

Communications Server z/OS® V1R5 and V1R6 Technical Update

SSL/TLS FTP Firewall Relief

© Copyright International Business Machines Corporation 2004. All rights reserved.



eserver

© Copyright International Business Machines Corporation 2004. All rights reserved.

Topics

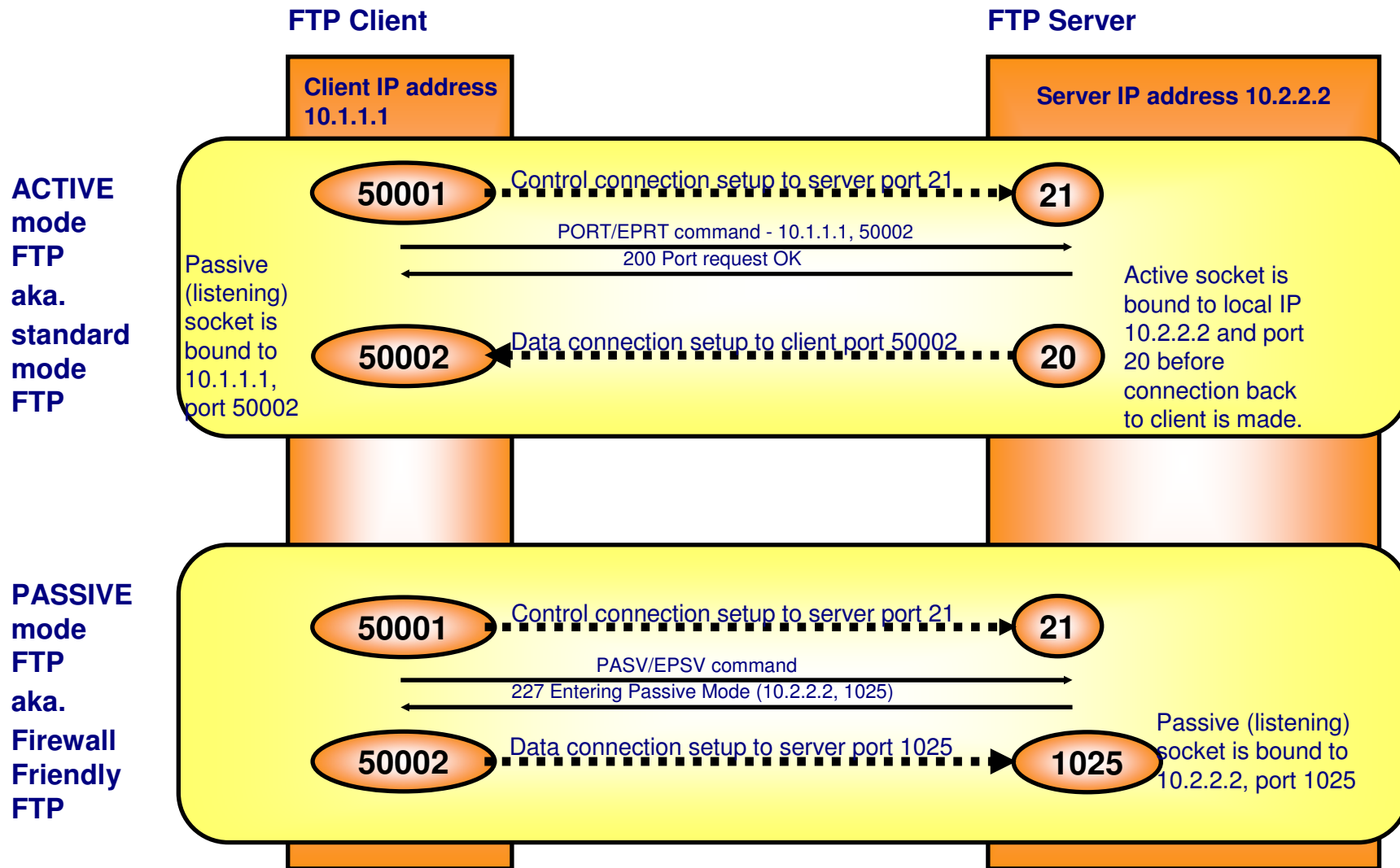
- z/OS V1R5
 - ▶ SSL/TLS FTP firewall relief
 - Extended passive mode data connections
 - Configurable port range for passive mode data connections
 - ▶ Improved PDSE support and PDS/PDSE library transfers
 - ▶ Cleaned up batch FTP client return codes
 - ▶ MSYS for setup for FTP.DATA
 - ▶ Miscellaneous

SSL/TLS FTP Firewall Relief

Copyright International Business Machines Corporation 2004. All rights reserved.

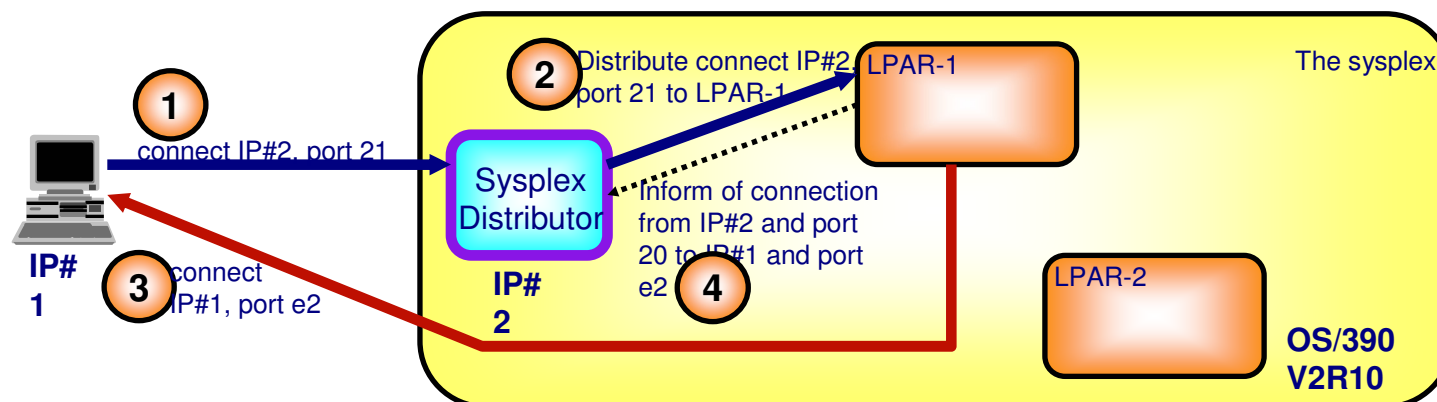


Those FTP data connections and port numbers - who establishes the data connection?



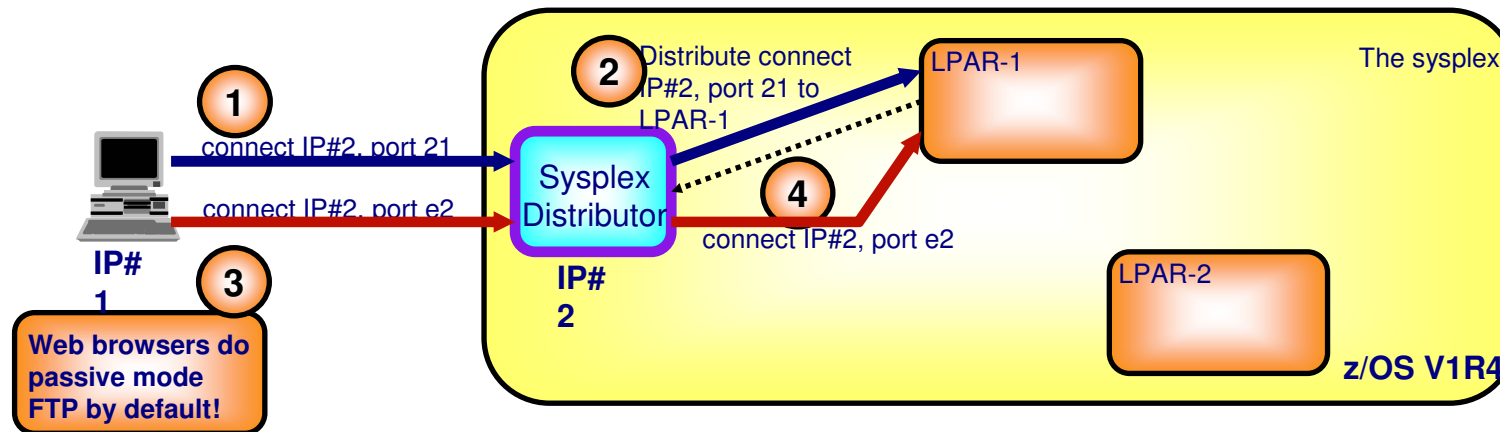
FTP workload balancing

Active mode FTP and Sysplex Distributor



- 1 Connection to the cluster address (IP#2) and the FTP control connection port number (port 21) is intercepted by the Sysplex Distributor LPAR
 - 2 Sysplex Distributor distributes the connection to LPAR-1 - and we now have a connection between IP#1, port e1 and IP#2, port 21 - Sysplex Distributor remembers this 4-tuple and forwards all inbound IP packets from IP#1 port e1 towards IP#2 port 21 to LPAR-1 hereafter
 - 3 When the data connection is to be established, the client opens a new listening socket and sends a PORT command to the FTP server over the control connection instructing it which IP address and port number to connect to in order to set up the data connection. The FTP server will do so from a new socket that is locally bound to port 20 - and we will now have a connection between IP#2 (the cluster IP address) port 20 and IP#1 port e2.
 - 4 Because the inbound IP packets for this data connection will come to the cluster IP address they will show up at the Sysplex Distributor node and it needs to know where to send them for this particular data connection. That information is conveyed to the Sysplex Distributor node from LPAR-1 if the source port number (port 20) is included in the list of port numbers for which the Sysplex Distributor is supposed to distribute.
- Active mode FTP connections can be distributed using Sysplex Distributor since OS/390 V2R10 as long as both the control connection and data connection server port numbers are included in the VIPADISTRIBUTE statement (port 21 and port 20)**

Passive mode FTP and Sysplex Distributor supported in z/OS V1R4



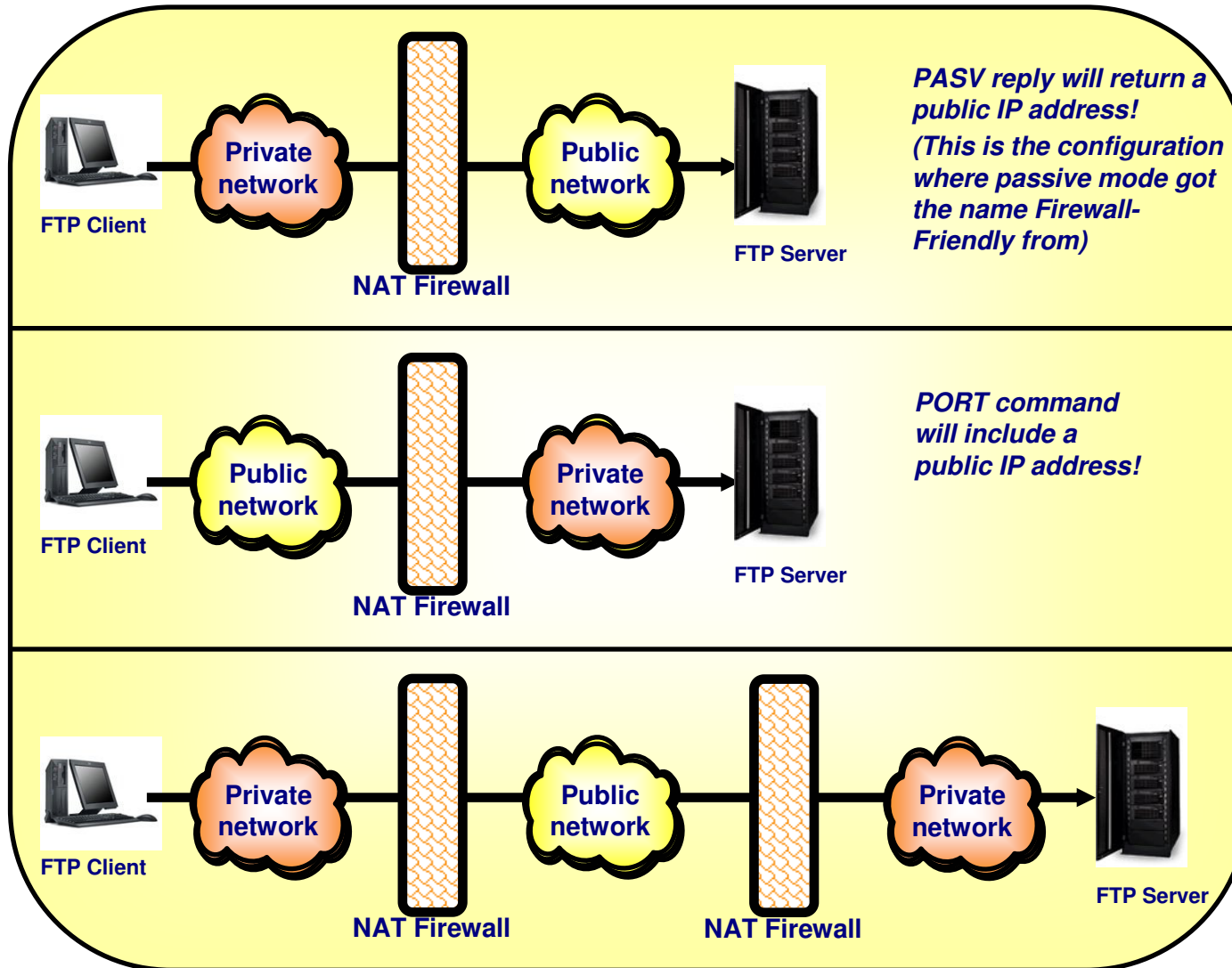
- 1 Connection to the cluster address (IP#2) and the FTP control connection port number (port 21) is intercepted by the Sysplex Distributor LPAR
- 2 Sysplex Distributor distributes the connection to LPAR-1 - and we now have a connection between IP#1, port e1 and IP#2, port 21 - Sysplex Distributor remembers this 4-tuple and forwards all inbound IP packets from IP#1 port e1 towards IP#2 port 21 to LPAR-1 hereafter
- 3 When the data connection is to be established the server now opens a new socket and binds it to some ephemeral port number (e2) and the IP address to which the control connection was established (IP#1) and sends this information to the client over the control connection as the PASV reply. The client now sends a connect request to IP#1 and port e2 and this request shows up at the Sysplex Distributor node. Since the destination port is an ephemeral port we cannot pre-configure it in the VIPADISTRIBUTE statement so the distributing node doesn't know that this connection really should go to LPAR-1 - and will in releases up until z/OS V1R4 not be able to distribute such passive mode FTP sessions.
- 4 In z/OS V1R4 support has been added so that when the FTP server binds its data socket to the cluster IP address (IP#1) and an ephemeral port number, that information will be sent to the distributing node and the distribution control tables will be dynamically extended with this ephemeral port number and an affinity with the LPAR from where it originated. So when the data connection request arrives in the distributing node, it knows it has to go to LPAR-1.

Passive mode FTP connections can be distributed using Sysplex Distributor from z/OS V1R4. Please note that this support requires SYSPLEXPORTS to be specified on the Distributed DVIPA that is used for FTP workload.

FTP and Firewalls

- When we back in z/OS V1R2 enabled SSL/TLS for FTP (using "FTP Security Extension", RFC2228 - "The TLS Protocol", RFC2246 - "Securing FTP with TLS", draft-RFC) - we ran into an ever increasing amount of issues with firewalls, especially firewalls that were configured to do NAT. There were three issues we identified as we analyzed this area:
 - 1 NAT firewalls rely on being able to not just translate the addresses in the IP headers, but also in the FTP control connection data stream - the PORT command or the reply to the PASV command.
 - 2 When doing FTP between business partners over a public network, neither active mode nor passive mode works well - active mode requires the client-side firewalls to open for the data connection coming back in from the public network (a wellknown source port number (20), but in general not something firewall administrators want to define a pass rule in their firewalls for) - and passive mode requires that the server-side firewall must open up for an incoming connection from an ephemeral port in the public network to an ephemeral port inside the firewall (which isn't really acceptable either)
 - 3 Some firewall vendors in analyzing the FTP control connection require that each interaction (command or response) on the control connection end in a NL character and will terminate the connection if an interaction doesn't do so. If the control connection is encrypted, these interactions do not end in any recognizable ASCII character. (Some even require this to be the case for a KEEPALIVE packet).
- When using secure FTP the control connection is always secured (unless one configures a NULL cipher), which means that firewalls cannot perform function 1 and 3 above - and what we saw was that secure FTP sessions were generally terminated/broken/shut-down by firewalls.
- We are implementing technologies on z/OS to deal with number 1 and 2 above. Number 3 is something we cannot change without violating the FTP protocol, and our recommendation has been to disable that check in the firewalls and it seems like customers are generally OK doing that (it is a somewhat odd check that actually could make an FTP control connection fail even in certain scenarios where encryption isn't used).
- Number 1 is dealt with by implementing "FTP Extensions for IPv6 and NAT", RFC2428 - of importance in this context is support on both client and server side for the EPSV (Extended Pasasive Mode) command. We did implement the IPv6 part of this RFC in z/OS V1R4, but are now extending the support to IPv4 for the NAT issues.
- Number 2 is dealt with by a new configuration option on our server that reserves a known range of port numbers the server is allowed to use for passive mode data connections - allowing firewalls to be configured with a known range of target port numbers for the data connections.

Which secure FTP NAT configurations may currently work and which will not?

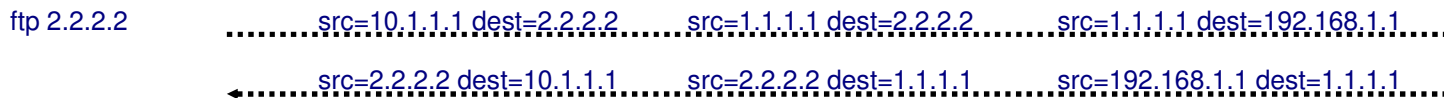
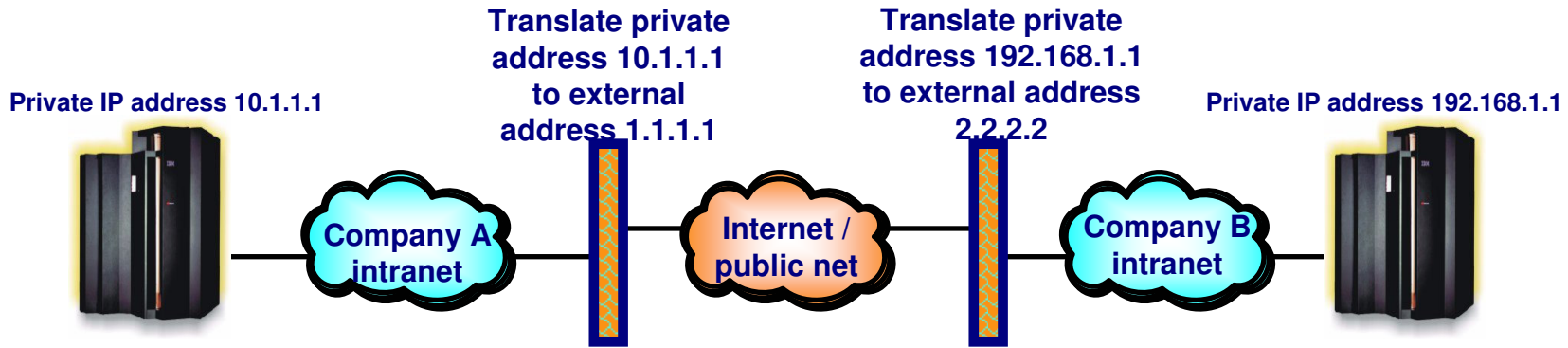


- Passive mode (PASV) will work
- Active mode (PORT) will not work

- Passive mode (PASV) will not work
- Active mode (PORT) will work

- Neither passive mode (PASV) nor active mode (PORT) will work!

Secure FTP and issues with Network Address Translation (NAT) and filtering firewalls today



Active:
PORT 10.1.1.1 1026

Passive:
PASV

Will try to connect back to 192.168.1.1 which won't work.

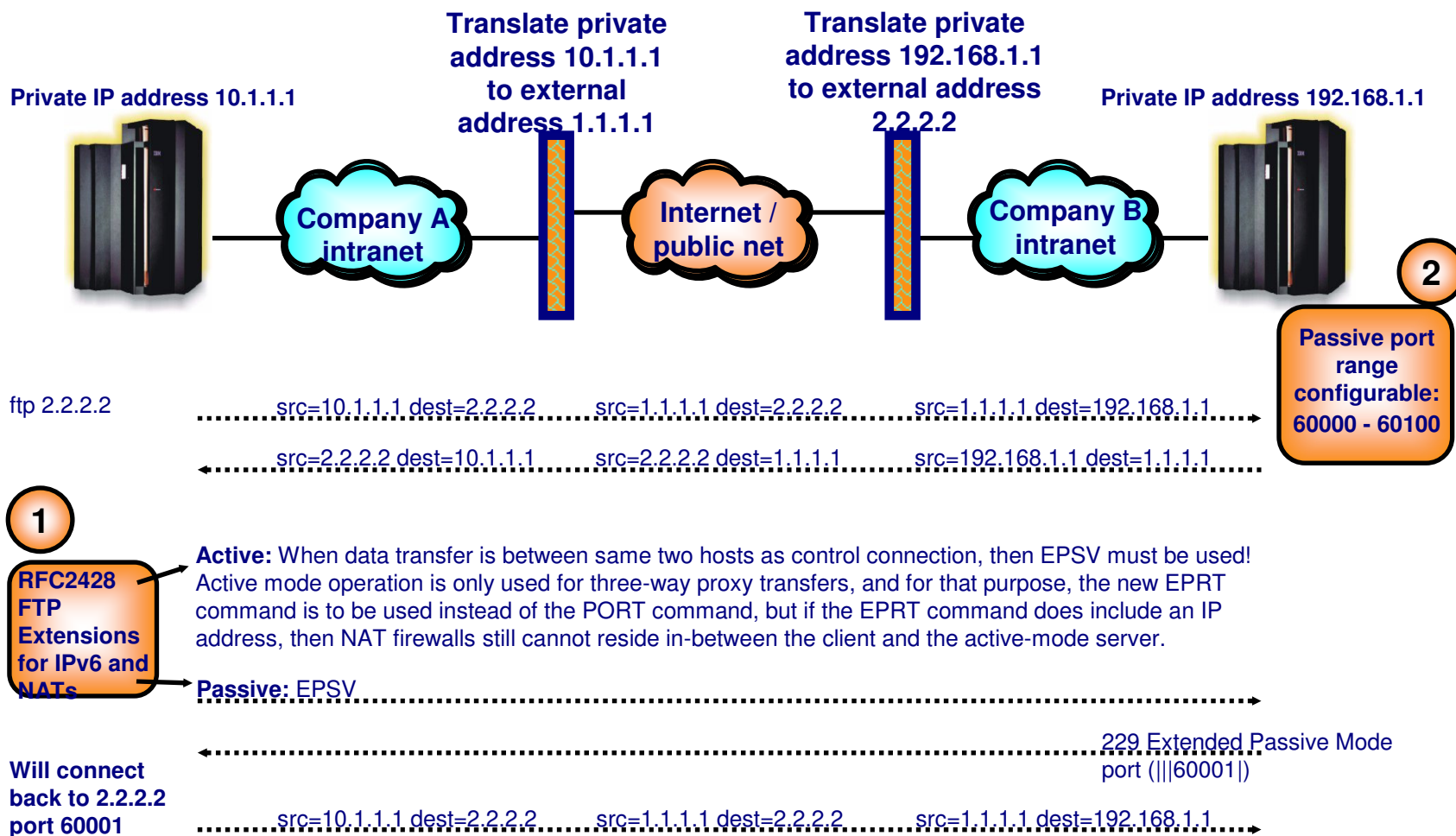
When firewalls do NAT, they rely on being able to snoop on the content of the FTP control connection and to modify the IP addresses in the PORT command or the reply to the PASV command. When the connection is secure (either because of use of SSL/TLS, Kerberos, or IPsec) that ability doesn't exist!

Will try to connect back to 10.1.1.1 which won't work.

227 Entering Passive Mode 192.168.1.1 1027

Another related issue with passive mode is that the server will choose an ephemeral port number for the data connection, which means that the data connection will come from an ephemeral port number to an ephemeral port number (not a nice rule to have in a firewall!).

Secure FTP, NAT, and filtering firewalls - addressed in z/OS V1R5



Client EPSV support and server passive data port range configuration
PTF'ed back to z/OS V1R4 - APAR PQ80281

PASSIVEDATAPORTS option in server FTP.DATA

The logo consists of the text "V1R5" in a bold, blue, sans-serif font, centered within an orange oval with a black border.

➤ FTP.DATA statements for Server

▸ PASSIVEDATAPORTS (low_port,high_port)

- the lowest number allowed for low_port is 1024
 - the highest number allowed for high_port is 65536
 - for EPSV and PASV data ports, the FTP server will pick a port from low_port to high_port, inclusive
 - higher port numbers are recommended
- When PASSIVEDATAPORTS is coded, the server will pick ephemeral ports for listening data sockets only from the range coded

New AUTHPORT PORT reservation option in TCP/IP Profile



➤ PROFILE.TCPIP statements

▶ PORTRange *1st_port num_ports TCP AUTHPORT*

- AUTHPORT reserves ports for FTP
- for TCP protocol only
- code same range as on PASSIVEDATAPORTS
- prevents other applications from consuming ports
- SYSPLEX dvipa users

- if you are distributing the FTP workload to multiple FTP servers in a Sysplex, code the same PORTRANGE ...AUTHPORT statement for each participating stack

PASSIVEDATAPORTS and AUTHPORT interaction

The logo consists of the text "V1R5" in a bold, blue, sans-serif font, centered within a horizontal oval. The oval has a gradient from light orange to dark orange and a black border.

The following table shows how PASSIVEDATAPORTS and AUTHPORT interact with FTP and other applications.

PASSIVEDATAPORTS	AUTHPORT	FTP listening data ports
(5000,5050)	5000-5050	FTP uses ports 5000-5050. No other application can use these ports.
(4000,4050)	5000-5050	FTP uses ports 4000-4050. Other applications can use ports 4000-4050. No application can use ports 5000-5050.
not coded	5000-5050	FTP uses normal ephemeral ports outside the 5000-5050 range. No application can use ports 5000-5050.
(5000,5050)	not coded	FTP uses ports 5000-5050. Other applications can use ports 5000-5050 too.

Netstat display



➤ Example: PORTRANGE 50000 10 TCP AUTHPORT in PROFILE.TCPIP

```
# netstat -o
MVS TCP/IP NETSTAT CS V1R6          TCPIP Name: TCPCS
Port# Prot User      Flags   Range      IP Address
-----
00007 TCP  MISCSERV DA
....
00020 TCP  OMVS      DA
00021 TCP  OMVS      DA
.....(lines omitted for brevity)
50000 TCP  AUTHPORT DAR      50000-50009
50001 TCP  AUTHPORT DAR      50000-50009
50002 TCP  AUTHPORT DAR      50000-50009
....(omitted lines differ only in Port#)
50007 TCP  AUTHPORT DAR      50000-50009
50008 TCP  AUTHPORT DAR      50000-50009
50009 TCP  AUTHPORT DAR      50000-50009
```

Firewall filter rules



➤ Firewall configuration

- ▶ Consult Firewall documentation for details
- ▶ The firewall filter rules can now be limited to only allowing connections that are destined for a port in the configured range and deny all other connection set up requests.
 - Allow connection setup from an ephemeral port to a port in the PASSIVEDATAPORTS range

➤ Additional benefits of coding PASSIVEDATAPORTS

- ▶ An added advantage of using this option is that it is now much easier to create QoS policies for passive mode FTP data connections to control maximum data transfer rates
 - Earlier, this was quite complex because both client and server ports were unpredictable. The only way to achieve this earlier was to enforce FTP server address space names using the BPX_JOBNAME environment variable and map policies to jobnames.

Running out of ports in PASSIVEDATAPORTS range



- Server can run out of ports if PASSIVEDATAPORTS coded
 - ▶ Coding PASSIVEDATAPORTS can cause the server to run out of ports for data sockets in these ways:
 - Other applications are using the ports
 - FTP can't force you to code a PORTRANGE ...TCP AUTHPORT statement in your PROFILE.TCPIP.
 - If you don't code the statement, other applications can monopolize the ports
 - code PORTRANGE ... TCP AUTHPORT in PROFILE.TCPIP to prevent this problem
 - You didn't configure enough ports in the PASSIVEDATAPORTS range
 - One per data connection that will be active at any one time
 - Additional ports to allow for the TIMEWAIT state
 - ★ When FTP releases a port, it enters TIMEWAIT state, about two minutes by default. FTP can't obtain the port again until it exits TIMEWAIT state.
 - ★ Code enough ports to allow for ports consumed by timewait state

FTP IPv6 uses EPRT/EPSV since z/OS V1R4 - z/OS V1R5 extends that to IPv4

The logo consists of the text "V1R5" in a bold, blue, sans-serif font, centered within a horizontal oval. The oval has a gradient from light orange to dark orange and a black border.

➤ z/OS FTP IPv6 sessions

- Since z/OS V1R4

- z/OS FTP supports IPv6 sessions
 - z/OS Server supports EPSV and EPRT commands
 - z/OS Client uses EPSV not PASV or PORT to start data connections
 - client uses EPRT to start data connection for proxy transfer only
 - ★ Proxy data connection not supported by z/OS for secure sessions
 - ★ EPRT parameter includes IP address; does not fix problem
 - ★ EPRT essential for IPv6 proxy data connection
- Passive mode FTP fixed since z/OS V1R4 for IPv6 logins

➤ Now about z/OS FTP IPv4 sessions

- z/OS client uses PASV and PORT

- on IPv4 sessions for data connection
- This release adds option to use EPSV and EPRT instead
 - EPRT or PORT must be used to set up proxy data connection

FTP.DATA for and LOC SITE commands for z/OS FTP client



- When EPSV4 is TRUE for IPv4 session, the z/OS FTP client
 - uses EPSV for data connections
 - uses EPRT only for proxy data connections
 - stops using EPSV and EPRT if the server rejects one of these commands
 - treats a reply to EPSV or EPRT that does not comply with RFC 2428 as a rejection

- FTP.DATA statements for FTP Client
 - EPSV4 {TRUE|FALSE}**
 - **FALSE**
 - means don't use EPSV or EPRT on IPv4 connections
 - **TRUE**
 - means use EPSV and EPRT on IPv4 sessions
 - IPv6 sessions are not affected by the EPSV4 value

- locsite subcommand parameter for current session
 - locsite EPSV4**
 - use EPSV and EPRT during IPv4 FTP sessions
 - locsite NOEPSV4**
 - don't use EPSV or EPRT on IPv4 FTP sessions
 - IPv6 FTP sessions are not affected by this setting

EPSV, FWFRIENDLY, server doesn't support EPSV

V1R5

➤ Example

```
Command:
locsite epsv4 fwf                <== EPSV4 and FWFRIENDLY are on
Command:
dir u*
>>> EPSV
500 Unknown command, 'EPSV'      <== server does not support EPSV
>>> PASV                          <== client recovers with PASV
227 Data transfer will passively listen to 9,xx,yyy,zz,233,174
>>> LIST u*
125 List started OK
UC      EXEC      V      72      30      1 1992-02-04 10:00:39
250 List completed successfully.
Command:
dir u*
>>> PASV                          <=== client stops sending EPSV
227 Data transfer will passively listen to 9,xx,yyy,zz,233,192
```

If server doesn't support EPSV and the client is configured to operate in firewall-friendly mode, it will revert to normal passive mode (sending a PASV command).

EPSV, NOFWFRIENDLY, server doesn't support EPSV

V1R5

➤ Example

```
locsite epsv4 nofwf          <<== set EPSV4 on and FWFRIENDLY off
Command:
dir q*
>>> EPSV
500 Unknown command, 'EPSV'  <== server doesn't understand EPSV
>>> PORT 9,xx,yy,zz,4,5     <== recovers with PORT because
200 Port request OK.        FWFRIENDLY is off
>>> LIST q*
125 List started OK
QB@@@OBJ QI@DR001 V          73          34          1
QWECS    MAC          F          80          52
250 List completed successfully.
Command:
```

If server doesn't support EPSV and the client is not configured to operate in firewall-friendly mode, it will revert to normal active mode (sending a PORT command).

EPSV, server does support EPSV

V1R5

➤ Example - z/OS FTP server and EPSV4

```
Command:
locsite EPSV4
Command:
dir t*
>>> EPSV
229 Entering Extended Passive Mode (|||50000|)
>>> LIST t*
125 List started OK
Volume Unit      Referred Ext Used Recfm Lrecl BlkSz Dsorg Dsname
CPDLB3 3390      2002/11/20 1   1  VB      256 6233 PO  TEST.PDS
250 List completed successfully.
Command:
locsite noepsv4
Command:
dir t*
>>> PASV
227 Entering Passive Mode (9,xx,yyy,zz,195,81)
... and so on
```

Migration Concerns

EPSV/EPRT for IPv4 data connections



- not all FTP servers support EPSV and EPRT for IPv4 connections
 - in fact, only a very few do at this point in time

- not all FTP servers support EPSV and EPRT per RFC 2428
 - some early implementation mistakes by some vendors - seem to have been solved by now

- FTP client stops sending EPRT and EPSV in these cases
 - To avoid the extra command flow per session
 - code EPSV4 FALSE in client's FTP.DATA

 - ★ or

 - issue locsite NOEPSV4 after logging in

Improved FTP Support for PDSE

Copyright International Business Machines Corporation 2004. All rights reserved.



z/OS V1R5 improves handling of PDS and PDSE data sets



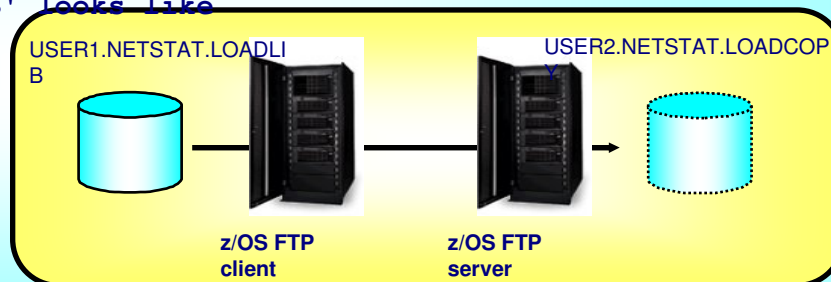
➤ z/OS V1R5 improves handling of PDS/PDSE libraries by both the FTP client and the FTP server:

- New FTP.DATA and SITE/LOCSITE options to specify whether an MKDIR or LMKDIR in MVS data set mode results in allocating a PDS or a PDSE:
 - PDSTYPE [PDS | PDSE]
- New option on the MKDIR and LMKDIR commands to specify a 'like' partitioned dataset from where to copy allocation attributes - avoiding specifying SITE/LOCSITE commands before creating the new partitioned data set:
 - mkdir remote_directory (like local_directory
 - lmkdir local_directory (like remote_directory

Example: creating a new partitioned data set on the server with the attributes of a data set on the client

```
lcd 'user1.netstat'  
cd 'user2.netstat'  
;  
; Make a new library on server called 'USER2.NETSTAT.LOADCOPY'  
; based on how local 'USER1.NETSTAT.LOADLIB' looks like  
;  
mkdir loadcopy (like loadlib  
lcd loadlib  
cd loadcopy  
mput *  
dir  
quit
```

Both client and server need to be at a z/OS V1R5 or higher level



Batch FTP client and return codes

Copyright International Business Machines Corporation 2004. All rights reserved.



Better feedback from batch FTP client jobs in z/OS V1R5



- FTP.DATA option CLIENTERRCODES enhanced:
 - FALSE: if error, generate std. 5-digit return code (ccyyy) - CC=ccyyy modulo 4096
 - TRUE: if error, generate one of 17 (z/OS V1R5: 24) fixed 2-digit client error code (xx) - CC=xx
 - EXTENDED: if error, generate a return code that contains the two-digit client error code concatenated to the two-digit subcommand code (xxcc) - will always yield a value that is less than 4096 - CC=xxcc

- New FTP.DATA option LOGCLIENTERR TRUE
 - Generate MVS syslog message EZZ9830I for automation if FTP client job fails
 - EZZ9830I USER1Q FTP failed - Cmd = 10(open) Reply = n/a EX CEE RC = 0810
 - Explanation: FTP client in address space USER1Q failed on OPEN, no reply has been received because the OPEN did not complete, the EXIT parameter was specified at client start, Client Error Codes Extended was specified in FTP.DATA, and the computed return code was 0810 (08 = FTP_CONNECT_FAILED, 10 = Open subcommand)
 - If EXIT was not specified, only the first error encountered will generate an EZZ9830I message

- FTP client EXIT option combinations:
 - If EXIT is not coded, the FTP client tries to execute all FTP subcommands in the input stream
 - If EXIT=nn is specified at client start, the client returns the nn value
 - If EXIT is specified at client start and CLIENTERRCODES is FALSE (the default) a standard return code (xxyy) concatenating the subcommand code and last reply code is generated by the FTP client
 - If EXIT is specified and CLIENTERRCODES is TRUE, the return code will be a two-digit client error code (cc)
 - If EXIT is specified and CLIENTERRCODES is EXTENDED, the return code will be a four-digit concatenation of the client error code and subcommand code (ccxx)

Functional Externals - FTP Client Return Codes

NOTES

	FTP Client Error Codes	New Descriptive Information
Code	Error	Examples of Cause
01	FTP INTERNAL ERROR	Failure to acquire storage, unexpected error in REXX stack
02	FTP SERVER ERROR	Error reply returned by the server
03	NOT USED	<Not returned as an error code>
04	FTP INVALID PARAM	Invalid parameter specified on FTP command
05	FTP OPEN IOSTREAM FAILED	Failed to open the INPUT stream
06	FTP ALREADY CONNECTED	Attempt to OPEN when already connected
07	FTP USAGE	Syntax error in a subcommand, invalid combination of settings
08	FTP CONNECT FAILED	Attempt to reach unknown host, lost connection, data connect failed
09	FTP TIMEOUT	Timeout waiting for response on the control or data connection
10	FTP SESSION ERROR	Socket error, other send/receive errors
11	FTP LOGIN FAILED	Invalid userid, password, or account info
12	FTP INPUT ERR	Error reading INPUT or STDIN
13	FTP INPUT EOF	<Not returned as an error code>
14	FTP_NOTFOUND	TCP/IP stack not found, resolver not found, translation table not found or could not be loaded
15	FTP INVALID ENVIRONMENT	Missing INPUT DD
16	FTP NOT ENABLED	Improper installation of TCP/IP
17	FTP_AUTHENTICATION	Security authentication or negotiation failure, incorrect specification of security keywords
18	FTP FILE ACCESS	Data set allocation failure, recall failure, open failure
19	FTP FILE READ	File corrupted
20	FTP FILE WRITE	Out of space condition, close failure
21	FTP CONVERSION	Error during data translation or setup not otherwise specified
22	FTP PROXY ERR	Error during proxy processing not otherwise specified
23	FTP SQL ERR	Error returned by the SQL process, including connect failure
24	FTP CLIENT ERR	Other errors in the client, some unrecoverable interface errors

MSYS for setup for FTP.DATA

Copyright International Business Machines Corporation 2004. All rights reserved.



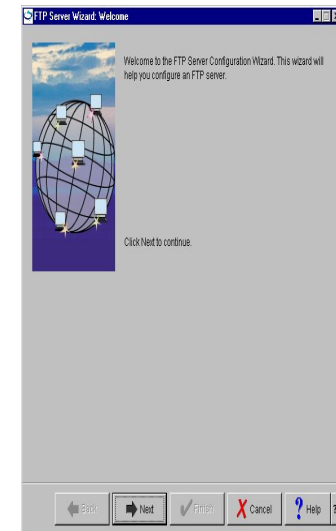
FTP configuration via MSYS dialog Example

The screenshot shows the "FTP Server - Edit Mode" dialog box with the "General" tab selected. The "Port numbers and security capability" section includes a text box for "Control connection port number" containing "21", and two optional text boxes for "Lower range" and "Upper range". There are checkboxes for "Enable TLS security" and "Enable Kerberos security", and a "Security Settings..." button. The "Starting file system (STARTDIRECTORY)" section has two radio buttons: "The user's root directory in the HFS." (unselected) and "MVS data sets. The user ID will be the prefix of the initial data set." (selected). The "Configuration file member names" section contains a text box for "Start procedure name" with "FTPD" and a checked "Autolog" checkbox, and another text box for "FTP configuration member name" with "FTPDATA". The bottom of the dialog has "OK", "Cancel", "Help", and "?" buttons.

➤ The configuration can be stored in the MSYS LDAP server

➤ It can also be viewed on the workstation in the traditional FTP.DATA text syntax

➤ (and copy/pasted into a file that can be transferred to MVS)



FTP Miscellaneous Items

Copyright International Business Machines Corporation 2004. All rights reserved.



Miscellaneous items

FTPKEEPALIVE in LOCSTAT

V1R5

- Added a line in the LOCSTAT subcommand display for FTPKEEPALIVE setting

```
locstat
EZA1600I Trace: FALSE, Send Port: TRUE
EZA1601I Send Site with Put command: TRUE
. . .
EZA2816I No automatic mount of tape volumes.
EZA2809I CCONNTIME is 30
EZA2810I DATACTIME is 120
EZA2811I DCONNTIME is 120
EZA2812I INACTTIME is 120
EZA2813I MYOPENTIME is 60
EZZ9813I FTPKEEPALIVE is 60
EZA2815I VCOUNT is 59
EZA2689I Prompting: ON, Globbing: ON
. . .
EZY2640I Using /u/user33/ftp.data for local site configuration parameters.
EZA1460I Command:
```

Miscellaneous items

Link-edit attributes



- Changed linkedit attribute for the server load module to RMODE=ANY
 - Daemon and client load modules were already linked RMODE=ANY
 - Migration concern: any user security exit (e.g., FTCHKCMD) that has a dependency on running with 24 bit addressing must be rewritten.

Miscellaneous items

FTP Serviceability



- Message EZA2589E has been expanded to identify the operation in progress when the timeout in the FTP client occurred. The operations thus identified are:
 - Initial connection
 - Initial IPv6 connection
 - Waiting for data connection
 - Sending a command
 - Sending ABORT command
 - Receiving data
 - Sending data
 - Waiting for reply
 - Sending command to SOCKS server
 - Waiting for reply from SOCKS server
 - Establishing data connection through SOCKS server
 - Initial connection to SOCKS server

Miscellaneous items

FTP Serviceability



- The IP Diagnosis Guide contains complete descriptions of each operation identified in EZA2589E. Here is a sample entry:

Initial IPv6 connection

Timer: MYOPENTIME

Explanation: The FTP client is trying to establish a connection with a FTP server using an IPv6 address. Either the TCP connection has not completed yet or the initial reply from the server has not been received.

User Response : Ensure the remote server responds to a ping request. The value of MYOPENTIME can be increased to allow more time for the server to send the initial reply. If the problem recurs, contact the System Programmer.

System Programmer Response: If there are firewalls between the FTP client and FTP server, ensure the firewalls are allowing IPv6 FTP traffic from the mainframe to the FTP server for the port being used. A packet trace of the failing transfer will show if the TCP connection has been completed, the IP addresses being used and any replies sent by the server.

Miscellaneous items

FTP Serviceability



➤ LE/Unix System Services error messages

- ▶ Messages, replies, log entries and trace entries that include LE/Unix System Services error messages will now contain errno2 data.

- ▶ Example: EDC5121I Invalid argument. (errno2=0x0C0F8402)

- ▶ errno2 is equivalent to errnojr for Unix System Services

➤ Dynamic allocation errors

- ▶ Dynamic allocation errors in both the client and server will either be logged (server only) or put into the trace if trace is active. Parts of this change were routed to V1R4 via APAR PQ62320.

- ▶ Where meaningful, S99ERSN and S99INFO are included in messages, replies, and log and trace entries

Trademarks, Copyrights, and Disclaimers

The following terms are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both:

IBM	CICS	IMS	MQSeries	Tivoli
IBM (logo)	Cloudscape	Informix	OS/390	WebSphere
e-business (logo)	DB2	iSeries	OS/400	xSeries
AIX	DB2 Universal Database	Lotus	pSeries	zSeries

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

Microsoft, Windows, Windows NT, and the Windows logo are registered trademarks of Microsoft Corporation in the United States, other countries, or both.

Intel, ActionMedia, LANDesk, MMX, Pentium and ProShare are trademarks of Intel Corporation in the United States, other countries, or both.

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

Linux is a registered trademark of Linus Torvalds.

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

Product data has been reviewed for accuracy as of the date of initial publication. Product data is subject to change without notice. This document could include technical inaccuracies or typographical errors. IBM may make improvements and/or changes in the product(s) and/or program(s) described herein at any time without notice. Any statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. References in this document to IBM products, programs, or services does not imply that IBM intends to make such products, programs or services available in all countries in which IBM operates or does business. Any reference to an IBM Program Product in this document is not intended to state or imply that only that program product may be used. Any functionally equivalent program, that does not infringe IBM's intellectual property rights, may be used instead.

Information is provided "AS IS" without warranty of any kind. THE INFORMATION PROVIDED IN THIS DOCUMENT IS DISTRIBUTED "AS IS" WITHOUT ANY WARRANTY, EITHER EXPRESS OR IMPLIED. IBM EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT. IBM shall have no responsibility to update this information. IBM products are warranted, if at all, according to the terms and conditions of the agreements (e.g., IBM Customer Agreement, Statement of Limited Warranty, International Program License Agreement, etc.) under which they are provided. Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products in connection with this publication and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. IBM makes no representations or warranties, express or implied, regarding non-IBM products and services.

The provision of the information contained herein is not intended to, and does not, grant any right or license under any IBM patents or copyrights. Inquiries regarding patent or copyright licenses should be made, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

© Copyright International Business Machines Corporation 2005. All rights reserved.

Note to U.S. Government Users - Documentation related to restricted rights-Use, duplication or disclosure is subject to restrictions set forth in GSA ADP Schedule Contract and IBM Corp.

© Copyright International Business Machines Corporation 2004. All rights reserved.