Session Title: The VSAM Redirector technology in z/VSE

Session ID: ZEO05

Speaker Name: Wilhelm Mild

Authorized

IBM | Training

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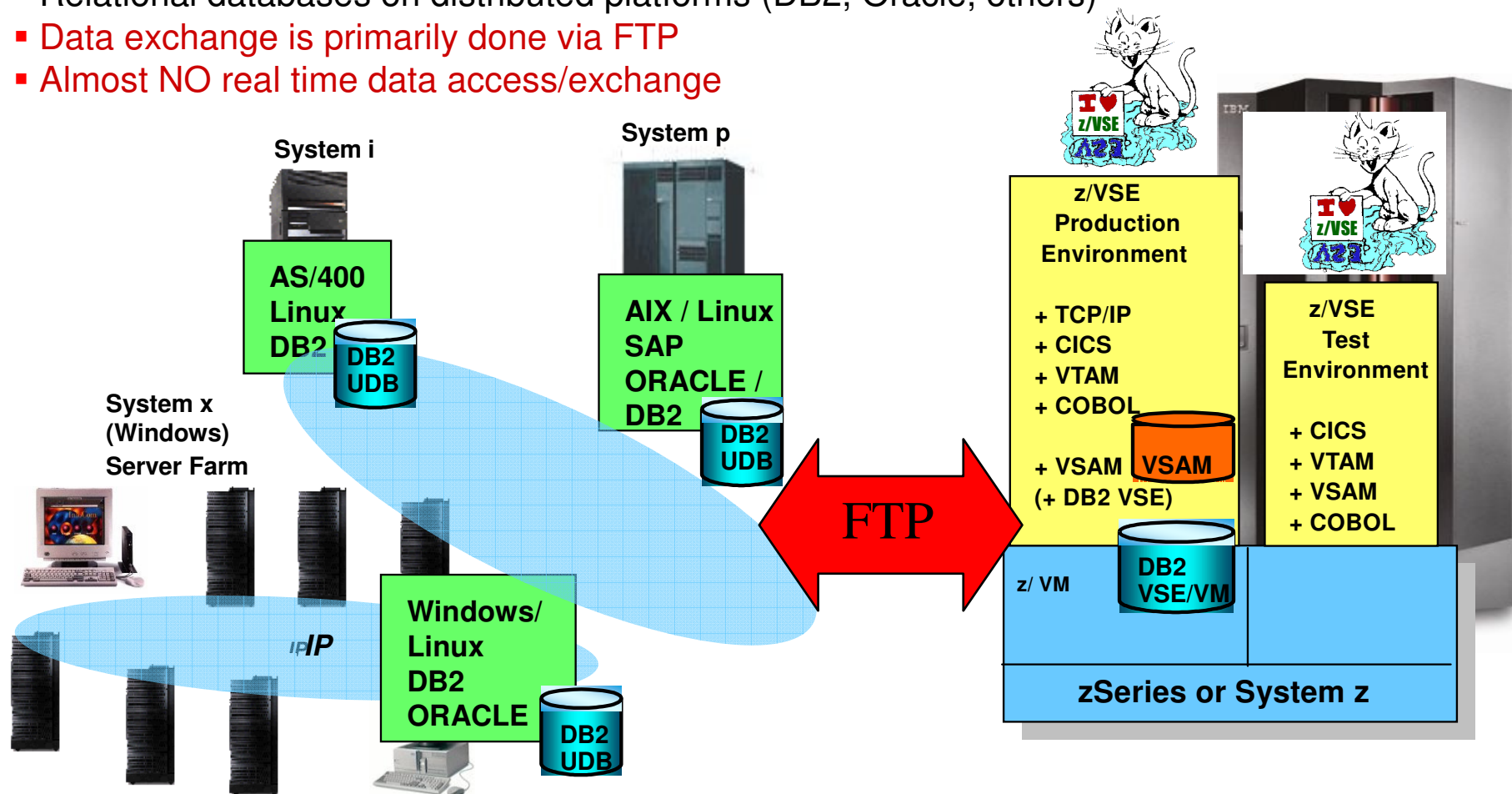UNIX is a registered trademark of The Open Group in the United States and other countries.

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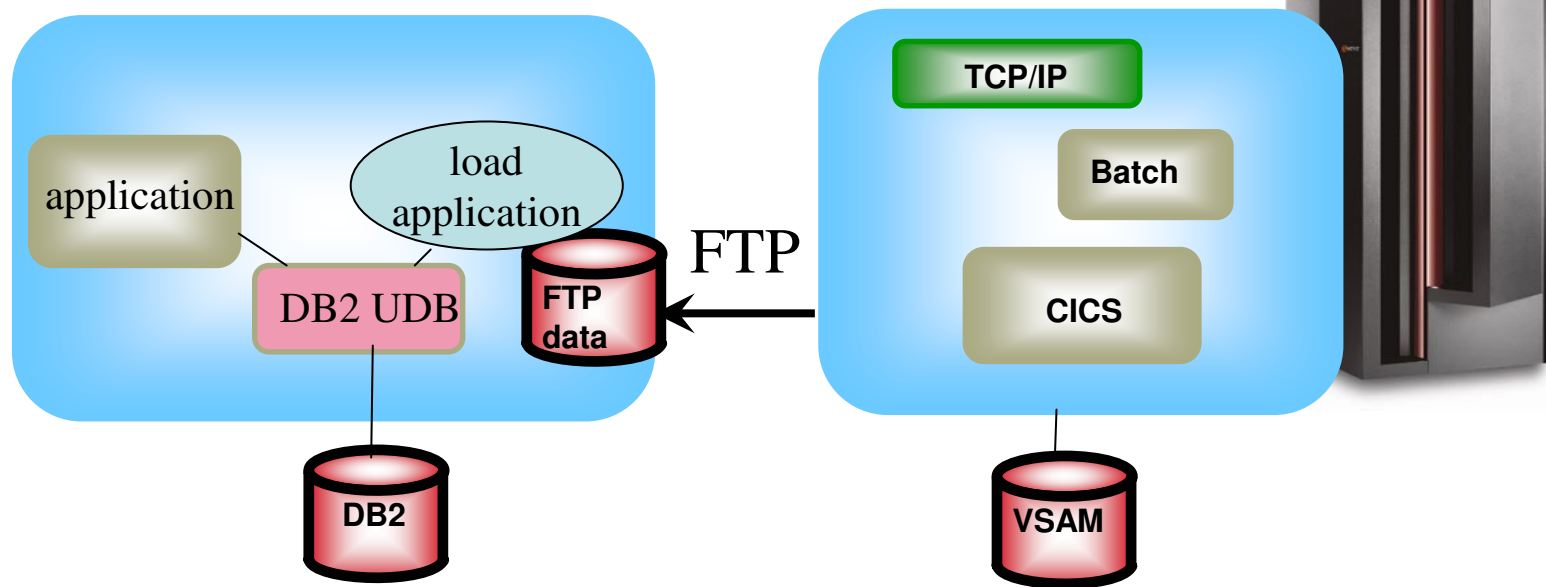
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A typical VSE environment today

- Various different servers (System z, System p, System i, System x, and others)
- VSAM data on VSE (some DB2 environments, some other databases)
- Relational databases on distributed platforms (DB2, Oracle, others)
- Data exchange is primarily done via FTP
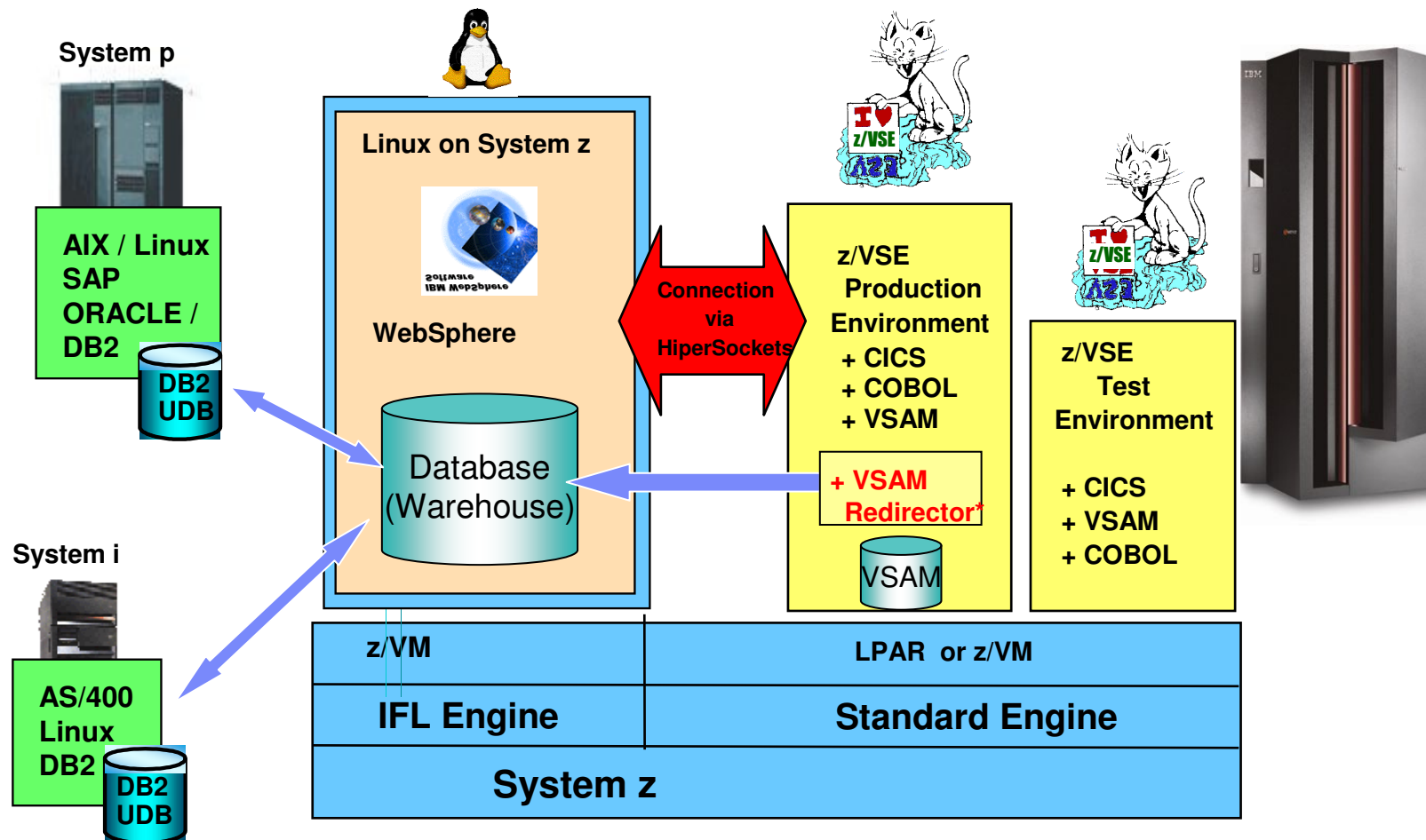- Almost NO real time data access/exchange

System i

AS/400 Linux DB2

DB2 UDB

System p

AIX / Linux SAP ORACLE / DB2

DB2 UDB

System x (Windows) Server Farm

IP

Windows/ Linux DB2 ORACLE

DB2 UDB

FTP

z/VSE Production Environment

+ TCP/IP
+ CICS
+ VTAM
+ COBOL

+ VSAM | VSAM
(+ DB2 VSE)

z/ VM

DB2 VSE/VM

z/VSE Test Environment

+ CICS
+ VTAM
+ VSAM
+ COBOL

zSeries or System z

VSE/VSAM applications and FTP data transfer today

(1) disadvantages of FTP

- a) NO real-time access/synchronization
- b) data immediate out of sync, till next FTP
- c) always the whole file is transferred
- d) intermediate step – database loader needed
- e) FTP is a stateless protocol – no guaranteed delivery
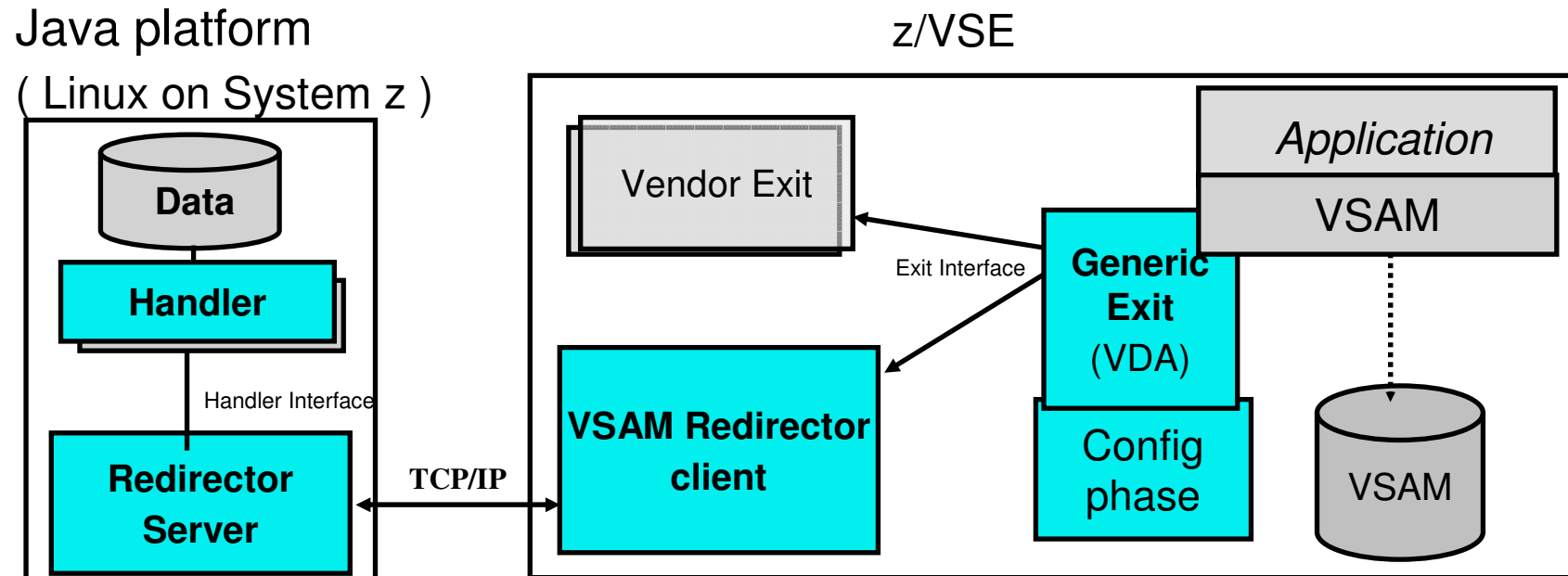- f) increased network traffic

z/VSE Server

application

load application

DB2 UDB

FTP data

FTP

TCP/IP

Batch

CICS

DB2

VSAM

VSAM Programs with DB2 UDB on Linux on System z

System p

AIX / Linux
SAP
ORACLE /
DB2
DB2 UDB

Linux on System z

WebSphere

Database
(Warehouse)

Connection via HiperSockets

z/VSE Production Environment
+ CICS
+ COBOL
+ VSAM

+ VSAM Redirector*
VSAM

z/VSE Test Environment

+ CICS
+ VSAM
+ COBOL

System i

AS/400
Linux
DB2
DB2 UDB

z/VM	LPAR or z/VM
IFL Engine	**Standard Engine**

System z

(*) VSAM Redirector – Common data store solution – with DB2 on Linux on zSeries Solutions without changes to VSAM programs

VSE/VSAM Redirector - functional view

Java platform

(Linux on System z)

z/VSE

Data

Handler

Handler Interface

Redirector Server

TCP/IP

Vendor Exit

Exit Interface

VSAM Redirector client

Generic Exit (VDA)

Config phase

Application

VSAM

VSAM

► **Redirector Components:**

► **Generic Exit is based on VSAM Data Access Exit (VDA)**

► **Config phase – contains the redirection properties**

► **Redirector client (SVA phase)**

► **Redirector server – manages the connections (Java component)**

► **Handler – takes care of data processing (Java component)**

VSAM Redirector
– the Client

- **The Client**, Shipped in VSE phase IESREDIR
- Forwards all requests via TCP/IP socket to VSAM Redirector Server on a remote site
- Important Parameter
  - OWNER=REDIRECTOR
    - VSAM requests are executed by remote site only
    - VSAM does not execute the request
      - controlled by return code from IKQVEX01
    - Allows migrating VSAM data to a database without changing the VSAM programs
  - OWNER=VSAM
    - Both, VSAM and remote site executes the request
    - Allows synchronization of VSAM and database without changing the VSAM programs
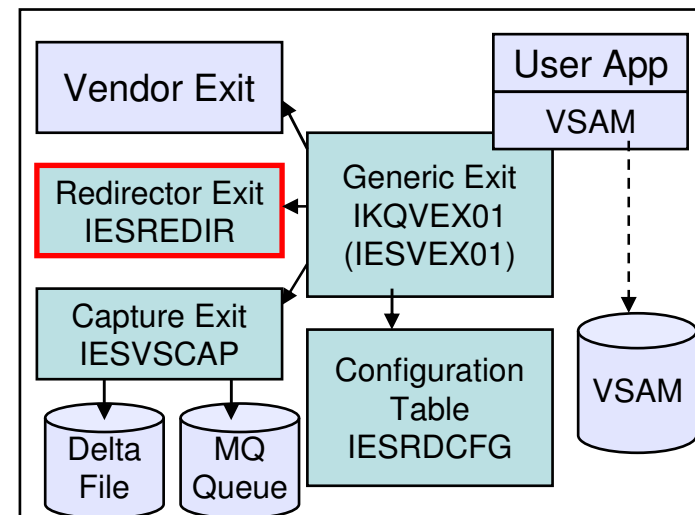
VSAM Redirector
– Configuration Table

- Gets assembled as VSE PHASE
  - Does not contain any executable code, just a table

```
IESRDENT CATALOG='MY.VSAM.CATALOG',
        CLUSTER='MY.VSAM.CLUSTER1',
        EXIT='IESREDIR',
        OWNER=REDIRECTOR,
        IP='1.2.3.4',
        HANDLER='com.ibm.vse.db2handler.DB2Handler,
        OPTIONS='dburl=jdbc:db2:database;dbuser=user;
                 maptable=maptable;map=mapname;
                 dbpassword=password;dbtable=table,

IESRDENT CATALOG='VSESP.USER.CATALOG',
        CLUSTER='MY.TEST.CLUSTER2',
        EXIT='IESVSCAP',
        MODE=JOURNALING,
        DELTADD='DELTAFI',
        DELTATYPE=KSDS,
        SHARE=ENDREQ,
        ORIGIN='TEST2'
```
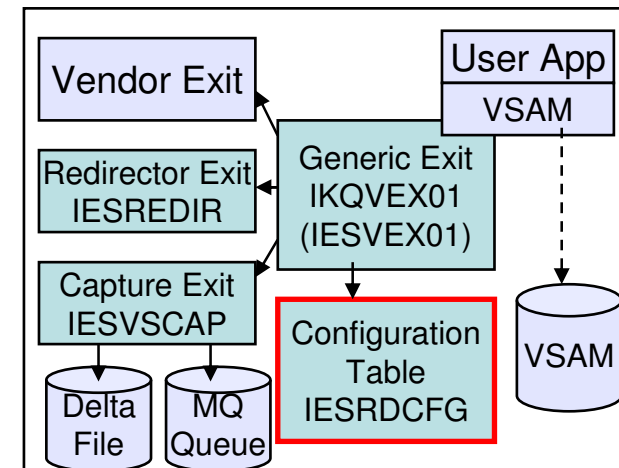
The flavors of VSAM redirector

(1) Remote processing - Real time VSAM access to remote

    a) Remote only processing to DB2 (no VSAM access anymore)

    b) Synchronization (two phase commit of VSAM and DB2)

(2) Capture - VSE local data processing in addition to VSAM

    a) Capture Exit for VSAM processing

    b) MQ Exit and MQ Series solutions

VSE/VSAM applications (without any change), access remote relational databases

(1) Real time access VSAM to DB2

    a) synchronization (two phase commit of VSAM and DB2)

    b) Real time push of VSAM data to DB2

z/VSE Server

VSAM Redirector Server

Handler

database

DB2

TCP/IP

VSAM Redirector Client

Batch

CICS
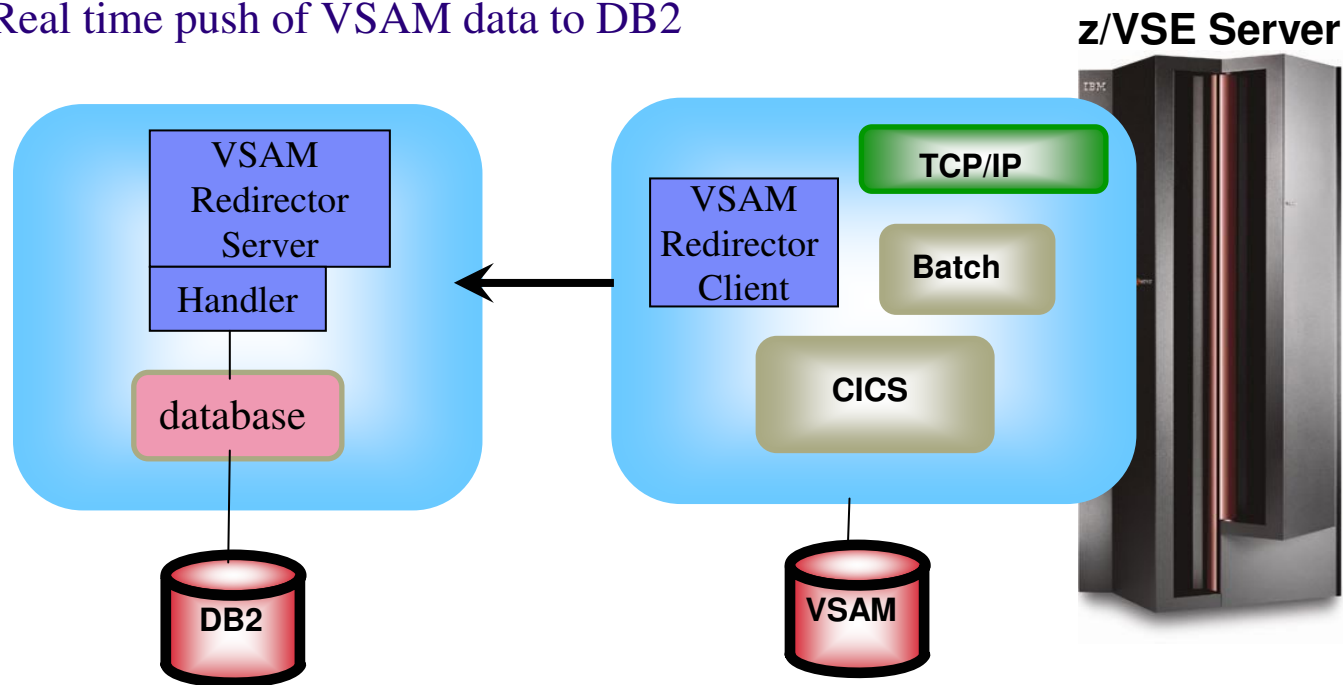
VSAM

VSE/VSAM applications (without any change), access remote relational databases

(1)   Real time access VSAM to DB2

    a)   synchronization (two phase commit of VSAM and DB2)

    b)   Real time push of VSAM data to DB2
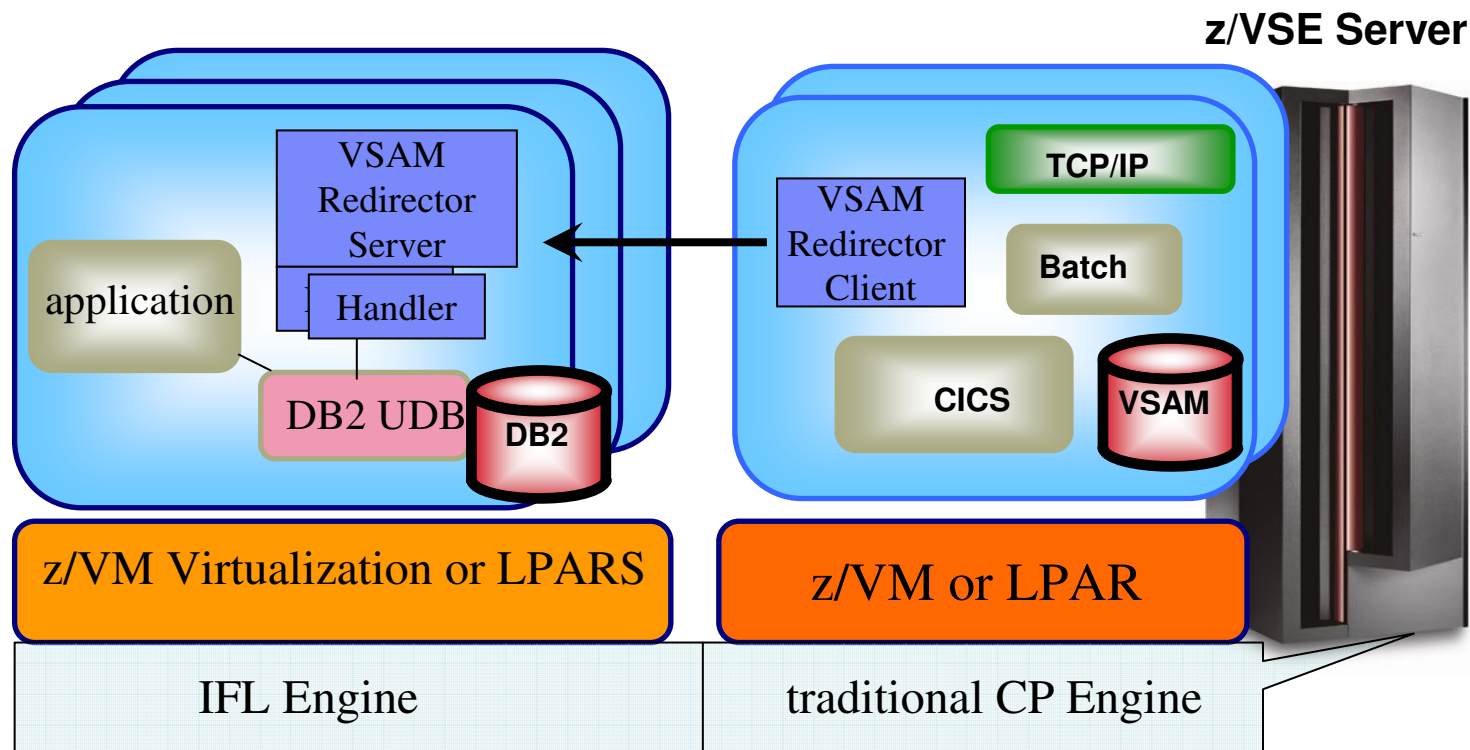
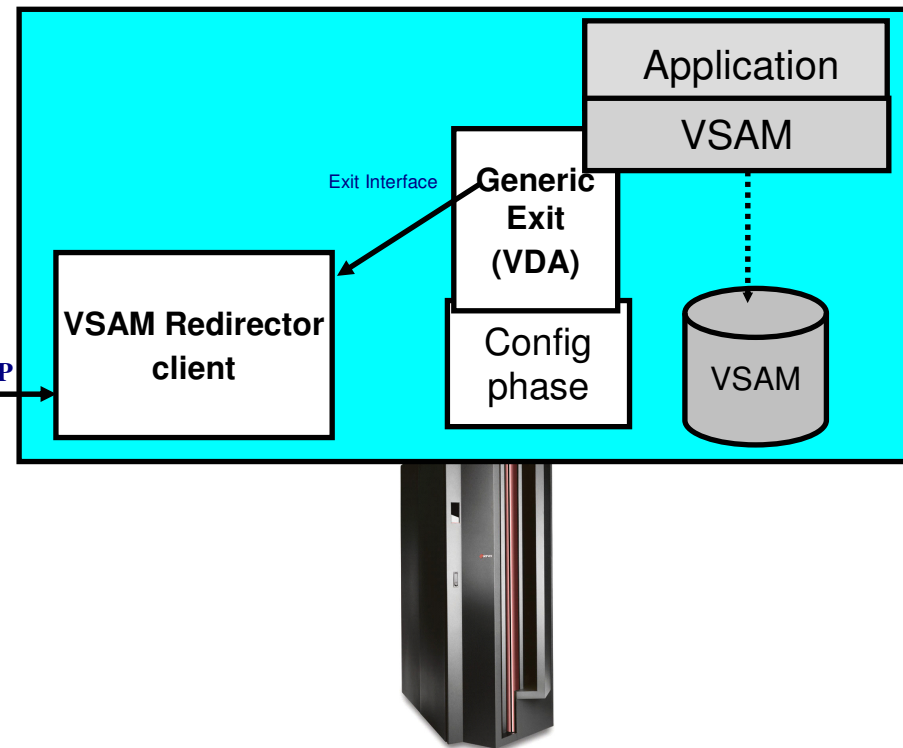# VSE/VSAM applications, access remote relational databases
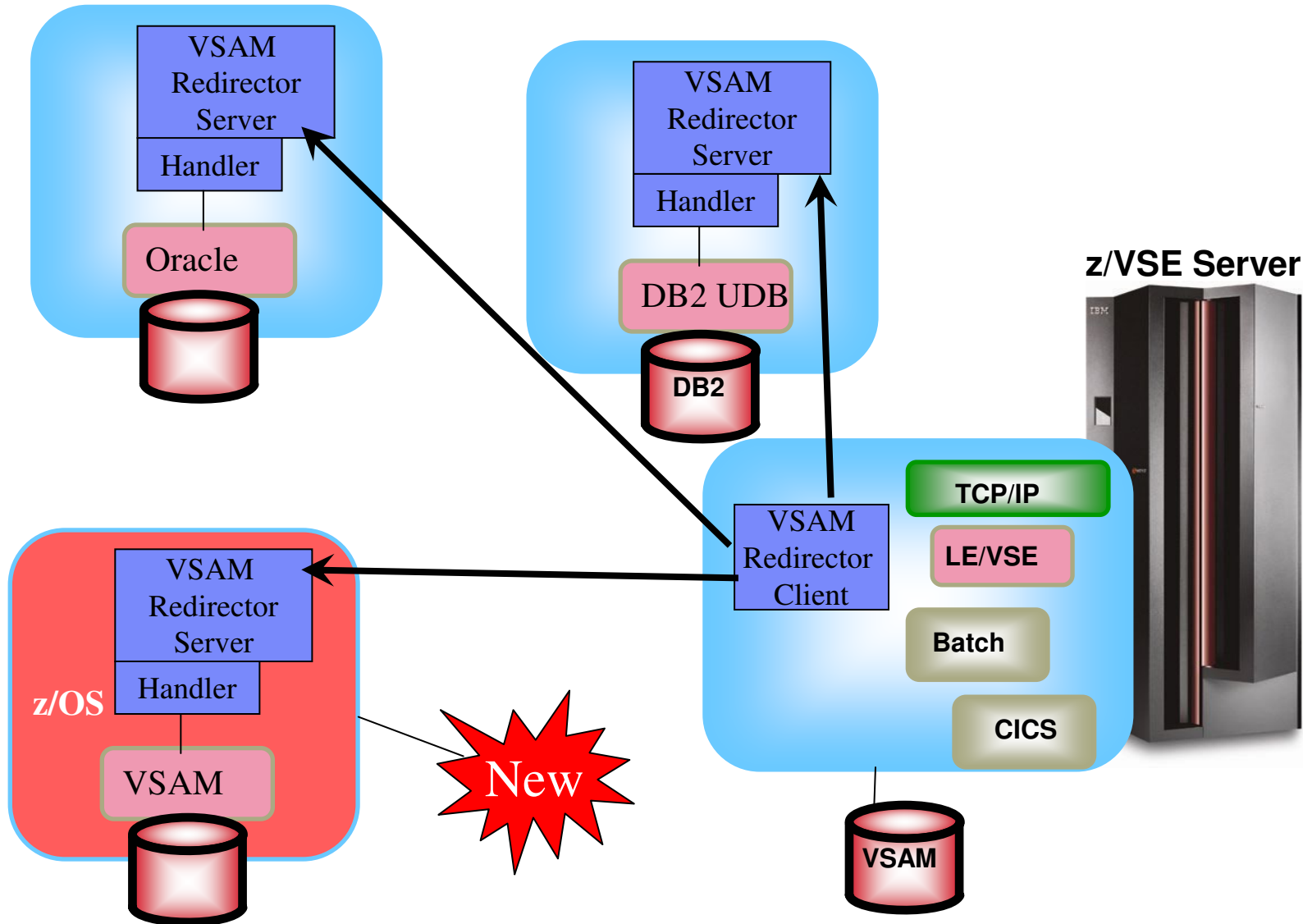
(1) Remote processing

a) Remote only processing – NO VSAM access anymore

- Requests for redirected VSAM files will be handled by VSAM Redirector client and send to the remote system.
- OWNER = REDIRECTOR

- Dataflow for a read/write request:
  - Generic exit is involved
  - VSAM Redirector Client is called
  - Redirector client sends request to Redirector Server
  - Handler processes data
  - Return Code if any is translated to VSAM error
- All reads and writes are done from/to remote

Java Platform (Linux for System z)

z/VSE

Data

Handler

Handler Interface

Redirector Server

TCP/IP

VSAM Redirector client

Exit Interface

Generic Exit (VDA)

Config phase
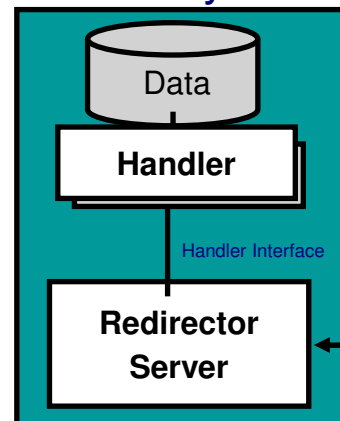
Application

VSAM

VSAM

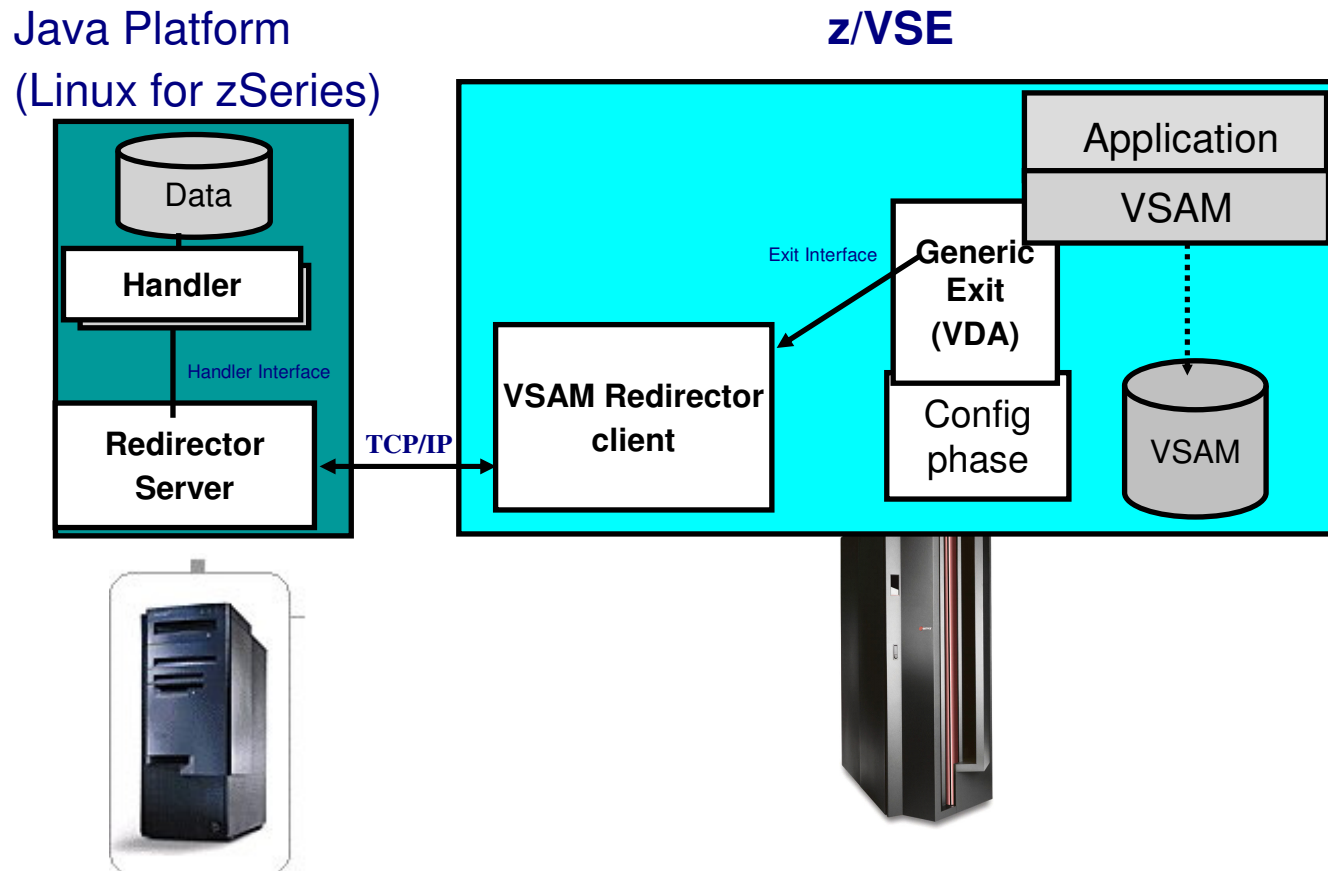No changes required in applications (CICS, batch).

Redirector enhancement

- VSE/VSAM redirector provides

the capability to perform requests to redirected KSDS clusters over the PATH using AIX for OWNER parameter equal REDIRECTOR.
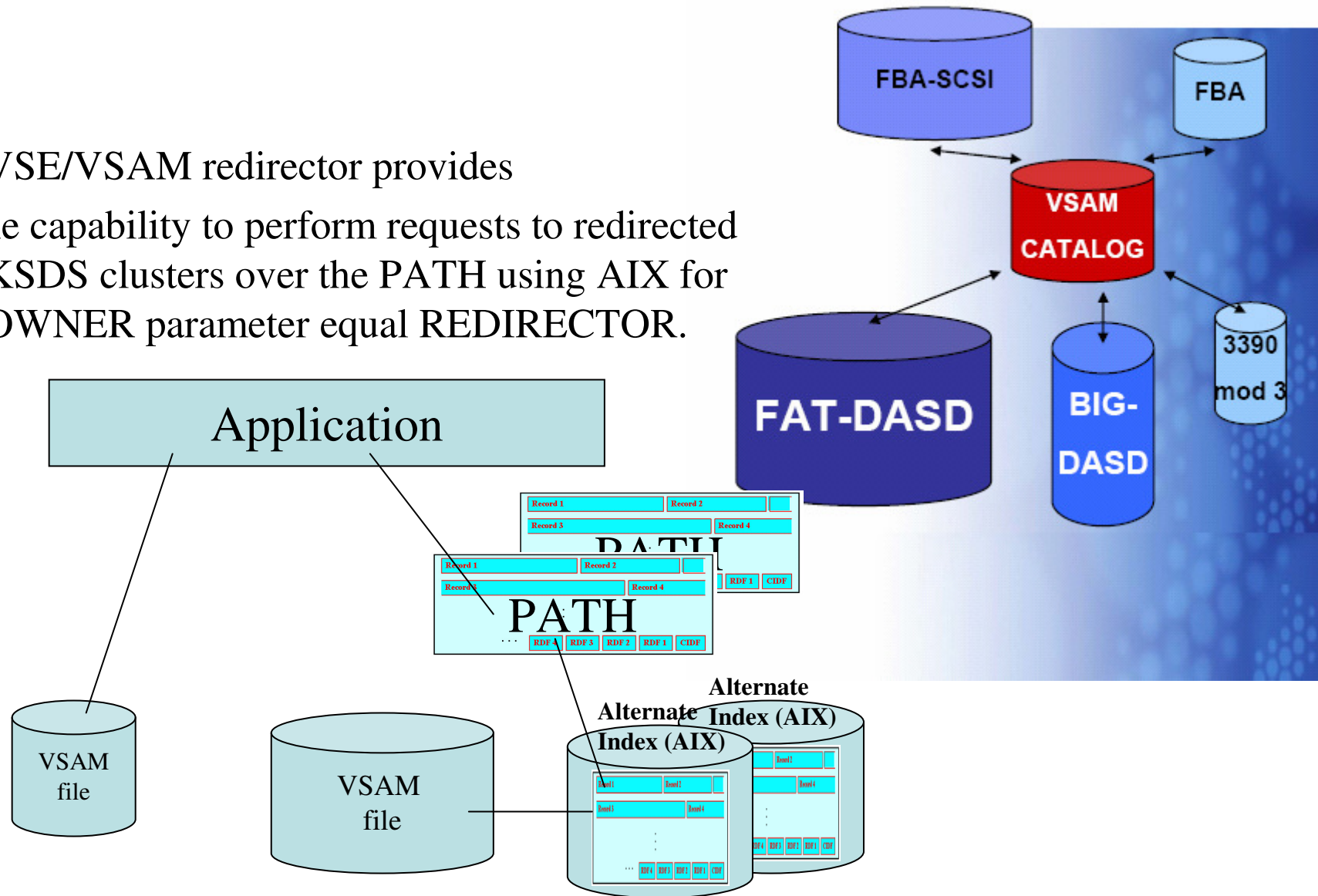
(1) Remote processing
a) Synchronization of VSAM with a database

Java Platform
(Linux for zSeries)

z/VSE

Data

Handler

Handler Interface

Redirector
Server

TCP/IP

VSAM Redirector
client

Exit Interface

Generic
Exit
(VDA)

Config
phase

Application

VSAM

VSAM

No changes required in applications (CICS, batch).

(1) Remote processing

a)   Synchronization of VSAM with a database

- Requests for redirected VSAM files will be handled by VSAM Redirector client and send to the remote system.
- OWNER = VSAM

- Dataflow for a read/write request:
  - READs will be performed from VSAM only
  - Generic exit calls VSAM Redirector Client
  - Redirector client sends request to Redirector Server
  - (a) Handler processes the request in the database
  - Return Code is send back to Redirector client
    - In case of an error it will be translated to a VSAM error
  - (b) If return code is favorable the request is processed in VSAM
  - (c-1) If the VSAM request is processed correct – the database will get a COMMIT request
  - through the Redirector Client-Server-Handler
  - (c-2) If the VSAM request ends in error – the database will get a ROLLBACK request

- This is the two phase commit mechanism to keep VSAM and DB2 in sync

Data synchronization – Normalization

VSE/VSAM Redirector can store VSAM data normalized

►No changes to the existing VSE applications

►**The new Redirector Handler in z/VSE 4.1 can store 'VSAM' data in multiple DB Tables .**

►**Redir Loader utility provided for initial data transfer**
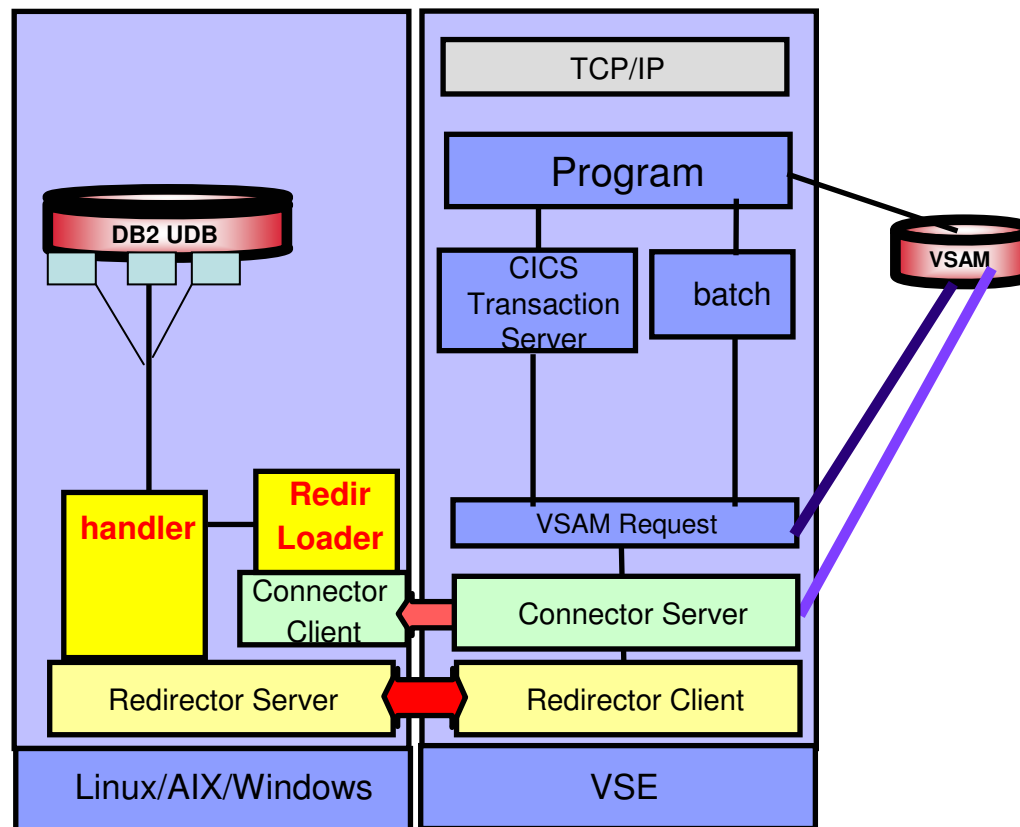
►Applications on VSE should be able to access DB2 data on Linux

►Population of DB2 UDB on Linux with VSAM using VSAM Redirector.
 (VSAM Redirector is part of VSE)

VSAM Redirector – Normalization - Handler

- Two different Handler with the New VSAM Redirector
  - Old: DB2Handler
    - Is still packaged with z/VSE
    - supports data access consolidation (OWNER=REDIRECTOR) as well as data synchronization (OWNER=VSAM)
    - supports DB2, Oracle, MS-SQL, ...
    - was enhanced with new data formats (packed, zoned, date, ...)

  - New: DBHandler
    - enables data Normalization
    - supports data synchronization only (OWNER=VSAM)
      - supports Record-Types
      - supports lists with fixed and variable length
    - supports new data formats (Packed, Zoned, Datum, ...)
      - supports DB2, Oracle, MS-SQL, ...

VSAM Redirector – Normalization - Handler
New Redirector handler in z/VSE 4.1

- Handler to Normalize VSAM data
  - store one VSAM record in multiple tables
    - based on VSAM indicator fields
    - administrator decision
    - for synchronization only (owner = VSAM) - READS are done from VSAM
  - relation between tables to be unique
  - definitions via GUI (mapping configuration)
  - SQL loader provided for database load
    - RedirLoader - fast initial LOAD of a database from VSAM
    - MQLoader - MQ trigger application
    - DeltaLoader – Processing of the Delta file – insert into the database

VSAM Redirector - Normalization – data types

- New extendable Concept: Converters
  - One Java-class per data type
  - Open interface
  - New data types can be extended easily
- Data types:
  - STRING
  - BINARY
  - BIT
  - Numbers (INTEGER, PACKED, ZONED, FLOAT, FIXEDTEXT, FLOATTEXT), supports Implied decimal positions
  - DATETIME, TOD
  - HEXCHAR
- Various Options
  - Settings (i.e. date format, number of decimals, ...)
  - Error handling: ONERROR= TERMINATE, TO-NULL, TO_ZERO
  - Text handling: TRIM, PAD, BLANK-TO-NULL, CODEPAGE

VSAM Redirector - Normalization – Record-Types

```
COBOL Copybook:
01 RECORD-3
  03 RECORD-TYPE            PIC X(1)
  03 RECORD-FORMAT-C
    05 CUSTOMER-NO                   PIC X(7)
    05 CUSTOMER-NAME       PIC X(25)
    05 CUSTOMER-ADDRESS    PIC X(45)
  03 RECORD-FORMAT-P REDEFINES RECORD-FORMAT-C
    05 PRODUCT-NO                    PIC X(7)
    05 PRODUCT-CATEGORY   PIC X(15)
    05 PRODUCT-NAME        PIC X(15).
```

Customers

Table for
Record-Type C

CustNo
Name
Address
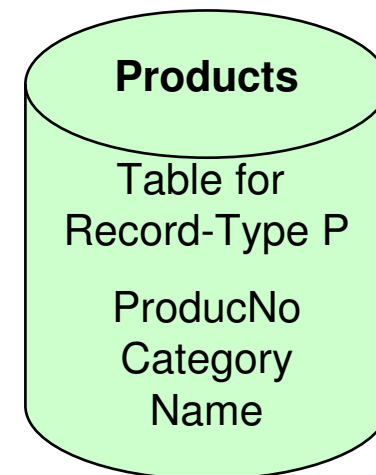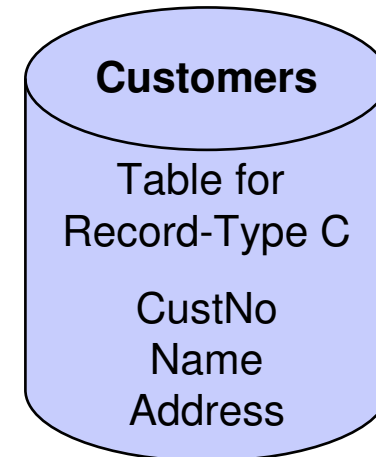
Depending on the value of Record-Type field, the data
will be store in different database tables

▪ Type = C → Customers-Table

▪ Type = P → Products-Table

The association takes place at runtime for each
individual record.

Products

Table for
Record-Type P

ProducNo
Category
Name

VSAM Redirector - Normalization – Lists

COBOL Copybook:

```
01 RECORD-2.
   03 KEYFIELD           PIC X(8).
   03 COUNTER            PIC 9(5) COMP-3.
   03 VARIABLE-LIST OCCURS 1 TO 5
                          DEPENDING ON COUNTER.
     05 LISTFIELD-1           PIC 9(9).
     05 LISTFIELD-2           PIC X(5).
   03 DATAVALUE               PIC X(10).
```
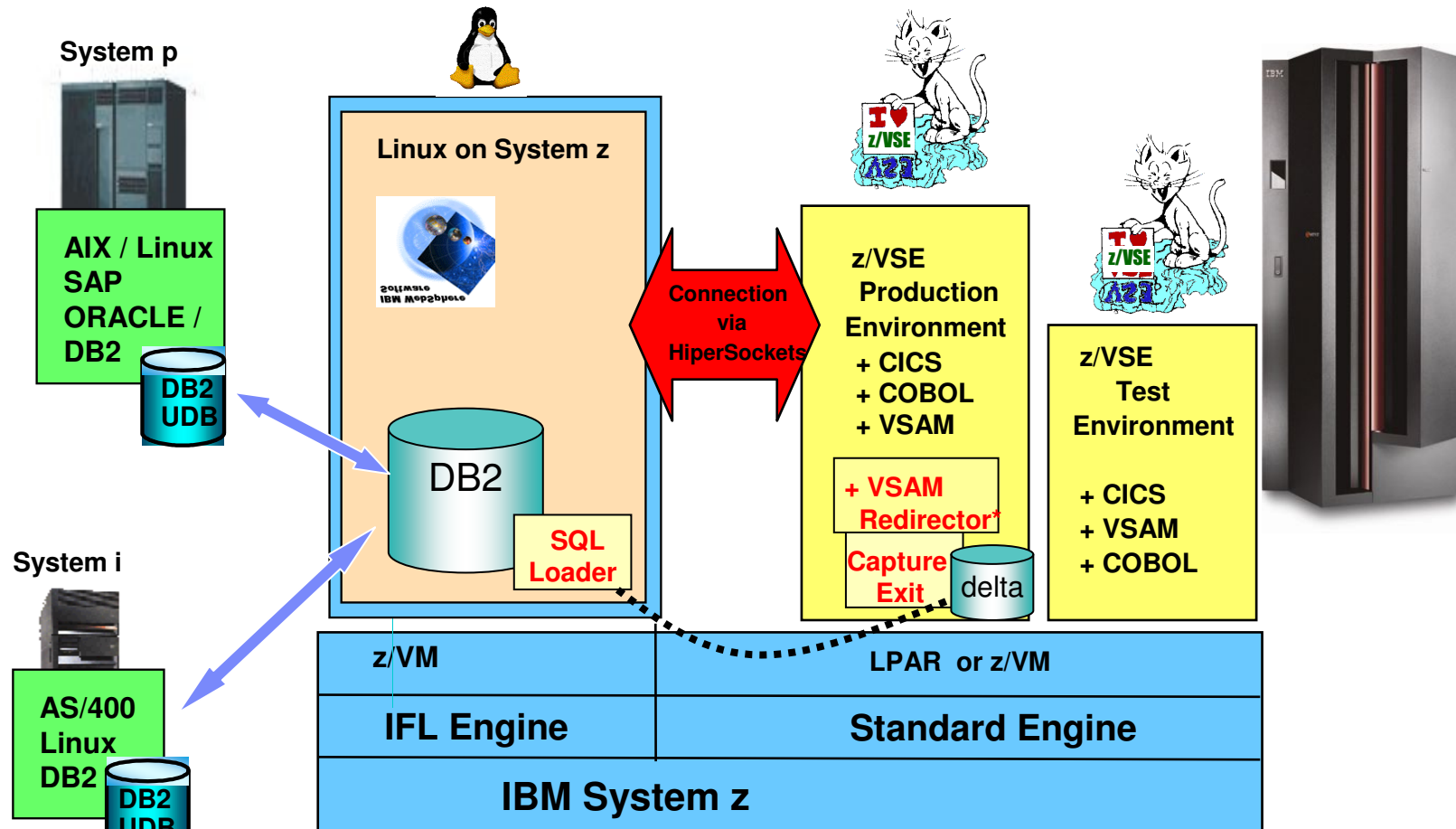
Master-Table

Master-Table

Keyfield
Counter
DataValue

Depending on the value of the field Counter, there will be inserted 1 to 5 rows into the List-Table.

The relation to the Master-Table is defined through the foreign key Keyfield in the List-Table

Normalization takes place at runtime for each individual record.

List-Table

Table for
Lists-Values

Keyfield
ListField1
ListField2

VSAM Programs with DB2 UDB on Linux on System z

System p

AIX / Linux
SAP
ORACLE /
DB2

DB2
UDB

Linux on System z

DB2

SQL
Loader

System i

AS/400
Linux
DB2

DB2
UDB

Connection
via
HiperSockets

z/VSE
Production
Environment
+ CICS
+ COBOL
+ VSAM

+ VSAM
Redirector*

Capture
Exit   delta

z/VSE
Test
Environment

+ CICS
+ VSAM
+ COBOL

z/VM   LPAR or z/VM

IFL Engine   Standard Engine

IBM System z

**(*) VSAM Redirector – Common data store solution – with DB2 on Linux on zSeries Solutions
without changes to VSAM programs**

VSAM **Data** collection / transformation / journaling on VSE
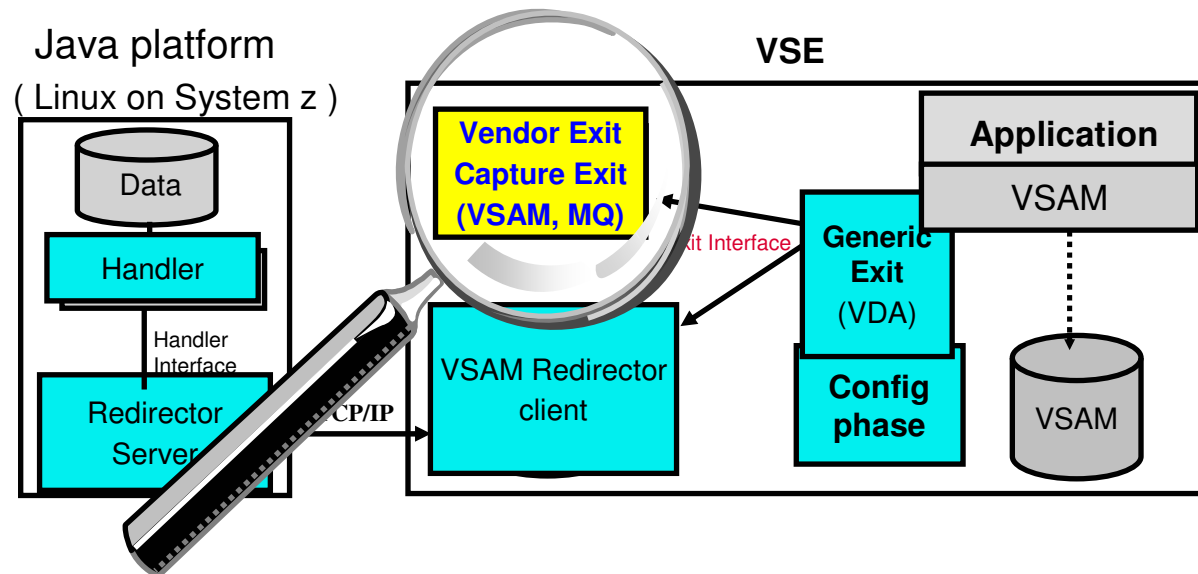
Capture Exit

Java platform
(Linux on System z)

VSE

Data

Handler

Handler Interface

Redirector Server

TCP/IP

Vendor Exit
Capture Exit
(VSAM, MQ)

Exit Interface

VSAM Redirector client

Generic Exit (VDA)

Config phase

Application

VSAM

VSAM

CAPTURE – wit Decision Exit as filter

► **Vendor Exit**
  ► **user (vendor) written phase for data collection/transformation**
  ► **has to comply with the documented Exit Interface**
► **Capture Exit**
  ► **an exit delivered by IBM for capturing changed VSAM data**
  ► **an exit delivered by IBM for generating MQ messages**
Note: No chaining of Vendor Exit with VSAM Redirector client supported

VSAM **Data** collection / transformation / journaling on VSE
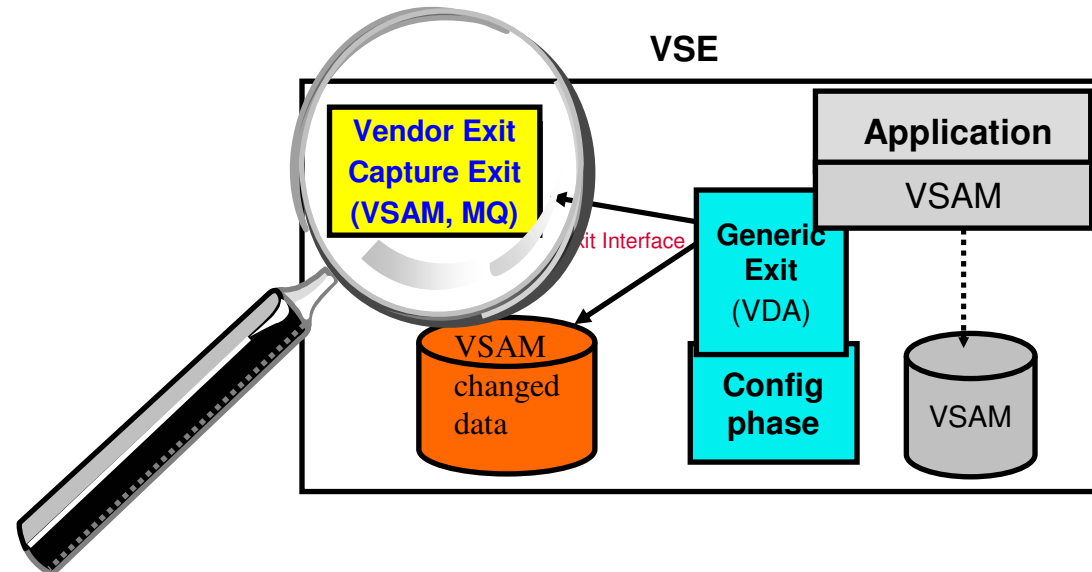
Capture Exit

VSE

Vendor Exit
Capture Exit
(VSAM, MQ)

Exit Interface

Application

VSAM

Generic
Exit
(VDA)

VSAM
changed
data

Config
phase

VSAM

CAPTURE – wit Decision Exit as filter

►**Vendor Exit**

  ►**user (vendor) written phase for data collection/transformation**

  ►**has to comply with the documented Exit Interface**

►**Capture Exit**

  ►**an exit delivered by IBM for capturing changed VSAM data**

  ►**an exit delivered by IBM for generating MQ messages**

Note: No chaining of Vendor Exit with VSAM Redirector client supported

z/VSE 4.1 VSAM Redirector – Capture Exit

- Shipped in phase IESVSCAP

- Captures all changes to a VSAM file
  - UPDATE
  - INSERT
  - DELETE
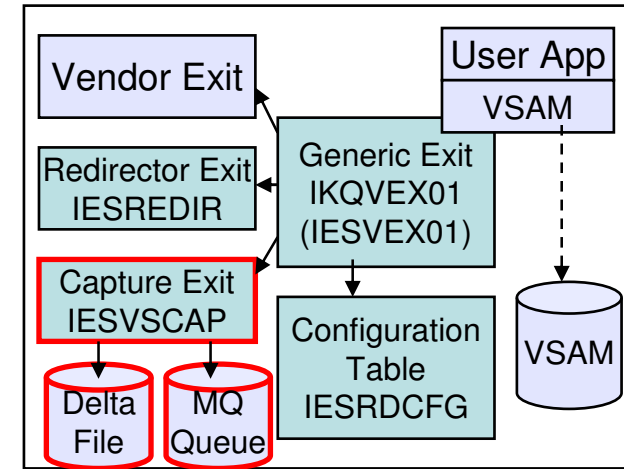
- Creates delta records with header + original data
  - Stored in second VSAM file (delta file)
  - Or creates MQ Series message

- Delta record header contains information about when and by whom the record was changed, and which request

- Allows customers to download the delta file and apply it to a database

Redirector Capture.
Architectural View

Application
(i.e. in CICS or batch)

VSAM

VSAM Redirector

Decision
Exit

Vendor Exit as
Capture Exit

access:
- reads records
- changes records
- inserts records
- deletes records

**marks the
changed
records**

VSAM changed
data
(delta)

VSAM
data store

z/VSE

VSAM Redirector Capture

z/VSE 4.1

Application
(CICS or batch)

VSAM

Redir Exit

VSAM Redirector
(Generic Exit)

Vendor Exit
(Customer developed)

access:
- reads records
- changes records
- inserts records
- deletes records

Capture Exit
(MQ Series)

Decision
Exit

Capture Exit
(Journaled, Cumulative)

Decision
Exit

VSAM
main data

MQ Message
Queue

VSAM delta
file

Journaling or **cumulative**

KSDS   Delta File   Delta File   KSDS

Journaling Delta File
Record 1   inserted
Record 2   inserted
Record 3   inserted
Record 2   updated
Record 1   deleted
Record 3   updated
Record 4   inserted
Record 1   inserted
Record 2   updated
Record 4   updated
Record 4   deleted

key
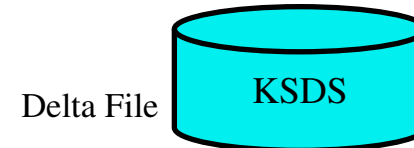
Cumulative Delta File
Record 1   inserted
Record 2   updated
Record 3   updated
Record 4   deleted

☞ The last version only of a changed VSAM record is stored into the delta file

Delta Record

KSDS:

| key | data |

| Delta Header | key | data |

delta key (cumulative)

RRDS/VRDS:

| data |

| Delta Header | RRN | data |

delta key (cumulative)

ESDS:

| data |

| Delta Header | RBA | data |

delta key (cumulative)

Delta Header

Delta Header	RRN/RBA	Rest...
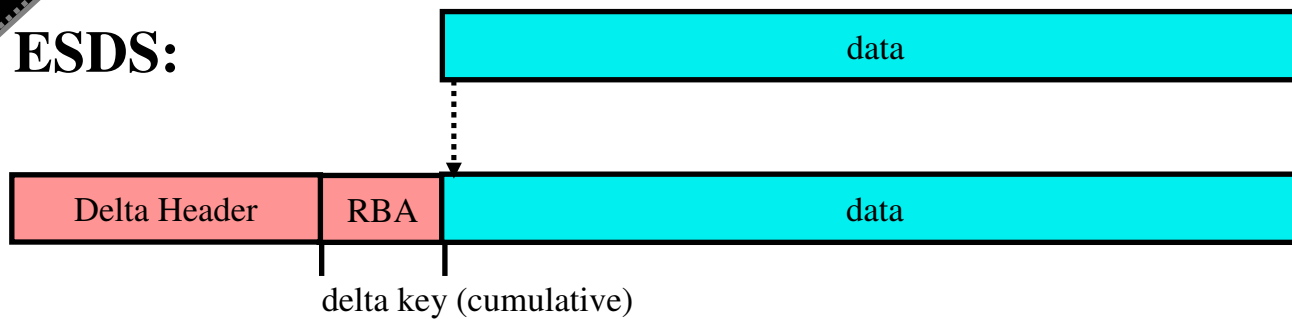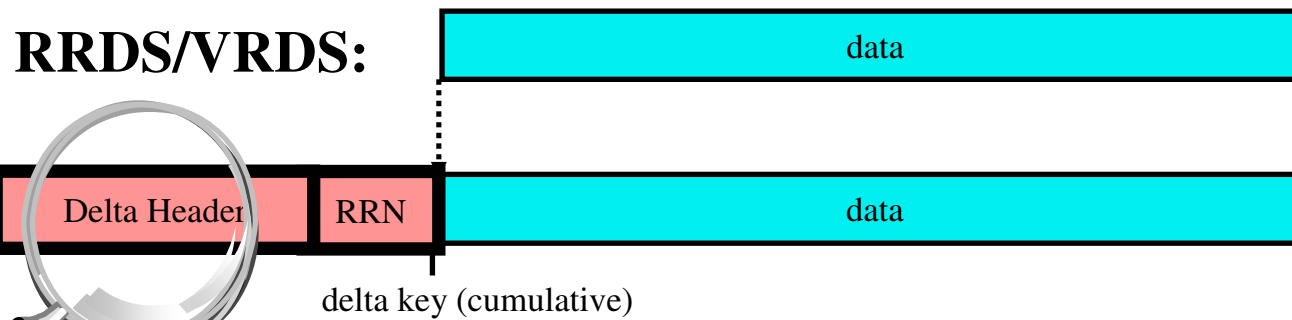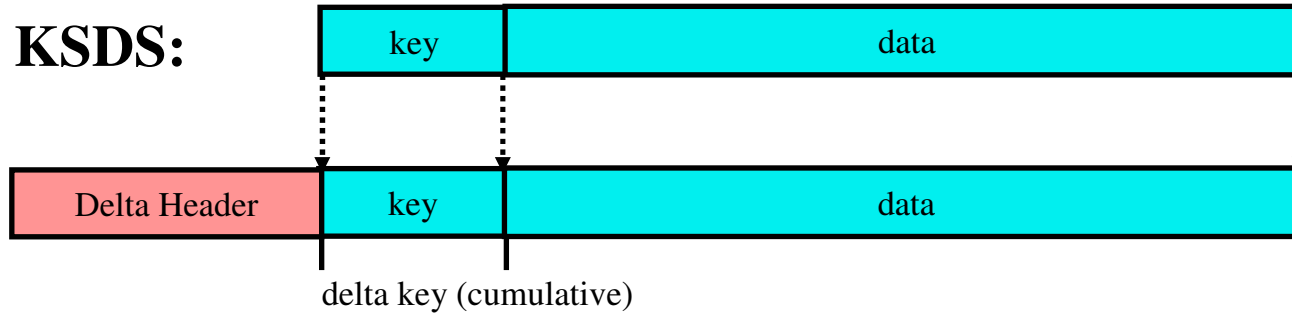
Offset	Parameters	Length	Description
0	TODCLOCK	8	Time of change
8	JobName	8	Job name
16	PHASEName	8	Phase name
24	Origin	8	String from Config or file Label
32	PartID	2	Partition ID (i.e. F2)
34	**OpCode**	**1**	**I=Insert, D=Delete,U=Update**
35	Flags	1	X'01'=RRN/RBA follows
36	RRN/RBA	4	RRN/RBA (RRDS/VRDS/ESDS)

Contains information about:

➔ **when** change took place (TODCLOCK)

➔ **who** did the change (Job/Phase/Partition)

➔ **request type** of change (Insert/Delete/Update)

➔ **which record** was affected (key/RRN/RBA)

VSAM Capture Exit - Solution options

- **Delta records** can be downloaded for processing
  - Using FTP
  - Using VSE Connector Client
  - After processing, delta records are deleted

- **Delta records** can be sent to a remote system via MQ Series
  - Asynchronous transportation or messages
  - Trigger program can process incoming messages

- Multiple VSAM files can be 'captured' into the same Delta File or MQ Series queue
  - Distinction possible via 'origin' value in header

Solution for FTP Replacement:

Bidirectional updates with VSE connectors

► With VSAM
Capture – the
performance of
the VSE
production
system protected

► The changes
are processed
asynchronously
and not
influencing the
production
system
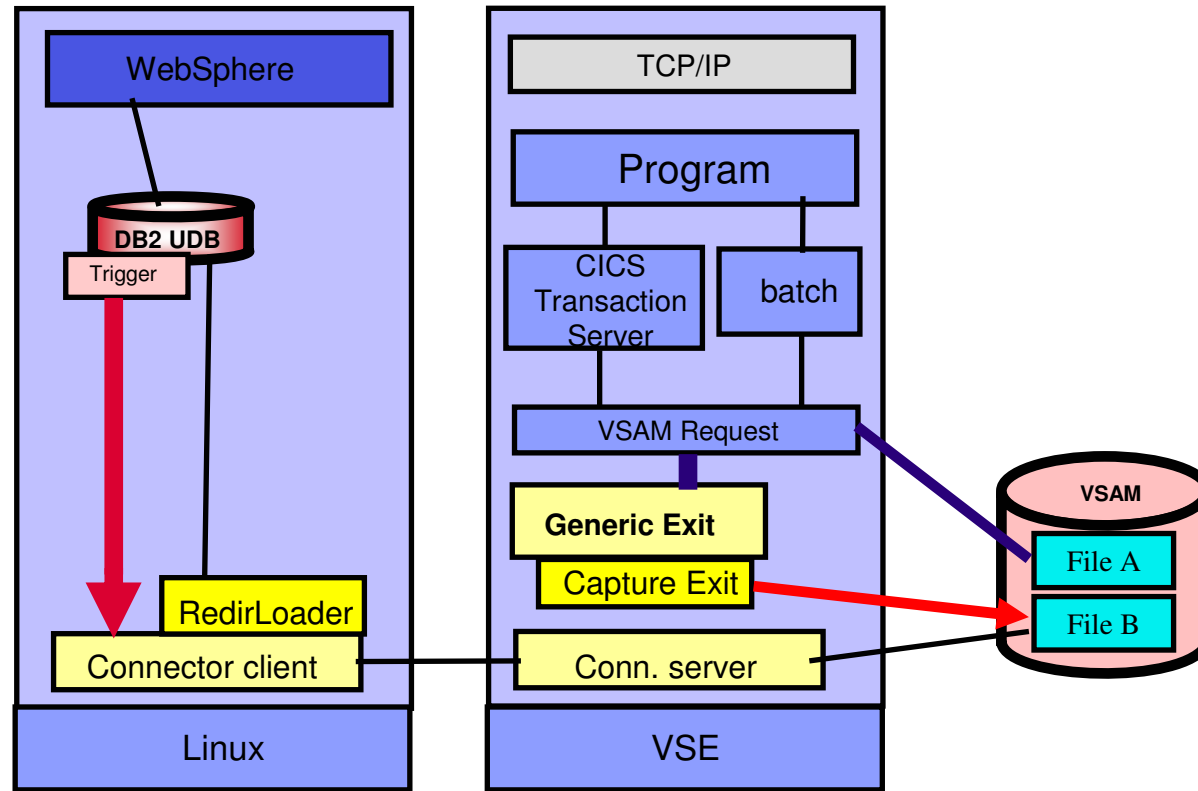
► Collect the changed records in a separate VSAM file

   ► Possibility of cleansing

► Process them – with the VSE Connectors ☐ provided by IBM

VSAM Programs enablement for MQ solutions

(*) VSAM Redirector – with MQ Exit – an MQ Solution without changes to VSAM programs
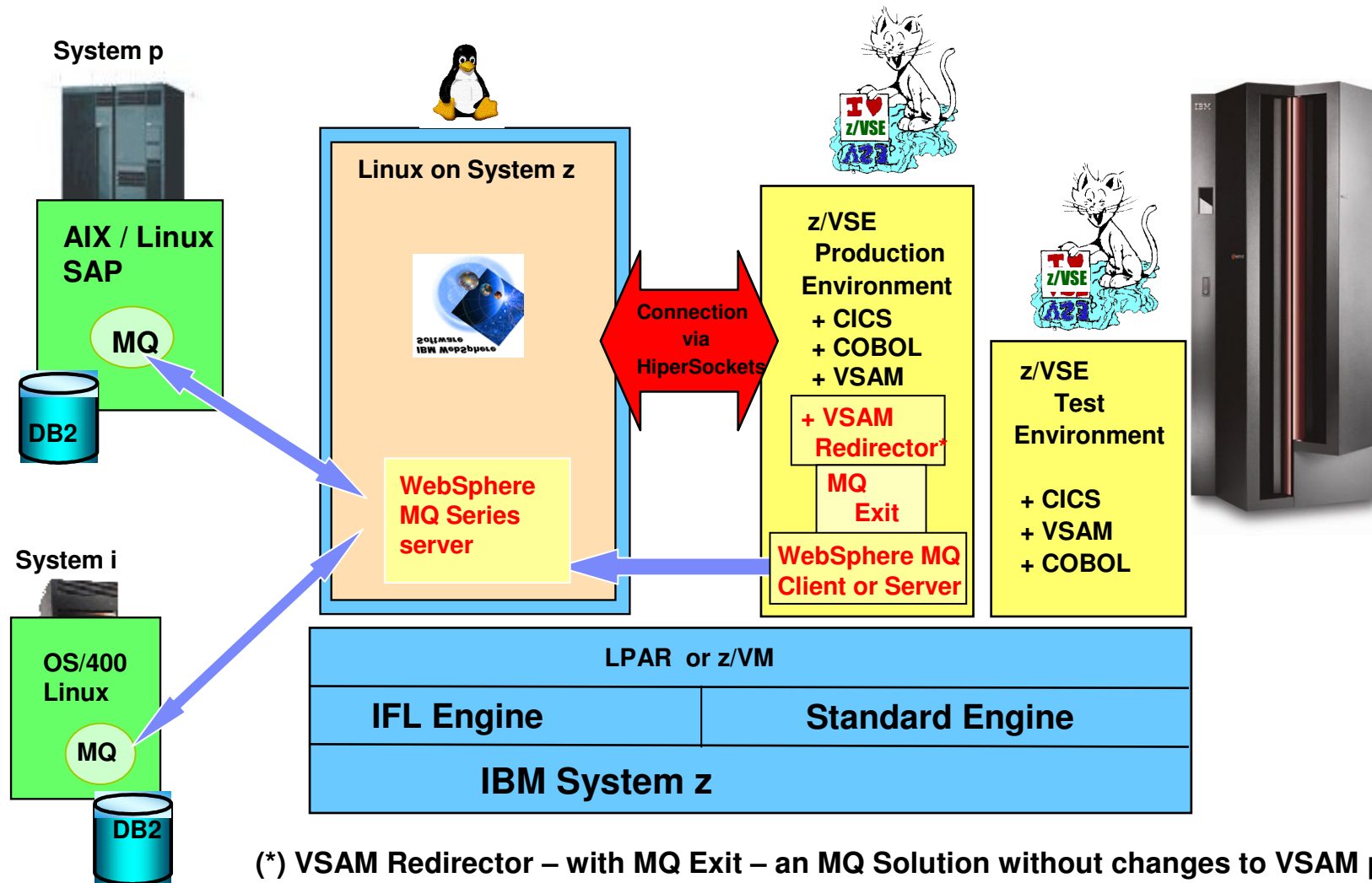
MQ Exit

Integration of VSE Application with MQ Series

► enablement for MQ Series w/o changing existing applications.

►Bidirectional processing

►Guaranteed processing using asynchronous data transfer method MQ

Linux panel:
- WebSphere
- DB2 UDB
  - Trigger
- MQLoader
- Program
- MQ Series Server

VSE panel:
- TCP/IP
- Application
- CICS Transaction Server
- batch
- VSAM Request
- VSAM Redirector
  - Capture (MQ)
- MQ Series
- Program
- VSAM
  - File A
  - File B
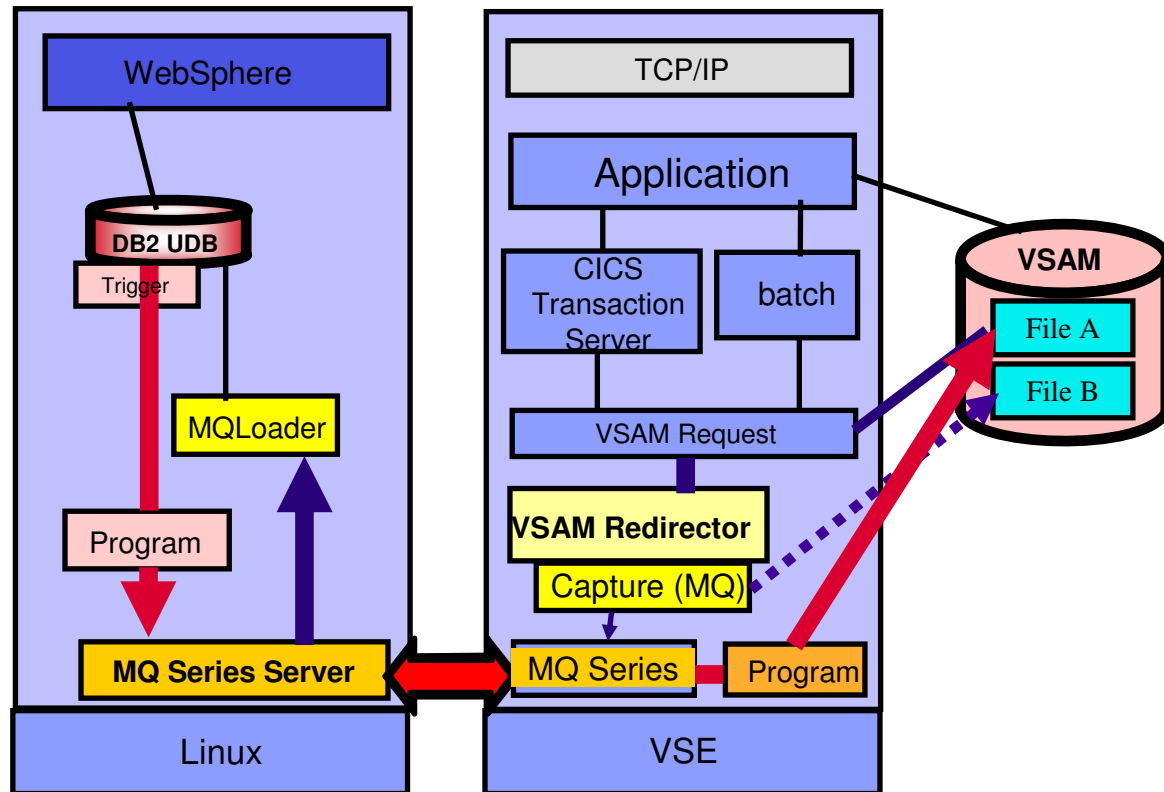
► tools provided by IBM

Web 2.0 Connectivity for IBM's SOA

WebSphere MQ goes Web 2.0!

– Helps enrich Web 2.0 applications with real business data

  • Distributed and z/VSE platforms

– Developer needs no MQ skills

  • Uses Ajax and simple interface to access data by URIs

– Helps simplify deployment and maintenance of large scale distributed applications

  • Enables simple access to MQ without need to install MQ clients

Ajax Library

Browser

HTTP GET

HTTP POST

HTTP DELETE

WebSphere MQ Bridge for HTTP

JEE Application Server

WebSphere MQ V7 Messaging Backbone

Business Applications & Data

Linux / UNIX / z/VSE / z/OS / Windows

Solutions

http://www.ibm.com/servers/eserver/zseries/zvse/

Additional Information

- z/VSE Home Page
  http://www.ibm.com/vse

- z/VSE solutions
  http://www-1.ibm.com/servers/eserver/zseries/zvse/solutions

- e-business Connectors User's Guide   SC33-6719
  http://www-1.ibm.com/servers/eserver/zseries/zvse/documentation/#conn

Redbooks

- e-business Solutions for VSE/ESA   SG24-5662

- e-business Connectivity for VSE/ESA   SG24-5950

- CICS Transaction Server for VSE/ESA
  CICS Web Support   *SG24-5997-00*

- WebSphere Connectivity Handbook   SG24-7042

We appreciate your comments at :   zvse@de.ibm.com