RACF® Remote Sharing Support for TCP/IP

George Markouizos  CISSP®
z/OS® Security Server (RACF®) Design and Development
IBM Poughkeepsie
gmarkou@us.ibm.com

SHARE Orlando
Session 9637
August 2011

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. If these and other IBM trademarked terms are marked on their first occurrence in this information with a trademark symbol (® or ™), these symbols indicate U.S. registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at www.ibm.com/legal/copyrtrade.shtml

Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Other company, product, or service names may be trademarks or service marks of others.
**Agenda**

- Overview of the RACF Remote Sharing Facility (RRSF)
- Changes to the TARGET command
- Simplified illustration of creating a TCP node
- Additional setup steps
  - Making the RACF subsystem address space a UNIX process
  - Trust policy (digital certificates)
  - Application Transparent Transport Layer Security (AT-TLS)
  - SERVAUTH class considerations
- TARGET LIST enhancements
- Protocol conversions
- Considerations for Multi-System Nodes
- References

---

**Overview - What is RRSF?**

- The RACF Remote Sharing Facility allows RACF to communicate with other z/OS systems that use RACF, allowing you to maintain remote RACF databases.
- Benefits of RRSF support for the security administrator include:
  - Administration from anywhere in the RRSF network.
  - User ID associations.
  - Automatic synchronization of databases.
- RRSF is designed in roughly three layers:
  - Application layer: Administrative commands and profiles
  - Presentation layer: command execution and return of command output and error and informational messages
  - Transport layer: Communication protocol used to transmit requests
- The new function deals exclusively with the transport layer
Overview - The RRSF network

- Consists of nodes
  - Local node: The one I'm logged on to at the moment
  - Remote nodes (all the others)
  - Local node can run in "local mode", where there are no remote nodes
- The TARGET operator command is used to define, modify, delete, and list nodes, as well as to de/activate them.
- TARGET commands are contained within the RACF parameter library, and are executed automatically when the RACF subsystem starts.
- The RACF parameter library member is specified in your started procedure JCL.
- RACF parameter library members can be "chained together" using the SET INCLUDE(xx) command

Overview - Multi-System Node (MSN)

- A set of systems sharing a RACF database (can be in a SYSPLEX, or simply on shared DASD)
- Managed with the TARGET command by specifying both NODE and SYSNAME
- All Single System Nodes (SSNs) send requests only to the MAIN system of a MSN
- All peer systems of an MSN send requests only to SSNs, and to the MAIN systems of remote MSNs
- Peer systems do not speak with each other, and do not speak with non-MAIN systems of remote MSNs
Overview - Workspace data sets (i.e. checkpoint files)

- VSAM data sets that RACF uses to temporarily hold data that RACF is sending from one node to another.
- RACF deletes data from the workspace data sets when it receives confirmation that the data has been successfully processed at the receiving node.
- RACF uses two workspace data sets, the INMSG data set and the OUTMSG data set, for the local node and for each of its remote nodes.
  - The INMSG data set is used to temporarily hold requests that are being sent to the local node from itself or from a remote node (e.g. commands directed to the local node, or output from RACF commands, application updates, and password changes that were directed to a remote node)
  - The OUTMSG data set is used to temporarily hold requests that are being sent to a remote node (e.g. commands, application updates, and password changes directed from the local node, or output to be returned to a remote node)
- Requests are queued to the files while a connection is DORMANT. Queued work is sent when the connection becomes OPERATIVE ACTIVE.
- Requests are "casually encrypted" while checkpointed

Possible configurations

![Multi-System Node Diagram with R12, R13 nodes connected via APPC and TCP/IP](image-url)
Syntax of the TARGET command

TARGET command syntax: The LISTPROTOCOL and TCP keywords are new

New

Defining a TCP/IP node and activating it using TARGET

The only difference from APPC is the PROTOCOL information:

- Define the local node with a socket listener

  TARGET NODE(LOCAL) LOCAL PROTOCOL(TCP)
  PREFIX(SYS1.RRSF) WORKSPACE(VOLUME(VOL001)) OPERATIVE
  IRRC054I (<) RACF REMOTE SHARING TCP LISTENER HAS BEEN SUCCESSFULLY ESTABLISHED.

- Define the remote node and make it operative

  TARGET NODE(REMOTE) PROTOCOL(TCP(ADDRESS{remote.pok.ibm.com}))
  PREFIX(SYS1.RRSF) WORKSPACE(VOLUME(VOL001)) OPERATIVE
  IRR027I (<) RACF COMMUNICATION WITH TCP NODE REMOTE HAS BEEN SUCCESSFULLY ESTABLISHED USING CIPHER ALGORITHM 35 TLS_RSA_WITH_AES_256_CBC_SHA.

- Harden your TARGET commands in the RACF parameter library
TCP workspace naming convention

- For local node, nothing has changed:
  prefix.sysname_or_wdsqual.INMSG|OUTMSG

- For remote nodes, the current convention uses LU names as qualifiers.
  prefix.local_luname.remote_luname_or_wdsqual.INMSG|OUTMSG
  - This continues to be the convention for APPC nodes

- For remote TCP nodes, the new convention is
  prefix.local-node-qualifier.wdsqual-or-nodename-or-sysname.INMSG|OUTMSG
  - This makes protocol conversions interesting. More later...

Setup

- There's more to the setup than just the TARGET command.
  - First you must:
    - Add an OMVS segment with UID to the RACF subsystem user ID, and an OMVS segment with GID to its default group
    - Deploy digital certificates/key rings which are used to authenticate RRSF servers to each other using the TLS protocol
    - Enable the AT-TLS policy required for RRSF connections (samples provided). The policy identifies the name of the key ring to use (and much more)
    - Permit the RACF subsystem identity to the necessary resources
      - Even if it's TRUSTED! (more later)
Setup: OMVS segment for the RACF subsystem ID profile

- Use of the TCP protocol requires the use of sockets, which requires UNIX System Services.

- Assign an OMVS segment with a UID to the RACF subsystem user ID using the ALTUSER command.
- Assign an OMVS segment with a GID to its default group using the ALTGROUP command.
- If you don't, you will see an error message when the socket listener attempts to start.
  - Just assign the OMVS segments, and make the local node OPERATIVE again.
  - You do not have to restart the RACF subsystem!

Setup: Digital certificates, a brief overview

- Network entities authenticate to each other via the trust policy established by digital certificates.
  - “I will believe you are who you say you are if someone I trust is vouching for your identity”.
  - “I have a list of the people I trust”.
- Identities of the people (or servers) with whom I talk, and the people who I trust, are represented by digital certificates.
- For a given application, I keep the server certificate, and those of the people I trust, in a container called a key ring.
- The TLS standard requires the server to send its certificate to the client for validation.
  - And optionally requires the client to send its certificate to the server for validation (a.k.a. “client authentication”).
Setup: Digital certificates, a brief overview …

- **Question:** In an RRSF network, who is the client and who is the server?
- **Answer:** RRSF runs within the RACF subsystem address space. Each node can initiate a connection or accept it. So, the RACF subsystem address space identity can act as either the client or the server.
  - That is, this is not the traditional client/server model; Rather, it is a mesh of peers.
- So, we must enforce client authentication so that both sides of the conversation are authenticated to each other.

Setup: Digital certificates, the deployment

- On each system, the RACF address space must have access to a key ring containing:
  - A server certificate (with private key) for that RRSF instance
  - The signing certificate (public key only) used to sign the RRSF server certificates, and no others
- In the simplest case, this can be accomplished with a single self-signed certificate added to each key ring (if your security policy allows it)
- Otherwise, create the signing certificate on one of the systems, and use it to create/sign that system’s server certificate. On the other systems, generate a certificate request, send it to the “signer system” where a certificate is generated. Send the certificate back to the original system and add it.
  - *Never use the signing certificate to sign anything but RRSF certificates!*
  - See the Security Administrator's Guide for details.
Setup: Digital certificates, the deployment

- Depending on your company’s policy,
  - You can use the RACDCERT command to generate the digital certificates, or
  - You can buy them from an external certificate authority.
- If you are going to use digital certificates obtained from an external certificate authority,
  - Change your AT-TLS policy to specify a client authentication level of SAFCheck (more on AT-TLS policy shortly)
  - “Map” every server certificate to a RACF user ID on every other system (there are multiple ways of accomplishing this)
  - Grant the mapped user ID READ access to IRR.RRSF.CONNECT in the RRSFDATA class on each system

Setup: AT-TLS policy

- **Question:** Now that you have your certificates in place, how will the system know to use them?
- **Answer:** Your AT-TLS policy contains the name of the key ring.
- TCP/IP, using System SSL, will use the policy to perform the TLS handshake when one RRSF attempts to connect to another.
- Working policy samples are provided. Policy just needs to be enabled and installed into the Policy Agent.
  - Communication Server Configuration Assistant GUI provides policy
  - RACF also ships raw policy statements in SYS1.SAMPLIB(IRRSSRRSF)
- RRSF is a “TLS-aware application”. RRSF will refuse to connect or accept connections unless adequate policy is in effect.
Setup: AT-TLS policy - Sample

The sample will satisfy RRSF, but in case you modify it, RRSF will enforce the following properties:

- Policy is in effect for the connection
  - The TCP/IP stack is enabled for policy (TCPCONFIG TTLS)
  - A matching policy rule was found (match is based on target port number)
  - The rule is enabled
- Policy specifies a client authentication level of at least “Required”
- SSL V3, or TLS, is specified as the protocol level
- Application-controlled attribute is OFF

Note:
A minimum encryption level is not enforced, though the sample specifies the strongest level currently available (AES-256), and the value is reported in the connection message and is displayed in TARGET LIST output.
Setup: Resource permissions for the RACF address space user ID

- Generally, you run the RACF started task with the TRUSTED attribute, and automatic access is granted to RACF-protected resources.
- However, this does not play well with the SERVAUTH class.
- So, the RRSF tasks that perform TCP/IP communication run under a task-level security environment (ACEE) without the TRUSTED or PRIVILEGED attributes.
- As a result, the subsystem user will need to be permitted to whatever SERVAUTH class profiles are protecting resources it is accessing
  - But do not permit it to the stack initialization resource (INITSTACK) or remote connections may fail during IPL.
- Permission will also be required to open the key ring
  - And, if the server's private key is stored in ICSF, then also to the appropriate CSFKEYS/CSFSERV profiles.

TARGET LIST: summary version

- A new message line, prefixed with IRRM091I, indicates the status of each protocol listener defined to the local node.

  - NODE1 <target list
  - NODE1 IRRM091I (<) LOCAL RRSF NODE NODE1 IS IN THE OPERATIVE ACTIVE STATE.
  - IRRM091I (<) LOCAL NODE APPC LISTENER IS ACTIVE.
  - IRRM091I (<) LOCAL NODE TCP LISTENER IS ACTIVE.
  - IRRM091I (<) REMOTE RRSF NODE NODE2 IS IN THE OPERATIVE ACTIVE STATE.

- Status values are ACTIVE, INACTIVE, and INITIALIZING
**TARGET LISTPROTOCOL**

- LISTPROTOCOL is a new keyword that displays the protocol in IRRM009I for remote nodes
  - NODE1 | target listprotocol
  - NODE1 | IRRM009I (<) LOCAL RRSF NODE NODE1 IS IN THE OPERATIVE ACTIVE STATE.
  - IRRM009I (<) LOCAL NODE APPC LISTENER IS ACTIVE.
  - IRRM009I (<) LOCAL NODE TCP LISTENER IS ACTIVE.
  - IRRM009I (<) REMOTE RRSF NODE NODE2 PROTOCOL TCP IS IN THE OPERATIVE ACTIVE STATE
  - IRRM009I (<) REMOTE RRSF NODE NODE3 PROTOCOL TCP IS IN THE OPERATIVE ACTIVE STATE
  - IRRM009I (<) REMOTE RRSF NODE NODE4 PROTOCOL APPC IS IN THE OPERATIVE ACTIVE STATE
  - IRRM009I (<) REMOTE RRSF NODE NODE5 PROTOCOL TCP IS IN THE OPERATIVE ACTIVE STATE
  - IRRM009I (<) REMOTE RRSF NODE NODE6 PROTOCOL APPC IS IN THE OPERATIVE ACTIVE STATE

- Comes in handy when displaying a mixed-protocol network

---

**TARGET LIST: detailed version**

- For the local node, shows protocol information for all defined protocols

```
NODE1 | target list node(nodel)

NODE1 | IRRM010I (<) RSWJ SUBSYSTEM PROPERTIES OF LOCAL RRSF NODE NODE1:

STATE     - OPERATIVE ACTIVE
DESCRIPTION   - <NOT SPECIFIED>

PROTOCOL   - APPC
    LU NAME  - MF1AP001
    TP PROFILE NAME - IRRACF
    MODENAME  - <NOT SPECIFIED>
    LISTENER STATUS  - ACTIVE

PROTOCOL   - TCP
    HOST ADDRESS   - 0.0.0.0
    IP ADDRESS    - 9.57.1.243
    LISTENER PORT  - 10236
    LISTENER STATUS  - ACTIVE
TIME OF LAST TRANSMISSION TO - <NONE>
TIME OF LAST TRANSMISSION FROM - <NONE>

...```

23 © 2011 IBM Corporation
TARGET LIST: detailed version

- For a connected remote node, shows some AT-TLS information
- Much more AT-TLS info is available with the NETSTAT command

NODE1 (target_list node(node2)

NODE2: REXEC SUBSYSTEM PROPERTIES OF LOCAL RRSF NODE node2:

STATE: OPERATIVE ACTIVE
DESCRIPTION: <NOT SPECIFIED>

PROTOCOL: TCP

HOST_ADDRESS: ALP94012.POK.IBM.COM
IP_ADDRESS: 9.57.1.243
LISTENER_PORT: 18136
LISTENER_STATUS: ACTIVE

AT-TLS POLICY:
RULE_NAME: RRSF-CLIENT
CIPHER_ALG: TLS_RSA_WITH_AES_256_CBC_SHA
CLIENT_AUTH: REQUIRED

TIME OF LAST TRANSMISSION TO: <NONE>
TIME OF LAST TRANSMISSION FROM: <NONE>

...

Protocol conversions - the pitfalls

- Because of the different workspace file naming conventions, TARGET commands for one protocol cannot derive the names used by the other, and there is no persistent memory across restart/IPL

- So when defining the new protocol for a given node, a new set of files will be allocated

- The following problems must be avoided:
  - We cannot lose whatever work may be queued in the old files
  - We cannot let requests run out of order
  - We cannot impose a “quiet time” on the customer to allow the old files to drain before queuing work to the new files.
  - If there is a disruption (subsystem restart), we must continue where we left off when the subsystem resumes
  - The conversion process should work in either direction

...
Protocol conversions - some new terminology

- Protocol instance - a set of protocol information for a particular transport mechanism
  - Local node - an instance is an attribute of the single logical representation of the local node
  - Remote node – an instance is a separate logical representation of the connection to a remote node. It contains its own workspace files, prefix, description, etc.
- Multi-Protocol node - A node which has more than one protocol instance. A remote node is multi-protocol throughout the conversion process. The local node is multi-protocol for as long as you have a mixed-protocol network.
- Protocol specification - the act of specifying protocol information using the TARGET command
- Protocol qualification - the act of identifying the protocol instance to modify using the TARGET command

Protocol conversions - the mechanics

- Specify protocol information for the local node if you haven't already
- For a remote node, enter a TARGET command as though you are defining the node from scratch, specifying the new protocol information (nothing will be copied from the existing protocol)
  - Communication will continue uninterrupted using the old protocol until the new protocol instance establishes a connection
  - The new protocol instance will assume ownership of the old protocol instance's files
  - The old protocol instance will be automatically deleted
  - New requests will be queued to the new instance's files while the old instance's files are draining
  - When the old instance's files have drained, they will automatically be deallocated and deleted
  - It will now appear as though the new protocol instance is the only one that ever existed
TARGET LIST shows both protocols by default

?target node(node1) list

IRRM101I (?) RSFX SUBSYSTEM PROPERTIES OF REMOTE RSFX NODE NODE1

**PROTOCOL APPC**
- STATE: OPERATIVE ACTIVE
- DESCRIPTION: <NOT SPECIFIED>

**PROTOCOL TCP**
- STATE: OPERATIVE PENDING CONNECTION

**WORKSPACE FILE SPECIFICATION**
- PROTOCOL: APPC
  - PREFIX: "RRSF1"
  - VOLUME: TEMP01
  - PREFIX: "RRSF1" (FILESIZE 500)
  - FILE USAGE: CONTAINS 0 RECORD(S)

**WORKSPACE FILE SPECIFICATION**
- PROTOCOL: TCP
  - HOST ADDRESS: ALPS4167.POK.IBM.COM
  - LISTENER PORT: 18136
Protocol qualification

- When 2 protocols are defined for a given remote node, the protocol keyword must be specified on subsequent TARGET commands to further qualify which instance of the node is being manipulated.

  TARGET node(node1) protocol(TCP) description('remote node node1')

- If the protocol is not qualified, an error message will be issued

  target node(node1) description('remote node node1')

  IRRM087I (?) RRSF SUBSYSTEM TARGET COMMAND REQUIRES THAT A PROTOCOL BE SPECIFIED FOR NODE NODE1 TO IDENTIFY THE INTENDED PROTOCOL INSTANCE.

Protocol conversions - “demo”

Example: From NODE2, convert NODE1’s protocol from APPC to TCP

Assumptions: TCP listeners have already been established on both systems, and NODE1 has already issued its remote node command

>target node(node1) prefix(sys1.rrsf) workspace(volume(temp01)) protocol(tcp(address(alps4242.pok.ibm.com))) operative

IRRC057I (>) RRSF COMMUNICATION WITH TCP NODE NODE1 HAS BEEN SUCCESSFULLY ESTABLISHED USING CIPHER ALGORITHM 35 TLS_RSA_WITH_AES_256_CBC_SHA.

IRRC058I (>) RRSF PROTOCOL CONVERSION FROM APPC TO TCP FOR NODE NODE1 IS COMPLETE.

Note:
To ensure that the conversion has no problems, harden the commands in the parameter library prior to issuing them on the console (see SPG for conversion procedure)
Protocol conversions - draining the old files

- After the old instance is deleted, but before the conversion completes, TARGET LIST will show that the node owns two sets of workspace files.

```plaintext
<target list node(node2)
IRRM010I (<) RSWJ SUBSYSTEM PROPERTIES OF REMOTE RRSF NODE NODE2:
STATE       - OPERATIVE ACTIVE
... WORKSPACE FILE SPECIFICATION
PREFIX      - "SYS1.RRSF"
MEMQUAL     - <NOT SPECIFIED>
FILESIZE    - 500
VOLUME      - TEMP01
FILE USAGE
"SYS1.RRSF.NODE2.NODE2.INMSG" - CONTAINS 0 RECORD(S)
"SYS1.RRSF.NODE2.NODE2.OUTMSG" - OCCUPIES 1 EXTENT(S)
```

After the conversion completes, there is no trace left of the APPC instance:

```plaintext
<target list node(node2) protocol(appc)
IRRM005I (<) RSWJ SUBSYSTEM TARGET COMMAND WAS UNABLE TO FIND DEFINITION OF NODE NODE2 PROTOCOL APPC.
IRRM003I (<) RSWJ SUBSYSTEM TARGET COMMAND ENDED IN ERROR.
```

```plaintext
<target list node(node2)
IRRM010I (<) RSWJ SUBSYSTEM PROPERTIES OF REMOTE RRSF NODE NODE2:
STATE       - OPERATIVE ACTIVE
... FILE USAGE
"SYS1.RRSF.NODE2.NODE2.INMSG" - CONTAINS 0 RECORD(S)
"SYS1.RRSF.NODE2.NODE2.OUTMSG" - OCCUPIES 1 EXTENT(S)
```
Possible configurations - Multi-System Nodes

R13 systems can communicate only via APPC.
R13 systems can communicate with R12 systems only via APPC.
R13 systems can communicate with other R13 systems via APPC or TCP/IP.

Multi-system Nodes (MSNs) can consist of mixed levels where communication is constrained as above.

MSNs can continue to use a shared RACF parameter library.

Two TARGET commands will be required for each remote system.
The TCP/IP command must follow the APPC command (assuming that's your preferred protocol).
The TCP/IP command will harmlessly fail when executed on R12.
The TCP/IP command will trigger a conversion when executed on R13.
New status messages for TCP communication

- Listener status (successful initialization and termination, and error message when failing to fail) are issued to the console.
- Connection status (successful or failed connection, and successful or failed termination) are issued to the console.
- On failure, attempts are periodically retried (except for hand shaking errors), but duplicate error messages will not be issued.
  - If unsuccessful after about 30 minutes, a console message is issued and no more retries are attempted.
- Subtask start and end messages are issued to SYSLOG only.
- There will not be one-to-one correspondence with messages issued for APPC (and we feel this is an improvement).

References

- RACF: Command Language Reference (SA22-7687-16)
- RACF: Diagnosis Guide (GA22-7689-14)
- UNIX System Services: Messages and Codes (SA22-7807-12)
- UNIX System Services Programming: Assembler Callable Services Reference (SA22-7803-14)
- Communication Server: IP Diagnosis Guide (GC31-8782-12)
- Communication Server: IP System Administrator's Commands (SC31-8781-11)
References …

- Communication Server web site

- Communications Server Configuration Assistant download from IBM support

- AT-TLS education assistant

- Search SHARE web site for AT-TLS presentations