



IBM Software Group  
Enterprise Networking and Transformation Solutions (ENTS)

# IBM Communication Controller for Linux (CCL) on System z

A Technical Introduction

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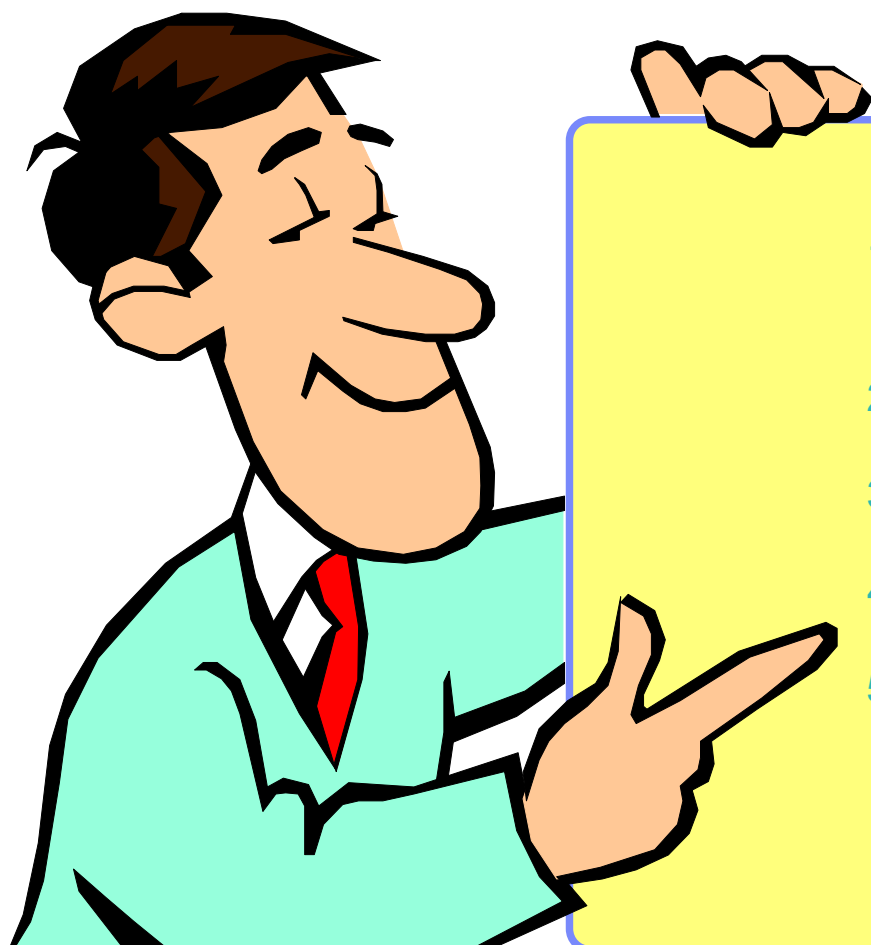
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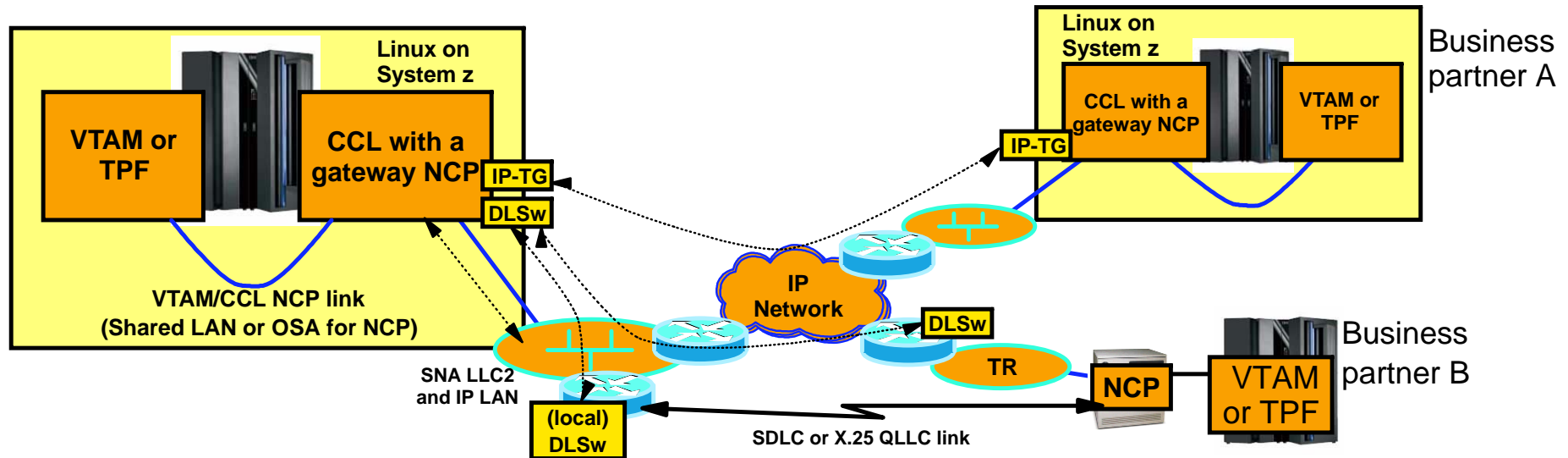
# Agenda



1. CCL Objectives and Overall Technical Structure
2. CCL Connectivity Options
3. Performance and Capacity
4. Summary
5. System Requirements and Reference Information

# CCL Objectives and Overall Technical Structure

## Primary objective of CCL: preserve SNI connectivity to business partners (SNI/INN traffic)



### ➤ Preserve existing SNA subarea capabilities and topology for business partner connectivity:

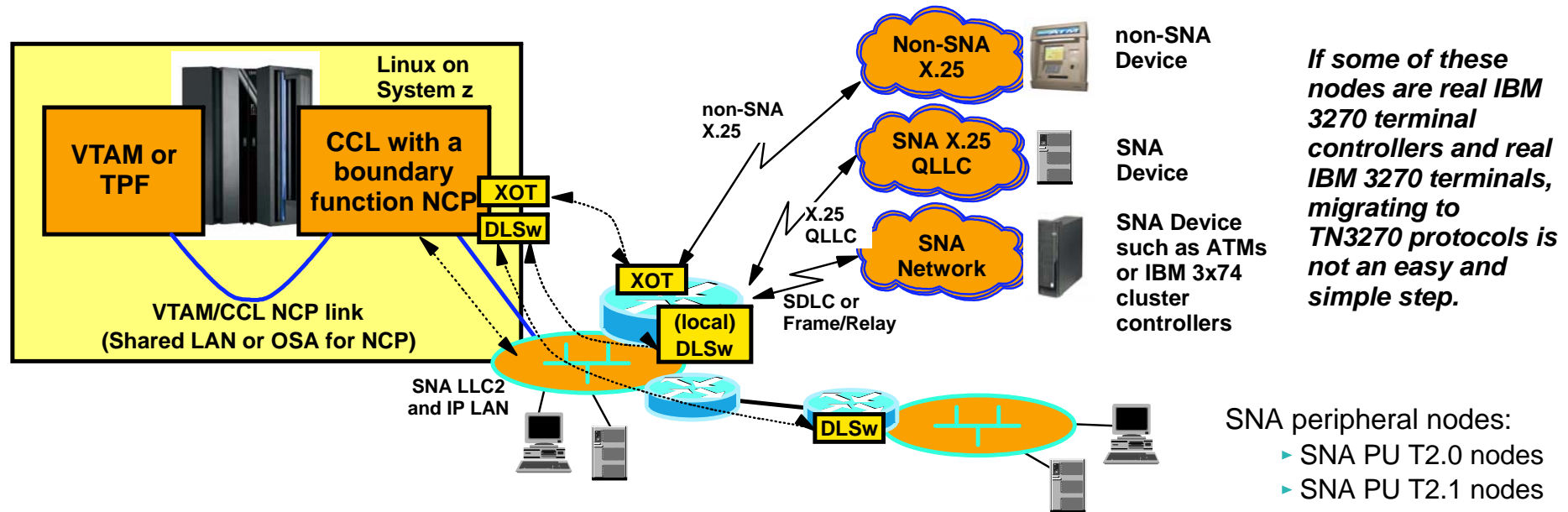
- ▶ For business partner SNA connectivity where your partner or you have decided to continue such communication based on SNA subarea networking protocols (SNI).
  - Business partners may continue to use IBM 3745/46 technology or also move to a CCL implementation.
- ▶ Has no impact on existing SNI topology.
- ▶ Has minimal impact on existing SNA network management procedures and disciplines.

### ➤ Simplify the networking infrastructure by Integrating SNA and IP traffic over common IP-based network:

- ▶ CCL NCP to CCL NCP connectivity (INN or SNI).
  - SNI or INN over a TCP connection - IP Transmission Group (IP-TG)
- ▶ CCL NCP to IBM 3745 NCP connectivity (INN or SNI).
  - CCL imbedded DLSw to remote DLSw node that switches to TR to which partner IBM 3745/46 is connected
  - CCL LAN SNA LLC2 to local aggregation layer router in which SDLC or X.25 QLLC link to partner IBM 3745/46 is terminated

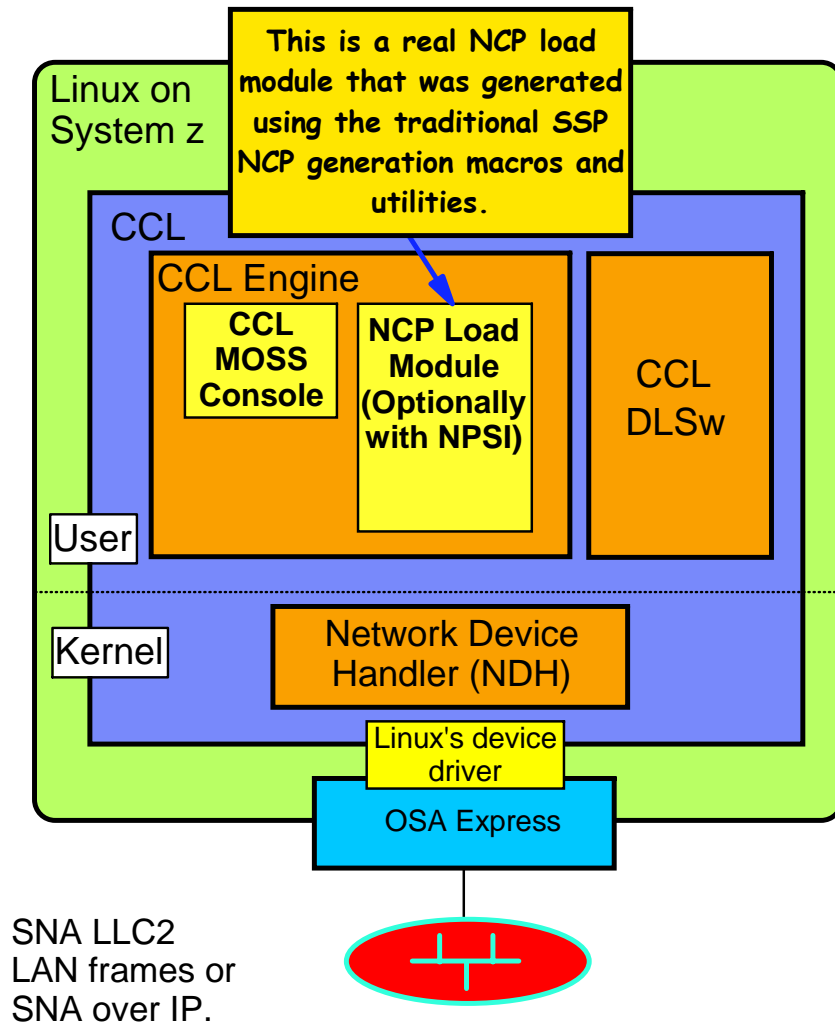


## Secondary objective of CCL: preserve selected NCP boundary functions (BNN traffic)



- **Preserve existing SNA subarea capabilities and topology for peripheral node connectivity:**
  - ▶ NCP boundary function support includes standard availability functions such as SSCP takeover, support for duplicate MAC addressing, NRF, and XRF.
  - ▶ SNA network management tools and functions such as NetView, NPA-LU, and NtuneMON are also supported.
- **SNA serial line termination is supported via a network aggregation layer router:**
  - ▶ LLC bridging/switching of the SNA frames between the serial line interfaces and the local LAN
  - ▶ Serial line SNA connectivity for SDLC, Frame Relay, and SNA X.25 QLLC links are supported
- **Simplify the networking infrastructure by Integrating SNA and IP traffic over common IP-based network:**
  - ▶ Remote SNA network segments can be connected via DLSw over an IP network to the imbedded DLSw component in CCL
    - This includes both LAN segments, and local and remote aggregation layer routers
  - ▶ Non-SNA X.25 links are supported via X.25 Over TCP (XOT) for connectivity to NPSI

## CCL overall structure and components



- **CCL** supports an **NCP** performing Boundary Functions, INN, and SNI link connectivity, as well as NPSI .
- **CCL** consists of both user-space and kernel-space functions:
  - ▶ **CCL engine** emulates an IBM 3745-31A with 16 MB memory supporting an NCP load module and a MOSS console interface.
  - ▶ The **MOSS console** is accessed through a standard Web browser.
  - ▶ **Network Device Handler (NDH)** is a kernel extension that acts as the interface between a real network interface (such as an OSA port) and the CCL adapter emulation support
  - ▶ **CCL DLSw** is a separate user-space application that communicates with CCL NCP through NDH, and with other DLSw peers through the Linux TCP sockets layer.

**Note:** You will continue to use ACF/SSP to generate, load, and dump an NCP load module.

## CCL and the MOSS console interface

- The CCL MOSS console functions are accessed via a Web browser.

The screenshot shows the IBM Communication Controller for Linux (CCL) MOSS console interface accessed via a web browser. The browser window title is "Communication Controller for Linux - Mozilla Firefox". The address bar shows the URL: `http://linux127.tcp.raleigh.ibm.com:4000/cgi-bin/sendDiskIplInfoPage.cgi?sessionId=2071937618`. The interface includes a sidebar with a list of functions, a main content area displaying system status and disk IPL information, and a footer with copyright information.

**IBM.**  
Communication Controller for Linux

CCL Name: CCL44  
NCP Name: CCL44  
Machine Time: 01/27/2006 03:06:19 PM

logoff

Status	X71	X72	LAR	IAR	Level	C-Latch	Z-Latch
Running	000000	000000	1605CA	1605CC	6	0	0

**Disk IPL Information**

CP Running: CCL44  
Auto Dump/Load: Yes  
Active Load Module: CCL44

Disk Contents:

Type:	Name:	Save:	Gen:	IPL:	IPL Alert:
Load Module	CCL44	12/13/2005 04:27:41 PM	12/13/2005 03:04:40 PM	None	None

**Dump**

Purge Dump Change Dump/Load Change Active Load Module Rename Load Modules

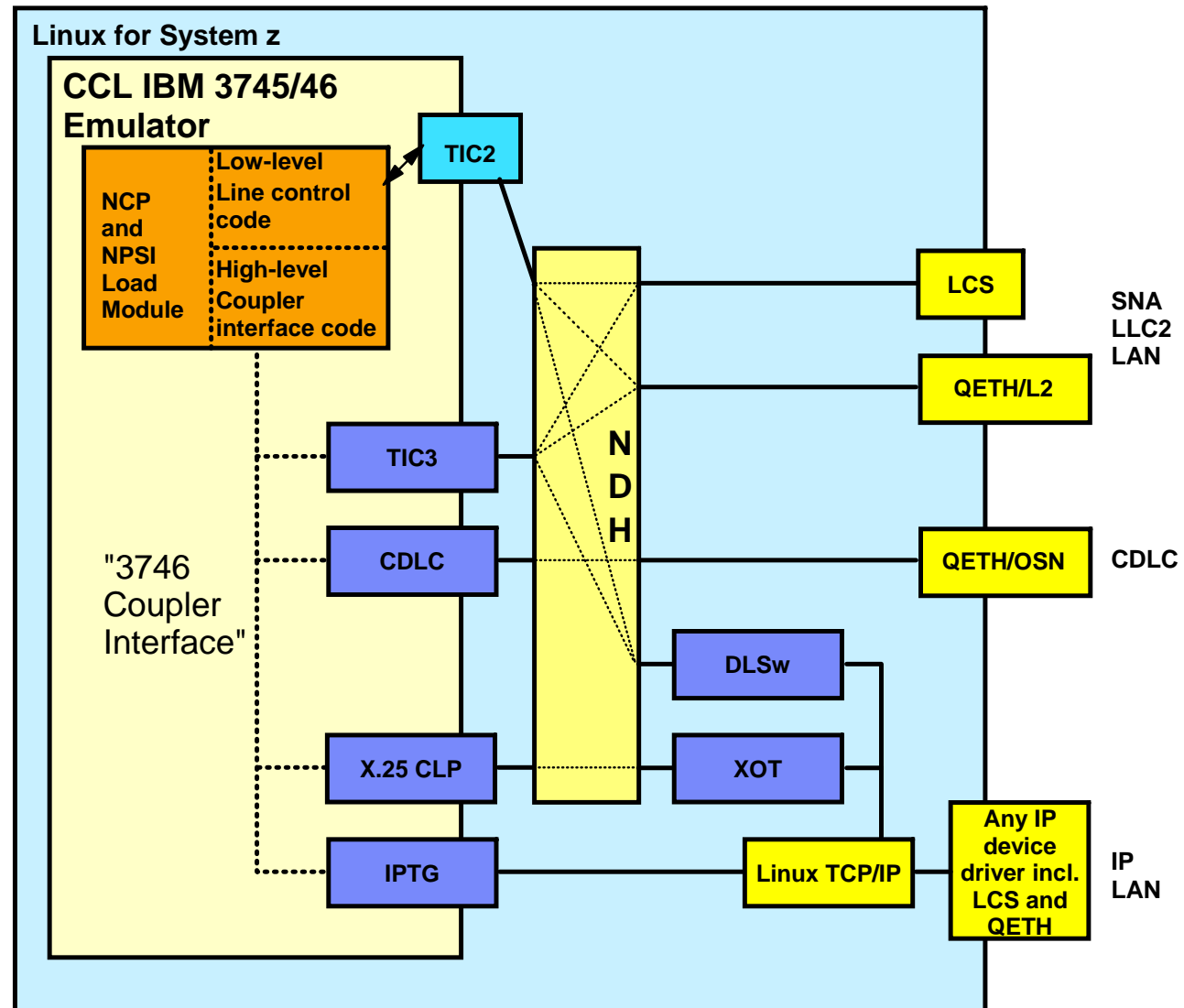
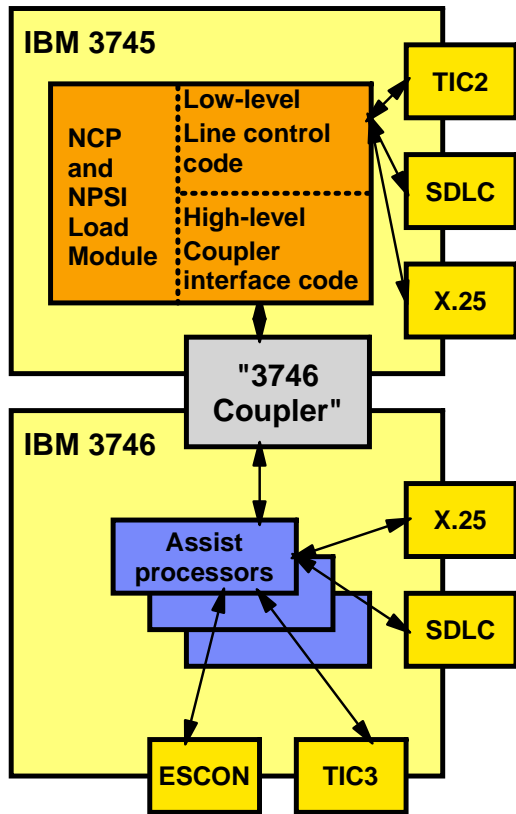
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**MOSS  
console  
access is  
password  
protected!**



## CCL Connectivity Options

# CCL NCP network interface architecture



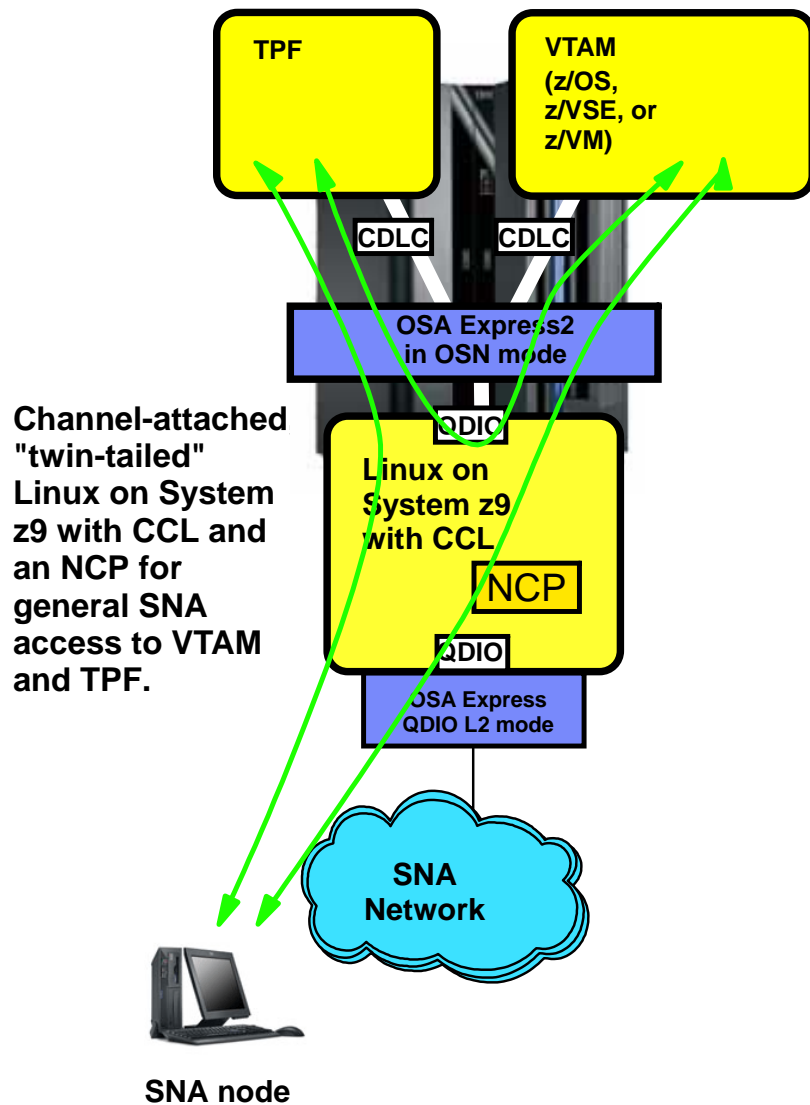
➤ Using network interfaces that are accessed through the IBM 3746 coupler interface, offloads the low-level line-specific control functions from the NCP to one of the assist processors in the IBM 3746 frame.

➤ For an NCP running in the CCL emulator - that means improved performance:

1. Less instructions to process by the emulator
2. Improved multi-processing capabilities - handing work from the emulator process to other processes and threads in Linux

- CCL V1R1 supported only the TIC2 (NTRI) technology over OSA LCS
- CCL V1R2 added support for CDLC, IPTG, X.25/XOT, and TIC2 over OSA QETH (QDIO in Layer 2 mode)
- CCL V1.2.1 added support for DLSw and TIC3 over LCS or QETH (QDIO in Layer 2 mode)

# OSA for NCP (OSN) connectivity on System z9 - CDLC



- **OSA Express2 on System z9 implements an OSA CHPID type - known as OSA for NCP (OSN).**
  - OSA-Express2 1000Base-T and 1 Gigabit Ethernet features on z9-109
- **TPF and VTAM see the OSA Express OSN port as a channel-attached IBM 3745 to which they communicate using the usual CDLC channel protocol.**
  - OSA CHPID defined as OSN
  - TPF and VTAM device number defined as IBM 3745
  - Linux device numbers (three in a set) defined as OSN (accessed through QDIO from Linux)
  - Same OSN port can be shared among more SNA host systems and more CCL NCPs
- **The OSA microcode relays the CDLC data over a QDIO interface to CCL, which presents it to the NCP as though it had arrived over an IBM 3746 channel interface.**
  - No cable needs to be attached to an OSA port that is defined in OSN mode
- **The fact that the NCP runs in CCL instead of an IBM 3745/46 is transparent to TPF and VTAM.**
  - Existing configuration definitions are used unchanged
  - Existing activation and management flows continue to work as before
- **The normal Load/Dump functions over a channel are supported**
  - No need to FTP an NCP load module to the Linux file system
- **TPF or VTAM must reside on the same System z9 CEC as where CCL resides**
  - This is a same-CEC connectivity technology

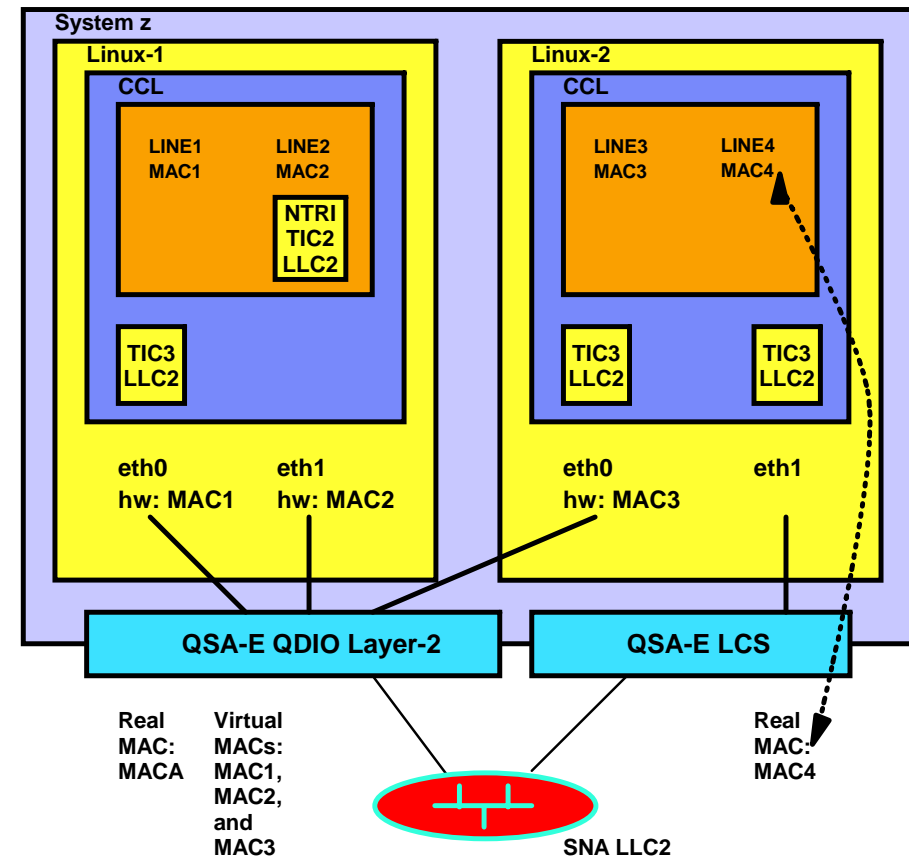
# CCL SNA LLC2 LAN connectivity overview

## ➤ NCP definitions for two types of LAN adapters:

- **TIC2** - NCP Token-ring Interface (NTRI) support
  - NCP instructions used for LLC2 logic
- **TIC3** - IBM 3746 Token-ring Processor (TRP)
  - Native System z instructions used for LLC2 logic
  - Also referred to as "native LAN" support
  - TIC3 performs better than TIC2 - uses much less CPU

## ➤ CCL uses two different LAN device drivers for SNA LLC2:

- **Lan Channel Station (LCS)**
  - Copper cabling
  - NCP physical LINE local MAC address specification must match OSA port's configured real MAC address (OSA/SF)
  - One NCP physical line per OSA LCS port
  - Limited sharing via configured SAP numbers
- **Queued Direct IO (QDIO) operating in layer 2 mode**
  - Copper and fiber cabling
  - NCP physical LINE local MAC address specification must match Linux interface hardware address (virtual MAC), but not OSA port's real MAC address
    - Up to 2048 virtual MAC addresses per OSA port
  - Requires a Linux 2.6 kernel
  - Works for Linux LPARs or z/VM guests
  - If used by Linux as z/VM guests it can be used in combination with z/VM's virtual switch



Layer-2 mode is supported by Fast Ethernet, 1000BASE-T Ethernet, Gigabit Ethernet, and 10 Gigabit Ethernet features on OSA-Express and OSA-Express2 on z890, z990, and System z9

# OSA-Express connectivity overview

Feature	Feature Name	Ports	z800 z900	z900 z990	z9-109	CHPIDs	Connectors
5201	OSA-2 Token Ring	2	X	N / A	N / A	OSA	Copper, RJ-45
5202	OSA-2 FDDI	1	X	N / A	N / A	OSA	Fiber, SC Duplex
2362	OSA-E 155 ATM SM	2	X	RPQ	N / A	OSD, OSE	Fiber, SC Duplex
2363	OSA-E 155 ATM MM	2	X	RPQ	N / A	OSD, OSE	Fiber, SC Duplex
2364	OSA-E GbE LX	2	X	C	C	OSD L2/L3**	Fiber, SC Duplex
2365	OSA-E GbE SX	2	X	C	C	OSD L2/L3**	Fiber, SC Duplex
2366	OSA-E Fast Ethernet	2	X	C	C	OSD L2/L3**, OSE	Copper, RJ-45
2367	OSA-E Token Ring	2	X	X	N / A	OSD, OSE	Copper, RJ-45
1364	OSA-E GbE LX	2	09/04	06/03	C	OSD L2/L3**	Fiber, LC Duplex
1365	OSA-E GbE SX	2	09/04	06/03	C	OSD L2/L3**	Fiber, LC Duplex
1366	OSA-E 1000BASE-T Ethernet	2	N / A	06/03	C	OSC, OSD L2/L3**, OSE	Copper, RJ-45
3364	OSA-E2 GbE LX	2	N / A	01/05	X	OSD L2/L3**, OSN *	Fiber, LC Duplex
3365	OSA-E2 GbE SX	2	N / A	01/05	X	OSD L2/L3**, OSN *	Fiber, LC Duplex
3366	OSA-E2 1000BASE-T Ethernet	2	N / A	N / A	X	OSC, OSD L2/L3**, OSE, OSN *	Copper, RJ-45
3368	OSA-E2 10 GbE LR	1	N / A	01/05	X	OSD L2/L3**	Fiber, SC Duplex

LX = Long wavelength transceiver, SX = Short wavelength transceiver, LR - Long Reach transceiver

X = Available for ordering C = Carry forward on an upgrade from z900 or z990

\* = OSN is exclusive to z9-109. Hardware availability is 09/16/05

\*\* = L2/L3 = Layer 2/Layer 3 which is applicable to z9-109, z990, z890

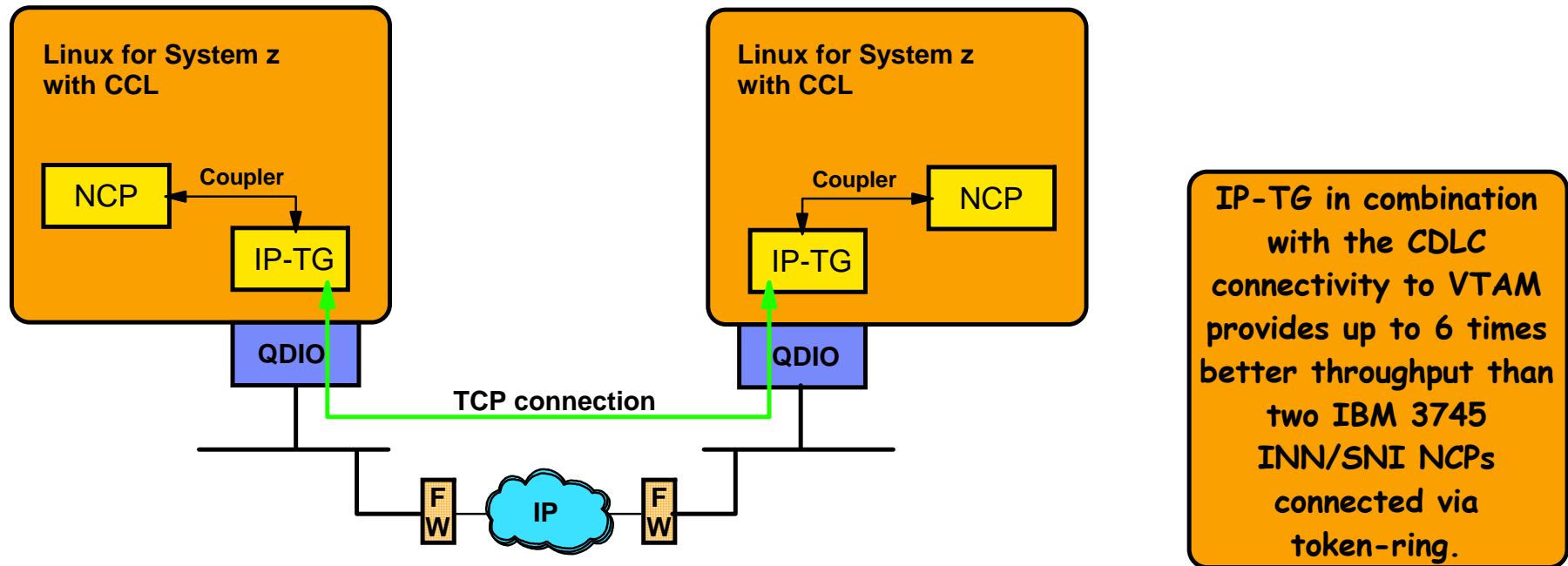
Copper  
(RJ45)  
cabling



## SNA LLC2 traffic over OSA LCS interfaces

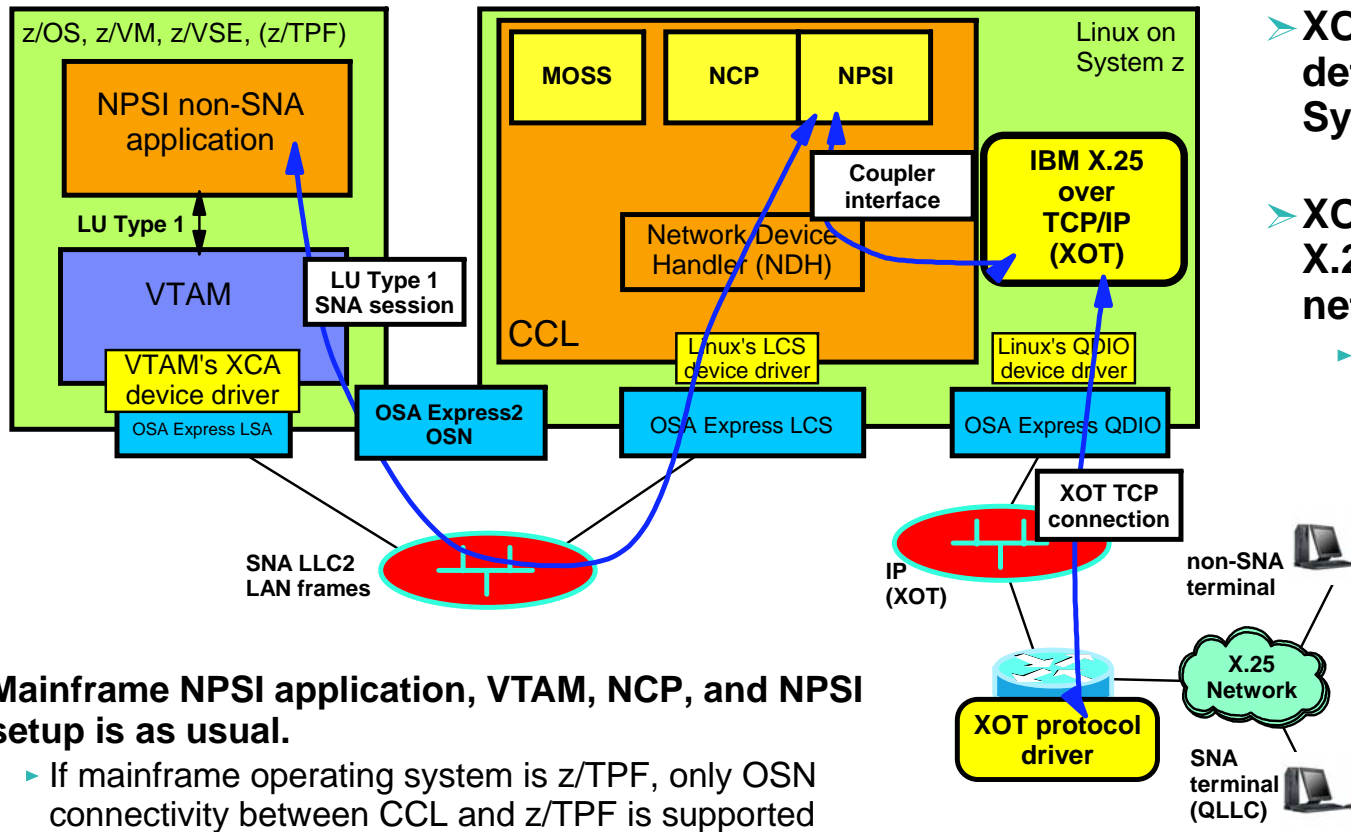
- **On mainframe hardware levels that do not support QDIO layer 2 mode, an OSA Token-ring or Ethernet copper port operating in LAN Channel Station (LCS) mode can be used for SNA LLC2 access by a CCL NCP TIC2 or TIC3 interface.**
  - ▶ G5, G6, z800, z900 do not support QDIO layer 2 mode
- **OSA/SF is needed for locally administered MAC addresses on OSA LCS ports and for maintenance of the OSA Address Table (OAT) when sharing OSA LCS ports between multiple Linux images.**
  - ▶ Locally administered MAC addresses can alternatively be set via the Hardware Management Console (HMC)
- **OSA LCS ports can be shared by multiple NCP lines (in the same CCL or across multiple CCLs) - given certain restrictions, of which the most important are:**
  - ▶ For G5/G6 OSA-Express (LCS mode) and for OSA-2 in general, a port cannot be shared, but must be dedicated to the Linux image in question in TCP/IP passthru-mode.
  - ▶ For zSeries OSA-Express (LCS mode), a port can be shared by configuring unique SAP numbers in OSA/SF and the CCL NCP line definitions
    - For HOME IP address - specify an address of 0.0.0.x in OSA/SF, where 'x' is the SAP number you want assigned
    - The OSA-Express microcode must be a level 3.50 for z900 and z800 - and 5.50 for z990 and z890
    - VTAM and CCL cannot share an OSA port for communication between them - VTAM's LSA port cannot be the same as CCL's LCS port
    - Two CCL NCP line definitions cannot share an OSA LCS port for BNN traffic (they both need SAP 04)
    - One BNN NCP line definition and one or more INN/SNI NCP line definitions can share an LCS port using different local SAPs for the INN/SNI traffic

# IP-TG - IP transmission group for INN/SNI traffic between two CCL NCPs



- IP transmission group exchanges INN/SNI traffic between two CCL NCPs over a TCP connection.
- The NCP sees the IP-TG endpoint as a TIC3 token-ring adapter
  - ▶ TIC3 adapters normally reside in the IBM 3746 frame and are attached to Token-Ring Processors (TRP)
  - ▶ A TRP in a real IBM 3746 does all the SNA LLC2 processing on behalf of the NCP
    - No LLC2 overhead in the NCP
  - ▶ The NCP interfaces to the TRP using the coupler programming interface
    - Used by the NCP for all line and channel resources that are located in an IBM 3746
- Because there is no real LLC2 processing when using IP-TG, IP-TG performs very well for INN/SNI traffic between two CCL NCPs.
- The IP-TG TCP connection can optionally be secured (encrypted) using the STUNNEL technology of Linux.
- Configuration options allow for control of port numbers and IP addresses at for easier firewall configuration between business partners.

# Transporting non-SNA X.25 access to CCL/NPSI over an IP Network - X.25 over TCP



➤ XOT is an open standard and defined in RFC 1613 "Cisco Systems X.25 over TCP (XOT)".

➤ XOT is used to encapsulate X.25 packets over a TCP/IP network.

▶ Supported by various router vendors - including Cisco

➤ Mainframe NPSI application, VTAM, NCP, and NPSI setup is as usual.

▶ If mainframe operating system is z/TPF, only OSN connectivity between CCL and z/TPF is supported

➤ NPSI processing remains offloaded from the mainframe OS environment.

➤ Physical connectivity to X.25 network is via an aggregation layer router.

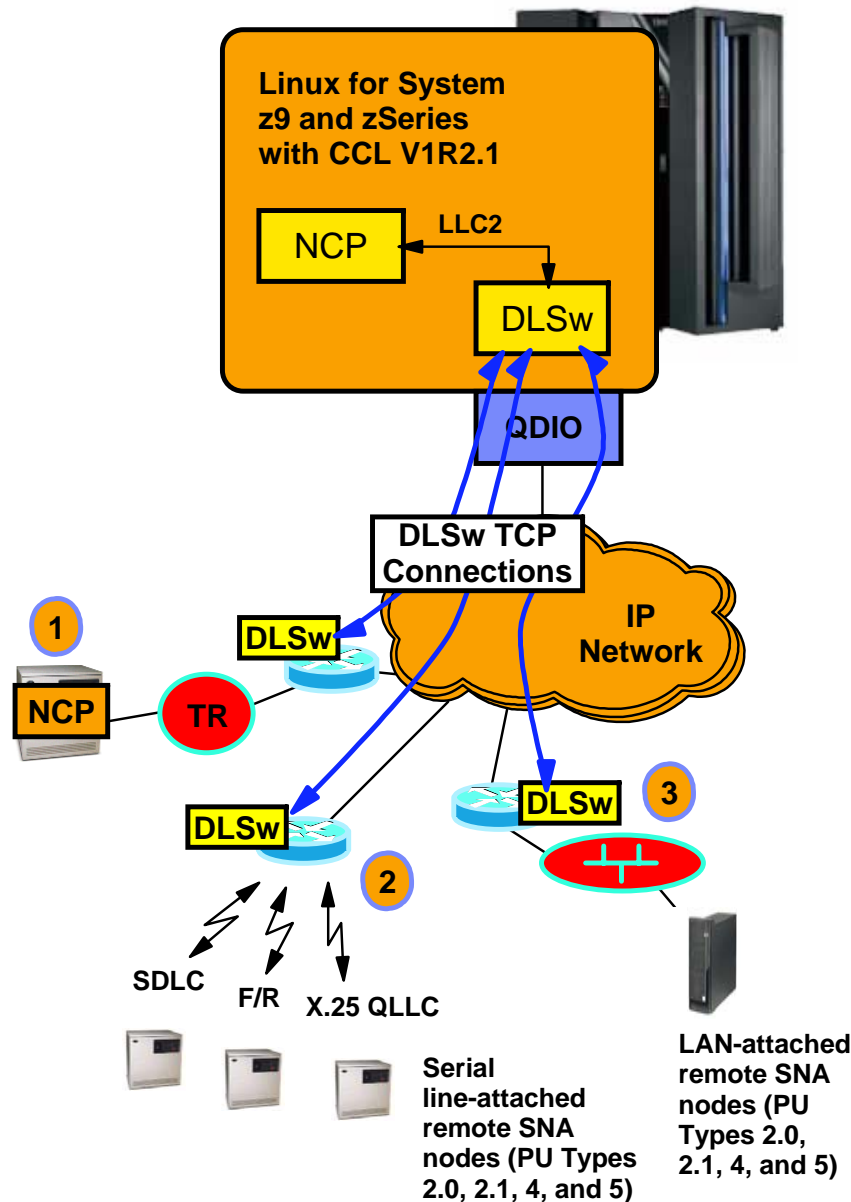
▶ Connectivity between aggregation layer router and NPSI is via an X.25 Over TCP/IP (XOT) TCP connection (IP network flows).

➤ Interface between NPSI and local XOT protocol component is the same as NPSI uses today when communicating over X.25 adapters in an IBM 3746 unit - the Coupler interface.

➤ X.25 over TCP/IP for CCL is a separate IBM software product that is needed in conjunction with CCL for X.25 connectivity to NPSI

**XOT with CCL enables continued use of NPSI-based applications and X.25 connectivity to the System z platform via an XOT router.**

# CCL imbedded DLSw support



## ➤ Network infrastructure simplification:

- ▶ Integration of data center DLSw functions with NCP functions in Linux on System z
- ▶ Avoids or reduces the need for separate data center DLSw router equipment

## ➤ CCL DLSw is based on the open standards version of DLSw - RFC1795 & RFC2166:

- ▶ Interoperability with all vendors who have implemented DLSw according to those standards
- ▶ Will interoperate with DLSw+ nodes
  - DLSw+ nodes will adapt to standard DLSw protocols when connecting to an open standards-based DLSw implementation

## ➤ Typical CCL DLSw scenarios:

1. INN/SNI to NCPs in remote IBM 3745/46
2. Peripheral nodes attached via serial lines to DLSw router
3. Peripheral nodes attached via LAN to DLSw router

## ➤ Virtualizes the SNA MAC address

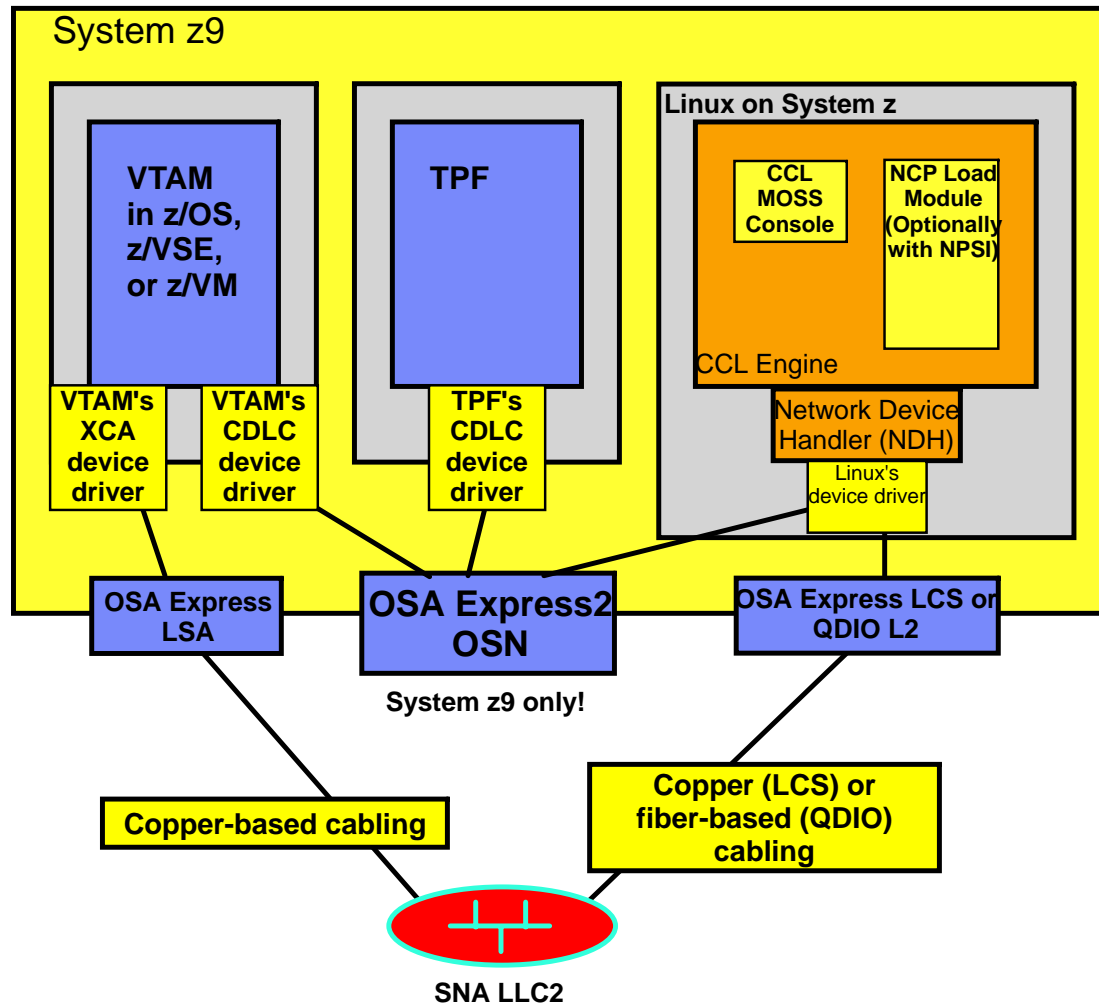
- ▶ A DLSw MAC address is a virtual MAC address that doesn't need to match any real MAC address
- ▶ Supports many virtual DLSw MAC addresses over a single physical MAC address (OSA port)
  - Especially of value on mainframe hardware platforms where QDIO layer-2 mode isn't available







# CCL and VTAM/TPF connectivity summary



**Note:** The OSN technology is available on System z9 hardware only.

## ➤ VTAM connects to a CCL NCP using one of two technologies:

- ▶ Over a LAN to which VTAM connects using an OSA port in LSA mode and Linux over an OSA port in LCS or QETH mode (QDIO Layer 2).
- ▶ If VTAM and CCL reside on the same System z9, they can connect via a shared OSA-E2 port operating in OSA for NCP (OSN) mode.
  - Both VTAM, TPF, and the NCP see this connectivity as an ESCON channel over which the usual CDLC channel protocol is used.

## ➤ TPF supports the OSN connectivity option only.

## ➤ No SNA subarea topology changes - VTAM is still a PU Type 5 and the NCP is a PU Type 4

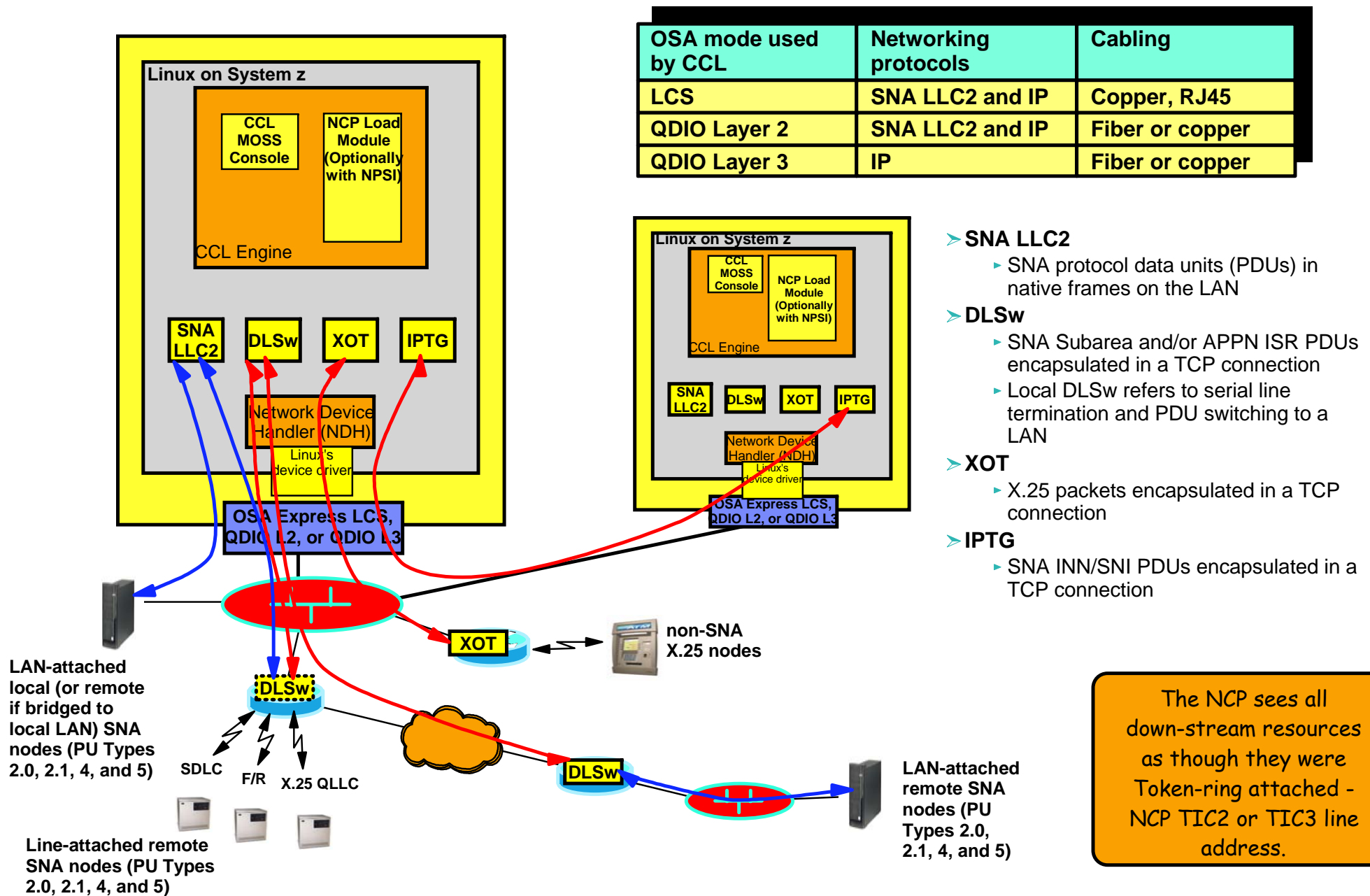
- ▶ In most cases no changes to SNA subarea pathing definitions

## ➤ When OSN connectivity is used, there are no changes to VTAM definitions or VTAM operations procedures.

## ➤ When LAN connectivity is used, there may be minor changes to VTAM definitions and VTAM operations procedures.

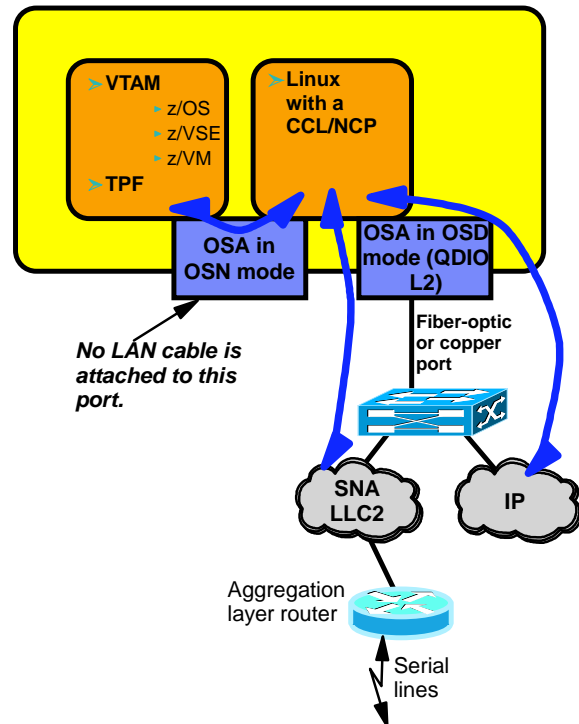
## ➤ In most cases no changes to NetView definitions and operations.

# CCL and down-stream connectivity summary



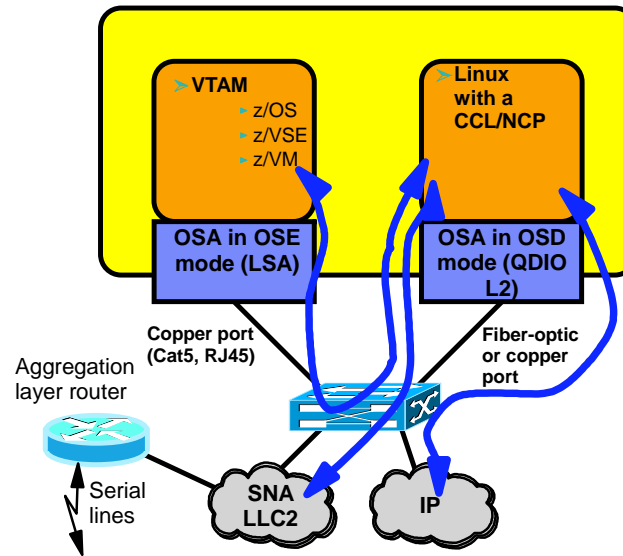
# Mainframe hardware level and CCL connectivity summary

## System z9



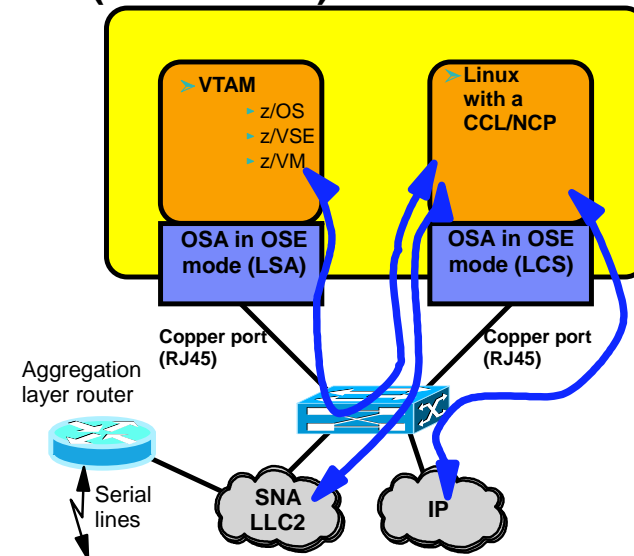
- **Owning VTAM**
  - OSN (CDLC)
  - Via shared LAN
- **SNA LLC2**
  - QDIO layer 2
  - LCS
- **IP**
  - IP-TG
  - DLSw
  - XOT

## zSeries z890/z990



- **Owning VTAM**
  - Via shared LAN
- **SNA LLC2**
  - QDIO layer 2
  - LCS
- **IP**
  - IP-TG
  - DLSw
  - XOT

## zSeries z800/z900 (and G5/G6)



- **Owning VTAM**
  - Via shared LAN
- **SNA LLC2**
  - LCS
- **IP**
  - IP-TG
  - DLSw
  - XOT

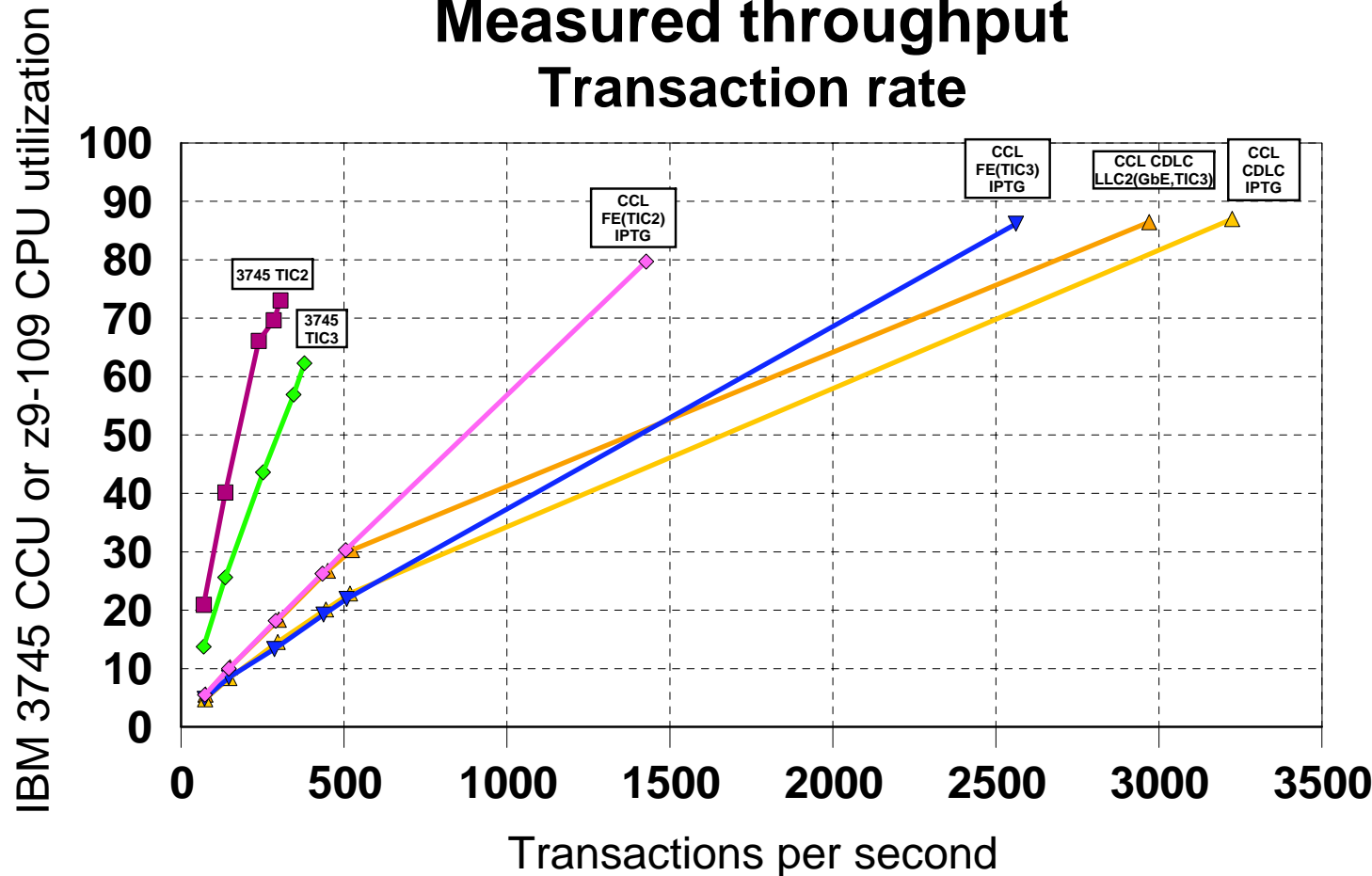
# Performance and Capacity

## SNI performance - throughput

## SNI Transactional Workload

### Measured throughput

### Transaction rate



#### ➤ FE(TIC2),IPTG

- Fast Ethernet between VTAMs and CCL/NCPs using TIC2 ports and IPTG between SNI CCL/NCPs

#### ➤ FE(TIC3),IPTG

- Fast Ethernet between VTAMs and CCL/NCPs using TIC3 ports and IPTG between SNI CCL/NCPs

#### ➤ CDLC,LLC2(GbE,TIC3)

- OSN between VTAMs and CCL/NCPs and SNA LLC2 over QDIO layer2 via a Gigabit Ethernet between SNI CCL/NCPs

#### ➤ CDLC,IPTG

- OSN between VTAMs and CCL/NCPs and IPTG between SNI CCL/NCPs

An IBM 3745-31A sample configuration with TIC3 ports maxes out around 380 transactions per second

**Note:** A wide area network in-between the two NCPs will have an impact on transaction rate.

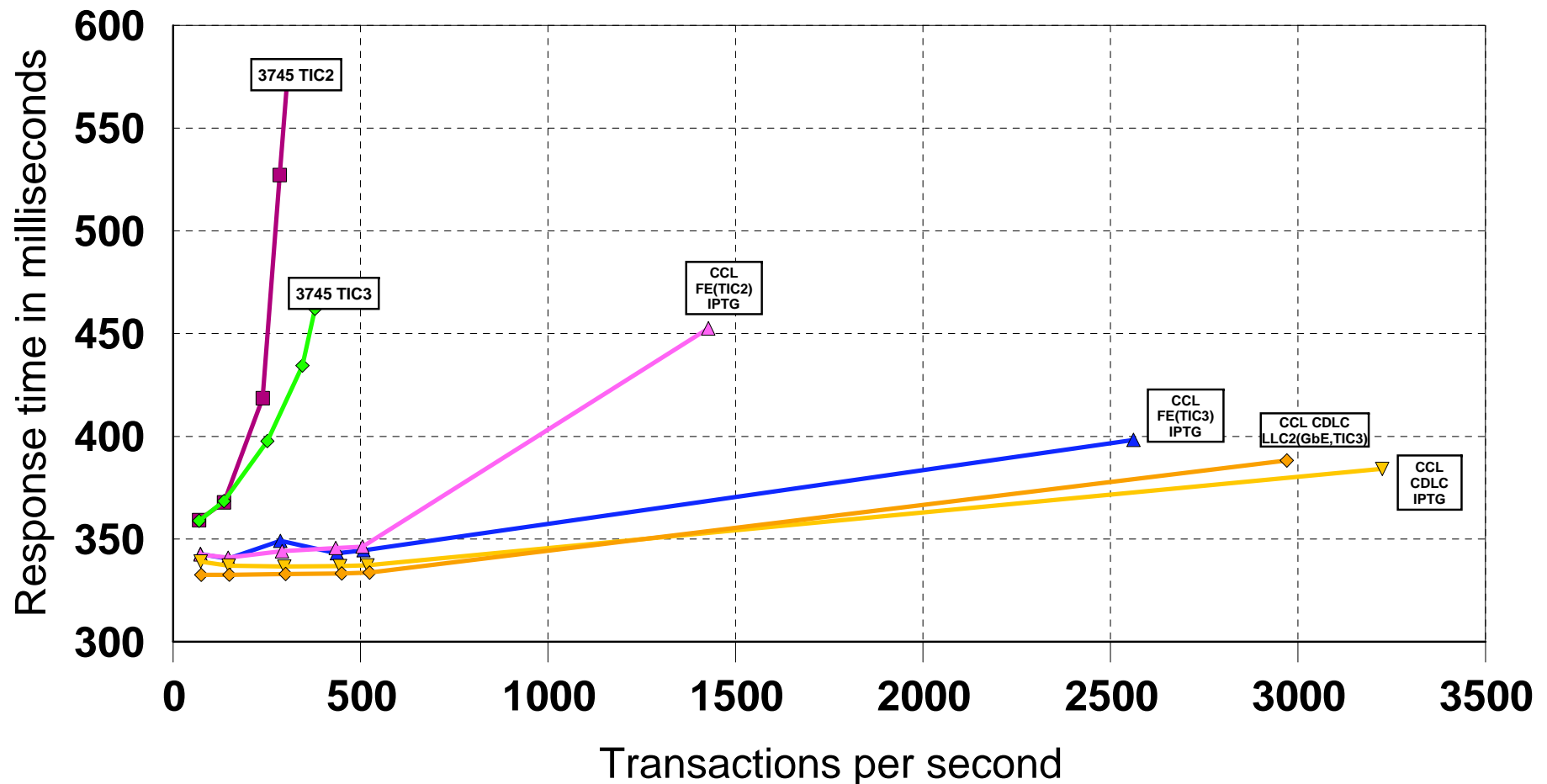
**Note:** All CCL data was captured with CCL V1.2.1



## SNI performance - response time

## SNI Transactional Workload

### Measured response time



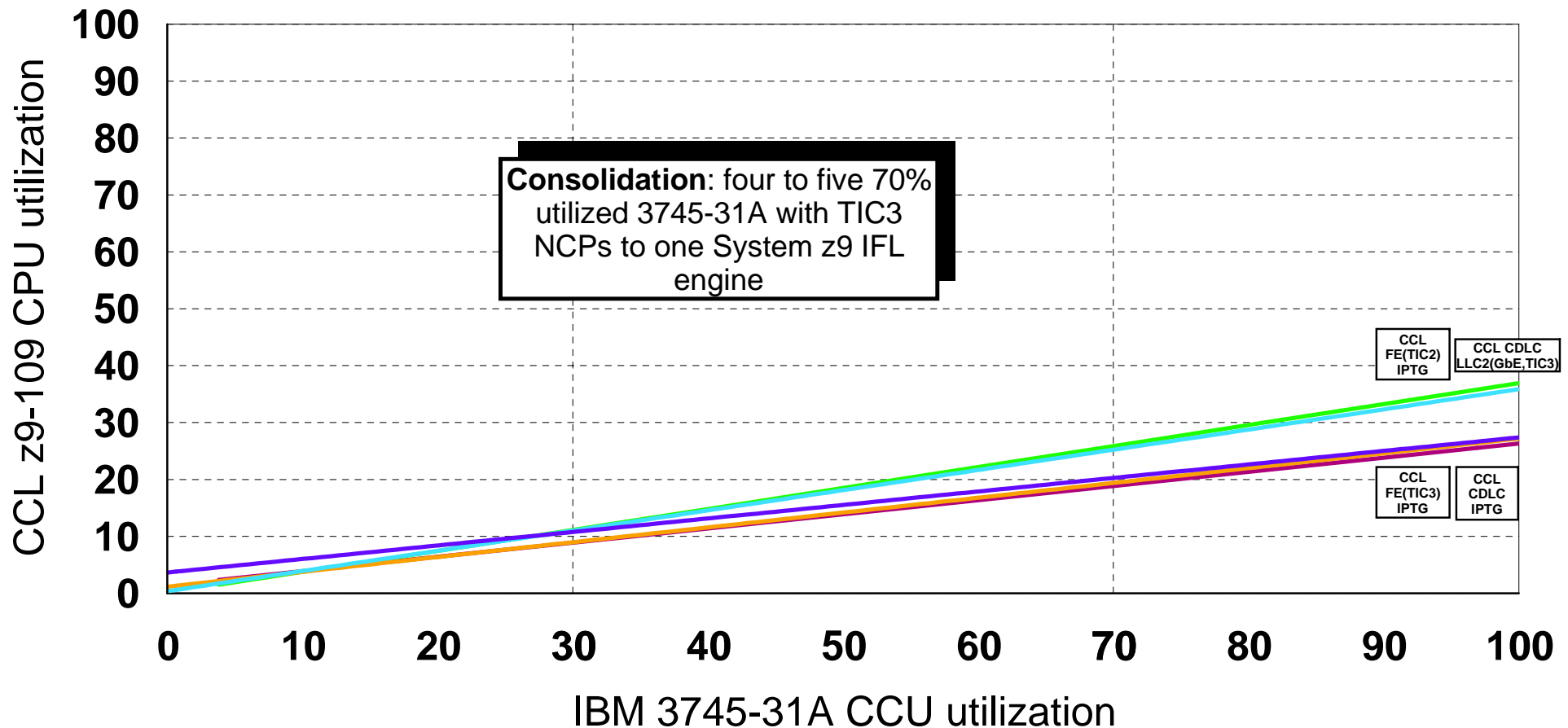
**Note:** The response time shown above includes an artificial thinktime between transactions of 330 milliseconds.

**Note:** The high-transaction volume measurement points were performed with a think time of zero - they have in this chart been increased with 330 milliseconds for comparison reasons.

# SNI workload CPU capacity planning data for CCL V1R2.1 running on System z9

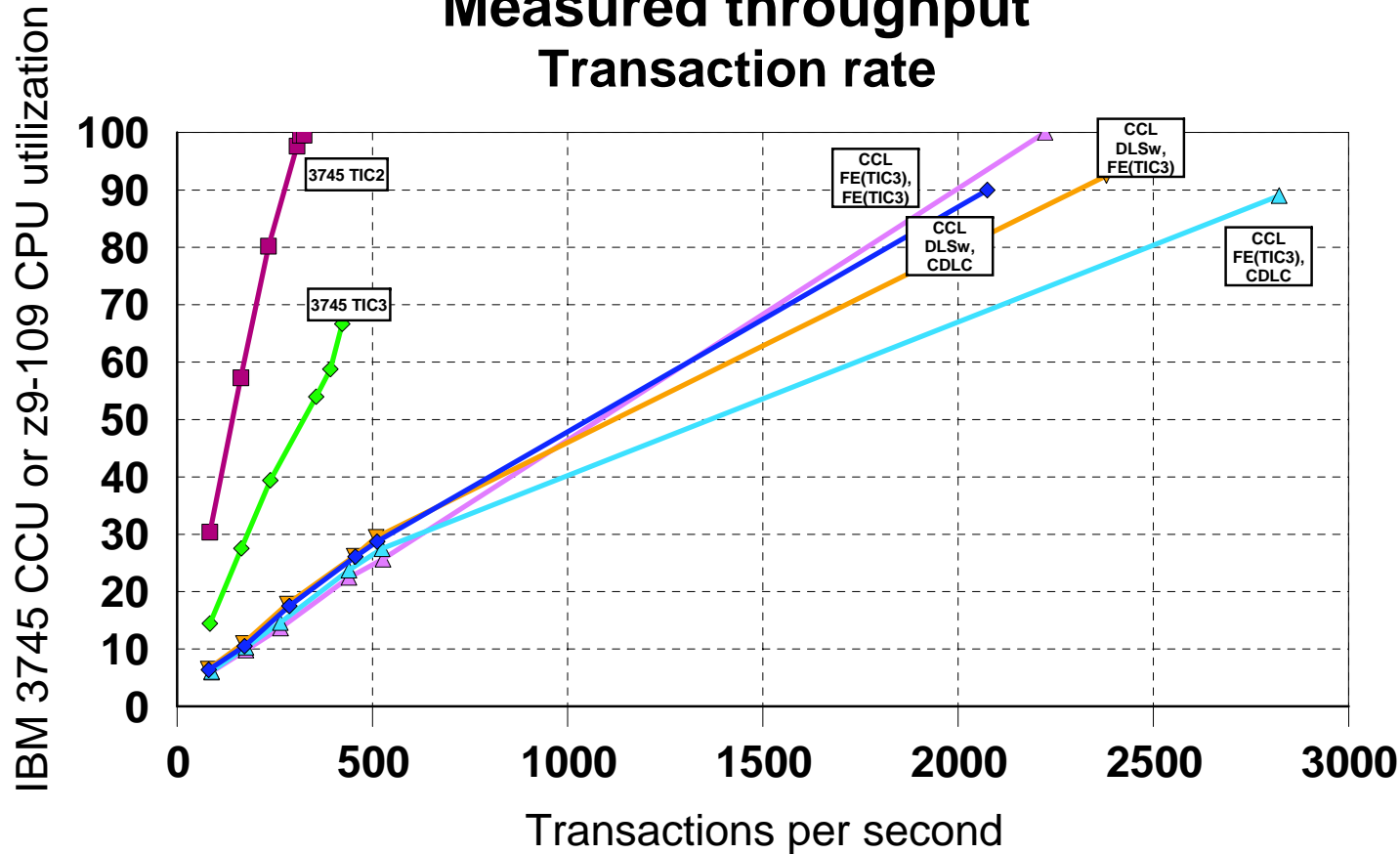
## SNI Transactional Workload

### IBM 3745-31A CCU utilization vs. z9-109 CPU utilization IBM 3745-31A with TIC3 adapters



## Boundary function performance - throughput

### Boundary Function Transactional Workload Measured throughput Transaction rate



#### ➤ FE(TIC3),FE(TIC3)

- Peripheral nodes SNA LLC2 via Fast Ethernet, CCL/NCP using TIC3 both downstream and upstream to VTAM

#### ➤ FE(TIC3),CDLC

- Peripheral nodes SNA LLC2 via Fast Ethernet, CCL/NCP using TIC3 downstream and CDLC upstream to VTAM

#### ➤ DLSw,FE(TIC3)

- Peripheral nodes via DLSw to CCL/NCP using TIC3 upstream to VTAM

#### ➤ DLSw,CDLC

- Peripheral nodes via DLSw to CCL/NCP using CDLC upstream to VTAM

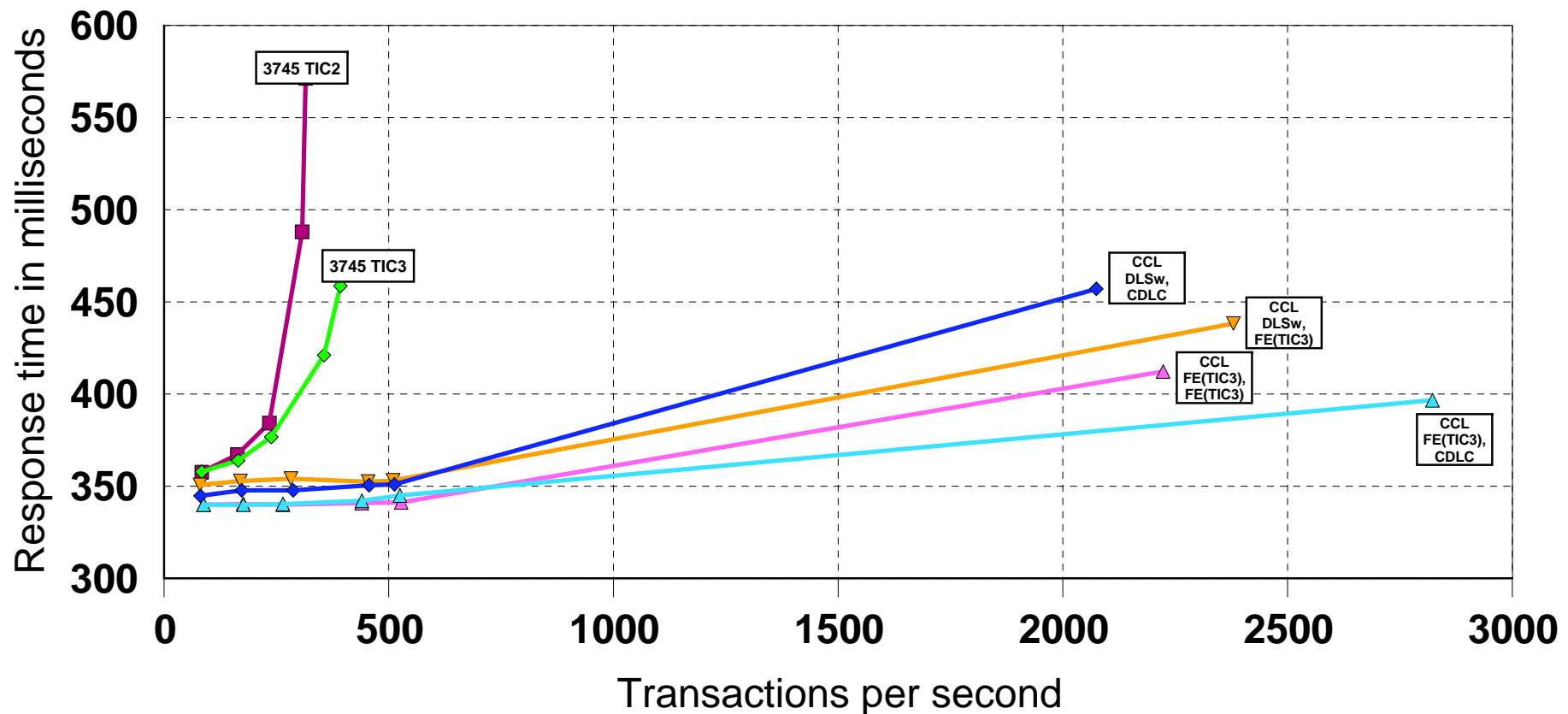
An IBM 3745-31A sample configuration with TIC3 ports maxes out around 268 transactions per second

**Note:** Clients emulated by four Linux servers. For DLSw workloads, clients are connected via two Cisco 7507 DLSw routers over GbE to CCL's imbedded DLSw component.

**Note:** All CCL data was captured with CCL V1.2.1

## Boundary function performance - response time

## Boundary Function Transactional Workload Measured response times

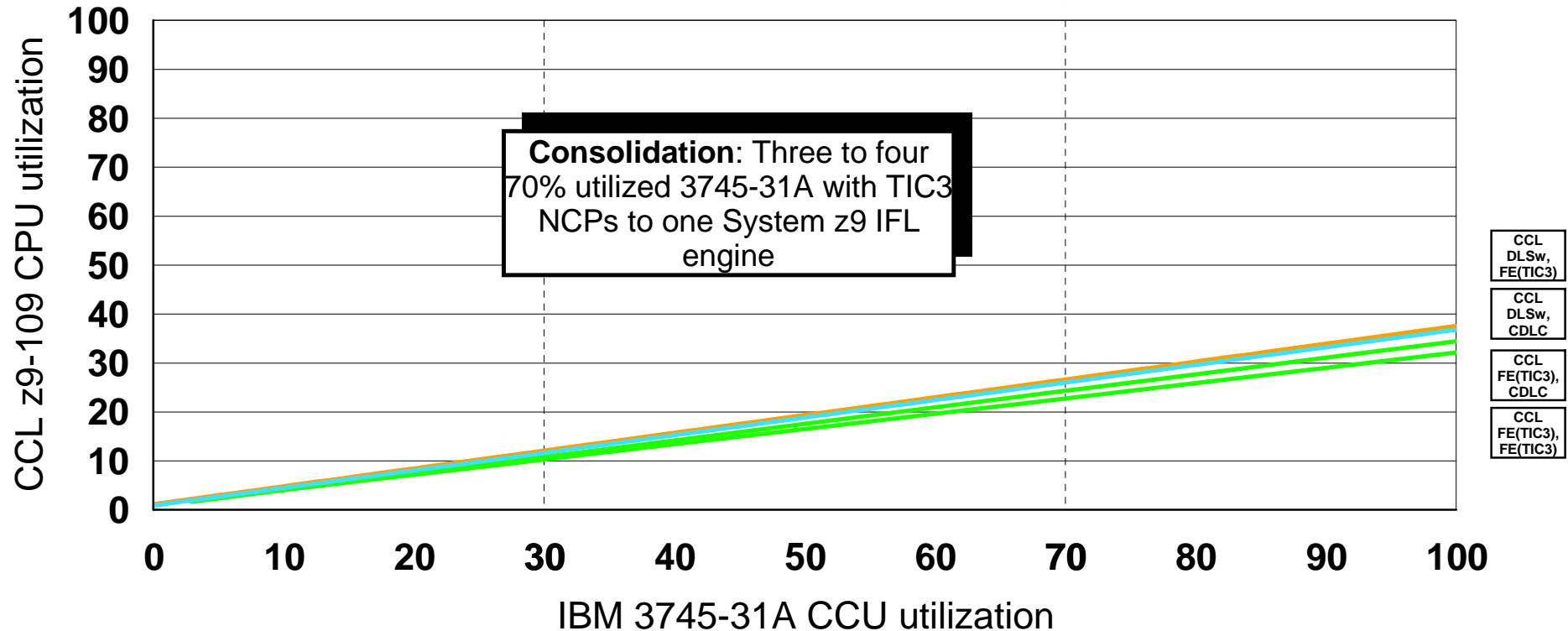


**Note:** The response time shown above includes an artificial thinktime between transactions of 330 milliseconds.

**Note:** The high-transaction volume measurement points were performed with a think time of zero - they have in this chart been increased with 330 milliseconds for comparison reasons.

# Boundary function workload CPU capacity planning data for CCL V1R2.1 running on System z9

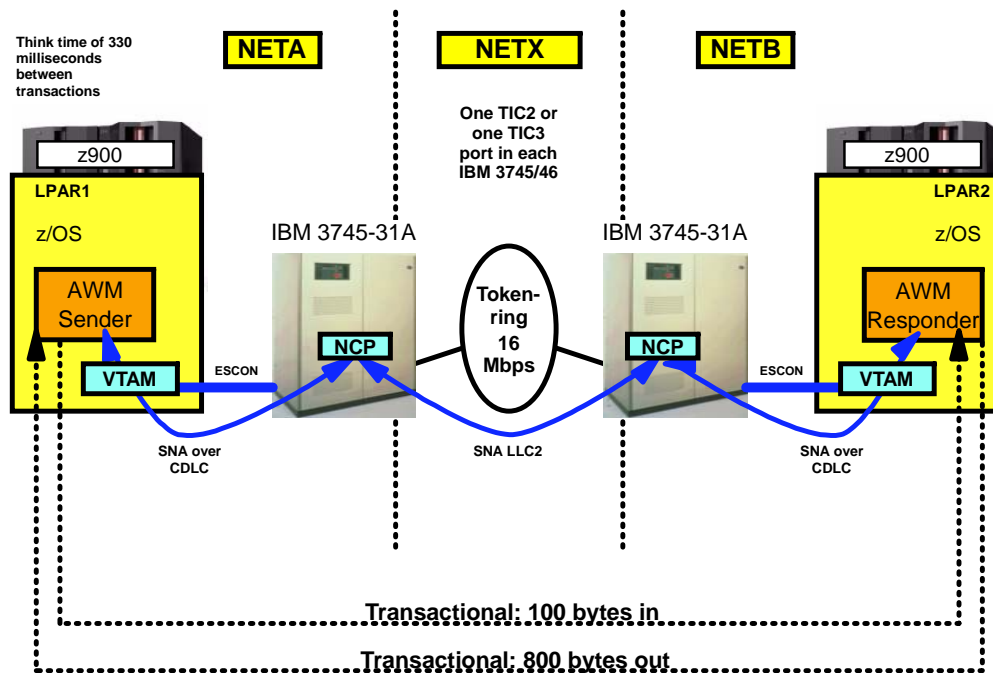
## Boundary Function Transactional Workload IBM 3745-31A CCU utilization vs. z9-109 CPU utilization IBM 3745-31A with TIC3 adapters





# CCL CPU usage - SNI transactional workload - setup notes

## IBM 3745/46 test environment overview



### ➤ IBM 3745-61A

- Tests were done with an IBM 3745-61A - divided into two IBM 3745-31A units
- CCU capacity equals an IBM 3745-31A
- One TIC2 or one TIC3 adapter

### ➤ CCL as z/VM guest

- 2 dedicated z990 or z9 CPs to z/VM
- 1 virtual CP to each CCL Linux guest
- "Client" side CCL working set 105 MB (as reported by z/VM)
- "Server" side CCL working set 340 MB (as reported by z/VM)

### ➤ z990 or z9-109 hardware for CCL

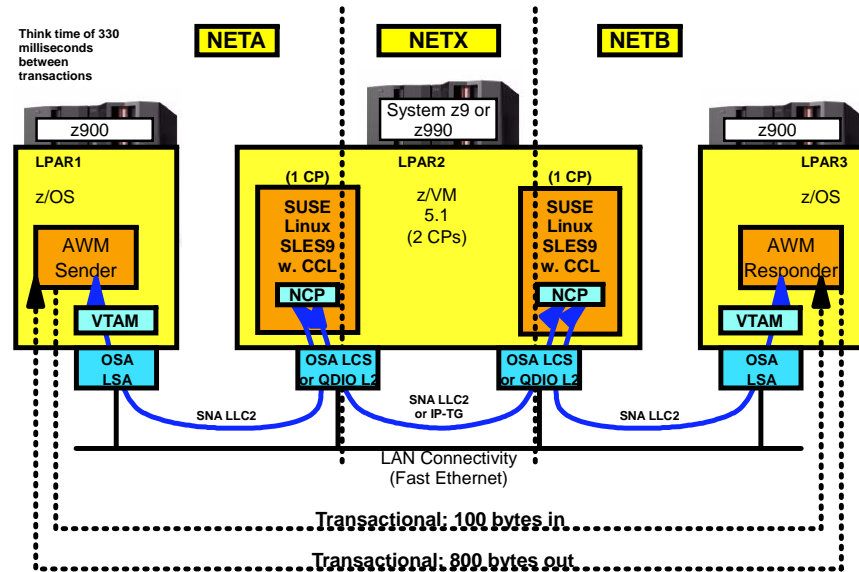
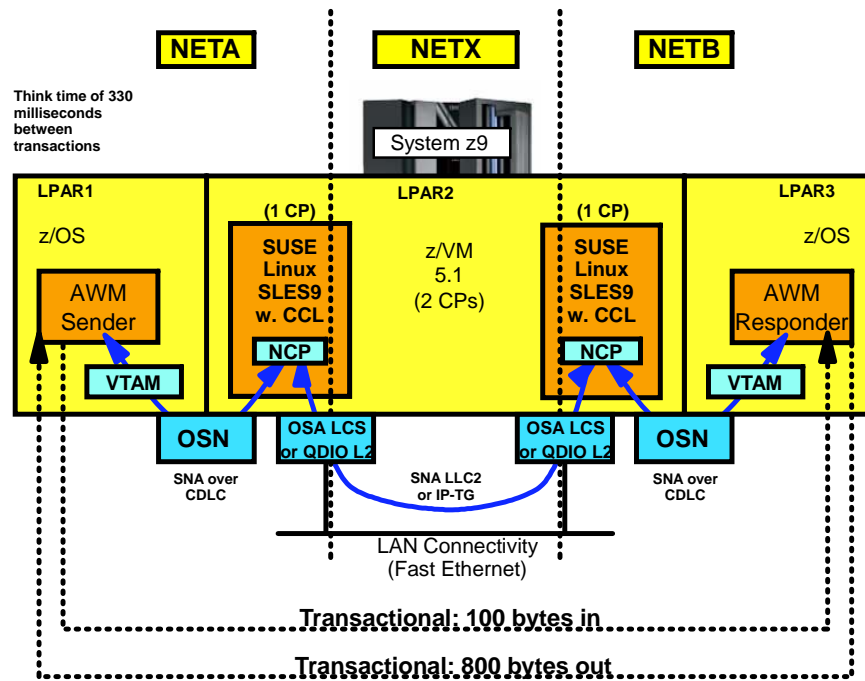
### ➤ CCL V1.2.1: SUSE SLES9 SP2 - Linux 2.6 kernel

### ➤ Transactional workload characteristics

- Up to 175 LU 6.2 sessions used to generate traffic
- 100 bytes in per transaction
- 800 bytes out per transaction
- Thinktime 330 milliseconds between transactions per SNA session
  - High transaction volume measurements achieved with a thinktime of zero
- VTAM IOBUF size=932
- IBM 3745 MAXBFRU=20
- All workloads were driven by AWM

# CCL CPU usage - SNI transactional workload - setup notes

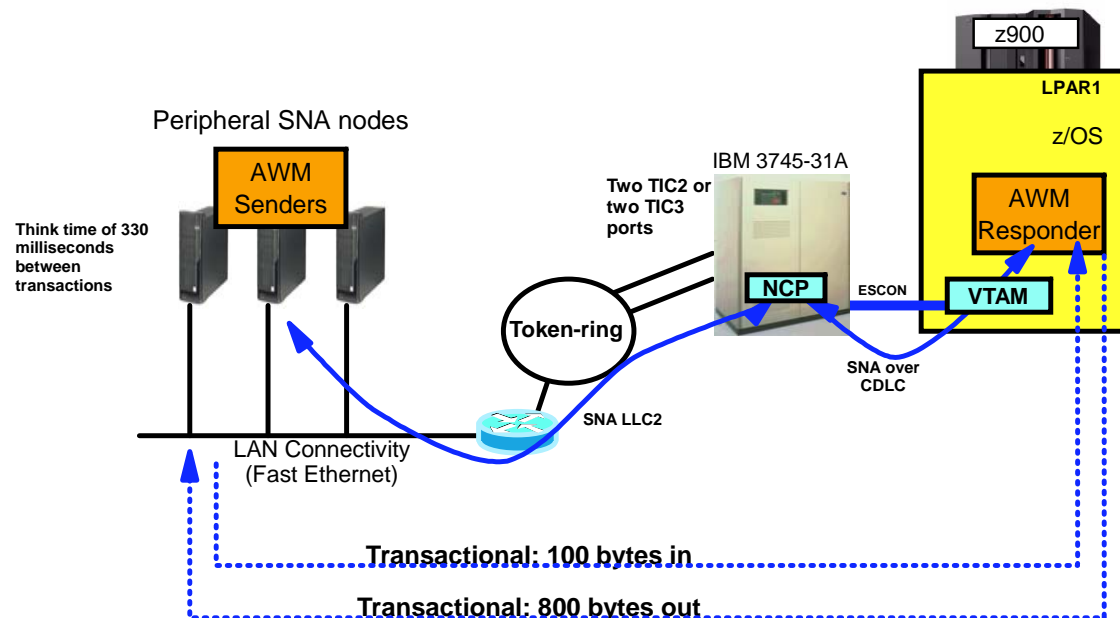
IBM CCL using shared LAN  
between VTAM and the CCL  
NCP:



IBM CCL using OSA for NCP  
(OSN) CDLC connectivity  
between VTAM and the CCL  
NCP:

# CCL CPU usage - boundary function transactional workload - setup notes

## IBM 3745/46 test environment overview



### > IBM 3745-31A

- ▶ CCU capacity equals an IBM 3745-31A
- ▶ Two TIC2 or two TIC3 adapters

### > CCL as z/VM guest

- ▶ 2 dedicated z990 or z9 CPs to z/VM
- ▶ 1 virtual CP to the CCL Linux guest

### > z990 or z9-109 hardware for CCL

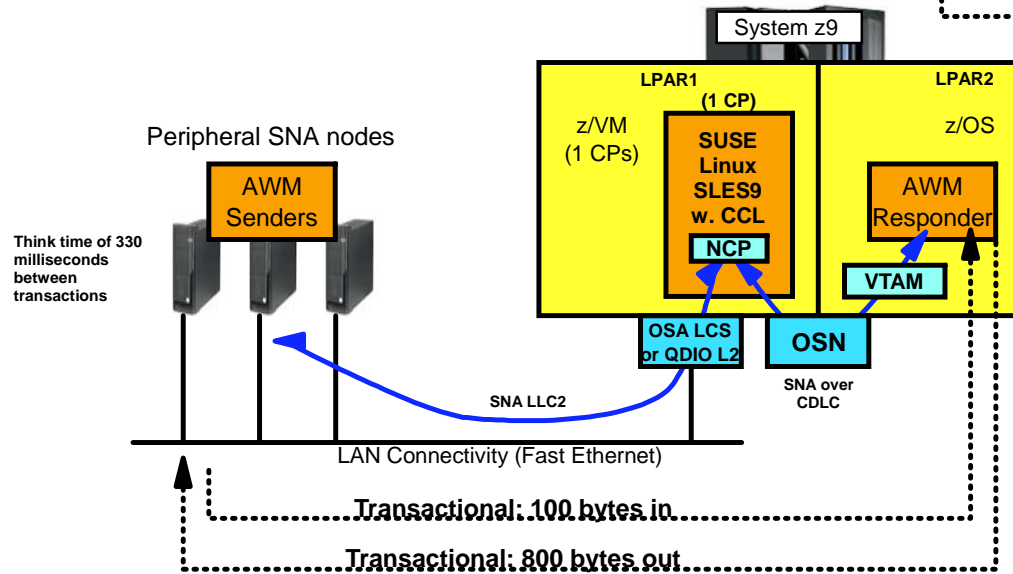
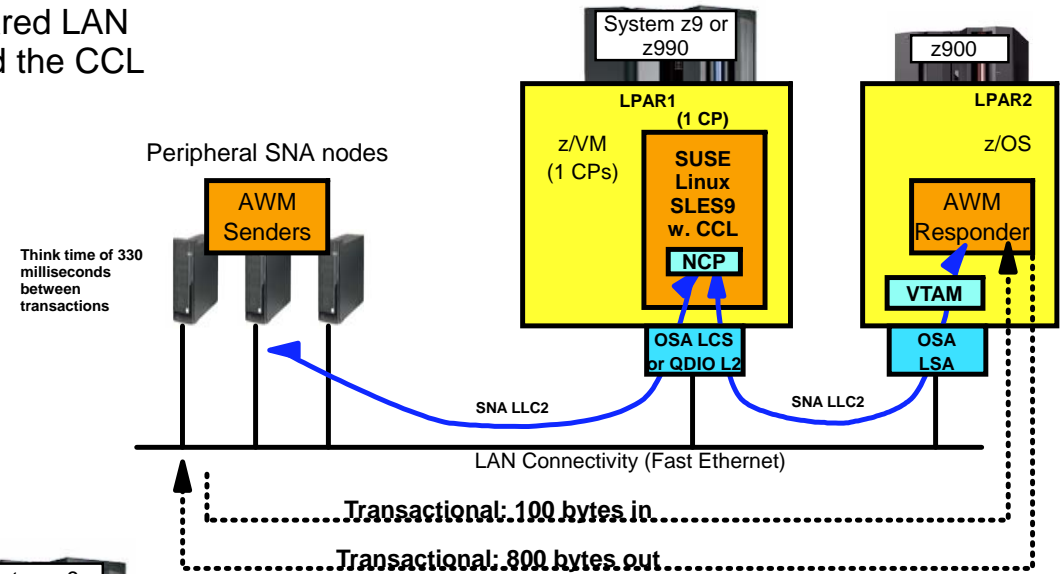
### > CCL V1.2.1: SUSE SLES9 SP2 - Linux 2.6 kernel

### > Transactional workload characteristics

- ▶ BF devices were emulated as one LU per PU SNA devices
- ▶ Each transaction consisted of a 100-byte request in and a 800-byte response
- ▶ A thinktime of 330 milli seconds was used between each transaction
  - High transaction volume measurements achieved with a thinktime of zero
- ▶ 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.
- ▶ All workloads were driven by AWM

# CCL CPU usage - boundary function transactional workload - setup notes

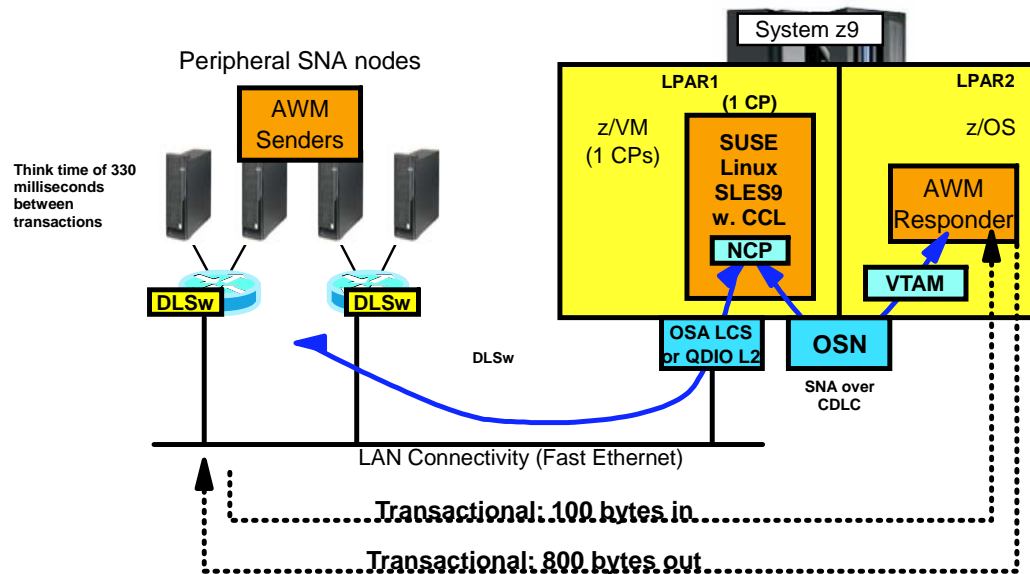
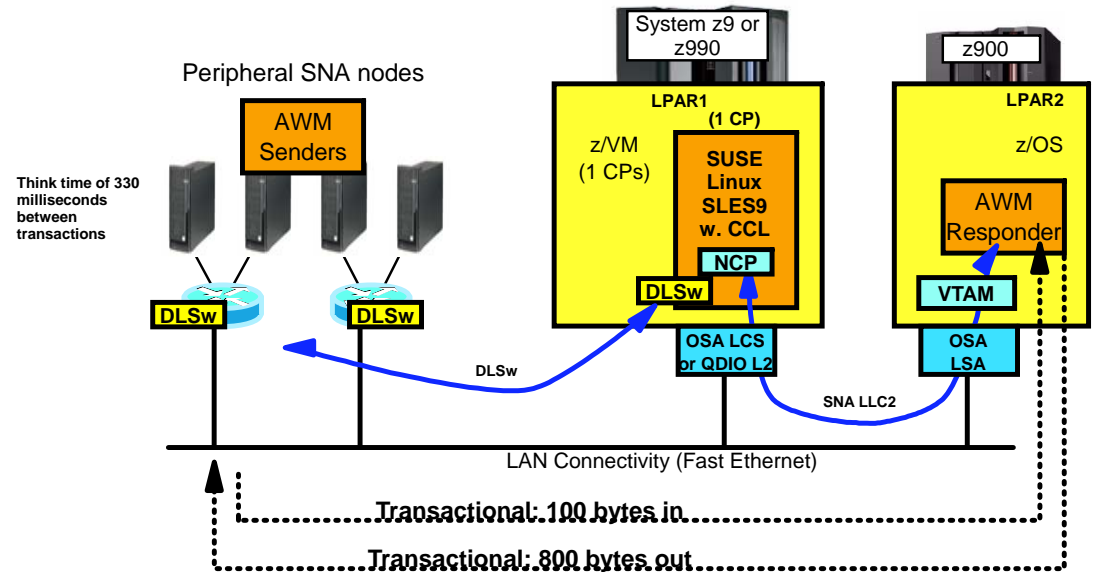
IBM CCL using shared LAN  
between VTAM and the CCL  
NCP:



IBM CCL using OSA for NCP  
(OSN) CDLC connectivity  
between VTAM and the CCL  
NCP:

# CCL CPU usage - boundary function transactional workload - setup notes

DLSw between peripheral nodes and the CCL NCP and shared LAN between VTAM and the CCL NCP:



DLSw between peripheral nodes and the CCL NCP and OSA for NCP (OSN) CDLC connectivity between VTAM and the CCL NCP:

NOTES



# Summary

# CCL offers an opportunity to simplify and improve the SNA hardware infrastructure

- **Removes the IBM 3745/46 hardware component for most of the current usage scenarios:**
  - ▶ Reduced need for raised floor space
  - ▶ Reduced requirements for power and cooling capacity
  - ▶ Reduced need for skills and resources to manage the physical IBM 3745/46 hardware
- **Reduces the requirement for continued use of ESCON technology in the data center:**
  - ▶ Removes the need for System z ESCON channel interfaces for NCP connectivity
  - ▶ Removes the need for ESCON director ports for NCP connectivity
  - ▶ If IBM 3745/46 is the last hardware component that uses ESCON directors, removes the ESCON directors themselves – including the skills and resources associated with managing the ESCON directors
- **A CCL NCP is not limited to token-ring LANs, but can use any LAN technology that is supported by an OSA port in OSE (LCS) or OSD (QDIO) mode:**
  - ▶ Includes token-ring on System z platforms where OSA continues to support token-ring
  - ▶ 10/100/1000 Mbps 10BASE-T Ethernet – cat5 cabling, RJ45
  - ▶ 1 Gbps and 10 Gbps Ethernet – fiber optic cabling
  - ▶ Removes the need for continued use of token-ring LAN equipment:
    - Access units
    - Token-ring ports in switch equipment
    - Token-ring LAN management skills and software
- **CCL through LAN interface virtualization, provides a much more efficient use of overall LAN capacity:**
  - ▶ QDIO layer 2: up to 2048 virtual LAN interfaces on one OSA port
  - ▶ DLSw virtualizes the LAN interface in a DLSw environment

## CCL offers improved opportunities for implementing high-availability NCP topologies

- **CCL runs on System z and inherits all the unique availability features of the System z platform**
- **Deploying redundant stand-by NCPs can be done without acquiring additional hardware CCUs or ESCON channel hardware**
  - ▶ A stand-by dormant CCL NCP on System z uses very few resources while it is not being used
  - ▶ Much easier and cheaper to design and deploy redundancy for high availability
- **Even though Ethernet does not support duplicate Medium Access Control (MAC) addresses, a traditional SNA duplicate MAC addressing topology can be deployed using DLSw technologies:**
  - ▶ To serve as a load balancing technology where peripheral nodes contact one of more boundary function NCPs or one of more OSA ports into a single boundary function NCP
  - ▶ To server as an availability technology, where a peripheral node re-connects to the same MAC address after a failure – but now connects to a back-up NCP

## CCL offers both existing and enhanced management capabilities

### ➤ Existing SNA management tools continue to work with an NCP running in CCL:

- ▶ SSCP takeover procedures in a traditional dual-CMC network host environment
- ▶ XRF for CICS and IMS session recovery
- ▶ Tivoli NetView for z/OS
- ▶ NTuneMon
- ▶ NPA/NPM
- ▶ OEM products

### ➤ The Linux platform offers management opportunities that are new to the NCP workload:

- ▶ Linux is a general-purpose open operating system with many management features built into it
- ▶ CCL runs as traditional Linux processes and can be monitored and managed as any normal Linux process
- ▶ Monitoring and automated recovery of a CCL process (a virtual CCU)
  - Restart in-place
  - Restart in other Linux instance
- ▶ Monitoring and automated actions to CCL event messages that in a real IBM 3745/46 environment went to the MOSS console
  - Messages can be consolidated to central message automation point, such as NetView on z/OS
- ▶ The structuring of CCL, NDH, and the Linux device drivers provide for more detailed insight into the flow of data between the NCP and the real network adapters
  - NDH diagnostics commands
  - Trace details that are unique to this environment
- ▶ Close integration of Linux management, CCL management, and CCL NCP management can be done using Tivoli System Automation for Operations

## NTuneMon V3R2 example when used with a CCL/NCP

ATUSS E74SVT6 Summary Status CCU= 0% Storage= 2% NTuneMON V3R2 11:58									
GENERATION INFORMATION			3745 HARDWARE INFO				SNI INFORMATION		
07/08/2005 09:35:21			MICROCODE EC = CCLV1R2				SNI NETWORKS= 2		
3745-31A 16MB E74SVT6			FIX = 07-12-05				HSCBS IN USE= 2400 48%		
SA 74 S/N= 00000000			CDS Update= 10/07/2004				NATIVE NETID= NETE		
ACF SSP V4R8.1 MVS			3746 M900 INFORMATION				BUFFER POOL INFORMATION		
ACF NCP V7R8.1F CCU A							BUFFERS 1%		
564806300 SINGLE CCU							BPOOL 0%		
USAGE TIER = 5			S/N= 00666666				DYNPOOL 0%		
DISK LOADED NOT VTAM									
VR INFORMATION			VRTP NETWORK SUBAREA CUR MAX MIN RCVDQ XMTQ VR STATE						
ACTIVE/MAX= 6/103			0.2 NETE 8 17 255 15 1 0						
ALARM/WARN= 0/3			0.0 NETX 78 80 255 80 0 0						
USER ALARM= 100%			0.0 NETE 8 15 255 15 0 0						
TG INFORMATION			TGN NETWORK SUBAREA LOW MEDIUM HIGH TOTAL						
ACTIVE/MAX= 3/6									
ALARM/WARN= 0/0									
ALARM= 100% STOP= 40									
=>									
PF1=HELP 2=VRs 3=RETURN 4=SNI(HSCBS) 5=ADAPTERS 6=ROLL 8=CBPOOLS 9=NNTs									
ENTER=REFRESH 10=UTIL 11=ALT-PFKS 12=REFRESH SUMMARY PA1=EXIT PA2=LOG									



## CCL offers new and enhanced security options for the traditional SNA workload

- **IP-based security for IP-partner authentication and data flow encryption can be extended to the IP-based CCL connectivity options:**
  - ▶ XOT and DLSw flows into CCL can be protected using standard IP Security (IPSec/VPN)
    - Between CCL and the partner XOT or DLSw router in the IP network.
  - ▶ INN or SNI connectivity to partner CCL NCPs over IP-TG can be protected using SSH tunnelling or standard IPSec Security (IPSec/VPN)
    - IP-TG between business partners require a single TCP connection between the two partner CCL NCPs with configurable listening TCP port numbers and IP addresses, which simplifies firewall configuration significantly
- **SNA Session Level Encryption (SLE) continues to be an SNA-based security option**
  - ▶ SLE can be used at an SNA session level through a CCL NCP as before

## CCL performs better than an IBM 3745/46 ever did

- **Significantly higher transactional throughput than compared to a real IBM 3745/46 environment**
- **Consistent low response times even at high throughput rates**
- **From a CPU workload perspective, it is possible to consolidate up to five 70% utilized IBM 3745 31A NCPs onto a single System z9 IFL engine:**
  - ▶ In one Linux image with five CCL engines
  - ▶ In five Linux images, each with one CCL engine
- **Based on the better performance, it may be possible to consolidate multiple NCPs into fewer NCPs**
  - ▶ Keep in mind that an NCP remains limited to 16 Mbyte of memory, which is an architectural limitation in the IBM 3745 instruction set
  - ▶ Consolidating more NCPs into fewer NCPs may result in buffer shortages in the NCP
- **CCL can use today's high-speed LAN technologies**
  - ▶ Up to 10 Gbps for SNA traffic
  - ▶ No longer limited to the 16 Mbps speed of token-ring LANs

# System Requirements and Reference Information

# CCL requirement for System z hardware

## ➤ Processor support

- ▶ G5/G6, z800/z900, z890/z990, or System z9

## ➤ CP requirements (can be IFL engines on zSeries and System z9)

- ▶ Depends on workload and connectivity options

## ➤ OSA port requirement

- ▶ Copper-based ports for SNA LLC2 (LCS) - can be used on all hardware levels
- ▶ Fiber optic or copper ports for SNA LLC2 (QDIO layer-2) - z890, z990, System z9 only
- ▶ Fiber optic or copper ports for SNA over IP such as IP-TG, XOT, or DLSw (QDIO layer-3, QDIO layer-2, or LCS)
- ▶ OSN port for CDLC connectivity - System z9 only

## ➤ Memory requirements

- ▶ Memory per CCL engine: 20 MB
- ▶ Usual memory requirements for Linux on zSeries
  - Memory: 256 - 512 MB memory (depending on distribution, packages, and kernel level)

## ➤ DASD requirements

- ▶ DASD for CCL and InstallShield code = 65 MB
- ▶ DASD for Linux kernel source = 300 MB
- ▶ DASD for CCL traces, dumps, logs, NCP load modules = 80-100 MB per CCL Engine instance
- ▶ Usual DASD requirements for Linux on zSeries
  - Approximate DASD space equivalent to two 3390-3 DASD volumes
    - Use the Linux Logical Volume Manager (LVM) to group the volumes together

## CCL requirements for Linux on System z

### ➤ **Minimum Linux requirements for CCL V1.2.1**

- ▶ SUSE LINUX Enterprise Server 8 for IBM zSeries and IBM S/390 (SLES8), kernel 2.4.21
  - Minimum level supported: Service Pack 4 (SLES8 + SP4)
  - **Note:** A Linux kernel level 2.4 does not support CDLC and QDIO layer 2 connectivity.
- ▶ SUSE LINUX Enterprise Server 9 for IBM zSeries and IBM S/390 (SLES9), kernel 2.6.5
  - Minimum level supported: Service Pack 1 (SLES9 + SP1)
  - Service Pack 3 (SLES9 + SP3) includes QDIO layer 2 and CDLC support (***The recommended level***)
- ▶ Red Hat Enterprise Linux AS 4 (RHEL4), kernel 2.6.9
  - Minimum level supported: Update 1 (RHEL4 + Update1)
  - Update 3 (RHEL4 + Update 3) includes QDIO layer 2 and CDLC support (***The recommended level***)
- ▶ Both 31-bit and 64-bit distributions are supported

### ➤ **Minimum Linux requirements for CCL V1.2.1 communication via QDIO layer 2 and CDLC**

- ▶ A Linux kernel level 2.6 is required
  - SUSE SLES 9 Service Pack 3 (SLES9 + SP3)
  - Red Hat AS 4 Update 3 (RHEL4 + Update 3)
- ▶ Processors:
  - For QDIO layer 2: IBM System z9 or IBM eServer zSeries z890, z990
  - For CDLC: IBM System z9

### ➤ **For availability of further distributions supporting CCL V1.2.1 functions and specific package requirements on top of available distributions refer to:**

- ▶ <http://www.ibm.com/software/network/ccl>



# CCL is not a complete replacement for the IBM 3745/46 Communication Controller

CCL Functional Overview Matrix	CCL V1.2.1 supports	CCL V1.2.1 support of serial lines via an aggregation layer router	CCL V1.2.1 does not support
<b>Software</b>	<p>NCP (V7R5 and above) and compatible levels of NRF</p> <p>SSP, NTuneMON, NetView, and NPM continue to work as they have in the past</p> <p>NCP Packet Switching Interface (NPSI)</p>		<p>Other IBM 3745 software products: XI/NSF, EP, NTO, NSI, MERVA, and TPNS</p> <p>Functions provided by the IBM 3746 MAE or NNP (most of these functions can be migrated to CS Linux on System z)</p> <p>NCP-based IP routing (migrate to standard Linux-based IP routing)</p>
<b>Physical network interfaces</b>	<p>SNA LLC2 (LAN) access to OSA token-ring and Ethernet LAN</p> <p>NCP TIC2 or TIC3 LAN interfaces via OSA LCS or OSA QETH (QDIO layer-2)</p> <p>CDLC channel connectivity through shared OSA-E2 on System z9</p> <p>IP-TG for direct IP connectivity between two CCL NCPs</p> <p>XOT for x.25 connectivity</p> <p>DLSw for DLSw termination in Linux for System z</p>	<p>SDLC, Frame Relay, X.25 QLLC, and ISDN serial line interfaces are not supported directly by CCL, but are supported via an aggregation layer router</p> <p>X.25 circuits are not supported directly by CCL, but are via an aggregation layer router that uses the XOT protocol to transport the X.25 packets to/from NPSI running in CCL</p>	<p>BSC, ALC, Start/Stop</p>

## Contact information for CCL

### ➤ CCL on the Web:

- ▶ CCL home page: <http://www.ibm.com/software/network/ccl>
- ▶ CCL news group: <news://news.software.ibm.com/ibm.software.linux.ccl>

### ➤ For more information, contact:

- ▶ EMEA: Peter Redman - [Peter\\_Redman@uk.ibm.com](mailto:Peter_Redman@uk.ibm.com)
- ▶ North America: Erika Lewis - [erika@us.ibm.com](mailto:erika@us.ibm.com)
- ▶ Latin America: Suvas Shah - [suvas@us.ibm.com](mailto:suvas@us.ibm.com)
- ▶ AP: Chuck Gardiner - [cgardine@us.ibm.com](mailto:cgardine@us.ibm.com)



### ➤ For planning and installation services, contact:

- ▶ Heather Johnson in IBM SWG Application and Integration Middleware Software e-Server Services - [hjd@us.ibm.com](mailto:hjd@us.ibm.com)

### ➤ For technical assistance in the Americas, IBMers can submit a TechExpress through [w3.ibm.com](http://w3.ibm.com) or a question through WWQ&A

For further technical assistance:

#### US:

- ▶ Access installation and technical support information via the WWQA database
  - IBMers can access via the WWQA database via QASearch on <http://w3.viewblue.ibm.com>
  - Customers can access installation and technical support information from IBMLink/ServiceLink.
- ▶ Please research questions through all available resources before submitting a question to the Q&A database.

#### EMEA

- ▶ Techline and local Field Technical Support Specialists provide technical pre-sales assistance. Additional technical support is available through worldwide Question & Answer (WWQA), QASearch function on ViewBlue or EHONE. For some brands/products, authoring of questions is only available via Techline.

# Important CCL configuration samples

## ➤ Go to the CCL home page:

- ▶ <http://www.ibm.com/software/network/ccl>



And click this link down here at the bottom of the page.

# Configurations for a number of CCL connectivity samples

The screenshot shows a Mozilla Firefox browser window displaying IBM search results for 'cclconfigs sample'. The search results are listed in a table with columns for item number, title, description, and modified date. The results are numbered 1 through 7.

Item	Configuration sample	Modified date
[1]	<a href="#">Configuration sample for Ethernet INN using Cisco DLSw</a> Sample configuration for ethernet connections using Communication Controller for Linux on zSeries (CCL). [ More items like this found in <a href="#">Enterprise Connectivity</a> ] [ This item's topic: Configuration ]	2006-06-20
[2]	<a href="#">Configuration sample for Token Ring INN using Cisco DLSw</a> Sample configuration for token ring connections using Communication Controller for Linux on zSeries (CCL). [ More items like this found in <a href="#">Enterprise Connectivity</a> ] [ This item's topic: Configuration ]	2006-06-20
[3]	<a href="#">Configuration sample for Ethernet BNN using Cisco DLSw</a> Sample configuration for ethernet connections using Communication Controller for Linux on zSeries (CCL). [ More items like this found in <a href="#">Enterprise Connectivity</a> ] [ This item's topic: Configuration ]	2006-06-20
[4]	<a href="#">Configuration sample for SDLC INN Using Cisco DLSw</a> Sample configuration for SDLC INN connections using Communication Controller for Linux on zSeries (CCL). [ More items like this found in <a href="#">Enterprise Connectivity</a> ] [ This item's topic: Configuration ]	2006-06-20
[5]	<a href="#">Configuration sample for QLLC BNN using Cisco DLSw</a> Sample configuration for QLLC connections using Communication Controller for Linux on zSeries (CCL). [ More items like this found in <a href="#">Enterprise Connectivity</a> ] [ This item's topic: Configuration ]	2006-06-20
[6]	<a href="#">Configuration sample for Token Ring to Ethernet BNN using Cisco DLSw</a> Sample configuration for converting Token Ring BNN to Ethernet using Communication Controller for Linux on zSeries (CCL). [ More items like this found in <a href="#">Enterprise Connectivity</a> ] [ This item's topic: Configuration ]	2006-06-20
[7]	<a href="#">Configuration sample for SDLC BNN using Cisco DLSw</a>	2006-03-13

On the left side of the browser window, there is a sidebar with the following sections:

- Feedback**
- Select language** (dropdown menu)
- Translate** (button)
- Related software**
  - Communications Server
  - z/OS Communications Server
  - Network Control Program
- Related hardware**
  - e(logo)server zSeries
  - IBM Communication Controllers
- Related solutions**
- Related services**

## CCL release summary

### ➤ **CCL V1R1 (initial release) - March 2005**

- ▶ CCL NCP V7R5+, NRF, and MOSS console support
  - NCP SNI/INN support
  - NCP boundary function support
- ▶ OSA LCS SNA LLC2 connectivity - NCP TIC2 LINE addresses only
  - Copper based cabling
  - LAN speeds up to 1000 Megabit (1000BASE-T Ethernet)

### ➤ **CCL V1R1+ (APAR number LI70826) - August 2005**

- ▶ CCL emulator performance improvements

### ➤ **CCL V1R2 - November 2005**

- ▶ CCL support for NPSI
  - Connectivity to NPSI via XOT protocol handler from Eicon
- ▶ OSA QETH QDIO Layer-2 mode support
  - Fiber based cabling
  - LAN speeds up to 10 Gigabit
- ▶ CDLC connectivity on System z9 over shared OSA-E2 in OSA for NCP mode
- ▶ IP Transmission group for INN/SNI connectivity to partner CCL NCP
- ▶ Additional CCL emulator performance improvements

### ➤ **CCL V1.2.1 - May 2006**

- ▶ Imbedded DLSw support
- ▶ Native LAN support - TIC3 adapters and NCP TIC3 LINE addresses
- ▶ Local IP address control for IP-TG connections



## For more information....



URL	Content
<a href="http://www.ibm.com/servers/eserver/zseries">http://www.ibm.com/servers/eserver/zseries</a>	IBM eServer zSeries Mainframe Servers
<a href="http://www.ibm.com/servers/eserver/zseries/networking">http://www.ibm.com/servers/eserver/zseries/networking</a>	Networking: IBM zSeries Servers
<a href="http://www.ibm.com/servers/eserver/zseries/networking/technology.html">http://www.ibm.com/servers/eserver/zseries/networking/technology.html</a>	IBM Enterprise Servers: Networking Technologies
<a href="http://www.ibm.com/software/network/commserver">http://www.ibm.com/software/network/commserver</a>	Communications Server product overview
<a href="http://www.ibm.com/software/network/commserver/zos/">http://www.ibm.com/software/network/commserver/zos/</a>	z/OS Communications Server
<a href="http://www.ibm.com/software/network/commserver/z_lin/">http://www.ibm.com/software/network/commserver/z_lin/</a>	Communications Server for Linux on zSeries
<a href="http://www.ibm.com/software/network/ccl">http://www.ibm.com/software/network/ccl</a>	Communication Controller for Linux on zSeries
<a href="http://www.ibm.com/software/network/commserver/library">http://www.ibm.com/software/network/commserver/library</a>	Communications Server products - white papers, product documentation, etc.
<a href="http://www.redbooks.ibm.com">http://www.redbooks.ibm.com</a>	ITSO Redbooks
<a href="http://www.ibm.com/software/network/commserver/support">http://www.ibm.com/software/network/commserver/support</a>	Communications Server technical Support
<a href="http://www.ibm.com/support/techdocs/">http://www.ibm.com/support/techdocs/</a>	Technical support documentation (techdocs, flashes, presentations, white papers, etc.)
<a href="http://www.rfc-editor.org/rfcsearch.html">http://www.rfc-editor.org/rfcsearch.html</a>	Request For Comments (RFC)