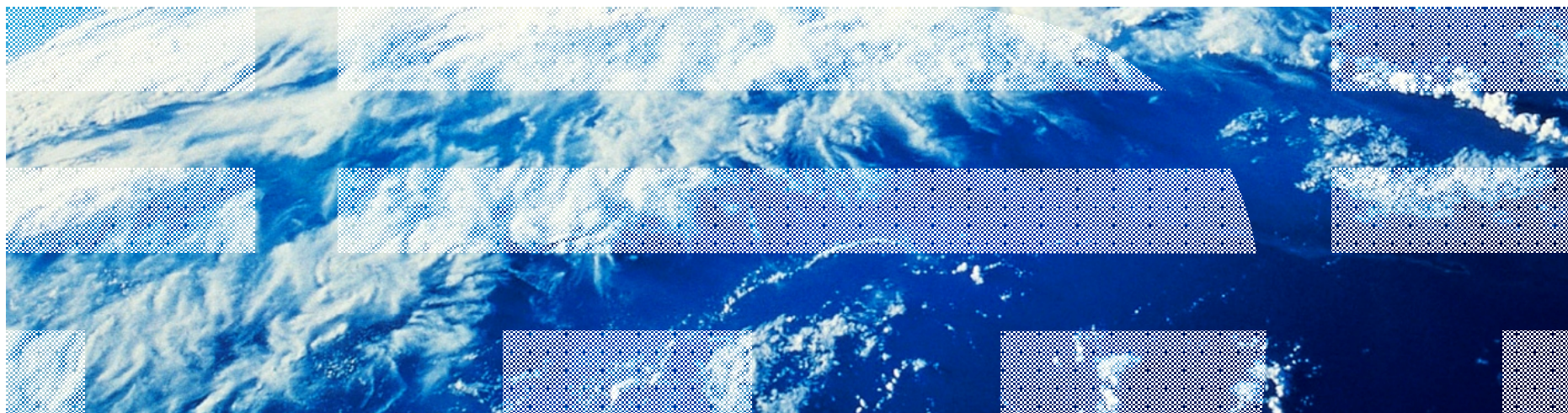


# z/VSE Fast Path to Linux on System z

Ingo Franzki, IBM



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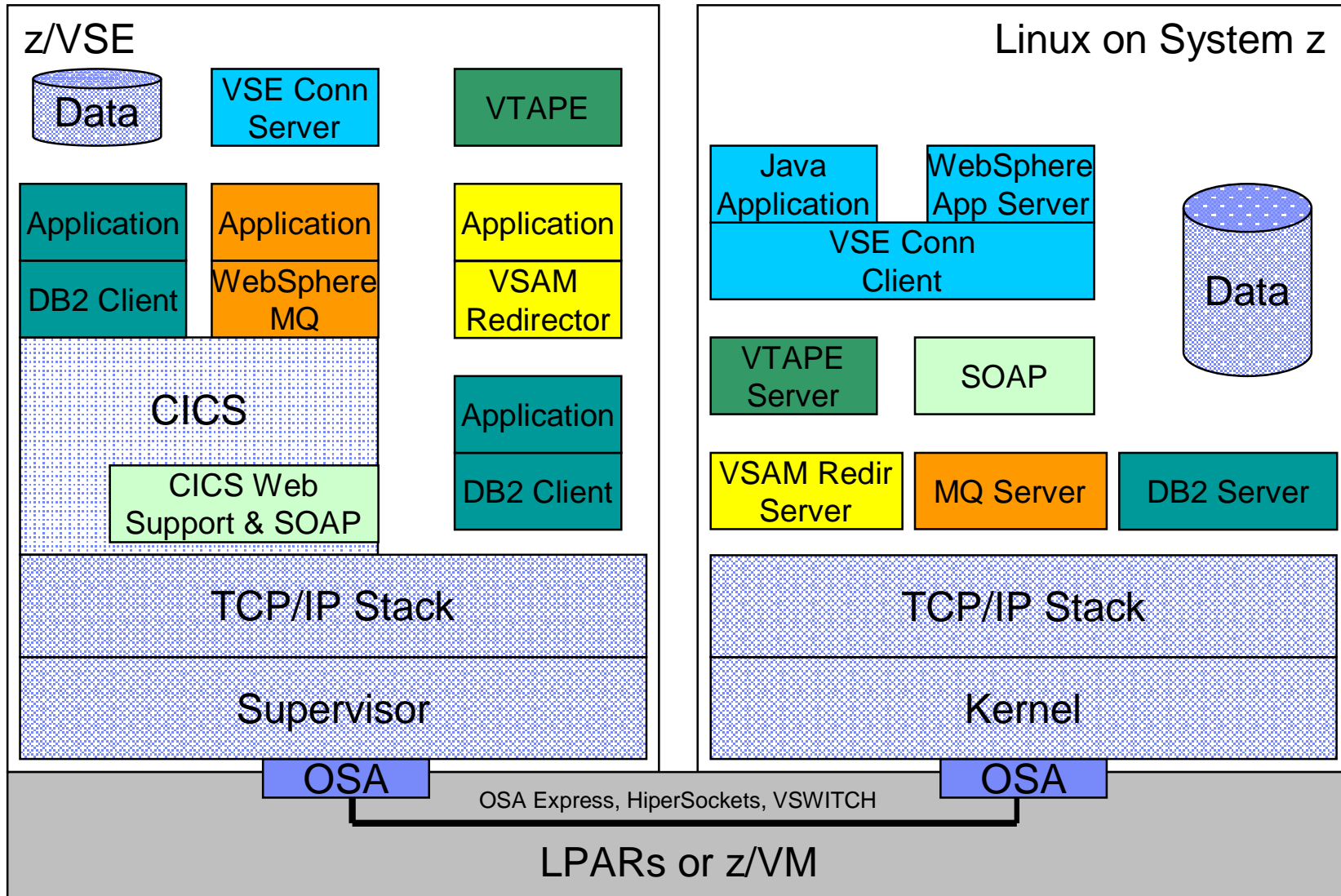
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## z/VSE Applications communicating with Applications on Linux



## z/VSE Applications communicating with Applications on Linux

### § Communication is mostly based on TCP/IP

- Although z/VSE and Linux run on the same box

### § TCP/IP

- Allow reliable communication over a non-reliable network
- Uses sequence numbers, acknowledges, checksums
  - To protect against packet loss, duplicate packets, packet sequence errors, damaged or incomplete packets, etc.

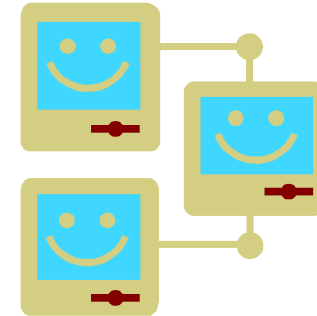
à Time consuming processing

### § When z/VSE and Linux run side by side on the same box

- Why do we need all this expensive processing in this case?
- There should be a more direct communication method !

à **z/VSE Fast Path to Linux on System z**

(for short: Linux Fast Path or just LFP)



## Fast Path to Linux on System z (LFP)

### è Linux Fast Path in a z/VM environment

- Both z/VSE and Linux on System z run as z/VM Guests in the same z/VM-mode LPAR on IBM z10, z114 or z196 servers
- Uses an IUCV connection between z/VSE and Linux

### è Linux Fast Path in an LPAR environment

- Both z/VSE and Linux on System z run in their own LPARs on a zEnterprise server
- A HiperSockets connection is used between z/VSE and Linux on System z
- LFP requires the HiperSockets Completion Queue function that is available with a zEnterprise server (z196, z114)



### § The fast path to Linux on System z provides standard TCP/IP socket APIs for programs running on z/VSE

- Other than the basic socket API, no other tools are provided
- Since z/VSE V5.1: LFP supports IPv6



### § Allows selected TCP/IP applications to communicate with the TCP/IP stack on Linux without using a TCP/IP stack on z/VSE

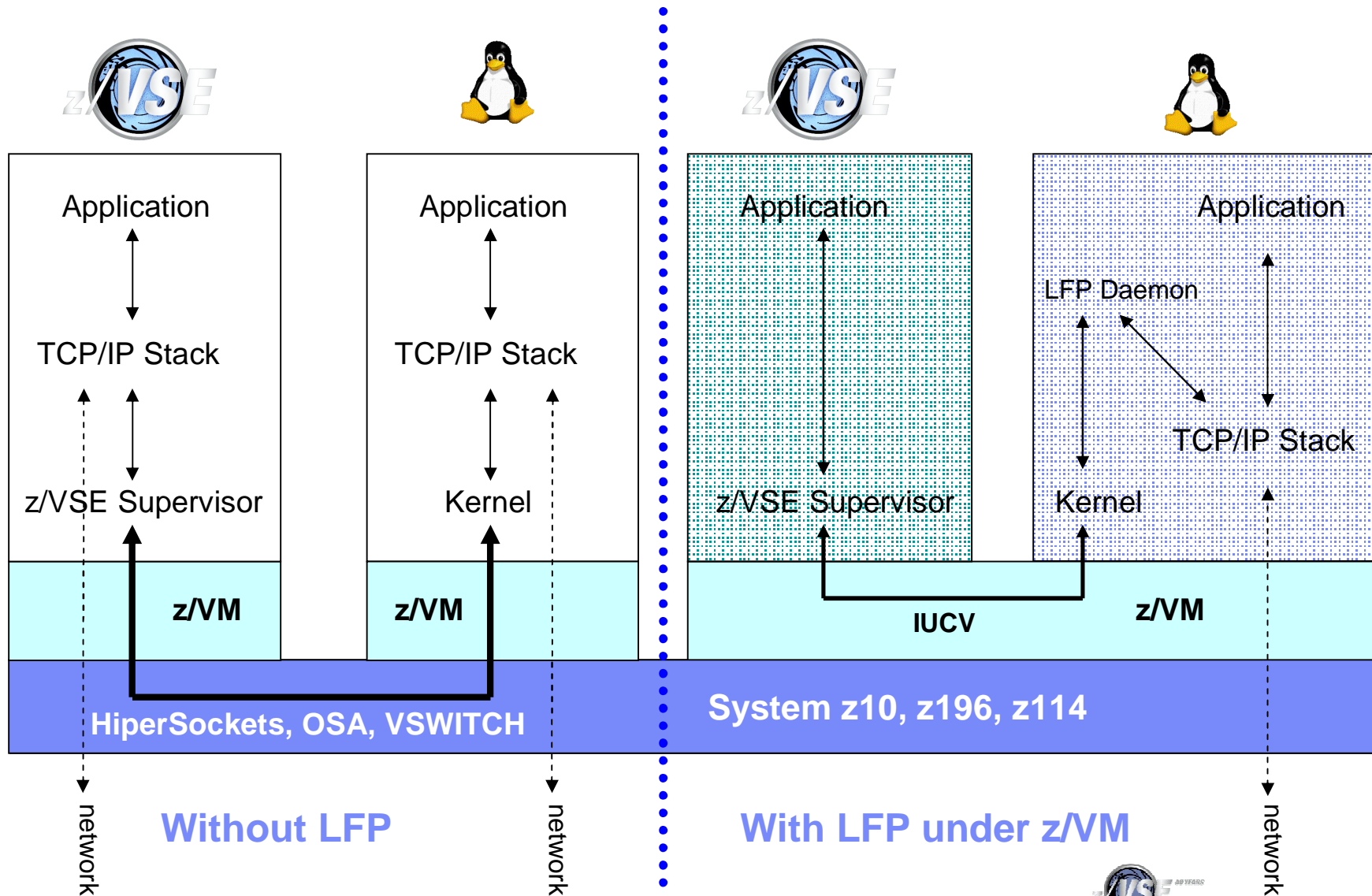
- All socket requests are transparently forwarded to a Linux on System z system

### § Possible performance increase due to:

- Less overhead for TCP/IP processing on z/VSE (TCP, sequence numbers and acknowledging, checksums, resends, etc)
- More reliable communication method (IUCV) compared to HiperSockets, which is a network device, with all its packet drops, resends, etc.

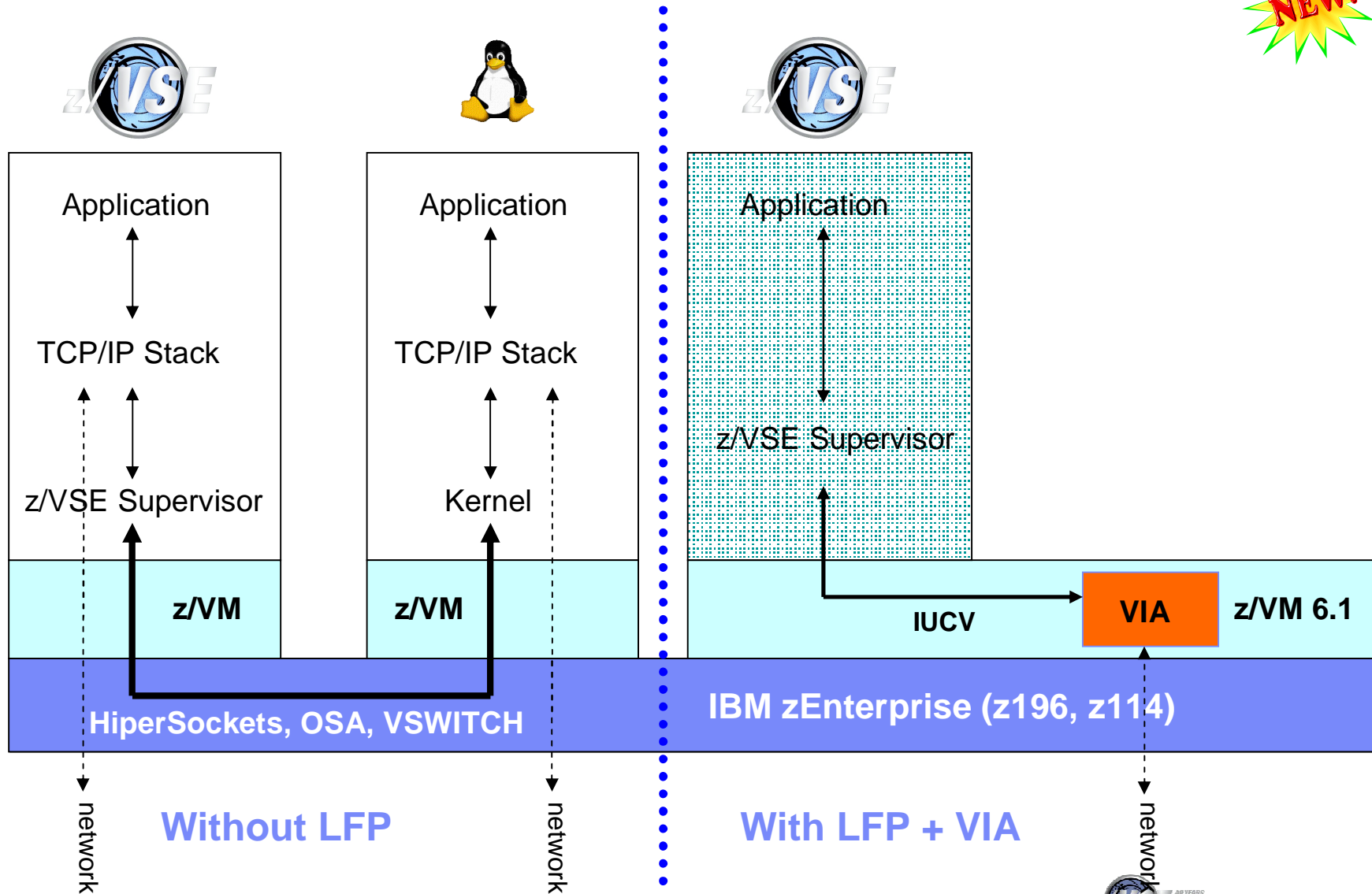
# Linux Fast Path in a z/VM environment (z/VSE 4.3 or later)

*Faster communication between z/VSE and Linux applications*



# New: z/VSE z/VM IP Assist (VIA) (z/VSE 5.1 + z/VM 6.1)

With z/VM IP Assist (VIA), no Linux is needed to utilize the LFP advantage



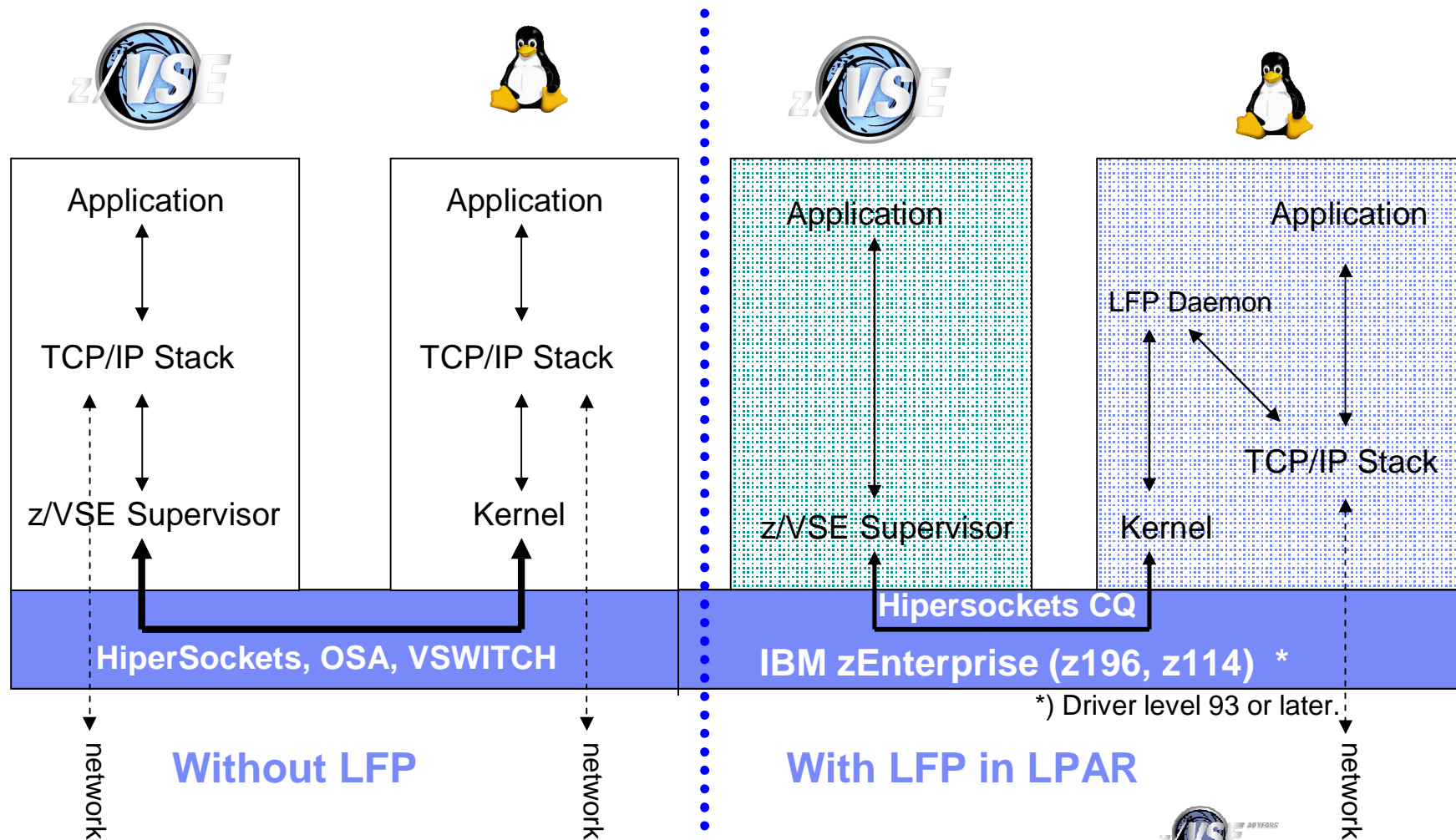


# New: Linux Fast Path in an LPAR environment (z/VSE 5.1 + PTFs)

*Faster communication between z/VSE and Linux applications*



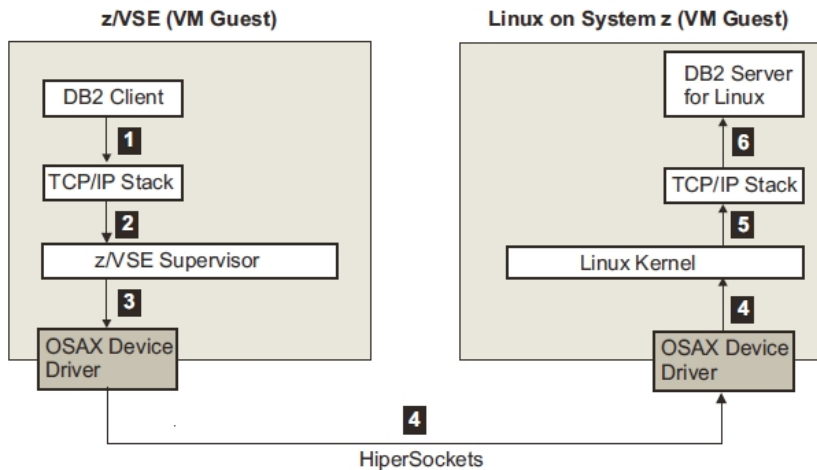
à Exploits the HiperSockets Completion-Queue support of IBM zEnterprise (z196, z114)



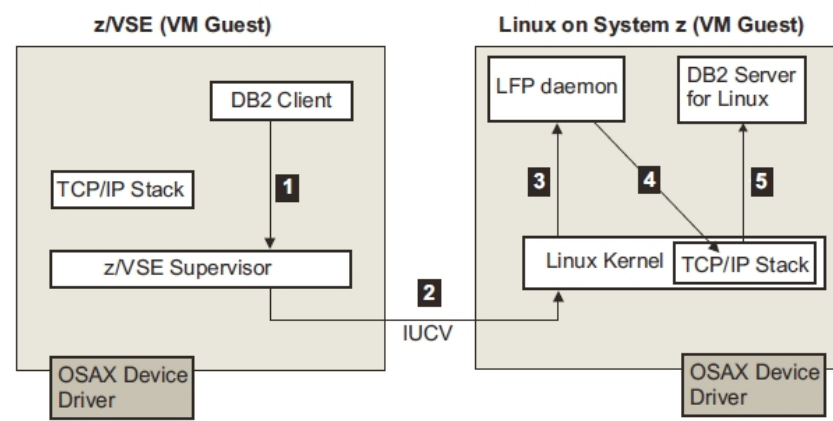


# Communication flows when using Linux Fast Path

Using a TCP/IP stack (CSI/BSI):



Using Linux Fast Path in a z/VM environment:



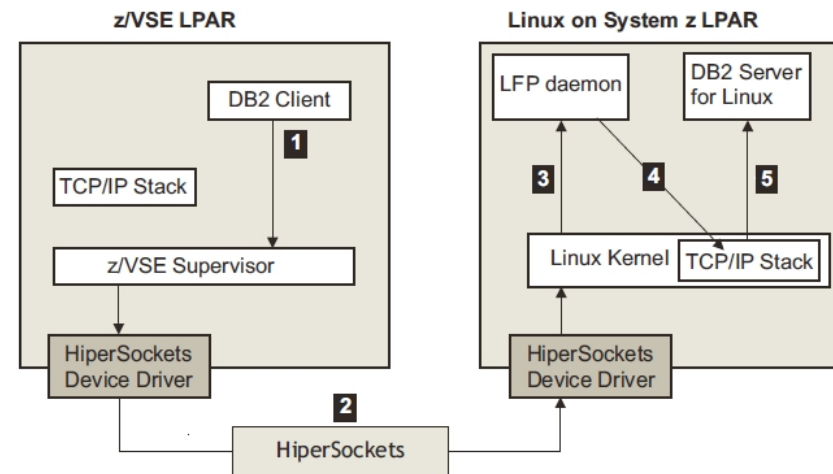
§ **Less overhead for TCP/IP processing on z/VSE**

- Building of IP and TCP packets
- Sequence numbers and acknowledging
- Checksums
- Retransmission of lost packets

§ **More reliable communication method compared to a traditional network device**

- IUCV is a reliable communication method (z/VM)
- HiperSockets Completion Queue support allows to build a reliable communication path (LPAR)

Using Linux Fast Path in an LPAR environment:



## Prerequisites for using the Linux Fast Path

In a **z/VM environment**:

§ Any IBM System z server supported by z/VSE

§ Any supported z/VM version/release

§ The use of a **z/VM-mode LPAR** is recommended

– z/VM-Mode LPAR is only available on **z10** or later and **z/VM 5.4** or later

§ **z/VSE 4.3** or later

§ **One of these Linux on System z operating systems:**

- SUSE Linux Enterprise Server 10 Service Pack 3 together with security update kernel 2.6.16.60-0.57.1
- SUSE Linux Enterprise Server 11 Service Pack 1
- Red Hat Enterprise Linux 5 Update 5
- Red Hat Enterprise Linux 6



§ **z/VSE and Linux on System z are configured as z/VM guests within the same LPAR**

§ The **IUCV** (“Inter-User Communication Vehicle”) is configured and enabled in both **z/VM guests (z/VSE and Linux on System z)**

## Prerequisites for using the Linux Fast Path

In an **LPAR environment**:

§ **A zEnterprise server (z196 or z114) at driver level 93 or later**

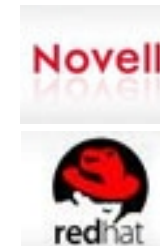
- LFP requires the HiperSockets Completion Queue function, which is only available with a zEnterprise server



§ **z/VSE 5.1 + PTFs**

§ **One of these Linux on System z operating systems:**

- SUSE Linux Enterprise Server 11 Service Pack 2
- Red Hat: IBM is working with its Linux distribution partners to include support in future Linux on System z distribution releases



§ **z/VSE and Linux on System z both run in LPAR mode**

§ **A HiperSockets Connection between z/VSE and Linux systems**

## Preparing the system for Linux Fast Path in z/VM environment

### § Preparing the LPAR

- For use with [LFP in z/VM environment](#), the Linux on System z and z/VSE must run under [the same z/VM system](#)
- The use of a [z/VM Mode-LPAR](#) is recommended
  - Allows you to mix CPs and IFL in one z/VM Installation
  - Linux runs on IFLs
  - z/VSE runs on CPs
- Change the LPAR Mode to z/VM-Mode and add the IFLs to it



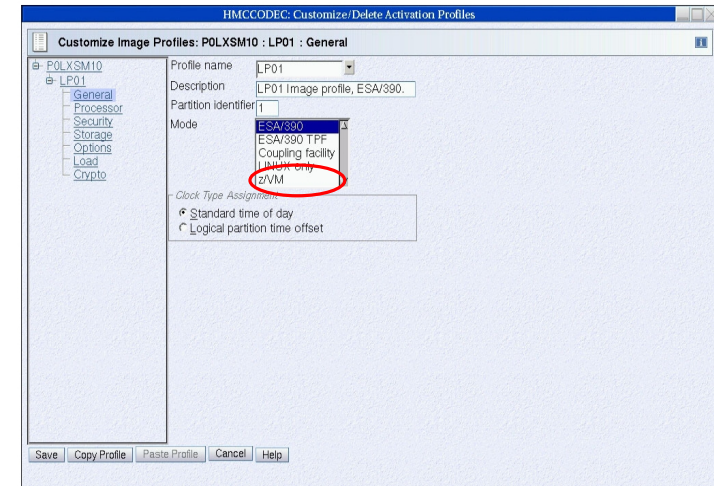
### § Preparing z/VM

- LFP uses IUCV as the underlying communication vehicle. Therefore the z/VSE and the Linux on System z guests on the z/VM system need to be configured for IUCV.
- The following z/VM parameters for the guest systems are relevant:
  - IUCV ALLOW
  - IUCV ANY
  - IUCV MSGLIMIT
  - OPTION MAXCONN *maxno*
- For details about the parameters check the z/VM documentation.

## z/VM-Mode LPAR

### LPAR Modes on z10 and later:

| Logical partition mode | PU type                              | Operating systems  | PUs usage  |
|------------------------|--------------------------------------|--|--|
| ESA/390                | CPs                                  | z/Architecture operating systems<br>ESA/390 operating systems<br>Linux | CPs DED <i>or</i> CPs SHR  |
|                        | CPs <i>and</i> zAAPs <i>or</i> zIIPs | z/OS<br>z/VM (V5.3 and later, for guest exploitation)                  | CPs DED <i>and</i> zAAPs DED, <i>and/or</i> zIIPs DED <i>or</i> CPs SHR <i>and</i> zAAPs SHR <i>and/or</i> zIIPs SHR |
| ESA/390 TPF            | CPs                                  | TPF<br>z/TPF   | CPs DED <i>or</i> CPs SHR  |
| Coupling facility      | ICFs <i>or</i> CPs                   | CFCC   | ICFs DED <i>or</i> ICFs SHR, <i>or</i> CPs DED <i>or</i> CPs SHR   |
| Linux only             | IFLs <i>or</i> CPs                   | Linux<br>z/VM  | IFLs DED <i>or</i> IFLs SHR, <i>or</i> CPs DED <i>or</i> CPs SHR   |
| z/VM                   | CPs, IFLs, zAAPs, zIIPs, ICFs        | z/VM V5.4 or later   | All PUs must be either SHR <i>or</i> DED   |



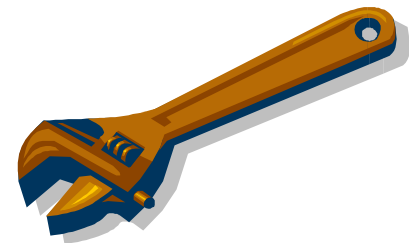
## Preparing to use Linux Fast Path

### § Preparing Linux on System z

- Download and install the LFP Daemon
  - Part of the “z/VSE Connector Workstation Code” component 5686-CF8-38 / 51P
  - Member IJBLFPLX.W from PRD2.PROD or download from Internet
  - This ZIP file contains an RPM (RPM Package Manager) that can be used to install the LFPD
- Configure one or multiple LFPD Instances
  - Textual configuration files in /etc/opt/ibm/vselfpd/confs-available and /etc/opt/ibm/vselfpd/confs-enabled
- It is recommended to use [separate \(virtual\) network adapters or at least separate IP addresses](#) for each LFPD Instance (give each VSE its own IP address)
- Start LFP daemon using lfpd-ctl or automatically at boot via init.d start script

### § Preparing z/VSE

- The LFP code is part of the z/VSE system, no installation step needed
- Start and configure an LFP Instance
  - Textual configuration statements in LIBR member or SYSIPT of start job
  - LFP Instance operation via IJBLFPOP tool
- LFP does not require a partition to run
- Every LFP Instance is identified by a 2 digit number (System ID)
  - Same concept as used by TCP/IP stacks



## Sample configuration on z/VSE



### For LFP in z/VM Environment:

```

* $$ JOB JNM=LFPSTART,CLASS=0,DISP=L
// JOB LFPSTART
// EXEC IJBLFPOP,PARM='START DD:SYSIPT LOGALL'
ID = 01
MTU = 8192
IucvMsgLimit = 1024
InitialBufferSpace = 512K
MaxBufferSpace = 4M
IucvSrcAppName = TESTV
IucvDestAppName = LINR02
IucvDestVMId = LINLFP
WindowSize = 65535
WindowThreshold = 25
/*
/&
* $$ EOJ

```

IJBLFPOP will read  
input from SYSIPT

IUCV Name of LFP  
on z/VSE

IUCV Name of LFPD  
on Linux

Guest name where  
Linux runs

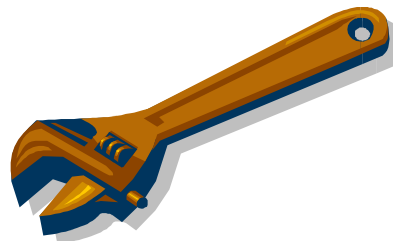


## z/VSE Skeletons for use with LFP



§ The following skeletons are available in ICCF library 59 for use with LFP:

| Skeleton  | Description   |
|-----------|---|
| SKLFPSTA  | Start an LFP Instance   |
| SKLFPSTO  | Stop an LFP Instance  |
| SKLFPPLST | List all active LFP Instances   |
| SKLFPINF  | Query information about an active LFP Instance  |
| SKLFPACT  | Contains control statements to activate LFP you may need to include into the JCL of your applications |



## Operating an Linux Fast Path on z/VSE



### § List active LFP Instances

```
- // EXEC IJBLFPOP,PARM='LIST'
- LFPB025I ACTIVE LFP INSTANCES: 1
          INSTANCE 01 HAS 3 ACTIVE TASKS
LFPB026I END OF ACTIVE LFP INSTANCES LIST
```

### § Display information about an active instance

```
- // EXEC IJBLFPOP,PARM='INFO <INSTID> [SHOWTASKS] [LOGALL]'
```

```
- LFPB023I INFO ABOUT LFP INSTANCE '01':
  *** INSTANCE ***
  STATUS ..... : UP
  WINDOW SIZE ..... : 65,535
  ...
  *** DEVICE ***
  DEVICE STATUS ..... : ACTIVE
  PACKETS WAITING FOR MSG COMPLETE : 0
  MAXIMUM PACKETS USED ..... : 37
  ...
  *** TASKS ***
  ACTIVE TASK COUNT ..... : 3
  -- TASK #1 --
  TASK ID (PARTITION ID)..... : 2E (Z1)
  SOCKET COUNT ..... : 1
  L2 SOCKET LIST COUNT ..... : 1
  ...
LFPB024I END OF INFO ABOUT LFP INSTANCE '01'.
```

## Sample configuration on Linux on System z

### lfpd-LINR02.conf:

```
# lfpd configuration file
IUCV_SRC_APPNAME = LINR02
# ensure that only TESTV from VSER05 can connect
PEER_IUCV_VMID = VSER05
PEER_IUCV_APPNAME = TESTV
IUCV_MSGLIMIT = 1024
MTU_SIZE = 8192
MAX_SOCKETS = 1024
INITIAL_IO_BUFS = 128
WINDOW_SIZE = 65535
WINDOW_THRESHOLD = 25
VSE_CODEPAGE = EBCDIC-US
VSE_HOSTID = 10.0.0.1
RESTRICT_TO_HOSTID = yes
LOG_INFO_MSG = no
```

IUCV Name of LFPD  
on Linux

Guest name where  
z/VSE runs

IUCV Name of LFP  
on z/VSE

This is the IP address  
VSE will appear under



**Note:** The configuration file must be named “lfpd-XXX”, where XXX is the IUCV\_SRC\_APPNAME specified in the configuration file!  
The XXX characters in the filename must be specified in uppercase !

## Operating an Linux Fast Path on Linux on System z



### § Display LFP daemon status

```
- lfpd-admin <--iucv_appname|-i appname> <--status|-s>
```

```
Status:
```

```
-----
z/VSE instance is connected.
Peer VM ID ..... : VSER05
Peer IUCV Appl. name : TESTV
Applied host id .... : 10.0.0.1
Applied host name .. : linlfp
Allocated I/O buffers ..... : 128
...
Number of active z/VSE tasks : 1
Number of active sockets : 1
```

```
Trace Status:
```

```
-----
Running in daemon mode
No trace is running
```

```
Configuration:
```

```
-----
LOCAL_IUCV_APPNAME = LINR02
PEER_IUCV_VMID = VSER05
PEER_IUCV_APPNAME = TESTV
MAX_VSE_TASKS = 512
MTU_SIZE = 8192
MAX_SOCKETS = 1024
INITIAL_IO_BUFS = 128
WINDOW_SIZE = 65536
WINDOW_THRESHOLD = 25% (16384 bytes)
...
-----
```

## Socket API Support of Linux Fast Path

### § Linux Fast Path supports the following Socket APIs

- LE/C Socket API
- EZA SOCKET and EZASMI
- CSI's SOCKET Macro (limited support)



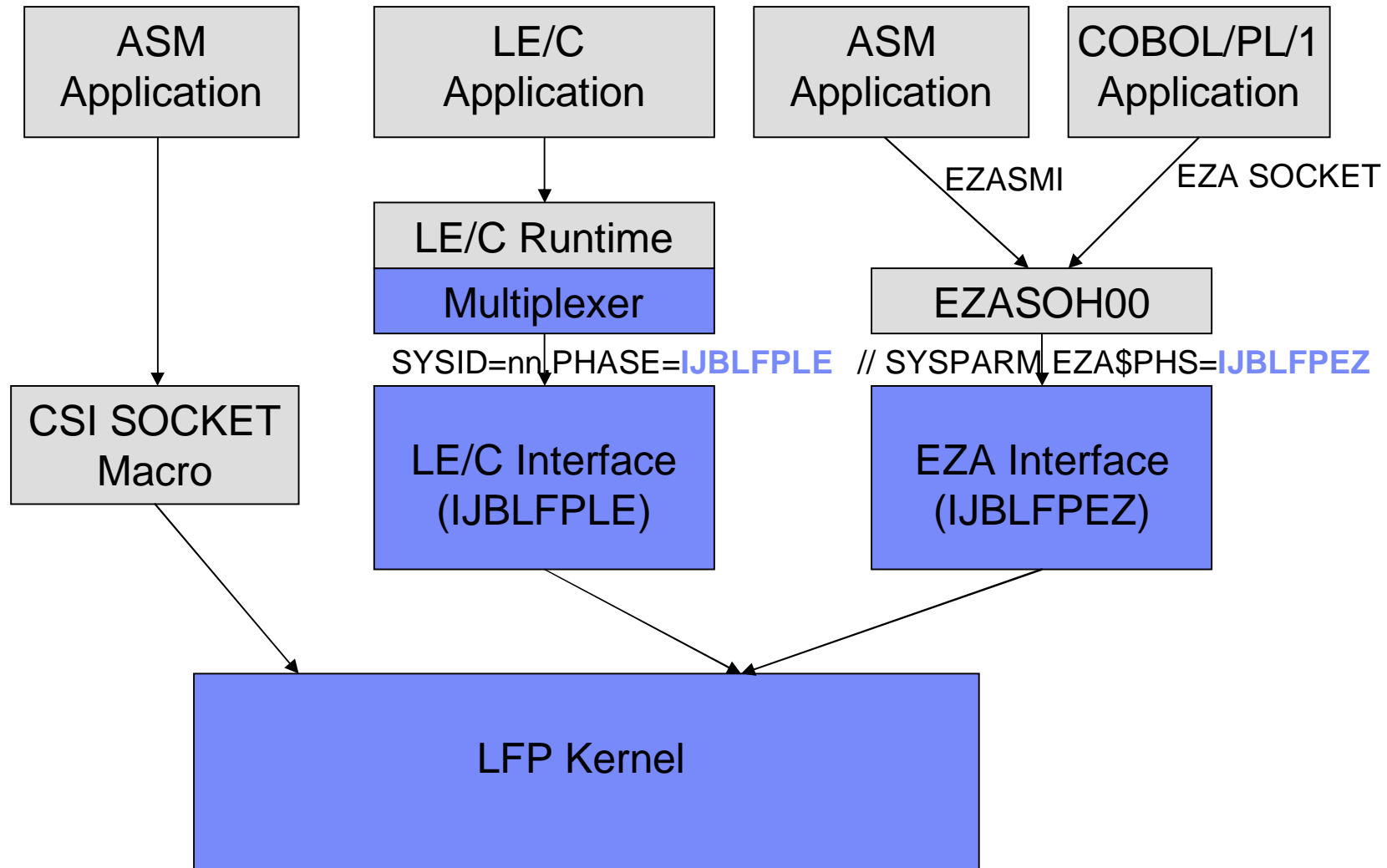
### § LE/C Socket API considerations

- The LE/C interface phase for LFP is shipped as IJBLFPLE.PHASE in IJSYSRS.SYSLIB
- You must configure the [LE/C TCP/IP Socket API Multiplexer](#) to use the LFP LE/C TCP/IP interface phase IJBLFPLE for the IDs of all LFP instances that are running
- To configure the multiplexer, use skeleton EDCTCPMC in ICCF library 62
- You can add entries for all your LFP instances with the following statement:
  - EDCTCPME SYSID='01',PHASE='IJBLFPLE'

### § EZA SOCKET and EZASMI considerations

- With the EZA socket and EZASMI interfaces you can specify which interface module is to be used
- For LFP, you must use the EZA interface module IJBLFPEZ
- You must set the JCL parameter “EZA\$PHA” in all your jobs that you want to use LFP
- To do so use the following statement in your jobs:
  - `// SETPARM [SYSTEM] EZA$PHA=IJBLFPEZ`
- If you are using the EZA SOCKET or EZASMI interface under CICS, you need to activate the EZA 'TASK-RELATED-USER-EXIT' (TRUE)

# Socket API Support of Linux Fast Path



## LE/C Socket API Multiplexer

### § Different Stacks use different Interface routines

- TCP/IP for VSE (CSI/IBM):           \$EDTCPV
- Linux Fast Path:                    IJBLFPLE
- IPv6/VSE (BSI/IBM):                BSTTTCP6

### § Avoid complicated setup using specific LIBDEFs for different stacks

### § Interface phase is selected by System ID

### § Use skeleton EDCTCPMC in ICCF library 62

```
// EXEC ASMA90,SIZE=(ASMA90,64K),PARM='EXIT(LIBEXIT(EDECKXIT)),SIZE(MAXC
-200K,ABOVE)'
EDCTCPMC CSECT
EDCTCPMC AMODE ANY
EDCTCPMC RMODE ANY
*
EDCTCPME SYSID='00',PHASE='$EDTCPV'
EDCTCPME SYSID='01',PHASE='IJBLFPLE'
EDCTCPME SYSID='02',PHASE='BSTTTCP6'
*
END
/*
```





## Specifying the System ID (Instance ID)

§ Using the System ID, you specify which Stack or LFP Instance an application will use

§ The following table shows how to specify instance IDs and where they can be applied

– The settings are checked from top to bottom as listed in the table

|                                      | LE/C Socket API | EZA SOCKET and<br>EZASMI APIs | CSI SOCKET<br>Macro |
|--------------------------------------|-----------------|-------------------------------|---------------------|
| 'LFP\$ID' (environment variable)     | X               |                               |                     |
| // SETPARM [SYSTEM] LFP\$ID=NN       | X               | X                             |                     |
| 'SYSID' (environment variable)       | X               |                               |                     |
| IDENT.TCPNAME passed to INITAPI call |                 | X                             |                     |
| ID parameter on SOCKET macro         |                 |                               | X                   |
| // OPTION SYSPARM='NN'               | X               | X                             | X                   |
| Default '00'                         | X               | X                             | X                   |

## CICS task isolation options



### § LFP isolates CICS tasks from each other

- This means that sockets that are allocated by one CICS task, **can not be used by another CICS task**
  - except the socket is passed to the other CICS task via **GIVESOCKET/TAKESOCKET** calls
- When a CICS task ends, all sockets allocated by this task will be **closed (terminated) automatically**
  - Except it has been given to another task prior to task termination

### § Some programs rely on passing sockets from one CICS task to another without the use of GIVESOCKET/TAKESOCKET

- For example, **DB2 (client or server) application requestor**, requires socket sharing, if running under CICS

### § To allow such programs to work with LFP, you need to specify the following JCL statement for the program:

- **// SETPARM [SYSTEM] LFP\$CIC=SHARE**
- This setting applies to the LE/C socket interface as well as the EZA interfaces

### § If socket sharing is active, the applications are responsible to close sockets that are no longer needed

- No automatic cleanup will be performed at end of CICS task
- If the applications miss to do proper cleanup, dead sockets may be left over

## CSI SOCKET macro considerations



§ For the **CSI SOCKET macro**, the Linux Fast Path only supports the following connection types:

- TCP
- UDP
- CONTROL
- Other connection types (such as CLIENT, TELNET, FTP, RAW, and so on) are not supported and will be rejected if used with the Linux Fast Path.

§ For **CONTROL type connections**, the only commands supported are:


- GETHOSTBYNAME
- GETHOSTBYADDR
- GETHOSTNAME
- GETHOSTID
- For details, refer to the individual macro descriptions in the "TCP/IP for VSE V1R5F Programmers Guide" manual.

§ For **CONTROL type connections**, these commands (from Barnard Software, Incorporated) are also supported:

- NTOP
- PTON
- GETVENDORINFO
- For details, refer to the "IPv6/VSE Programming Guide" manual

## z/VSE Fast Path to Linux on System z (LFP)

### § Most existing applications run unchanged with Linux Fast Path

- Provided they use one of the supported Socket API (LE/C, EZA or ASM SOCKET)
  - And they do not use any CSI or BSI specific interface, features or functions
  - Since z/VSE V5.1: LFP supports IPv6 

### § IBM Applications supporting Linux Fast Path

- VSE Connector Server
- CICS Web Support
- VSE Web Services (SOAP) support (client and server)
- CICS Listener
- DB2/VSE Server and Client
- WebSphere MQ Server and Client
- VSAM Redirector
- VSE VTAPE
- VSE LDAP Support
- VSE Script Client
- POWER PNET
- TCP/IP-TOOLS included in IPv6/VSE product (e.g. FTP Server/Client)



### § Customer applications should run unchanged:

- Provided they use one of the supported Socket API (LE/C, EZA or ASM SOCKET)

## Performance measurements using Linux Fast Path

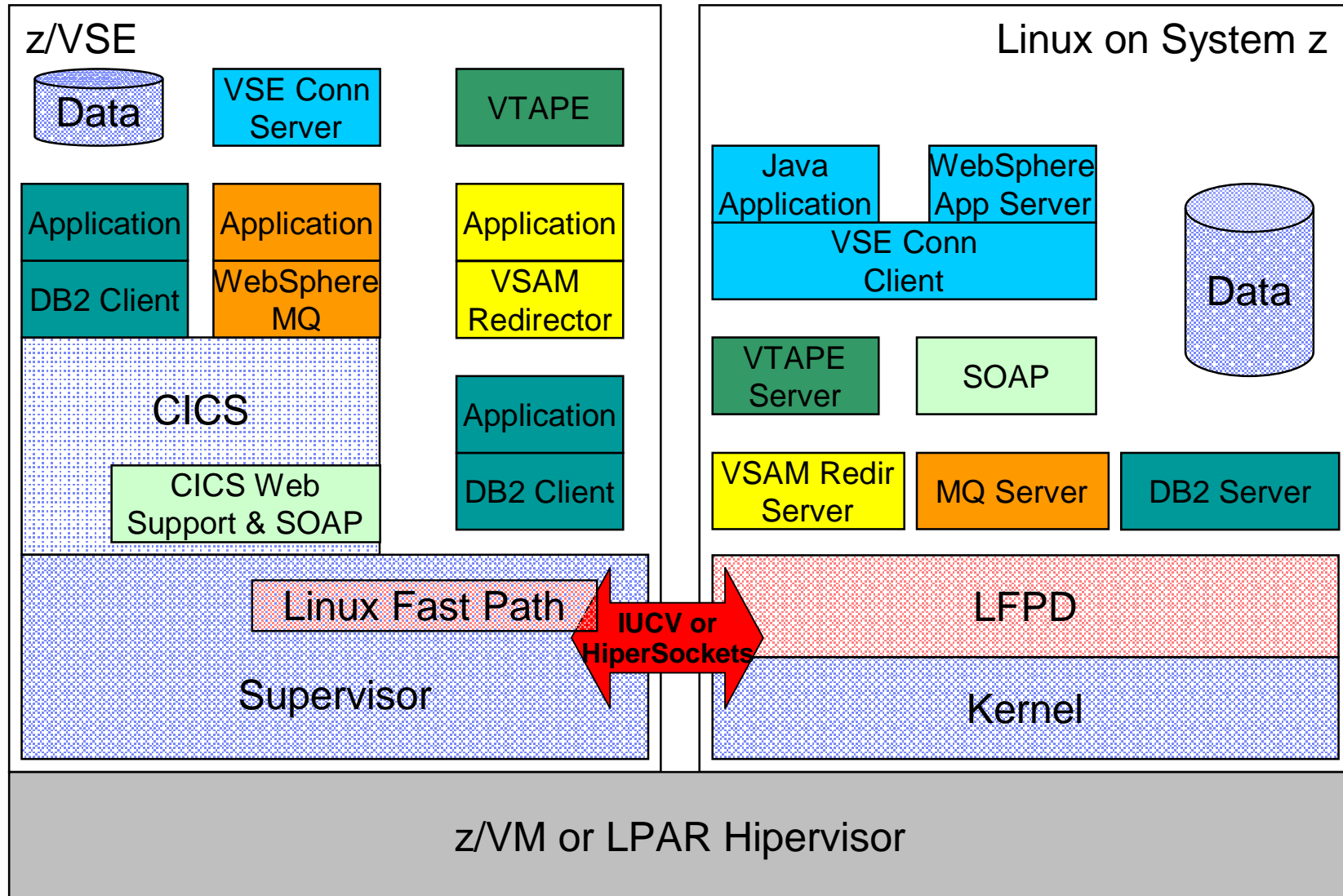
### Comparison TCP/IP for VSE versus Linux Fast Path (z/VM Environment):

| Workload  | TCP/IP for VSE  | Linux Fast Path (LFP)  | Difference   |
|---|---|--|--|
| <b>FTP (BSI FTP server)</b><br>§VSE à Linux (1GB)<br>(NULL file, no I/O)                        | 19 MB/sec<br>29% CPU (5% App + 24% TCPIP)   | 72 MB/sec<br>20% CPU (App)   | 3.7 times faster<br>9% less CPU                      |
| §Linux à VSE (1GB)<br>(NULL file, no I/O)   | 21 MB/sec<br>55% CPU (11% App + 44% TCPIP)  | 70 MB/sec<br>20% CPU (App)   | 3.3 times faster<br>35% less CPU                     |
| <b>Socket Application<br/>(running 3 times)</b><br>§VSE à Linux (100MB)<br>§Linux à VSE (100MB) | 4.6 MB/sec (*3 = 13.8 MB/sec)<br>9.7 MB/sec (*3 = 29.1 MB/sec)<br>26% CPU (3*1% App + 23% TCP/IP) | 14.6 MB/sec (*3 = 43.8 MB/sec)<br>16.2 MB/sec (*3 = 48.6 MB/sec)<br>9 % CPU (3*3% App) | 3.2 times faster<br>1,7 times faster<br>17% less CPU |

Environment: IBM System z10 EC (2097-722). TCP/IP connection via shared OSA adapter.

- à Significant benefits in transfer rate as well as CPU usage
- à Reduced Sub Capacity Cost

## z/VSE Applications communicating with Applications on Linux



## Questions ?

