessments of capacity for the 2021 year will be performed upon conclusion of AV2.16 deployments to begin planning for capacity requirements in fiscal year 2021.