8. SYSTEM ENGINEERING

System Software

8.1 When the 1603 SM is first turned up, the plug-in units have only bootcode installed. The ATM12 09.xx supports both OC3, OC12, and OC48 linear terminal and add/drop, ring configurations, as well as ATM routing functions. The software kits are described in the Unit Data Sheets (UDS) section in this manual.

NOTE: *ATM12 R09.00.00 software load must be used in conjunction with NEP 60x plug-in units.*

8.2 During the turn-up process, the system configuration software is loaded into the 1603 SM using a personal computer (see Figure 60). This can be accomplished with either the Simplified DOS Loader for Software (DLT07.00) or the download function on the 1301 NMX.

NOTE: *All plug-in units are dynamically tested using system software loads before being shipped from the factory. Customers should disregard any residual system software loads found on new units and load the appropriate system software per 1603 SM installation procedures.*

NOTE: *Refer to the Database Management portion of the OAM&P section for information on remote downloading.*

Figure 60. 1603 SM Software Downloading Options

8.3 After system software is loaded into the 1603 SM, the system responds to all administration and maintenance commands. These commands can be entered using the 1301 NMX, a locally attached video display terminal, the remote network element logon function, an Operations System, or an optional modem interface.

Simplified DOS Loader for Software

8.4 The Simplified DOS Loader for Software (DLT07.00.00) is a software utility that runs on a customer-supplied personal computer (PC). The PC communications port is connected to the COA50x/60x front panel mounted, 9-pin RS-232 connector.

NOTE: *The DLT07.00.00 is included with the 1603 SM. The PC configuration requirements are listed in the DLT07.00.00 unit data sheet.*

1301 NMX Explorer

8.5 The 1301 NMX Explorer is a software kit that transforms a customer-supplied PC into a user system interface capable of provisioning and monitoring a single network element (NE) or a small network of NEs from a subtended NE. The 1301 NMX Explorer uses the Windows® environment to display iconic NE status, pull-down menus, and pop-up screens. This eliminates users having to know TL1 commands and the sequence for entering these commands.

8.6 The 1301 NMX Explorer supports the 1603 SM, the 1648 SM and other Alcatel SONET network elements, therefore providing a common look and feel for interacting with systems across the product line. The 1301 NMX Explorer is the recommended method for configuring and provisioning the 1603 SM. The 1301 NMX Explorer incorporates download functionality, which eliminates ordering the DLT07.00.00 Simplified DOS Loader for Software. All administration and maintenance functions for the 1603 SM can be handled by the 1301 NMX Explorer software.

NOTE: *The 1301 NMX Explorer is ordered separately (not included with the 1603 SM). For details on the 1301 NMX Explorer, refer to the 1301 NMX General System Description in this manual.*

Software Releases/Upgrades

8.7 The 1603 SM is designed so the customer can load and install initial software releases and future software upgrades. Alcatel provides both major feature releases and maintenance releases.

8.8 The software release comes in a kit, which consists of the necessary system program diskettes and a set of engineering release notes. These engineering notes list the product features, provide installation and download procedure notes, indicate changes since the previous release, and list operating issues, such as known problems.

Hardware and Software Configuration

8.9 Appendix F includes a hardware and software configuration matrix that indicates which hardware units are compatible with the various software releases.

Network Applications

8.10 The 1603 SM is designed for point-to-point terminal multiplexer, linear add/drop, optic repeater, and Unidirectional Path Switched Ring (UPSR) applications. The following paragraphs describe these applications.

NOTE: *In the following linear applications, the 1603 SM is equipped with various fixed path cross-connect units. These same configurations can also be achieved with the variable cross-connect units (VSCC101, VSCC30x, or VSCC501). The fixed path cross-connect is not supported for OC12 or OC48 configurations.*

NOTE: *In the following linear network applications, the 1603 SM drop groups are equipped with DS1 interfaces. However, the drop groups could be alternatively configured as EC1 interfaces, DS3 interfaces, DS3 transmultiplexer interfaces, or ATM mapped DS3 interfaces.*

NOTE: *The following linear network applications show OC3 configurations using fixed-path VT/STS1 cross-connect units (VSCC20x). However, the same applications can be configured using the programmable OC3 VT/STS1 cross-connect unit (VSCC101). OC12 variations of these configurations are supported by using the programmable OC3/12 VT/STS1 cross-connect unit (VSCC30x/VSCC501) and OC12 optical interfaces (HIF60x, HIF704, HIF90x, or HIFA0x).*

Point-to-Point Loop

8.11 The point-to-point application (Figure 61) consists of an OC3 multiplexer in the Central Office (CO) and Remote Terminal (RT) sites, connected by four single mode fibers. Each multiplexer is configured as a Terminal Multiplexer (TM), which means only one high speed port is equipped. At the RT site, the multiplexer typically interfaces to a digital loop carrier system with DSX-1 interfaces. DS1 extensions to customer premises or another RT site are provided

with T1 repeater shelves. Other drop interfaces are also supported in this configuration. As the network evolves, the vacant high speed port at the RT may be equipped to serve applications such as add/drop, hubbing and ring applications.
Figure 61. OC3 Point-to-Point Loop Application

Add/Drop Application

8.12 The 1603 SM add/drop application (Figure 62) allows a linear arrangement of two or three RT sites to be served from a single multiplexer at the CO site. An RT site can expand to the equivalent of two STS1 payloads (i.e., 56 DS1 signals), provided the total network demand does not exceed the OC3 capacity of 84 DS1 circuits. Bandwidth is assigned to the RT sites in STS1 increments using variations of the fixed VT/STS1 cross-connect plug-in units (VSCC20x).
Figure 62. OC3 DS1 Add/Drop Application
8.13 In some situations, the less complex drop function may be required (also known as tapering). In this arrangement, any drop RT site can send local traffic to and receive local traffic from the CO site. However, it does not allow traffic from one RT site to be sent directly to another RT site. This arrangement addresses typical loop feeder applications, while minimizing the complexity of administration and operation.

Through-Connection

8.14 When a 1603 SM is equipped with the VSCC204 plug-in unit, it provides an OC3 repeater function using a through-connection ADM. Figure 63 shows this arrangement.
NOTE: *When a 1603 SM is in this mode, it terminates and generates both section and line overhead on both east and west ports (Line Groups 1 and 2) as defined for line terminating equipment in Telcordia's TR-917.*
Figure 63. OC3 Through-Connection Application

Optical Carrier Grooming

8.15 The 1603 SM can be equipped with a variable cross-connect plug-in unit (VSCC101). This cross-connect can provision each STS1 for either STS1 or VT1.5/DS1 grooming (nonblocking) from any port to any port based on software provisionable assignments. VT1.5/DS1 grooming allows the 1603 SM to interconnect VT1.5/DS1 signals within a common STS1 (e.g., connect DS1 No. 5 in Drop Group 1 to DS1 No. 15 in Drop Group 1), or interconnect DS1 signals in two different STS1s (e.g., connect DS1 No. 7 in Drop Group 2 to DS1 No. 10 in Drop Group 3). Likewise, the 1603 SM can groom DS1 signals between STS1s on the high speed line groups or between an STS1 on a high speed line group and an STS1 on a low speed drop group. High speed to high speed and drop to drop grooming is also supported.
8.16 Figure 64 shows a linear network of three 1603 SM NEs, each equipped with VSCC101 cross-connect units. Traffic is routed between the central office site and the other sites, as well as between the Remote Terminal (RT) and intermediate sites. Each site can add or drop DS1s within the system constraints of 84 DS1s maximum. The variable cross-connect at each site allows software provisionable assignments between the low speed DS1 ports and any high speed time slot.
Figure 64. OC3 Linear Network Using Variable Cross-Connects

Path Switched Ring Networks

8.17 A ring network consists of network elements connected in a point-to-point arrangement that forms an unbroken circular configuration. The 1603 SM supports path switched ring functionality for VT1.5, DS1, DS3, ATM mapped DS3, EC1, STS1, and STS3c payloads and ATM cell streams (with VSCC501). The main reason for implementing Path Switched Rings is to improve network survivability. The ring provides protection against fiber cuts and equipment failures.
8.18 A variety of names are used in the telecommunications industry to describe path switched ring functionality. For example, Unidirectional Path Protection Switched (UPPS) rings, Unidirectional Path Switched Rings (UPSR), Uni-Ring, and Counter Rotating rings.
8.19 Path switched rings use two fiber-optic cable links to form the interconnecting spans from NE-to-NE around the ring. This two-fiber approach offers substantial savings over four-fiber linear networks and four-fiber bidirectional rings by eliminating half the high-speed interface units and half the point-to-point fiber links. The names of the two fibers also have a variety of designations including: Protected and Protecting, Clockwise and Counterclockwise, and Ring 1 and Ring 2.
8.20 Figure 65 shows a three-node, two-fiber path switched ring configuration. Although the flexibility of the 1603 SM allows for other configurations, deviating from the recommended configuration will cause difficulties when trying to relate the special configuration network to the terminology used in the technical manuals, the 1301 NM User System Interface (USI), and the various NE alarm and messaging reports related to the ring.
Figure 65. Three-Node Path Switched Ring
8.21 The OC48 interfaces on the 1603 SM provide grooming for the first 12 STS1's with the remaining 36 STS1's cut through between Line Group 1 and Line group 2. An application for this is shown in Figure 69 with a 1603 SM node in a ring with 1603 SMX nodes. The 1603 SM nodes accesses the first 12 STS1's, the 1603 SMX nodes can access all 48 STS1's.
Figure 66. 1603 SM in an OC48 1603 SMX Ring
8.22 Although individual (stand-alone) rings are used, multiple interconnected rings are also required. Interconnection of two rings can be as simple as connecting tributary ports from one ring NE to the tributary ports of the other ring NE. However, this introduces the risk of single point of failure or meshed node failure. To improve survivability, rings can be interconnected at two nodes; then, if one interconnecting node fails, the second interconnecting node provides the traffic connection. This is shown in Figure 67. In large networks, multiple ring networks might be required and possibly at different line rates. This two-node redundancy scheme uses drop-and-continue connections. The drop-and-continue mode of operation can be used to interconnect two OC3 rings, two OC12 rings, two OC48 rings, or interconnecting different rate rings. Figure 68 shows this configuration.
NOTE: *Rings using drop-and-continue mode of operation can be interconnected using DS1, DS3, DS3 transmultiplexer, ATM mapped DS3, EC1, or OC3 facilities. DS3, EC1, or OC3 can be used for ATM cell streams.*
8.23 In drop-and-continue mode, the two rings are treated as distinctly separate, independent rings. Switching does not occur in one ring because of unrelated failures in the other ring. Drop-and-continue also protects against simultaneous fiber cuts, equipment failures (one in each ring), or failures of an interconnecting node (NE). Figure 68 shows the STS1 signal flow through the meshed nodes.
8.24 In a path switched ring node, traffic is transmitted around the ring in both directions simultaneously. When two nodes are provisioned as drop-and-continue, the functionality changes slightly. Traffic in the drop-and-continue nodes is no longer transmitted in both

directions. Instead, traffic is sent only in the direction toward the drop NE and the other drop-and-continue node. Traffic is still sent in both directions around each ring so the basic ring functionality remains the same, but the two meshed nodes are involved in the two directions. Therefore, a failure in either drop-and-continue node does not interrupt traffic in either ring.

NOTE: *When only a few DS1 signals need to be linked from a node in one ring to a node in another ring, it is not necessary to dedicate the bandwidth of an entire EC1. The 1603 SM has the VT cross-connect matrix on the VSCC101, VSCC30x, or VSCC501 plug-in unit and the EC1 drop group circuitry on different plug-in units (LIF20x and LDR201 combination). Therefore, only the traffic that needs to traverse both rings needs to be groomed into the interconnect. This design makes possible a partially filled EC1 (containing a few DS1s), and the remainder of the EC1 capacity can be used for traffic within each of the interconnected rings (making more efficient use of ring bandwidth).*

8.25 In the receive direction, both interconnection nodes operate similarly to all other nodes in the ring. They select the best of the two traffic paths, but also continue to receive traffic on the other drop-and-continue node. Since the drop-and-continue nodes only transmit in one direction, the bandwidth between the two nodes is available for this continuation of received traffic.

Figure 67. Double Node Meshed Rings

Figure 68. STS1 Signal Flow Through Dual Nodes

8.26 The 1648 SM supports EC1 drops, and the 1603 SM can be connected to a 1648 SM to provide VT services (add/drop and grooming) to the higher capacity OC48 ring.

Figure 69 shows this OC48 VT-service. In this example, Nodes 0 and 3 are performing DS3 add/drop transport; nodes 1 and 2 are performing DS1 add/drop transport. In this configuration, all 28 DS1s in a given drop group must be transported between the two points as a bundle.

Figure 69. 1603 SM Providing Point-to-Point DS1 Services

8.27 The previous example uses EC1 transmit and receive interfaces to interconnect the OC48 NE to the 1603 SM NE. This provides VT bundle add/drop services. If the application requires the 28 DS1s to be split among several nodes around the OC48 ring, then VT level path protection switching is required. To achieve this, the OC48 NE must be connected to the 1603 SM through the OC3 interfaces. OC12 interfaces can also be used to interconnect the OC48 ring to the 1603 SM NE.

8.28 Figure 70 shows a 1648 based OC48 ring with 1603 SM NEs operating in VT level switching mode. The 1603 SM connected to OC48 ring node 2 is handling 28 DS1s of traffic; other 1603 SM NEs around the OC48 ring are handling 8 and 10 DS1s of traffic.

8.29 Additional ring capabilities include handling degraded STS1/STS3c/VT or severely errored bit error rates (BER). Path Defect Indicator (PDI) generation and ring switching is supported. STS1 signal fail error rate detection can be provisioned to insert AIS on VTs associated with (i.e., groomed out of) the STS1. Likewise, STS1 and STS3c can be provisioned to insert VPAIS into the ATM cell stream (for provisioned VPLs only) when STS1 or STS3c signal fail error rate is detected.

Figure 70. 1603 SM Providing Multiple Point DS1 Services

Linear-to-Ring Considerations

8.30 Linear add/drop and path switched ring configurations use the same hardware. Therefore, conversion from point-to-point systems to a ring system can be performed in-service. In addition, the forced break feature allows adding new nodes to an in-service ring network (up to

32 nodes).
8.31 When designing an initial network configuration, keep future growth and enhancement offerings in mind. Alcatel recommends that 1603 SM systems be configured with fully redundant interfaces. This serves two purposes: it provides maximum survivability for linear networks, and it provides ease of conversion to ring networks.
8.32 In addition, network designers should consider the NE-to-NE fiber connections. Figure 71 shows the recommended Line Group 2 to Line Group 1, A-to-A and B-to-B fiber connections for a linear network. This configuration is required to minimize the complexity of the linear to ring in-service upgrade. Upgrade procedures are found in the 1603 SM A Guide to Upgrading (Using PC and 1301 NM) manual. Additional assistance is available by contacting Alcatel's Technical Assistance Center.
Figure 71. Linear 1603 SM with Straight OC3 Fiber Connections

Optic Extension

8.33 The low speed drops of the 1603 SM can be equipped with the OC3 intermediate reach LIF40x units. This provides a linear 1:1 protected optic extension interface (Figure 72). NE A is equipped with an LIF40x drop and the optic extension is formed with NE B. NE B could be an end node (terminal configuration) or part of a linear configuration with other NEs, such as NE C. See paragraphs 7.51 through 7.55 for more details.
Figure 72. Linear Optic Extension (LIF40x)

M13 Facilities

8.34 Prior to R06.00, the 1603 SM was equipped with a DS3 plug-in unit (LIF3) and the entire DS3 signal traffic payload was transported to another NE in the network. If the customer wanted to map individual DS1 signals into or from the DS3 signal, an external M13 multiplexer was required. Figure 73 shows a DS3 signal converted into DS1 signals by the M13 multiplexer. The DS1 signals are connected to VTG interfaces and mapped into a STS1 payload at NE A. Then, the individual DS1 signals can be transported to either NE B or NE C (which are equipped with DMI/VTG configurations). The DS3 signal at NE B can only be transported to NE C. With the introduction of R06.00, *FlexPoint* (TM) functionality eliminates these configuration restraints and the need for M13 equipment.
Figure 73. Conventional M13 Add/Drop

FlexPoint

8.35 FlexPoint is an Alcatel trademark for a series of functions associated with electrical and optical interfaces that provide true SONET gateway functionality and perform varying payload management. When the 1603 SM is equipped with the DS3 transmulitplexer (LIF601), the system provides some of this functionality. Specifically, it eliminates the need for external M13 equipment and provides a number of highly flexible options for DS3 to VT1.5 applications (in both linear and ring networks), including:

- Distributed DS1 add/drop from a single DS3
- Stand-alone 3/1 digital cross-connect system
- Distributed 3/1 digital cross-connect system
- Mixed DS3 interface networks

Distributed DS1 Add/Drop from a Single DS3

8.36 If one NE is equipped with the DS3 Transmultiplexer plug-in unit (LIF6) and the appropriate LDR plug-in unit, and the rest of the NEs are equipped with DMI/VTG configurations, the individually mapped DS1 signals in the DS3 signal can be dropped at each DS1 equipped NE. In Figure 74, NE A has the LIF6, and DS1 signals can be added or dropped at NE B and NE C. Unlike conventional DS3 interfaces, the LIF601 only uses the amount of bandwidth necessary to carry the active DS1 traffic. Therefore, partially filled DS3 signals can be transported with a savings in bandwidth (i.e., unused DS3 capacity does not cause wasted bandwidth in the fiber).
Figure 74. Distributed DS1 Add/Drop from a Single DS3

Stand-alone 3/1 Digital Cross-Connect System

8.37 If two or more drop groups in an NE are equipped with the DS3 transmultiplexer (LIF6) plug-in unit, DS1 signals can be cross-connected between the LIF6 equipped drop groups. There are two restrictions:

- No more than 84 DS1s (three drop groups' worth of traffic) can be cross-connected within a single NE.
- The more drop groups used in this manner, the less bandwidth is available for high speed add/drop applications. If all three drop groups are used as a DS1 digital cross-connect system (DCS), the line group slots need not be equipped with high speed interfaces and the NE effectively becomes a stand-alone three-port DCS. This configuration is shown in Figure 75.

Figure 75. Stand-alone 3/1 Cross-Connect

Distributed 3/1 Digital Cross-Connect System

8.38 If several NEs in a network are equipped with the DS3 transmultiplexer (LIF6) plug-in unit, DS1 signals can be cross-connected from one LIF6 equipped NE to any other LIF6 equipped NE. The key restriction is the optical carrier rate of the line groups. For networks operating at OC3, the distributed cross-connect traffic cannot exceed 84 DS1 signals. For networks operating at OC12, the distributed cross-connect traffic cannot exceed 336 DS1 signals. Figure 76 shows this arrangement. The DS3 input of each NE is mapped into DS1 signals that can be cross-connected to any of the other NEs in the network.
NOTE: *The NEs forming the DCS can either be co-located in the same rack by using short reach multimode high speed interfaces, or the NEs can be distributed geographically using intermediate or long reach single mode high speed interfaces.*
Figure 76. Distributed 3/1 Digital Cross-Connect System

Mixed DS3 Interface Networks

8.39 The 1603 SM can be equipped with either the conventional DS3 interface (LIF30x) plug-in unit or the DS3 transmultiplexer (LIF601). However, if an LIF30x plug-in unit is used as a DS3 interface, the traffic must be transported/cross-connected to another plug-in unit that accepts DS3 mapped STS1 signals, such as an LIF30x or LIF50x. In Figure 77, NE A is equipped with an LIF30x and an LIF601 plug-in unit. The LIF601 traffic is transported to NE B and connected to a corresponding DMI/VTG combination (could also be an LIF601). The LIF30x traffic in NE A

is transported to NE C and connected to a corresponding LIF30x plug-in unit.
Figure 77. Mixed DS3 Interface Network

Tapered Route

8.40 The 1603 SM can simultaneously support OC3 line groups in one direction (e.g., east port) and OC12 line groups in the other (e.g., west port). This is referred to as tapered route operation. In a linear network (Figure 78), it might be used when the end node (NE) must be OC3 to accommodate site equipment requirements.
Figure 78. Linear Network Example of Tapered Route
8.41 Another application is in a mixed rate ring network (Figure 79). In this example, the traffic requirements between nodes C, D, E, and F can be satisfied with an OC3 ring. However, traffic requirements between nodes A and B exceed OC3, requiring an OC12 facility. This could be the case if nodes A and B are central offices or main nodes in a private network.
Figure 79. Mixed Rate Ring
8.42 Although an OC12 facility exists between nodes A and B, the maximum traffic capacity that can be ring protected is equivalent to OC3. An OC3 payload is dedicated out of the OC12 connection to complete the OC3 ring. The OC12 ports should be equipped with redundant OC12 interfaces (i.e., the additional bandwidth would be 1-for-1 protected). The OC12 connection can be further protected by route diversity between the A and B nodes.
8.43 The OC12 connection between nodes A and B is set up like a point-to-point linear path so four fiber-optic cable links are used and redundant optic units (line groups) are used for protection (Figure 80).
Figure 80. Mixed Rate Ring

Multiple Shelf Configurations

8.44 NE configurations, specifically those operating with OC12 high speed interfaces, may require more than a single shelf to achieve the desired number and mix of add/drop circuits. Multiple shelf, or collapsed node, configurations can exist in all networks whether the collapsed node is high density terminal, intermediate ADM in a linear string, or an ADM ring node. Treatment of the shelves in terms of installation, setup and operational administration is the same as for a series of individual shelves; however, they are in a single collected arrangement to achieve the circuit drops required.
8.45 OC3 high-speed systems typically require only a single shelf to access the full OC3 bandwidth (three STS1s or 84 VT1.5s). All drop plug types can be mounted in the shelf to terminate any quantity and mix of circuit types (DS1, DS3, DS3 transmultiplexer, STS1, OC3) up to the full capacity of the high speed OC3 signal.
8.46 The advantages to multiple shelf drop combinations are realized in the OC12 or OC48 configurations when terminating DS1 circuits. When any drop group is configured for DS1 interfaces, the whole drop group becomes dedicated to DS1 type traffic. That drop group can then terminate only 50 Mbs of bandwidth (28 DS1 interfaces). In contrast, that same drop group could terminate up to 200 Mbs worth of bandwidth if configured with four DS3 interfaces (or the EC1 interfaces or an equivalent mix) using LIF50x plug-in units.
8.47 The interface circuit tradeoff possibilities for a single OC12/OC48 shelf are listed in Table W. For example, if the situation requires one OC3 interface, then two drop groups can be equipped with DS1 circuits (1 to 28 circuits per drop group). If the situation requires eight DS3

interfaces, then only one drop group can be equipped with DS1 circuits (1 to 28 circuits). When more circuits are available in the high speed bandwidth and desired at a single node than can be configured into a single shelf, additional shelves can be physically collocated as a collapsed node.

NOTE: *Table W only shows the maximum DS1 configuration when used in conjunction with either quad DS3/STS1 interfaces (LIF50x unit) or the OC3 interfaces (LIF40x unit); not both. A wider mix of combinations is possible. For example, one drop group might be equipped with a quad DS3 interface, another drop group might be equipped with an OC3 interface, and the third drop group might have 28 DS1 circuits.*

Table W. OC12 and OC48 Single Shelf Capabilities*

DS1 CIRCUITS	DS3/STS1 INTERFACES	OC3 INTERFACES
57 to 84	0	0
29 to 56	1 to 4	1
1 to 28	5 to 8	2
0	9 to 12	3

** The information in this table is correct when using the SP101 shelf. If the ADM150 shelf is used, there can only be one LIF50x unit (four DS3/STS1 interfaces) or one LIF40x unit (one OC3 interface).*

8.48 A typical example of a multiple NE node is a site terminating the entire OC12 payload as 336 DS1 interfaces at a single location. This node would need four interconnected shelves, each dropping 84 DS1s per shelf. Figure 81 shows the block diagram of such a configuration, and Figure 82 shows the rack layout. The short reach OC12 interface could also be used to connect a 1603 SM NE to a 16192 SM (OC192) or 1648 SM NE (Figure 83).

NOTE: *For simplicity, redundant optical units and individual transmit and receive fibers are not shown.*

Figure 81. 336 DS1 Configuration using HIF70x

Figure 82. 84 to 336 DS1 Configurations using HIF70x

Figure 83. OC192 Configuration using HIF702

8.49 Another example of multiple shelf configuration flexibility is a 1603 SM node accessing a portion of the possible circuits. In Figure 84, only two shelves are required to provide four DS3 interfaces, two EC1 interfaces (STS1), and 38 DS1 interfaces.

Figure 84. Partially Loaded Multiple Shelves

8.50 In each of these multiple shelf node configurations, the individual shelves are set up and managed as individual NEs. Shelf-to-shelf interconnections are always optical between the high-speed optical interfaces. The node behavior is equivalent to a stream of individual NEs collocated in a single location, typically a single rack. There is no special cabling that has to be installed between such collapsed node multiple shelf configurations. The DCC can be left to pass over the inter-shelf fibers or, if the shelf is equipped with LAN, the DCC can be set up to talk between the shelves over the LAN.

8.51 Because of the short distances involved in a collocated multiple shelf node, Alcatel offers a multi-mode OC12 optical interface, the HIF70x, suitable for connecting shelves over a distance of up to 500 meters. This interface could also be used to deliver services or make another network connection over multi-mode fiber within the 500-meter limit. If single-mode optics are preferred, they can also be used. The cost of such a single-mode connected collapsed node can be minimized in one particular configuration involving terminals. If the last shelf in the stream terminates no more than three STS1s (84 VT1.5s) worth of bandwidth, the shelf-to-shelf single-mode optics between these last two shelves can be OC3 optics, not the full bandwidth

OC12 optics.
8.52 Another multiple shelf application would be to configure three 1603 SM NEs into a concentrator configuration (Figure 85) so that three partially loaded OC12 inputs could be concentrated into a single OC12 output.

Figure 85. OC12 Concentrator Configuration

8.53 The 1603 SM can also provide VT grooming for OC48 ring nodes (Figure 86). In this configuration, three of the STS1 signals from the OC48 can be used to add/drop 84 DS1s at the 1603 SM. Since the 1603 SM can perform payload grooming at the VT level, customers can add/drop traffic in single DS1 increments. The 1603 SM does not require the entire payload of an STS1 to be dedicated to the add/drop node. The STS1 payload can be shared among multiple nodes, dropping the required number of DS1s at each node.

Figure 86. VT Grooming from OC48 using HIF70x