z/TPF Communications Enhancements

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Venue: Communications Subcommittee

AIM Enterprise Platform Software
IBM z/Transaction Processing Facility Enterprise Edition 1.1.0

Overview

- This presentation covers recent z/TPF communications enhancements
- All APARs listed in this presentation will ship on PUT 4

I Hear You Knockin', but You Can't Come In

Starting an SNA APPN Session (Current Support)

- When an SNA remote LU is starting a session with z/TPF across an APPN network
  - The APPN Select a Host User Exit (UAPN) is called
- UAPN can choose:
  - The z/TPF host on which the LU-LU session will be established (if loosely-coupled)
  - The first hop link (ALS) over which to start the session
- UAPN can also tell the z/TPF system to select the z/TPF host and link to use

New APPN User Exit Option (APAR PJ31939)

- A new return code option has been added to UAPN indicating that z/TPF should reject the session request indicating the target (z/TPF) application is not available
- Can be used if you do not want this remote LU to log on at this time
- Can be used to reject certain session requests during peak periods or when the z/TPF complex is overloaded

The Boomerang Effect

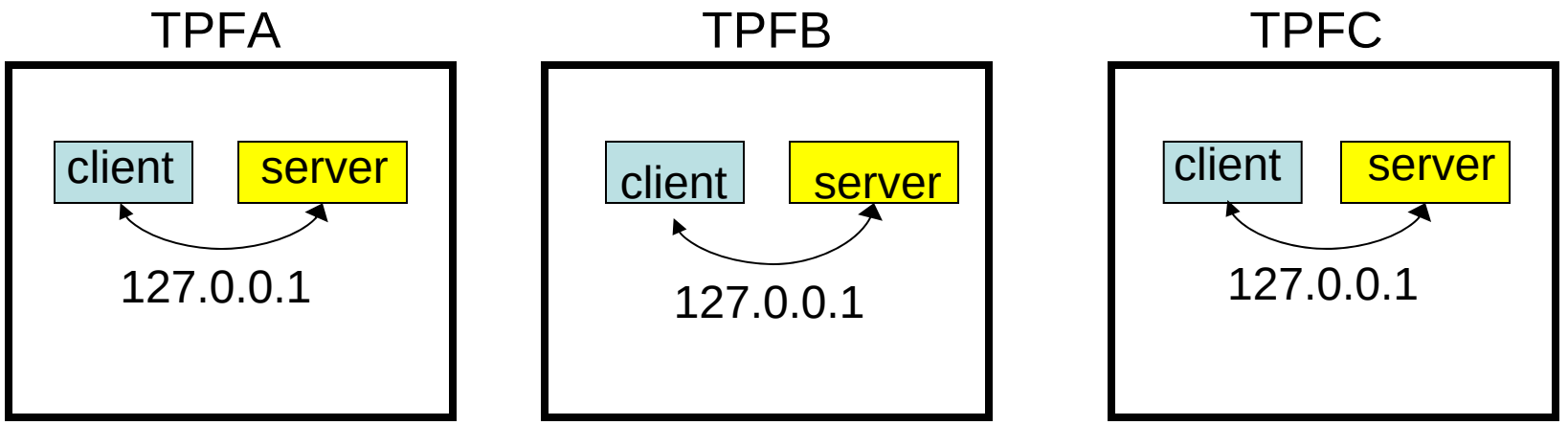
Local Sockets

- Client and server programs reside on the same host (same z/TPF processor)
- Client program issues *connect* (TCP) or *sendto* (UDP) specifying an IP address that is local to this z/TPF processor
- Outbound packet is built and placed on input list for processing
- No physical network interface (OSA-Express) is needed or used

Localhost Interface Support

- IP address 127.0.0.1 is defined by the architecture as the loopback address
- APAR PJ32025 adds support for the loopback address
- Operates the same as local sockets
  - No OSA-Express adapter is needed or used
- Makes it easier to port code where client and server application reside on the same host
- Makes set up easier for loosely coupled systems that have the client and server application on each host
  - Define the application name with 127.0.0.1 as its IP address in the etc/hosts file used by DNS client

Loopback Example



etc/hosts file

```
my_server.com    127.0.0.1
```

Loopback Considerations

- IP address 127.0.0.1 is automatically defined by z/TPF as a local IP address
- A socket bound to 127.0.0.1 cannot be used to communicate with external applications
  - Packets with 127.0.0.1 in the IP header never flow outside the local host (never flow on a real network)
- 127.0.0.1 cannot be set as the default local IP address
- If application does not bind to a local IP address and then issues connect to 127.0.0.1, the socket gets bound to 127.0.0.1 as well
  - Socket is not bound to the default local IP address in this case

The Art of Negotiation

TCP Packet Size Negotiation

- When TCP socket is started, the client and server nodes agree upon the largest size packet that can flow across this socket
  - Maximum segment size (MSS) option in the TCP header in the TCP handshake flows
  - MSS is the maximum amount of user data in a packet and does not include the sizes of IP and TCP headers
- Client node sends its MSS value in the TCP SYN packet that starts a TCP socket
- Server node responds with an MSS value in the SYN/ACK packet
  - This value may be the negotiated value (smaller of what the client and server support) or the largest MSS that the server supports
- Both the client and server nodes use the smaller of the MSS value it advertised and MSS value received from the partner node

Old TCP Clients

- Sending an MSS option in a SYN message is optional for clients
  - Modern clients do include the MSS option
- If the client does not provide an MSS option, the MSS value provided by the server in the SYN/ACK message is used for this socket

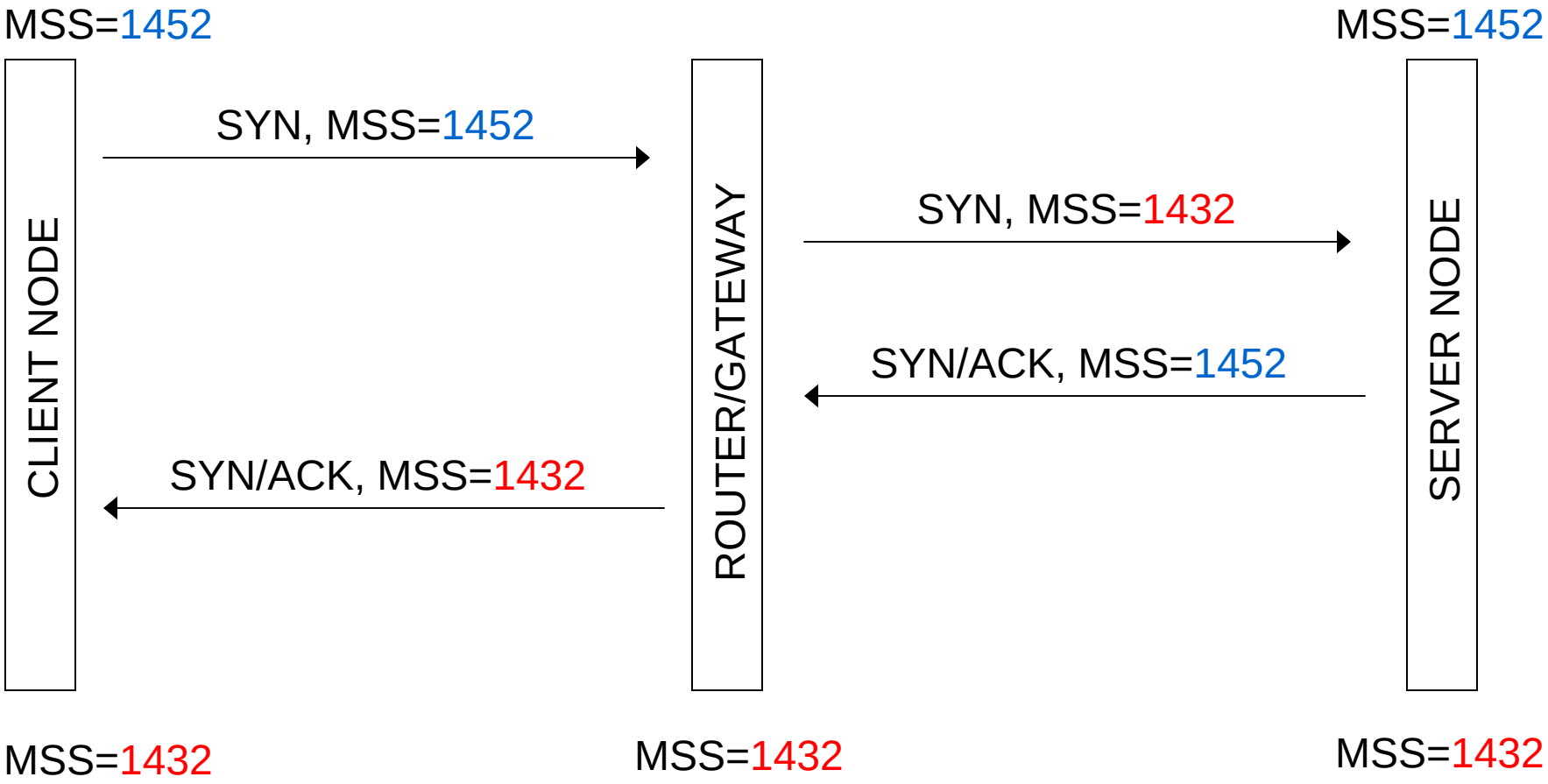
Routers and MSS

- Some router/gateway products modify (reduce) the MSS values in SYN and SYN/ACK packets
  - For example, if the router/gateway plans on adding information to the headers flowing on packets over this session
- This is OK when the client provides an MSS value in the SYN message
- Some router/gateway product enforce MSS rules
  - Discard packets larger than the agreed upon MSS value during the TCP handshake

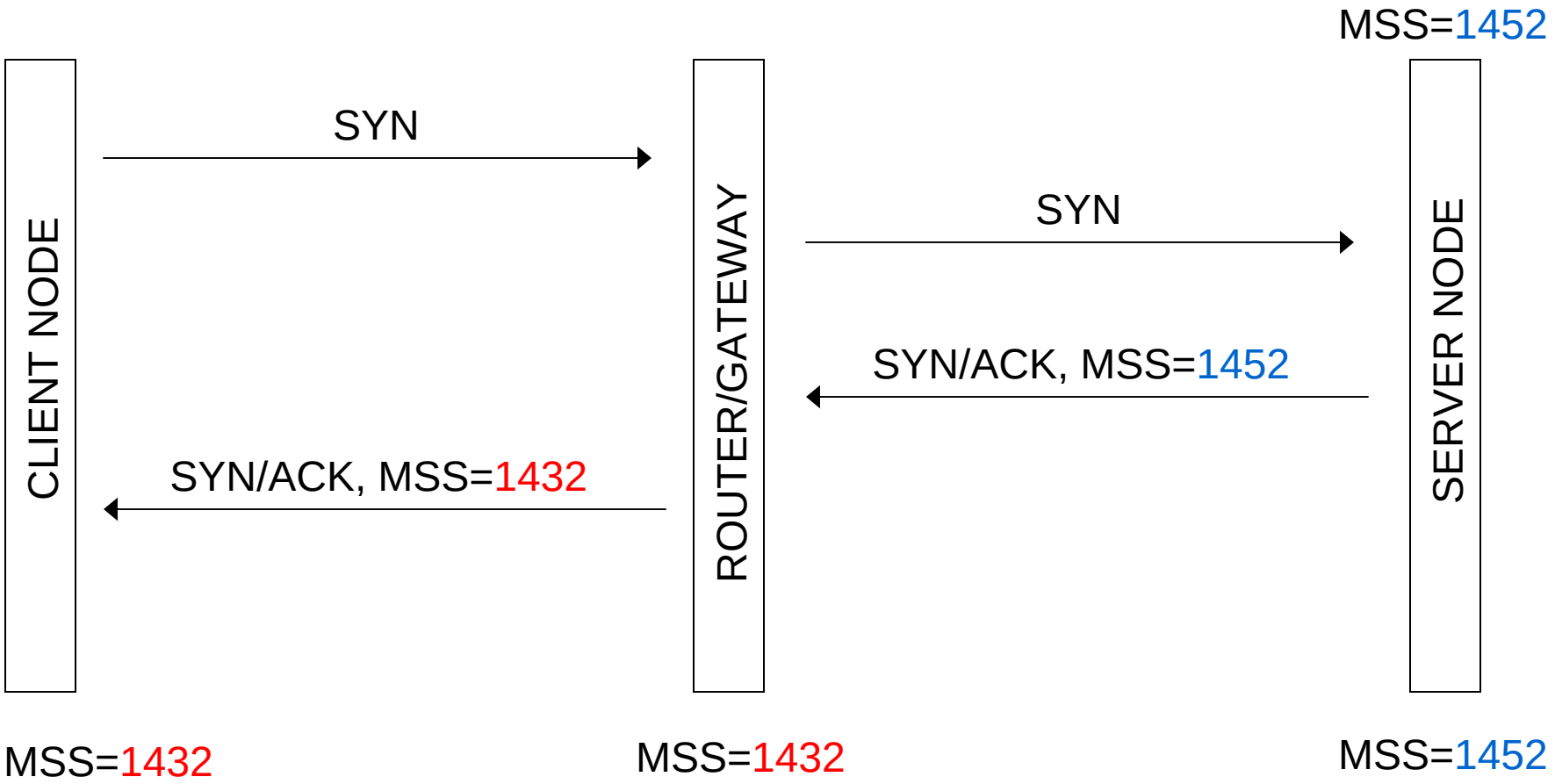
In the Following Example…

- Client and server are connected via networks that support up to 1492-byte packets
  - Maximum transmission unit (MTU) size is 1492
- Standard IP header size is 20 bytes
- Standard TCP header size is 20 bytes
- MSS value advertised by the client and server is:
  - MSS = MTU – IP header size – TCP header size
  - MSS = 1492 – 20 – 20 = 1452 bytes
- Router wants to add 20 bytes to the IP/TCP headers of each data packet; therefore, the largest MSS value the router can allow is:
  - Largest MSS = 1492 – 20 – 20 – 20 = 1432 bytes
  - MSS values above 1432 are reduced to 1432 by the router

Modern TCP Client, Semi-Intelligent Gateway → OK



Old TCP Client, Semi-Intelligent Gateway → Problem



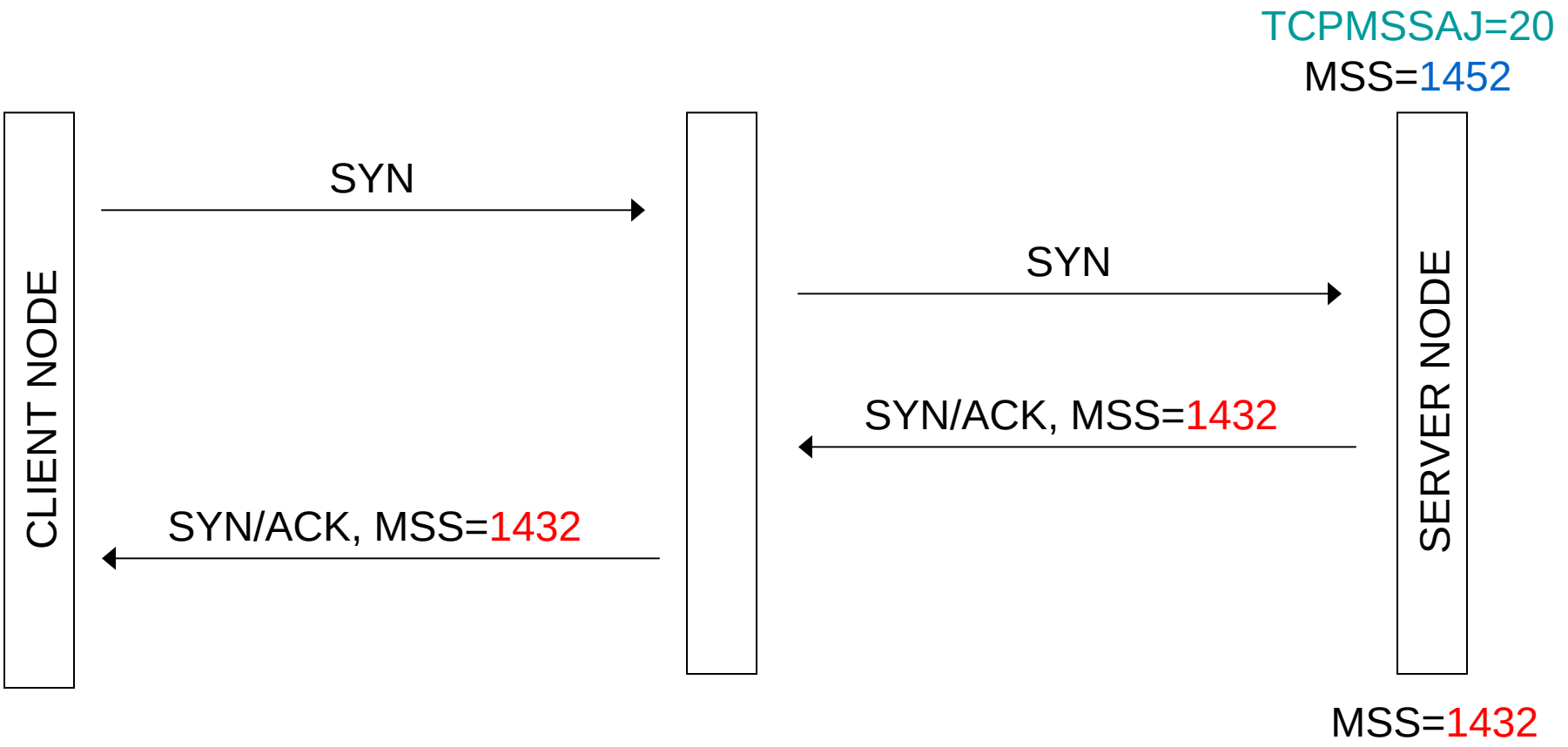
The Problem

- In the previous example, if the server sends a packet with more than 1432 bytes of user data, the router/gateway might discard the packet
  - This will eventually cause the socket to fail
- Reducing MSS value has become the default setting for some router/gateway products
  - This has resulted in problems with connections to old TCP clients
- Fixing the source of the problem is not easy
  - Changing the setting to not adjust MSS values is not always possible if the router is outside your network

The Solution

- APAR PJ31970 adds a new TCPMSSAJ parameter in CTK2
- Only used if remote client does not provide an MSS value in the SYN message that it sends to z/TPF
- The MSS value that z/TPF would normally send in the SYN/ACK message is reduced by the value of TCPMSSAJ

Old TCP Client, Semi-Intelligent Gateway, More Intelligent Server

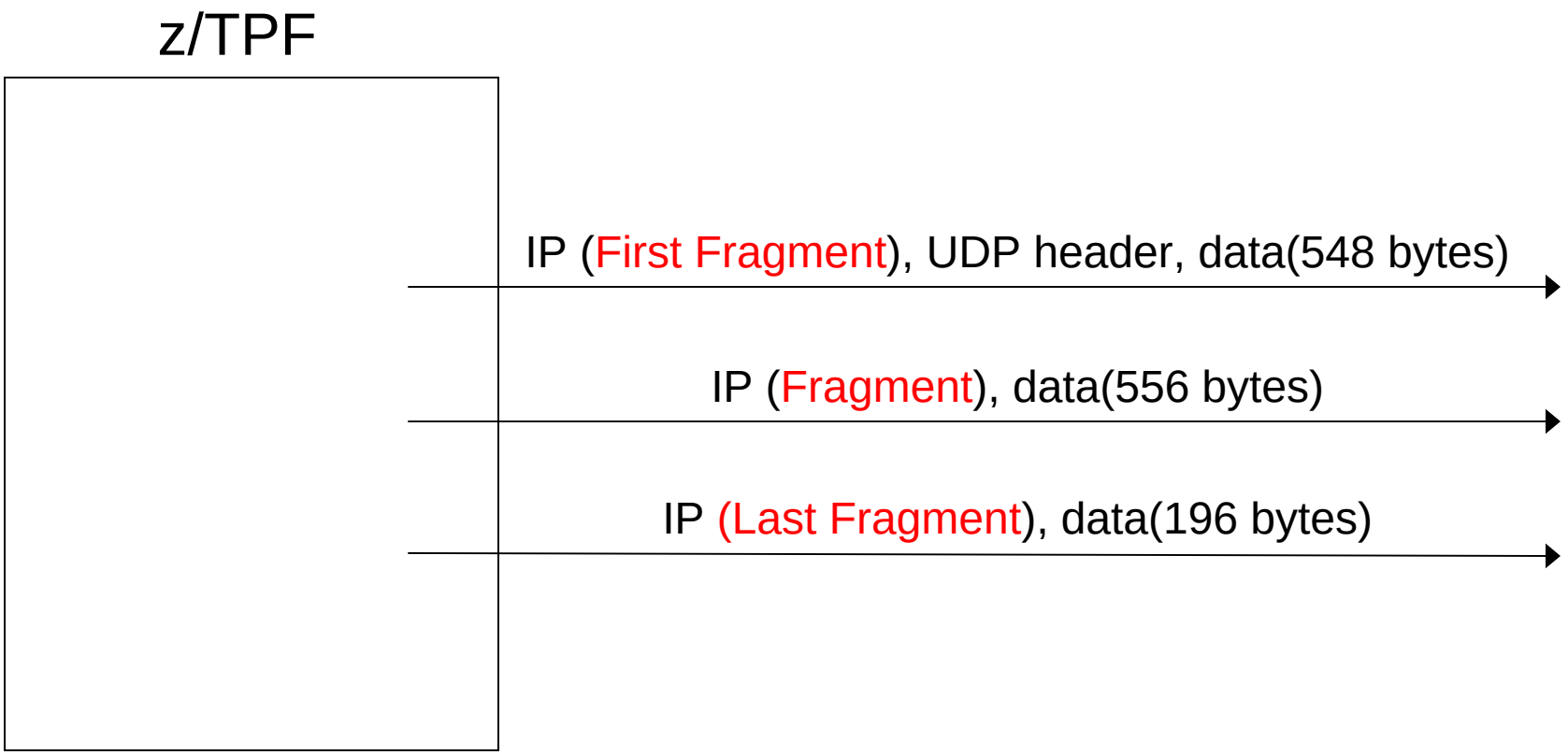


All For One and One For All

Existing UDP Packet Size Support

- TCP sockets agree upon the largest packet size (via MSS option of TCP handshake)
- There is no handshake or packet size negotiation with UDP sockets
- All IP devices (clients, servers, routers) must support packets of at least 576 bytes
- If a z/TPF application issues a send type API that would result in more than 576 bytes of data (including IP and UDP headers):
  - Data is sent as multiple packets (IP fragments)
  - Fragmentation is done by the source node (z/TPF) to avoid having to do fragmentation by routers in the network
  - Destination node must reassemble the fragments into the original message before delivering it to the application

Sending UDP Data with Existing Support



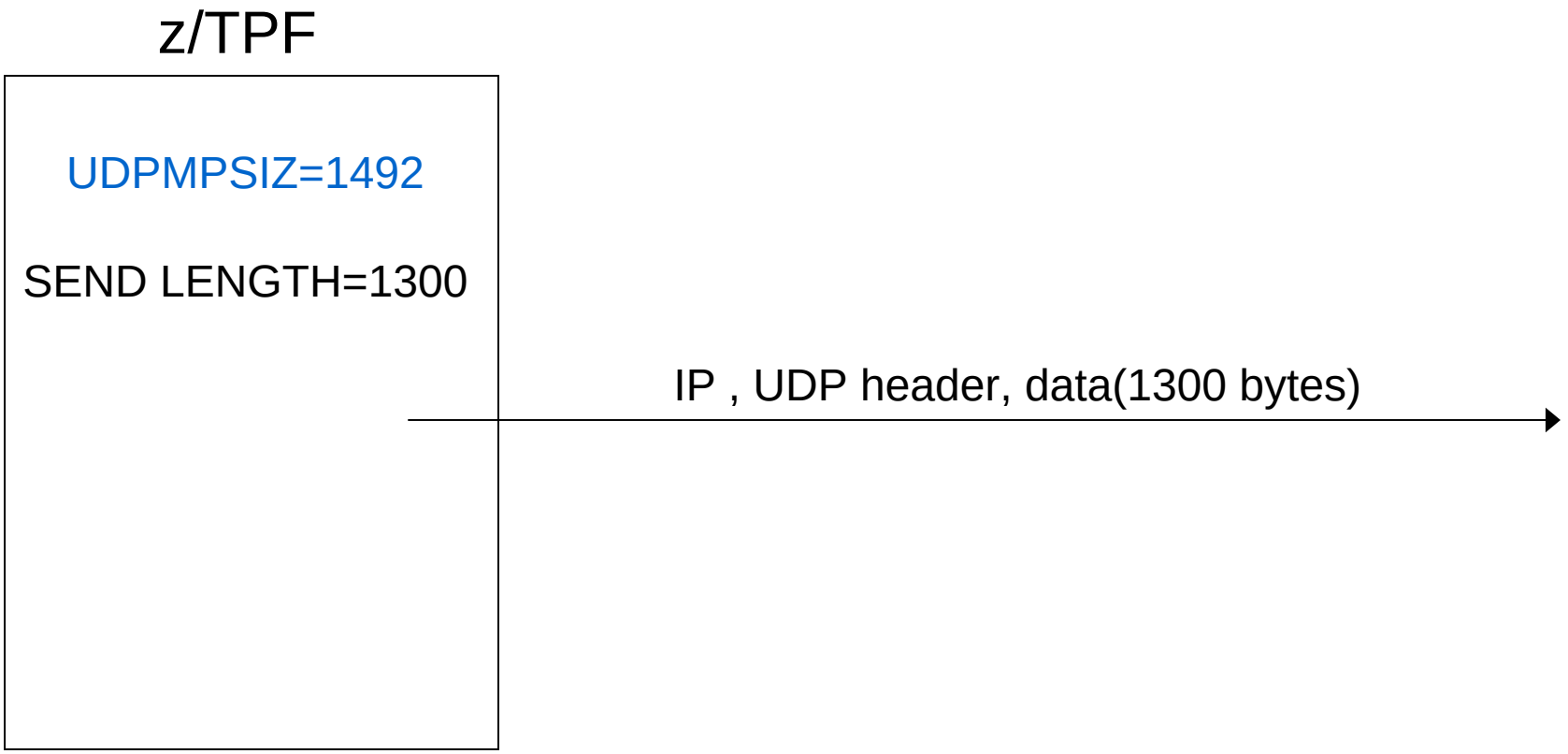
User Definable UDP Maximum Packet Size

- APAR PJ31970 allows you to customize the maximum UDP packet size sent by z/TPF
- New UDPMPSIZ parameter in CTK2
  - Default maximum packet size to use for UDP sockets
- New SO_UDPMPSIZ *setsockopt* option
  - Allows you to set the maximum packet size for a given UDP socket
- The actual maximum packet size used by a UDP socket is the smaller of the value defined for that socket (via SO_UDPMPSIZ value or UDPMPSIZ) and the MTU size of the OSA-Express connection

UDP Maximum Packet Size Considerations

- UDPMPSIZ defaults to 576
  - No change in behavior to existing support
- You should increase the maximum packet size value for UDP sockets where z/TPF sends large data and the networks between z/TPF and the remote node support larger packets
  - This reduces the number of packets that flow
  - Can eliminate fragmentation overhead (if all the data fits into one packet) or reduce fragmentation overhead
- Example where UDP application sends 20K of data
  - If UDPMPSIZ is 576, then 36 packets flow
  - If UDPMPSIZ is 1492, then 14 packets flow

Sending UDP Data with New Support



First 64-bit, Now 64K!

More UDP Message Size Information

- Data of each send type API for a UDP socket represents one message
  - Send type APIs include *send*, *sendto*, *write*
- If the message will not fit in one packet, multiple packets are sent using IP fragmentation
  - Remote end of the socket reassembles the fragments and delivers the entire message to the application when it issues a read type API
- IP fragmentation supports up to 64K of data
  - Therefore, maximum UDP message size is 64K

UDP Message Size Support Old and New

- Existing z/TPF support for UDP sockets
  - Send type APIs allow you to send up to 32K of data
  - Read type APIs allow you to receive up to 32K of data
  - Therefore, maximum UDP message size that can be sent or received is 32K
- New Support for UDP sockets (APAR PJ31970)
  - Can now send up to 64K of data on a send type API
  - Can now receive up to 64K of data on a read type API
  - Therefore, you can now exchange the largest UDP messages (64K) allowed by architecture

Considerations for Sending Very Large UDP Messages

- A send type API on a UDP socket is atomic
  - There must be enough room in the send buffer of the socket to hold all of the data passed on the API
- The socket send buffer size default is 32K
- If you have UDP applications that want to send messages larger than 32K
  - The application must increase the send buffer size of those UDP sockets using the SO_SNDBUF *setsockopt* option
- You should also increase the maximum UDP packet size (UDPMPSIZ) if possible

Considerations for Receiving Very Large UDP Messages

- When a fragmented UDP message is received from the network, it is reassembled in the socket receive buffer
  - If there is not enough room in the receive buffer, the message is truncated
- Socket receive buffer size default is 32K
- If you have UDP applications that want to receive messages larger than 32K
  - The application must increase the receive buffer size of those UDP sockets using the SO_RCVBUF *setsockopt* option

Closing Time

New Socket Closed User Exit (APAR PJ32046)

- Called whenever a socket is cleaned up
- Allows you to clean up user tables that contain the file descriptor (FD) of the socket that no longer exists
- Allows you to notify an operator or alert an automation platform to take action regarding a failed socket, application, or network component

Socket Closed User Exit Details (Segment UCLO)

- Inputs to the user exit include:
  - FD of the socket
  - Local IP address and port
  - Remote IP address and port
  - Protocol (TCP, UDP)
  - Reason why the socket is being cleaned up, such as:
    - The application issued a *close* API
    - z/TPF operator command ended the socket
    - The socket sweeper cleaned up the socket because it had not been used for a long period of time
    - z/TPF received a TCP reset (RST) for this socket

Summary

- Ability to reject SNA APPN session (PJ31939)
- Loopback IP address support (PJ32035)
- Ability to adjust TCP MSS values (PJ31970)
- Ability to set maximum UDP packet size at both system and socket level (PJ31970)
- Ability to send and receive UDP messages up to 64K in size (PJ31970)
- Socket closed user exit (PJ32046)
- All of these enhancements were requirements submitted by multiple customers

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