



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.

- www.rshconsulting.com
- 617-969-9050



Robert S. Hansel is Lead RACF Specialist and founder of RSH Consulting, Inc. He began working with RACF in 1986 and has been a RACF administrator, manager, auditor, instructor, developer, and consultant. Mr. Hansel is especially skilled at redesigning and refining large-scale implementations of RACF using role-based access control concepts. He is a leading expert in securing z/OS Unix using RACF. Mr. Hansel has created elaborate automated tools to assist clients with RACF administration, database merging, identity management, and quality assurance.

- 617-969-8211
- R.Hansel@rshconsulting.com
- www.linkedin.com/in/roberthansel
- http://twitter.com/RSH_RACF

Topics



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

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Monitoring Basics



- RACF terminology - AUDITING

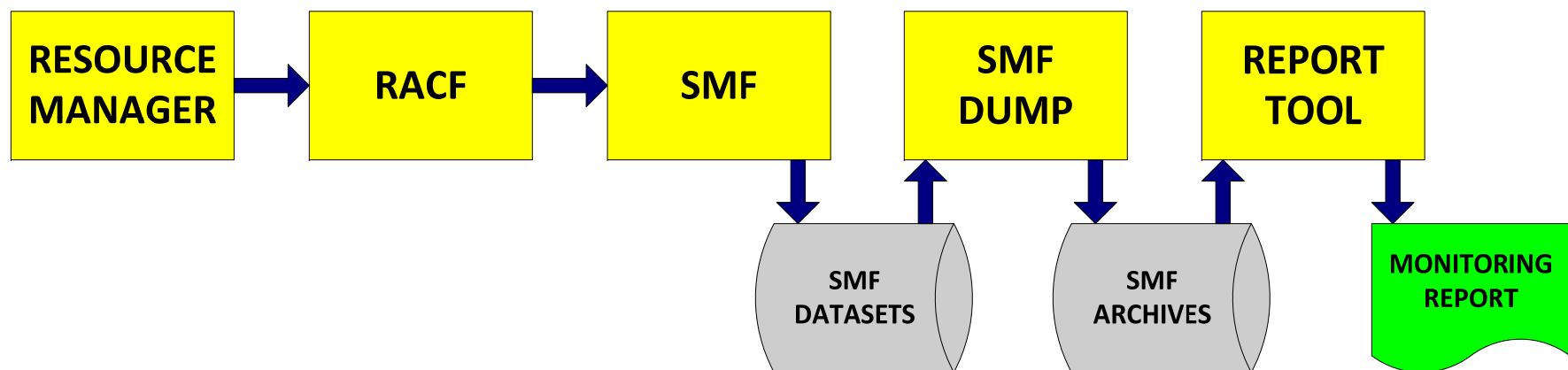
- RACF auditing generates SMF records

- 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)

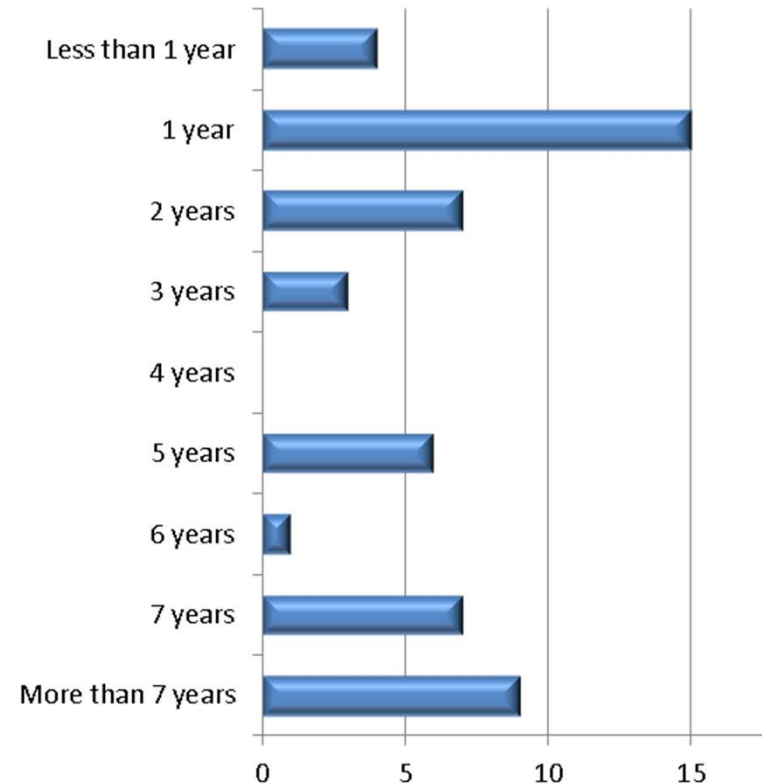
- SMF records used for TSO, Batch, and Started Task logon information
 - 20 Job Initiation (RACFRW only)
 - 30 Common Address Space Work - Subtypes:
 - 1 Initiation
 - 5 Termination

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 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=RACFTST  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



```
LISTDS D 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
- To log successes for sensitive resources
 - `AUDIT(SUCCESS(UPDATE),FAILURES(READ))`
 - `AUDIT(ALL)`
- Use profile `LEVEL(##)` to tag ACCESS records for report selection
- Auditing *options*
 - SUCCESS Authorized Access
 - FAILURES Violation
 - ALL Both
 - NONE No Logging
- Auditing *levels* - at or above
 - ALTER
 - CONTROL
 - UPDATE
 - READ
- PRIVILEGED and TRUSTED Started Task access is not logged

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



- SAUDIT SETROPTS Option
 - Audit all RACF commands executed by SPECIAL user
 - Audit all resource access using SPECIAL authority

- OPERAUDIT SETROPTS Option
 - 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

- CMDVIOL SETROPTS Option
 - 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



- AUDIT(*resource-class*) SETROPTS Option
 - 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 all classes

Resource Monitoring



■ LOGOPTIONS SETROPTS Options

- LOGOPTIONS(*level*(*class*)) - set for each individual class

- Levels:

- ❖ ALWAYS Log all access
- ❖ NEVER Do not log
- ❖ SUCCESSES Log all authorized access
- ❖ FAILURES Log all violations (*recommended for most classes*)
- ❖ DEFAULT Use resource profile log options

- SUCCESSES and FAILURES augment resource profile audit settings

- ALWAYS and NEVER override resource profile audit settings

- ALWAYS level

- ❖ 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



- LOGOPTIONS SETROPTS Options (continued)
 - 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
 - NEVER does not suppress user UAUDIT logging
 - 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



- APPLAUDIT SETROPTS Option
 - 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

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

- SECLABELAUDIT | NOSECLABELAUDIT SETROPTS Option
 - 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 ...
 - 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
 - If access is checked by FASTAUTH and auditing is not specified, no ICH408I is issued
- 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
- RACF RACROUTE TYPE=AUDIT - generates log records

System Management Facilities (SMF)



- Record Collection
- Record Dumping
- Monitoring and Integrity

Factors Affecting SMF Logging



- SMF collects and saves log records
 - SMF parameters can ignore record types
 - SMF exits can suppress records

- SMF records are dumped for archive and for 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)
- SID(processer-model# | *sysid*) System Identifier (up to 4 characters)
- PROMPT(ALL | *option*) Operator intervention at IPL allowed
 - IPLR Enter reason for IPL
 - LIST Change Options
 - ALL IPLR + LIST
- SYS(*options*) Global Options
 - TYPE(0:255 | #, #, #) | NOTYPE(#, #, #) Type records collected or ... excluded
 - EXITS(*name, name*) Exits invoked
- SUBSYS(*name, options*) Subsystem options
 - [Same as SYS] Supersede SYS
- BUFSIZMAX(128M | nnnnM) Maximum size of SMF buffers - up to 1024M (1G)
- BUFUSEWARN(25 | 10 to 90) Begin issuing warnings when buffers to nn% full

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 IFASMFDL Dump SMF datasets
 IFASMFDL Dump SMF logstream

SMF - Record Dumping - IFASMFDP



```
//DUMPSMFR JOB (001),'HANSEL RS',CLASS=A,NOTIFY=&SYSUID
//STEP0001 EXEC PGM=IFASMFDP
//SYSPRINT DD SYSOUT=*
//SYSMANDS DD DSN=SYS1.MAN1,DISP=SHR
//SMFMTHLY DD DSN=SMF.MONTHLY.ARCH(0),DISP=SHR
//DATA DD DSN=RSH.RACF.SMF.SELECT,DISP=(NEW,CATLG,DELETE),UNIT=SYSDA,
//      SPACE=(CYL,(100,10),RLSE),DCB=(LRECL=32767,RECFM=VBS)
//SYSIN DD *
      INDD(SYSMANDS,OPTIONS(DUMP))
      INDD(SMFMTHLY,OPTIONS(DUMP))
      OUTDD(DATA,TYPE(30(1,5),80,81,83))
      DATE(2018240,2018243) START(0800) END(1600)
      SID(MVSA)
      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)
//XMLOUT DD DSN=RSH.SMF.XMLOUT,DISP=(NEW,CATLG,DELETE), <<< XML #2
//      SPACE=(CYL,(100,10),RLSE),UNIT=SYSDA,DCB=(LRECL=12888,RECFM=VB)
//OUTDD DD DSN=RSH.SMF.UNLOAD,DISP=(NEW,CATLG,DELETE), <<< Text
//      SPACE=(CYL,(100,10),RLSE),UNIT=SYSDA,DCB=(LRECL=12888,RECFM=VB)
```

Reporting Tools



- SMF Unload
 - Creates text and XML formatted data from unformatted SMF data
 - Invoked through user exits in the SMF Dump Utility (IFASMFDL or IFASMFDP)
 - 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



- 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)
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 manual - RACF Macros and Interfaces

- 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 - <http://www.racf.co.uk/>

- Steve Neeland - http://www.oocities.org/steveneeland/Sort_Reports.html