Session B02

zMainframe Concepts (The Big Picture) - Part 2

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September 19 - 23, 2005 San Francisco, CA

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Session Objectives

In this session we will Discuss

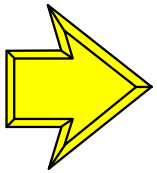
S/W and Server Architectural Overview
- MVS to z/OS big picture overview
- Compare previous 31 bit addressing to 64-bit addressing
  - H/W registers, region and segment tables, data spaces and hiper spaces, and address space layout

Mainframe Environment, Partitioning, Initialization and CHPID Usage
- Compare BASIC mode to LPAR mode
- List initialization sequence, profile requirements for both modes and CHPID usage in LPAR mode

I/O Configuration and HCD Overview
- Identify HCD concepts to define the I/O configuration in the mainframe environment

zSeries platform functions
- Identify Capacity on Demand and other zSeries exclusives enabling Autonomic Computing

MVS to z/OS, Server Architectural Overview and 64-bit to 31-bit addressing comparison



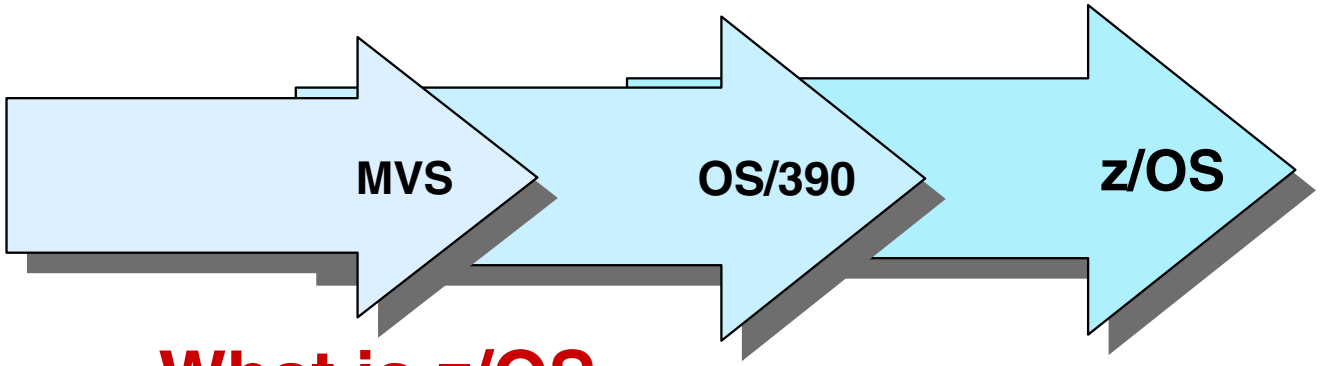
MVS to z/OS, Server Architectural Overview and 64-bit to 31-bit addressing comparison

Mainframe Environment, Physical/Logical Partitioning, CPC Initialization and CHPIDs

Operational Environment, I/O Configuration and HCD Overview

zSeries platform functions, Capacity on Demand and other zSeries exclusives enabling Autonomic Computing

From MVS to z/OS



What is z/OS

- The ultimate mainframe operating system
- A packaging of over 70 different functions
  - Base operating system
  - Many industry exclusives:
    - Workload Manager, Parallel Sysplex, Intelligent Resource Director
  - Key e-business Services:
    - Networking, security, storage management, distributed files, and print
  - UNIX built right into the base
  - Exploiting the technologies of the IBM Eserver zSeries 800 and IBM Eserver zSeries 900 servers

z/OS V1 R1 Overview

- **z/OS V1 R1** (Announced Oct 2000) **for the zSeries z900**
  - Available March 2001
  - z/Architecture provides new platform function (zPlatform) that works in combination with z/OS
  - Major functions supported with z/OS V1R1 in addition to 64-bit addressing capabilities
    - ★ Intelligent Resource Manager
    - ★ Workload License Charges (WLC)
    - ★ MSYS for setup
  - Major functions to be supported in other z/OS releases for the **zSeries z900 and z800**
    - zSeries Entry License (zELC), HiperSockets, MSYS for operations, CF duplexing.....

z/OS V1 R2 to V1 R4

- **z/OS V1R2** (Aug 2001) for **zSeries 900**
  - Enhancements including MSYS for operations
  - **Project eLiza** (now Autonomic Computing) next stage of new tools for zSeries
  - **z/OS & *z/OS.e V1R3** (Feb 2002) for **z900 and z800**
    - z/OS.e, sometimes called z/OS lite, offers a reduced price OS for workloads that are consolidated from other non-IBM platforms; traditional workloads are restricted
- **z/OS & *z/OS.e V1R4** (Aug 2002) for **z900 and z800**
  - Enhancements in MSYS, networking IP protocol, PKI support and workload balancing in a Sysplex.....
  - z/OS will begin to transition from a 6-month release cycle to an annual release cycle

*Note: z/OS.e is only available for zSeries z800 CPCs

z/OS V1 R5 to V1 R6

- **z/OS and *z/OS.e V1R5** (Mar 2004) for **z900/z800 and z990**
  - Multilevel Security
  - Enhancements to
    - Self-optimization of WebSphere applications
    - Backup and recovery of DB2 data
    - Performance for DFSORT
    - Intrusion Detection Services
    - Managing print across the enterprise
    - Last OS release to support 9672 CPCs
- **z/OS and *z/OS.e V1R6** (Sept 2004) **z900/z800/z990/z890**
  - Support for more than 16 engines in a single image
  - 64-bit application development support for C/C++
  - Requires a zSeries CPC

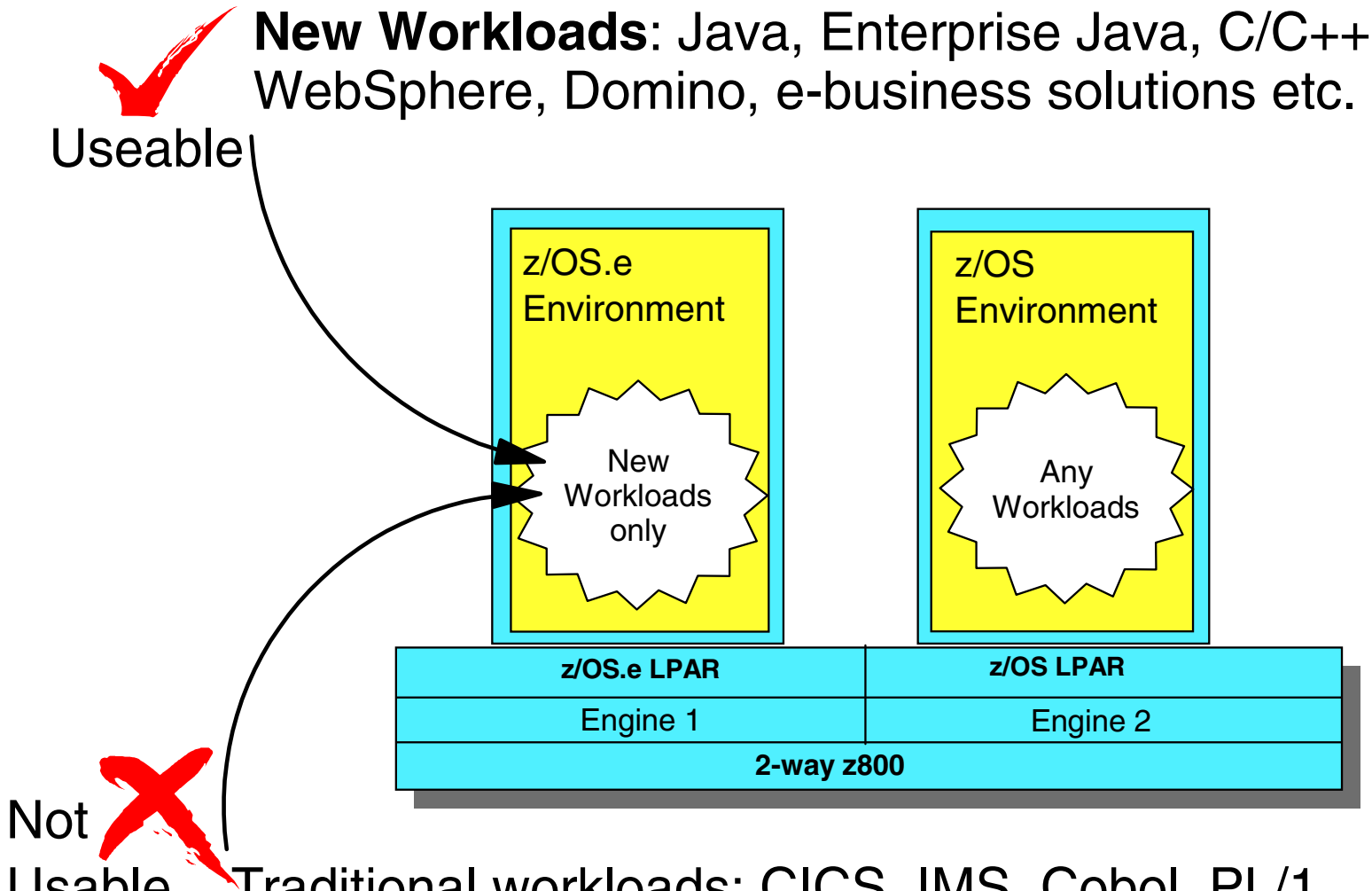
z/OS.e Overview

- A specially priced z/OS offering available at a fraction of the cost of z/OS
- Runs on z800 or z890:
  - Engine-level pricing
  - Engine-level granularity
- For enterprise and e-business applications only, some limitations apply:
  - Some z/OS base elements and features are disabled
  - Cannot run traditional workloads such as CICS, IMS, COBOL, and FORTRAN.
- Same code base as z/OS:
  - Unique Program Number for Ordering

z890

z800

z/OS.e Workloads



z/OS Hardware support

IBM S/390 Multiprise 3000

IBM S/390 Parallel Enterprise Server G5/G6

S/390 Servers

To z/OS V1 R5 only

- ESA/390 mode (31-bit)
- z/OS V1 R6 and above NOT supported

zSeries

zSeries 800 / 900 Servers

All z/OS operating systems

- ESA/390 mode (31-bit)
- z/Architecture mode (64-bit)

zSeries 890 / 990 Servers

From z/OS V1 R2 and above

- ESA/390 mode (31-bit)
- z/Architecture mode (64-bit)

*z/OS on zSeries intended to run in z/Architecture only

z/OS.e V1R3 through R6 are supported on z800 /z890 servers, in z/Architecture mode only (64-bit mode)

Architecture Overview

Today, two architectural modes exist, ESA and z/Architecture OS/390 and z/OS software support these modes. Both OS's use a wide range of H/W registers and control blocks that describe the available resources and addressing available for the supported mode.

Some H/W registers

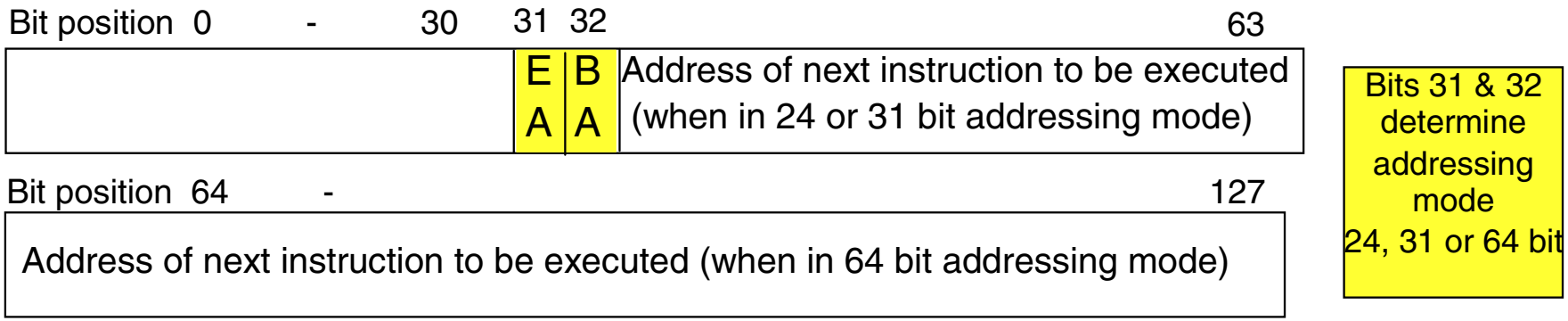
- PSW - Program Status word
  - Controls instruction sequence and state of CP
- GR or GPR - General Purpose Registers (16)
  - Contains data used by instructions, arithmetic function, accumulator, special purpose
- CR - Control Registers (16)
  - Maintains and manipulate control information outside of PSW
- AR - Access Registers (16)
  - Used for dynamic address translation (DAT) when PSW is in access register mode

Storage and Control Blocks

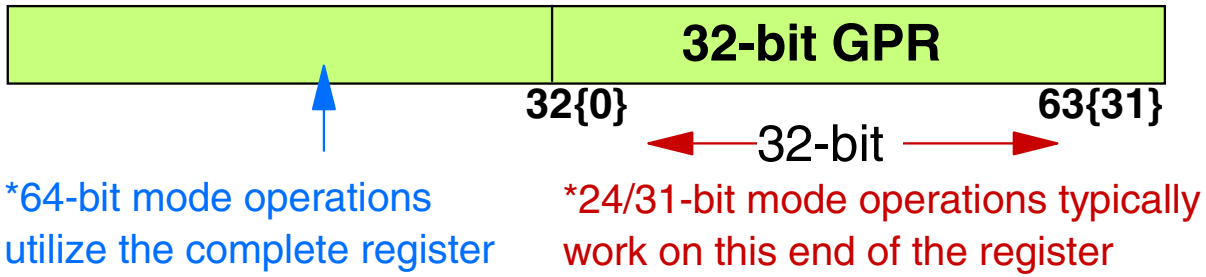
- The OS uses areas of storage in predetermined formats, control blocks, that applications can exploit.
- The application runs in a virtual address space. The address space is divided into private and common areas which also contain control blocks like the CVT and PSA
  - Address Space - contains the range of virtual storage locations that can be addressed
  - CVT - Communications vector table, contains the address of the next control block to be used when a chain of control blocks are to be constructed
  - PSA - Prefixed Save Area, critical information stored here, such as location of new PSWs to use during interrupts

z/Architecture (New Extensions)

- PSW expanded to 16 bytes



- 64-bit general purpose registers and control registers

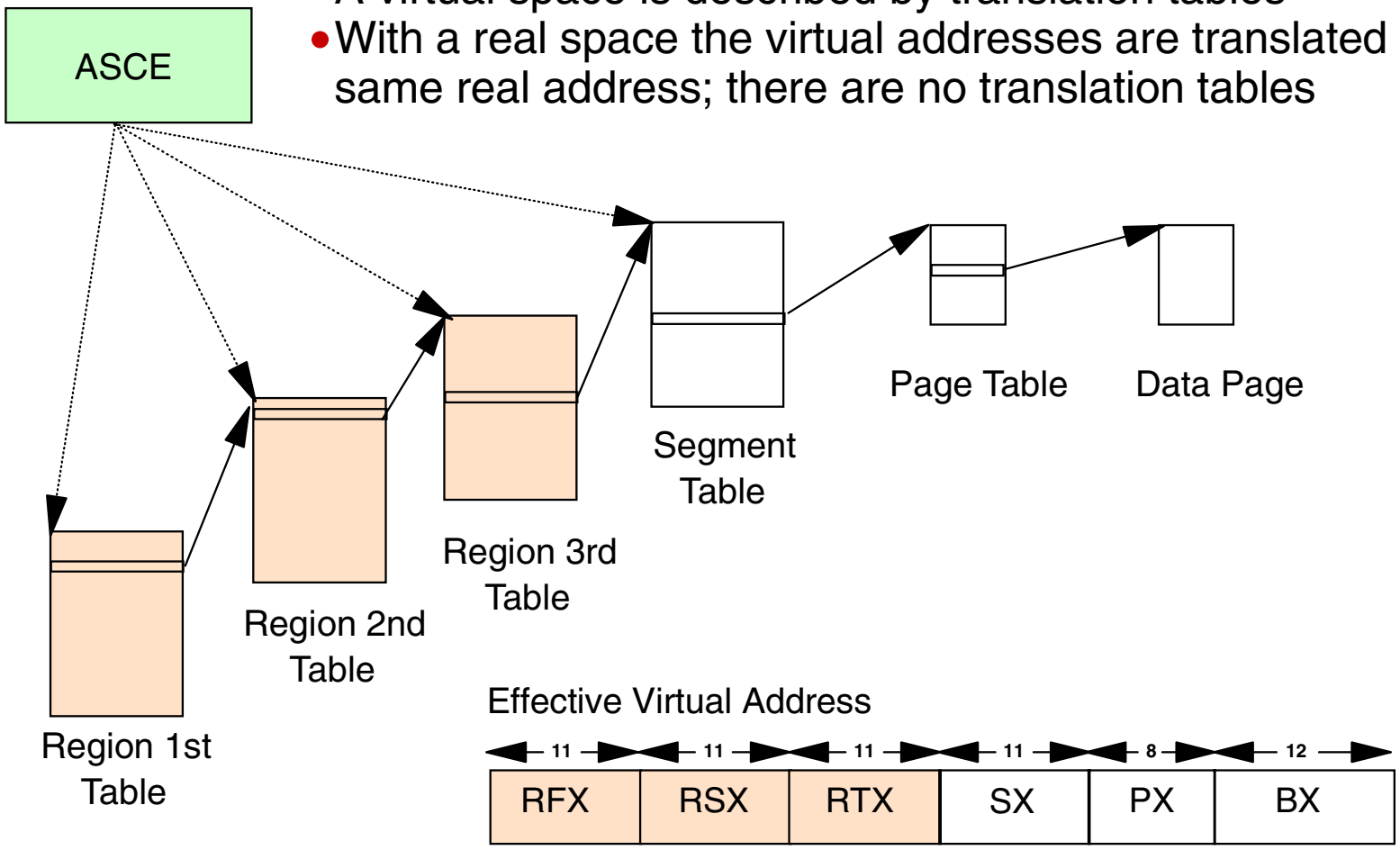


- Up to three additional levels of DAT, called region tables
- 8 KB prefix area for PSWs and register save areas
- A SIGNAL PROCESSOR order to switch processor modes at IPL

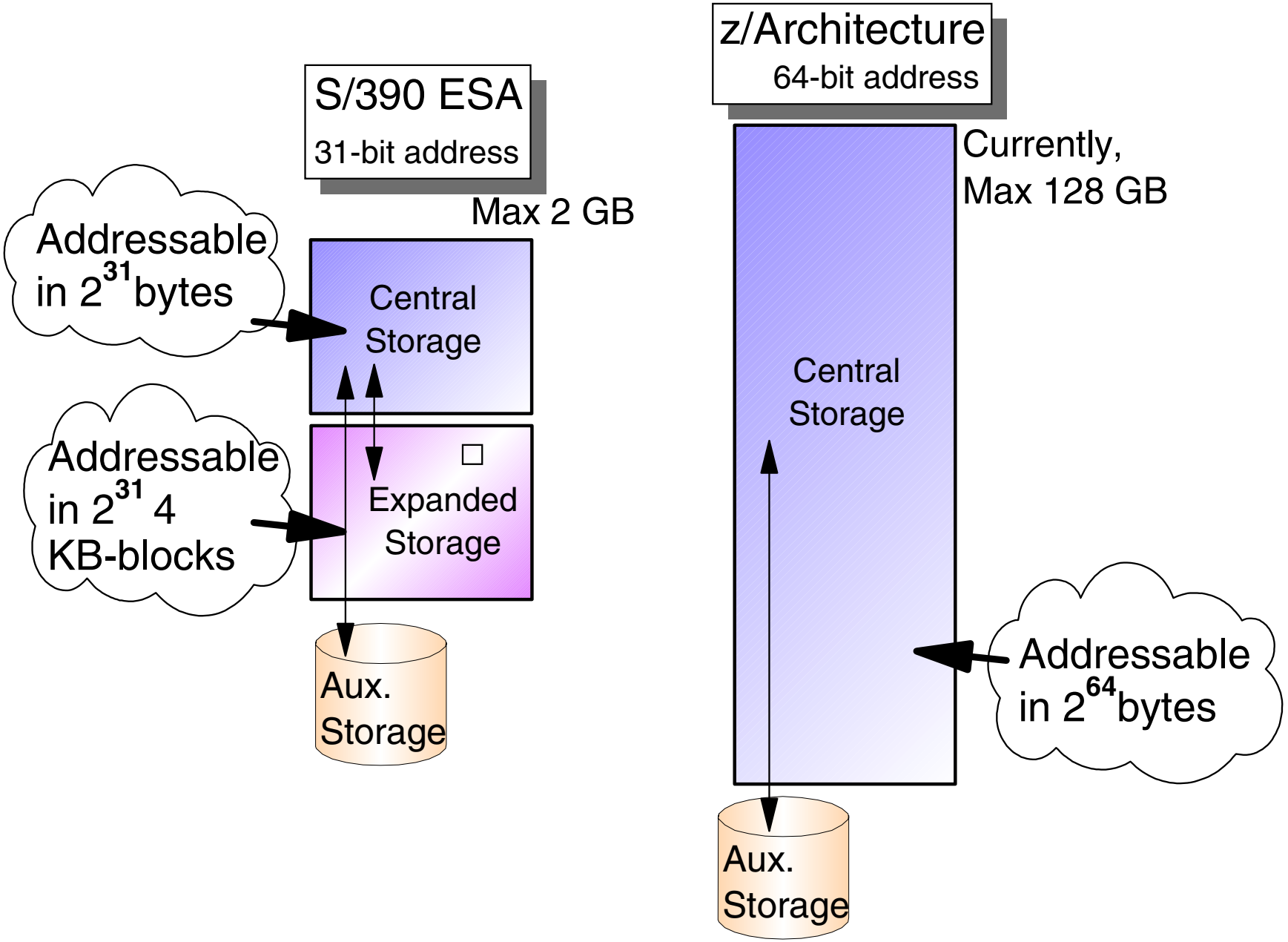
Dynamic Address Translation Region Tables

The Address-Space-Control-Element (ASCE) describes an address space

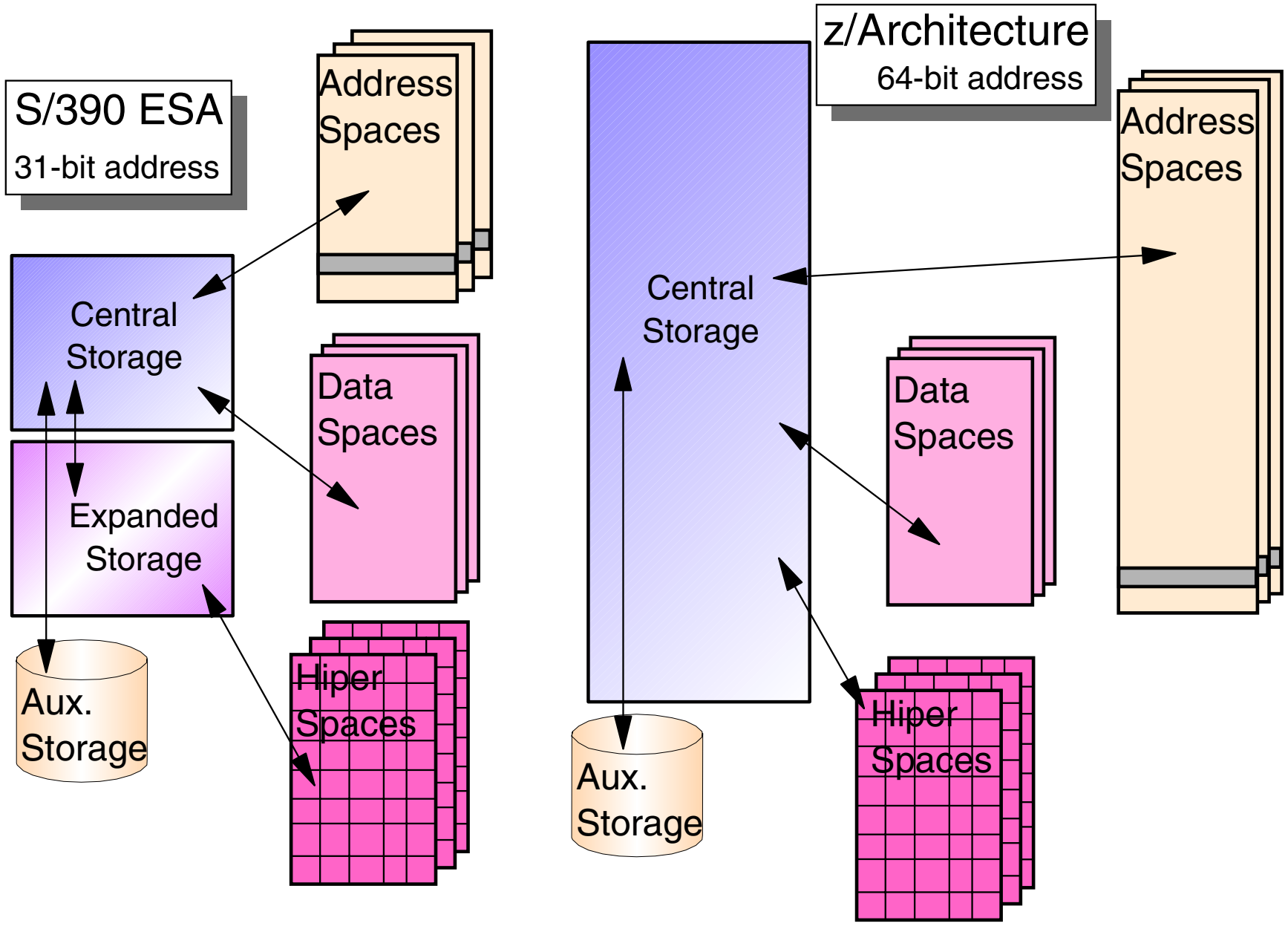
- A virtual space is described by translation tables
- With a real space the virtual addresses are translated to the same real address; there are no translation tables



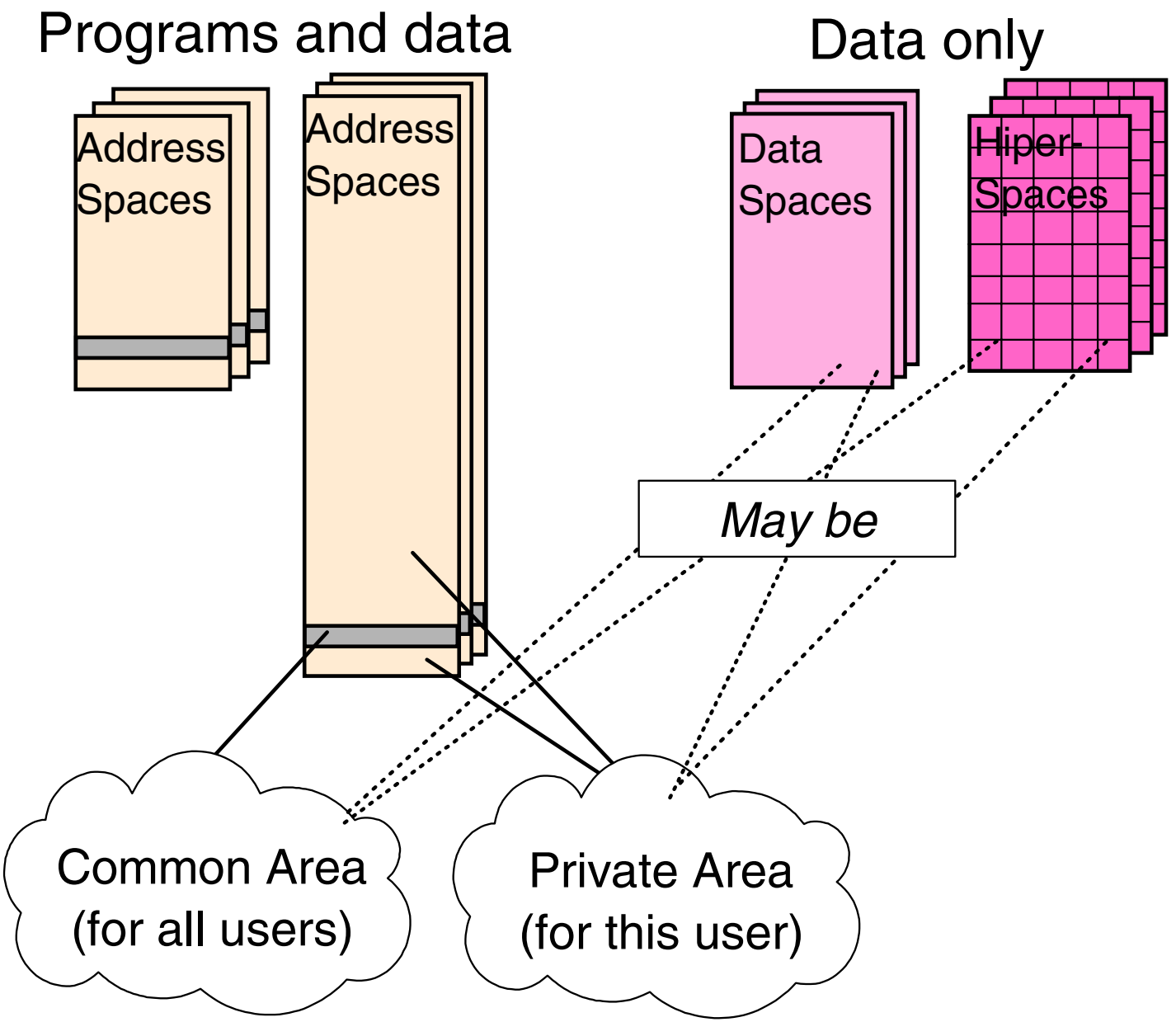
Enterprise Server Storage, Real and Auxiliary



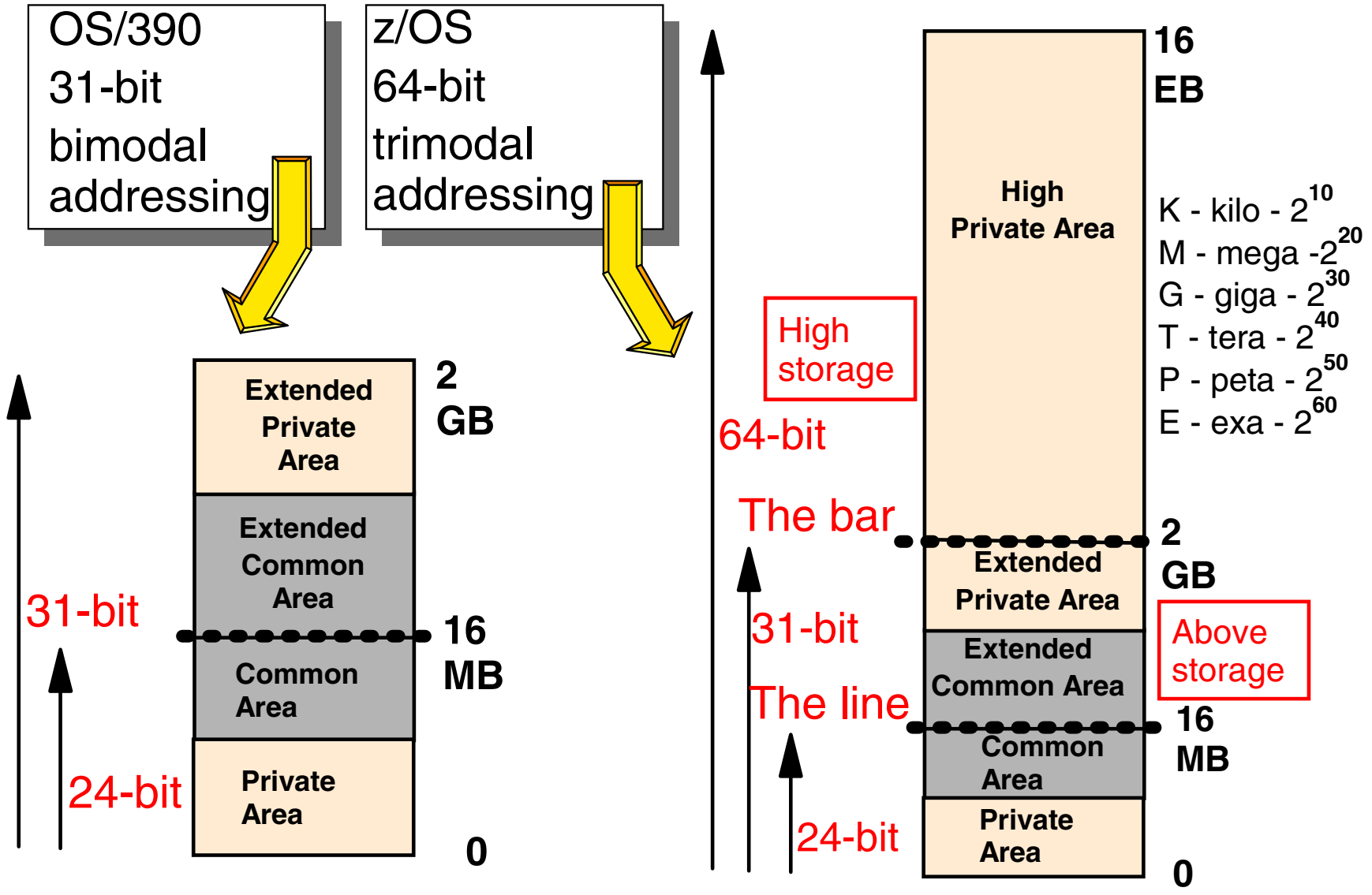
Enterprise Server Storage and Virtual



Virtual Storage Usage



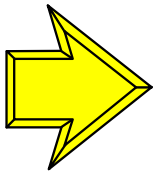
Address Space Layout



Note: Not to scale. 8+ billion traditional address spaces in one 64-bit address space. (billion = million million)

Mainframe Environment, Physical/Logical Partitioning, CPC Initialization and CHPIDs

MVS to z/OS, Server Architectural Overview and 64-bit to 31-bit addressing comparison



Mainframe Environment, Physical/Logical Partitioning, CPC Initialization and CHPIDs

Operational Environment, I/O Configuration and HCD Overview

zSeries platform functions, Capacity on Demand and other zSeries exclusives enabling Autonomic Computing

Today's Mainframe Environment

Logical Partitioning mode

NATIVE mode

Network

LANs, WANs
various network devices

Many types of channels, switches, directors, and cabling exist to provide connectivity to an ever increasing complex I/O environment

Operator console used to control/monitor environment, typically directly channel attached to CPC

Printing devices

Hi-speed printers

Storage devices
SANs

DASD, Tapes

Physical Partitioning (yesterday)

Physical partitioning, available in the 1980s is the capability of taking one physical CPC and dividing it into two separate CPCs with no sharing of resources.

- Supported on bipolar CPCs such as the 308x, 3090-x, and ES/9000 required certain CPC model configurations
  - These CPCs (model dependent) could operate in one physical Single Image (SI) or two physically partitioned (PP) images
- Physical partitioning was optionally enabled via H/W definition panels and required a POR
- Each physical partition required its own IOCDS
- Initially the two physically partitioned images could IPL only one operating system each in its architectural mode
  - Starting in the 1980s the operational architectural supported modes on various CPC H/W was 370-XA, ESA/370 and then ESA/390 which is supported on the ES/9000 through zSeries CPCs

Logical Partitioning (today)

Logical Partitioning (LPAR mode) available with PR/SM in the late 1980s is the capability of taking one physical CPC and dividing it into many logical partitions, sharing and/or dedicating resources from the physical CPC.

- Supported on CPCs such as the Bipolar 3090-x, ES/9000, CMOS 9672, zSeries and System z9
  - All zSeries CPCs supports 15 LPs in LPAR mode
  - System z9 and zSeries 990/890 supports more than 15 LPs
- IOCDS must support LPAR mode
- Setup is done via activation profiles on 9672, zSeries and System z9
  - The operational architectural supported mode that is initially available to every LP is ESA/390, (3090-x through System z9 CPCs)
  - Other modes, ESA/390 TPF, ICF and Linux are also supported

Today's CPCs (9672s and zSeries) may be defined via activation profiles to operate in one of two modes at POR time

- LPAR mode - Resources shared and/or dedicated
- ESA/390 mode - Resources dedicated to a single image
  - This mode is typically called ***NATIVE*** or ***BASIC*** mode

Modes of Operation

Basic Mode

POR in Basic Mode

- One Operating System
- All processor resources available to the operating system
  - CPs, Storage, CHPIDs
- ESA/390 or ESA/390 TPF modes supported
- Coupling Facility mode is NOT supported - requires LPAR mode

LPAR Mode

POR in LPAR Mode

- Up to 60 partitions
- One operating system/partition
- A partition may be defined to operate in either ESA/390 or other such as ICF, Linux or TPF
- CPs may be shared or dedicated to a partition
- Storage allocated to the partition at LP activation
- LP owns assigned storage
- CHPIDs may be dedicated, reconfigurable, shared or spanned

CPC Activation Overview

- CPC Activation is initiated and monitored at the Hardware Management Console (HMC).
- Activation is controlled by activation profiles that reside on the Support Element (SE).
- Three types of activation profiles exist on the SE.
  - Reset type Profile
    - Controls mode of operation (Basic or LPAR), supported I/O configurations and POR process.
  - Image type Profile
    - Defines LP options and resources (LPAR mode only).
  - Load type Profile
    - Defines IPL options, load address, and parameters.

Basic Mode Initialization Overview

Power on Reset (POR) in Basic mode to initialize the CPC

- Initialize CPs, storage, and channel subsystem
  - Load selected IOCDS into the Hardware System Area
  - POR complete - CPC status is Not Operating
- Initial Program Load (IPL)
  - IPL the operating system
    - Additional steps required for zSeries
    - Determine architecture mode (z/Architecture or ESA/390)
    - Determine storage assignments (ignore expanded storage assignments in z/Architecture)
  - Initialize the software
  - Initialization complete
  - CPC status is Operating
  - Image status is Operating

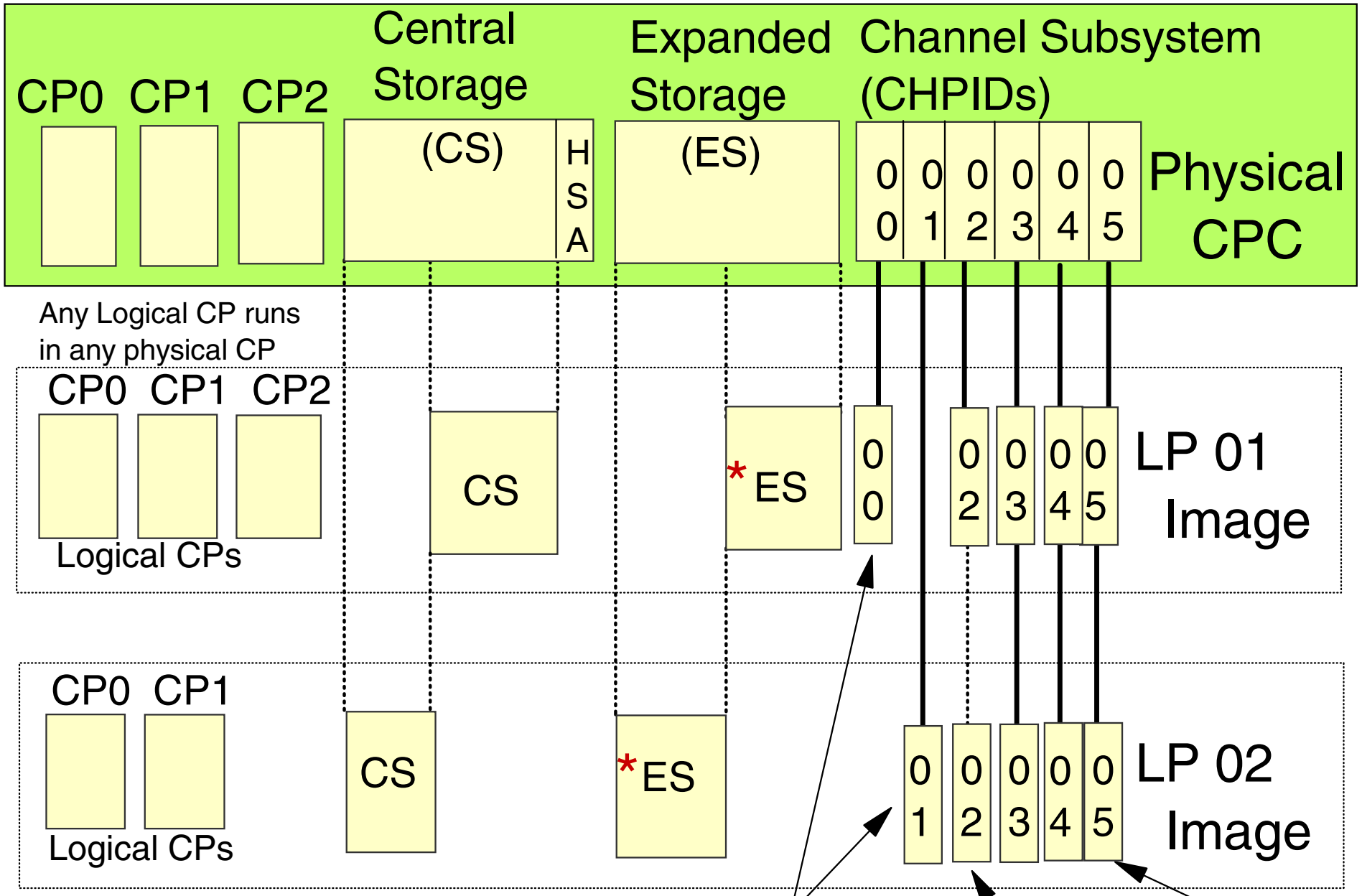
Note: CPC and Image status as determined from HMC details panel

LPAR Mode Initialization Overview

Power on Reset (POR) in LPAR mode to initialize CPC

- Initialize CPs, storage, and channel subsystem (CSS)
  - Load selected IOCDS into the Hardware System Area (HSA)
  - Load LPAR LIC code into HSA
  - POR complete - CPC status is Operating
  - Image status is Not Activated
- Activate LPAR partitions
  - Initialize each Image defined in the selected IOCDS as per each image's image profile
  - Assign CPs, central and expanded storage, and CHPIDs
  - Activate complete (OS Image) - Image status is Not Operating
  - Activate complete (CF Image) - Image status is Operating
- Initial Program Load (IPL)
  - IPL the operating system
    - Additional steps required for zSeries
    - Determine architecture mode (z/Architecture or ESA/390)
    - Determine storage assignments (ignore expanded storage in z/Architecture mode)
    - Initialize the software
    - OS Initialization complete - Image status is Operating

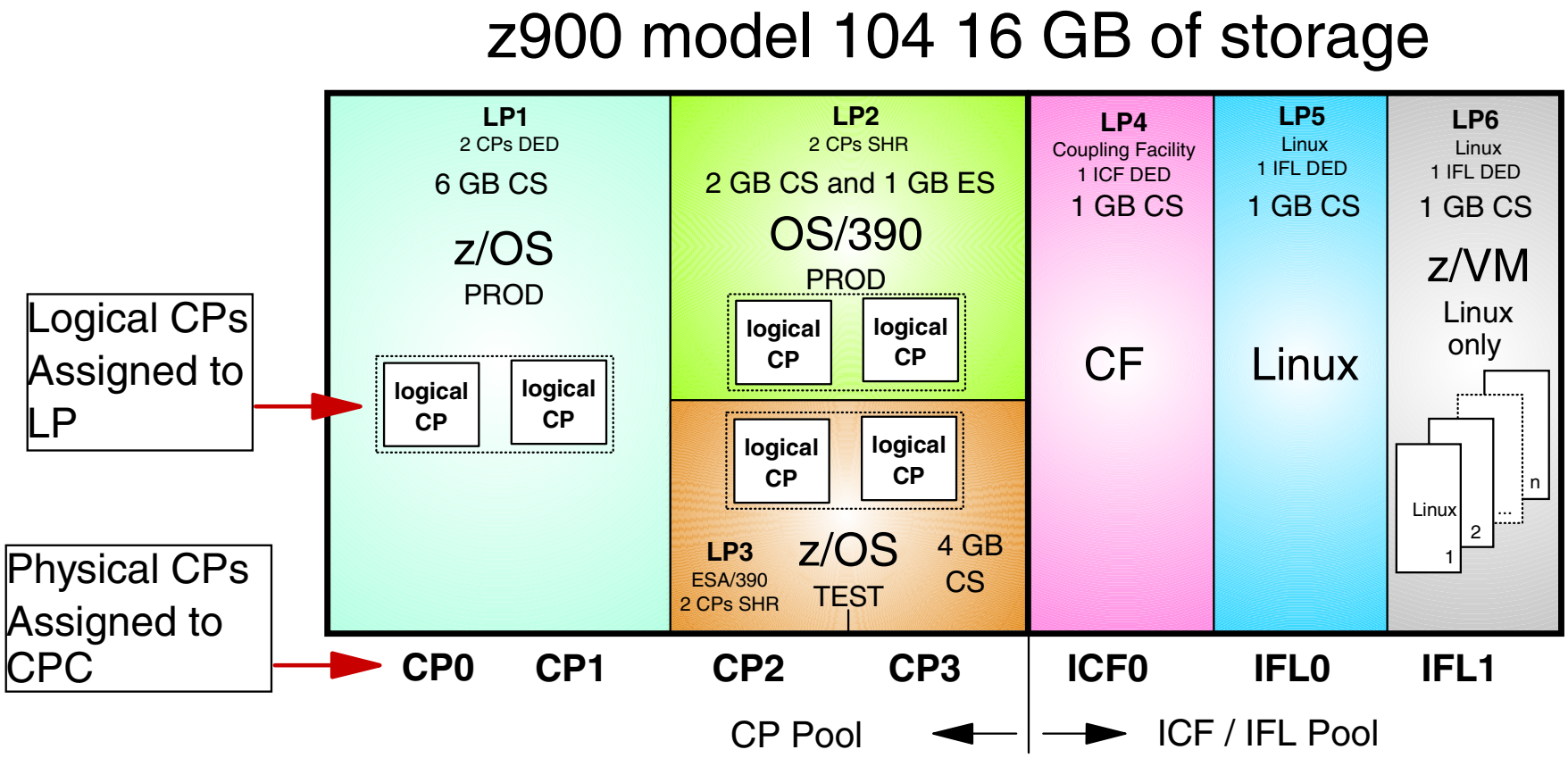
LPAR Overview (Physical to Logical)



***ES not used in z/Architecture**

z800/z990/z890 does not support Parallel Channels

LPAR Configuration Example



- This Model 104 assigns the PUs as 4 CPs, 1 ICF, 2IFLs 2SAPs and has up to 3 spare PUs.
- Spare PUs may be assigned to the ICF/IFL Pool via feature codes through IBM.
- Above configuration example only, Some storage would have to be taken into consideration for HSA use.

zSeries CPC in LPAR Mode

Reset Profile defines mode of operation at POR
IMAGE Profile (*LPAR mode*) defines mode of operation at LP activation

One of three operational modes may be defined by the Reset Profile

- LPAR
- ESA/390
- ESA/390 TPF

*__LPAR mode only supported on z990__

RESET PROFILE

One IMAGE PROFILE per LP

IMAGE profiles defines / assigns

- Operational mode
- Security Options
- Resources
  - CPs (shared or dedicated)
  - Storage (Central / Expanded)

1 to 15 (or more) LPs can be defined

★ One operating system can be activated (IPL'd) in each LP

ESA/390 Linux	ICF	ESA/390	ESA/390	ESA/390 TPF
★ Linux	★ CFCC	★ z/OS(64-bit only) ★ OS/390 R10 ★ z/VM	★ OS/390 pre R10 ★ VM/ESA ★ VSE/ESA ★ Linux ★ VIF for Linux	★ TPF

z/Architecture (64-bit)
or
ESA/390 Architecture (31-bit)

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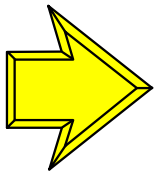

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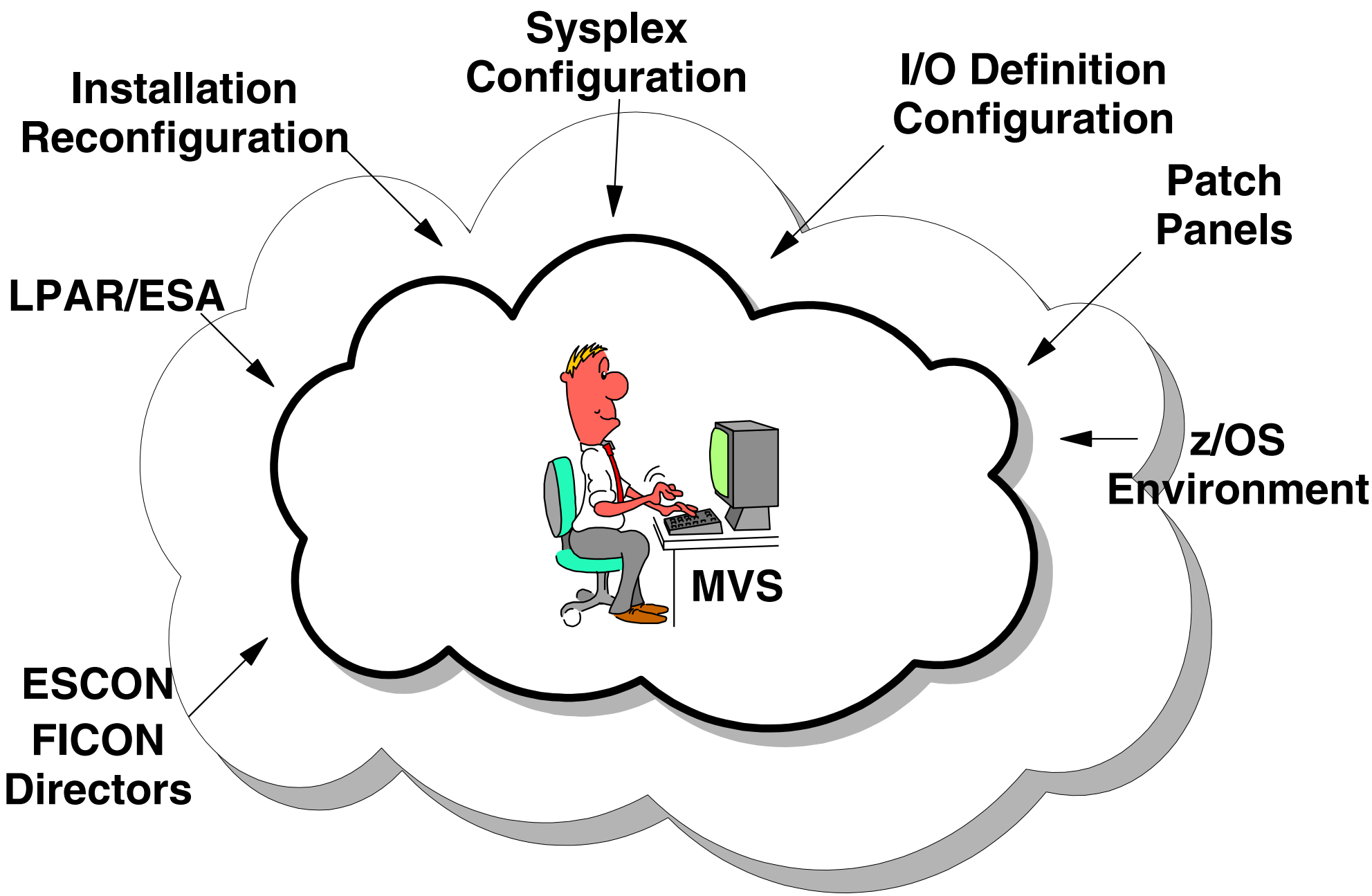
zSeries platform functions, Capacity on Demand and other zSeries exclusives enabling Autonomic Computing

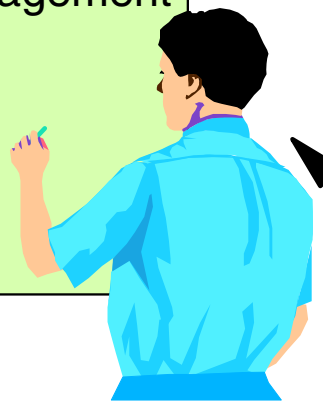
Operational Environment



Complexity 24 x 7 Availability

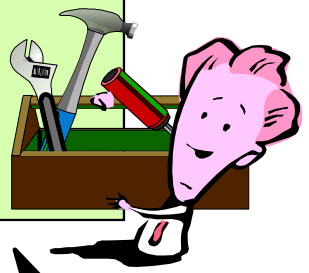
I/O Configuration Management - The People

Configuration Management
Plan
Define
Activate
Operate



Configuration Planning

HCD
LPAR/BASIC
Channel definitions
Directors
Patch Panels
Change
Performance
Problems

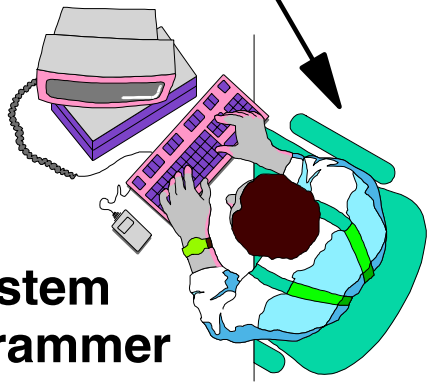


Cabling

System tools
LPAR/Basic
I/O
Availability
Configuration
Problem determination
recovery

Operations Problem detection/reporting

Installation



System Programmer

Teamwork

Communication **Cooperation**

HCD Introduction

Today's System environments use HCD to define both OS and CSS configurations.

- MVSCP was used previous to MVS release 5
  - MVSCP configuration program used to define I/O to Operating system
- Since MVS release 5 HCD must be used to define I/O to the Operating system
  - HCD may and typically is used to define CSS

IOCP Statements

- ID
  - Specifies ID (machine characteristics) of CPC
- RESOURCE
  - Specifies partitions, type, and number
- CHPID
  - Specifies channel paths, type, mode, and accessibility from LPARs
- CNTLUNIT
  - Specifies control unit, type, and connections to Proc/CHP/ESCD
- IODEVICE
  - Specifies devices, type, connections to CUs, and accessibility from LPARs

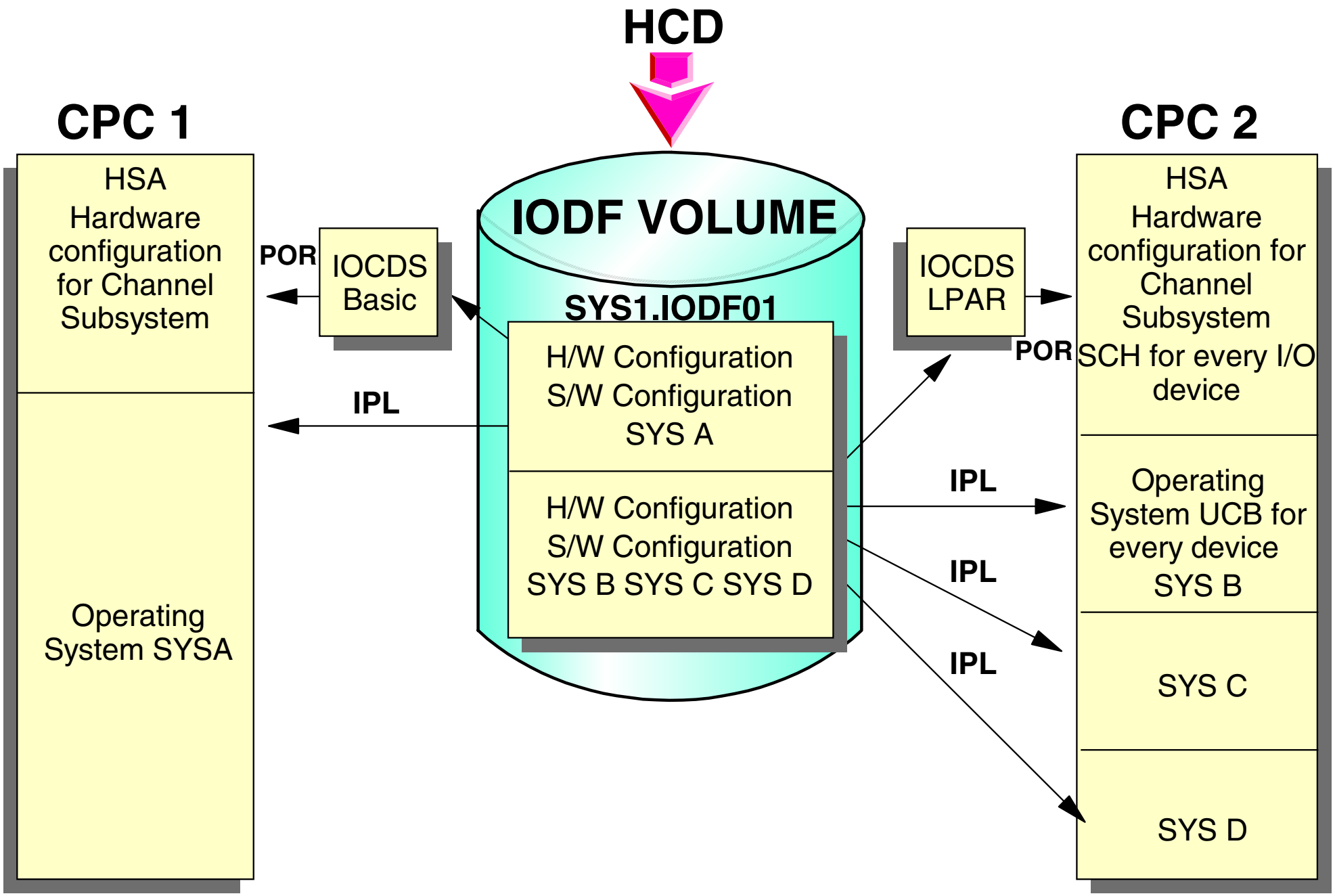
MVSCP Statements

- IOCONFIG ID
  - Specifies the numerical identifier of the OS (mandatory).
- EDT
  - An Eligible Device Table is specified with the EDT statement.
- NIPCON
  - Specifies a list of device numbers to be used as NIP consoles (mandatory).
- UNITNAME
  - Esoteric and generic device groups is specified with the UNITNAME statement.
- IODEVICE
  - Defines device parameters.

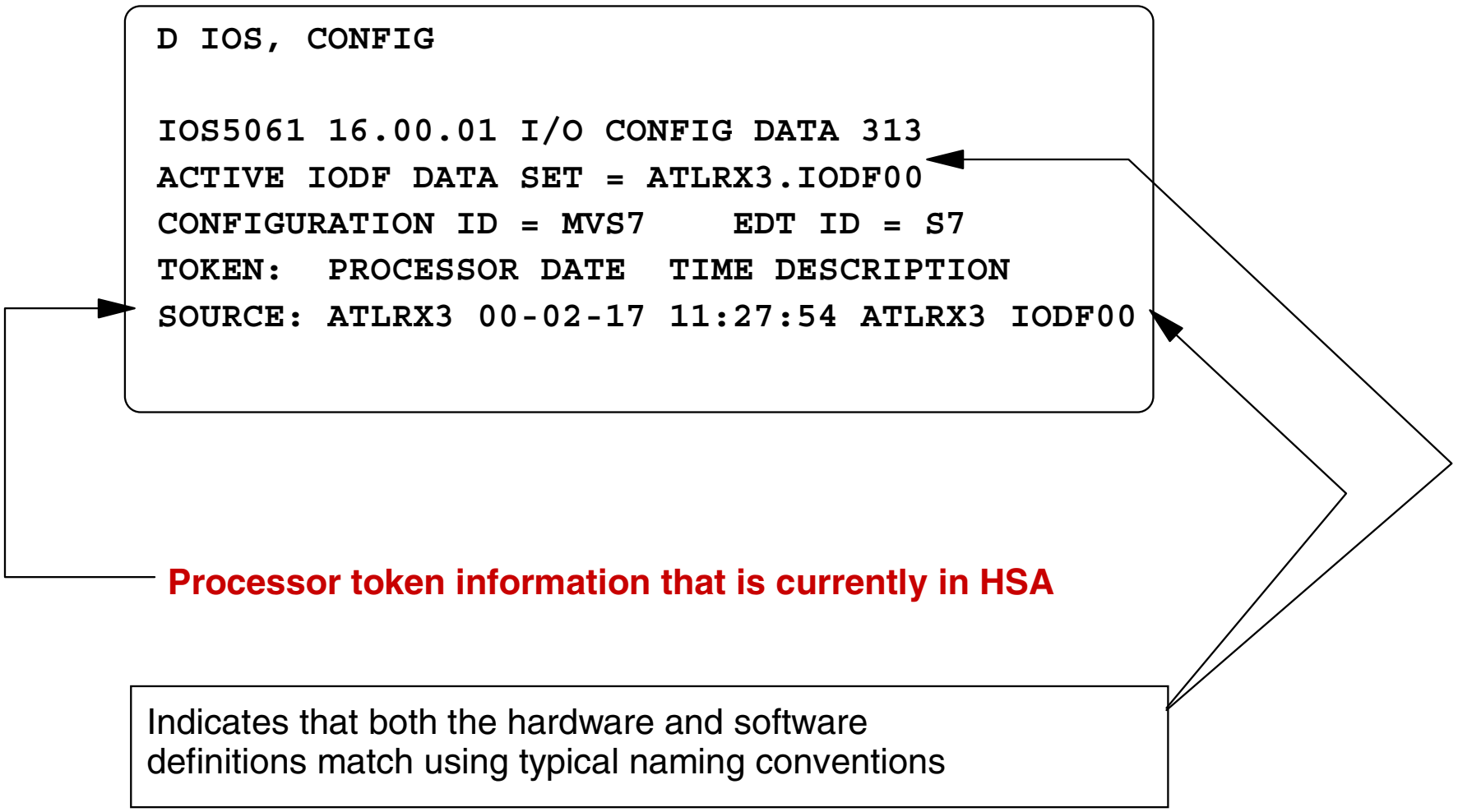
Hardware Configuration Definition Concept

- HCD provides a Dialog to maintain the configuration description in an I/O Definition File (IODF)
- The IODF can contain multiple hardware and software I/O configurations
- LOAD Members are used at IPL time to
  - Select the IODF to be read
  - Choose the desired software configuration
  - Select the master catalog to be used
  - Set other IPL parameters
- The activate function of HCD or the MVS ACTIVATE command is used to manage dynamic hardware and software changes.

Hardware Configuration Definition Overview



HCD Dynamic Activation



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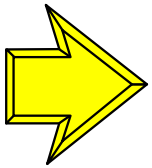


zSeries platform functions, Capacity on Demand and other zSeries exclusives enabling Autonomic Computing

zSeries Platform For On Demand Capacity

zSeries provides platform function (zPlatform) for On Demand Capacity for the On Demand e-business world

On demand capacity for nondisruptive:

- Planned Outages
- Unplanned Outages

Autonomic Computing - combining zPlatform and z/OS functions for self-management capabilities

zSeries Nondisruptive Planned Upgrades

Capacity Upgrade on Demand (CUoD)

- Standard machine capability for concurrent upgrades
- Nondisruptive permanent addition of CP/ICF/IFL/zAAPs, memory, I/O ports and channel cards
  - CIU, CBU and IBM field upgrades use this process

Customer Initiated Upgrade (CIU)

- Customer capability to order and install CUoD-capable upgrades
- CIU feature ordered to initiate contract and administrative setup
- Customer orders and installs upgrade via the WEB using IBM Resource Link and RSF

On / Off Capacity on Demand (On/Off CoD) **System z9 and zSeries 990/890 only**

- Temporarily activation of unowned CP/ICF/IFL/zAAPs within model
- Requires CIU contract with IBM and uses CIU process
- Billed on a monthly basis

zSeries Nondisruptive Unplanned Upgrades

Capacity BackUp (CBU)

- Nondisruptive temporary addition of CPs only in an emergency or disaster recovery situation
- CBU contract required to order CBU features and CBU LIC-CC
- CBU cannot be used for peak and workload management
- CBU activation can last up to 90 days
- One CBU feature for each stand-by CP
- Spare characterizable PUs must be available for each CBU feature
- Downgrade (Nondisruptive) required after test or recovery is complete
- Both CBU and On/Off CoD LIC-CC can be installed
  - Activation of CBU and activation On/Off CoD are mutually exclusive.
  - Deactivation of one is required to activate the other

zSeries Capacity Upgrade Functions Summary

On demand capacity for on demand e-business

Function	Upgrades	Via	Type	Process
CUoD	CPs,IFLs,ICFs Memory I/O	LIC or Hardware Installation	Concurrent and permanent	Ordered as an normal upgrade and activated by IBM
CIU	CPs,IFLs,ICFs, zAAPs Memory	LIC-only (cannot add book)	Concurrent and permanent	Initiated via web and activated by customer
On/Off CoD z9 and z990/890	CPs,IFLs,ICFs, zAAPs	LIC-only (cannot add book)	Concurrent and temporary (no time limit)	Initiated via web and activated by customer
CBU	CPs	LIC-only (cannot add book)	Concurrent and temporary (up to 90 days)	Ordered for backup/recovery only and activated by customer

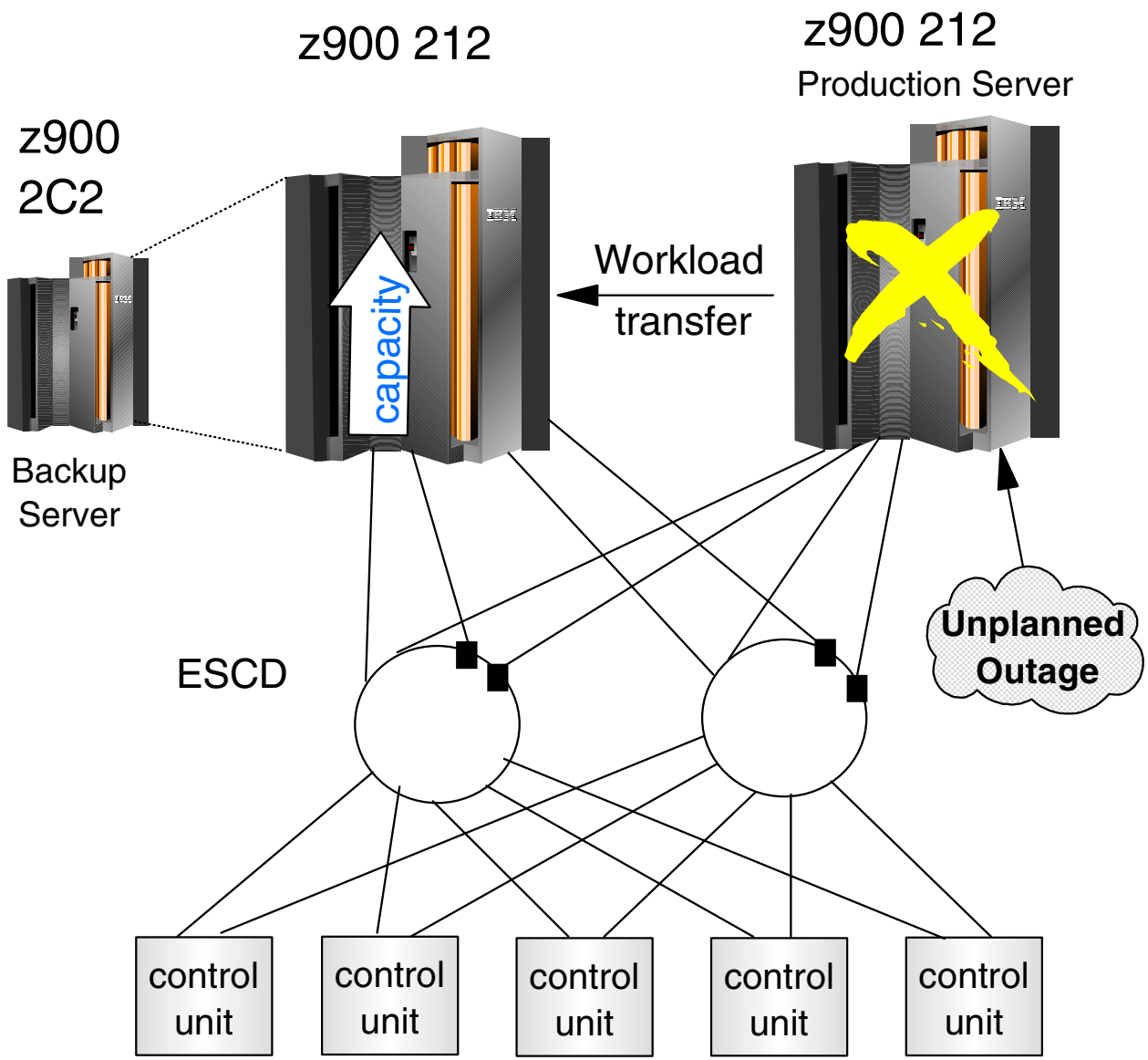
IBM System z9 adds capability to include other engine types for CBU

z900 CBU Operation Example

z900 2C2
Current model with
10 CBU features

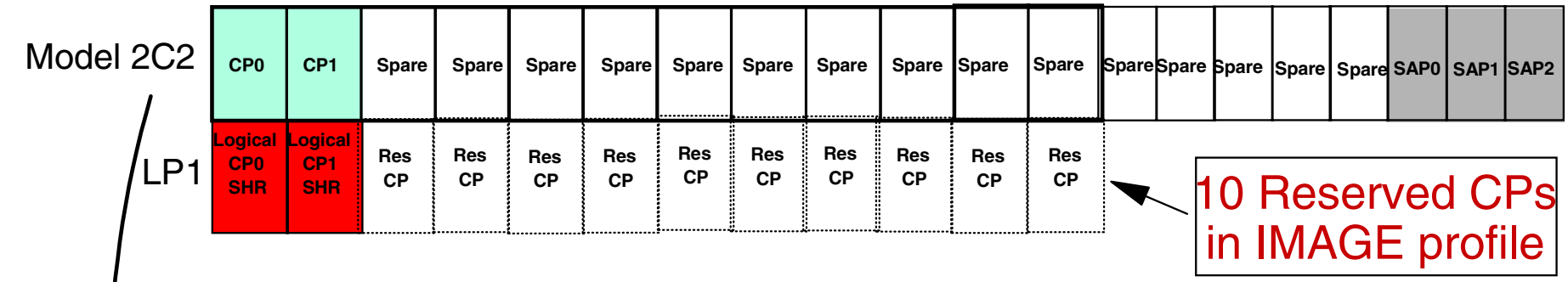
Emergency
processor upgrade

z900 212
target model

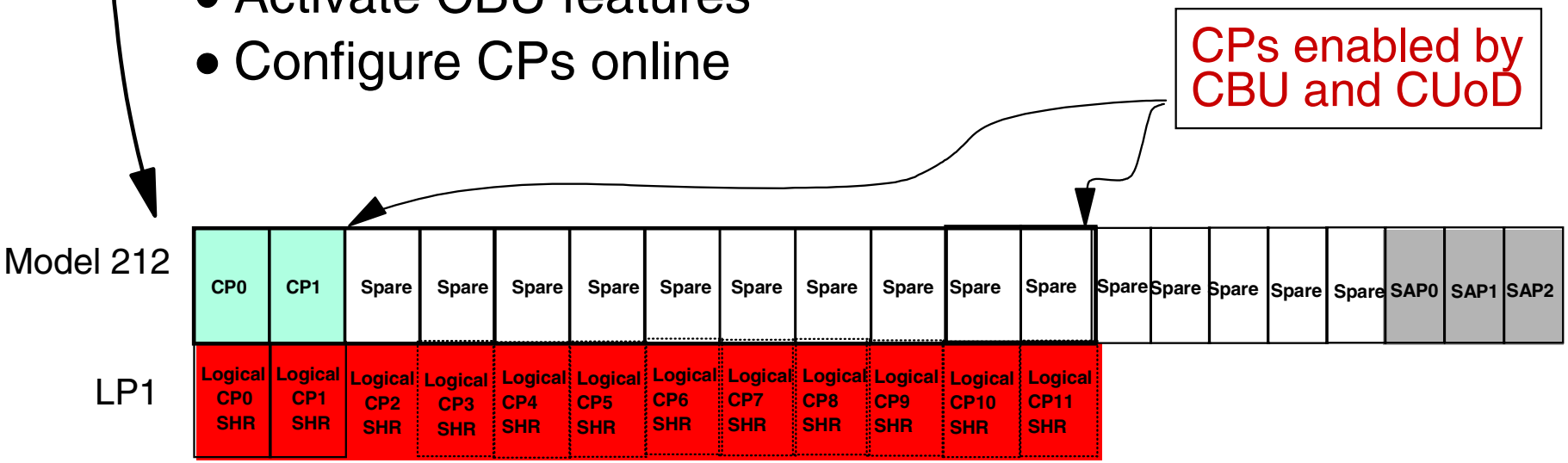


CBU available on all z9 & zSeries CPCs, depending on CPC configuration

z900 2C2 to 212 Capacity Upgrade (CBU) Example

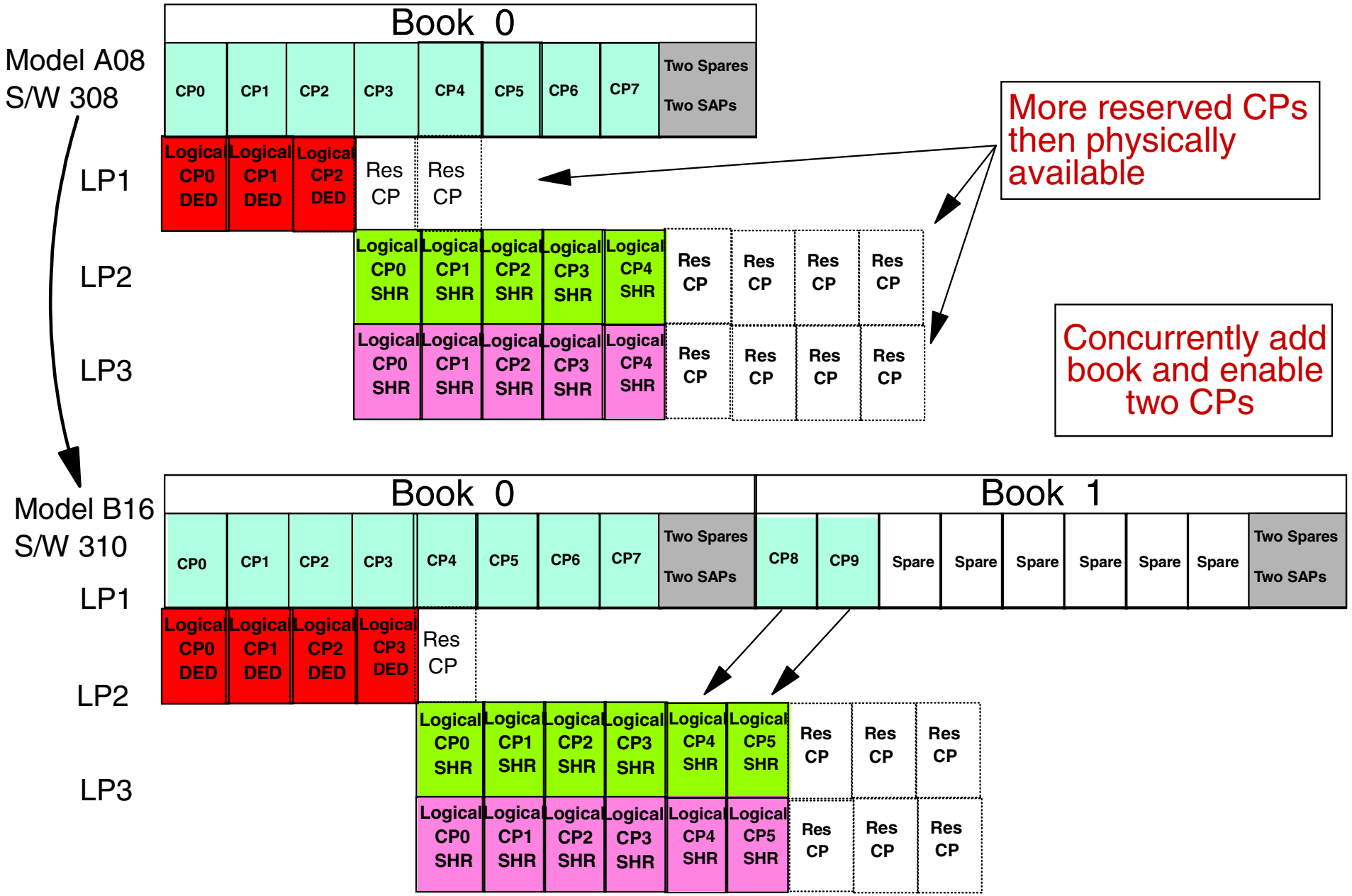


- IBM notified via RSF connection to RETAIN
- Obtain password
- Activate CBU features
- Configure CPs online



Concurrent upgrade within MCM hardware with reserved CPs and CUoD

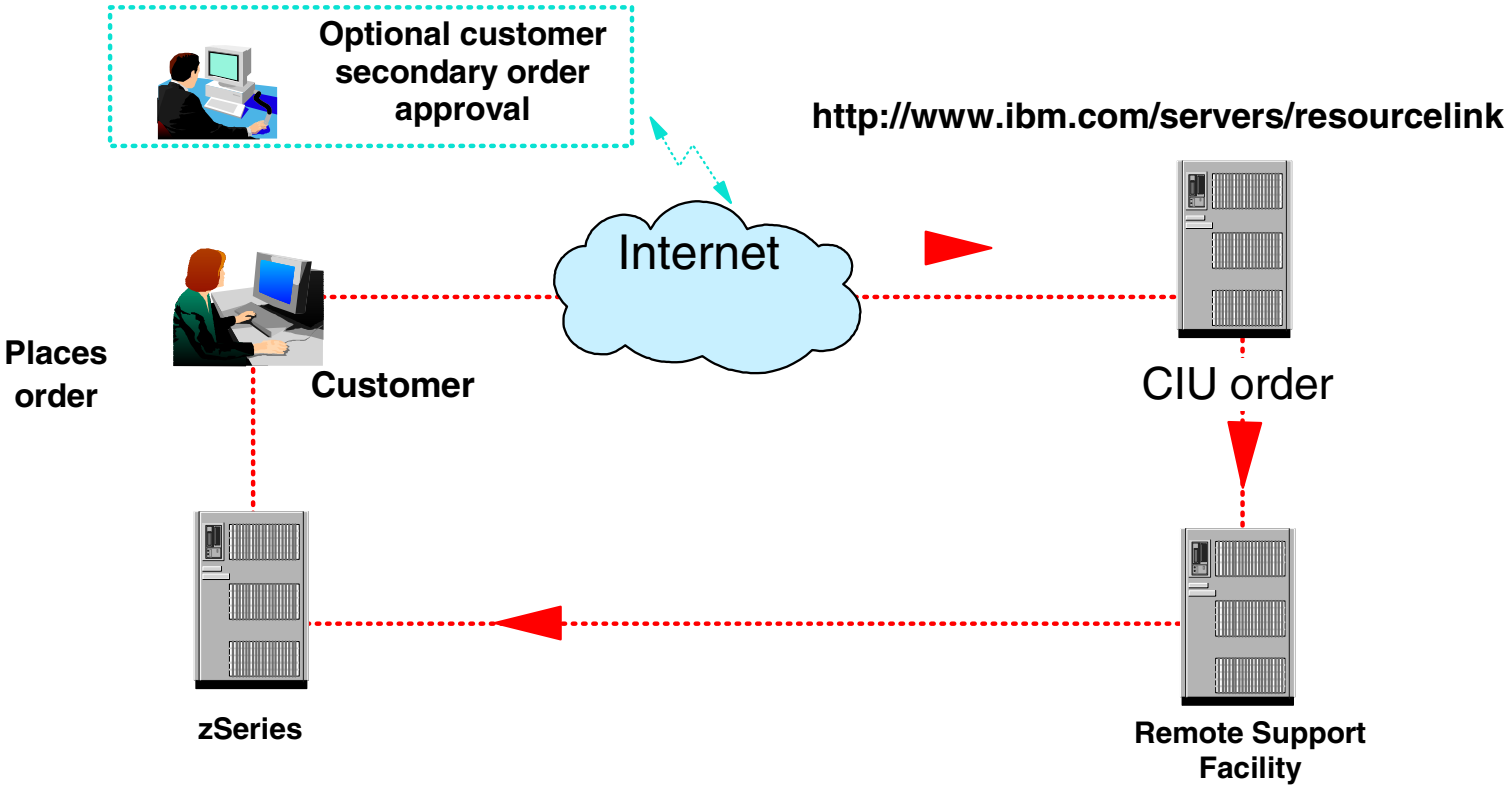
z990 Concurrent Book add With CUoD



Concurrent upgrade - model A08 to B16, Book add and enable two CPs (CUoD)

Web Based CIU and On/Off CoD

- **What is it?**
  - IBM Resource Link Web-based solution
  - Enables customers to configure, order and download microcode for vertical upgrade of processor and/or memory
  - Permanent upgrades (CIU)
  - Temporary upgrades of CPs, IFLs, ICFs and zAAPs (On/Off CoD)



Note: Assumes spare PUs available (zSeries memory can also use CIU if H/W configuration supports)

z/Architecture, zPlatform and z/OS

z/Architecture provides new platform function (zPlatform)
z/OS enables these functions plus other z/OS components

zPlatform Features:
- ★ 64-bit Architecture
- ★ Intelligent Resource Director (IRD)
- ★ HiperSockets
- ★ Workload License Charges (WLC) and zSeries Entry License Charges (zELC)
- ★ Integrated Facility for Linux
- ★ zSeries Application Assist Processor

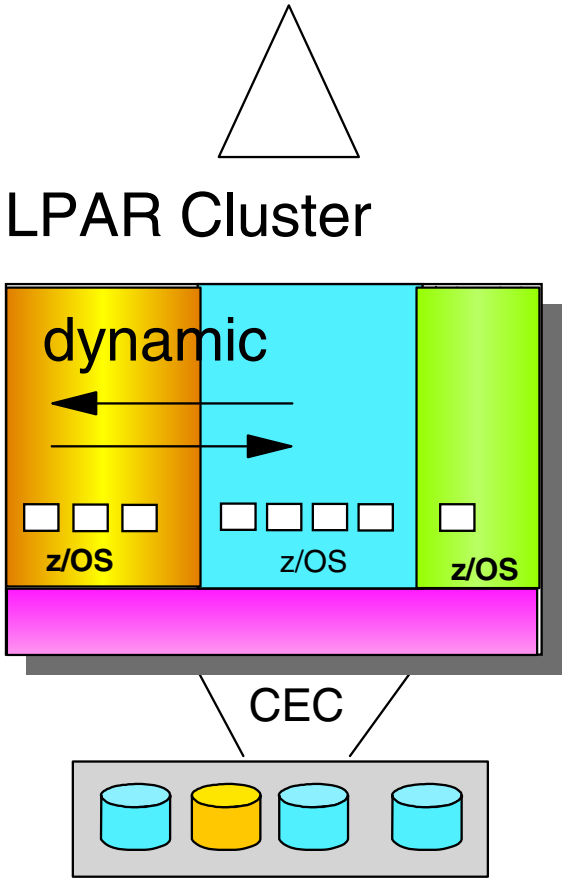
z/OS new systems management components
- ★ msys for Setup
- ★ msys for Operations
- ★ Autonomic Computing

Autonomic Computing - combining zPlatform and z/OS functions for self-management capabilities

Intelligent Resource Director (IRD)

Available only with z/OS on zSeries hardware

- Goal-oriented management of logical partition resources:
  - Processors
  - Channels
- Integration of PR/SM, Workload Manager, Channel Subsystem, and Parallel Sysplex
- IRD Functions:
  - LPAR CPU management
  - Dynamic channel path management
  - Channel subsystem priority queuing

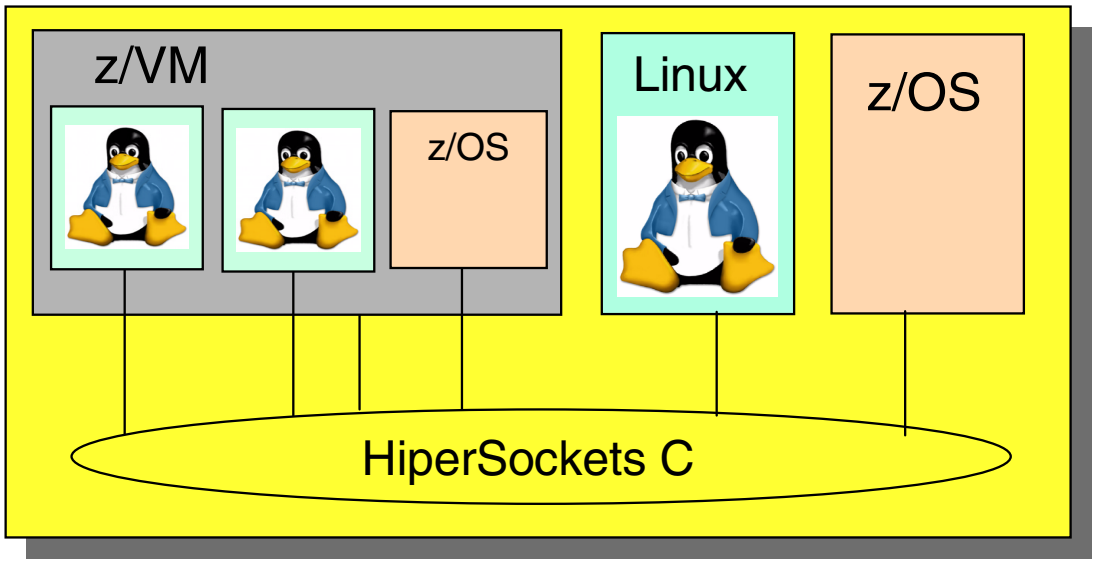


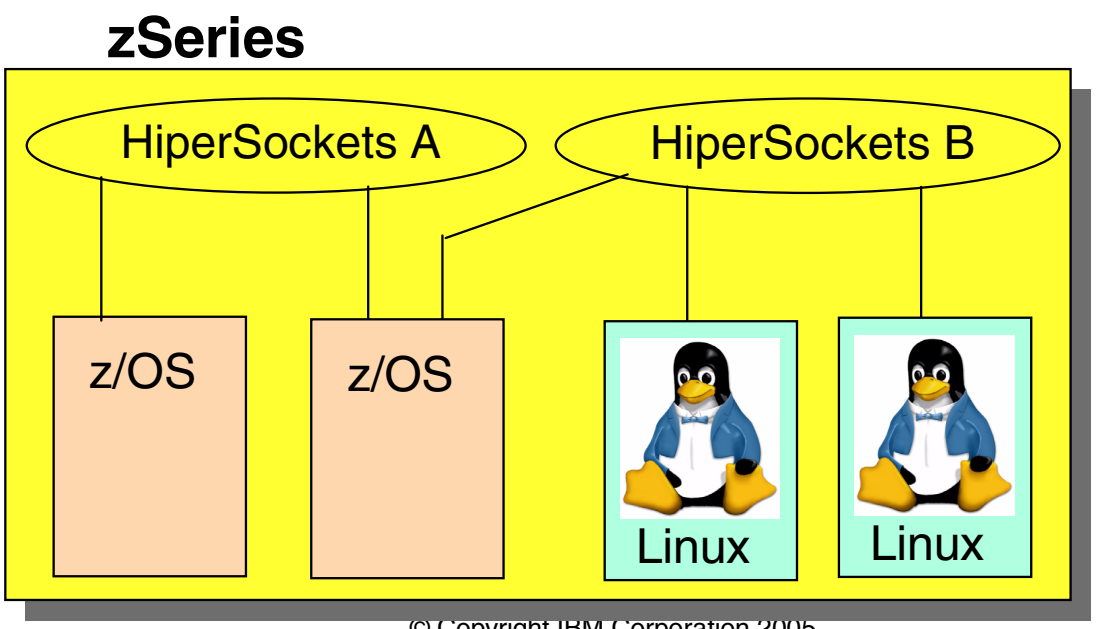
★ Directing resources to the priority work

HiperSockets: Network in the Box

16 HiperSockets available for z9 / z990 / z890

4 HiperSockets available for z800 / z900

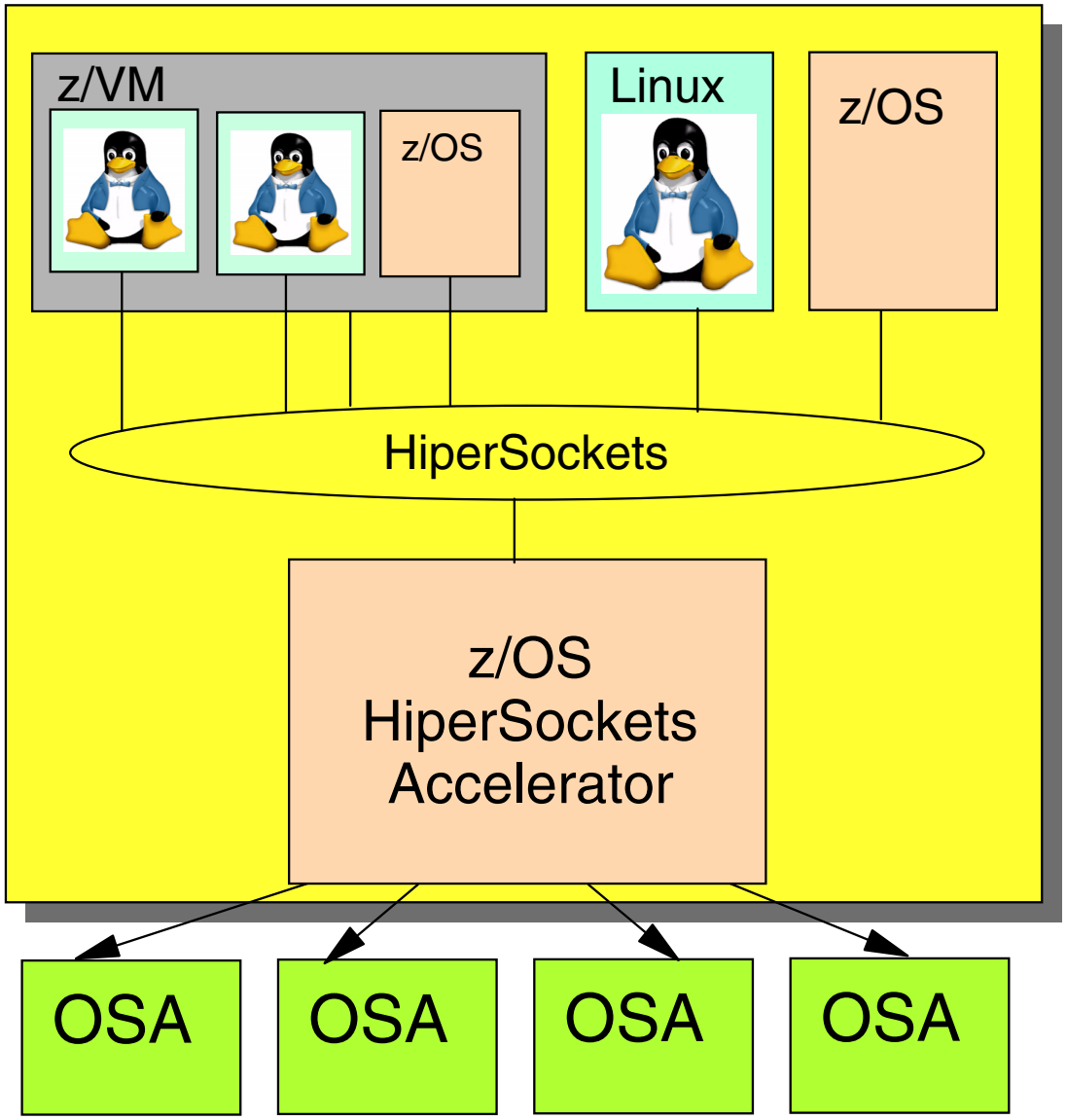




HiperSockets Accelerator

16 HiperSockets available for z9 / z990 / z890

4 HiperSockets available for z800 / z900



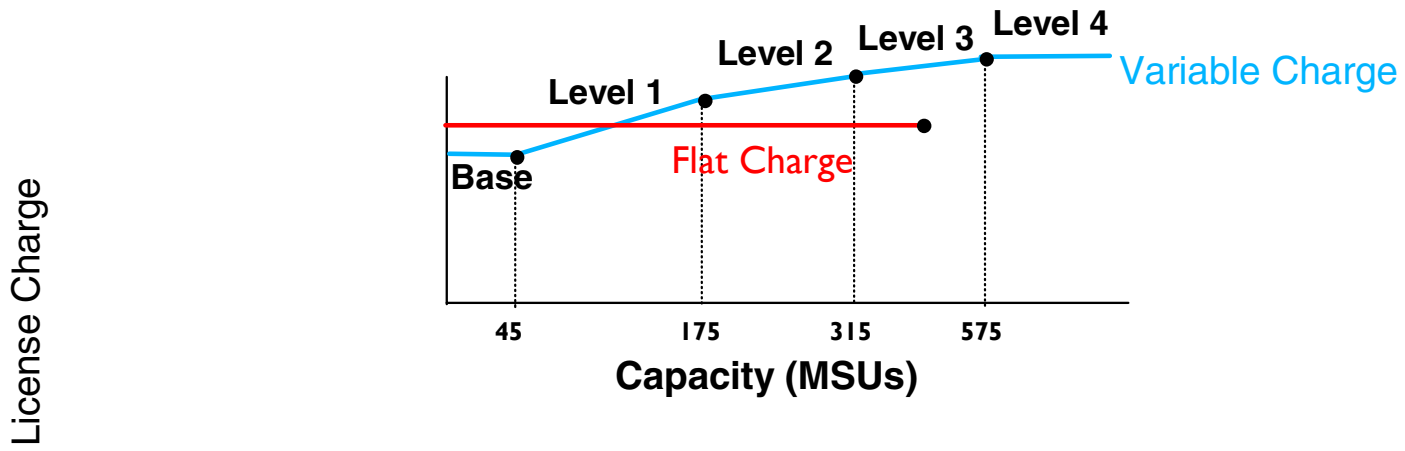
Workload License Charges Overview

Pricing model for zSeries: Workload License Charges (**WLC**) is IBM's newest software pricing model.

With WLC, customers pay only for the software capacity that they need.

Available on zSeries Machines running z/OS

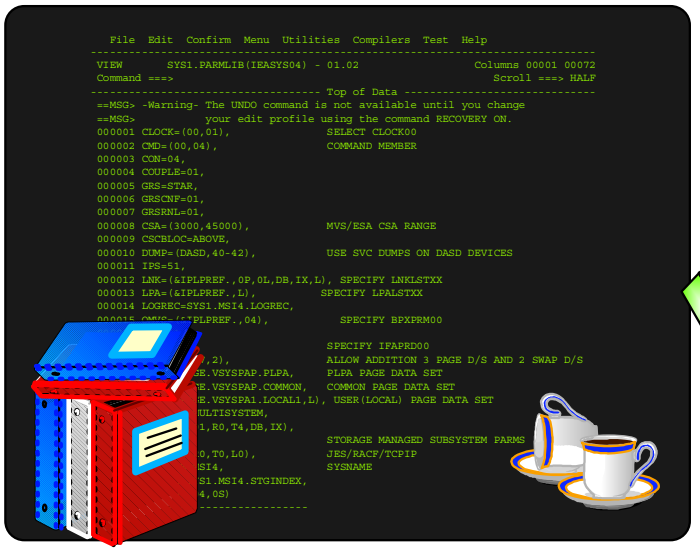
Variable Charge Products:	Flat Charge Products:
• Product LPAR utilization capacity • $/MSU decreases as capacity increases • Priced via Monthly License Charge • Aggregation across a Qualified Sysplex • Applies to z/OS, DB2, IMS, CICS, MQSeries, System Automation, NetView and others	• Single Price per Machine • Priced via Monthly License Charge • Applies to Other Current Products, VM, VSE and legacy S/390 products

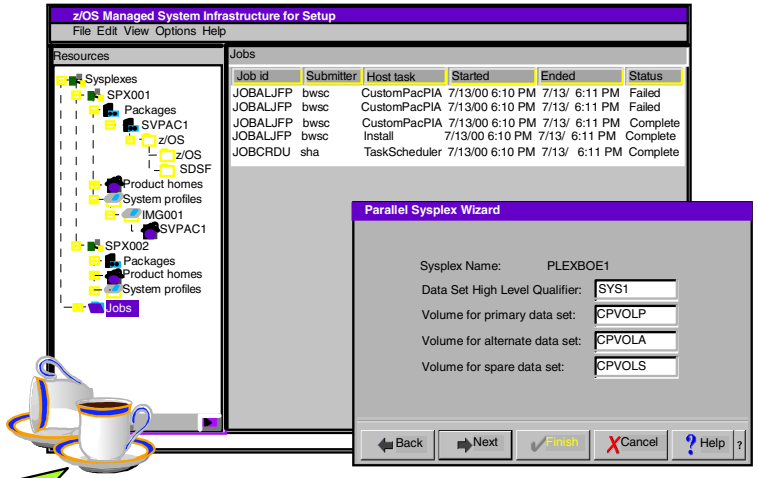


msys for Setup

New z/OS technology for product setup

- Increased productivity
- Lower skill requirements
- z/OS Management Directory





Used for setup of:

- Parallel Sysplex
- Base Sysplex
- TCP/IP
- ISPF
- UNIX System Services
- Language Environment Run-time
- LDAP

msys for Operations

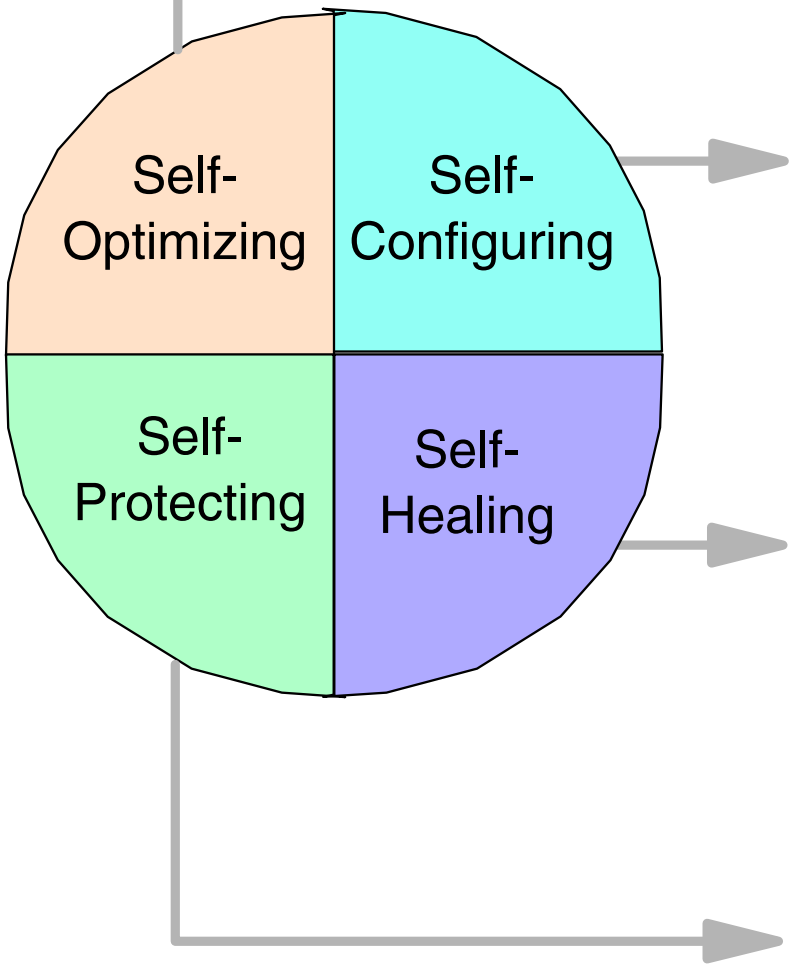
z/OS base element

- Increase availability of systems and applications
  - Improve system recoverability
  - Reduce outages due to operations errors
- Decrease total cost of ownership
  - Reduce operations complexity
  - Greater operational awareness
- Manage:
  - Systems in a Parallel Sysplex environment
  - Coupling Facilities, couple data sets and structures

Automate

- WTO(R) buffer shortage
- System log problems
- Relieve ENQ contention or auxiliary storage shortages
- Clear "pending" conditions of CF structures

IBM Eserver and Autonomic computing



- Intelligent Resource Director
- Parallel Sysplex extensions - Cisco distributors
- z/OS Workload Manager
- TCP/IP BIND9 Domain Named Server

- z/OS msys for Setup
- z/OS wizardry
- Capacity Upgrade (CPs, I/O, memory)
- Automatic hardware detection/configuration
- Automatic communication configuration

- z/OS msys for Operations and System Automation for OS/390
- Concurrent memory upgrade (CUoD)
- Capacity backup
- CPU, memory (ECC), I/O, network
- Sysplex coupling facility duplexing
- Concurrent maintenance
- Virtual IP takeover
- Electronic service agent (call-home support)

- Intrusion detection (IDS)
- Cryptographic enhancements (PCI accelerator)
- Digital certificates
- SSL
- LDAP
- Tivoli Policy Director

Formerly know as Project eLiza (Self-Configured)

zSeries Educational Offerings

Sysplex / zSeries course offerings

- H4016 (2 days) HMC Class
- H4041 (3) Plex Ops & Recovery (sysplex only)
- H4057 (5) Plex Ops & Recovery (H4016 & H4041)
- ES902 (5) Advanced Plex Recovery
- ES420 (5) Plex Implementation
- ES830 (5) CSAR (Complex Systems Availability & Recovery)
- ES820 (2) System z9 and zSeries Mainframe Environment (A Technical Overview)
- OZ09 (2) z/Architecture for z900 and z800
- OZ05 (2) System z9 / zSeries 990/z890 Technical Update & Configuration
- OZ96 (5) zSeries Channel Architecture, ESCON/FICON Operation and PD
- ES326 (3) FICON(fc,fcv,fcp) Planning, Implementation, Operation and PD
- ES960 (4) HCD and Dynamic I/O
- ES270 (3) z/OS and OS/390 System Operations

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