

Configuring the Bandwidth Allocation Control Protocol

This chapter describes how to configure the Bandwidth Allocation Control Protocol (BACP), described in RFC 2125.

The Bandwidth Allocation Control Protocol provides Multilink PPP peers with the ability to govern link utilization. Once peers have successfully negotiated BACP, they can use the Bandwidth Allocation Protocol (BAP), which is a subset of BACP, to negotiate bandwidth allocation. BAP provides a set of rules governing dynamic bandwidth allocation through call control; a defined method for adding and removing links from a multilink bundle for Multilink PPP is used.

The addition of any link to an existing multilink bundle is controlled by a BAP call or callback request message, and the removal of a link can be controlled by a link drop message.

BACP is designed to operate in both the virtual interface environment and the dialer interface environment. It can operate over any physical interface that is PPP multilink capable and has a dial capability; at initial release, BACP supports ISDN and asynchronous serial interfaces.

BACP provides the following benefits:

- Allows multilink implementations to interoperate by providing call control through the use of link types, speeds, and telephone numbers.
- Controls thrashing caused by links being brought up and removed in a short period of time.
- Ensures that both ends of the link are informed when links are added or removed from a multilink bundle.

For simplicity, the remaining text of this chapter makes no distinction between BACP and BAP. Only BACP is mentioned.

For a complete description of the PPP BACP commands in this chapter, refer to the *Dial Solutions Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

Configuration Options

PPP BACP can be configured to operate in the following ways:

- **Passive mode—(Default)** The system accepts incoming calls; the calls might request callback, addition of a link, or removal of a link from a multilink bundle. The system also monitors the multilink load by default.

Passive mode is for virtual template interfaces or for dialer interfaces.

- **Active Mode**—The system initiates outbound calls, sets the parameters for outbound calls, and determines whether links should be added to or removed from a multilink bundle. The system also monitors the multilink load by default.

Active mode is for dialer interfaces, but not for virtual template interfaces. (If you attempt to configure active mode on a virtual template interface, no calls will be made.)

Restrictions

A virtual or dialer interface must be configured either to make call requests or to make callback requests, but cannot be configured to do both.

Support of BACP on virtual interfaces in an MMP environment is restricted to incoming calls on the multilink group. Support of BACP for outgoing calls is provided by dialer interface configuration only.

BACP supports only ISDN and asynchronous serial interfaces.

Dialer support is provided only for legacy DDR dialer configurations; BACP cannot be used in conjunction with the dialer profiles DDR feature.

BACP configured on virtual template interfaces and physical interfaces that are multilink capable. For both the virtual template interfaces and the dialer interfaces, BACP requires multilink PPP and bidirectional dialing to be working between the routers that will negotiate control and allocation of bandwidth for the multilink bundle.

Prerequisites

BACP requires a system only to have the knowledge of its own phone numbers and link types. A system must be able to provide the phone numbers and link type to its peer to satisfy the call control mechanism. (Certain situations might not be able to satisfy this requirement; numbers might not be present because of security considerations.)

Before you configure BACP on an interface, determine the following important information. The router might be unable to connect to a peer if this information is incorrect.

- Type of link (ISDN or analog) to be used. Link types must match on the local and remote ends of the link.
- Line speed needed to reach the remote peer. The speed configured for the local physical interface must be at least that of the link. The **bandwidth** command or the **dialer map** command with the **speed** keyword can be used.
- Local telephone number to be used for incoming PPP BACP calls, if it is different from a rotary group base number or if incoming PPP BACP calls should be directed to a specific number.

During negotiations with a peer, PPP BACP might respond with a telephone number *delta*, indicating that the peer should modify certain digits of the dialed phone number and dial again to reach the PPP BACP interface or to set up another link.

Configure BACP

BACP can be configured on a virtual template interface or on a dialer interface (including dialer rotary groups and ISDN interfaces).

Complete the following steps to configure BACP on a selected interface or interface template:

Step 1 Enable BACP.

Passive mode is in effect and the values of several parameters are set by default when PPP BACP is enabled.

If you can accept *all* the passive mode parameters, do not go to Step 2.

Step 2 Modify BACP Passive Mode Default Settings

or

Configure Active Mode BACP

Note You can configure one interface in passive mode and another in active mode so that one interface accepts incoming call requests and makes callback requests (passive mode), and the other interface makes call requests and accepts callback requests (active mode).

A dialer or virtual template interface should be configured to reflect the required dial capability of the interface. A dial-in pool (in passive mode) might have no requirement to dial out but might want remote users to add multiple links, with the remote user incurring the cost of the call. Similarly, a dial-out configuration (active mode) suggests that the router is a client, rather than a server, on that link. The active-mode user incurs the cost of additional links.

You might need to configure a base telephone number, if it is applicable to your dial-in environment. This is a number that remote users can dial to establish a connection. Otherwise, individual PPP BACP links might need numbers. Information is provided in the task lists for configuring passive mode or active mode PPP BACP. See the **ppp bap number** command options in the task lists.

You can also troubleshoot BACP configuration and operations and monitor interfaces configured for PPP BACP. See the “Troubleshoot BACP” and “Monitor Interfaces Configured for BACP” sections for details.

For examples of PPP BACP configuration, see the “BACP Configuration Examples” section.

Enable BACP

To enable PPP bandwidth allocation control and dynamic allocation of bandwidth, use one of the following commands in interface configuration mode:

| Command | Purpose |
|-----------------------------------|--|
| ppp multilink bap | Enable PPP BACP bandwidth allocation negotiation. |
| or | |
| ppp multilink bap required | Enable PPP BACP bandwidth allocation negotiation and enforce mandatory negotiation of BACP for the multilink bundle. |

When PPP BACP is enabled, it is in passive mode by default and the following settings are in effect:

- Allows a peer to initiate link addition.
- Allows a peer to initiate link removal.
- Requests that a peer initiate link addition.
- Waits 20 seconds before timing out on pending actions.
- Waits 3 seconds before timing out on not receiving a response from a peer.
- Makes only one attempt to call a number.
- Makes up to three retries for sending a request.
- Searches for and logs up to five free dialers.
- Makes three attempts to send a call status indication.
- Adds only ISDN links to a multilink bundle.
- Monitors load.

The default settings will be in effect in the environment for which the **ppp multilink bap** command is entered:

- Virtual template interface, if that is where the command is entered.

When the command is entered in a virtual template interface, configuration applies to any virtual access interface that is created dynamically under Multilink PPP, the application that defines the template.

- Dialer interface, if that is where the command is entered.

Modify BACP Passive Mode Default Settings

To modify the default parameter values or to configure additional parameters in passive mode, use the following commands, as needed, in interface configuration mode for the interface or virtual template interface that is configured for PPP BACP:

| Command | Purpose |
|---|---|
| ppp bap timeout pending <i>seconds</i> | Modify the timeout on pending actions. |
| ppp bap timeout response <i>seconds</i> | Modify the timeout on not receiving a response from a peer. |
| ppp bap max dial-attempts <i>number</i> | Modify the number of attempts to call a number. |
| ppp bap max ind-retries <i>number</i> | Modify the number of times to send a call status indication. |
| ppp bap max req-retries <i>number</i> | Modify the number of retries of a particular request. |
| ppp bap max dialers <i>number</i> | Modify the maximum number of free dialers logged. |
| ppp bap link types analog or | Specify that only analog links can be added to a multilink bundle |
| ppp bap link types isdn analog | Allow both ISDN and analog links to be added. |
| ppp bap number default <i>phone-number</i> | For all DDR-capable interfaces in the group, specify a primary telephone number for the peer to call for PPP BACP negotiation, if different from any base number defined on the dialer interface or virtual template interface. |

| Command | Purpose |
|---|--|
| ppp bap number secondary <i>phone-number</i> | For BRI interfaces on which a different number is provided for each B channel, specify the secondary telephone number. |
| ppp bap drop timer <i>seconds</i> | Specify a time to wait between outgoing link drop requests. |
| no ppp bap monitor load | Disable the default monitoring of load and the validation of peer requests against load thresholds. |

Configure Active Mode BACP

To configure active mode BACP, complete the following tasks in interface configuration mode for the dialer interface on which BACP was enabled. For your convenience, the tasks that make BACP function in active mode are presented before the tasks that change default parameters or add parameters.

| Command | Purpose |
|---|---|
| Enable Active Mode | |
| ppp bap call request | Enable the interface to initiate the addition of links to the multilink bundle. |
| ppp bap callback accept | Enable the interface to initiate the addition of links upon peer request. |
| ppp bap drop after-retries | Enable the interface to drop a link without negotiation after receiving no response to retries to send a drop request. |
| ppp bap call timer <i>seconds</i> | Set the time to wait between outgoing call requests. |
| Modify Default Settings | |
| ppp bap timeout pending <i>seconds</i> | Modify the timeout on pending actions. |
| ppp bap timeout response <i>seconds</i> | Modify the timeout on not receiving a response from a peer. |
| ppp bap max dial-attempts <i>number</i> | Modify the number of attempts to call a number. |
| ppp bap max ind-retries <i>number</i> | Modify the number of times to send a call status indication. |
| ppp bap max req-retries <i>number</i> | Modify the number of retries of a particular request. |
| ppp bap max dialers <i>number</i> | Modify the maximum number of free dialers logged. |
| ppp bap link types analog | Specify that only analog links can be added to a multilink bundle or |
| ppp bap link types isdn analog | Allow both ISDN and analog links to be added. |
| ppp bap number default <i>phone-number</i> | For all DDR-capable interfaces in the group, specify a primary telephone number for the peer to call for PPP BACP negotiation, if different from any base number defined on the dialer interface or virtual template interface. |
| ppp bap number secondary <i>phone-number</i> | For BRI interfaces on which a different number is provided for each B channel, specify the secondary telephone number. |

When BACP is enabled, multiple dialer maps to one destination are not needed when they differ only by number. That is, once the initial call has been made to create the bundle, further dialing attempts are realized through the BACP phone number negotiation.

Outgoing calls are supported through the use of dialer maps. However, when an initial incoming call creates a dynamic dialer map, the router can dial out if the peer supplies a phone number. This is achieved by the dynamic creation of static dialer maps for BACP. These temporary dialer maps can be displayed by the **show dialer map** command. These temporary dialer maps last only as long as the BACP group lasts and are removed when the BACP group or the associated map is removed.

Monitor Interfaces Configured for BACP

To monitor interfaces configured for PPP BACP, use the following commands in EXEC mode:

| Command | Purpose |
|---|--|
| show ppp bap group <i>[name]</i> | Display information about all PPP BACP multilink bundle groups or a specific, named multilink bundle group. |
| show ppp bap queues | Display information about the BACP queues. |
| show ppp multilink | Display information about the dialer interface, the multilink bundle, and the group members. |
| show dialer | Display BACP numbers dialed and the reasons for the calls. |
| show dialer map | Display configured dynamic and static dialer maps and dynamically created BACP temporary static dialer maps. |

Troubleshoot BACP

To troubleshoot the BACP configuration and operation, use the following debug commands:

| Command | Purpose |
|---|--|
| debug ppp bap <i>[error event negotiation]</i> | Display BACP errors, protocol actions, and negotiation events and transitions. |
| debug ppp multilink events | Display information about events affecting multilink bundles established for BACP. |

BACP Configuration Examples

This section provides the following BACP configuration examples:

- Basic Examples
- Dialer Rotary Group with Different Dial-In Numbers Example
- Passive Mode Dialer Rotary Group Members with One Dial-In Number Example
- PRI Interface with No Defined PPP BACP Number Example
- BRI Interface with No Defined BACP Number Example

Basic Examples

The following example configures an ISDN BRI interface for BACP to make outgoing calls and prevent the peer from negotiating link drops:

```
interface bri 0
  ip unnumbered ethernet 0
  dialer load-threshold 10 either
  dialer map ip 172.21.13.101 name bap-peer 12345668899
  encapsulation ppp
  ppp multilink bap
  ppp bap call request
  ppp bap callback accept
  no ppp bap call accept
  no ppp bap drop accept
  ppp bap pending timeout 30
  ppp bap number default 5664567
  ppp bap number secondary 5664568
```

In the following example, a dialer rotary group is configured to accept incoming calls:

```
interface async 1
  no ip address
  encapsulation ppp
  dialer rotary-group 1
  ppp bap number default 5663456
!
! Set the bandwidth to suit the modem/line speed on the remote side.
interface bri 0
  no ip address
  bandwidth 38400
  encapsulation ppp
  dialer rotary-group 1
  ppp bap number default 5663457
!
interface bri 1
  no ip address
  encapsulation ppp
  dialer rotary-group 1
  ppp bap number default 5663458
!
interface dialer1
  ip unnumbered ethernet 0
  encapsulation ppp
  ppp multilink bap
  ppp bap call accept
  ppp bap link types isdn analog
  dialer load threshold 30
  ppp bap timeout pending 60
```

The following example configures a virtual template interface to use BACP in passive mode:

```
multilink virtual-template 1
!
interface virtual-template 1
  ip unnumbered ethernet 0
  encapsulation ppp
  ppp multilink bap
  ppp authentication chap callin
```

The bundle is created from any Multilink-capable interface. In the following example, the bundle is created on a BRI interface:

```
interface bri 0
  no ip address
  encapsulation ppp
  ppp multilink
  ppp bap number default 4000
  ppp bap number secondary 4001
```

Dialer Rotary Group with Different Dial-In Numbers Example

In this example, a dialer rotary group that has four members, each with a different number, accepts incoming dial attempts. The dialer interface does not have a base phone number; the interface which is used to establish the first link in the multilink bundle will provide the appropriate number from its configuration.

```
interface bri 0
  no ip address
  encapsulation ppp
  isdn spid1 01234567890
  dialer rotary-group 1
  no fair-queue
  no cdp enable
  ppp bap number default 6666666
!
interface bri 1
  no ip address
  encapsulation ppp
  isdn spid1 01234567891
  dialer rotary-group 1
  no fair-queue
  no cdp enable
  ppp bap number default 6666667
!
interface bri 2
  no ip address
  encapsulation ppp
  isdn spid1 01234567892
  dialer rotary-group 1
  no fair-queue
  no cdp enable
  ppp bap number default 6666668
!
interface bri 3
  no ip address
  encapsulation ppp
  isdn spid1 01234567893
  dialer rotary-group 1
  no fair-queue
  no cdp enable
  ppp bap number default 6666669
!
interface dialer 1
  ip unnumbered Ethernet0
  encapsulation ppp
  dialer in-band
  dialer idle-timeout 300
  dialer-group 1
  no fair-queue
  no cdp enable
  ppp authentication chap
  ppp multilink bap
```

```
ppp bap call accept
ppp bap callback request
ppp bap timeout pending 20
ppp bap timeout response 2
ppp bap max dial-attempts 2
ppp bap monitor load
```

Passive Mode Dialer Rotary Group Members with One Dial-In Number Example

In this example, a dialer rotary group with two members, each with the same number, accepts incoming dial attempts. The dialer interface has a base phone number because each of its member interfaces is in a hunt group and the same number can be used to access each individual interface.

```
interface bri 0
  no ip address
  encapsulation ppp
  isdn spid1 01234567890
  dialer rotary-group 1
  no fair-queue
  no cdp enable
!
interface bri 1
  no ip address
  encapsulation ppp
  isdn spid1 01234567890
  dialer rotary-group 1
  no fair-queue
  no cdp enable
!
interface dialer 1
  ip unnumbered Ethernet0
  encapsulation ppp
  dialer in-band
  dialer idle-timeout 300
  dialer-group 1
  no fair-queue
  no cdp enable
  ppp authentication chap
  ppp multilink bap
  ppp bap call accept
  ppp bap callback request
  ppp bap timeout pending 20
  ppp bap timeout response 2
  ppp bap max dial-attempts 2
  ppp bap monitor load
  ppp bap number default 6666666
```

PRI Interface with No Defined PPP BACP Number Example

In the following example, a PRI interface has no BACP number defined and accepts incoming dial attempts (passive mode). The PRI interface has no base phone number defined, so each attempt to add a link would result in a delta of zero being provided to the calling peer. To establish the bundle, the peer should then dial the same number as it originally used.

```
interface serial 0:23
 ip unnumbered Ethernet0
 encapsulation ppp
 dialer in-band
 dialer idle-timeout 300
 dialer-group 1
 no fair-queue
 no cdp enable
 ppp authentication chap
 ppp multilink bap
 ppp bap call accept
 ppp bap callback request
 ppp bap timeout pending 20
 ppp bap timeout response 2
 ppp bap max dial-attempts 2
 ppp bap monitor load
```

BRI Interface with No Defined BACP Number Example

In the following example, the BRI interface has no base phone number defined. The number that it uses to establish the bundle is that from the dialer map, and all phone delta operations are applied to that number.

```
interface bri 0
 ip unnumbered Ethernet0
 encapsulation ppp
 dialer in-band
 dialer idle-timeout 300
 dialer map ip 10.1.1.1 name bap_peer speed 56 19998884444
 dialer-group 1
 no fair-queue
 no cdp enable
 ppp authentication chap
 ppp multilink bap
 ppp bap call request
 ppp bap timeout pending 20
 ppp bap timeout response 2
 ppp bap max dial-attempts 2
 ppp bap monitor load
```