

Coding for System Integrity in z/OS for ISVs

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Coding for System Integrity in z/OS

- ***Definition***
- ***Guidelines***
- ***Examples***

System Integrity Definition

- ***Announced with MVS in 1973***
- ***Property of a system that prevents users from circumventing security mechanisms***
- ***In z/OS, there is no way for an unauthorized problem program to:***
 - ***Bypass store or fetch protection***
 - ***Bypass password/RACF protection***
 - ***Obtain control in an authorized state***

Types of Authorization

- ***PSW Key 0-7***
- ***PKM 0-7***
- ***Supervisor State***
- ***APF Authorization***

Ways of becoming authorized

- ***SVC routines***
- ***PC routines***
- ***APF authorized programs***
- ***Program Properties Table***

z/OS System Integrity Guidelines

- *Creating predictable interfaces*
- *Dealing with user supplied storage*
- *Dealing with user supplied control blocks*
- *Dealing with user supplied values*
- *Protecting data*
- *Authorization requirements*
- *Serializing Resources*

Predictable Interfaces

- ***Interfaces between unauthorized and authorized programs must behave predictably***
 - *Applies to intended and unintended interfaces*
 - *Security checking must be performed in authorized code*
 - *Only load modules intended to run as authorized jobsteps or commands should be linked AC(1)*

User Supplied Storage

- ***Access caller supplied storage in the key of the caller***
- ***For example, use MVCSK or MVCDK***

User Supplied Control Blocks

- ***Verify system control blocks through trusted pointers in system key storage***
- ***Serialize as appropriate***

User Supplied Values

- ***Verify that values are legitimate***
- ***Beware of values that might change after verification***

Protecting Data

- ***Authorized programs must protect data from unauthorized tampering***
- ***Do not use key 8 common storage***

Authorization Requirements

- ***Services that bypass security checks must be restricted to authorized callers***
- ***Callers allowed to bypass security checks must provide equivalent controls***
- ***Do not provide services that make unauthorized callers authorized***

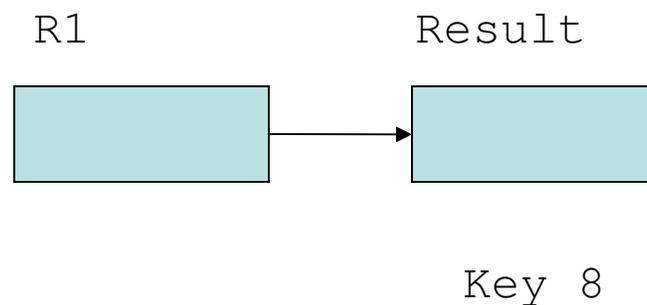
Serializing Resources

- ***Serialize to control multiple access to resources***
- ***Serialization technique must be one restricted to authorized programs***

System Integrity Exposures Examples

Example 1: SVC (Key 0, Supervisor State)

```
•  
•  
MODESET EXTKEY=TCB . .  
OC      0(4,R1),0(R1)  
MODESET EXTKEY=ZERO . .  
•  
•  
ST       R5,0(R1)  
•  
•
```



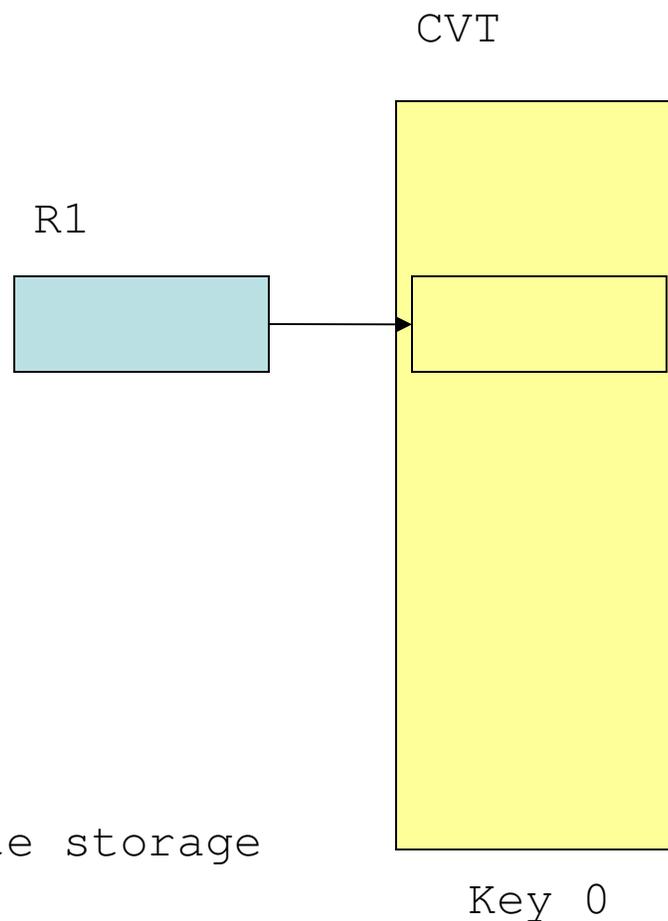
Example 1

```

.
.
MODESET EXTKEY=TCB . .
OC      0(4,R1),0(R1)
MODESET EXTKEY=ZERO . .
.
.
ST      R5,0(R1)
.
.

```

Attempts to validate storage

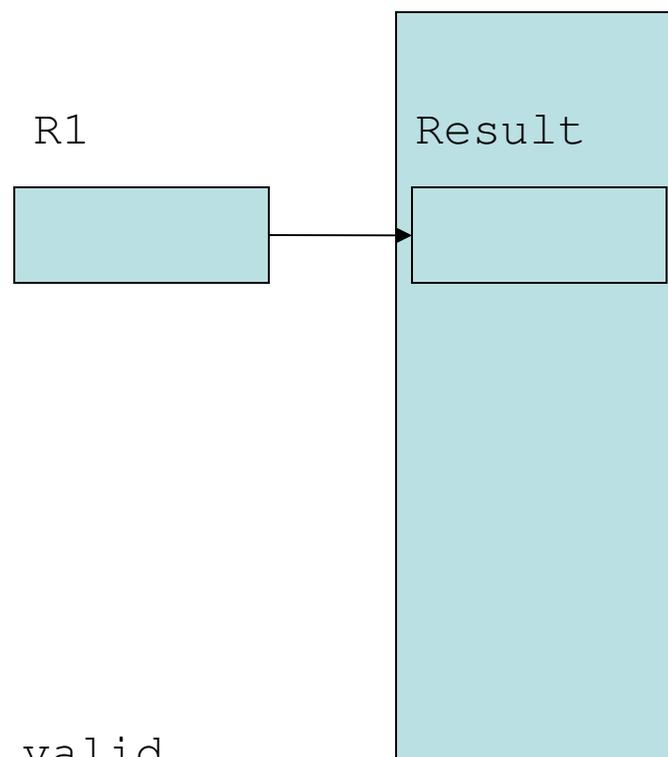


Example 1

```

.
.
MODESET EXTKEY=TCB . .
OC      0(4,R1),0(R1)
MODESET EXTKEY=ZERO . .
.
.
ST      R5,0(R1)
.
.

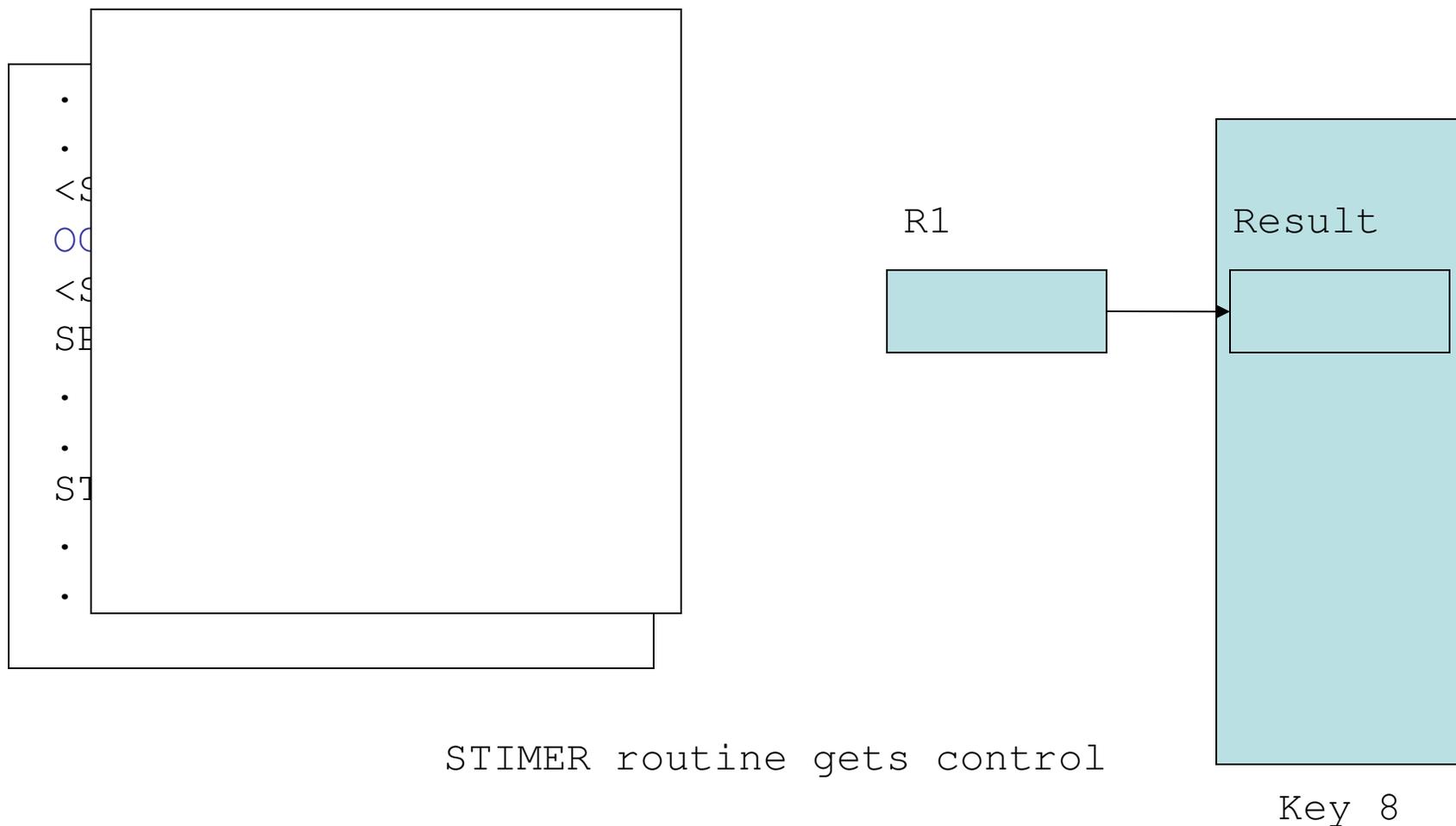
```



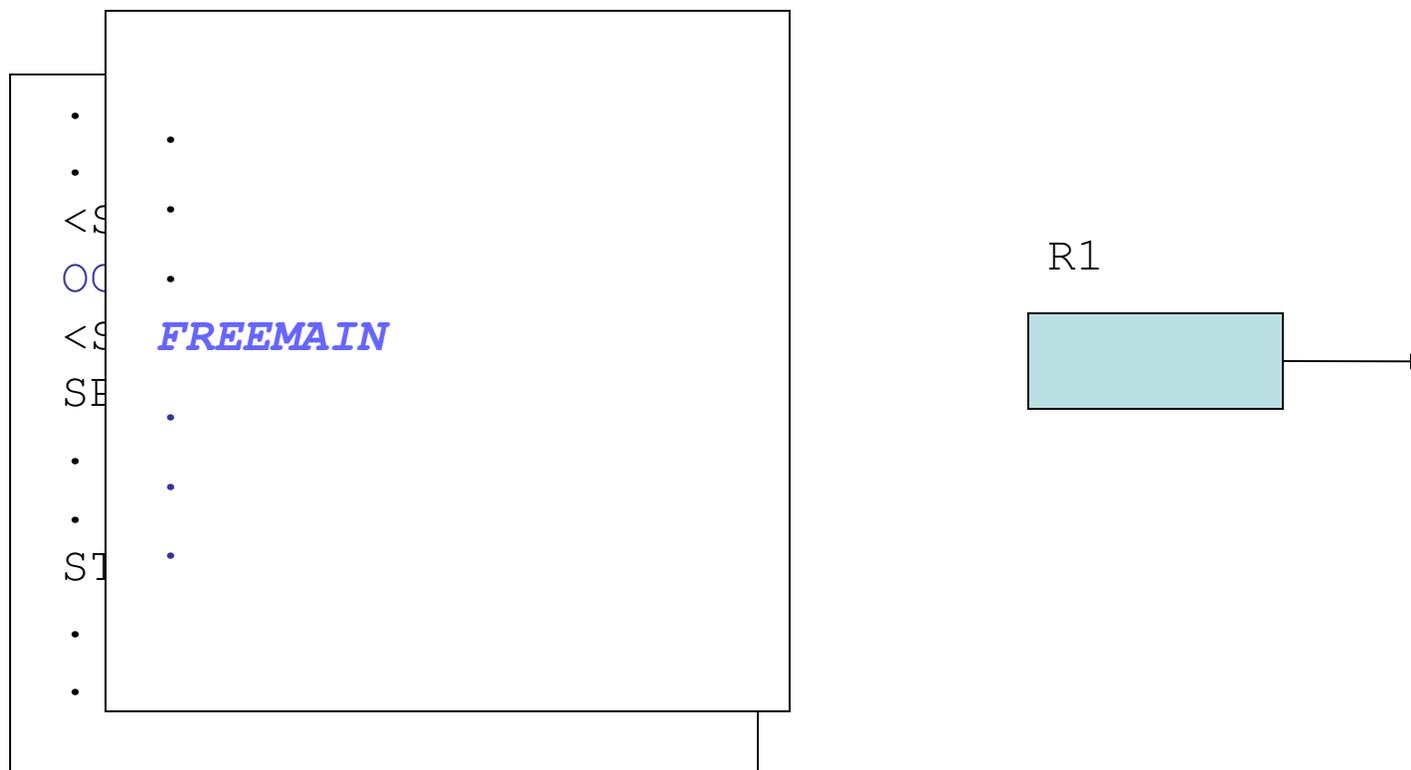
Storage appears valid

Key 8

Example 1

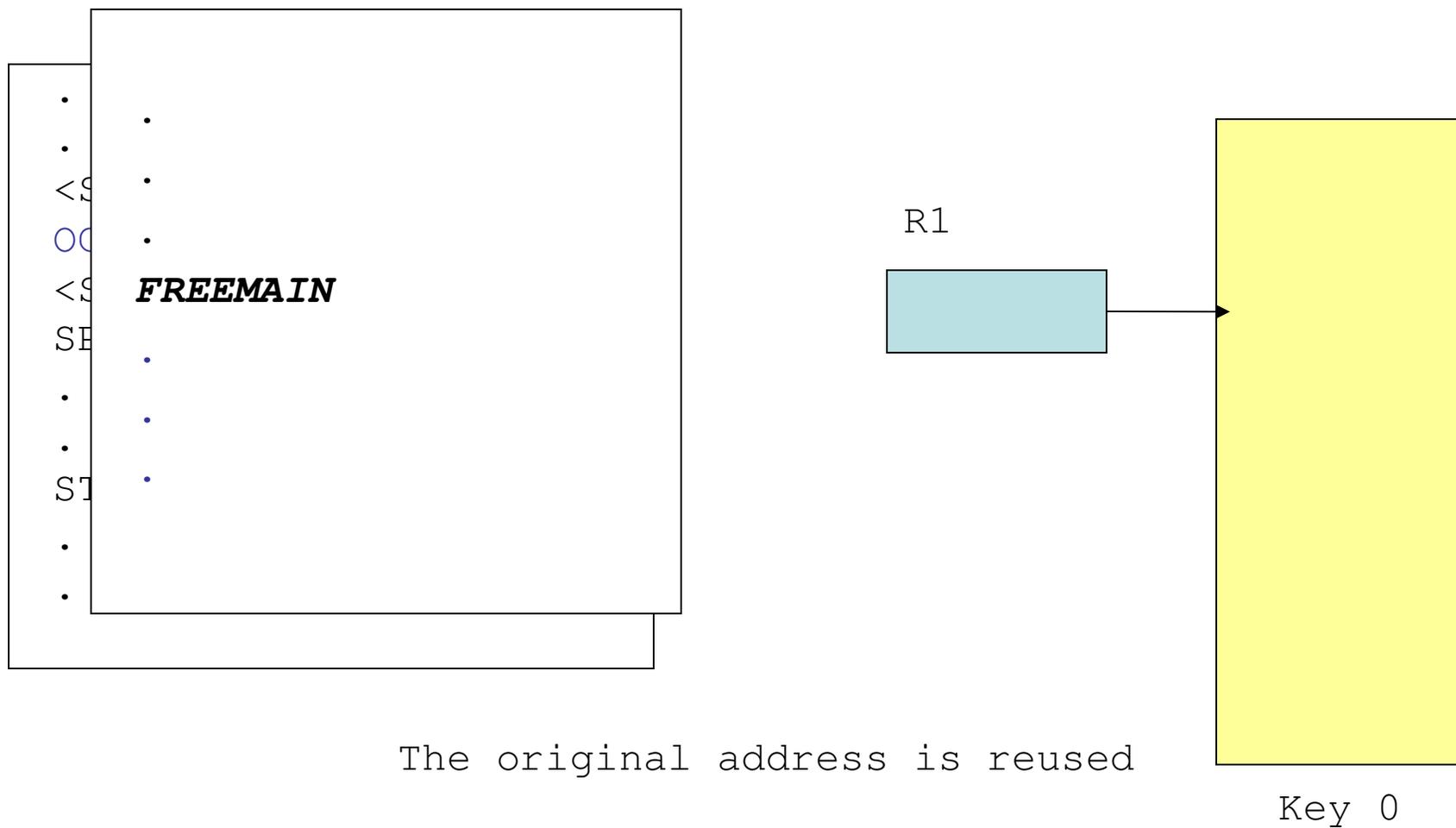


Example 1



The key 8 storage is freed

Example 1

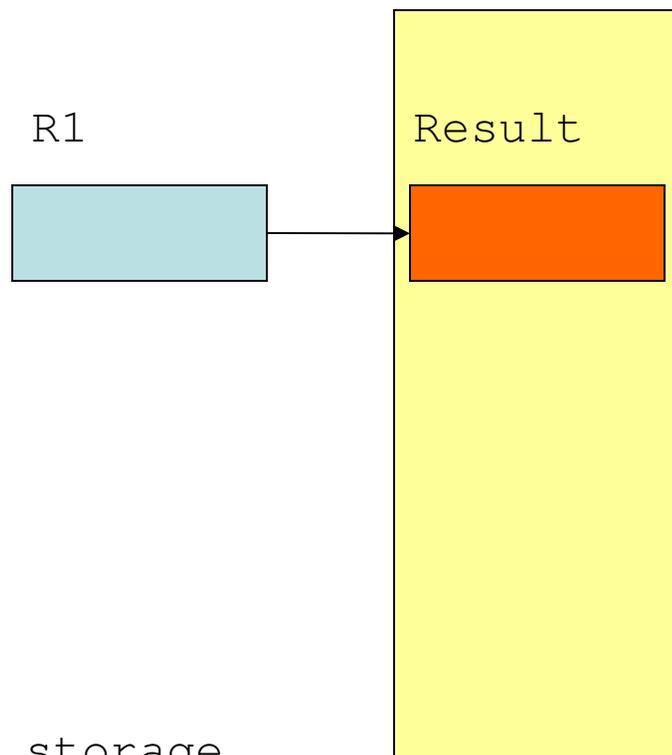


Example 1

```

.
.
MODESET EXTKEY=TCB . .
OC          0(4,R1),0(R1)
MODESET EXTKEY=ZERO . .
.
.
ST          R5,0(R1)
.
.

```



Overwrites key 0 storage

Key 0

Example 1

- ***Violates guidelines for dealing with user supplied storage:***
 - ***Access caller supplied storage in the key of the caller***
 - ***For example, use MVCSK or MVCDK***

Example 2: SVC (Key 0, Supervisor State)

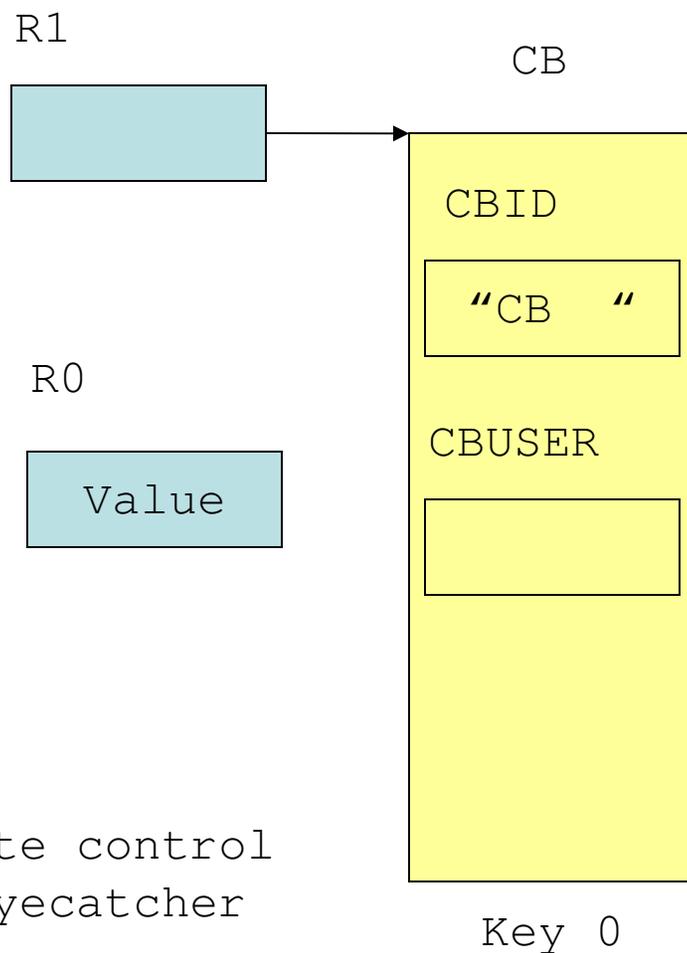
- ***Imaginary set of services***
 - ***CBINIT – creates control block and returns address***
 - ***CBSET – accepts control block address***
 - ***CBTERM – accepts control block address and frees control block***

Example 2

```

•
USING  CB,R1
SR     R5,R5
IVSK   R5,R1
LTR    R5,R5
BNZ    ERROR
CLC    =C'CB ',CBID
BNE    ERROR
ST     R0,CBUSER
•

```



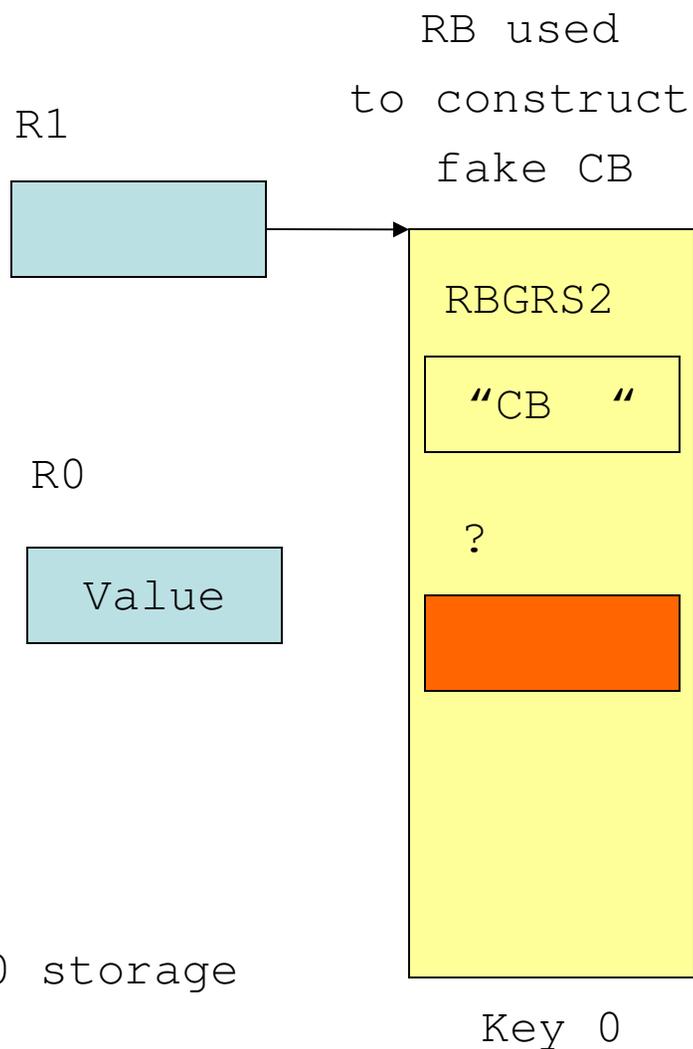
Attempts to validate control blocks's key and eyecatcher

Example 2

```

•
USING  CB,R1
SR     R5,R5
IVSK  R5,R1
LTR    R5,R5
BNZ    ERROR
CLC   =C'CB ',CBID
BNE    ERROR
ST     R0,CBUSER
•

```



Overwrites key 0 storage

Example 2

- ***Violates guideline for dealing with user supplied control blocks:***
 - ***Verify system control blocks through trusted pointers in system key storage***
 - ***Treat unverified control blocks as user supplied storage***

Example 3: SVC (Key 0, Supervisor State)

```

IGC00ATH      CSECT                      Bad Auth SVC
              BALR          12,0
              USING        *,12
              L            2,28(5)        Caller's RB
* Resume address < Beginning of PLPA
              CLC          21(3,2),361(3) Is caller in LPA?
              BL          RETURN
              L            2,180(4)        JSCB
* R0 != 1 request auth off
              BCT          0,AUTHOFF
AUTHON        OI          236(2),X'01'    Set JSCBAUTH
              B            RETURN
AUTHOFF       NI          236(2),X'FE'    Clear AUTH
RETURN        BR          14
              END          IGC00ATH

```

Example 3

- ***Many ways to misuse this SVC***
- ***Violates guidelines for dealing with authorization requirements:***
 - ***Services that bypass security checks must be restricted to authorized callers***
 - ***Callers allowed to bypass security checks must provide equivalent controls***
 - ***Do not provide services that make unauthorized callers authorized***

Example 4: APF authorized Unix program (Key 8, Problem State, APF authorized)

```
main(int argc, char * argv[])  
  
char  valueBuffer[100];  
strcpy(valueBuffer, argv[1]);
```

Example 4

- ***Classic buffer overflow vulnerability since length of input can be greater than 100***
- ***Violates guidelines for dealing with user supplied values:***
 - ***Verify that values are legitimate (in this case, length of argument string.***

Conclusion

- ***The security of z/OS requires attention to detail***
- ***Developers of authorized programs should follow the guidelines described in this presentation***