Understanding the Maximum Number of Active Virtual Circuits on Cisco ATM Router Interfaces

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Introduction

A frequent application of Cisco ATM interfaces is to aggregate a large number of ATM permanent virtual circuits (PVCs) to DSL users or to remote corporate users. This document explains the maximum number of active virtual circuits (VCs), the range of virtual path identifier (VPI) values, and the range of virtual channel identifier (VCI) values that Cisco's ATM router interfaces support. The architecture of some segmentation and reassembly (SAR) chips places limits on these supported values.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.

Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

ATM Five−Byte Cell Header

The ATM cell includes a five−byte header. As shown in this illustration, the user−network interface (UNI) cell header includes eight bits for the VPI field and 16 bits for the VCI field.

The size of these fields plays a role in the range of VPI and VCI values that a router interface, which serves as the user side of a UNI link, can support.

Supported Values Per ATM Hardware

Hardware	Maximum Number of Active VCs	Range of VPI Values	Range of VCI Values	Use of **atm vc−per−vp** Command
AIP	2,048	0 − 255	Varies with vc−per−vp, up to 1023	Adjusts number of unique VPIs
PA−A1	2048	0 − 255	Varies with vc−per−vp, up to 2047	Adjusts number of unique VPIs
PA−A2	2048	0 − 255	0 − 2047	−
PA−A3−OC3/T3 on Cisco 7100, 7200, 7400 and 7500 routers	4096	0 − 255	0 − 65535	−
PA−A3−OC3/T3 on the OSR/7600, FlexWAN	1024	0 − 255	0 − 65535	−
PA−A6−OC3/T3 on Cisco 7200, 7400 and 7500 routers	8192	0 − 255	0−65535	
PA−A3−OC3/T3 on the FlexWAN	4096	0 − 255	0−65535	
PA−A3−IMA	512 per T1, 4096 per group based on the number of member links	0 − 255	0−65535	−
PA−A3−OC12	4096	0 − 255	Varies with vc−per−vp, up to 1023	Adjusts the number of unique VPIs
NP−1A−OC (4500/4700)	1024	0 − 7	1 − 1023	−

NP−1A−E3/DS3 (4500/4700)	1024	0 − 7	1 − 1023	−
NM−1A−OC	1024	0 − 15	1 − 1023	−
NM−1A−DS3	1024	0 − 15	1 − 1023	−
NM−4T1−IMA NM−8T1−IMA	256	Specific ranges: 0−15, 64−79, 128−143, and 192−207	Varies with vc−per−vp, up to 4095 with 12.1(5)T	Adjusts the bit divider between VPI and VCI
NM−1ATM−25	4096	Varies with vc−per−vp value: 1 − 63, 0 −3, 0 −1	Varies with vc−per−vp, up to 8191	Adjusts the bit divider between VPI and VCI
AIM−ATM AIM−ATM−VOICE−30	255 per T1 or 4−port IMA bundle. 1024 VCs with 4 separate T1 interfaces	Varies with vc−per−vp. Defaults to 5 VPI bits with range of 0 to 31	Varies with vc−per−vp. Defaults to 8 bits with a range of 1 to 256	Adjusts bit divider between VPI and VCI. 13−bit range per interface
NRP (6400)	2046	0 − 255	1 − 16383	−
OSM−2OC12−ATM−MM OSM−2OC12−ATM−SI**	1000 VCs per module, 500 per physical ATM interface	Varies with vc−per−vp. Up to 0−255; default is 15.	Varies with vc−per−vp. Up to 1−1023; default is 1023.	Adjusts bit divider between VPI and VCI
7300−2OC3ATM−MM 7300−2OC3ATM−SMI 7300−2OC3ATM−SML	2,048 per interface	0 − 255	1 − 65535	−
Mulitflex Trunk (MC3810)	512	Varies with vc−per−vp value, up to 255	Varies with vc−per−vp, up to 8191	Adjusts bit divider between VPI and VCI
OC−3 ESR*	512 VPI/VCI combinations across the 4 ports	0 to 255	1 − 65535	−
OC−12 ESR*	512	0 to 255	1 − 65535	−
GSR 4xOC3	2048 per port, 8192 per card	Varies with vc−per−vp value, up to 255	Varies with vc−per−vp, up to 8191	Adjusts bit divider between VPI and VCI

GSR 1xOC12	2048 per port, 8192 per card	Varies with vc−per−vp value, up to 255	Varies with vc−per−vp, up to 8191	Adjusts bit divider between VPI and VCI
Cisco 827 (ADSL)	1024	0 − 31	1 − 1023	−
Catalyst 2900M−XL WS−X2951 WS−X2961 WS−X2971 WS−X2971	1024	0	1 − 1023	−

* The number of nrt−VBR PVCs supported by the router is a function of the Cisco IOS® software release. See the OC−3 and OC−12 ATM Line Cards for the ESR section for more information.

** See the 2−Port ATM Optical Services Module for the Cisco 7600 Series Internet Router datasheet for valid VCI and VPI values.

OC−3 and OC−12 ATM Line Cards for the ESR

The Edge Services Router (ESR) or Cisco 10000 Series supports 4xOC−3 and 1xOC−12 ATM line cards. The maximum number of active VCs depends on the Cisco IOS software release.

- The Cisco IOS leased−line images, 12.0(x)ST, support up to 8000 UBR VCs per system and 4000 VBR VCs. A single interface can support up to 4000 VBR VCs. This guideline applies to both the OC−3 and OC−12 line cards.
- The Cisco IOS broadband images, 12.2(x)B, support up to 32000 PVCs per system. The OC−12 card can support 16000 per interface, while the OC−3 card can support up to 8000 per interface.

The ESR ATM line cards support the full range of VPI/VCIs (UNI only), and includes a restriction on how these VCs are assigned that may reduce the VC counts. A single SAR per card is used on both the 4xOC−3 and 1xOC−12. To allow the SAR to support the same VPI/VCI values per interface and thus discriminate among the VCs, the SAR translates the external PVC values into an internal value that uses bits for the port number. The 512 unique combinations use this bit pattern:

- Three reserved bits.
- Five PHY bits to designate the physical interface of the PVC.
- Eight VPI bits (represents the entire VPI value).
- Upper nine bits of VCI value (bits 7−15 of the VCI field).

This scenario shows an example:

If only the first seven bits of the VCI field (all VCIs are numbered 127 or below) are used, then only the first three portions of the bit pattern are used. As a result, the number of unique combinations used follows:

```
(# of interfaces being used on the SAR) * (# of different VPIs provisioned) <=  512
```

This value must be less than or equal to 512. If this scenario is used as well as all four interfaces, then 128

VPIs can be provisioned (4 interfaces * 128 VPIs).

When the VCI values exceed 127, the ATM driver starts to take away from the possible VPI values. This assumes the interface count stays constant. The easiest way to determine how many unique combinations are being used in this scenario is to count the number of bits being used out of the upper nine VCI bits. Then, determine the maximum different combinations possible with those nine bits. Finally, multiply that by the number of VPIs used and the number of interfaces available.

Based on the earlier scenario, assume that pvc 2/32−1023 is configured for interface atm 4/0. This means that you configure all of these PVCs: 2/32, 2/33, 2/33 .... 2/1023. This totals to 992 VCs on port four with VPI = 2. With respect to the limitation, this range uses bits 8, 9 and 10 of the VCI field. The same thing is true with pvc 3/32−1023, where it uses VPI = 3. In short, you can have this configuration:

```
atm 4/0
        pvc 2/32−1023
        pvc 3/32−1023
        pvc 4/32−1023
      atm 4/1
        pvc 2/32−1023
        pvc 3/32−1023
        pvc 4/32−1023
     atm 5/0
        pvc 2/32−1023
        pvc 3/32−1023
        pvc 4/32−1023
      atm 5/1
        pvc 2/32−1023
        pvc 3/32−1023
        pvc 4/32−1023
```

Define the variables:

- # of interfaces = 4
- # of VPIs = 3
- # of upper 9 VCI bits used = 3 which translates to 2^3 or 8.

Thus, the number of unique combinations used equals 4*3*8 = 96.

You can configure up to 512 unique combinations of values for the upper nine bits of the VCI and the eight bits of the VP and the port number. For example, if you configure VPIs 1−64 on four different OC−ports, this consumes 256 of the 512 values. Alternately, if you configure VPI=0 & 1, VCI=128−256 on all four ports uses all 512 values. Cisco recommends dense usage of the lower seven bits of the VCI space.

Also note that the ESR ATM line cards do not support the **atm vc−per−vp** command.

Note: Originally, the ESR ATM line cards were limited by hardware to 2,000 UBR PVCs and 8191 nrt−VBR PVCs per card. In addition, depending on the Cisco IOS software release, the OC−12 line card supported up to 254 VBR−NRT PVCs. These limits no longer apply, although documentation stating these limits may still appear on Cisco.com.

In addition, note that VCs used for control functions which are created automatically, such as Operation, Administration, and Maintenance (OAM) cells, as well as Interim Local Management Interface (ILMI), are assigned to a VPI value of 0. This may impact the number of entries available for user PVCs.

show Commands to Display Maximum Active VCs

In addition to consulting the Supported Values Per ATM Hardware table, use the **show atm interface atm** command or the **show interface atm** command to view the maximum number of configurable VCs and the current number of active VCs on your ATM interface. This output was generated on a NM−4T1−IMA network module in a Cisco 3640 router.

```
3640#show atm interface atm 2/0
    Interface ATM2/0:
    AAL enabled: AAL5 , Maximum VCs: 256, Current VCCs: 0

!−−− Note value for "Maximum VCs" and "Current VCCs".

    Maximum Transmit Channels: 0
    Max. Datagram Size: 4496
    PLIM Type: DS1, Framing is T1 ESF, TX clocking: LINE
    Cell−payload scrambling: OFF
    0 input, 0 output, 0 IN fast, 0 OUT fast, 0 out drop
    Avail bw = 1000
    Config. is ACTIVE

   3640#show interface atm 2/0
      ATM2/0 is up, line protocol is up
       Hardware is ATM T1
       MTU 4470 bytes, sub MTU 4470, BW 1500 Kbit, DLY 20000 usec,
       reliability 0/255, txload 1/255, rxload 1/255
       Encapsulation ATM, loopback not set
       Keepalive not supported
       Encapsulation(s): AAL5
       256 maximum active VCs, 0 current VCCs

!−−− Note the "maximum active VCs" and "current VCCs" values.

       VC idle disconnect time: 300 seconds
       [output omitted]
```

atm vc−per−vp Command

Cisco ATM router interfaces support a default range of VPI and VCI values. You can configure non−default values on some interface hardware with the **atm vc−per−vp** command. This command helps to overcome the limitations imposed by some ATM SAR chips on the configurable VC values.

In general, the **atm vc−per−vp** command adjusts the supported ranges in one of two ways:

- Changes the maximum number of unique VPI numbers and the VCI value range per VPI.
- Moves the bit divider between the VPI range and the VCI range. Does not set the maximum number of unique VPI numbers.

These sections clarify how specific ATM interface hardware uses the **atm vc−per−vp** command.

PA−A3−OC12

The PA−A3−OC12 port adapter uses the **atm vc−per−vp** command as follows:

- The VC table that resides in physical memory supports 4096 entries (or rows).
- The VPI space supports any value from 0 to 255 (eight bits). This space is called "sparse." An eight−bit value matches the size of the VPI field in an ATM cell header with UNI formatting.

Note: Some ATM hardware does not support the full eight bits. For example, the NM−1A−OC3 and NM−1A−DS3 support four VPI bits and VPI values of 0 to 15.

- The number of unique VPI values that a single interface supports is limited by this formula:

```
Maximum Active VCs / atm vc-per-vp = Number of Unique VPIs
```

On the PA−A3−OC12, an **atm vc−per−vp** value of 256 configures the router to support eight unique VPI values:

```
4096 / atm vc-per-vp 256 = 8
```

You are free to select any eight arbitrary VPI values between 0 and 255. Choose a non−sequential series of numbers like 9, 25, 50 and 240 or a sequential series of numbers like 1, 2, 3, and 4.

- In contrast, the VCI space is linear and starts from zero. A VCI number must fall between 0 and the configured vc−per−vp value. For example, vc−per−vp=256 configures the router to reject VCI values above 255.

PA−A1

The PA−A1 uses an approach that is similar to the PA−A3−OC12. It supports these guidelines:

- The VC table that resides in physical memory supports 6144 entries (or rows).
- The VPI space always supports any value from 0 to 255 (eight bits).
- The VCI range for each unique VPI number is configured with **atm vc−per−vp**.

6144 Table Entries / atm vc−per−vp = Number of VCI Bits.

This table illustrates the configurable **vc−per−vp** values.

vc−per−vp Value	Number of VCI Bits	Number of Unique VPIs
32	5	192
64	6	96
128	7	48
256	8	24
512	9	12
1024 (default)	10 (default)	6 (default)
2048	11	3

PA−A2−4E1XC−E3ATM and PA−A2−4T1C−T3ATM

The PA−A2−4E1XC−E3ATM and PA−A2−4T1C−T3ATM do not support VCI values greater than 2047. However, the command−line allows you to configure values from 1 − 16383 on the ATM interface and adds the invalid **pvc** command to the configuration. This issue is documented and resolved in Cisco bug ID CSCdw21467 (registered customers only) .

MC3810 Multiflex Trunk Module

The multiflex trunk (MFT) module on the Cisco MC3810 is one of several ATM router interfaces that uses the **atm vc−per−vp** command to move the bit divider between the VPI and VCI spaces. By bit divider, we

mean that the command changes the number of bits allocated internally by the SAR to the VPI and VCI fields.

In other words, the MFT supports a fixed number of VC bits. However, the **atm vc−per−vp** command configures the router to rob bits from one space to give it to the other. For example, an **atm vc−per−vp** value of 8192 allocates 13 bits (values 1 − 8191) to the VCI space and leaves five bits (values 0 − 31) to the VPI space.

```
3810(config−if)#atm vc−per−vp 8192
   3810(config)#int atm 0
      3810(config−if)#pvc ?
       <0−31> Enter VPI/VCI value(slash required)
            <1−8191> Enter VCI value
       WORD Optional handle to refer to this connection
```

An **atm vc−per−vp** value of 128 reduces the VCI space. It allocates seven bits (values 1 − 127) for the VCI space and eight bits (values 0 − 255) for the VPI space.

```
3810(config−if)#atm vc−per−vp 128
    3810(config−if)#pvc ?
     <0−255> Enter VPI/VCI value(slash required)
     <1−127> Enter VCI value
     WORD Optional handle to refer to this connection
```

NM−1ATM−25

The NM−1ATM−25 network module supports 14 bits for the VPI/VCI values. For example, an **atm vc−per−vp** value of 64 configures the module to support six VPI bits and eight VCI bits.

This table lists the supported **vc−per−vp** values for the NM−1ATM−25. A value of 8192 is achieved by robbing a bit from the VPI range.

vc−per−vp Setting	VPI Range	Number of Bits	VCI Range	Number of Bits
64	1−63	6	0−255	8
4096	0−3	2	1−4095	12
8192	0−1	1	1−8191	13

After the bit divider is adjusted, the router applies this formula to determine how many unique VPIs and the range of VCIs per VPI. The NM−1ATM−25 supports up to 4096 active VCs.

- 4096 active VCs / 255 unique VPI values = 16 VCs per unique VPI
- 4096 active VCs / 4 unique VPI values = 1024 VCs per unique VPI
- 4096 active VCs / 2 unique VPI values = 2048 VCs per unique VPI

NM−4T1/8T1−IMA

The inverse multiplexing over ATM (IMA) network module for the 2600/3600 series uses the **atm vc−per−vp** command to rob bits from the VPI space to increase the VCI space. This command was introduced in Cisco IOS® Software Release 12.1(5)T (Cisco bug ID CSCdr43079 (registered customers only)) for the IMA modules; it will be fully implemented for these modules in Cisco IOS Software Release 12.2 (Cisco bug ID CSCdt64050 (registered customers only)). Since the IMA module uses a single SAR chip for all four or eight T1s, changing the **atm vc−per−vp** value on one T1 affects all other interfaces.

VCI Range	Number of Bits	VPI Range	Number of Bits
0−255	8	0−15, 64−79, 128−143 and 192−207	8
0−511	9	0−15, 64−79	5*
0−1023	10	0−15	4*
0−2047	11	0−15	4*
0−4095	12	0−15	4

* IMA modules use two bits for VPI translation logic. See Inverse Multiplexing over ATM on Cisco 2600 and 3600 Routers for clarification.

AIM−ATM

When you use AIM−ATM, AIM−VOICE−30, or AIM−ATM−VOICE−30 Network Modules, the number of VPI/VCI is 13 bits. The default values are:

- VPI = 5 bits for VPI with values from 0 − 31 or up to 32 unique VPI values.
- VCI = 8 bits for VCI with values from 1 to 255 or up to 255 VCI values.
- Word = optional PVC identifier (letters only); if you assign a PVC identifier, you can use it to specify this PVC when configuring network dial peers.

Notes:

- The PVC 100/200 is not possible because the VPI range is from 0 to 31.
- The PVCs are configurable at the CLI to be in the range of:
  - number of VPIs 8 − 256
  - number of VCIs 32 to 1024
- The **atm vc−per−vp** command can be used to change the VCI or VPI/VCI bit range.

For more detailed information on the AIM−ATM card, read Configuring AAL2 and AAL5 for the High Performance ATM Advanced Integration Module on the Cisco 2600 Series.

4xOC3 GSR ATM Line Card

By default, the 4xOC3 ATM line card for the Gigabit Switch Router (GSR) supports three unique VPI values per interface. You can increase the number of supported VPIs by reducing the number of VCs per VPI with the **atm vc−per−vp** command. The number of VPIs available to each 4xOC3 ATM line card interface is determined by this formula:

```
#VPIs/interface = 15K / (#interfaces/card) / (VCs/VP)  (rounded down)
```

The default value of **vc−per−vp** is 1024, so the default number of VPIs supported per interface is 15K / 1K / 4 = 3.

atm vc−per−vp Value	Number of VPIs Supported per Interface
atm vc−per−vp 2048	1
atm vc−per−vp 1024	3 (default)

atm vc−per−vp 512	7
atm vc−per−vp 256	15
atm vc−per−vp 128	30
atm vc−per−vp 64	60
atm vc−per−vp 32	120
atm vc−per−vp 16	240

In other words, the 4xOC3 ATM line card uses the **atm vc−per−vp** command to move the bit divider. Configurable values are always a power of two.

```
GSR(config)#interface atm 7/0
    GSR(config−if)#atm vc−per−vp ?
     16 VCs per VP
     32
     64
     128
     256
     512
     1024
     2048
```

With an **atm vc−per−vp** value of 16, the highest configurable VCI value is 15.

```
GSR(config−if)#atm vc−per−vp 16
    GSR(config−if)#pvc ?
     <0−255> Enter VPI/VCI value(slash required)
     <1−15> Enter VCI value

!−−− Highest VCI value is 16 − 1.

        WORD Optional handle to refer to this connection
```

Changing the **atm vc−per−vp** value to 2048 adjusts the bit divider and gives seven bits to the VPI space and 11 bits to the VCI space. The highest configurable VCI value is now 2047.

```
GSR(config−if)#atm vc−per−vp 2048
    GSR(config−if)#pvc ?
     <0−127> Enter VPI/VCI value(slash required)
     <1−2047> Enter VCI value

!−−− Highest VCI value is 2048 − 1.

        WORD Optional handle to refer to this connection
```

The **show interface atm** and **show atm interface** atm commands display the maximum active VCs value only. You must use the **show running** command to view the configured vc−per−vp value.

```
GSR−1#show run interface atm 7/0
    Building configuration...

   Current configuration:
      !
      interface ATM7/0
      no ip address
      no ip directed−broadcast
      atm vc−per−vp 2048

!−−− Non−default values are displayed.
```

```
     atm clock INTERNAL
no atm enable-ilmi-trap
no atm ilmi-keepalive
end
```

PA−A3−8T1IMA and PA−A3−8E1IMA

The inverse multiplexing over ATM (IMA) port adapter for the 7x00 series supports a maximum active VCs value that increases on a virtual IMA interface as the number of physical T1 links in an IMA group increases. Each T1 link supports up to 512 active VCs.

This output shows how to increase the maximum number of active VCs on the IMA port adapter:

1. Add two T1 links to an IMA group (IMA 0) and confirm your group settings with the **show ima interface** command. Specify the IMA virtual interface (atm2/ima0).

```
7200#show ima interface atm2/ima0
    ATM2/ima0 is administratively down
     ImaGroupState: NearEnd = notConfigured, FarEnd = notConfigured
     ImaGroupFailureStatus =    otherFailure
    IMA Group Current Configuration:
     ImaGroupMinNumTxLinks = 1
    ImaGroupMinNumRxLinks = 1
     ImaGroupDiffDelayMax =    250
 ImaGroupNeTxClkMode = common(ctc)
     ImaGroupFrameLength    = 128
 ImaTestProcStatus = disabled
     ImaGroupTestLink    = 255
 ImaGroupTestPattern = 0xFF
    IMA Link Information:    Link    Link Status    Test Status
    ------ ----------------------------    --------------
    ATM2/0 down    disabled    ATM2/1 down    disabled
```

2. Execute the **show interface atm2/ima0** command to display the maximum active VCs value on the IMA virtual interface.

```
7200#show interface atm2/ima0
    ATM2/ima0 is administratively down, line protocol is down
     Hardware is IMA PA
     MTU 4470 bytes, sub MTU 4470, BW 1536 Kbit, DLY 100 usec,
     reliability 0/255, txload 1/255, rxload 1/255
        Encapsulation ATM, loopback not set
     Keepalive not supported
     Encapsulation(s): AAL5
     1024 maximum active VCs, 0 current VCCs

!--- 1024 maximum active VCs on the IMA virtual interface.

     VC idle disconnect time: 300 seconds
     0 carrier transitions
     Last input never, output never, output hang never
     Last clearing of "show interface" counters never
     Queueing strategy: fifo
     Output queue 0/40, 0 drops; input queue 0/75, 0 drops
     5 minute input rate 0 bits/sec, 0 packets/sec
     5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
        0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
        0 output buffer failures, 0 output buffers swapped out
```

3. Add a third T1 link, ATM 2/2, to the IMA group

```
7200(config)#interface atm 2/2
     7200(config-if)#ima-group    0
```

4. Execute the **show int atm2/ima0** command. Note how the IMA virtual interface now supports up to 1536 maximum active VCs.

```
7200#show interface atm2/ima0
    ATM2/ima0 is administratively down, line protocol is down
     Hardware is IMA PA
     MTU 4470 bytes, sub MTU 4470, BW 1536 Kbit, DLY 100 usec,
     reliability 0/255, txload 1/255, rxload 1/255
        Encapsulation ATM, loopback not set
     Keepalive not supported
     Encapsulation(s): AAL5
     1536 maximum active VCs, 0 current VCCs

!--- 3 T1 links x 512 = 1536 maximum active VCs for the IMA group.

     VC idle disconnect time: 300 seconds
     0 carrier transitions
     Last input never, output never, output hang never
     Last clearing of "show interface" counters never
     Queueing strategy: fifo
     Output queue 0/40, 0 drops; input queue 0/75, 0 drops
     5 minute input rate 0 bits/sec, 0 packets/sec
     5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
        0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
        0 output buffer failures, 0 output buffers swapped out
```

When all eight T1 links on the IMA port adapter are added to an IMA group, the IMA virtual interface can support up to 4096 open VCs. See Important Considerations About Maximum Active VCs.

ATM DXI Considerations

If you do not have a native ATM port, you can configure a serial interface with the **encapsulation atm−dxi** command. Data exchange interface (DXI) encapsulates your data inside HDLC−like frames and carries these frames to an ATM data service unit (DSU). When you configure ATM DXI PVCs with the **dxi pvc <vpi> <vci>** command, note that these VPI and VCI limitations:

- VPI − Values from 0 − 15 or up to 16 unique VPI values.
- VCI − Values from 0 − 63 or up to 64 unique VCI values.

Important Considerations About Maximum Active VCs

When you configure a large number of PVCs on a single ATM interface, Cisco recommends that you consider:

- The advertised maximum number of active VCs is derived from Cisco estimates on the number of simultaneous SARs and the size of the packets. Importantly, the PA−A3 supports 1024 simultaneous SARs and an advertised maximum active VCs value of 4096. If all 4096 VCs receive packets at the same instant, the ATM interface may run out of packet buffers and begin dropping packets. Therefore, Cisco strongly recommends you use a powerful hardware SAR capable of reassembling a large

number of cells very quickly.

- When you configure a large number of VCs on a single interface, Cisco also strongly recommends you use a powerful processor capable of making a large number of switching decisions very quickly and a large amount of packet memory. Monitor CPU utilization with the **show process cpu** command and the lowest available memory with the **show memory sum** command.

  Avoid oversubscribing the guaranteed bandwidth of the configured VCs. The **atm oversubscribe** command on the PA−A3 allows you to configure VBR−nrt PVCs with sustained cell rate (SCR) values that sum to greater than the line rate. However, in a worst−case scenario, when all the VCs need to see traffic that exceeds the line rate, queues back up and packets are dropped without being able to guarantee the SCR for each VC. The percentages of which VC gets how much bandwidth is unpredictable. If you have no oversubscription, then each VC gets up to its configured SCR. Therefore, the VCs with higher SCRs gets more bandwidth. In a worst case of oversubscription, with each VC trying to send more than its SCR, each VC will get <line−rate / # VC's> if all the competing VCs have the same SAR priority. If configured with differing SCRs, the VCs are given the same bandwidth or VCs with a higher SCR are given more. This all depends on what the load is at a certain point in time. This is why it is difficult to predict the exact bandwidth percentage each VC has.

  Note: In an oversubscription scenario, the SAR does not drop any cells on the router once a packet has been scheduled to it. If the rate at which cells are being sent to the SAR exceeds the SAR's capability to transmit, the driver activates a backpressure mechanism. Also, the host queueing system then stores and subsequently drops any excess packets. In other words, the ATM interface driver controls the rate at which it sends packets to the SAR to avoid starving the SAR of its internal buffers.
- The total number of interfaces and subinterfaces per system is limited by the number of interface descriptor blocks (IDBs) that your version of Cisco IOS supports. An IDB is a portion of memory that holds information about the interface such as counters, status of the interface, and so on. Cisco IOS maintains an IDB for each interface present on a platform and maintains an IDB for each subinterface. Higher speed interfaces require more memory than lower speed interfaces. Each platform contains different amounts of maximum IDBs and these limits may change with each Cisco IOS release. However, there is a definite relationship between IDBs and DRAM. Maximum DRAM per each platform guarantees the maximum IDB limits per platform. Cisco IOS Software Release 12.2 supports the **show idb** command to view the maximum value. On some platforms, Cisco IOS Software Release 12.1(5)T and later support 10,000 IDBs. Cisco IOS Software Release 12.2(2)T introduces these maximum IDB limits for Cisco 2600 and 3600 series platforms:

Platform	IDB Limit
261x and 262x series	800 IDBs
265x series	800 IDBs
3620 and 3640	800 IDBs
3660	1400 IDBs

  See Maximum Number of Interfaces and Subinterfaces for Cisco IOS Platforms: IDB Limits for more information.
- The Catalyst 6000 Series and Cisco 7600 with FlexWAN uses an architecture that assigns a hidden VLAN for each physical interface and logical subinterface. A maximum of 4096 VLANs limits the total number of subinterfaces to a theoretical maximum of 4096. The IDB limit on the Catalyst 6000 Series and Cisco 7600 is currently limited by the maximum number of IDBs supported, which is 3000. Note this value when you configure a single PVC per subinterface across more two or more PA−A3s in FlexWAN interface modules.
- The maximum number of PA−A3s per Cisco 7200 series router is based on the data−carrying capacity, referred to as bandwidth, that affects the port adapter distribution in the chassis. This also affects the number and types of port adapters you can install. Depending on the processor model, the

Cisco 7200 series uses a concept of either bandwidth points or simply bandwidth. Each of the two Peripheral Component Interconnect (PCI) buses on the 7200 series supports 600 bandwidth points. The PA−A3 uses 300 bandwidth points. Note that the fast Ethernet port on the input/output (I/O) card also uses bandwidth points.

- When used in DSL deployments, the 7200 Series supports 8,000 Route Bridge Encapsulation (RBE) sessions with two PA−A3s and a recommended NPE−400. (Broadband features such as RBE support for VRFs are available in the Cisco IOS Software Release 12.2(4)B.) The 7500 Series supports an IDB limit of 2000, which forms the upper limit for the maximum number of DSL PPPoX sessions. Purchase of a software license is required when supporting more than 1000 sessions on a router. Refer to this resource for more information:

    - ♦ Cisco 7200/7400 in Broadband Aggregation Frequently Asked Questions
- On the 7500 Series, DSL aggregation features other than RFC 1483 routing are not switched by distributed Cisco Express Forwarding dCEF. As a result, platforms such as the 7200 Series, 7400 Series and the 10000 Series are recommended for DSL aggregation.

Related Information

- **Inverse Multiplexing Over ATM on Cisco 2600 and 3600 Routers**
- **Maximum Number of Interfaces and Subinterfaces for Cisco IOS Software Platforms: IDB Limits**
- **ATM Technology Support Pages**
- **Technical Support − Cisco Systems**

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