
REPORT:

TermAppISONFT: Orchestra Cross Test Resource Usage
Summary

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```
## Loading required package: lattice
##
## Attaching package: 'BSDA'
##
## The following object is masked from 'package:datasets':
##
##   Orange
##
##   : starts:   Wed Jul 28 12:23:01 2021
##
## The following files in ../Test_Summary_Comparisons/csv match pattern "Resource_S
##   File = Test_Resource_Summary_D20201207.csv
##   File = Test_Resource_Summary_D20201208.csv
##   File = Test_Resource_Summary_D20201209_2.csv
##   File = Test_Resource_Summary_D20201209.csv
##   File = Test_Resource_Summary_D20201216.csv
##   File = Test_Resource_Summary_D20210115.csv
##   File = Test_Resource_Summary_D20210510.csv
##   File = Test_Resource_Summary_D20210520.csv
##   File = Test_Resource_Summary_D20210628.csv
##   File = Test_Resource_Summary_D20210629.csv
##   File = Test_Resource_Summary_D20210716.csv
##   File = Test_Resource_Summary_D20210719.csv
##   File = Test_Resource_Summary_D20210722.csv
##   File = Test_Resource_Summary_D20210723.csv
##   File = Test_Resource_Summary_D20210727.csv
##   File = Test_Resource_Summary_D20210728.csv
##   File = Test_Resource_Summary_D20201207.csv with 12 rows added to total making
##   File = Test_Resource_Summary_D20201208.csv with 12 rows added to total making
##   File = Test_Resource_Summary_D20201209_2.csv with 12 rows added to total making
##   File = Test_Resource_Summary_D20201209.csv with 12 rows added to total making
##   File = Test_Resource_Summary_D20201216.csv with 36 rows added to total making
##   File = Test_Resource_Summary_D20210115.csv with 12 rows added to total making
##   File = Test_Resource_Summary_D20210510.csv with 18 rows added to total making
##   File = Test_Resource_Summary_D20210520.csv with 18 rows added to total making
##   File = Test_Resource_Summary_D20210628.csv with 18 rows added to total making
##   File = Test_Resource_Summary_D20210629.csv with 18 rows added to total making
##   File = Test_Resource_Summary_D20210716.csv with 14 rows added to total making
##   File = Test_Resource_Summary_D20210719.csv with 14 rows added to total making
##   File = Test_Resource_Summary_D20210722.csv with 14 rows added to total making
##   File = Test_Resource_Summary_D20210723.csv with 14 rows added to total making
##   File = Test_Resource_Summary_D20210727.csv with 14 rows added to total making
##   File = Test_Resource_Summary_D20210728.csv with 14 rows added to total making
```

1 Introduction

There are two elements to this cross test resource usage comparison report. The first compares the current test sessions test(s) estimate of resource and measure for each server group to the corresponding

pooled estimates of the resource and measure for that group. The second compares each of the tests current and earlier tests individually for each resource and measure for each server group.

For the pooled comparison, the resource usage data for each resource type and measure of each server group (as grouped by the corresponding server classification file) for the current test(s) (the last set of tests by date) are isolated as individual tests and compared to the corresponding pooled resource usage distribution using a Welch modified two-sample t-test (`tsum.test`) based on the distribution parameters. Each resource type and measure, the estimation of the background usage (*Bias*, or load independent resource usage), for that resource and measure for the current test(s) are compared to the estimated pooled background usage of that resource type and measure. In a similar way, the estimation of the usage rate (*Rate*, or load dependant resource usage, the measure of the cost in terms of the corresponding resource for a rate of one customer arrival per second). For the pooling, the previous test results are filtered so that only the tests for which there is some confidence in the corresponding coefficient estimate are included in the pool statistics. A set resource usage coefficient estimate is included in the pooling of the corresponding p -value does not exceed $\alpha = 0.05$ (so that there is some confidence in the pooled coefficients). The *Bias* and *Rate* together with the actual customer arrival rate (*ArrivalRate*) give an estimation of the cost in terms of the resource being considered as $TotalCost = Bias + ArrivalRate * Rate$.

For each of the resource types and measures (Percent CPU Utilisation) and for each of the coefficient estimates (*Bias* and *Rate*), three `tsum.test`s are performed: One two-sided test to for differences in the corresponding distributions, and two one-sided tests, one to test for increases in the resource usage, and one to test for decreases in resource usage (of each of the current tests over pooled prior tests). These comparisons of the tests are ranked by the corresponding p -values. The items for which the p -value does not exceed the cut-off α value (0.05) are high-lighted by reporting them in a ranked table. are included in the corresponding comparison table. Up to the first 15 are included in an accompanying box-plot as well.

This high-lighting is intended to quickly bring outliers or significant changes in resource usage to the readers attention, but the second part of the report includes a full cross test comparison of current and earlier tests each server group, resource and measure, for both *Bias* and *Rate*.

These summary results have been taken from the analysis sections of the individual NFT sessions. For the *Rate* coefficient, only those results which are considered significant in the response of the resource usage to the applied load are included. The *Bias* parameter is included wherever there was some significance in the estimated intercept value.

The coefficients are determined from linear models regressing the resource usage onto the throughput observed. A model is generated for each server class in the server classification list for the specific project's server landscape. In each case, the resource usage is a measure of the resource usage, and these metrics are added up for all servers in the class. In addition, for the z/OS workload, the RMF measured CPU for each address space of interest is totalled and used as resource measure to regress onto the throughput observed (field `R791TCPU` of RMF record type 79 subtype one is used for this). A class is simply a group of servers intended to deliver the function to the application. The class name is intended to indicate the function provided (for example, `TFIM_CLIENT`). For each linear model, two coefficients are estimated. The Bias/Intercept is an estimate of the background resource usage, which is independent of the load applied. This load could be unrelated or overhead workload on a shared server or overhead workload on dedicated servers. For dedicated servers, this value is expected to be reasonably small as it should only reflect the overhead in managing and monitoring the workload. For shared servers, the value should ideally be reasonably low, and where this is the case, this indicates a reasonably controlled test environment (making the shared server behave like a dedicated server for the test duration). Where there is workload on a shared server/servers unrelated to the system under

test during a test, the additional workload may confound the estimation of the Rate coefficient, making the required resource usage over or understated.

The *Rate* is the coefficient on the achieved load. This is usually the session rate or customer arrival rate, measure in customer arrivals per second. Depending on the NFT setup, a session would do either a chain of application functions on behalf of a single business/user-level function or may do a single function or operation. This distinction usually correlates to simulating end-users (multiple calls/operations within a session) or single function/call/operation within a session (system to system or device to device calls). In either case, the Rate coefficient is the session arrival rate achieved.

The interpretation of the *Rate* coefficient is that it is the resource cost in (one of) the appropriate metric for the server type, and hence is the estimated cost in terms that metric of a single session per second (or customer arrival per second).

Coef	Description
Rate	Resource usage per customer arrival per second.
Bias	Load independent resource usage or background load

2 Server classification from application landscape

```
## The following files in landscape match pattern "Server_Classification.*csv":
##   File = CMLEcoSystem_Server_Classification.csv
##   File = CMLEcoSystem_Server_Classification.csv with 5 rows added to total make
```

Classification	Server	IP_Address	OSType	Description	Hardware_Support	Software_Support	Application_Support	SOURCE_FILE
LOAD	LOAD0	176.67.166.86	Linux	CML EcoSystem	Patrick Hayward	Patrick Hayward	Patrick Hayward	CMLEcoSystem_Server_Classification.csv
LOAD	LOAD1	176.67.166.89	Linux	CML EcoSystem	Patrick Hayward	Patrick Hayward	Patrick Hayward	CMLEcoSystem_Server_Classification.csv
MODEL	MODELAPP0	176.67.166.10	Linux	CML EcoSystem	Patrick Hayward	Patrick Hayward	Patrick Hayward	CMLEcoSystem_Server_Classification.csv
MODEL	MODELAPP1	176.67.166.11	Linux	CML EcoSystem	Patrick Hayward	Patrick Hayward	Patrick Hayward	CMLEcoSystem_Server_Classification.csv
NETWORK	NETWORK00	109.123.111.17	Linux	CML EcoSystem	Patrick Hayward	Patrick Hayward	Patrick Hayward	CMLEcoSystem_Server_Classification.csv

3 Comparison of current tests to pooled earlier tests

The last test date in the summary data is used to delimit the prior tests from the tests in the last test session. This section compares the resource usage for each resource type and measure for each server group to the corresponding pooled resource usage and measure for the server group. The current test(s) are the tests performed on 2021-07-28. Resource usage metrics are pooled only where the corresponding *p*-value is demonstrates some confidence in the estimated coefficient.

3.1 Differences in resource usage

The following show the comparisons of the tests performed on 2021-07-28 as compared to the tests performed before this date. The tables are ranked in increasing order of the p -values from the corresponding Welch Modified Two-Sample t-Test (two.sided), starting from server group where the resource usage distribution differences are the greatest. Results are only shown for which the p -value is less than or equal to the cutoff value ($\alpha = 0.05$).

3.1.1 Test 1 - TermAppISO

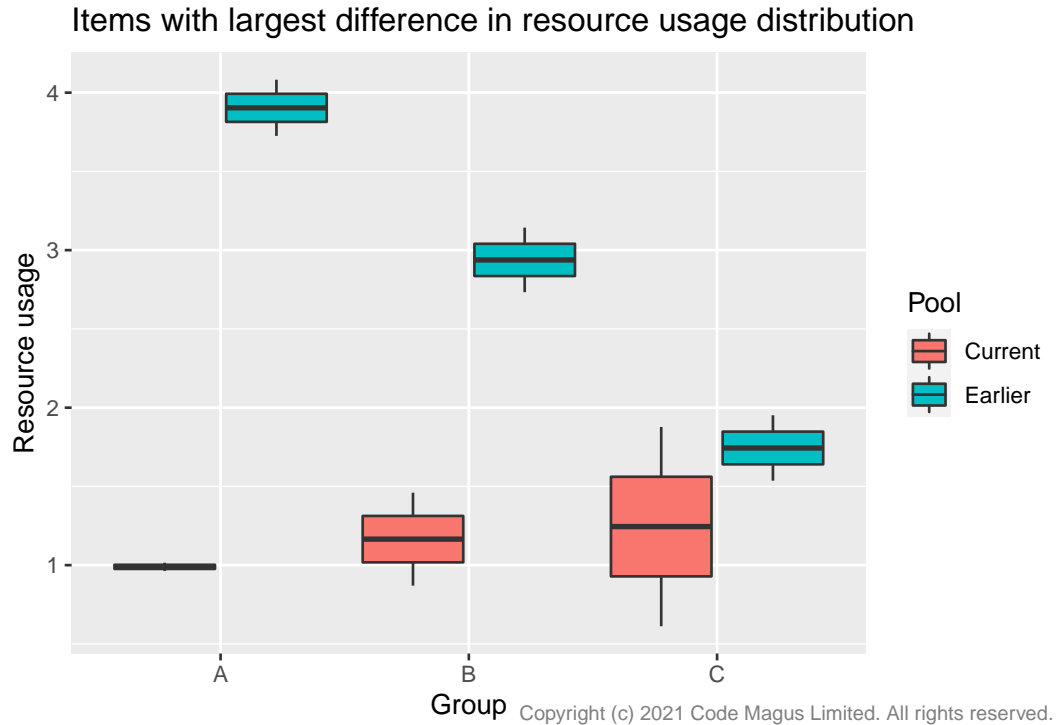
3.1.1.1 Resource class: CPU

3.1.1.1.1

The following compares the Rate coefficient for the CPU resource usage differences from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSE	pvalue.d
LOAD	Rate	78	cpu.cpu.system.us	Percent single processor	0.989	0.013	1145	3.904	0.089	0
MODEL	Rate	78	cpu.cpu.system.us	Percent single processor	1.165	0.147	1047	2.938	0.102	0
NETWORK	Rate	78	cpu.cpu.system.us	Percent single processor	1.245	0.316	333	1.744	0.104	0

Loading required package: grid

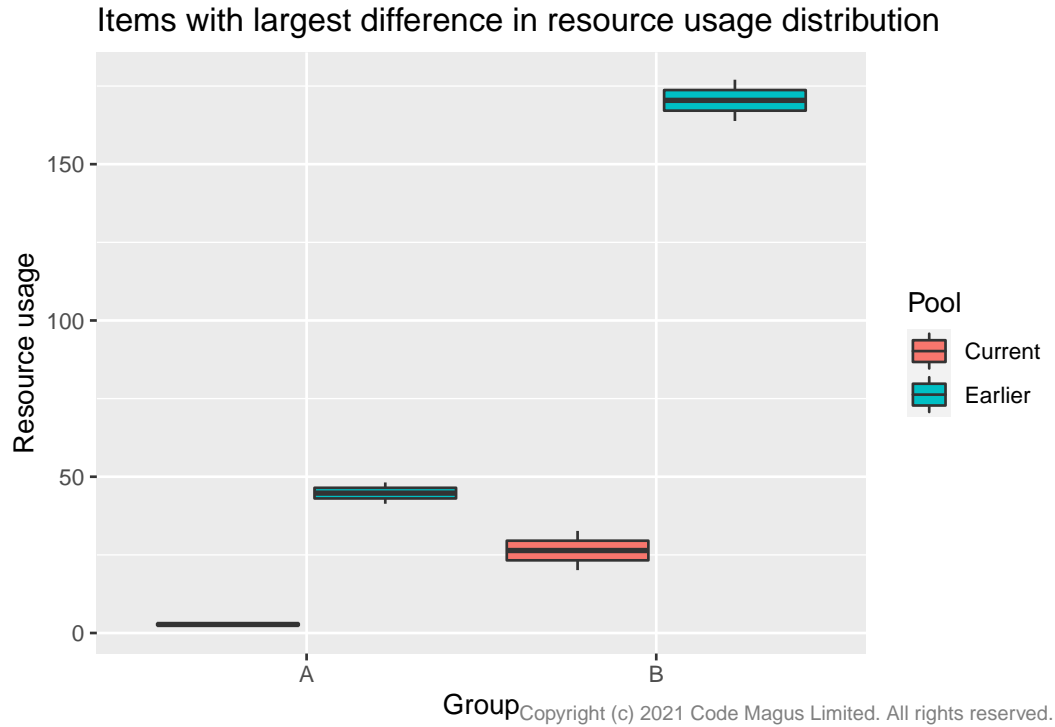


Key	Group
A	LOAD Rate Percent single processor CPU Usage
B	MODEL Rate Percent single processor CPU Usage
C	NETWORK Rate Percent single processor CPU Usage

3.1.1.1.2

The following compares the Bias coefficient for the CPU resource usage differences from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSE	pvalue.d
LOAD Bias	78	cpu.cpu.system.us	Percent single processor		2.737	0.279	1123	44.76	1.705	0
MODE Bias	78	cpu.cpu.system.us	Percent single processor		26.395	3.137	1145	170.42	3.301	0



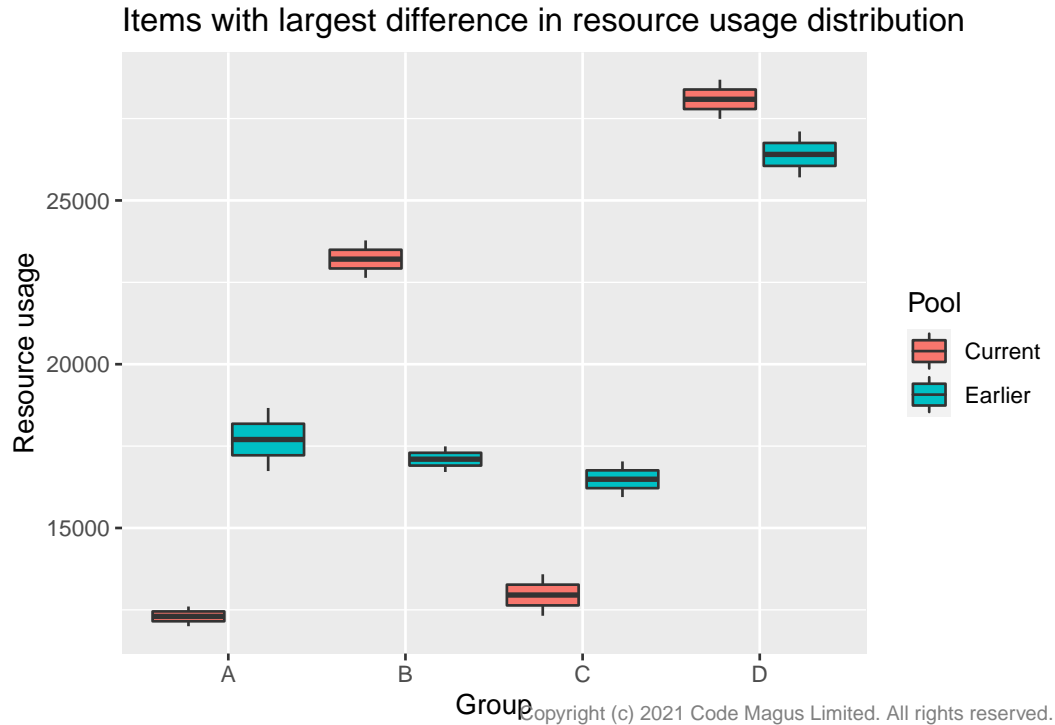
Key	Group
A	LOAD Bias Percent single processor CPU Usage
B	MODEL Bias Percent single processor CPU Usage

3.1.1.2 Resource class: Network

3.1.1.2.1

The following compares the Rate coefficient for the Network resource usage differences from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.d
MODEIRate		78	recv	bits per second	12301.59	150.338	1067	17701.03	481.545	0
LOAD Rate		78	recv	bits per second	23208.79	285.686	1145	17100.41	195.445	0
MODEIRate		78	sent	bits per second	12952.81	316.605	918	16487.95	271.858	0
LOAD Rate		78	sent	bits per second	28088.95	298.640	1145	26405.65	350.288	0

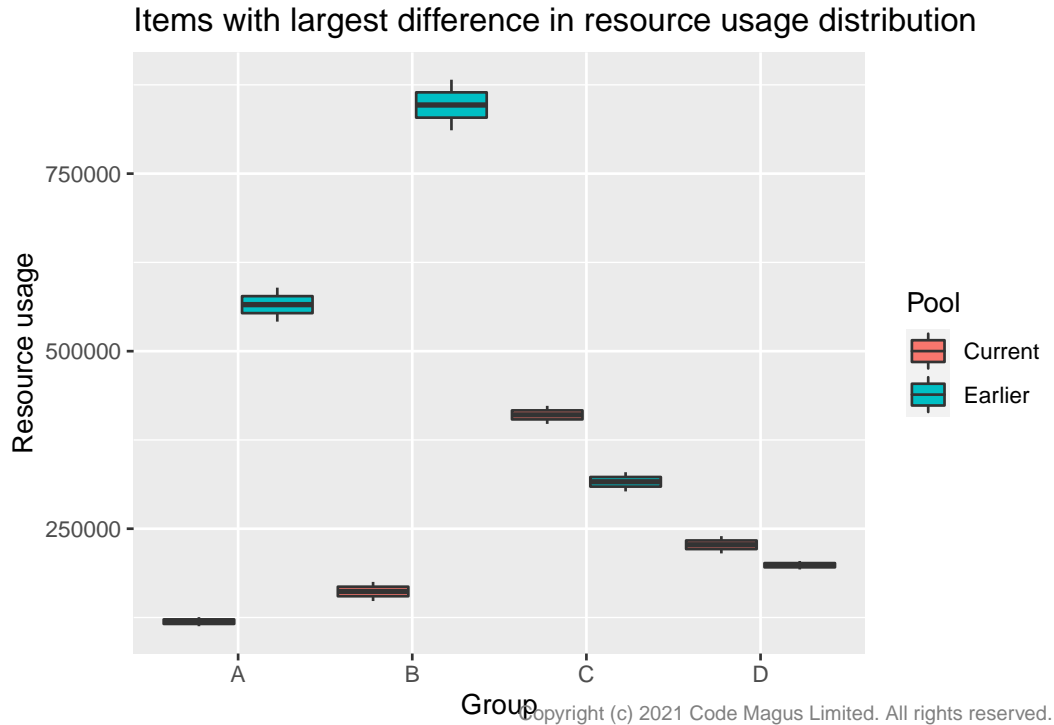


Key	Group
A	MODEL Rate bits per second Network Usage recv
B	LOAD Rate bits per second Network Usage recv
C	MODEL Rate bits per second Network Usage sent
D	LOAD Rate bits per second Network Usage sent

3.1.1.2.2

The following compares the Bias coefficient for the Network resource usage differences from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.d
MODEIBias		78	recv	bits per second	119129.0	3197.513	1121	565515.3	11959.552	0
MODEIBias		78	sent	bits per second	161652.7	6733.818	1121	846623.8	17795.389	0
LOAD Bias		78	sent	bits per second	410292.8	6351.720	1145	316057.7	6765.211	0
LOAD Bias		78	recv	bits per second	227386.5	6076.202	1067	198631.4	2979.363	0



Key	Group
A	MODEL Bias bits per second Network Usage recv
B	MODEL Bias bits per second Network Usage sent
C	LOAD Bias bits per second Network Usage sent
D	LOAD Bias bits per second Network Usage recv

3.2 Increases in resource usage

The following show the comparisons of the tests performed on 2021-07-28 as compared to the tests performed before this date. The tables are ranked in increasing order of the p -values from the corresponding Welch Modified Two-Sample t-Test (greater), starting from server group where the resource usage distribution increases are the greatest. Results are only shown for which the p -value is less than or equal to the cutoff value ($\alpha = 0.05$).

3.2.1 Test 1 - TermAppISO

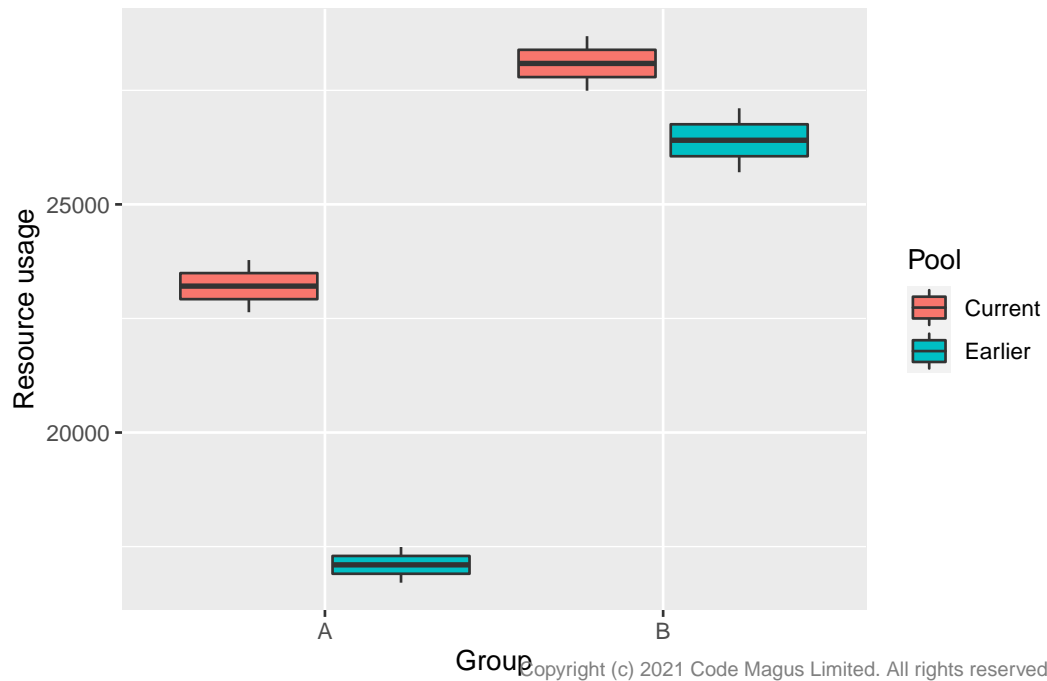
3.2.1.1 Resource class: Network

3.2.1.1.1

The following compares the Rate coefficient for the Network resource usage increases from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.g
LOAD	Rate	78	recv	bits per second	23208.79	285.686	1145	17100.41	195.445	0
LOAD	Rate	78	sent	bits per second	28088.95	298.640	1145	26405.65	350.288	0

Items with largest increase in resource usage distribution

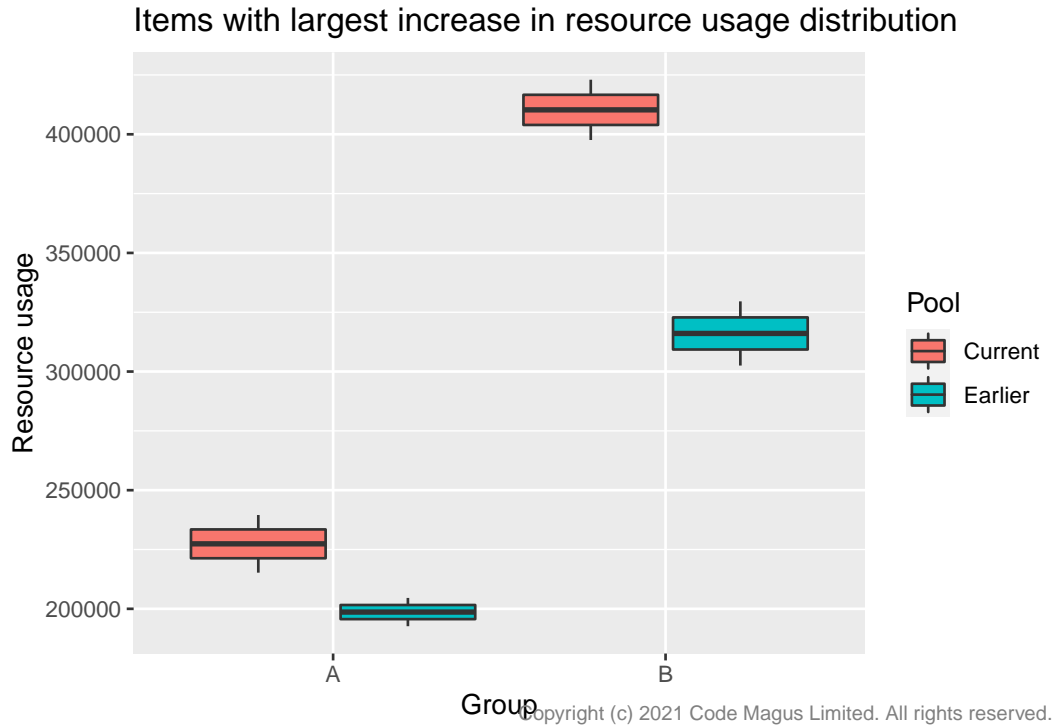


Key	Group
A	LOAD Rate bits per second Network Usage recv
B	LOAD Rate bits per second Network Usage sent

3.2.1.1.2

The following compares the Bias coefficient for the Network resource usage increases from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.g
LOAD	Bias	78	recv	bits per second	227386.5	6076.202	1067	198631.4	2979.363	0
LOAD	Bias	78	sent	bits per second	410292.8	6351.720	1145	316057.7	6765.211	0



Key	Group
A	LOAD Bias bits per second Network Usage recv
B	LOAD Bias bits per second Network Usage sent

3.3 Decreases in resource usage

The following show the comparisons of the tests performed on 2021-07-28 as compared to the tests performed before this date. The tables are ranked in increasing order of the p -values from the corresponding Welch Modified Two-Sample t-Test (less), starting from server group where the resource usage distribution decreases are the greatest. Results are only shown for which the p -value is less than or equal to the cutoff value ($\alpha = 0.05$).

3.3.1 Test 1 - TermAppISO

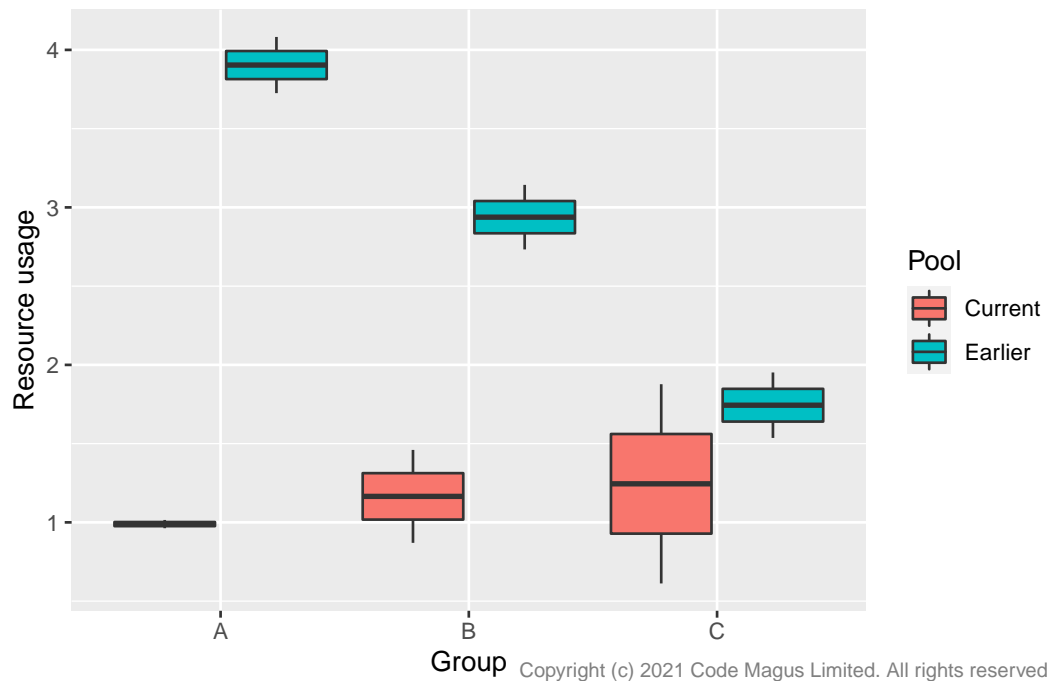
3.3.1.1 Resource class: CPU

3.3.1.1.1

The following compares the Rate coefficient for the CPU resource usage decreases from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.1
LOAD	Rate	78	cpu.cpu.system.us	Percent single processor	0.989	0.013	1145	3.904	0.089	0
MODEL	Rate	78	cpu.cpu.system.us	Percent single processor	1.165	0.147	1047	2.938	0.102	0
NETWORK	Rate	78	cpu.cpu.system.us	Percent single processor	1.245	0.316	333	1.744	0.104	0

Items with largest decrease in resource usage distribution



Key	Group
A	LOAD Rate Percent single processor CPU Usage
B	MODEL Rate Percent single processor CPU Usage
C	NETWORK Rate Percent single processor CPU Usage

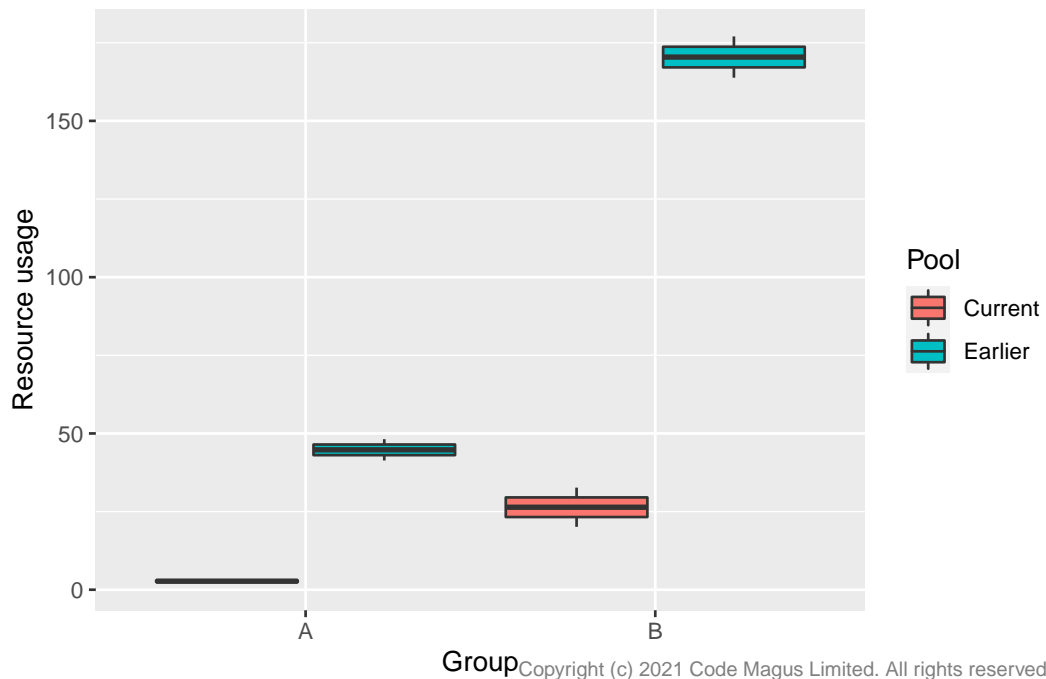
3.3.1.1.2

The following compares the Bias coefficient for the CPU resource usage decreases from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.1
LOAD	Bias	78	cpu.cpu.system.us	Percent single processor	2.737	0.279	1123	44.76	1.705	0

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.l
MODEBias	78	cpu.cpu.system.us	Percent single processor		26.395	3.137	1145	170.42	3.301	0

Items with largest decrease in resource usage distribution



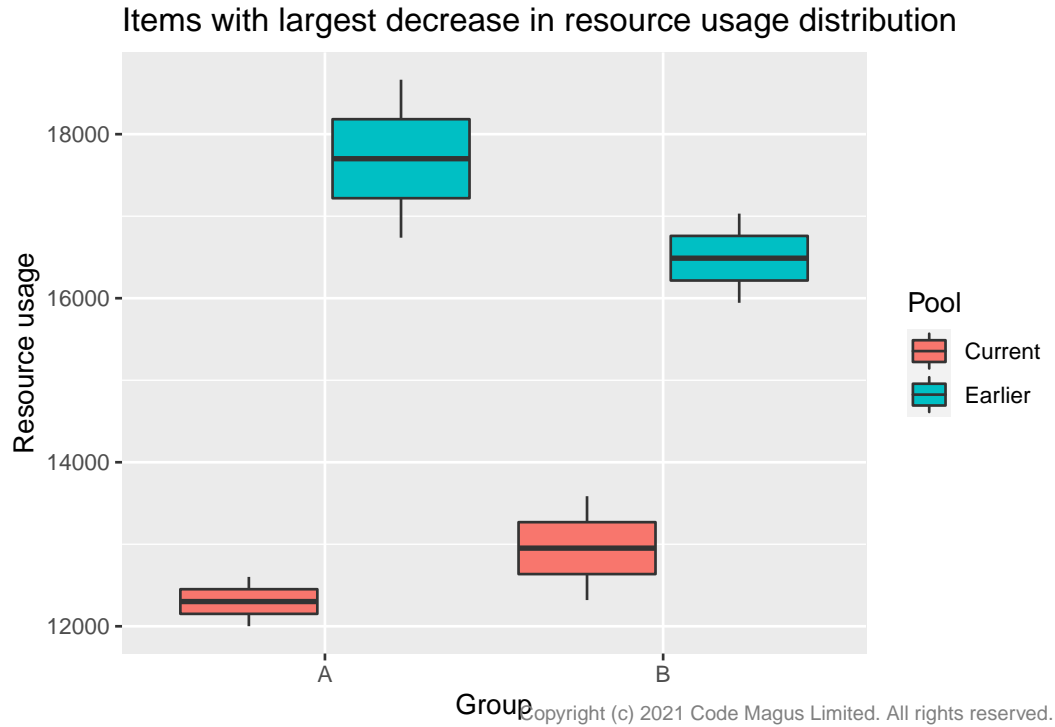
Key	Group
A	LOAD Bias Percent single processor CPU Usage
B	MODEL Bias Percent single processor CPU Usage

3.3.1.2 Resource class: Network

3.3.1.2.1

The following compares the Rate coefficient for the Network resource usage decreases from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.l
MODEIRate	78	recv	bits per second		12301.59	150.338	1067	17701.03	481.545	0
MODEIRate	78	sent	bits per second		12952.81	316.605	918	16487.95	271.858	0

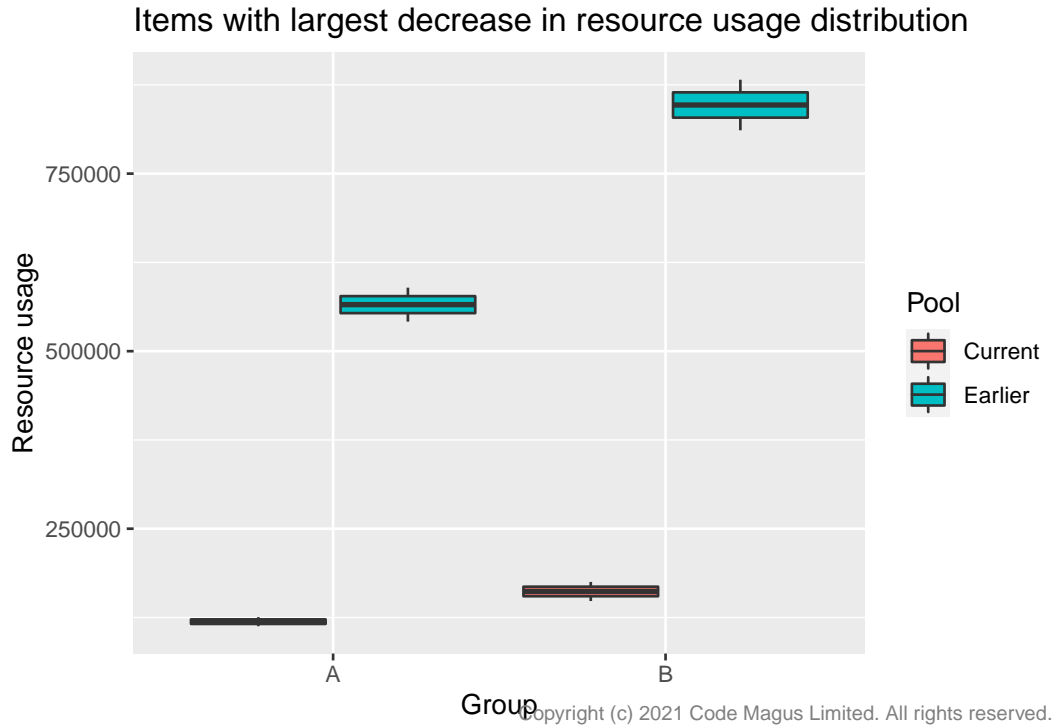


Key	Group
A	MODEL Rate bits per second Network Usage recv
B	MODEL Rate bits per second Network Usage sent

3.3.1.2.2

The following compares the Bias coefficient for the Network resource usage decreases from the test started at 2021-07-28 09:48:01 to the tests from previous test sessions.

Class	Coef	Count	Metric	Units	Estimate	Std..Error	PrevCount	PrevEst	PrevSEM	pvalue.l
MODEIBias		78	recv	bits per second	119129.0	3197.513	1121	565515.3	11959.55	0
MODEIBias		78	sent	bits per second	161652.7	6733.818	1121	846623.8	17795.39	0



Key	Group
A	MODEL Bias bits per second Network Usage recv
B	MODEL Bias bits per second Network Usage sent

4 Comparison of resource usage across tests

This section compares the resource usage between the NFT tests to date for each of the groups/servers in the classification list for which data has been collected.

In the box-plots that follow, in each case, the centre is the estimated value of the coefficient calculated for the particular test. The lower edge of the box is the corresponding estimated value less the standard error, and the upper edge of the box is the corresponding estimated value plus the standard error. The minimum and maximum values are calculated by taking two times the standard error values in a similar manner.

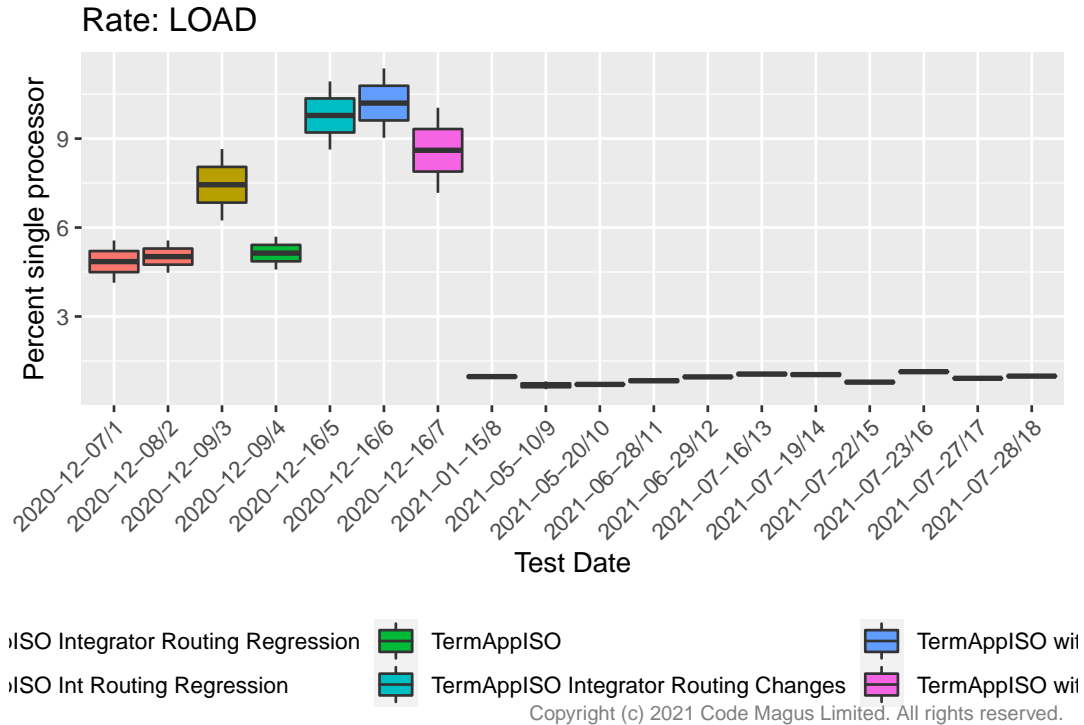
4.1 CPU Resource usage for LOAD by CPU Usage using `cpu.cpu.system.user` in Percent single processor

Server	OSType	Description
LOAD0	Linux	CML EcoSystem
LOAD1	Linux	CML EcoSystem

Server	OSType	Description
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The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: Percent single processor.

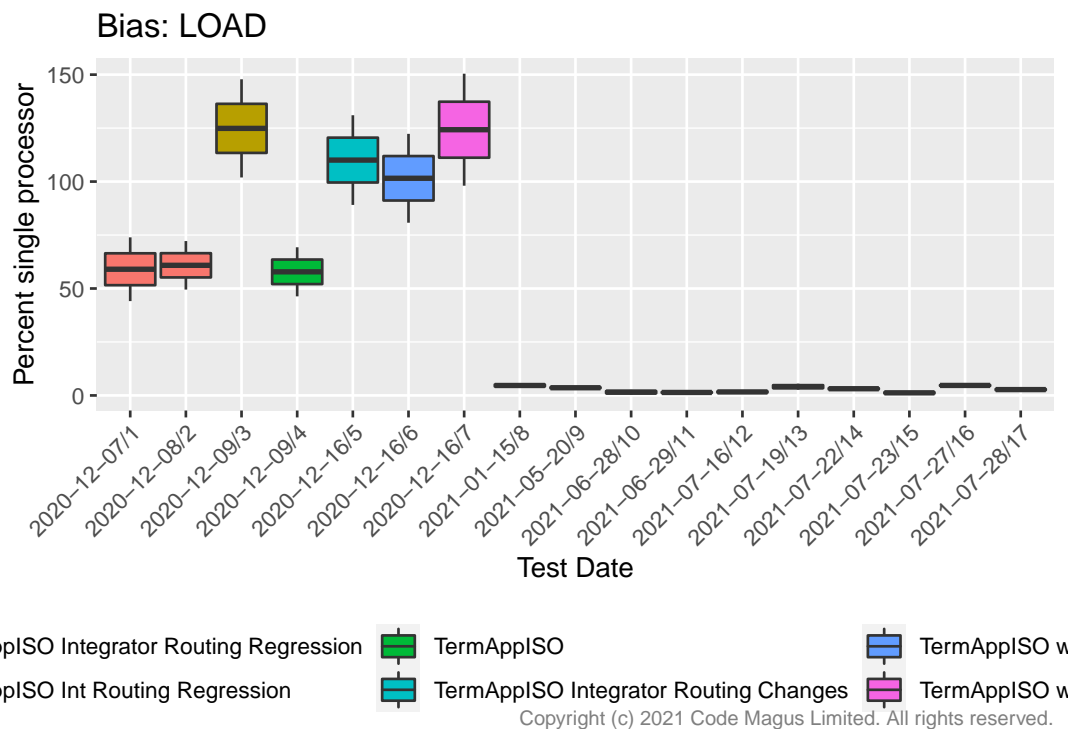
TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Rate	4.852	0.356	13.627	0	TermAppISO Integrator Routing Regression
2020-12-08	Rate	5.021	0.271	18.501	0	TermAppISO Integrator Routing Regression
2020-12-09	Rate	7.444	0.602	12.360	0	TermAppISO Int Routing Regression
2020-12-09	Rate	5.138	0.277	18.561	0	TermAppISO
2020-12-16	Rate	9.780	0.574	17.034	0	TermAppISO Integrator Routing Changes
2020-12-16	Rate	10.198	0.584	17.447	0	TermAppISO with 40 provider threads
2020-12-16	Rate	8.606	0.718	11.993	0	TermAppISO with 80 provider threads
2021-01-15	Rate	0.973	0.022	44.250	0	TermAppISO
2021-05-10	Rate	0.680	0.066	10.297	0	TermAppISO
2021-05-20	Rate	0.710	0.013	52.850	0	TermAppISO
2021-06-28	Rate	0.834	0.035	23.721	0	TermAppISO
2021-06-29	Rate	0.963	0.014	66.737	0	TermAppISO
2021-07-16	Rate	1.059	0.029	37.102	0	TermAppISO
2021-07-19	Rate	1.041	0.034	30.497	0	TermAppISO
2021-07-22	Rate	0.786	0.018	44.845	0	TermAppISO
2021-07-23	Rate	1.139	0.014	81.322	0	TermAppISO
2021-07-27	Rate	0.915	0.011	85.841	0	TermAppISO
2021-07-28	Rate	0.989	0.013	75.418	0	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: Percent single processor.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Bias	59.012	7.451	7.921	0.000	TermAppISO Integrator Routing Regression
2020-12-08	Bias	60.847	5.668	10.735	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Bias	124.874	11.476	10.882	0.000	TermAppISO Int Routing Regression
2020-12-09	Bias	57.803	5.740	10.071	0.000	TermAppISO
2020-12-16	Bias	110.050	10.485	10.496	0.000	TermAppISO Integrator Routing Changes
2020-12-16	Bias	101.540	10.390	9.773	0.000	TermAppISO with 40 provider threads
2020-12-16	Bias	124.248	13.091	9.491	0.000	TermAppISO with 80 provider threads
2021-01-15	Bias	4.653	0.462	10.075	0.000	TermAppISO
2021-05-20	Bias	3.599	0.216	16.641	0.000	TermAppISO
2021-06-28	Bias	1.532	0.539	2.841	0.006	TermAppISO

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-06-29	Bias	1.399	0.205	6.822	0.000	TermAppISO
2021-07-16	Bias	1.648	0.283	5.824	0.000	TermAppISO
2021-07-19	Bias	4.109	0.698	5.884	0.000	TermAppISO
2021-07-22	Bias	3.138	0.269	11.687	0.000	TermAppISO
2021-07-23	Bias	1.224	0.295	4.150	0.000	TermAppISO
2021-07-27	Bias	4.675	0.229	20.451	0.000	TermAppISO
2021-07-28	Bias	2.737	0.279	9.813	0.000	TermAppISO



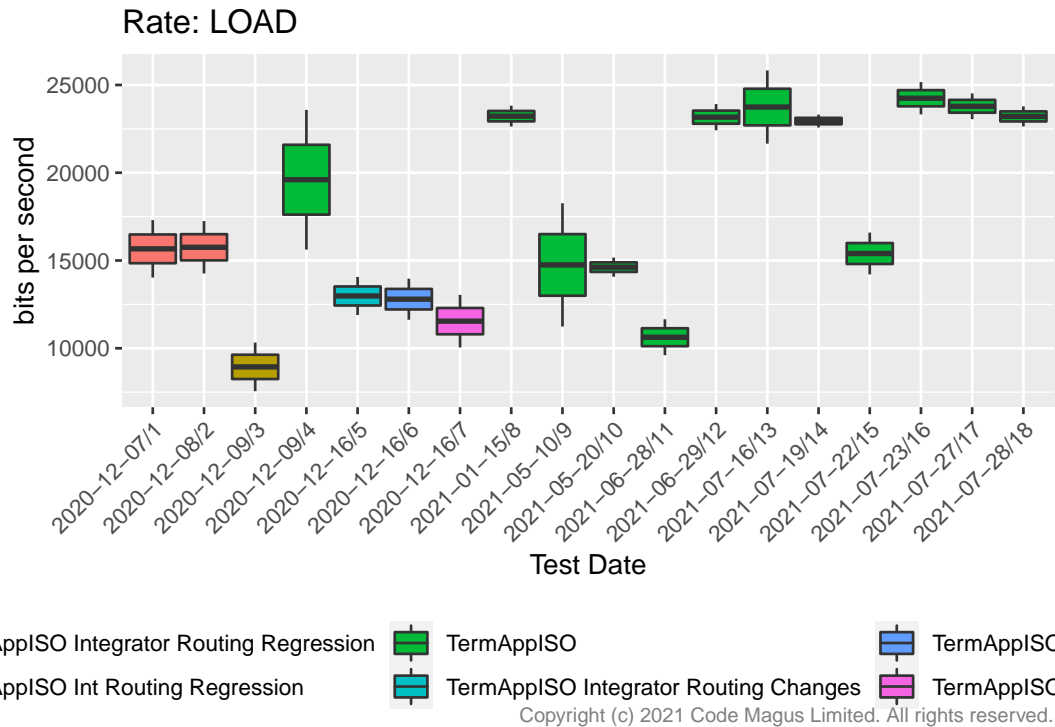
4.2 Network Resource usage for LOAD by Network Usage recv using recv in bits per second

Server	OSType	Description
LOAD0	Linux	CML EcoSystem

Server	OSType	Description
LOAD1	Linux	CML EcoSystem

The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

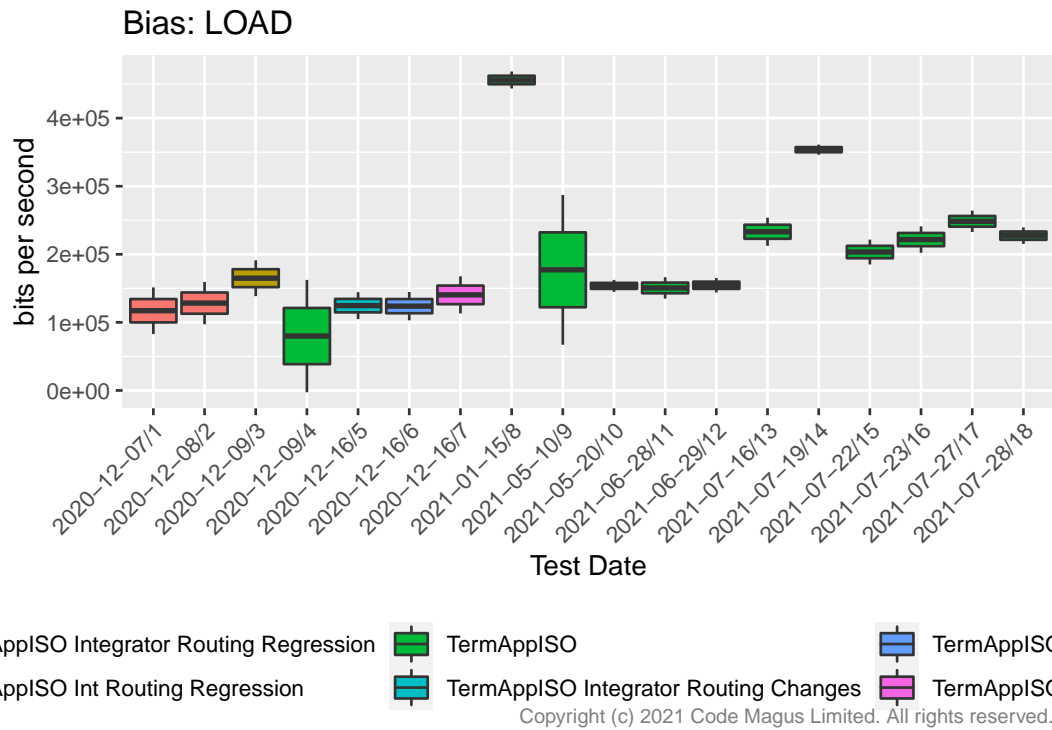
TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Rate	15663.585	818.945	19.127	0	TermAppISO Integrator Routing Regression
2020-12-08	Rate	15753.089	745.948	21.118	0	TermAppISO Integrator Routing Regression
2020-12-09	Rate	8938.586	692.304	12.911	0	TermAppISO Int Routing Regression
2020-12-09	Rate	19602.564	1989.670	9.852	0	TermAppISO
2020-12-16	Rate	12978.364	542.369	23.929	0	TermAppISO Integrator Routing Changes
2020-12-16	Rate	12795.930	585.131	21.868	0	TermAppISO with 40 provider threads
2020-12-16	Rate	11544.987	748.371	15.427	0	TermAppISO with 80 provider threads
2021-01-15	Rate	23224.409	297.261	78.128	0	TermAppISO
2021-05-10	Rate	14748.670	1755.623	8.401	0	TermAppISO
2021-05-20	Rate	14621.637	272.552	53.647	0	TermAppISO
2021-06-28	Rate	10629.033	511.557	20.778	0	TermAppISO
2021-06-29	Rate	23164.964	373.138	62.082	0	TermAppISO
2021-07-16	Rate	23741.774	1043.020	22.763	0	TermAppISO
2021-07-19	Rate	22942.579	183.455	125.058	0	TermAppISO
2021-07-22	Rate	15398.095	595.974	25.837	0	TermAppISO
2021-07-23	Rate	24244.471	460.658	52.630	0	TermAppISO
2021-07-27	Rate	23785.093	366.436	64.909	0	TermAppISO
2021-07-28	Rate	23208.786	285.686	81.239	0	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Bias	117112.32	17136.631	6.834	0.000	TermAppISO Integrator Routing Regression
2020-12-08	Bias	128316.44	15580.341	8.236	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Bias	164916.40	13191.587	12.502	0.000	TermAppISO Int Routing Regression
2020-12-09	Bias	79903.07	41255.594	1.937	0.056	TermAppISO
2020-12-16	Bias	124584.24	9904.489	12.579	0.000	TermAppISO Integrator Routing Changes
2020-12-16	Bias	123844.15	10400.926	11.907	0.000	TermAppISO with 40 provider threads
2020-12-16	Bias	140398.04	13653.452	10.283	0.000	TermAppISO with 80 provider threads
2021-01-15	Bias	456044.32	6245.241	73.023	0.000	TermAppISO
2021-05-10	Bias	177202.72	54997.316	3.222	0.004	TermAppISO
2021-05-20	Bias	153604.59	4390.310	34.987	0.000	TermAppISO

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-06-28	Bias	150601.54	7845.304	19.196	0.000	TermAppISO
2021-06-29	Bias	154516.43	5300.697	29.150	0.000	TermAppISO
2021-07-16	Bias	233115.34	10338.395	22.549	0.000	TermAppISO
2021-07-19	Bias	353663.23	3754.451	94.198	0.000	TermAppISO
2021-07-22	Bias	203343.05	9128.552	22.275	0.000	TermAppISO
2021-07-23	Bias	221648.78	9699.374	22.852	0.000	TermAppISO
2021-07-27	Bias	248432.92	7859.754	31.608	0.000	TermAppISO
2021-07-28	Bias	227386.46	6076.202	37.422	0.000	TermAppISO

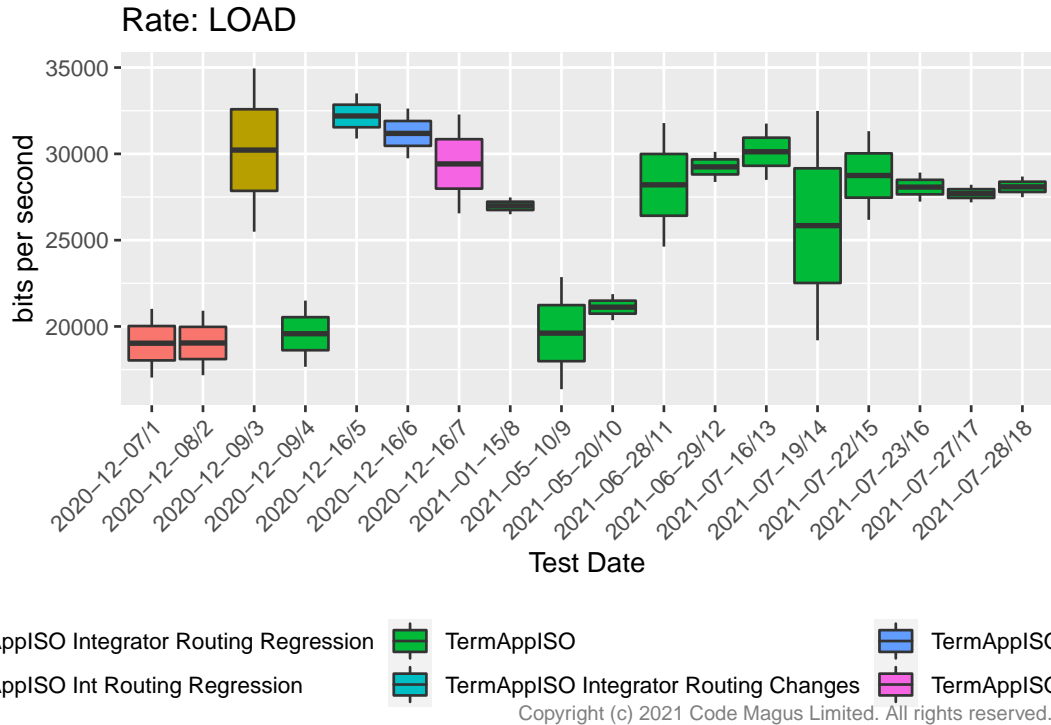


4.3 Network Resource usage for LOAD by Network Usage sent using sent in bits per second

Server	OSType	Description
LOAD0	Linux	CML EcoSystem
LOAD1	Linux	CML EcoSystem

The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

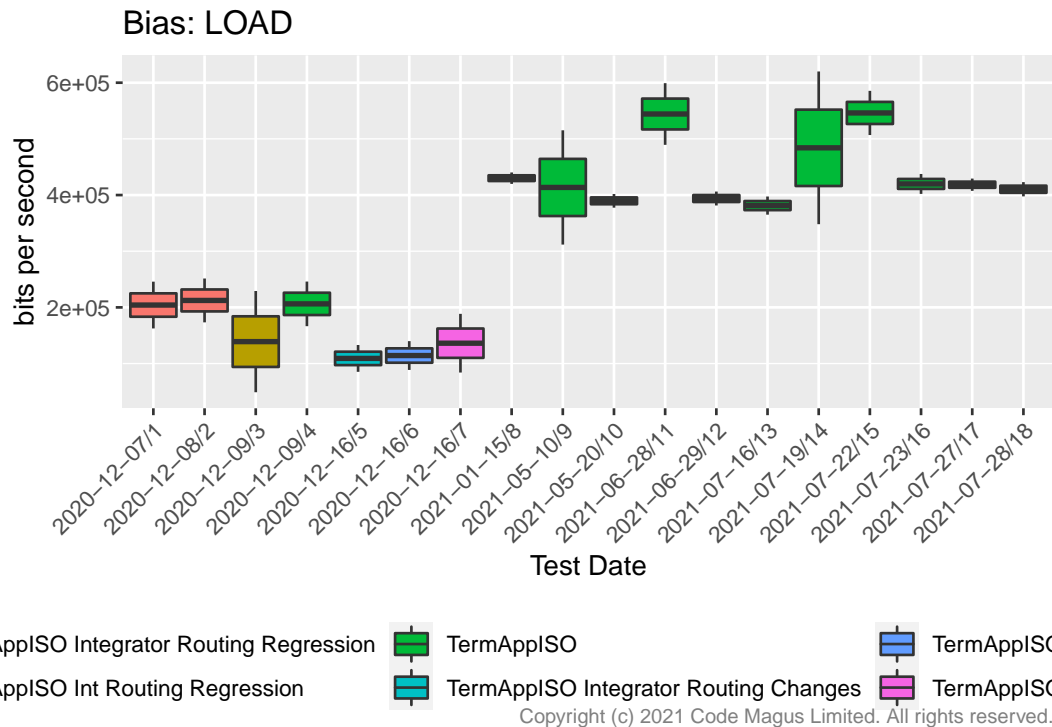
TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Rate	19028.66	995.145	19.121	0	TermAppISO Integrator Routing Regression
2020-12-08	Rate	19042.75	934.235	20.383	0	TermAppISO Integrator Routing Regression
2020-12-09	Rate	30219.17	2364.677	12.779	0	TermAppISO Int Routing Regression
2020-12-09	Rate	19579.56	958.369	20.430	0	TermAppISO
2020-12-16	Rate	32193.80	653.690	49.249	0	TermAppISO Integrator Routing Changes
2020-12-16	Rate	31183.83	720.365	43.289	0	TermAppISO with 40 provider threads
2020-12-16	Rate	29416.80	1431.859	20.544	0	TermAppISO with 80 provider threads
2021-01-15	Rate	26987.33	242.256	111.400	0	TermAppISO
2021-05-10	Rate	19612.35	1623.789	12.078	0	TermAppISO
2021-05-20	Rate	21117.29	377.348	55.962	0	TermAppISO
2021-06-28	Rate	28204.25	1788.951	15.766	0	TermAppISO
2021-06-29	Rate	29243.75	436.441	67.005	0	TermAppISO
2021-07-16	Rate	30122.86	815.291	36.947	0	TermAppISO
2021-07-19	Rate	25840.71	3321.221	7.780	0	TermAppISO
2021-07-22	Rate	28744.37	1284.023	22.386	0	TermAppISO
2021-07-23	Rate	28074.25	420.903	66.700	0	TermAppISO
2021-07-27	Rate	27699.57	255.067	108.597	0	TermAppISO
2021-07-28	Rate	28088.95	298.640	94.056	0	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Bias	204158.9	20823.674	9.804	0.000	TermAppISO Integrator Routing Regression
2020-12-08	Bias	212375.4	19513.027	10.884	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Bias	139054.3	45057.989	3.086	0.003	TermAppISO Int Routing Regression
2020-12-09	Bias	206257.3	19871.668	10.379	0.000	TermAppISO
2020-12-16	Bias	109170.1	11937.368	9.145	0.000	TermAppISO Integrator Routing Changes
2020-12-16	Bias	114274.4	12804.747	8.924	0.000	TermAppISO with 40 provider threads
2020-12-16	Bias	136247.9	26123.167	5.216	0.000	TermAppISO with 80 provider threads
2021-01-15	Bias	430030.4	5089.620	84.492	0.000	TermAppISO
2021-05-10	Bias	413513.8	50867.430	8.129	0.000	TermAppISO
2021-05-20	Bias	389686.3	6078.379	64.110	0.000	TermAppISO

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-06-28	Bias	544271.4	27435.564	19.838	0.000	TermAppISO
2021-06-29	Bias	393824.0	6199.974	63.520	0.000	TermAppISO
2021-07-16	Bias	381222.7	8081.151	47.174	0.000	TermAppISO
2021-07-19	Bias	484032.6	67969.577	7.121	0.000	TermAppISO
2021-07-22	Bias	546152.8	19667.416	27.769	0.000	TermAppISO
2021-07-23	Bias	419787.0	8862.318	47.368	0.000	TermAppISO
2021-07-27	Bias	418372.5	5470.982	76.471	0.000	TermAppISO
2021-07-28	Bias	410292.8	6351.720	64.596	0.000	TermAppISO

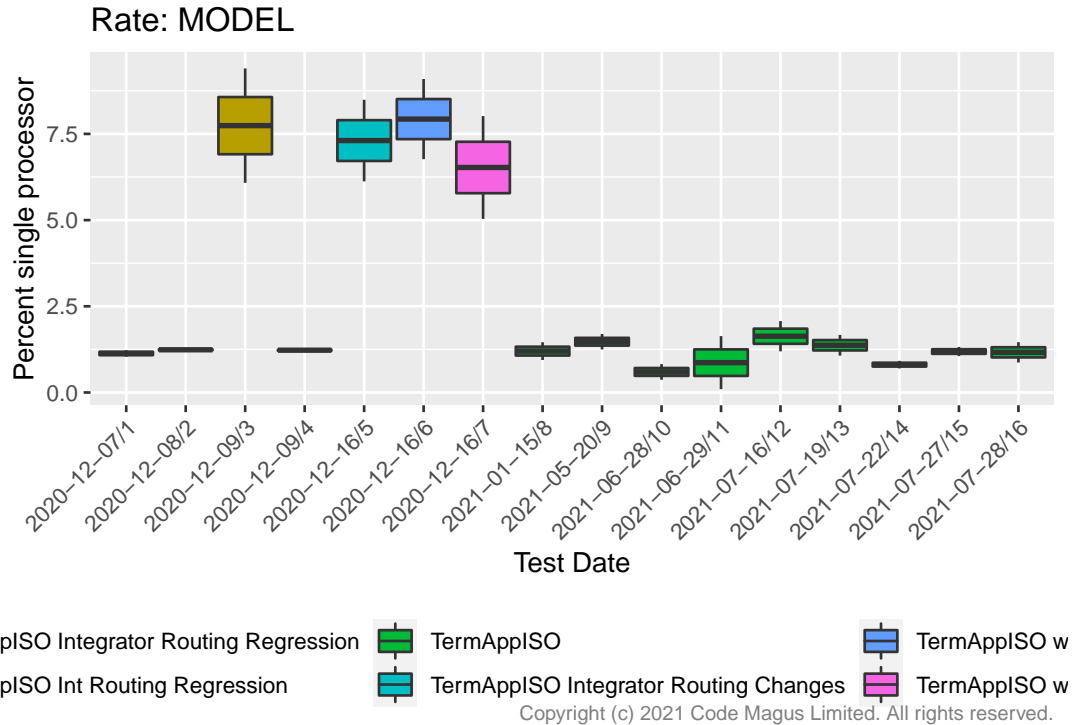


4.4 CPU Resource usage for MODEL by CPU Usage using `cpu.cpu.system.user` in Percent single processor

Server	OSType	Description
MODELAPP0	Linux	CML EcoSystem
MODELAPP1	Linux	CML EcoSystem

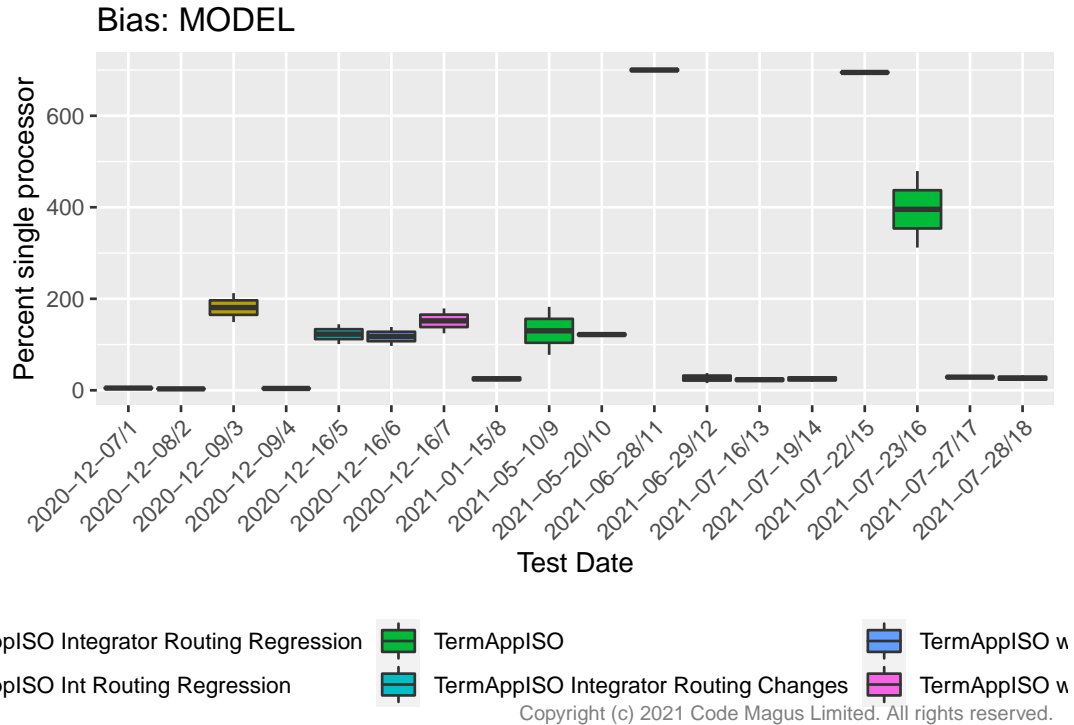
The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: Percent single processor.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Rate	1.132	0.048	23.545	0.000	TermAppISO Integrator Routing Regression
2020-12-08	Rate	1.239	0.017	74.254	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Rate	7.740	0.829	9.331	0.000	TermAppISO Int Routing Regression
2020-12-09	Rate	1.227	0.015	80.090	0.000	TermAppISO
2020-12-16	Rate	7.307	0.592	12.351	0.000	TermAppISO Integrator Routing Changes
2020-12-16	Rate	7.929	0.581	13.643	0.000	TermAppISO with 40 provider threads
2020-12-16	Rate	6.526	0.746	8.752	0.000	TermAppISO with 80 provider threads
2021-01-15	Rate	1.200	0.129	9.336	0.000	TermAppISO
2021-05-20	Rate	1.473	0.112	13.117	0.000	TermAppISO
2021-06-28	Rate	0.597	0.113	5.266	0.000	TermAppISO
2021-06-29	Rate	0.866	0.385	2.249	0.029	TermAppISO
2021-07-16	Rate	1.632	0.220	7.435	0.000	TermAppISO
2021-07-19	Rate	1.370	0.150	9.104	0.000	TermAppISO
2021-07-22	Rate	0.808	0.055	14.686	0.000	TermAppISO
2021-07-27	Rate	1.189	0.067	17.836	0.000	TermAppISO
2021-07-28	Rate	1.165	0.147	7.899	0.000	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: Percent single processor.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Bias	4.808	1.006	4.779	0	TermAppISO Integrator Routing Regression
2020-12-08	Bias	3.084	0.348	8.849	0	TermAppISO Integrator Routing Regression
2020-12-09	Bias	180.757	15.805	11.437	0	TermAppISO Int Routing Regression
2020-12-09	Bias	3.996	0.318	12.580	0	TermAppISO
2020-12-16	Bias	122.689	10.804	11.356	0	TermAppISO Integrator Routing Changes
2020-12-16	Bias	117.633	10.331	11.386	0	TermAppISO with 40 provider threads
2020-12-16	Bias	151.751	13.604	11.155	0	TermAppISO with 80 provider threads
2021-01-15	Bias	25.053	2.701	9.275	0	TermAppISO
2021-05-10	Bias	129.953	26.227	4.955	0	TermAppISO
2021-05-20	Bias	121.790	1.809	67.324	0	TermAppISO
2021-06-28	Bias	699.995	1.738	402.874	0	TermAppISO
2021-06-29	Bias	26.687	5.467	4.881	0	TermAppISO
2021-07-16	Bias	23.169	2.176	10.646	0	TermAppISO
2021-07-19	Bias	24.944	3.080	8.099	0	TermAppISO
2021-07-22	Bias	694.715	0.843	824.181	0	TermAppISO
2021-07-23	Bias	395.494	41.801	9.461	0	TermAppISO
2021-07-27	Bias	28.779	1.429	20.134	0	TermAppISO
2021-07-28	Bias	26.395	3.137	8.414	0	TermAppISO



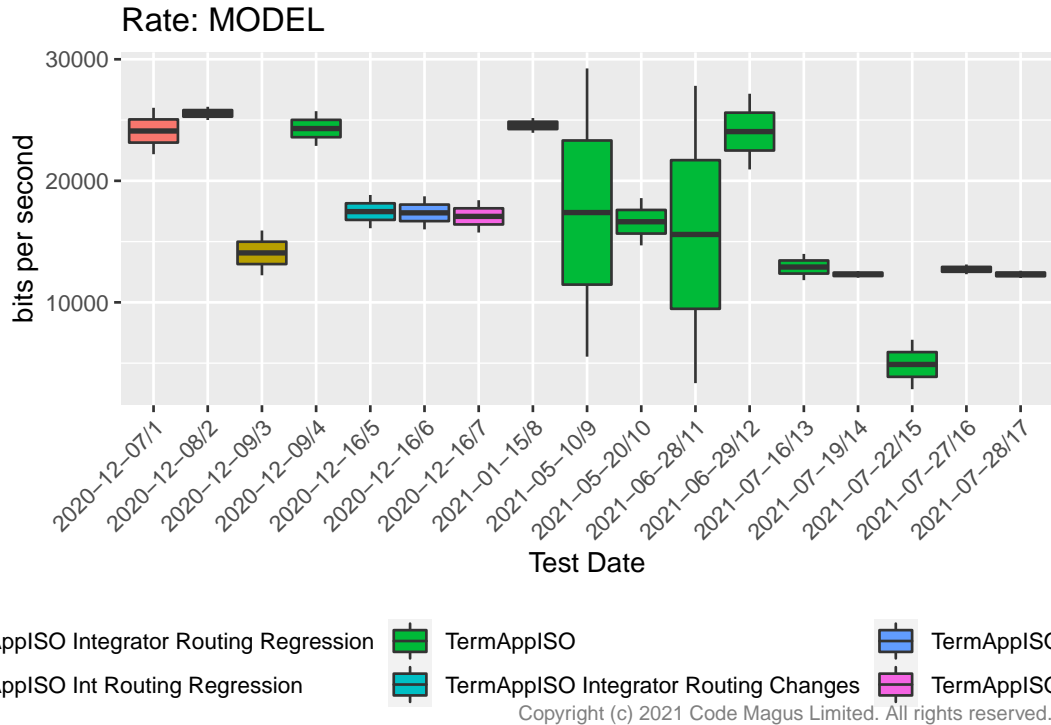
4.5 Network Resource usage for MODEL by Network Usage recv using recv in bits per second

Server	OSType	Description
MODELAPP0	Linux	CML EcoSystem
MODELAPP1	Linux	CML EcoSystem

The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Rate	24100.050	954.550	25.248	0.000	TermAppISO Integrator Routing Regression
2020-12-08	Rate	25548.990	271.665	94.046	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Rate	14069.744	920.324	15.288	0.000	TermAppISO Int Routing Regression
2020-12-09	Rate	24302.467	713.257	34.073	0.000	TermAppISO
2020-12-16	Rate	17467.524	683.900	25.541	0.000	TermAppISO Integrator Routing Changes

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-16	Rate	17365.660	680.340	25.525	0.000	TermAppISO with 40 provider threads
2020-12-16	Rate	17074.863	664.909	25.680	0.000	TermAppISO with 80 provider threads
2021-01-15	Rate	24560.174	304.261	80.721	0.000	TermAppISO
2021-05-10	Rate	17389.627	5929.025	2.933	0.008	TermAppISO
2021-05-20	Rate	16631.667	971.810	17.114	0.000	TermAppISO
2021-06-28	Rate	15585.305	6115.750	2.548	0.013	TermAppISO
2021-06-29	Rate	24051.354	1557.272	15.445	0.000	TermAppISO
2021-07-16	Rate	12907.062	539.876	23.907	0.000	TermAppISO
2021-07-19	Rate	12306.350	138.379	88.932	0.000	TermAppISO
2021-07-22	Rate	4888.864	1017.101	4.807	0.000	TermAppISO
2021-07-27	Rate	12716.180	200.060	63.562	0.000	TermAppISO
2021-07-28	Rate	12301.593	150.338	81.826	0.000	TermAppISO

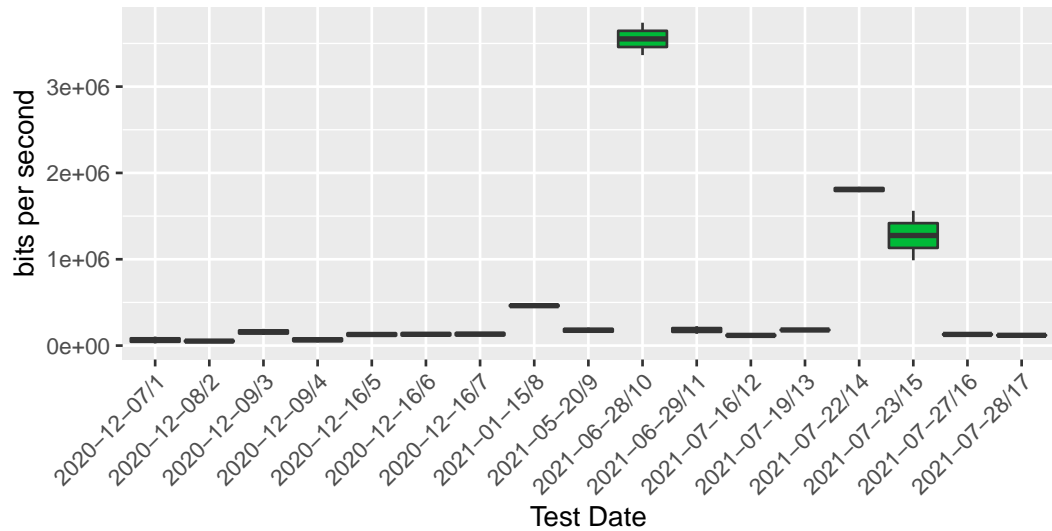






The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Bias	64596.51	19974.205	3.234	0.002	TermAppISO Integrator Routing Regression
2020-12-08	Bias	52159.33	5674.160	9.192	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Bias	158388.92	17536.412	9.032	0.000	TermAppISO Int Routing Regression
2020-12-09	Bias	67665.26	14789.314	4.575	0.000	TermAppISO
2020-12-16	Bias	128789.60	12489.057	10.312	0.000	TermAppISO Integrator Routing Changes
2020-12-16	Bias	130831.54	12093.291	10.819	0.000	TermAppISO with 40 provider threads
2020-12-16	Bias	132636.80	11969.911	11.081	0.000	TermAppISO with 80 provider threads
2021-01-15	Bias	462642.65	6392.297	72.375	0.000	TermAppISO
2021-05-20	Bias	177120.97	15654.052	11.315	0.000	TermAppISO
2021-06-28	Bias	3552601.09	93791.875	37.877	0.000	TermAppISO

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-06-29	Bias	180897.77	22122.205	8.177	0.000	TermAppISO
2021-07-16	Bias	118244.76	5351.244	22.097	0.000	TermAppISO
2021-07-19	Bias	180920.17	2831.954	63.885	0.000	TermAppISO
2021-07-22	Bias	1808374.69	15578.961	116.078	0.000	TermAppISO
2021-07-23	Bias	1275083.95	143254.541	8.901	0.000	TermAppISO
2021-07-27	Bias	129537.85	4238.183	30.564	0.000	TermAppISO
2021-07-28	Bias	119129.01	3197.513	37.257	0.000	TermAppISO

Bias: MODEL



ppISO Integrator Routing Regression  TermAppISO  TermAppISO
 ppISO Int Routing Regression  TermAppISO Integrator Routing Changes  TermAppISO
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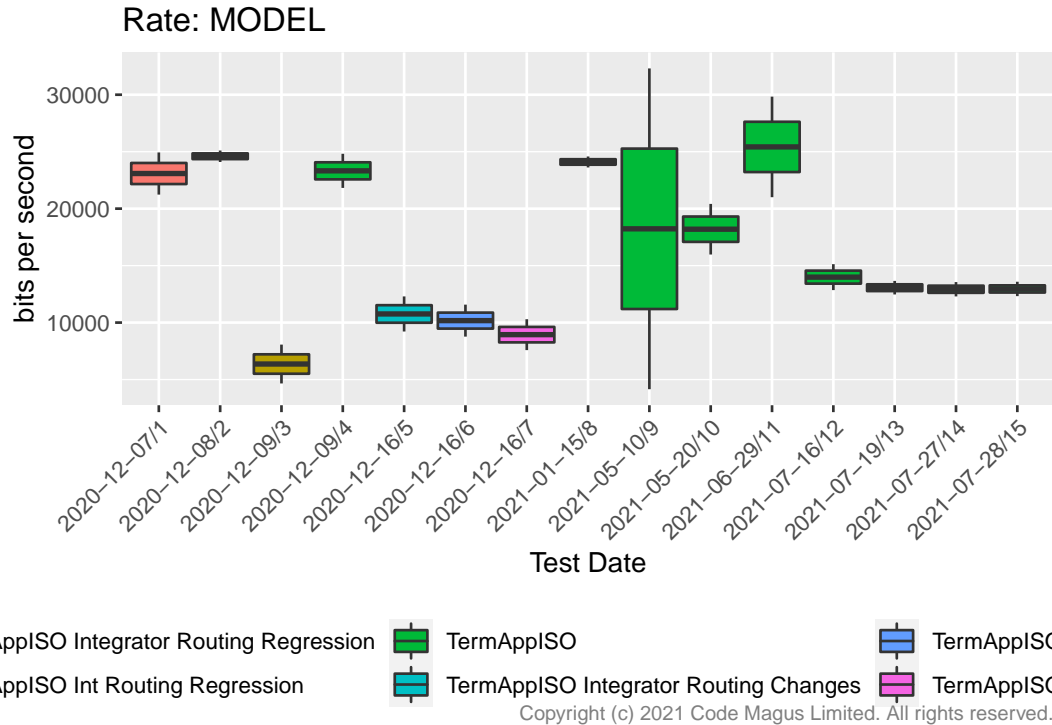
4.6 Network Resource usage for MODEL by Network Usage sent using sent in bits per second

Server	OSType	Description
MODELAPP0	Linux	CML EcoSystem

Server	OSType	Description
MODELAPP1	Linux	CML EcoSystem

The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

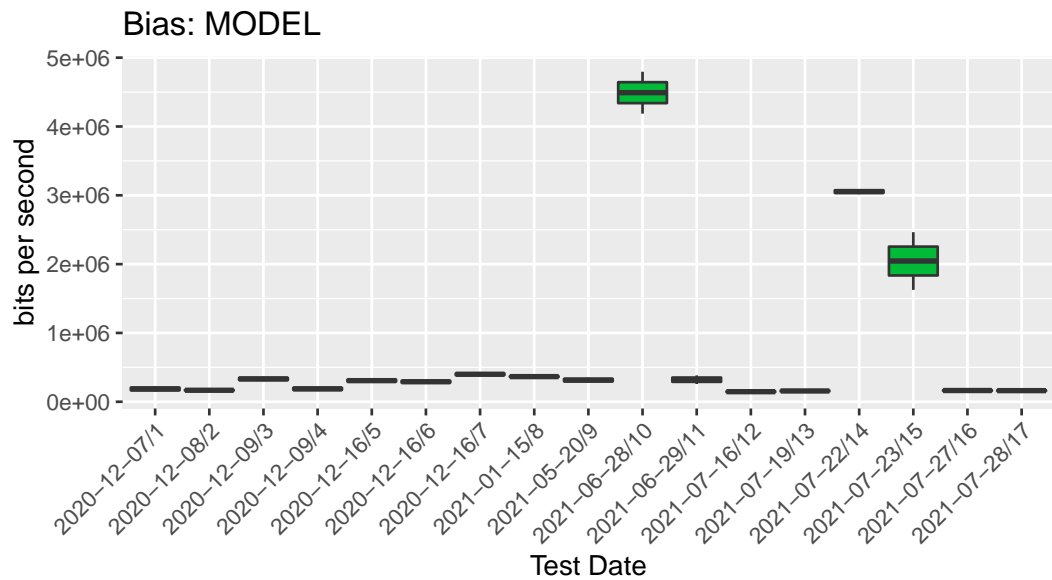
TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Rate	23083.902	924.847	24.960	0.000	TermAppISO Integrator Routing Regression
2020-12-08	Rate	24600.259	251.866	97.672	0.000	TermAppISO Integrator Routing Regression
2020-12-09	Rate	6362.325	852.572	7.463	0.000	TermAppISO Int Routing Regression
2020-12-09	Rate	23318.892	749.322	31.120	0.000	TermAppISO
2020-12-16	Rate	10756.811	769.527	13.978	0.000	TermAppISO Integrator Routing Changes
2020-12-16	Rate	10172.372	701.912	14.492	0.000	TermAppISO with 40 provider threads
2020-12-16	Rate	8940.326	678.158	13.183	0.000	TermAppISO with 80 provider threads
2021-01-15	Rate	24097.187	241.131	99.934	0.000	TermAppISO
2021-05-10	Rate	18230.092	7038.605	2.590	0.018	TermAppISO
2021-05-20	Rate	18196.215	1111.117	16.377	0.000	TermAppISO
2021-06-29	Rate	25419.663	2207.053	11.517	0.000	TermAppISO
2021-07-16	Rate	13989.533	569.403	24.569	0.000	TermAppISO
2021-07-19	Rate	13062.866	297.431	43.919	0.000	TermAppISO
2021-07-27	Rate	12926.270	314.888	41.050	0.000	TermAppISO
2021-07-28	Rate	12952.805	316.605	40.912	0.000	TermAppISO







The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2020-12-07	Bias	186452.2	19352.666	9.634	0	TermAppISO Integrator Routing Regression
2020-12-08	Bias	167394.2	5260.624	31.820	0	TermAppISO Integrator Routing Regression
2020-12-09	Bias	331861.2	16245.425	20.428	0	TermAppISO Int Routing Regression
2020-12-09	Bias	187742.4	15537.099	12.083	0	TermAppISO
2020-12-16	Bias	307108.4	14052.742	21.854	0	TermAppISO Integrator Routing Changes
2020-12-16	Bias	291049.7	12476.750	23.327	0	TermAppISO with 40 provider threads
2020-12-16	Bias	400012.4	12208.426	32.765	0	TermAppISO with 80 provider threads
2021-01-15	Bias	365642.3	5065.982	72.176	0	TermAppISO
2021-05-20	Bias	314872.1	17898.032	17.593	0	TermAppISO
2021-06-28	Bias	4491325.5	152240.008	29.502	0	TermAppISO

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-06-29	Bias	320788.4	31352.822	10.232	0	TermAppISO
2021-07-16	Bias	146356.9	5643.910	25.932	0	TermAppISO
2021-07-19	Bias	157004.9	6086.997	25.793	0	TermAppISO
2021-07-22	Bias	3053866.8	18802.581	162.417	0	TermAppISO
2021-07-23	Bias	2045037.6	209529.611	9.760	0	TermAppISO
2021-07-27	Bias	163493.5	6670.780	24.509	0	TermAppISO
2021-07-28	Bias	161652.7	6733.818	24.006	0	TermAppISO



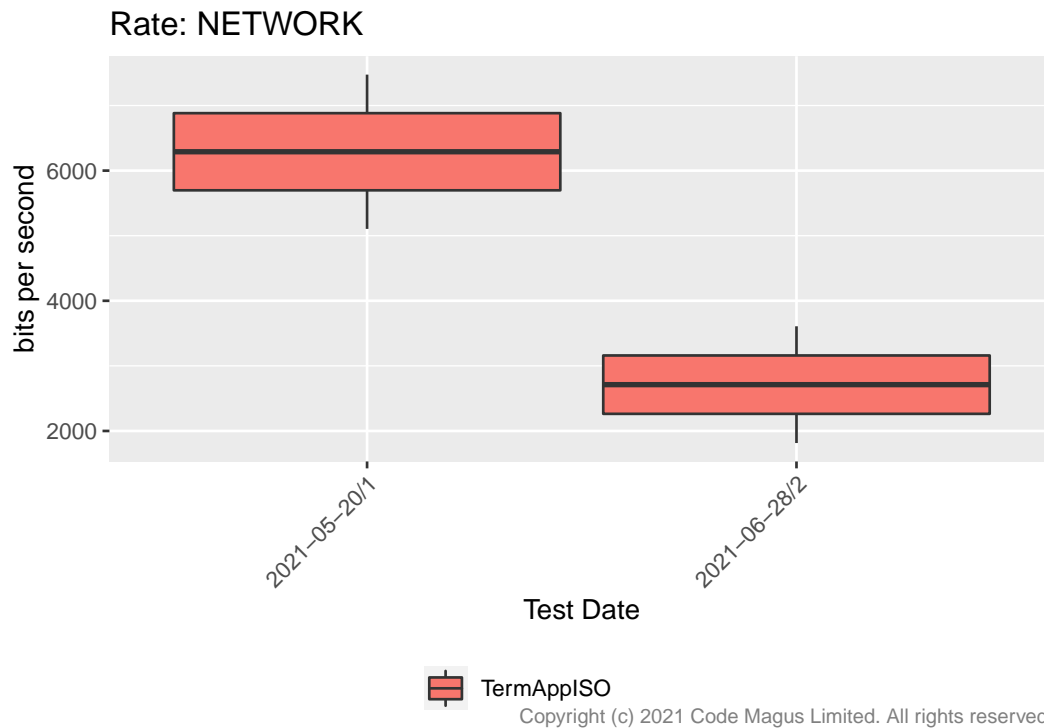
pplISO Integrator Routing Regression  TermAppISO  TermAppISO
 pplISO Int Routing Regression  TermAppISO Integrator Routing Changes  TermAppISO
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4.7 Network Resource usage for NETWORK by Network Usage recv using recv in bits per second

Server	OSType	Description
NETWORK	Linux	CML EcoSystem

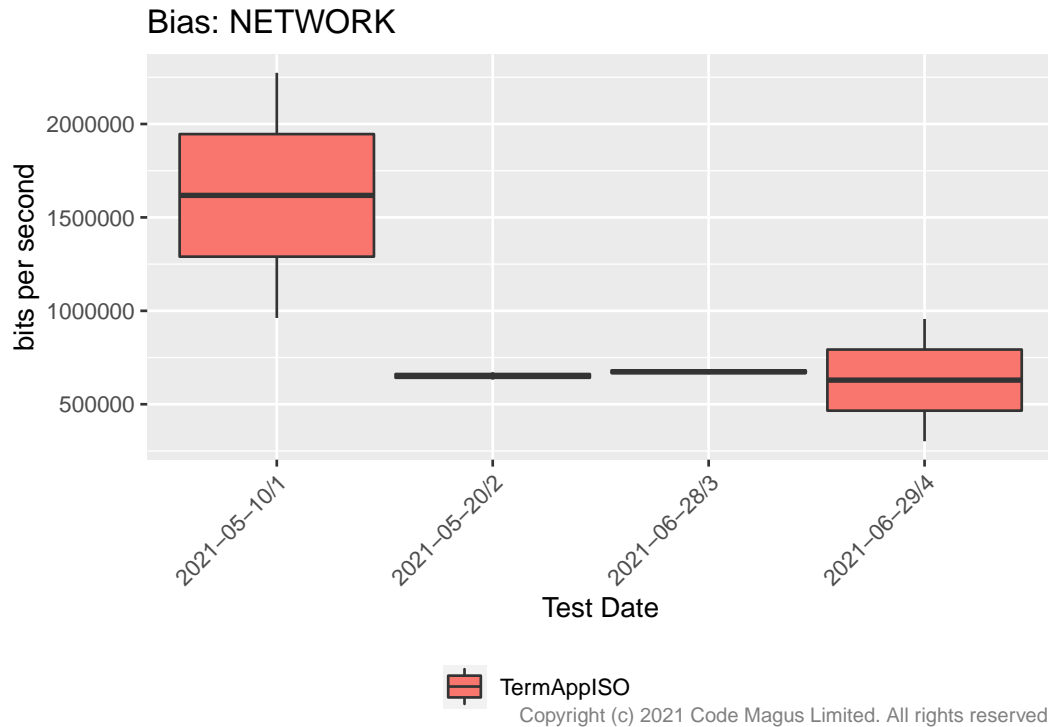
The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-05-20	Rate	6289.748	592.594	10.614	0	TermAppISO
2021-06-28	Rate	2711.282	448.421	6.046	0	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-05-10	Bias	1617885.6	328037.628	4.932	0	TermAppISO
2021-05-20	Bias	651687.7	9991.711	65.223	0	TermAppISO
2021-06-28	Bias	674006.3	6877.032	98.008	0	TermAppISO
2021-06-29	Bias	629183.3	163624.078	3.845	0	TermAppISO

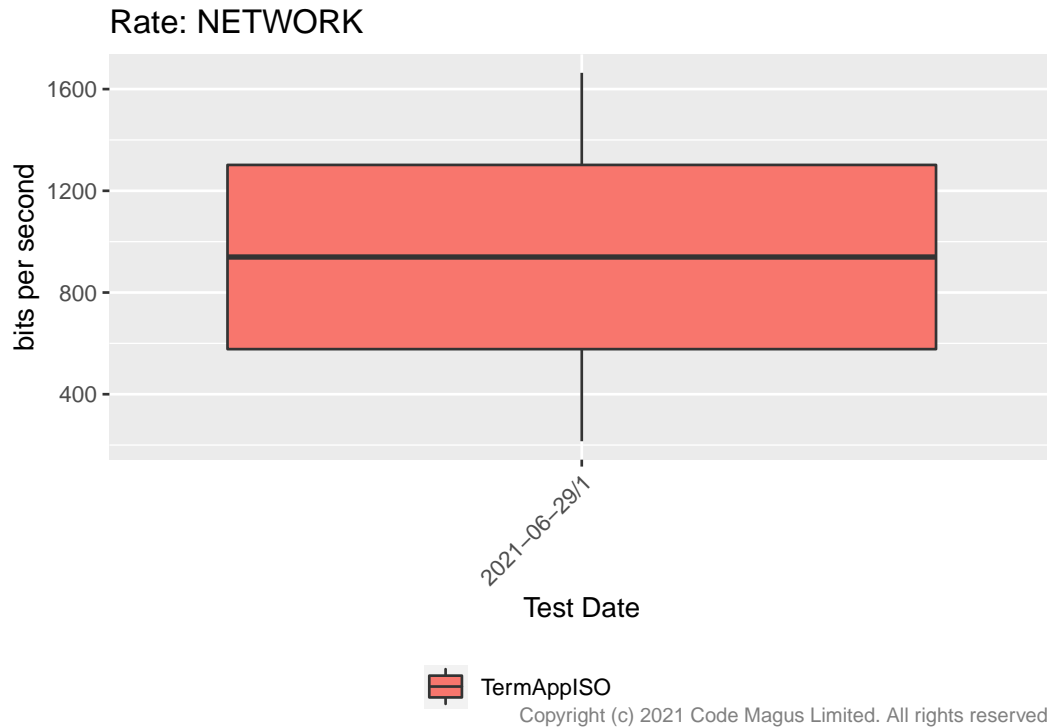


4.8 Network Resource usage for NETWORK by Network Usage sent using sent in bits per second

Server	OSType	Description
NETWORK	Linux	CML EcoSystem

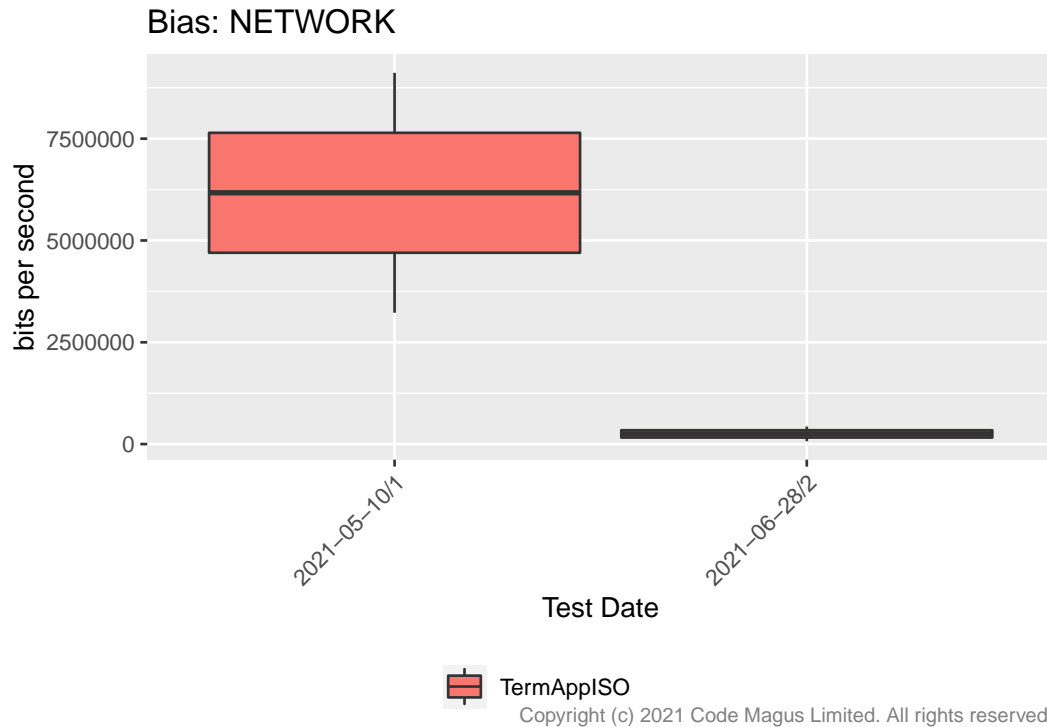
The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-06-29	Rate	939.561	362.238	2.594	0.013	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: bits per second.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-05-10	Bias	6171231.4	1472966.74	4.190	0.000	TermAppISO
2021-06-28	Bias	250236.8	90104.11	2.777	0.007	TermAppISO

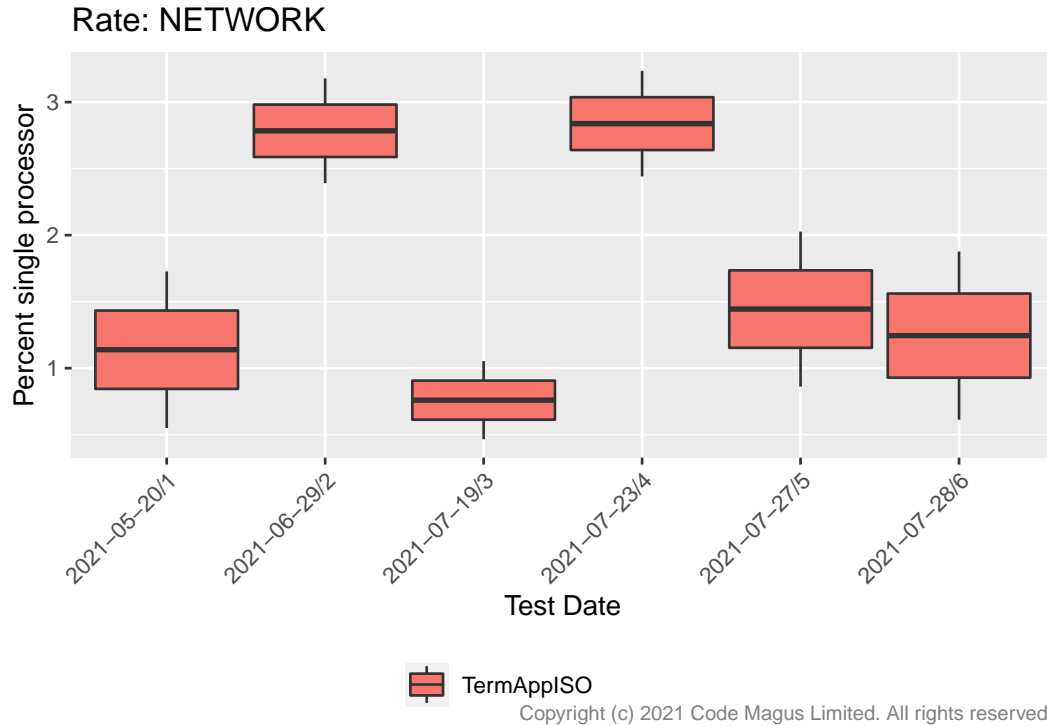


4.9 CPU Resource usage for NETWORK by CPU Usage using cpu.cpu.system.user in Percent single processor

Server	OSType	Description
NETWORK	Linux	CML EcoSystem

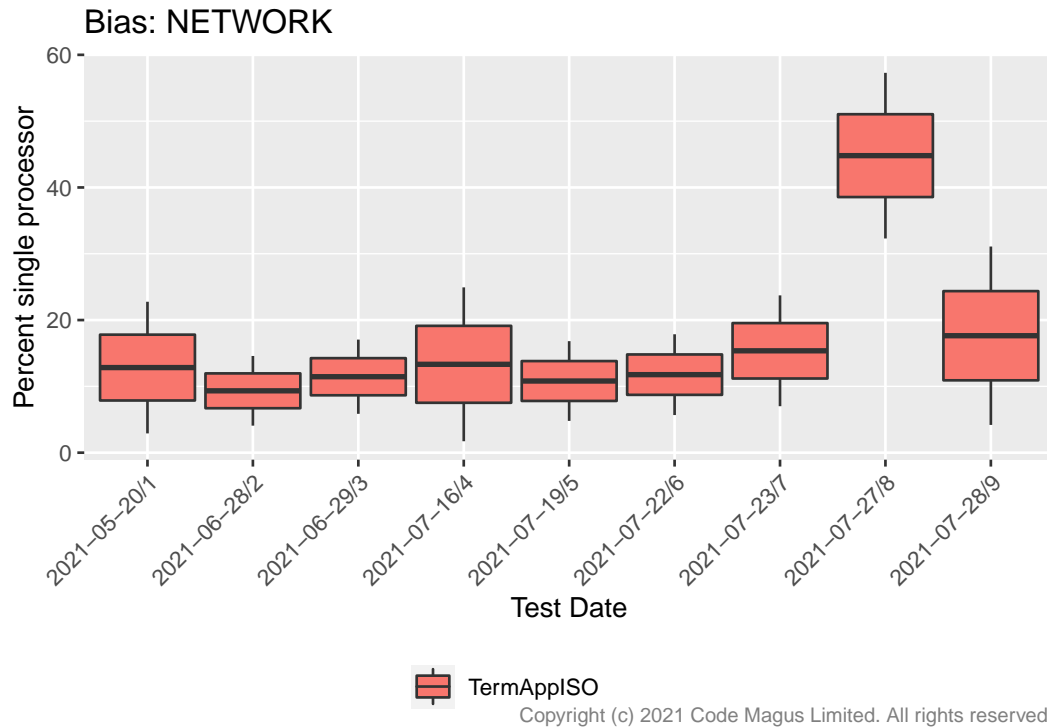
The following table shows the Rate coefficient values over the various tests performed. In this table the units of estimate are: Percent single processor.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-05-20	Rate	1.139	0.294	3.868	0	TermAppISO
2021-06-29	Rate	2.785	0.197	14.135	0	TermAppISO
2021-07-19	Rate	0.760	0.147	5.171	0	TermAppISO
2021-07-23	Rate	2.838	0.198	14.300	0	TermAppISO
2021-07-27	Rate	1.444	0.291	4.960	0	TermAppISO
2021-07-28	Rate	1.245	0.316	3.936	0	TermAppISO



The following table shows the Bias coefficient values over the various tests performed. In this table the units of estimate are: Percent single processor.

TestDate	Coef	Estimate	Std..Error	t.value	p.value	Test
2021-05-20	Bias	12.834	4.965	2.585	0.012	TermAppISO
2021-06-28	Bias	9.329	2.628	3.550	0.001	TermAppISO
2021-06-29	Bias	11.455	2.799	4.093	0.000	TermAppISO
2021-07-16	Bias	13.326	5.802	2.297	0.029	TermAppISO
2021-07-19	Bias	10.806	3.007	3.594	0.001	TermAppISO
2021-07-22	Bias	11.766	3.047	3.862	0.000	TermAppISO
2021-07-23	Bias	15.364	4.179	3.676	0.000	TermAppISO
2021-07-27	Bias	44.797	6.247	7.171	0.000	TermAppISO
2021-07-28	Bias	17.637	6.727	2.622	0.011	TermAppISO



5 Session details

```

sessionInfo();

## R version 3.6.0 (2019-04-26)
## Platform: x86_64-redhat-linux-gnu (64-bit)
## Running under: CentOS Linux 7 (Core)
##
## Matrix products: default
## BLAS/LAPACK: /usr/lib64/R/lib/libRblas.so
##
## locale:
##  [1] LC_CTYPE=en_US.UTF-8      LC_NUMERIC=C
##  [3] LC_TIME=en_US.UTF-8      LC_COLLATE=en_US.UTF-8
##  [5] LC_MONETARY=en_US.UTF-8  LC_MESSAGES=en_US.UTF-8
##  [7] LC_PAPER=en_US.UTF-8     LC_NAME=C
##  [9] LC_ADDRESS=C             LC_TELEPHONE=C
## [11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C
##
## attached base packages:
## [1] grid      stats    graphics grDevices utils    datasets methods
## [8] base
##

```



```
## other attached packages:
## [1] pander_0.6.3      doBy_4.6.7        cmlrutils_1.19   XML_3.98-1.20
## [5] scales_1.1.1      ggplot2_3.3.2     BSDA_1.2.0       lattice_0.20-38
##
## loaded via a namespace (and not attached):
## [1] Rcpp_1.0.5         highr_0.8         pillar_1.4.6     compiler_3.6.0
## [5] class_7.3-15      tools_3.6.0       digest_0.6.25    evaluate_0.14
## [9] lifecycle_0.2.0  tibble_3.0.3      gtable_0.3.0     pkgconfig_2.0.3
## [13] rlang_0.4.7       Matrix_1.2-17     yaml_2.2.1       xfun_0.17
## [17] e1071_1.7-4       withr_2.2.0       stringr_1.4.0    dplyr_1.0.2
## [21] knitr_1.30        generics_0.0.2    vctrs_0.3.2      tidyselect_1.1.0
## [25] glue_1.4.1        R6_2.4.1          rmarkdown_2.6    farver_2.0.3
## [29] tidyr_1.1.2       purrr_0.3.4       cmlbrandr_3.0    magrittr_1.5
## [33] backports_1.1.8   ellipsis_0.3.1    htmltools_0.5.0  MASS_7.3-51.4
## [37] colorspace_1.4-1 Deriv_4.0.1        labeling_0.3      stringi_1.5.3
## [41] munsell_0.5.0     broom_0.7.0       crayon_1.3.4
```