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FTP Passphrases and Certificates

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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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Sources and References



- z/OS Communications Server - IP Configuration Guide (SC27-3650)
- WinSCP - <https://winscp.net/eng/download.php>
- SimpleAuthority - <http://simpleauthority.com/>



- FTP – File Transfer Protocol
 - A TCP/IP application used to bulk-transfer data between hosts
 - Described by Request For Comment (RFC) 959 from the Internet Engineering Task Force (IETF)
 - ❖ Implemented on many platforms
 - ❖ FTP on z/OS has a unique feature of interfacing with JES and SQL
- FTPS – File Transport Protocol with Secure SSL
 - Feature of z/OS Communication Server FTP Server
 - Integrated with IBM System SSL support
 - ❖ Can access cryptographic hardware
 - Incompatible with SFTP
- SFTP – Secure File Transfer Protocol
 - An extension of SSH (Secure SHell) cryptographic protocol
 - ❖ A port of Open Source Software's OpenSSH to z/OS
 - ❖ A unique protocol, not SSH over FTP
 - Not integrated with IBM System SSL support
 - ❖ Can't use IBM cryptographic hardware
 - Incompatible with FTPS
 - Not demonstrated in this presentation

FTP Client and Certificate Authority (CA)



- MS-Windows FTP client is very basic
 - No certificate support, i.e. no SFTP, no FTPS
 - Can only connect to well-known server port 21 (default)
 - Does not support spaces in passphrases

- WinSCP supports certificates
 - Free download
 - Supports encryption and non-standard ports
 - Supports spaces in passphrases
 - FTP, FTPS, SFTP and other file transfer protocols

- Certificate Authority (CA) is SimpleAuthority
 - Free download for demonstration
 - Mimics non-RACF certificate signer like Entrust or Verisign

RACF Password Phrases



- Formally referred to as RACF Password Phrases
- Passphrase is informal and is the commonly used term
- Allow mixed case and special characters
- Characteristics
 - Length
 - ❖ 14 to 100 characters
 - ❖ 9 to 13 characters can be implemented using RACF exit ICHPWX11
 - ❖ 9 to 100 characters with PASSWORD ALGORITHM K DFAES
 - Must not contain the user ID as sequential uppercase or lowercase characters
 - Must contain at least 2 alphabetic characters (A - Z, a - z)
 - Must contain at least 2 non-alphabetic characters (numeric, punctuation, or special characters)
 - Must not contain more than 2 consecutive characters that are identical (e.g., 'aaa')

FTP.DATA for Passphrases



- Set by the PASSPHRASE keyword
 - DEFAULT=TRUE
 - FTP passphrases are enabled by default, no system modifications required

- If PASSPHRASE set to FALSE
 - FTP server truncates password to first eight characters

- FTP Server recycle required to change keyword values

FTP Server - Passphrase Limitations



- No mechanism to change expired passwords or passphrases with FTP
 - Set passwords/passphrases or change by other means (TSO, CICS, batch) or set with NOEXPIRE keyword
 - NOEXPIRE is used in this demonstration

- Leading and trailing spaces are not honored

- Valid RACF passphrase characters that are FTP control characters are not handled by the server
 - Colon (:)
 - At sign (@)

Setting the FTP Client Passphrase



- Setting the USERID passphrase and removing the password

```
ALU REGTEST PHRASE('This passphrase has 37 characters!') noexpire nopassword

READY
lu regtest
USER=REGTEST NAME=ROBYN E TEST OWNER=TSTOWNR CREATED=18.136
DEFAULT-GROUP=TESTGRP PASSDATE=N/A PASS-INTERVAL=180 PHRASEDATE=21.012
ATTRIBUTES=NOPASSWORD PASSPHRASE
REVOKE DATE=NONE RESUME DATE=NONE
LAST-ACCESS=21.012/13:00:43
CLASS AUTHORIZATIONS=NONE
NO-INSTALLATION-DATA
```

FTP Logon with Passphrase



- Note the 37 character passphrase

The screenshot shows the WinSCP interface for a session named 'regtest@172.29.122.166 - unencrypted'. A modal dialog box titled 'Password - regtest@172.29.122.166 - unencrypted' is open, displaying 'Connecting to 172.29.122.166 ...' and a password field filled with 37 dots. The 'OK' button is highlighted by the mouse cursor. The background interface shows a file browser view of 'C:\Users\Robyn\Desktop\FTP JCL\'. At the bottom, a 'Queue' table is visible with columns for Operation, Source, Destination, Transferred, Time, Speed, and Progress. The status bar at the bottom left indicates 'Not connected.'

FTP Logon with Passphrase



- Success! A non-secure logon, note the grey key in the lower right corner

FTP JCL - regtest@172.29.122.166 - unencrypted - WinSCP

Local Mark Files Commands Session Options Remote Help

Synchronize Queue Transfer Settings Default

regtest@172.29.122.166 - unencrypted × regtest@172.29.122.166 - unencrypted × New Session

Desktop

Upload Edit Properties New

Name	Size	Type	Changed
Parent directory			10/28/2020 16:44:58

C:\Users\Robyn\Desktop\FTP JCL\

0 B of 0 B in 0 of 0

Command >

Queue

Oper...	Source	Destination	Transf...	Time	Speed	Progress
---------	--------	-------------	-----------	------	-------	----------

FTP 0:00:22

Required z/OS Components for FTPS



- z/OS Communication Server (TCP/IP)
 - TCPCONFIG TTLS statement in PROFILE.TCP

- z/OS Communications Server Policy Agent (PAGENT)
 - PAGENT Started Task configures security policy into TCP/IP
 - ❖ Application Transparent – Transport Layer Security (AT-TLS)
 - ❖ TLS protocols provide communication privacy over the internet in a way designed to prevent eavesdropping, tampering or message forgery
 - PAGENT must have READ access to SERVAUTH EZB.INITSTACK.sysname.tcpname
 - ❖ If profile does not exist (RC=4), PAGENT socket requests will fail
 - PAGENT policy configuration either ...
 - ❖ IBM Configuration Assistant for z/OS Communications Server in z/OSMF
 - ❖ Manually coding statements in a z/OS UNIX file or MVS dataset

- z/OS Communications Server Syslog Daemon (syslogd)
 - SYSLOGD Started Task (STC) logs events for Unix System Services (USS)
 - ❖ telnet, TN3270/E, FTP, SMTP, etc.

FTPS Configuration Steps - Server



- Implement required z/OS components
 - PAGENT responsible for specifying FTP server HandshakeRole and Keyring name

- FTP Server certificate setup
 - Obtain server certificate – RACF signed or external CA
 - ADD certificates to RACF
 - ❖ Server certificate CA as CERTAUTH
 - ❖ Server certificate as ID(<USERID of FTP server STC>)
 - ADDRING to create the FTP server keyring
 - CONNECT server and CA certificates to FTP server keyring
 - ❖ Server certificate CA as CERTAUTH
 - ❖ Server certificate as ID(<USERID of FTP server STC>) with DEFAULT attribute

- Modify FTP.DATA server configuration to activate security

- Recycle FTP Server to activate configuration changes

FTP Server Certificate – RACF Signed



```
racdcert list (label('FTPTEST SERVER CERT')) ID(FTPTEST)
Digital certificate information for user FTPTEST:
Label: FTPTEST SERVER CERT
Certificate ID: 2QbG49fj4uPG49fj4uNA4snjxUDDxdnj
Status: TRUST
Start Date: 2020/01/22 01:00:00
End Date: 2022/02/01 00:59:59
Serial Number:
    >03<
Issuer's Name:
    >CN=RSH RACF Certificate Authority.O=RSH Consulting Inc..L=MA.C=US<
Subject's Name:
    >CN=FTP.SERVER.IP.ADDRESS.COM.O=RSH Consulting Inc.SP=MA.C=US<
Signing Algorithm: sha256RSA
Key Usage: HANDSHAKE, DATAENCRYPT, DOCSIGN
Key Type: RSA
Key Size: 2048
Private Key: YES
Ring Associations:
    Ring Owner: FTPTEST
    Ring:
        >RSHKEYRING<
```

FTP Server Keyring



- Certificate owner is FTP server STC USERID and is set DEFAULT
- Server CA and Client CA are added to FTP server keyring

```
racdcert listring(*) ID(FTPTEST)
```

```
Digital ring information for user FTPTEST:
```

```
Ring:
```

```
>RSHKEYRING<
```

Certificate Label Name	Cert Owner	USAGE	DEFAULT
-----	-----	-----	-----
RSH RACF CA	CERTAUTH	CERTAUTH	NO
FTPTEST SERVER CERT	ID(FTPTEST)	PERSONAL	YES
RSH SIMPLEAUTHORITY TEST CA	CERTAUTH	CERTAUTH	NO

FTP.DATA – Activate FTPS Secure Server



- FTP.DATA configuration statements that enable FTPS

EXTENSIONS AUTH_TLS	; Support TLS authentication
TLSMECHANISM ATTLS	; TLS implemented by AT-TLS, not FTP ; Preferred method of implementation ; ATTLS specification causes KEYSRING keyword to ; be ignored and use PAGENT
SECURE_CTRLCONN PRIVATE	; Integrity and privacy protection required ; on control connection
SECURE_DATACONN PRIVATE	; Integrity and privacy protection required ; on data connection
SECURE_FTP REQUIRED	; REQUIRED keyword disallows clear text login ; ALLOWED keyword permits clear text or TLS login
TLSPORT 0	; Explicit secure FTP (disable implicit)

FTP.DATA – Activate FTPS Client Authentication



- SECURE_LOGIN configuration statement enables FTPS client authentication

```
SECURE_LOGIN REQUIRED      ; NO_CLIENT_AUTH (default)
                          ; REQUIRED verifies client certificate authentication
                          ; VERIFY_USER verifies client certificate and checks
                          ; authority to
                          ; SERVAUTH EZB.FTP.<sysname>.ftpservername.PORTxxxx
```

FTPS Configuration Steps - Client



- Obtain client certificate with private key
 - RACF generated Certificate Signing Request (CSR) or 3rd party client certificate
 - Demonstration uses RACF CSR

- RACDCERT actions
 - ADD client certificate and CA signer certificate into RACF
 - ❖ If completing a RACF Certificate Signing Request, this action generates the private key
 - CONNECT client certificate signer CA to FTP server keyring/virtual keyring
 - ❖ Client certificate CA as CERTAUTH
 - ❖ Client certificate need not be connected to user's keyring

- Configure FTP client
 - Add P12 file to TLS/SSL configuration
 - Explicit encryption and a non-default port are used in this demonstration

FTPS – Generating Certificate Signing Request



- Use RACDCERT GENCERT and GENREQ commands to create a Certificate Signing Request (CSR) for the client certificate

```
RACDCERT ID(REGTEST) GENCERT -  
SUBJECTSDN( -  
  CN('Robyn Test Cert - REGTEST') -  
  O('RSH Consulting Inc') -  
  SP('MA') -  
  C('US') ) -  
SIZE(2048) -  
NOTBEFORE(DATE(2021-01-12)) -  
NOTAFTER(DATE(2022-01-11)) -  
WITHLABEL('REGTEST 3rd party cert')
```

```
RACDCERT GENREQ(LABEL('REGTEST 3rd party cert')) -  
  ID(REGTEST) -  
DSN('REGTEST.TSO.CERT.CSR')
```

FTPS Client – RACF CSR



- Cut and paste the CSR file into a .txt file on the PC.
- Send the .txt file to the Certificate Authority for signing.

```
-----BEGIN NEW CERTIFICATE REQUEST-----  
MIIC0DCCAbgCAQAwWzELMAkGA1UEBhMCMVVMxCzAJBgNVBAGTAk1BMRswGQYDVQQK  
ExJSU0ggQ29uc3VsdGluZyBJbmMxIjAgBgNVBAMTGvJvYnluIFRlc3QgQ2VydCAt  
IFJFR1RFU1QwggeiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQM7Eb+w2Jf  
fHIvk/qOkou9ACmg0doOnbD+nt1bYLMN4Au16OR5scmtDaho98FyETucQbw4RkOP  
.br/>.br/>.br/>/pmyAzMw2meIUvQsFYMEBwt2q9mDiLj80pkEZfXJC/P+829gBAYO83KFnWjHo9Sy  
AO71iA==  
-----END NEW CERTIFICATE REQUEST-----
```

FTPS Client – Generating the Private Key



- Binary upload the file from the CA that contains the signed certificate. Upload it into a file with RECFM=VB

```
RACDCERT ID(REGTEST) ADD('REGTEST.TSO.CERT.SIGNED') -  
WITHLABEL('REGTEST 3rd party FTP cert')
```

- The password secures the private key in the PKCS#12 file. It can not be reset. If it is forgotten, a new certificate will be needed.

```
RACDCERT ID(REGTEST) -  
EXPORT(LABEL('REGTEST 3rd party FTP cert')) -  
DSN('REGTEST.TSO.CERT.FTP.CLIENT.P12') PASSWORD('PVTKEYPW') -  
FORMAT(PKCS12DER)
```



- Verify the certificate is signed by proper CA, the private key has been generated and the private key password works

```
RACDCERT CHECKCERT('REGTEST.TSO.CERT.FTP.CLIENT.P12') PASSWORD('PVTKEYPW')
```

```
Certificate 1:
```

```
Digital certificate information for user REGTEST:
```

```
Label: REGTEST 3rd party FTP cert
```

```
Certificate ID: 2QfZxcfjxeLj2cXH48Xi40DzmYRAL4GZo6hAxuPXQIOFmaNA
```

```
Status: TRUST
```

```
Start Date: 2021/01/12 07:48:08
```

```
End Date: 2022/01/12 07:48:09
```

```
Serial Number:
```

```
>0176F6DA91E0<
```

```
Issuer's Name:
```

```
>CN=RSH SimpleAuthority TEST CA.OU=TEST.O=TESTRSH.C=US<
```

```
Subject's Name:
```

```
>CN=Robyn Test Cert - REGTEST.O=RSH Consulting Inc.SP=MA.C=US<
```

```
Signing Algorithm: sha256RSA
```

```
Key Usage: HANDSHAKE
```

```
Key Type: RSA
```

```
Key Size: 2048
```

```
Private Key: YES
```

```
Ring Associations:
```

```
*** No rings associated ***
```

FTPS Client Connection – Configuration



- Binary download P12 file to the FTP client machine and configure client

The screenshot displays the WinSCP application window with two configuration dialog boxes open. The background window shows the main interface with a menu bar (Local, Mark, Files, Commands, Session, Options, Remote, Help) and a toolbar. The 'Advanced Site Settings' dialog box is in the foreground, showing the 'TLS/SSL' tab selected in the left sidebar. It contains the following settings:

- TLS/SSL options:**
 - Minimum TLS/SSL version: TLS 1.0
 - Maximum TLS/SSL version: TLS 1.3
 - Reuse TLS/SSL session ID for data connections
- Authentication parameters:**
 - Client certificate file: C:\Users\Robyn\Desktop\REGTEST.TSO.CERT.FTP.CLIENT.P12

The 'Session' dialog box is also open, showing the following settings:

- File protocol:** FTP
- Encryption:** TLS/SSL Explicit encryption
- Host name:** 172.29.122.166
- Port number:** 1073
- User name:** (empty field)
- Password:** (empty field)
- Anonymous login

Buttons for 'Save', 'Cancel', and 'Advanced...' are visible at the bottom of the 'Session' dialog. The 'Advanced Site Settings' dialog has 'OK', 'Cancel', and 'Help' buttons. The main WinSCP window shows a status bar at the bottom with 'Not connected.' and a table with columns: Oper..., Source, Destination, Transf..., Time, Speed, Progress.

FTPS Client Connection – Connecting



- The private key passphrase is required, not the 37 character RACF passphrase

The screenshot displays the WinSCP interface for a connection to zOS 2.4 at IP 172.29.122.166. A modal dialog box is open, titled "Client certificate passphrase - zOS 2.4 - 172.29.122.166". The dialog contains a loading icon and the text "Loading client certificate...". Below this, there is a label "Passphrase for client certificate:" followed by a text input field filled with seven dots. At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help". The background interface shows a file browser view of the local directory "C:\Users\Robyn\Desktop\FTP JCL\" and a status bar at the bottom indicating "Not connected."

FTPS Client Connection – Connected!



- Note the gold key in the lower right corner indicating encryption is active

FTP JCL - zOS 2.4 - 172.29.122.166 - WinSCP

Local Mark Files Commands Session Options Remote Help

Synchronize Queue Transfer Settings Default

zOS 2.4 - 172.29.122.166 x New Session

C:\Users\Robyn\Desktop\FTPS JCL

Name	Size	Type
Parent directory		

/REGTEST:/

Name	Size	Changed
..		
S0W1.ISPF.ISPPROF		1/11/2021
TSO.CERT.CSR	1 KB	1/12/2021
TSO.CERT.FTP.CLIENT.P12	1 KB	1/12/2021
TSO.CERT.SIGNED	1 KB	1/12/2021

0 B of 0 B in 0 of 0

0 B of 300 B in 0 of 4

Command >

Queue

Open...	Source	Destination	Transf...	Time	Speed	Progress
---------	--------	-------------	-----------	------	-------	----------

FTP 0:00:18

FTPS with Client Authentication - Summary



- Unique protocol from SFTP

- Ensure z/OS Communication Server components are in place
 - PROFILE.TCP, PAGENT, syslogd

- Update FTP.DATA for TLS activation and client authentication

- Use TLSPORT 0 to disable implicit secure FTP
 - Explicit secure FTP
 - FTPS will run on PORT defined at FTP Server startup

- Use an FTP client that supports TLS

- Create client certificate with a USERID that will be certificate owner

- Passphrase required to access private key on FTP client machine



- z/OS offers the opportunity for FTP to submit jobs and retrieve output from the JES SPOOL
 - See RSH RACF tips article “FTP and JES” from April 2010 Volume 4, Issue 2.
[https://www.rshconsulting.com/racftips/RSH Consulting RACF Tips April 2010.pdf](https://www.rshconsulting.com/racftips/RSH%20Consulting%20RACF%20Tips%20April%202010.pdf)

- Carefully consider the controls governing use of JES by FTP
 - JESINTERFACELEVEL = 2 allows any FTP user to read the entire SPOOL

- Access to JES allows FTP to run TSO commands, REXX programs, issue system commands, etc.

- JES is a challenge for WINSCP
 - WINSCP looks for file names and file types
 - Can not determine names and file types from JES

- JES is easy for MS-Windows FTP client, so that is what we will use

FTP-JES Interface



```
C:\Users\Robyn\Desktop\JCL>ftp 172.29.122.166
Connected to 172.29.122.166.
220-FTP 18:59:49 on 2021-01-12.
220 Connection will close if idle for more than 5 minutes.
501 command OPTS aborted -- no options supported for UTF8
User (172.29.122.166:(none)): regtest
331 Send password please.
Password:
230 REGTEST is logged on. Working directory is "REGTEST.".
ftp> cd /tmp
250 HFS directory /tmp is the current working directory
ftp> put IPLINFO.txt IPLINFO.rx
200 Port request OK.
125 Storing data set /tmp/IPLINFO.rx
250 Transfer completed successfully.
ftp: 177990 bytes sent in 0.94Seconds 189.15Kbytes/sec.
ftp> quote site chmod 755 /tmp/IPLINFO.rx
200 SITE command was accepted
ftp> quote site filetype=jes
200 SITE command was accepted
ftp> put BPXBATCH.run.IPLINFO.rx.txt
200 Port request OK.
125 Sending Job to JES internal reader FIXrecfm 80
250-It is known to JES as JOB00209
250 Transfer completed successfully.
ftp: 795 bytes sent in 0.08Seconds 9.46Kbytes/sec.
ftp> get JOB00209 JOB00209.txt
```

FTP-JES Interface



- Doing an MGET * with JESINTERFACELEVEL 2 will download the JES SPOOL

```
ftp> quote site jesowner=*
200 SITE command was accepted
ftp> quote site jesjobname=*
200 SITE command was accepted
ftp> quote stat
<snip>
211-JESINTERFACELEVEL is 2
ftp> mget *
200 Representation type is Ascii NonPrint
200 Port request OK.
125 Sending all spool files for requested Jobid
250 Transfer completed successfully.
ftp: 3250 bytes received in 1.25Seconds 2.60Kbytes/sec.
200 Port request OK.
125 Sending all spool files for requested Jobid
250 Transfer completed successfully.
ftp: 3252 bytes received in 1.24Seconds 2.62Kbytes/sec.
200 Port request OK.
```

FTP-JES Interface Blocking



- The STEPLIB contains FTP exit FTCHKCMD. The library with the exit must be APF authorized. The library containing FTCHKCMD must be PROGRAM profile protected, if the PROGRAM class is active.

```
//FTPD      EXEC PGM=&MODULE,REGION=4096K,TIME=NOLIMIT,  
//          PARM='POSIX(ON) ALL31(ON) /&PARMS '  
//*  
//* STEPLIB CONTAINS FTCHKCMD CODED TO DENY FILETYPE=JES  
//STEPLIB DD DSN=TCPIP.LOADLIB.USEREXIT,DISP=SHR
```

FTP-JES Interface Blocking



```
C:\Users\Robyn\Desktop\JCL>ftp 172.29.122.166
Connected to 172.29.122.166.
220-FTP 19:08:56 on 2020-01-12.
220 Connection will close if idle for more than 5 minutes.
501 command OPTS aborted -- no options supported for UTF8
User (172.29.122.166:(none)): regtest
331 Send password please.
Password:
230 REGTEST is logged on. Working directory is "REGTEST.".
ftp> cd /tmp
250 HFS directory /tmp is the current working directory
ftp> quote site filetype=jes
500-UX-FILETYPE=JES change denied by installation exit
500 User Exit denies Userid 'REGTEST' from using Command 'SITE'.
ftp> quote site filelet=jes
500-UX-FILETYPE=JES change denied by installation exit
500 User Exit denies Userid 'REGTEST' from using Command 'SITE'.
ftp> quote site filetype=sql
200 SITE command was accepted
ftp> quote site filetype=seq
200 SITE command was accepted
ftp>
```

IBM Request For Enhancement



- An IBM Request For Enhancement (RFE) has been created by RSH Consulting to improve the FTP to JES interface security

- RFE 125660 – Increasing Security and Control for FTP JES Interface
 - Requests JESINTERFACELEVEL=0 parameter in FTP.DATA to disable the FTP to JES interface
 - Requests a SAF resource to restrict job submission and sysout retrieval via FTP for installations that require the FTP to JES interface

- See RSH RACF Tips article on entering, examining, and voting on RFEs
[https://www.rshconsulting.com/racftips/RSH Consulting RACF Tips January 2016.pdf](https://www.rshconsulting.com/racftips/RSH%20Consulting%20RACF%20Tips%20January%202016.pdf)

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