VANGUARD 2023
Security & Compliance

SAFTRACE Demystified

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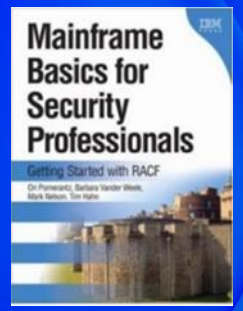

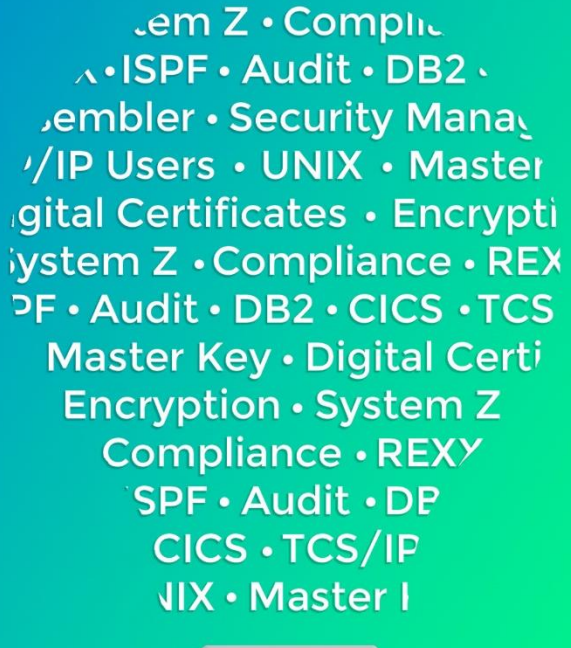

KNOWLEDGE
is your best defense

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Agenda

- What is SAFTRACE?
- When should SAFTRACE be used?
- Who uses SAFTRACE?
- Where does the tracing occur?
- How is SAFTRACE used?
- A SAFTRACE example
- Where to get more information

A big thank you to Russ Hardgrove and John Reale for creating the original versions of this session and to the RACF Service Team who really know how to use SAFTRACE!

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What is SAFTRACE?

- **SAFTRACE is a RACF-provided tracing facility that allows the tracing of:**
  - RACROUTEs
  - RACF callable services
  - RACF database requests (“ICHEINTY”)
- **Creates a trace record before and after each service is called**
- **Writes records to the z/OS Generalized Trace Facility (GTF)**
- **Formatted with IPCS, using IPCS exit IRRUSR57 (alias AMDUSR57) which is shipped by RACF**

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When should SAFTRACE be used?

- **When you need/desire to know what security calls are being made by a resource manager**
  - Unexpected actions being taken by resource managers after a RACF call
  - Absence/excessive number of log records
- **If excessive contention for the RACF database is being experienced**
  - … by tracing ALTER requests to the database
- **Excessive**
  - RACROUTEs
  - RACF callable services
  - I/O RACF database requests (“ICHEINTY”)

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Who uses SAFTRACE?

- Intended for use under the direction of the RACF support team
- Requires a *strong* working knowledge of RACF interfaces and the z/OS security architecture (ACEEs, RACROUTE…)
- Requires a *strong* working knowledge of the resource managers whose RACF requests are being traced
- SAFTRACE is oriented towards the z/OS Systems programmer
- Must be willing to wade through a high volume of data

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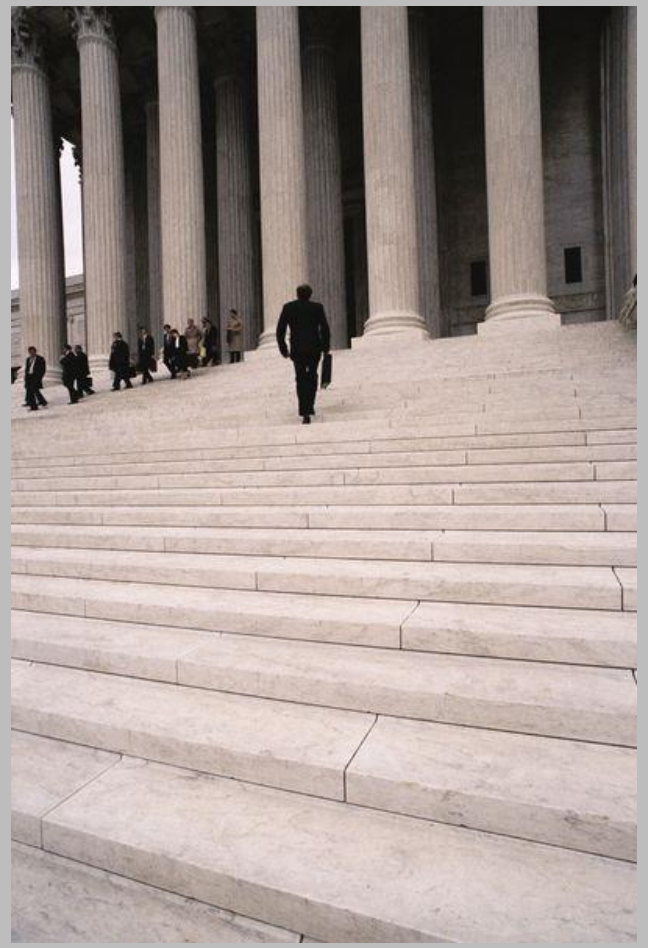
Where does the Tracing Occur?

- **The primary trace point is in the SAF router modules, ICHSFR00 and IRRSFR11**
- **All calls made using RACROUTE or the RACF Callable Service Interface can be traced**
- **Calls made to the RACF data base manager interface (“ICHEINTY”) can be traced**
- **RACF invocations that are made using the “Independent System Macros (RACINIT, RACHECK, RACLIST, RACDEF, FRACHECK, RACSTAT) *are not traced,* other than by database (“ICHEINTY”)**

How is SAFTRACE Used?

- **The seven SAFTRACE steps:**
  1. Ensure that the RACF subsystem is active
  2. Determine what events you want to trace
  3. Set the trace options using the RACF SET command
  4. Start GTF / ensure that GTF is running
  5. Recreate the scenario that is to be traced
  6. Stop the trace/GTF
  7. Formatting and reviewing the trace output



How do I Decide what to Trace?

- **The goal is to trap only those events which are relevant to the investigation.**

- **Key questions:**
  - Do the requests come from a known set of jobs or user IDs?
  - Are z/OS UNIX System Services functions being invoked?
  - Are the requests access control questions (REQUEST=AUTH, REQUEST=FASTAUTH…)?
    - Are they directed to specific classes?
  - Are the requests related to authentication (REQUEST=VERIFY, REQUEST=VERIFYX…)
  - Are other RACF requests potentially involved?
  - Is a trace of RACF data base I/O required?

Setting the SAFTRACE Options

- The RACF subsystem SET command is used to set the TRACE options

```
SET TRACE(
    APPC | NOAPPC
    ASID(asid ... | *) | ALLASIDS | NOASID
    CALLABLE(ALL | NONE | TYPE(type ...)) | NOCALLABLE
    CLASS(class-name ... | *) | ALLCLASSES
    IFCLASS(class-name ... | *)
    NEVERCLASS(class-name ... | *)
    NOCLASS
    NODATABASE | DATABASE(
      ALL | NONE
      ALTER | NOALTER
      ALTERI | NOALTERI
      READ | NOREAD )
    JOBNAME(jobname ... | *) | ALLJOBNAMES | NOJOBNAME
    PDCALLABLE(ALL | NONE | TYPE(type ...)) | NOPDCALLABLE
    RRSF | NORRSF
    RACROUTE(ALL | NONE | TYPE(type ...)) | NORACROUTE
    SYSTEMSSL | NOSYSTEMSSL
    USERID(userid ... | *)  | ALLUSERIDS
    IFUSERID(userid ... | *)
    NEVERUSERID(userid ... | *)
    NOUSERID
```

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Do I Need to Worry About Performance?

- **From the "SAFTRACE Performance Considerations" in the RACF Diagnosis Guide:**

  "Security as implemented on the OS/390, z/OS platform includes many calls to the security product. This trace facility can adversely affect system performance by adding to the path length associated with performance sensitive security functions.

  "This trace should only be used as a debugging aid. Caution should be exercised when designing the trace (as with any other trace) to impose the least performance penalty. For example, if the address space ID or jobname is known, use these to restrict the scope of the trace."

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SAFTRACE IN ACTION: EXAMPLE 1

Let’s explore why a user can delete a data set to which they have no access

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Example: Why Can Bert Delete Ernie's data?

- Meet Bert. He wants to copy member SOMEDATA from 'ERNIE.TOOLS.CNTL' into his own data set 'BERT.TOOLS.CNTL'.
- He has no access to 'ERNIE.TOOLS.CNTL' and so he is denied access and receives a 913-38 abend and an ICH408I message for his troubles.

```
//SAFTEBRW JOB 'D5202P,?',MSGLEVEL=(1,1),CLASS=A,MSGCLASS=H,
// REGION=0M,USER=BERT,NOTIFY=MARKN
//COPY     EXEC PGM=IEBGENER
//SYSIN    DD   DUMMY
//SYSPRINT DD   SYSOUT=*
//SYSUT1   DD   DISP=SHR,DSN=ERNIE.TOOLS.CNTL(SOMEDATA)
//SYSUT2   DD   DISP=SHR,DSN=BERT.TOOLS.CNTL(SOMEDATA)



 11.36.41 JOB00031 ---- WEDNESDAY, 16 OCT 2022 ----
 11.36.41 JOB00031  ICH70001I BERT     LAST ACCESS AT 22:14:30 ON TUESDAY, OCTOBER 15, 2022
 11.36.41 JOB00031  $HASP373 SAFTEBRW STARTED - INIT 1    - CLASS A
 11.36.41 JOB00031  ICH408I USER(BERT    ) GROUP(SYS1    ) NAME(####################)  621
    621               ERNIE.TOOLS.CNTL CL(DATASET ) VOL(SMSVL1)
    621               INSUFFICIENT ACCESS AUTHORITY
    621               FROM ERNIE.** (G)
    621               ACCESS INTENT(READ   )  ACCESS ALLOWED(NONE   )
 11.36.41 JOB00031  IEC150I 913-38,IFG0194E,SAFTEBRW,COPY,SYSUT1,1080,SMSVL1,  622
    622              ERNIE.TOOLS.CNTL(SOMEDATA)
 11.36.41 JOB00031  IEA995I SYMPTOM DUMP OUTPUT  623
    623              SYSTEM COMPLETION CODE=913  REASON CODE=00000038
    623               TIME=11.36.41  SEQ=00018  CPU=0000  ASID=0029
```

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Example: Why Can Bert Delete Ernie's data?

- But, it turns out that Bert can delete Ernie's data set!
- WHY?

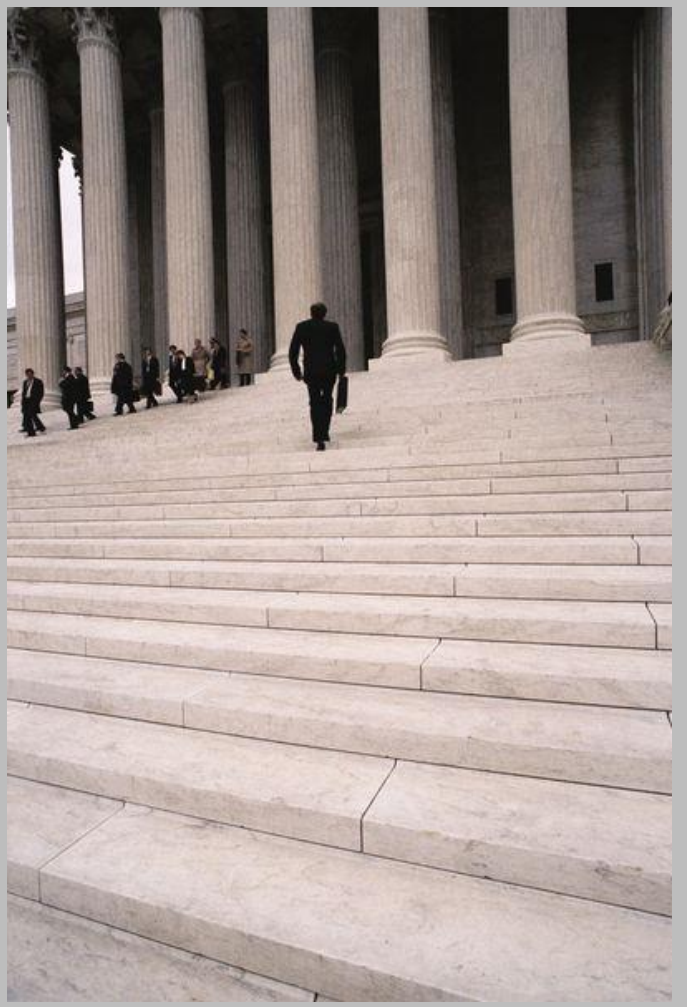
```
//SAFTEDEL JOB 'D5202P,?',MSGLEVEL=(1,1),CLASS=A,MSGCLASS=H,
// REGION=0M,USER=BERT,NOTIFY=MARKN
//COPY     EXEC PGM=IEFBR14
//DD1      DD   DISP=(SHR,DELETE),DSN=ERNIE.TOOLS.CNTL




 ICH70001I BERT     LAST ACCESS AT 12:41:00 ON WEDNESDAY, OCTOBER 16, 2022
 IEF236I ALLOC. FOR SAFTEDEL COPY
 IGD103I SMS ALLOCATED TO DDNAME DD1
 IEF142I SAFTEDEL COPY - STEP WAS EXECUTED - COND CODE 0000
 IGD105I ERNIE.TOOLS.CNTL                              DELETED,  DDNAME=DD1
 IEF373I STEP/COPY    /START 2022289.1255
 IEF032I STEP/COPY    /STOP  2022289.1255
```

Let's Apply the Steps…

- **Recall the seven SAFTRACE steps:**
  1. Ensure that the RACF subsystem is active. **Done!**
  2. Determining what events you want to trace. **RACROUTE REQUEST=AUTH (but let's trace all RACROUTEs just to see what is happening with job SAFTEDEL). Done!**
  3. Set the trace options using the RACF SET command. **Shown in a moment.**
  4. Start GTF / ensure that GTF is running. **Shown in a moment.**
  5. Recreate the scenario that is to be traced. **Shown in a moment.**
  6. Stopping the trace/GTF. **Shown in a moment.**
  7. Formatting the trace output. **We'll spend a lot of time on this in a moment.**



Step 3: Setting the Trace Options

- The SET TRACE command is used to set the trace options. Note that it's issued from any place where console commands can be issued.
- If we wanted REQUEST=AUTH only, that's service #1 (TYPE(1)). But let's get all of the RACROUTEs issued by jobname SAFTEDEL

```
 .-------------------------------------------------------------------------.
-- |   Edit  Options  Help                                                  |
SD | ------------------------------------------------------------------------ |
CO |                         System Command Extension                       |
 0 |                                                                        |
   | ===> @set trace(RACROUTE(all)) jobname(SAFTEDEL))                      |
 0 | ===>                                                                   |
 4 |                                                          STORELIMIT    |
 0 | Comment                                                                |
C0 |                                                                        |
 4 | Group                        Show *                 (F4 for list)      |
 0 |                                                             More:    + |
** | =>  STOP GTF                                                           |
   | =>  STOP GTFMARKN                                                      |
   | =>  D A,L                                                              |
   | =>  S HC                                                               |
   |                                                                        |
   |  F1=Help       F3=Cancel     F4=Prompt     F5=FullScr    F6=Details    |
PF |  F7=Up         F8=Down      F10=Save      F11=Clear     F12=Cancel     |
  *SDSF
```

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Step 3: Setting the Trace Options…

- It's a Real Good Idea to ensure that you got the trace set as you wanted it to be set.
- The SET LIST command shows the current trace settings

```
  .-------------------------------------------------------------------------.
-- |   Edit  Options  Help                                                   |
SD | ------------------------------------------------------------------------ |
CO |                        System Command Extension                         |
RE |                                                                         |
 I | ===> @set list                                                          |
 0 | ===>                                                                    |
 4 |                                                          STORELIMIT     |
 0 | Comment                                                                 |
C0 |                                                                         |
 4 | Group                       Show *                 (F4 for list)        |
 0 |                                                            More:     +  |
** | =>  @set trace(RACROUTE(all) jobname(SAFTEDEL))                         |
   | =>  STOP GTF                                                            |
   | =>  STOP GTFMARKN                                                       |
   | =>  D A,L                                                               |
   | =>  $PI2                                                                |
   | =>  $PI1-20                                                             |
   | =>  S HC                                                                |
   | =>  setprog apf,add,dsn=markn.hrf77C0.load,vol=d94rf4                   |
   |                                                                         |
   |  F1=Help       F3=Cancel     F4=Prompt     F5=FullScr    F6=Details     |
PF |  F7=Up         F8=Down      F10=Save      F11=Clear     F12=Cancel     |
  *SDSF
```

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Step 3: Setting the Trace Options…

- **RACROUTE(ALL) and JOBNAME(SAFTEDEL) are in effect as we requested**

```
------------------------------------------------------------------------------
SDSF HELD OUTPUT DISPLAY ALL CLASSES LINES 367          13 RESPONSES NOT SHOWN
COMMAND INPUT ===>                                        SCROLL ===> HALF
RESPONSE=SY1
 IRRH005I (@) RACF SUBSYSTEM INFORMATION:
    TRACE OPTIONS                      - NOIMAGE
                                       - NOAPPC
                                       - NOSYSTEMSSL
                                       - NORRSF
                                       - RACROUTE
                                          ALL
                                       - NOCALLABLE
                                       - NOPDCALLABLE
                                       - NODATABASE
                                       - NOGENERICANCHOR
                                       - NOASID
                                       - JOBNAME
                                          SAFTEDEL
                                       - NOCLASS
                                       - NOUSERID
```

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Step 4: Starting GTF

- **GTF must be started before you run your test scenario. These are the values that I used:**
  - **PROCLIB (member GTFMARKN in my PROCLIB concatenation)**

```
//GTFRACF PROC MEMBER=GTFMARKN
//BR14     EXEC PGM=IEFBR14,REGION=512K
//SYSPRINT DD SYSOUT=*
//D        DD DISP=(OLD,DELETE),UNIT=3380,VOL=SER=D94RF1,
//         DSN=MARKN.GTF.TRACE
//IEFPROC  EXEC PGM=AHLGTF,PARM='MODE=EXT,DEBUG=NO,SA=100K,AB=100K',
//              REGION=2880K,TIME=NOLIMIT
//IEFRDER  DD   DSNAME=MARKN.GTF.TRACE,UNIT=3380,VOL=SER=D94RF1,
//             DISP=(NEW,CATLG),SPACE=(TRK,(30,10))
//SYSLIB   DD   DSNAME=RACFDRVR.PARMLIB.ZR13(&MEMBER),DISP=SHR
```

  - **PARMLIB (member GTFMARKN in my PARMLIB concatenation)**

```
TRACE=USRP
USR=(F44)
END
```

Step 4: Starting GTF…

- Starting GTF using the PARMLIB/PROCLIB shown earlier

```
.-------------------------------------------------------------------------.
-- |   Edit  Options  Help                                                 | --
SD | ----------------------------------------------------------------------  |
CO |                        System Command Extension                       |
PR |                                                                       |
NP | ===> s gtfmarkn.gtf,,,noprompt                                        |
   | ===>                                                                  |
   |                                                          STORELIMIT   |
   | Comment                                                               |
   |                                                                       |
   | Group                       Show *                  (F4 for list)     |
   |                                                             More:   + |
   | =>  @set list                                                         |
   | =>  @set trace(RACROUTE(all) jobname(SAFTEDEL))                       |
   | =>  @set trace(RACROUTE(all)) jobname(SAFTEDEL))                      |
   | =>  @set trace(RACROUTE(type(all)) jobname(SAFTEDEL))                 |
   | =>  @set trace(RACROUTE(type(1)) jobname(SAFTEDEL))                   |
   | =>  STOP GTF                                                          |
   | =>  STOP GTFMARKN                                                     |
   | =>  D A,L                                                             |
   |                                                                       |
   |  F1=Help       F3=Cancel     F4=Prompt     F5=FullScr    F6=Details   |
PF |  F7=Up         F8=Down      F10=Save      F11=Clear     F12=Cancel    |
```

Step 4: Starting GTF…

- Console messages after a successful start

```
S GTFMARKN.GTF,,,NOPROMPT
IRR813I NO PROFILE WAS FOUND IN THE STARTED CLASS FOR 608
        GTFMARKN WITH JOBNAME GTFMARKN. RACF WILL USE ICHRIN03.
$HASP100 GTFMARKN ON STCINRDR
IRR813I NO PROFILE WAS FOUND IN THE STARTED CLASS FOR 610
        GTFMARKN WITH JOBNAME GTFMARKN. RACF WILL USE ICHRIN03.
IEF695I START GTFMARKN WITH JOBNAME GTFMARKN IS ASSIGNED TO USER STCUSER
 , GROUP SYSGRP
$HASP373 GTFMARKN STARTED
IEF188I PROBLEM PROGRAM ATTRIBUTES ASSIGNED
AHL121I  TRACE OPTION INPUT INDICATED FROM MEMBER GTFMARKN OF PDS
RACFDRVR.PARMLIB.ZR13
  TRACE=USRP
  USR=(F44)
  END
AHL103I  TRACE OPTIONS SELECTED --USR=(F44)
AHL906I THE OUTPUT BLOCK SIZE OF    23476 WILL BE USED FOR OUTPUT 619
AHL906I THE OUTPUT BLOCK SIZE OF    23476 WILL BE USED FOR OUTPUT 619
        DATA SETS:
          MARKN.GTF.TRACE
AHL080I GTF STORAGE USED FOR GTF DATA: 620
        GTFBLOCK STORAGE       68K BYTES (BLOK=        40K)
        PRIVATE STORAGE      1031K BYTES (SIZE=      1024K)
        SADMP HISTORY          45K BYTES (SADMP=       40K)
        SDUMP HISTORY          45K BYTES (SDUMP=       40K)
        ABEND DUMP DATA         0K BYTES (ABDUMP=       0K)
AHL031I GTF INITIALIZATION COMPLETE
```

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Step 5: Recreating the Scenario

- **Our test scenario is straightforward: Submitting our batch job**

```
------------------------------------------------------------------------------
EDIT       MARKN.TOOLS.CNTL(SAFTDEL) - 01.04               Columns 00001 00072
****** ***************************** Top of Data ******************************
002200 //SAFTEDEL JOB 'D5202P,?',MSGLEVEL=(1,1),CLASS=A,MSGCLASS=H,
002300 // REGION=0M,USER=BERT,NOTIFY=MARKN
002400 //COPY     EXEC PGM=IEFBR14
002700 //DD1      DD   DISP=(SHR,DELETE),DSN=ERNIE.TOOLS.CNTL
****** **************************** Bottom of Data ****************************




Command ===> sub                                          Scroll ===> PAGE
 F1=Help      F2=Split     F3=Exit      F4=Expand    F5=Rfind     F6=Rchange
 F7=Up        F8=Down      F9=Swap     F10=Left     F11=Right    F12=Cancel
```

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Step 5: Recreating the Scenario…

- … and verifying that we got the result that we want to investigate

```
 ------------------------------------------------------------------------------
 SDSF OUTPUT DISPLAY SAFTEDEL JOB00026  DSID     2 LINE 0       COLUMNS 02- 81
 COMMAND INPUT ===>                                            SCROLL ===> PAGE
******************************** TOP OF DATA ***********************************
                       J E S 2  J O B  L O G  --  S Y S T E M  I B M 2  --  N O

23.11.20 JOB00026 ---- MONDAY,    21 OCT 2022 ----
23.11.20 JOB00026  ICH70001I BERT     LAST ACCESS AT 23:10:16 ON MONDAY, OCTOBER
23.11.20 JOB00026  $HASP373 SAFTEDEL STARTED - INIT 1    - CLASS A        - SYS
23.11.20 JOB00026  $HASP395 SAFTEDEL ENDED - RC=0000
------ JES2 JOB STATISTICS ------
  21 OCT 2022 JOB EXECUTION DATE
            4 CARDS READ
           37 SYSOUT PRINT RECORDS
            0 SYSOUT PUNCH RECORDS
            5 SYSOUT SPOOL KBYTES
         0.00 MINUTES EXECUTION TIME
       1 //SAFTEDEL JOB 'D5202P,?',MSGLEVEL=(1,1),CLASS=A,MSGCLASS=H,
         // REGION=0M,USER=BERT,NOTIFY=MARKN
       2 //COPY     EXEC PGM=IEFBR14
                                                      IFIND      F6=BOOK
  F7=UP        F8=DOWN      F9=SWAP     F10=LEFT     F11=RIGHT    F12=RETRIEVE
```

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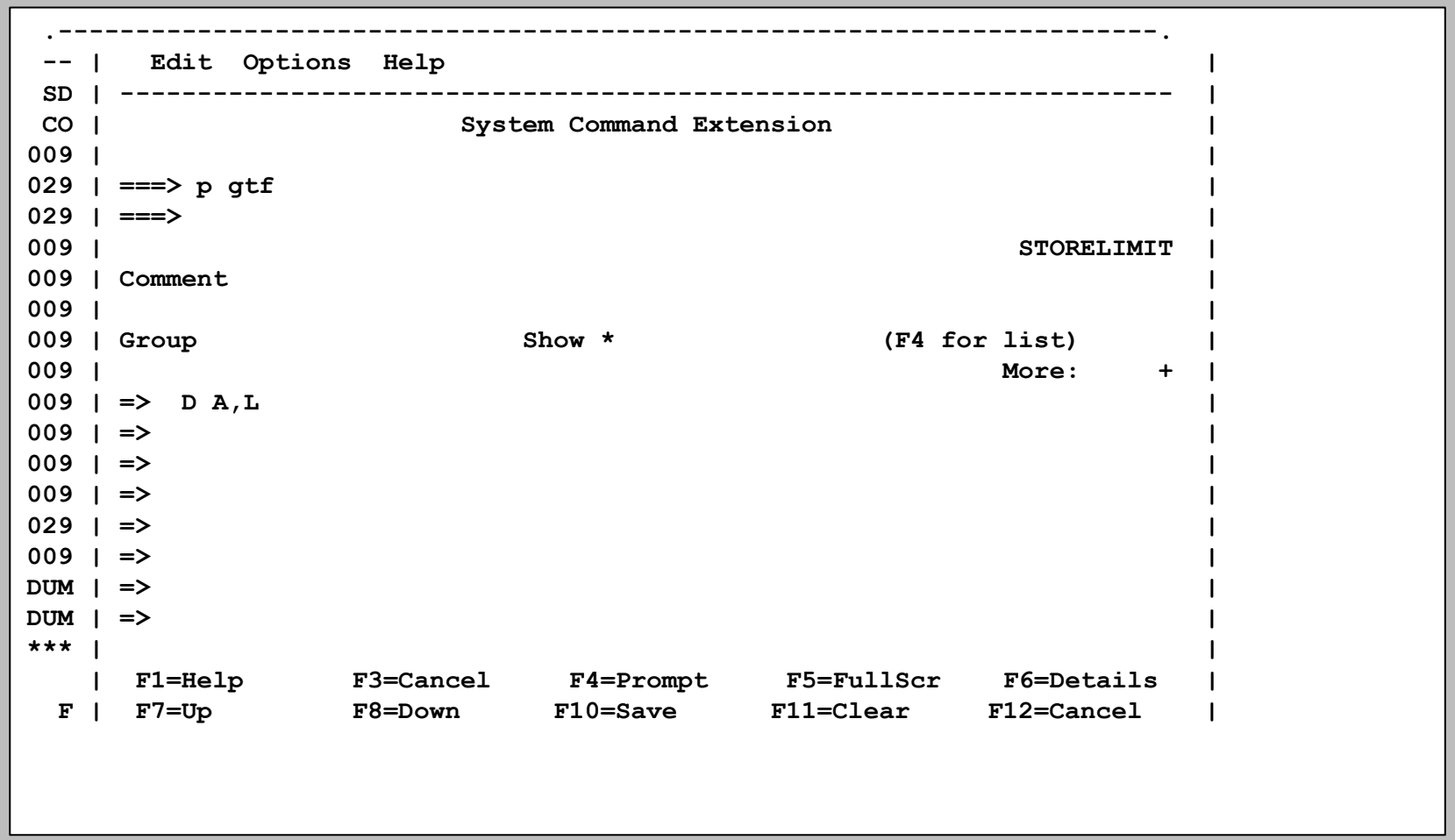
Step 6: Stopping GTF

- **We stop GTF using the MVS STOP command**



Step 7: Formatting and Reviewing the Trace

- IPCS is used to format the SAFTRACE records

```
//SAFTIPCS JOB 'D5203P,?',
//             'M.NELSON BIN 1016',
//             REGION=0M,
//             MSGLEVEL=(1,1),
//             NOTIFY=&SYSUID,
//             CLASS=A,
//             MSGCLASS=H
//IPCS     EXEC  PGM=IKJEFT01
//IPCSDDIR DD    DISP=SHR,DSN=MARKN.DDIR
//SYSTSPRT DD    SYSOUT=*
//SYSPRINT DD    SYSOUT=*
//SYSTSIN  DD    *
SE 'HELLO, WORLD!'
IPCS NOPARM
SETDEF DSN('MARKN.GTF.TRACE') LIST NOCONFIRM
GTF USR
END
/*
```

Step 7: Formatting and Reviewing the Trace…

- **SAFTRACE output consists three distinct parts**

1. **Fixed-length header portion**
2. **The parameters specified on the RACFROUTE REQUEST, RACF callable service, or ICHEINTY**
3. **A “raw” hex dump of the entire GTF record**

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Step 7: Formatting and Reviewing the Trace…

- **(1) The Header portion, which contains**
  - Date and time of the event
  - Service number (RACROUTE or Callable Service)
  - Type of request, “RACF”, “OMVS”, “RACF” appended with “PRE” or “POST”
  - Job name/ASID
  - Pointers to ACEE
  - REQSTOR/SUBSYS for RACROUTE
  - RACF return and reason code
  - Count of parameters in the request

```
Following is a formatted R_TRACE record.
 This trace record was generated by IRRTRC00 with IDENT(R_TRACE).

Trace Identifier:            00000036
Record Eyecatcher:           RTRACE
Trace Type:                  RACFPRE
Ending Sequence:             ........
Calling address:             00000000  8417454E
Requestor/Subsystem:         ........  ........
Primary jobname:             SAFTEDEL
Primary asid:                00000029
Primary ACEEP:               00000000  009FC870
Home jobname:                SAFTEDEL
Home asid:                   00000029
Home ACEEP:                  00000000  009FC870
Task address:                00000000  009F81A0
Task ACEEP:                  00000000  009FC870
Time:                        D6E1A424  4A65BC95
Error class:                 ........
Service number:              00000001
RACF Return code:            00000000
RACF Reason code:            00000000
Return area address:         00000000  0000682C
Parameter count:             0000000B
```

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Step 7: Formatting and Reviewing the Trace…

- **(2) The Request Parameter portion, which consists of:**
  - The SAF parameter list
  - The function-specific parameter list
  - The individual parameters
    - OFFSETnn is the offset of the next “area value” in the function-specific parameter list
    - In this example, “nn” = x’24’, which is the entity name
- **The RACF Diagnosis Guide has detailed parameter list diagrams**

```
     Area length:                  00000068

     Area value:
     00000000  00000000  00A40000  00010000  | .........u...... |
     00000000  00000000  000069A4  00000000  | ..........u.... |
     00000000  00000068  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000                      | ........         |

     Area length:                  0000003C

     Area value:
     3C000000  9C000000  80000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00006C48  00006C74  00006C7C  | ......%...%...%@ |
     00000000  00000000  00000000            | ............     |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E30024                      | OFFSET..         |

     Area length:                  0000002C

     Area value:
1    D7C1C7C5  F0F84BC3  C1E3C1D3  D6C74040  | PAGE08.CATALOG   |
     40404040  40404040  40404040  40404040  |                  |
     40404040  40404040  40404040            |                  |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E30028                      | OFFSET..         |

     Area length:                  00000008

     Area value:
     07C4C1E3  C1E2C5E3                      | .DATASET         |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E3002C                      | OFFSET..         |

     Area length:                  00000006

     Area value:
     D7C1C7C5  F0F8                          | PAGE08           |
```

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Step 7: Formatting and Reviewing the Trace…

- **(3) The raw hex dump**
  - I rarely use this….

```
Hexadecimal dump of record follows:
 +0000  00000036  D9E3D9C1  C3C54040  D9C1C3C6  | ....RTRACE  RACF |
 +0010  D7D9C540  00000000  00000000  00000000  | PRE ............ |
 +0020  00000000  00000000  00000000  00000000  | ................ |
 +0030  83C78020  C9C5C5F0  F0F0F3C4  4040C3D6  | cG..IEE0003D  CO |
 +0040  D5E2D6D3  C5400000  00000000  00000000  | NSOLE .......... |
 +0050  00000000  00000000  009F81A0  00000000  | .........a..... |
 +0060  00F53700  00000000  00F53700  00000029  | .5.......5..... |
 +0070  00000029  E2C1C6E3  C5C4C5D3  E2C1C6E3  | ....SAFTEDELSAFT |
1+0080  C5C4C5D3  00000000  009FC870  00000000  | EDEL......H..... |
 +0090  009FC870  00000000  009FC870  D6E1A424  | ..H.......H.O.u. |
 +00A0  4368CA98  00000000  00000000  009D2F80  | ...q............ |
 +00B0  00000007  0000000E  00000068  00000000  | ................ |
 +00C0  00000000  00680000  000E5000  03C789A0  | ..........&..Gi. |
 +00D0  03C78998  009D2D80  00000000  00000000  | .Giq............ |
 +00E0  00000068  00000000  00000000  00400000  | ............. .. |
 +00F0  00000000  00000000  00000000  00000000  | ................ |
 +0100  00000000  00000000  00000000  00000000  | ................ |
 +0110  00000000  00000000  00000000  00000000  | ................ |
 +0120  00000000  0000000C  03C78D50  00000000  | .........G.&.... |
 +0130  000C0000  00000008  D6C6C6E2  C5E30000  | ........OFFSET.. |
 +0140  00000008  D6D7C5D9  C3D4C4E2  000000C0  | ....OPERCMDS...{ |
 +0150  C1C3C5C5  FF0000C0  03E1CE2F  00000000  | ACEE...{........ |
 +0160  00000000  04C2C5D9  E3404040  4004E2E8  | .....BERT    .SY |
 +0170  E2F14040  40400101  0019289F  40404040  | S1    ......     |
 +0180  40404040  00000000  00000000  00000000  |     ............ |
 +0190  40404040  40404040  00000000  00000000  |         ........ |
 +01A0  00000000  00000000  40404040  40404040  | ........         |
 +01B0  00000000  009FC930  00000000  009FC948  | ......I.......I. |
 +01C0  00000000  009FC980  00000000  0119289F  | ......I......... |
 +01D0  00000000  00200000  00000000  00000000  | ................ |
 +01E0  00000000  00000000  009FC9B8  00000000  | ..........I..... |
 +01F0  00000000  009FCA48  00000000  00000000  | ................ |
 +0200  00000000  00000000  00000000  12555720  | ................ |
 +0210  00000050  50010007  0403C000  00000000  | ...&&.....{..... |
 +0220  00000000  E6C3C340  40404040  D4C1D9D2  | ....WCC     MARK |
 +0230  D5404040  E6C3C340  40404040  E2E8E2F1  | N   WCC     SYS1 |
 +0240  40404040  C9D5E3D9  C4D94040  00000000  |     INTRDR  .... |
 +0250  00000000  C2C5D9E3  40404040  E2E8E2F1  | ....BERT    SYS1 |
 +0260  40404040  00000090  C1C3C5E7  032DDC4E  |     ....ACEX...+ |
 +0270  00F54278  00000000  00000000  00000000  | .5.............. |
 +0280  00000000  00000046  000000AD  00000028  | ................ |
 +0290  009FCA98  00000000  00000000  00000000  | ...q............ |
 +02A0  00000000  00000000  00000000  0000807B  | ...............# |
 +02B0  00000000  00000000  00000000  00000000  | ................ |
 +02C0  00000000  00000000  00000000  00000000  | ................ |
 +02D0  00000000  00000000  00000000  00000000  | ................ |
 +02E0  00000000  00000000  00CD6C78  00290000  | ..........%..... |
 +02F0  00000000  00000000                      | ........         |
```

VANGUARD SECURITY & COMPLIANCE

SAFTRACE Records for our Batch Job

- **Our simple batch job has created 20 SAFTRACE entries, 10 RACFPRE and 10 RACFPOST. These are the RACFPOST records**

Event	REQSTOR	SUBSYS	Return and Reason Codes	Description/Comments
TOKENMAP(XM)	IEE0003D	CONSOLE	0/0/0	Not related to our investigation
EXTRACT(BR)	JBSTXTRT	JES2z204	0/0/0	Not related to our investigation
VERIFYX	JBSTTMAP	JES2z204	0/0/0	Not related to our investigation
AUTH			4/4/0	????? Authority to FACILITY/IARRSM.LRGPAGES Not related to our investigation
AUTH			8/8/200	????? Authority to XFACILIT/STGADMIN.IGG.DELAUDIT.PAGE08.CATALOG
AUTH			8/8/0	???? Authority to DATASET/ERNIE.TOOLS.CNTL
AUTH			0/0/0	????? Authority to DATASET/PAGE08.CATALOG
AUTH			8/8/0	???? Authority to DATASET/ERNIE.TOOLS.CNTL
DEFINE			0/0/0	DATASET/ERNIE.TOOLS.CNTL
VERIFY			0/0/0	Not related to our investigation

Note: z/OS V2R4 adds a new check for the resource STGADMIN.IGG.DELAUDIT.catalogname in the XFACILIT class

VANGUARD SECURITY & COMPLIANCE

Step 7: Formatting and Reviewing the Trace…

- **Let's look at the last three REQUEST=AUTHs**
- **The X'3C' length is the function-specific parameter list for RACROUTE REQUEST=AUTH**
  - Offset X'04' (value X'0C') indicates LOG=NOFAIL was specified and ENTITY (not ENTITYX) was specified
  - Offset X'08 (value X'80') indicates that ATTR=ALTER was specified
  - OFFSETxx (X'24') is the ENTITY name ("ERNIE.TOOLS.CNTL")
  - OFFSETxx (X'28') is the CLASS name ("DATASET")
  - OFFSETxx (X'2C') is the VOLSER ("SMSVL1")
- **Where do we find the parameter list mappings?**

```
     Area length:                  00000068

     Area value:
     00000008  00000000  00A40000  00010000  | .........u...... |
     00000000  00000000  000069A4  00000000  | ...........u.... |
     00000000  00000068  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000                      | ........         |

     Area length:                  0000003C

     Area value:
     3C000000  0C000000  80000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00006C48  00006C74  00006C7C  | ......%...%...%@ |
     00000000  00000000  00000000            | ............     |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E30024                      | OFFSET..         |

     Area length:                  0000002C

     Area value:
     C5D9D5C9  C54BE3D6  D6D3E24B  C3D5E3D3  | ERNIE.TOOLS.CNTL |
     40404040  40404040  40404040  40404040  |                  |
     40404040  40404040  40404040            |                  |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E30028                      | OFFSET..         |

1    Area length:                  00000008

     Area value:
     07C4C1E3  C1E2C5E3                      | .DATASET         |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E3002C                      | OFFSET..         |

     Area length:                  00000006

     Area value:
     E2D4E2E5  D3F1                          | SMSVL1           |

     Area length:                  000000C0
```

VANGUARD SECURITY & COMPLIANCE

Step 7: Formatting and Reviewing the Trace…

- **RACF Diagnosis Guide Mapping of the SAF parameter List**

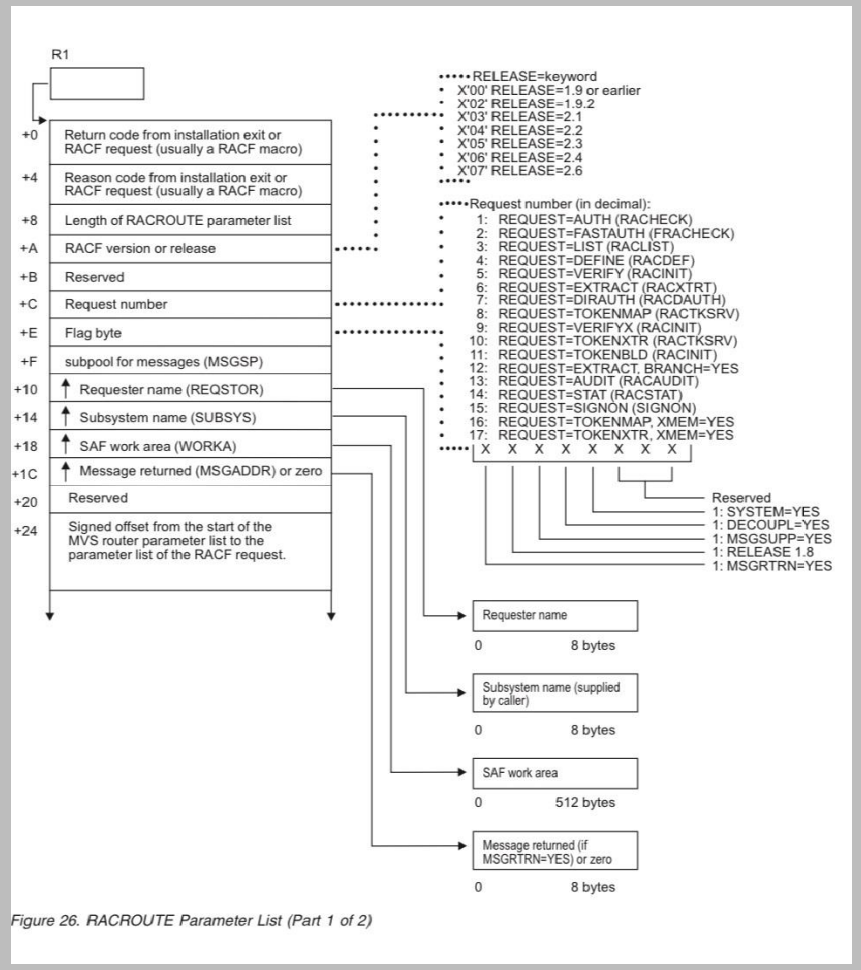


Figure 26. RACROUTE Parameter List (Part 1 of 2)

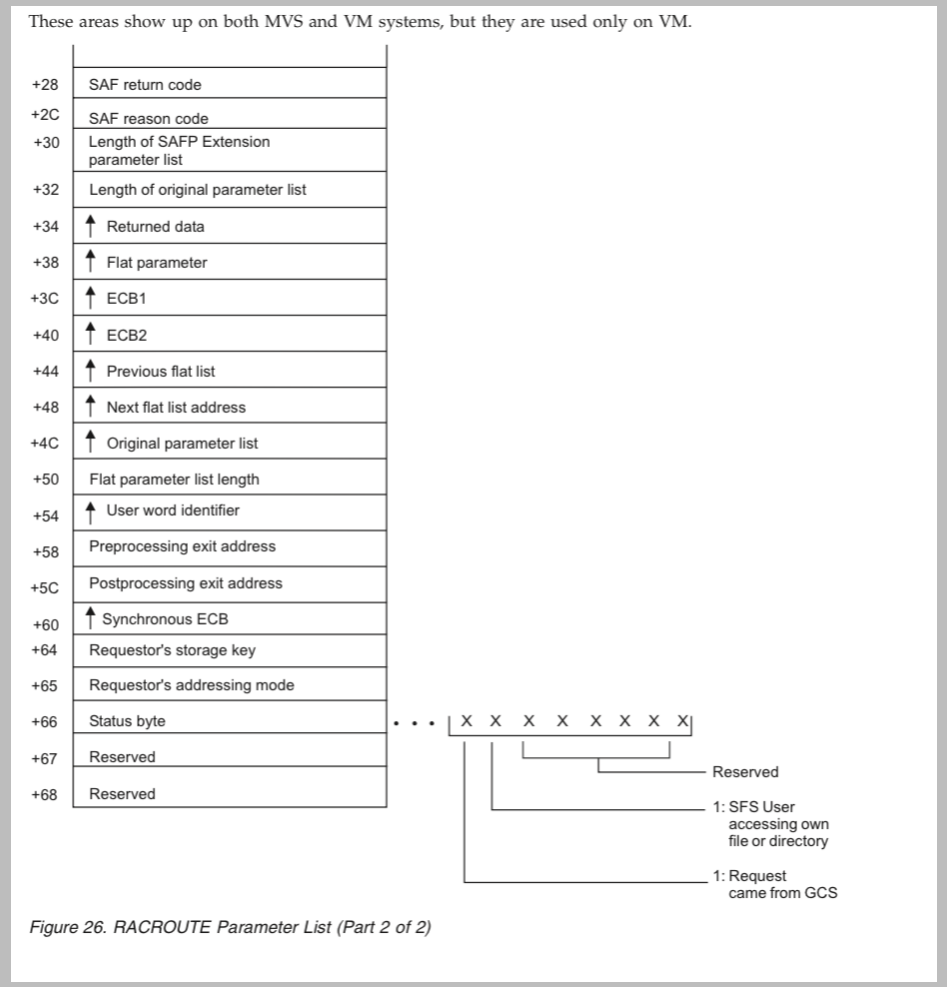
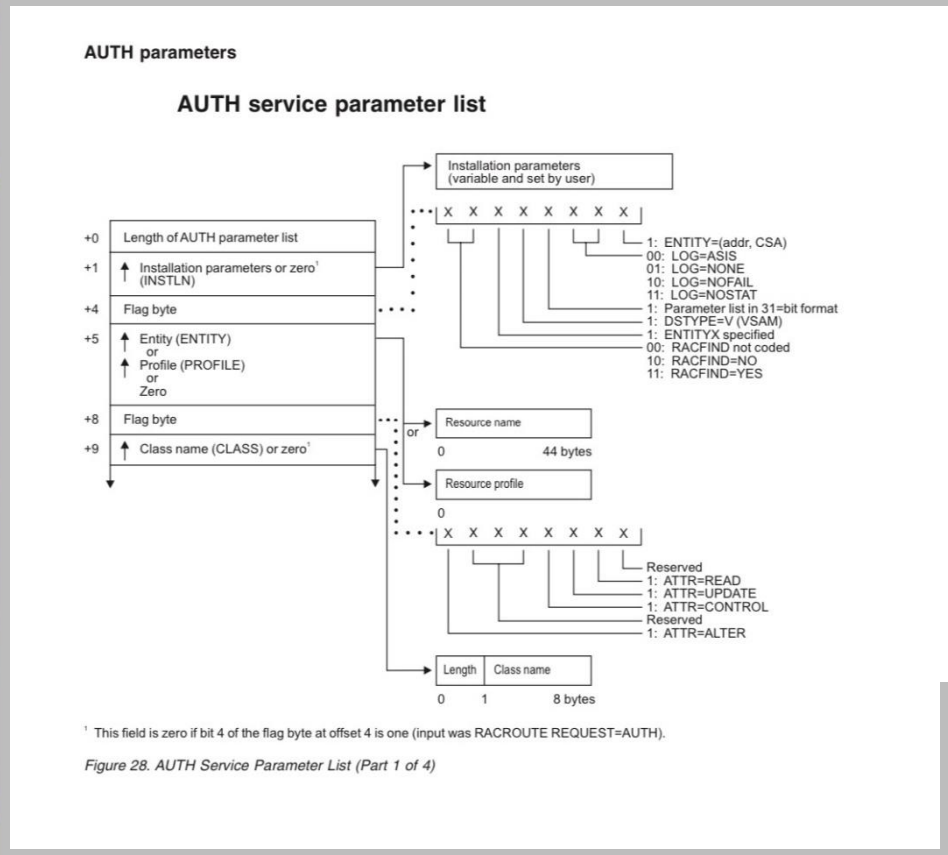


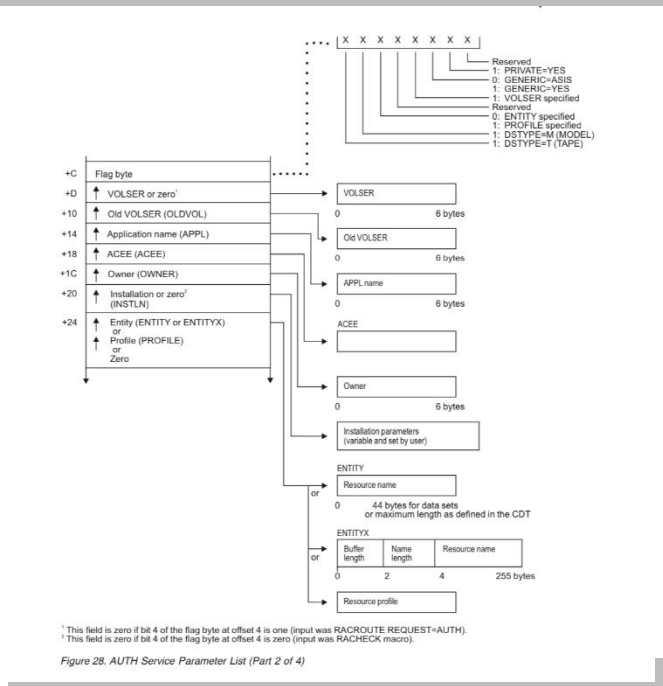
Figure 26. RACROUTE Parameter List (Part 2 of 2)

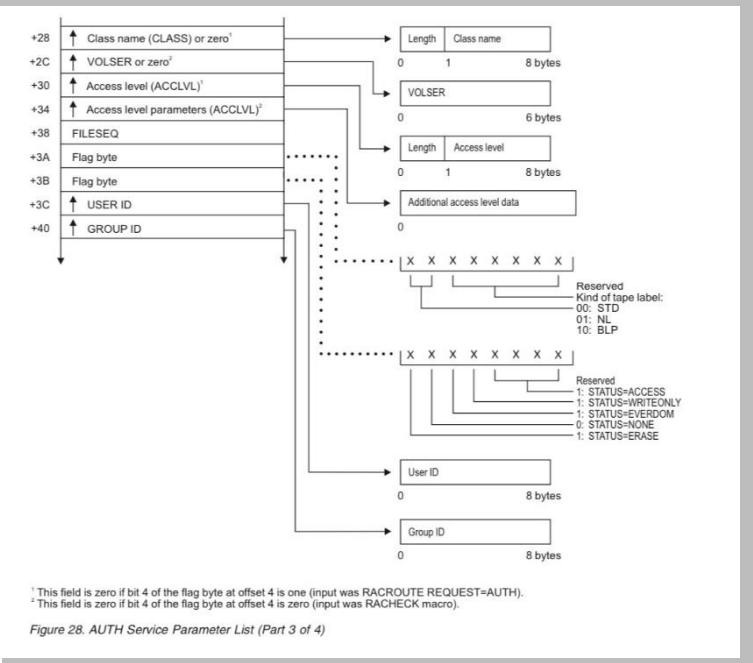
VANGUARD SECURITY & COMPLIANCE

Step 7: Formatting and Reviewing the Trace…

- **RACF Diagnosis Guide Mapping of the REQUEST=AUTH parameter list**







VANGUARD SECURITY & COMPLIANCE

Step 7: Formatting and Reviewing the Trace…

- **Let's look at the second of the last three REQUEST=AUTHs**
- **The X'3C' length is the function-specific parameter list for RACROUTE REQUEST=AUTH**
  - Offset X'04' (value X'9C') indicates LOG=ASIS, RACFIND=NO, and DSTYPE=V and ENTITY (not ENTITYX) were specified
  - Offset X'08 (value X'80') indicates that ATTR=ALTER was specified
  - OFFSETxx (X'24') is the ENTITY name ("PAGE08.CATALOG")
  - OFFSETxx (X'28') is the CLASS name ("DATASET")
  - OFFSETxx (X'2C') is the VOLSER ("PAGE08")

```
Area length:                  00000068

     Area value:
     00000000  00000000  00A40000  00010000  | .........u...... |
     00000000  00000000  000069A4  00000000  | ...........u.... |
     00000000  00000068  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00000000                      | ........         |

     Area length:                  0000003C

     Area value:
     3C000000  9C000000  80000000  00000000  | ................ |
     00000000  00000000  00000000  00000000  | ................ |
     00000000  00006C48  00006C74  00006C7C  | ......%...%...%@ |
     00000000  00000000  00000000            | ............     |
1
     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E30024                      | OFFSET..         |

     Area length:                  0000002C

     Area value:
     D7C1C7C5  F0F84BC3  C1E3C1D3  D6C74040  | PAGE08.CATALOG   |
     40404040  40404040  40404040  40404040  |                  |
     40404040  40404040  40404040            |                  |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E30028                      | OFFSET..         |

     Area length:                  00000008

     Area value:
     07C4C1E3  C1E2C5E3                      | .DATASET         |

     Area length:                  00000008

     Area value:
     D6C6C6E2  C5E3002C                      | OFFSET..         |

     Area length:                  00000006

     Area value:
     D7C1C7C5  F0F8                          | PAGE08           |
```

Step 7: Formatting and Reviewing the Trace…

- **Let's look at the third of the last three REQUEST=AUTHs, which is for 'ERNIE.TOOLS.CNTL'**
- **The X'3C' length is the function-specific parameter list for RACROUTE REQUEST=AUTH**
  - Offset X'04' (value X'8E') indicates RACFIND=NO, and DSTYPE is not V and LOG=NOSTAT was specified and ENTITY (not ENTITYX) was specified
  - Offset X'08 (value X'02') indicates that ATTR=READ was specified
  - OFFSETxx (X'24') is the ENTITY name ("ERNIE.TOOLS.CNTL")
  - OFFSETxx (X'28') is the CLASS name ("DATASET")
  - OFFSETxx (X'2C') is the VOLSER ("SMSVL1")

```
<SAP Plist omitted>


Area length:                    0000003C

Area value:
3C000000  8E000000  02000000  00000000  | ................ |
00000000  00000000  00000000  00000000  | ................ |
00000000  009C4A58  009C4D30  009C403C  | ......¢...(... . |
00000000  00000000  00000080            | ............     |

Area length:                    00000008

Area value:
D6C6C6E2  C5E30024                      | OFFSET..         |

Area length:                    0000002C

Area value:
C5D9D5C9  C54BE3D6  D6D3E24B  C3D5E3D3  | ERNIE.TOOLS.CNTL |
40404040  40404040  40404040  40404040  |                  |
40404040  40404040  40404040            |                  |

Area length:                    00000008

Area value:
D6C6C6E2  C5E30028                      | OFFSET..         |

Area length:                    00000008

Area value:
07C4C1E3  C1E2C5E3                      | .DATASET         |

Area length:                    00000008

Area value:
D6C6C6E2  C5E3002C                      | OFFSET..         |

Area length:                    00000006

Area value:
E2D4E2E5  D3F1                          | SMSVL1           |
```

Step 7: Formatting and Reviewing the Trace…

- **The final REQUEST= in our job was a REQUEST=DEFINE The X'68' length is the function-specific parameter list for RACROUTE REQUEST=AUTH**
  - Offset X'04' (value X'88') indicates that this is a TYPE=DELETE and DSTYPE is not V or M
  - OFFSETxx (X'0C') is the VOLSER name ("SMSVL1")
  - OFFSETxx (X'10') is the CLASS name ("DATASET")
  - OFFSETxx (X'34') is the ENTITY ("ERNIE.TOOLS.CNTL")

```
Area length:                    00000068
Area value:
68000000  88000000  00000000  009C403C  | ....h......... . |
009C4D30  00000000  00000000  00000000  | ..(.............. |
00000000  00000080  00000000  00000000  | .................. |
00000000  009C4A58  00000000  00000000  | ......¢......... |
00000000  00000000  00000000  00000000  | .................. |
00000000  00000000  00000000  00000000  | .................. |
00000000  00000000                      | ........          |

Area length:                    00000008

Area value:
D6C6C6E2  C5E3000C                      | OFFSET..          |

Area length:                    00000006

Area value:
E2D4E2E5  D3F1                          | SMSVL1            |

Area length:                    00000008

Area value:
D6C6C6E2  C5E30010                      | OFFSET..          |

Area length:                    00000008

Area value:
07C4C1E3  C1E2C5E3                      | .DATASET          |

Area length:                    00000008

Area value:
D6C6C6E2  C5E30034                      | OFFSET..          |

Area length:                    0000002C

Area value:
C5D9D5C9  C54BE3D6  D6D3E24B  C3D5E3D3  | ERNIE.TOOLS.CNTL  |
40404040  40404040  40404040  40404040  |                   |
40404040  40404040  40404040            |                   |
```

VANGUARD SECURITY & COMPLIANCE

SAFTRACE Records for our Batch Job

- Now we can fill in our table…

Event	REQSTOR	SUBSYS	Return and Reason Codes	Description/Comments
TOKENMAP(XM)	IEE0003D	CONSOLE	0/0/0	Not related to our investigation
EXTRACT(BR)	JBSTXTRT	JES2z204	0/0/0	Not related to our investigation
VERIFYX	JBSTTMAP	JES2z204	0/0/0	Not related to our investigation
AUTH			4/4/0	READ authority to FACILITY/IARRSM.LRGPAGES Not related to our investigation
AUTH			8/8/200	READ Authority to XFACILIT/STGADMIN.IGG.DELAUDIT.PAGE08.CATALOG
AUTH			8/8/0	ALTER Authority to ERNIE.TOOLS.CNTL with LOG=NOFAIL
AUTH			0/0/0	ALTER Authority to PAGE08.CATALOG with LOG=ASIS
AUTH			8/8/0	READ Authority to ERNIE.TOOLS.CNTL with LOG=NOSTAT
DEFINE			0/0/0	TYPE=DELETE for ERNIE.TOOLS.CNTL
VERIFY			0/0/0	Not related to our investigation

VANGUARD SECURITY & COMPLIANCE

RACROUTE and Callable Service Numbers

Table 17. Callable services type numbers (continued)

IRRSIU00	1	1
IRRSDU00	2	2
IRRSMF00	3	3
Reserved	4	4
IRRSMM00	5	5
IRRSKA00	6	6
IRRSKP00	7	7
IRRSUM00	8	8
IRRSGM00	9	9
IRRSGG00	A	10
IRRSSU00	B	11
IRRSEU00	C	12
IRRSSG00	D	13
IRRSEG00	E	14
IRRSCO00	F	15
IRRSCF00	10	16
IRRSCA00	11	17
IRRSEX00	12	18
IRRSAU00	13	19
IRRSKO00	14	20
IRRSQS00	15	21
IRRSQF00	16	22
IRRSCS00	17	23
IRRSKF00	18	24
IRRSMR00	19	25
IRRSPT00	1A	26
IRRSUG00	1B	27
IRRSFK00	1C	28
IRRSM100	1D	29
IRRSK100	1E	30
IRRSC100	1F	31
IRRSC200	20	32
IRRSGE00	21	33
IRRSD100	22	34
IRRSDK00	23	35
IRRSUD00	24	36
IRRSDA00	25	37
IRRSIA00	26	38
IRRSEQ00*	27	39
IRRSIM00	28	40
IRRSDL00	29	41

Table 17. Callable services type numbers (continued)

IRRSMK00	2A	42
IRRSPK00	2B	43
IRRSPX00	2C	44
IRRSCH00	2D	45
IRRSPY00	2E	46
IRRSCL00	2F	47
IRRSSB00	30	48
IRRSWP00	31	49
IRRSGS00	32	50
IRRSAX00	33	51
IRRSGI00	34	52
IRRSPS00	35	53

Note: Callable Service IRRSEQ00, R_Admin, has its own trace facility.

Table 18. RACROUTE CALL= service type number

RACROUTE CALL=	Service / Type Number in Hex	Service / Type Number in Decimal
AUTH	1	1
FASTAUTH	2	2
LIST	3	3
DEFINE	4	4
VERIFY	5	5
EXTRACT	6	6
DIRAUTH	7	7
TOKENMAP	8	8
VERIFYX	9	9
TOKENXTR	A	10
TOKENBLD	B	11
EXTRACT, BR=YES	C	12
AUDIT	D	13
STAT	E	14
SIGNON	F	15
TOKENMAP, XMEM	10	16
TOKENXTR, XMEM	11	17

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A Few Last Points

- Due to nesting of some services PRE and POST trace records might not be in sequential order. For example, you might see two PRE calls and then two POST calls.
- Not all parameters appear in the trace. For example, passwords don’t appear in the trace.
- When tracing z/OS UNIX System Services calls, you need to have a “*” in the jobname to catch any spawned address spaces.

VANGUARD SECURITY & COMPLIANCE

Questions

How to Contact Me

Mark Nelson

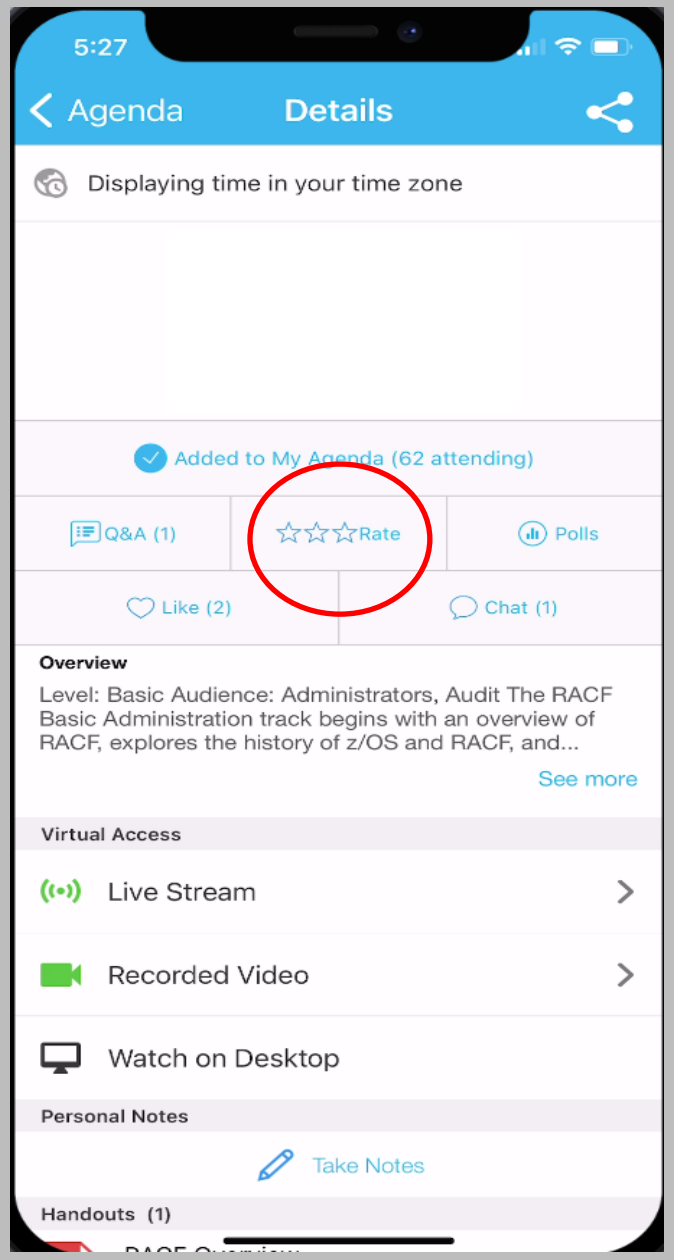
markan@us.ibm.com

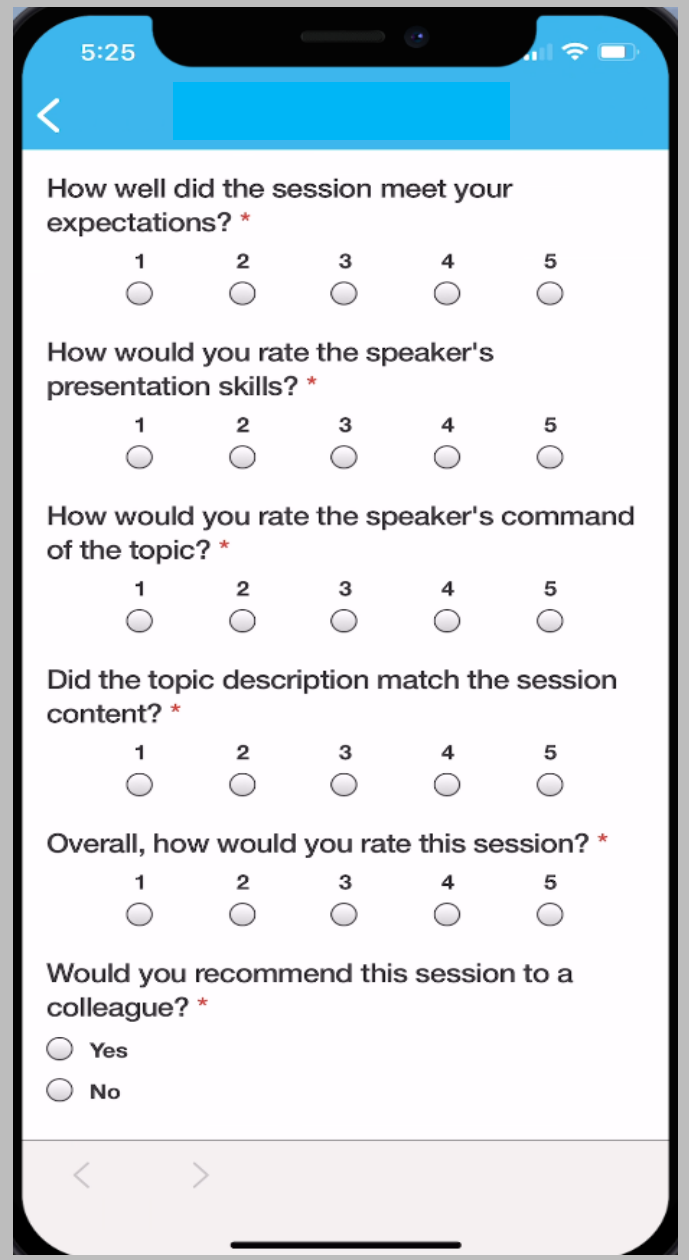
VANGUARD SECURITY & COMPLIANCE

Session Evaluation

Be sure to rate your experience using the VSC2023 app.

Your opinion helps us bring you the best experience.
Please let us know your thoughts.





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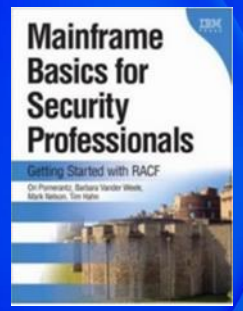
Security & Compliance

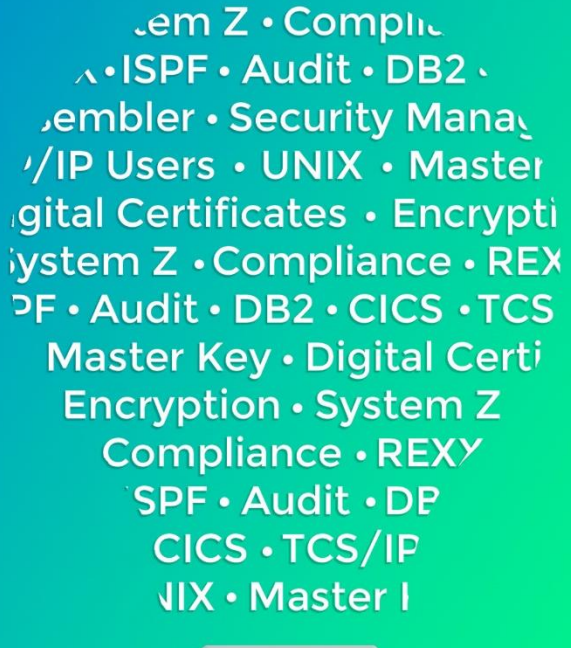
SAFTRACE Demystified

Mark Nelson, CISSP®, CSSLP ®,

Senior Technical Staff Member

IBM ® Poughkeepsie





KNOWLEDGE
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