I10: Multilevel Security, z/OS R6, DB2, TCP/IP, and You

Walt Farrell, CISSP
z/OS Security Design
Telephone: (845) 435-7750
e-mail: wfarrell@us.ibm.com

Table of Contents

❑ Why Multilevel Security?

❑ What is Multilevel Security?

❑ Commercial Exploitation

❑ General SECLABEL Considerations and Options

❑ Multilevel Security with TCP/IP

❑ Multilevel Security with JES

❑ Multilevel Security with DB2

❑ References

❑ Trademarks

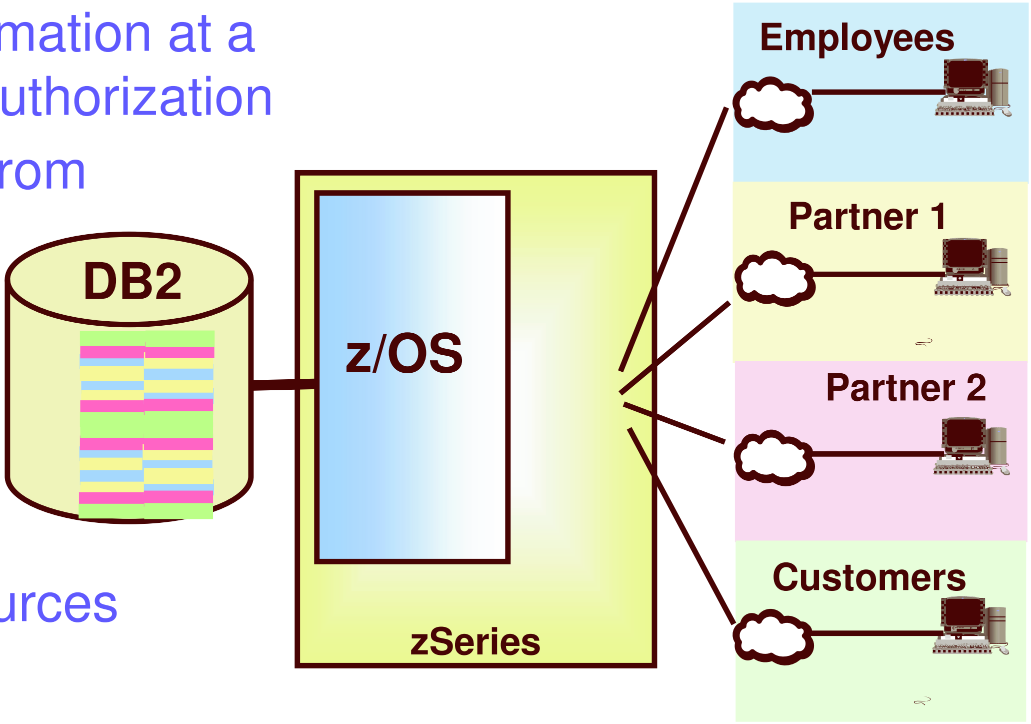
Why Multilevel Security?

- ❑ Highly secure data
- ❑ Shared between people/organizations with different "need to know“.
  - ➢ Multilevel Security provides a way to segregate users and their data from other users and their data regardless of access lists, UACC, etc.
- ❑ Must be
  - ➢ Manageable, Affordable, Resilient, Highly available
- ❑ Valuable to government agencies
  - ➢ Use of functions like name-hiding, write-down, *-property (no write-down)
- ❑ Valuable to commercial clients (e.g. service bureau)
  - ➢ Can be set up using a small set of SECLABELs and a few SETROPTS options (MLACTIVE and SECLABELCONTROL)
  - ➢ Most SECLABEL-related SETROPTS options not needed for commercial use

    Example: MVS system with HTTP Server
    - ❖ Assign a “low” SECLABEL to external customers so they can access “external” data
    - ❖ Assign a “high” SECLABEL to employees so they can access both “internal” and “external” data

What is Multilevel Security?

- ❑ A secure computing environment with two goals:
  - ➢ Controls to prevent unauthorized individuals from accessing information at a higher classification than their authorization
  - ➢ Controls to prevent individuals from declassifying information
- ❑ Controls
  - ➢ Classifies data using
    - ▪ Security Levels
    - ▪ Security categories
  - ➢ System controls access to resources
    - ▪ Labels all resources
    - ▪ Enforces accountability
    - ▪ Prevents 'declassifying' data
    - ▪ Does not allow reuse of data objects until purged



Multilevel Security on zSeries

Commercial Exploitation

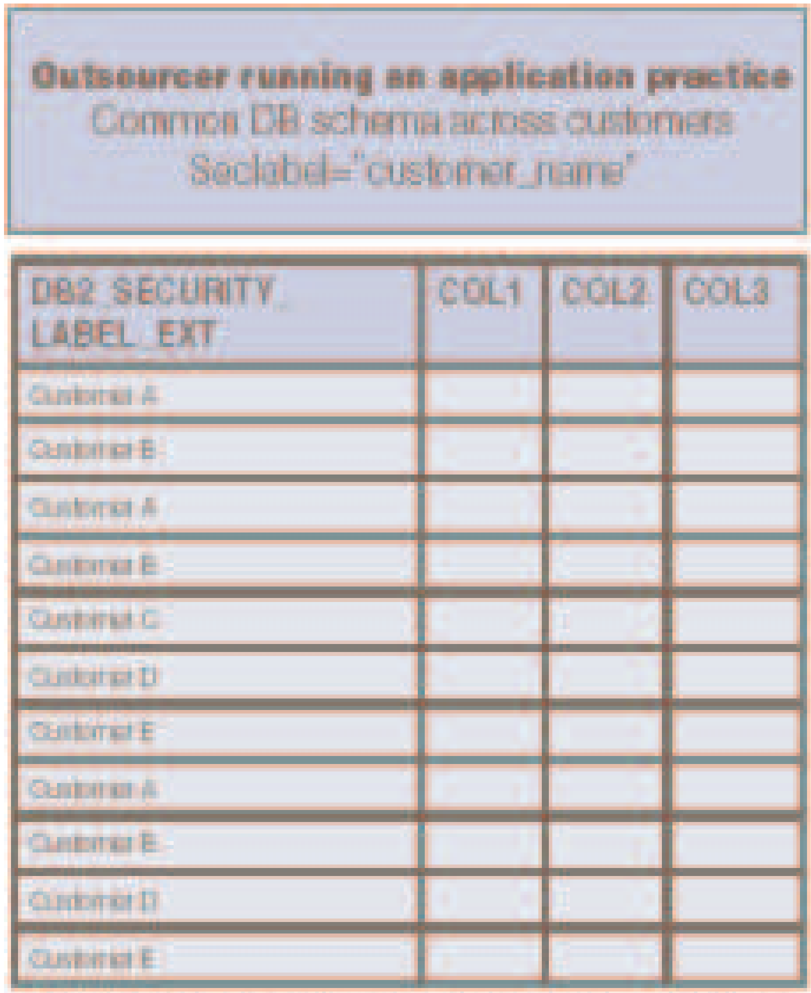
- Application servers shared across multiple customer constituencies
  - Labeling allows data to be compartmentalized or isolated from other customers
    - Data protected for competitive, privacy and integrity reasons
  - Labeling of data and application identities provides the means for both the aggregation and compartmentalization of data.

- zSeries is able to host large databases on behalf of transaction programs or other application servers
  - Facilitates some database aggregation that reduces execution costs

- Database on demand capability
  - Functionality is provided by strength of security on z/OS and within DB2
  - DB2 z/OS V8 row-level security and z/OS V1R5 with RACF provide the operating system and security services that make database on demand capability whole

Application serving on demand

- ❑ Service business acquires a collection of servers and hosts a specific application and its associated data on that server infrastructure.
- ❑ Sells subscriptions for the application to other businesses
  - ➢ Subscribers need their data isolated from other businesses
- ❑ Make a subset of the information available by aggregating data using labels. Isolate sensitive data.
- ❑ Saves server and network costs associated with replicating data across business units.



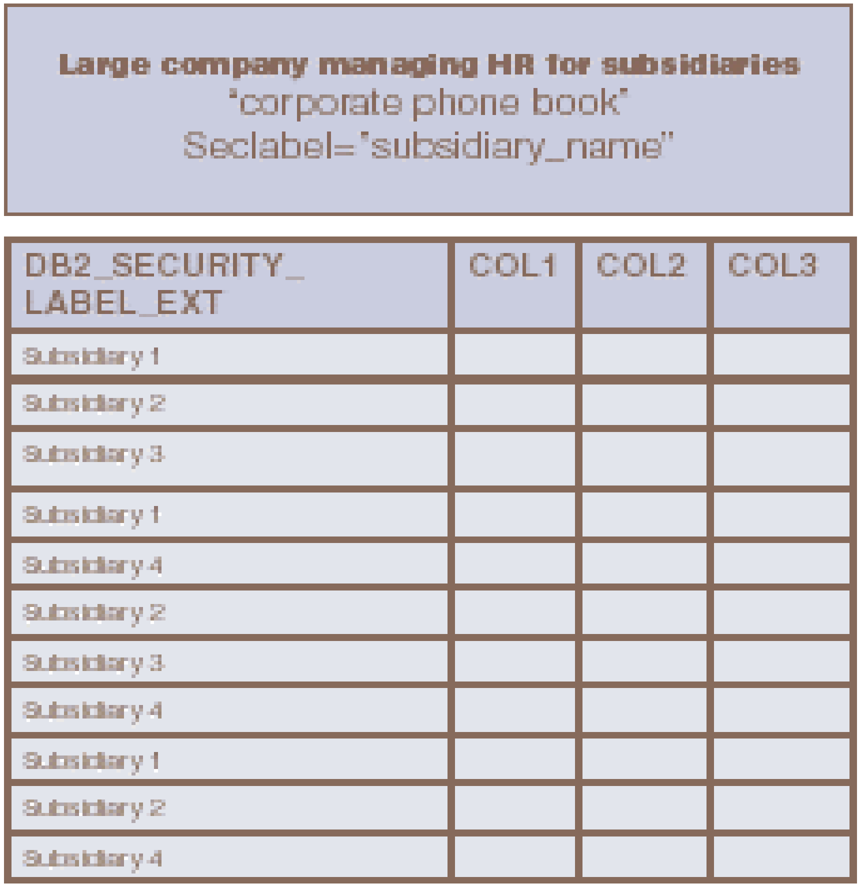
Outsourcer running an application practice
Common DB schema across customers
Seclabel='customer_name'

DB2_SECURITY_LABEL_EXT	COL1	COL2	COL3
Customer A			
Customer B			
Customer A			
Customer B			
Customer C			
Customer D			
Customer E			
Customer A			
Customer B			
Customer D			
Customer E			

Figure 2 - Using security labels for application serving on demand

Financial services on demand

- ❑ Government regulations may inhibit one business unit from seeing personal , consumer information associated with another business unit.
- ❑ Subset of information may be valuable for data mining
  - ➢ Identifying trends
  - ➢ Developing new services
- ❑ Make a subset of the information available by aggregating data using labels. Isolate sensitive data.
- ❑ Saves server and network costs associated with replicating data across business units.



Large company managing HR for subsidiaries
'corporate phone book'
Seclabel='subsidiary_name'

DB2_SECURITY_ LABEL_EXT	COL1	COL2	COL3
Subsidiary 1			
Subsidiary 2			
Subsidiary 3			
Subsidiary 1			
Subsidiary 4			
Subsidiary 2			
Subsidiary 3			
Subsidiary 4			
Subsidiary 1			
Subsidiary 2			
Subsidiary 4			

Figure 3 - Using security labels for financial services on demand

Commercial on demand services summary

- ❑ Security labeling of data and application identities
  - ➢ Provides both compartmentalization and aggregation of data

- ❑ Need to replicate or move data to provide a new security container or isolation point?
  - ➢ Consider labeling
    - ✓ Save on processor, network, storage and administrative expense

- ❑ Examine database organization and flow of data between application servers
  - ➢ Labeling may provide additional security and deployment savings to your business

Original SECLABEL support (before z/OS V1R5)

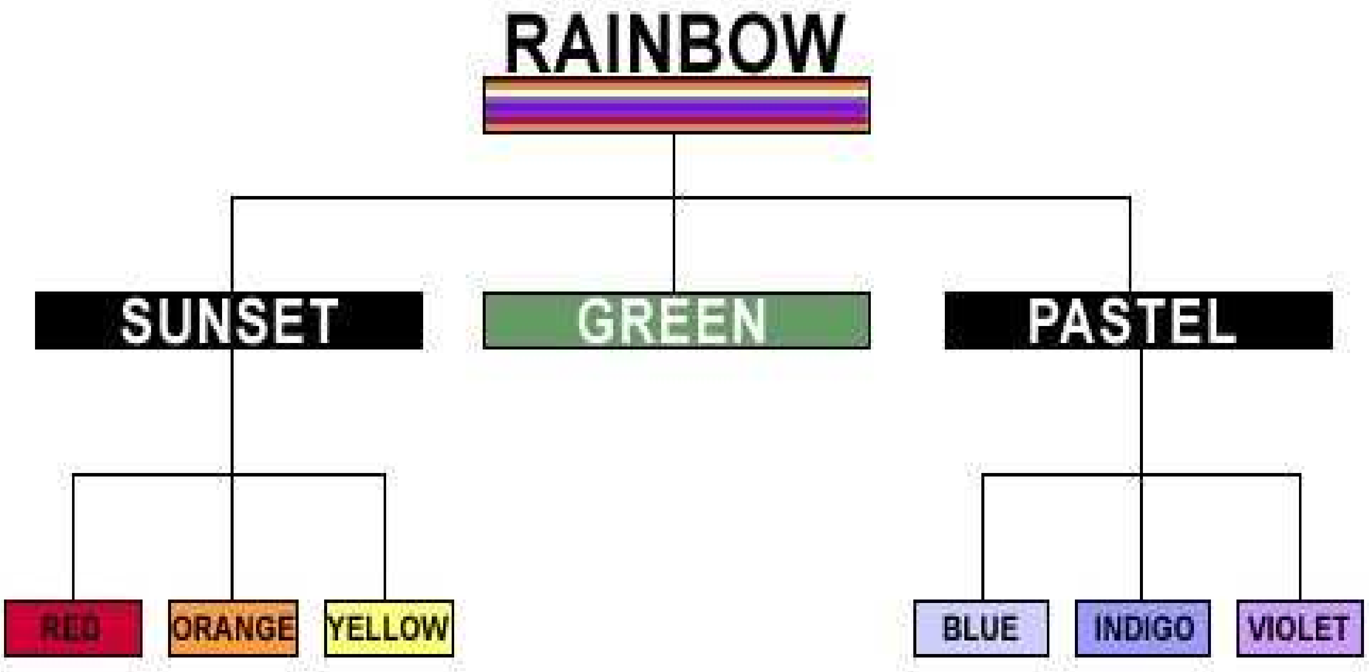
- RACF and other evaluated system components support Security Labels (a.k.a. SECLABELs).

- SECLABELs have two components:
  - Level (a named number in the range 1-254)
    - Unclassified/1
    - Sensitive/25
    - Confidential/50
    - Secret/100
  - List of Categories (0 or more named categories)
    - Green
    - Yellow, Orange
    - Yellow, Orange, Red
- For commercial usage, the categories are probably more important than the level, and most SECLABELS may use the same level, but different sets of categories.

SECLABEL Dominance

- SECLABELs defined
  - RED
    - SECLEVEL = SECRET
    - CATEGORY = PROJA, PROJB, PROJC, PROJD, PROJE
  - ORANGE
    - SECLEVEL = SENSITIVE
    - CATEGORY = PROJA, PROJB, PROJC, PROJE
  - GREEN
    - SECLEVEL = SENSITIVE
    - CATEGORY = PROJC, PROJD, PROJE
  - BLUE
    - SECLEVEL = UNCLASSIFIED
    - CATEGORY = PROJE
  - RED dominates all
  - ORANGE & GREEN dominate BLUE
  - ORANGE & GREEN are disjoint security labels

SECLABEL Hierarchy



Session SECLABEL Assignment

- ❑ Each user has a default SECLABEL
- ❑ A user may have access to other SECLABELs, too
- ❑ Some applications (TSO/E, batch jobs) support user requesting a specific SECLABEL
- ❑ Each port of entry (TERMINAL, TCP/IP security zone, ...) has a SECLABEL
- ❑ Each SECLABEL has a RACF profile
  - ➢ Access list
  - ➢ Universal access
  - ➢ Auditing
- ❑ During user authentication, depending on application, user may request a SECLABEL, or RACF may infer one from the port of entry or application, or assign the user's default
- ❑ RACF validates session SECLABEL
  - ➢ User must have access to that SECLABEL
  - ➢ SECLABEL must properly match the port of entry and application

Some SECLABEL-related Options

- MLACTIVE – Requires users and some resources to have SECLABELs
- SECLABELCONTROL – Restricts who can assign SECLABELs to resources
- SECLABELAUDIT – Allows audit generation based on user SECLABEL or (new in z/OS R6) resource SECLABEL
  - Good for logging access to especially restricted data (privacy, financial)
- Possibly MLS – Prevents “write down” (prevents, for example, a user running with SUNSET from writing to a file or data set with the RED SECLABEL.
- If using SETROPTS MLS, then you can also allow selected users to “write down” in a controlled fashion, via the RACPRIV command.

Resource Access Checking & SECLABELs (Commercial Use)

- ❑ User tries to access resource
  - ➢ RACF compares user's SECLABEL and resource's SECLABEL
  - ➢ Reading: User SECLABEL > resource SECLABEL
  - ➢ Updating: (without SETROPTS MLS, or if user has WRITEDOWN authority)

    User SECLABEL > resource SECLABEL or
    Resource SECLABEL > User SECLABEL
  - ➢ Updating: (with SETROPTS MLS)

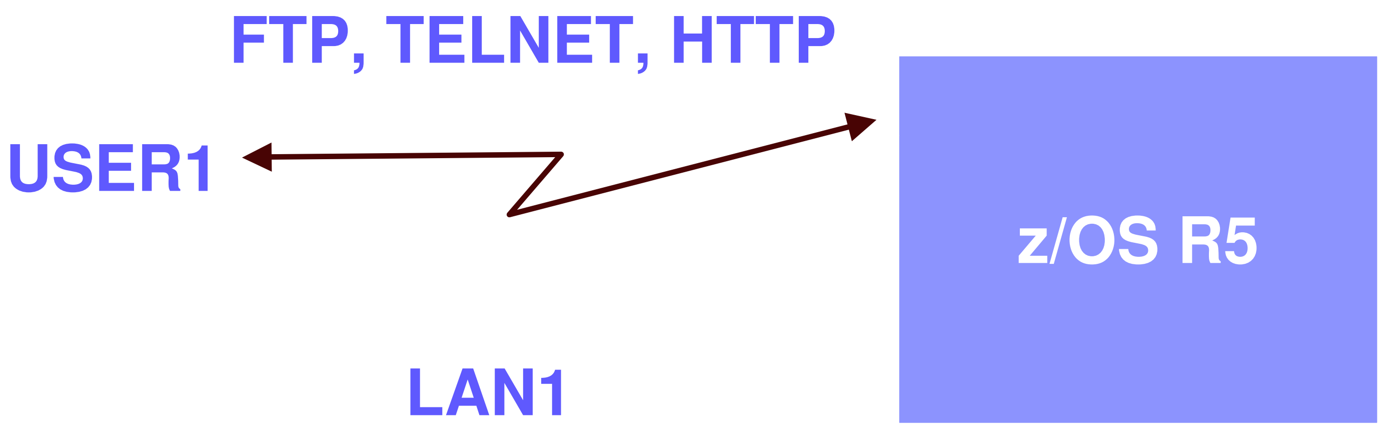
    User SECLABEL = resource SECLABEL

SECLABELs for TCP/IP

- Administrator can define “security zones” representing IP subnetworks via TCP/IP configuration data
  - Specifies hostname, or address, or subnet range
  - Any granularity desired, down to individual IP address if needed
  - Specifies a “zone” name. Example: INTERNAL, EXTERNAL, PARTNER1
- TCP/IP maps zone names to RACF SERVAUTH resource EZB.NETACCESS.sysname.stackname.zonename
  - Installation is responsible for network topology and protection of network links
    - IPSEC (VPN) can also be used to help this
- TCP/IP stack ensures that application on host can only send/receive packets if application and IP address have appropriate SECLABELs
  - Support for servers or daemons that understand MLS (FTP, TELNET, INET) or even HTTP for some usage
    - Assign SYSMULTI SECLABEL to server/daemon
    - Can then communicate with any of the subnetworks

SECLABELs for TCP/IP

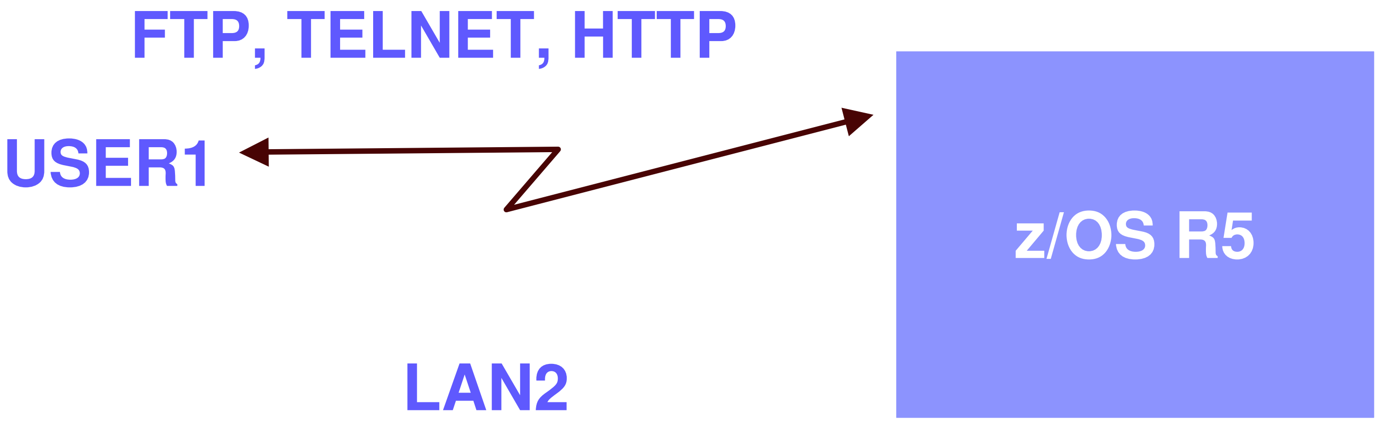
- ❑ Consider USER1 with access to
  - ➢ SECLABELs A and B
  - ➢ Workstations on three LANs
    - ▪ LAN1 defined with SECLABEL A
    - ▪ LAN2 defined with SECLABEL B
    - ▪ LAN3 defined with SECLABEL C



The user's session will run with SECLABEL A

SECLABELs for TCP/IP

- Consider USER1 with access to
  - SECLABELs A and B
  - Workstations on three LANs
    - LAN1 defined with SECLABEL A
    - LAN2 defined with SECLABEL B
    - LAN3 defined with SECLABEL C



FTP, TELNET, HTTP

USER1

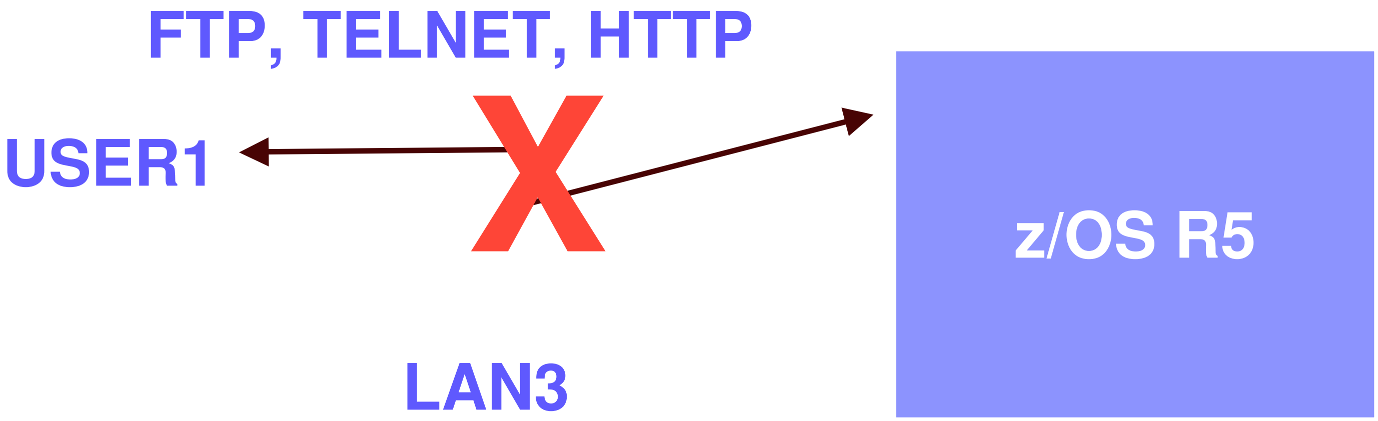
z/OS R5

LAN2

The user's session will run with SECLABEL B

SECLABELs for TCP/IP

- Consider USER1 with access to
  - SECLABELs A and B
  - Workstations on three LANs
    - LAN1 defined with SECLABEL A
    - LAN2 defined with SECLABEL B
    - LAN3 defined with SECLABEL C



FTP, TELNET, HTTP

USER1

X

z/OS R5

LAN3

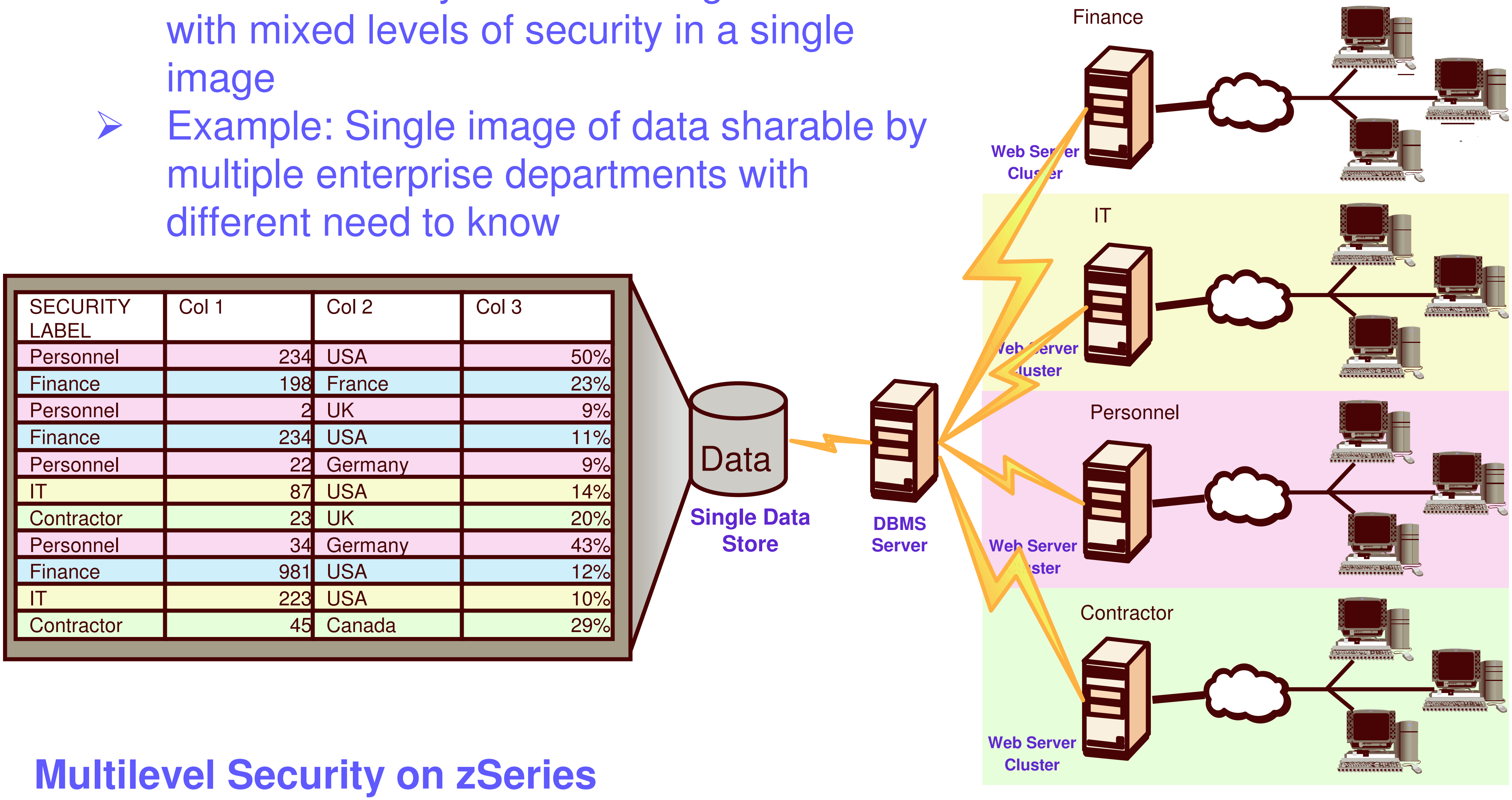
The user’s session will fail,
since the user cannot use SECLABEL C

Multilevel Security with JES

- ❑ Consider a Service Bureau with multiple customers
- ❑ Customer A does not want their output printed on Customer B’s printers
- ❑ Create disjoint SECLABELs A and B
- ❑ Create WRITER profiles for customer A printers; assign SECLABEL A
- ❑ Create WRITER profiles for customer B printers; assign SECLABEL B
- ❑ Customer A users (with SECLABEL A) cannot print to wrong printers
- ❑ Customer B users (with SECLABEL B) cannot print to wrong printers
- ❑ System operators cannot misdirect the output, either

Multilevel Security on z/OS V1R5 and DB2 V8

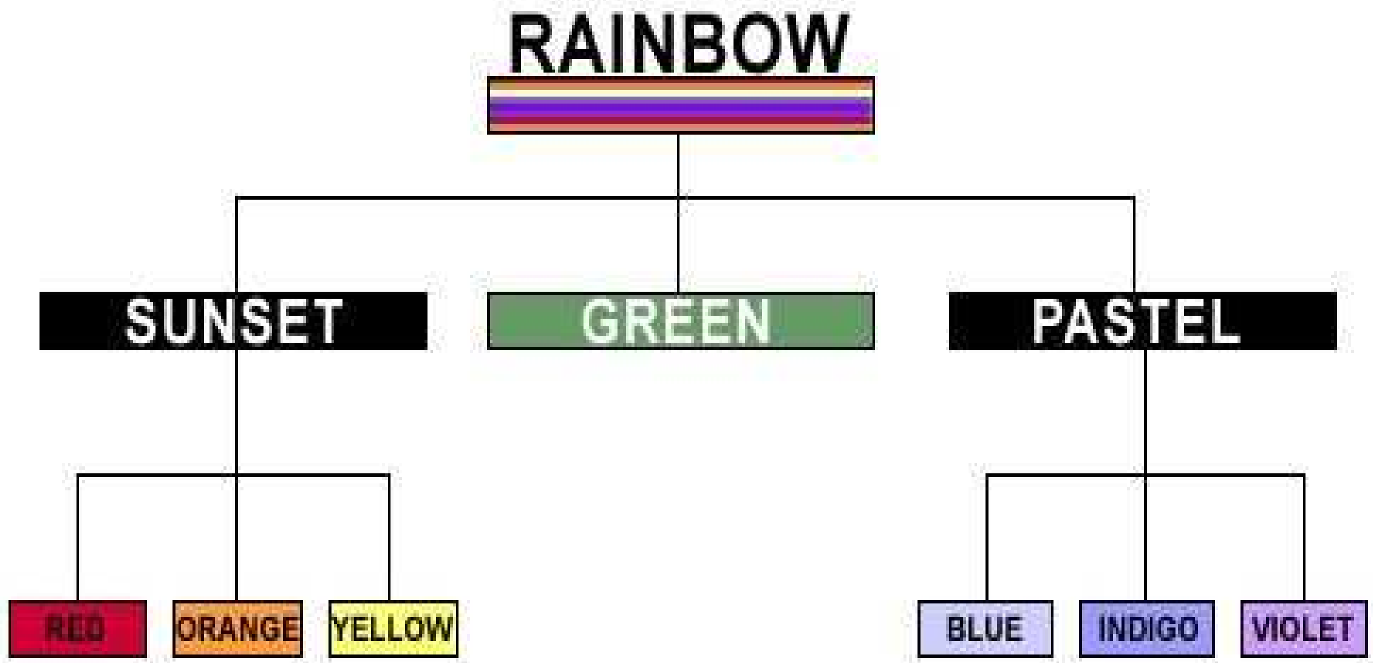
- Multilevel Security on z/OS V1R5 with DB2 V8
  - Labeled security allows sharing of resources with mixed levels of security in a single image
  - Example: Single image of data sharable by multiple enterprise departments with different need to know



SECURITY LABEL	Col 1	Col 2	Col 3
Personnel	234	USA	50%
Finance	198	France	23%
Personnel	2	UK	9%
Finance	234	USA	11%
Personnel	22	Germany	9%
IT	87	USA	14%
Contractor	23	UK	20%
Personnel	34	Germany	43%
Finance	981	USA	12%
IT	223	USA	10%
Contractor	45	Canada	29%

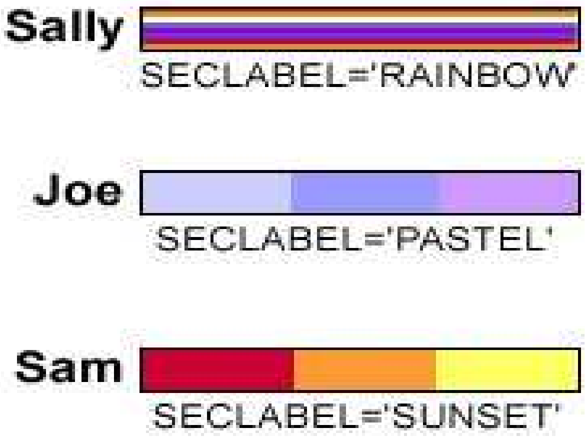
Multilevel Security on zSeries

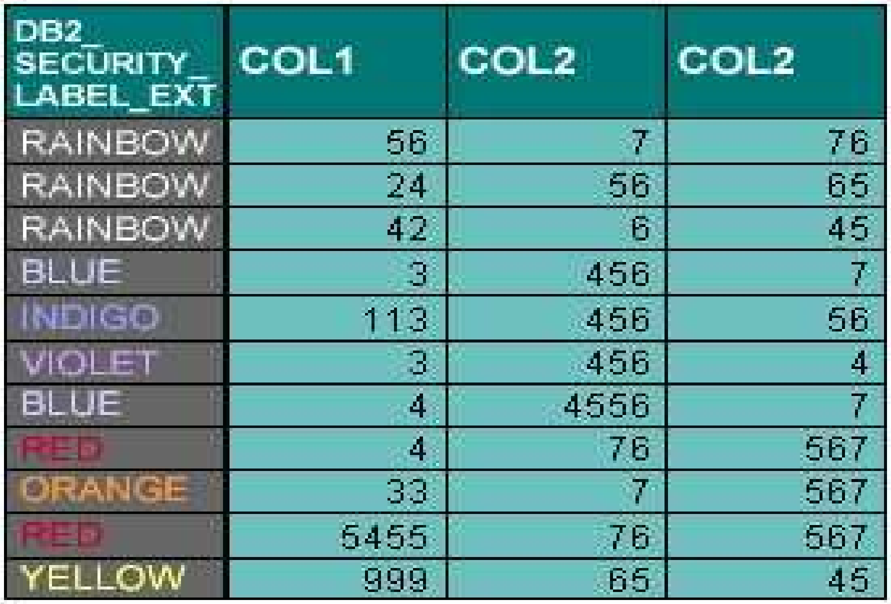
SECLABEL Hierarchy



Multilevel Security and DB2

Row Granularity Multilevel Security





DB2_SECURITY_LABEL_EXT	COL1	COL2	COL2
RAINBOW	56	7	76
RAINBOW	24	56	65
RAINBOW	42	6	45
BLUE	3	456	7
INDIGO	113	456	56
VIOLET	3	456	4
BLUE	4	4556	7
RED	4	76	567
ORANGE	33	7	567
RED	5455	76	567
YELLOW	999	65	45

- ❑Table column defined AS SECURITY LABEL
- ❑Check for each new SECLABEL value accessed
- ❑Mandatory access control: run time user to data

Multilevel Security and DB2

❖ Multilevel Security with Row Level Granularity

- ❑ Use RACF for MAC
  - ➢ Use SECLABELs
  - ➢ Key advantage is consistent, integrated security
- ❑ Table has a column defined as a security label
  - ➢ Each row value has a specific security label
  - ➢ Get user security label from RACF
  - ➢ Save in rows for INSERT, UPDATE, LOAD, ...
- ❑ Compare SECLABEL in row to SECLABEL for the DB2 users
  - ➢ If access is allowed, then normal access
  - ➢ If access is not allowed, data not returned
- ❑ Runtime user to data checking
- ❑ Seclabel values are cached to minimize processing time

Multilevel Security and DB2

❖ CREATE TABLE / ALTER TABLE statements

- ❑ Use to enable the row level security
  - ➢ Table must have a column to store the SECLABEL
- ❑ To define the security label column
  - ➢ Specify "AS SECURITY LABEL" in the column-options in the "create table / alter table" column-definition
- ❑ Table once created with SECLABEL cannot be disabled
- ❑ Audit record produced if the table with security label is created, altered or dropped

Multilevel Security and DB2

- **Using SECLABELs with Row operations:**

SELECT

- User’s SECLABEL compared to SECLABEL of row
  - If user SECLABEL dominates the data SECLABEL
    - Row is returned
  - If user SECLABEL does not dominate the data SECLABEL
    - Row is not returned, but no error is reported

Multilevel Security and DB2

- Using SECLABELs with Row operations:

  INSERT

  - Value of the SECLABEL column for inserted row is set to the value of the user's SECLABEL.
    - If user has authority for Write-Down,
      - The user is allowed to set the SECLABEL field to any value.
    - If user does not have authority for Write-Down,
      - The SECLABEL of the inserted rows will be set to current SECLABEL.

Multilevel Security and DB2

- **Using SECLABELs with Row operations:**

  UPDATE

  - User’s SECLABEL compared with the SECLABEL of the row to be updated.
    - If the SECLABELs are equivalent,
      - Row is updated.
      - The SECLABEL in updated row is set to the user SECLABEL.
    - If user has Write-Down authority,
      - Rows with lower SECLABELs can be accessed and updated.

Multilevel Security and DB2

❖ **Using SECLABELs with Row operations:**

DELETE

- ❑ User's SECLABEL compared with the SECLABEL of the row to be deleted.
  - ➢ If the SECLABELs are equivalent,
    - ▪ Row is deleted.
  - ➢ If user has Write-Down authority,
    - ▪ Rows with lower SECLABELs can be accessed and deleted.

References

- Security Server (RACF) publications:
  - RACF Command Language Reference (SC28-1919)
  - RACF Security Administrator's Guide (SC28-1915)
  - RACF Callable Services Guide (SC28-1921)
- z/OS publications:
  - Planning for Multilevel Security (GA22-7509-00)
- Communications Server Publications:
  - IP Configuration Guide (SC31-8775-04)
  - IP Configuration Reference (SC31-8776-05)
- RACF web site:
  http://www.ibm.com/servers/eserver/zseries/zos/racf
- DB2 web site:
  http://www.ibm.com/software/db2zos
  - Related publications / presentations:
    http://www.ibm.com/software/db2zos/db2zosv8.html
    http://www.ibm.com/software/db2zos/presentations.html
    http://www.ibm.com/software/db2zos/support.html

Trademarks

- The following are trademarks or registered trademarks of the International Business Machines Corporation:
  - DB2
  - RACF
  - z/OS