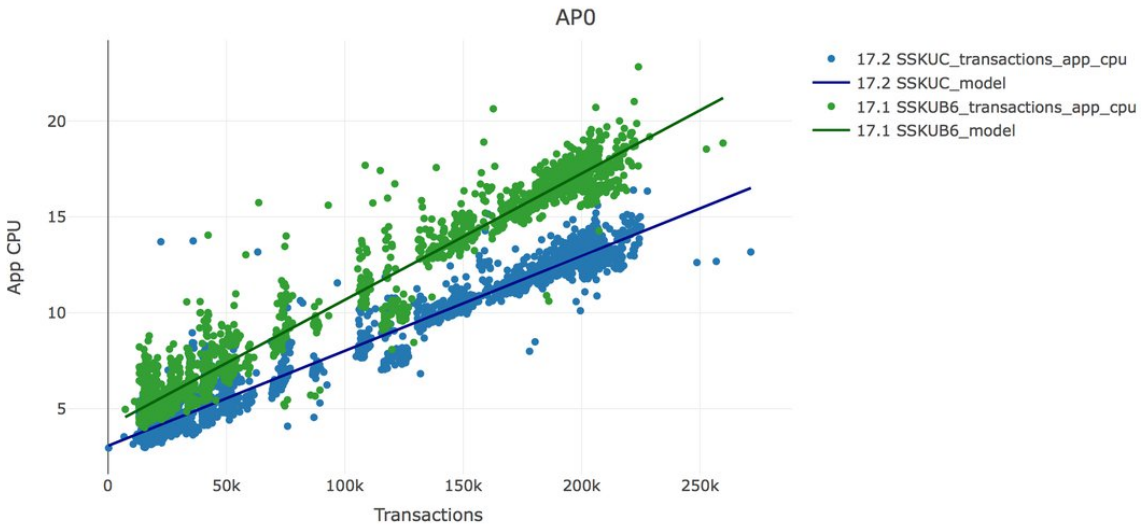
# Capacity Simulator Hardware Gain

Authors: Ana Bertran and Lauren Valdivia

For App CPU:

For each pod we can fit a linear model regression line for each of the asset types found in that pod.  We take a weeks worth of data (4/21st till 4/27th) to avoid picking changes that would affect the continuity of our model (site switches, hardware refreshes, code regressions, ... ). We also check for as many possible such changes (for example site switches) within a pod each week and don't process that pod. The ratio of the fitted slopes will give us the hardware gain. We remove the weekends from our data. In the future we need to investigate whether focusing on prime hours improves our fit. Below you can find an example for AP0.




For AP0 shown above the slope for the SSKUB6 model is 6.59e-5, the intercept is 4.08 with a R squared of 0.95; the slope for the SSKUC model is 4.95e-5 and the intercept is 3.07 with an R squared of 0.96. The ratio between the two models (hardware gain) is 1.33

Running this analysis for all pods for the week from 4/21st till 4/27th we have found consistency in the ratio. For example going from SSKUB6 to SSKUC we see an improvement ranging between 30% and 40% across all kinds of pods across different regions (AP, NA, GS, ...), even pods with significantly different slopes. [Note that the R squared for some pods and thus the fit - GS0, GS1 - is low; we need to zoom in to those pods to see what happened]

We have seen three groups of hardware gains, one at around 1.35, another at 1.51 and a third at 2.03

| | A | B | C | D | E | F | G | H | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | podName | model_from | asset_type_from | model_to | asset_type_to | ratio | R_squared_from | R_squared_to | Min |
| 2 | NA7 | DL360 | SSKUC | R430 | 17.2 SSKUC | 1.04356 | 0.82818 | 0.81726 | |
| 3 | NA44 | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | R430 | 17.1 SSKUB6 | 1.00547 | 0.94208 | 0.94137 | |
| 4 | NA55 | R430 | 17.2 SSKUC | DL360 | SSKUC | 1.05941 | 0.92778 | 0.91207 | |
| 5 | EU11 | R430 | 17.2 SSKUC | R430 | SSKUC | 1.03237 | 0.90805 | 0.90193 | |
| 6 | EU6 | R430 | SSKUC | R430 | 17.2 SSKUC | 1.02434 | 0.93955 | 0.9257 | |
| 7 | NA35 | R430 | SSKUC | R430 | 17.2 SSKUC | 1.02975 | 0.94414 | 0.94756 | |
| 8 | NA29 | R620 | 2NL 256GB IVY | R620 | 2NL 128G IVY | **1.00323** | 0.93291 | 0.93898 | |
| 9 | NA30 | R620 | 2NL 256GB IVY | R620 | 2NL 128G IVY | **1.00364** | 0.93997 | 0.92972 | |
| 10 | NA31 | R620 | 2NL 256GB IVY | R620 | 2NL 128G IVY | **1.01443** | 0.92629 | 0.92917 | |
| 11 | NA6 | R620 | 2NL 256GB IVY | R620 | 2NL 128G IVY | **1.00009** | 0.94576 | 0.94241 | |
| 12 | | | | | | | | | |
| 13 | AP0 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.33063** | 0.95408 | 0.95521 | |
| 14 | AP1 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.40672** | 0.91001 | 0.8752 | |
| 15 | AP3 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.33758** | 0.96738 | 0.96491 | |
| 16 | AP4 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.30784** | 0.90754 | 0.91205 | |
| 17 | AP5 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.29054** | 0.83202 | 0.82499 | |
| 18 | AP6 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.33138** | 0.91142 | 0.91492 | |
| 19 | AP7 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.36315** | 0.93447 | 0.91793 | |
| 20 | EU4 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.30377** | 0.94982 | 0.94474 | |
| 21 | ~~EU9~~ | ~~R430~~ | ~~17.1 SSKUB6~~ | ~~R430~~ | ~~17.2 SSKUC~~ | **1.37489** | 0.73575 | 0.93693 | |
| 22 | ~~GS0~~ | ~~R430~~ | ~~17.1 SSKUB6~~ | ~~R430~~ | ~~17.2 SSKUC~~ | **1.4061** | 0.45587 | 0.27884 | |
| 23 | NA32 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34004** | 0.90844 | 0.93205 | |
| 24 | NA37 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.35582** | 0.86635 | 0.88358 | |
| 25 | ~~NA40~~ | ~~R430~~ | ~~17.1 SSKUB6~~ | ~~R430~~ | ~~17.2 SSKUC~~ | **1.5065** | 0.75234 | 0.78139 | <--- |
| 26 | NA44 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.31736** | 0.94137 | 0.92124 | |
| 27 | NA47 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34133** | 0.87487 | 0.83039 | |
| 28 | NA48 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.32291** | 0.87651 | 0.884 | |
| 29 | NA51 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.32639** | 0.93502 | 0.95051 | |
| 30 | NA52 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34678** | 0.91975 | 0.93204 | |
| 31 | NA54 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.39394** | 0.92883 | 0.93623 | |
| 32 | NA55 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34771** | 0.79928 | 0.92778 | |
| 33 | NA58 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34614** | 0.92572 | 0.91839 | |
| 34 | NA61 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.32133** | 0.97272 | 0.88566 | |
| 35 | NA63 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.27985** | 0.91113 | 0.88197 | |
| 36 | NA74 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34474** | 0.93568 | 0.91572 | |
| 37 | NA88 | R430 | 17.1 SSKUB6 | R430 | 17.2 SSKUC | **1.34057** | 0.89833 | 0.85359 | |
| 38 | EU1 | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | R430 | 17.2 SSKUC | **1.36841** | 0.91847 | 0.89857 | |
| 39 | NA38 | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | R430 | 17.2 SSKUC | **1.39845** | 0.95208 | 0.95739 | |
| 40 | ~~NA42~~ | ~~DL360 Gen9~~ | ~~2670v3 128GB 4TB 480GB SSD~~ | ~~R430~~ | ~~17.2 SSKUC~~ | **1.47081** | 0.72243 | 0.91684 | |
| | | | 2670v3 128GB 4TB | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41 | NA44 | DL360 Gen9 | 128GB 4TB 480GB SSD | R430 | 17.2 SSKUC | **1.32456** | 0.94208 | 0.92124 | |
| 42 | NA79 | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | R430 | 17.2 SSKUC | **1.27332** | 0.93133 | 0.66786 | |
| 43 | EU7 | R430 | 17.1 SSKUB6 | DL360 | SSKUC | **1.23585** | 0.94105 | 0.78547 | |
| 44 | NA55 | R430 | 17.1 SSKUB6 | DL360 | SSKUC | **1.42777** | 0.79928 | 0.91207 | |
| 45 | NA39 | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | DL360 | SSKUC | **1.41051** | 0.7396 | 0.92504 | |
| 46 | EU1 | DL360P | 4NL 128GB 2X480SSD | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | **1.50183** | 0.90723 | 0.91847 | |
| 47 | ~~NA42~~ | ~~DL360P~~ | ~~4NL 128GB 2X480SSD~~ | ~~DL360 Gen9~~ | ~~2670v3 128GB 4TB 480GB SSD~~ | **1.40456** | 0.95229 | 0.72243 | |
| 48 | NA45 | DL360P | 4NL 128GB 2X480SSD | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | **1.4884** | 0.86979 | 0.90254 | |
| 49 | NA79 | DL360P | 4NL 128GB 2X480SSD | DL360 Gen9 | 2670v3 128GB 4TB 480GB SSD | **1.5218** | 0.9026 | 0.93133 | |
| 50 | EU4 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.1 SSKUB6 | **1.54578** | 0.8973 | 0.94982 | |
| 51 | NA32 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.1 SSKUB6 | **1.50232** | 0.93662 | 0.90844 | |
| 52 | NA7 | DL360P | 4NL 128GB 2X480SSD | DL360 | SSKUC | **1.89047** | 0.80666 | 0.82818 | |
| 53 | EU1 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.05512** | 0.90723 | 0.89857 | |
| 54 | EU4 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.01533** | 0.8973 | 0.94474 | |
| 55 | NA32 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.01317** | 0.93662 | 0.93205 | |
| 56 | NA33 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.16045** | 0.94777 | 0.93624 | |
| 57 | NA34 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.0303** | 0.91686 | 0.90747 | |
| 58 | NA42 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.06583** | 0.95229 | 0.91684 | |
| 59 | ~~NA59~~ | ~~DL360P~~ | ~~4NL 128GB 2X480SSD~~ | ~~R430~~ | ~~17.2 SSKUC~~ | **1.7789** | 0.48678 | 0.50807 | <--- |
| 60 | NA7 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **1.97282** | 0.80666 | 0.81726 | |
| 61 | ~~NA79~~ | ~~DL360P~~ | ~~4NL 128GB 2X480SSD~~ | ~~R430~~ | ~~17.2 SSKUC~~ | **1.93774** | 0.9026 | 0.66786 | |
| 62 | NA8 | DL360P | 4NL 128GB 2X480SSD | R430 | 17.2 SSKUC | **2.09027** | 0.91275 | 0.9105 | |

The input data for the linear regressions is formed by getting transaction, app cpu, tech asset and active host information from Horizon. The queries used for this analysis are below.

To get model, asset type information for all hosts we do the following query from **Tech Asset Force** (fact_tech_asset):

SELECT discovered_host_name__c, asset_type_asset_type__c, asset_type_category__c, asset_type_make__c, asset_type_manufacturer__c,asset_type_model__c, asset_type_configuration__c FROM infra_analytics.fact_tech_asset WHERE (discovered_host_name__c LIKE 'ap%-app%' OR discovered_host_name__c LIKE 'eu%-app%' OR discovered_host_name__c LIKE 'na%-app%' OR discovered_host_name__c LIKE 'gs%-app%') and date_key=20180424 AND gus_source_tstamp>1524268800

[Note that these are just samples and ..]

To get a list of active pods we do the following query for idb data:
SELECT name FROM idb.idb_cluster WHERE cluster_type = 'POD' AND operational_status = 'ACTIVE' AND is_dr=FALSE AND build_type IN ('RELEASED', 'NEW') AND environment IN ('PRODUCTION') AND (name LIKE 'EU%' OR name LIKE 'AP%' OR name LIKE 'NA%' OR name LIKE 'GS%') ORDER BY name;
Then for each active pod we get the app cpu and transaction data using the queries below:

To get app cpu and transactions data for each pod from **Horizon** we do the following queries:
SELECT date_key,hour_key,datacenter,superpod,pod,hostname,avg_app_cpu FROM agg_application_host_hourly WHERE date_key >= 20180421 AND date_key <= 20180427 AND pod ={pod_Name}

SELECT date_key,hour_key,datacenter,superpod,pod,hostname,total_transactions FROM infra_analytics.agg_business_host_hourly WHERE date_key >= 20180421 AND date_key <= 20180427 AND pod = {pod_Name}

We merge the results from app cpu and transaction queries based on date_key, hour_key, datacenter, superpod, pod, hostname and timestamp.
We then merge with tech asset force results based on hostname.

For DB:
As shown in the chart below for DB different hardware models typically don't co-exist within a pod, so in that case we need to do the analysis using data before a hardware refresh vs data after a hardware refresh. The following pods have undergone recent hardware refreshes:
Eu6 LON 11/30/17 refresh done. 1st a refresh happened then cap add a month
EU6 FRF (DR) 12/15/17 refresh done
Na30 CHI 11/22/2017 [changepoint]
NA30 WAS (DR) 12/7/2017 refresh done 12/14/2017 capadd done
Na35 12/17/2017 [changepoint]
Na44 1/14/2018 [changepoint] should it be 1/20/2018?
NA44 (DR) 1/6/2018
Na6 2/17/2018? or 2/24/2018?
NA6 (DR) 2/2/2018
Na24 3/16/2018?
A calendar of refreshes can be found here:
DB CPU Capacity Add and Refresh Schedule

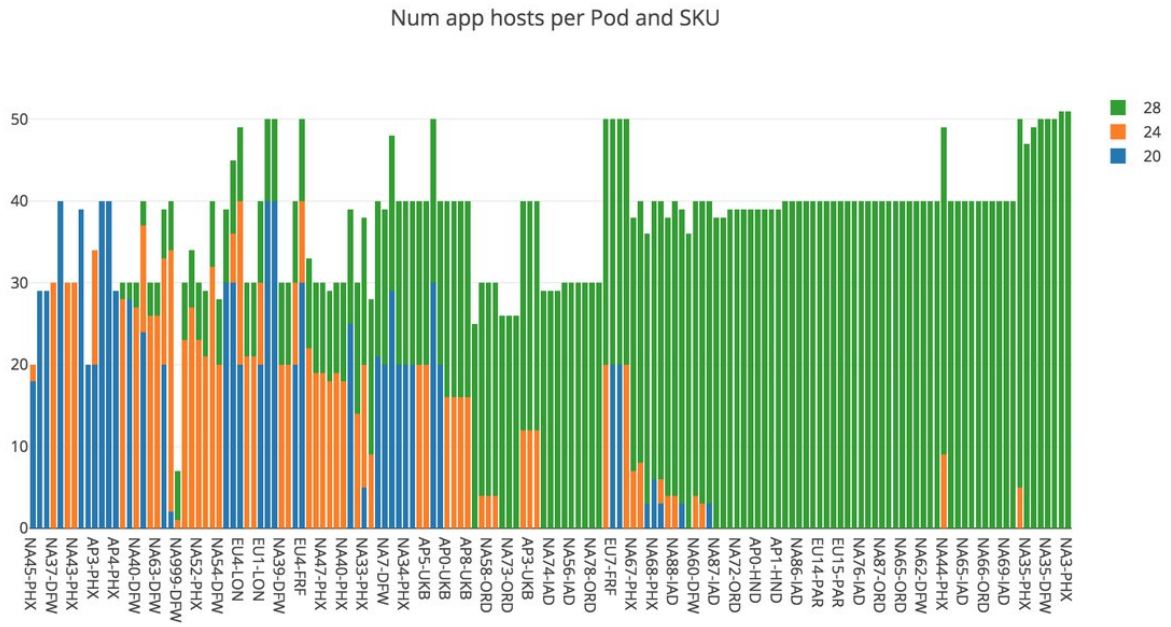
Eu11 will be refreshing soon

SELECT discovered_host_name__c, asset_type_asset_type__c, asset_type_category__c, asset_type_make__c, asset_type_manufacturer__c,asset_type_model__c, asset_type_configuration__c FROM infra_analytics.fact_tech_asset WHERE (discovered_host_name__c LIKE 'ap%-db%' OR discovered_host_name__c LIKE 'eu%-db%' OR discovered_host_name__c LIKE 'na%-db%' OR discovered_host_name__c LIKE 'gs%-db%') and date_key>=20171120 and date_key<=20171215 and gus_source_tstamp >= 1511136000 and gus_source_tstamp <= 1513296000

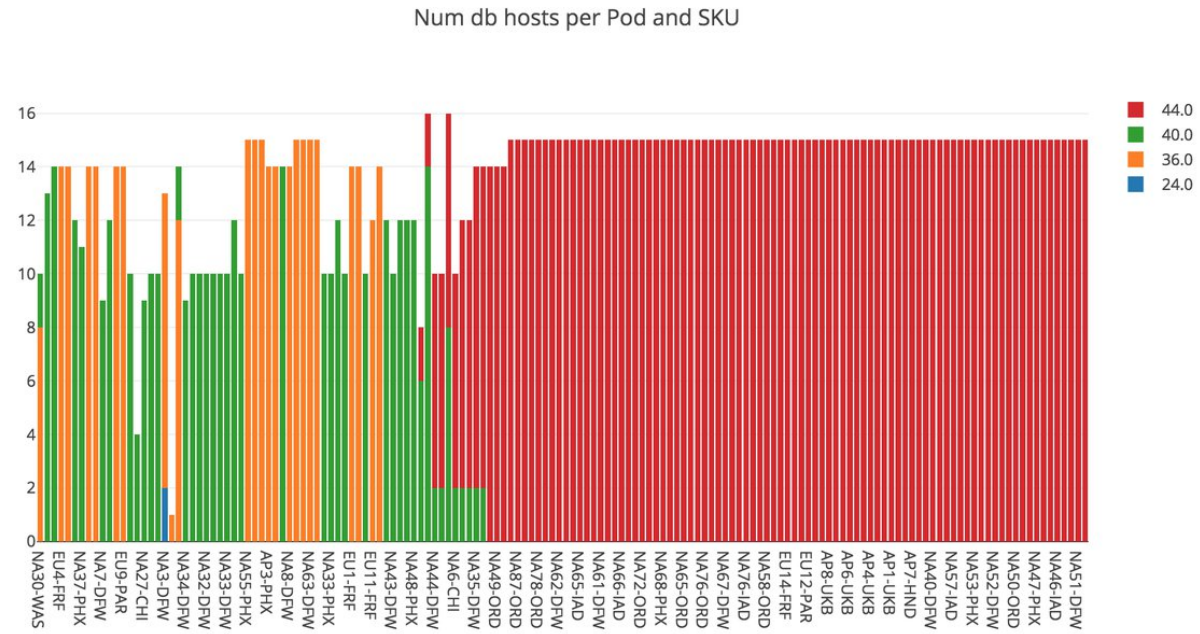
The query for sql executions in Argus is:
SUM(DOWNSAMPLE(1519862400:1520294400:db...na6:Executions_ps{source=OEM,device=db1-*}:max:1m-avg, #1h-p91#),#UNION#)

Hardware distribution

We can look at the distribution of hardware across pods as of now for app:




and for DB:




The charts above were generated using the following query in Deep Sea:

```
SELECT load_dt,pod,host,role, model, cpu_cnt,cpu_model,load_dt,host_ope_status,status,
FROM infradss.dim_gus_host_snap_now
```

```
WHERE role IN ('app','db') AND (pod LIKE "NA%" OR pod LIKE "AP%" OR pod LIKE "EU%")
AND host_ope_status ='ACTIVE' AND status='Active' AND (host LIKE "eu%" or host LIKE "a
```

Dataset as of 5/3
Note: there is some data included for decommed hosts but that should be resolved when we join with transacting host data. For now, excluding this list manually ['EU0','EU5000','NA26','NA28','NA41','EU5'] + ['NA21'] (gov pod).

KLT

- We are using current transaction pipeline - but it has missing data - future switch to trust transactions - need to watch it.

Notes for db cpu:
We are doing at the pod level to avoid partition movement right before refresh date.
We are using sql executions vs cpu instead of request_cnt vs oraclecputime because some requests do not touch the db.
For na6 the ratio between slopes for those two pairs of metrics was found to be different: 0.25 vs 0.35