Multilink PPP Addendum

to the *Remote Annex Administrator's Guide for UNIX*

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This addendum is designed as a supplementary document to be used in conjunction with the *Remote Annex Administrator's Guide for UNIX*, the *Remote Annex 6300 Supplement to the Remote Annex Administrator's Guide for UNIX*, and the *Annex Manager User Guide.*

This addendum covers the following topics:

- Overview
- Supported and Unsupported MP Features
- MP Function and Process Information
- MP Configuration
- The **acp_userinfo** File
- Administration of Multilink PPP
- SNMP Proprietary MIB Objects
- MP Parameters for Annex
- PPP Parameters

Overview

Multilink PPP (MP) is a protocol standard that provides a method to adjust the bandwidth of a connection between two network devices to accommodate dynamically changing network loads. This implementation of MP is based on the RFC1990 technical specification.

Member Links and Bundle Links

To support this protocol, the RA 6300 PPP protocol stack has been extended to allow one or more PPP links to form a single virtual PPP interface for the network layer protocols, such as IP, IPX and AppleTalk over PPP. In this document, the virtual PPP interface is referred to as the bundle and the PPP links are referred to as member links.

When a member link is established, several options are negotiated between the two endpoints of the connection to allow each to assign the new link to a bundle. Refer to Figure 1 for a representation of the functional flow.

Supported MP Features

The following MP features are supported for this software release:

- Short and Long Sequence Header
- Fragmentation
- Local Endpoint Discriminators:
  - NULL
  - IP
  - MAC (alias is DEFAULT)
  - PSNDN
- All Remote Endpoint Discriminators
- Maximum Reconstructed Receive Unit

Unsupported MP Features

The following MP features are not supported for this software release:

- Local Endpoint Discriminators:
  - Locally Assigned Address
  - Magic Number Blocks

MP Functional Diagram

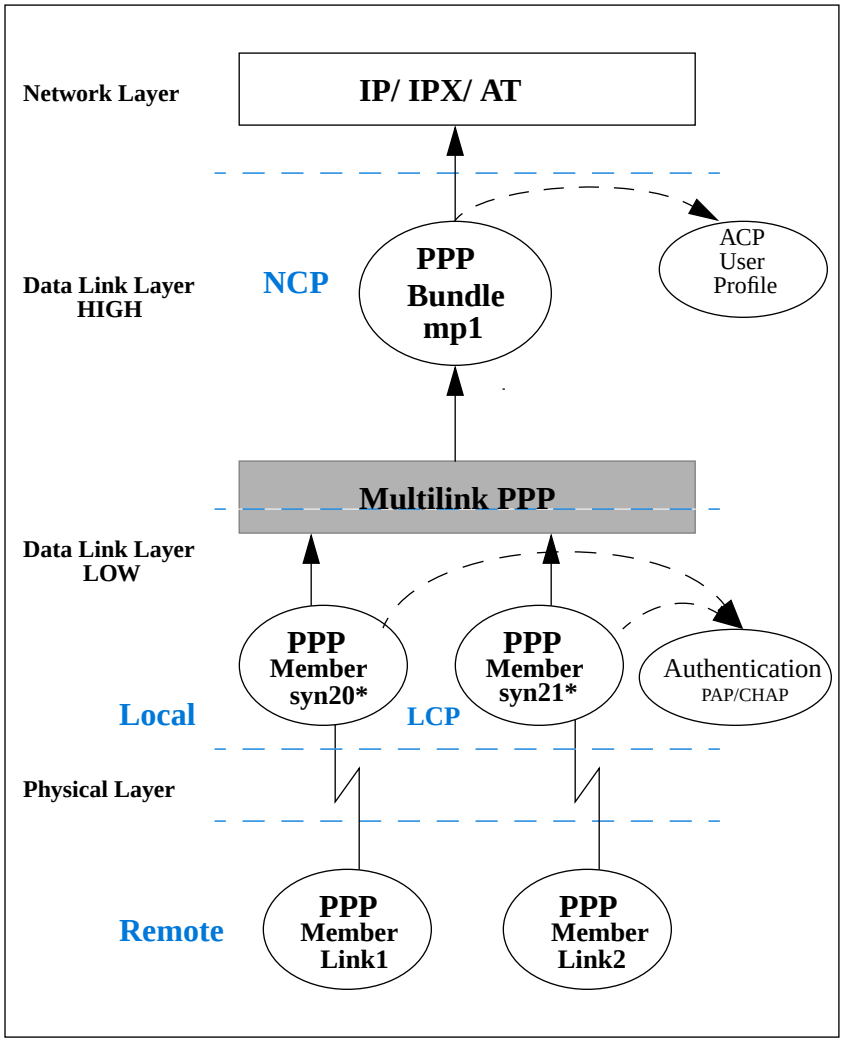

Figure 1. MP Functional Flow

The number of member links can be adjusted to increase bandwidth in response to network traffic over the bundle. Active bandwidth control protocols, such as BACP/BAP, are not supported in this release. However, the RA 6300, using the security services of RACP, can restrict the maximum number of member links permitted to join a bundle, if this control is required by the network administrator. For more information, see *mp_max_links* on page 11.

The MP Process

The following table outlines the processing of a typical MP connection:

When...	Then...	For More Information See...
a remote user opens PPP link1,	link control protocol (LCP) establishes and negotiates the data link options for PPP link1.	*Remote Annex Administrator's Guide for UNIX*
the LCP negotiation is successful,	PPP link1 requests (optional) authentication by CHAP or PAP security protocols.	*Remote Annex Administrator's Guide for UNIX*
the PPP link1 is authenticated (optional) by CHAP or PAP security protocols,	the member link attempts to join a bundle.	*Remote Annex Administrator's Guide for UNIX*

When...	Then...	For More Information See...
the member link's MP LCP options and authentication information match an existing bundle,	the bundle checks that the maximum number of member links will not be exceeded and adds the member link to the bundle.	RFC1990 / **mp_max_links**
the member link's MP LCP options and authentication information do not match an existing bundle,	the bundle checks that the maximum number of member links has not been reached and establishes a new bundle.	RFC1990 / **mp_max_links**
a bundle determines that a network layer protocol needs to be transported,	the network control protocol (IPCP, IPXCP, ATCP) establishes and negotiates the network protocol options and attaches the bundle to a proper network route.	*Remote Annex Administrator's Guide for UNIX*

Bundling Scenarios

The following four scenarios are used as guidelines for bundling member links.

If there is...	Then...
no authentication and no discriminator,	all new links must be joined to one bundle.
a discriminator but no authentication,	if the discriminator matches, the new member link must join a matching bundle.
	if the discriminator does not match, a new bundle must be established.
no discriminator but authentication is successful,	the authenticated match must join a matching bundle.
	the authenticated mismatch must establish a new bundle.
a discriminator and authentication is successful,	if the discriminator and authentication match, the new member link must join a matching bundle.
	if the discriminator and / or authentication is mismatched, a new bundle must be established.

Closing Member Links

Terminate-Request Terminate-Ack

Member links may be terminated according to normal PPP LCP procedures using LCP Terminate-Request and Terminate-Ack packets on the member link. Receipt of a Terminate-Ack is a sufficient indicator that any MP packets ahead of it are at no special risk of loss.

Security Considerations

It is important to understand that LCP and authentication negotiations do not occur on the bundle itself. These phases occur on the member links. Refer to Figure 1.

MP Configuration

All PPP port parameters still apply to MP bundled links. See the *Remote Annex Administrator's Guide for UNIX* for more information.

The MP configuration information is as follows:

Option	Description	MP Parameter
ppp_ncp	This option makes MP active. In order for NCP to recognize MP as a valid protocol, you must set **ppp_ncp** to **all** or to include mp. If you do not set this option, NCP will ignore all MP bundling implementation.	**mp**
Short Sequence Number Header Format (**SSNHF**), LCP option 18	This option advises the peer that the implementation expects to receive fragments with short, 12-bit sequence numbers. By default, sequence numbers are 24-bits long.	The RA 6300 will always request this option.

(continued on next page)

Option	Description	MP Parameter
Multilink Maximum Reconstructed Receive Unit (**MRRU**), LCP option 17	This option initiates MP. The RA 6300 will support an MRRU of 1500 octets or less for the local value (will accept any reasonable value for the remote MRRU). This option also advises the peer that the implementation will be able to reconstruct a PPP packet whose information will contain the number of bytes as Max-Receive-Reconstructed-Units (**MRRU**).	**mp_mrru**
Endpoint Discriminator, LCP option 19	This option presents identification of the system transmitting the packet. It advises a system that the peer on this link could be the same as the peer on another existing link. If this option distinguishes a peer from all others, a new bundle is created. The RA 6300 will accept all remote class requests, but only supports NULL, MAC, IP, and PSNDN locally.	**mp_endpoint_class, mp_endpoint_address**

MP Operational Characteristics

MP Load Balancing

The bundle distributes fragmented packets over all active member links.

MP Fragmentation Bypass

Packets smaller than a fixed size are not fragmented in order to reduce processing load caused by reassembly at the remote endpoint.

MP Parameters

ppp_ncp

Allows you to set the mode for NCP negotiations for MP. You must set this parameter to **all** or include **mp** in order to negotiate MP over NCP.

mp_mrru

Sets the upper limit of the MRRU LCP negotiation. All LCP negotiations will start with this value. Downward negotiation is allowed.

- Default = 1500
- Minimum value = 64
- Maximum value = 1500

mp_endpoint_ class

Sets the value of the local Endpoint Discriminator Class to one of the following allowed classes. (The remote endpoint is allowed to use all classes specified in RFC 1990.)

- Default = MAC (class 3)
- Accepted values:

  NULL, IP, MAC, PSNDN, DEFAULT (alias for MAC)

Selecting...	Causes the RA 6300...
NULL	to use the NULL Endpoint Discriminator.
IP	to use the ethernet interface IP address of the RA 6300 for the Endpoint Discriminator Address.
MAC	to use the MAC address of the ethernet interface of the RA 6300 for the Endpoint Discriminator Address.
PSNDN	to use the value stored in the **mp_endpoint_address** parameter for the Endpoint Discriminator Address.
DEFAULT	to use the default Endpoint Discriminator Class (MAC).

mp_endpoint_ address

Sets the value of the Endpoint Discriminator Address for Endpoint Discriminator Classes that allow user-configured information. This parameter is only accessed when set to PSNDN (Public Switched Network Directory Number).

- Default = not set or empty string
- Minimum length = 0 characters
- Maximum length = 15 characters

mp_endpoint Class and Address Example

PSNDN - Public Switched Network Directory Number

A telephone number, up to 15 numeric characters long.

Example: 16172728140

The acp_userinfo File

The identity of the bundle is not fully qualified until the LCP Endpoint-Discriminator and the (optional) authentication processing has been done. After this process is complete, the bundle policy can be determined and enforced.

mp_max_links

Controls the total number of simultaneously active PPP links that can be joined in the identified bundle. If this number is exceeded, by allowing the link to become fully established, the RA 6300 will abort the PPP link attempting to join the bundle.

- Default value = 1
- Minimum value = 1
- Maximum value = 255 (RA 6300 only supports 30 channels)

mp_max_links Example

```
user username=myname;group=developers
     climask telnet end
     mp_max_links 3
end
```

Administration of MultiLink PPP

Several extensions are added to allow management of MP from the network and from the administrative utilities (host-based **na** and RA 6300-based **admin**). Additional status information is also available through the CLI **netstat** command and SNMP proprietary MIB objects.

netstat -i

This command lists bundles as devices named "**mp<n>**" where <**n**> is a number assigned when the bundle is created. Member links appear but do not have associated addresses, since they are represented by the bundle as a single interface to the network layer. A bundle has an address after it completes the NCP negotiations selected for that connection.

When B-channel assigned addresses are used by MP, only the address of the first channel called is used. All future calls use the same IP, IPX, and IPX-net as the first call.

netstat -i Example

The following example displays a bundle with two links:

```
annex# net -i
```

Name	Mtu	Network	Address	Ipkts	Ierrs	Opkts	Oerrs	Collis
en0	1500	132.245.66	132.245.66	85422	0	30832	1	0
en0	1500	32004-32005	32005.243	85422	0	30832	1	0
pri0*	1500	none	none	0	0	0	0	0
lo0	1536	127	127	0	0	0	0	0
syn20*	1500	none	none	73	0	105	0	0
mp1	1524	132.245.252	132.245.252	129	0	123	0	0
syn21*	1500	none	none	65	0	100	0	0
en0	576	80230066	00802d02cea1					

You may notice that there is an * after the two member links, **syn20*** and **syn21***. You can use this as a visual cue of the **netstat -i** command. It is an indicator that the interface is not completely configured or that it might be a member link. Use the **netstat -ip** command on a member link, **syn20*** or **syn21***, to identify the bundle to which it belongs.

For more information on the interface status information, refer to your *Remote Annex Administrator's Guide for UNIX*.

netstat -ip

This command has been extended to provide MP information, including negotiated MP LCP options. If the command is issued for a member link, the MP status block identifies the bundle device name to which the link has been attached.

netstat -ip Bundle Example

```
annex# net -ip mp1
                    *** LCP Status ***
State               Current:  Open          Prior:    Open
Options             Local:                  Remote:
MRU                 1500                    1524
MRRU                1500                    1524
Short Sequence      Off                     Off
Endpoint Disc       3:00-80-2d-02-ce-a1     3:00-c0-7b-41-6e-2b
                    *** NCP (IPCP) Status ***
State               Current:  Open          Prior: Ack received
Options             Local:                  Remote:
IP addresses        132.245.66.37  [ANX]    132.245.252.22 [REM]
Compression         VJ TCP/IP     15/1      VJ TCP/IP     15/1

                    *** NCP (CCP) Status ***
State               Current:  Request sent  Prior:    Request sent

                    *** NCP (MP) Status ***
State               Current:  Open          Prior:    Closed
```

NCP states not negotiated are not displayed.

netstat -ip Member Link Example

```
annex# net -ip syn1
                    *** LCP Status ***
State               Current:  Open          Prior:    Open
Options             Local:                  Remote:
MRU                 1500                    1524
Auth type           None                    None
LQM                 None                    None
Magic               0x8d4ba408              None
MRRU                1500                    1524
Short Sequence      Off                     Off
Endpoint Disc       3:00-80-2d-02-ce-a1     3:00-c0-7b-41-6e-2b
                    *** NCP (CCP) Status ***
State               Current:  Open          Prior:    Closed
                    Attached to bundle mp1
```

The following list details the new MP Options available in this release. For more information on the remaining standard options, see the *Remote Annex Network Administrator's Guide for UNIX*.

netstat -b

A new option, **-b**, displays MP bundle information for currently active bundles.

The syntax for **netstat -b** is:

netstat -b [bundle]

If the bundle ID is not specified, then all active bundle information is displayed. If the bundle ID is specified (e.g. **netstat -b mp1**) then the specified bundle information is displayed.

netstat -b Example

The following example displays a bundle with two links. The member link PPP statistics details are repeated for each link in the bundle:

```
annex# netstat -b
[Bundle: mp1]
     MP packets sent: 133        MP packets accepted: 154
  Packets fragmented: 62         Fragments discarded: 1
 Fragments generated: 195        Fragments assembled: 154
     Peak links used: 0           Current links used: 2
         Frames sent: 133            Frames received: 308
    Frames discarded: 2
              Dropped: 0                      No memory: 0
      Missing mbuf: 0                         Net down:0
               Short: 0                 Unknown codes: 0
[Bundle: mp1][Member link: syn12]
         Frames sent: 300          Frames received: 333
    Frames discarded: 0
      Dropped: 0                              No memory: 0
      Missing mbuf: 0                         Net down:0
               Short: 0                 Unknown codes: 0
[Bundle: mp1][Member link: syn13]
         Frames sent: 300          Frames received: 315
    Frames discarded: 0
              Dropped: 0                      No memory: 0
        Missing mbuf: 0                       Net down:0
               Short: 0                 Unknown codes: 0
```

MP Statistics

The following table describes the MP data displayed when entering a **netstat-b** command:

MP Statistics	Description
MP packets sent:	Packets sent to all NCPs.
MP packets accepted:	Packets received from all NCPs.
Packets fragmented:	Packets that were fragmented.
Fragments discarded:	Fragments lost.
Fragments generated:	Fragments that were generated.
Fragments assembled:	Fragments successfully assembled.
Peak Links used:	Peak links used during the lifetime of the bundle.
Current Links used:	Current links in use.

PPP Statistics

The following table describes the PPP data displayed when entering a **netstat-b** command:

PPP Statistics	Description
Frames sent:	The number of frames successfully sent.
Frames received:	The total number of frames received.
Frames discarded:	The total number of frames that were discarded for one of the following reasons:
Dropped:	Queuing slots were not available.
No memory:	Insufficient memory available for processing packets.
Missing mbuf:	The output routines were called without a packet.
Net down:	The interface wasn't ready.
Short:	Received frame was missing data.
Unknown codes:	Frames received with invalid or unsupported protocol types.

SNMP Proprietary MIB Objects

The following table lists new SNMP MIB variables that are supported in this release. These objects can be found in the file XYLO-PORTS.MIB:

SNMP MIB Variable	Access	Default	Corresponding Annex Variable
anxpAutoPPPSecurity	read-write	Disable 2	**ppp_sec_auto**
anxpAutoTimeout	read-write	30 seconds	**autodetect-timeout**

The following table lists MIB objects. These objects can be found in the file XYLO-ANX.MIB:

SNMP MIB Variable	Access	Default	Corresponding Annex Variable
anxVcliInactivity	read-write	0	**vcli_inactivity**

MP Selectable Parameters for the Remote Annex

The following table lists MP parameters for the Remote Annex. These objects can be found in the file XYLO-PORTS.MIB:

SNMP MIB Variable	Access	Default	Corresponding Annex Parameter
mpMrru	read-write	1500 octets	**mp_mrru**
mpEndPointClass	read-write	unitmacaddr (4)	**mp_endpoint_option**
mpEndPointValue	read-write	N/A	**mp_endpoint_value**