New Cisco T3/E3 ATM Network Module for the Cisco 2800 and 3800 Series Integrated Services Routers

Q. **What new functions does the new Cisco[®] T3/E3 ATM Network Module for the Cisco 2800 and 3800 Series Integrated Services Routers provide?**

A. The Cisco T3/E3 ATM Network Module provides ATM DS-3 or E3 WAN connectivity for enterprise and service provider customers for deployments at medium to large branch and regional offices (Figure 2). This combined T3/E3 ATM network module provides the option of an ATM connection of either 44 Mbps for DS-3/T3 or 34 Mbps for E3 using standard 75-ohm BNC connectors. The module supports ATM Forum-compliant framing standard ATM Adaption Layer 5 (AAL5), as well as ATM Traffic Management for unspecified bit rate (UBR), UBR+ (for switched virtual circuits [SVCs] only), real-time variable bit rate (VBR-rt), non-real time variable bit rate (VBR-nrt), constant bit rate (CBR), and available bit rate (ABR) classes of traffic.

The T3/E3 ATM network modules provide a cost-effective solution for deployment in the Cisco 2800 and 3800 Integrated Services Routers as service provider-managed customer premises equipment (CPE) or by enterprise customers for DS-3/E3 and fractional DS-3/E3 connectivity to medium to large branch and smaller regional office locations for multiservice data, voice, and video services over a single ATM link.

Q. **What platforms support the new Cisco 3800 Series T3/E3 ATM Network Module? What is the part number of this new T3/E3 ATM network module?**

A. The new T3/E3 ATM network module is supported on the modular Cisco 2800 Series Integrated Services Router (including the Cisco 2811, 2821, 2851, 3825, and 3845) platforms. The ordering product number for this new network module is NM-1A-T3/E3.

Figure 1.   Cisco T3/E3 ATM Network Module
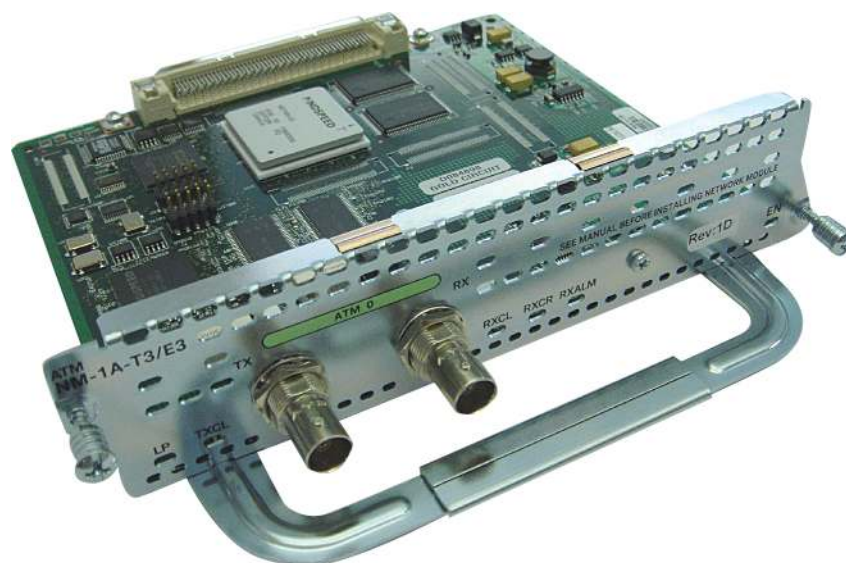
Q. What is the minimum Cisco IOS® Software release required to support the new T3/E3 ATM network module?

A. Cisco IOS Software 12.4(15)T is the minimum Cisco IOS Software release required.

Q. What Cisco IOS Software feature sets are the T3/E3 ATM network module supported on?

A. The network module is supported on Cisco IOS Software SP Services and above including the following feature sets:

- SP Services (spservicesk9)

- Enterprise Services (entservicesk9)

- Advanced IP Services (advipservicesk9)

- Advanced Enterprise Services (adventerprisek9)

Q. Are there any additional DRAM memory requirements for this network module?

A. No, there are no additional flash or DRAM memory requirements to support the T3/E3 ATM network module; the minimum memory requirements specified in the supported Cisco IOS Software release are sufficient.

Q. How does the T3/E3 ATM network module differ from the Cisco 3800 Series 1-Port DS-3 ATM Network Module (NM-1A-T3) and Cisco 3800 Series 1-Port E3 ATM Network Module (NM-1A-E3)?

A. The new T3/E3 ATM network module is based on a new hardware design. The new network module uses innovative technology similar to the Cisco 3800 Series ATM OC-3 Network Module (NM-1A-OC3-POM) to deliver greater flexibility and improved performance levels than the current separate T3/E3 network modules. The new T3/E3 ATM network module combines T3 and E3 functions and support to allow for maximum flexibility for worldwide deployment for the customer.

Q. How are the T3/E3 ATM network modules positioned and deployed?

A. The Cisco 3825 and 3845 can support full T3 or E3 wire-rate performance with a single network module. The Cisco 3845 supports two network modules, but the second module is generally recommended for backup deployment, because wire-speed performance of the second interface is not supported. On the Cisco 2800 Series, full wire-rate performance is supported only on the Cisco 2851. The Cisco 2821 and 2811 are recommended for branch office deployments when less than wire-rate performance is required; for instance, 5, 10, or 20 Mbps of throughput. Figure 2 shows a common ATM deployment for the Cisco integrated services router product family.

Figure 2.   Cisco T3/E3 ATM Network Module Typical Customer Deployment
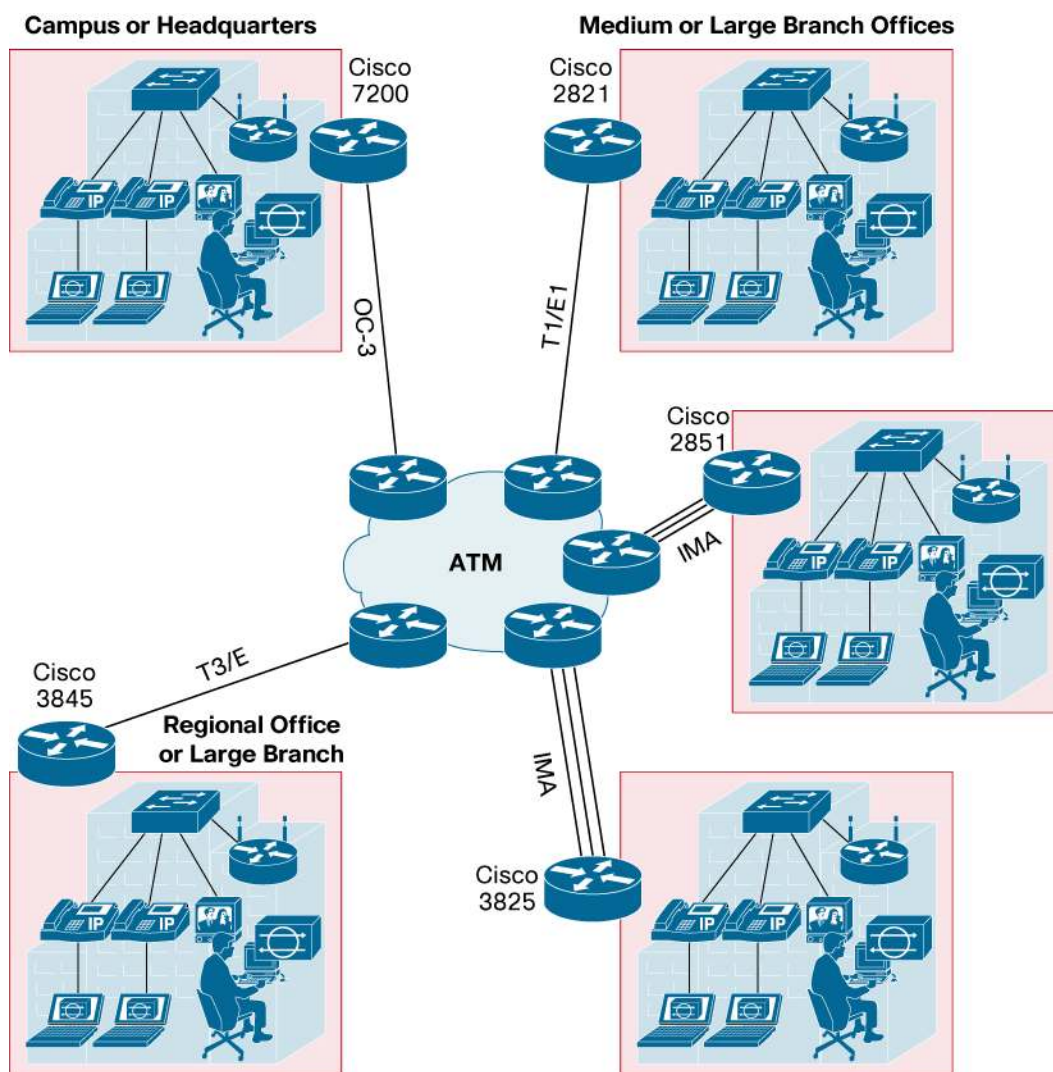
Q. **Is online insertion and removal (OIR) supported on this network module?**

A. Yes, but only on the Cisco 3845 Integrated Services Router. It is always safer to power down the router when you perform any hardware changes, but following are some recommendations if you need to perform an OIR (the system may indicate a hardware failure if you do not follow proper procedures):

- The interface must be shut down prior to removal.

- Insert only one card at a time, allowing time for the system to complete insertion steps; you must allow the system time to complete the preceding tasks before you remove or insert another interface processor. Disruption of the sequence before the system completes its verification can cause the system to detect spurious hardware failures.

- Insert the cards swiftly and firmly, but do not shove them in.

- Use the little plastic levers on the side of the card (if present) to lock the card in.

- If the OIR is successful, there is no need to schedule a reload of the router.

Q. **What cables should I use for this module?**

A. The T3/E3 ATM network module supports standard 75-ohm coaxial cable using a BNC connector type. The maximum distance for T3 is 450 ft and for E3, 1250 ft.

Q. **How many T3/E3 ATM network modules are supported in the Cisco 3825 and 3845?**

A. A maximum of one T3/E3 ATM network module is supported on the Cisco 3825; a maximum of two are supported on the Cisco 3845. The second T3/E3 network module in the Cisco 3845 is supported for connectivity purposes only, and line rate is not guaranteed.

Q. **What AALs are supported over the T3/E3 ATM network module?**

A. Only AAL5 is supported on this new T3/E3 network module; AAL2 is supported only on ATM T1/E1 interfaces for Cisco integrated services routers.

Q. **What ATM service categories are supported on the new T3/E3 ATM network module?**

A. UBR, CBR, VBR-rt, VBR-nrt, and ABR are supported.

Q. **Is VoIP over ATM supported on this new T3/E3 ATM network module?**

A. Yes, VoIP over ATM can be supported over the WAN using VBR-rt class-of-service SVCs with the currently available voice or fax network module and associated voice interface cards.

Q. **Does the new T3/E3 ATM network module support traffic shaping?**

A. Yes, the new network module supports Layer 2 per-virtual circuit queuing at the hardware level, and implements Layer 2 traffic-shaping capabilities in hardware using ABR, UBR, UBR+ (for SVCs only) VBR-rt, VBR-nrt, or CBR ATM traffic classes. Each of these services classes has a unique way to shape traffic for specific customer requirements. The Layer 2 per-virtual circuit queuing support for ATM traffic shaping has a simple mechanism that helps ensure that one or a few virtual circuits do not consume all the transmit resources on the router. This mechanism limits the number of transmit buffers available on a per-connection basis, thereby prohibiting a single virtual circuit or virtual path from oversubscribing the transmit resources of the interface. The new T3/E3 ATM network module has only one transmit queue for all virtual circuits.

Q. **What is the maximum number of virtual circuits supported on the new T3/E3 ATM network module? Can users always configure the maximum number of virtual circuits on it?**

A. A maximum of 1024 virtual circuits are supported for each network module. However, internally one virtual circuit descriptor is reserved for operation, administration, and maintenance (OAM), and users can use only 1023 virtual circuits. The Cisco 3845 supports up to 1400 virtual circuits, even though a maximum of two T3/E3 ATM network modules are supported on the platform. The virtual path identifier/virtual channel identifier (VPI/VCI) support range follows: VPI: 0–255; and VCI: 0–65535.

Optimizing the maximum 1023 virtual circuits may require users to select their VPI/VCI combinations carefully. More VPI numbers consume more memory resources. Cisco also recommends using consecutive VCI numbers and starting on multiples of 8. If a single VPI is employed, users can easily open 1023 consecutive VCIs. Alternatively, up to 511 different VPIs can be opened, with multiple VCIs corresponding to each VPI—again assuming consecutive VCI numbers are used and VCIs are opened on a multiple of 8. Given the worst case, users can open 511 completely sparse channels.

Q. **Can you change permanent-virtual-circuit (PVC) parameters while another PVC with a higher-priority traffic class is sending traffic at line rate?**

A. No, the PVC parameter cannot be changed while another PVC with a higher traffic class is sending traffic at line rate. The PVC with lower priority will remain inactive after any parameter changes. The PVC will be active again as long as there is bandwidth relief from higher-priority traffic.

According to the ATM Forum standard, CBR has the highest traffic class priority. VBR-rt has priority over VBR-nrt, and both ABR and UBR have the lowest priority.

Q. **What are permanent virtual paths (PVPs)? What is the maximum number of PVPs that can be supported on the new T3/E3 ATM network module?**

A. A PVP is a connection that is manually configured by a network operator and is provisioned by configuring ATM switch-to-switch cells using only the VPI in the cell header. The network module can support up to three PVPs.

Q. **Is the tx-ring-limit command still available under PVC on the new module?**

A. No, the **tx-ring-limit** configuration is no longer available on the per-virtual circuit level on this new ATM network module. Traditionally the **tx-ring-limit** command, which is available per virtual circuit level, is used as a lever to control latency when a virtual circuit is overdriven. A lower value given by this command is used to achieve less latency on latency-sensitive traffic at the cost of increased drops on the background traffic, whereas a higher value is used to have fewer drops in the background traffic by providing greater latency. This network module uses a new software scheme to improve the performance; the traditional tx-ring-limit concept is not applicable to this interface on the new network module. Therefore, the option to adjust the latency by tuning the **tx-ring-limit** configuration is not available on this module.

Q. **Is there any flow-control mechanism between the platform and the new T3/E3 ATM network module interface line card?**

A. Yes, the **queue-depth** command provides flow control between the host platform and the new T3/E3 ATM interface line card. On this line card, the `segmentation-and-reassembly` (SAR) mechanism has a queue for each PVC. Each PVC queue has two associated thresholds called the *high watermark* and *low watermark*. The high and low watermark settings define the number of cells the PVC interface queue can hold.

The high-watermark threshold triggers a flow-off signal, and the low-watermark threshold triggers a flow-on signal. The high watermark is the maximum number of cells that can be in the PVC queue. As long as the high watermark is reached, the virtual circuit is marked as the throttled and cells are held in Cisco IOS Software hold queue. As long as the number of cells in PVC queue is lower than low watermark, the virtual circuit is marked Open and traffic flow from the Cisco IOS Software hold queue to that virtual circuit resumes.

The **queue-depth** command gives customers flexibility to configure watermark values suitable for their applications. Following is the command:

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface atm 1/0
Router(config-if)#pvc 1/1
Router(config-if-atm-vc)#queue-depth ?
  <1-65535>  queue depth high watermark, in cells
Router(config-if-atm-vc)#queue-depth 200 ?
  <1-200>  queue depth low watermark, in cells
```

Even the high-watermark and low-watermark values are adjustable; Cisco recommends using default values of the watermarks whenever possible, keeping the use of the queue-depth command to an absolute minimum. A big high-watermark value may introduce more latency. Cisco does not recommend altering the default watermark values when sending small time-sensitive high-priority packets. High watermarks translate to bigger PVC queue sizes inside SAR, thus introducing higher latency. Low watermarks translate to a traffic-shaping mechanism within SAR. If the low watermark is too low, then SAR might drain the PVC queue completely, thus causing breakage in traffic shaping.

Adjusting the high and low watermarks by using the **queue-depth** command is recommended only when the PVC has a bandwidth of 10 Mbps or less, for packets experiencing large delays, and in cases where Low-Latency Queuing (LLQ) is not used. Users might experience large delays while transmitting large files with low-bandwidth PVCs. This command is subject to the scenario discussed previously.

Although the queue-depth command can configure the watermark to 65535/65535, Cisco does not recommend a maximum level. However, it should be noted that at extreme watermark settings, packets may be lost under certain traffic conditions.

Guidelines for Configuring Watermarks

Please follow the following guidelines to change the watermark values:

1. For better latency, decrease the high-watermark value.

2. For a higher number of cells in the queue or for better TCP performance, increase the high-watermark value.

3. Do not configure Low watermark value = High watermark value, because that configuration defeats the purpose of the flow-control mechanism.

4. Even though the command-line interface (CLI) allows the high-watermark value to go up to 65535, it is not recommended to go that high. The high-watermark value translates to queues within SAR, and how high a high watermark can go is a function of SAR memory because the queues are inside SAR. For 1024 virtual circuits, if the high watermark is configured above 400 cells, then SAR can run out of memory, a situation that will result in dropped packets.

Q. **How are traffic-shaping rates (peak cell rate [PCR], sustainable cell rate [SCR], and maximum cell rate [MCR]) calculated in the new ATM network module? Can the new network module support 100-percent accuracy for traffic shaping?**

A. The traffic-shaping rates are configured in kbps and communicated to the traffic-shaping processor by converting the configured rate, specified in cells per second, to the ATM Forum rate format (per ATM Forum Traffic Management Specification 4.1 [TM 4.1]). Converting to the ATM Forum format rate does not allot the user infinite precision. As a result, the number calculated using the ATM rate format is slightly different from the configured PCR. Because shaping rates are rounded down (for PCR, SCR, and MCR), the actual rates may fall slightly below the specified rates, but they always fall within 1 percent of the specified rates. Rounding down is necessary to avoid violating a downstream device with a higher rate than that specified. For this reason the new network module can support 99 percent or more accuracy for traffic shaping.

The configured shaping rate is shown in the show atm vc output, but the actual received rate might be slightly different, and the difference will be less than 1 percent.

Q. **Does the new T3/E3 ATM network module support network clocking?**

A. Yes, network clocking is supported. The clock can be derived from the T3/E3 ATM link and passed to the backplane time-division multiplexing (TDM) bus. The clock can also be taken from the backplane TDM bus to lock the network module to the derived clock.

Q. **What is the ATM Bandwidth Manager feature?**

A. The ATM Bandwidth Manager feature keeps track of the bandwidth used by a virtual circuit on a per-interface basis. This user-configurable feature prevents oversubscription of the ATM link. ATM Bandwidth Manager for CBR is turned on automatically for all interfaces supporting CBR. All other ATM service categories need to be manually configured.

For More Information

For more information about the Cisco T3/E3 ATM Network Module, please visit http://www.cisco.com/en/US/prod/collateral/routers/product_promotion0900aecd8017150a.html.

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