

Always On/Dynamic ISDN (AO/DI)

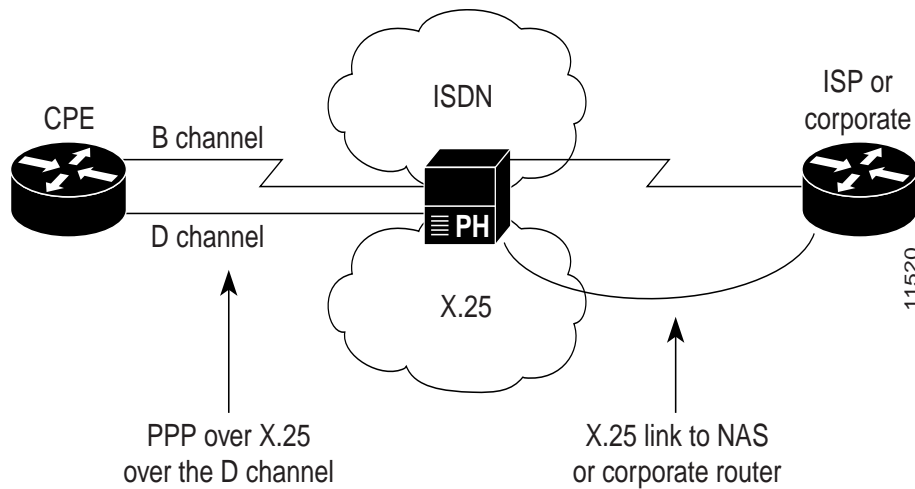
Feature Summary

Always On/Dynamic ISDN (AO/DI) is an on-demand service that is designed to optimize the use of an existing Integrated Services Digital Network (ISDN) signaling channel (D channel) to transport X.25 traffic. The X.25 D channel call is placed from the subscriber to the packet data service provider. The use of PPP allows protocols to be encapsulated within the X.25 logical circuit carried by the D channel. The bearer channels (B channels) use the Multilink protocol without the standard Q.922 and X.25 encapsulations, and invoke additional bandwidth as needed. Optionally, the Bandwidth Allocation Control Protocol (BACP) and the Bandwidth Allocation Protocol (BAP) can be used to negotiate bandwidth allocation as required.

AO/DI takes full advantage of existing packet handlers at the central office by using an existing D channel to transport the X.25 traffic. The link associated with the X.25 D channel packet connection is used as the primary link of the Multilink bundle. The D channel is a connectionless, packet-oriented link between the Customer Premise Equipment (CPE) and the central office. Since the D channel is always available, it is possible to in turn offer “always available” services. On-demand functionality is achieved by using the B channels to temporarily boost data throughput and are disconnected after use. A step-by-step breakdown of the functional components is covered in the “Functional Description” section of this document. Figure 1 shows the AO/DI environment and how ISDN and X.25 resources are implemented.

Note On the client side the X.25 SVC can only be terminated on an ISDN D channel; however, on the server side, the SVC can be terminated on an ISDN Basic Rate Interface (BRI) using a D channel, a Primary Rate Interface (PRI) using specific timeslots, or a high-speed serial link.

Figure 1 AO/DI Environment



Benefits

AO/DI provides the following benefits:

- ISDN telecommuting cost savings. Low-speed, D channel services are typically more cost efficient than the time-based tariffs applied to the B channels, which usually carry user data.
- Reduces the amount of data traffic from service provider voice networks. The D channel X.25 packets are handled at the central office by the X.25 packet handler thereby routing these packets bypassing the switch, which reduces impact on the telephony network.
- Network access server (NAS) cost reductions. AO/DI can reduce service provider NAS costs by increasing port efficiencies. Initial use of the “always on” D channel connection lowers the contention ratio on standard circuit switched dial ports.

List of Terms

Basic Rate Interface (BRI)—An ISDN interface composed of two B channels and one D channel for circuit-switched communication of voice, video, and data.

bearer channel (B Channel)—A channel that carries data on the ISDN interface.

cloning—A virtual interface created and configured by applying a specific virtual template interface. The template is the source of the generic user information and router-dependent information. The result of cloning is a virtual access interface configured with all the commands in the template.

customer premise equipment (CPE)—Terminating equipment installed at customer sites.

dialer interface—A logical interface that includes settings needed to make calls in order to reach specific remote destinations (subnetworks).

E.164—ITU-T recommendation for international telecommunication numbering, especially in ISDN, BISDN, and SMDS.

Integrated Services Digital Network (ISDN)—Communication protocols offered by telephone companies that permit telephone networks to carry data, voice, and other source traffic.

Multilink PPP (MLP)—A protocol that provides the capability of splitting and recombining packets to a single end system across a logical pipe (also called a bundle) formed by multiple links. Multilink PPP provides bandwidth on demand and reduces transmission latency across WAN links.

Primary Rate Interface (PRI)—An ISDN interface to primary rate access. Primary rate access consists of a single 64-kpbs D channel plus 23 (T1) or 30 (E1) B channels.

signaling channel (D Channel)—A channel used to carry control signals on the ISDN interface.

virtual access interface—A unique virtual interface that is created dynamically and exists temporarily. Virtual access interfaces can be created and configured differently by different applications, such as virtual profiles and virtual private dialup networks.

virtual circuit—A logical circuit created to ensure reliable communication between two network devices. A virtual circuit can be either permanent (a PVC) or switched (an SVC).

X.121—ITU-T standard describing an addressing scheme used in X.25 networks. X.121 addresses are sometimes called International Data Numbers (IDNs).

X.25—An ITU-T standard that defines how connections between DTE and DCE are maintained for remote terminal access and computer communications in public data networks (PDNs). X.25 specifies LAPD, a data-link layer protocol, and PLP, a network layer protocol.

Restrictions

AO/DI supports PPP encapsulation on switched X.25 virtual circuits (VCs) only.

The X.25 encapsulation (per RFC 1356), PPP, BAP, and BACP modules must be present in both the AO/DI client and server.

Platforms

This feature is supported on these platforms:

- Cisco 1000 series
- Cisco 1600 series
- Cisco 2500 series
- Cisco 3600 series
- Cisco 4000 series (Cisco 4000, 4000-M, 4500, 4500-M, 4700, 4700-M)
- Cisco 5200
- Cisco 5300
- Cisco 7200 series
- Cisco 7500 series

Prerequisites

AO/DI relies on features from X.25, PPP, and BACP modules and must be configured on both the AO/DI client and server. BAP, if negotiated, is a subset of BACP, which is responsible for bandwidth allocation for the Multilink PPP peers. It is recommended you configure PPP multilink with the BAP option due to the differences between the ISDN (E.164) and X.25 (X.121) numbering formats.

In order to implement AO/DI you must configure the AO/DI client and server for PPP, incorporating BAP and X.25 module commands. This involves configuring the BRI or PRI interfaces with the appropriate X.25 commands and the dialer interfaces with the necessary PPP or BAP commands.

The following tasks are required before you can configure specific commands required to run AO/DI:

- Configure PPP and BAP on the Client
- Configure X.25 Parameters on the Client
- Configure PPP and BAP on the Server
- Configure X.25 Parameters on the Server

Configure PPP and BAP on the Client

Perform the following tasks in interface configuration mode, to configure PPP and BAP under the dialer interface on the AO/DI client:

Task	Command
Enable PPP BACP bandwidth allocation negotiation.	ppp multilink bap
Enable PPP on the interface.	encapsulation ppp
Enable DDR on the interface.	dialer in-band
Set the dialer load threshold.	dialer load-threshold <i>load</i>
Control access to this interface by adding it to a dialer access group.	dialer-group <i>group-number</i>
Enable the interface to initiate additional links upon peer request (optional).	ppp bap callback accept
Enable the interface to initiate additional links.	ppp bap call request
Enable a serial interface or an ISDN interface to initiate and receive calls, to or from, remote sites.	dialer map <i>protocol next-hop-address</i> [name <i>hostname</i>] [spc] [speed 56 64] [broadcast] [modem-script <i>modem-regexp</i>] system-script <i>system-regexp</i>
or Specify the destination string (telephone number) for calling:	
• A single site (using legacy DDR)	dialer string <i>dial-string</i> [<i>:isdn-subaddress</i>]
• Multiple sites (using dialer profiles)	dialer string <i>dial-string</i> [class <i>class-name</i>]

Configure X.25 Parameters on the Client

The AO/DI client interface must be configured to run PPP over X.25. In order to configure the interface for the X.25 parameters, perform the following tasks in interface configuration mode:

Task	Command	Default
Configure the X.25 address.	x25 address <i>address</i>	no default value
Set the highest two-way circuit number.	x25 htc <i>circuit-number</i>	1024—for X.25
Set the default virtual circuit receive window size.	x25 win <i>packets</i>	2 ¹
Set the default virtual circuit transmit window size.	x25 wout <i>packets</i>	2 ²

1. The default input window size is typically defined by your network administrator. Cisco IOS- configured window sizes must be set to match that of the network.
2. The default output window size is typically defined by your network administrator. Cisco IOS-configured window sizes must be set to match that of the network.

For details and usage guidelines for X.25 configuration parameters, refer to Cisco IOS Release 11.3 *Wide-Area Networking Configuration Guide* and *Command Reference*.

Configure PPP and BAP on the Server

Perform the following tasks in interface configuration mode to configure PPP and BAP under the dialer interface on the AO/DI server:

Task	Command
Enable PPP BACP bandwidth allocation negotiation.	ppp multilink bap
Enable PPP on the interface.	encapsulation ppp
Enable DDR on the interface.	dialer in-band
Set the dialer load threshold.	dialer load-threshold load
Control access to this interface by adding it to a dialer access group.	dialer-group group-number
Enable the interface to accept additional links upon peer request.	ppp bap call accept
Enable the interface to initiate additional links (optional).	ppp bap callback request

BAP configuration commands are optional. For information on how to configure BACP/BAP refer to the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide*.

Configure X.25 Parameters on the Server

The AO/DI server BRI, PRI, or serial interface must be configured for the X.25 parameters necessary to run PPP over X.25. Perform the following tasks in interface configuration mode to configure the interface for X.25 parameters:

Task	Command	Default
Configure the X.25 address.	x25 address address	no default value
Set the highest two-way circuit number.	x25 htc circuit-number	1024—for X.25
Set the default virtual circuit receive window size.	x25 win packets	2 ¹
Set the default virtual circuit transmit window size.	x25 wout packets	2 ²

1. The default input window size is typically defined by your network administrator. Cisco IOS-configured window sizes must be set to match that of the network.
2. The default output window size is typically defined by your network administrator. Cisco IOS- configured window sizes must be set to match that of the network.

For details and usage guidelines for X.25 configuration parameters, refer to Cisco IOS Release 11.3 *Wide-Area Networking Configuration Guide* and *Command reference*.

Supported MIBs and RFCs

No MIBs are supported by this feature.

This feature supports the following RFCs:

- RFC 1598

Note In addition to the above RFC, this feature takes into consideration the “Vendor’s ISDN Association (VIA) requirement specification for AO/DI”.

Functional Description

AO/DI functionality is based on the following technology modules:

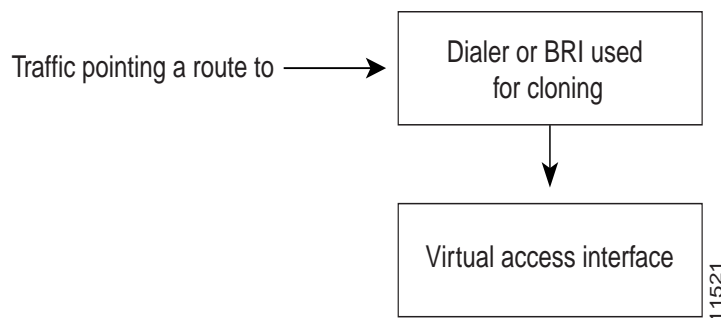
- PPP over X.25 Encapsulation
- Multilink PPP Bundle
- BACP/BAP

PPP over X.25 Encapsulation

PPP over X.25 is accomplished through the following process:

- 1 The X25 map statement on the client side, creates a virtual access interface. A virtual access interface is dynamically created and configured by cloning the configuration from a dialer interface (dialer interface 1, for example).
- 2 The dialer interface goes into “spoofing” mode and stays in this mode until interesting traffic is seen.
- 3 When interesting traffic is seen, the dialer interface activates the virtual access interface, which creates the X.25 SVC. Once the SVC is established, PPP negotiation begins in order to bring up the line protocol. The client will initiate a call to the remote end server, per the **x25 map ppp** command.
- 4 When the AO/DI server receives a call intended for its X.25 map statement, the call is accepted and an event is queued to the X.25 encapsulation manager. The encapsulation manager is an X.25 process that authenticates incoming X.25 calls and AO/DI events, and creates a virtual access interface that clones the configuration from the dialer or BRI interface. Figure 2 shows the virtual interface creation process.

Figure 2 **Creating a Virtual Access Interface**

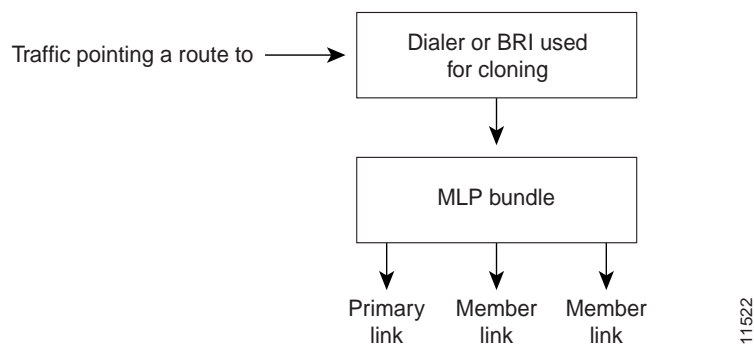


Multilink PPP Bundle

Multilink offers load balancing, packet fragmentation, and the bandwidth allocation functionality that is key to AO/DI structure. The Multilink PPP bundle process is achieved through the following process:

- 1 The **ppp multilink bap** command initiates Multilink PPP and, subsequently, BAP. The virtual access interface that is created above the X.25 virtual circuit (over the D channel) becomes the first member link of the Multilink PPP bundle.
- 2 The **ppp multilink idle-link** command works in conjunction with the **dialer load-threshold** command in order to add additional B channels as needed to boost traffic throughput. When an additional B channel is added, the first member link enters “receive only” mode, allowing the link additions. When the higher throughput is no longer needed, the additional B channels are disconnected and the primary link is the only link in the bundle, it disengages “receive only” mode. The X.25 SVC stays active. Figure 3 shows the MLP bundle sequence.

Figure 3 **MLP Bundle Creation Sequence**



BACP/BAP

Bandwidth resources are provided by BACP, described in RFC 2125. Once the MLP peers have successfully negotiated BACP, BAP negotiates bandwidth resources in order to support traffic throughput. BAP is a subset of BACP, and it defines the methods and governing rules for adding and removing links from the bundle for MLP. BACP/BAP negotiations are achieved through the following process:

- 1 Once the MLP session is initiated and BACP is negotiated over the MLP bundle, the AO/DI client issues a BAP call request for additional bandwidth.
- 2 The AO/DI server responds with the BAP call response, which contains the phone number of the B channel to add. B channels are added, as needed, to support the demand for increased traffic throughput.
- 3 B channels are disconnected as the traffic load decreases.

Configuration Tasks

Once the AO/DI client and server is configured with the necessary PPP, BAP, and X.25 commands, you can configure the routers to perform AO/DI. In order to configure AO/DI, perform the following tasks:

- Configure the AO/DI Client
- Configure the AO/DI Server

Configure the AO/DI Client

To configure AO/DI, you must complete the tasks in the following section. The last task, to define local number peer characteristics, is optional.

- Enable AO/DI on the Interface
- Enable the AO/DI Interface to Initiate Client Calls
- Enable the MLP Bundle to Add Multiple Links
- Modify BACP Default Settings (optional)

Enable AO/DI on the Interface

To enable an interface to run the AO/DI client, perform the following task in interface configuration mode:

Task	Command
Enable the AO/DI client on an interface.	x25 aodi

Enable the AO/DI Interface to Initiate Client Calls

You must enable the interface to establish a PPP session over the X.25 protocol. The cloning interface will hold the PPP configuration, which will be cloned by the virtual access interface that is created and attached to the X.25 virtual circuit (VC). The cloning interface must also hold the MLP

configuration that is needed to run AO/DI. To add the X.25 map statement that will enable the PPP session over X.25, identify the cloning interface, and configure the interface to initiate AO/DI calls, perform the following task in interface configuration mode:

Task	Command
Enable the interface to initiate a PPP session over the X.25 protocol and remote end mapping.	x25 map ppp <i>x.121-address</i> interface <i>cloning-interface</i>

Enable the MLP Bundle to Add Multiple Links

Once Multilink PPP is enabled and the primary traffic load is reached (based on the **dialer load-threshold** value), the MLP bundle will add additional member links (B channels). The addition of another B channel places the first link member into “receive-only” mode and subsequent links are added, as needed. To configure the dialer interface or BRI interface used for cloning purposes and to place the first link member into receive only mode, perform the following task in interface configuration mode:

Task	Command
Configure the interface to enter “receive-only” mode so that MLP links are added as needed.	ppp multilink idle-link

Modify BACP Default Settings

During BACP negotiation between peers, the called party indicates the number to call for BACP. This number may be in either a national or subscriber format. A national format indicates that the phone number returned from the server to the client should contain 10 digits. A subscriber number format contains 7 digits. To assign a prefix to the phone number that is to be returned, perform the optional task in interface configuration mode:

Task	Command
Specify a primary telephone number prefix for a peer to call for PPP BACP negotiation (optional).	ppp bap number prefix <i>prefix-number</i>

Note The **ppp bap number prefix** command is not typically required on the server side, as the server usually does not initiate calls to the client. This command would only be used on the server in a scenario where both sides are configured to act as both client and server.

Configure the AO/DI Server

The AO/DI server will receive calls from the remote end interface running AO/DI client and likewise, must be configured to initiate a PPP session over X.25, allow interface cloning, and be capable of adding additional links to the MLP bundle. The interface configured for AO/DI server relies on the **no-outgoing** option for the **x25 map** command to ensure calls are not originated by the interface. Perform the following tasks to configure the AO/DI server:

- Enable the Interface to Receive AO/DI Client Calls
- Enable the MLP Bundle to Add Multiple Links
- Modify BACP Default Settings (optional)

Enable the Interface to Receive AO/DI Client Calls

Configure the **x25 map** command with the calling client's X.121 address. This enables the AO/DI server interface to run a PPP over X.25 session with the configured client. The **no-outgoing** option must be set in order to ensure calls do not originate from this interface. To configure an interface for AO/DI server, perform the following task in interface configuration mode:

Task	Command
Enable the interface to initiate a PPP session over the X.25 protocol and remote end mapping.	x25 map ppp x.121-address interface cloning-interface no-outgoing

Enable the MLP Bundle to Add Multiple Links

Once Multilink PPP is enabled and the primary traffic load is reached (based on the **dialer load-threshold** value), the MLP bundle will add additional member links (B channels). The addition of another B channel places the first link member into "receive-only" mode and subsequent links are added, as needed. To configure the dialer interface or BRI interface used for cloning purposes and to place the first link member into receive only mode, perform the following task in interface configuration mode:

Task	Command
Configure the interface to enter "receivce-only" mode so that MLP links are added as needed.	ppp multilink idle-link

Modify BACP Default Settings

During BACP negotiation between peers, the called party indicates the number to call for BACP. This number may be in either a national or subscriber format. A national format indicates that the phone number returned from the server to the client should contain 10 digits. A subscriber number format contains 7 digits. To assign a prefix to the phone number that is to be returned, perform the optional task in interface configuration mode:

Task	Command
Specify that the primary telephone number for a peer to call is in either a national or subscriber number format (optional).	ppp bap number format [national subscriber]

Note The **ppp bap number prefix** command is not typically required on the server side, as the server usually does not initiate calls to the client. This command would only be used on the server in a scenario where both sides are configured to act as both client and server.

Configuration Examples

This section provides the following configuration examples:

- AO/DI Client Configuration Example
- AO/DI Server Configuration Example

AO/DI Client Configuration Example

The following example shows BRI interface 0 configured with the necessary PPP, multilink, and X.25 commands necessary for the AO/DI client:

```
hostname Router_client
!
ip address-pool local
isdn switch-type basic-5ess
x25 routing
!
interface Ethernet0
 ip address 172.21.71.99 255.255.255.0
!
interface BRI0
 isdn switch-type basic-5ess
 ip address 6.1.1.9 255.0.0.0
 encaps ppp
 dialer in-band
 dialer load-threshold 1 either
 dialer-group 1
 no fair-queue
 ppp authentication chap
 ppp multilink bap
 ppp bap callback accept
 ppp bap call request
 ppp bap number prefix 91
 ppp multilink idle-link
 isdn x25 static-tei 23
 isdn x25 dchannel
 dialer rotary-group 1
!
interface BRI0:0
 no ip address
 x25 address 12135551234
 x25 aodi
 x25 htc 4
 x25 win 3
 x25 wout 3
 x25 map ppp 12135556789 interface bri0
!
dialer-list 1 protocol ip permit
```

AO/DI Server Configuration Example

The following example shows the configuration for the AO/DI server, which is configured to only receive calls from the AO/DI client. The configuration uses the command **x25 aodi**, **x25 map ppp** with the **no-outgoing** option, and **ppp bap number format**, which implements the **national** format.

```
hostname Router_server
!
ip address-pool local
isdn switch-type basic-5ess
x25 routing
!
interface Ethernet0
 ip address 172.21.71.100 255.255.255.0
!
interface BRI0
 isdn switch-type basic-5ess
 ip address 6.1.1.10 255.0.0.0
 encaps ppp
 dialer in-band
```

```
dialer load-threshold 1 either
dialer-group 1
ppp authentication pap
ppp multilink bap
ppp multilink idle-link
ppp bap number default 2135550904
ppp bap number format national
ppp bap call accept
ppp bap timeout pending 20
isdn x25 static-tei 23
isdn x25 dchannel
dialer rotary-group 1
!
interface BRI0:0
no ip address
x25 address 12135556789
x25 htc 4
x25 win 3
x25 wout 3
x25 map ppp 12135551234 interface bri0 no-outgoing
!!
dialer-list 1 protocol ip permit
```

Command Reference

This section documents the commands required to configure AO/DI. The existing **ppp bap number** and **x25 map** commands are modified to accept new keywords, which can be used to configure AO/DI. Only the keyword information that applies to AO/DI configurations is provided. Existing keyword options and related commands used with this feature are documented in the Cisco IOS Release 11.3 command references.

- **ppp bap number**
ppp multilink idle-link
x25 aodi
x25 map ppp

ppp bap number

To specify a local telephone number that peers can dial to establish a multilink bundle, use the **ppp bap number** interface configuration command. To remove a previously configured number, use the **no** form of this command.

```

ppp bap number { default phone-number | secondary phone-number | prefix prefix-number }
no ppp bap number { default phone-number | secondary phone-number |
  prefix prefix-number }

ppp bap number { format national | subscriber }
no ppp bap number { format national | subscriber }

```

Syntax Description

prefix <i>prefix number</i>	Prefix number for the PPP BAP phone number.
format national subscriber	Format for the primary phone number to be dialed should be either national or subscriber where the number of digits assigned to the number is as follows: <ul style="list-style-type: none"> • 10-digit number for a national format. • 7-digit number for a subscriber format.
default <i>phone-number</i>	Primary (base) phone number for the interface and the number that can be used for incoming dial calls.
secondary <i>phone-number</i>	Telephone number for the second B channel. Applies only to BRI interfaces that have a different number for each B channel or to dialer interfaces that are BRIs.

Default

No base number is provided.

Command Mode

Interface configuration

Usage Guidelines

The **ppp bap number** command first appeared in Cisco IOS Release 11.3.

The **prefix** and **format** keywords first appeared in Cisco IOS Release 11.3 T.

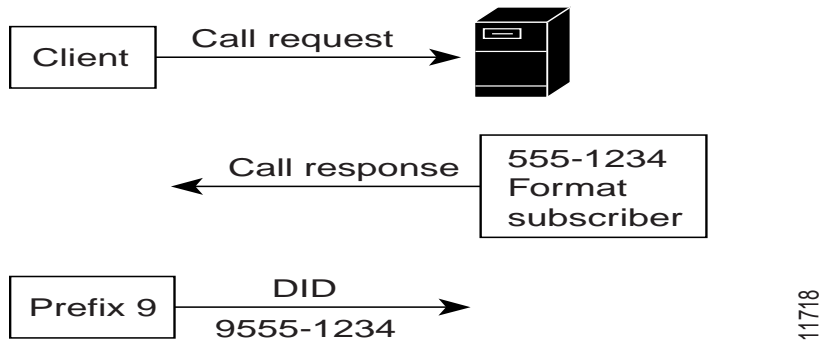
Use this command to supply a local default number to be exchanged between peers in order to establish a multilink bundle.

Use the **prefix** keyword on the AO/DI client side to specify what will precede any number dialed to a multilink peer. This command is used by the client side for dialing instructions when communicating with the server. For example, the client issues a call request to the server whereby the server issues a call response which includes the dialing number the client should use and the format this number should be in (national or subscriber). The client then dials the number supplied by the server, preceded by any prefix information contained in the **ppp bap number prefix** command. Figure 4 shows an overview about the information exchange between the client and the server.

Use the **format** keyword on the AO/DI server side to specify how many digits should be returned by BAP. BAP will return the numbers based on either a national or subscriber format. The value that is returned is preceded by the prefix before dialing occurs. For example, if the **format national** keywords are configured, then the national format (which is equivalent to 10 digits) is returned by BAP (during BAP negotiation) from the server.

Note The **ppp bap number prefix** and **ppp bap number format** keyword options cannot be combined to a single-string command line; they must be entered in two separate command strings.

Figure 4 Client and Server Response Sequence



Use the **format** keyword its used on the server side to specify how many digits should be returned by BAP. BAP will return the numbers based on either a national or subscriber format. The value that is returned is preceded by the prefix before dialing. For example, if the **format national** keywords are configured, then the national format (which is equivalent to 10 digits) is returned by BAP (during BACP negotiation), from the server to the client.

This command is applicable on both the dialer interface and the individual physical interfaces.

Examples

In the following example, the AO/DI client uses a **ppp bap prefix** value of 9, which indicates that the dialed number of 5551234 will be preceded by a 9. The number that is actually dialed is 95551234. The AO/DI server uses a subscriber format, which indicates that when the client asks the server for the numbers to dial, BAP will return 7-digits.

Client router

```
interface dialer1
  ppp bap number prefix 9
```

Server Router

```
interface dialer1
  ppp bap number format subscriber
  ppp bap number default 5555678
```

In the following example, the AO/DI client uses a **ppp bap prefix** value of 1, which indicates that the dialed number of 5551234 will be preceded by a 1. The number that is actually dialed is 19195555678 because the server is using a national format, and BAP therefore, returns 10-digits.

Client router

```
interface dialer1
  ppp bap number prefix 1
```

Server Router

```
interface dialer1
  ppp bap number format national
  ppp bap number default 9195555678
```

ppp multilink idle-link

To configure the PPP Multilink bundle so that the first link member enters into “receive-only” mode when an additional B channel is added, use the **ppp multilink idle-link** command. To remove this functionality, use the **no** form of this command.

```
ppp multilink idle-link  
no ppp multilink idle-link
```

Syntax Description

This command has no keywords or arguments.

Default

Multilink idle-link is not set.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.3 T.

Use this command to ensure that the primary link in the AO/DI bundle enters “receive-only” mode as soon as the first additional B channel is added to the bundle. Additional member links are added to the Multilink PPP bundle in order to increase traffic throughput and are disconnected once the traffic load is reduced. During this timeframe, the X.25 SVC remains active. The **dialer load-threshold** value determines the traffic threshold limits for the bundle.

Example

The following example configures the interface (dialer interface 1) to add additional links to the MLP bundle once the traffic load on the primary link is reached:

```
interface dialer1  
  ppp multilink idle-link
```

x25 aodi

To enable the AO/DI client on an interface, use the **x25 aodi** interface configuration command. To remove AO/DI client functionality, use the **no** form of this command.

```
x25 aodi  
no x25 aodi
```

Syntax Description

This command has no arguments or keywords.

Default

AO/DI client is not enabled.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.3 T.

Use this command to enable the AO/DI client on an interface.

Example

The following example enables the AO/DI client on the interface running X.25, using the **x25 aodi** command:

```
interface bri0  
  isdn x25 dchannel  
  isdn x25 static-tei 8  
interface bri0:0  
  x25 aodi  
  x25 address 12135551234  
  x25 htc 4  
  x25 win 3  
  x25 wout 3  
  x25 map ppp 12135556789 interface dialer 1
```

Note Configuring the BRI interface with the **isdn x25 dchannel** command creates a configurable interface (bri 0:0) for other necessary X.25 commands. Refer to Cisco IOS Release 11.3 *Dial Solutions Configuration Guide* and *Command Reference* for additional information about this command.

x25 map ppp

To enable a PPP session over the X.25 protocol, use the **x25 map ppp** interface configuration command. To remove a prior mapping, use the **no** form of this command.

```
x25 map ppp x121-address interface cloning-interface no-outgoing  
no x25 map ppp x121-address interface cloning-interface no-outgoing
```

Syntax Description

<i>x.121 address</i>	The X.121 address as follows: <ul style="list-style-type: none">• Client side—The calling number.• Server side—The called number.
interface	The interface to be used for cloning the configuration.
no-outgoing	Ensures that the X.25 map does not originate calls.

Default

Disabled

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.3 T.

Use **x25 map ppp** command to allow a PPP session to run over X.25.

The **interface** keyword refers to the interface that will be used to clone the configuration.

Client Example

The following example enables the AO/DI client on the interface and configures the D channel (BRI interface 0:0) with the x25 map statement in order to allow PPP sessions over X.25 encapsulation with the configured AO/DI server:

```
interface BRI0:0  
  x25 address 16193368208  
  x25 aodi  
  x25 htc 4
```

```
x25 win 3
x25 wout 3
x25 map ppp 16193368209 interface dialer 1
```

Server Example

The following example enables the AO/DI server to receive calls from the AO/DI client and configures the D channel (BRI0:0) with the x25 map statement which allows PPP sessions over X.25 encapsulation with the configured AO/DI client:

```
interface BRI0:0
x25 address 16193368209
x25 htc 4
x25 win 3
x25 wout 3
x25 map ppp 16193368208 interface dialer 1
```

Note Configuring the BRI interface with the **isdn x25 dchannel** command creates a configurable interface (bri 0:0) for other necessary X.25 commands. Refer to Cisco IOS Release 11.3 *Dial Solutions Configuration Guide* and *Command Reference* for additional information about this command.

Debug Command

The **debug x25** command is revised to add the **aodi** keyword, which supports the AO/DI feature. Only the information that applies to **debug ppp aodi** is provided. Refer to the Cisco IOS Release 11.3 *Debug Command Reference* for complete **debug x25** information.

debug x25 aodi

Use the **debug x25 EXEC** command with the **aodi** keyword to display information about an interface running PPP over an X.25 session. To disable debugging output, use the **no** form of this command.

[no] debug x25 aodi

Syntax Description

aodi Causes the **debug x25** command to display AO/DI events and processing information.

Usage Guidelines

Use this command to debug X.25 connections between a client and server configured for AO/DI.

Use the **debug x25 aodi** command to display interface PPP events running over an X.25 session.

Sample Display

The examples below show the normal sequence of events for both the client and server sides:

Client Side

```
Router# debug x25 aodi
PPP-X25: Virtual-Access1: Initiating AODI call request
PPP-X25: Bringing UP X.25 AODI VC
PPP-X25: AODI Client Call Confirm Event Received
PPP-X25: Cloning interface for AODI is Di1
PPP-X25: Queuing AODI Client Map Event
PPP-X25: Event:AODI Client Map
PPP-X25: Created interface Vi2 for AODI service
PPP-X25: Attaching primary link Vi2 to Di1
PPP-X25: Cloning Vi2 for AODI service using Di1
PPP-X25: Vi2: Setting the PPP call direction as OUT
PPP-X25: Vi2: Setting vectors for RFC1598 operation on BRI3/0:0 VC 0
PPP-X25: Vi2: Setting the interface default bandwidth to 10 Kbps
PPP-X25: Virtual-Access2: Initiating AODI call request
PPP-X25: Bringing UP X.25 AODI VC
PPP-X25: AODI Client Call Confirm Event Received
```

Server Side

```
Router# debug x25 aodi
PPP-X25: AODI Call Request Event Received
PPP-X25: Event:AODI Incoming Call Request
PPP-X25: Created interface Vi1 for AODI service
PPP-X25: Attaching primary link Vi1 to Di1
PPP-X25: Cloning Vi1 for AODI service using Di1
PPP-X25: Vi1: Setting vectors for RFC1598 operation on BRI3/0:0 VC 1
```

```
PPP-X25: Vi1: Setting the interface default bandwidth to 10 Kbps  
PPP-X25: Binding X.25 VC 1 on BRI3/0:0 to Vi1
```

Related Commands

debug ppp bap
debug ppp bap negotiation
debug ppp multilink
debug ppp negotiation

