Stitcher Capacity Analysis:
Charter Internal Note.
Draft Version 2.2.2

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1 Introduction

The stitcher combines a set of audio and video assests into a unified guide experience. Prior to reaching the stitcher, the audio and video assets are pre-encoded into stitchable MPEG objects where they can be dynamically assembled into a single full screen MPEG video stream. That full screen stream (or session) can be personalized for each user request. This customization necessitates that each user get their own session. Those sessions present themselves as an html5client process which is managed by the SGUI application.

The following Active Video services run on the Stitcher. These services can be started, stopped, and restarted using these service names.

1. lsm- the Local Session Manager (LSM)
2. compositor- the Streaming Engine
3. virga- the default Application Engine
4. trafficserver- the standard internet cache used as local Stitcher cache
5. udc- the service that collects and redirects reporting messages.

Another common action is h5restartall, 5 being a referance to the 5 core Active Video services present on the stitcher.

Because user guide streams require customization, stitchers scale with customer count 1:1 since information for each guide session must be loaded individually for each session. The size of user sessions in memory (and therefore the required comupting resources) also grows with the content provided/delivered. Each new overlay, content provided, or feature added to the SGUI appliction increases the computational burdon for providing the Spectrum Guide experience. Not all features are created equally, so the additional computational resources needed per feature would need to be assessed on a case by case basis and compared to a baseline measurement without the feature.

1.1 Interactions with other systems

The stitchers get sessions assigned to them by the Central Session Manager (CSM). Sessions can only get routed to the stitchers if the CSMs are functioning properly, and load balancing (which is managed by CSMs) can put extra load or alleviate load on the stitchers themselves. A discussion on this algorithm and CSMs in general should be addressed in the CSM capacity analysis document.

Stitchers get their content from many places, one of the largest in terms of capacity is scaled tiles. Those are delivered by the scalars and processed on the scalar by the SGUI application. The interaction of these systems contains several potential bottlenecks to be assessed/addressed.

Stitchers send the final video stream to the users STB through either the QAM or the CMTS in DOCSIS markets. The communication proticol to and the bandwidth through those edge devices present another potential bottleneck.

Market	Number of stitchers	Memory (GB)	Number of cores
EDPRMN	89	96	40
KNWDMI	149	96	40
MDDCWI	187	96	40
PLDCOR	50	96	56
RENONV	56	96	40
SLDCMO	258	96	40
SPDCSC	84	96	40
BODCMA	55	128	56
DLDCTX	23	128	56
LADCCA	47	128	56
NVDCTN	50	128	56
SLDCLA	23	128	56
SLOTCA	13	128	72
TWCCA	287	256	72
TWCNY.NYDC	195	256	72
TWCNY.SYDC	323	256	72
TWCOH	443	256	72
TWCSC	307	256	72
TWCTX	282	256	72

Table 1: Stitcher availability market by market.

Bandwidth concerns for the edge devices will be addressed in that capacity analysis document.

1.2 Technical Debt

Two main pieces of technical debt that we are aware of at the time this analysis began were log rotations, and CCO being disabled in QAM markets.

UPDATE April 2019: Logrotate was addressed in March 2019 by a reconfiguring of the logrotate utility. CCO being disabled in QAM markets is outstanding, which complicates code deployments, but chef being enabled on stitchers means standardization can occour, it is just delayed and less automated than it could/should be.

2 Where We Stand Today

2.1 Stitchers Available

The first step in calculating how much capacity our markets have is to know how many and of what kind of stitchers are available market by market. A summary can be seen in table 1.

2.2 Stitcher Capacity Analysis

The stitchers (as well as any server we operate) should at a minimum be assessed on memory consumption, CPU use, disk space utilization, networking usage, and application performance.

2.2.1 Networking Usage

Stitchers have a 10Gb NIC each, and we will not be network limited by the stitchers in the forseeable future. Any networking constraints would need to be addressed by an audit and analysis of networking hardware utalization in our datacenters. Peak ussage of the stitcher networking varies from approximatly 500Kb to 150Mb. In future hardware acquisitions a 1Gb NIC would be sufficient and could present significant savings.

2.2.2 CPU Utalization

Overall CPU utalization of the stitchers is quite low, This can be seen by running top, but more illustrative is the CPU consumption of the SGUI application seen in figure 1 and figure 2. This shows that each instance of the SGUI application is using $< 5\%$ of one core. With 20 concurrent sessions that means that even the lowest provisioned stitchers are utilizing approximatly $\frac{1}{40}$ of the cores on the blade. Averge sessions show approx 1% CPU utalization as seen in tables presented in appendix A.

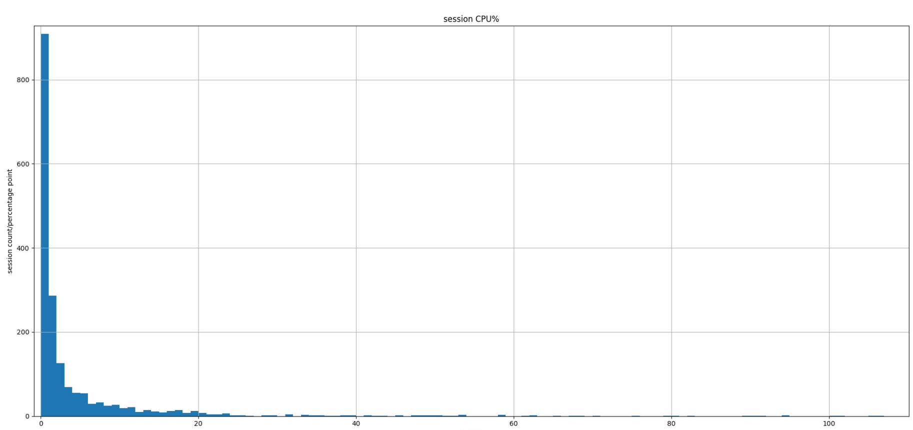

Figure 1: CPU useage of sessions. Note that a majority of sessions use ¡5% CPU. A few sessions use sigificant CPU when they are first beginning, as seen in figure 2

but the average is still quite low.

It is worth noting that some CPUs in some markets have 3100 GHz processors, while some have 2800 GHz processors. If in the future markets become

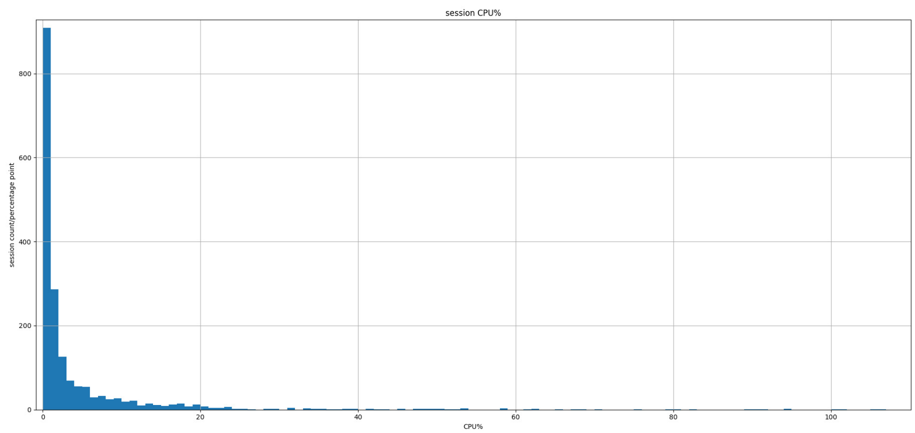

Figure 2: CPU usage of sessions over time. Note that most sessions use $< 5\%$ CPU.

CPU bound then that effect will have to be taken into account. This represents an approximately 10% effect in the unlikely event that our capacity becomes CPU bound.

2.2.3 Application Performance

AV's 5 applications are generally performing well with little concern over capacity. There is some concern over the virga cache clear process, traffic server utilization and logging, and compositor's use of networking communications. These concerns are being assessed for impact and any related customer impacting issues are being addressed with Active Video.

As mentioned the SGUI application is using small amounts of CPU, and is generally well controled. What we have identified, however, is that the SGUI application is using substantial amounts of memory. The primary rendering of the user experience is an html5client process, and can be measured with the ps utility. The memory demands of the SGUI application average (enterprise wide) nearly 1GB of memory for each user session, with some QAM markets using nearly 1.5GB of memory per user session and the largest sessions using up to 20GB of memory for one user. A market by market summary of session size can be seen in appendix A as well as an example of session size plotted in RENONV taken from prime time in figure 3.

2.2.4 Memory Consumption

The memory utilization of the stitcher is by design primarily driven by the SGUI application. Since the SGUI application is using so much memory this leads to hardware constraints that must be addressed.

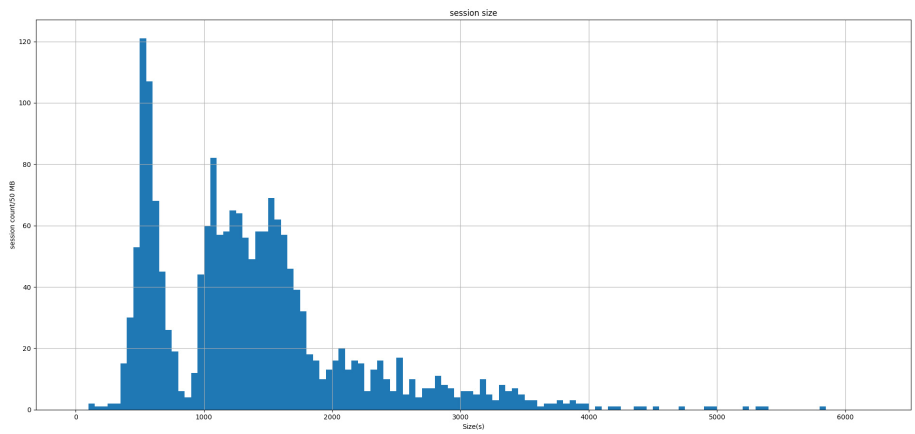

Figure 3: Sample histogram showing session size taken from renonv in prime time. Note the multiple peak structure and sparsely populated region at approx. 750MB. The space between each peak is almost certainly a catalog of some kind being loaded into memory.

For our purposes there are three types of stitchers in production, those with 96 GB of memory, those with 128 GB, and those with 256 GB. The capacity of these stitchers is calculated by

$$Capacity = \frac{Mem * 0.8 * 1000}{SesSize + 2.32 * SesVar}$$

Where $Capacity$ is the number of sessions a stitcher can take, Mem is the memory of the stitcher in GB, 0.8 is the threshold for avoiding stitcher degredation (alloting for some system proceses as well) 1000 is a conversion factor, $SesSize$ is the average size of sessions in MB, $SesVar$ is the standard deviation of session size, and the 2.32 factor is a statistical Z-score corresponding to a 1% chance of stitcher degredation. The results can be calculated market by market but in the end all markets are exhibiting similar behaviour. For the observed size of sessions capacity for each stitcher by memory provisioning is summarized in table 2.

Stitcher Memory (GB)	Stitcher Capacity (sessions)
96	20
128	65
256	125

Table 2: Stitcher Capacity by memory provisioning of stitcher

Note that reducing average session size isn't sufficient to reduce hardware needs unless variance in session size can be addressed. As long as we are supporting sessions that are in the multiple/tens of GB then increased allocation is needed to ensure degredation doesn't occur.

To calculate how many customers a particular provisioning could support, simply take the stitcher capacity calculated above, and multiply by the number of stitchers available.

$$NCust = Capacity * Nstitch$$

where $Capacity$ is the number of sessions a stitcher can take (calculated above) $NStitch$ is the number of stitchers available, and $NCust$ is the number of customers that the given stitchers will support without negative effects. Note that the 20/65/125 numbers are guidelines, and as the environment changes $Capacity$ will have to be recalculated to match current production conditions.

This model has been (unfortunately) validated by the AV2.11 upgrade attempt in RENONV in Dec. 2018. In that upgrade attempt half the stitchers were taken out of the pool in preparation for code deployment. Unfortunately that exceeds the capacity by enough that the remaining stitchers couldn't handle prime time load, and every stitcher on the market went degraded at once. The load RENONV was under when it collapsed was estimated to be 35 sessions per stitcher, which was already over the threshold for a total market failure.

2.3 Market Capacity Analysis

With the number of sessions that we need to support the current environment right now, and the number of sessions a stitcher can handle with acceptable error rates, the number of stitchers needed to support our customers can be calculated. Hardware needed can be seen in table 3. Columns for both current provisioning as well as 256GB memory upgrades are presented. Note highlighted rows which show capacity limitations being exceeded before this analysis took place.

3 Projections to eoy 2019

We can also cacluate the need if we upgrade to 256 GB stitchers and project how many stitchers we need in order to achieve our growth expectations. Growth model shown in table 4.

Growth Model	EOY 2018	EOY 2019	EOY 2020
Enterprise wide	2,565,010	6,667,773	9,709,285
L-TWC DOCSIS	1,258,324	4,364,276	6,199,043
L-CHTR DOCSIS	323,200	638,898	826,690
L-CHTR QAM	983,486	1,656,986	2,053,339

Table 4: Projected growth (number of STB) by type of market.

Market	N stitchers available	Memory of stitchers on market	N stitchers needed EOY 2018	N 256GB stitchers needed EOY 2018
EDPRMN	89	96	70	26
KNWDMI	149	96	167	63
MDDCWI	187	96	188	70
PLDCOR	50	96	49	18
RENONV	56	96	80	30
SLDCMO	258	96	219	82
SPDCSC	84	96	141	53
BODCMA	55	128	17	8
DLDCTX	23	128	23	11
LADCCA	47	128	46	23
NVDCTN	50	128	21	11
SLDCLA	23	128	13	7
SLOTCA	13	128	6	3
TWCCA	287	256	30	30
TWCNY.NYDC	195	256	12	12
TWCNY.SYDC	323	256	23	23
TWCOH	443	256	46	46
TWCSC	307	256	49	49
TWCTX	282	256	46	46

Table 3: Stitcher availability and needs market by market for EOY 2018 with current provisioning and 256GB upgrades.

Market	N stitchers available	Memory of stitchers on market	N stitchers needed EOY 2019	N 256GB stitchers needed EOY 2019
EDPRMN	89	96	118	44
KNWDMI	149	96	281	106
MDDCWI	187	96	316	118
PLDCOR	50	96	83	31
RENONV	56	96	135	51
SLDCMO	258	96	369	138
SPDCSC	84	96	238	89
BODCMA	55	128	33	16
DLDCTX	23	128	45	23
LADCCA	47	128	90	45
NVDCTN	50	128	42	21
SLDCLA	23	128	22	11
SLOTCA	13	128	13	6
TWCCA	287	256	105	105
TWCNY.NYDC	195	256	41	41
TWCNY.SYDC	323	256	82	82
TWCOH	443	256	161	161
TWCSC	307	256	169	169
TWCTX	282	256	160	160

Table 5: Stitcher availability and needs market by market for EOY 2019 with current provisioning and with 256GB upgrades.

With no software fix forthcoming for session size then we can use the model defined in table 4 to project EOY 2019 needs. Those results are summarized in table 5.

The expected effects of addressing stitcher related tech debt on capacity are minimal.

Other short term mitigation strategies include disabling suspended sessions while in VOD or other features, paginating loaded catalogs such as channel lineup information or VOD from within the SGUI application, and reallocation of stitchers and scalars to ensure sufficient hardware to continue supporting the SGUI application. A hybrid approach of these techniques will be necessary.

4 Projections to eoy 2020

With no software fix forthcoming for session size then we can use the model defined in table 4 to project EOY 2020 needs similar to our EOY 2019 projection. Similarly Table 7 shows when each market would go over capacity under current provisioning, and under a 256GB upgrade plan. Those results are summarized

Market	N stitchers available	Memory of stitchers on market	N stitchers needed EOY 2020	N 256GB stitchers needed EOY 2020	N 512GB stitchers needed EOY 2020	N 768 GB stitchers needed EOY 2020
EDPRMN	89	96	146	55	28	18
KNWDMI	149	96	350	131	66	44
MDDCWI	187	96	393	147	74	49
PLDCOR	50	96	103	39	20	13
RENONV	56	96	168	63	32	21
SLDCMO	258	96	458	172	86	57
SPDCSC	84	96	295	111	56	37
BODCMA	55	128	43	21	11	7
DLDCTX	23	128	59	29	15	10
LADCCA	47	128	117	58	29	19
NVDCTN	50	128	55	27	14	9
SLDCLA	23	128	27	14	7	5
SLOTCA	13	128	17	8	4	3
TWCCA	287	256	149	149	74	50
TWCNY.NYDC	195	256	58	58	29	19
TWCNY.SYDC	323	256	116	116	58	39
TWCOH	443	256	229	229	114	76
TWCSC	307	256	241	241	120	80
TWCTX	282	256	228	228	114	76

Table 6: Stitcher availability and needs market by market for EOY 2020 with current provisioning, 256GB, 512GB, and 768GB upgrades.

in table 6. The large number of stitchers required in some markets shows that no hardware based resolution can be the only steps taken. It would be prohibitively expensive to attempt, and so a software based solution is needed.

5 Mitigation and Resolution Strategies

Stitcher mitigation strategies would be tied to scalar cluster logistics. The following plan is presented in three parts. Phase 1 is meant to provide additional capacity to the most at risk markets. Phase 2 is meant to extend the capacity of our most at risk markets and address our other markets of concern while also providing the hardware for scalar clusters for both QAM and DOCSIS scaled tiles. Phase 3 brings all our stitcher clusters to a minimum hardware specification, while also filling out other markets which were only brought to a minimum capacity in previous phases.

Market	Month Over Capacity	Month Over Capacity 256GB Upgrade
EDPRMN	June 2019	Good
KNWDMI	Nov 2018	Good
MDDCWI	Jan 2019	Good
PLDCOR	Feb 2019	Good
RENONV	Aug 2018	July 2020
SLDCMO	Apr 2019	Good
SPDCSC	Jun 2018	Nov 2019
BODCMA	Good	Good
DLDCTX	Feb 2018	Mar 2020
LADCCA	Feb 2018	Apr 2020
NVDCTN	Sept 2020	Good
SLDCLA	May 2020	Good
SLOTCA	Mar 2020	Good
TWCCA	Good	Good
TWCNY.NYDC	Good	Good
TWCNY.SYDC	Good	Good
TWCOH	Good	Good
TWCSC	Good	Good
TWCTX	Good	Good

Table 7: Timeline of stitcher overrun assuming no software fix for current provisioning and 256GB upgrades. Phase 1 mitigation strategies not accounted for. EDIT April 2019: If we were to upgrade SPDCSC to 256GB stitchers on all stitchers including ones added would address that market through 2020. DLDCTX was given enough stitchers to carry through 2020. The rest of phase 1 markets would still need attention.

5.1 Phase 1 Mitigation

UPDATE: Phase 1 POV was approved Mar 2019. Timeline - 12 weeks to completion. Cost, $30000 for shipping, $250000 for contracted hands on site.

Phase 1 of mitigation is designed to get us through end of Q2 2019 when the first software fix is expected. This hardware reallocation comes in three parts. First, 102 stitchers were discovered in SPDCSC, and those should be built out and used to alleviate capacity issues in that market. Second, shared datacenter reallocation can take place where 256 GB stitchers from TWC markets in TX and CA can be reallocated to L-CHTR TX and CA. 32 stitchers from TWCTX to DLDCTX, and 40 stitchers from TWCCA to LADCCA. Third and lastly, 236 blades have been identified as unused, 120 of them which are unracked, and 116 of them which are in racks. The 120 unracked blades will go 81 to KNWDMI and 39 to RENONV. The 116 blades currently in racks will go 91 to MDDCWI, 24 Stitchers to PLDCOR, 1 to KNWDMI.

5.2 Phase 2 Mitigation

Phase 2 of mitigation is designed to get us through end of 2020. Numbers of blades listed are based on no software fix, and are subject to change. Hardware needs will be reassessed when AV2.16 is in production and/or relevant SGUI deployments are pushed. This phase is closely tied to our scalar clusters and the buildout of the Charlotte datacenter.

Using the 442 96 GB blades freed up in Phase 1, build out/rebuild scalar clusters in Peakview and Charlotte, freeing up the 256 GB blades currently in use as scalars for use in phase 3. We will need at least 130 96 GB blades to support Peakview and 118 96 GB blades to support Charlotte under current load. The recommendation would be (if we have the datacenter resources to support the build out) to use the 442 96GB M3 blades divided up as 231/211 blades for Peakview/Charlotte which would give us extra capacity for turning on scaled tiles in aditional markets (DOCSIS) when we are ready. At that time we would need to assess the extra load caused by adding the DOCSIS markets in the form of additional content to create scaled tiles for. It is anticipated that capacity issues then would be datacenter space to build out scaler clusters and datacenter networking capacity.

Assess any 256 GB blades that are unused, and prioritize using those first. If further blades are needed they can be taken (200 each) out of TWCNY.NYDC, TWCNY.SYDC, and TWCOH with enough capacity remaining through EOY 2020. We should take only what is needed to help keep shipping costs to a minimum. Other markets have additional capacity as well, but these three are some of the most over provisioned for current load.

Any 256 GB blades that can be distributed should be sent, in order of priority, 172 SLDCMO, 111 SPDCSC, and 55 EDPRMN to replace the stitchers in those markets. These first three will then put all our stitchers in all markets at either 128 GB or 256 GB memory. Then we need to round out the QAM markets we addressed in Phase 1 with enough to get them through EOY 2020 by adding 256GB blades. They will need aditional blades of 56 MDDCWI, 49 KNWDMI, 24 RENONV, 15 PLDCOR. We will also extend the Re-IP effort with 20 more from TWCCA to LADCCA.

From The 47 128 GB blades that were freed up from LADCCA in Phase 1 should be sent as 16 NVDCTN, 16 SLDCLA, 15 SLOTCA.

The 23 128 GB blades from DLDCTX should be built out as an analysis cluster for audience measurement data aggregation.

5.3 Phase 3 Mitigation

The up to 533 96 GB blades taken from SLDCMO, EDPRMN, and SPDCSC in phase 2 can be sent to scalar clusters in peakview/charlotte to add capacity to the scalar clusters as necessary. These will give ample capacity to support DOCSIS and any remaining can be kept for parts in order to maintain the clusters.

256 GB blades taken from the old scalar clusters, and any that weren't used to complete Phase 2, should be allocated to replace 128 GB blades as 32 BODCMA, 32 NVDCTN, 32 SLDCLA, 32 SLOTCA. Further 256 GB blades should be allocated based on projected 2021 growth when that information becomes available.

At this point all stitcher clusters have a minimum of 32 256GB blades.

6 Conclusion

Mitigation strategies proposed here would address capacity concerns through 2020, would prepare us for features such as scaled tiles for DOCSIS markets, always on guide, and stitcher virtualization. There are other technical limitations to getting those projects off the ground, but this will put our hardware in a position to support those as best as is possible.

Long term it is vital that new features and customer growth be approved with ongoing assessments of stitcher resources used by each new feature/code release in order to ensure we are not overrunning our computational resources. Stitchers in their current bare metal architecture are especially prone to resource limitations if we aren't keeping a careful eye on our utilization.

A Appendix A Session Size Tables

All markets	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	7964	7964.000000	7964.000000	7964.00000
mean	0 days 16:57:29.043571	6.670191	704.325508	1016.00872
std	6 days 12:33:38.785822	17.375503	587.128283	751.04424
min	0 days 00:00:00	0.000000	26.296000	37.20400
25%	0 days 00:04:08	0.300000	306.063000	502.49400
50%	0 days 00:28:41.500000	0.900000	604.702000	906.51000
75%	0 days 01:13:26	4.500000	888.213000	1256.41700
max	131 days 03:35:10	145.000000	14712.656000	16320.25200

edprmn	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	703	703.000000	703.000000	703.00000
mean	3 days 23:41:03.660028	9.510953	687.757826	1037.11116
std	14 days 10:19:40.838831	19.807971	875.313315	1095.16143
min	0 days 00:00:00	0.000000	26.296000	37.20400
25%	0 days 00:01:28	0.400000	299.240000	519.00800
50%	0 days 00:13:56	1.700000	563.340000	828.87200
75%	0 days 00:52:57	9.950000	807.120000	1152.59800
max	61 days 20:24:45	136.000000	12119.260000	13713.00400

knwdmi	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	854	854.000000	854.000000	854.00000
mean	0 days 01:50:32.909836	7.179040	742.129691	1106.20582
std	0 days 11:45:10.901628	16.393025	730.700326	942.02897
min	0 days 00:00:01	0.000000	124.752000	209.78000
25%	0 days 00:02:39	0.400000	371.277000	626.71100
50%	0 days 00:18:28.500000	1.100000	638.800000	933.37400
75%	0 days 00:51:55	6.575000	920.667000	1273.83700
max	7 days 07:38:22	111.000000	13115.864000	14916.46000

mddcwi	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	663	663.000000	663.000000	663.00000
mean	0 days 01:13:31.853695	7.504827	871.828561	1323.55937
std	0 days 05:18:41.994081	17.288993	697.919157	1085.96406
min	0 days 00:00:01	0.000000	155.052000	222.77200
25%	0 days 00:03:22	0.400000	311.396000	528.56600
50%	0 days 00:21:19	1.300000	710.036000	1025.54400
75%	0 days 00:57:54.500000	6.350000	1140.840000	1598.61800
max	3 days 03:49:19	99.800000	5271.756000	8797.68000

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

renonv	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	990	990.000000	990.000000	990.00000
mean	0 days 01:00:09.429292	4.826869	968.266428	1315.58436
std	0 days 01:28:07.999288	11.318484	643.358079	761.49195
min	0 days 00:00:00	0.000000	87.840000	156.11200
25%	0 days 00:04:56.250000	0.400000	407.672000	640.68700
50%	0 days 00:32:28.500000	0.900000	857.420000	1223.10600
75%	0 days 01:13:59.750000	4.000000	1267.769000	1644.98900
max	0 days 17:49:29	100.000000	4509.704000	5523.24800

sldcmo	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	811	811.000000	811.000000	811.00000
mean	0 days 00:48:12.890258	4.603083	991.308099	1350.01964
std	0 days 01:16:55.655732	9.059367	681.528005	798.25732
min	0 days 00:00:00	0.000000	140.636000	225.09600
25%	0 days 00:04:00	0.400000	402.364000	658.48400
50%	0 days 00:24:37	1.200000	858.612000	1207.46800
75%	0 days 00:58:13.500000	4.700000	1315.152000	1718.66600
max	0 days 16:32:18	93.000000	4124.472000	5313.78000

spdcsc	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	1344	1344.000000	1344.000000	1344.00000
mean	0 days 05:33:22.727678	10.047545	747.331970	1148.42780
std	1 days 02:24:33.678990	22.922085	744.264176	1063.67384
min	0 days 00:00:00	0.000000	108.732000	163.03600
25%	0 days 00:03:07.500000	0.400000	363.873000	616.14000
50%	0 days 00:21:37.500000	1.300000	617.814000	876.55200
75%	0 days 01:02:09.250000	7.300000	818.191000	1253.15700
max	10 days 03:05:09	154.000000	11340.324000	12773.81600

bodcma	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	593	593.000000	593.000000	593.00000
mean	0 days 00:33:41.399662	5.413322	537.107386	765.38517
std	0 days 00:44:57.083644	12.469223	307.470807	369.60064
min	0 days 00:00:00	0.000000	144.824000	210.89600
25%	0 days 00:01:55	0.300000	280.832000	462.84000
50%	0 days 00:17:30	1.000000	412.584000	637.72800
75%	0 days 00:49:06	5.200000	722.672000	989.54400
max	0 days 08:33:57	153.000000	2237.936000	2545.99200

dldctx	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	1240	1240.000000	1240.000000	1240.00000
mean	0 days 09:59:56.741129	9.365484	484.178539	729.23009
std	3 days 22:37:16.728882	18.061337	295.350663	359.44808
min	0 days 00:00:00	0.000000	84.692000	132.11200
25%	0 days 00:01:12	0.600000	274.080000	477.95400
50%	0 days 00:04:50.500000	3.300000	343.756000	568.51400
75%	0 days 00:38:54	9.250000	635.297000	909.19700
max	70 days 04:14:55	119.000000	2011.240000	2581.69200

ladcca	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	867	867.000000	867.000000	867.00000
mean	0 days 08:47:35.552479	8.360208	450.936166	669.28376
std	2 days 16:09:18.559904	18.904368	244.823500	307.58961
min	0 days 00:00:00	0.000000	12.792000	22.89200
25%	0 days 00:01:21.500000	0.400000	275.056000	466.51000
50%	0 days 00:09:43	1.400000	336.452000	557.32000
75%	0 days 00:47:16.500000	7.850000	594.040000	820.15200
max	28 days 05:24:52	150.000000	1996.924000	2973.56800

nvdctn	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	773	773.000000	773.000000	773.00000
mean	1 days 23:34:24.972833	9.574774	581.608310	834.08841
std	11 days 21:42:02.836950	21.275061	351.990133	428.15494
min	0 days 00:00:00	0.000000	55.104000	105.19200
25%	0 days 00:02:02	0.400000	299.696000	492.51200
50%	0 days 00:19:12	1.500000	499.720000	732.01600
75%	0 days 00:56:50	7.900000	779.652000	1067.57600
max	127 days 05:50:07	115.000000	2500.564000	3165.04800

sldcla	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	358	358.000000	358.000000	358.00000
mean	0 days 00:58:12.290502	6.725419	680.787911	928.31454
std	0 days 05:02:56.766229	14.714847	384.019453	454.63616
min	0 days 00:00:00	0.000000	24.804000	55.67600
25%	0 days 00:01:33	0.300000	314.110000	508.44400
50%	0 days 00:16:41	1.300000	614.728000	848.91000
75%	0 days 00:54:09.250000	6.300000	965.019000	1233.39500
max	3 days 22:07:52	105.000000	1957.948000	2583.84800

slotca	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	189	189.000000	189.000000	189.00000
mean	2 days 05:08:17.068783	10.966667	517.918413	743.12943
std	12 days 06:00:47.279801	23.232777	254.689270	314.38865
min	0 days 00:00:00	0.000000	68.068000	113.12400
25%	0 days 00:02:09	0.400000	291.140000	466.89600
50%	0 days 00:13:11	1.900000	506.636000	705.66000
75%	0 days 00:58:16	8.800000	690.876000	947.54800
max	103 days 06:27:34	100.000000	1366.460000	1732.20800

twcca	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	505	505.000000	505.000000	505.00000
mean	0 days 00:35:02.885148	4.480000	515.805513	793.22996
std	0 days 00:45:24.634973	8.867115	255.678862	365.21607
min	0 days 00:00:00	0.000000	122.608000	176.76000
25%	0 days 00:03:25	0.300000	288.092000	459.67200
50%	0 days 00:18:04	0.900000	398.276000	666.70800
75%	0 days 00:50:38	4.200000	702.064000	1059.37600
max	0 days 05:29:07	82.500000	1365.628000	1919.64400

twcny.nydc	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	439	439.000000	439.000000	439.00000
mean	0 days 00:42:33.881548	3.782232	505.566378	770.06229
std	0 days 00:56:37.780297	10.605681	253.195549	353.68918
min	0 days 00:00:00	0.000000	84.100000	132.11200
25%	0 days 00:05:23.500000	0.200000	284.092000	456.28800
50%	0 days 00:25:12	0.700000	413.500000	646.48800
75%	0 days 00:54:22.500000	2.350000	682.940000	1027.04000
max	0 days 07:27:59	119.000000	1451.068000	1988.59200

twcny.sydc	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	442	442.000000	442.000000	442.00000
mean	0 days 01:01:03.726244	6.148190	500.684950	763.87129
std	0 days 05:46:28.356034	15.162467	260.041742	358.83244
min	0 days 00:00:00	0.000000	84.572000	132.11200
25%	0 days 00:03:06	0.300000	276.576000	455.65000
50%	0 days 00:22:50	0.800000	367.764000	581.14200
75%	0 days 00:59:00.750000	4.875000	697.221000	1039.71500
max	3 days 13:49:05	118.000000	1466.484000	1944.98800

twcoh	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	611	611.000000	611.000000	611.00000
mean	0 days 00:41:26.962356	4.990344	499.298710	762.94798
std	0 days 00:55:17.385177	10.710850	253.252774	350.21950
min	0 days 00:00:00	0.000000	18.548000	55.67600
25%	0 days 00:03:01.500000	0.300000	282.944000	460.38400
50%	0 days 00:20:57	0.800000	373.420000	609.91200
75%	0 days 00:59:45	4.300000	683.328000	1013.02800
max	0 days 07:08:58	90.500000	1385.548000	2101.02800

twcsc	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	697	697.000000	697.000000	697.00000
mean	0 days 02:14:16.459110	5.776327	497.244746	757.31775
std	0 days 21:17:15.405321	13.323263	287.396410	387.90609
min	0 days 00:00:00	0.000000	36.252000	82.15600
25%	0 days 00:02:47	0.300000	273.080000	447.08000
50%	0 days 00:17:00	1.000000	347.376000	561.42400
75%	0 days 00:53:12	5.500000	693.360000	1035.06000
max	14 days 02:01:05	101.000000	2512.328000	3058.43600

twctx	ELAPSED	CPU%	RSS(mb)	SIZE(mb)
count	1234	1234.000000	1234.000000	1234.00000
mean	0 days 00:38:16.789303	4.593112	490.834882	751.81550
std	0 days 00:58:26.775946	10.083455	253.906020	352.73699
min	0 days 00:00:00	0.000000	25.388000	69.82800
25%	0 days 00:03:03.750000	0.300000	272.858000	446.80800
50%	0 days 00:18:51	0.900000	366.556000	588.50600
75%	0 days 00:53:25.750000	4.700000	670.100000	1007.64800
max	0 days 14:24:02	130.000000	1614.120000	2286.67600