RSH CONSULTING

RACF

Monitoring & Reporting

(Maximizing your SIEM ROI)

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RSH Consulting - Robert S. Hansel

RSH Consulting, Inc. is an IT security professional services firm established in 1992 and dedicated to helping clients strengthen their IBM z/OS mainframe access controls by fully exploiting all the capabilities and latest innovations in RACF. RSH's services include RACF security reviews and audits, initial implementation of new controls, enhancement and remediation of existing controls, and training.

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Topics

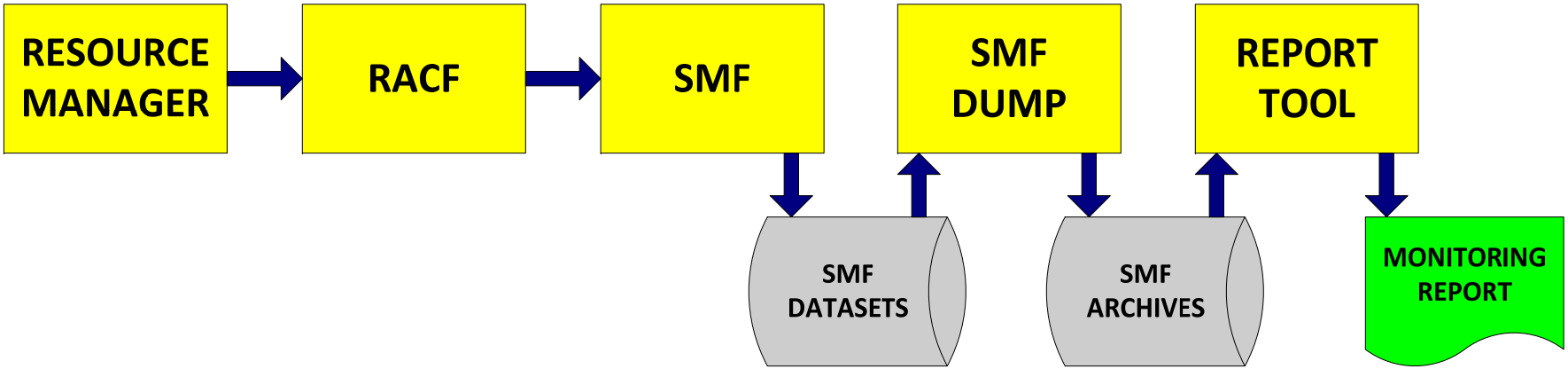
- Monitoring Basics
- User Monitoring
- Resource Monitoring
- High Level Authority Monitoring
- Monitoring and SMF Record Considerations
- System Management Facilities (SMF)
- Reporting Tools

Monitoring Basics

- RACF terminology - AUDITING
- RACF auditing generates SMF records
- Auditing options can be specified in ...
  - RACROUTE Macro LOG= parameter
  - User profile
  - Resource profile
  - SETROPTS Options

SMF Generation and Reporting Process

- Reporting tools require comprehensive SMF data collection and retention to be effective
- Log collection and reporting process
  - Resource Manager is configured to call RACF for an authorization check and does not suppress logging
  - RACF options are set to generate an SMF log record
  - SMF is configured to collect and save the log record
  - SMF records are dumped and archived for report processing
  - Software tools generate reports from the SMF record



SMF Records

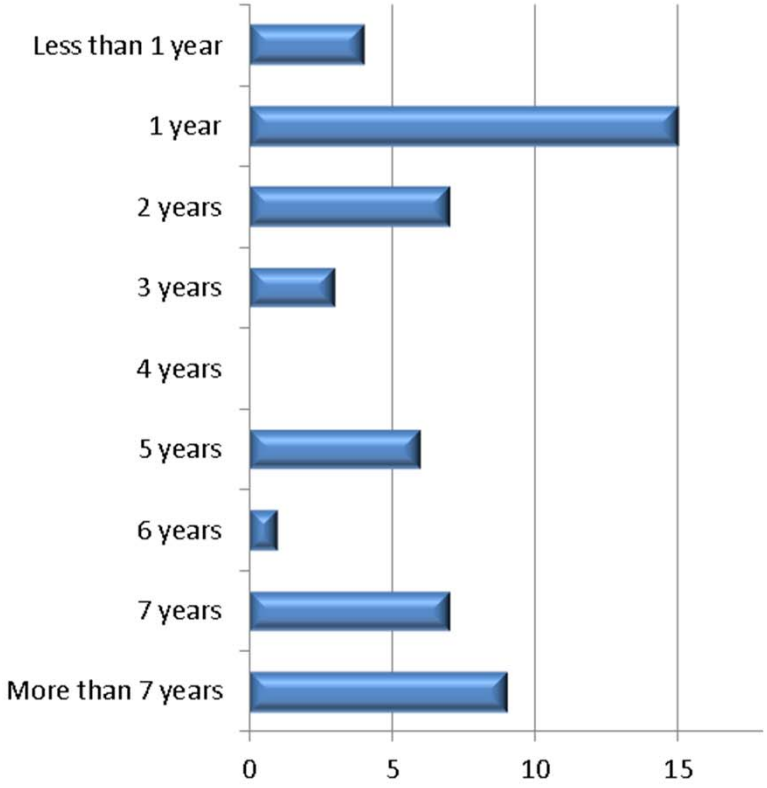
- RACF SMF records
  - 80 RACF Processing - Logged Events
  - 81 RACF Initialization - IPL
  - 83 RACF Audit - Subtypes:
    - 1 Dataset SECLABEL
    - 2 Enterprise Identity Mapping (EIM)
    - 3 LDAP
    - 4 R-auditx
    - 5 WebSphere
    - 6 Tivoli Key Lifecycle Manager (TKLM)

- SMF records used for TSO, Batch, and Started Task logon information
  - 20 Job Initiation (RACFRW only)
  - 30 Common Address Space Work - Subtypes:
    - 1 Initiation
    - 5 Termination

RSH RACF Survey - April 2012

How long does your organization retain RACF-related SMF records?

Responses	Count	Percent %
Less than 1 year	4	7.7%
1 year	15	28.8%
2 years	7	13.5%
3 years	3	5.8%
4 years	0	0%
5 years	6	11.5%
6 years	1	1.9%
7 years	7	13.5%
More than 7 years	9	17.3%
Total	52	100%



Approximate Average - 4 years

RACROUTE LOG=

- RACROUTE Macro LOG= parameter
  - Can expand or suppress auditing
  - REQUEST=AUTH
    - NONE — No logging or console operator messages
    - NOSTAT — Same as NONE and no profile statistics are updated
    - NOFAIL — Do not log violations - log successes per ASIS
    - ASIS — Log in accordance with profile and SETROPTS audit settings
  - REQUEST=FASTAUTH
    - NONE — No logging or console operator messages
    - NOFAIL — Do not log violations - log successes per ASIS
    - ASIS — Log in accordance with profile and SETROPTS audit settings
  - REQUEST=VERIFY or VERIFYX
    - NONE — No logging or console operator messages
    - ASIS — Log logon failures
    - ALL — Log all logon events

User Monitoring

- UAUDIT (User Audit) attribute on user profile
  - All accesses logged - unless granted by Global Access Table, PRIVILEGED Started Task, or caller specifies RACROUTE LOG=NONE
  - Used to selectively monitor untrusted/external users and TRUSTED Started Tasks
  - Useful in analyzing access activity in order to remediate access
  - Some IDs may generate a substantial number of SMF records, especially those accessing Unix
  - Requires AUDITOR authority to add and remove UAUDIT

```
LU RSHTEST
USER=RSHTEST  NAME=RSH RACF TEST ID      OWNER=RACFTEST  CREATED=09.292
 ATTRIBUTES=UAUDIT
```

- Logon events always logged
  - Authentication using a PassTicket
  - Authentication of an IBM Multi-Factor Authentication (MFA) user using a password or password phrase

Resource Monitoring

```
LISTDSD DATASET('SYS1.LIBS*') ALL
INFORMATION FOR DATASET SYS1.LIBS* (G)

LEVEL   OWNER    UNIVERSAL ACCESS   WARNING   ERASE
-----   -------- ----------------   -------   -----
 00     TECHSPT1         READ          NO      NO

AUDITING
--------
FAILURES(UPDATE)

NOTIFY
--------
NO USER TO BE NOTIFIED

YOUR ACCESS  CREATION GROUP  DATASET TYPE
-----------  --------------  ------------
   READ         TECHSPT1       NON-VSAM

GLOBALAUDIT
-----------
NONE
```

Resource Monitoring

Dataset and General Resource Profile

- Parameters
  - AUDIT(*options*(*level*))
    - Set by Profile owner or SPECIAL
    - Default: FAILURES(READ)
  - GLOBALAUDIT(*options*(*level*))
    - Set by AUDITOR
    - Default: NONE
  - Used in combination - event is logged if either requires it
  - PRIVILEGED and TRUSTED Started Task access is not logged

- To log successes for sensitive resources
  - At a level different than violations, specify...
    AUDIT(SUCCESS(UPDATE) FAILURES(READ))
  - At the same level as violations, specify ...
    AUDIT(ALL(READ))

- Auditing *options*
  - SUCCESS — Authorized Access
  - FAILURES — Violation
  - ALL — Both
  - NONE — No Logging

- Auditing *levels* - at or above
  - ALTER
  - CONTROL
  - UPDATE
  - READ

- Use profile LEVEL(##) to tag ACCESS records for report selection

Resource Monitoring

```
SETROPTS LIST
ATTRIBUTES = INITSTATS WHEN(PROGRAM -- BASIC) TERMINAL(READ) SAUDIT CMDVIOL OPERAUDIT
…
AUDIT CLASSES = DATASET USER GROUP DASDVOL GDASDVOL GTERMINL TERMINAL
…
LOGOPTIONS "ALWAYS" CLASSES =  SURROGAT
LOGOPTIONS "NEVER" CLASSES =  NONE
LOGOPTIONS "SUCCESSES" CLASSES =  NONE
LOGOPTIONS "FAILURES" CLASSES =  FACILITY
LOGOPTIONS "DEFAULT" CLASSES = DATASET ACCTNUM ACICSPCT ALCSAUTH APPCLU
                               ... VTAMAPPL VXMBR WIMS WRITER
```

High Level Authority Monitoring

- SETROPTS SAUDIT
  - Audit all RACF commands executed by SPECIAL user
  - Audit all resource access using SPECIAL authority
- SETROPTS OPERAUDIT
  - Audit all resource access using OPERATIONS authority
  - Audit all ADDSDs using OPERATIONS authority
  - Can generate massive amounts of SMF records if this authority is being relied on extensively
- SETROPTS CMDVIOL
  - Audit all violations using RACF commands by anyone
  - SEARCH and LIST-type command violations are not logged
  - Rarely invoked - most command 'violations' are treated as 'errors'

Profile Change Monitoring

- SETROPTS AUDIT(*resource-class*)
  - Audits all changes to RACF profiles in the associated resource class
  - Captures administrative events not covered by SAUDIT and OPERAUDIT
  - For certain classes, also logs:
    - DATASET Creation and deletion of datasets
    - FSOBJ Creation and deletion of UNIX file system objects
    - IPCOBJ Creation and deletion of UNIX objects (e.g., semaphores)
    - PROCESS Dubbing and undubbing of a process
    - USER All password changes, even those made during logon and auto-assignment of OMVS segments by BPX.UNIQUE.USER
    - GROUP Auto-assignment of OMVS segments by BPX.UNIQUE.USER
  - Recommended for <u>all</u> classes

Resource Monitoring

- SETROPTS LOGOPTIONS(*level*(*class*))
  - Specifies the level of access logging enforced for each class
  - Auditing Levels
    - ALWAYS Log all access
    - NEVER Do not log any access
    - SUCCESSES Log all successful access
    - FAILURES Log all violations
    - DEFAULT Log according to the profile audit settingsLevels:
  - ALWAYS, SUCCESSES, and FAILURES augment resource profile auditing
  - NEVER suppresses resource profile auditing but not UAUDIT logging
  - ALWAYS
    - Logs all accesses for a given resource class, even when no profile is defined to RACF
      - Class must also be active
    - Logs TRUSTED Started Tasks

Resource Monitoring

- SETROPTS LOGOPTIONS(*level*(*class*))
  - Activates logging of certain z/OS Unix events
    - ALWAYS
      - FSSEC File system security changes
    - FAILURES
      - PROCESS Process UID or GID changes and privileged operations
      - PROCACT Functions effecting other processes (e.g., kill)
      - IPCOBJ Object access, UID or GID changes
  - LOGOPTIONS is ignored when access is granted by:
    - Global Access Table
    - RACROUTE FASTAUTH processing (use profile auditing (e.g., UNIXPRIV, VTAMAPPL))
    - RACROUTE LOG=NONE
  - LOGOPTIONS(ALWAYS(PROCACT)) required to log 'w_getpsent'

APPC and MLS Auditing

- SETROPTS APPLAUDIT
  - Allows user verification auditing at the beginning and ending of a user's transaction processing
  - Must also specify AUDIT(ALL) or GLOBALAUDIT(ALL) on the APPL class profile associated with the APPC/MVS LU
  - Can produce excessive SMF data if the APPL profile specifies AUDIT(SUCCESS(READ)) or ALL(READ)) and the application does not support persistent verification

- SETROPTS SECLEVELAUDIT(*seclevel*) | NOSECLEVELAUDIT
  - Activates auditing of all access attempts to resources at or above a specified security level
  - Security level must be defined in SECDATA SECLEVEL profile

- SETROPTS SECLABELAUDIT | NOSECLABELAUDIT
  - Specified that SECLABEL profile auditing options are to be used in addition to the resource profile auditing options in logging access

RACF Authorities to Administer Audit Settings

	User UAUDIT	Resource AUDIT	Resource GLOBALAUDIT	SETROPTS Audit Options
Profile Owner		List + Set		
System-SPECIAL		List + Set		
Group-SPECIAL		List + Set		
System-AUDITOR	List + Set	List	List + Set	List + Set
Group-AUDITOR	List + Set	List	List + Set	List
ROAUDIT	List	List	List	List

For Group level authorities, profile must be within user's Scope-of-Groups

Additional Monitoring

- Real Time Notification
  - NOTIFY(*userid*) - Messages to *single* TSO user
  - Security Console
    - Defined in PARMLIB(CONSOLxx) - MCS or SMCS
    - Route code 2, 9, and 11 messages
    - Recommend require logon if outside computer room

- SETROPTS STATISTICS(*class*)
  - Access counts kept on Discrete profiles
  - Counts not incremented for Global Access Table or RACLIST access
  - Activated by class
  - Little value and performance drag
  - Best Practice - Turn off for all classes

Monitoring Considerations

- WARNINGs are only logged if either ...
  - AUDIT or GLOBALAUDIT are set to log either SUCCESS or FAILURE events at the level associated with the user's insufficient access (e.g. READ)
  - The user has UAUDIT
  - SETROPTS LOGOPTIONS for the class is set to either SUCCESS or ALWAYS, provided the check is made with RACROUTE REQUEST=AUTH and not FASTAUTH
- With RACROUTE REQUEST=FASTAUTH, if audit options are not set to log a violation, no ICH408I violation message will be displayed
- LIST and SEARCH command usage is not logged
- All SETROPTS command execution is automatically logged
- PRIVILEGED Started Task access is never logged
- Global Access Table (GAT) authorized access is never logged
  - Dataset creation is logged if SETROPTS AUDIT(DATASET) is in effect
- RACF exits can expand or suppress auditing
- Access granted during Failsoft is logged
- RACROUTE REQUEST=AUDIT - generates log records

Monitoring - RACF List Commands

- Recommend defining PROGRAM profiles to monitor use of RACF list and search commands and their aliases to detect probing of defenses

```
RDEFINE PROGRAM command UACC(READ) GLOBALAUDIT(ALL(READ))
        ADDMEM('SYS1.LINKLIB'//NOPADCHK)
```

- Command programs and aliases to protect and monitor
  - LISTUSER LU
  - LISTGRP LG
  - LISTDSD LD
  - RLIST RL
  - SEARCH SR

- Utility program to protect and monitor
  - IRRUT100

System Management Facilities (SMF)

- Record Collection
- Record Dumping

Factors Affecting SMF Logging

- SMF collects and saves log records
  - Records are written to either a specified set of datasets or logstreams
  - SMF parameters can ignore record types
  - SMF exits can suppress records
  - SMF records can be digitally signed to detect alteration
- SMF records are dumped for archive and report processing
  - Live SMF datasets must be dumped to archive datasets when they fill
  - SMF dump utility and its exit can ignore records
  - Datasets holding dumped archive SMF records can be manipulated or deleted

SMF - Record Collection - IEASYSxx

- Parameters
  - PARMLIB(IEASYSxx)
    - SMF=xx SMFPRMxx member director
    - OPI=YES | NO IPL Operator Intervention
  - PARMLIB(SMFPRMxx)
- To display current options, issue operator command:

  DISPLAY SMF,O

```
IEE967I 15.38.31 SMF PARAMETERS 373
        MEMBER = SMFPRMB1
        INTVAL(30) -- DEFAULT
        SUBSYS(STC,TYPE(0:98,100:255)) -- SYS
        SUBSYS(STC,NOINTERVAL) -- SYS
        SUBSYS(STC,NODETAIL) -- SYS
        SUBSYS(STC,EXITS(IEFUSO)) -- PARMLIB
        SUBSYS(STC,EXITS(IEFUJP)) -- PARMLIB
        SUBSYS(STC,EXITS(IEFU83)) -- PARMLIB
        SUBSYS(STC,EXITS(IEFU29)) -- PARMLIB
        SID(RSHB) -- PARMLIB
        JWT(0400) -- PARMLIB
        NOPROMPT -- PARMLIB
        DSNAME(SYS1.RSHB.MAN3) -- PARMLIB
        DSNAME(SYS1.RSHB.MAN2) -- PARMLIB
```

SMF - Record Collection - SMFPRMxx

▪ ACTIVE | NOACTIVE	SMF recording active
▪ RECORDING(DATASET | LOGSTREAM)	Where to record SMF records
▪ DSNAME [(*dsnames*)]	SMF datasets (defaults - SYS1.MANX and SYS1.MANY)
▪ LSNAME(IFASMF.*lsname*,TYPE(...))	Logstream for collecting records of specified types
▪ DEFAULTLSNAME(IFASMF.*lsname*)	Logstream for collecting all other records
▪ SID(*processer-model#* | *sysid*)	System Identifier (up to 4 characters)
▪ PROMPT(ALL | *option*) | NOPROMPT	List and change SMF options at IPL or ... disallow changes (recommended)
• IPLR	Enter reason for IPL
• LIST	Change options
• ALL	IPLR + LIST
▪ AUTHSETSMF | NOAUTHSETSMF	Allow changes via SETSMF command (NO if NOPROMPT or IPLR)
▪ SYS(*options*)	Global Options
• TYPE(0:255|#,#:#,#(#)) | NOTYPE(#,#:#,#(#))	Type(subtype) records to be collected or ... excluded
• EXITS(*name*,*name*) | NOEXITS	Exits invoked
▪ SUBSYS(*name*,*options*)	Subsystem options
• [Same as SYS]	Supersede SYS
▪ NORECSIGN | RECSIGN(*options)*	Digitally sign SMF records

SMF - Record Collection

- Exits
  - IEFU83 - Receives control before record is written to the SMF dataset; can suppress record
  - IEFU84 - Receives control when SMF Writer Routine is branch-entered and is not entered in cross-memory mode, before record is written to the SMF dataset; can suppress record
  - IEFU85 - Receives control when SMF Writer Routine is branch-entered and is entered in cross-memory mode, before record is written to the SMF dataset; can suppress record
- Many SIEMs install SMF exits to capture records as they are being generated
- Exits, and hence most SIEMs, do not see excluded record types

SMF - Record Dumping

▪ Dump Exit	IEFU29	Automatic dump and switch
▪ Dump Utility	IFASMFDP	Dump SMF datasets
	IFASMFDL	Dump SMF logstream

Reporting Tools - SMF Unload

- SMF Unload
  - Creates text and XML formatted data from unformatted SMF data
  - Invoked through user exits in the SMF Dump Utility (IFASMFDP or IFASMFDL)
  - No pre-unload record selection capability
  - DB2 table load SQL provided
  - Text data can be browsed
  - XML data can be viewed in an HTML browser
  - Requires programming skills to generate reports
    - DB2 SQL queries
    - DFSORT and ICETOOL
    - SAS, REXX, or other report writer

```
ACCESS  SUCCESS 16:43:00 1999-06-24 SYSA NO  NO  NO ONORATO SYSP  YES …
ACCESS  SUCCESS 16:43:01 1999-06-24 SYSA NO  NO  NO ONORATO SYSP  YES …
ACCESS  SUCCESS 16:43:01 1999-06-24 SYSA NO  NO  NO ONORATO SYSP  YES …
ACCESS  SUCCESS 16:43:01 1999-06-24 SYSA NO  NO  NO ONORATO SYSP  YES …
ACCESS  SUCCESS 16:43:02 1999-06-24 SYSA NO  NO  NO ONORATO SYSP  YES …
```

Reporting Tools - SMF Unload - IFASMFDP

```
//DUMPSMFU JOB (001),'HANSEL RS',CLASS=A,NOTIFY=&SYSUID,REGION=0M
//STEP0001 EXEC PGM=IFASMFDP
//SYSPRINT DD SYSOUT=*
//DUMPIN   DD DSN=SMF.MONTHLY.ARCH(0),DISP=SHR
//DUMPOUT  DD DUMMY
//SYSIN    DD *
   ABEND(NORETRY)
   USER2(IRRADU00) USER3(IRRADU86)                                  <<< SMF Unload
//ADUPRINT DD SYSOUT=*
//XMLFORM  DD DSN=RSH.SMF.XMLFORM,DISP=(NEW,CATLG,DELETE),         <<< XML #1
//            SPACE=(CYL,(100,10),RLSE),UNIT=SYSDA,
//            DCB=(LRECL=12888,RECFM=VB,BLKSIZE=0)
//XMLOUT   DD DSN=RSH.SMF.XMLOUT,DISP=(NEW,CATLG,DELETE),         <<< XML #2
//            SPACE=(CYL,(100,10),RLSE),UNIT=SYSDA,
//            DCB=(LRECL=12888,RECFM=VB,BLKSIZE=0)
//OUTDD    DD DSN=RSH.SMF.UNLOAD,DISP=(NEW,CATLG,DELETE),          <<< Text
//            SPACE=(CYL,(100,10),RLSE),UNIT=SYSDA,
//            DCB=(LRECL=12888,RECFM=VB,BLKSIZE=0)
```

Only one SMF unload output is generated - DD statements are shown in order of precedence

XML #1 - One line per XML data tag

XML #2 - One line per event

Reporting Tools

▪ RACF Report Writer	RACFRW (stabilized 1992)
▪ RACF SMF Unload	IFASMFDx User Exits IRRADU00 and IRRADU86
▪ SMF Unload Processing	DFSORT / ICETOOL - see SYS1.SAMPLIB(IRRICE) REXX DB2 SQL
▪ SMF Unload Facilitator	RSH Software - RSMFSEL
▪ SMF Reporting	IBM - IBM Security zSecure Audit Vanguard Integrity Professionals - Advisor Allen Systems Group - ASG-Audit ASPG - Event, Report, Audit (ERA) EKC - E-SRF Beta Systems - Beta 88 z/Security Auditor Software Engineering of America - RA7
▪ SIEM Reporting	Syncsort - Ironstream SDS - VitalSigns SIEM Agent for z/OS (formerly SMA_RT) BMC - Correlog - Correlog SIEM Agent for z/OS IBM - QRadar

Effective Reporting

- Correct, comprehensive SMF archive datasets must be included for processing
  - All pertinent SMF record types must be processed
  - Data from all system images must be included
- Reporting tool must be properly coded to select desired records for reporting
  - Ensure all Violation events are requested
  - Ensure Warnings and Successes are selected
- Reports on important types of activities should be generated
  - Access to sensitive and critical resources
  - Warnings
  - Activities of UAUDIT users
  - Logons by undefined users
  - OPERATIONS and Storage Admin authority use
  - Security administration actions
- Reports must be organized for efficient review
- Reports must be disseminated to user and resource owners

Reporting Resources

- IBM RACF manuals
  - RACF Auditor's Guide - SMF Unload Utility and Audit Options
  - RACF Macros and Interfaces - SMF Unload Record Formats
- RSH - www.rshconsulting.com
  - Presentations
    - RACF Utilities
    - DFSORT and ICETOOL
    - RACF and REXX
  - RACF Tips Newsletters - articles on logging and SMF records
  - RACF Surveys
    - SETROPTS LOGOPTIONS
    - RACF-related SMF Record Retention
- SYS1.SAMPLIB(IRRICE)
- Nigel Pentland - www.nigelpentland.co.uk
- Steve Neeland - www.oocities.org/steveneeland/Sort_Reports.html