

IBM Communication Controller for Linux on System z9 and zSeries

(CCL)

V1R2

Performance Summary

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IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

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IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Introduction

This document will show the performance summary for the 'IBM Communication Controller for Linux on System z9 and zSeries' V1R2. 'CCL' will be used as an abbreviated name for 'IBM Communication Controller for Linux on System z9 and zSeries' throughout this document.

Performance Disclaimer

Disclaimer:

All performance data contained in this document was obtained in the specific operating environment and under the conditions described and is presented as an illustration only. Performance obtained in other operating environments may vary and customers should conduct their own testing.

CCL release and maintenance levels

The first version of CCL shipped in late March 2005 as CCL V1R1.

A performance APAR for CCL V1R1 (APAR number LI70826) was made available mid August 2005. This document will refer to a CCL V1R1 system with the performance APAR applied as CCL V1R1+.

CCL V1R2 shipped mid November 2005. CCL V1R2 further improves throughput and reduces CPU consumption as compared to CCL V1R1+.

CCL Connectivity Options

CCL V1R1 and CCL V1R1+ were both limited to use of OSA LCS copper-based LAN connectivity for SNA network flows – both upstream to VTAM and downstream to other NCPs or boundary function SNA devices.

CCL V1R2 added numerous new connectivity options for SNA network flows. On a System z9, VTAM or TPF can connect to a CCL V1R2 NCP via a shared OSA adapter operating

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in OSA for NCP (OSN) mode. The OSN connectivity appears to VTAM, TPF, and the NCP as an ESCON channel over which the traditional CDLC channel protocol is used.

On zSeries z890 and z990 or on a System z9, CCL V1R2 also adds support for OSA QDIO Layer-2 copper or fiber-based LAN connectivity for SNA network flows.

On all supported hardware levels, two CCL V1R2 NCPs communicating with each other (INN or SNI traffic) can exploit a new CCL V1R2 function known as IP Transmission Group (IP-TG) that allows the two CCL environments to exchange the INN/SNI traffic over a TCP connection via an intermediate IP-based network infrastructure.

Use of these new CCL V1R2 connectivity options has in some cases significant impact on both throughput and CPU consumption.

CCL Capacity Planning

For CCL V1R2 capacity planning information, please refer to the 'IBM Communication Controller for Linux on System z9 and zSeries, V1R2 (CCL), System z9 and zSeries CPU Capacity Planning Information for SNI and Boundary Function Workload' document which can be found at :

<http://www.ibm.com/support/docview.wss?uid=swg27006207>

Workload characteristics

This document covers transactional SNI workload and transactional NCP boundary function workload.

SNI transactional workload

The transactional SNI workload that was used in the performance tests is intended to simulate interactive transactions between two SNI partners, where one SNI partner sends short transaction requests to the other, and the second SNI partner responds with slightly longer messages. The workload resembles a traditional 3270 terminal dialog or typical LU 0 and LU 6.2 transactions being exchanged between the two business partners.

The transactional workload had the following characteristics:

- SNA APPC sessions between two z/OS systems were used to generate the transactional workload.
- Each transaction used 100 bytes in and 800 bytes out with a 330 millisecond think time between transactions.
- The workload was generated using the IBM Application Workload Modeler (AWM) tool.

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- You can get information about AWM at <http://www.ibm.com/software/network/awm/>.
- A series of runs were performed where the number of APPC sessions was gradually increased from 25 to 50, then to 100, 150, and finally 175 sessions.
- VTAM IOBUF size was set to 932 in all test runs.
- NCP MAXBFRU was set to 20 in all test runs.
- CCL NCP MAXOUT was set to 7 for CCL to VTAM.

Boundary function transactional workload

The BF transactional workload had the following characteristics:

- SNA APPC sessions were used to generate the BF transactional workload.
- Each transaction used 100 bytes in and 800 bytes out with a 330 millisecond think time between transactions
- The workload was generated using the IBM Application Workload Modeler (AWM) tool.
- You can get information about AWM at <http://www.ibm.com/software/network/awm/>.
- A series of runs were performed where the number of APPC sessions was gradually increased from 30 to 60, then to 90, 150, and finally 180 sessions.
- VTAM IOBUF size was set to 932 in all test runs.
- NCP MAXBFRU was set to 20 in all test runs.
- CCL NCP MAXOUT was set to 7 for CCL to VTAM.

Test environment overview

For the SNI performance tests, there are two z/OS systems in two separate SNA networks (NETA and NETB) and two NCPs were configured in an SNI configuration using a null net (NETX). The transactional workload was generated using IBM Application Workload Modeler (AWM), where both the AWM sender component and the AWM responder component were deployed on z/OS systems.

For the NCP boundary function performance tests, a single z/OS system was used. The peripheral nodes were simulated using IBM Application Workload Modeler (AWM) with all peripheral nodes attached through a LAN.

The NCP level used in all measurements was NCP V7R8.1.

The Linux images that were used in the performance tests were all running SUSE Linux SLES9 with SP2 (a Linux 2.6 kernel) and IBM Communication Controller for Linux on System z9 and zSeries.

Measurements were made with the original CCL V1R1 code, the CCL V1R1+ code (with the August 2005 performance APAR applied), and with the CCL V1R2 code.

The Linux images all ran as guests under z/VM 5.1 and each had one virtual CP and 512 MB memory assigned.

Architectural differences between IBM 3745/46 and CCL

An IBM 3745/46 environment can be a very complex environment that may consist of multiple

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specialized processors that assist the general IBM 3745 CCU in processing the NCP workload. Examples of specialized processors are the ESCON channel processor that handles low-level ESCON channel processing and the token-ring processor that handles the link-layer control functions for the token-ring LANs that are attached through TIC3 adapters. The type, the number, and the mix of assist processors in an IBM 3745/46 configuration is an installation choice and varies significantly. The use of assist processors offloads various types of processing from the general IBM 3745 CCU to the assist processors and therefore reduces the IBM 3745 CCU utilization. Comparing CCU utilization between two IBM 3745/46 environments can be quite complex, since the two environments may support comparable workloads, but each shows a different CCU utilization due to different sets of assist processors. An environment with many combined processors will in general not show a linear scalability, but will tend to show a gradually decreasing throughput as workload increases.

The CCL environment is best compared to an IBM 3745 environment without any assist processors, which means that the System z9 or zSeries CPU performs general NCP functions as well as all low-level link-layer control functions. From a structural perspective, the CCL environment resembles an IBM 3745 using TIC2 token-ring adapters. The CCL environment will therefore also in general exhibit a more linear scalability than an IBM 3745/46 environment. The CCL environment is best compared to an IBM 3745 environment without any assist processors, which means that the System z9 or zSeries CPU performs general NCP functions as well as all low-level link-layer control functions. From a structural perspective, the CCL environment resembles an IBM 3745 using TIC2 token-ring adapters. The CCL environment will therefore also in general exhibit a more linear scalability than an IBM 3745/46 environment.

IBM 3745/46 SNI Test Environment

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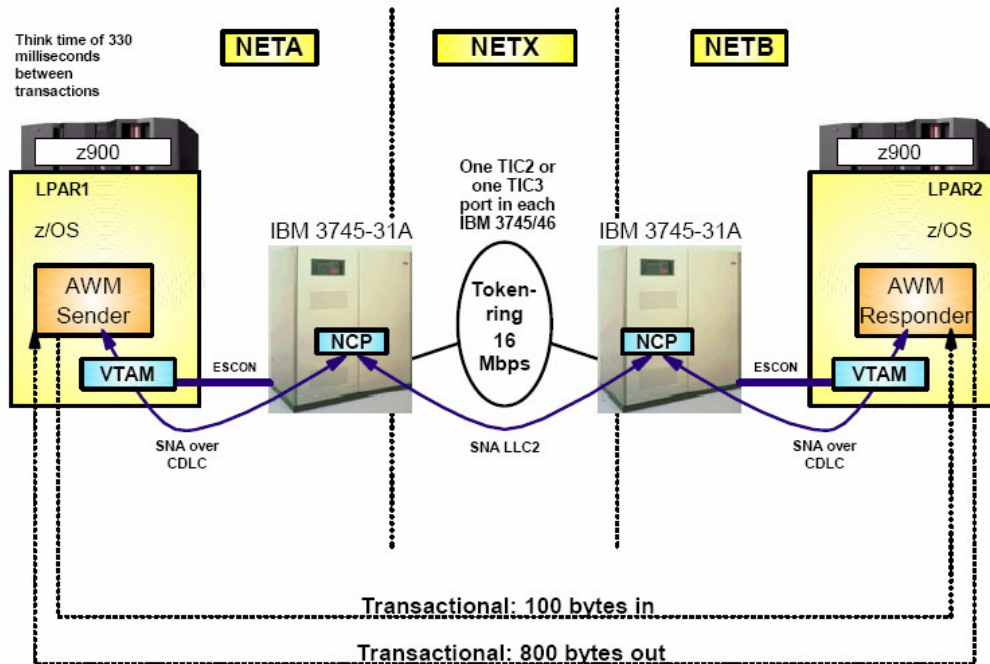


Figure 1: IBM 3745/46 SNI test environment

The two z/OS systems were ESCON channel-attached to each of their IBM 3745-31A. The two IBM 3745-31As were connected together over a 16 Mbps token-ring network using TIC2 or TIC3 adapters. One set of test runs were done using TIC2 adapters and another set of runs were done using TIC3 adapters. The TIC2 token-ring adapters are located in the IBM 3745 frame and linklayer control functions are performed by the NCP code. The TIC3 token-ring adapters are located in the IBM 3746-900 module under control of a Token-Ring Processor (TRP) to which the NCP offloads the link-layer control functions.

CCL SNI test environment

There were two different CCL test environments used for the performance tests for this document. One scenario used shared LAN between VTAM and the CCL – VTAM using an OSA LSA port to a Fast Ethernet, and CCL using an OSA LCS port to the same Fast Ethernet.

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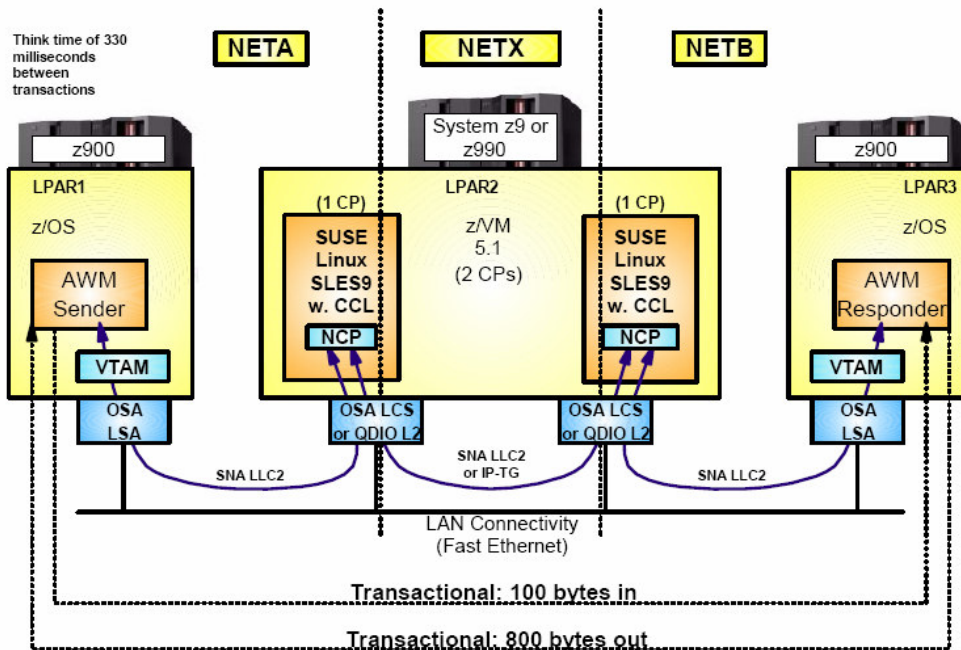


Figure 2: IBM CCL SNI test environment using a shared LAN between VTAM and CCL

This scenario is referred to as FE/FE – Fast Ethernet between VTAM and CCL – and Fast Ethernet between the two CCL NCPs.

The other test scenario for SNI workload used the OSA for NCP connectivity between VTAM and the CCL. In this scenario, z/OS and CCL need to reside on the same System z9 processor in order to share an OSA port configured in OSN mode.

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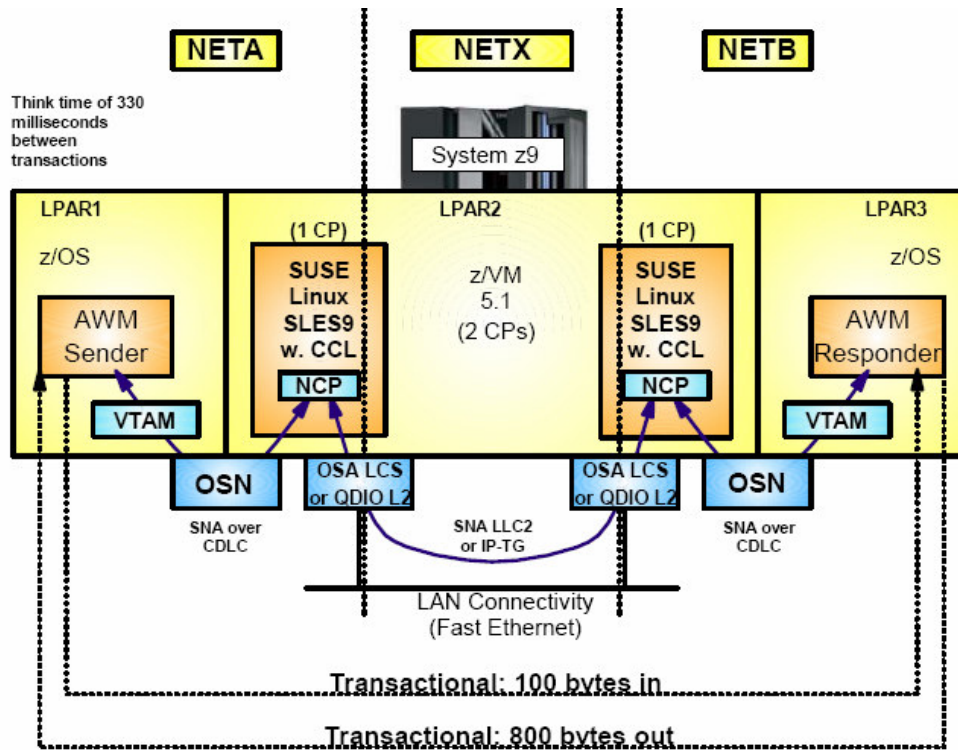


Figure 3: IBM CCL SNI test environment using OSN between VTAM and CCL

This scenario is referred to as either CDLC/FE or CDLC/IPTG. CDLC/FE stands for CDLC over OSN between VTAM and CCL – and Fast Ethernet (SNA LLC2) between the two CCL NCPs. CDLC/IPTG stands for CDLC over OSN between VTAM and CCL – and IP Transmission Group (also over a Fast Ethernet in this case) between the two CCL NCPs.

In both CCL SNI test scenarios, the two Linux images running CCL were deployed as z/VM 5.1 guests, each with one CP. The two Linux images each had an OSA LCS port or a QDIO Layer-2 port.

For the test scenario using IP Transmission Group, each of the two Linux images had an OSA QDIO port connected to a 1 Gbps Ethernet instead of the usual OSA LCS ports connected to a Fast Ethernet.

For the test cases using LAN connectivity between z/OS and CCL, each of the two z/OS systems and each of the two Linux systems had separate OSA CHPIDs – for a total of four OSA CHPIDs.

IBM 3745/46 boundary function test environment

For the boundary function tests with IBM 3745/46, a 16 Mbps token-ring LAN was used with the IBM 3745/46s each attached to that LAN using two TIC2 or two TIC3 adapters. As for the SNI test runs, two runs were performed with the BF workload: one using TIC2 and the other using TIC3 token-ring adapters.

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Preliminary tests showed that using a single token-ring adapter for this type of workload limited the total throughput too much to establish a reasonable comparison with the CCL environment.

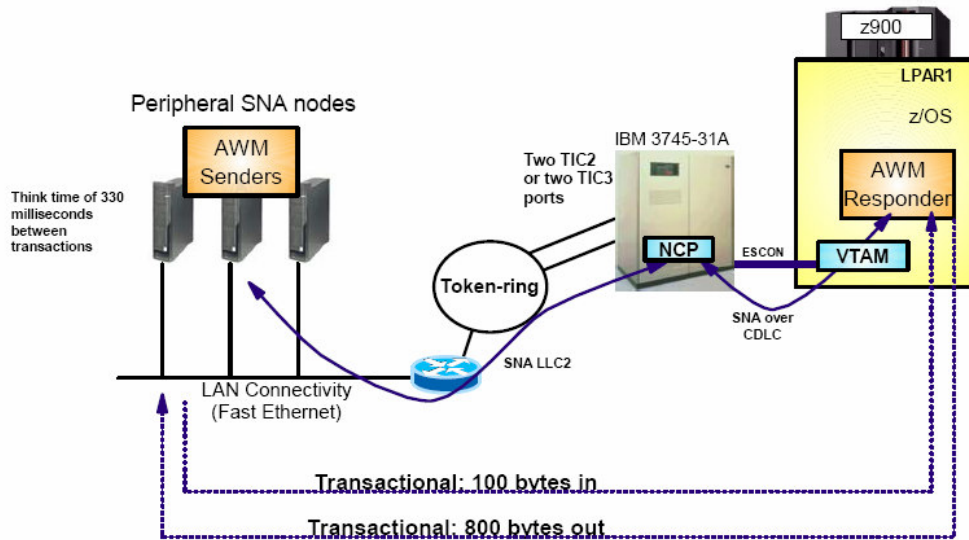


Figure 4: IBM 3745/46 boundary function test environment

CCL boundary function test environment

For the boundary function tests with CCL, two test scenarios were deployed. The first scenario had z/OS connected to CCL over a Fast Ethernet (100 Mbps) LAN (z/OS using an OSA LSA port and CCL an OSA LCS port).

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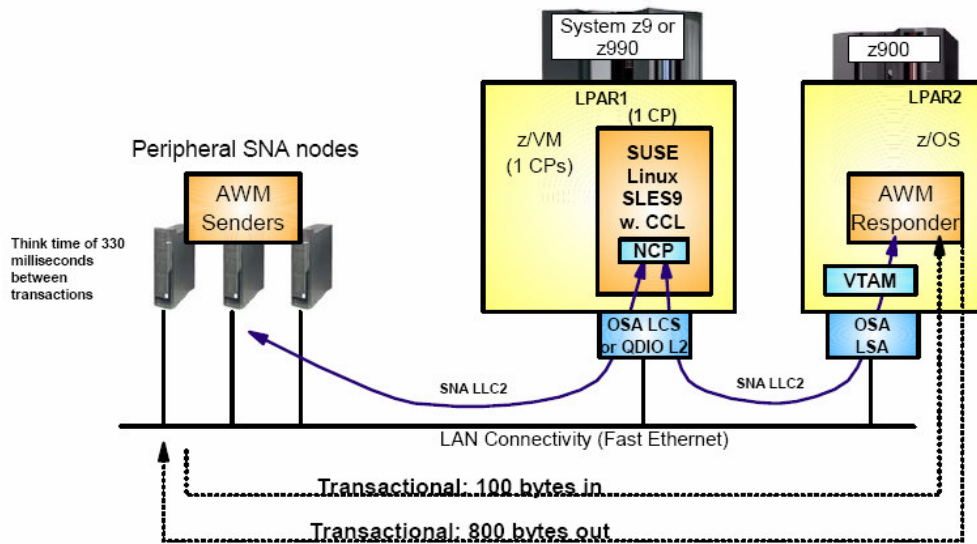


Figure 5: IBM CCL boundary function test scenario using a shared LAN between VTAM and CCL

This scenario is referred to as FE/FE – Fast Ethernet between VTAM and CCL – and Fast Ethernet between CCL and the peripheral nodes.

The other boundary function test scenario had VTAM and CCL connected via a shared OSA port operating in OSA for NCP mode. In this scenario, z/OS and CCL resided on the same System z9 processor in order to share an OSA port in OSN mode.

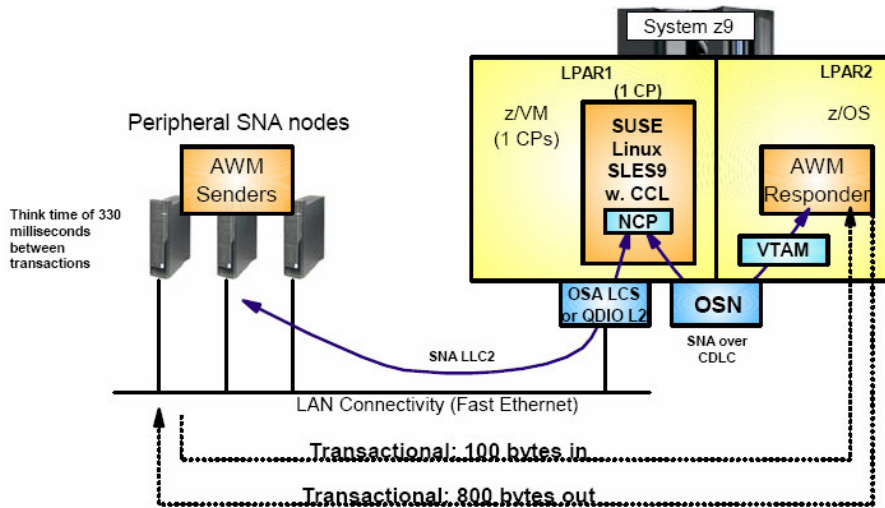


Figure 6: IBM CCL boundary function test scenario using OSN between VTAM and CCL

This scenario is referred to as CDLC/FE – CDLC over OSN between VTAM and CCL – and Fast Ethernet between CCL and the peripheral nodes.

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The peripheral SNA nodes were connected to the CCL NCP through an OSA Ethernet port operating in OSA LCS mode or in QDIO Layer-2 mode. Each OSA port was assigned separate OSA CHPIDs – for a total of up to two OSA CHPIDs.

CCL memory requirements

The base CCL storage and memory requirements are:

- 55 MB DASD for Communication Controller for Linux and Java code
- 300 MB DASD for Linux kernel source
- 80 MB to 100 MB DASD per Communication Controller for Linux instance for traces, dumps, logs, and NCP load modules
- 20 MB RAM per Communication Controller for Linux instance

Our test environment was not storage constrained. Each z/VM guest had a virtual machine size of 512MB defined.

z/VM reported a storage working set between 240 MB and 310 MB for the CCL V1R2 SNI test runs, while a working set between 220 and 300 MB was reported for the CCL V1R2 boundary function test runs.

The test runs using OSN (CDLC between VTAM and CCL) and QDIO layer-2 in general used a higher working set – up to around 500 MB.

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CCL V1R2 Performance vs Previous CCL Releases

CCL performance has been improved in CCL V1R2 by optimizing the CCL code, support of CDLC over an OSA Express chipid, and with a new function called IPTG.

CCL V1R2's throughput performance is improved by either 10 or 21 % and CPU/Transaction is reduced 19.6 or 20.9 % depending on an SNI or boundary function environment compared to CCL V1R1+ (LI70826).

CCL V1R2 vs CCL V1R1+ (LI70826) Performance Deltas:

Meas. Type	TPUT Delta %	CPU / Transaction Delta %
SNI	+ 21.1	- 19.6
Boundary	+ 10.2	- 20.9

Note: Configurations used for above comparison is all FE.
+ : means an increase in TPUT or CPU / Transaction
- : means a decrease in TPUT or CPU / Transaction

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CCL V1R2 Performance Improvements

This section will quantify the performance impact of the key CCL V1R2 functions (CDLC, IPTG) and Layer2 which is used in a z/VM environment. Performance differences will also show the impact of running on a z9 vs a z990 system.

As can be seen in the CCL V1R2 table below for SNI, by using CDLC (over an OSA Express chpid), throughput is increased between 25.3 and 28.6 % and CPU / Transaction is reduced between 29.1 and 30.3 % compared to using FE.

By using IPTG, throughput is increased 7.4 or 52 % and CPU / Transaction is reduced 13 or 22.3 % compared to FE.

When using Layer2 (over GbE), throughput is increased either 5.6 or 8.3 % and CPU / Transaction is reduced by 1.1 % or increased 0.5 %.

Running on a z9 system in an all FE environment, throughput is improved either 36.9 % (SNI) or 45.8 % (Boundary) and CPU / Transaction is reduced either 32.9 (SNI) or 32.3 % (Boundary) when compared to similar runs on a z990 system. This is slightly better than the z9 to z990 LSPR ratio of 35.8 % for mixed workloads. Throughput can be increased and CPU / Transaction can be reduced even more if using CDLC on a z9 system.

For boundary function environment, the use of CDLC can increase throughput by 2.25 times and reduce the CPU / Transaction cost by 42.9 %. When using Layer2 (over GbE), throughput is reduced 1.1 % and CPU / Transaction is increased 2.9 % compared to a similar environment running FE.

CCL V1R2 Performance Deltas:

Meas. Type	Performance Item	Performance Comparison	TPUT Delta %	CPU/Transaction Delta %
SNI	CDLC	CDLC, FE(z9) vs All FE (z9)	+ 25.3 %	- 30.3 %
SNI	CDLC	CDLC, Layer2 (Gbe) z9 vs FE, Layer2 (GbE) z9	+ 28.6 %	- 29.1 %
SNI	IPTG	FE, IPTG (GbE) z990 vs All FE z990	+ 7.4 %	- 13.0 %
SNI	IPTG	CDLC, IPTG (GbE) z9 vs CDLC, FE z9	+ 52.0 %	- 22.3 %
SNI	Layer2(GbE) vs FE	FE, Layer2 (GbE), FE z9 vs ALL FE z9	+ 5.6 %	- 1.1 %

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SNI	Layer2(GbE) vs FE	CDLC, Layer2 (GbE), CDLC z9 vs CDLC, FE, CDLC z9	+ 8.3 %	+ 0.5 %
SNI	z9 vs z990	FE z9 vs FE z990	+ 36.9 %	- 32.9 %
Boundary	z9 vs z990	FE z9 vs FE z990	+ 45.8 %	- 32.3 %
Boundary	CDLC	FE, CDLC z9 vs FE z9	+ 2.25 X	- 42.9 %
Boundary	Layer2 (GbE) vs FE	FE, Layer2 (GbE), CDLC z9 vs FE, FE, CDLC z9	- 1.1 %	+ 2.9 %

Note: + : means an increase in TPUT or CPU / Transaction
- : means a decrease in TPUT or CPU / Transaction

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SNI Performance Summary

SNI Configurations

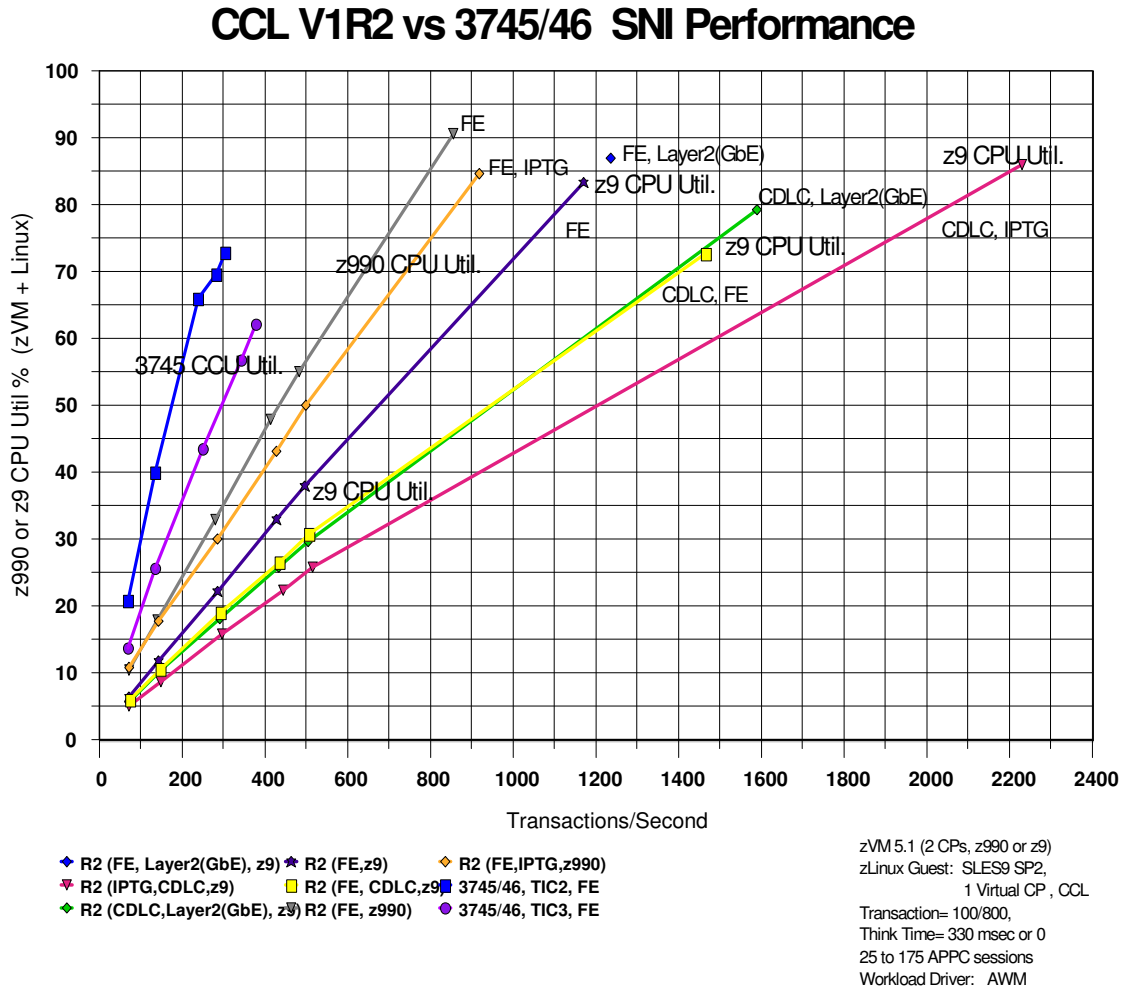
The following configurations were used for the SNI performance measurements.

Configuration Type	zOS Client to CCL Connectivity	CCL to CCL Connectivity	CCL to zOS Server Connectivity	zlinux/CCL System Type
All Fast Ethernet	OSA Express / Fast Ethernet	OSA Express / Fast Ethernet	OSA Express / Fast Ethernet	z990
All Fast Ethernet	OSA Express-2 / Fast Ethernet	OSA Express-2 / Fast Ethernet	OSA Express-2 / Fast Ethernet	z9
CDLC, Fast Ethernet, CDLC	OSA Express-2 Gbe (OSN mode)	OSA Express-2 / Fast Ethernet	OSA Express-2 Gbe (OSN mode)	z9
Fast Ethernet, IPTG (GbE), Fast Ethernet	OSA Express / Fast Ethernet	OSA Express / GbE (IPTG)	OSA Express / Fast Ethernet	z990
CDLC, IPTG (GbE), CDLC	OSA Express-2 Gbe (OSN mode)	OSA Express -2 / GbE (IPTG)	OSA Express-2 Gbe (OSN mode)	z9
Fast Ethernet, Layer2 (GbE), Fast Ethernet	OSA Express-2 / Fast Ethernet	OSA Express -2 / GbE (Layer2, Guest Lan)	OSA Express-2 / Fast Ethernet	z9
CDLC, Layer2 (GbE), CDLC	OSA Express-2 Gbe (OSN mode)	OSA Express -2 / GbE (Layer2, Guest Lan)	OSA Express-2 Gbe (OSN mode)	z9

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CCL V1R2 vs 3745/46 SNI Performance

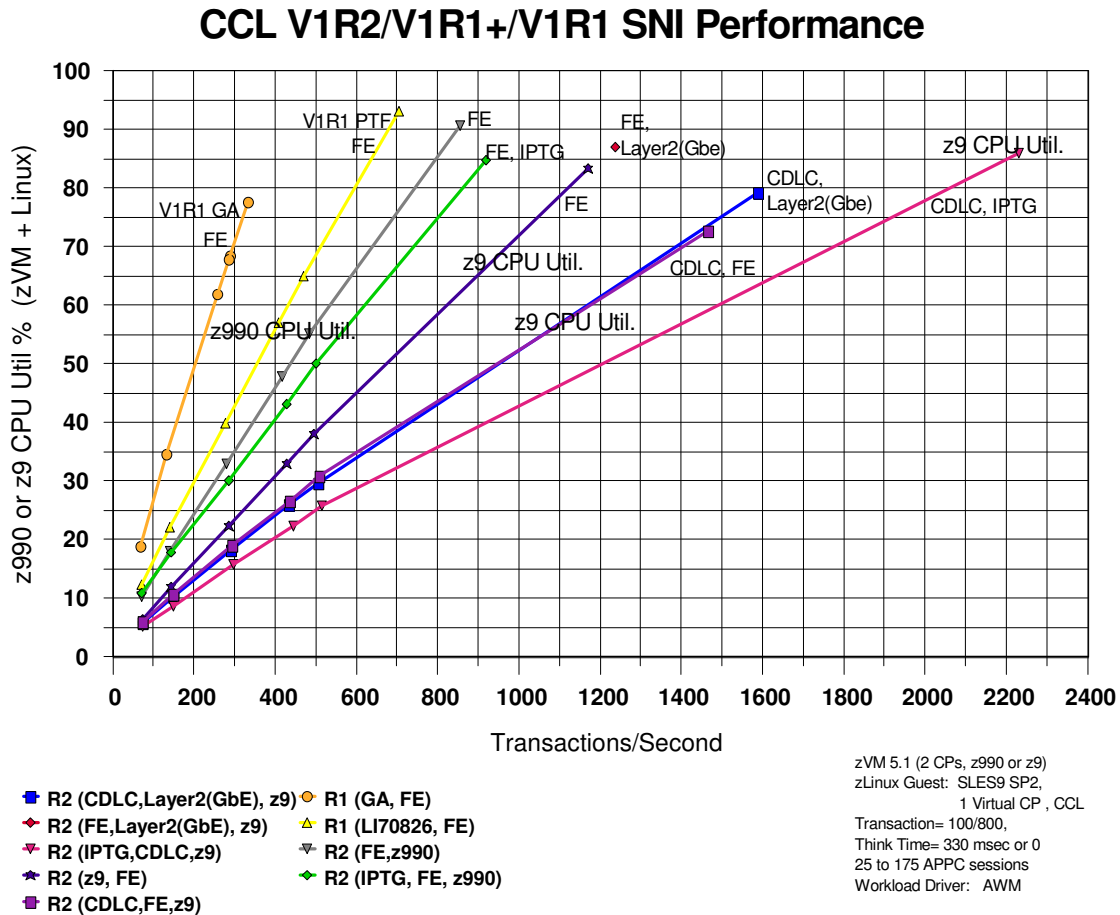
The following graph shows the SNI Performance measurements for CCL V1R2 and the base 3745/46. Transaction per seconds are plotted vs either z990 or z9 CPU utilization or the CCU utilization of the 3745.



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CCL V1R2/V1R1+/V1R1 SNI Performance

The following graph shows the SNI Performance measurements for CCL V1R1, V1R1+ (LI70826) and V1R2. Transaction per seconds are plotted vs either z990 or z9 CPU utilization.



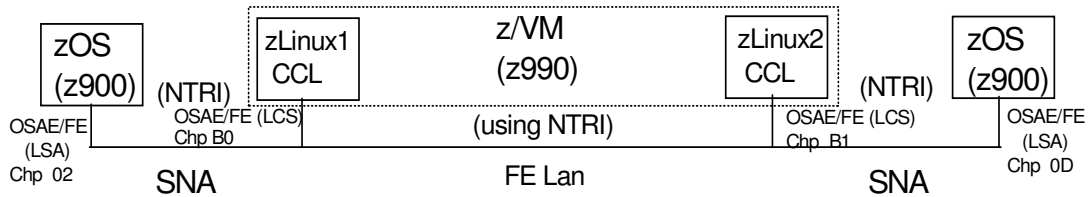
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SNI Low Level Performance Summary

This section shows the low level performance metrics for the SNI performance runs. Details are shown for the the seven SNI performance configurations.

Config 1 (ALL FE, z990):

All FE (NTRI) :



# of sess	z/VM Total CPU Util % (per guest)	Transaction Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Client Avg CPU Util % (CPU usec / TR)	zOS Server Avg CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
25	10.39	71.3	1457.223	64.455	1.83 (513.323)	1.65 (462.833)	350.61	519.1
50	18.06	141.9	1272.727	128.295	2.63 (370.683)	2.25 (317.124)	352.28	519.4
100	33.0	279.5	1180.679	252.684	4.49 (321.288)	3.45 (246.869)	357.56	519.0
150	47.93	416.0	1152.163	376.132	6.44 (309.615)	4.86 (233.653)	360.18	519.3
175	55.17	483.1	1141.999	436.739	7.45 (308.424)	5.55 (229.766)	361.84	519.1
175 (No TT)	90.72	855.1	1060.928	773.070	9.40 (220.091)	7.68 (179.628)	203.86	519.3

z/VM: z990, 2 Ded. CPs, zVM 5.1

CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2), 512 MB

CCL Server: 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2), 512 MB

zOS Client system: z990, 2 dedicated CP LPAR (NS11), zOS V1R5

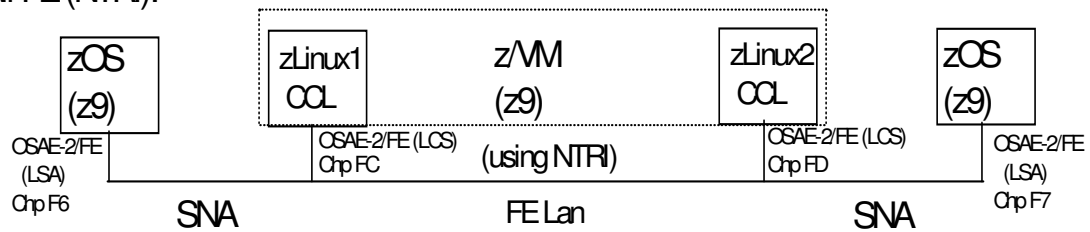
zOS Server system: z990, 2 dedicated CP LPAR (NS12), zOS V1R5

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

zOS Settings: VTAM IOBUF Size = 932 bytes
 NCP Settings: MAXOUT = 7 (CCL to VTAM)
 Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)
 Think Time: 330 milliseconds or 0
 Tran: RR 100 / 800 (APPC)
 Workload Driver: AWM

Config 2 (FE, z9):

All FE (NTRI):



# of sess	z/VM Total CPU Util % (per guest)	Transation Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Client Avg CPU Util % (CPU usec / TR)	zOS Server Avg CPU Util % (CPU usec / TR)	Avg Response Time (milli- seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
25	6.5	73	890.41	66.042	1.39 (389.821)	1.1 (301.369)	342.03	284.3
50	11.89	144.7	821.302	130.876	1.79 (247.408)	1.48 (204.561)	345.13	284.4
100	22.25	286.5	776.614	259.028	2.92 (203.839)	2.38 (166.143)	348.9	284.5
150	33.0	427.5	771.929	386.503	4.02 (188.07)	3.18 (148.771)	350.69	284.6
175	38.0	496.3	765.665	448.716	4.63 (186.58)	3.69 (148.7)	352.33	284.5
175 (No TT)	83.31	1170.9	711.503	1058.472	6.16 (105.218)	5.56 (94.969)	149.4	284.5

z/VM: z990, 2 Ded. CPs, zVM 5.1
 CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2), 512 MB

8/29/2006

CCL V1R2 Performance Summary

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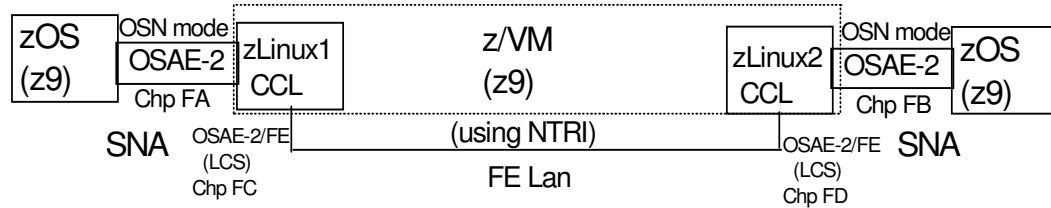
IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

CCL Server: 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2), 512 MB
zOS Client system: z990, 2 dedicated CP LPAR (NS41), zOS V1R5
zOS Server system: z990, 2 dedicated CP LPAR (NS42), zOS V1R5
zOS Settings: VTAM IOBUF Size = 932 bytes
NCP Settings: MAXOUT = 7 (CCL to VTAM)
Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)
Think Time: 330 milliseconds or 0
Tran: RR 100 / 800 (APPC)
Workload Driver: AWM

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Config 3 (CDLC,FE,CDLC, z9):

CDLC, FE (NTRI), CDLC :



# of sess	z/VM Total CPU Util % (per guest)	Transaction Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Client Avg CPU Util % (CPU usec / TR)	zOS Server Avg CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
25	6.0	74.4	806.451	67.271	1.26 (338.709)	1.08 (290.322)	335.95	247.6
50	10.67	148.7	717.3	134.480	1.79 (240.753)	1.46 (196.368)	336.112	247.6
100	19.06	294.6	646.978	266.327	2.81 (190.767)	2.17 (147.318)	339.254	247.8
150	26.69	436.6	611.314	394.673	3.88 (177.737)	3.11 (142.464)	343.21	247.8
175	30.83	508.3	606.448	459.568	4.43 (174.306)	3.54 (139.287)	343.97	247.7
175 (No TT)	72.81	1467.6	496.116	1326.772	6.31 (85.99)	5.81 (79.193)	119.68	247.9

z/VM: z990, 2 Ded. CPs, zVM 5.1

CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2), 512 MB

CCL Server: 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2), 512 MB

zOS Client system: z990, 2 dedicated CP LPAR (NS41), zOS V1R5

zOS Server system: z990, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)

Think Time: 330 milliseconds or 0

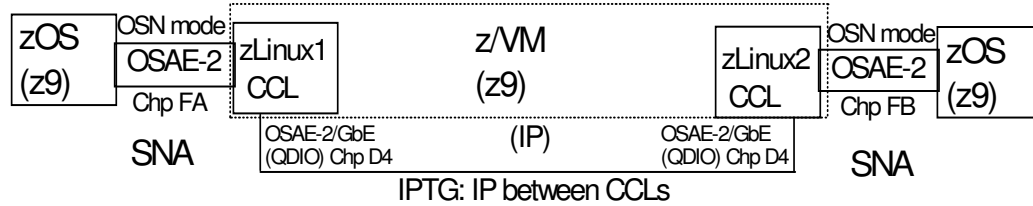
IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Tran: RR 100 / 800 (APPC)
Workload Driver: AWM

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Config 5 (CDLC,IPTG(GbE), CDLC, z9):

CDLC, IPTG (GbE), CDLC :



# of sess	z/VM Total CPU Util % (per guest)	Transaction Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Client Avg CPU Util % (CPU usec / TR)	zOS Server Avg CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
25	5.17	73.6	702.445	66.529	1.17 (317.934)	1.03 (279.891)	339.69	309.6
50	8.72	148.3	587.997	134.095	1.64 (221.173)	1.39 (187.457)	337.0	309.3
100	15.89	297.3	534.476	268.758	2.65 (178.271)	2.13 (143.289)	336.2	309.8
150	22.43	445.5	503.479	402.761	3.66 (164.309)	2.92 (131.088)	336.5	309.2
175	25.83	516.2	500.387	466.637	4.15 (160.79)	3.3 (127.857)	336.9	309.7
175 (No TT)	86.0	2230.9	385.494	2016.745	7.69 (68.94)	7.16 (64.189)	78.57	309.3

z/VM: z990, 2 Ded. CPs, zVM 5.1

CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2), 512 MB

CCL Server: 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2), 512 MB

(IPTG): OSAE-2 GbE(QDIO) between two Linux virtual machines (CCLs)

zOS Client system: z990, 2 dedicated CP LPAR (NS41), zOS V1R5

zOS Server system: z990, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)

Think Time: 330 milliseconds or 0

Tran: RR 100 / 800 (APPC)

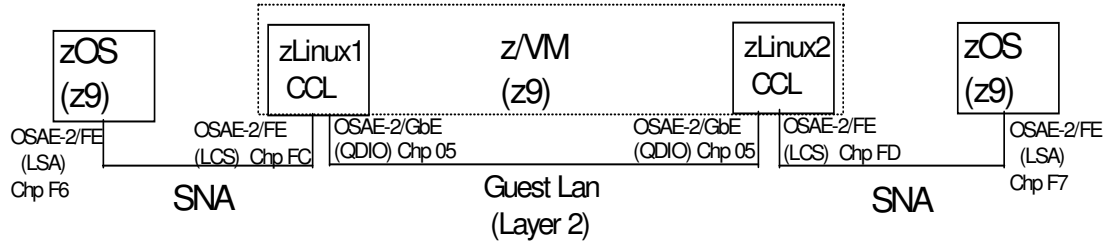
Workload Driver: AW

**IBM Communication Controller for Linux on System z9 and zSeries
V1R2 Performance Summary**

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Config 6 (FE, Layer2(GbE),FE, z9):

FE (NTRI), Layer2 (GbE), FE (NTRI):



# of sess	z/VM Total CPU Util % (per guest)	Transaction Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Client Avg CPU Util % (CPU usec / TR)	zOS Server Avg CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
175 (No TT)	86.97	1236.3	703.47	1117.6	5.83 (94.313)	5.81 (93.99)	141.6	238.6

z/VM: z9, 2 Ded. CPs, zVM 5.1

CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2+), 512 MB

CCL Server: 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2+), 512 MB

zOS Client system: z9, 2 dedicated CP LPAR (NS41), zOS V1R5

zOS Server system: z9, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)

Think Time: 0

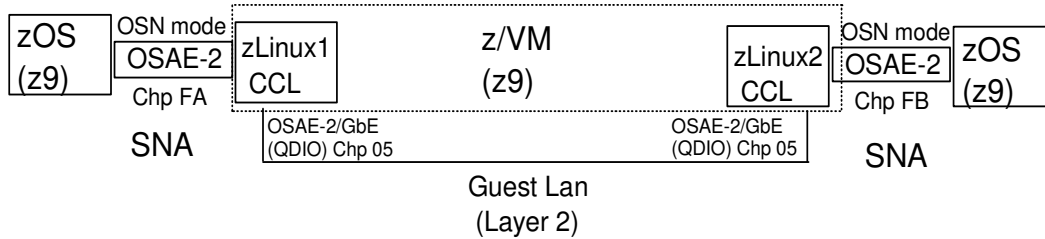
Tran: RR 100 / 800 (APPC)

Workload Driver: AWM

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Config 7 (CDLC,Layer2(GbE), CDLC, z9):

CDLC, Layer2 (GbE), CDLC :



# of sess	z/VM Total CPU Util % (per guest)	Transation Rate (Trans / Sec)	z/VM CPU Usec / TRAN	TPUT (KBytes / Sec)	zOS Client Avg CPU Util % (CPU usec / TR)	zOS Server Avg CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
25	5.88	74.3	791.386	67.162	1.43 (384.925)	1.33 (358.008)	336.5	505.6
50	10.39	148.1	701.553	133.921	1.91 (257.933)	1.75 (236.326)	337.4	506.0
100	18.19	292.8	621.243	264.702	3.08 (210.382)	2.64 (180.327)	341.4	506.1
150	25.93	435.2	595.818	393.451	4.13 (189.797)	3.43 (157.628)	344.5	506.0
175	29.71	506.8	586.227	458.104	4.59 (181.136)	3.8 (149.96)	345.2	506.1
175 (No TT)	79.29	1590.3	498.585	1437.711	7.65 (96.208)	6.8 (85.518)	110.65	506.1

z/VM: z9, 2 Ded. CPs, zVM 5.1

CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2+), 512 MB

CCL Server: 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2+), 512 MB

zOS Client system: z9, 2 dedicated CP LPAR (NS41), zOS V1R5

zOS Server system: z9, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)

Think Time: 330 milliseconds or 0

Tran: RR 100 / 800 (APPC)

Workload Driver: AWM

**IBM Communication Controller for Linux on System z9 and zSeries
V1R2 Performance Summary**

Boundary Function Performance Summary

Boundary Configurations

The following configurations were used for the boundary performance measurements.

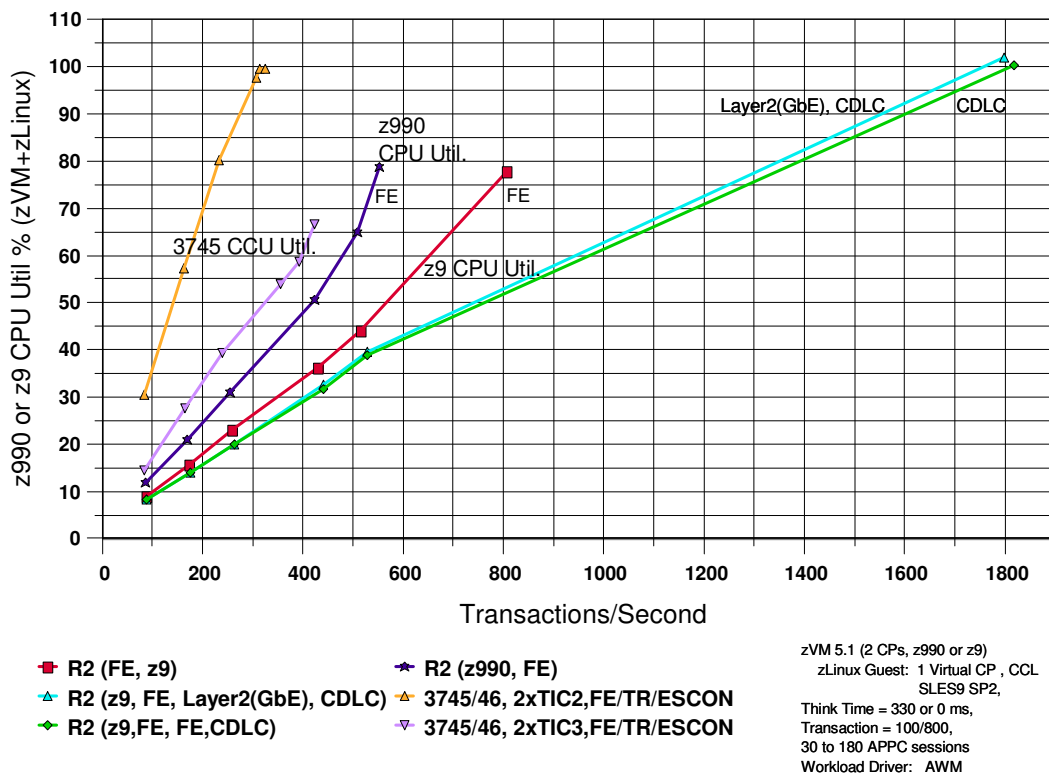
Configuration Type	Linux Clients to CCL Connectivity	CCL to zOS Server Connectivity	zlinux/CCL System Type
All Fast Ethernet	FE & OSA Express / Fast Ethernet	OSA Express / Fast Ethernet	z990
All Fast Ethernet	FE & OSA Express-2 / Fast Ethernet	OSA Express-2 / Fast Ethernet	z9
Fast Ethernet, Fast Ethernet (LCS), CDLC	FE & OSA Express-2 / Fast Ethernet	OSA Express-2 GbE (OSN mode)	z9
Fast Ethernet, Layer2 (GBE), CDLC	FE & OSA Express-2 / Fast Ethernet	OSA Express-2 GbE (OSN mode)	z9

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

CCL V1R2 vs 3745/46 Boundary Performance

The following graph shows the Boundary Performance measurements for CCL V1R2 and the base 3745/46. Transaction per seconds are plotted vs either z990 or z9 CPU utilization or the CCU utilization of the 3745.

CCL V1R2 vs 3745/46 Boundary Performance

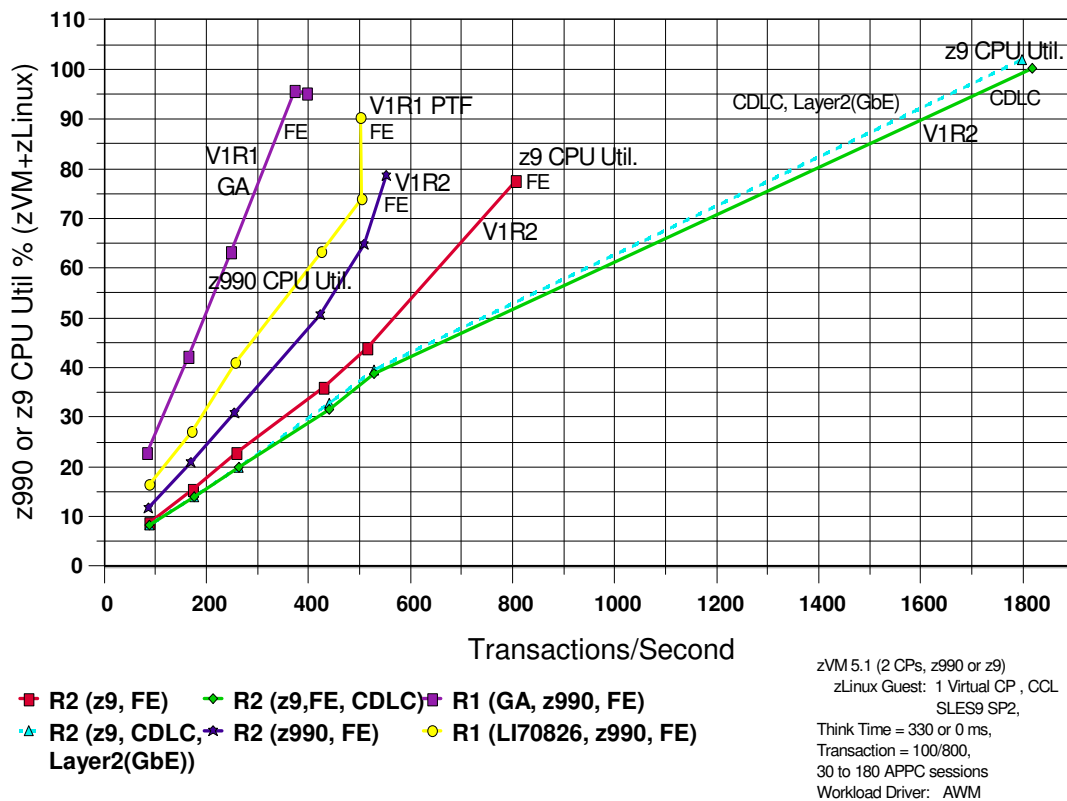


IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

CCL V1R2/V1R1+/V1R1 Boundary Performance

The following graph shows the Boundary Performance measurements for CCL V1R1, V1R1+ (LI70826) and V1R2. Transaction per seconds are plotted vs either z990 or z9 CPU utilization.

CCL V1R2/V1R1+/V1R1 Boundary Performance



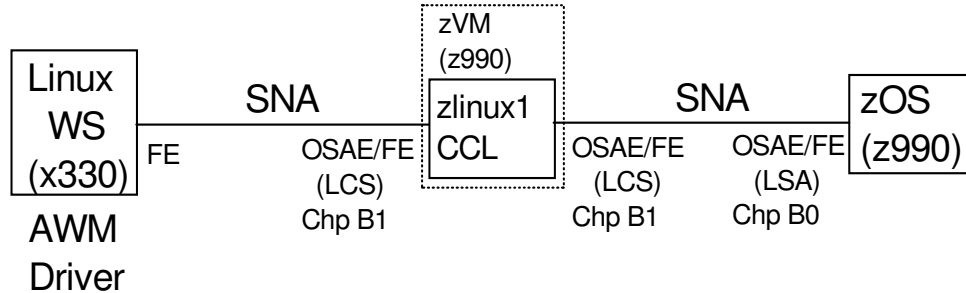
IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Boundary Low Level Performance Summary

This section shows the low level performance metrics for the Boundary performance runs. Details are shown for the the four Boundary performance configurations.

Config 1 (FE, z990):

All FE :



# of sess	z/VM Total CPU Util %	Transation Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Server AVG CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time
30	11.78	85.88	1371.681	77.637	1.43 (333.022)	349.34
60	21.0	170.6	1230.949	154.227	2.04 (238.875)	351.52
90	30.88	255.5	1208.61	230.989	2.75 (215.264)	352.16
150	50.62	424.4	1192.742	383.706	4.13 (194.627)	353.21
180	64.86	508.6	1275.265	459.756	4.84 (190.326)	353.92
180 (No TT)	78.78	552.8	1425.108	499.771	5.08 (183.791)	325.55

z/VM: z990, 2 Ded. CPs, zVM 5.1

CCL Server: 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2)

Linux Client systems: zSeries 330, 2 CPs, Red Hat 7.3

zOS Server system: z990, 2 dedicated CP LPAR (NS25), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Think Time: 330 milliseconds or 0

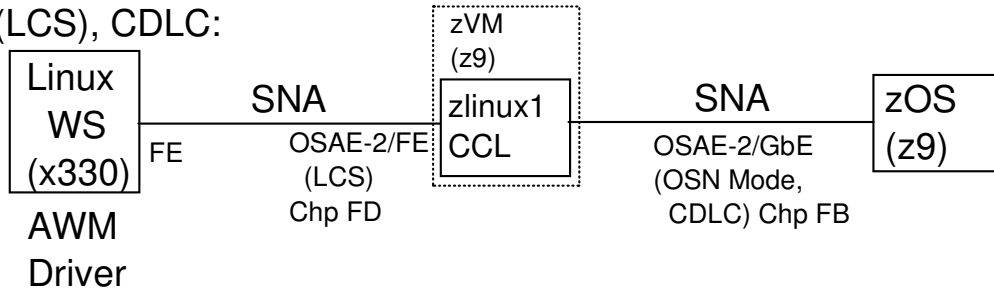
IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Tran: RR 100 / 800 (APPC)
Workload Driver: AWM

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Config 3 (FE, FE(LCS), CDLC, z9):

FE, FE(LCS), CDLC:



# of sess	z/VM Total CPU Util %	Transaction Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Server AVG CPU Util % (CPU usec / TRAN)	Avg Response Time (milliseconds) includes Think Time
30	8.2	88.2	929.705	79.763	1.13 (256.235)	340.0
60	14.1	176.4	799.319	159.513	1.58 (179.138)	340.13
90	19.89	264.1	752.745	238.769	1.99 (150.7)	340.77
150	31.63	440.9	717.169	398.576	2.91 (132.002)	340.2
180	38.86	529.2	734.315	478.426	3.41 (128.873)	340.11
180 (No TT)	100.25	1819.0	551.181	1,644.398	6.3 (69.268)	99.27

z/VM: z9, 2 Ded. CPs, zVM 5.1

CCL Server: 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2)

Linux Client systems: xSeries 330, 2 CPs, Red Hat 7.3

zOS Server system: z9, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Think Time: 330 milliseconds or 0

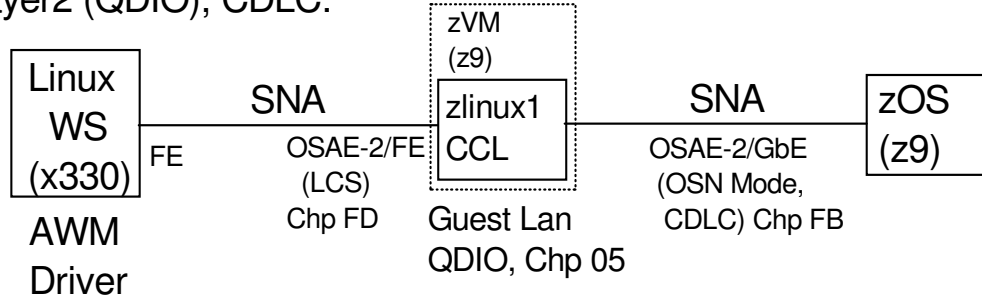
Tran: RR 100 / 800 (APPC)

Workload Driver: AWM

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Config 4 (FE, Layer2(GbE), CDLC, z9):

FE, Layer2 (QDIO), CDLC:



# of sess	z/VM Total CPU Util % (per guest)	Transation Rate (Trans / Sec)	z/VM CPU usec / TRAN	TPUT (KBytes / Sec)	zOS Server AVG CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
30	8.22	88.2	931.972	79.763	1.26 (285.714)	340.0	518.7
60	14.0	176.3	794.1	159.396	1.75 (198.525)	340.25	518.2
90	20.0	264.7	755.572	239.290	2.26 (170.759)	340.0	518.7
150	32.72	441.1	741.781	398.752	3.27 (148.265)	340.06	518.0
180	39.58	528.0	749.621	477.268	3.87 (146.59)	340.94	518.7
180 (No TT)	102.0	1798.9	567.013	1626.160	6.83 (75.935)	100.19	518.4

z/VM: z9, 2 Ded. CPs, zVM 5.1

CCL Client : 1 Virtual CP (Linux1 Virt. Machine, SUSE SLES9 SP2+), 512 MB

Linux Client systems: 3 x xSeries 330, 2 CPs, Red Hat 7.3

zOS Server system: z9, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)

Think Time: 330 milliseconds or 0

Tran: RR 100 / 800 (APPC)

Workload Driver: AWM

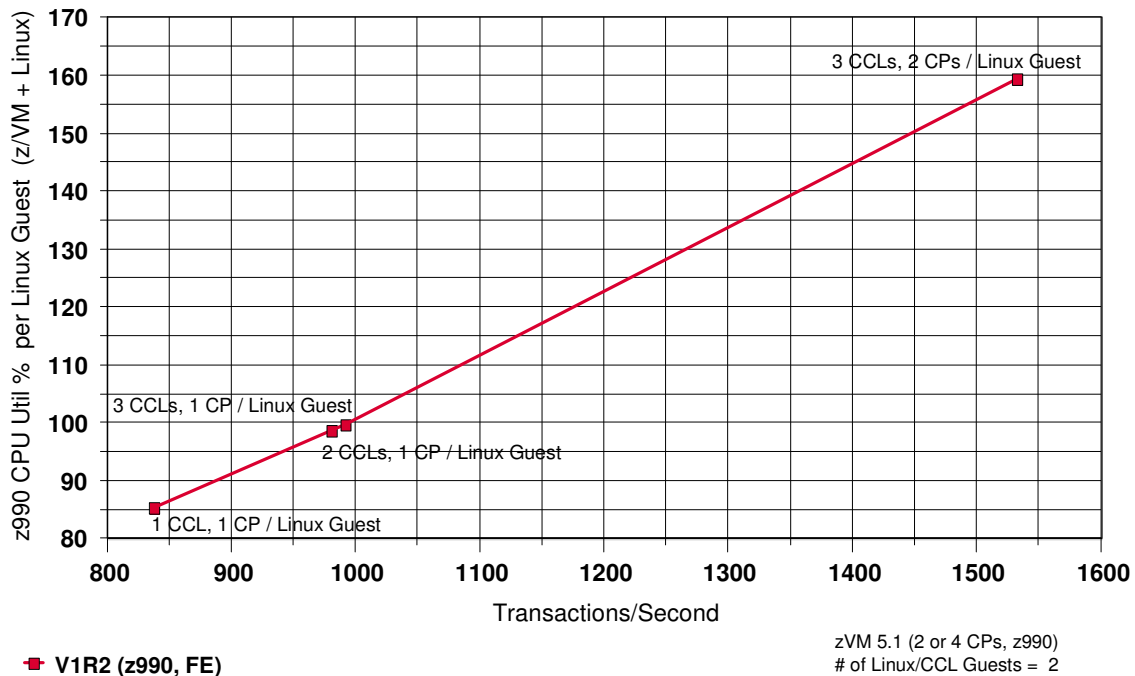
IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Multiple CCL's

This sections shows the performance of running multiple CCL's within a single Linux image. One, two and three CCL's were run within a single Linux image on a z990 system. With one virtual processor allocated to the z/VM Linux guest, 3 CCL's could be run with a cpu utilization of approx. 100 % while running 992 transaction per second. With two virtual processors allocated to the z/VM Linux guest, 3 CCL's could be run with a cpu utilization of approx. 159 % (or 80 % average across the 2 processors) while running 1533 transaction per second. It is probably possible that one could run more CCL images within a single Linux image at the same transaction rate. Details can be seen in the graph and table below.

Multiple CCL High Level Performance Summary

CCL V1R2 SNI Performance (Multiple CCLs)



zVM 5.1 (2 or 4 CPs, z990)
of Linux/CCL Guests = 2
zLinux Guest: SLES9 SP2,
1 or 2 Virtual CPs ,
1 to 3 CCLs
Transaction= 100/800,
Think Time= 0
150 APPC sessions
Workload Driver: AWM

**IBM Communication Controller for Linux on System z9 and zSeries
V1R2 Performance Summary**

Multiple CCL Low Level Performance Summary

CCL V1R2 SNI Performance (Multiple CCLs)

# CCLs / # CPs per Linux Guest	Trans / Second	Tr / Sec Delta %	Avg z/VM Util % (per Linux Guest)	Average Response Time (milliseconds)	CPU / Tran (per Linux Guest)	CPU / Tran Delta %
1 CCL / 1 CP	838.2	Base	85.3	177.6	1017.4	Base
2 CCLs / 1 CP	980.7	+ 17.0 %	98.8	154.2	1006.9	- 1.0 %
3 CCLs / 1 CP	992.0	+ 18.3 %	99.6	161.0	1004.1	- 1.3 %
3 CCLs / 2 CPs	1533.0	+ 82.9 %	159.4	100.3	1040.1	+ 2.2 %

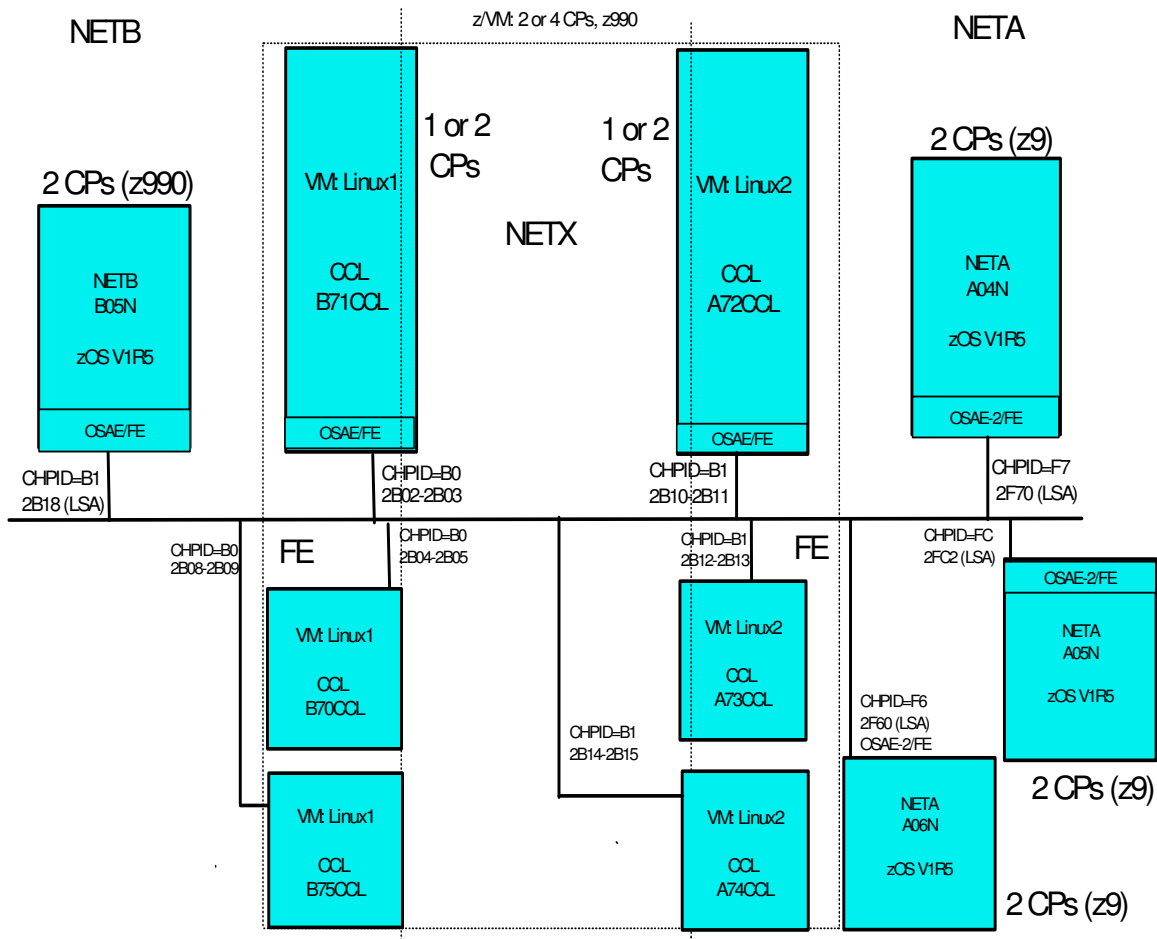
Config: z/VM 5.1 (2 CPs or 4 CPs, z990),
2 Linux Guests (1 or 2 CPs each, SLES9 SP2, 1 to 3 CCLs)
FE, No delays, 150 APPC sessions, Transaction: 100 / 800

As can be seen in the table above, CCLs can be added until one runs out of CPU. By adding an additional virtual CPU to the z/VM Linux guest, the throughput can be increased by 54 % with an increase of the CPU utilization by 60 %.

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Multiple CCL Configuration

Multiple CCL's SNI Config zVM: 2 zLinux images, 3 CCLs / zlinux image



For the one CCL test, the zOS client (B05N) communicates with the B71CCL and A72CCL CCLs and then to the zOS server system (A04N).

For the two CCL test, the zOS client (B05N) communicates with the B71CCL, A72CCL, B70CCL and A73CCL CCLs and then to the zOS server systems (A04N & A05N).

For the three CCL test, the zOS client (B05N) communicates with the B71CCL,

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

A72CCL, B70CCL, A73CCL, B75CCL and A74CCL CCLs and then to the zOS server systems (A04N, A05N & A06N).

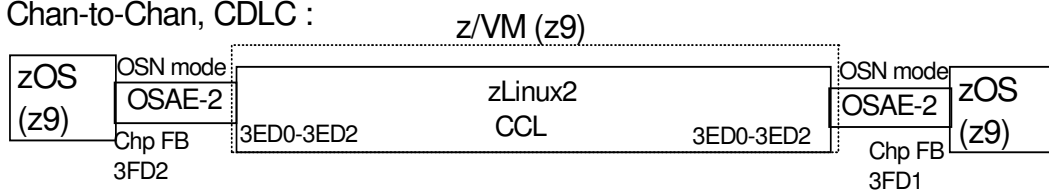
IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Channel-to-Channel Performance

This section shows the performance when using a Channel-to-Channel configuration. One OSA Express 2 GbE adapter was shared between the two zOS LPARs and one z/VM Linux system running CCL. As can be seen below, a very high transaction rate can be achieved in this type of configuration with a low cpu per transaction and a low average response time.

Configuration:

CDLC, Chan-to-Chan, CDLC :



Performance Summary:

# of sessions	z/VM Total CPU Util %	Transation Rate (Trans / Second)	z/VM CPU usec / TRAN	TPUT (KBytes / Second)	zOS Client AVG CPU Util % (CPU usec / TR)	zOS Server AVG CPU Util % (CPU usec / TR)	Avg Response Time (milli-seconds) includes Think Time	Max Storage Used by Linux Guest (MB)
175 (No TT)	69.6	5153.4	135.017	4658.675	13.8 (53.556)	13.72 (53.246)	34.0	263.6

z/VM: z9, 2 Ded. CPs, zVM 5.1

CCL : 1 Virtual CP (Linux2 Virt. Machine, SUSE SLES9 SP2), 512 MB

zOS Client system: z9, 2 dedicated CP LPAR (NS41), zOS V1R5

zOS Server system: z9, 2 dedicated CP LPAR (NS42), zOS V1R5

zOS Settings: VTAM IOBUF Size = 932 bytes

NCP Settings: MAXOUT = 7 (CCL to VTAM)

Max storage used by Linux Guest: virtual machine's working set (reported from z/VM)

Think Time: 0

Tran: RR 100 / 800 (APPC)

zOS Client Channel Utilization (chpid FB): 30 % max (zOS Client), 92 % max (Total)

zOS Server Channel Utilization (chpid FB): 20.5 % max (zOS Server), 92 % max (Total)

Workload Driver: AWM

IBM Communication Controller for Linux on System z9 and zSeries V1R2 Performance Summary

Summary

CCL V1R2's throughput performance is improved by up to 21 % and the CPU/Transaction cost is reduced up to 21 % compared to CCL V1R1+ (LI70826) when using an all Fast Ethernet (FE) environment.

CCL performance has been improved in CCL V1R2 by optimizing the CCL code, support of CDLC over an OSA Express chipid, and with a new function called IPTG.

CDLC can increase throughput up to 28 % and reduce the CPU / Transaction cost up to 30 % when compared to a similar environment using Fast Ethernet (FE).

IPTG can increase throughput up to 52 % and reduce the CPU / Transaction cost up to 22 % when compared to a similar environment using Fast Ethernet (FE).

Layer2 (over GbE) can increase throughput up to 8.3 % and reduce the CPU / Transaction cost up to 1 %.

Running on a z9 system in an all FE environment, throughput can increase up to 45.8 % and CPU / Transaction can be reduced up to 32.9 % when compared to similar runs on a z990 system. This throughput can be increased and CPU / Transaction can be reduced even more if using CDLC on a z9 system.

Overall, the performance of CCL V1R2 is significantly better than prior releases of CCL and 3745/46.