

# Cisco 3600 Series Memory Options and Configuration Guide

## Introduction

This Product Bulletin for the Cisco 3600 Series covers the following:

- Processor and memory specifications
- Platform hardware overview
- Cisco 3600 Series memory
- Cisco IOS® minimum DRAM and Flash memory requirements
- Factory standard DRAM and Flash memory options
- Memory rules
- Main and shared DRAM functionality
- Network module memory requirements
- Flash and personal computer memory card international association (PCMCIA) memory options
- Factors that affect default memory configurations
- Memory product numbers and APV

## Processor and Memory Specifications

Table 1 Processor and Memory Specifications

	Cisco 3620	Cisco 3640	Cisco 3660
Processor	80 Mhz IDT RISC R4700	100 Mhz IDT RISC R4700	225 Mhz QED RISC RM5271
Memory (Main plus Share)	4 to 64 MB DRAM	4 to 128 MB DRAM	32 to 256 MB SDRAM
Flash SIMM	4 to 32 MB	4 to 32 MB	8 to 64 MB
Flash PCMCIA	4 to 32 MB	4 to 32 MB	8 to 32 MB
NVRAM	32K	128K	128K
ROM Monitor memory	512K	512K	512K

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## Platform Hardware Overview

### Cisco 3660

- 255 Mhz RM5271 RISC processor with 32K internal cache
- System controller with PCI bus and 4 DMA channels
- 25Mhz PCI based 6-slot bus
- 64-bit wide DRAM memory system
- Two 10ns, 168-pin DIMM slots for up to 256 MB of SDRAM
- Non-parity and parity SDRAM DIMMS supported
- Two 80-pin SIMM slots for up to 64 MB of Flash memory
- Six general purpose PCI bus slots for Network Modules
- Two PCMCIA slots for additional Flash memory capabilities
- 115.2 kbps asynchronous support for console and auxiliary ports
- No xboot functionality. Netbooting not supported in Remote Monitoring (RMON) mode

### Cisco 3640

- 100 Mhz R4700 RISC processor with 32K internal cache
- System controller with PCI bus and 4 DMA channels
- 25 Mhz PCI based 4-slot bus
- 64-bit wide DRAM memory system (configurable for 32 bit also)
- Four 60ns,72-pin SIMM slots for up to 128 MB of DRAM
- Non-parity DRAM SIMMS supported
- Two 80-pin SIMM slots for up to 32 MB of Flash memory
- Four general purpose PCI bus slots for network modules
- Two PCMCIA slots for additional Flash memory capabilities
- 115.2 kbps asynchronous support for console and auxiliary ports
- No xboot functionality. Netbooting not supported in RMON mode

### Cisco 3620

- 80 Mhz R4700 RISC processor
- System controller and PCI bus interface
- 20 Mhz PCI based 2 slot bus
- 32-bit wide DRAM memory system
- Four 60ns, 72-pin SIMM slots for up to 64 MB of DRAM
- Non-parity DRAM SIMMS supported
- Two 80-pin SIMM slots for up to 32 MB of flash memory
- Two general purpose PCI bus slots for network modules
- Two PCMCIA slots for additional Flash memory capabilities
- 115.2 kbps asynchronous support for console and auxiliary ports
- No xboot functionality. Netbooting not supported in RMON mode

The following table list the maximum number of Network Modules that can be configured on a Cisco 3640/3620, and the minimum Cisco IOS version required.

Table 2 Cisco 3600 Series Maximum Network Modules Supported

Network Module	Cisco 3620 Max	Cisco 3640 Max	Cisco 3660 Max	Minimum Cisco IOS Version
NM-1E2W	2	4	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: 12.0(5)T
NM-2E2W	2	4	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: 12.0(5)T
NM-1E1R2W	2	4	6	Cisco 3640/3620: 11.1(8+)AA Cisco 3660: 12.0(5)T
NM-1E	2	4	6	Cisco 3640/3620: 11.2(4)XA Cisco 3660: 12.0(5)T
NM-4E	2	4	6	Cisco 3640/3620: 11.2(6)P Cisco 3660: 12.0(5)T
NM-1FE-TX	2	4	4 <sup>1</sup>	Cisco 3640/3620: 11.2(6)P Cisco 3660: 12.0(5)T
NM-1FE-FX	2	4	4 <sup>1</sup>	Cisco 3640/3620: 11.2(10)P Cisco 3660: 12.0(5)T
NM-1FE-1CT1 NM-1FE-1CT1-CSU	2	3	4 <sup>1</sup>	Cisco 3640/3620: 11.3(4)T or later Cisco 3660: 12.0(5)T
NM-1FE-2CT1 NM-1FE-2CT1-CSU	2	3	4 <sup>1</sup>	Cisco 3640/3620: 11.3(4)T or later Cisco 3660: Q1CY200
NM-1FE-1CE1B NM-1FE-1CE1U	2	3	4 <sup>1</sup>	Cisco 3640/3620: 11.3(4)T or later Cisco 3660: Q1CY200
NM-1FE-2CE1B NM-1FE-2CE1U	2	3	4 <sup>1</sup>	Cisco 3640/3620: 11.3(4)T or later Cisco 3660: Q1CY200
NM-1HSSI	1	3	4	Cisco 3640/3620: 11.2(6)P Cisco 3660: 12.0(5)T
NM-4T	1	3	6	Cisco 3640/3620: 11.2(4)XA Cisco 3660: 12.0(5)T
NM-16A	1	3	6	Cisco 3640/3620: 11.2(7)P Cisco 3660: 12.0(5)T
NM-32A	1	3	6	Cisco 3640/3620: 11.2(7)P Cisco 3660: 12.0(5)T
NM-4A/S	1	3	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: 12.0(5)T
NM-8A/S	1	3	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: 12.0(5)T
NM-4B-U	1	3	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-8B-U	1	3	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-4B-S/T	1	3	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-8B-S/T	1	3	6	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200

Table 2 Cisco 3600 Series Maximum Network Modules Supported (Continued)

Network Module	Cisco 3620 Max	Cisco 3640 Max	Cisco 3660 Max	Minimum Cisco IOS Version
NM-1CT1	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-1CT1-CSU	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-2CT1	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-2CT1-CSU	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-1CE1B	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-1CE1U	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-2CE1B	1	3	5	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
NM-2CE1U	1	3	3	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: Q1CY200
AIM-COMPR4	0	0	2	Cisco 3660: 12.0(5)T
NM-COMPR	1	1	0	Cisco 3620: 11.2(7)P
NM-6D-MODEM	1 <sup>2</sup>	2	5	Cisco 3640: 11.2(9)XA Cisco 3660: Q1CY200
NM-12D-MODEM	1 <sup>2</sup>	2	5	Cisco 3640: 11.2(9)XA Cisco 3660: Q1CY200
NM-18D-MODEM	1 <sup>2</sup>	2	4	Cisco 3640: 11.2(9)XA Cisco 3660: Q1CY200
NM-24D-MODEM	1 <sup>2</sup>	2	4	Cisco 3640: 11.2(9)XA Cisco 3660: Q1CY200
NM-30D-MODEM	1 <sup>2</sup>	2	4	Cisco 3640: 11.2(9)XA Cisco 3660: Q1CY200
NM-HDV-1T1-24	1	3	6	Cisco 3600 Series: 12.0(5)XK, 12.0(6)T or later
NM-HDV-1T1-24E	1	3	6	Cisco 3600 Series: 12.0(5)XK, 12.0(6)T or later
NM-HDV-2T1-48	1	2	6	Cisco 3600 Series: 12.0(5)XK, 12.0(6)T or later
NM-1ATM-25	1	2	TBD	Cisco 3640/3620: 11.3(3a)T or later Cisco 3660: Q1CY200
NM-1A-OC3MM	1	1	2	Cisco 3640/3620: 12.0(3)T or later Cisco 3660: 12.0(5)T or later
NM-1A-OC3SMI	1	1	2	Cisco 3640/3620: 12.0(3)T or later Cisco 3660: 12.0(5)T or later
NM-1A-OC3SML	1	1	2	Cisco 3640/3620: 12.0(3)T or later Cisco 3660: 12.0(5)T or later

Table 2 Cisco 3600 Series Maximum Network Modules Supported (Continued)

Network Module	Cisco 3620 Max	Cisco 3640 Max	Cisco 3660 Max	Minimum Cisco IOS Version
NM-4T1-IMA	1	3	6	Cisco 3600 Series: 12.0(5)T or later
NM-4E1-IMA	1	3	6	Cisco 3600 Series: 12.0(5)T or later
NM-8T1-IMA	1	3	6	Cisco 3600 Series: 12.0(5)T or later
NM-8E1-IMA	1	3	6	Cisco 3600 Series: 12.0(5)T or later

1. The Cisco 3660 will support 4 NM-1FE-TX/FX modules if the internal Fast Ethernet interfaces are not used.

2. With any of these modules installed: NM-1FE1CT1, NM-1FE1CT1-CSU, NM-1FE2CT1, NM-1FE2CT1-CSU, NM-1FE1CE1B, NM-1FE1CE1U, NM-1FE2CE1B, and NM-1FE2CE1U

Table 3 WAN Interface Cards Maximum Network Modules Supported

WAN Interface Card	Maximum Per Combo (NM-1E2W,2E2W,1E1R)	Minimum Cisco IOS Version
WIC-1T	2	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: 12.0(5)T
WIC-1DSU-T1	2	Cisco 3640/3620: 11.1(7+)AA Cisco 3660: 12.0(5)T
WIC-1B-S/T	2	Cisco 3640/3620: 11.2(4)XA Cisco 3660: 12.0(5)T
WIC-1B-U	2	Cisco 3640/3620: 11.2(4)XA Cisco 3660: 12.0(5)T
WIC-1DSU-56K4	2	Cisco 3640/3620: 11.2(4)XA Cisco 3660: 12.0(5)T

**Note:** 2 NM-1FE + 2 NM-4E - not supported, 1 NM-1FE + 3 NM-4E - not supported

### Cisco 3600 Series Memory

The Cisco 3600 Series supports run-from-ram images only. The Cisco 3600 Series routers support the following types of memory:

- *Main processor memory*—Used to store the running configuration and routing tables. Cisco IOS software is executed from the main memory.
- *Shared (packet) memory*—Used for packet buffering by the router's network interfaces.
- *Flash memory*—Used to store the IOS® software image. Can be stored on either the Flash SIMM, or PCMCIA card.
- *Nonvolatile random-access memory (NVRAM)*—Used to store the system configuration file and the virtual configuration register.
- *EPROM-based memory*—Stores the ROM monitor, that allows booting an operating system software image from Flash or PCMCIA memory when Flash memory does not contain a valid boot helper image.

## Minimum Memory Requirements for DRAM and Flash

Table 4 Cisco 3600 Series Minimum Memory Requirements for 12.0(5)T

Feature Set	Minimum Flash	Minimum DRAM
IP Only	8 MB	24 MB
IP Plus	8MB	32 MB
IP Plus 40	8 MB	32 MB
IP Plus IPSec 56	8 MB	32 MB
IP/IPX®/AT/DEC	8 MB	24 MB
IP/IPX/AT/DEC Plus	8 MB	32 MB
Enterprise Plus	8 MB	48 MB
Enterprise Plus 40	8 MB	48 MB
Enterprise Plus IPSec 56	8 MB	48 MB
Enterprise/APPN/Plus	16 MB	48 MB
Enterprise/APPN/Plus40	16 MB	48 MB
Enterprise/APPN/Plus IPSec 56	16 MB	48 MB

### Standard Default Factory Options for DRAM and Flash Changes to New System Cisco 3600 Series Default Memory Configuration

As of October 26th, 1998 the Cisco 3600 Series default DRAM memory size has been increased to 32 MB (MEM3600-32D-INCL) replacing the old default of 16 MB. This replaces the existing 16 MB DRAM memory option available on both the Cisco 3640 and Cisco 3620.

The 32 MB DRAM memory default is available on all new system orders placed after October 26th, 1998 on the following feature sets including: 11.1A, 11.2P, 11.3, 11.3T, 12.0, and 12.0T. There will be no additional charge for this memory increase. The Cisco 3600 Series minimum DRAM memory requirement of 24 MB for the IP and IP/IPX/AT/DEC feature sets is still valid for customers who are upgrading to 12.0(1) or 12.0(1)T, and who currently run with 16 or 20 MB of DRAM memory. There are no changes to the Cisco 3600 Series Flash memory default, currently set at 4 MB.

The new DRAM product numbers will include:

- Cisco 3630 (DRAM)
  - MEM3620-32U48D
  - MEM3620-32U48D
  - MEM3620-32U64D
- Cisco 3640 (DRAM)
  - MEM3640-32U48D
  - MEM3640-32U64D
  - MEM3640-32U128D
- Cisco 3660 (SDRAM)
  - MEM3660-32D
  - MEM3660-64D
  - MEM3660-128D

The obsoleted DRAM product numbers for the Cisco 3620 will include:

- MEM3620-16U24D
- MEM3620-16U32D
- MEM3620-16U48D
- MEM3620-16U64D

The following include the only memory options that are orderable from the factory. If additional memory is required because of the network module configuration, or IOS image size, then only the below configurations are available. Customers may choose to purchase additional memory elsewhere in order to obtain non-standard, and in some cases non-64-bit wide memory configurations.

Memory options orderable from factory for the Cisco 3640:

- MEM3640-16U24D
- MEM3640-16U32D
- MEM3640-16U48D
- MEM3640-16U64D
- MEM3640-16U128D

Memory options orderable from factory for the Cisco 3660:

- MEM3660-32U64D
- MEM3660-32U96D
- MEM3660-32U128D
- MEM3660-32U256D

Table 5 Flash Memory product numbers

Product number	Description
MEM3600-4FC	4 MB Blank Flash PCMCIA Card
MEM3600-8FC	8 MB Flash Card
MEM3600-16FC	16 MB Flash Card
MEM3600-8U16FS	8 to 16 MB Flash Factory Upgrade
MEM3600-8U32FS	8 to 32 MB Flash Factory Upgrade

Table 6 Cisco 3660 SDRAM Standard Factory Options

Slot 0	Slot 1	Total Memory
32MB	–	32 MB
32MB	32 MB	64 MB
64MB	–	64 MB
64MB	32 MB	96 MB
64MB	64 MB	128 MB
128MB	–	128 MB
128MB	128 MB	256 MB

Table 7 Cisco 3640 DRAM Standard Factory Options

Slot 0	Slot 1	Slot 2	Slot 3	Total Memory
8MB	8 MB	–	–	16 MB
8MB	8 MB	4 MB	4 MB	24 MB
16MB	16 MB	–	–	32 MB
16MB	16 MB	8 MB	8 MB	48 MB
32MB	32 MB	–	–	64 MB
32MB	32 MB	32 MB	32 MB	128 MB

Table 8 Cisco 3620 DRAM Standard Factory Options

Slot 0	Slot 1	Slot 2	Slot 3	Total Memory
16MB	–	–	–	16 MB
8MB	8 MB	4 MB	4 MB	24 MB
16MB	16 MB	–	–	32 MB
16MB	16 MB	16 MB	–	48 MB
16MB	16 MB	16 MB	16 MB	64 MB

**Note:** Cisco 3620 does not support double sided SIMMs or 64-bit addressing

Table 9 Cisco 3660 Flash Standard Factory Options

Slot 0	Slot 1	Total Memory	Notes
8MB	–	8 MB	Minimum memory requirement—No DBF support
16MB	–	16 MB	DBF support
16MB	16MB	32 MB	DBF support

Table 10 Cisco 3640/3620 Flash Standard Factory Options

Slot 0	Slot 1	Total Memory	Notes
4MB	–	4 MB	Minimum memory requirement—No DBF support
8MB	–	8 MB	DBF support
8MB	8 MB	16 MB	DBF support

**Note:** Slot 0 supports two separate banks. Slot 1 only supports a single bank SIMM (double-sided SIMM looks like a single 8 MB SIMM).

## Memory Rules

The Cisco 3620, Cisco 3640 and Cisco 3660 have different memory options and product numbers due to the difference in memory architectures. The Cisco 3640 can support industry standard dual-bank 8 and 32 MB SIMMs, because of its 64-bit memory architecture. The Cisco 3620, with a 32-bit architecture, cannot use dual-bank SIMMs, but instead uses a custom Cisco 8 MB single-bank SIMM. It cannot be mixed with the dual-bank 8 MB SIMMs. Both the Cisco 3620 and Cisco 3640 use the same 4 MB and 16 MB SIMMs, but have different product numbers. By default, the 3640 and 3620 ship with non-parity DRAM SIMMS, but parity SIMMs are supported if all banks contain SIMMs that have parity enabled. If parity SIMMs are mixed in a system with non-parity SIMMs the parity function is not supported on any of the SIMMs. Only certain combinations of DRAM SIMMS are permitted. These combinations are shown in Table 6 for the Cisco 3660, in Table 7 for the Cisco 3640 and in Table 8 for the Cisco 3620.

### General Guidelines

- The sum of memory in slots 0 and 1 must be a power of 2 in order to stuff slots 2 and 3.
- Largest memory sizes must always be first.
- No holes. An unoccupied slot cannot be followed by an occupied one.
- ROM monitor will display a warning message if illegal SIMM placement or sizing has occurred.

For the Cisco 3660 the following SDRAM rule apply:

1. The SIMM in socket 0 must be of the same size or larger in megabyte, than the SIMM in socket 1.

For 64-bit mode operation on the Cisco 3640 the following DRAM rules apply:

1. The SIMMs in sockets 0 and 1 must be of the same size in megabyte, and have the same access time in ns.
2. The SIMMs in sockets 2 and 3 must be of the same size and also have the same access time in ns.
3. The size of the SIMMs in sockets 2 and 3 must be less then or equal to the size of the SIMMs in sockets 0 and 1.

For the Cisco 3620 the following rules apply:

1. In order to use banks 2 and 3, the SIMMs in banks 0 and 1 must be identical.
2. The SIMMs in banks 0 and 1 must be the same size or greater then those SIMMs located in banks 2 and 3.

Table 11 Cisco 3640 32-bit Wide DRAM Configurations

Bank 0 (SIMM 0)	Bank 1 (SIMM 1)	Bank 2 (SIMM 2)	Bank 3 (SIMM 3)	Total Memory
4MB	4 MB	8 Mb	–	16 MB
4MB	16MB	–	–	20 MB
8MB	16 MB	–	–	24 MB
8MB	8 MB	4 MB	–	20 MB
8MB	8 MB	8 MB	–	24 MB
8MB	8 MB	4 MB	8 MB	28 MB
8Mb	8 MB	8 MB	4 MB	28 MB
8MB	8 MB	16 MB	–	32 MB
16MB	–	–	–	16 Mb
16MB	4 MB	–	–	20 MB
16MB	8 MB	–	–	24 MB

Table 11 Cisco 3640 32-bit Wide DRAM Configurations (Continued)

Bank 0 (SIMM 0)	Bank 1 (SIMM 1)	Bank 2 (SIMM 2)	Bank 3 (SIMM 3)	Total Memory
16MB	16 MB	4 MB	–	36 MB
16MB	16 MB	8 MB	–	40 MB
16MB	16 MB	8 MB	4 MB	44 MB
16MB	16 MB	4 MB	8 MB	44 MB
16MB	16 MB	16 MB	–	48 MB
16Mb	16 MB	16 MB	4 MB	52 MB
16MB	16 MB	4 MB	16 MB	52 MB
16MB	16 MB	16 MB	8 MB	56 Mb
16MB	16 MB	8 MB	16 MB	56 MB

Table 12 Cisco 3640 64-Bit Wide DRAM Configurations

Bank 0 (SIMM 0)	Bank 1 (SIMM 1)	Bank 2 (SIMM 2)	Bank 3 (SIMM 3)	Total Memory
4MB	4 MB	4 MB	4 MB	16 MB
8MB	8 MB	–	–	16 MB
8MB-DUAL	8 MB-DUAL	–	–	16 MB
8MB	8 MB	4 MB	4 MB	24 MB
8MB-DUAL	8 MB-DUAL	4 MB	4 MB	24 MB
8MB	8 MB	8 MB	8 MB	32 MB
8MB-DUAL	8 MB-DUAL	8 MB	8 MB	32 MB
8MB	8 MB	8 MB-DUAL	8 MB-DUAL	32 MB
8MB-DUAL	8 MB-DUAL	8 MB-DUAL	8 MB-DUAL	32 MB
16MB	16 MB	–	–	32 MB
16MB	16 MB	4 MB	4 MB	40 MB
16MB	16 MB	4 MB	4 MB	40 MB
16MB	16 MB	8 MB	8 MB	48 MB
16MB	16 MB	8 MB-DUAL	8 MB-DUAL	48 MB
16MB	16 MB	16 MB	16 MB	64 MB
32MB-DUAL	32 MB-DUAL	–	–	64 MB

Table 12 Cisco 3640 64-Bit Wide DRAM Configurations (Continued)

Bank 0 (SIMM 0)	Bank 1 (SIMM 1)	Bank 2 (SIMM 2)	Bank 3 (SIMM 3)	Total Memory
32MB-DUAL	32 MB-DUAL	4 MB	4 MB	72 MB
32MB-DUAL	32 MB-DUAL	8 MB	8 MB	80 MB
32MB-DUAL	32 MB-DUAL	8 MB-DUAL	8 MB-DUAL	80 MB
32MB-DUAL	32 MB-DUAL	16 MB	16 MB	96 MB
32MB-DUAL	32 MB-DUAL	32 MB-DUAL	32 MB-DUAL	128 MB

Table 13 32-Bit Wide DRAM Configurations for Cisco 3620

Bank 0 (SIMM 0)	Bank 1 (SIMM 1)	Bank 2 (SIMM 2)	Bank 3 (SIMM 3)	Total Memory
4 MB	4 MB	4 MB	4MB	16 MB
4MB	4 MB	8 MB	–	16 MB
4MB	16 MB	–	–	20 MB
8MB	8 MB	–	–	16 MB
8MB	16 MB	–	–	24 MB
8MB	8 MB	4 MB	–	20 MB
8MB	8 MB	8 MB	–	24 MB
8MB	8 MB	16 MB	–	32 MB
8MB	8 MB	4 MB	4 MB	24 MB
8MB	8 MB	4 MB	8 MB	28 MB
8MB	8 MB	8 MB	4 MB	28 MB
8MB	8 MB	8 MB	8 MB	32 MB
16MB	–	–	–	16 MB
16MB	4 MB	–	–	20 MB
16MB	8 MB	–	–	24 MB
16MB	16 MB	–	–	32 MB
16MB	16 MB	4 MB	–	36 MB
16MB	16 MB	4 MB	4 MB	40 MB
16MB	16 MB	4 MB	8 MB	44 MB
16MB	16 MB	4 MB	16 MB	52 MB
16MB	16 MB	8 MB	–	40 MB
16MB	16 MB	8 MB	4 MB	44 MB

Table 13 32-Bit Wide DRAM Configurations for Cisco 3620 (Continued)

Bank 0 (SIMM 0)	Bank 1 (SIMM 1)	Bank 2 (SIMM 2)	Bank 3 (SIMM 3)	Total Memory
16MB	16 MB	8 MB	8 MB	48 MB
16MB	16 MB	16 MB	–	48 MB
16MB	16 MB	16 MB	4 MB	52 MB
16MB	16 MB	16 MB	8 MB	56 MB
16MB	16 MB	16 MB	16 MB	64 MB

**Note:** The valid memory configurations can also be found on the router when in the RMON mode. The command `meminfo-1` will display valid memory configurations.

### Main and Shared DRAM Memory Functionality

The Cisco 3660, Cisco 3640 and Cisco 3620 platforms are partitioned into main processor memory (pmem), and shared packet memory (I/O memory) area's. The IOS software is capable of making a distinction between the two with a finer granularity than if there were hardware distinctions between the two. For example, with 16 MB DRAM configurations, the memory is split by default into 12MB for pmem and 4MB for I/O memory. This 75/25 split occurs upon system initialization, and allows enough packet memory to bring up the most common interface combinations regardless of the total amount of DRAM present in the Cisco 3640/3620 and SDRAM in the Cisco 3660.

In addition, user's have the ability to choose from several options to change this split when required. The new IOS command `memory-size` (I/O memory) percentage allows DRAM split increases of 30, 40 and 50 percent depending on the type and number of network modules configured.

The Cisco IOS supports an auto-adjusting feature upon startup in which if the I/O memory-percentage has been configured too high; leaving insufficient pmem available for bringing up the IOS image, then the IOS automatically reduces the percentage to a lower value. If the default is not sufficient for an image to boot up, then the user does not have enough DRAM/SDRAM for that particular subset image, and the router will complain in the same manner as existing Cisco platforms that encounter insufficient processor memory.

Main and packet DRAM/SDRAM cannot share or borrow from the other as on the 25xx series routers. If the main DRAM/SDRAM memory is insufficient then either an increase in memory is required; or if the memory size had be adjusted via the IOS, then it would require a decrease.

At least 2 MB of free processor memory and 1.2 MB of free I/O memory is required for most average size networks. You can use the Cisco IOS command `show memory free` to view the amount of used and available system memory.

Table 14 Default Processor Memory / IO Memory Split

Total DRAM/SDRAM	Processor Memory	I/O Memory
16 MB	12 MB	4 MB
20 MB	15 MB	5 MB
24 MB	18 MB	6 MB
32 MB	24 MB	8 MB
40 MB	30 MB	10 MB
48 MB	36 MB	12 MB
64 MB	48 MB	16 MB
96 MB	72 MB	24 MB
128 MB	96 MB	32 MB

### Network Modules Memory Requirements

The amount of packet memory required is dependent on the number and types of Network Modules configured, but is also dependent on the amount of memory the Cisco IOS uses for each specific feature. For example, additional processor and packet memory is used when a CT1 or CE1 is configured for Integrated Services Digital Network (ISDN). When the CT1 or CE1 network modules are used in channelized mode much less memory is required. See Table 15 below.

For two or more T1/E1 PRIs, or 12 or more basic rate interfaces (BRIs) configured, Cisco recommends a 60/40 memory split. At this time, the Cisco 3600 Series is shipped with a default memory split of 75/25, so the user will have to reconfigure with the Cisco IOS command `memory-size I/O memory 40`, or they may receive a `SYS-2 MALLOCFAIL` error message. This error message occurs when less than 1.2 MB of free I/O memory is available for system use. Increasing the I/O memory size will eliminate this error message.

Table 15 shows the total amounts of memory required, which is a combination of processor and packet memory. The CT1 and CE1 numbers are based on memory required when ISDN Primary-group timeslots have been configured.

Table 15 Network Module Memory Requirements for Various Combinations

Network Module	Minimum Memory Required
NM-16A	0.4 MB
NM-32A	0.8 MB
NM-1FE-TX	0.4 MB
NM-1FE-1CT1, NM-1FE-1CT1-CSU	2.48 MB
NM-1FE-2CT1, NM-1FE-2CT1-CSU	3.68 MB
NM-1FE-1CE1B, NM-1FE-1CE1U	2.82 MB
NM-1FE-2CE1B, NM-1FE-2CE1U	4.35 MB
NM-COMP	0.78 MB
NM-4E	0.7 MB
NM-4T	0.3 MB

Table 15 Network Module Memory Requirements for Various Combinations (Continued)

Network Module	Minimum Memory Required
NM-1E	0.2 MB
1E	0.2 MB
2E2T	514K
1E2T	360K
2E1T1B	522K
1E1T1B	378K
1E1R2T	432K
1E1R1T1B	450K
1 CT1	2.6 MB
2 CT1	4.4 MB
3 CT1	6.2 MB
4 CT1	8.0 MB
5 CT1	9.8 MB
6 CT1	11.6 MB
1 CE1	3.0 MB
2 CE1	5.4 MB
3 CE1	8 MB
4 CE1	10.2 MB
5 CE1	12.5 MB
6 CE1	15.0 MB
8B	2.2 MB
4B	1.1 MB
8 A/S	0.6 MB
4 A/S	0.3 MB

**Note:** 1.2MB of free I/O memory is required for all systems regardless of the network modules configured.

As a basic rule of thumb the required DRAM memory for a 60/40 split of each T1/primary rate interface (PRI) can be calculated by assuming that each module requires 4.5 MB of memory, and the E1/PRI requires 6 MB of memory. If the total number is above a factory orderable size then the next available orderable size is recommended.

Table 16 Minimum Memory Requirements Based on 60/40 Memory Split<sup>1</sup>

Quantity	Network Module	Memory Required
1	NM-1CT1	16 MB
2	NM-1CT1	16 MB
3	NM-1CT1	16 MB
1	NM-2CT1	16 MB
2	NM-2CT1	24 MB
2 (5 total)	NM-2CT1 + 1 NM-1CT1	24 MB
3	NM-2CT1	32 MB
1	NM-1CE1B or NM-1CE1U	16 MB
2	NM-1CE1B or NM-1CE1U	16 MB
3	NM-1CE1B or NM-1CEU	24 MB
1	NM-2CE1B or NM-2CE1U	16 MB
2	NM-2CE1B or NM-2CE1U	24 MB
3	NM-2CE1B or NM-2CE1U	48 MB
1 (3 total)	NM-2CE1B + 1 NM-1CE1B	24 MB
2 (5 total)	NM-2CE1B + 1 NM-1CE1B	32 MB
1	NP-8B	16 MB
1	NM-1ATM-25	32 MB
2	NM-1ATM-25	48 MB
1	NM-1A-OC3MM /MI/ML	32 MB
1	NM-4T1-IMA/ NM-4E1-IMA	48 MB
1	NM-8T1-IMA/ NM-8E1-IMA	48 MB
2	NM-4T1-IMA/ NM-4E1-IMA	48 MB
2	NM-8T1-IMA/ NM-8E1-IMA	48 MB
2	NP-8B	16 MB
3	NP-8B	24 MB
1	NP-8B + 1 NP4B	24 MB
1	NM-HDV-1T1-24/ NM-HDV-1T1-24E	32 MB
2	NM-HDV-1T1-24/ NM-HDV-1T1-24E	32 MB

Table 16 Minimum Memory Requirements Based on 60/40 Memory Split<sup>1</sup> (Continued)

Quantity	Network Module	Memory Required
1	NM-HDV-2T1-48	32 MB
2	NM-HDV-2T1-48	48 MB
3	NM-HDV-2T1-48	64 MB
4	NM-HDV-2T1-48	128 MB

1. These minimum memory requirements are based on IP only feature sets. Other feature sets do require more memory. Please refer to Tables 2 and 3 for details.

**Note:** The NM-1CT1-CSU requires the same amount of additional memory as the NM-1CT1, and the NM-2CT1-CSU requires the same amount of additional memory as the NM-2CT1.

Table 17 Detailed CE1 Network Module Processor and I/O Memory Breakdown

Network Module	Processor Memory	I/O Memory
1st 2-port Channelized E1	885k	330K
Each additional 2-port CE1	75k	330K
1st 2-port PRI E1	2230k	3300K
Each additional 2-port PRI	1420k	3300K
4 CE1 no configuration	851k	0.6K
6 CE1 no configuration	873	0.6K
2 CE1 1 channel 30 timeslots	859k	161k
2 CE1 2 channels 30 timeslots	883k	315k
4 CE1 3 channels 30 timeslots	923k	469K
4 CE1 4 channels 30 timeslots	952k	624K
6 CE1 5 channels 30 timeslots	999k	880K
6 CE1 5 channels 30 timeslots	1023k	1034K
2 CE1 1 Full PRI	1532k	1449K
2 CE1 2 Full PRI	2227k	3197K
4 CE1 3 Full PRI	2945k	4949K
4 CE1 4 Full PRI	3638k	6596K
6 CE1 5 Full PRI	4354k	8245K
6 CE1 6 Full PRI	5050k	9995K

## Flash and PCMCIA Memory Options

### Flash SIMM

The Cisco 3600 Series routers contain two Flash memory SIMM sockets for storing the Cisco IOS software image. These SIMMs are not interchangeable with the DRAM SIMMs in the Cisco 3640/3620 and the SDRAM DIMMs in the Cisco 3660. The Flash memory can be upgraded by replacing the existing SIMM with an 8 or 16 MB SIMM, or by adding an additional SIMM to the 2nd Flash memory socket. Unequal value SIMMs are supported by Flash. You must always have at least 1 Flash SIMM installed in the router for normal operations. Partitioning of the Flash memory (Dual Bank Flash [DBF]) is supported if the router is configured for at least 8MB of memory.

### Flash PCMCIA

The Cisco IOS software image can also be stored on a PCMCIA Flash card on either of the 2 available PCMCIA slots provided on the Cisco 3660, Cisco 3640 and Cisco 3620. Partitioning is also supported on the PCMCIA cards that support 8 MB or more capacity.

## Factors that Affect Default Memory Configurations

The size of the Network routing tables and access lists have the greatest impact on the amount of DRAM required. Only the main processor memory is affected, not the I/O memory, by the size of the routing tables. Increasing the I/O memory only affects the Network Modules packet buffers. In an ideal situation, 16 MB of DRAM with the default memory split, can support up to 10,000 IP and 9,000 IPX routes in the routing tables.

The use of multiple high density Network Modules, such as T1/E1 or MBRI, will require additional packet be configured using the Cisco IOS command `memory-size I/O memory` command. A 60/40 split is recommended in most situations where more than 2 T1/E1 PRI's or 3 NP-8B's are configured, but 50/50 will also work if network routing tables will allow. The router error message `SYS-2-MALLOCFAIL` is an indication that insufficient I/O memory is available for the Network Modules configured. This error occurs when less than 1.2 MB of free I/O memory is available to the system. See the preceding Network Module Memory Requirements table for specific amount of memory required.

## Memory Product Numbers

Cisco has changed the way that memory upgrades are packaged for the Cisco 3640. This new packaging will reduce customer failures by making it impossible to order invalid memory configurations.

Table 18 Cisco Part Number

Product Number	Description	Cisco Part Number
MEM3620-4D=	One 1Mx32 single bank SIMM—4 MB DRAM	15-1873-02
MEM3620-8D=	One 2Mx36 single bank SIMM—8 MB DRAM	15-1593-01
MEM3620-16D=	One 4Mx32 single bank SIMM—16 MB DRAM	15-2095-01
MEM3620-16U24D	Two 2Mx36 single bank SIMMs + Two 1Mx32 single bank SIMMs—24 MB DRAM	15-1593-01 and 15-1873-02
MEM3620-16U32D	Two 4Mx32 single bank SIMMs—32 MB DRAM	15-2095-01
MEM3620-16U48D	Three 4Mx32 single bank SIMMs—48 MB DRAM	15-2095-01
MEM3620-16U64D	Four 4Mx32 single bank SIMMs—64 MB DRAM	15-2095-01
MEM3640-4D=	One 1Mx32 single bank SIMM—4 MB DRAM	15-1873-02
MEM3640-8D=	One 2Mx32 dual bank SIMM—8 MB DRAM	15-1630-02
MEM3640-16D=	One 4Mx32 single bank SIMM—16 MB DRAM	15-2095-01
MEM3640-32D=	One 8Mx32 dual bank SIMM—32 MB DRAM	15-2096-01

Table 18 Cisco Part Number (Continued)

Product Number	Description	Cisco Part Number
MEM3640-16U24D	Two 2Mx32 dual bank SIMMs + Two 1Mx32 single bank SIMMs—24 MB DRAM	15-1630-01 and 15-1873-02
MEM3640-16U32D	Two 4Mx32 single bank SIMMs—32 MB DRAM	15-2095-01
MEM3640-16U48D	Two 4Mx32 single bank SIMMs + Two 2Mx32 dual bank SIMMs—48 MB DRAM	15-2095-01 and 15-1630-02
MEM3640-16U64D	Two 8Mx32 dual bank SIMMs—64 MB DRAM	15-2096-01
MEM3640-16U128D	Four 8Mx32 dual bank SIMMs—128 MB DRAM	15-2096-01
MEM3660-32D=	32 MB SDRAM memory field upgrade	15-3417-01
MEM3660-64D =	64 MB SDRAM memory field upgrade	15-3353-01
MEM3660-128D =	128 MB SDRAM memory field upgrade	15-3346-01
MEM3660-32U64D	32 to 64 MB SDRAM memory factory upgrade	15-3357-01
MEM3660-32U96D	32 to 96 MB SDRAM memory factory upgrade	15-3353-01 + 15-3417-01
MEM3660-32U128D	32 to 128 MB SDRAM memory factory upgrade	15-3346-01
MEM3660-32U256D	32 to 256 MB SDRAM memory factory upgrade	15-3346-01 + 15-3346-01

Table 19 New Memory Part Numbers

New Memory Part Numbers	Replaces	Description
MEM3640-2X4D=	MEM3640-8D=	8 MB DRAM for the Cisco 3640 (2x4 MB DRAM SIMMs)
MEM3640-2X8D=	MEM3640-16D=	16 MB DRAM for the Cisco 3640 (2x8 MB DRAM SIMMs)
MEM3640-2X16D=	MEM3640-32D=	32 MB DRAM for the Cisco 3640 (2x16 MB DRAM SIMMs)
MEM3640-2X32D=	Two MEM3640-32D='s	64 MB DRAM for the Cisco 3640 (2x32MB DRAM SIMMs)

Table 20 Product Description

Product Name	ROMMON Version	Description
BOOT-3600=	11.1(17)AA	New ROMMON for Cisco 3620 and Cisco 3640



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