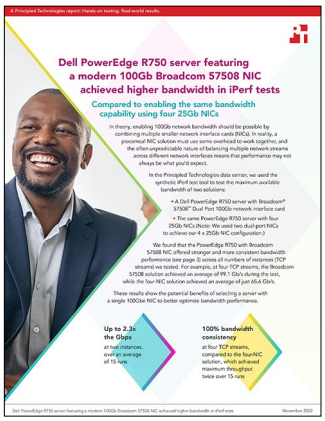

The science behind the report:

Dell PowerEdge R750 server featuring a modern 100Gb Broadcom 57508 NIC achieved higher bandwidth in iPerf tests

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report Dell PowerEdge R750 server featuring a modern 100Gb Broadcom 57508 NIC achieved higher bandwidth in iPerf tests.

We concluded our hands-on testing on June 6, 2022. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on July 11, 2022 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

To learn more about how we have calculated the wins in this report, go to http://facts.pt/calculating-and-highlighting-wins. Unless we state otherwise, we have followed the rules and principles we outline in that document.

iPerf 3 results: Average throughput

Table 1: Average throughput during iPerf testing.

1x 100Gb (Broadcom 57508) solution | Average Gbps						
Run	Instances					
	1	2	4	8	16	32
1	54.4	99.0	99.1	99.2	99.4	99.8
2	54.6	99.0	99.1	99.2	99.4	99.9
3	54.4	99.0	99.0	99.1	99.4	99.9
4	53.9	99.0	99.1	99.2	99.3	99.8
5	54.5	96.5	99.1	99.2	99.4	99.9
6	54.3	99.0	99.1	99.2	99.4	99.8
7	54.5	99.0	99.1	99.1	99.4	99.8
8	54.2	96.7	99.2	99.2	99.4	99.8
9	54.0	99.0	99.1	99.2	99.4	99.9
10	54.5	99.0	99.1	99.2	99.4	99.9
11	54.3	99.0	99.0	99.2	99.4	99.9
12	54.2	99.0	99.1	99.2	99.4	99.9
13	54.1	99.0	99.1	99.2	99.4	99.9
14	54.6	99.0	99.1	99.2	99.4	99.8
15	46.5	96.7	99.1	99.2	99.4	99.8
Average	53.8	98.5	99.1	99.2	99.4	99.9
Median	54.3	99.0	99.1	99.2	99.4	99.9

Table 2: Average throughput during iPerf testing.

4x 25Gb solution | Average Gbps						
Run	Instances					
	1	2	4	8	16	32
1	24.7	49.5	73.5	49.6	97.7	98.1
2	24.7	49.5	73.5	73.5	97.6	98.1
3	24.7	49.5	73.5	97.5	97.5	98.2
4	24.7	48.8	73.5	73.6	97.7	98.1
5	24.7	49.5	49.6	97.6	97.6	98.2
6	24.7	48.8	49.5	73.6	97.8	98.2
7	24.7	49.5	49.5	73.6	97.7	98.0
8	24.7	49.5	97.6	97.6	73.8	98.1
9	24.7	49.5	97.6	73.5	97.7	98.0
10	24.7	24.8	73.4	97.7	97.7	97.9
11	24.7	49.5	73.6	73.6	97.7	98.3
12	24.7	48.8	73.6	73.6	97.7	98.2
13	24.7	49.5	48.8	97.6	97.6	97.9
14	24.7	48.8	49.6	97.4	97.7	98.2
15	24.7	49.5	73.6	97.6	97.9	98.1
Average	24.7	47.7	68.7	83.2	96.1	98.1
Median	24.7	49.5	73.5	73.6	97.7	98.1

iPerf 3 results: Consistency comparisons

Two instances

Table 3: iPerf results for the Broadcom 57508 solution at two instances. Source: Principled Technologies.

1x100 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	48.9	49.0	49.1	49.1	44.1	49.9	48.9	44.2	49.1	49.0	49.0	49.1	48.9	48.8	50.8
Instance 2	50.1	50.0	49.9	49.9	52.4	49.1	50.1	52.5	49.9	50.0	50.0	49.9	50.1	50.2	45.9
Sum	99.0	99.0	99.0	99.0	96.5	99.0	99.0	96.7	99.0	99.0	99.0	99.0	99.0	99.0	96.7
Average	49.5	49.5	49.5	49.5	48.3	49.5	49.5	48.4	49.5	49.5	49.5	49.5	49.5	49.5	48.4
Std. Deviation	0.6	0.5	0.4	0.4	4.15	0.4	0.6	4.15	0.4	0.5	0.5	0.4	0.6	0.7	2.45

Table 4: iPerf results for the four-NIC solution at two instances. Source: Principled Technologies.

4x25 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	24.7	24.7	24.7	24.4	24.7	24.4	24.7	24.7	24.7	12.4	24.7	24.4	24.7	24.4	24.7
Instance 2	24.8	24.8	24.8	24.4	24.8	24.4	24.8	24.8	24.8	12.4	24.8	24.4	24.8	24.4	24.8
Sum	49.5	49.5	49.5	48.8	49.5	48.8	49.5	49.5	49.5	24.8	49.5	48.8	49.5	48.8	49.5
Average	24.8	24.8	24.8	24.4	24.8	24.4	24.8	24.8	24.8	12.4	24.8	24.4	24.8	24.4	24.8
Std. Deviation	0.05	0.05	0.05	0	0.05	0	0.05	0.05	0.05	0	0.05	0	0.05	0	0.05

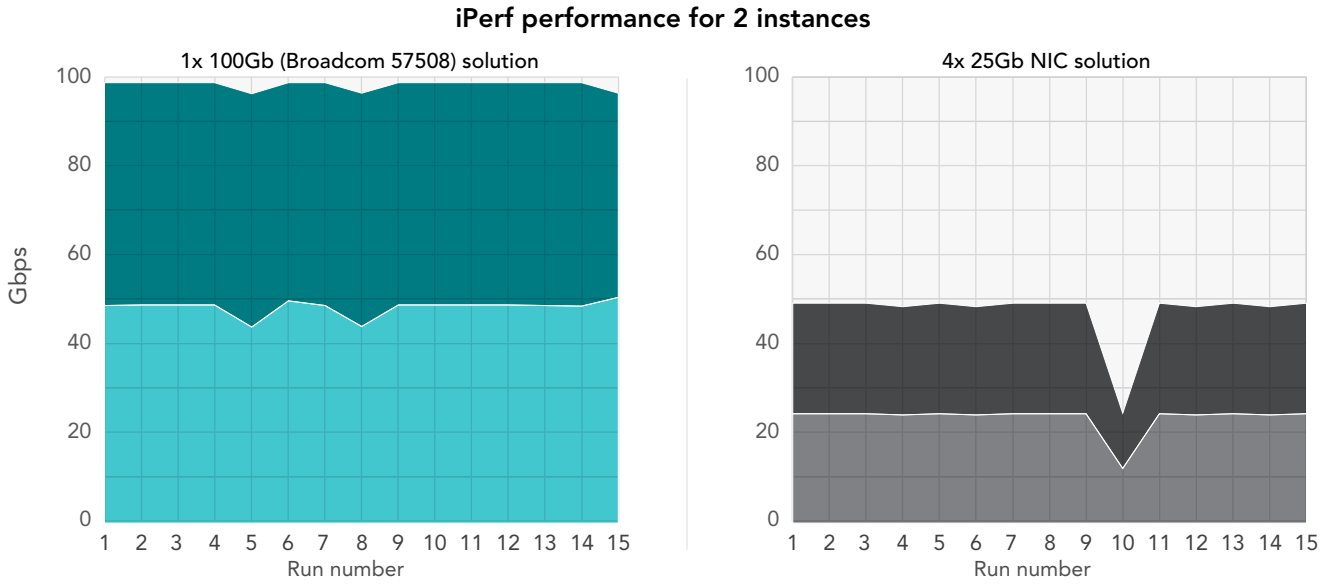

Table 5: iPerf results, in Gbps, for two TCP streams. Higher numbers and more consistency is better. Source: Principled Technologies.

Four instances

Table 6: iPerf results for the Broadcom 57508 solution at four instances. Source: Principled Technologies.

1x100 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	24.8	24.7	24.7	24.8	24.7	24.7	24.7	24.8	24.7	24.8	24.8	24.8	24.7	24.8	24.7
Instance 2	24.7	24.8	24.7	24.7	24.8	24.8	24.8	24.8	24.8	24.7	24.7	24.8	24.8	24.8	24.8
Instance 3	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.7	24.7	24.8	24.8	24.8
Instance 4	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.7	24.8
Sum	99.1	99.1	99.0	99.1	99.1	99.1	99.1	99.2	99.1	99.1	99.0	99.1	99.1	99.1	99.1
Average	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8
Std. Deviation	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0

Table 7: iPerf results for the four-NIC solution at four instances. Source: Principled Technologies.

4x25 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	24.4	24.7	12.2	12.1	8.3	24.7	12.4	24.4	24.4	24.7	24.4	12.4	7.9	8.3	12.3
Instance 2	24.8	12.1	12.1	24.8	8.2	8.3	12.3	24.4	24.4	24.4	12.2	24.4	24.4	8.2	24.4
Instance 3	12.1	24.4	24.4	12.2	8.3	8.3	12.3	24.4	24.4	11.9	24.8	24.4	8.1	24.8	12.5
Instance 4	12.2	12.3	24.8	24.4	24.8	8.3	12.5	24.4	24.4	12.4	12.2	12.4	8.3	8.2	24.4
Sum	73.5	73.5	73.5	73.5	49.6	49.5	49.5	97.6	97.6	73.4	73.6	73.6	48.8	49.6	73.6
Average	18.4	18.4	18.4	18.4	12.4	12.4	12.4	24.4	24.4	18.4	18.4	18.4	12.2	12.4	18.4
Std. Deviation	6.2	6.2	6.2	6.2	7.2	7.1	0.1	0.0	0.0	6.2	6.2	6.0	7.0	7.2	6.0

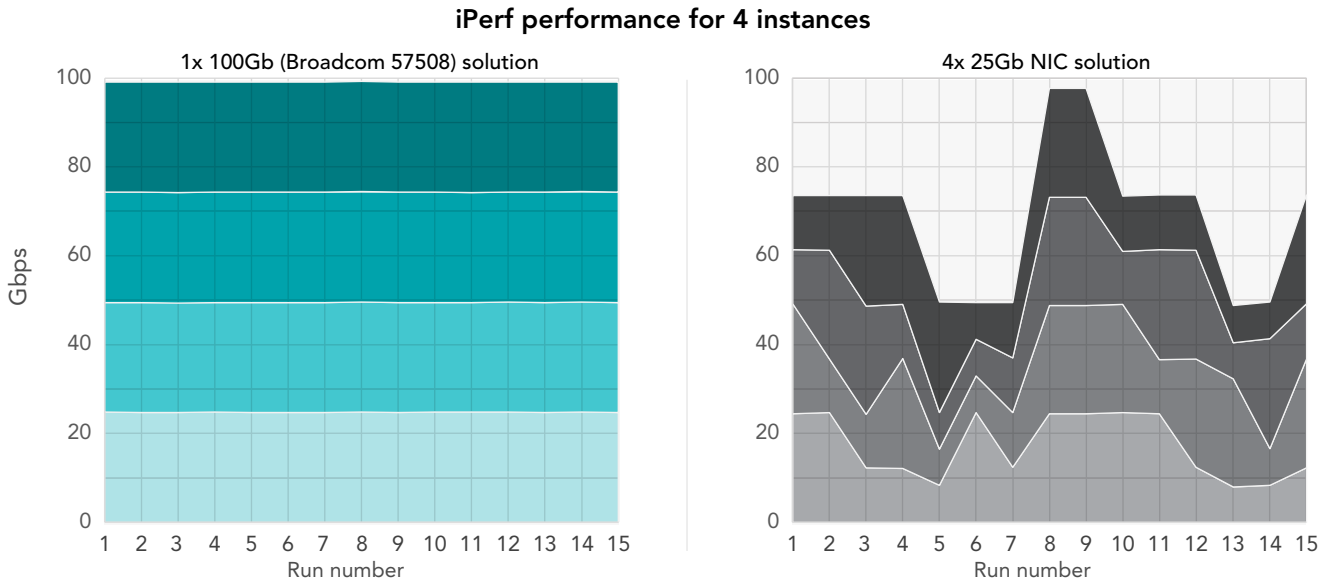

Figure 3: iPerf results, in Gbps, for four TCP streams. Higher numbers and more consistency is better. Source: Principled Technologies.

Eight instances

Table 8: iPerf results for the Broadcom 57508 solution at eight instances. Source: Principled Technologies.

1x100 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 2	12.4	12.4	12.3	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 3	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 5	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 6	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 7	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Instance 8	12.4	12.4	12.4	12.4	12.4	12.4	12.3	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Sum	99.2	99.2	99.1	99.2	99.2	99.2	99.1	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2
Average	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Std. Deviation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 9: iPerf results for the four-NIC solution at eight instances. Source: Principled Technologies.

4x25 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	5.1	12.7	12.5	5.8	8.1	12.2	12.2	24.4	12.6	8.6	24.4	8.9	12.4	8.0	12.4
Instance 2	4.7	6.5	8.2	6.6	8.6	8.2	8.3	12.6	7.1	8.5	8.3	8.3	12.4	12.1	6.5
Instance 3	8.2	12.4	8.1	12.1	8.3	12.2	8.7	12.1	12.3	8.6	6.4	8.2	8.2	8.1	24.4
Instance 4	8.3	11.7	8.1	6.5	24.4	8.1	12.6	8.1	12.5	24.4	8.2	7.9	8.7	12.2	24.4
Instance 5	5.2	6.5	11.9	5.5	8.9	8.2	8.4	8.3	5.6	8.1	6.1	8.2	24.4	12.1	5.8
Instance 6	4.9	5.5	12.2	12.3	7.4	8.1	7.2	8.0	5.9	7.4	6.0	12.0	12.0	8.2	12.0
Instance 7	8.2	12.3	24.4	12.4	24.4	8.3	7.8	12.3	11.7	24.4	8.3	7.7	7.5	24.4	5.6
Instance 8	4.8	5.9	12.1	12.4	7.5	8.3	8.3	11.8	5.8	7.7	5.9	12.4	12.0	12.2	6.5
Sum	49.6	73.5	97.5	73.6	97.6	73.6	73.6	97.6	73.5	97.7	73.6	73.6	97.6	97.4	97.6
Average	6.2	9.2	12.2	9.2	12.2	9.2	9.2	12.2	9.2	12.2	9.2	9.2	12.2	12.2	12.2
Std. Deviation	1.6	3.1	5.0	3.1	7.1	1.7	1.9	5.0	3.1	7.1	5.8	1.8	5.0	5.0	7.5

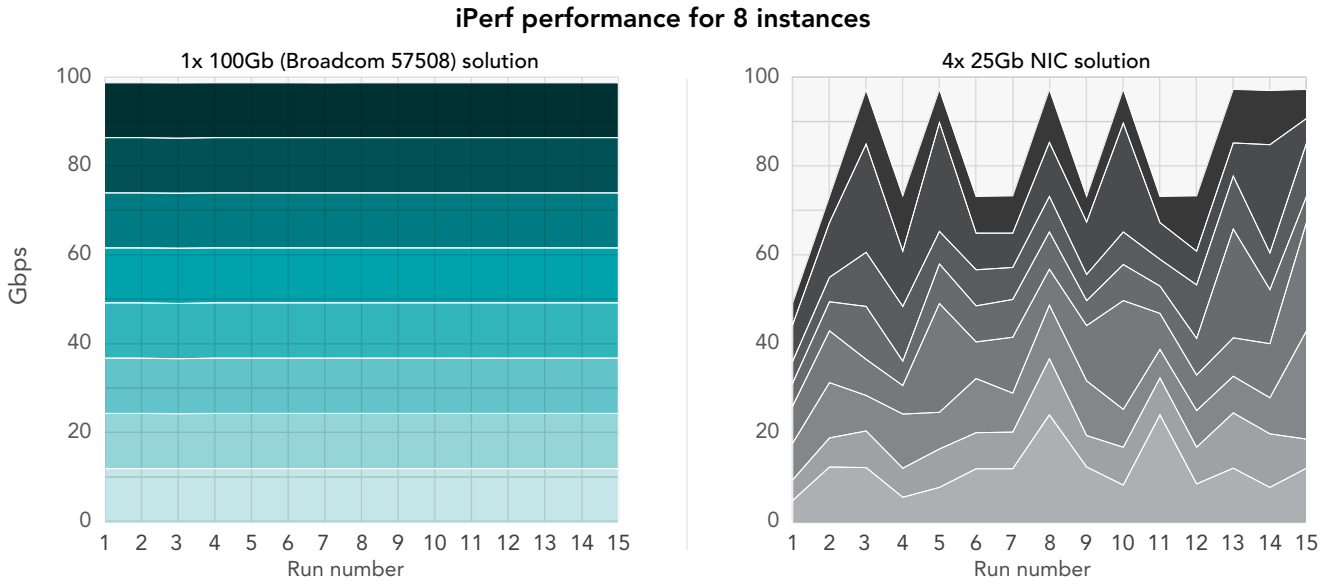

Figure 4: iPerf results, in Gbps, for eight TCP streams. Higher numbers and more consistency is better. Source: Principled Technologies.

16 instances

Table 10: iPerf results for the Broadcom 57508 solution at 16 instances. Source: Principled Technologies.

1x100 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	6.4	6.3	6.2	6.0	6.2	6.3	6.2	6.2	6.2	6.0	6.3	6.3	6.3	6.1	6.0
Instance 2	6.6	6.3	6.2	6.3	6.2	6.0	6.2	6.0	6.2	6.3	6.0	6.3	6.3	6.1	6.0
Instance 3	6.5	6.3	5.9	6.3	6.2	6.3	6.2	6.2	6.2	6.0	6.3	6.3	6.3	5.9	6.0
Instance 4	6.5	6.0	6.2	6.0	6.2	6.3	6.2	6.2	6.2	6.3	6.3	6.0	6.0	6.4	6.0
Instance 5	6.4	6.3	6.2	6.3	6.2	6.0	6.2	6.2	6.2	6.3	6.3	6.0	6.3	6.0	6.0
Instance 6	6.5	6.3	6.3	6.3	6.2	6.0	6.0	6.2	6.2	6.0	6.0	6.3	6.0	6.4	6.0
Instance 7	5.2	6.0	6.3	6.3	6.2	6.3	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.4	6.4
Instance 8	6.5	5.9	6.3	6.0	6.2	6.3	6.2	6.0	6.2	6.3	6.3	6.3	6.0	6.4	6.4
Instance 9	6.2	6.3	6.3	6.3	6.2	6.3	6.2	6.2	6.2	6.3	6.3	6.3	6.0	6.4	6.4
Instance 10	6.5	6.3	6.3	6.3	6.2	6.3	6.2	6.2	6.2	6.3	6.0	6.3	6.3	5.9	6.4
Instance 11	6.4	6.3	6.3	6.3	6.2	6.0	6.3	6.2	6.2	6.3	6.4	6.3	6.0	5.9	6.4
Instance 12	5.3	6.3	5.9	6.3	6.2	6.3	6.3	6.2	6.2	6.3	6.3	6.0	6.0	6.5	6.4
Instance 13	6.2	6.3	6.3	6.3	6.2	6.3	6.3	6.3	6.2	6.0	6.0	6.0	6.3	6.5	6.4
Instance 14	6.4	6.3	6.3	6.0	6.2	6.3	6.3	6.3	6.2	6.3	6.0	6.3	6.4	6.0	6.0
Instance 15	5.3	5.9	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.0	6.3	6.4	5.9	6.1
Instance 16	6.5	6.4	6.3	6.3	6.3	6.3	6.0	6.3	6.3	6.3	6.4	6.3	6.4	6.5	6.5
Sum	99.4	99.4	99.4	99.3	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4
Average	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Std. Deviation	0.5	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.2

Table 11: iPerf results for the four-NIC solution at 16 instances. Source: Principled Technologies.

4x25 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	4.5	4.2	5.7	6.1	6.5	12.8	6.8	5.0	3.9	6.5	5.5	5.7	3.2	4.8	7.9
Instance 2	5.1	4.5	3.3	9.1	5.1	5.3	6.2	8.5	4.4	6.4	7.3	5.5	4.5	5.3	8.4
Instance 3	5.4	3.1	3.0	4.5	6.7	4.6	12.7	4.9	3.7	5.4	6.3	6.8	3.7	4.3	6.9
Instance 4	4.4	6.2	6.2	8.2	5.5	4.4	5.2	3.3	12.3	6.5	7.1	6.0	11.9	11.8	4.5
Instance 5	6.6	3.0	6.4	8.5	8.6	4.3	5.5	3.3	6.5	8.6	8.1	6.3	3.5	6.3	7.3
Instance 6	6.1	3.0	8.6	6.2	5.7	8.7	5.9	3.3	6.4	8.6	5.2	6.1	3.9	5.3	5.4
Instance 7	12.2	3.6	6.2	6.3	6.4	4.1	4.5	5.1	6.6	5.3	9.1	6.3	2.9	5.0	3.9
Instance 8	4.5	6.3	12.1	5.8	7.9	4.8	5.1	3.3	6.8	5.6	4.7	6.2	3.9	5.2	3.8
Instance 9	5.4	3.2	12.2	4.5	7.9	4.2	5.3	8.9	4.3	6.2	4.5	6.6	3.7	6.6	8.0
Instance 10	4.6	6.1	3.7	7.7	6.2	8.1	11.8	2.4	12.1	7.2	5.8	6.4	12.5	5.1	5.5
Instance 11	4.5	6.0	3.6	4.4	6.3	3.7	4.7	3.3	4.7	4.9	5.9	6.3	3.6	5.3	4.0
Instance 12	5.1	6.4	8.6	3.5	5.3	3.7	4.4	4.9	5.6	5.2	5.0	6.5	4.5	5.1	4.5
Instance 13	6.6	5.7	7.2	7.1	4.5	11.7	5.5	2.5	6.4	5.3	4.8	5.5	24.3	12.6	3.8
Instance 14	12.2	24.3	3.6	8.3	5.5	7.6	4.5	3.1	5.9	4.6	5.7	5.7	3.5	6.2	6.7
Instance 15	5.7	6.1	3.6	3.6	4.1	5.6	5.3	7.1	4.5	6.9	6.3	6.4	3.7	4.2	8.6
Instance 16	4.7	6.1	3.7	3.8	5.3	4.4	4.1	5.0	3.8	4.5	6.6	5.4	4.5	4.5	8.8
Sum	97.7	97.6	97.5	97.7	97.6	97.8	97.7	73.8	97.7	97.7	97.7	97.7	97.6	97.7	97.9
Average	6.1	6.1	6.1	6.1	6.1	6.1	6.1	4.6	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Std. Deviation	2.4	4.9	2.9	1.8	1.2	2.8	2.4	1.9	2.5	1.2	1.2	0.4	5.5	2.4	1.8

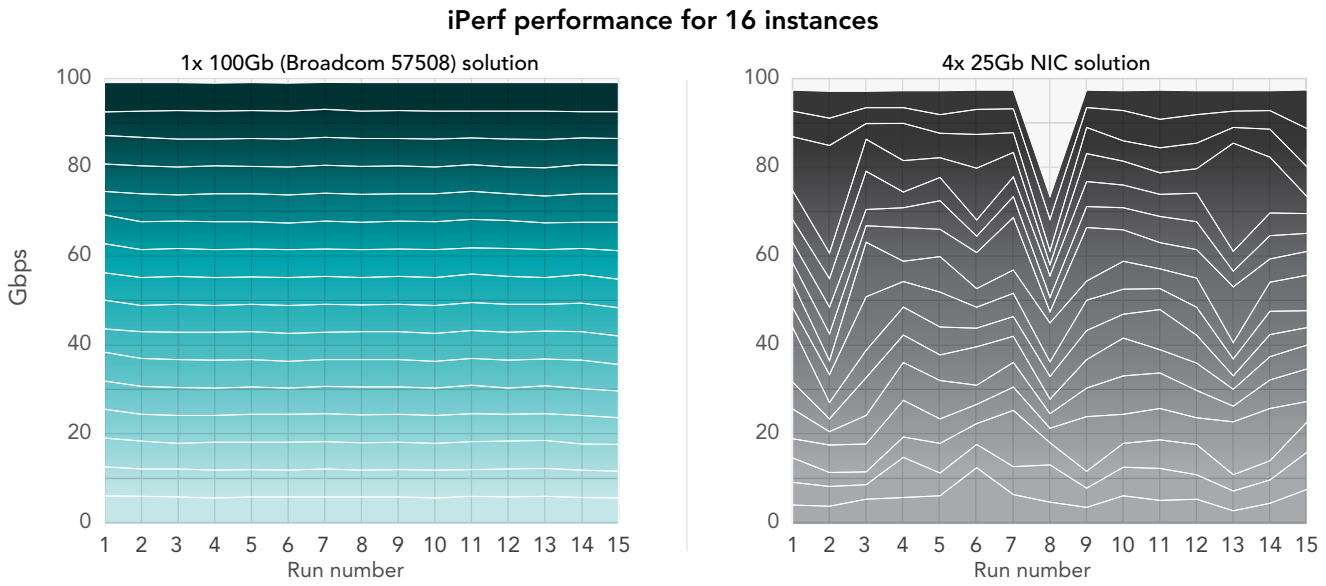

Figure 5: iPerf results, in Gbps, for 16 TCP streams. Higher numbers and more consistency is better. Source: Principled Technologies.

32 instances

Table 12: iPerf results for the Broadcom 57508 solution at 32 instances. Source: Principled Technologies.

1x100 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	3.4	4.4	1.4	2.2	3.6	1.6	3.5	1.5	4.4	2.0	4.2	2.3	4.1	2.0	4.0
Instance 2	3.4	2.4	4.1	2.2	3.5	2.4	3.5	4.0	1.6	3.8	4.2	4.2	4.1	2.0	4.0
Instance 3	3.4	1.6	4.1	2.2	3.4	4.4	3.5	1.5	2.4	3.8	2.3	4.2	4.1	3.6	1.4
Instance 4	3.4	4.3	1.1	2.2	3.5	4.4	3.5	4.1	1.6	2.0	2.3	4.2	4.0	3.6	1.4
Instance 5	3.4	2.4	4.0	2.2	3.6	1.6	3.5	2.2	4.3	1.3	2.3	2.3	4.1	2.0	2.2
Instance 6	1.7	2.4	4.1	4.0	1.6	1.6	1.8	4.1	2.4	3.8	4.2	4.3	4.1	3.6	4.1
Instance 7	1.7	4.4	4.0	4.0	3.5	2.4	3.5	1.5	1.6	2.0	4.2	4.2	4.0	3.6	2.2
Instance 8	3.4	1.6	4.1	4.1	1.6	1.6	3.5	4.1	2.4	3.8	4.2	4.2	2.2	3.6	1.5
Instance 9	3.4	4.3	2.2	2.2	1.6	4.3	1.2	2.2	2.4	3.8	4.2	4.3	4.1	3.6	4.1
Instance 10	3.4	4.4	1.1	4.0	3.5	4.4	3.5	1.5	4.4	2.0	4.2	4.3	4.1	3.6	4.1
Instance 11	3.4	2.4	4.1	4.0	3.5	4.4	1.8	1.5	4.4	2.0	4.3	4.2	4.1	2.0	4.1
Instance 12	3.4	4.4	4.1	2.2	3.5	2.4	3.6	4.1	2.4	3.8	4.2	4.3	2.2	2.1	4.1
Instance 13	3.4	1.6	1.1	2.2	3.5	1.6	1.2	4.1	4.3	3.8	1.1	1.2	4.1	3.6	4.1
Instance 14	3.4	4.3	4.1	4.0	3.5	2.4	3.6	1.5	4.4	3.8	1.5	1.2	4.1	3.6	2.2
Instance 15	3.4	4.4	4.1	4.0	3.6	4.4	3.6	2.2	2.4	3.8	4.2	2.3	2.2	2.1	4.1
Instance 16	3.4	2.4	2.2	2.2	3.5	4.4	1.2	2.2	2.4	3.8	2.3	1.0	2.2	3.6	4.1
Instance 17	3.4	2.4	1.5	2.1	3.6	4.4	3.6	4.1	4.4	3.8	4.3	1.0	2.2	2.0	4.1
Instance 18	1.7	4.4	2.2	2.2	2.3	4.4	3.6	4.1	4.4	3.8	4.3	4.2	1.4	3.6	1.5
Instance 19	3.4	1.6	2.2	4.0	3.5	1.6	3.6	4.1	4.4	3.8	1.1	4.3	4.1	2.1	2.2
Instance 20	1.7	1.6	4.1	4.0	1.6	1.6	1.8	4.1	4.4	1.4	4.2	4.3	1.5	2.1	4.1
Instance 21	3.4	2.4	4.1	2.2	3.6	4.4	3.6	4.1	2.4	1.4	2.4	4.3	4.1	3.6	4.1
Instance 22	3.4	2.4	2.2	4.1	3.5	4.4	3.6	2.2	1.6	3.8	2.3	1.2	2.2	3.6	4.1
Instance 23	3.4	2.4	4.1	4.1	1.6	2.4	3.6	4.1	4.4	3.8	1.2	1.0	1.5	3.6	1.5
Instance 24	3.5	1.6	4.1	4.0	3.6	4.4	3.6	4.1	4.4	3.8	4.3	1.0	2.2	2.1	2.2
Instance 25	1.8	4.4	1.5	2.2	3.6	2.4	3.6	4.1	4.4	2.1	4.2	1.2	4.1	3.6	4.1
Instance 26	3.5	2.4	4.1	2.2	3.7	1.6	3.6	2.2	2.4	2.1	2.4	4.3	2.2	3.6	2.2
Instance 27	3.5	4.4	1.2	4.1	3.6	4.4	3.6	2.2	1.7	3.8	1.6	4.3	2.2	3.6	4.1
Instance 28	3.5	4.4	4.1	4.1	1.7	2.5	1.9	4.1	4.4	3.8	2.4	4.3	2.2	3.6	4.1
Instance 29	3.5	2.5	2.3	4.1	3.6	2.5	3.6	4.1	2.5	3.8	1.2	2.4	2.2	3.6	4.1
Instance 30	3.5	4.4	4.1	2.3	3.6	1.7	3.6	4.1	2.5	3.8	1.6	0.9	4.1	3.7	2.3
Instance 31	3.5	4.4	4.2	4.1	2.6	4.5	3.6	4.1	1.7	3.9	4.3	4.3	2.3	3.7	1.6
Instance 32	1.8	2.6	4.2	2.3	3.6	4.5	3.6	2.3	2.5	2.1	4.3	4.3	4.2	3.7	2.3
Sum	99.8	99.9	99.9	99.8	99.9	99.8	99.8	99.8	99.9	99.9	99.9	99.9	100.0	99.8	99.8
Average	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Std. Deviation	0.7	1.1	1.2	0.9	0.8	1.2	0.8	1.1	1.1	0.9	1.2	1.4	1.0	0.7	1.1

Table 13: iPerf results for the four-NIC solution at 32 instances. Source: Principled Technologies.

4x25 Gb NIC	Run number														
Avg. Gbps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Instance 1	1.5	2.5	3.2	2.9	3.6	3.7	2.3	2.2	2.9	2.4	2.8	6.3	1.8	2.3	2.2
Instance 2	2.4	2.6	3.3	1.9	4.2	2.7	2.3	1.9	2.1	3.6	4.4	6.3	2.6	4.2	3.4
Instance 3	6.3	3.1	3.4	4.5	3.6	2.6	2.6	1.9	2.3	3.6	3.2	2.7	2.2	3.1	2.0
Instance 4	6.7	2.8	3.5	3.5	3.6	2.6	2.9	3.8	3.8	3.6	2.2	4.0	2.1	2.0	3.6
Instance 5	3.0	6.3	2.2	1.9	3.1	4.9	2.5	2.3	2.6	3.3	3.2	2.3	1.9	2.6	2.8
Instance 6	1.5	2.8	3.8	2.7	2.4	2.0	2.3	3.2	3.2	3.6	2.8	3.0	2.8	2.6	2.8
Instance 7	2.3	2.9	3.5	3.3	4.0	2.7	3.0	1.8	2.3	2.3	3.5	2.3	2.4	2.8	3.4
Instance 8	1.8	2.2	4.2	3.7	3.0	2.1	3.0	2.2	3.9	2.3	3.0	2.1	2.6	2.3	1.6
Instance 9	5.5	2.8	2.3	2.6	2.4	3.6	2.9	3.9	3.0	3.4	2.9	2.0	2.8	2.7	2.3
Instance 10	5.6	2.1	2.7	1.8	3.8	2.7	2.4	2.1	3.2	3.1	2.5	2.1	2.7	3.0	2.9
Instance 11	1.7	2.2	2.6	2.6	2.5	2.1	2.4	3.7	3.0	3.7	2.2	2.4	1.7	3.3	4.6
Instance 12	1.9	2.8	3.7	2.6	2.4	2.5	2.8	1.8	2.3	3.4	2.4	1.8	2.0	2.4	3.6
Instance 13	5.9	3.0	1.9	3.2	3.2	3.7	3.0	4.3	2.6	2.3	4.5	2.0	2.8	2.1	5.1
Instance 14	3.0	2.9	4.1	3.3	3.7	3.6	2.6	3.0	3.7	1.9	2.2	1.6	1.8	2.4	2.9
Instance 15	1.8	2.4	4.2	2.4	3.0	2.6	6.6	3.6	4.4	3.6	3.0	3.0	2.2	3.0	2.0
Instance 16	1.8	2.8	4.2	3.7	2.5	2.7	2.9	4.2	3.8	3.6	3.1	2.0	2.0	2.6	3.5
Instance 17	2.9	2.9	3.6	3.3	2.5	2.7	2.6	4.3	2.7	3.6	3.2	2.0	2.9	2.7	2.2
Instance 18	1.5	2.1	3.9	2.6	2.1	4.6	2.4	3.1	2.7	3.7	2.3	3.5	1.9	2.6	2.3
Instance 19	1.9	2.2	1.9	1.9	2.5	2.7	2.9	3.6	3.0	2.4	2.8	6.0	2.1	5.3	5.0
Instance 20	1.6	2.3	2.3	3.7	2.5	2.7	3.0	3.8	4.3	2.3	2.9	2.0	2.3	2.8	4.9
Instance 21	2.1	5.5	3.7	3.7	4.0	4.3	2.3	1.9	2.6	3.6	3.3	4.4	3.0	3.0	2.3
Instance 22	4.7	2.2	2.4	3.6	2.7	1.9	5.9	4.5	2.7	3.1	3.2	4.6	2.4	3.1	4.9
Instance 23	1.8	6.1	2.9	3.7	2.5	5.4	3.0	2.9	4.2	1.9	4.6	4.4	1.8	3.2	3.2
Instance 24	3.1	2.9	3.1	3.7	4.2	2.7	6.3	3.9	4.0	3.6	2.9	3.0	24.3	2.5	3.2
Instance 25	1.9	3.0	3.7	2.5	2.5	2.6	2.2	2.3	2.3	2.3	2.9	1.7	2.6	3.2	1.7
Instance 26	1.9	6.7	3.7	2.4	4.4	2.6	2.7	3.7	3.0	3.5	3.4	6.1	2.6	2.7	2.2
Instance 27	5.4	3.0	2.4	2.5	3.0	3.5	3.0	3.7	2.7	2.3	3.2	1.8	2.7	5.2	2.1
Instance 28	3.2	2.9	2.7	3.3	3.9	3.8	2.7	3.6	2.1	3.7	2.7	1.9	2.0	4.4	2.9
Instance 29	4.5	2.3	2.3	4.6	2.4	5.4	2.6	2.3	2.6	3.7	2.9	2.9	2.7	3.2	3.7
Instance 30	2.5	3.0	2.5	3.6	2.4	2.6	2.1	2.0	2.8	2.0	3.0	1.8	3.1	5.3	3.3
Instance 31	4.4	2.2	1.9	2.0	2.6	1.9	5.7	3.1	3.4	3.2	4.6	2.9	2.8	3.2	4.1
Instance 32	1.9	2.8	2.4	4.5	3.1	2.1	2.5	3.6	4.1	3.2	2.8	3.6	2.4	2.5	1.8
Sum	98.1	98.1	98.2	98.1	98.2	98.2	98.0	98.1	98.0	97.9	98.3	98.2	97.9	98.2	98.1
Average	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Std. Deviation	1.6	1.2	0.7	0.8	0.7	1.0	1.2	0.9	0.7	0.6	0.6	1.4	3.8	0.9	1.0

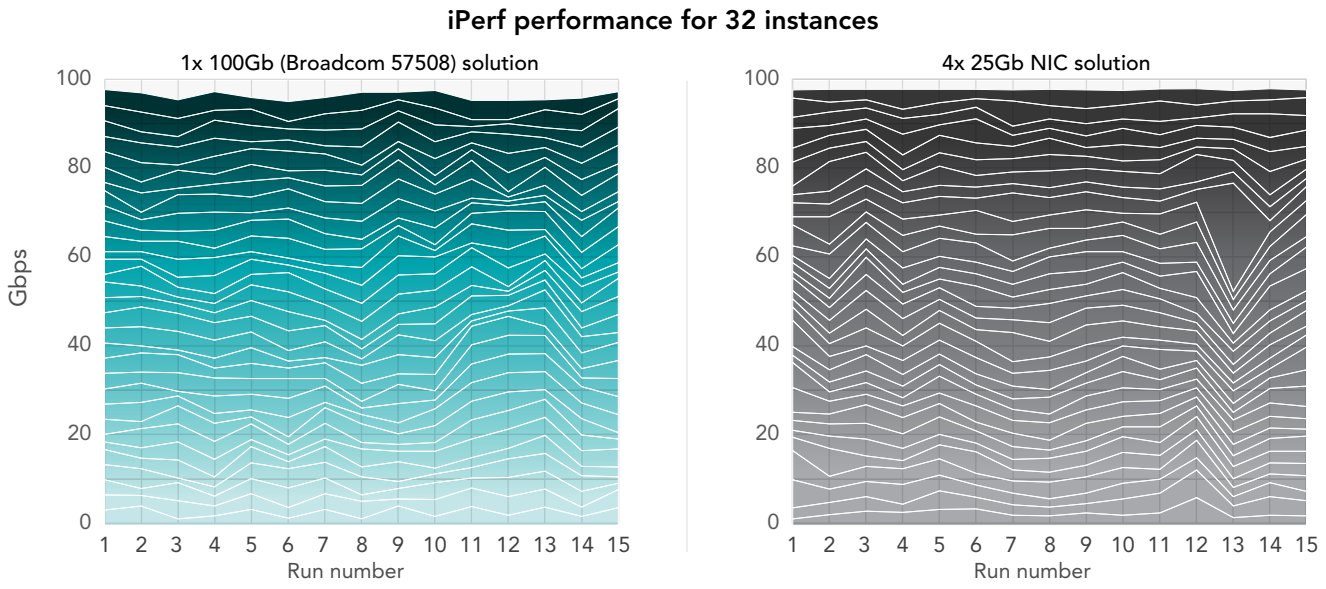

Figure 6: iPerf results, in Gbps, for 32 TCP streams. Higher numbers and more consistency is better. Source: Principled Technologies.

System configuration information

Table 14: Detailed information on the systems we tested.

System configuration information	Dell PowerEdge R750 (SUT)	Dell PowerEdge R750 (client)
BIOS name and version	Dell 1.6.5	Dell 1.6.5
Operating system name and version/build number	Red Hat® Enterprise Linux® release 8.6 (Ootpa) 4.18.0-372.19.1.el8_6.x86_64	Red Hat Enterprise Linux release 8.6 (Ootpa) 4.18.0-372.19.1.el8_6.x86_64
Date of last OS updates/patches applied	8/23/22	8/23/22
Power management policy	Performance	Performance
Processor		
Number of processors	2	2
Vendor and model	Intel® Xeon® Gold 6330	Intel Xeon Gold 6330
Core count (per processor)	28	28
Core frequency (GHz)	2.00	2.00
Stepping	6	6
Memory module(s)		
Total memory in system (GB)	256	256
Number of memory modules	16	16
Vendor and model	Samsung® M393A2K43DB3-CWE	Samsung M393A2K43DB3-CWE
Size (GB)	16	16
Type	DDR4	DDR4
Speed (MHz)	3,200	3,200
Speed running in the server (MHz)	2,933	2,933
Storage controller		
Vendor and model	Broadcom® PEX880xx PCIe® Gen 4 Switch	PERC H755 front SAS (PCIe® Gen4)
Firmware version	N/A	52.16.1-4158
Local storage		
Number of drives	24	12
Drive vendor and model	Dell Ent NVMe™ CM6 MU 3.2 TB	KIOXIA KRM6VVUG3T84
Drive size (GB)	3,200	3,840
Drive information (speed, interface, type)	PCIe Gen 4 NVMe SSD	12 Gbps SAS SSD
Network adapter (LOM)		
Number of drives	Broadcom NetXtreme® BCM5720 2-port Gigabit Ethernet PCIe	Broadcom NetXtreme BCM5720 2-port Gigabit Ethernet PCIe
Drive vendor and model	2 x 1GbE	2 x 1GbE
Drive size (GB)	tg3 4.18.0-372.19.1.el8_6.x86_64	tg3 4.18.0-372.19.1.el8_6.x86_64
Drive information (speed, interface, type)	FFV22.00.6 bc 5720-v1.39	FFV22.00.6 bc 5720-v1.39

System configuration information	Dell PowerEdge R750 (SUT)	Dell PowerEdge R750 (client)
Network adapter (OCP)		
Vendor and model	Broadcom NetXtreme-E BCM57412 2-port 10Gb RDMA Ethernet (rev 01)	Broadcom NetXtreme-E BCM57412 2-port 10Gb RDMA Ethernet (rev 01)
Number and type of ports	2 x 10GbE	2 x 10GbE
Driver version	bnxt_en 1.10.2-222.0.142.0	bnxt_en 1.10.2-222.0.142.0
Firmware version	222.0.138.0/pkg 22.21.06.80	222.0.138.0/pkg 22.21.06.80
Network adapter		
Vendor and model	Broadcom BCM57414 NetXtreme-E BCM57508 2-port 100Gb Ethernet (rev 11)	Broadcom BCM57414 NetXtreme-E BCM57508 2-port 100Gb Ethernet (rev 11)
Number and type of ports	2 x 10GbE	2 x 10GbE
Driver version	bnxt_en 1.10.2-222.0.142.0	bnxt_en 1.10.2-222.0.142.0
Firmware version	222.0.138.0/pkg 22.21.06.80	222.0.138.0/pkg 22.21.06.80
Network adapter		
Vendor and model	2x Intel XXV710-DA2T 2-port 25Gb Ethernet Controller	N/A
Number and type of ports	2 x 25GbE, 2 x 25GbE	N/A
Driver version	i40e 2.19.3	N/A
Cooling fans		
Vendor and model	Dell 7002W-A00	Dell 7002W-A00
Number of cooling fans	6	6
Power supplies		
Vendor and model	Dell 0M63JNA00	Dell 0M63JNA00
Number of power supplies	2	2
Wattage of each (W)	2,400	750

How we tested

Testing overview

For the system under test (SUT), we used a PowerEdge R750 configured with a single 100Gb Broadcom dual-port NIC and two 25Gb Intel dual-port NICs (four ports total). We configured the Broadcom 100Gb NIC using just the first port. We combined the four Intel 25Gb NIC ports into an LACP network bond in Linux with layer 3+4 load balancing. We configured an additional R750 with a single 100Gb Broadcom dual-port NIC to operate as a load generating client. Everything was connected to a single Dell Networking S5048F-ON switch using direct attached cables. We configured the four 25Gb ports used by the SUT as an active (LACP) port-channel on the switch.

Installing Red Hat Enterprise Linux 8.6

Install the operating system on both the SUT and client system

1. Open a browser window, and connect to the iDRAC.
2. Log into the iDRAC.
3. Click Virtual Console.
4. Click Connect Virtual Media.
5. Next to Map CD/DVD, click Browse.
6. Browse to the ISO for Red Hat 8.6.
7. Click Map Device.
8. Click Boot.
9. Click the Virtual CD/DVD/ISO text.
10. Click Yes.
11. Click Power, and boot the machine.
12. At the Red Hat Enterprise Linux boot menu, press Up, select Install Red Hat Enterprise Linux 8.6.0, and press Enter.
13. At the Welcome screen, make sure English is selected, and click Continue.
14. At the Installation Summary screen, click Time & Date.
15. To adjust your location, use the down arrows next to Region and City, and click Done.
16. At the Installation Summary screen, click Software Selection.
17. At the Software Selection screen, click Minimal Install, and click Done.
18. At the Installation Summary screen, click Installation Destination.
19. At the Installation Destination screen, select the internal JBOSS drive. Leave Automatic selected for the Storage Configuration, and click Done.
20. At the Installation Summary screen, click Network & Host Name.
21. At the Network & Host Name screen, where it says Host Name, enter r750-server or r750-client, and click Apply.
22. At the top-right of the screen, next to Ethernet information, click the OFF slider to ON, allow the NIC to connect, pick up an IP address from DHCP, and click Done.
23. Click Begin Installation.
24. At the Configuration screen, click Root Password. Next to Root Password and Confirm, type in your preferred password, and click Done.
25. When the Reboot button appears, click it.
26. Wait for the system to reboot.

Configuring Red Hat Enterprise Linux 8.6

Run the following commands on both the SUT and client system.

1. Set the time zone, disable SELinux, disable the firewall, and set the tuned profile:

```
sudo timedatectl set-timezone America/New_York
setenforce 0
sed -i 's/SELINUX=.*/SELINUX=disabled/' /etc/selinux/config
systemctl disable --now firewalld
tuned-adm profile throughput-performance
```

2. Register the system with RHN, and configure subscriptions:

```
subscription-manager register
subscription-manager service-level --set="Self-Support"
subscription-manager usage --set="Development/Test"
subscription-manager role --set="Red Hat Enterprise Linux Server"
subscription-manager attach
subscription-manager release --set=8.6
```

3. Install updates, and reboot if new kernel is installed:

```
dnf update -y
reboot
```

4. Install EPEL and extra packages:

```
subscription-manager repos --enable codeready-builder-for-rhel-8-$(arch)-rpms
dnf install -y https://dl.fedoraproject.org/pub/epel/epel-release-latest-8.noarch.rpm
dnf install -y wget tar smartmontools vim sysstat numactl pcp-system-tools nvme-cli
net-tools usbutils
```

5. Install the iPerf3 package from RHN:

```
dnf install -y iperf3
```

6. Install the Broadcom bnxt_en driver:

```
dnf groupinstall -y "Development Tools"
dnf install -y libibverbs-devel qperf perftest infiniband-diags make gcc kernel kernel-devel autoconf
libtool libibverbs-utils rdma-core-devel
cd ~
mkdir broadcom
cd broadcom
wget https://docs.broadcom.com/docs-and-downloads/ethernet-network-adapters/NXE/BRCM_222.1.68.0/
bcm_222.1.68.0.tar.gz
tar -xf bcm_222.1.68.0.tar.gz
cd bcm_222.1.68.0/Linux/Linux_Driver/
tar -xf netxtreme-bnxt_en-1.10.2-222.0.142.0.tar.gz
cd netxtreme-bnxt_en-1.10.2-222.0.142.0
make
make install
depmod -a
dracut -f
```

7. Install the Intel i40e driver:

```
cd ~
mkdir intel
cd intel
wget https://versaweb.dl.sourceforge.net/project/e1000/i40e%20stable/2.19.3/i40e-2.19.3.tar.gz
tar -xf i40e-2.19.3.tar.gz
cd i40e-2.19.3/src/
make install
cp ../scripts/set_irq_affinity /usr/local/sbin/
```

8. Reboot the system:

```
reboot
```

Configuring networking on the SUT

1. For the Broadcom 100Gb connection, we used the interface ens6f0np0.
2. Run the following commands to configure the 100Gb single port interface:

```
nmcli connection delete ens6f0np0
nmcli connection add type ethernet ifname ens6f0np0 con-name ens6f0np0
nmcli connection modify ens6f0np0 ipv4.addresses '192.168.100.1/24'
nmcli connection modify ens6f0np0 ipv4.method manual ipv6.method ignore
nmcli connection up ens6f0np0
```

3. For the Intel 4x25Gb connection, we used the following interfaces: ens4f0, ens4f1, ens5f0, ens5f1.
4. Run the following commands to configure the bonded network interface:

```
nmcli connection delete bond0
nmcli connection delete ens4f0
nmcli connection delete ens4f1
nmcli connection delete ens5f0
nmcli connection delete ens5f1
nmcli connection delete bond0-port1
nmcli connection delete bond0-port2
nmcli connection delete bond0-port3
nmcli connection delete bond0-port4
nmcli con add type bond con-name bond0 ifname bond0 bond.options "mode=802.3ad,miimon=100,xmit_hash_
policy=layer3+4" ethernet.mtu 9000
nmcli connection add type ethernet con-name bond0-port1 ifname ens4f0 master bond0 ethernet.mtu 9000
nmcli connection add type ethernet con-name bond0-port2 ifname ens4f1 master bond0 ethernet.mtu 9000
nmcli connection add type ethernet con-name bond0-port3 ifname ens5f0 master bond0 ethernet.mtu 9000
nmcli connection add type ethernet con-name bond0-port4 ifname ens5f1 master bond0 ethernet.mtu 9000
nmcli connection modify bond0 ipv4.addresses '192.168.25.1/24'
nmcli connection modify bond0 ipv4.method manual ipv6.method ignore
nmcli connection up bond0
```

Configuring networking on client

1. For the Broadcom 100Gb connection, we used the interface ens6f0np0.
2. Run the following commands to configure the 100Gb single port interface:

```
nmcli connection delete ens6f0np0
nmcli connection add type ethernet ifname ens6f0np0 con-name ens6f0np0
nmcli connection modify ens6f0np0 ethernet.mtu 9000
nmcli connection modify ens6f0np0 ipv4.addresses "192.168.100.11/24"
nmcli connection modify ens6f0np0 ipv4.addresses "192.168.25.11/24"
nmcli connection modify ens6f0np0 ipv4.method manual ipv6.method ignore
nmcli connection up ens6f0np0
```

Preparing scripts and running iPerf tests

Prepare FIO and bash script files to automate testing and gathering results on both systems. We modified a number of parameters (e.g., buffer length, window size). We then ran the test with 1, 2, 4, 8, 16, and 32 instances of iPerf running simultaneously.

1. Create the following bash scripts and run as instructed:

   • On the client, create and run the following script after every boot to tune the network interface: `tune_client.sh`

```
#!/bin/bash
systemctl stop irqbalance ; sleep 3 ; pgrep irqbalance ;

for IFNAME in ens6f0np0 ;
do
  ethtool -L ${IFNAME} combined 56
  sleep 1
  set_irq_affinity local ${IFNAME}
done
```

• On the SUT, create and run the following script after every boot to tune the network interfaces: `tune_server.sh`

```
#!/bin/bash
systemctl stop irqbalance ; sleep 3 ; pgrep irqbalance ;

for IFNAME in ens6f0np0 ens4f0 ens4f1 ens5f0 ens5f1;
do
  ethtool -L ${IFNAME} combined 56
  sleep 1
  set_irq_affinity local ${IFNAME}
done
```

• On the client, create the following script: `run_test.sh`

```
#!/bin/bash

APP=iperf3
BUFFER_LENGTH=128k
TCP_WINDOW=512k
NIC_SPEED=100
TARGET_IP=192.168.${NIC_SPEED}.1
PORT_BASE=5200
SERVER_HOST=r750-server
CLIENT_HOST=r750-client
PROCESSES=1
INSTANCES=$1
RUNS=15
WARMUP=3
RUNTIME=20
PAUSE=3
RAMPDELAY=1
CONGESTION=cubic

STEP=1
TIMESTAMP=$(date '+%Y%m%d_%H%M%S')
SERVER_CPU_START=1
SERVER_CPU_SKIP=2
CLIENT_CPU_START=1
CLIENT_CPU_SKIP=2

TOTAL_TIME=$((WARMUP+RUNTIME))

# Prepare nmon on client and server
#sudo killall -q -w nmon ; sudo sync ; sudo rm -f /tmp/client.nmon
#ssh ${TEST_HOST} "sudo killall -q -w nmon ; sudo sync ; sudo rm -f /tmp/server.nmon"

# Start nmon on client and server and wait 1 step
#sudo nmon -F /tmp/client.nmon -s${STEP} -c$((SAMPLES_TOTAL)) -J -t
#ssh ${TEST_HOST} "sudo nmon -F /tmp/server.nmon -s${STEP} -c$((SAMPLES_TOTAL)) -J -t"
#sleep ${STEP}

for PROC in ${PROCESSES};
do
  # Make results folder
  RESULTS_DIR=results/${APP}_${INSTANCES}I_${PROC}P_${RUNS}RC_${NIC_SPEED}G_${TIMESTAMP}
  mkdir -p ${RESULTS_DIR}
  RESULTS_FINAL=${RESULTS_DIR}/${APP}_${INSTANCES}I_${PROC}P_${RUNS}RC_${NIC_SPEED}
G_${TIMESTAMP}.csv
  echo "RESULTS_DIR: ${RESULTS_DIR}"
  echo
  for RUN in `seq -w 1 ${RUNS}`;
  do
    echo "RUN: ${RUN}"
    ssh ${SERVER_HOST} "killall -q -w ${APP}"
    ssh ${CLIENT_HOST} "killall -q -w ${APP}"
    sleep ${PAUSE}
    for INSTANCE in `seq -w 1 ${INSTANCES}`;
    do
      SERVER_CPU_PIN=`expr \( \( ${INSTANCE} - 1 \) \* ${SERVER_CPU_SKIP} \) + ${SERVER_CPU_START}`
      CLIENT_CPU_PIN=`expr \( \( ${INSTANCE} - 1 \) \* ${CLIENT_CPU_SKIP} \) + ${CLIENT_CPU_START}`
```

```
      SERVER_PORT=`expr ${PORT_BASE} + ${INSTANCE}`
      SERVER_FILE=${RESULTS_DIR}/${APP}_server_R${RUN}_I${INSTANCE}
      CLIENT_FILE=${RESULTS_DIR}/${APP}_client_R${RUN}_I${INSTANCE}
      echo "INSTANCE: ${INSTANCE}"
      TOTAL_TIME=${RUNTIME}
      echo "TOTAL_TIME: ${TOTAL_TIME}"
      OMIT_TIME=`expr ${WARMUP} + \( ${INSTANCES} \* ${RAMPDELAY} \) - \( ${INSTANCE} \*
${RAMPDELAY} \)`
      echo "OMIT_TIME: ${OMIT_TIME}"
      ssh ${SERVER_HOST} "numactl -C ${SERVER_CPU_PIN} -l ${APP} --server --one-off --port ${SERVER_
PORT}" > ${SERVER_FILE}.txt &
      ssh ${CLIENT_HOST} "sleep `expr ${PAUSE} + \( ${INSTANCE} \* ${RAMPDELAY} \)` ; numactl -C
${CLIENT_CPU_PIN} -l ${APP} --forceflush --format g --client ${TARGET_IP} --port ${SERVER_PORT}
--time ${TOTAL_TIME} --omit ${OMIT_TIME} --length ${BUFFER_LENGTH} --window ${TCP_WINDOW} --parallel
${PROC} --congestion ${CONGESTION}" | tee ${CLIENT_FILE}.txt &
    done
    wait
    sync
    echo -n "Combined average throughput (Gb/s): "
    awk '/receiver/{sum+=$7}END{print sum}' ${RESULTS_DIR}/${APP}_client_R${RUN}_I*.txt | tee -a
${RESULTS_FINAL}
    awk '/receiver/{print $7}' ${RESULTS_DIR}/${APP}_client_R${RUN}_I*.txt > ${RESULTS_DIR}/${APP}_
client_R${RUN}.csv
    echo
  done
  echo "Final results:"
  paste ${RESULTS_DIR}/${APP}_client_R*.csv | tee ${RESULTS_DIR}/${APP}_client.csv
  echo
  echo "Final combined results:"
  cat ${RESULTS_FINAL}
done
echo

# Save script, timestamp, and environment variables to results directory
cp -pvf ${0} ${RESULTS_DIR}/
echo ${TIMESTAMP} > ${RESULTS_DIR}/timestamp.txt
set > ${RESULTS_DIR}/set.txt
echo
```

2. Modify the variables at the top of the run_test.sh script as needed. To start the test, execute the script using the following command and by sure to include the first parameter to set the number of instances:

```
./run_test.sh <NUMBER_OF_INSTANCES>
```

Read the report at https://facts.pt/6rJx2IK ▶

This project was commissioned by Dell.