IBM

Enterprise Systems Support

Enterprise Systems Connection: Planning for Migration

Edited by:
R. L. Clark, WSC
S. G. Glassen, POK
C. P. Grossman, TUC
J. Mahan, KGN
K. R. Neslund, KGN
D. S. Stary, KGN

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	MVS/ESA	VM/ESA
Enterprise Systems/9000	MVS/SP	VSE
ES/3090	NetView	VSE/ESA
ES/3090-9000T	OS/2	VTAM
ES/9000	Personal System	

Preface

This book contains information about how to plan for migration to an Enterprise Systems Connection (ESCON*) environment.

Abstract

Enterprise Systems Connection: Planning for Migration provides information about planning for a migration to an ESCON environment. The document discusses the ESCON-capable processors, control units, and the ESCON-support products included with the original announcements. The software environments that support these products are listed. In addition, several sample migration scenarios are discussed and a bibliography is provided.

This Technical Bulletin does NOT provide basic product knowledge about these hardware products. The reader should refer to manuals listed in the bibliography for that information. Likewise, this bulletin does not focus upon installation of the new processors, but upon the migration to the ESCON environment.

Most of this manual was written by development personnel. The review was done by both development and WSC personnel. These contributors are listed on the Acknowledgement page.

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Who Should Use This Book

This book is written for anyone who will plan a migration to an ESCON environment or assist the migration planner.

How This Book Is Organized

This book contains three parts and an appendix, organized as follows:

- **Part 1. Migration Planning Tasks**: an overview of the tasks involved in formulating a plan to migrate.
- **Part 2. General Migration Considerations**: information about general system level considerations, for example:
  - Cabling
  - Using Customized Operational Services (COS)
  - Managing logical paths
  - IOCP changes
  - Migrating data to an ESCON environment
  - Understanding and minimizing potential disruptions
  - Understanding potential impacts to user and software vendors' applications.
- **Part 3. Detailed Product Migration Considerations**: introduces ESCON products and (for each) if applicable:
  - Gives a short description of the product
  - Lists specific configuration considerations (for example, logical addressing capabilities and physical interface limitations)
  - Describes installation and upgrade requirements (if applicable)
  - Details product inter-relationships and dependencies (for example, Input/Output Configuration Program considerations)
  - Describes special considerations and recommendations for the product
  - Gives migration examples.
- **Appendix. Enterprise Systems Connection-Support Publications**: groups publications according to task and lists those publications that contain information helpful when migrating to an ESCON environment.

Where to Find More Information

Before you use this book, you should have read the following:

Introducing Enterprise Systems Connection, GA23-0383

Planning for Enterprise Systems Connection Links, GA23-0367.

For a list of other, more product-related publications, refer to Appendix A, "Enterprise Systems Connection/390-Support Publications" on page 199.

How to Read the Figures in This Book

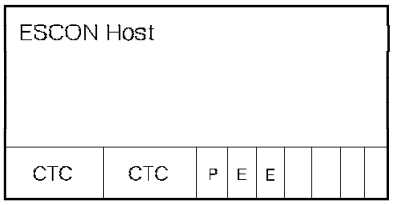
This book contains several figures that represent various configurations of host processors, Enterprise Systems Connection Directors (ESCDs), control units, and devices. This section describes the elements that make up these figures:

- Hosts

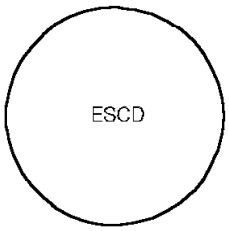
  Host processors only using the System/360* and System/370* I/O interface (referred to in this book as parallel hosts) will be labeled with P (or Parallel). A processor that can support Enterprise Systems Connection channels will be labeled with ESCON.

- Channels

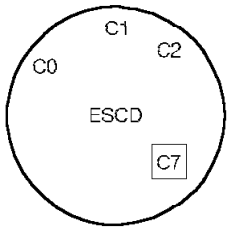
  Parallel channels will be labeled with P. ESCON channels will be labeled as E or, when operating in channel-to-channel (CTC) communications mode, CTC.



- ESCDs are shown as circles and are labeled with *ESCD*.



- ESCD ports are shown as two-digit port addresses within the ESCD. In some artwork, only one or two port addresses may be shown; this does not imply that these are the only ports on the ESCD.
  - A blocked port is indicated by a box enclosing the port address.



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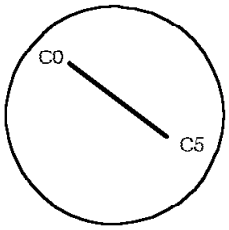
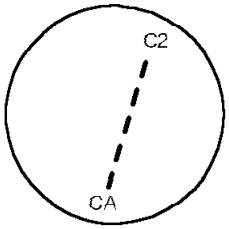
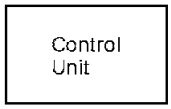
  - Dedicated connections are indicated as solid lines passing through the ESCD



  - Dynamic connections (active) are indicated as dashed lines passing through the ESCD



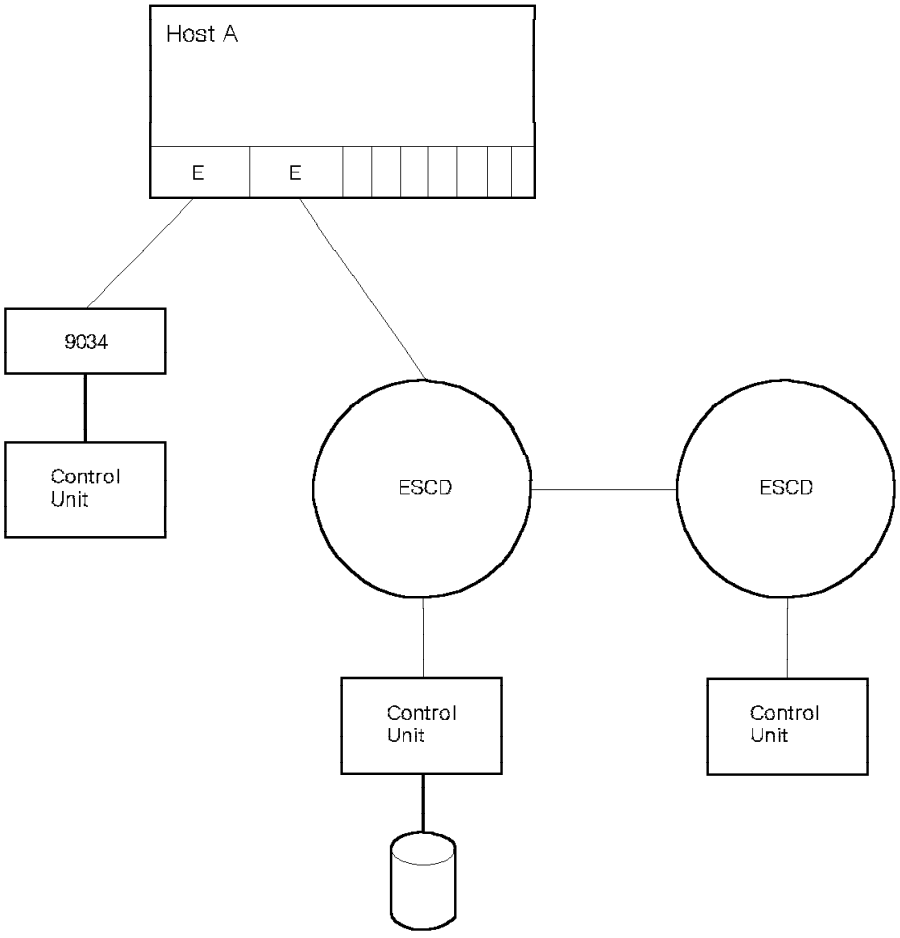
- Control units will be labeled appropriately, depending on the purpose of the figure. Control unit interfaces (sometimes referred to as ports or adapters) can be labeled P (parallel) or E (ESCON).



- Physical cables

  Fiber optic cables are shown as thin solid lines. Bus-and-tag cables are shown as wider solid lines.

  Note: For information on the types of cable required for each product, refer to the product's publications.



Contents

Figures

Part 1. Migration Planning Tasks

This section helps you develop a migration plan. The following list of tasks describes the recommended procedure for developing the plan and lead up to the actual implementation.

Step 1. Understand the Enterprise Systems Connection Products and Environment

Before you begin to plan your migration, you should have a general idea about what the Enterprise Systems Architecture/390* products offer and how they work together, including:

- Architecture
- Topology
- Technology.

Refer to the publication *Introducing Enterprise Systems Connection* for information about the ESCON* products or to Appendix A, “Enterprise Systems Connection/390-Support Publications” on page 199 for a list of publications that may prove helpful.

Step 2. Review Your Current Configuration

Before planning your future configuration, you should ensure that you know what your current configuration contains and looks like, for example:

- Hardware
- Software
- Program products (and their associated levels)
- I/O configuration information
- Physical layout information (for example, how many buildings are involved).

Step 3. List Goals You Want to Reach Using Enterprise Systems Connection Products

When you understand your configuration and what the ESCON products can offer, determine which particular ESCON functions you are interested in. For example:

- Connectivity
- Distance
- Increased availability
- Configuration management.

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Step 4. Understand Your Major Migration Considerations

When you have completed your list of goals and determined their priority, refer to Part 2, “General Migration Considerations” on page 5 for information on system level migration considerations, including limitations and recommendations for:

- Cabling
- Using Customized Operational Services (COS)
- Managing logical paths
- IOCP changes
- Migrating data to an ESCON environment
- Understanding and minimizing potential migration disruptions
- Understanding potential impacts to software vendor (SV) programs.

Step 5. Define Your Target Configuration

When you understand the major migration considerations, define your target configuration. This target configuration should consider future growth. For example, it is recommended that you develop both a short term and a long term plan. Refer to Part 3, “Detailed Product Migration Considerations” on page 31 for specific product-related information. For example:

- New connectivity (logical paths) and hardware physical planning requirements
- New and upgraded hardware
- New software levels and products.

Step 6. Draft Your Initial Plan

After defining your target configuration, draft a preliminary migration plan. This plan will involve several stages. Within the plan, identify the person responsible for each task, the amount of time that the task will probably take, and when the task needs to be performed.

Define the Physical Layout

The initial plan should include a definition of the physical layout of your data processing environment, including the new hardware and any changes to the original layout.

Define the Cable Layout

To define the cable layout, determine where trunks, distribution panels, and spare and alternate fiber cables are needed. This preliminary design will require a good deal of preparation and it is strongly recommended that you begin cable design as soon as possible. Refer to “Cabling” on page 7 for information on special cable considerations.

Draft the Product-Specific Migration Plan

Your initial draft of the migration plan should also include information about ESCON products that you plan to order. Use this list and the information in Part 3, “Detailed Product Migration Considerations” on page 31 to determine the details of your product migrations. These details will be based on a variety of considerations, including:

- Software support requirements
- Connectivity requirements
- Mixed parallel and ESCON environments
- Equipment lease expirations.

Step 7. Complete Your Detailed Step-by-Step Plan

Complete the plan, making sure that you have already included the following planning tasks:

- Design cable layout
- Order hardware
- Upgrade software
- Ensure that operations personnel are properly trained for the new products
- Understand the inter-relationships of the hardware and software that you will be using.

Step 8. Develop a Migration Checklist

When you have completed your step-by-step plan, it is recommended that you develop a checklist to follow when implementing your plan.

Part 2. General Migration Considerations

Cabling

Size and Weight Reduction and Increased Distance

With Enterprise Systems Architecture/390, there can be significant changes to the planning, installation and maintenance of your cabling network. Fiber Optic cables are much smaller and lighter than bus-and-tag cables. They come in the form of jumpers (usually with duplex connectors) and trunks (groups of individual fiber optic cables). As an example, a 144 fiber trunk (72 channels) is similar in diameter to a single bus-and-tag cable but weighs substantially less. A trunk can be used in place of multiple jumpers with similar placement, and will save cabling costs in some installations.

Because fiber optic cables allow for greater distances, you will have much more flexibility in locating and connecting your data processing equipment. When longer cables are used, you should also preplan the locations of your distribution panels (panels through which your trunks are connected).

Fiber optic jumper cables can also be used to provide extended distances within a data processing center. Fiber optic jumper cables can be easily installed by your IBM service representative.

Ease of Planned Growth

The forecast of your planned growth should consider both a short term and a long term plan. This will provide a guideline by which to plan growth of both the fiber optic cable and accessory requirements. By planning for growth, you can save the long term cost of multiple installations (labor cost and disruptions).

Note: This forecasting is critical when addressing installations that involve inter-building networks requiring excavation or the crossing of public domain (under highways or across Public Telephone and Telegraph (PTT) or right of way (ROW)).

In many environments, the higher short-term cost to install fiber optic cabling for growth is significantly less than the long-term cost of incremental installations. The fiber optic cables installed for growth can be installed without a terminating connector. The cost of termination can be deferred until additional terminated fiber optic cables are required. Fiber optic cable trunks provide a good basis for planned growth and are recommended for on-floor as well as off-floor usage.

Reliability, Availability, Serviceability and Security

Once installed, fiber optic cables provide reliability, availability and serviceability (RAS) characteristics exceeding that of the copper cables used in data processing centers today. The use of fiber optic cables for optical signal transmission provides high bandwidth, and is not susceptible to radio frequency interference (RFI) or electro magnetic interference (EMI). The IBM* duplex connector is constructed to ensure a proper connection. Features such as these make fiber optic cables attractive for data communication.

Disaster Recovery

Because of ease of use and increased attachment distance, fiber optic cables may assist in implementing disaster recovery plans. It is recommended that alternate trunks planned for disaster recovery be installed using different routes.

Other Cabling Migration Considerations

Cable Design and Installation Lead Time

With the added advantages of increased distance and connectivity, it is important to consider the many possibilities of cable network design within your data center. With the ability to go from floor to floor and building to building, along with the connectivity advantages, there may be many cabling considerations, for example:

- Jumper cables
- On-floor backbones
- Off-floor trunking systems
- Your equipment forecast (for example, location and number of ESCDs).

Because of these considerations, you may need to allow for lead time to design and install your fiber optic cabling system.

Fiber Optic Cabling Accessories and Measurement Considerations

Fiber optic cabling has different requirements than bus-and-tag cabling. Things to consider include:

Fiber Accessories

- IBM duplex fiber jumper cable
- Fiber optic cables for each trunk
- Fiber trunk size
- Fiber trunk bandwidth
- Distribution (or patch) panel
- Patch panel coupler
- Trunk termination
- Splicing
- Conduit
- Reenterable raceway

Measurement Considerations

- End-to-end light loss budget
- Optical time domain reflectometer (OTDR) printout
- Bandwidth

Note: Please see *Planning for Enterprise Systems Connection Links* for details on fiber optic cabling specifications.

Location of Devices

Because of the installation and cost differences between fiber optic jumper cables and fiber optic trunks, it is important to keep in mind the location of your hardware resources and where it would be best to connect your fiber optic cables. If the majority of the ports of your ESCD are going to have processors attached to them, it can be best to locate the ESCDs near the processors. If, however, the majority of your ESCD ports are to have I/O devices attached (for example, 3990s) it can be best to locate your ESCD near the I/O devices. Your fiber optic cabling system design will help determine which is easier to install and more cost effective (fiber optic jumpers or fiber optic trunks).

Note: Current locations of processors and I/O devices can affect where you decide to place your ESCDs.

Cabling Assistance

IBM provides the following assistance to help you in better understanding, planning, designing, and installing your fiber optic cabling.

Related Publications: For information on planning and specifications for your fiber optic cables, refer to *Planning for Enterprise Systems Connection Links*.

Customized Operational Services (COS): In the U.S., assistance in planning, design, and installation of fiber optic cabling systems is available in Connectivity Services (a COS offering from IBM).

Customers outside the U.S. should contact their marketing representative about similar services that may be offered in their country.

Note: If you do not use IBM COS for your fiber optic cabling, you must ensure that your fiber optic cabling system meets IBM specifications.

Customized Operational Services (COS)

Connectivity Services

As part of the IBM National Service Division (NSD), COS has an offering portfolio called Connectivity Services. Connectivity Services is available to assist you in consulting, design, and installation of fiber optic cabling systems for your Enterprise Systems Connection environment. Connectivity Services is available in the U.S. only. Customers outside the U.S. should contact their IBM representative about services offered in their country.

Connectivity Services consists of three service modules:

- Consulting Services
- Design Services
- Installation Support Services

You may choose those service modules that will best fit your requirements.

Consulting Services

This option converts your unique connectivity requirements into a high level, physical fiber optic cabling system design. This design will be in narrative form and contain descriptions and specifications of cabling components and accessories required to complete the fiber optic cabling system.

Design Services

Under Design Services, IBM provides you with a complete fiber optic cabling solution based on your connectivity requirements and the physical characteristics of your building (as required in Part 1, “Migration Planning Tasks” on page 1 Planning Step 5). Under Design Services, you receive a complete physical cabling system design including:

- Descriptions and specifications of cabling components
- Detailed design and floor plan drawings depicting cabling routing
- Distribution panel and termination details.

The information included in the physical cabling system design allows for the successful installation of the cabling system by a qualified contractor.

Installation Support Services

This service is available only for cable designs provided by Design Services.

Installation Support Services consists of three options that go beyond Design Services into the actual installation of the cabling system. You may decide that you do not have personnel experienced to install the cabling system or that you do not want to use your own resources. Each option in the Installation Support Services module provides a different level of support to perform the tasks that you elect not to do.

Bidding Services: Through competitive bidding, IBM assists you in selecting a qualified contractor to install the COS-designed cabling system. Included in this service, is an IBM-conducted walkthrough of the site with any contractors. IBM also acts as the technical focal point for any questions and performs the technical review of the bidder responses.

Project Supervision: This option is for anyone who already has, or will select, a contractor but who wants IBM to supervise the installation of the COS-designed cabling system. With this option IBM monitors the installation of the fiber optic cabling system to ensure it is being installed in accordance with the COS design specifications. Information obtained during the monitoring is provided to you.

Installation Turnkey: Installation Turnkey provides for the complete installation of the designed connectivity solution. Under this module, IBM assumes full responsibility for the installation and provides complete project management. IBM selects a qualified contractor and ensures a completed, high quality installation. IBM Connectivity Services provides a one-year warranty on the Installation Turnkey cabling systems.

Related Publications: Planning for Enterprise Systems Connection Links

Managing Logical Paths on Enterprise Systems Connection Channels

This section describes logical paths, explains overall system considerations, and makes specific configuration recommendations.

Description

A logical path is a logical connection between a channel and a control unit. Logical paths are important because channels can request more of them than can be allocated by a control unit. If this occurs, then logical path allocation must be considered. Logical paths are allocated by a control unit in two ways:

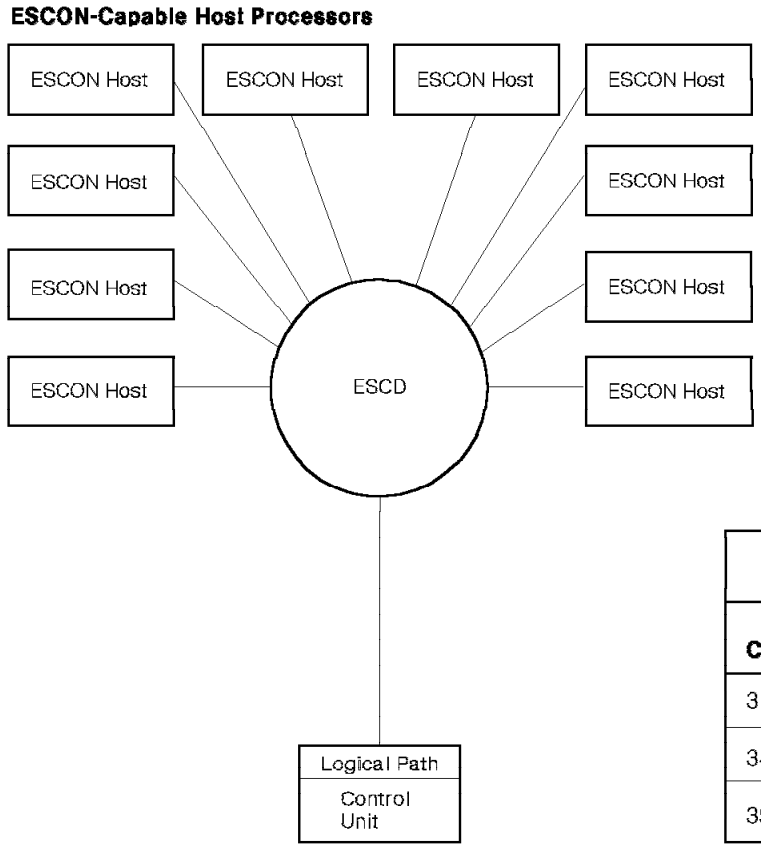
- A logical path is allocated to each Enterprise Systems Connection (ESCON) port on a control unit. In this way, each channel to which a control unit is directly attached is allocated a logical path.
- If some control unit ports have ESCON channel links directly attached to them and some ESCON channel links pass through ESCDs, the links that pass through ESCDs compete for allocation of the remaining logical paths on the control unit.

The ESCON environment and ESCDs greatly enhance the connectivity potential for control units. It is possible, but not practical, to configure a single control unit port to 59 ESCON channels through an ESCD. Consider, for example, Figure 1 on page 14, which shows an ESCD with ten attached ESCON channels requesting logical paths to the attached control unit's one ESCON port. If the control unit is a 3174, it allocates its eight logical paths among the ten channels. Clearly, the 3174's eight logical paths cannot satisfy the ten requests, and some management of the allocation is needed.

Special Considerations

If multiple system images exist, logical paths must be managed. When planning management of logical paths, consider the following:

- Logical paths are allocated dynamically.
- Logical paths are allocated to channels by a control unit on a first-come-first-served basis.
- Each ESCD port to which a control unit is attached can have up to 59 ports on which channels requesting logical paths are attached. This concern can be compounded if the control unit is attached to more than one ESCD.
- With LPAR, up to seven images (14 if in physically partitioned mode) are possible on a single host processor, which can result in a large number of channels requesting logical paths to the same control unit.
- I/O configuration definitions for an individual control unit are not coordinated automatically among the IOCDS definitions of different processors.
- The number of logical paths supported by a control unit varies by control unit type. For a summary of possible ESCON physical and logical paths for each control unit, refer to Figure 1 on page 14.



Logical Path Summary		
CU	**Maximum ESCON Physical Paths**	**Maximum ESCON Logical Paths**
3174	1	8
3490	4	64
3990	16	16

Figure 1. Managing Logical Paths

- Logical paths are requested by channels according to their individual processor I/O configuration definitions during a power on reset (POR) of the host processor. After a POR, the channel subsystem requests logical paths when it detects that a control unit has powered up, or when it detects an ESCD configuration change that could free previously allocated logical paths.
- Logical paths are not established for ESCON channels operating in 9034 mode and configured through an ESCD. The ESCD connection for the 9034 is a dedicated connection, and the link is treated as if it were a physical parallel channel link.
- An established logical path is released when:
  - The ESCON channel or control unit port used in the path is blocked by the ESCD
  - The dynamic connection between the ESCON channel and control unit port used in the path is prohibited by the ESCD
  - The ESCON channel is configured offline
  - A link involved in the path fails or is disconnected
  - The ESCON channels, ESCON control units, or ESCDs are powered off.
- In the 3990, 9035 configurations require special Vital Product Data (VPD) specifications. When an ESCD port supporting a 9035 is blocked or the dynamic connection between the channel and a control unit is prohibited in the ESCD configuration data, the established logical path is not released. A

new VPD must be configured and loaded into the 3990 before the path is made available to other non-9035 channels.

Configuring More Attachments than Logical Paths

Defining more physical links (connections) than logical paths available may be necessary for:

- Workload balancing:

  When a system image becomes overloaded, you may need to reassign a workload and the logical paths it needs (for example, its tape or DASD volumes, a set of display terminals, or a set of printers), to another system image that has available capacity.

- Backup:

  When an outage occurs, the critical application set (the program and associated data) and the logical paths it needs can be moved to the backup or spare processor. This process is simple if the processors have identical configurations.

- Physical or logical partitioning (LPAR):

  This allows you to run production and test systems on the same host processor to test new hardware, programming, and procedures without risk to the production system.

When the configuration requirements exist for more physical links than the logical paths available, the number of physical links defined can exceed the number of logical paths available.

Recommendations for Managing Logical Paths through ESCDs

Each ESCD port can be dynamically connected to any other port on that ESCD unless:

- Either port is blocked
- Either port has a dedicated connection to another port
- The dynamic connection between the two ports is prohibited.

The ESCD maintains a table of all possible connections for each port. The table, called the active configuration table, specifies the connectivity status of a port relative to the other ports in the ESCD.

This ESCD capability allows logical path management by means of blocking communications, or prohibiting dynamic communication for a port without having to configure a channel (CHPID) offline.

Use the ESCD to Establish the Desired Configuration

When an ESCD is first installed, it has a default configuration that allows any-to-any connectivity (every port is allowed to dynamically connect with every other port).

If a configuration other than this is required during power-on, a different table can be designated as the default configuration and set to allow only the dynamic connections needed to establish the desired logical paths. Dynamic connections

needed to establish other logical paths (those needed for backup, for example) would be prohibited by the default configuration of the ESCD.

If a channel has been allocated a logical path by a control unit, the logical path can be released by reconfiguring the ESCD to prohibit the connection between the control unit and that channel. The control unit and channel sense the change and release the logical path.

If the control unit is connected to more than one ESCD, it is necessary to coordinate allocation of the control unit's logical paths across all of the ESCDs.

Using ESCM to Control the ESCD

The Enterprise Systems Connection Manager (ESCM) can be used to dynamically manage the ESCDs and logical paths. An ESCM user can issue ESCM commands to reconfigure one or more ESCDs. ESCM in turn issues the appropriate host operating system Vary Path requests. ESCM can also provide coordination between host operating systems when logical paths are being removed from one system and transferred to another.

Summary of IOCP Changes for the Enterprise Systems Connection Environment

The I/O configuration process is the same for supporting Enterprise Systems Connection (ESCON) products and physical environment as it has been in the past. Details that should be considered are outlined below.

Current IOCP batch programs are updated or replaced. For MVS*, IXPIOCP replaces IOPIOCP as name of the batch hardware configurator program. For VM*, the name remains as IOCP, but the contents are updated.

Enterprise Systems Connection has produced a number of changes to the channel-to-control unit attachment topology, and has introduced a number of new products that are added to IOCP rules. These changes are reflected in configuration relationships and IOCP macros:

- CHPID macro changes
  - New “TYPE=” values:
    - FX defines an ESCON channel that operates in 9034 mode. The CHPID connects to a 9034 but appears to control units the same as a block multiplexor channel (TYPE=BL).
    - S defines an ESCON channel that operates in native mode. It attaches to ESCON-capable control units.
    - CTC defines an ESCON channel that operates in channel-to-channel (CTC) communication mode and can communicate only with other processor channels defined as CHPID TYPE=S.
  - The SWITCH keyword, if specified, identifies the logical number of the ESCD to which this channel is attached, and to which all channels and control units that are defined on channel paths to this CHPID must attach. A CHPID can be assigned to only one ESCD logical number. The SWITCH keyword is required for dynamic connectivity and management by Enterprise Systems Connection Manager.
- CNTLUNIT macro changes
  - The LINK keyword specifies the destination address (port address on an ESCD) to which this control unit is attached. The CHPID.LINK path is:
    - Unique for TYPE=S and TYPE=CTC CHPIDs for a CNTLUNIT
    - Not unique for TYPE=FX CHPIDS for a CNTLUNIT and can appear on multiple CNTLUNIT macros to allow multidropping of control units.
  - The CUADD keyword specifies the control unit logical address. It is used for Device Level Support (DLS) mode operation of the 3990 and for addressing the eight different control unit images on the 3174.

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- IODEVICE macro change
  - Status Verification Facility enabled (STADET=Y) becomes the default for control units attached to ESCON CHPIDs TYPE=S.
  - The PROTOCL and SHARE keywords are not used for ESCON control units.

For an example of the relationships of the IOCP definitions and other system I/O definitions on a 3174, refer to Figure 18 on page 98. For additional information on IOCP and the changes for ESCON products, refer to *ES/9000* Processor Complex, ES/3090* Processor Complex: Input/Output Configuration Program User Guide*.

Defining Configurations Using the MVS Hardware Configuration Dialog

MVS/ESA* 4.1 introduces a new interface for managing configuration definitions. The hardware configuration dialog (HCD) interface allows you to create I/O definitions for ESCON host processors and for the software that runs on them. HCD allows these definitions to be defined for multiple systems (for example all of a JES-plex) from one processor, rather than requiring each to be done on the processor being defined.

For additional information on HCD and dynamic I/O reconfiguration, refer to "Considerations to Minimize Disruptions" on page 25. For information on planning for HCD and dynamic I/O reconfiguration, refer to *MVS/ESA Migration Planning: Dynamic I/O Configuration (V4)*.

ES/9000, ES/3090, and MVS/ESA are trademarks of the IBM Corporation.

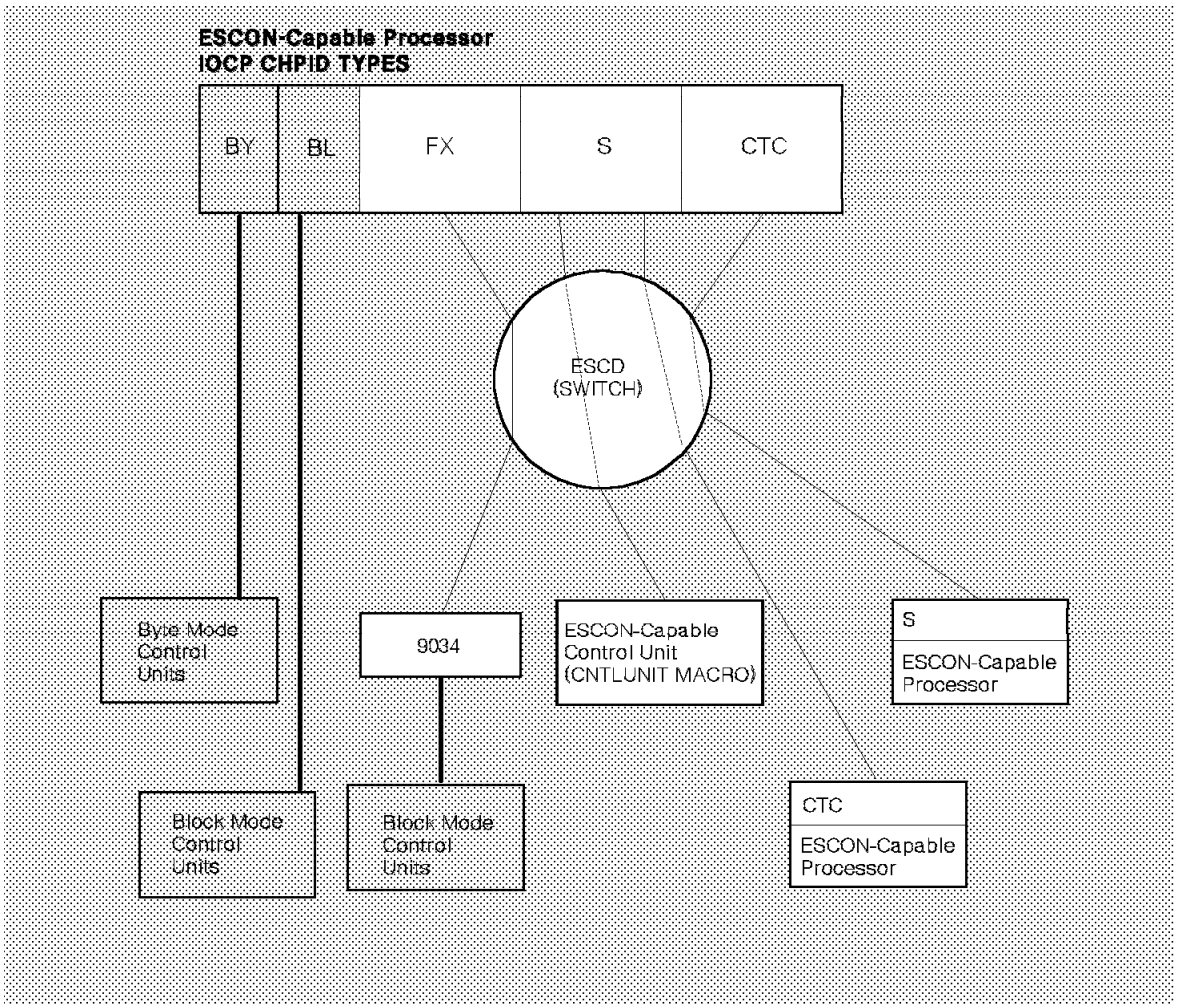

Figure 2. Channel Type Connection Summary. This diagram shows the relationship between an IOCP CHPID TYPE and the channels and control units to which it can communicate.

Recommended Changes to IOCDSs to Support Enterprise Systems Connection Configurations

The following procedures can help you change your existing IOCDSs for ESCON channels.

Migrating from Block Multiplexor Channels to ESCON Channels Operating in 9034 Mode

1. If you are changing an existing CHPID, change TYPE=BL to TYPE=FX on the CHPID macro. If you are also changing the CHPID number, change the CHPID number on the CHPID macro and in the PATH keywords of all CNTLUNIT macros for that CHPID. If there is a 9034 attached to an ESCD, add a SWITCH= keyword.
2. Run IOCP to create the new IOCDS
3. Turn the power off at the host processor
4. Install the ESCON channels
5. Cable the new configuration
6. Power on reset the host processor specifying the new IOCDS to activate the new configuration.
7. Initial Program Load the operating system.

Migrating from Block Multiplexor Channels to ESCON Channels Operating in Native Mode

1. If you are changing an existing CHPID, change TYPE=BL to TYPE=S on the CHPID macro. If you are also changing the CHPID number, change the CHPID number on the CHPID macro and in the PATH keywords of all CNTLUNIT macros for that CHPID.
2. If the CHPID attaches to more than one control unit, an ESCD is required, and the SWITCH keyword must be coded on the CHPID macro (multidropped configurations on an ESCON CHPID operating in native mode or CTC mode are not allowed).
3. If an ESCD with dynamic connections is being used, the destination ports on the ESCD for each ESCON channel path must be coded as the link address for the CHPID in the LINK keyword on the CNTLUNIT macro.
4. Run IOCP to create the new IOCDS.
5. Turn the power off at the host processor.
6. Cable the new configuration.
7. Power on reset the host processor specifying the new IOCDS to activate the new configuration.
8. Initial Program Load the operating system.

Migrating Channels from 9034 Mode to Native Mode

1. Change the TYPE=FX to TYPE=S or TYPE=CTC on the CHPID macro
2. Run IOCP to create the new IOCDS
3. Modify the ESCD configuration as necessary to remove the dedicated connections and allow dynamic connections
4. Power on reset the host processor specifying the new IOCDS to activate the new configuration.

Migrating Data to an Enterprise Systems Connection Environment

You may need to migrate your data to newer device types when moving to an Enterprise Systems Connection/390 environment. The following sections identify the IBM facilities that will help you migrate data.

Detailed information on data migration is contained in the publication *IBM 3390 Direct Access Storage Migration Guide*.

Multiple Virtual Storage (MVS) Considerations

MVS data migration considerations include data owned by the following:

- Time Sharing Option (TSO)
- Batch
- Data Base 2 (DB2*)
- Information Management System (IMS)
- Customer Information Control System (CICS)
- Data Facility Hierarchical Storage Manager (DFHSM)
- Data Facility Data Set Services (DFDSS).

Data Facility Data Set Services (DFDSS) is the recommended data-mover in an MVS environment. DFDSS jobstreams that perform the migration can be generated easily using the Interactive Storage Management Facility (ISMF). The publication *IBM 3390 Direct Access Storage Migration Guide* gives explicit instructions on migrating data in each of the above-mentioned environments. The instructions apply to data migration between unlike device geometries and capacities.

The Storage Group Application in ISMF can control the allocation of data in Data Facility Storage Management Subsystem (DFSMS*) managed data. This becomes important when DASD volumes are being emptied or “drained” of data.

Virtual Machine (VM) Considerations

VM data migration is also described in detail in the publication *IBM 3390 Direct Access Storage Migration Guide*. There are three facilities to migrate data in a VM environment:

- Data Facility Storage Management Subsystem (referred to as DFSMS/VM)
- DASD Dump Restore (DDR) or DASD Dump Restore Extended Architecture (DDRXA)
- COPYFILE.

DFSMS/VM provides high-speed movement of minidisks between like or unlike device types. With DFSMS/VM, the storage administrator can use ISMF panels to create and execute minidisk copies. There is also a DFSMS CHECK command to analyze minidisk structures and verify the integrity of migrated minidisks.

DB2 and DFSMS are trademarks of the IBM Corporation.

DDR and DDRXA can be used to move data between like device types:

- 3380 to 3380
- 3390 to 3390.

COPYFILE moves minidisks between like or unlike device types, file by file. It requires more manual intervention than DFSMS/VM and is not as fast.

Related Publications

- *Using IBM 3390 Direct Access Storage in an MVS Environment*
- *Using IBM 3390 Direct Access Storage in a VM Environment*
- *Using IBM 3390 Direct Access Storage in a VSE Environment*
- *Using IBM 3380 Direct Access Storage in a Virtual Storage Extended (VSE*) Environment*

VSE is a trademark of the IBM Corporation.

Potential Disruptions

Miscellaneous Equipment Specifications

When a Miscellaneous Equipment Specification (MES) is needed to upgrade a host processor or control unit, a disruption possibility exists to that hardware and any applications associated with it or attached to it. Not all MESs are disruptive. Please read “Considerations to Minimize Disruptions” on page 25 and the detailed product migration sections in Part 3 (for the products in which you are interested) to minimize or eliminate possible disruptions.

Hardware Replacements

When existing hardware is functionally replaced with an upgraded model, a disruption possibility exists when disconnecting the current model from the hardware and software configuration. The same possibility also exists when installing the new model.

Initial Program Load (IPL), Power On Reset (POR)

To invoke the following new items:

- I/O configuration
  - The MVS Configuration Program (MVSCP)
  - The VM Real I/O Configuration File (HPRIO)
- The input/output configuration data set (IOCDS)
- System control programs (SCPs)
- Application/Program Product upgrades

you may sometimes perform one of the following functions: a POR, an IPL, or a Restart.

Performance and Connectivity

Some hardware can be upgraded by shutting down one side, cluster, or channel of the hardware at a time and upgrading the side that is down. This may provide availability on the side that is up for all applications associated with that hardware. However, overall performance and connectivity may be reduced.

Considerations to Minimize Disruptions

Various methods and tools can be used to minimize disruptions to your data processing environment when migrating to an Enterprise Systems Connection environment. The following may prove helpful in alleviating disruptions to your environment:

- Predefine your configurations
- Use Dynamic I/O Configuration
- Plan for and install additional ports and channels
- Manage single points of failure
- Install new hardware and software on a test or backup host processor
- Educate system programmers and operations personnel.

Predefine Your Configurations

To minimize PORs and IPLs you should continue to include planned devices in the following:

- The MVS Configuration Program (MVSCP)
- The VM Real I/O Configuration File (HCPRIO)
- The Virtual Telecommunications Access Method (VTAM)
- Input/Output Configuration Program (IOCP) configuration definitions
- Hardware configuration definition (HCD).

Use Dynamic I/O Configuration

Dynamic I/O Configuration provides the ability to select a new I/O configuration definition without performing a power on reset (POR) of the hardware or an initial program load (IPL) of the MVS system. Dynamic I/O Configuration allows you to add, delete, or modify the definitions of channel paths, control units, and I/O devices in the software and hardware I/O configurations. You can choose to update only software I/O configuration definitions, only hardware I/O configuration definitions, or both.

The Dynamic I/O Configuration capability is included in MVS/ESA SP Version 4 Release 2.

If the I/O device supports nondisruptive installation (that is, can be installed without requiring a power down), I/O configuration updates, in general, do not need to be synchronized with planned or unplanned outages. This allows for more timely I/O configuration updates, including initial installation and subsequent modifications in order to adjust to installation specifications (for example, performance or availability).

For an introduction to the program products and their associated levels that exploit Dynamic I/O Configuration and the hardware that participates, refer to the MVS/ESA SP Version 4 Release 2 publications. For additional information about Dynamic I/O Configuration, refer to the publication *MVS/ESA Migration Planning: Dynamic I/O Configuration (V4)*.

After installing Dynamic I/O Configuration function and prior to the initial use, a hardware POR is required using a functionally compatible input/output configuration data set (IOCDS), followed by an IPL of the MVS control program.

At POR time, the installation must explicitly enable the Dynamic I/O Configuration function, as well as indicate the additional amount of hardware system area (HSA) that is to be reserved to contain planned modifications to the I/O configuration definition. Refer to *MVS/ESA Migration Planning: Dynamic I/O Configuration (V4)* for details.

Plan for and Install Additional Ports and Channels

As you plan additional hardware installations, consider cost disruption trade-offs. For example, you could install an ESCD with only the number of ports necessary for the initial ESCON devices. At some future time, you could then add more ports to that ESCD for additional devices, but this upgrade causes a disruption to your environment. You can avoid this disruption by installing additional ports during the initial installation. Consider the additional installation cost in comparison with the cost of the potential downtime necessary to install your ports at a later date.

If your installation is a “9-to-5” operation, then the cost of the disruption would probably be very small; however, in a 24-hour, seven-day-a-week operation the cost could be very high. By adding ESCD ports during the initial installation, you can avoid future disruptive upgrades for ESCON devices.

Early installation of additional ESCON channels and ESCON ports (adapters or interfaces) on control units will also reduce the number of future outages needed to accomplish the installation at a later date.

Manage Single Points of Failure

An ESCON environment offers the opportunity to reduce possible single points of failure in a configuration by carefully configuring your paths between channels and control units. The following list describes environments where possible single points of failure might exist and recommendations to minimize them:

- Multi-processor

  Configuring channel paths from a control unit to both sides of a multi-processor host allows continued access when one processor side is unavailable due to a planned or unplanned disruption. Therefore it is recommended that ESCON channels be configured from both sides of a multi-processor complex to a given control unit.

- Channels

  ESCON channels are grouped together in channel elements. A channel element is a group of channels which constitute the smallest set of resources that can be impacted from a RAS standpoint. It is recommended that paths from a control unit be attached to different channel elements to minimize the effect of a failure or planned preventive maintenance of a channel element.

- Fiber optic cables

To minimize the effect of a fiber optic cable failure:

  - In cases where trunks are used or additional installation is difficult, backup fiber optic cables should be installed.
  - Route backup fiber optic cables through alternate routes.
  - For the same control unit with multiple paths, install the fiber optic cables on different physical routes to avoid accidental disruption of all cables at one time.

- ESCD

  To minimize the effect of a planned or unplanned outage of an ESCD, multiple paths between channels and the same control units should be routed to more than one ESCD.

- ESCD ports

  ESCD ports come in increments of four ports on each card. It is recommended that alternate paths to control units and channels be attached to different port cards.

- Control units

  Various control units have redundant paths (clusters) for RAS. Refer to the control unit information in “Enterprise Systems Connection-Capable Control Units” on page 93 for more details.

- Control unit cards

  When there are multiple ports on a control unit card, it is recommended that channels from the same processor be divided between cards.

Install New Hardware and Software on a Test or Backup Host Processor

Consider installing the required software and some initial hardware (perhaps an ESCD with ESCM) on a test or backup host processor before using it in a production environment. This allows your system personnel to modify existing hardware and software procedures, develop new procedures, and gain new environment management experience prior to a full production commitment. Involve your personnel early in the installation process.

Educate System Programmers and Operations Personnel

From a data processing environment viewpoint, it is important to remember system programmer and operator education and the inter-relationships with the personnel responsible for the IOCP, MVSCP, hardware configuration definition (HCD), HCPRIO, VTAM, ESCDs, and ESCM information. Changes to any of these areas of information must be coordinated with the other areas. Consider training that might be required for the new environment and products and develop a plan to accomplish this training prior to final implementation. As a result of increased distances, new or changed procedures might be required for lights-out operation of a remote location or the routing of printed output. Power sequencing procedures of remote equipment may need to be updated. Also include information about new commands in the operator training (for example, ESCM commands).

Refer to the publications listed in Appendix A, “Enterprise Systems Connection/390-Support Publications” on page 199 for a list of publications that may prove helpful when designing your system programmer and operator education programs.

User or Vendor Written Software Applications

Most application programs will run on Enterprise Systems Connection (ESCON) control units attached to ESCON channels without change. ESCON and parallel channel configurations can coexist on a system, allowing you to move applications to ESCON channels or leave them where they currently are. The following paragraphs summarize the high-level changes that may affect your applications.

There are a few areas where a potential impact exists to software applications. The extensions to the I/O architecture and introductions of new ESCON hardware could impact application software written to low-level interfaces (for example channel program level). Programs written to higher-level interfaces, such as Virtual Storage Access Method (VSAM) or Virtual Telecommunication Access Method (VTAM) will probably be unaffected.

Changes that may affect your application programs include:

- 3990 nonsynchronous operation
- I/O architecture
- SMF records
- IOCP macro changes
- CTC protocols.

3990 Nonsynchronous Operation

Programs written at the channel program level to DASD storage and that are dependent on the hardware characteristics will run, but could experience performance reductions. Refer to the guidelines in *Introduction to Nonsynchronous Direct Access Storage Subsystems* for additional information.

IBM standard access methods at the levels that support ESCON channels have been previously upgraded to support nonsynchronous DASD subsystems.

I/O Architecture Considerations

The architecture has been extended in areas like management of SENSE data in support of ESCON channels and control units. Refer to the publication *IBM ESA/390* Principals of Operations* for additional information.

System Management Facility Changes

RMF and SMF are changed to support new channels and new devices. Refer to the publication *MVS/ESA System Programming Library: System Management Facilities* for more information.

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IOCP Macro Changes

IOCP macros are changed for architectural extensions and new hardware. Refer to “Summary of IOCP Changes for the Enterprise Systems Connection Environment” on page 17 for a summary of the IOCP changes and to the following hardware product sections in Part 3, “Detailed Product Migration Considerations” for device specific changes:

- “Enterprise Systems Connection-Capable Processors” on page 53
- “Enterprise Systems Connection-Capable Control Units” on page 93
- “Enterprise Systems Connection-Support Products” on page 135

Refer to *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide* for additional information.

CTC Protocol Changes

The CTC protocol is changed for an ESCON environment.

CTC programs must be written to be compatible with the ESCON CTC architecture to run properly. Programs written in S/370 CTC Basic Mode will not run. Applications using VTAM CTC support will not be affected because VTAM 3.3 and the operating systems (MVS/ESA, VM/ESA*, and TPF 3.1) manage the differences.

These potential impacts apply to IBM programming products as well as your user- or vendor-written software applications. If you wish to run your CTC applications at extended distances over ES Connection channels, you may need to change to VTAM CTC versions of these programs. Refer to “Channel-To-Channel Migration” on page 47 for details about supported IBM program products.

Refer to the publication *IBM ESA/390 Channel-to-Channel Adapter Architecture* for additional information.

Software Vendor Applications

Your software vendors should be contacted to determine if additional support may be required to run their applications at a distance over ESCON channels.

VM/ESA is a trademark of the IBM Corporation.

Part 3. Detailed Product Migration Considerations

Software System Control Programs (SCP) Operating Systems

IBM Software

IBM's System Control Programs (SCPs) require Enterprise Systems Architecture (ESA) to be able to support ESCON functions.

- MVS

  Users of MVS/SP* versions 3.1.0e and 3.1.3 will be able to install small program enhancements (SPEs) to add ESCON support. A new version of MVS/ESA with additional new function will also be available.
- VM users will have to convert to a new ESA version.
- VSE users will have to convert to a new ESA version.
- TPF users will be able to install PTFs to add ESCON support to TPF version 3.1, which already supports ESA.

Figure 3 summarizes these migration paths.

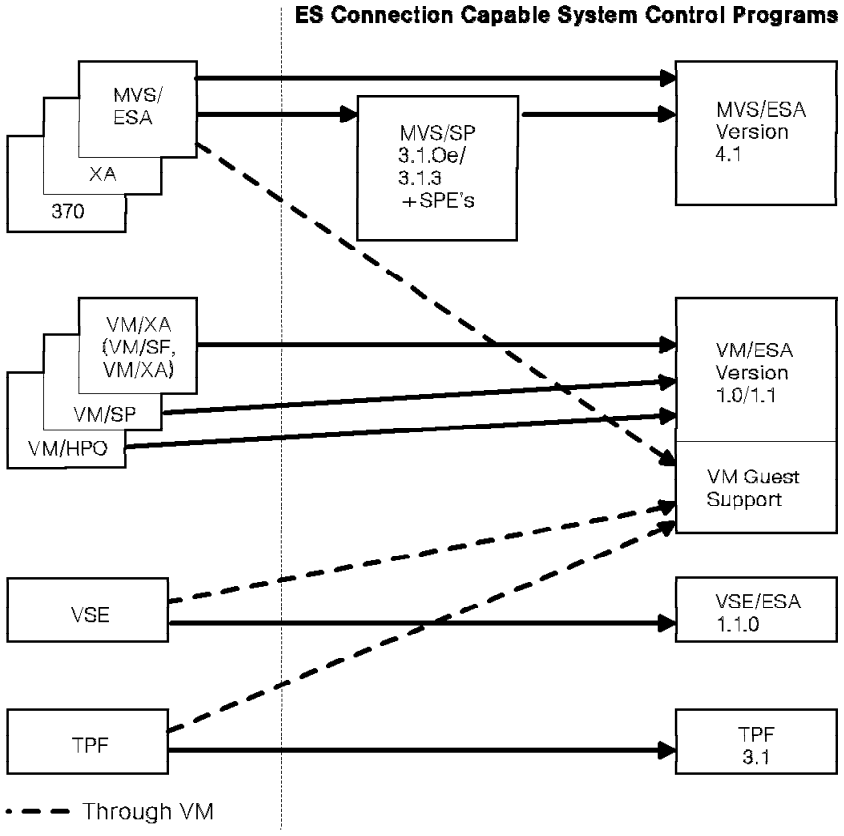

Figure 3. SCP Migration Paths

MVS/SP is a trademark of the IBM Corporation.

IBM program products, for the most part, will be unaffected by this change in channel support except where they are directly affected by new device support—notably EREP, IOCP, VTAM, and the storage management products. See “MVS,” “VM” on page 40 , “TPF” on page 43, and “VSE” on page 44 for supported software levels.

Processors that support ESCON channels can be physically partitioned or logically partitioned with PR/SM* and LPAR, just as they are today. For customers who need to run current SCPs and new ESA versions on the same processor, use of VM/ESA or PR/SM with LPAR is an alternative.

Combined, the hardware offerings and the software support offer greater choice in solutions and growth opportunity.

MVS

Tables 1, 2, and 3 show the releases and levels of MVS/ESA and their support for ESCON products. The number in the Level column defines the minimum required level of a program. Where more current levels, modifications, or releases exist, they also support the listed ESCON products.

If there is an “x” in the column for a product, the base level of the MVS or program product (PP) supports that ESCON product. Where a small program enhancement is used to add support for ESCON channels or control units, it will be shipped as a Program Temporary Fix (PTF), “PTF” appears in the column, and you need to install the (PTF) as well as the base level of support. When another level of MVS appears in a column, you need to update to that level to get ESCON support.

Table 4 on page 39 contains ESCON-related APARs that are known at the time of publication. To determine which PTFs are needed, contact your IBM representative.

PR/SM is a trademark of the IBM Corporation.

MVS/SP 3.1.0e Base

	Level	9034	ESCON Channel	ESCON CTC (Note 1)	3174	3490	3990	ES Connection Manager	9032 9033	9035	9037
MVS/SP	3.1.0e	x	PTF	x	PTF	PTF	x	PTF	Feature (Note 2)	x	(Note 3)
JES3	3.1.1							PTF			
RMF	4.1.1	PTF	PTF	PTF		x	x		PTF	x	
RACF	1.8.1								PTF		
ES Connection Manager	1.0	x	x	x	x	x	x		x	x	
VTAM*	3.3			x	PTF			(Note 4)			
EREP	3.4.2	x	x	x	x		x		x	x	
IXPIOCP	1.0	x	x	x	x	x	x	n/a	x	n/a	
DFP	3.1.1					PTF (Note 5)	PTF			x	
DFDSS	2.4					x	x			x	
DFSORT	11.0						PTF			x	
DFHSM	2.4					x	x			x	
ICKDSF	10.0 11.0					x	x (Note 6)			x	

Notes:

1. For applications to run in CTC mode on ESCON channels, they must operate in S/370 CTC Extended Mode. Refer to “Channel-To-Channel Migration” on page 47 for more information about supported IBM program products and alternatives.
2. Use of ESCDs requires that the Director feature on MVS/SP (feature code 5870, 5871 or 5872) be installed.
3. MVS/ESA 4.1.0 supports the 9037 Sysplex Timer.
4. If you are not communicating over ESCON channels in CTC mode, or with ESCON 3174s, ESCM only requires VTAM 3.1 to communicate with other ESCMs (over 3745s, for example).
5. When ESCON ports are installed on a 3490, this PTF must be installed on all other operating systems to which the 3490 is attached. This includes those attached through parallel ports. Refer to “3490 Magnetic Tape Subsystem with ESCON Adapters” on page 100 for specifics.
6. ICKDSF 10.0 supports ES Connection attachment of 3380s on 3990s. Support for 3390s on 3990s requires version 11.0.

Table 1. Software Support for ESCON Products under a Base Level of MVS/SP 3.1.0e.

VTAM is a trademark of the IBM Corporation.

MVS/SP 3.1.3 Base

	Level	9034	ESCON Channel	ESCON CTC (Note 1)	3174	3490	3990	ES Connection Manager	9032 9033	9035	9037
MVS/SP	3.1.3	x	PTF	x	PTF	PTF	x	PTF	Feature (Note 2)	x	(Note 3)
JES3	3.1.1							PTF			
RMF	4.1.2	PTF	PTF	PTF		x	x		PTF	x	
RACF	1.8.1								PTF		
ES Connection Manager	1.0	x	x	x	x	x	x		x	x	
VTAM	3.3			x	PTF			(Note 4)			
EREP	3.4.2	x	x	x	x		x		x	x	
IXPIOCP	1.0	x	x	x	x	x	x	n/a	x	n/a	
DFP	3.1.1					PTF (Note 5)	PTF			x	
DFDSS	2.4					x	x			x	
DFSORT	11.0						PTF			x	
DFHSM	2.4					x	x			x	
ICKDSF	10.0 11.0					x	x (Note 6)			x	

Notes:

1. For applications to run in CTC mode on ESCON channels, they must operate in S/370 CTC Extended Mode. Refer to “Channel-To-Channel Migration” on page 47 for more information about supported IBM program products and alternatives.
2. Use of ESCDs requires that the Director feature on MVS/SP (feature code 5870, 5871 or 5872) be installed.
3. MVS/ESA 4.1.0 supports the 9037 Sysplex Timer.
4. If you are not communicating over ESCON channels in CTC mode, or with ESCON 3174s, ESCM only requires VTAM 3.1 to communicate with other ESCMs (over 3745s, for example).
5. When ESCON ports are installed on a 3490, this PTF must be installed on all other operating systems to which the 3490 is attached. This includes those attached through parallel ports. Refer to “3490 Magnetic Tape Subsystem with ESCON Adapters” on page 100 for specifics.
6. ICKDSF 10.0 supports ES Connection attachment of 3380s on 3990s. Support for 3390s on 3990s requires version 11.0.

Table 2. Software Support for ESCON Products under a Base Level of MVS/SP 3.1.3.

MVS/ESA 4.1.0 Base

	Level	9034	ESCON Channel	ESCON CTC (Note 1)	3174	3490	3990	ES Connection Manager	9032 9033	9035	9037
MVS/ESA	4.1.0	x	x	x	x	PTF	x	x	Feature (Note 2)	x	x
JES3	3.1.1							PTF			
RMF	4.2.0	PTF	PTF	PTF		x	x		PTF	x	
RACF	1.8.1 (Note 3)								PTF		
ES Connection Manager	1.0	x	x	x	x	x	x		x	x	
VTAM	3.3			x	PTF			(Note 4)			
EREP	3.4.2	x	x	x	x		x		x	x	
IXPIOCP	1.0	x	x	x	x	x	x	n/a	x	n/a	
DFP	3.2.0					PTF (Note 5)	PTF			x	
DFDSS	2.4					x	x			x	
DFSORT	11.0						PTF			x	
DFHSM	2.4					x	x			x	
ICKDSF	10.0 11.0					x	x (Note 6)			x	

Notes:

1. For applications to run in CTC mode on ESCON channels, they must operate in S/370 CTC Extended Mode. Refer to “Channel-To-Channel Migration” on page 47 for more information about supported IBM program products and alternatives.
2. Use of ESCDs requires that the Director feature on MVS/ESA (feature code 5870, 5871 or 5872) be installed.
3. RACF 1.8.1 is the minimum required for use of ESCDs on MVS/ESA 4.1.0. However, other functions on MVS 4.1.0 will require upgrade to RACF 1.9.
4. If you are not communicating over ESCON channels in CTC mode, or with ESCON 3174s, ESCM only requires VTAM 3.2 to communicate with other ESCMs (over 3745s, for example).
5. When ESCON ports are installed on a 3490, this PTF must be installed on all other operating systems to which the 3490 is attached. This includes those attached through parallel ports. Refer to “3490 Magnetic Tape Subsystem with ESCON Adapters” on page 100 for specifics.
6. ICKDSF 10.0 supports ES Connection attachment of 3380s on 3990s. Support for 3390s on 3990s requires version 11.0.

Table 3. Software Support for ESCON Products under a Base Level of MVS/ESA 4.1.0.

For additional information on migration planning for MVS/ESA 4.1.0, refer to *MVS/ESA Planning; Installation Guide for MVS/ESA System Product Version 4*.

Inter-Relationships and Dependencies with Other Products

- Installation of the program products listed in Table 1 on page 35, Table 2 on page 36, and Table 3 on page 37 using System Modification Program Extended (SMP/E) will not require a SYSGEN.
- Installation of ESCON channels, ESCDs and ESCON-capable control units requires reconfiguration and use of the IXPIOCP program product to validate the new hardware configuration. Loading the resultant Input Output Configuration Dataset (IOCDS) requires a Power On Reset (POR) of the processor and Initial Program Load (IPL) of MVS. For a discussion of MVS/ESA 4.2 Dynamic I/O Configuration capability, which limits some system PORs required to do reconfigurations in the past, refer to “Considerations to Minimize Disruptions” on page 25.
- Addition of channels or control units to an MVS system requires an update of the I/O configuration using MVS Configuration Program.
- Reconfiguring existing ESCON channels or control units, or adding others may also require a corresponding reconfiguration of the ESCD.

It is important that the relationships between Input/Output Configuration Program (IOCP), MVS I/O configurations, ESCD configurations and Enterprise Systems Connection Manager (ESCM) are clearly understood, as each of these may potentially impact the others. Refer to “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13, “Summary of IOCP Changes for the Enterprise Systems Connection Environment” on page 17, and individual product sections for more complete discussions.

Special Considerations and Recommendations

To limit the number of products and procedures that you change in your configuration at any one time you may want to update and test new versions or levels of MVS or program products before installing the ESCON hardware.

MVS APAR Numbers for ESCON Support

Table 4 contains the list of ESCON-related APARs known at the time of publication. In addition, as base support for ES/9000 Water-Cooled Frame models, there is APAR OY30740. For ES/9000 Air-Cooled Frame models, there are APARs OY31097 (3.1.0e, 3.1.3) and OY30740 (all releases).

Table 4. APARs for Adding ESCON Support to MVS

Product	APAR Numbers
MVS	OY21350 OY21407 OY27078 OY28619 OY28645 OY28643 OY28664 OY28668 OY28670 OY28671 OY28672 OY28673 OY28675 OY28805 OY29354 OY30786 OY33846 OY33981
IXPIOCP	OY28801
JES3	OY29607
RMF	OY29122
RACF	OY30250
VTAM	OY29256

APAR numbers for the following were not known at the time of publication:

- MVS support for 3490
- DFP
- DFSORT

VM

If you want to use ESCON channels and control units with VM, you need to install a new version of VM, VM/ESA 1.0 with the ESA Feature. VM/ESA allows you to run production and test images of systems during their migration to a full ESCON environment.

The following table shows the releases and levels of VM/ESA and their support for ESCON products. The number in the Level column defines the minimum required level of a program. Where more current levels, modifications, or releases exist, they also support the listed ESCON products.

If there is an "x" in the column for a product, the base level of the VM/ESA or Program Product (PP) supports that ESCON product. Where a small program enhancement is used to add support for ESCON channels or control units, it will be shipped as a Program Temporary Fix (PTF), "PTF" appears in the column, and you need to install the (PTF) as well as the base level of support. When another level of VM appears in a column, you need to update to that level to get ESCON support.

VM/ESA Levels

	Level	9034	ESCON Channel	ESCON CTC	3174	3490	3990	ES Connection Manager	9032 9033	9035	9037
VM/ESA	1.0 (Note 1)	x	x	x	x			x (Note 2)	x		(Note 3)
VM/ESA	1.1	x	x	x	x	PTF	x	x (Note 2)	x	x	(Note 3)
VTAM	3.3			x	x			(Note 4)			
TSAF (In Base VM/ESA)				x (Note 5)							
TCP/IP	1.2			x (Note 5)							
PVM	1.4			x (Note 5)	x (Note 6)						
RSCS	3.0			x (Note 5)							
RACF	1.8.2								PTF		
EREP	3.4.2	x	x	x	x	x	x		x	x	
ES Connection Manager	1.0	x	x	x	x	x	x		x	x	
IOCP	2.0	x	x	x	x	x	x		x	n/a	

Notes:

1. VM/ESA 1.0 with the ESA feature supports ESCON channels. VM/ESA 1.0 with the CP/370 feature will not.
2. Enterprise Systems Connection Manager is supported for native VM/ESA use, but not for use by VM guests.
3. VM does not support use of the 9037 Sysplex Timer and the processor External Time Reference Adapter feature clocking function.
4. If you are not communicating over ESCON channels in CTC mode, or with ESCON 3174s, ESCM only requires VTAM 3.1 to communicate with other ESCMs (over 3745s, for example).
5. ES Connection channel-to-channel (CTC) communication is only supported through VTAM communication links for these products.
6. 3174 is supported by PVM as non-SNA only.

Table 5. VM/ESA Software Support for ESCON Products

VM Guest Support Considerations

- VM/ESA 1.0 provides support for 9034 attachment of a 3490 or 3990
- ESCON attachment for a 3490 or 3990 is available with VM/ESA 1.1
- DASD communicating with ESCON channels should be formatted without filler records so that CP will use ECKD* channel programs. This does not apply to ESCON channels operating in 9034 mode
- VM guests may use ESCON channels operating in 9034 mode subject to the following:
  - XA and ESA guests are allowed communication with all 9034-supported Devices. Refer to Table 18 on page 158 for a list of supported devices
  - individual customer configurations for 370 mode guests need to be evaluated for benefit.
- An ESA guest which is ESCON-capable and supports the ESCON 3990 may use the ESCON 3990 when it is defined to HCPRIO as an “unsupported” device.
- Full CMS support for ESCON-capable 3990s is provided with VM/ESA 1.1.

Inter-Relationships and Dependencies with Other Products

- Installation of the program products listed in Table 5 on page 40 requires a SYSGEN.
- Installation of ESCON channels, ESCDs and ESCON-capable control units requires reconfiguration and use of the IOCP program product to validate the new hardware configuration. Loading the resultant Input Output Configuration Dataset (IOCDS) requires a Power On Reset (POR) of the processor and an Initial Program Load (IPL) of VM.
- Addition of channels or control units to a VM system requires an update of VM′s I/O configuration in HCPRIO.
- Reconfiguring existing ESCON channels or control units, or adding them, may also require a corresponding reconfiguration of the ESCD.

It is important that the relationships between Input/Output Configuration Program (IOCP), HCPRIO, ESCD configurations and Enterprise Systems Connection Manager (ESCM) are clearly understood, as each of these may potentially impact the others. Refer to “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13 and “Summary of IOCP Changes for the Enterprise Systems Connection Environment” on page 17 for more complete discussions.

Special Considerations and Recommendations

To limit the number of products and procedures that you change in your configuration at any one time, you may want to update and test new versions or levels of the SCP or program products before installing the ESCON hardware.

ECKD is a trademark of the IBM Corporation.

VM APAR Numbers for ESCON Support

Table 6 contains the list of ESCON-related APARs known at the time of publication.

Table 6. APARs for Adding ESCON Support to VM

Product	APAR Numbers
VM	(TBD)
RACF	OY30250

APAR numbers for the following were not known at the time of publication:

- VM support for 3490
- VM support for the ES/9000 processors.

TPF

The following table shows TPF 3.1 support for ESCON products. The numbers define the minimum level of a program that is required; where more current levels exist, they also support ESCON connectivity.

An “x” in a column signifies that the base level of the system control program (SCP) or program product supports the ESCON product. Where a small program enhancement is used to add support for ES Connection, it is associated with an Authorized Program Analysis Report (APAR), “APAR” is cited in the column, and you need to install the Program Temporary Fix (PTF) as well as the base level of support. To determine the necessary PTF, contact your local IBM representative. When another level is cited, you need to update to that level of program to get the support.

TPF 3.1 Support

	Level	9034	ESCON Channel	ESCON CTC	3174	3490	3990	ES Connection Manager	9032 9033	9035	9037
TPF	3.1	x	x	APAR WP12249	NO	APAR (Note 1)	x (Note 2)	NO (Note 3)	x	x (Note 2)	APAR WP12248 (Note 4)

Notes:

1. The APAR number will be available prior to hardware availability. Contact your local IBM representative for the APAR number.
2. The 3990 model 2 is supported.

   Both 3990s and 3880s (with and without airlines caching and locking RPQs) can be attached to 9034s on 9034 channels to benefit from ES/Connectivity distance improvements and configuration management through the Enterprise Systems Connection Director. See Table 18 on page 158 for distance limitations.
3. ESCM is not supported under TPF. ESCD configuration changes are to be controlled from either the ESCD console or from the ESCM application running on the MVS system. The TPF system will not be informed when configuration changes are made from ESCM on the MVS systems. Adequate procedures should be put in place to guard against potential impacts to the running TPF systems from configuration changes executed from the MVS system.
4. Time-of-Day Synchronization Compatability (TSC) RPQ 8K1731

   The TSC RPQ allows attachment to the 9037 Sysplex Timer of processors with the Time-Of-Day (TOD) Clock Synchronization RPQ installed. See “9037 Sysplex Timer” on page 166 for additional information.

Table 7. TPF Software for ESCON Products

VSE

If you want to use ESCON channels and control units with VSE, you will need to install a new version, VSE/ESA 1.1.0.

The following table shows VSE/ESA 1.1.0 support for ESCON products. The number in the Level column defines the minimum required level of a program. Where more current levels, modifications, or releases exist, they also support the listed ESCON products.

If there is an "x" in the column for a product, the base level of the VSE/ESA or program product (PP) supports that ESCON product. Where a small program enhancement is used to add support for ESCON channels or control units, it will be shipped as a Program Temporary Fix (PTF), "PTF" appears in the column, and you need to install the (PTF) as well as the base level of support. To determine which PTFs are needed, contact your IBM representative.

VSE/ESA 1.1.0 provides support for attachment of current parallel control units directly to ESCON channels operating in 9034 mode.

VSE/ESA 1.1.0 Base

	Level	9034	ESCON Channel	ESCON CTC	3174	3490	3990	ES Connection Manager	9032 9033	9035	9037
VSE/ESA	1.1.0	x						(Note 1)			(Note 2)
EREP	3.4.2	x									
VSE/IOCP	1.1.0	PTF									
Standalone IOCP	2.0 (Note 3)	x									

Notes:

1. VSE/ESA does not support Enterprise Systems Connection Manager (ESCM)
2. VSE/ESA does not support the 9037 Sysplex Timer
3. The correct level of the standalone IOCP is provided with the processor or with the field installation of the ESCON channels.

Table 8. Software Levels for ESCON Products on VSE/ESA 1.1.0

Special Considerations

- Enterprise Systems Connection Manager (ESCM)

  VSE/ESA will not support ESCM. If you have configurations which include multiple host systems which share devices, you may want to run ESCM on an MVS or VM image, if one is available.

- IOCP

  VSE/ESA* uses the VSE/IOCP batch program rather than IXPIOCP to define processor configurations. The major difference is that with VSE/IOCP, the IOCDS is not downloaded into the processor.

  For the configuration process:

  – Run VSE/IOCP as a batch job to validate the configuration and then write the configuration out to tape

  – Quiesce jobs running on VSE to allow IPL of the standalone IOCP program

  – IPL the standalone IOCP to load the IOCDS for this hardware configuration

  – POR the processor to activate the configuration

  – Re-IPL VSE/ESA with the TYPE=SENSE parameter, which will SENSE all I/O devices and build the VSE I/O configuration tables according to the output from the SENSE-ID

  – Start applications again

- PR/SM

  VSE will also be supported running in LPAR mode on processors with the PR/SM feature. VSE/ESA 1.1.0 can communicate with devices attached to ESCON channels operating in 9034 mode, but not ESCON devices. Non-ESA versions of VSE cannot communicate with either.

- 9037 Sysplex Timer

  VSE does not support the 9037 Sysplex Timer.

- VSE cannot use host systems with multiple processors directly (for example, an ES/9000 air-cooled frame, model 440 or 3090J model 200, each of which has two processor engines). VSE can be run under VM or in LPAR mode in these cases.

VSE/ESA is a trademark of the IBM Corporation.

Channel-To-Channel Migration

When considering migration from a 3088 Multi-system Channel Communication Unit or an ES/9000-9221 MCCU feature 6200 (integrated CTC adapter on the ES/9000 Air Cooled Rack models) to an ESCON channel operating in CTC mode, you must verify that the CTC access method you are using supports ESCON CTC (refer to Table 9 on page 48). If the access method you are currently using does not support ESCON CTC, you must continue to use the 3088.

Check the first column in the table to find the CTC application you are using, then check the Primary CTC access method in column 2. If the access method is listed as native, check column 3. A YES in column 3 indicates that the access method you are using supports ESCON CTC. Your application must be at the level listed in column 1 to provide ESCON CTC support.

In planning CTC migration, there are three major items to consider:

- The addressing in the ESCON channel operating in CTC mode is increased from 256 devices per channel to 512
- The IOCP in the different system images must be coordinated
- The number of redundant CTC communication paths between host processors must be determined.

Table 9. CTC Applications and Access Methods

CTC Application	Primary CTC Access Method	ESCON CTC Support?
—MVS—		
MVS/VTAM 3.3	Native	YES
GRS (MVS/ESA 4.1)	XCF	YES
TCP/IP	VTAM 3.3	YES
IMS - ISC	VTAM 3.3	YES
IMS - IRLM	VTAM 3.3	YES
IMS - MSC	Native	NO [1,2]
CICS - ISC	VTAM 3.3	YES
DB2 - IRLM	VTAM 3.3	YES
BDT	VTAM 3.3	YES
BSC NJE - JES2/3	Native	NO [1,2]
SNA NJE - JES2/3	VTAM 3.3	YES
JES3	Native	NO [2]
GRS (MVS/SP V3)	Native	NO [2]
—TPF—		
MPIF	Native	YES
SNA/CTC	Native	YES
—VM—		
VM/VTAM 3.3	Native	YES
PVM 1.4	Native	NO [1,2]
TCP/IP	VTAM 3.3	YES
RSCS	Native	NO [1,2]
TSAF	Native	NO [1,2]
—AIX*—		
AIX/370*	Native	YES

Notes:

1. Alternate support is available through VTAM 3.3.
2. These applications can continue to use the 3088 with parallel channels or can use ESCON channels operating in 9034 mode.

AIX and AIX/370 are trademarks of the IBM Corporation.

IOCP Considerations: Channels supporting CTC communications must be paired, one operating in CTC mode (TYPE=CTC) and the other operating in native mode (TYPE=S). (Refer to Figure 4.) When using a single ESCD, the number of channels required for TYPE=CTC and TYPE=S is:

$$(n-1) \times (ctc + s)$$

where n is the number of system images or host processors, ctc is the number of channels TYPE=CTC, and s is the number of channels TYPE=S. This allows any one image to be able to communicate with any other image. The configuration in Figure 4 does not provide for alternate paths. The availability in the case of a single channel failure can be increased by making all images the same; that is, each image would have a TYPE=CTC and a TYPE=S defined. Full redundancy can be achieved with the number of channels defined for TYPE=CTC and for TYPE=S equal to (2 x $[(n-1) \times (ctc + s)]$) and with two Enterprise Systems Connection Directors. (Refer to Figure 5 on page 50.)

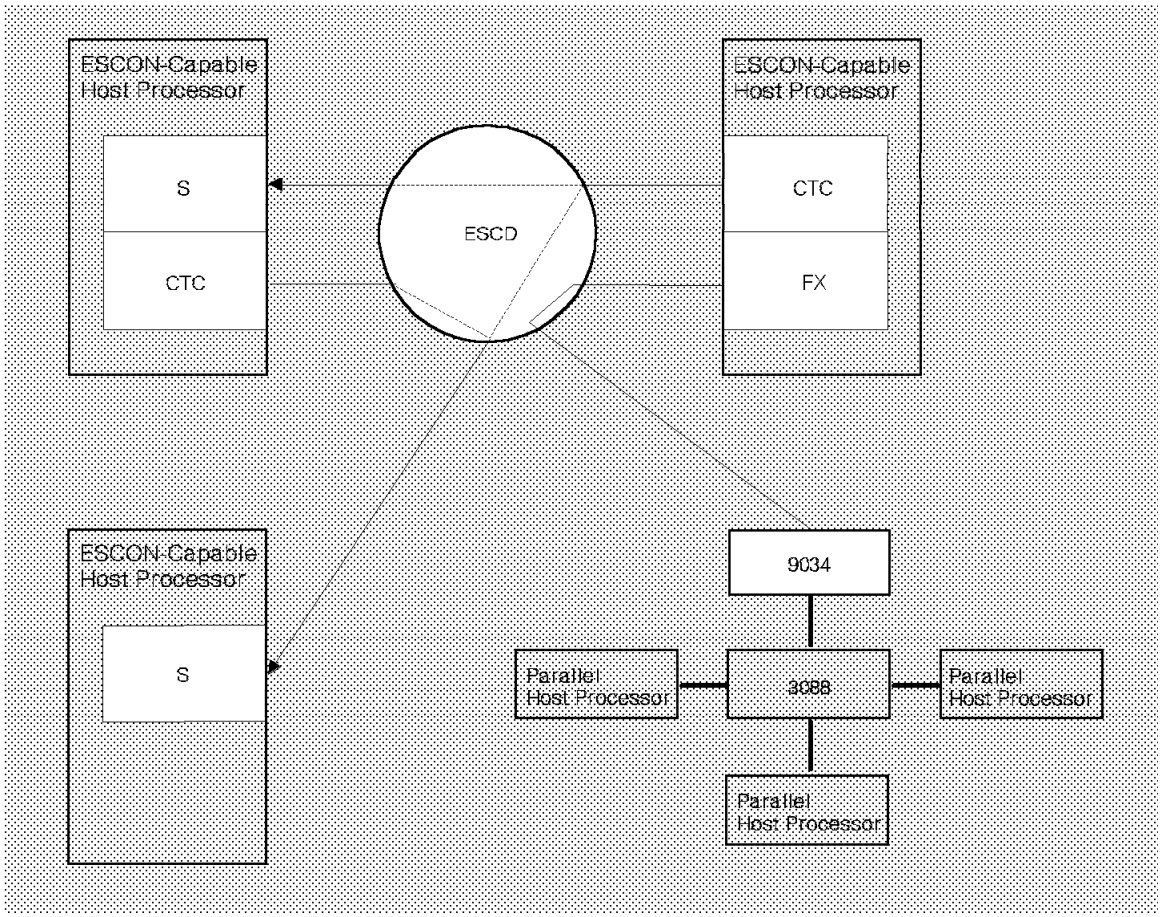

Figure 4. Channel-to-Channel Processor Communications.

TYPE=CTC CHPIDs can communicate with TYPE=S CHPIDs, but not with each other.

TYPE=FX channels allow CTC communication from an all-ESCON processor to non-ESCON processors through a 9034-attached 3088. A TYPE=FX channel is required on each ESCON-capable processor that needs to attach to the 3088, and each requires a 3088 port (in the figure, only one ESCON-capable host processor is able to communicate with the 3088).

Existing CTC communication on parallel channels through 3088s is still supported and is unaffected.

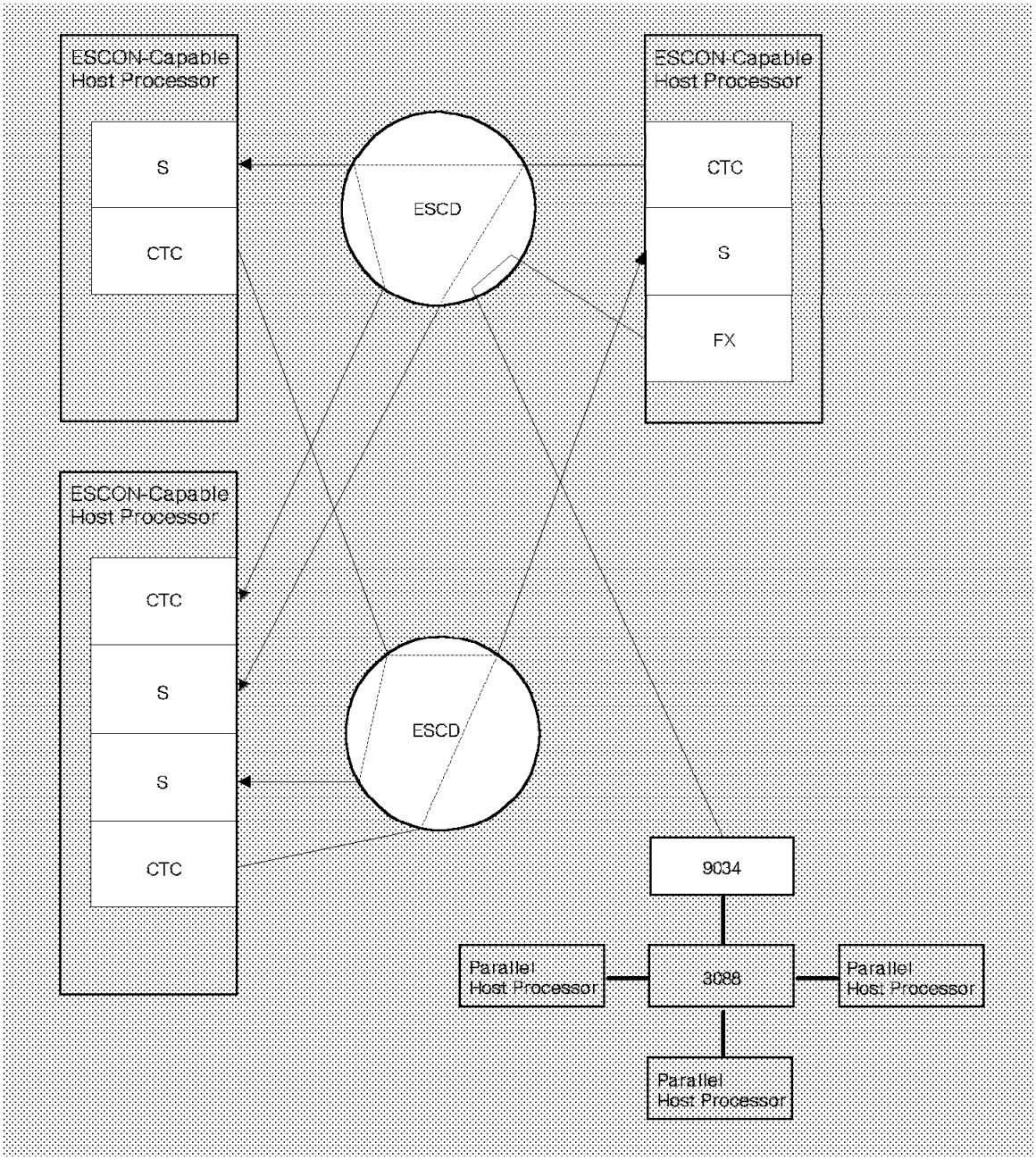

Figure 5. Fully Redundant Channel-to-Channel Processor Communications. To establish communication between any two system images, you must have a channel TYPE=S on one image and channel TYPE=CTC on the other.

The following general considerations apply for ESCON channels operating in CTC mode.

- An ESCON channel operating in CTC mode can communicate with an ESCON channel operating natively.
- An ESCON channel operating in CTC mode cannot communicate with another ESCON channel operating in CTC mode. Also, an ESCON channel operating in native mode cannot communicate with another ESCON channel operating in native mode.
- If an ESCON channel operating in CTC mode is to communicate with more than one channel, an ESCD is required and the SWITCH keyword must be coded on the CHPID macro.
- It is recommended that all control unit definitions for channel-to-channel communication have UNIT=SCTC coded on the CNTLUNIT macros.
- CTC communication requires CNTLUNIT and IODEVICE macros. Also, communicating systems must specify the same unit address(es) in the corresponding CNTLUNIT and IODEVICE macros.
- For multiple ESCDs, the number of TYPE=CTC and TYPE=S channels required is determined by the following formula:

  $$m \times [(n-1) \times (ctc + s)]$$

  where m is the number of ESCDs, n is the number of systems or images, ctc is the number of TYPE=CTC channels, and s is the number of TYPE=S channels.

Enterprise Systems Connection-Capable Processors

The host processors discussed in the following sections are ESCON-capable and contain the following on each processor (where applicable):

- One short paragraph description of the processor
- Configuration data
  - The number of attachments (physical)
  - Increments of ESCON/Parallel channels for each model (only versions containing ESCON) or a table with these increments.
  - A diagram showing these increments pictorially
  - Any special limitations
- MES steps and times for adding ESCON channel increments
- Any product- or system-level special considerations
  - Possible disruptions and how to alleviate them
  - Inter-relationships (for example with IOCP, ESCM, ESCDs)
  - RAS recommendations

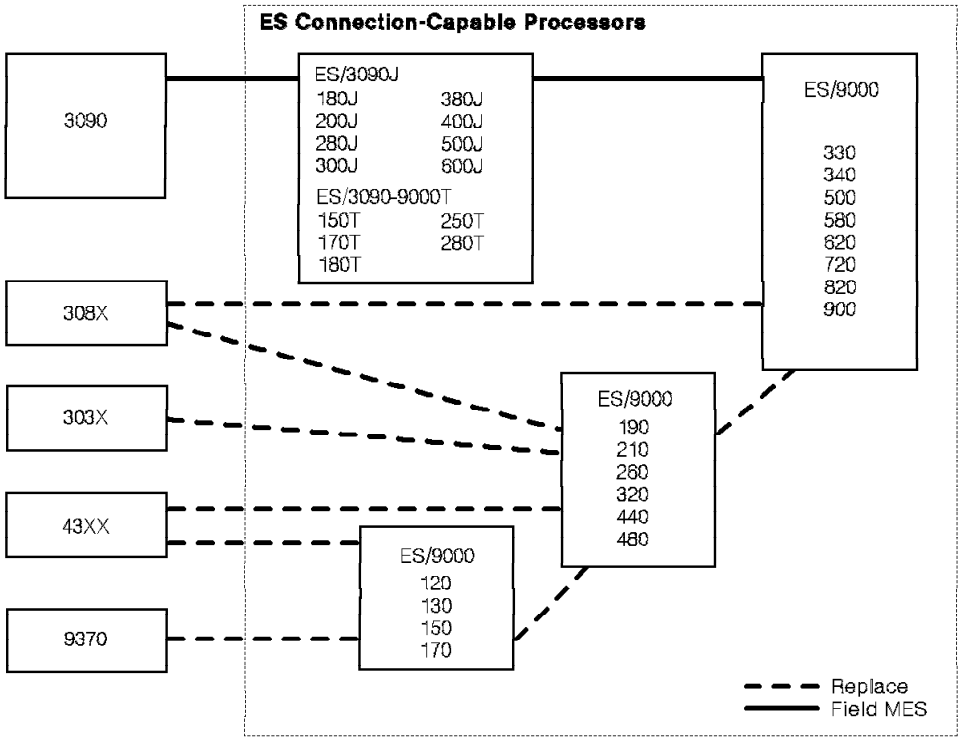

Figure 6. Processor Migration Paths to an Enterprise Systems Connection Environment

Figure 6 shows migration paths from existing IBM processors to those having Enterprise Systems Connection/390 capability. ESCON channels are supported on the following processors:

- ES/3090J (selected models) and ES/3090-9000T* models
- ES/9000 Air-Cooled Rack models
- ES/9000 Air-Cooled Frame models
- ES/9000 Water-Cooled Frame models.

To use ESCON channels, the host processor must be PORd in ESA/370* or LPAR mode. An ESCON-capable system initialized in S/370 mode will not be able to use the ESCON channels.

IBM System Control Programs (SCPs) must be at a level that supports ESA operation. This includes some existing ESA versions of MVS, TPF 3.1 (which already accommodates ESA), and new ESA versions of VM and VSE. Refer to “IBM Software” on page 33 for IBM SCP and program product versions and levels.

ES/3090-9000T and ESA/370 are trademarks of the IBM Corporation.

Introducing ESCON Channels in a Parallel I/O Environment

ESCON channels can be installed on processors and operated with currently installed parallel I/O control units. Figure 7 shows how 9034s can attach parallel I/O control units through an ESCD or directly to an ESCON channel. This capability allows you to continue using current I/O while migrating to ESCON capability on your host processors. Refer to Table 18 on page 158 for a list of supported control units.

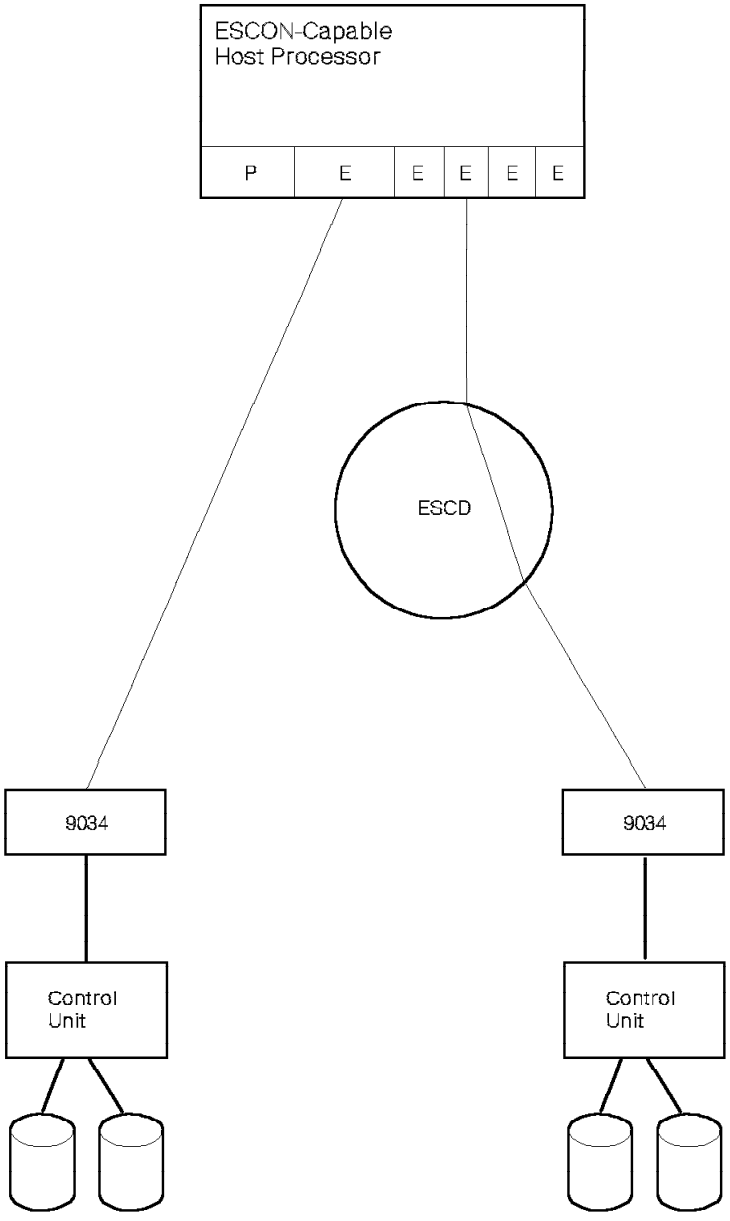

Figure 7. Processor Migration in a Parallel I/O Environment

ES/3090J and ES/3090-9000T Processors

Description

The following ES/3090 models support ESCON channels.

- ES/3090J
  - 180J
  - 200J
  - 280J
  - 300J
  - 380J
  - 400J
  - 500J
  - 600J
- ES/3090-9000T
  - 150T
  - 170T
  - 180T
  - 250T
  - 280T

Field upgrades to convert to these ES/3090J and ES/3090-9000T models are supported. The model upgrades must be made before installing ESCON channels. Contact your IBM representative for model upgrade paths and estimated upgrade times.

Channel Configurations

ESCON Channel Increments for ES/3090J and ES/3090-9000T Models: ESCON channels are available in the following increments which **must** be applied sequentially:

First ESCON Channel Group	(E1)	4 channels	CHPIDs 3C-3F
Second ESCON Channel Group	(E2)	4 channels	CHPIDs 38-3B
Third ESCON Channel Group	(E3)	8 channels	CHPIDs 30-37
Fourth ESCON Channel Group	(E4)	16 channels	CHPIDs 20-2F

ESCON channels may be installed asymmetrically on sides of multiprocessor configurations.

For the ES/3090J and ES/3090-9000T models, there are two basic channel configurations:

- Models that have a maximum of 32 parallel channels per side.
  Installation of ESCON channels does not displace parallel channels in these models. A new model maximum of 64 channels (including 32 ESCON channels) is allowed (refer to Figure 8).

  In the figure, the first increment beyond the 16 minimum parallel channels is noted as P1. The first increment for ESCON is noted as E1. Parallel increments are installed from the lower addresses upward, and the ESCON increments are installed from the upper addresses (CHPID address 3F or 7F) downward.

  For example, consider an ES/3090 Model 180J that allows a maximum of 32 parallel channels (16 minimum channels with CHPIDs 00 through 0F and two channel group increments of 8, CHPIDs 10 through 17 and 18 through 1F, respectively). Refer to Figure 8. The installation of ESCON channels increases the total channel maximum for the 180J to 64. The parallel channel limits and CHPID addresses are unchanged, and the additional 32 ESCON CHPIDs are assigned addresses from 20 through 3F.

  As ESCON channels are installed, they are assigned the high-end CHPID addresses and, depending on model and existing channel configuration, may require removing parallel channel groups.

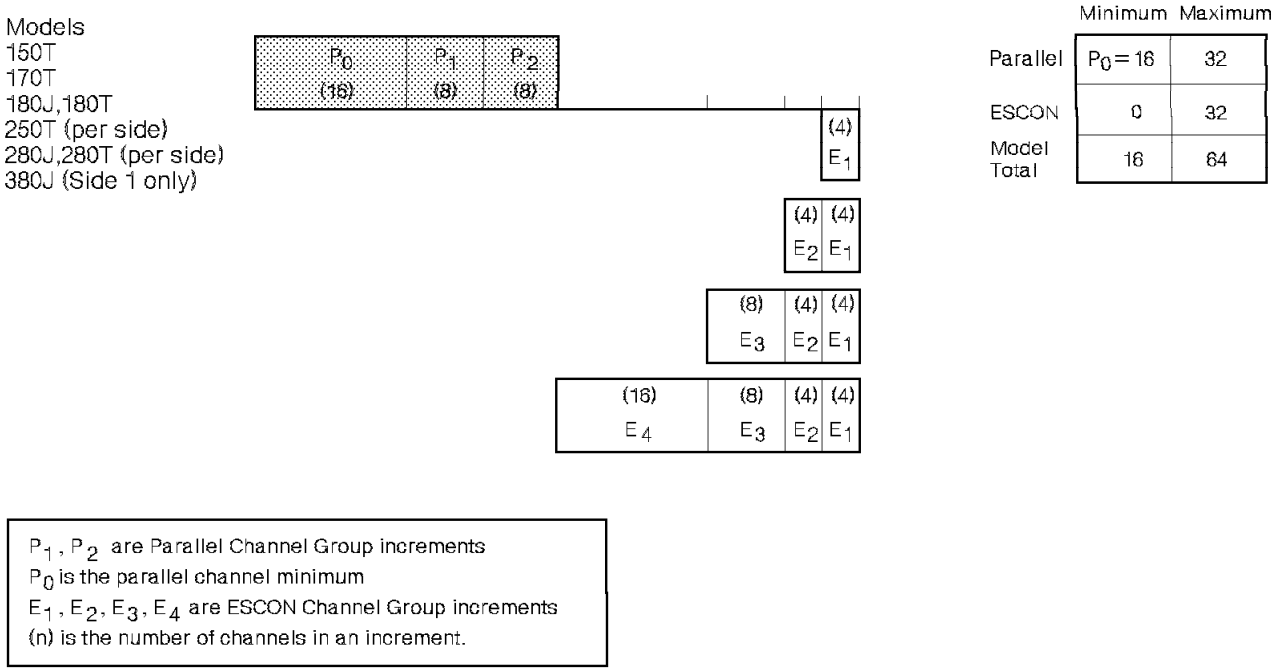

Figure 8. Channel Arrangement for ES/3090J and ES/3090-9000T Processors. (ESCON Channels Added to the Existing Parallel Channel Maximum.)

- Models that have a maximum of 64 parallel channels per side. Displacement may occur here (see the unshaded area of Figure 9).

The first increment beyond the 32 minimum parallel channels is noted as P1. The first increment for ESCON is noted as E1. Parallel increments are installed from the lower addresses upward, and the ESCON increments are installed from the upper addresses (CHPID address 3F or 7F) downward.

Installation of any combination of ESCON channel group increments E1 (four channels), E2 (four channels), and E3 (eight channels) displaces parallel channel group increment P3 (16 channels). ESCON channel group increment E4 (16 channels) displaces parallel channel group increments P2 and P1 (eight channels each).

For example, consider an ES/3090 model 200J fully configured with its maximum of 64 parallel channels (32 minimum channels with CHPIDs 00 through 1F and channel group increments of 8, 8, and 16 with CHPID addresses 20 through 27, 28 through 2F, and 30 through 3F, respectively). Refer to Figure 9. The installation of the first ESCON channel group of four channels would use the CHPID addresses 3C through 3F and require removing the last parallel channel group (16 channels with CHPID addresses 30 through 3F). This results in a loss of 12 CHPIDs. The first three ESCON channel group increments (four, four, and eight channels) would have to be installed together to provide an equivalent number of channels.

Make sure that you match the number of ESCON channels being installed with the number of parallel channels being removed, or that you plan for reassignment and recabling of control units on the removed channels to other channels. Refer to “Impact on Existing Parallel Channels” on page 61 for additional discussion.

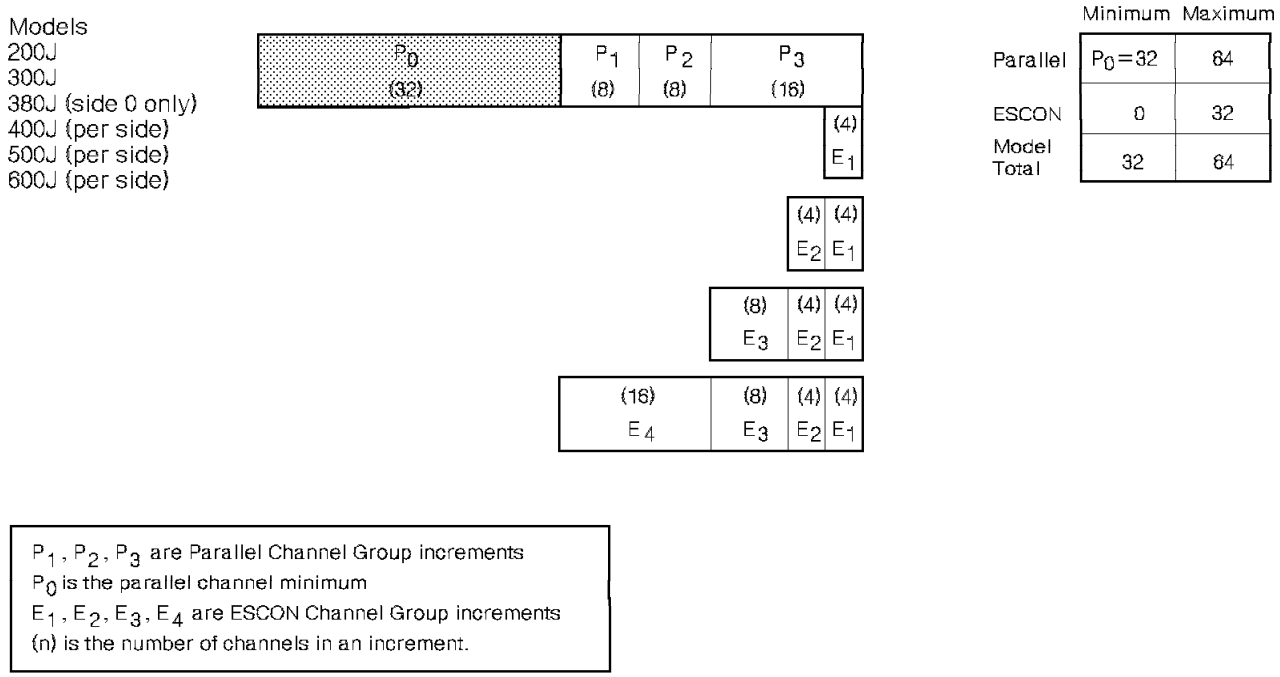

Figure 9. Channel Arrangement for ES/3090J and ES/3090-9000T Processors where ESCON channels may displace parallel channels.

ESCON Channel Installation and Upgrades

ES/3090 Family Upgrade Paths to ESCON-capable Models:

ES Connection capability can be installed on an ES/3090 system by three methods:

- A fully-configured system with ESCON channels can be ordered and installed
- An installed ES/3090 system can be upgraded in the field to an ES/3090J or ES/3090-9000T model which is ESCON-capable and ESCON channels added
- ESCON-capable ES/3090J and ES/3090-9000T models can be field upgraded to add ESCON channels.

Preparing for Installation of ESCON Channels: Before the field upgrade is done, the following steps should be performed:

- Update SCP and program product levels if required. (Refer to “IBM Software” on page 33 for details on required levels.)
- Install fiber cabling. (Refer to “Cabling” on page 7 for additional details.)
- If necessary, recable parallel control unit system attachments and modify IOCP CHPID definitions to maintain proper configurations. (Refer to “Impact on Existing Parallel Channels” on page 61 for a more complete discussion of this.)
- Prepare an IOCDS with the definitions for the new CHPIDs and ESCON control units
- If adding new CHPIDs or new control units, update the operating system I/O configuration definitions
- Prepare ESCD configurations as necessary for 9034 links or for managing control unit logical paths (see “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13 for more information)
- Install ESCON channel Licensed Internal Code upgrades on the 3092 service processor
- Update the processor to the proper System Engineering Change (SEC) level (contact your IBM representative for information on the correct SEC level).

Installing ESCON Channels:

Installation of ESCON channel hardware requires the installation of one or more MESs. The installation of these MESs requires that the processor be powered off. If the system is a Multi-Processor (MP) configuration, the side that is to be upgraded must be powered off. That side will be unavailable for use until installation is complete. Table 10 shows an estimate of the outage times.

	First ESCON Increment (4 to 32) Per Side	Next Two Increments (Each) Per Side	Last Increment Per Side
New frame 5/15	Less than 8 hours	5 to 6 hours	Up to 7 hours
Frame 5/15 replacement	8.3 to 10 hours		
64 channel configuration: Frame 5/15 OK; MES to remove parallel group MES to install ESCON group	15.5 to 17.0 hours		

Notes:

1. The times are not additive: column 2 reflects the range of time to install from four to 32 ESCON channels.
2. The times are only estimates. They apply to an upgrade of a single side.

Table 10. Time Estimates for Field Installation of ESCON Channels

The following choices are available for MES installation:

- MP configuration: upgrade both sides at the same time
  (For the fastest upgrade, both sides should be upgraded simultaneously.)
- MP configuration: upgrade one side at a time
  (For continued operation during the upgrade, this is the least disruptive.)
- MP configuration: upgrade only one side with ESCON channels
- Non-MP configuration: the whole system must be turned over to the service representative.

To determine the best procedure to follow, it is suggested that an estimate be made of the total outage time impact.

MP Configuration: Upgrade Both Sides at the Same Time:

For the fastest upgrade, both sides should be upgraded simultaneously. The procedure to upgrade both sides at a time is:

- Change the ESCD configuration (using ESCM if available) as necessary for ESCON control units
- An IBM service representative performs the upgrade by:
  - Installing the MESs and running tests
  - Moving parallel cabling if necessary
  - Connecting the ESCON fiber optic cables
  - A POR for the side with a new IOCDS supplied by the customer
- Perform normal customer testing for new hardware or software.

MP Configuration: Upgrade One Side at a Time:

If the system contains two sides, the upgrade can be done one side at a time to minimize the outage. This allows continued operation on the remaining side, though at reduced capacity. After MES installation of the first side is complete, and I/O cabling and IOCDS changes are made, this side is available for use. However, it cannot be merged into the running side until that side is also upgraded. At this point a disruption occurs to the second side, and the workload can be moved to the upgraded side so that the MES may be applied to the second side. After upgrade and checkout of the second side has been completed, that side can be merged into the running side to reach full capacity. The process steps are:

1. **Configure** the side to be upgraded **offline**
2. Perform the steps defined above for doing both sides at the same time, but only on the side being upgraded. Make sure your new IOCDS is configured for both sides of the MP (including the new channels to be added to the second side). This will then only require one POR for both sides to be upgraded with ESCON channels.
3. Test the upgraded side
4. Move the workload to the upgraded side and turn the second side over to the IBM service representative
5. Upgrade the second side in the same way as the first and perform normal customer testing
6. Merge the second side into the first to regain full computing capacity.

MP configuration: Upgrade Only One Side with ESCON Channels:

One side of an MP may be upgraded to have ESCON channels without installing them on the other (channel configurations may be asymmetric). Although there may be good reasons for installing ESCON channels on only one side, it is not advised because of availability reasons.

Upgrading only one side of a processor with ESCON channels can be performed using either of the procedures described above. Although only one side will contain ESCON channels, both sides must have the ESCON MES installed in order to run as a merged single image system.

Non-MP Configuration:

The only choice available is to turn the entire system over to the service representative. This process is like doing both sides of an MP at one time.

Impact on Existing Parallel Channels:

When adding ESCON channels to an ES/3090J or ES/3090-9000T system, it may be necessary to remove parallel channels other than those that are being replaced by the ESCON channels. The installation of ESCON channels requires that any parallel channel group 3 (P3), (CHPID addresses 30 through 3F), if installed, be removed. Refer to Figure 9 on page 58 for illustration of the potential channel displacement. If the processor being upgraded has the parallel channels in these locations, the following migration options are available for those channels being removed:

1. Move control unit attachments to other non-ESCON channels

If other parallel channels are available on the machine, the control units connected to parallel CHPIDS 30 through 3F may be moved to the other parallel CHPIDS. This will require physically moving the connectors at the tailgate. Before these control units can be accessed on the new CHPIDs, the IOCDS will have to be updated, a POR done to load the IOCDS, and an IPL to the operating system. If these control units will not be moved until the upgrade to ESCON channels, this upgrade should be planned so that the new IOCDS can be loaded during the POR of the machine after the ESCON MES installation is complete.

2. Attach the control units on ESCON channels operating in 9034 mode

   Parallel channels may be replaced with ESCON channels configured to operate in 9034 mode. This allows the installation of ESCON cabling, ESCDs, and ESCON channel hardware, while continuing operation with parallel control units. If this option is chosen, 9034 must be installed, and the IOCDS must be changed to reflect the change to TYPE=FX parameters.

   Future conversion of these channels to native ESCON mode operation requires (in addition to upgrading the control unit to ESCON) an IOCP change for the CHPID from TYPE=FX to TYPE=S and a POR of the processor to load this IOCDS.

Paths to a Control Unit Must be of the Same Type:

All channel paths to a logical control unit from an ES/3090J or ES/3090-9000T system image must have the same CHPID type in their IOCP definitions (either TYPE=FX, TYPE=S or TYPE=CTC). Parallel channels paths (TYPE=BL or TYPE=BY) may not be mixed with ESCON channel paths to a logical control unit. It may be necessary to move other control unit interfaces connected to parallel CHPIDs to 9034 mode (TYPE=FX) channels or to reassign and recable parallel control unit attachments to other parallel CHPIDs to avoid mixing CHPID types to a logical control unit. Refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide* for more details.

Example of Impact on Existing Parallel Channels:

Consider the ES/3090 model 200J example discussed earlier. The first ESCON channel group increment of four channels, E1, displaces parallel channel group P3, which contained 16 channels with CHPID addresses 30 through 3F.

Some of the control units assigned to this address range may be targeted to be migrated to ESCON-capable models in the near future (for example, a 3880 to be migrated to a 3990). These control units can attach to 9034s so that cabling and ESCDs can be installed as a group, rather than separately. As the 3880s are replaced with ESCON 3990s, only the IOCDS and ESCD configurations would have to be changed.

If the control units, which are to be attached to 9034s, have channels paths to addresses which are not in the 30 through 3F range, there will be a conflict in CHPID path types (a mix of TYPE=BL and TYPE=FX) to the control unit that can be resolved by reassigning the control unit paths to CHPID numbers within the 30 through 3F range in the IOCDS and recabling them to 9034s and ESCON channels operating in 9034 mode (TYPE=FX).

If a control unit like the 3880 is not planned to be migrated soon or will not be attached to 9034s, it will have to be reassigned to CHPID addresses 00 through 2F (those not in the P3 channel group) and recabled. If it is expected that the configuration will grow beyond 16 ESCON channels, it is advisable to reassign and recable these control units to CHPIDs which are not ESCON-capable (00 through 1F) so that they won't have to be reassigned and moved again later.

Inter-Relationships and Dependencies with Other Products

SCP Support ESCON Channels:

IBM System Control Programs (SCPs) must be at a level that supports ESA operation. This includes new ESA versions of VM and VSE, TPF 3.1 which already accommodates ESA, and some existing ESA versions of MVS. Refer to "IBM Software" on page 33 for additional information on required IBM SCP and program product versions and levels.

Changes to IOCP for ESCON Channels:

When ESCON channels are installed, the IOCDSs for the processor will have to be updated. New keywords for IOCP have been added and new values allowed for some existing keywords. Refer to "Summary of IOCP Changes for the Enterprise Systems Connection Environment" on page 17 for a general discussion of the IOCP changes. The following section lists specific considerations for defining your ESCON configurations for these processor models.

Selected ESCON Channel I/O Configuration Considerations:

The following lists some important ESCON channel considerations for the ES/3090J and ES/3090-9000T processors. For further information, refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide*.

- The ESCON channel hardware can operate in three modes: native (TYPE=S), CTC (TYPE=CTC), or 9034 (TYPE=FX). The IOCDS specification determines the mode
- Channels defined as TYPE=S, CTC, and FX do not operate on processors in 370 mode.
- All ESCON channel paths to the same device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (either TYPE=FX, TYPE=S or TYPE=CTC). Parallel channel paths (TYPE=BL or TYPE=BY) may not be mixed with ESCON channel paths to a logical control unit.
- The maximum number of destination links that can be defined for an ESCON channel path is determined by the model of ESCD to which it is attached (16 for 9033 and 60 for 9032, including port FE for the ESCD)
- The maximum number of control unit addresses that can be defined on an ESCON channel path is 120 (a control unit on a destination link can have multiple logical addresses using the CUADD keyword)
- A maximum of 48 physical control units can be defined on a 9034 mode channel path (TYPE=FX), although electrical limitations further restrict the number of attached control units on the interface usually to eight (or 16 if attached to a 2914 or 3814 switch)
- Configuration maximums for control units attached to ESCON channel path:
  - 1024 devices for TYPE=S
  - 256 devices for TYPE=FX

  - 512 Devices for TYPE=CTC
- Only one ESCD may be defined in IOCP to a CHPID path (a second chained ESCD may exist on the path, but does not get defined to IOCP)
- The number of ESCDs that can be defined is determined by the number of ESCON channels installed. The maximum numbers are determined by the number of ESCON channels possible:
  - 32 per side are possible for models 250T, 280J, 280T, 380J, 400J, 500J, and 600J.
  - 32 in total are possible for the other models.
- The default for the Status Verification Facility (STADET) is changed to STADET=Y for ESCON control units on ESCON CHPIDs.
- A maximum of four paths is permitted to a logical control unit from a system image.

Considerations for Managing Single Points of Failure:

It is recommended, when assigning parallel channel paths to a control unit, that channels be selected from different processor sides if possible and from different channel elements (groups of four channels) to minimize impacts of unplanned or planned system outage. This is also advisable for assigning ESCON channel paths. For the same reason, channel paths to a logical control unit should be spread across two or more ESCDs.

PR/SM LPAR Considerations

- PR/SM logical partitions running in S/370 mode cannot use ESCON channels.
- Each LPAR is treated as a separate system image. Rules about numbers of paths to a logical control unit and mixing of CHPID TYPEs apply to each image independently.
- To coordinate ESCD changes across system images, each image should have its own copy of ESCM.

Special Considerations and Recommendations

Testing:

You may want to use PR/SM in LPAR mode to continue running your production system while testing the SCP, program product, and the ESCON products in a separate LPAR. You should analyze the number of channels and the amount of storage required to run both systems.

Power Sequencing for Control Units at Distances Greater than 400 Feet:

If power sequencing for control units is normally done from the processor, control units that are more distant will have to be treated differently. The IBM Enterprise Systems Connection Monitor System products will allow operators at the processor location to perform this and other operations over a common telephone line. Refer to “Enterprise Systems Connection Monitor System” on page 171 for more details.

Analyzing ESCON-Link-Incident Records

The ESCON Analyzer is included with ESCON channels when the appropriate no-charge specify feature is ordered with the ESCON channels. The ESCON Analyzer collects and analyzes ESCON-link-incident records from ESCON channels, ESCDs, or ESCON control units attached to the processor complex. Refer to “Enterprise Systems Connection Analyzer” on page 87.

ES/9000 Air-Cooled Rack models

Description

The ES/9000 Air-Cooled Rack models are the entry to the ES/9000 family of processors. The series consists of four processor models, each offering a range of memory, communications, and I/O attachment options. Enterprise Systems Connection channels are supported on these models when operated in ESA mode. Communications with these channels is supported by appropriate levels of MVS, VM, and VSE. TPF is not supported.

Configuration

Channel Increments for all Models (Parallel and ESCON):

Model	Minimum Number of Parallel/ESCON Channels	Maximum Number of Parallel/ESCON Channels	Notes
120	0	12	1, 3
130	0	12	1, 3
150	0	12	1, 3
170	0	24	2, 3

Notes:

1. This model contains four card slots.
2. This model contains eight card slots.
3. You can plug one or three channels, or none, into each card slot. Each card slot is either exclusively parallel or exclusively ESCON.

These models feature both Integrated I/O adapter and channel adapter attachment of control units and I/O.

A sample of the configurations possible for the model 170 is shown in Figure 10 on page 67.

When either parallel or ESCON channels are installed, any S/370 Block Multiplexor feature on the I/O Bus Link must be removed .

A maximum configuration of channels requires 3-Channel Adapter cards in each slot, leaving no room for I/O Bus Link adapters. Also note that the processor Sysplex Attachment card installs in slot 15, which limits the maximum channel configuration to 21 channels.

Installation and Upgrades

Preparing for Installation of ESCON Channels

- Update SCP and program product levels if required. (Refer to “IBM Software” on page 33 for details on required levels.)
- Install fiber cabling. (Refer to “Cabling” on page 7 for additional details.)
- If necessary, recable parallel control unit system attachments and modify IOCP CHPID definitions to maintain proper configurations. (Refer to “Impacts on Existing Channels” on page 68 for a more complete discussion of this.)

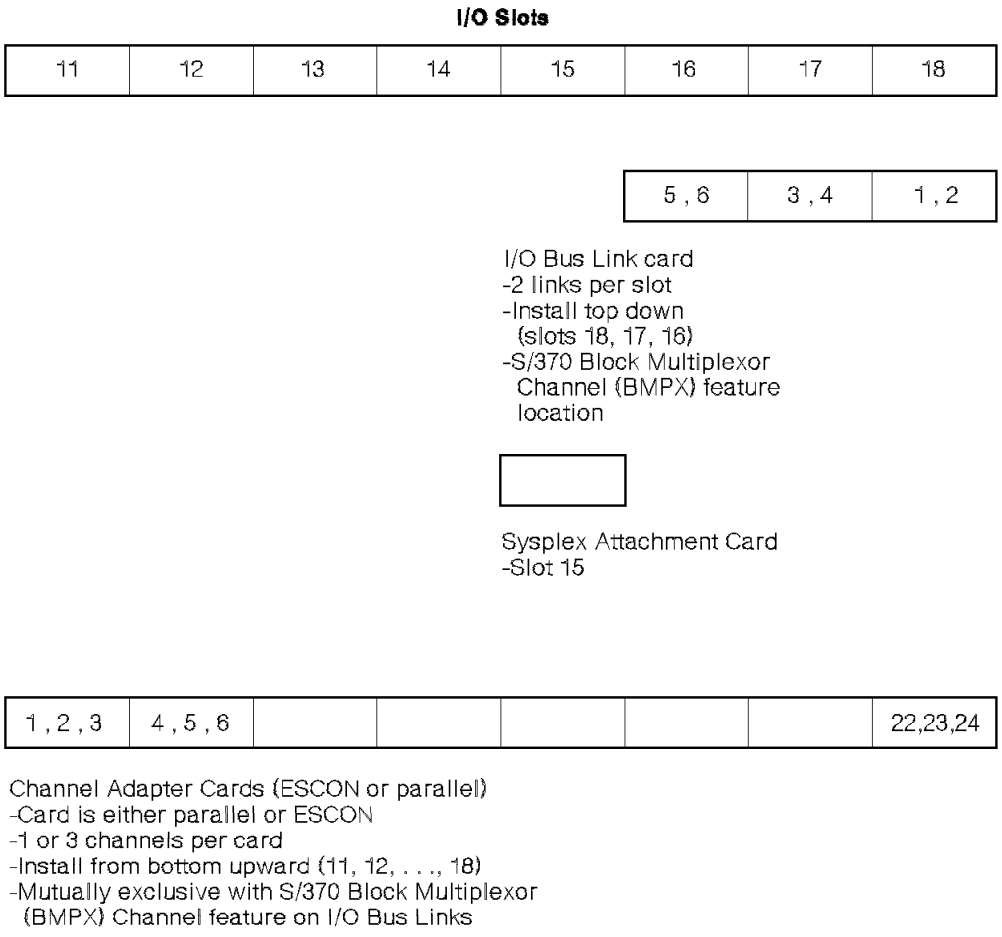

Figure 10. Channel Configuration Example for ES/9000 Air-Cooled Rack models

- Prepare an IOCDS with the definitions for the new CHPIDs and ESCON control units
- If adding new CHPIDs or new control units, update the operating system I/O configuration definitions
- Prepare ESCD configurations as necessary for 9034 links or for managing control unit logical paths (see “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13 for more information on logical paths)
- Install ESCON channel Licensed Internal Code upgrades on the service processor
- Update the processor to the proper System Engineering Change (SEC) level.

Field Installation of Channels: The installation of an ESCON channel (single channel or channel group of three) in an installed ES/9000 Air-Cooled Rack model processor requires you to do the following:

- Power-down the processor
- Install the channel card
- Install the fiber optic cable
- Update the ESCD configuration
- Update the IOCDS
- Power-up the processor to load the IOCDS
- Test the system.

The estimated installation time is approximately two hours. This time does not include the time to install and test new I/O control units to be connected to the newly installed ESCON channels nor to recable control units if required.

Impacts on Existing Channels: All ESCON channel paths to the same device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (TYPE=FX, TYPE=S or TYPE=CTC). Parallel channels paths (TYPE=BL or TYPE=BY) may not be mixed with ESCON channel paths to a logical control unit. It may be necessary to move other control unit interfaces connected to parallel CHPIDs to 9034 mode (TYPE=FX) channels or to reassign and recable parallel control unit attachments to other parallel CHPIDs to avoid mixing CHPID types to a logical control unit. Refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide* for more details.

Inter-Relationships and Dependencies with Other Products

Changes to IOCP for ESCON Channels: When ESCON channels are installed, the IOCDS for the processor will have to be updated. New keywords for IOCP have been added and new values allowed for some existing keywords. Refer to "Summary of IOCP Changes for the Enterprise Systems Connection Environment" on page 17 for a general discussion of the IOCP changes. The next section lists specific considerations for defining your ESCON configurations.

Selected ESCON Channel I/O Configuration Considerations: The following lists some important ESCON channel considerations for the ES/9000 Air-Cooled Rack model processors. For further information refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide*.

- The ESCON channel hardware can operate in three modes: ESCON native (TYPE=S), ESCON CTC (TYPE=CTC), or 9034 (TYPE=FX). The IOCDS specification determines the mode.
- Channels defined as TYPE=S, CTC, and FX operate only in ESA/370 mode.
- All ESCON channel paths to the same device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (TYPE=FX, S, or CTC). Parallel channels paths (TYPE=BL or BY) may not be mixed with ESCON channel paths to a logical control unit.
- The maximum number of destination links (including port FE for the ESCD) which can be defined for an ESCON channel path is determined by the model of ESCD to which it is attached (16 for 9033 and 60 for 9032).
- The maximum number of control unit addresses that can be defined on an ESCON channel path is 120 (a control unit on a destination link can have multiple logical addresses using the CUADD keyword).
- A maximum of 48 physical control units can be defined on a 9034 mode (TYPE=FX) channel path, although electrical limitations further restrict the number of attached control units on the interface usually to eight (or 16 if attached to a 2914 or 3814 switch).
- Configuration maximums for devices attached to ESCON channel path are:

Maximum Devices	**TYPE=**
1024	S
256	FX
512	CTC

- Only one ESCD may be defined in IOCP to a CHPID path (a second chained ESCD may exist on the path but does not get defined to IOCP).

- The number of ESCDs that can be defined is determined by the number of ESCON channels installed. The maximums are determined by the number of ESCON channels possible:
  - 12 ESCDs for an ES/9000 Air-Cooled Rack model 120, 130, or 150
  - 24 ESCDs for an ES/9000 Air-Cooled Rack model 170.
- The default for the Status Verification Facility (STADET) is STADET=Y for ESCON control units on ESCON CHPIDs.
- A maximum of four paths is permitted to a logical control unit from a system image.

Considerations for Managing Single Points of Failure: It is recommended that when you assign parallel channel paths to service a control unit, you select channels from different channel cards, if possible, to minimize impacts of unplanned or planned system outage. This is also advisable for assigning ESCON channel paths. For the same reason, channel paths to a logical control unit should be spread across two or more ESCDs.

PR/SM LPAR Considerations

- PR/SM logical partitions running S/370 operating systems cannot use ESCON channels.
- Each LPAR is treated as a separate system image; the same rules about numbers of paths to a logical control unit and mixing of CHPID TYPEs apply to each image independently.
- Control or management of the ESCD may require that each image have its own copy of ESCM to coordinate ESCD changes across images.

Special Considerations and Recommendations

Testing:

You may want to use PR/SM in LPAR mode to continue running your production system while testing the SCP, program product and the Enterprise Systems Connection products in a separate LPAR at the same time. Make sure that you have enough channels and storage to run both systems.

Power Sequencing for Control Units at Distances Greater than 400 Feet:

If power sequencing for control units is normally done from the processor, control units that are more distant will have to be treated differently. The IBM Enterprise Systems Connection Monitor System products will allow operators at the processor location to perform this and other operations over a common telephone line. Refer to “Enterprise Systems Connection Monitor System” on page 171 for more details.

Analyzing ESCON-Link-Incident Records

The ESCON Analyzer is included with ESCON channels when the appropriate no-charge specify feature is ordered with the ESCON channels. The ESCON Analyzer collects and analyzes ESCON-link-incident records from ESCON channels, ESCDs, or ESCON control units attached to the processor complex. Refer to “Enterprise Systems Connection Analyzer” on page 87.

ES/9000 Air-Cooled Frame models

Description

The IBM Enterprise System/9000* Processor Family Air-Cooled Frame models consists of four uniprocessor and two dyadic models. They provide an air-cooled compatible processor growth path for customers with IBM 43XX and 308X processors.

Upgrade offerings provide for growth from an ES/9000 Air-Cooled Rack model to an ES/9000 Air-Cooled Frame model. Upgrades will be offered between ES/9000 Air-Cooled Frame models. Contact your IBM representative for model upgrade paths and estimated upgrade times. ESCON channels may be field installed on all models.

Channel Configurations

Table 11 on page 71 shows channel configurations for different ES/9000 Air-Cooled Frame models. A configuration is composed of channel features (where the channels are installed), and channel groups. A channel group is four channels and is either all ESCON or all parallel channels.

- Maximum of four channel features:
  - The Base Parallel Channel Feature is standard
  - One to three Optional Parallel Channel Features are allowed
  - One or two Optional ESCON Channel Features are allowed
  - The Optional Parallel Channel Feature 1 or 2 can be replaced with optional ESCON Channel Feature 1 or 2
- Configuration rules for a channel feature
  - Parallel Channel Feature
    - Base and Optional Parallel Channel Features 1 and 2 can contain a mix of up to three Parallel Channel Groups, totaling 12 channels, and one ESCON Channel Group with four channels
    - Optional Parallel Channel Feature 3 contains the 12 parallel channels, but cannot contain the ESCON Channel Group. Installation of Parallel Channel Feature 3 is mutually exclusive with installation of any ESCON Channel Groups or Optional ESCON Channel Feature (refer to Figure 12 on page 73 and note that installation of ESCON Channel Group 1 (E1) displaces Parallel Channel Feature 3 (PCF3) and Parallel Channel Groups P7, P8 and P9).
  - The two Optional ESCON Channel Features (1 and 2) can each contain up to four ESCON Channel Groups totaling 16 channels.

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Table 11. Channel Configurations for ES/9000 Air-Cooled Frame Models						
Channel Types	**Models**					
	190	**210**	**260**	**320**	**440**	**480**
Minimum Parallel Minimum ESCON	8 0	8 0	12 0	12 0	12 0	12 0
Maximum Parallel Maximum ESCON	24 20	48 36	48 36	48 36	48 36	48 36
Total Parallel and ESCON	32 (See figure 12)	48	48	48	48	48
Note: Channels are added in increments of four.						

Model 190 Configuration:

The model 190 permits only Base Channel Feature and Optional Channel Feature 1, limiting the mix of channels allowed. Refer to Table 12 for specific configurations. If future configuration plans call for more than 12 parallel and more than eight ESCON channels, installation of a model other than the model 190 should be considered to minimize later model upgrades and field installs of ESCON channels.

Table 12. Model 190 Channel Configurations					
Channel Type	**Number of Channels Allowed**				
Parallel	8	12	16	20	24
ESCON	0-20	0-20	0-8	0-8	0-8
Note: Channels are added in increments of four.					

Figure 11 on page 72 shows how installation of ESCON channels replaces parallel channels on the model 190.

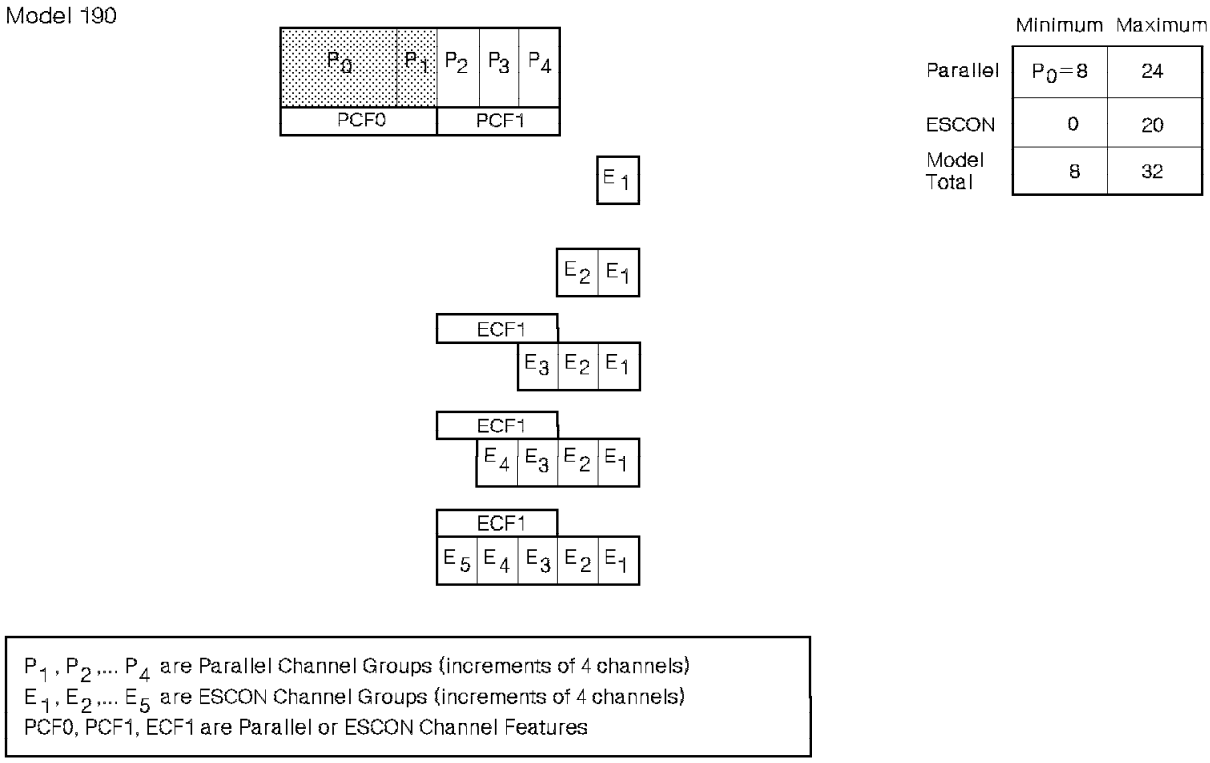


Figure 11. Channel Arrangement for ES/9000 Air-Cooled Frame Model 190 Processors

Models 210, 260, 320, 440, and 480: As ESCON channels are installed, they are assigned the high-end CHPID addresses and may, depending on existing channel configuration, require removing Parallel Channel Groups.

For a model 440 configured with 12 ESCON and 36 parallel channels, the ESCON CHPIDs use addresses 24 through 2F. The 12 minimum channels and six parallel Channel Group increments (24 channels) use CHPID addresses 00 through 0B and 0C through 23, respectively.

Figure 12 on page 73 shows how installation of ESCON channels replaces parallel channels.

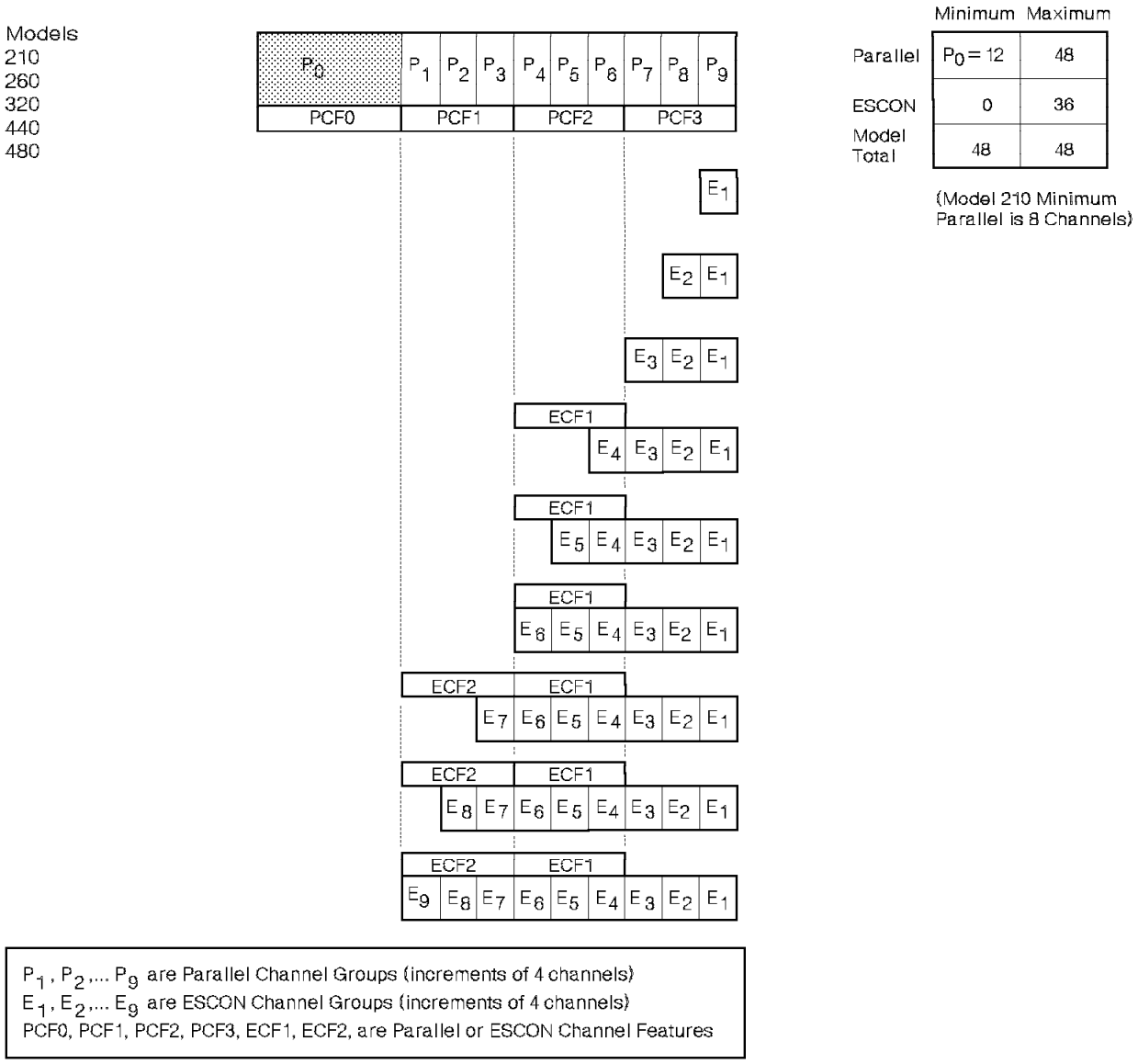


Figure 12. Channel Arrangement for ES/9000 Air-Cooled Frame Model Processors

The field installation of ESCON Channel Group 4 (E4) would use the CHPID addresses 20 through 23 and require:

- Replacement of Parallel Channel Feature 2 (PCF2) and the removal of three Parallel Channel Groups it houses (P4,P5, and P6)
- Installation of ESCON Channel Feature 1, which houses ESCON Channel Groups E4, E5,and E6
- Installation of ESCON Channel Group E4.

This is a net loss of eight CHPIDs. Two additional ESCON Channel Group increments would have to be installed to provide an equivalent number of channels.

Care should be taken to match the number of ESCON channels being installed with the number of parallel channels being removed, or to plan for reassignment and recabling of control units on the removed channels to other channels. Refer to “The Impact on Existing Parallel Channels” on page 75 for additional discussion.

Channel Installation Steps and Upgrade Times

ES/9000 Air-Cooled Frame Model System Channel Field Upgrades

Preparing for Installation of ESCON Channels

- Update SCP and program product levels, if required. (Refer to "IBM Software" on page 33 for details on required levels.)
- Install fiber cabling. Refer to "Cabling" on page 7 for additional details
- Recable parallel control unit system attachments and modify IOCP CHPID definitions to maintain proper configurations, if necessary. (Refer to "The Impact on Existing Parallel Channels" on page 75 for a more complete discussion of this.)
- Prepare an IOCDS with the correct definitions for the new CHPIDs and ESCON-capable control units
- Update the operating system I/O configuration definitions if adding new CHPIDs or new control units
- Prepare ESCD configurations as necessary for 9034 links or for managing control unit logical paths (see "Managing Logical Paths on Enterprise Systems Connection Channels" on page 13 for more information)
- Install ESCON channel Licensed Internal Code upgrades on the I/O Support Processor (IOSP)
- Update the processor to the proper System Engineering Change (SEC) level.

Installing ESCON Channels: Installation of ESCON channel hardware requires the installation of one or more MESs. The installation of these MESs requires that the processor be powered off.

Table 13 on page 75 lists time estimates for field installation of ESCON channels. The steps for installation are:

1. Change ESCD configuration (with ESCM if available) as necessary for ESCON devices
2. Turn the machine over to the IBM service representative
3. The IBM service representative performs the upgrade as follows:
   - Installs the MES or MESs and run tests
   - Moves parallel cabling if necessary
   - Connects the ESCON fiber optic cables
   - PORs the host processor with a new IOCDS supplied by the customer
4. The customer performs the normal testing for new hardware or software.

Assumptions for MES Installation Times

- The times shown below are based on one service representative doing the upgrade. Contact you service representative for updated estimates.

Table 13. Channel Installation Time Estimates

Possible Steps	**Installation Times**
Add the ESCON Channel Group to an existing Channel Feature option (four channels)	1 hour
Add a new Channel Feature option and install ESCON Channel Groups (16 channels)	2 to 2.5 hours
Replace a Parallel Channel Feature with an ESCON Channel Feature option and install ESCON Channel Groups (16 channels)	2.5 to 3 hours
The range of possible times	1 to 3 hours

Note: The times are estimates only and depend on the channel features installed. The addition of ESCON channels may require removal of parallel channels and add 2.5 to 3 hours to the outage times (refer to Figure 11 on page 72 and Figure 12 on page 73).

The Impact on Existing Parallel Channels:

When adding ESCON channels to an ES/9000 Air-Cooled Frame model system, it may be necessary to move control unit attachments other than those that are being replaced by the ESCON channels. The following migration options are available for control units on those channels being replaced:

1. Move control unit attachments to other non-ESCON channels

   If other parallel channels are available on the machine, the control units may be moved to the other parallel CHPIDS. This will require physically moving the connectors at the tailgate. Before these control units can be accessed on the new CHPIDs, the IOCDS will have to be updated, a Power-On-Reset (POR) done to load the IOCDS, and the customer′s operating system IPLd. If these control units will not be moved until the upgrade to ESCON channels, this should be planned so that the new IOCDS can be loaded during the POR of the machine after the ESCON MES installation is complete.

2. Attach the control units through ESCON channels operating in 9034 mode

   Parallel channels may be replaced with ESCON channels configured to operate in 9034 mode. This allows the installation of ESCON cabling, ESCDs, and ESCON channel hardware, while continuing operation with parallel control units. If this option is chosen, the 9034 must be installed, and the IOCDS must be changed to reflect TYPE=FX for the CHPID.

   Future conversion of these channels to ESCON mode operation requires, in addition to upgrading the control unit to ESCON, an IOCP change for the CHPID from TYPE=FX to TYPE=S and a POR to load this IOCDS.

A Further Consideration—Paths to a Control Unit Must be of the Same CHPID Type: All ESCON channel paths to the same device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (TYPE=FX, S, or CTC). Parallel channel paths (TYPE=BL or BY) may not be mixed with ESCON channel paths to a logical control unit. It may be necessary to move other control unit interfaces connected to parallel CHPIDs to ESCON

channels operating in 9034 mode, or to reassign and recable parallel control unit attachments to other parallel CHPIDs, to avoid mixing CHPID types to a logical control unit. Refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide* for more detail.

An Example of the Impact on Existing Parallel Channels: Consider a model 440 with the maximum configuration of parallel channels. The addition of four ESCON channels will require the removal of Parallel Channel Groups P7, P8, and P9 (refer to Figure 12 on page 73). For our example, we will add 12 ESCON channels, four each to Parallel Channel Feature PCF0, PCF1, and PCF2. These ESCON channels will have addresses 24 through 2F.

Some of the devices assigned to this address range may be targeted to be migrated to ESCON-capable models in the near future (for example, a 3880 to be migrated to a 3990). These are control units that may make sense to attach to 9034s, so that cabling and ESCDs can be installed as a group. As the 3880s are replaced with ESCON-capable 3990s, only the IOCDS and ESCD configurations would have to be changed.

If these control units, which are to be attached to 9034s, have channels paths to CHPID addresses that are parallel, there will be a conflict in CHPID path types (a mix of TYPE=BL and TYPE=FX) to the control unit, which can be resolved by reassigning the control unit paths to ESCON CHPID addresses and recabling them to 9034s and ESCON channels operating in 9034 mode.

If a device like the 3880 is not planned to be migrated soon or will not be attached to 9034s, its paths will need to be reassigned and recabled to CHPIDs that will stay parallel.

Inter-Relationships and Dependencies with Other Products

- Software
  - To use ESCON channels, IBM SCPs must be at a level that supports ESA operation. This includes new ESA versions of VM and VSE, TPF 3.1 which already accommodates ESA, and some existing versions of MVS.
  - VSE/ESA 1.1.0 is supported, but cannot run natively on models 440 and 480 which have multiple processors. It can run under PR/SM in LPAR mode or as a VM guest on these models.

  Refer to “IBM Software” on page 33 for more information on the software levels required.
- Additions of ESCON channels or control units can affect IOCP configurations, require updates to the SCP I/O configuration, require SYSGENs or System Modification Program Extended (SMP/E) updates to install upgrades to the SCP and program products, and require updates to the ESCD configuration. Consider these relationships when installing ESCON products.

When ESCON channels are installed, the IOCDSs for the processor will have to be updated. New keywords for IOCP have been added and new values allowed for some existing keywords. Refer to “Summary of IOCP Changes for the Enterprise Systems Connection Environment” on page 17 for a general discussion of the IOCP changes.

Selected ESCON Channel I/O Configuration Considerations: The following lists some important ESCON channel considerations for the ES/9000 Air-Cooled Frame model processors. For further information, refer to *ES/9000 Processor*

Complex, ES/3090 Processor Complex: Input/Output Configuration Program User's Guide and Reference

- The ESCON channel hardware can operate in three modes: ESCON native (TYPE=S), ESCON CTC (TYPE=CTC), or 9034 (TYPE=FX). The IOCDS specification determines the mode.
- Channels defined as TYPE=S, CTC, and FX operate only in ESA/370 mode.
- All channel paths to the same device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (TYPE=FX, S, or CTC). Parallel channel paths (TYPE=BL or BY) may not be mixed with ESCON channel paths to a logical control unit.
- The maximum number of destination links (including port FE for the ESCD) that can be defined for an ESCON channel path is determined by the model of ESCD to which it is attached (16 for a 9033 and 60 for a 9032).
- The maximum number of control unit addresses that can be defined on an ESCON channel path is 120 (a control unit on a destination link can have multiple logical addresses using the CUADD keyword).
- A maximum of 48 physical control units can be defined on a 9034 mode (TYPE=FX) channel path, although electrical limitations further restricts the number of attached control units on the interface usually to eight (or 16 if attached to a 2914 or 3814 switch).
- Configuration maximums for devices attached to ESCON channel path are:

Maximum Devices	**TYPE=**
1024	S
256	FX
512	CTC

- Only one ESCD may be defined in IOCP to a CHPID path (a second chained ESCD may exist on the path but does not get defined to IOCP)
- The number of ESCDs that can be defined is determined by the number of ESCON channels installed. The maximums are determined by the number of ESCON channels possible:
  - 20 ESCDs for a model 190 or 150
  - 36 ESCDs for the other models.
- The default for the Status Verification Facility (STADET) is STADET=Y for ESCON control units on ESCON CHPIDs.
- A maximum of four paths is permitted to a logical control unit from a system image.

Considerations for Managing Single-Points-of-Failure: As with parallel channels, when choosing channel paths for a control unit, select channels from different ESCON Channel Features and from different Channel Groups to minimize the impact of an unplanned outage. For the same reason, channel paths to a control unit should be spread across two or more ESCDs when possible.

PR/SM LPAR Considerations

- PR/SM logical partitions running S/370 operating systems cannot use ESCON channels or ESCON channels running in 9034 mode
- Each LPAR is treated as a separate system image; the same rules about numbers of paths to a logical control unit and mixing of CHPID TYPEs are applied to each image independently.
- Control or management of the ESCD may require that each image have its own copy of ESCM to coordinate ESCD changes across images.

Special Considerations and Recommendations

Testing: You may want to use PR/SM in LPAR mode to continue running your production system while testing the SCP, program product, and the ESCON products in a separate LPAR. Take care to analyze the number of channels and the amount of storage required to run both systems.

Power Sequencing for Control Units at Distances Greater than 400 Feet: If power sequencing for control units is normally done from the processor, control units that are more distant will have to be treated differently. The IBM Enterprise Systems Connection Monitor System products will allow operators at the processor location to perform this and other operations over a common telephone line. Refer to “Enterprise Systems Connection Monitor System” on page 171 for more details.

Analyzing ESCON-Link-Incident Records

The ESCON Analyzer is included with ESCON channels when the appropriate no-charge specify feature is ordered with the ESCON channels. The ESCON Analyzer collects and analyzes ESCON-link-incident records from ESCON channels, ESCDs, or ESCON control units attached to the processor complex. Refer to “Enterprise Systems Connection Analyzer” on page 87.

ES/9000 Water-Cooled Frame models

Description

The ES/9000 Water-Cooled Frame model processors are the follow-on to the ES/3090 family of processors. Field upgrades from selected ES/3090 J and ES/3090-9000T models to ES/9000 Water-Cooled Frame models will be available (refer to Table 14). Contact you IBM representative for additional information.

From ES/3090 Models	To ES/9000 Models
ES/3090 J models	
180J	500
200J	580, 620
280J	620
300J	720
400J	720
500J	720
600J	720
ES/3090-9000T models	
150T	330
170T	330
180T	500
250T	620
280T	620

Table 14. ES/3090J and ES/3090-9000T Model Upgrade Paths to ES/9000 Water-Cooled Frame models.

ES/9000 Family Channel Upgrade Options: All ES/9000 Water-Cooled Frame models are ESCON-capable. ESCON channels may be installed on an ES/9000 Water-Cooled Frame model complex using one of the following methods:

- A host processor configured with ESCON channels may be ordered and installed.
- An installed ES/3090J or ES/3090-9000T can be field-upgraded to an ES/9000 Water-Cooled Frame model with ESCON channels.
- An installed host processor can be field-upgraded to add ESCON channels.

For possible channel configurations, refer to Table 15 on page 80. For channel planning considerations, refer to Figure 13 on page 80 and Figure 14 on page 81.

ESCON Channel Configurations

Channels	Models			
	330,340	**500,580**	**620,720**	**820,900**
Minimums: Total/Parallel/ESCON	16/16/0	32/32/0	64/64/0	128/0/32
Maximums: Total/Parallel/ESCON	64/32/32	64/64/32	128/128/64	256/96/256
Increments	16	16	16 (Note 1)	16 (Note 1)

Notes:

1. Channel configurations may be asymmetrical by side.

Table 15. ES/9000 Water-Cooled Frame Model Channel Configurations

Channel Installation Steps and Upgrade Times

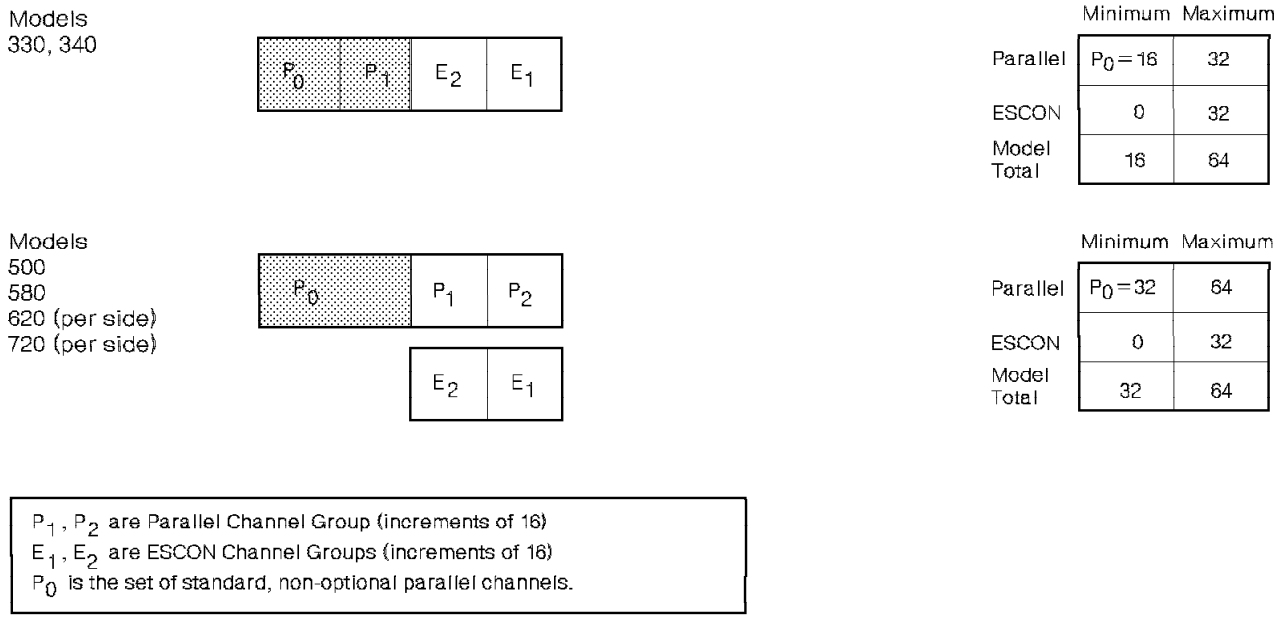


Figure 13. ESCON Channel Configurations for All ES/9000 Water-Cooled Frame Models Except 820 and 900

Figures 13 and 14 show parallel channel displacement considerations when installing ESCON channels.

- For models 330 and 340, addition of ESCON channels will cause no displacement of parallel channels. (Refer to Figure 13.)
- For models 500, 580, 620 and 720, an increment of ESCON channels will cause a corresponding displacement of parallel channels if the model is already fully configured with channels. (Refer to Figure 13.)

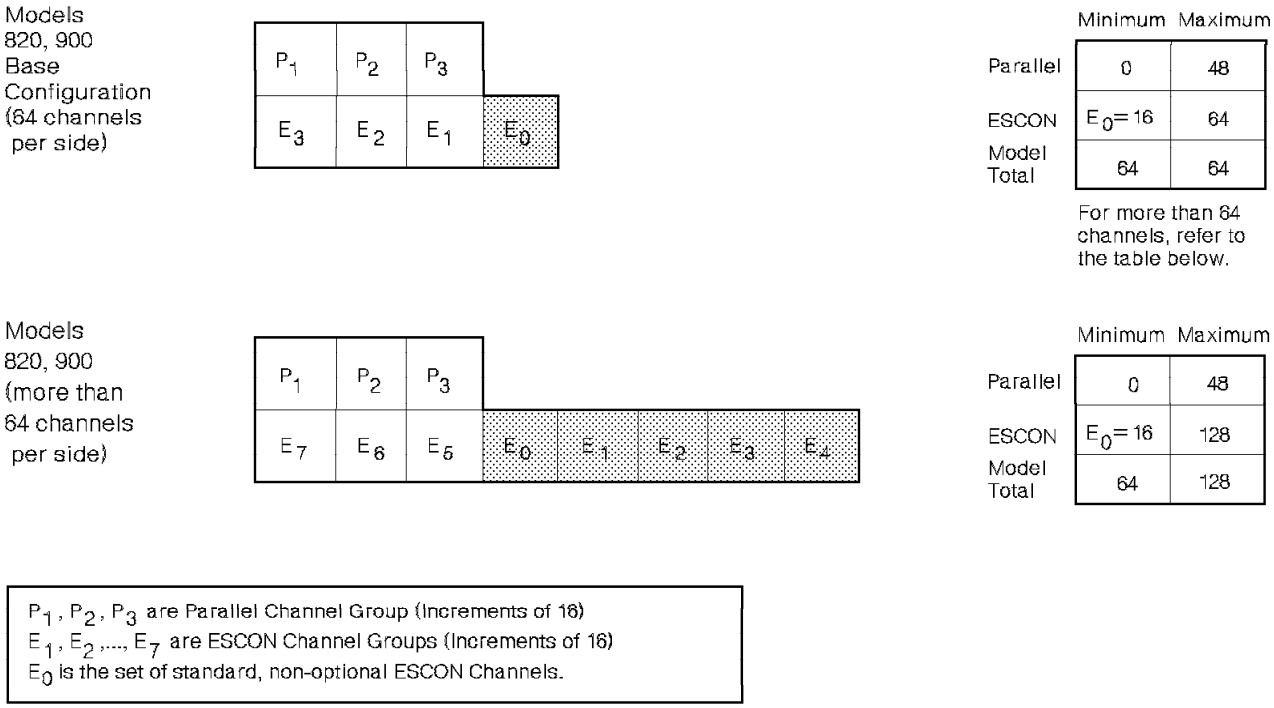


Figure 14. ESCON Channel Configurations for ES/9000 Water-Cooled Frame Models 820 and 900

- For Models 820 and 900 models, the first 16 ESCON channels per side are standard. The remaining 48 required channels per side can be either parallel or ESCON channels. When you decide to install the next increment of ESCON channels, you can choose between two upgrade paths:

  1. Displace existing parallel channels in the existing minimum mixed set of 64 channels. In this case, ESCON increment S1 displaces P3, S2 displaces P2, and S3 displaces P1 and their corresponding CHPIDs. (Refer to top of Figure 14.)

  2. Expand your channel configuration beyond the minimum 64 channels. In this case, parallel channels need not be disrupted, and ESCON increments S1 through S4 could be added without affecting P3. (Refer to bottom of Figure 14.)

The lower 64 channel addresses are filled first; parallel channels starting upward from 0, and ESCON starting downward from 3F. If another ESCON increment is required, it is inserted at 40 to 4F. Additional ESCON increments proceed upward from there.

Preparing for Installation of ESCON Channels

- Update SCP and program product levels, if required. (Refer to “IBM Software” on page 33 for details on required levels.)
- Install fiber cabling. Refer to “Cabling” on page 7 for additional details.
- Recable parallel control unit attachments and modify IOCP CHPID definitions to maintain proper configurations, if necessary. (Refer to “The Impact on Existing Parallel Channels” on page 83 for a more complete discussion of this.)
- Prepare an IOCDS with the correct definitions for the new CHPIDs and ESCON control units

- Update the operating system I/O configuration definitions, if adding new CHPIDs or new control units
- Prepare ESCD configurations as necessary for 9034 links or for managing control unit logical paths (see “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13 for more information)
- Install ESCON channel Licensed Internal Code upgrades on the 9022-1A Processor Controller
- Update the processor to the proper System Engineering Change (SEC) level.

MES Steps for Field-Installing ESCON Channels on an ES/9000 Water-Cooled Frame model Processor

Installing ESCON Channels: Installation of ESCON channel hardware requires the installation of one or more MESs. The installation of these MESs requires that the processor be powered off. If the system is a Multi-Processor (MP) configuration, the side that is to be upgraded must be powered off. That side will be unavailable for use until installation is complete. Table 16 shows an estimate of the outage times.

Cases	**Estimated Time (Notes 1 and 2)**
No parallel channels are displaced	6 hours
Parallel channels are displaced	10-12 hours

Notes:

1. These times apply to the upgrade of a single side. They are **only estimates** and may change. Contact you IBM representative for current estimates.
2. Field installation times for ESCON channels for models 820 and 900 were not available at the time of printing. Contact your IBM representative for more current information.

Table 16. Time Estimates for Field Installation of ESCON Channels.

The following choices are available for MES installation:

- MP Configuration: upgrade both sides at the same time
  (For fastest upgrade, both sides should be upgraded simultaneously.)
- MP Configuration: upgrade one side at a time
  (For continued operation during the upgrade, this is least disruptive.)
- MP Configuration: upgrade only one side with ESCON channels
- Non-MP Configuration: The whole system turned over to the service representative.

It is suggested that an estimate be made of the outage time impact to determine the best procedure to follow.

MP Configuration: Upgrade Both Sides at the Same Time: For the fastest upgrade, both sides should be upgraded simultaneously. The procedure to upgrade both sides at a time is:

- The IBM service representative performs the upgrade by:
  - Installing the MESs and running tests
  - Moving parallel cabling if necessary
  - Connecting the ESCON fiber optic cables
  - Changing ESCD configuration as necessary for ESCON devices

  - PORing the side with a new IOCDS supplied by the customer

- The customer performs the normal testing for new hardware or software.

MP Configuration: Upgrade One Side at a Time: If the system contains two sides, the customer can upgrade one side at a time to minimize the outage. This allows continued operation on the remaining side, though at reduced capacity. After MES installation of the first side is complete and I/O cabling and IOCDS changes are made, this side is available for use. However, it cannot be merged into the running side until that side is also upgraded. At this point a disruption will occur to the second side, and the workload can be moved to the upgraded side, so that the MES may be applied to the second side. After upgrade and checkout of the second side has been completed, that side can be merged into the running side to reach full capacity. The process steps are:

1. **Configure** the side to be upgraded **offline**
2. Perform the steps defined above for doing both sides at the same time, but only on the side being upgraded. Make sure that your new IOCDS is configured for both sides of the MP (including the new ESCON channels to be added to the second side). This will allow both sides to be upgraded with ESCON channels with only one required POR.
3. Test the upgraded side.
4. Move the workload to the upgraded side and turn the second side over to the IBM service representative.
5. Upgrade the second side in the same way as the first and perform testing.
6. Merge the second side into the first to regain full computing capacity.

MP configuration: Upgrade only one side with ESCON channels: One side of an MP may be upgraded to have ESCON channels without installing them on the other (channel configurations may be asymmetric). Although there may be good reasons for installing ESCON channels on only one side, it is not advised because of availability reasons.

Upgrading only one side of a processor with ESCON channels can be performed using either of the procedures described above. Although only one side will contain ESCON channels, both sides must have the ESCON MES installed in order to run as a merged single image system.

Non-MP Configuration: The only choice available is to turn the entire system over to the service representative. This process is like doing both sides of an MP at one time.

The Impact on Existing Parallel Channels: When adding ESCON channels to an ES/9000 Water-Cooled Frame model, it may be necessary to remove parallel channels. Refer to Figure 14 on page 81 for an illustration of the potential channel displacement. If the processor being upgraded has the parallel channels in these locations, the following migration options are available for those channels being removed:

1. Move control unit attachments to other non-ESCON channels

   If other parallel channels are available on the machine, the control units may be moved to the other parallel CHPIDs. This will require physically moving the connectors at the tailgate. Before these control units can be accessed on the new CHPIDs, the IOCDS will have to be updated, a Power-On-Reset (POR) done to load the IOCDS, and an IPL to the operating system. If these control units will not be moved until the upgrade to ESCON channels, this

should be planned so that the new IOCDS can be loaded during POR of the machine after the ESCON MES installation is complete.

2. Attach the control units to ESCON channels operating in 9034 mode.

   Parallel channels may be replaced with ESCON channels but configured to operate in 9034 mode (TYPE=FX). This allows the installation of ESCON cabling, ESCDs, and ESCON channel hardware, while continuing operation with parallel control units. If this option is chosen, the 9034 must be installed, and the IOCDS must be changed to reflect the change to TYPE=FX parameters.

   Future conversion of these channels to ESCON mode operation requires, in addition to upgrading the control unit to ESCON, an IOCP change for the CHPID from TYPE=FX to TYPE=S and a POR to load this IOCDS.

A Further Consideration—Paths to a Device Must be of the Same Type: All ESCON channel paths to a device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (TYPE=FX, S, or CTC). Parallel channels paths (TYPE=BL or BY) may not be mixed with ESCON channel paths to a logical control unit. It may be necessary to move other control unit interfaces connected to parallel CHPIDs to 9034 mode (TYPE=FX) channels or to reassign and recable parallel control unit attachments to other unaffected parallel CHPIDs, to avoid mixing CHPID types to a logical control unit. Refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide* for more detail.

Inter-Relationships and Dependencies with Other Products

SCP Support for ESCON Channels: IBM System Control Programs (SCPs) must be at a level that supports ESA operation. This includes new ESA versions of VM and VSE, TPF 3.1 (which already accommodates ESA), and some existing ESA versions of MVS. Refer to “IBM Software” on page 33 for IBM SCP and program product versions and levels. These SCPs may be run on processors operating in physical partition mode, in single image mode, or in PR/SM logical partition mode.

Changes to IOCP for ESCON Channels: When ESCON channels are installed, the IOCDSs for the processor will have to be updated. New keywords for IOCP have been added and new values allowed for some existing keywords. Refer to “Summary of IOCP Changes for the Enterprise Systems Connection Environment” on page 17 for a general discussion of the IOCP changes. The next section lists specific considerations for defining your ESCON configurations for these processor models.

Selected ESCON Channel I/O Configuration Considerations: The following is a list of some important ESCON channel considerations for the ES/9000 Water-Cooled Frame model. For complete information on defining configurations, refer to the publication *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide*.

- The ESCON channel hardware can operate in three modes: native (TYPE=S), CTC (TYPE=CTC), or 9034 (TYPE=FX). The IOCDS specification determines the mode.
- Channels defined as TYPE=S, CTC, and FX operate only in ESA/370 mode.
- All ESCON channel paths to a device on a logical control unit from a system image must have the same CHPID type in their IOCP definitions (TYPE=FX,

S, or CTC). Parallel channels paths (TYPE=BL or BY) may not be mixed with ESCON channel paths to a logical control unit.

- The maximum number of destination links (including port FE for the ESCD) that can be defined for an ESCON channel path is determined by the model of ESCD to which it is attached (16 for 9033 and 60 for 9032).
- The maximum number of control unit addresses that can be defined for an ESCON channel path is 120 (a control unit can have multiple logical addresses using the CUADD keyword).
- A maximum of 48 physical control units can be defined on a 9034 mode channel path (TYPE=FX), although electrical limitations further restrict the number of attached control units on the interface, usually to eight (or 16 if attached to a 2914 or 3814 switch).
- Configuration maximums for devices attached to ESCON channel path:

Maximum Devices	TYPE=
1024	S
256	FX
512	CTC

- Only one ESCD may be defined in IOCP to a CHPID path (a second chained ESCD may exist on the path but does not get defined to IOCP).
- One ESCD can be defined on an ES/9000 Water-Cooled Frame model for each ESCON channel defined. The maximum number allowed is:
  - 128 per side for models 820 and 900
  - 32 per side for models 620 and 720
  - 32 for models 330, 340, 500, and 580.
- The default for the Status Verification Facility (STADET) is changed to STADET=Y for ESCON control units on ESCON CHPIDs.
- A maximum of four ESCON paths to a logical control unit is permitted from a system image.

PR/SM LPAR Considerations

- PR/SM logical partitions running S/370 operating systems cannot use ESCON channels.
- Each LPAR is treated as a separate system image. Rules about numbers of paths to a logical control unit and mixing of CHPID TYPEs are applied to each image independently.
- To coordinate ESCD changes across system images, each image should have its own copy of ESCM.

Special Considerations and Recommendations

Testing: You may want to use PR/SM in LPAR mode to continue running your production system while testing the SCP, program product and the ESCON products in a separate LPAR. Take care to analyze the number of channels and the amount of storage required to run both systems.

Considerations for Managing Single Points of Failure: As with parallel channels, when assigning channel paths to service a control unit, select channels from different ESCON Channel Elements (groups of four channels) to minimize the impact of an unplanned outage. For the same reason, channel paths to a control unit should be spread across two or more ESCDs when possible.

Power Sequencing for Control Units at Distances Greater than 400 Feet:

If power sequencing for control units is normally done from the processor, control units that are more distant will have to be treated differently. The IBM Enterprise Systems Connection Monitor System products will allow operators at the processor location to perform this and other operations over a common telephone line. Refer to “Enterprise Systems Connection Monitor System” on page 171 for more details.

Processor Physical Planning:

The following changes should be considered when planning for an ES/9000 Water-Cooled Frame model:

- The footprint for models 620, 720, 820 and 900 is very slightly increased over the footprint for an ES/3090 600J
- The ES/9000 Water-Cooled Frame model uses a new power system design (60Hz Input Power), rather than the 400Hz required on ES/3090J systems. New ES/9000 Water-Cooled Frame models will not need a 3089 Motor Generator to generate 400Hz power.
- Changes in the chilled water system may be required. ES/9000 Water-Cooled Frame models have an increased size (2-inch diameter) chilled water coupler. For models 330 through 720, an adapter for existing water feeds will be available to connect to existing chilled water systems. Models 820 and 900 will require more chilled water; therefore the larger distilled water feed source is required.

  An increase in water chiller capacity for 820 and 900 models may be required.

Analyzing ESCON-Link-Incident Records

The ESCON Analyzer is included with ESCON channels when the appropriate no-charge specify feature is ordered with the ESCON channels. The ESCON Analyzer collects and analyzes ESCON-link-incident records from ESCON channels, ESCDs, or ESCON control units attached to the processor complex. Refer to “Enterprise Systems Connection Analyzer” on page 87.

Enterprise Systems Connection Analyzer

Description

The ESCON Analyzer is included with ESCON channels when the appropriate no-charge specify feature is ordered with the ESCON channels. See your IBM representative for more information on ordering this feature. The ESCON Analyzer IBM Licensed Internal Code (LIC) is installed as part of the base support for Enterprise Systems Connection (ESCON) on a dedicated IBM PS/2* Model 8580 A31 (or the equivalent). The console is attached by an IBM Token-Ring Network to the support processors of the processors with ESCON channels in the processor complex. Depending on processor type and model, the support processor may be:

- A processor controller (PCE)
- An input output support processor (IOSP)
- A processor console.

This section refers to all of these units as the support processor unless specifically mentioned otherwise.

The ESCON Analyzer collects and analyzes ESCON-link-incident records from ESCON channels, ESCDs, or ESCON-capable control units attached to the processor complex.

If an ESCON-link-incident occurs, the support processor sends the ESCON-link-incident records by way of the IBM* Token-Ring Network to the ESCON Analyzer. The ESCON Analyzer isolates ESCON-link-incident records applicable to a single incident, analyzes them to identify the most probable source of the incident, creates a summary record for the incident, and reports the problem. An operator or service representative uses the ESCON Analyzer console to retrieve, display, and examine the incident information.

Configuration

Supported Processors: The ESCON Analyzer connects to various IBM processors. ESCON supported host processors can be found in “Enterprise Systems Connection-Capable Processors” on page 53.

The ESCON Analyzer communicates with the processor’s support processor through the IBM token-ring local area network (LAN). For the various support processors, LAN connection requirements vary by type. The requirements are summarized in the following paragraphs.

ES/3090J and ES/3090-9000T Models: These processors use the 3092 Processor Controller (PCE) as their support processor. The 3092s use a PS/2 running IBM-provided LAN Support as their LAN connection mechanism. The method of connecting the console to the 3092 varies by 3092 model. Refer to the publication *IBM Processor Controller Element—LAN Support: Description/Installation/Operation* for connection and code ordering details.

ES/9000 Models

PS/2, IBM, ES/3090, and ES/9000 are trademarks of the IBM Corporation.

Models 120, 130, 150, and 170: These processors use a processor console that attaches directly to the LAN. Contact your IBM marketing representative for details on connection features.

Models 190, 210, 260, 320, 440, and 480: These processors use an I/O Support Processor (IOSP) that attaches directly to the LAN. Contact your IBM marketing representative for details on connection features.

Models 330, 340, 500, 580, 620, 720, 820, and 900: These processors use the ES/9000 Processor Controller (PCE) Model 1A (9022-1A) as their support processor. Like the 3092, 9022s use a PS/2 running IBM-provided LAN Support as their LAN connection mechanism. The method of connecting the PS/2 to the 9022 is the same as for the 3092 Models 4 and 5. Refer to the publication *IBM Processor Controller Element—LAN Support: Description/Installation/Operation* for connection and code ordering details.

Refer to Figure 15 for an example of an ESCON Analyzer configuration.

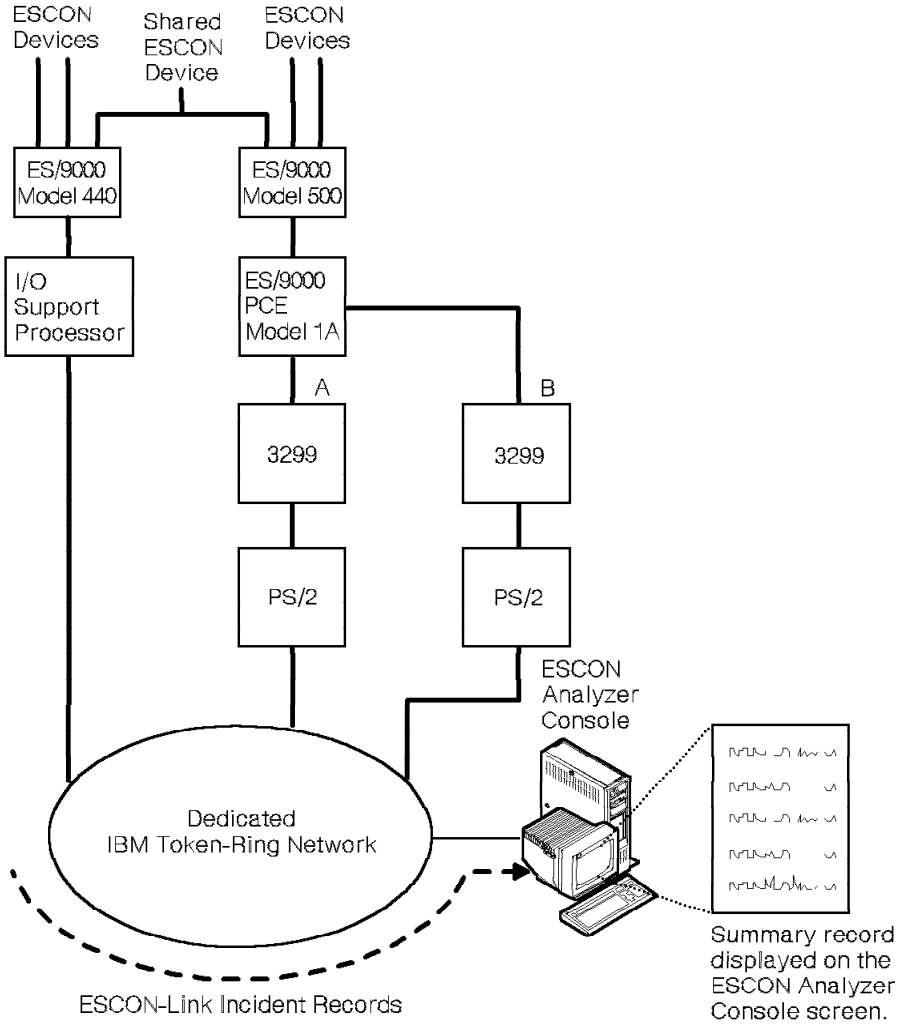


Figure 15. Example of an ESCON Analyzer Configuration

Figure 15 is an example and does not show all possible combinations of ESCON Analyzer configurations.

Installation and Upgrades

The following steps are required to install the ESCON Analyzer (LIC) and associated required hardware. They are:

1. Install a dedicated IBM Token-Ring Local Area Network. (Refer to the publication *IBM Token-Ring Network: Introduction and Planning Guide*, GA27-3677.)
2. Install the required features in the IBM Personal System/2 (or equivalent) that you will be using as a console for the ES Connection Analyzer (LIC) and then attach the console to the token-ring network.
3. Install the ESCON Analyzer (LIC) on the ESCON Analyzer console.

   Using a combination of the tapes and diskettes and guidance from the publication *Using the Enterprise Systems Connection Analyzer*, GA23-0386, you will install the ESCON Analyzer (LIC) on the ESCON Analyzer console. There is a configuration function to help you enter required configuration data.

   It should take approximately four hours to install the ESCON Analyzer (LIC) and to enter configuration information. This does not include the planning for configuration.
4. Power down the support processors.

   Note: Power down/power up requirements vary depending on the types of support processors. Refer to the support processor documentation and your IBM representative for details.
5. Install the required attachment hardware and attach the support processors to the LAN.
6. Power up the support processors.
7. Perform LAN configuration for the ESCON Analyzer and the support processors.
8. Power on Reset (POR) the processor and IPL the operating system to activate the connections.

Hardware Requirements: The following sections describe the hardware required to support the ESCON Analyzer.

ESCON Analyzer Console Requirements: The ESCON Analyzer requires an IBM Personal System/2 Model 8580 A31 (or equivalent) as a console, with the following additional features and devices (or equivalent):

- An IBM Personal System/2 4MB system board memory expansion kit
- A Token-Ring 16/4 adapter (configured to run at 16MbPS)
- A PS/2 internal tape backup unit
- An adapter kit for attaching tape in the B drive slot
- An IBM Token-Ring Network PC adapter cable
- An IBM 8512 or IBM 8513 color display
- A pointing device (mouse).

IBM Token-Ring Network Requirements: The ESCON Analyzer Token-Ring local area network (LAN) may consist of one or more of the following components:

- 8228 Multistation Access Units
- An 8220 Fiber Convertor (4/16 Mb) set to run at 16MbPS
- An IBM Token-Ring cable (Types 1 and 2).

The publication *IBM Token-Ring Network: Introduction and Planning Guide* describes these network components and provides information about planning for the installation of an IBM Token-Ring Network.

Note: The token-ring local area network installed for the ESCON Analyzer must be dedicated to its use. The LAN cannot be shared and an existing LAN cannot be used unless it is to be used exclusively by ESCON Analyzer.

Required Hardware to Attach an I/O Support Processor (IOSP) or Processor Console to the IBM Token-Ring Network: I/O support processors and processor consoles require only an adapter card and a connection cable to attach to the LAN. Contact your IBM marketing representative for details on connection features.

Required Hardware to Attach a 3092 or 9022 Processor Controller (PCE) to the IBM Token-Ring Network: Figure 15 on page 88 illustrates the typical PCE attachment to the ESCON Analyzer IBM Token-Ring Network. 3092 Models 1,2, and 3 use a different connection method. Refer to the publication *IBM Processor Controller Element—LAN Support: Description/Installation/Operation* for details about connecting processor controllers to the ESCON Analyzer token-ring network.

3299 Terminal Multiplexer: Used to provide a connection port for the PCE-attached IBM Personal System/2.

PCE-Attached IBM Personal System/2 Model 8580 A21: The PCE-attached IBM Personal System/2 Model 8580 A21 (or equivalent) requires the following additional features and devices:

- IBM 3270 connection
- Token-ring 16/4 adapter (configured to run at 16MbPS)
- IBM Token-Ring Network PC Adapter Cable
- Video graphics array/adapter (VGA) Display.

LAN Support for the PCE-Attached IBM Personal System/2: You must install PCE-LAN Support on the fixed disk of the PCE-attached PS/2 to enable it to communicate with the ESCON Analyzer console. This package is available from IBM as a no charge feature on the PCE on 88.9 mm (3.5inch) diskettes. For instructions on how to install this package, refer to the publication *IBM Processor Controller Element—LAN Support: Description/Installation/Operation*. It should take approximately 1 hour for installation.

Inter-Relationships and Dependencies with Other Products

Support for the connection to, and communication with, the ESCON Analyzer is part of the base support for an ESCON environment. Thus, there are no dependencies other than the hardware requirements discussed above. The ESCON Analyzer runs independently of any system control programs (for example, MVS, VM, TPF, and VSE).

Special Considerations and Recommendations

No special skills are required to operate and monitor the ESCON Analyzer.

Once the entire installation procedure is complete and the ESCON Analyzer is activated, it will automatically collect and analyze ESCON-link-incident records from the connected support processors.

It is also possible to review past problems using the ESCON Analyzer console. This could be a useful tool for monitoring the incidents in the fiber-optic network.

Related Publications: The following publications will also help you plan, install, operate, and diagnose problems for components of the ESCON Analyzer system.

Introducing and Planning for the Enterprise Systems Connection Analyzer
Enterprise Systems Connection Link Fault Isolation

Enterprise Systems Connection-Capable Control Units

The following control units can be ESCON-capable:

- 3174
- 3490
- 3990

Specific details about control unit support of ESCON system attachment and about system considerations for migration are provided in the sections that follow.

3174 Establishment Controller Models 12L and 22L

Description

The IBM Establishment Controller 3174 Models 12L and 22L support up to eight control unit images, which provide for up to eight logical hosts through the fiber optic link to the host. The logical host connections can be to the same host or up to eight different hosts. Each control unit image appears to the host as a separate physical 3174.

3174 Model 12L/22L Compatibility: The new models 12L and 22L are full function 3174s that support all features of their parallel counterparts (11L and 21L) with the exception of remote power, which they do not support. Models 12L and 22L take on the same physical and environmental characteristics of the existing 3174s but have the ability to attach with increased distances from the host through the fiber optic cable attachment. Models 12L and 22L are ESCON-capable control units and achieve multiple control unit connections to a channel through an ESCD, rather than through multi-dropping.

Further information about the 3174 and other features not described here are contained in the publication *IBM 3174 Establishment Controller Introduction*.

9034 Attachment: 3174 Models 1L, 11L, and 21L can also be used in an ESCON environment. These models use the S/370 bus-and-tag channel cables. They can communicate with an ESCON host through the 9034.

Configuration

Configuration Data for the ESCON 3174 (Models 12L and 22L)

- One ESCON port
- Eight control unit images
- One logical path for each control unit image
- Up to 32 3270 devices and up to 24 ASCII devices can be supported on the 3174.
- One physical terminal can become five logical terminals (or have five logical sessions) by using Licensed Internal Code (LIC) customization within the 3174 and the “jump key” on the terminal.
- There are 16 hexadecimal addresses (0 through F) of which eight can be configured in the 3174 to support communication with eight host processors. These 16 addresses correspond to the CUADD value in the host processor IOCDS (refer to Figure 18 on page 98 to see the inter-relationships of the ESCON 3174 addresses with VTAM, MVS, IOCP, and the ESCD).

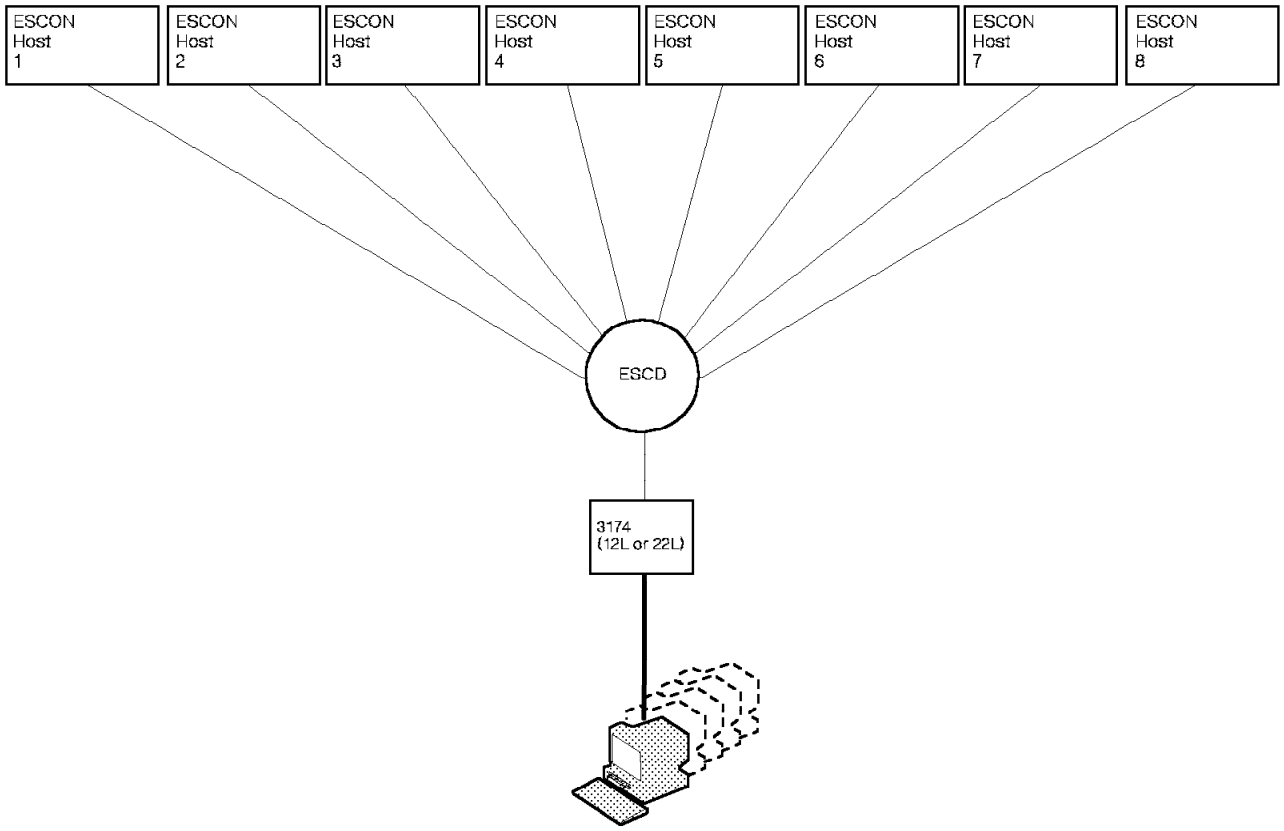


Figure 16. Model 12L and 22L ESCON Configuration to Eight Hosts or Images

Figure 16 illustrates a possible configuration with eight different ESCON hosts or system images communicating with a 3174 through an ESCD. Figure 17 on page 96 is a possible configuration demonstrating ESCON 3174 Models 12L and 22L coexisting with parallel 3174s. The Token Ring is used to provide connectivity to parallel host processors. The ESCD provides paths to multiple ESCON processors.

Note: Each of the terminals attached to the 3174 Terminal Controllers (1, 2, or 3) can be independently configured to communicate with up to five of the ESCON hosts, or a combination of up to five of the ESCON and/or parallel hosts.

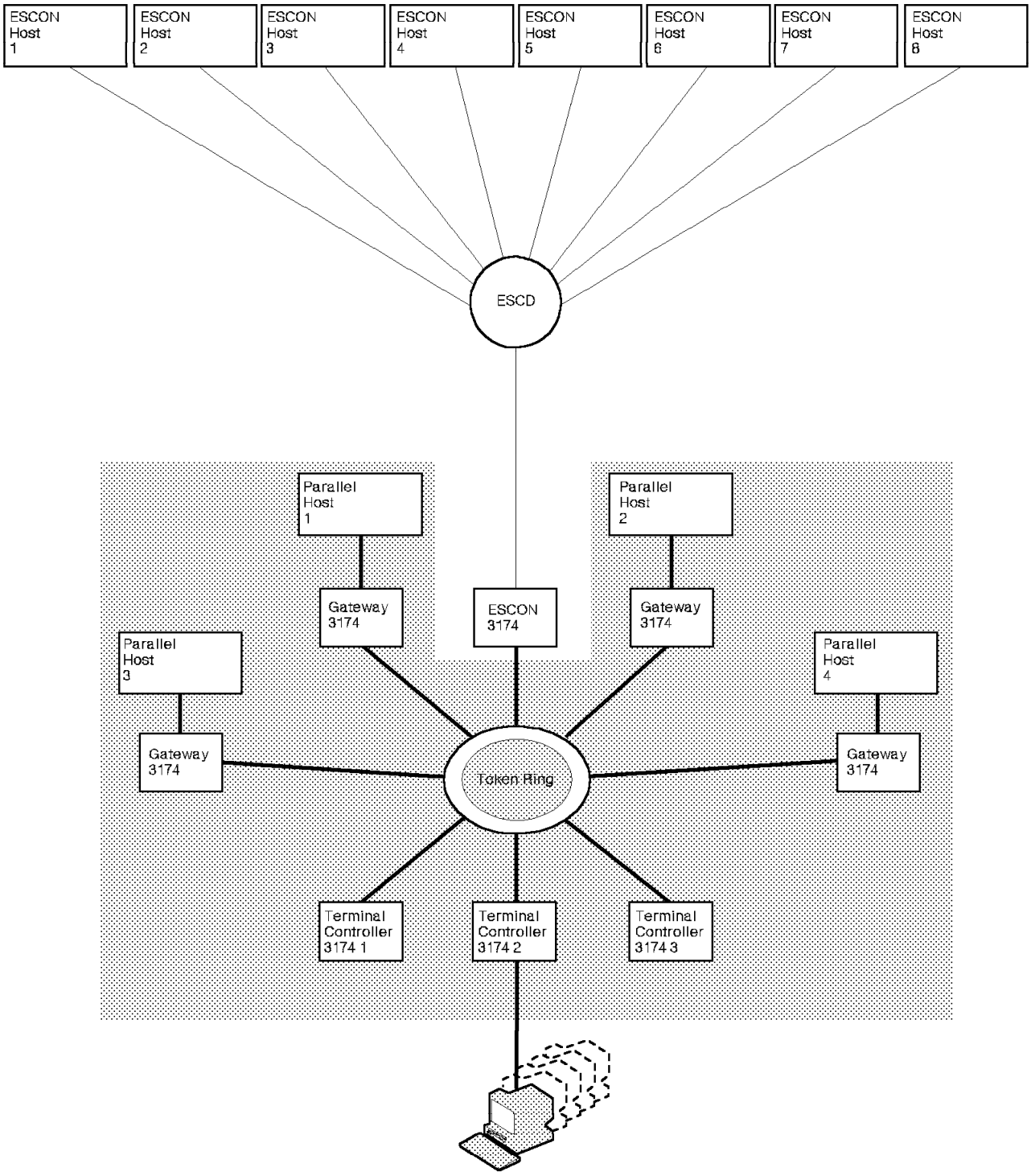


Figure 17. Model 12L and 22L Coexistence with Parallel 3174s

Installation

The 3174 is a Customer Set Up (CSU) unit. The installation tasks are:

- Attaching cables
  - Communication
  - Fiber optic
  - Work station
  - Printer.
- Customizing the controller Licensed Internal Code

  The time to do this task varies, depending upon the complexity of the configuration and the experience of the person doing the task. The average time should be approximately 30 minutes, assuming that the configuration data has been determined beforehand.

  In Figure 17 on page 96, using the LIC customization, you could configure any of the 3174 terminal controllers to communicate with any combination of the host processors (up to a maximum of eight host processors).

  Note: The 3174 Controller LIC must be at Release Level B3 or higher to support the 3174 Models 12L and 22L.
- If needed, update VTAM, IOCDS, and the ESCD configuration with the corresponding addresses.

Inter-Relationships and Dependencies with Other Products

Software: The 3174 is supported in an ESCON environment by the following IBM operating systems:

- MVS (see “MVS” on page 34)
- VM (see “VM” on page 40)
- VSE (see “VSE” on page 44)

Note: ESCON 3174 is not supported by TPF.

ESCON 3174 Addressing Inter-Relationships: To better understand the inter-relationships of the addressing of VTAM, MVS, IOCDS, ESCD and the ESCON-capable 3174, refer to Figure 18. This figure illustrates two of the eight possible host processors (Host 1 and Host 8) being configured to the ESCON 3174. This figure demonstrates only two of the eight possible control unit images (CUADD 1 and CUADD 0) on the ESCON 3174. (Up to eight total host processors can be configured to the eight possible control unit images of the ESCON 3174.)

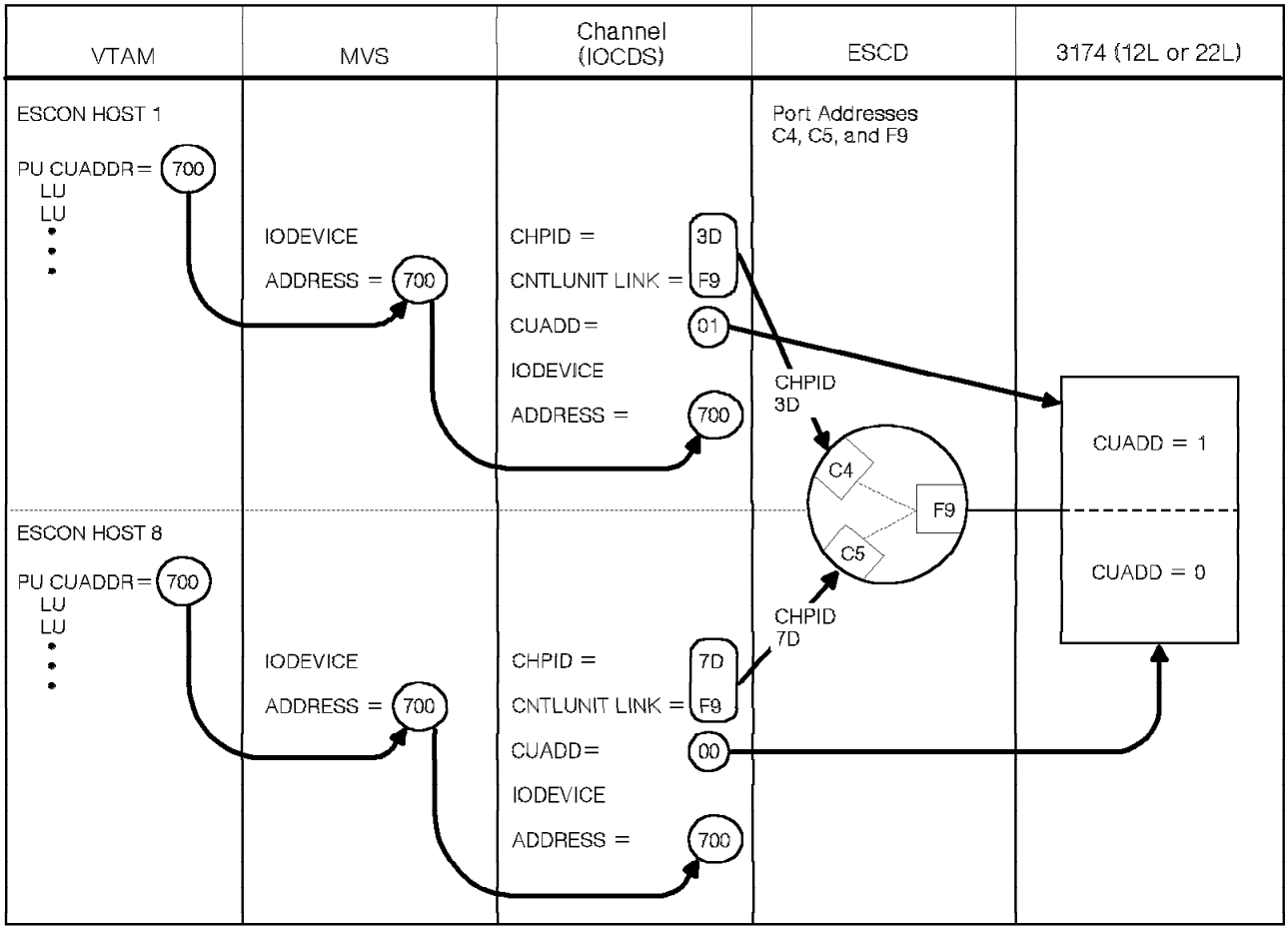


Figure 18. ESCON 3174 Addressing Inter-Relationships. The channel determines the address of the ESCD port to which it is attached or through which it communicates. (In the example, C4 for CHPID 3D and C5 for CHPID 7D.)

Special Considerations and Recommendations

- Each of the eight logical control unit images has its own CNTLUNIT statement (CUADD) within the IOCP. When adding new attached devices to your 3174, VTAM updates will be necessary. If you are using an ESCD in your 3174 configuration, the ESCD will require updates also (as well as ESCM updates if applicable). Because of these changes, we recommend incorporating any other modifications needed for other hardware updates with the ESCON 3174 installation to minimize the potential disruptions to your data processing environment. Refer to "Considerations to Minimize Disruptions" on page 25 for methods of alleviating these potential disruptions.
- The 3174 Models 12L and 22L have one ESCON interface, therefore you should consider attaching it through an ESCD. If an ESCON 3174 is attached to an ESCD and an ESCON channel is unavailable, the ESCON 3174 will be available to other ESCON channels attached to that same ESCD.

Related Publications

- *3174 Models 12L and 22L Customer Information Supplement*

3490 Magnetic Tape Subsystem with ESCON Adapters

Description

This chapter provides:

- A description of the tape subsystems that can participate in an Enterprise Systems Connection (ESCON) environment
- The ways in which they can be configured
- Considerations for the available options
- A description of the primary scenarios for converting to ESCON operation
- The affect of the conversion process on the system and the tape subsystem
- And the hardware and software prerequisites.

Full participation in the ESCON environment with the tape subsystem will require:

- ESCON channels
- The appropriate host software
- 3490s with ESCON adapters.

However, older tape subsystems are accommodated through use of the 9034 Enterprise Systems Connection Converter. 9034s may also be used as migration devices to facilitate converting to the desired ESCON configuration. Thus, there are several different migration paths you may follow, depending on:

- Your current hardware configuration
- Software levels
- Financial considerations (such as lease expirations)
- The priority of ESCON functions you wish to exploit
- Other considerations unique to your installation.

Configuration

Figure 19 on page 101 contains all the ESCON adapter-capable configurations of the 3490. This configuration data will be helpful in determining the models of 3490 that would be best for your environment. Initially, you may want to use models that have both parallel and ESCON adapter capability, and in the future migrate to a full ESCON environment. This is dependent on your data processing environment and requirements.

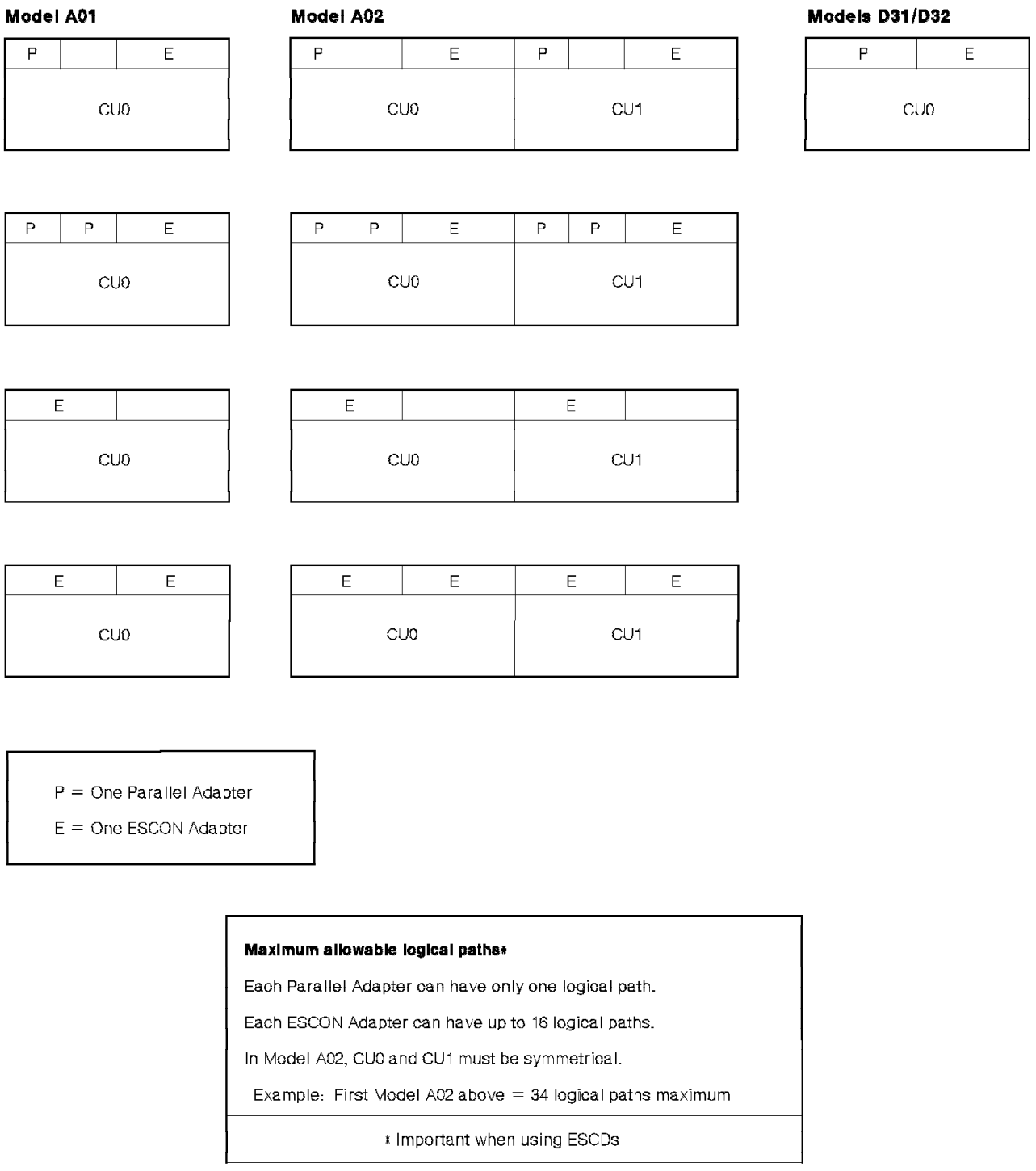


Figure 19. 3490 ESCON Adapter-Capable Configurations

Installation

3490 Control Unit Install Times: The following table lists estimated times required for installing 3490 control units and adding ESCON adapters.

Installation (ESCON or Parallel)	Control Unit Model	Time
3490 Control Unit—Single	A01	5.5 hours
3490 Control Unit—Dual	A02	6.5 hours
3490 Control Unit	D31 D32	3.6 hours
Add one ESCON adapter to a 3490 Control Unit	A01	2.7 hours
Add one ESCON adapter to both sides of a dual 3490 Control Unit	A02	5.0 hours
Add one ESCON adapter to a 3490 Control Unit	D31 D32	2.7 hours

MES Installation Components and Steps for a 3490 with an ESCON Adapter: Detailed instructions for the 3490 with ESCON adapter can be found in the MES installation kit. Refer to the related publications at the end of the 3490 section for more detailed information.

Inter-Relationships and Dependencies with Other Products

Software: IBM System Control Programs (SCPs) must be at a level that supports ESA operation. See “IBM Software” on page 33 for IBM SCP and program product version and levels.

Note: There will be a toleration APAR for Data Facility Products (DFP) 2.4.0 systems that are parallel attached to a 3490 that has ESCON adapter capability. See your IBM representative for the appropriate software support.

It is important to keep in mind the inter-relationships of 3490s with ESCON adapters and how they will affect the IOCP, Enterprise Systems Connection Director (ESCD), and Enterprise Systems Connection Manager (ESCM).

Remote Power: Installations that now use the remote power on/off capability of the 3490, or installations that wish to control power on/off for control units located more than 400 feet away from the controlling location, may wish to install the Enterprise Systems Connection Monitor System (ESCMS) to provide this capability in an ESCON environment. For information about ESCMS, refer to “Enterprise Systems Connection Monitor System” on page 171.

Special Considerations and Recommendations

Tape Control Unit Considerations: Installations with 3803/3420/3422 and 3480 tape subsystems installed have at least the following options:

- Continue operations with the 3803/3420/3422, and 3480 control unit with the 9034

  The 3803/3420/3422, or 3480 control units may be connected to a host processor with ESCON channels only through a 9034. Extended distances

are supported in this attachment configuration. (See Table 18 on page 158 for device attachment and data transfer modes supported by the 9034.)

- Replace the 3803/3420/3422 or 3480 configuration with a 3490 configuration

  If plans are in place to replace your 3803/3420, 3422 or 3480 tape subsystems, this is a good time to migrate to a 3490 with ESCON adapters. This has the advantage of accomplishing the upgrades to a 3490 and to ESCON with only one disruption.

  – The steps to accomplish this are as follows:

    - Install the ESCON channels on the host processors
    - Install the appropriate software levels and perform the IOCP required to describe the new subsystems as well as the existing ones
    - Install and configure the ESCD (if applicable)
    - Install the new ESCON adapter-capable 3490 on the ESCON channels or on the ESCDs
    - Begin normal operations with the new 3490s
    - Discontinue the old tape subsystem by varying offline one channel path at a time and disconnecting the control unit on that interface. By doing this one path at a time, other tape subsystems on the same set of channels are still accessible through at least one other path.

Configuration Considerations: For 3490s, the choice of whether to install parallel or ESCON adapters, or whether to use 9034s, depends on the current configuration of the 3490, the host channel configurations, the host ESCON capability, the host software level, and the number of host processors attaching to the 3490.

The 3490 adapter configurations can be the following:

- All parallel
- Mixed parallel and ESCON
- All ESCON.

The possible choices, “all parallel” and “mixed parallel and ESCON”, are described below with the alternatives and considerations for each.

- All parallel

  – The 3490 can retain its parallel channel adapters, which is up to four per control unit function, and make the ESCON channel connection through the 9034.

    The 9034 should be used when there is a desire to install the ESCON-capable channels on the host processor and:

    - The host processor channel configurations require the substitution of ESCON channels operating in 9034 mode for parallel channels (refer to “Impact on Existing Parallel Channels” on page 61 for more details)
    - The 3490s have not been converted to ESCON adapters.

- Mixed parallel and ESCON
  - The 3490 can be upgraded to mixed parallel and ESCON capability by installing one ESCON adapter feature for each control unit function and leaving up to two parallel channels for each control unit function. (See Figure 19 on page 101 for possible increments of 3490 parallel/ESCON and ESCON-only adapters for each 3490 tape subsystem control unit.)

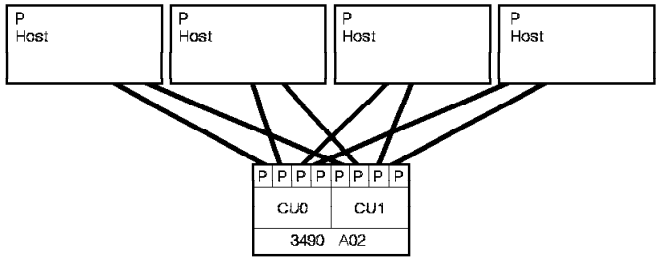
    If this is done, the 3490 can be shared with both ESCON and parallel host processors. The installation of one ESCON adapter feature on a 3490 may require that up to two parallel channels be removed. As channel features are installed and/or removed, they must remain equal between both control unit functions of the 3490 A02 (for example, control unit 0 must have the same numbers and types of adapters as control unit 1).

    The following scenario will demonstrate how you could migrate from a parallel multi-host processor complex with 8-way connectivity that is currently configured to a parallel 3490 Model A02 with eight parallel adapters.

    Note: This is one of the more complex migration scenarios. Many migrations to ESCON would not be this complex.

    The first diagram in Figure 20 on page 105 represents this multi-host processor complex with 8-way connectivity. In this situation, if you upgrade your first host processor and your 3490 Model A02 to ESCON at the same time, a concern may arise because of a connectivity reduction from 8-way to 6-way (see the second diagram in Figure 20 on page 105). Because of this reduction in connectivity, it may be advisable to use 9034s to provide attachment to the first ESCON capable host processor without upgrading the 3490 to be ESCON adapter-capable (see the third diagram in Figure 20). This maintains 8-way connectivity.

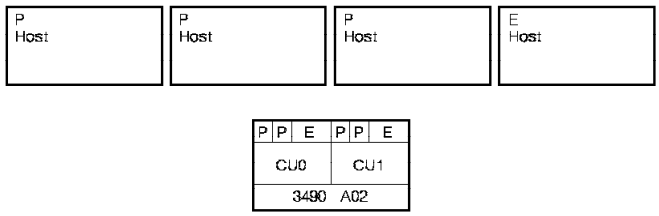
    An alternative solution is to connect your ESCON host to the ESCON adapters of your 3490. Before doing this, we recommend that you measure the performance to the parallel host processors which will have less connectivity (see the fourth diagram in Figure 20 on page 105). (To measure this performance, we recommend that you vary offline the paths to the host processors that would be losing adapter connectivity before you do the installation of the ESCON adapters on your 3490. The results of this performance measurement will help you determine which are the best steps in upgrading your 3490 to ESCON.) At the time the second host processor is to be upgraded to be ESCON-capable, the 3490 could also be upgraded. With the increased logical path capability of the 3490 ESCON adapter (16 logical paths per ESCON adapter physical path) and with the advantages of the ESCD, both of these ESCON-capable host processors can now be attached to this one physical connection through the ESCD, and the parallel host processors can maintain their connectivity (see the fifth diagram in Figure 20 on page 105).



Today:

Full Parallel environment

(8-way connectivity)

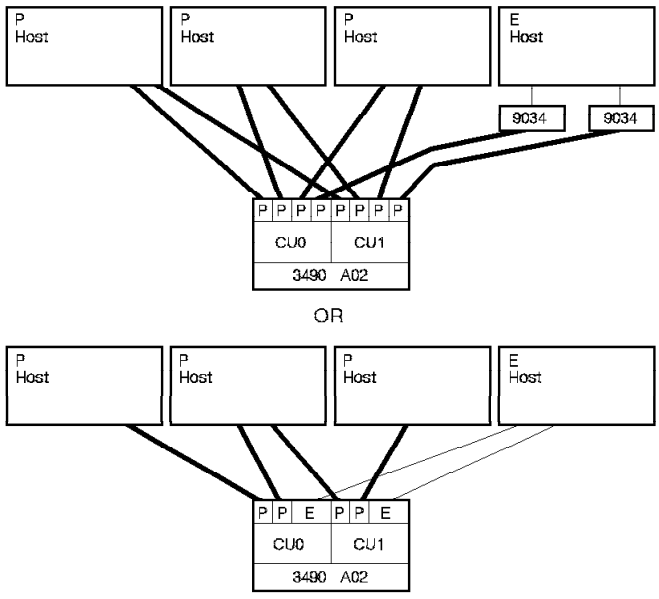


First ESCON-capable host
First 3490 ESCON upgrade

Concern:

Connectivity reduction

(6-way connectivity)



First ESCON-capable host

Recommendation:

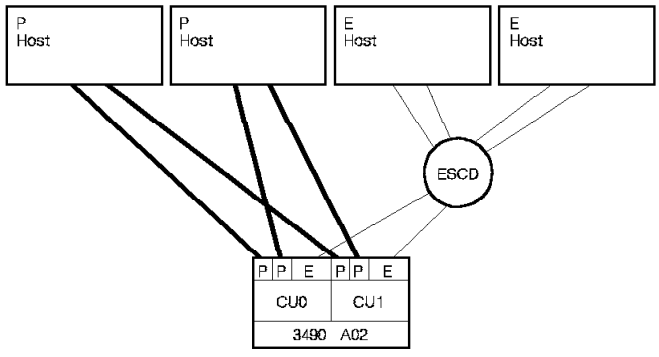
Use 9034s and postpone 3490 ESCON upgrade until second host becomes ESCON-capable.

(Maintain 8-way connectivity)

Alternative solution:

Potential performance or connectivity reduction

(6-way connectivity)



Second ESCON-capable host

(8-way connectivity or more)

Figure 20. 3490 Migration Configuration Alternatives and Recommendations

IOCP Considerations: IOCP changes are required for using a 3490 with either the ESCON channels, a 9034, or the ESCD.

A particular item to note in using the 3490 is that the UNITADD parameter must be specified as:

UNITADD=00

Information regarding the system configuration is stored in a number of different places within the various system components. It is important to understand what these are, how they relate to each other, and to make sure that they are consistent. The MVSCP (or the HCPRIO for VM) and the IOCP have the same relationship to one another as before. The IOCP includes additional information now, including:

- Recognition of the new CHPID types—ESCON native (TYPE=S) and ESCON running in 9034 mode (TYPE=FX)
- The presence of an ESCD
- The port addresses used
- Device-specific items such as those mentioned above.

Enterprise Systems Connection Manager uses the IOCDS to generate its tables for managing the ESCD configuration.

For more information related to IOCP, see “Summary of IOCP Changes for the Enterprise Systems Connection Environment” on page 17 or refer to *ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User’s Guide and Reference*.

RAS Considerations: While adequate performance may be obtained with a minimal configuration, availability requirements may well dictate the installation of redundant pathing and ESCDs. Customers with high availability requirements should consider the installation of pairs of ESCDs, with all host processors and storage control connections split across the two.

Each 3490 model A01/A02 control unit will have a maximum of two ESCON physical paths (32 logical paths) for each control unit function. The model D31/D32 has a maximum of one ESCON physical path (16 logical paths) for each control unit function. Availability considerations may dictate using this full path capability.

Figure 21 on page 107 demonstrates a configuration utilizing two ESCDs to improve RAS.

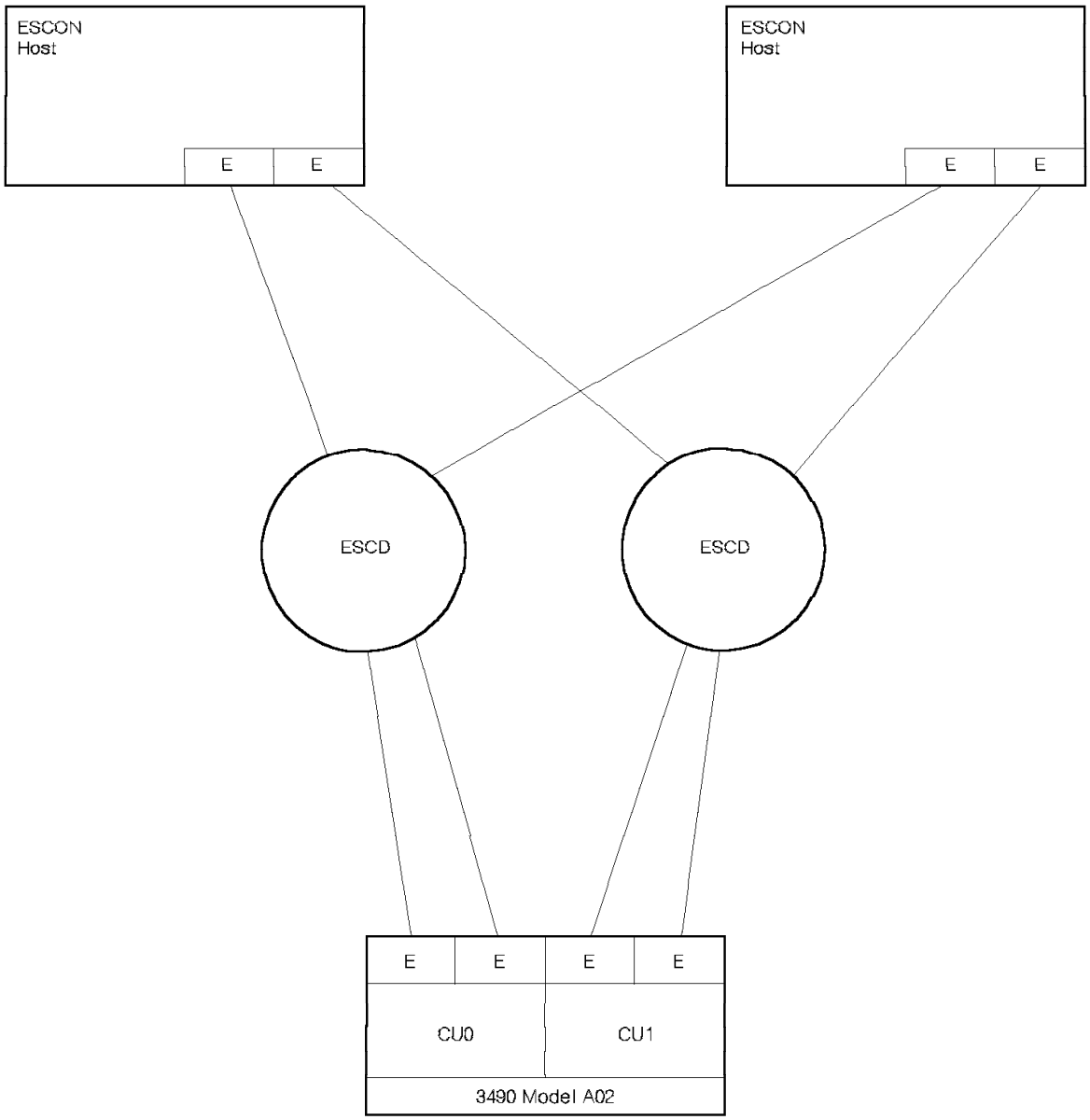


Figure 21. 3490 RAS Configuration

Related Publications: The following publications describe the IBM 3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04:

- *IBM 3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04 Introduction*
- *IBM 3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04 Planning and Migration Guide*

The following publications describe the IBM 3490 Magnetic Tape Subsystem Models D31 and D32:

- *IBM 3490 Magnetic Tape Subsystem Models D31 and D32 Introduction*
- *IBM 3490 Magnetic Tape Subsystem Models D31 and D32 Planning and Migration Guide*

3990 Storage Control with ESCON Adapters

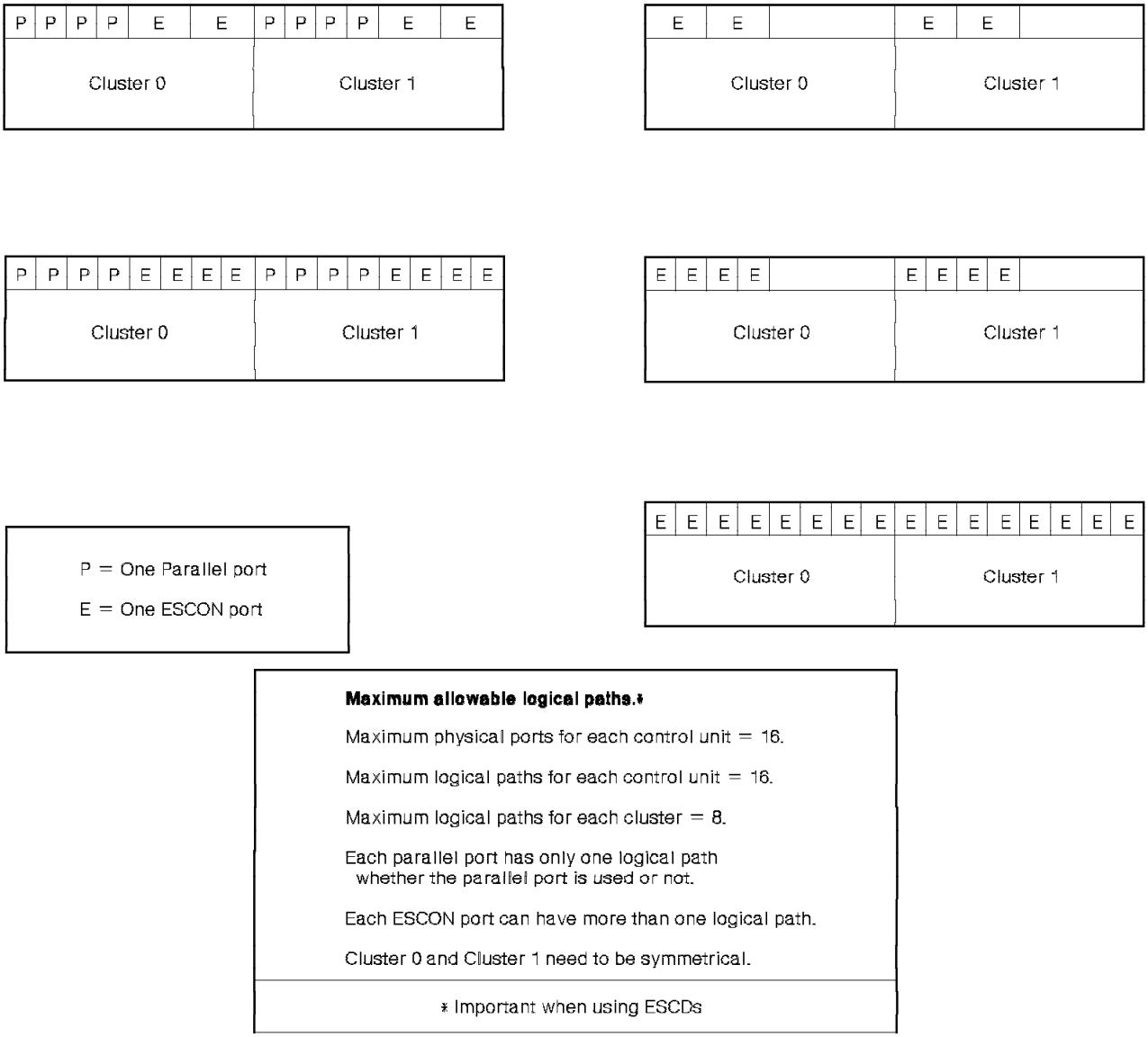
Description

Products Supported in the Enterprise Systems Connection Environment: Full participation in the Enterprise Systems Connection environment with the DASD subsystem will require not only the Enterprise Systems Connection/390 channels and appropriate host software, but also a 3990 Storage Control Model 2 or 3 with the ESCON adapter features, and 3380 Model D, E, J, or K, and/or 3390 DASD. However, older DASD subsystems (such as 3880 with 3380 standards) are accommodated through use of the 9034 Enterprise Systems Connection Converter. These devices may also be used effectively as migration devices to ease the effort of converting to the desired ESCON configuration. In addition, 9035 Enterprise Systems Connection Converters may be used to allow attachment of 3990 Storage Controls with ESCON adapters to parallel channels. Thus, there are several different migration paths you may follow, depending on:

- Your current hardware configuration
- Your current software levels
- Financial considerations (such as lease expirations)
- The prioritization of the ESCON functions you wish to exploit
- Other considerations unique to your installation.

Configuration

Figure 22 shows the 3990 ESCON configurations.



Note: The 3990 channel attachment features for the Models 2 and 3 are ordered in pairs, one for each cluster. In this document, when an attachment feature is mentioned, one for each cluster is assumed.

Figure 22. 3990 ESCON Configurations

Installation and Upgrades

Migration Paths to Full ESCON Implementation: The intent of this section is to describe in detail the various migration paths to a full ESCON environment and provide the reader with an understanding of the process and the system impacts of the various alternatives. The diagrams in this chapter depict separate processors attached to the 3990s; these system images in most cases could also be logical partitions.

Conversion of a 3880/3380 Subsystem to a 3990/3390 Subsystem with ESCON Capability: This is probably the most straightforward and perhaps least disruptive migration path. The steps are as follows:

- Install the new processor with ESCON channels, or install the ESCON channels on the current processors. (If some of the processors are not ESCON-capable, see the considerations below in the section on field upgrades ("Field Upgrade of an Installed 3990")).
- Install the appropriate software levels and execute the IOCP, MVSCP, or HCPRIO required to describe the new subsystems as well as the existing ones.
- Install the ESCD and define the default configuration.
- Install the new 3390 and 3990.
- Begin converting the data from the 3380s on a schedule dictated by the application availability requirements.
- After all the data is migrated to the 3390s, remove the 3880/3380 subsystem by configuring off one channel path at a time and disconnecting the control unit on that path. By doing this one path at a time, other DASD on the same set of channels are still accessible through at least one other path. Consider the impact of other 3880s on the same channel path.

Field Upgrade of an Installed 3990: Field upgrades of an installed 3990 may be accomplished in two ways:

- Terminate all applications using the DASD under this 3990 (including bringing down systems if system data sets are located under the 3990 in question). Power down the 3990. Bring the systems up after the upgrade is complete.
- Install the upgrade one cluster at a time. Take the first cluster offline and install the upgrade while the second cluster continues running. Then take the second cluster offline, possibly taking applications and systems down as well, and continue the installation. The first cluster is brought online, and applications may be started. While both clusters are offline, data access is not allowed.

The choice of which procedure to use will be installation-dependent. The first has the potential benefit of simplicity and potentially shorter total time for installation, quiescing the system, and bringing the system back up. In addition, because all storage control activity is stopped, there is no need for reestablishing dual copy pairs, as will happen in the second case.

If there are other control units daisy-chained on the same channels as this one, refer to "Considerations for Daisy-Chained (or Multi-Dropped) Control Units" on page 114.

In the first case, the sequence of activities would be as follows:

- Quiesce the applications and systems using the data under the 3990.
- Allow the customer engineer to power down the 3990 and install the ESCON adapter features.
- Power up the 3990, now with ESCON capability.
- Bring the devices online and resume normal operation of the affected applications and systems.

In the second case, field upgrades may also be accomplished by upgrading one cluster at a time. For most of the upgrade installation, data access is allowed through two of the four paths. (For 2-path DASD, data access is allowed on one path.)

Consideration must be given to the requirement to quiesce the systems accessing data under this 3990 for the period of time when both clusters are unavailable. This should begin at such a time as to ensure that all applications running on the affected systems are terminated by the time the customer engineer quiesces the second storage cluster. It will take some time after the clusters are varied online for all applications to resume at a normal level of activity. Also, because the cache and nonvolatile storage (NVS) must be set off during part of the installation, be sure to consider the performance impact of reestablishing all the dual copy pairs (which were suspended when the cache was set off). Four scenarios to consider are described below.

Note: Some of the procedures described below include the activities required for a 3990 Model 3 using DASD fast write and dual copy. If these functions are not being used, or a 3990 Model 2 is to be upgraded, these steps may be ignored.

Scenario 1: The 3990 to be upgraded is attached to a single processor, which is being upgraded with ESCON channels.

In this case, the 3990 hardware upgrade can be completed concurrently with the processor upgrade.

Scenario 2: The 3990 is shared with other processors, and only the Four Channel Switch, Parallel is currently installed. One or more processors are being upgraded.

The installation steps are as follows:

- The ESCON channels are installed on the processors at the same time that the 3990 is upgraded.
- From the active processors, vary off the channel paths to cluster 0.
- The customer engineer quiesces cluster 0, installs the ESCON adapter, loads the new microcode, and completes the Vital Product Data update.
- Cache and NVS are now set off. All caching and Extended Functions cease operation. Complete the upgrades to the cache and NVS.
- The channels on the second cluster are now taken offline.
- The customer engineer now quiesces the second cluster and completes the hardware installation.
- While the customer engineer continues the 3990 installation, the processor upgraded with ESCON channels may be IPLed.
- After the first cluster is resumed, the paths to cluster 0 are brought online and access to the devices through the ESCON channels is possible.
- After cluster 1 is upgraded, its channel paths may be varied on, and the cache and NVS operation may be resumed. After you have set cache, NVS, and DASD fast write on, and reestablished dual copy operation, the 3990 is now fully operational.

Note that for the period from varying the channel paths to the second cluster offline to completion of the vary online of the paths on cluster 0, no access to the data is allowed.

Scenario 3: The Four Channel Switch, Parallel, Additional feature is installed, and only the processor being upgraded with ESCON channels uses the additional ports.

This is exactly like the previous case.

Scenario 4: The Four Channel Switch, Parallel, Additional feature is installed, and at least one processor image using the 3990 Four Channel Switch, Parallel, Additional feature will continue to use parallel channels.

In this case, the channel connections must first be recabled so that the channel paths that will remain fully parallel all use the eight parallel ports that will remain. This will require varying channel paths offline, but should not cause any loss of access to data. See Figure 23 for an example.

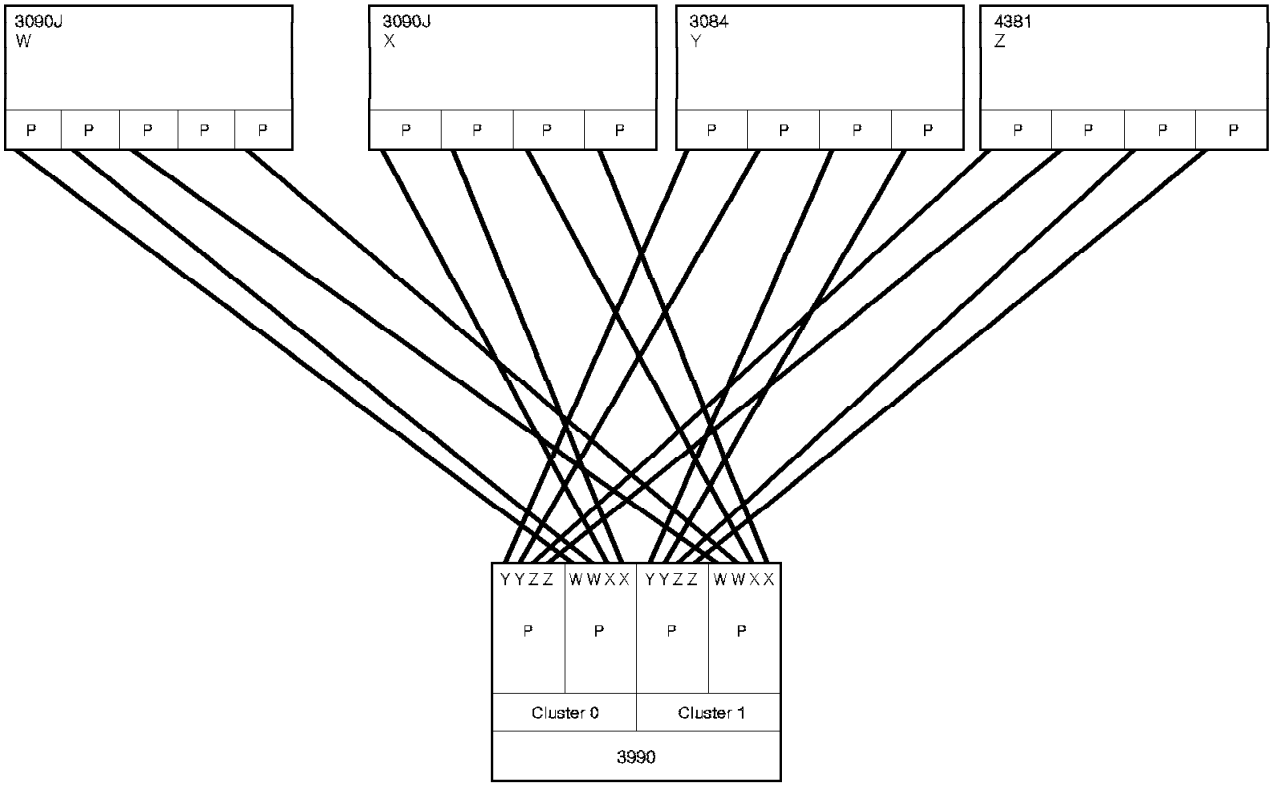


Figure 23. Preparing for 3990 Upgrade: Recabling the Channel Ports. The processor channel paths that will remain parallel must be recabled to the 3990's remaining eight parallel ports.

For the processor that must use a set of ESCON ports, but is still operating with parallel channels, the 9035s must be installed. The remainder of the installation is essentially the same as scenario 2, with the parallel processor channels connected to the 9035s or to the remaining parallel ports.

Figure 24 shows a possible configuration after the installation of the ESCON channels on the first processor (W). In this case, 9035s are used to provide connectivity for the second processor image (X).

In order to use the 9035, the attaching processor must be running with host software that supports nonsynchronous DASD operation. If this is not the case, then 9035s cannot be used, and all of the systems using parallel channels must share the eight parallel ports remaining on the 3990. This may necessitate a reduction in the number of paths to one or more of the processors with parallel channels (refer to Figure 30 on page 124).

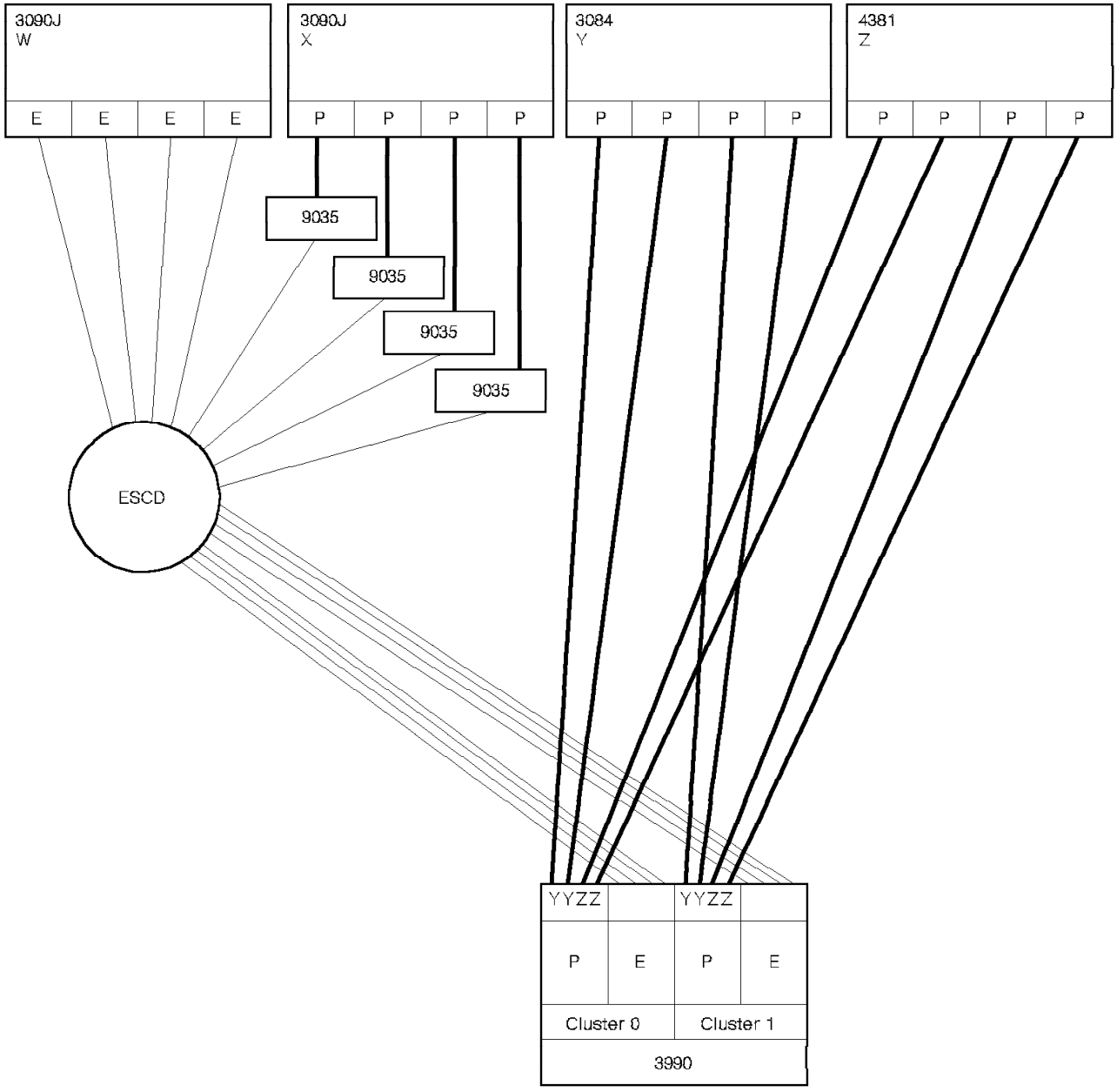


Figure 24. Initial Installation of ESCON Channels on Host W, with 9035s Used to Access the 3990 from Host X

Considerations for Daisy-Chained (or Multi-Dropped) Control Units: Many installations have more than one storage control attached to a channel. This is called a daisy-chained configuration. This must be taken into consideration when only one of the storage controls on a channel is being upgraded with ESCON adapters. Figure 25 shows a daisy-chain configuration.

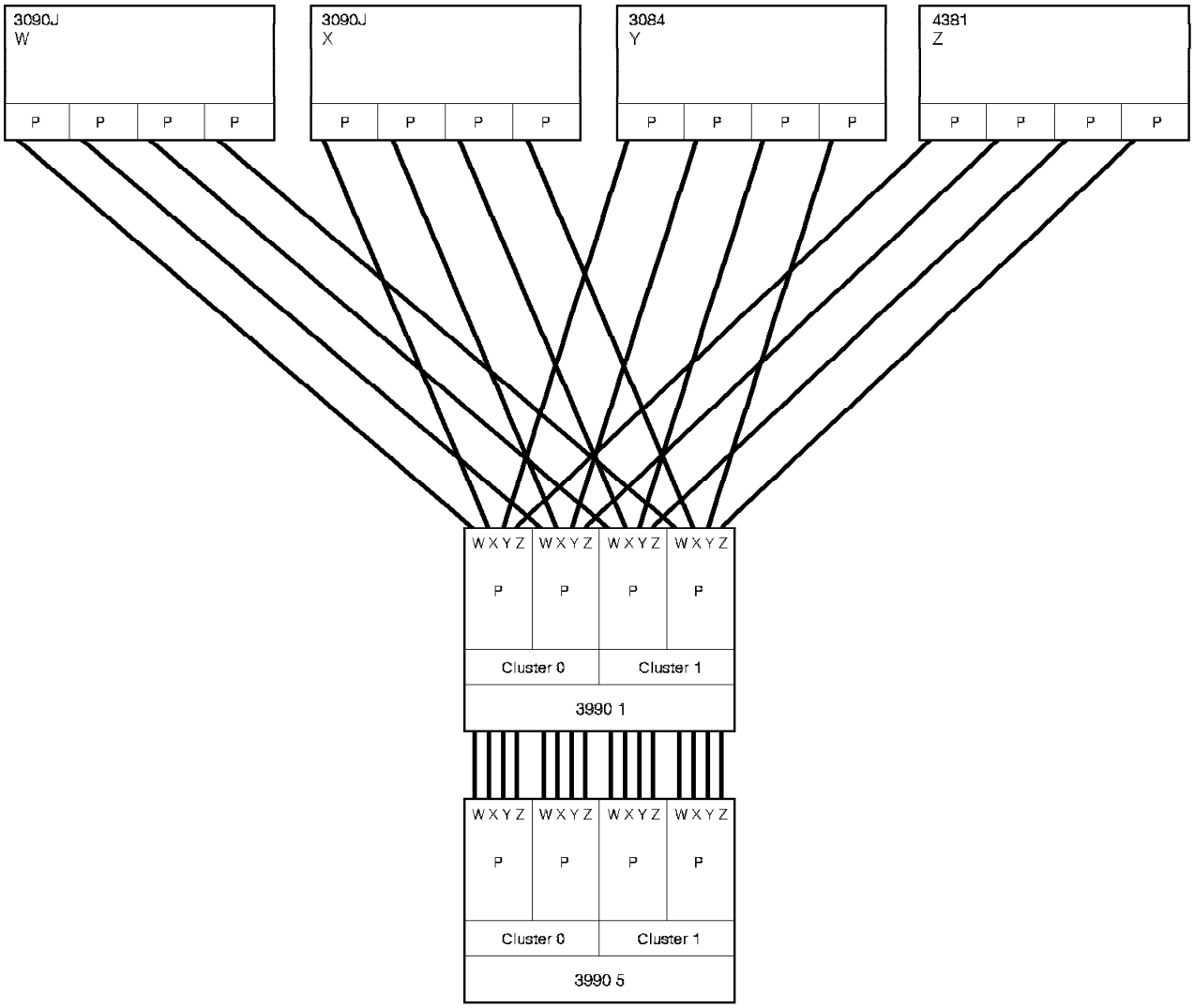


Figure 25. Daisy-Chained 3990 Configuration. 3990s 1 and 5 are daisy-chained (physically cabled) together.

There are a couple of options here, depending on whether or not the second control unit will be upgraded later to have ESCON adapters.

- If it will be upgraded to have ESCON adapters later, reconfigure the channel connections to the second 3990, so that it is multidropped from the respective channels coming from the first 3990. Be sure that the eight sets of cables from the processors that will continue to use the parallel ports are attached to the first set of parallel ports (that is, ports A through D on each cluster). The sets of cables for the processors that will use the ESCON ports should use ports E through H on each cluster. This machine is now ready for its ESCON adapter upgrade.

- If the second control unit will not be upgraded with ESCON adapters, it may not be necessary to realign the channel/port connections on the second 3990. For the first processor (W), the channel cables disconnected from the first 3990 will be butted to the cables leaving the first 3990.

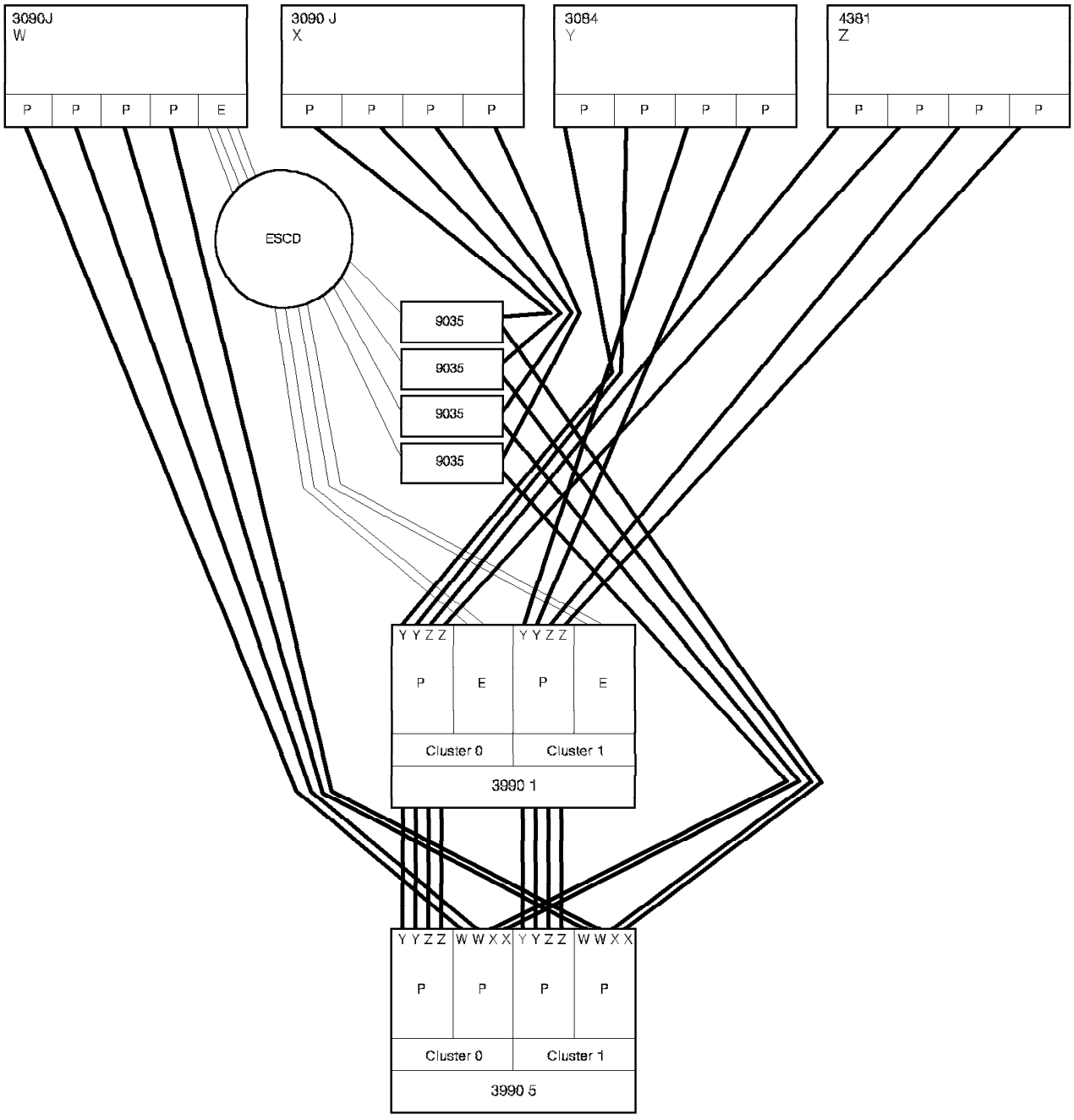


Figure 26. Upgrading a Daisy-Chained 3990 Configuration. 3990 1 is upgraded and attached to an ESCD. Host W attaches to the ESCD to reach 3990 1 and is recabled around 3990 1 to reach 3990 5 on parallel channels. All the remaining host processors must share the eight parallel ports on the 3990 or, where applicable (such as host processor X), be attached through use of 9035s.

Host processor X is attached to 9035s which have been inserted in the daisy chain where 3990 1 used to be. This gives processor X access to 3990 5 through the daisy chain and to 3990 1 through the 9035s and the ESCD. Processors Y and Z retain their connectivity to both 3990s through the daisy chains on the remaining 3990 1 parallel channel ports. Figure 26 on page 115 illustrates the final configuration after the first 3990 is upgraded with ESCON adapters. For each channel cable, the path to all attached storage controls must be configured offline, the cable removed from the 3990 being upgraded, and the remaining storage controls cabled back in place, typically by butting cables together. After the cables are butted, the path may be configured back online. When this is done one path at a time, the impact to the remaining storage controls is limited to one path unavailable at a time. Figure 27 on page 117 illustrates the configuration after the second control unit on the channel is upgraded with ESCON adapters.

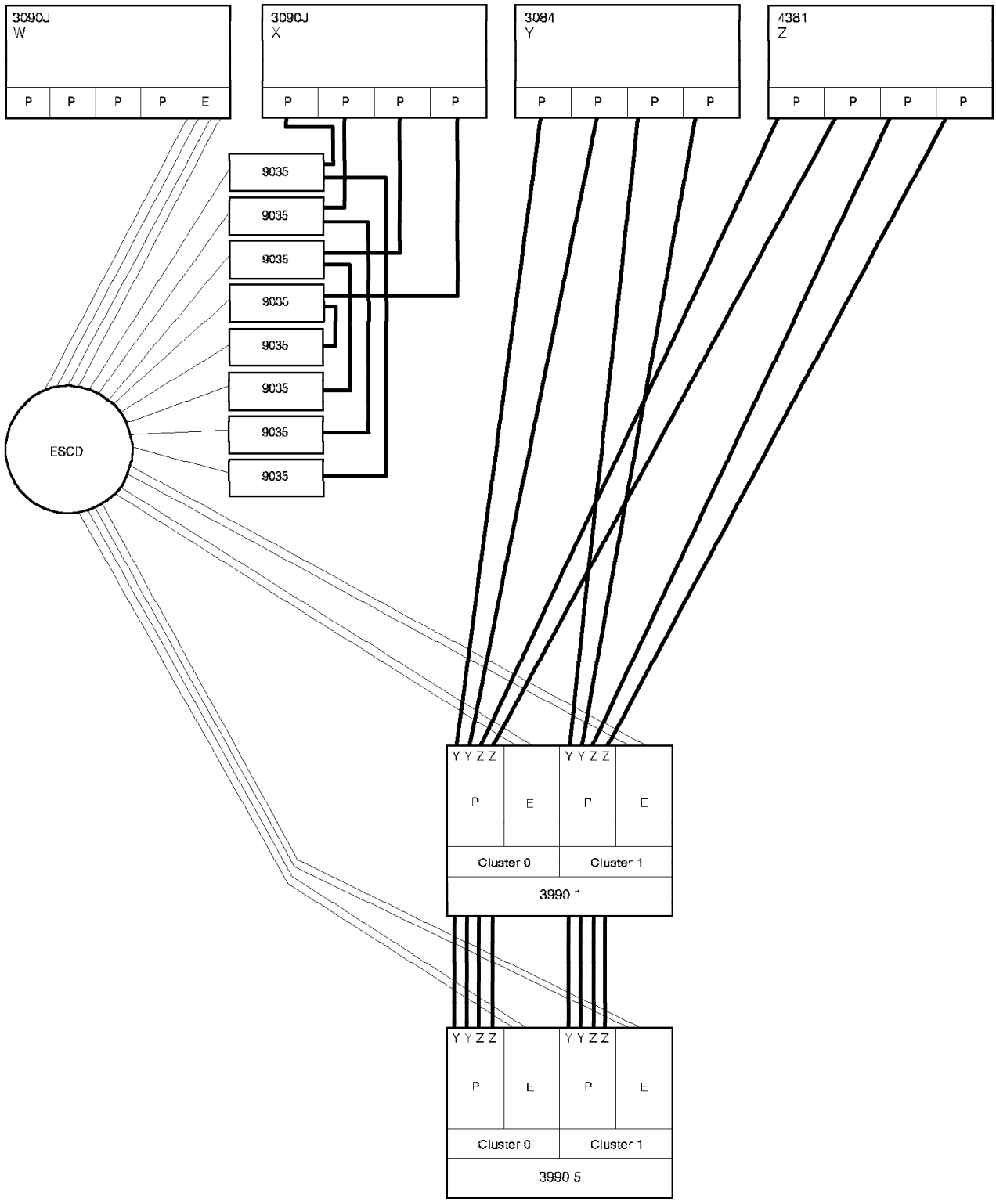


Figure 27. Upgrading the Second 3990 in a Daisy-Chained 3990 Configuration. 3990 5 is upgraded and attached to an ESCD. Host processor W reaches 3990 5 through the ESCD.

3990 5 is upgraded and attached to an ESCD. Processor W reaches 3990 5 through the ESCD. Processor X reaches 3990 5 through a second set of 9035s daisy-chained to the first set. All the remaining processors share the eight parallel ports.

Using the 9034 as an Interim Migration Device: While the processor is powered down for the installation of the ESCON channels configured for the 9034s, the channel cables from the storage control to the host should be recabled to the 9034 units. Make any IOCP, MVSCP, or HCPRIO changes required for the new configuration. In particular, since all channels from one storage control to a given processor image must be of the same type, some reconfiguration and revised addressing may be required to accomplish this.

Note that this procedure assumes that the ESCON channels configured for 9034s can be installed in addition to the existing parallel channels. When these channels must replace the corresponding parallel channels, recabling of the storage controls may be required so that all of the channels attached to the storage control from the same system image are of the same type, that is one of the following:

- All parallel
- All ESCON operating in Native mode
- All ESCON operating in 9034 mode
- All parallel configured with 9035

This will also require an IOCDS change, and either Dynamic I/O Configuration or a POR of the processor. Since the storage control will be unavailable while the channels are being upgraded, the data is not accessible. Configure the paths offline before the channel upgrade, and online after the channel upgrade is complete.

To upgrade the storage control with ESCON adapters and remove 9034s, the following steps must be followed:

- Configure offline all four channels with 9034s installed
- Complete any fiber connections necessary
- Install the 3990 with ESCON adapters as described above, selecting the appropriate installation scenario depending on sharing considerations, among other things
- Activate the new IOCDS that redefines the ESCON channels configured for 9034 operation as ESCON channels in native mode.

Using a 9035 as an Interim Device: Scenario 4 of the field upgrade cases requires the use of 9035s for at least one processor image. When this processor image is upgraded to ESCON, the 9035s will be removed at the same time. The 3990 vital product data (VPD) must be updated to reflect that these channel connections are now ESCON channels.

Inter-Relationships and Dependencies with Other Products

Software Considerations: The software levels required for your installation depend on the desired hardware configuration and operational characteristics. Refer to “IBM Software” on page 33 for more information on ESCON support of the 3990 Storage Control for:

- ESCON channels
- 9034s
- 9035s.

IOCP Considerations: IOCP changes are required for using a 3990 with either the ESCON channels, a 9034, or the ESCD. See the IOCP discussion for details. Particular items to note for the 3990 include:

- The UNITADD parameter is specified with a value of 00.
- If the 3990 is operating in DLS mode (with 3380 Model D, E, J, or K DASD), then the CUADD parameter is used to designate which logical DASD subsystem is being described.

Inter-Relationships: Information regarding the system configuration is stored in a number of different places within the various system components. It is important to understand what these are, how they relate to each other, and to make sure that they are consistent. The MVSCP (or the HCPRIO for VM) and the IOCP have the same relationship to one another as before. The IOCP includes more information now, including:

- The channel types—parallel (TYPE=BL), ESCON operating in native mode (TYPE=S), and ESCON operating in 9034 mode (TYPE=FX)
- The presence of an ESCD
- The port addresses used
- Device-specific items such as those mentioned above.

The Enterprise Systems Connection Manager (ESCM) uses the IOCDS to generate its tables for managing the ESCD configuration. The 3990 uses information contained in its VPD, such as:

- Channel ports
- The type of channel
- 9035 descriptions
- Device addresses
- The mode of operation.

Remote Power: Installations that use the remote power on/off capability of the 3990 today, or installations that wish to control power on/off for control units located more than 400 feet away from the controlling location, may wish to install the Enterprise Systems Connection Monitor System (ESCMS) to provide this capability in an ESCON environment. For information about ESCMS, refer to “Enterprise Systems Connection Monitor System” on page 171.

Special Considerations and Recommendations

DASD and Storage Control Considerations: Considerations for migration vary, depending on the currently installed hardware.

- Installations with 3380 standards installed have these options:
  - Operate the 3880 or 3990 storage control with the 9034

    Use of the 9034 provides limited distance enhancement, but does provide investment protection for the future use of the ESCON channel with a 3990 with the ESCON adapters. The 9034 distance with a 3990 is 1.2 km, with a 3880, .9 km. If an ESCD is used, it decreases the maximum distances for both control units by .2 km.
  - Upgrade the 3380 standard configuration to a 3990/3390 configuration

If you have plans for retiring your 3380 standards, this may be a good opportunity to combine the migration to 3390 with a move to a 3990 with ESCON adapters. This has the advantage of accomplishing both upgrades with only one disruption—the actual move of the data from the 3380 standard to the 3390 device. The 3990 with ESCON adapters and the 3390 DASD would be installed with minimal disruption (depending on the degree to which you have anticipated these requirements), and the actual migration of the data could be scheduled to lessen the impact on the applications. In addition, this migration allows full use of all of the ESCON advantages, for example, distance, connectivity, and configuration management.

- 3880 Storage Controls only operate with the ESCON channels when they are configured for 9034s.

  Such operation provides extended attachment distance up to 0.9 km. If an ESCD is used, the maximum distance is .7 km. There is investment protection in using the 9034, since it may be configured in the future to operate with a 3990 with ESCON adapters. For full ESCON participation, 3880 storage controls with 3380 Model D, E, J, or K should be replaced with 3990s with the ESCON adapter features.

- Considerations for the 3380 CJ2 are similar.

  This device does not have ESCON capability. Either operate it with a 9034 or replace it with a 3990 Model 2 or 3 subsystem.

- 3990 Model 1s do not support ESCON.

  Either use the 9034 or upgrade to a 3990 with the ESCON adapter features.

- 3990s (other than Model 1s) may be either upgraded with ESCON adapters, or operated with a 9034. The latter is required if there are 3380 Standards attached.

- 3390s operating in 3380 track compatibility mode may not be accessed by channels configured with the Model 2 3044 Fiber Optic Channel Extender Link, the 9034, the 9035, or with any of the installed ESCON adapter features.

Considerations for Choices of ESCON Channel Features, 9034s, or 9035s for 3990 Configurations: For 3990s, the choice of which ESCON features to install or whether to use 9034s or 9035s depends on a number of factors:

- Current configuration of the 3990
- Host channel configurations
- Host ESCON capability
- The number of processors attaching to the 3990
- The ESCON benefits desired.

The possible choices are described below, with the possible alternatives and considerations for each.

- Guidelines for selecting 3990 ESCON adapter features
  - The 3990 has only the Four Channel Switch, Parallel feature installed.

    This case is very straightforward. Install either the ESCON Adapter with the Two Ports feature, or the ESCON Adapter with the Four Ports feature, at the same time as the processor ESCON channels are installed. The choice of the ESCON Adapter with the Two Ports feature, or the ESCON Adapter with the Four Ports feature, is dependent on both the ultimate

channel configuration for the storage control and RAS considerations. See “Considerations for Configuration Choices” on page 125 for more detail on the RAS considerations.

– 3990 has the Four Channel Switch, Parallel, Additional Feature installed.

  In this case, the Four Channel Switch, Parallel, Additional Feature will have to be removed, and either the ESCON Adapter with the Two Ports, or the ESCON Adapter with the Four Ports Feature installed. Details of the installation process are in “Migration Paths to Full ESCON Implementation” on page 109. Further steps will be determined by the current processor configuration. There are several cases to consider:

  - Only one processor image is using the channel ports provided by the Four Channel Switch, Parallel, Additional Feature. In this case, install the 3990 ESCON adapter features at the same time as the processor upgrade.
  - All processor images using the Four Channel Switch, Parallel, Additional Feature will be upgraded with ESCON channels at the same time. Install the 3990 ESCON adapters at the same time as the processor upgrade.
  - Only one of the processors using the Four Channel Switch, Parallel, Additional Feature will be upgraded with ESCON channels at this time. Install the ESCON adapters and use 9035s to provide connectivity to the parallel image. If the ESCON Adapter with Two Ports Feature is used, the ESCD will have to be used to provide connectivity to the 9035s. See Figure 28 on page 122.

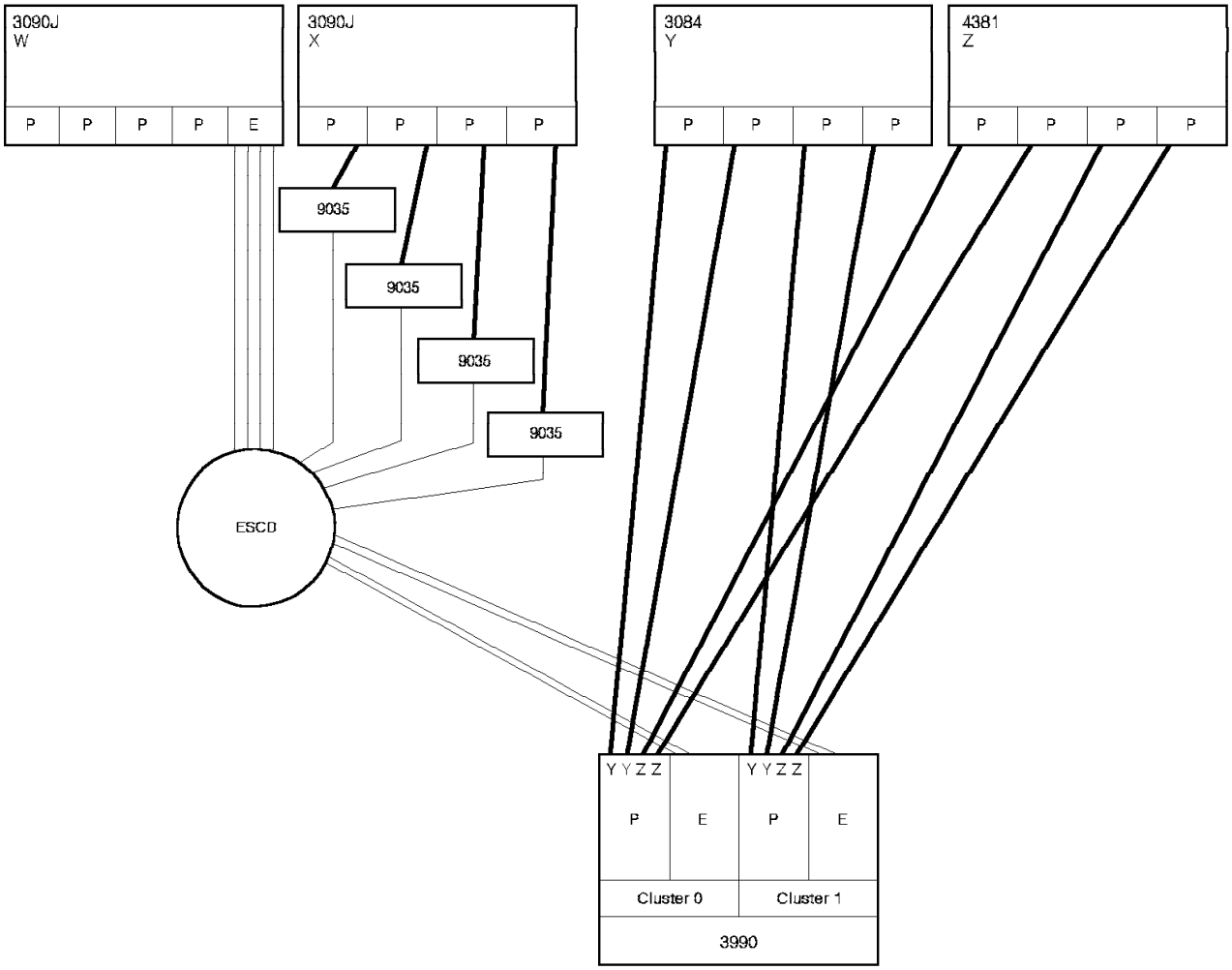


Figure 28. 9035 Using ESCD Ports. This shows a 3990, with a feature (ESCON Adapter, with Two Ports), illustrating attachment to three "parallel channel" processors, one using 9035s through the ESCD.

If the ESCON Adapter, with Four Ports Feature is used, then the 9035s may be directly attached to the ports on the 3990. Refer to Figure 29. Note that use of 9035s on the second processor image requires a level of host software that supports nonsynchronous DASD operation. See “IBM Software” on page 33.

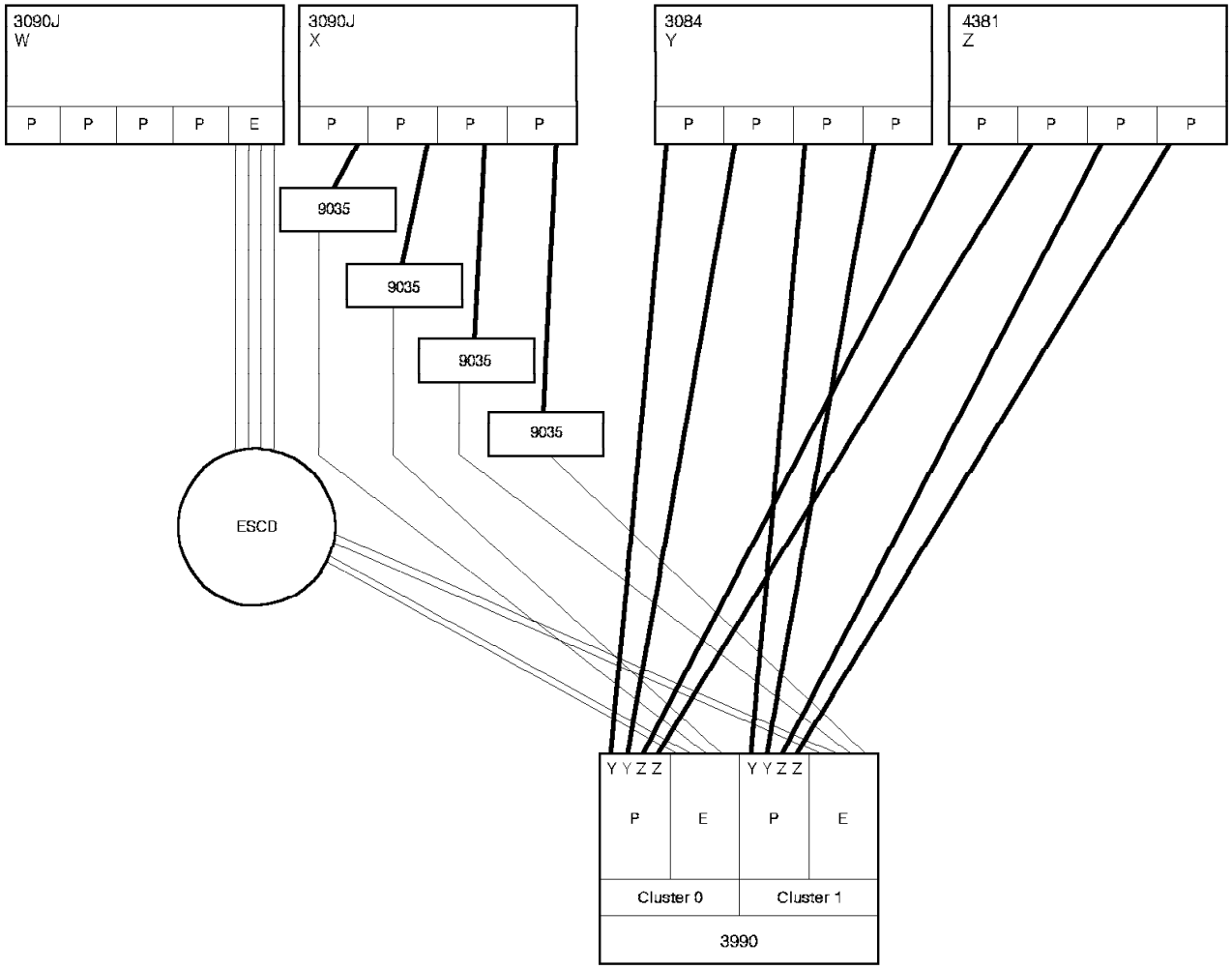


Figure 29. 9035s Using 3990 ESCON Ports. This shows a 3990, with a feature (ESCON Adapter, with Four Ports), illustrating attachment to three “parallel channel” processors, one using 9035s directly.

- In some cases, the parallel processors may not need full four path connectivity to the DASD subsystem. In this case, the use of 9035 may be avoided by reducing the number of parallel channels from each processor to the storage control. The aggregate number of parallel channel connections may not exceed the eight available with the Four Channel Switch.
- If the other processor images sharing the ports on the Four Channel Switch, Parallel, Additional Feature cannot be upgraded to a level of software that supports nonsynchronous operation, then the only alternative is to reduce the number of channel paths for each of the processors operating in parallel mode. See Figure 30 for an example. In this case, all of the processor images operating with parallel channels will share the eight parallel ports. There are performance and RAS considerations for this. See "Considerations for Configuration Choices" on page 125 for further discussion.

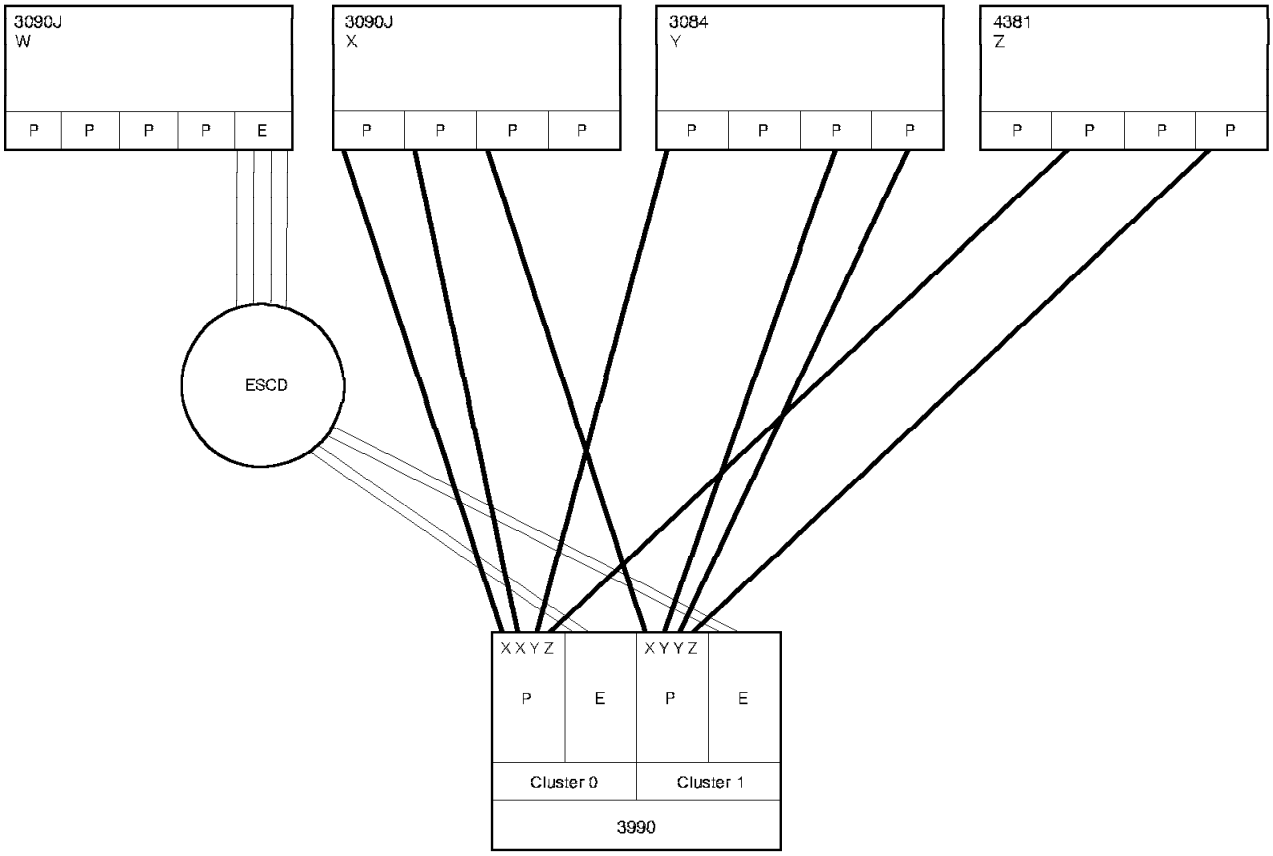


Figure 30. Migration When One Host Is Converted to ESCON and the Other Host Images Do Not Support Non-Synch DASD Subsystems. When only one host processor is being upgraded with ESCON channels and the other host processor images do not support nonsynchronous DASD subsystems, the number of parallel channels attaching to the 3990 will have to be reduced.

- Guidelines for using 9034s

  The 9034 should be used when you want to install the ESCON channels on the processor and one of the following is true:

  – The 3990s are not yet going to be upgraded with ESCON adapters
  – 3380 Standards are installed on the 3990
  – 3880s need to be attached to these channels

  - Processor channel configurations require the substitution of ESCON channels operating in 9034 mode for parallel channels.

  All of these are reasonable migration paths to the ultimate full ESCON implementation.

- Guidelines for using the 9035
  - The 9035 is used to ease the migration to the ESCON environment when one or more processors in the complex are not yet ESCON-ready, and the installation wishes to begin investing in ESCON adapters for the storage control. Typical migration scenarios were described above. Remember that the use of the 9035 requires nonsynchronous DASD support in the SCP. See "IBM Software" on page 33.

Considerations for Configuration Choices: As we have seen, the set of products we are introducing provide great flexibility in configuring the DASD subsystem in the new environment. Both for the interim configurations used in migration, as well as the final ESCON configuration, there are configuration choices to be made with different trade-offs. These must be well understood before the proper decisions can be made. Areas to be considered include:

- Availability
- Distance
- Ability to use the new function.

For the interim configurations, thought must be given to the final configuration, and interim configurations should be chosen with consideration for minimizing disruption for the duration and minimizing interim hardware replacement.

General Considerations: The traditional considerations of the number of channel paths still apply in the ESCON environment, but with some important differences.

For the remaining processors with parallel channels attaching to a storage control in mixed mode (that is, operating with both parallel and ESCON channels), there may be a requirement to reduce the number of **parallel** paths to the 3990. This must be carefully analyzed in terms of the current channel utilization and performance levels for the 3990. It may in fact be possible to reduce the parallel channels between a processor and the 3990 from four to three or even two. We would not recommend further reduction because of the availability considerations of having only one path from a given processor to a storage control.

For an ESCON environment there is no need to maintain a one-to-one correspondence between the processor paths defined to the storage control (through the ESCD) and the paths from the ESCD to the storage control. For performance reasons, there is no need to go beyond four ESCON ports on the storage control. In other words, the ESCON Adapter with Two Ports feature is adequate for performance of the storage control, since there can only be four concurrent data transfer operations between the 3990 and the channel. Thus, we could see a configuration with the full complement of 16 channels defined from the various processors attached to the storage control through the ESCD, but only four ports used from the 3990 to the ESCD. (See Figure 31 on page 126.) For availability reasons, it may be desirable to have eight ports (using the ESCON Adapter with Four Ports Feature). The only situation where 16 (the ESCON Adapter with Four Ports, Additional feature) would be considered is an installation that does not need an ESCD.

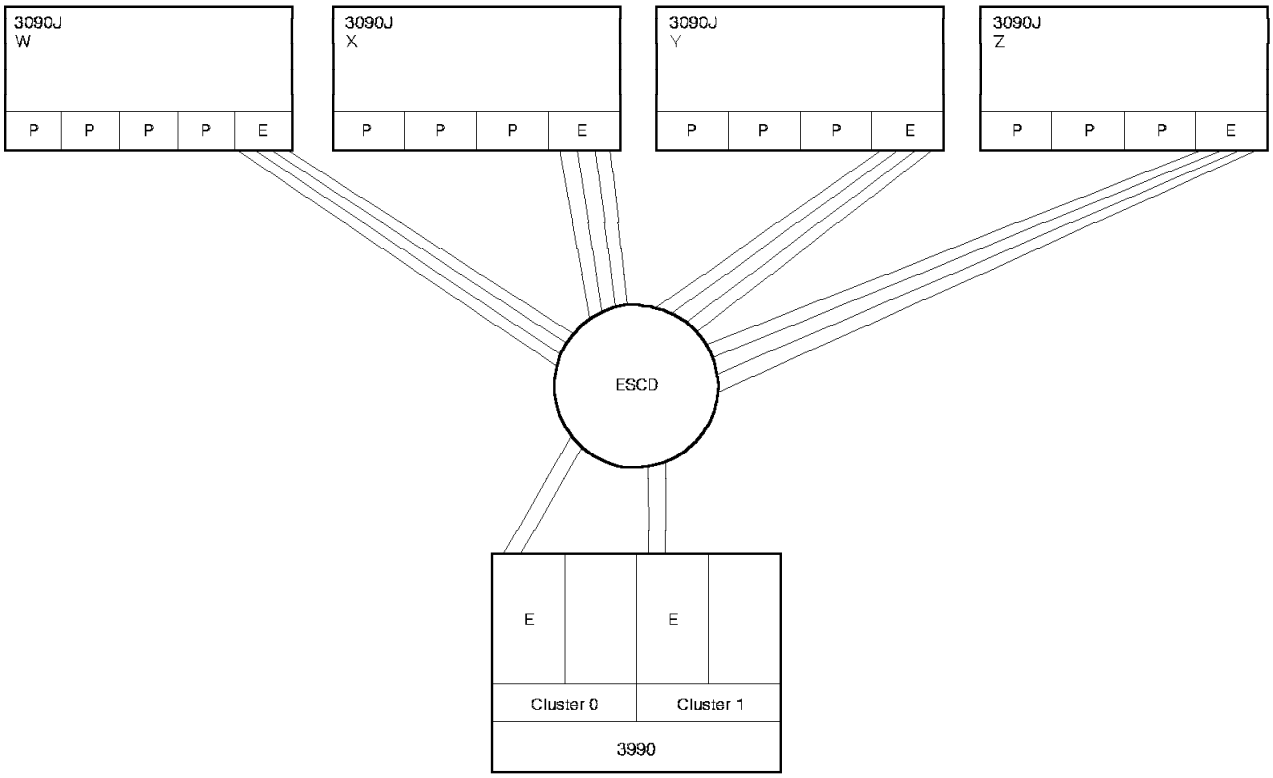


Figure 31. 3990 Minimum Configuration. A 3990 with the ESCON Adapter with Two Ports Feature allows full use of all four concurrent data transfer paths.

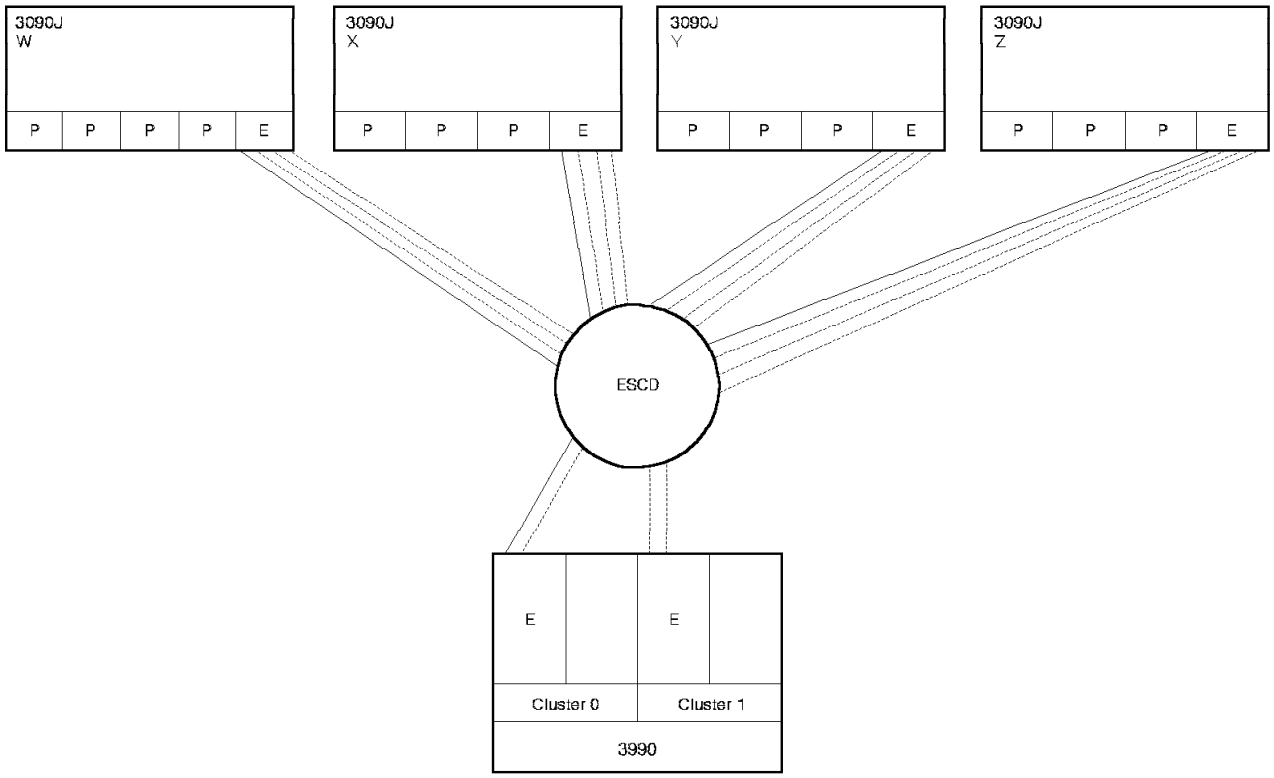


Figure 32. 3990 Logical Channel Relationship. Several processor channels may be associated with one 3990 ESCON port.

Logical Paths and Physical Channels: With the implementation of the ESCON architecture, we have to make a distinction between logical paths and physical channels. In the parallel configuration, there is a one-to-one correspondence between the two. However, in the ESCON environment—because of the way we make use of the ESCD, there is a possibility of having multiple processor channel connections associated with one ESCON port on the 3990. See Figure 32. In this figure, the four processor links drawn with solid lines all use the same link from the ESCD to the storage control—again, the one drawn with a solid line.

A 3990 is capable of having up to 16 physical channel connections, and also 16 logical paths, eight on each cluster. Each parallel port physically installed on the 3990 takes one logical path. All logical paths not used by the parallel channels may be shared by the ESCON port connections. Thus, if a 3990 has the Four Channel Switch, Parallel Feature installed, along with the ESCON Adapter with Two Ports Feature, then the eight parallel ports consume eight of the logical paths, and the four ESCON ports share the eight remaining logical paths. See Figure 33 on page 128. It is important to note that the parallel ports reserve logical paths even if they are not being used. When these logical paths need to be used for ESCON attachments, the parallel port cards must be physically removed. This may introduce some implementation or migration considerations: as long as even one processor uses the parallel ports, these eight logical paths are not available for sharing by the ESCON ports.

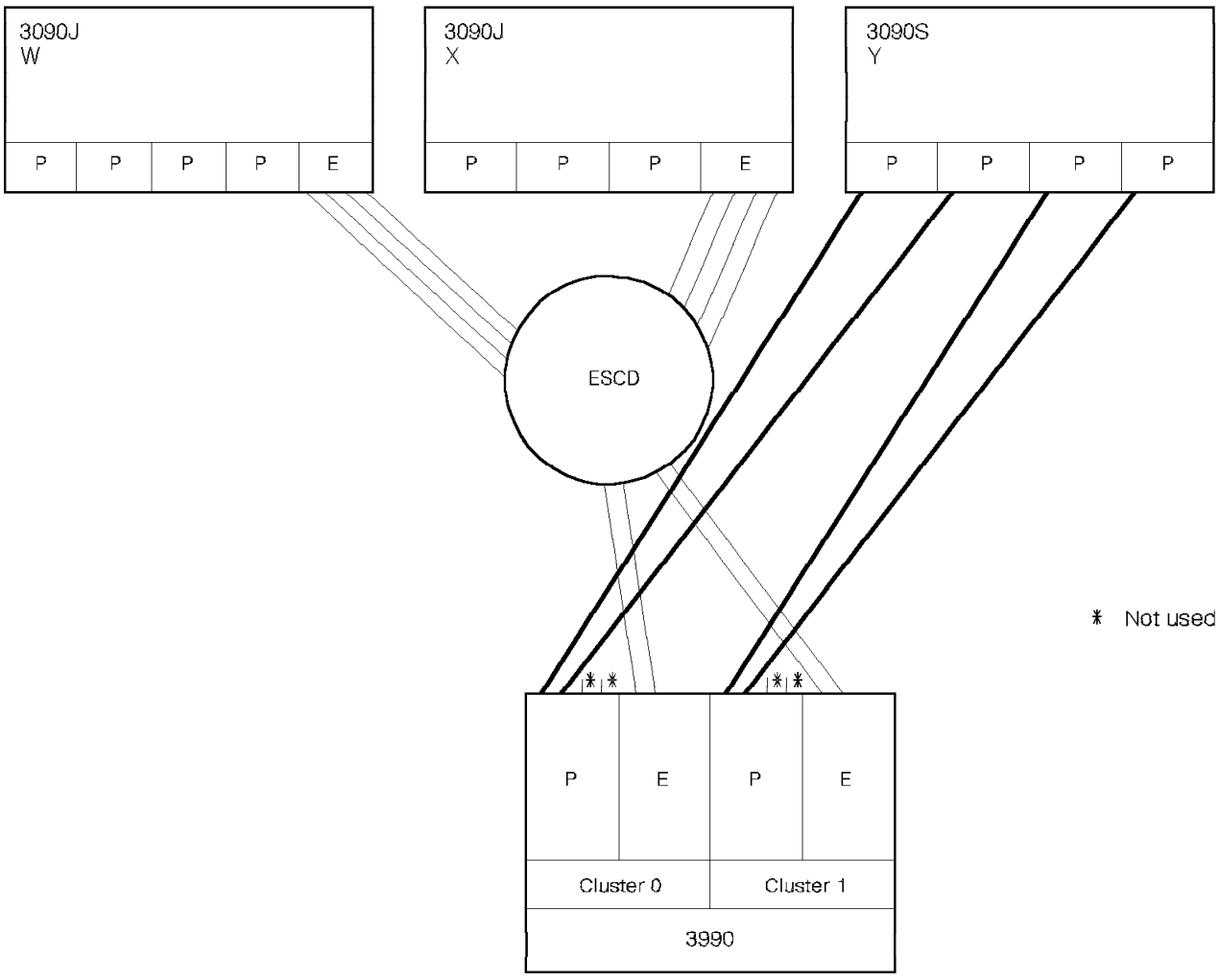


Figure 33. Sharing Logical Channels

At the time a processor is initialized, it attempts to establish logical connections to the 3990. It will establish logical connections based on the host processor′s active IOCDS. After all 16 of the 3990′s logical paths have been established, any further attempts to establish logical paths will fail with a “path not available” message. For this reason, it is important to define the proper number of channel paths from each processor and ensure that the correct processors are allowed to establish connections. IOCP parameters and the ESCM may be used to ensure that the proper configuration is established.

Availability: Availability plays an important role in configuring systems today. While adequate performance may be obtained with a minimal configuration, availability requirements may well dictate the installation of redundant pathing and ESCDs. Customers with high availability requirements should consider the installation of pairs of ESCDs, with all processor and storage control connections split across the two. (See Figure 36 on page 132.) If minimal performance impact of an ESCD outage is required along with maximum pathing capability to the DASD, using ESCDs in groups of four may be desirable. (See Figure 34 on page 130 and Figure 35 on page 131.) Similarly, additional pathing to the 3990 storage control may be desirable. There are several possibilities here.

As we have seen, full performance capability of the storage control only requires four paths from the 3990 to the ESCD. Availability considerations may dictate more. The possible choices include:

- Use four ESCDs, and have one path from each 3990 going to each ESCD, with the appropriate channel paths from each processor going to each ESCD. The performance impact of an ESCD failure is loss of one path to each 3990 attached to the failing ESCD, as well as loss of all paths from each processor to the failing ESCD. (See Figure 34 on page 130.)
- Use four ESCDs with two paths from each 3990 to each ESCD. The performance impact of an ESCD failure is reduced to the loss of all paths from each processor to the failing ESCD. Because there are still six paths from the 3990 to the remaining three ESCDs, it is still possible to sustain four concurrent I/O operations to the attached processors (of course no more than three to any one processor). (See Figure 35 on page 131.)
- Using two ESCDs with four paths from each 3990 to each ESCD provides protection from the ESCD as a single point of failure, but an ESCD failure will result in the loss of all of the paths from the processors to the failing ESCD. Four concurrent I/O operations may be executed, but no more than two may be directed at any one processor. (See Figure 36 on page 132.)

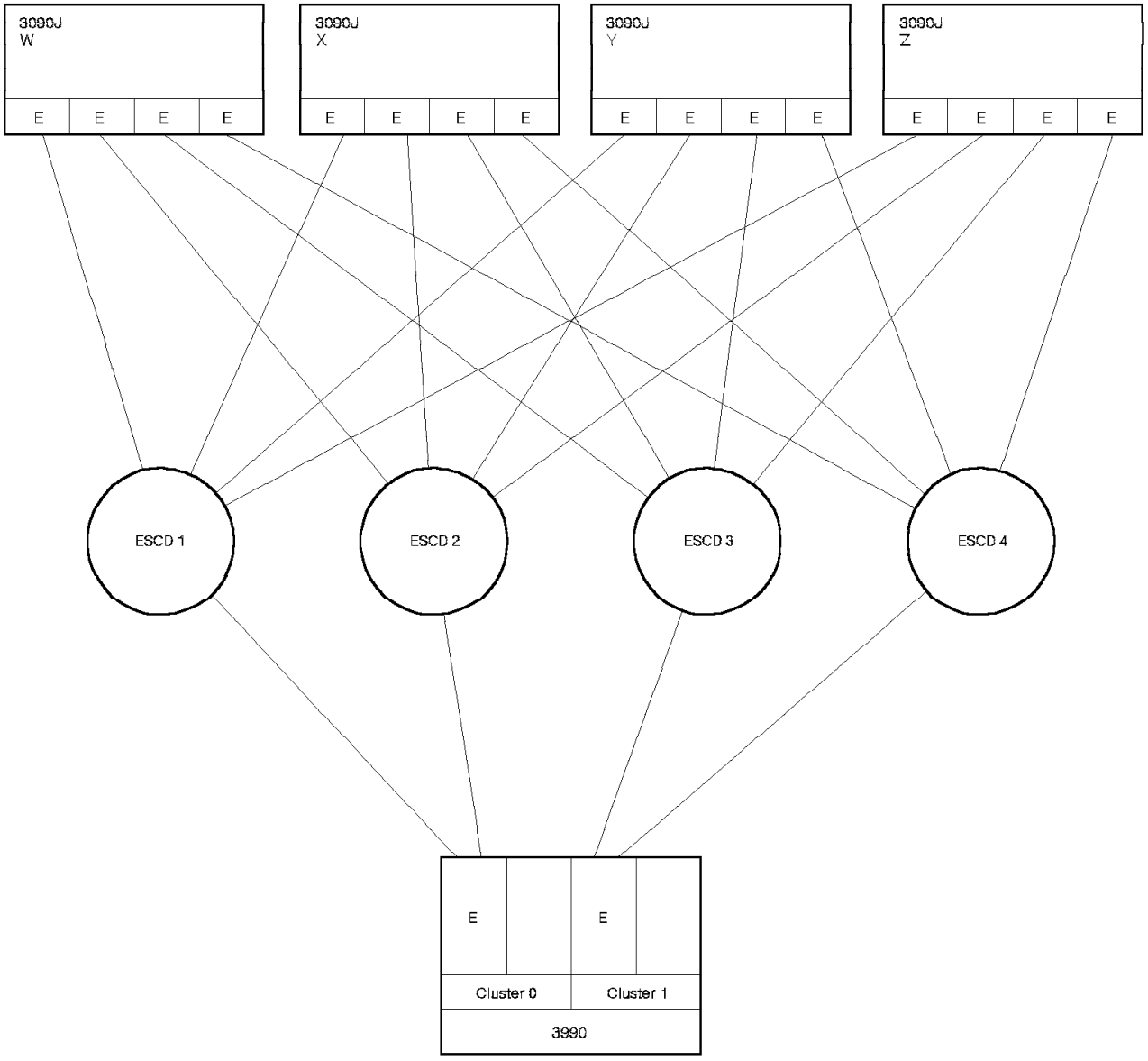


Figure 34. The Use of Four ESCDs and the 3990 with the ESCON Adapter with Two Ports Feature to Improve Availability. The use of four ESCDs improves the availability of host channels to a 3990 with the ESCON Adapter with the Two Ports feature.

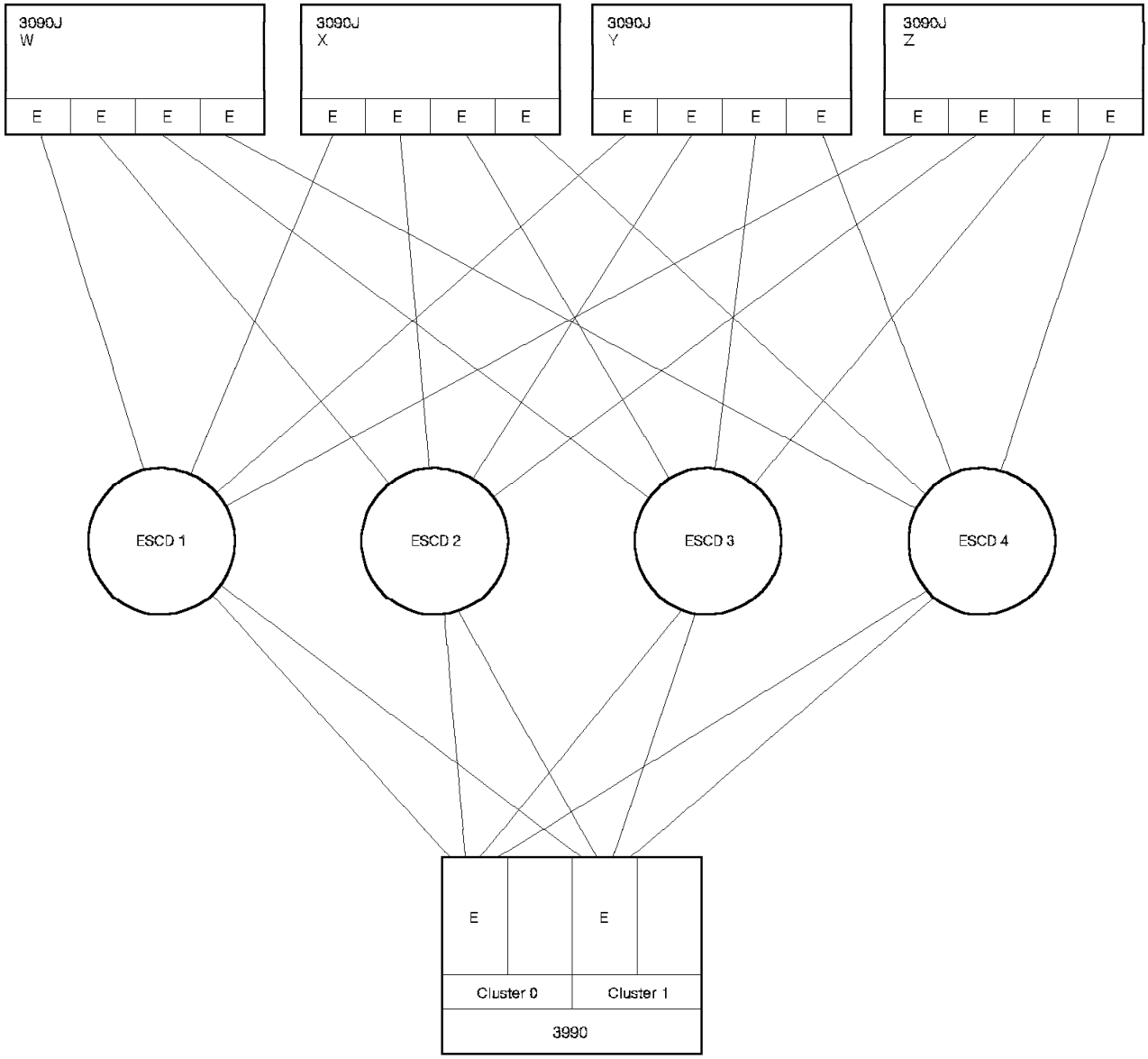


Figure 35. The Use of Four ESCDs and the 3990 with the ESCON Adapter with Four Ports Feature to Improve Availability. The use of a path from an ESCD to each side of a 3990 with the ESCON Adapter with the Four Ports feature further improves path availability.

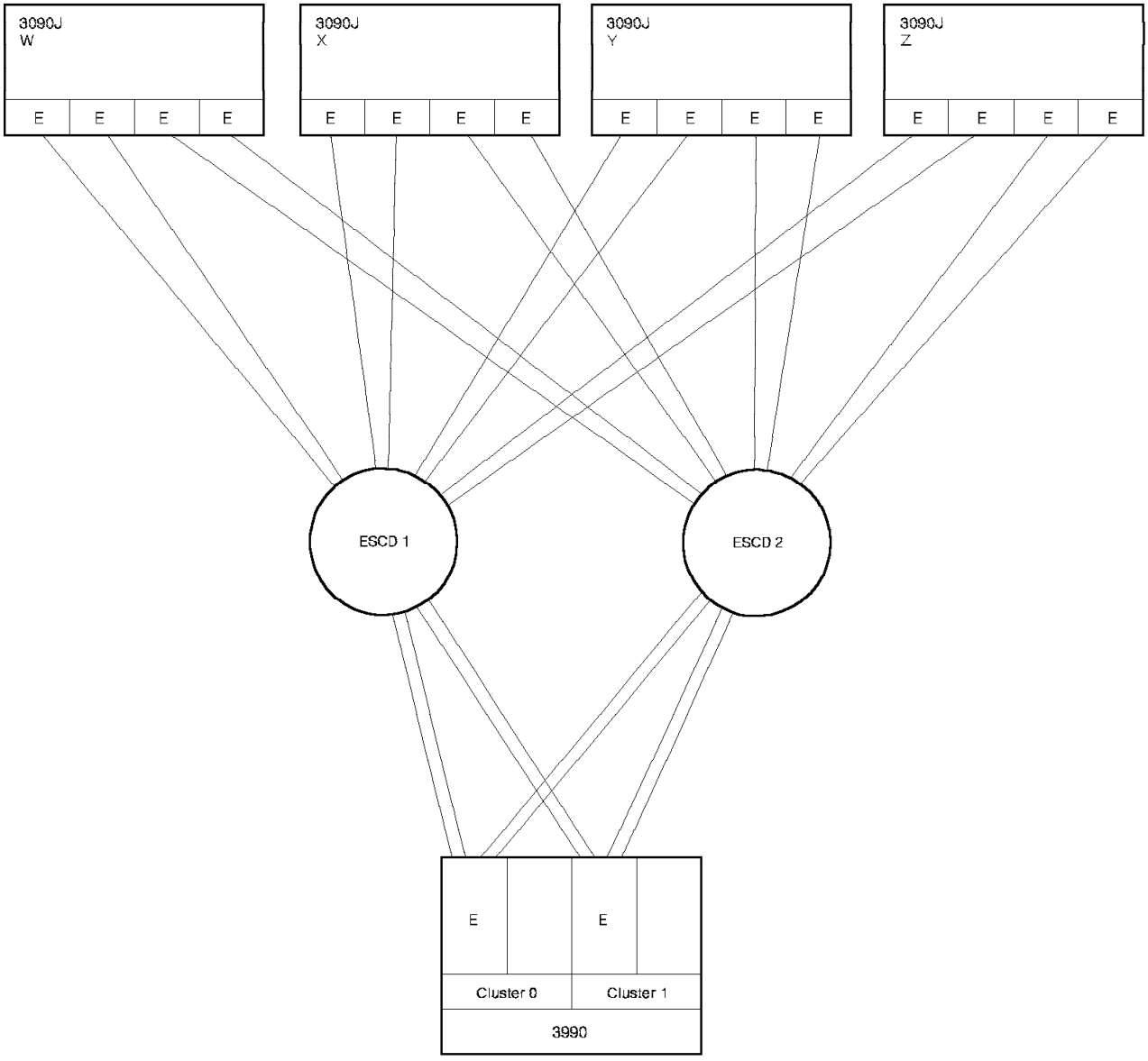


Figure 36. The Use of Two ESCDs and a 3990 with the ESCON Adapter with the Four Ports Feature. The loss of an ESCD reduces the number of available paths to any host processor from four to two.

In the parallel environment, static connection of a 3990 to more than 16 channel paths is not possible unless a 3814 switch is used for manual reconfiguration or cables are physically moved. Use of the ESCD and its dynamic configuration change capabilities provides an important enhancement to application availability. The channel connections allocated to one processor can be changed to a different processor through operator commands. Thus, by proper definition of the IOCP and the MVSCP or HCPRIO, connectivity for such workload shifts may be provided quite easily. See Figure 37. The ESCM programming interface can be used to facilitate these changes.

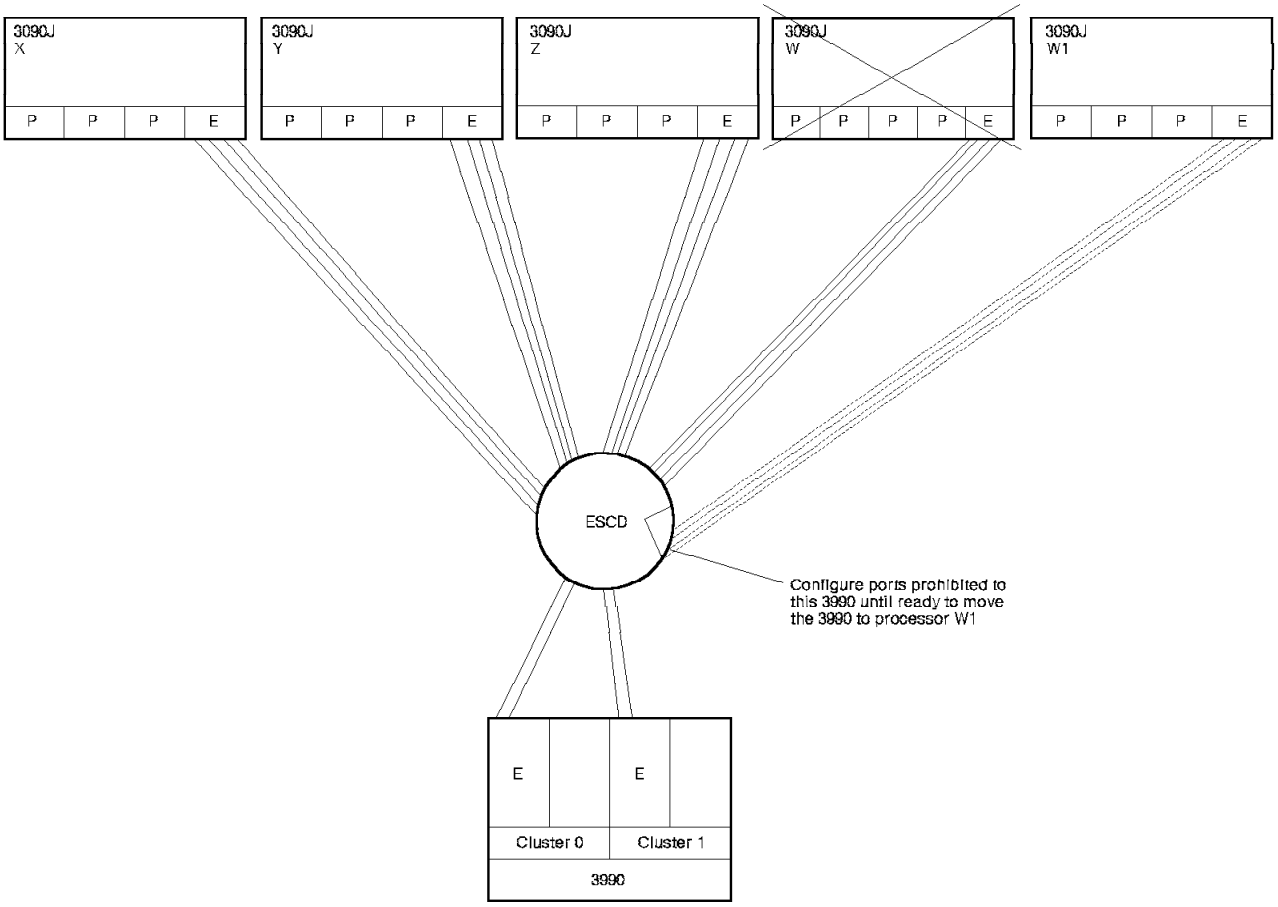


Figure 37. Shifting Workload to a Backup Processor Using the ESCD. The 3990 can be moved from processor W to W1 by configuring off channels on processor W and configuring on channels to processor W1.

Another possibility is to configure all four channel paths from a given host to a 3990 through the appropriate ESCDs, but have one or two of them offline, that is, not configured. If one of the active channel paths failed, the ESCM could be used to enable one of these unused paths. In this way, the installation could in effect have more redundancy in paths without dedicating four 3990 logical channel connections to the processor. In environments with more than four systems images, this may be desirable. NetView* might be automatically invoked with the appropriate EXEC to accomplish this. (Refer to Figure 38, which includes an LPAR configuration for the second processor).

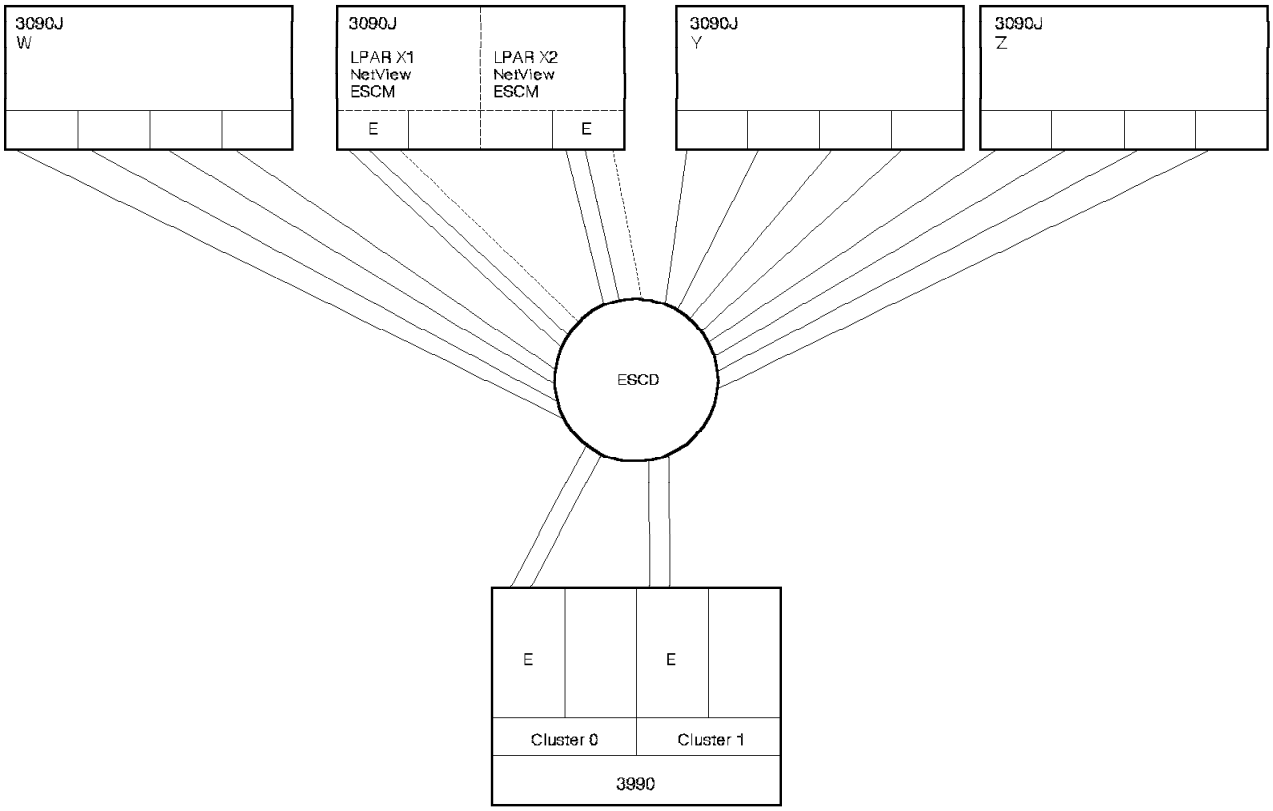


Figure 38. Using the ESCD with the ESCM to Configure Backup Channels

In all cases, there should be a minimum of two logical paths to a storage control with proper separation for best availability.

NetView is a trademark of the IBM Corporation.

Enterprise Systems Connection-Support Products

The products in the following sections are new for ESCON and either participate as part of the ESCON environment or support changes resulting from ESCON.

- 9032 and 9033 Enterprise Systems Connection Directors
- Enterprise Systems Connection Manager
- 9034 Enterprise Systems Connection Converter
- 9035 Enterprise Systems Connection Converter
- 9037 Sysplex Timer
- The Enterprise Systems Connection Monitor System.

9032 and 9033 Enterprise Systems Connection Directors (ESCDs)

Description

The IBM 9032 and 9033 Enterprise Systems Connection Directors (ESCDs) provide dynamic connections between attached Enterprise Systems Connection products (for example, channels or control units).

Each host in your installation can have ESCON channels attached to one or more ESCDs. Also, more than one host can have ESCON channels attached to the same ESCD. You can have a combination of 9032s and 9033s in your configuration, depending on your connectivity needs. Figure 39 illustrates a simple configuration with ESCDs (either 9032s or 9033s).

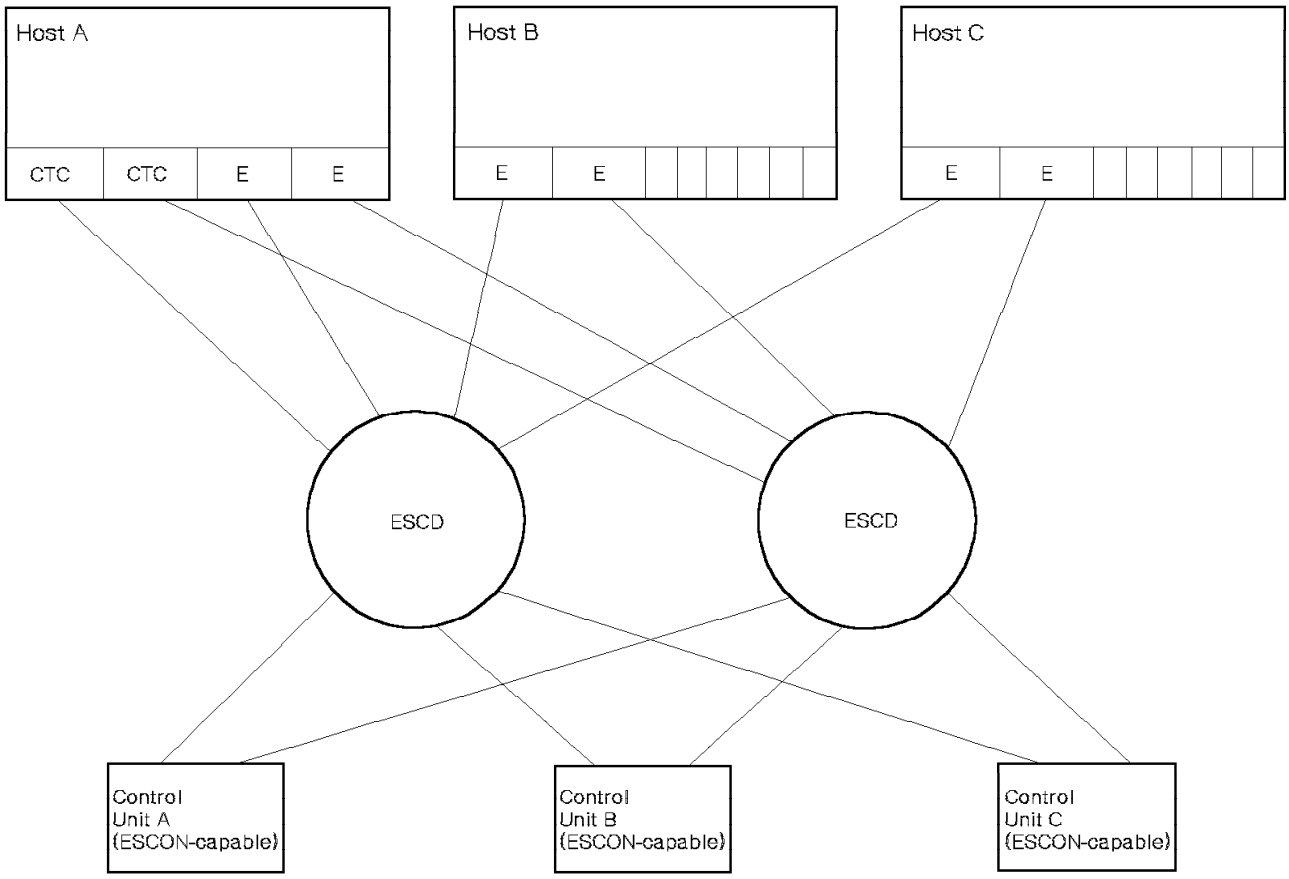


Figure 39. A Simple Configuration of ESCDs

Configuration

The 9032: The 9032 can be ordered with 28 to 60 external ports (in four-port increments). If the 9032 is initially ordered with fewer than 60 ports, you can add ports (in four-port increments) to a maximum of 60 ports. Each 9032 port provides for the attachment of any ESCON-capable control unit, an ESCON channel, a 9034 Enterprise Systems Connection Converter, a 9035 Enterprise Systems Connection Converter, or another ESCD.

The 9032 requires a console (referred to as an ESCD console). The console is ordered separately and is used for operator and service functions.

Optional Features: The 9032 has two types of optional features, port cards, and an Enhanced Availability feature.

Port cards (each containing four ports) are separately orderable for the 9032.

The Enhanced Availability feature (also ordered separately) reduces disruption of operations if a 9032 port, power supply, or fan fails. This feature provides:

- Two spare ports, which the service representative can substitute for failing ports
- An additional power supply/fan assembly.

9033: The 9033 can be ordered with eight, 12, or 16 external ports. If the 9033 is initially ordered with less than 16 ports, you can add ports (in four-port increments) to a maximum of 16 ports. Each 9033 port provides for the attachment of any ESCON-capable control unit, an ESCON channel, a 9034, a 9035, or another ESCD.

The 9033 also requires a console (also referred to as the ESCD console). The console is ordered separately and is used for operator and service functions.

Optional Feature: Port cards (each containing four ports) are separately orderable for the 9033.

Installation and Upgrades

The following section includes information on installation and upgrade times and steps for the 9032 and 9033.

Note: Dynamic I/O Configuration (MVS only) removes the power on reset (POR) requirement for initializing I/O configuration changes that may result from ESCD installations and upgrades. Refer to “Use Dynamic I/O Configuration” on page 25 for information on Dynamic I/O Configuration.

Installation Times

ESCD	Installation Time	Port Card MES Time	Enhanced Availability MES Time
9032	1.7 hours	.6 hours	1.8 hours
9033	1.3 hours	2.0 hours	Not Applicable

Installation Steps: The installation of either the 9032 or 9033 is performed by an IBM service representative. The following steps represent specific customer actions that must be taken in conjunction with the service representative′s installation of the ESCD:

1. Make sure that, for each host attached to the new ESCD, the I/O definitions exist that define the new ESCD and define the control units attached to the ESCD.

2. Plan the configuration for the ESCD. Define the configuration, using ESCM on a host processor that will be attached to the ESCD. If ESCM is not available, after the new ESCD is in position, define the ESCD configuration at the ESCD console.
3. Ask your IBM service representative to make the physical fiber optic cable connections from the channels to the new ESCD and from the new ESCD to the other ESCON products (for example, 9034s and ESCON-capable control units).
4. Power on reset any host processor that has new I/O definitions not previously activated.
5. If ESCM is being used, activate the ESCD configuration that was previously defined. If ESCM is not being used, activate the configuration from the ESCD console.
6. Verify that the new ESCD and the paths through it are varied online.

Upgrades: There are various ways you can increase the number of ports available for connections:

- Adding Port Cards to the ESCD

  If an installed ESCD does not have the maximum number of ports, you can add port cards to it. (The port cards must be installed by an IBM service representative.) It is necessary to switch off power to the ESCD to add port cards. For this reason, ensure that the control units requiring high availability have paths through another ESCD.

- Adding another ESCD to your installation

  If you have ESCDs installed, you can increase the number of ports available for connections by installing another ESCD, as illustrated in Figure 40 on page 139. (The ESCD must be installed by an IBM service representative.)

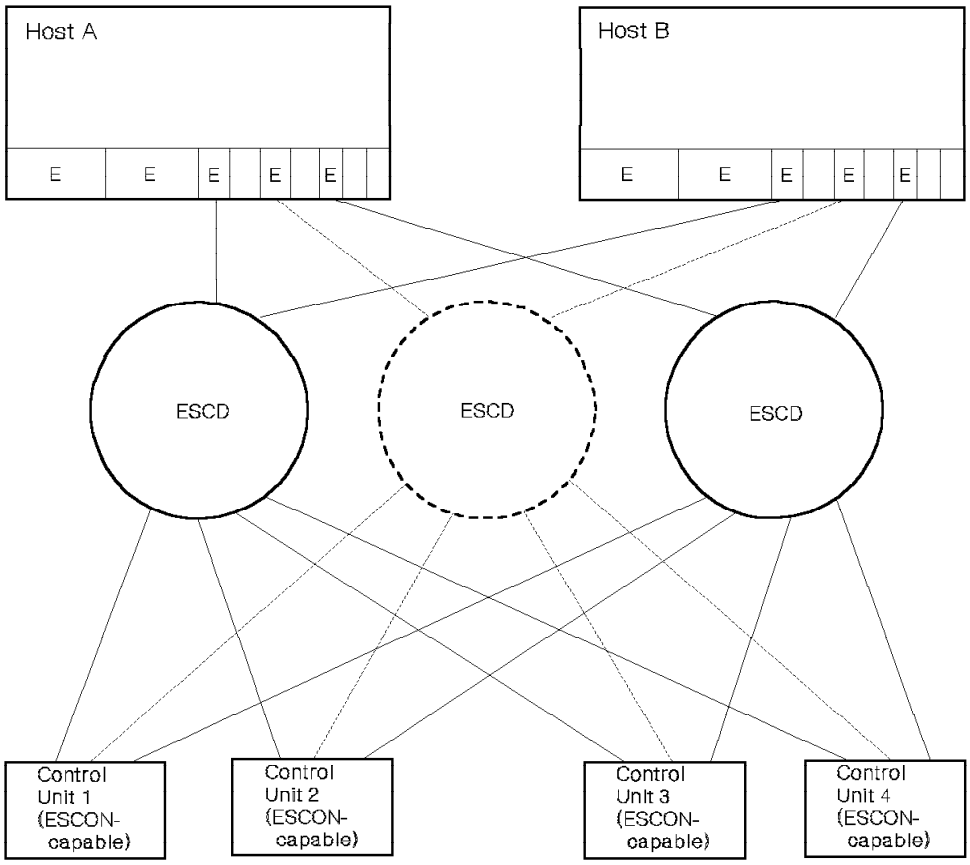


Figure 40. Adding an ESCD to Your Installation

- Replacing a 9033 with a 9032

  You can increase the number of ports available for connections by replacing a 9033 with a 9032. Perform the following steps:

  Note: For each host communicating through the ESCD, perform step 1, step 2, and step 7.

  1. Make sure that, for each host attached to the 9032, the I/O definitions exist that define the 9032 and define the control units attached to the 9032.
  2. Plan the configuration for the 9032. Define the configuration using ESCM on a host processor that will be attached to the 9032. If ESCM is not available, after the 9032 is in position, define the 9032 configuration at the ESCD console.
  3. Vary all paths through the 9033 to I/O devices offline.
  4. Ask your IBM service representative to install the 9032.
  5. Block all ports on the 9033 that have control units or 9034s attached.

     Note: You must configure the ESCON channels that are operating in 9034 mode (for example, using the MVS CONFIG command) before you block the ports that support the 9034s connected to those channels.

6. Vary the 9033 offline.

   If you have followed the availability recommendations to distribute each control unit's attachments among more than one ESCD (with all host processors connected to all ESCDs), varying this 9033 offline should not disrupt your connectivity. However, I/O throughput may be affected. Also, you increase the risk of losing availability to your control units if this step leaves you with only one ESCD.

7. Ask an IBM service representative to make the physical fiber optic cable connections from the channels to the new 9032 and from the 9032 to the control units.

8. Power on reset any host that has new I/O definitions, and IPL the operating system on that host.

9. Verify that the new 9032 and the paths through it are varied online.

10. Activate the configuration on the new 9032, using ESCM if the any-to-any connectivity must be changed, or if ESCM is not available, activate the configuration at the ESCD console.

11. Remove or relocate the 9033.

Inter-Relationships and Dependencies with Other Products

The following sections describe how ESCDs inter-relate with other products and specific dependencies.

Note: Dynamic I/O Configuration (MVS only) removes the power on reset (POR) requirement for initializing I/O configuration changes that may result from ESCD configuration changes. Refer to "Use Dynamic I/O Configuration" on page 25 for information on Dynamic I/O Configuration.

Controlling an ESCD: An operator can change connectivity for ports on an ESCD either at the ESCD console (located at the ESCD) or through a host program.

The ESCD has an integrated control unit addressable from a host. If the ESCD control unit is defined to a host's I/O configuration and the host has the required ESCD Device Support code, the host program can manage the ESCD (refer to "Enterprise Systems Connection Manager" on page 153 for information about host program control of ESCDs).

Attaching Channels and Control Units to ESCDs: An IBM service representative can attach channels and control units to ESCDs without disrupting other ESCD operations or applications running at the host:

- Connecting Another Host to ESCDs

  When you install a new host, you may want to attach ESCDs to it. This is illustrated in Figure 41 on page 141.

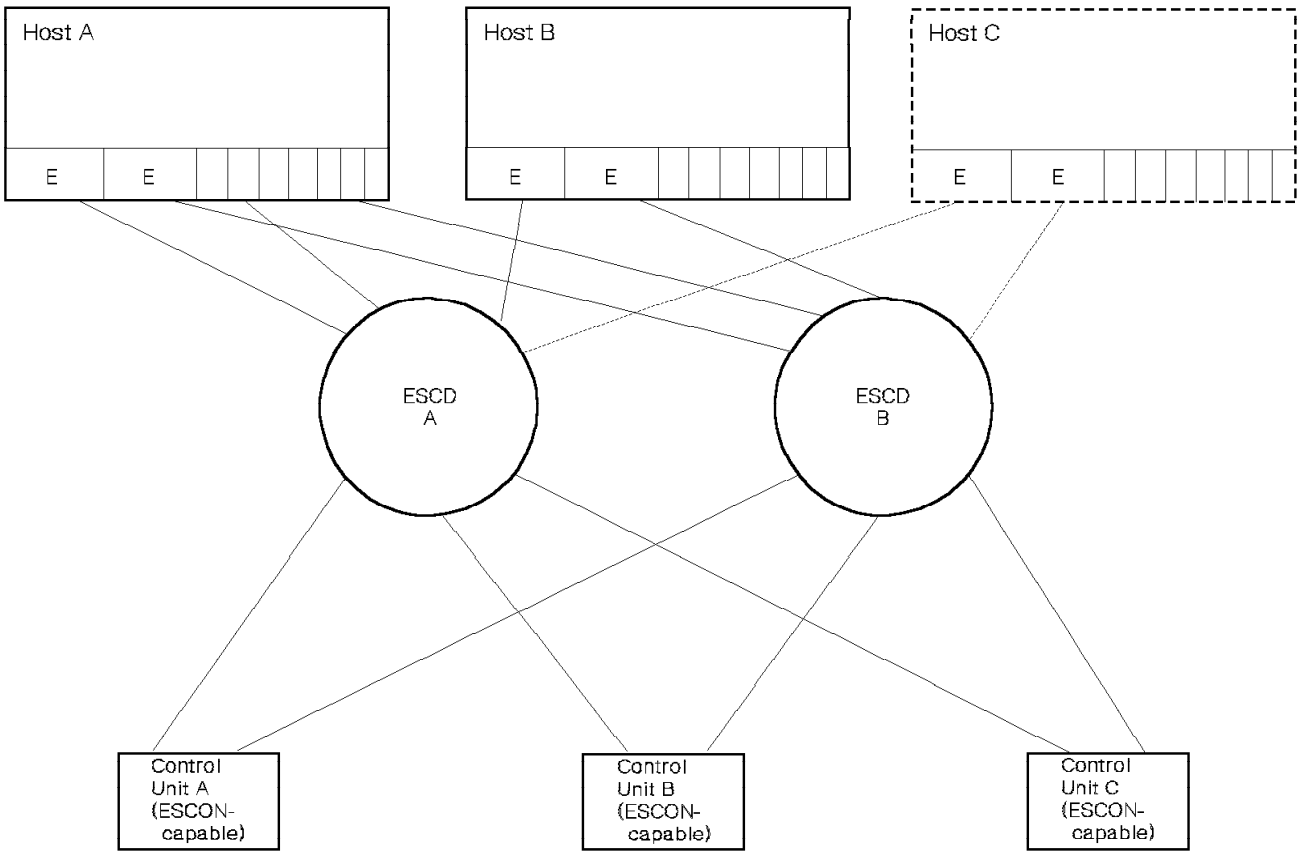


Figure 41. Connecting Another Host to ESCDs

After the new host is installed, perform the following steps:

1. Make sure that, for each host attached to the ESCD, the I/O definitions exist that define the ESCD and define the control units attached to the ESCD.
2. Plan the configuration for the ESCD. Define the configuration using ESCM on a host processor that will be attached to the ESCD. If ESCM is not available, after the ESCD is in position, define the ESCD configuration at the ESCD console.
3. Ask your IBM service representative to make the physical fiber optic cable connections from the channels to the ESCDs.
4. Make sure that the ports the channels are attached to are unblocked. (They may have been previously blocked because they were not being used.)
5. Power on reset the new host and IPL the operating system (if this has not been done previously).
6. Verify that the paths from the new host through the ESCD are varied online.

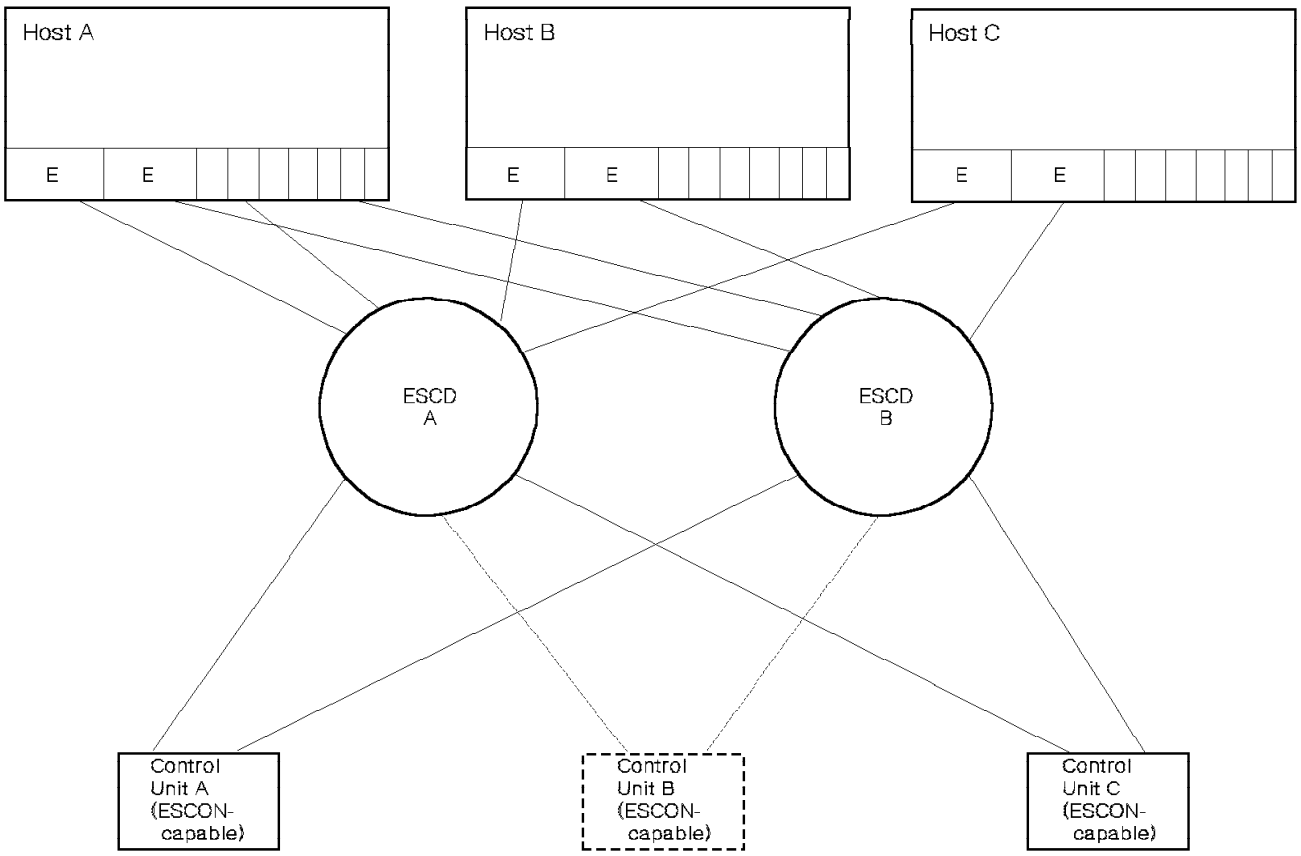


Figure 42. Connecting Control Units to ESCDs

- Connecting Control Units to ESCDs

  When you install new control units, you may want to attach them to ESCDs. This is illustrated in Figure 42. Perform the following steps:

  1. Make sure that, for each host that has paths to the control unit, the I/O definitions exist that define the new control unit and its devices.
  2. Plan the configuration for the ESCD. Define the configuration using ESCM on a host processor that will be attached to the ESCD. If ESCM is not available, after the ESCD is in position, define the ESCD configuration at the ESCD console.
  3. Block any ports on the ESCDs that will be connected to the control unit.
  4. Ask your IBM service representative to make the physical fiber optic cable connections from the control unit to the ESCDs.
  5. Power on reset any host with I/O configuration definition changes and IPL the operating system (if this has not been done previously).
  6. Unblock the ports connected to the control unit.
  7. Vary the devices online.

Special Considerations and Recommendations

The following pages contain information that you should keep in mind when planning to include ESCDs in your configuration.

Power

- If necessary, make sure that you maintain continuous operation by connecting power to an uninterruptible power supply.
- If remote power control is needed, install an ESCMS and attach the ESCD to an ES Connection Monitor Power Adapter.

Physical Planning: For each ESCD being installed, you should design a site plan to ensure efficient work flow, operator convenience and safety, and adequate service clearances. Refer to the *IBM System/360, System/370, 4300 Processors Input/Output Equipment Installation Manual—Physical Planning* for ESCD specifications, service clearances, and environmental and safety considerations. Consider the following items:

- Air conditioning requirements
- Power requirements

  Several types of power cables and power plugs are available to meet local electrical requirements. Contact your IBM marketing representative for power cable types, and refer to the *IBM General Information Manual Installation Manual—Physical Planning* for the types of power plugs.
- Security sufficient to protect your installation′s physical integrity while maintaining accessibility to the ESCD
- The proximity of ESCDs to hosts and control units
- Accessibility to a telephone to aid in the installation and serviceability
- Position of fiber optic cables (for easier migration from an environment with both fiber optic cables and copper cables, to one with only fiber optic cable). Consider the placement of the ESCD in relation to the distance of attached control units for cost-effective fiber-optic cabling.

  Your data processing facility′s needs for additional fiber optic cabling may grow rapidly. You should consider installing spare fiber optic cable, especially in hard-to-reach places like underground trenches. For more information, refer to “Cabling” on page 7, or the publication *Planning for Enterprise Systems Connection Links*.

You should not plan to move the ESCD after installation. Casual movement could result in cable or connector damage.

Chaining and Logical Path Limitations: If you choose to chain ESCDs together, remember:

- At least one ESCD must have a dedicated connection to support the chained path through the ESCDs.
- If you want to increase availability to a specific control unit through a chained path, make sure that at least two paths are available to the control unit.

Increased Availability of Control Units: You can achieve higher availability of a control unit in a configuration that has at least two ESCDs and has every control unit attached to at least two ESCDs. In this configuration, if an ESCD fails, you will still have access to all your control units. You may decide to have more than two control unit connections to improve performance. Remember, however, that some control units allow only one physical connection. Refer to the publications for your control units to determine the connection capabilities.

Sharing Control Units across Host Systems: Setting up connectivity through an ESCD to allow multiple hosts to share control units can be straightforward if you follow the general recommendations mentioned previously in this chapter.

Figure 43 begins with a simple configuration with one host and one ESCD. Host B and two control units are added (to illustrate a multiple-host environment) and host B given access to host A′s control units through the ESCD.

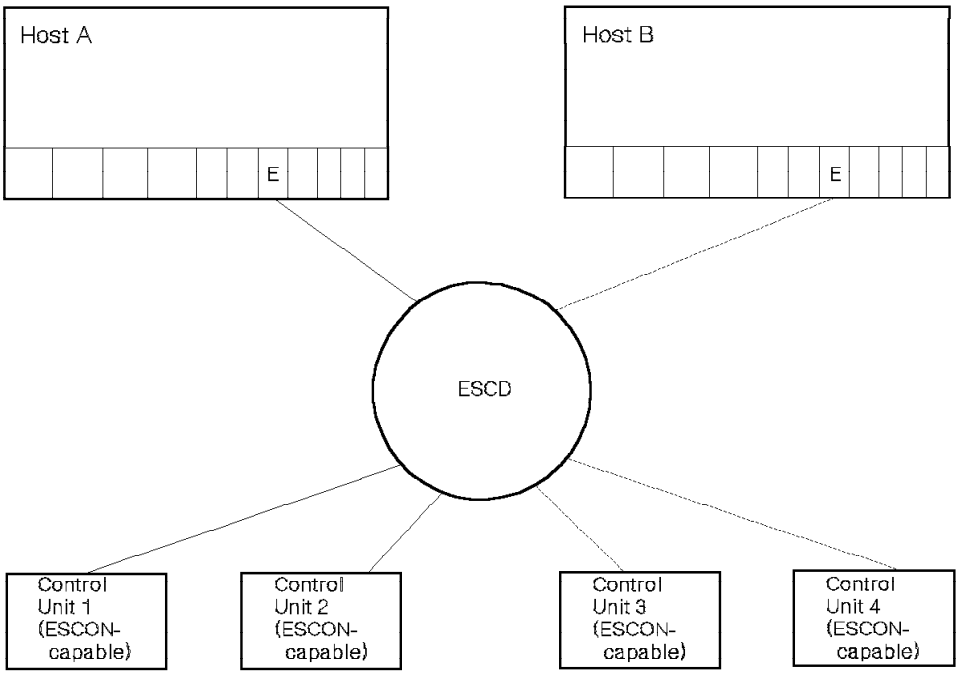


Figure 43. Two Hosts through One ESCD

To improve the availability of the control units of both hosts, add another ESCD, as shown in Figure 44 on page 145 (refer to “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13).

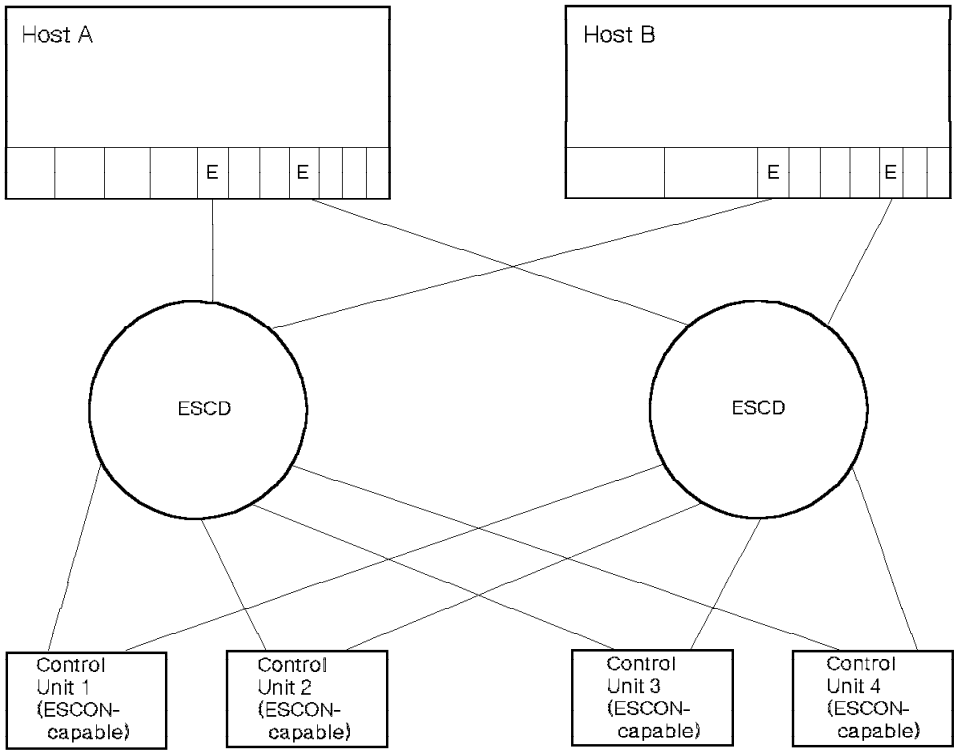


Figure 44. Two Hosts through Two ESCDs

In this illustration, assume that the applications on host A would normally use control units 1 and 2 (through either ESCD). If necessary, host A would also have access to control units 3 and 4 for backup or for sharing. Similarly, assume that the applications on host B would normally use control units 3 and 4. If necessary, host B would also have access to control units 1 and 2.

Nondisruptive Growth and Service: A factor to consider when planning your installation is that you can connect control units or channels to an ESCD without disrupting the ESCD′s operation or applications running at the host. Service actions or configuration changes can occur after your ESCD is operational without having an adverse effect on the applications.

For example, to add a control unit interface, the port to which it will be attached can be blocked while the service representative installs and attaches the control unit. The port can be unblocked when the control unit is operational without disrupting the activity at other ports.

Taking Advantage of Increased Distances: As you assess the number and type of control units that attach to each channel, remember the increased distance available with ESCON channels and fiber optic cabling. This increased distance gives you more flexibility when setting up your installation. If a 9034 is used, check the publications for each attached device to verify that the device itself does not limit the distance capabilities.

You can extend the distance from host to control units by chaining two ESCDs, with a dedicated connection through at least one of the ESCDs. Chained ESCDs require a physical connection (through a fiber optic cable) from a port on one ESCD to a port on another ESCD. Chained ESCDs are illustrated in Figure 45.

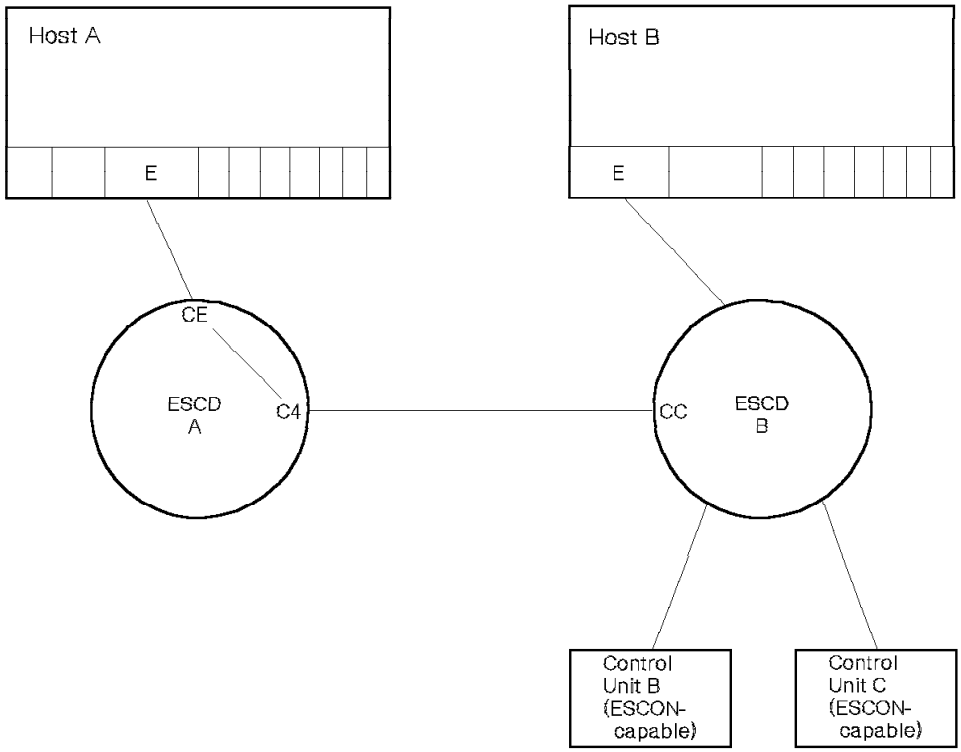


Figure 45. Chained ESCDs

Chained ESCDs must meet the following criteria:

- One or both of the ESCDs must provide a dedicated connection.

  The figure shows the dedicated connection on ESCD A between ports C4 and CE.

- A path cannot pass through more than two ESCDs.

9034 Enterprise Systems Connection Converter Considerations: This section describes certain guidelines for using 9034 Enterprise Systems Connection Converters that you should be aware of when you plan your ESCD configuration.

The 9034 allows you to attach ESCON channels to parallel control units. However, connecting the 9034 to an ESCD makes it easier to move the communication capability of a 9034 from one host system to another host system. An illustration of a 9034 in a mixed (ESCON and parallel) environment is in Figure 46 on page 147.

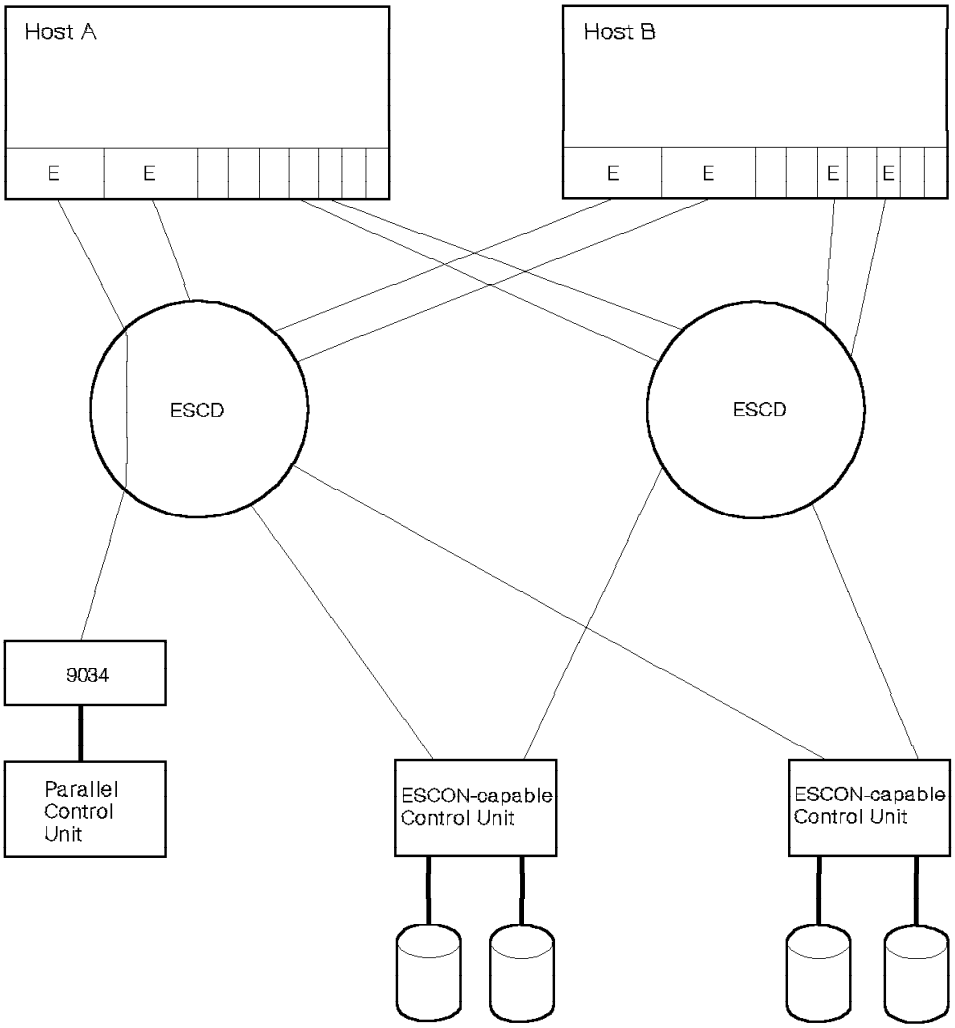


Figure 46. Use of 9034s

To use a 9034 through an ESCD, you must have a dedicated connection through the ESCD. That is, there must be a dedicated connection between the port supporting the 9034 and the port attached to the ESCON channel. Use the ESCD console or the Enterprise Systems Connection Manager, if available, to establish dedicated connections.

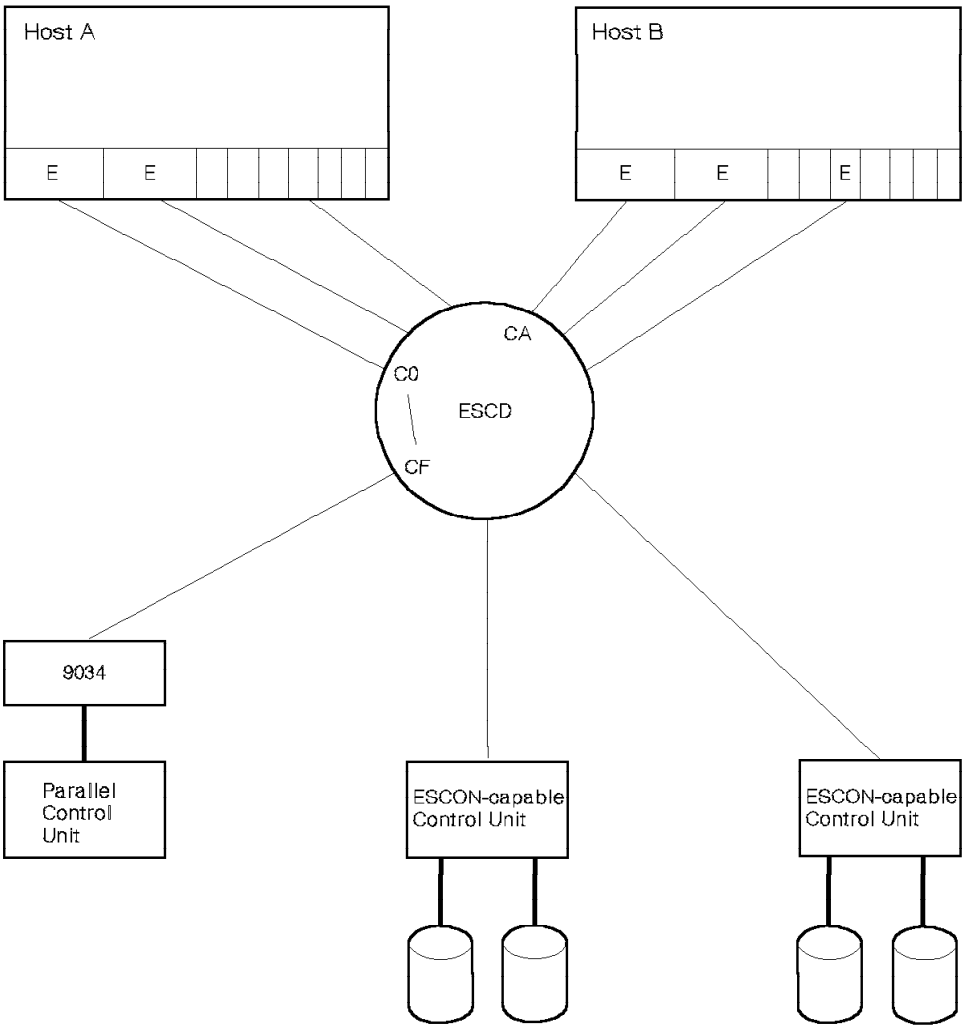


Figure 47. Two Hosts with ESCON Channels

9034 Backup: The use of 9034s when one host is a backup for another host requires planning and preparation. Figure 47 illustrates a situation with two hosts: each host has at least one ESCON channel defined for use with a 9034 but the channel on host B is not being used. The required dedicated connection is shown between C0 and CF. Each channel is defined in the current I/O configuration and has paths defined to the parallel devices. If you want to move applications that use the parallel devices from host A to host B, perform the following steps:

1. Ensure that the ESCON channel defined for the 9034 on host B is available.

   If the channel on host B is being used for another 9034, you have to decide whether to suspend normal operations for that channel to enable backup.

   In Figure 47, the channel is attached to port CA.

2. Remove the dedicated connection between ports C0 and CF.

   Before removing a dedicated connection associated with an ESCON channel defined for a 9034, the system operator must issue the appropriate hardware system configuration commands to support the ESCD connectivity change (for example, an MVS CONFIG command for channels).

3. Create a dedicated connection between ports CA and CF.

After establishing a dedicated connection associated with the channel, the operator must issue the appropriate hardware system configuration commands (for example, an MVS CONFIG command for channels).

In Figure 48, the dedicated connection is between ports CA and CF.

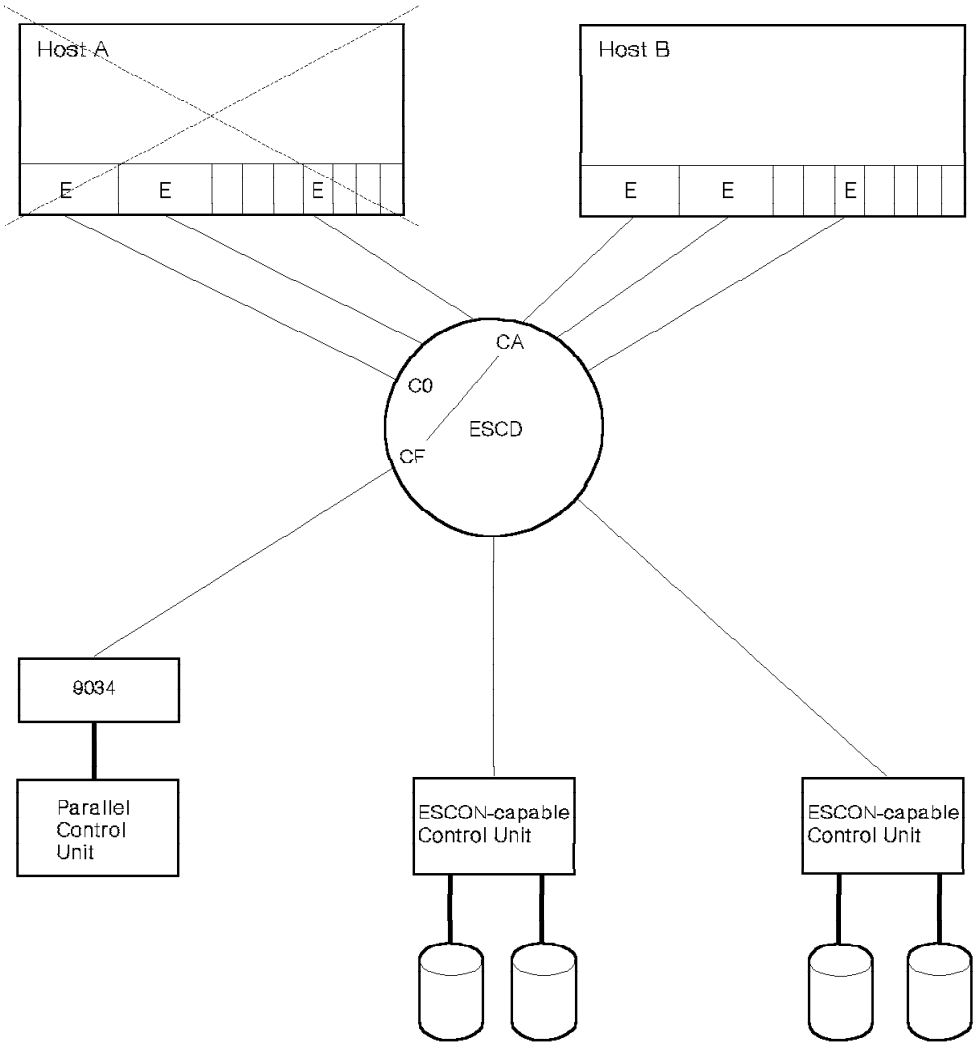


Figure 48. ESCON Channel Needed for Backup

Upgrading from 9034s to ESCON-capable Control Units: To replace the 9034 and parallel control units with ESCON-capable control units **without performing a power-on reset of the host**, the new ESCON-capable control unit must be defined in the current I/O configuration. Also, you must have other ESCON channels attached to this ESCD with paths to the ESCON-capable control unit.

To replace the 9034 and parallel control units with ESCON-capable control units, perform the following steps:

1. Physically attach the new ESCON-capable control unit to the port on the ESCD that was defined to the I/O configuration.
2. The application may have to be brought down.
3. Vary the devices attached to the parallel control units offline.

4. Remove the dedicated connection between the 9034 and the ESCON channel.

   Before removing a dedicated connection associated with an ESCON channel defined for a 9034, the operator must issue the appropriate hardware system configuration commands to support the ESCD connectivity change (for example, an MVS CONFIG command for channels).

5. Vary the devices attached to the new control unit online.
6. If necessary, restart the application.
7. Physically remove the 9034 and the parallel control units.

The ESCON channel defined for a 9034, will not be used; however, it can be reinitialized as an ESCON channel operating in native mode.

You may want to consider predefining planned control units to the I/O configuration to allow for future conversion from 9034s to ESCON-capable control units. After the conversion is completed, you can, at your convenience, update the I/O configuration to redefine the channel that was used for the 9034 as an ESCON channel, and power-on reset the host. If you want to be able to use the port to which the 9034 was attached for ESCON-capable control units, you will have to update the I/O configuration to define ESCON channel paths to that port, and power-on reset the host.

Note: If you use Dynamic I/O Configuration (as described in "Use Dynamic I/O Configuration" on page 25), you will not need to predefine control units or POR the host processor.

9035 Enterprise Systems Connection Converter Considerations: This section describes certain guidelines for using 9035s that you should be aware of when you plan your ESCD configuration.

The 9035 allows you to communicate between parallel channels and ESCON-capable 3990 control units. The 9035 converts parallel channel protocol to protocol that is accepted by the ESCON-capable 3990. Figure 49 on page 151 illustrates use of 9035s.

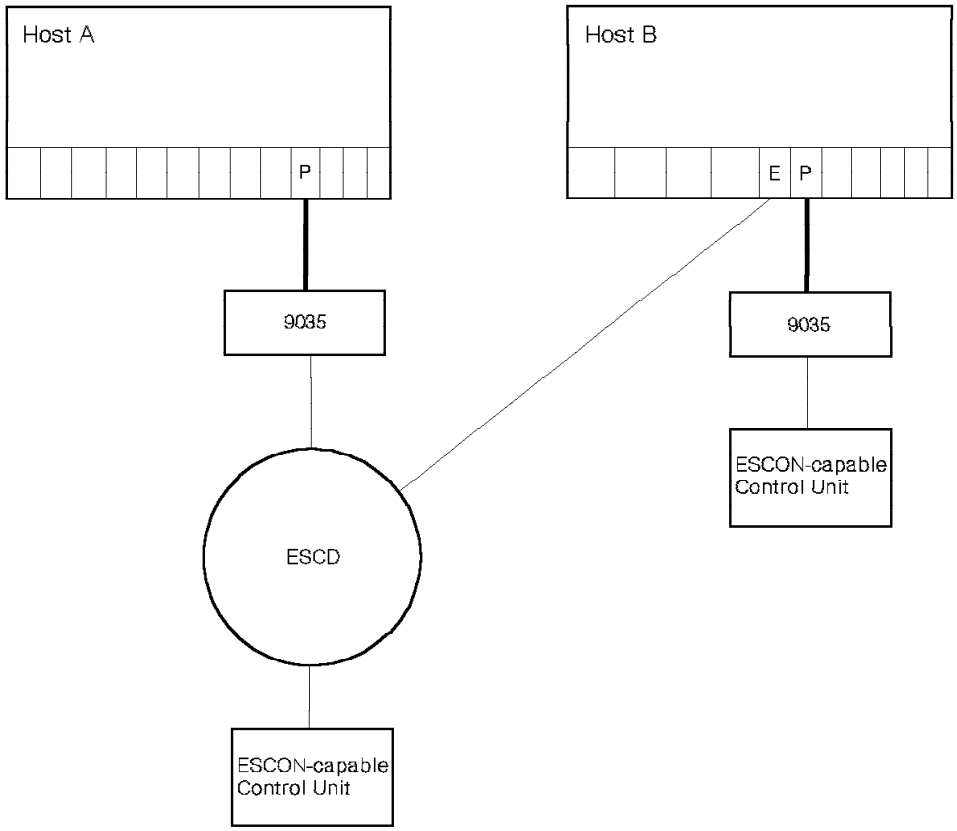


Figure 49. Use of 9035s

In Figure 49, the ESCON-capable 3990 unit can be directly attached to the 9035, or it can be attached to an ESCD that has a connection to a 9035, and the parallel channel attached to the 9035 is dedicated to a single ESCON-capable 3990. However, if the 3990 is attached to an ESCD, it can be accessed (through dynamic connections) by any ESCON channel or by another 9035 using the ESCD. Paths from a 3990 to a host system image must be either all parallel, all ESCON, all 9035, or all 9034.

In Figure 49, host B can function as a backup for applications on host A that use the 9035 to access the 3990. The ESCON channel from host B, connected to the ESCD, can access the 3990.

General Considerations: When you plan your ESCON configuration, remember the following general recommendations:

- Consider management of logical paths (refer to “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13)
- Make sure that, for each host that has paths to a control unit, the I/O definitions exist that define the control unit and its devices.
- Plan the configuration for each ESCD. Define the configurations using ESCM on a host processor that will be attached to the ESCDs. If ESCM is not available, after each ESCD is in position, define the ESCD configuration at the ESCD console.

- To maintain a high availability for control units, it is recommended that your data processing facility should have at least two ESCDs, or if two paths exist to one control unit, a path through different port cards in a single ESCD.
- If full connectivity and sharing of control units across all hosts is desired, you should connect every host to every ESCD. This, however, may not always be desirable, for reasons of data security and data integrity.
- Whenever possible, each control unit should have at least two connections to one or more ESCDs when high availability is desired. (Remember, not all control units allow two connections.)
- Reserve some port attachment capability on each ESCD for growth and conversion.
- Define your ESCDs within your IOCP to allow for control by a host program (for example, ESCM).
- During installation, it is recommended that you establish a primary reporting path for each ESCD for error reporting purposes. If you do not assign this path, the ESCD selects an alternate path.

The number of ports you will require is equal to the total number of control unit connections **and** the total number of channels (including not only the channels for attachment of ESCON-capable control units, but also the channels for channel-to-channel communication and for 9034s) **and** an allowance for growth.

After you have determined the number of ports you require, you must decide how you want to distribute these ports. Remember:

- A 9032 can have from 28 to 60 ports; a 9033 can have from eight to 16 ports.
- Your data processing facility should have more than one ESCD.
- At least one ESCON channel is required for control by a host program (for example, ESCM).
- Control units with multiple interfaces should be connected to as many different ESCDs as possible.

Related Publications

- *Planning for the 9032 Enterprise Systems Connection Director*
- *Planning for the 9033 Enterprise Systems Connection Director*

Enterprise Systems Connection Manager

This section includes information on the IBM Enterprise Systems Connection Manager (ESCM), special considerations, and recommendations for migration planning purposes.

Description

ESCM is a licensed program (Program No. 5688-008) that provides host control to help manage connectivity within a data processing facility that uses IBM Enterprise Systems Connection Directors (ESCDs).

When you run ESCM on each host, users do not have to coordinate connectivity changes across multiple ESCDs and other hosts. ESCM provides this coordination through the following functions:

- Providing a single point of control, including:
  - The ability to control multiple ESCDs
  - Communication with other ESCM hosts about proposed changes to an ESCD′s connectivity capability (to ensure that the changes do not adversely affect the other hosts)
  - The ability to have another ESCM host become the control point
- Coordinating ESCD changes across your computer facility (ensuring that connectivity changes made to the ESCD are synchronized with the other ESCM hosts)
- Providing a display capability for information about:
  - The configuration of the ESCM hosts
  - The connectivity status of your ESCDs
- Providing the capability to audit and control access to ESCM commands.

For more detailed information on the ESCM′s functions, refer to *Introducing the Enterprise Systems Connection Manager*.

Configuration

To control an ESCD, the ESCM host must be attached to the ESCD, and the ESCD must be defined to the host processor (in the active I/O configuration definitions). To coordinate ESCD changes, each ESCM host must be defined to VTAM, VTAM links must exist between the hosts, and ESCM must be operational on each host.

ESCM does not require special I/O configuration definitions for its initialization. ESCM gets its information from your hardware (IOCP) definitions. Therefore, before starting ESCM you must define your hardware configuration.

Installation

Before installing ESCM, make sure that you have the correct prerequisite hardware and software installed. For a list of the ESCM prerequisites, refer to the publication *Planning for Enterprise Systems Connection Manager*.

When you have prepared the system and are ready to install ESCM, you must do the following:

1. Use SMP/E to install ESCM on MVS systems. Use VMSERVE to install ESCM on VM/ESA.
2. Make sure that ESCM code has been authorized. ESCM must run in an APF-authorized library.

3. If you are interested in coordination between your ESCMs (for ESCD changes), make sure that an ESCM copy exists on each system image (logical partition).
4. If you want ESCM to communicate with other ESCMs, define ESCM as a VTAM application.

   Note: Each ESCM should be defined.

5. If you haven't initialized the channel subsystem with the latest I/O configuration definition, POR the host.
6. IPL the operating system.

Inter-Relationships and Dependencies with Other Products

Software: ESCM relies on the following software for minimal operation:

- One of the following:
  - MVS/SP 3.1.0e (with the appropriate PTFs) and subsequent releases and modifications
  - MVS/ESA 4.1 and subsequent releases and modifications
  - VM/ESA Release 1.0 and subsequent releases and modifications
- ESCD Device Support (Program Number 5685-001).

Table 17 specifies the minimum version and release levels of products required to support the associated ESCM functions. Although the subsystems and applications are not required for ESCM operation, they are recommended for ESCM functional reasons. For information on a software product, refer to the publications for that software product.

Table 17 (Page 1 of 2). Optional Products Used by ESCM

Product	Version and Release	Used to:	Required only if you plan to:
ISPF	Version 3 Release 1	Access ESCM functions through the ISPF dialog, or access menus called by REXX EXECs.	Use the ISPF dialog in either MVS or VM. (TSO/E is also required on MVS systems.)
NetView	Version 1 Release 2	Automate operations.	Use NetView to issue ESCM commands and monitor ESCM-initiated activity.
RACF for MVS	Version 1 Release 8 Mod. Level 1	Control access to ESCM commands.	Use ESCM in a secure environment and you do not have an equivalent product.
RACF for VM	Version 1 Release 8 Mod. Level 2	Control access to ESCM commands.	Use ESCM in a secure environment and you do not have an equivalent product.
TSO/E	Version 2 Release 1	Invoke REXX EXECs and support an ISPF dialog.	Use the ISPF dialog or use REXX EXECs on an MVS system.

Table 17 (Page 2 of 2). Optional Products Used by ESCM

Product	Version and Release	Used to:	Required only if you plan to:
VTAM	Version 3 Release 1	Communicate between hosts that are running ESCM.	Run ESCM on more than one host and maintain coordination between ESCMs. Note that VTAM is not used for communication between ESCM and ESCDs.

Hardware: ESCM requires that at least one ESCON channel is operational on each ESCM host and the channel cannot be operating in 9034 or CTC communications mode.

9034s: The IOCP SWITCH parameter must be specified for any 9034s that communicate through ESCDs. If the parameter is not specified, ESCM does not recognize that the 9034 communicates through an ESCD.

Service: ESCM is a fully supported IBM program product. Changes made to the ISPF dialog are not IBM′s responsibility. It is recommended that you maintain a copy of the unmodified code for problem determination purposes.

Special Considerations and Recommendations

There are several special considerations and recommendations on how to install, start, and use ESCM, including:

- Prior to ESCM installation, ensure that the host is working with the most current I/O configuration definitions.
- After installing ESCM, educate and train operations personnel using the ESCM ISPF dialog′s default matrix and inform personnel about the command syntax used at the master console.
- Using the ISPF default matrix, predefine and save ESCD configurations so that when the ESCDs are installed, you can activate the configurations on the ESCDs.
- When starting ESCM in an MVS environment, issue the start command using the SUB=MSTR parameter; this guarantees that ESCM will operate, regardless of whether JES is operational.
- Use ESCM for all changes to ESCD connectivity; this ensures that all ESCMs (attached to the same ESCD) are aware of the changes and coordinate the changes on their resident hosts.
- Use ESCM to reduce disruptions. ESCM can perform the ESCD changes and send the necessary Vary Path requests to support the following changes:
  - Migration from 9034s to ESCON-capable control units
  - Upgrading ESCDs (for example, when adding ports or replacing a smaller ESCD with a larger one)
  - Enabling backup systems.

  Note: For more information on how ESCM can help perform these tasks, refer to the publication *Introducing the Enterprise Systems Connection Manager*.

9034 Enterprise Systems Connection Converter

This section includes information about the 9034, special considerations, and recommendations for migration planning purposes.

Description

The IBM 9034 Enterprise Systems Connection Converter allows attachment of parallel control units to ESCON channels at extended distances. The control unit copper bus-and-tag cables attach to the 9034, which attaches to an ESCON channel through a fiber optic duplex cable.

The 9034 consists of a fiber optic transmitter and receiver, and the logic that supports the attachment of I/O devices. The 9034 receives outbound information from the ESCON channel (operating in 9034 mode), converts and decodes the information, and transmits it to the addressed control unit. Inbound information is encoded, converted, and transmitted to the ESCON channel.

Figure 50 on page 157 illustrates an example 9034 configuration.

Configuration

The maximum number of control units that can be physically attached to the 9034 (in the same multi-drop configuration) is eight (refer to Figure 50 on page 157). One channel supports one 9034. If the 9034 is connected to the channel through an ESCD, a dedicated connection must be established in the ESCD to support the path between the channel and the 9034.

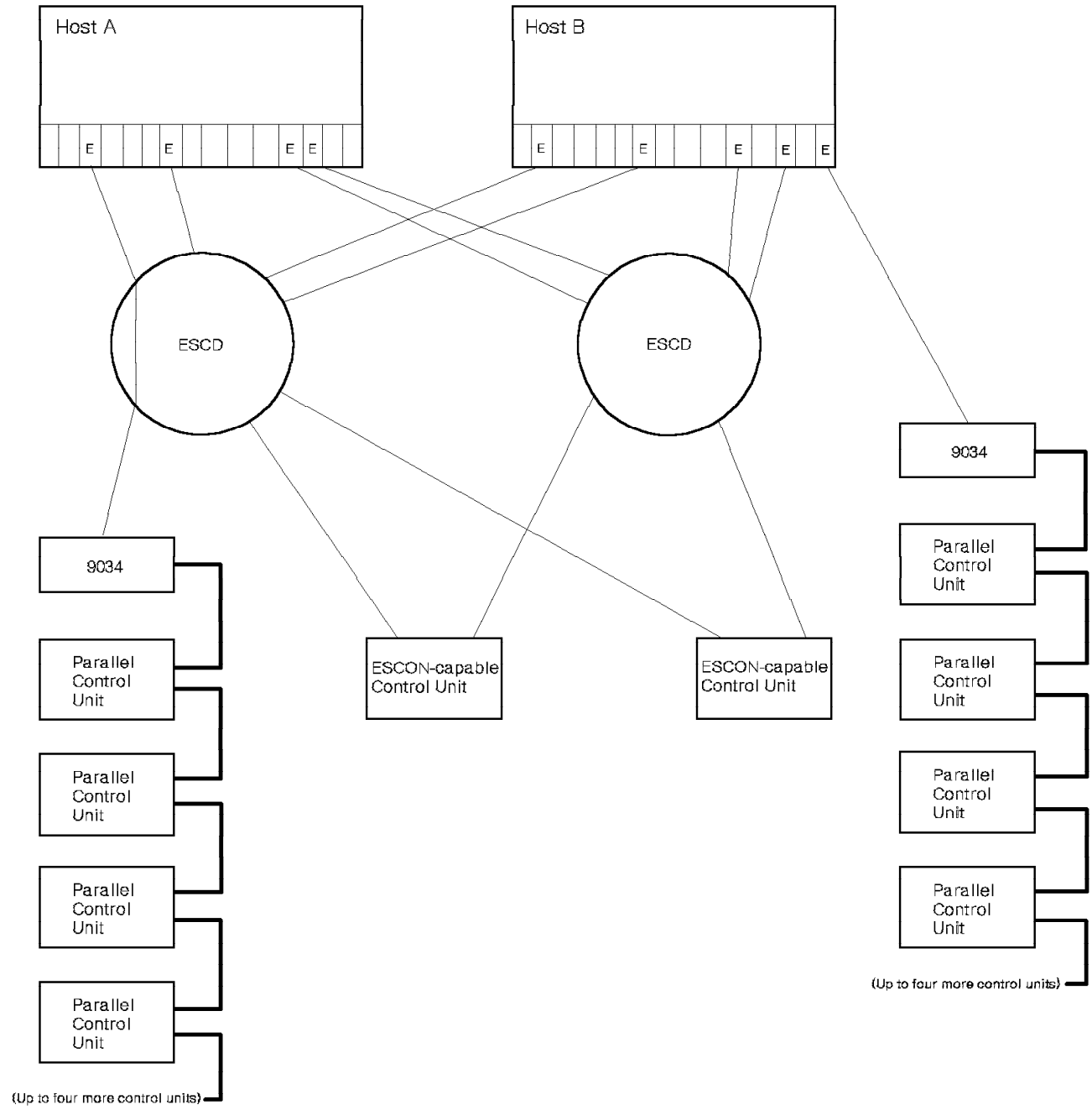


Figure 50. Example of a Configuration Using 9034s

The 9034 supports all IBM devices that are supported by the ESCON channel, including those listed in Table 18 on page 158. Unless a smaller distance is indicated, all distances are no greater than 3 km. Data transfer modes are defined as follows:

DS—Data Streaming.
HST—High Speed Transfer (DCI alternate tag mode).
DCI—Direct-Current Interlock (single tag mode).

Table 18 (Page 1 of 2). 9034 Parallel Device Attachment

Device	Control Unit	Data Transfer Mode (See note 1)	Notes
DASD			
3380	3880-3,13,23, or 23 with Airlines RPQs	DS	1
3380	3990-1,2,3, or 3 with Airlines RPQs	DS	2
3380-CJ2		DS	2
3390	3990-2,3	DS	2
Magnetic Tape Devices			
2440		DCI	
3420-3,5,7	3803-1	DCI	
3420-4,6,8	3803-2	DCI	3,4
3422		DCI	
3480	3480	HST, DS	
3490	3490	HST, DS	
Display Controllers and Workstations			
	3174-x1L	DCI, HST, DS	
	3274 A,B,D	DCI	
5081,5085,5083 3251,3255	5088	HST, DS	
6091,6095 5081,5085,5083	6098	HST, DS	
Teleprocessing Devices			
3172		DCI, DS	
3720, 3725		DCI	
3745		DCI, DS	5
8232		DCI, DS	
Printers			
3262-5		DCI	
3800-1		DCI	
3800-3,6,8		HST, DS	
3820-1		DCI	
3825, 3827, 3835		HST, DS	
4245, 4248, 6262		DCI	
Channel-To-Channel Adapters			
3088		HST, DS	6
ES/9000-9221 MCU Feature 6200		DS	
ESCDs			
9032, 9033			7,8

Table 18 (Page 2 of 2). 9034 Parallel Device Attachment

Device	Control Unit	Data Transfer Mode (See note 1)	Notes
Other			
3814			
3848 Crypto		DCI, DS	
3890-XP		DCI	
3897/3898		DCI, DS	
4753		DCI, DS	

Notes:

1. The maximum distance is 900 meters, except for a 3380-23 with the airline RPQ which may experience degraded performance when operating in Direct Mode at distances greater than 600 meters.
2. The maximum distance is 1200 meters.
3. The maximum distance for the 3420-8 is 2800 meters.
4. A 3803-2 with RPQ #870021 (CLOI—Cable Length Offset Interlock) is not supported by the 9034. RPQ #870021 must be removed for the 3803-2 to operate with a 9034.
5. The 3745 Channel Adapter PROM must be at the C51 level for 9034 support.
6. 3088 units require EC C22761.
7. The 9034 requires a dedicated connection through an ESCD.
8. An ESCON channel operating in 9034 mode cannot address the control unit port (Port x′FE′) on an ESCD.

Installation

The 9034, because of its small size, offers location flexibility. For example, a 9034 can be placed on a shelf, or in an enclosure or equipment closet that meets environmental requirements. Refer to the publication *Planning for the 9034 Enterprise Systems Connection Converter* for information on environmental requirements.

An enclosure is available that consists of a base and a minimum of one shelf assembly. Up to seven additional shelf assemblies can be ordered in one-shelf increments. A maximum of eight 9034s can be installed in one enclosure. This enclosure is installed by an IBM service representative. The enclosure does not provide power.

Installation Steps and Times: The installation of the 9034 includes channel considerations and control unit impacts, for example:

- An ESCON channel installation on the host processor
- IOCP changes (TYPE=FX for ESCON channels operating in 9034 mode)
- An attachment of the 9034 between the parallel control unit and either the ESCON channel or an ESCD
- If necessary, power-on-resets (PORs).

The approximate installation time for a 9034 is one hour and includes time for an average fiber optic cable installation, diagnostic checkout, and cleanup and associated paperwork.

Inter-Relationships and Dependencies with Other Products

Application Software: The 9034 is transparent to user application software that uses standard IBM access methods. For specific information on how other system software should be updated to reflect the 9034 function, refer to "IBM Software" on page 33.

Enterprise Systems Connection Manager: ESCM does not protect the 9034 from ESCD changes that may adversely affect the 9034 (for example, removal of the necessary dedicated connection).

Hosts: ESCON channels operating in 9034 mode can operate only on the following host processors:

- ES/3090, Model 180J and above (excluding model 250J)
- ES/3090-9000T
- ES/9000

The channel must be operating in 9034 mode. For information about channel operation and for channel configuration guidelines, see the appropriate host processor channel characteristics manual.

IOCP: To support a 9034, an ESCON channel must be identified as TYPE=FX in the IOCP definitions. If the 9034 will communicate through an ESCD, the SWITCH parameter must also be specified.

ESCDs: If the 9034 is to communicate through an ESCD, the ESCD must have a dedicated connection between the port supporting the 9034 and the port supporting the ESCON channel.

See Table 18 on page 158 for a list of hardware resources that can be attached to a 9034 and the data-transfer modes supported.

The 9034 does not provide remote power control for either itself or the attached control unit. However, the ES Connection Monitor Power Adapter within the Enterprise Systems Connection Monitor System can be used for remote power control of the 9034. Refer to "Enterprise Systems Connection Monitor System" on page 171 for information on the Enterprise Systems Connection Monitor System.

Special Considerations and Recommendations

The following paragraphs describe 9034-specific considerations and recommendations that you should keep in mind when planning to use 9034s in your configuration.

Data transfers can occur using high-speed-transfer (HST), data-streaming (DS), or direct-current interlock (DCI). The 9034 supports data-streaming I/O rates up to the maximum data rate supported by the parallel channel interface; 4.5 megabytes (4.5MB) per second.

The 9034 supports IBM devices only when operating in block-multiplexer mode.

Control units with critical timing dependencies (synchronous, direct access storage devices (DASDs)), have distance restrictions imposed. For information on these distance restrictions, refer to "Special Considerations and Recommendations" on page 119.

When using a 9034, channel programs using data-chaining are more subject to chaining checks or deferred accesses on an ESCON channel than on a parallel channel.

When planning for an enclosure, it is recommended that all the 9034s installed in the same enclosure have a single common power switch – for example, a circuit breaker.

When planning enclosure power, consider channel path availability. For example, make sure that channels for a single host communicate through 9034s in different enclosures; if a power failure occurs, the host can still communicate through the channels attached to the 9034s in the other enclosure.

If the unit attached to the 9034 is critical and is powered from an uninterruptible power supply (for example, a 3990), the 9034 should also be powered from an uninterruptible power supply.

If possible, attach your 9034s to ESCDs rather than directly to Enterprise Systems Connection channels. If you attach 9034s to ESCDs, you will not need to recable or make extensive changes to your IOCP when you replace the 9034 with an ESCON-capable control unit..

To migrate to an ESCON environment over an extended period of time, you can stage your migration using 9034s and 9035s as follows:

- Stage 1—Add ESCON channels and ESCON-capable control units, using 9034s and 9035s to communicate with your parallel channels and control units.

  Note: 9035s only support 3990 control units.

- Stage 2—Add ESCDs to prepare for increased connectivity (with the 9034s and 9035s attached to the ESCDs, you retain the same connectivity as in Stage 1).
- Stage 3—Gradually replace your 9034s and parallel control units with ESCON-capable control units and gradually replace your 9035s with ESCON channels.

9035 Enterprise Systems Connection Converter

This section includes information about the 9035, special considerations, and recommendations for migration planning purposes.

Description

The IBM 9035 Enterprise Systems Connection Converter allows attachment of ESCON-capable 3990 control units to parallel channels at extended distances. The fiber optic cable of the ESCON-capable 3990 attaches to the 9035, which attaches to the parallel channel through bus-and-tag cables. The fiber optic cable can also be attached through an ESCD (for information on ESCDs, refer to "9032 and 9033 Enterprise Systems Connection Directors (ESCDs)" on page 136).

The 9035 consists of a fiber optic transmitter and receiver, and the logic that supports the attachment of parallel channels. The 9035 receives outbound information from the parallel channel, converts and encodes the information, and transmits it to the ESCON-capable 3990. Inbound information is decoded, converted, and transmitted to the parallel channel.

Figure 51 and Figure 52 on page 163 illustrate an example of how 9035 can be used in migrating to an ESCON environment.

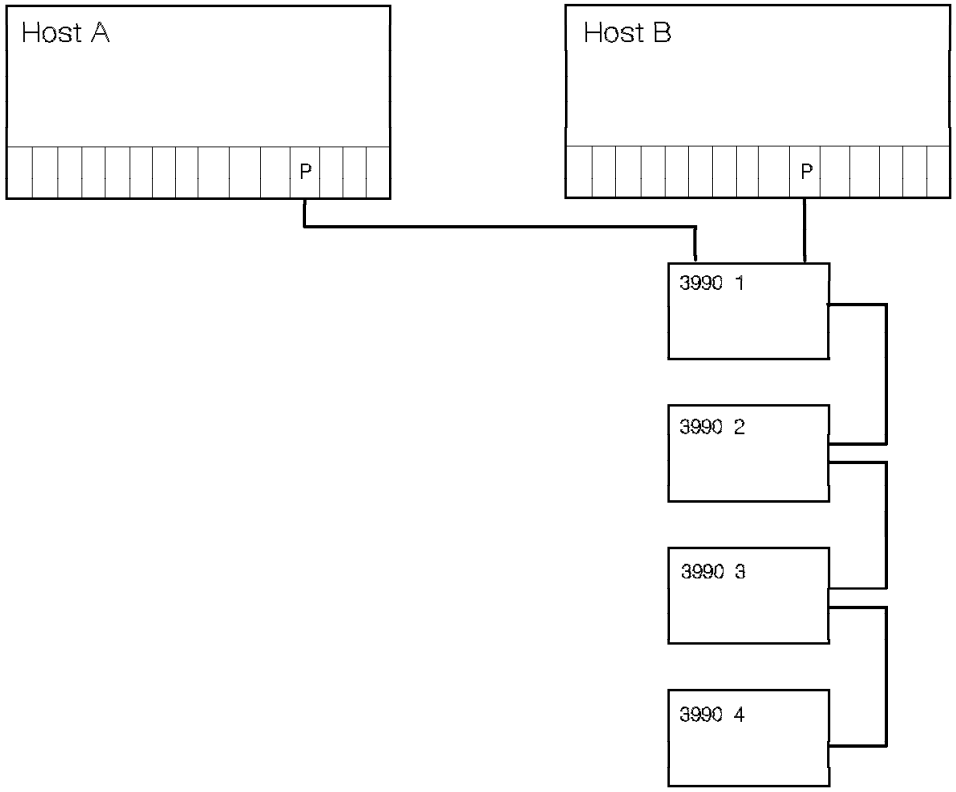


Figure 51. Configuration Example 1 (before 9035)

Example 1 (Figure 51) illustrates a simple multi-drop configuration in which only 3990 1 is shared by host processor A and host processor B.

Example 2 (Figure 52) illustrates a configuration that uses a 9035 to recreate the same communication capability, but also prepares for other ES Connection-capable devices (for example, the 3990s can be field-upgraded at an earlier date and Host processors A and B can be upgraded with ESCON channels at different times). In Example 2, the 9035 could be directly attached to another port on the ESCON-capable 3990 (with or without connecting through an ESCD).

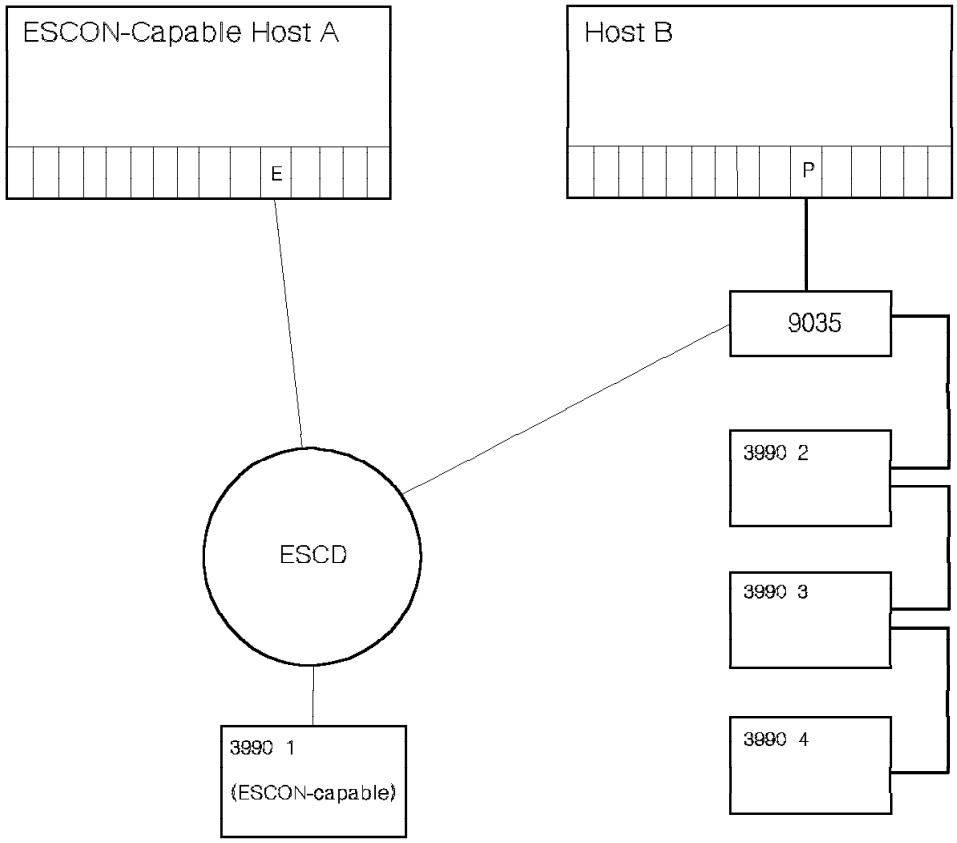


Figure 52. Configuration Example 2 (with 9035)

Configuration

Only one ESCD or ESCON port on a 3990 can be physically attached to the 9035. One channel can support up to eight 9035s. A 9035 is associated with only one 3990 port, even if it is connected through an ESCD. On the other hand, an ESCON port or a 3990 may communicate with more than one 9035 when using an ESCD. A 3990 ESCON port may communicate with both ESCON channels and 9035s. The maximum distance possible between the parallel channel and the 9035 is 122 meters (400 feet).

Installation

The 9035, because of its small size, offers location flexibility. For example, a 9035 can be placed on a shelf or in an equipment closet (see your IBM representative about environment requirements).

Installation Steps and Times: The steps to install a 9035 are essentially the same as the steps to move a parallel control unit and include:

- Installing ESCON adapters on the 3990
- Updating the ESCON-capable 3990′s Vital Product Data (to include information about the 9035)
- Physically attaching the 9035 between the parallel channel and the ESCON-capable 3990 or ESCD
- If needed, reinitializing the parallel channel.

The approximate installation time for a 9035 is 1.0 hour and includes time for an average fiber optic cable installation, diagnostic checkout, and cleanup and associated paperwork.

Inter-Relationships and Dependencies with Other Products

The following paragraphs indicate product-specific inter-relationships and dependencies for 9035.

Application Programs: The 9035 is transparent to user application software that uses standard IBM access methods.

Enterprise Systems Connection Manager (ESCM): ESCM provides limited function for parallel channels using 9035s through ESCDs. However, you should make sure that 9035 ports on the ESCDs or the ports that support their 3990s are not inadvertently blocked or prohibited.

Operating Systems: Because the 3990 ESCON interface operates non-synchronously, the 9035 requires levels of operating systems or subsequent releases that support the Extended Count Key Data (ECKD) architecture. For information on software levels required, refer to “IBM Software” on page 33.

Host Processors: 9035 can only be attached to a parallel channel on the following host processors:

- 4381 model 90E, 91E, and 92E
- ES/3090 E models, S models and J models
- ES/3090-9000T models
- ES/9000 models.

3990s: Initial installation of the 9035 will require VPD updates. When changing 9035s, VPD information may need to be updated.

ESCDs: To allow a 9035 to communicate through an ESCD, if the 9035 port or the port to the 3990 that it supports is blocked from communicating, unblock the port or ports. For other considerations that affect logical paths for the 9035 through the ESCD, refer to “Managing Logical Paths on Enterprise Systems Connection Channels” on page 13.

Remote Power: The 9035 does not provide remote power control for either itself or the control unit with which it communicates. However, the ES Connection Monitor Power Adapter of the Enterprise Systems Connection Monitor System can be used for remote power control of the 9035. For information on the Enterprise Systems Connection Monitor System, refer to "Enterprise Systems Connection Monitor System" on page 171.

Special Considerations and Recommendations

The following paragraphs describe 9035-specific considerations and recommendations that you should keep in mind when planning to use 9035s in your configuration.

When planning for an enclosure, it is recommended that all the 9035s installed in the same enclosure have a single common power switch – for example, a circuit breaker.

When planning enclosure power, consider channel path availability. For example, make sure that channels for a single host processor communicate through 9035s in different enclosures; if a power failure occurs, the host processor can still communicate through the channels attached to the 9035s in the other enclosure.

If the 3990 attached to the 9035 is considered a critical control unit and is powered from an uninterruptible power supply, the 9035 should also be powered from an uninterruptible power supply.

9037 Sysplex Timer

Description

The IBM 9037 Sysplex Timer is a device that, when attached to multiple host processors, allows the customer to synchronize their time-of-day (TOD) clocks. This capability allows events occurring on different processors to be properly time stamped. For example, if multiple host processors update the same data base and data base reconstruction is necessary, all updates will have been time stamped in proper sequence relative to a single clock, rather than the independent clocks of one or more host processors.

The IBM 9037 Sysplex Timer supports the following host processors:

- ES/3090 Models 180J, 200J, 280J, 300J, 380J, 400J, 500J, 600J
  - ES/3090 J Models must have System EC 227574 or above installed
- ES/3090-9000T, all models
- ES/9000, all models with the following exceptions; 120, 130, 150

The 9037 Sysplex Timer attaches to the processor External Time Reference Adapter feature in the processors using customer-supplied fiber optic cables. The 9037 Sysplex Timer fiber optic cables are the same cables as are used in an ESCON environment (for example, cables attached to ESCON channels) and must be directly attached to the processor External Time Reference Adapter feature on one end and the 9037 Sysplex Timer on the other. The 9037 Sysplex Timer can not be attached to or communicate through an ESCD.

When multiple host processors share access to the same data and/or workload, you can use the Expanded Availability feature to link two 9037 Sysplex Timers together, thereby providing a synchronized and redundant configuration. If you use the Expanded Availability feature, you ensure that the failure of one 9037 Sysplex Timer or processor connection will not cause loss of time synchronization. Otherwise, such a fault could—depending on system control program, host processor configuration and application—result in a loss of data-sharing capability for a single or multiple host processors.

The clock in the 9037 Sysplex Timer can be set manually from the 9037 Sysplex Timer console. An Automated Computer Time Service (ACTS) option can be installed in the 9037 Sysplex Timer console to allow the clock to be automatically set by dialing the National Institute Of Standards Technology (NIST—formerly NBS). With this option, the console dials NIST, and NIST returns a TIME VALUE calibrated such that when it reaches the 9037 Sysplex Timer console, the clocks at NIST and the 9037 Sysplex Timer will be within 0.1 second of one another. This option requires a user-installed modem. Contact your marketing representative for information about the modem required for your console.

If a power outage occurs, a backup battery in the 9037 Sysplex Timer allows critical data to be maintained within the 9037 Sysplex Timer. When power is restored to the 9037 Sysplex Timer, it resumes transmitting data without customer intervention, even if the 9037 Sysplex Timer console power has not been restored.

Configuration

A console (IBM PS/2 or equivalent) dedicated to a 9037 Sysplex Timer contains a 9037 Sysplex Timer adapter, which allows the user or the service representative to communicate with the 9037 Sysplex Timer, and a 3.5 inch diskette drive used to initial program load (IPL) the 9037 Sysplex Timer.

Note: The console is not supplied as part of the 9037 Sysplex Timer product. See your IBM representative for console specific information or refer to the publication *Planning for the IBM 9037 Sysplex Timer*.

The 9037 Sysplex Timer comes with four processor connection ports. Up to twelve additional ports can be ordered in increments of four. If a host processor has two sides (a multiprocessor configuration), the 9037 Sysplex Timer must attach to both sides. Two port connections to each side are recommended.

Figure 53 illustrates a basic configuration, which consists of a 9037 Sysplex Timer console and a 9037 Sysplex Timer attached to the processor External Time Reference Adapter feature. Each 9037 Sysplex Timer port connects to a processor External Time Reference Adapter feature port.

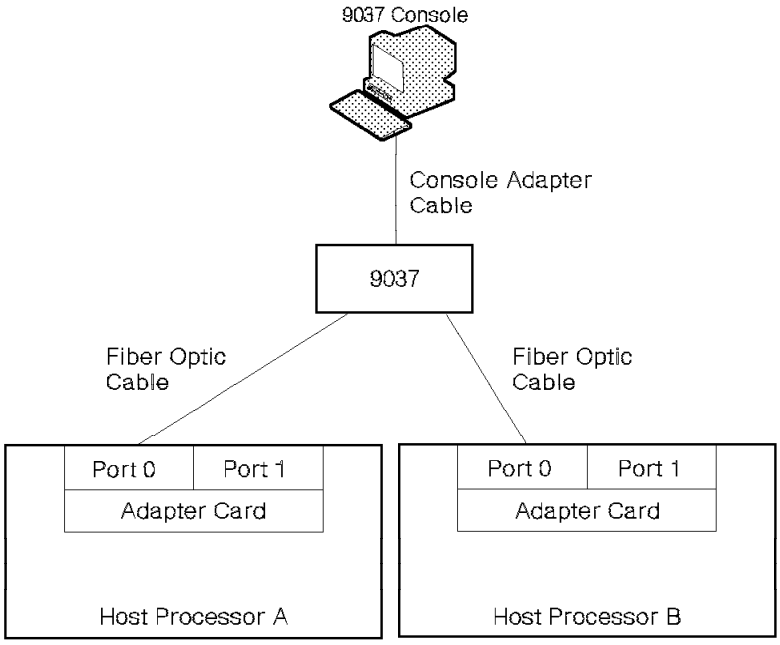


Figure 53. 9037 Sysplex Timer Basic Configuration

The Expanded Availability configuration in Figure 54 on page 168 includes one console and two 9037 Sysplex Timers linked together and synchronized with each other. Each 9037 Sysplex Timer must have the Expanded Availability feature installed. With a connection from each 9037 Sysplex Timer to a port on the processor External Time Reference Adapter feature, a failure in either 9037 Sysplex Timer unit or processor connection will be recovered by the back-up 9037 Sysplex Timer or processor connection. Sysplex clock synchronization will be maintained for the affected processors.

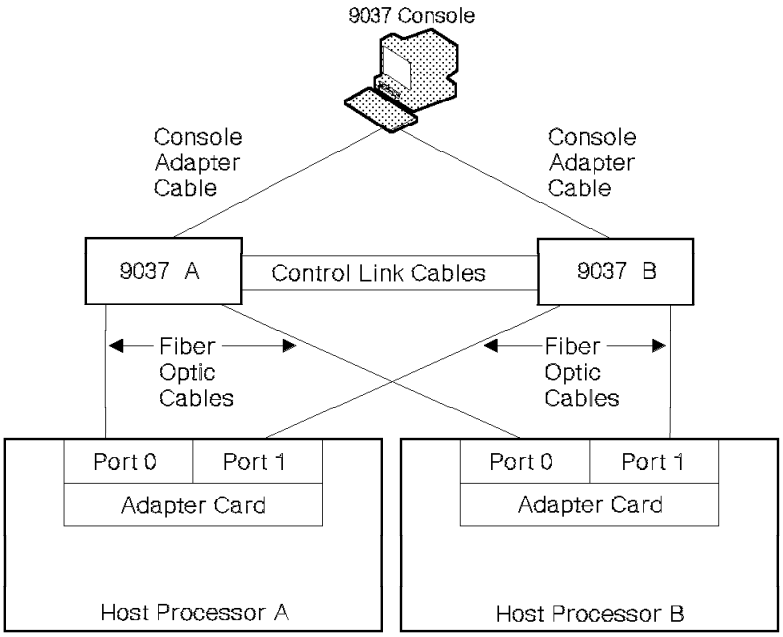


Figure 54. 9037 Sysplex Timer Expanded Availability Configuration

Installation Steps and Times

Installation Steps

- Installation Prerequisites
  - Install the 9037 Sysplex Timer console
  - Install the fiber optic cabling
  - If required, upgrade the host processor or processors to the required System Engineering Change (SEC) level (227574 for the ES/3090 J processors)
- Nondisruptive steps:
  - Install the 9037 Sysplex Timer console adapter card.
  - Install the modem for automated time setting through the National Institute of Standards Technology (NIST) (optional)
  - Install the 9037 Sysplex Timer or 9037 Sysplex Timers
  - Initialize the 9037 Sysplex Timer. Online help information will guide the following steps:
    - Set the time and date on the 9037 Sysplex Timer
    - Configure the 9037 Sysplex Timer.
- Steps that require a host processor outage:
  - Install the processor External Time Reference Adapter feature (which requires replacement of the processor service board)
  - Attach 9037 Sysplex Timer fiber optic processor External Time Reference Adapter feature cables
  - Change the processor's machine configuration table (MCT) to indicate that the processor External Time Reference Adapter feature and 9037 Sysplex Timer are installed.
  - Power on Reset (POR) the processor.

When the host processor is powered up and the operating system is IPLd, the operating system and the host processor will recognize that the 9037 Sysplex Timer is active and set the processor clock to the time sent by the 9037 Sysplex Timer.

Multi-Processor (MP) Considerations: An MP can be upgraded one side at a time; the second side can be in productive use while the first is being upgraded to support the processor External Time Reference Adapter feature. After the POR on the first side, the second side can be upgraded. If you are running in single image mode on the processor, you can CONFIGURE the second side online after it has been updated and PORd.

Table 19. Estimated Installation Times:

Processor External Time Reference Adapter feature (per side)	8.0 host processor hours
9037 Sysplex Timer basic unit	1.2 (non-disruptive host processor) hours
9037 Sysplex Timer Expanded Availability units (two units installed)	1.7 (non-disruptive host processor) hours

Inter-Relationships and Dependencies with Other Products

Processors: Each host processor attached to the 9037 Sysplex Timer requires that a processor External Time Reference Adapter feature be installed on each processor side. The adapter feature provides two ports for attachment to either one or two 9037 Sysplex Timers.

Operating Systems

- MVS/ESA 4.1.0 and subsequent releases.
- TPF version 3.1 with APAR (see “TPF” on page 43).
- VSE does not support the 9037 Sysplex Timer.
- VM (native or guest) does not support the 9037 Sysplex Timer.

Processor External Time Reference Adapter feature capability is supported on all ESCON capable processors. Refer to Figure 6 on page 54 for models. The ES/3090J Models must have SEC 227574 or its follow-on installed. ESCON need not be installed to use the 9037 Sysplex Timer.

The Processor External Time Reference Adapter feature is available to logically partitioned mode (LPAR) configurations.

Console: The 9037 Sysplex Timer console must be dedicated to the 9037 Sysplex Timer and be an IBM PS/2 or equivalent. See your IBM representative for console specific information or refer to the publication *Planning for the IBM 9037 Sysplex Timer*.

Special Considerations and Recommendations

Power: It is recommended that the 220V power supplies for the two 9037 Sysplex Timers are from separate sources; if one source fails, only one 9037 Sysplex Timer is affected.

Cabling and Physical Location: 9037 Sysplex Timer transmits data to processors using fiber optic links at a maximum distance of up to 3000 meters (9843 feet). This distance applies when using 62.5/125 micrometer cable. For distances when using other cable sizes, refer to *Planning for Enterprise Systems Connection Links*. The 9037 Sysplex Timer connections do not use the same protocols as ESCON. 9037 Sysplex Timer communications cannot be transmitted

through the ESCDs. However, to get the extended fiber optic distances, it may be desirable to situate the 9037 Sysplex Timer at the same location as the ESCDs. Make sure that the 9037 Sysplex Timer cables bypass the ESCDs because of the incompatibilities of the different protocols.

Managing Potential Single Points of Failure: The 9037 Sysplex Timer can have as many as 16 port connections. Two connections can be made to any one processor side through the processor External Time Reference Adapter feature in the processor (one connection as the primary and the other as backup). When the processor operates with the processor External Time Reference Adapter feature, a failure of the active port will result in switching automatically to the backup port.

TPF considerations: Current TPF host processor complexes rely on the Time-of-Day (TOD) Clock Synchronization RPQ to ensure system synchronization. The orderly migration from this environment to a processor External Time Reference Adapter feature facility is supported by the TOD Synchronization Compatibility RPQ (TSC RPQ 8K1731 (available only through factory installation)). This RPQ allows the 9037 Sysplex Timer to assume the role of “master” clock control in the TOD Sync central processor complex (CPC) network concurrent with CPCs capable of processor External Time Reference Adapter feature attachment. Both facilities coexist in the same network and allow for migration to the processor External Time Reference Adapter feature.

The staged migration of a TPF installation is as follows:

1. The related systems are interconnected using the TOD Sync RPQ.
2. Interconnection consists of CPCs with the processor External Time Reference Adapter feature and TOD Sync RPQ attached through a 9037 Sysplex Timer unit with the TSC RPQ.
3. All attached processors use the processor External Time Reference Adapter feature with 9037 Sysplex Timer to achieve clock synchronization.

Related Publication

- *Planning for the IBM 9037 Sysplex Timer*

Enterprise Systems Connection Monitor System

Description

An Enterprise Systems Connection Monitor System (ESCMS) consists of hardware units and an OS/2* application that work together to control power or monitor, and respond to, changes in the data processing environment. As your data processing environment grows beyond the 400-foot limit, the need for ESCMS becomes evident.

Controlling Power: ESCMS can switch power on or off to remote hardware resources (for example, host processors or control units) that use the standard 6-wire interface or are attached through an Enterprise Systems Connection Monitor Power Adapter. For information about the 6-wire interface, refer to the publication *IBM S/360 and S/370 Power Control Interface Original Equipment Manufacturers' Information Manual*.

Monitoring and Responding to Changes in the Data Processing Environment: ESCMS can:

- Monitor devices (for example, analog or digital sensors)
- Record exception conditions or events
- Respond to an event with an action that you predetermined and configured through the ESCMS application (resident at the ESCMS console).

For example, the ESCMS could respond to a temperature reading out of range by calling a preset telephone number and speaking a preset message.

Note: ESCMS is not intended to replace existing fire alarm or security systems. ESCMS provides information for environmental management that complements existing systems.

Figure 55 on page 172 illustrates a simple ESCMS configuration.

OS/2 is a trademark of the IBM Corporation.

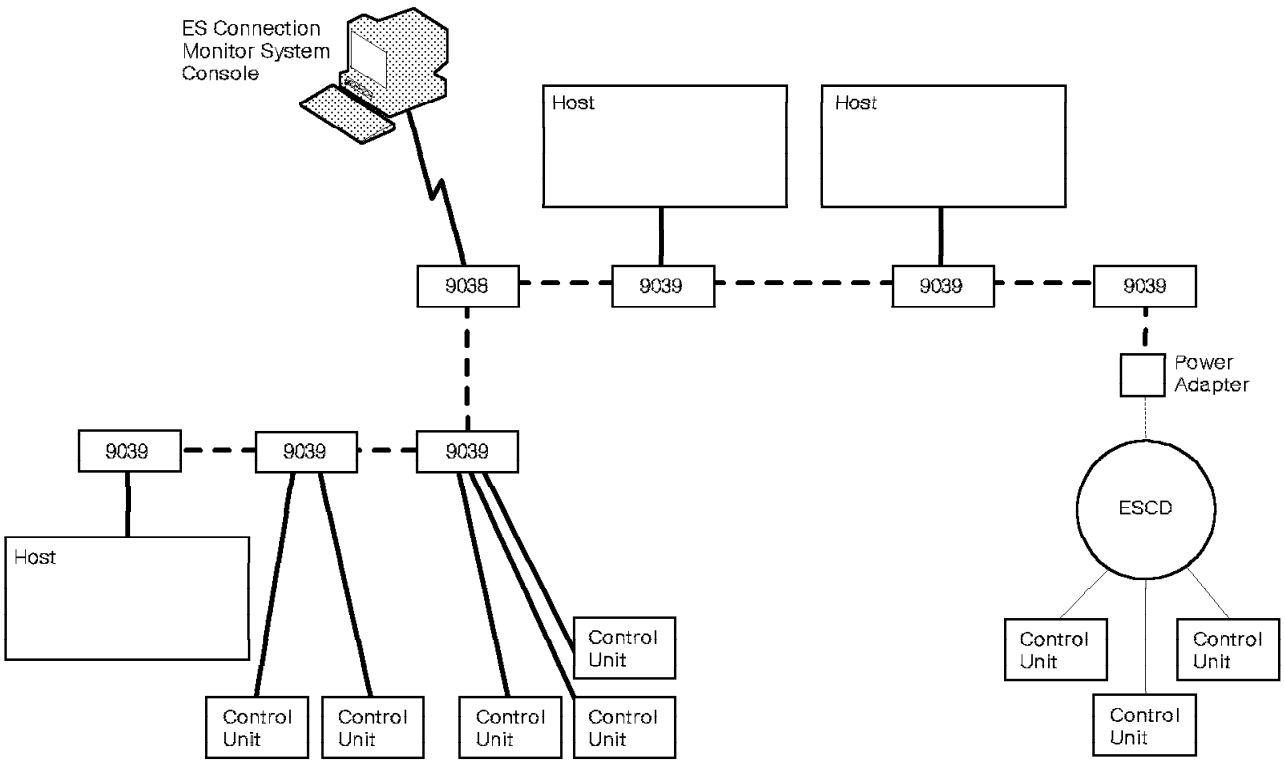


Figure 55. Example of an ESCMS Configuration

Configuration

ESCMS consists of the following:

- An ESCMS console
- 9039 ES Connection Monitor Sensor Adapters
- ES Connection Monitor Power Adapters
- 9038 ES Connection Monitors (Model 1 or Model 2)

ESCMS Console: This device controls communication between 9038s and the ESCMS application. You use the console and program to initialize and configure ESCMS and monitor the status of the events ESCMS manages. The application runs under the IBM Operating System/2 Extended Edition and requires at least an IBM Personal System 2 Model 50Z (or equivalent). IBM Operating System/2 Extended Edition provides a menu-driven interface that allows you to set up and display data graphically. The ESCMS application can be configured either locally (at the ESCMS console) or remotely (through a modem).

9039 Model 1: This provides twelve ports, of which eight are sensor ports and four are relay-control ports. A sensor port continuously senses any change to the equipment that is attached to the port. A relay-control port can turn power on or off to peripheral equipment (for example, lights or alarms).

9039 Model 2: This provides eight ports, of which four are sensor ports and four are power-sequencing ports. A power-sequencing port can turn power on or off to hardware resources that are attached through the standard 6-wire interface or ES Connection Monitor Power Adapter.

ES Connection Monitor Power Adapter Model 1 and Model 2: These allow attachment to the 9039s of hardware resources without a standard power control interface (that do not use the 6-wire interface). Model 1 is High Power with AC output through an International Electrotechnical Commission (IEC) 320 C19 plug. Model 2 is Low Power with AC output through an IEC 320 C13 plug. Refer to the publication *International Electrotechnical Commission (IEC) Standard 320* for information on the IEC power standards for the ES Connection Monitor Power Adapter.

Upgrade Feature: This feature upgrades a 9038 model 1 to a 9038 model 2. (The 9038 controls 9039s to which the data processing equipment or environmental sensors are attached.)

9038 Model 1 is the base model and can support up to 20 9039s.

9038 Model 2 has built-in backup functions and can support up to 50 9039s. Up to three expansion features (supporting 50 9039s each) can be added to a 9038 Model 2, for a total support of 200 9039s.

Installation and Upgrades

To install an ESCMS, you need to:

- List the types of events and hardware resources that you want to monitor and control
- Map the locations of these hardware resources
- Define the cabling requirements for your ESCMS.

This list will help you decide how many 9038s, Upgrade Features, 9039s, and ES Connection Monitor Power Adapters you need, and their locations.

You also need to devise an addressing and naming scheme to identify each 9038, 9039, and hardware resource or ES Connection Monitor Power Adapter within the ESCMS to the program product (at the ESCMS console) and to application and operating system software.

Cabling: The ESCMS console can be attached to 9038s by leased telecommunications line, dialed telecommunications line (through modems), or through direct (RS-232) cable. If attached through a direct cable, the ESCMS console must be within 12.3 meters (40 feet) of the 9038.

For Countries Other Than the United States and Canada

If you want the ESCMS console to communicate through the modem port on a master card in the 9038, contact your IBM representative to determine any modem restrictions that may apply.

The 9039s are attached by twisted pair copper wire to the 9038. The total wire length from the 9038 to the last 9039 on the wire cannot exceed 1.5 km (1 mile).

The total distance permitted between a 9039 and the hardware resource (for example, a host) or ES Connection Monitor Power Adapter attached to the 9039 is 123 meters (400 feet).

Power: The 9038 houses a main power supply unit, which can also service up to eight 9039s within 30 meters (100 feet) of the main power supply unit. Auxiliary power units (APUs) can be added to the system. Each APU can service up to 16 9039s within 30 meters (100 feet) of the unit.

Special Considerations and Recommendations

You should consider the points of human control that you want, such as telephone numbers you want the ESCMS to call, display terminal identifiers, and printers.

Involve your facility management personnel in the planning of 9039 placement and wiring.

Note: You may want to contact a contractor familiar with control system wiring to wire your 9039 networks. If you do not use a contractor, determine whether right-of-way or local fire and safety codes have any impact on your wiring plans.

Define your power sequencing requirements and plan the power sequencing for your ESCMS accordingly. For example, if your ESCON-capable DASD control units are attached to ESCDs, the recommended power up sequence would be:

1. ESCDs
2. Control units
3. Host processors.

9038 has a built-in modem. This modem may not be approved in countries other than the United States or Canada. For information on approved modems, contact your IBM representative.

Related Publications: Refer to the planning publication for Enterprise Systems Connection Monitor System for more information on ESCMS.

Examples of Migrating to an ESCON Environment

This chapter shows examples of configurations before and after migrating full Enterprise Systems Connection (ESCON) environment.

IBM has provided two migration products to help customers stage the exploitation of an ESCON environment in their data processing centers.

- The IBM 9034 Enterprise Systems Connection Converter
- The IBM 9035 Enterprise Systems Connection Converter.

These two products allow customers additional flexibility in staging the implementation of ESCON. The IBM 9034 and 9035 are described in more detail in “9034 Enterprise Systems Connection Converter” on page 156 and “9035 Enterprise Systems Connection Converter” on page 162, but briefly they provide the following:

- The 9034 allows current control units that cannot be, or have not yet been, upgraded to ESCON capability, to be attached to ESCON channels
- The 9035 allows attachment of ESCON-enabled 3990s to selected current processors that cannot be upgraded with ESCON channels (for example the 4381 or ES/3090E models) or to ESCON-capable processors which have not yet been upgraded with ESCON channels.

The first example shows a company that plans to migrate to new processors first, while continuing to use bus-and-tag control units. This example shows the use of 9034s to aid in migration by allowing ESCON channels and fiber networks to be installed and non-ESCON-capable control units attached.

The second example shows a larger company that plans to convert to new control units first, while staging its movement to new processors more slowly. This example shows the use of 9035s to aid in the attachment of ESCON-enabled 3990s to non-migrated or selected non-ESCON-capable processors.

The third example is a company that is running several system images on different processors with separate I/O devices. Company C would like to consolidate these images on a single processor and get better control of operation of its data center.

The configurations shown in these examples are not representative of the numbers of control units or channels that would be appropriate for data centers of the sizes shown, but rather are intended to highlight considerations that are important in planning for migration of these products.

The companies and situations are hypothetical.

An Enterprise Replacing Processors and Channels First

Company A has two host processors (refer to the configuration shown in Figure 56) and a growing amount of information to be gathered, stored, and processed.

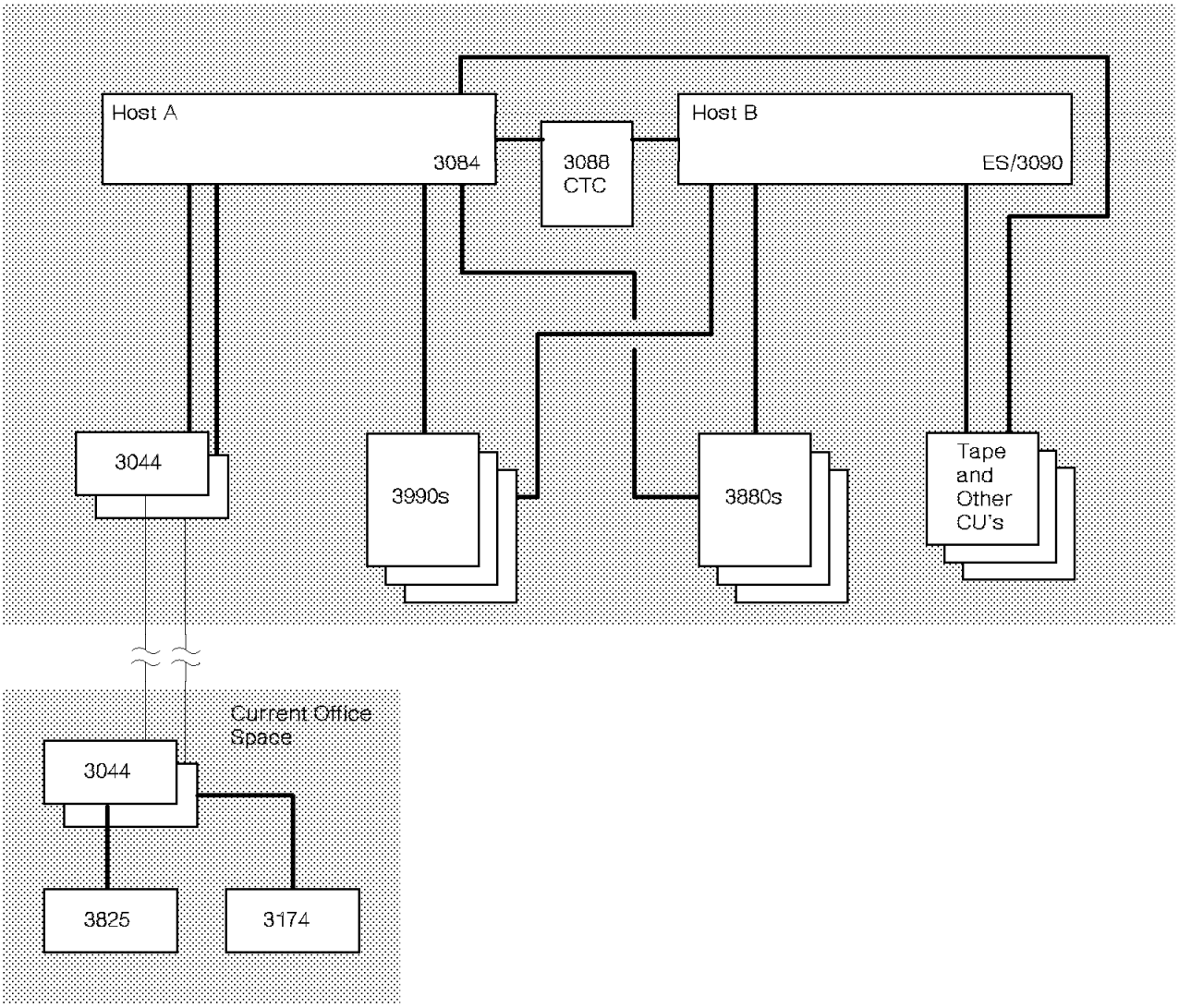


Figure 56. Company A's Initial Configuration

Initial Configuration and Plans

Company A has just upgraded an ES/3090-400E processor to a 400J for improved throughput and over a holiday weekend plans to replace a 3084 processor, which is used for backup, with a 400J. This would allow the balancing of work more evenly between the two processors and provide backup for the workload from the primary 400J.

Company A has been satisfying data growth and performance needs with 3990 Model 3s and 3390s. They also have an older 3880 whose lease has several years to run.

Company A uses the IBM 3044 Fiber-Optic Channel Extender Link to extend channel distances to 3174-attached displays and 3825 printers that are located in other parts of the building. To accommodate employee growth, Company A plans to expand office space into a new building wing to be occupied later in the year. They had been planning to use 3044s to reach the displays and printers in the new wing.

New Plans for ESCON Environment

After considering the ESCON environment, Company A's information system personnel make new plans.

Connection System: Company A plans to install an ESCON fiber optic cabling system and Enterprise Systems Connection Directors (ESCDs) at the very first. Company A plans to contract with IBM to design and install the ESCON fiber system.

Processors: Company A decides that instead of installing a 400J, they want to exploit the processor technology and programming capabilities of an ES/9000 Water-Cooled Frame model. Company A will install the ES/9000 model 720 with both parallel and ESCON channels to learn about the ESCON environment and to test new hardware, software, fiber optic cabling system, and operating procedures.

After they have had some experience with the ES/9000 model 720, Company A will upgrade the ES/3090 model 400J with ESCON channels. For channel-to-channel applications, Company A plans to configure ESCON channels on both to operate in ESCON CTC mode. The current 3088 will no longer be required.

Data Storage: Company A plans to upgrade the existing 3990s so that they can attach to both bus-and-tag and ESCON channel interfaces. Later, when the 400J processor is field-upgraded with ESCON channels, the bus-and-tag ports can be replaced with ESCON ports.

The company plans to use the bus-and-tag interface 3880 until its lease expires and then replace it with an ESCON-capable 3990.

Other Control Units: Company A plans to use one of the existing bus-and-tag 3174 and 3825 control units in the new office wing, but give them some of the benefits of an ESCON environment by attaching them to the new system with 9034s. Later, the 3174s will be replaced by ESCON-enabled 3174s (Model 12L or 22L).

The 3174s and 3825s in the current office space connected with 3044s need access only to the primary processor. For the time being, Company A plans to

leave this arrangement in place. Later, if access to the other processor for additional applications or additional availability becomes a requirement, Company A can develop plans to attach the bus-and-tag control units to an ESCD through a 9034.

While Company A has no immediate plans for additional office space, they are considering expanding into other buildings in their office complex. They consider the data rate and the additional connectivity and distance of fiber optic cabling and Enterprise Systems Connection environment to be attractive for their still-developing long-term plans.

Migration Plans: The new plan calls for a two-stage migration to a data center that uses Enterprise Systems Connection products. The stages are:

1. Installing a new ES/9000 Water-Cooled Frame model 720 processor and testing the ESCON environment cabling, hardware, and software.
2. Field-upgrading the 400J processor with ESCON channels and attaching it to the already-installed ESCON system.

Company A plans to carry out this migration so that productive operation will continue with as little interruption as possible during the migration.

Company A′s Phase 1: Installing an ES/9000 and Testing an ESCON Environment System

Using the IBM design and installation services offered in their country, Company A orders and installs a fiber optic network, the ES/9000 model 720 and products for an ESCON environment (as indicated in Figure 57).

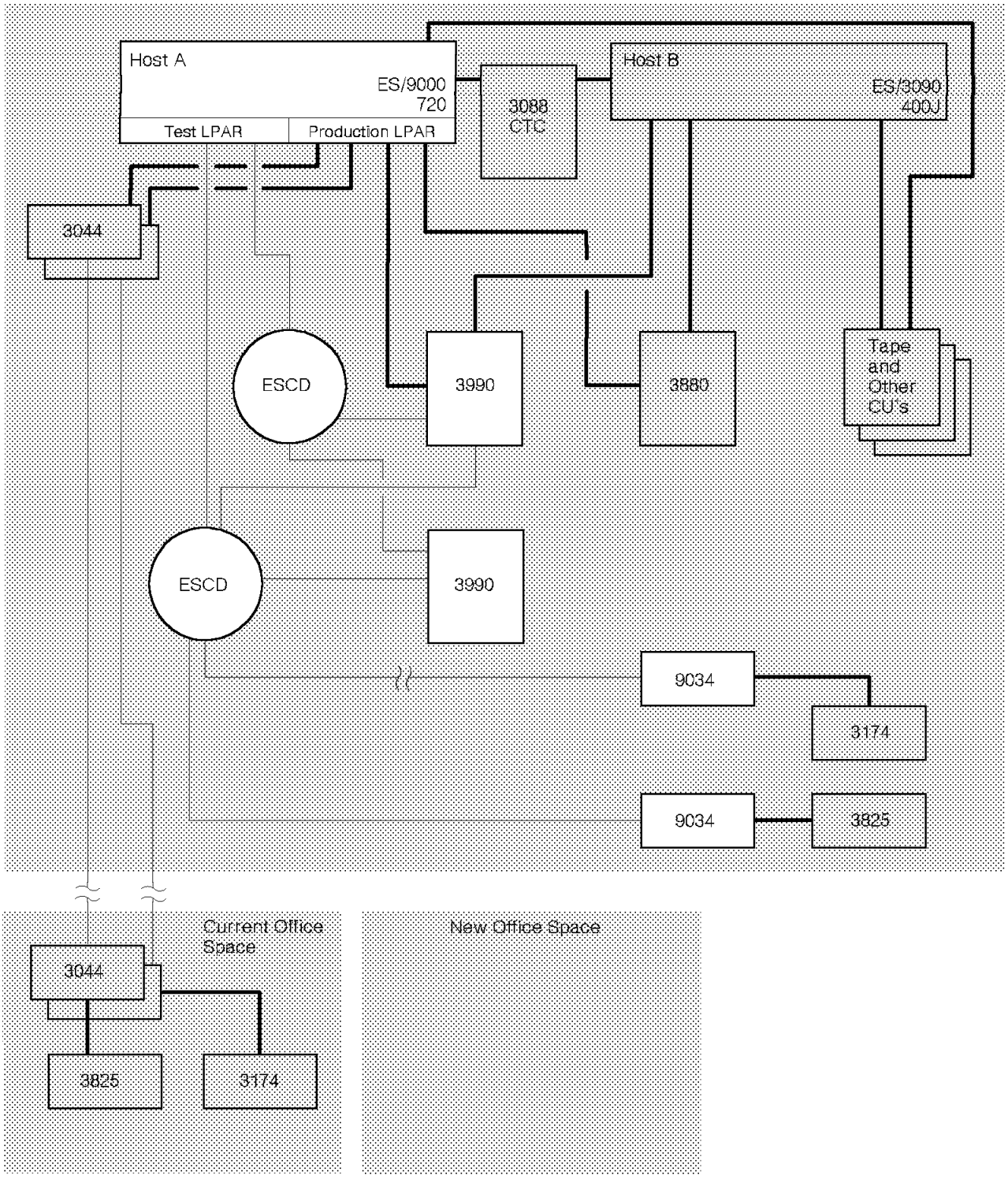


Figure 57. Company A′s Phase 1: Installing an Enterprise Systems Connection Environment for the First Processor

The ESCON environment is made up of the following products:

- Fiber optic cabling and associated connectors and distribution panels to interconnect the system
- The operating system level required to support the new ESCON channels (MVS 3.1.0e with required PTFs)
- 16 ESCON channels on each side of the ES/9000 model 720 with eight connected to each ESCD
- Two ESCON Adapter, with Four Ports features (a pair for each of the two 3990s)
- 9034s for the already purchased bus-and-tag 3825s, to be installed in the new office wing
- Two ESCDs
- The Enterprise Systems Connection Manager (ESCM) licensed program to manage the ESCDs.

The Model 720 will be operated in LPAR mode, with one LPAR for testing the new configuration; a second LPAR will be used for the existing production and backup functions performed today on the 3084.

Company A′s existing control units are attached on the Model 720 parallel channels for the production system LPAR, and run on the current version of the operating system during the testing phase. When the test is complete, the new PTFs for ESCON channel support can be applied and tested before switching to the ESCON port connections on the 3990s and installing the ESCON-capable 3174s in the new office wing.

The 3990s are attached to the ES/9000 Model 720 over the new fiber optic connections and ESCDs in the test system LPAR while they continue to be attached to parallel channels on the production system. (However, the 3990 cannot be accessed from the same LPAR through both interfaces.)

The 9034s serving the 3174s and the 3825s are also attached through the ESCD. (Later, the ESCON-capable 3174s will be attached directly to the ESCD, but in the meantime, attaching bus-and-tag 3174s through a 9034 will serve to test the channel path through the fiber optic cable and the ESCD.)

Company A decides to install 32 optical interface channels (more than they currently need) because they will need them as they add 3990s in the future and want to limit future system disruption for planned channel upgrades. The channels are divided between sides of the Model 720 so that a side can be configured off-line for service while they continue to run on the other side.

Company A can add the new ESCON channels to the 3990s while remaining attached to the parallel channels because the 3990s are attached to only two system images with parallel channels (four physical path connections to each). This leaves eight remaining system attachments available for the ESCON environment attachments. Company A can continue normal operation in one LPAR and test the new configuration in the other.

The ESCDs attached to Host A are both attached to the 3990s. This ensures an alternate path from the host to either 3990 and removes the ESCD as a single point of failure for the links to the 3990.

For testing the 3174 and 3825 connections, fiber optic cabling that matches the eventual distance that will be used can be left wound on the spool and then

extended and connected when the new office wing and control units are ready for use.

Company A′s Phase 2: Upgrading the 400J with ESCON Channels and Operating in a Full ESCON Environment

As shown in Figure 58 on page 182, the Model 400J is upgraded with ESCON channels and is added to the ESCON configuration already in place and attached to the ES/9000 Model 720. (In addition, both processors are also configured with parallel channels so that they can continue to service 3880s and other control units that cannot quickly be replaced by ESCON-capable versions.) The upgraded 400J configuration consists of these ESCON environment elements:

- An ESCON 32-channel upgrade for the 400J
- An ESCON environment cabling system that has already been tested with the model 720 system
- 3990s with four ESCON ports per cluster
- ESCON-capable 3174 models in the new office wing
- 3825 models attached through 9034s in the new office wing
- ESCON channels on each processor operating in CTC mode, to allow channel-to-channel communication between the processors. These channels would replace the 3088 bus-and-tag connections between the 400J and the 3084 which exists today.
- MVS 3.1.0e with the required PTFs (to match the ES/9000 model 720′s SCP level).
- The Enterprise Systems Connection Manager (ESCM) licensed program

The 3044-attached 3174s and 3825s can remain attached as-is to the Model 720, since these models are not upgradable. (These control units will have access only to the Model 720, however.) To have access to both processors through an ESCD, these control units would need to be attached to 9034s (in which case they would have dedicated paths to one or the other processor, but could be switched as necessary with ESCM when workload movement was necessary) or replaced with ESCON-capable models, in the case of the 3174.

Company A plans to order and install ESCON 3174s as its number of users grows, but continue to use the existing ones for the indefinite future.

The 9034 will continue to be used for the new bus-and-tag 3825 printer installed in the new office wing. Since new ESCON models of the 3174 are being put in the new wing, they can be connected directly to fiber optic cable when they arrive, and 9034s will not be required for them.

The 3990s scheduled for delivery after the transition to full production operation with ESCON environment will be configured with eight ESCON ports and no parallel ports. For any 3990s that arrive with parallel ports and are installed before the ESCON environment system is fully operational, an ESCON channel upgrade feature can be installed in the field.

Since Company A intends to retain its 3880s until their leases expire, Company A will move any data critical for maximizing throughput to the 3990s as they arrive and will move less critical data to the 3880s.

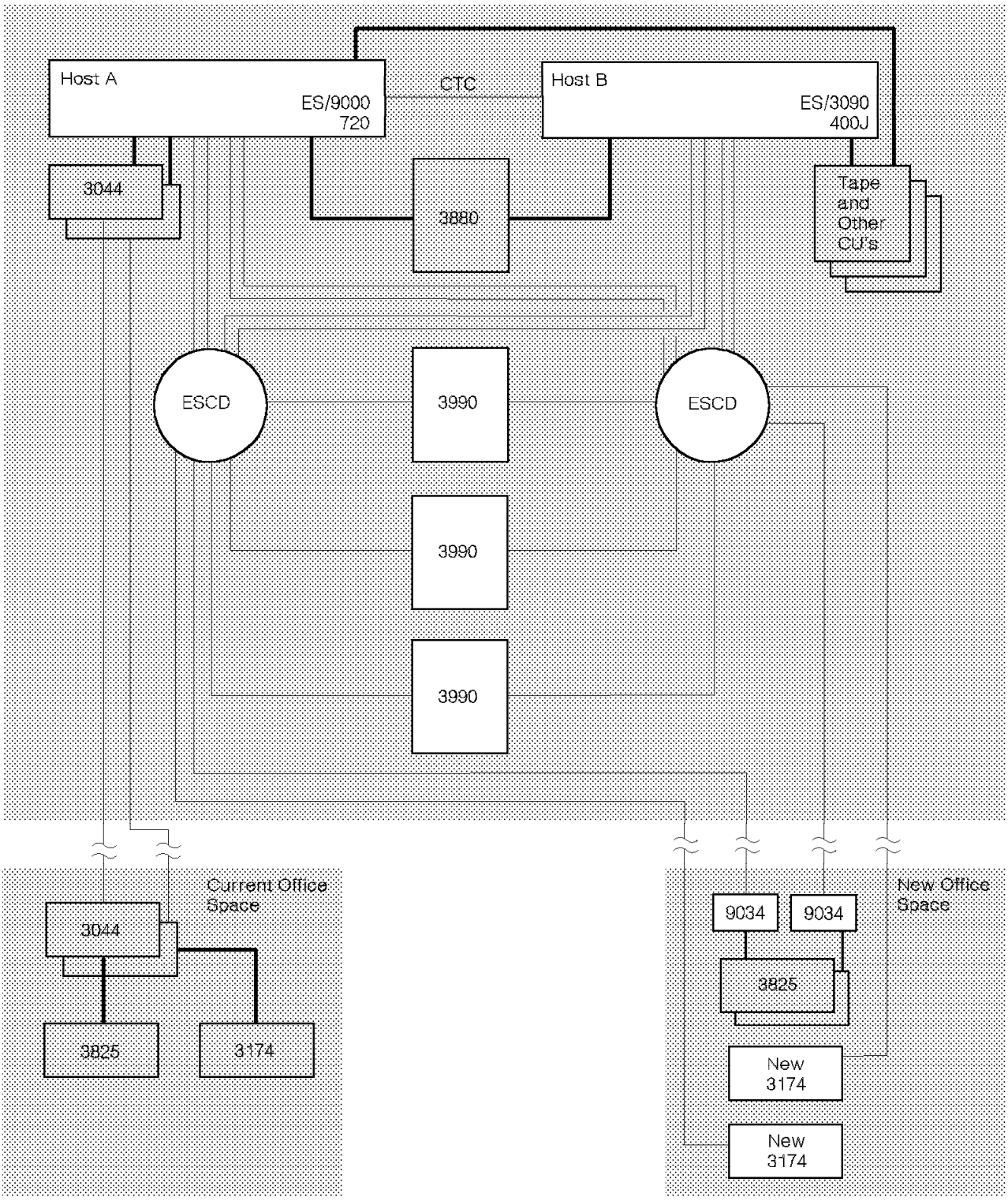


Figure 58. Company A's Phase 2: Upgrading the Second Processor and Operating in a Full ESCON Environment

Full Production Data Center with ESCON Environment

After completing testing for the 400J, Company A has arrived at an operational Enterprise Systems Connection configuration whose benefits include:

- The flexibility and backup capability offered by dynamic connectivity for all ESCON-attached channels and control units
- Increased distance for control units in the new office wing.

Company A is now in position to add current and future models of channels, control units, and even ESCDs as growth needs determine, with little disruption to productive operation. Meanwhile, Company A has protected its investment of installed equipment (a newly upgraded Model 400J, unexpired leases on 3880s and 3990s, and other parallel channel attached control units) by either continuing to support them on parallel channels or attaching them to the new ESCON channels through 9034s.

A Larger Enterprise Replacing Control Units First

Company B differs from Company A in two major ways. First, its data center is larger. Second, it plans to migrate to new control units first and replace or upgrade its host processors over a longer time period.

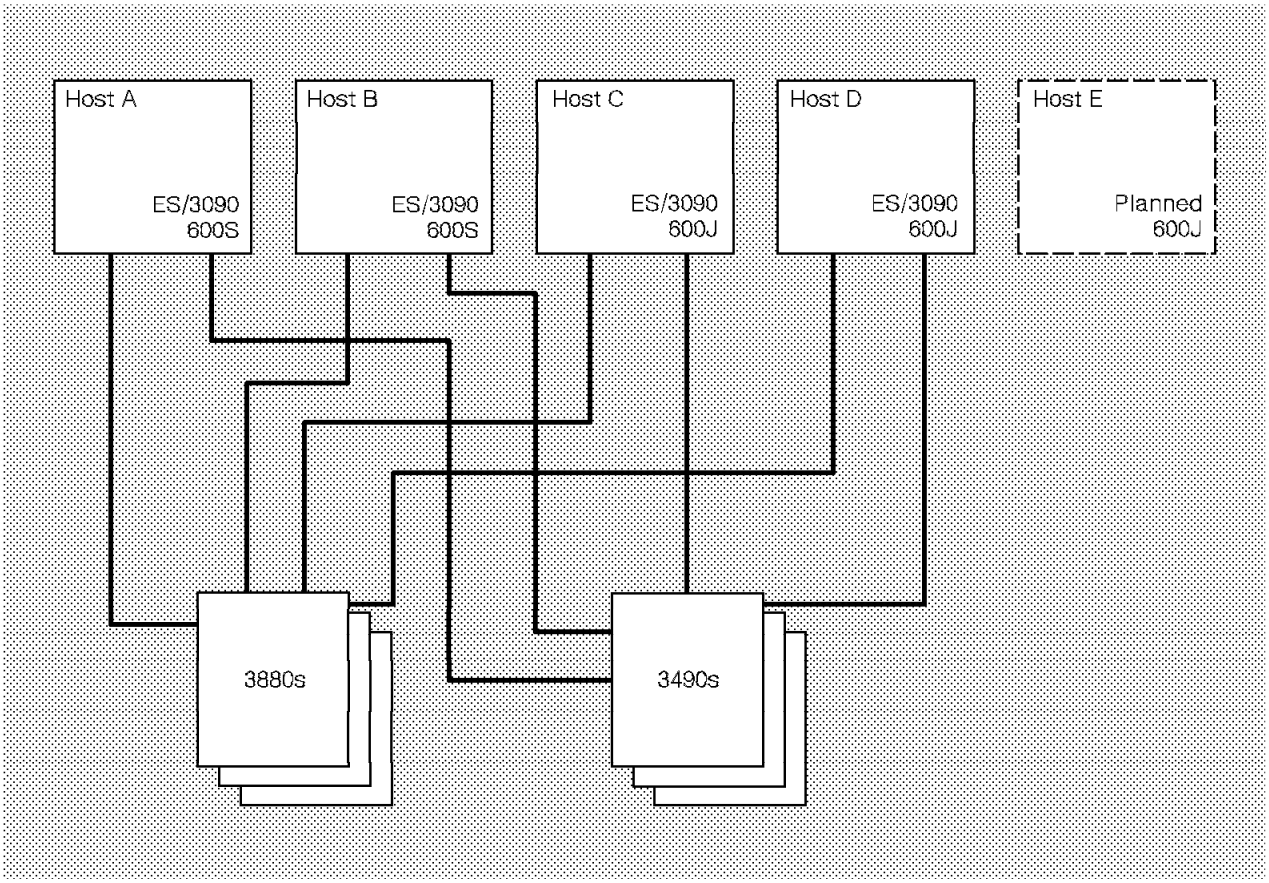


Figure 59. Company B's Initial Configuration

Initial Configuration and Plans

As shown in Figure 59, Company B has two ES/3090 600Ss and two ES/3090 600Js. These systems are relatively new investments and Company B plans to use them for two or three more years. Since Company B′s information system installation plans are already aggressive, they do not currently plan to convert the 600Ss to 600Js. Thus, coexistence between bus-and-tag channels on the 600Ss and new ESCON channels on the 600Js will be an important part of Company B′s migration.

With a need for increased throughput, Company B plans to add a new 600J processor to their configuration this year. This provides Company B with a connectivity challenge. Currently, each 3880 is connected on two channel paths to each of the four processors for possible workload redistribution, in case one processor is temporarily down. Since the 3880 addresses no more than eight channels, adding connectivity to a fifth processor would probably require configuring only two paths to each of two processors and one each to the other two. This would mean, however, that the I/O configurations would be dissimilar and

more difficult to manage and that backup would be only feasible between the processors with the same number of paths.

Company B has already started the 3990 migration, using four-path 3390 DASD to reduce performance constraints that were appearing in their 3880 two-path DASD. These 3990s have four parallel channel connections to each production system.

New Plans for ESCON environment

After considering Enterprise Systems Connection environment, Company B′s information system personnel develop new plans.

ESCON Cabling System and ESCDs: Like Company A, Company B plans to install an ESCON fiber optic cabling system and ESCDs at the outset. Company B plans to contract with IBM to do the design and installation.

Processors: The two Model 600Ss can not be upgraded with ESCON channels. However, Company B plans to keep them in operation for a few more years and recognizes that they will be able to get connectivity to the new ESCON-capable 3990s through 9035s on existing parallel channels.

Company B decides to install an ES/9000 Water-Cooled Frame Model 720 instead of the planned 600J. It will be attached to the ESCON system when it arrives, but will also be able to support attachment to bus-and-tag control units as long as they are needed.

By moving to an ES/9000 Model 720 rather than an ES/3090 Model 600J (as previously planned), Company A believes it will have one less processor migration to make and will have a longer period in which to exploit the advantages of ES/9000 technology and programming.

Later, company B plans to upgrade each of the Model 600Js with ESCON channels.

Company B is currently running MVS/SP 3.1.3 on the processors and has installed the latest levels of storage program products. They will need only to apply the latest PTFs for the ESCON products to have their operating systems at the right levels.

Storage Control Units: Company B plans to install 3990s with both ESCON ports and parallel ports.

Company B plans to field-upgrade its existing 3490 Magnetic Tape Unit so that as soon as the second host is upgraded with ESCON channels, they will have access to the 3490 through ESCDs and fiber optic cabling.

Other Control Units: Company B plans to purchase the ESCON-capable model of the 3174 Establishment Controller as new 3174s become required. Existing 3174s and 3825 printers will be attached to the ESCDs through 9034s (not shown in this example).

Migration Plans: Company B′s new plan calls for a multi-stage migration to a data center that uses an ESCON environment. The stages are:

1. Installing an ESCON Fiber Optic Cabling System

2. Installing, testing, and putting into productive operation the new ES/9000 model 720 in an Enterprise Systems Connection environment with ESCON 3990s and 3490s for testing
3. Installing, testing, and putting into productive operation the new ESCON-capable 3990s using:
   - 9035s or parallel links to the Model 600Ss until they are replaced
   - 9035s or parallel links to the Model 600Js until they are upgraded
   - ESCON links to the 720.
   - Upgrading the first of the ES/3090 Model 600Js with ESCON channels and upgrading all of the 3490s with ESCON ports
4. Upgrading the other ES/3090 Model 600Js with ESCON channels
5. Replacing the first ES/3090 600S with an ES/9000 Model 720
6. Replacing the other ES/3090 600S with an ES/9000 Model 720.

Company B plans to carry out this migration so that productive operation continues with as little interruption as possible during the migration stages.

Company B′s Phase 1: Installing a Fiber Optic Cabling System

Although Company B has some experience planning and installing fiber optic cable, it decides to contract with IBM to plan and install an ESCON fiber optic cabling system. IBM designs and installs a fiber cabling network, which entails sets of fiber distribution panels close to the processors, the ESCDs, the current control unit positions, and the planned DASD on the next floor. The plan includes dual routing of fiber, spare fiber, floor space for future ESCDs, 9034′s, 9035′s spare ports on the ESCDs for addition of new channels and control units, and spare capacity in distribution panels (refer to Figure 60 on page 187).

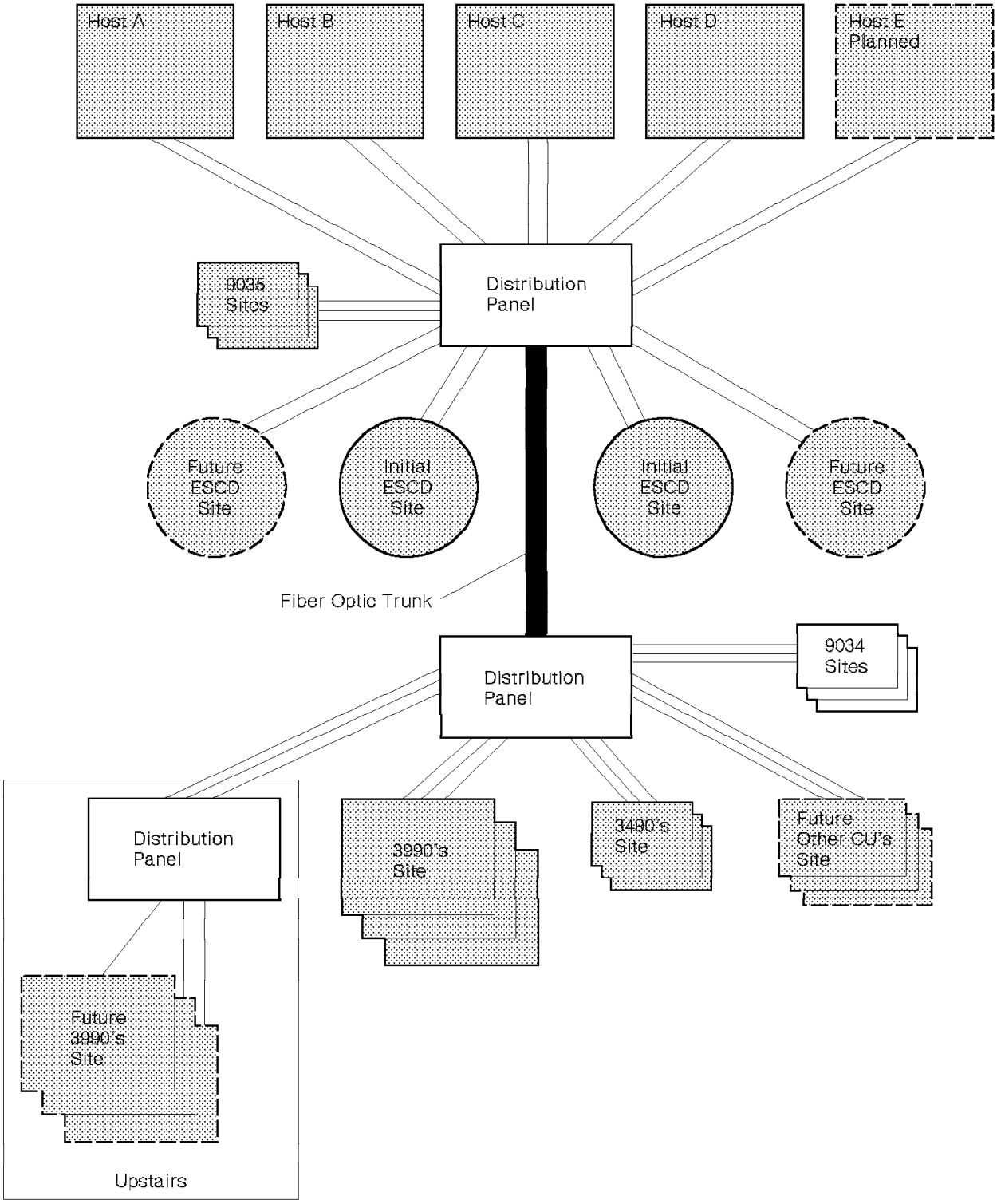


Figure 60. Company B's Phase 1: Installing a Fiber Optic Cabling System

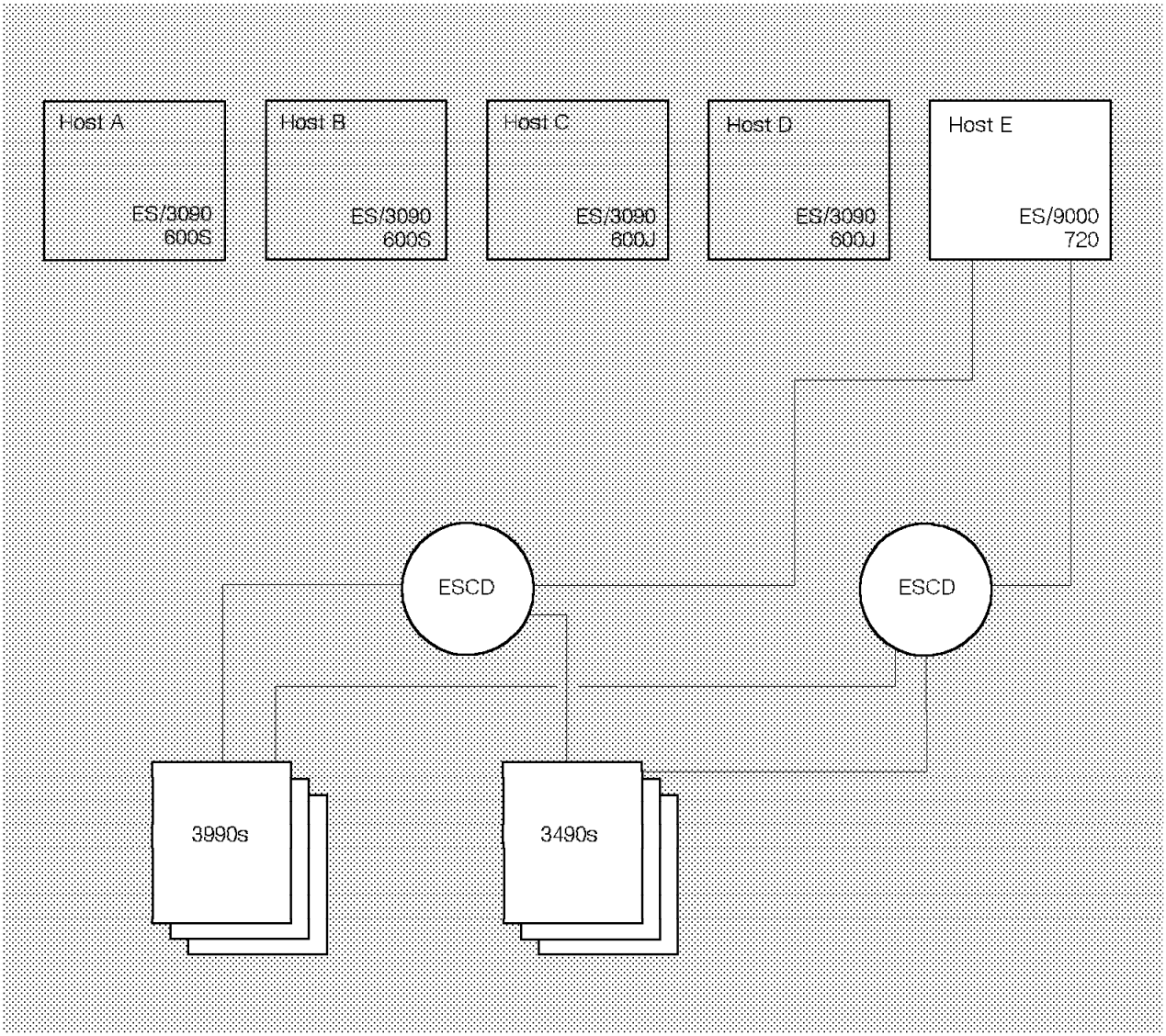


Figure 61. Company B's Phase 2: Installing the ES/9000 Water-Cooled Frame Model 720 and the ESCON 3990s and 3494s for Testing

Company B′s Phase 2: Installing and Testing the ES/9000 Model 720 and the ESCON Environment

As shown in Figure 61, Company B installs the new ES/9000 model 720, the various components of the Enterprise Systems Connection environment, and control units for testing with the ESCON configuration. All of the ESCON hardware (ESCON ports on the control units, ESCON channels, 9034s and 9035s) are connected through the ESCD to build up a connectivity base and to allow management of the ESCON configurations with ESCM.

The processor will be configured in single-image mode with multiple LPARs to test new procedures, to get accustomed to operating in the ESCON environment, and to allow testing of channels and control units in the configurations in which they will be attached:

- Parallel channels directly through parallel control unit ports
- ESCON channels operating in native mode

- ESCON channels operating in 9034 mode
- ESCON channels operating in CTC mode to communicate between ESCON processors
- Parallel channels communicating through 9035s through an ESCD to ESCON ports on a 3990.

Company B orders and installs these products (as indicated in Figure 61 on page 188):

- MVS/SP 3.1.3 with appropriate PTFs required to support the new ESCON environment I/O
- An ES/9000 Model 720 with a mix of parallel and ESCON channels
- Two ESCDs
- An ESCON Adapter, with Four Ports feature for each of the 3990s
- The Enterprise Systems Connection Manager (ESCM) licensed program

Company B will use this configuration to do normal testing of hardware and software upgrades, and to get accustomed to operating in an Enterprise Systems Connection environment before using them in production.

When the testing is completed, Company B is ready to move the workload from host D to the new host and to install the ESCON-capable 3990s.

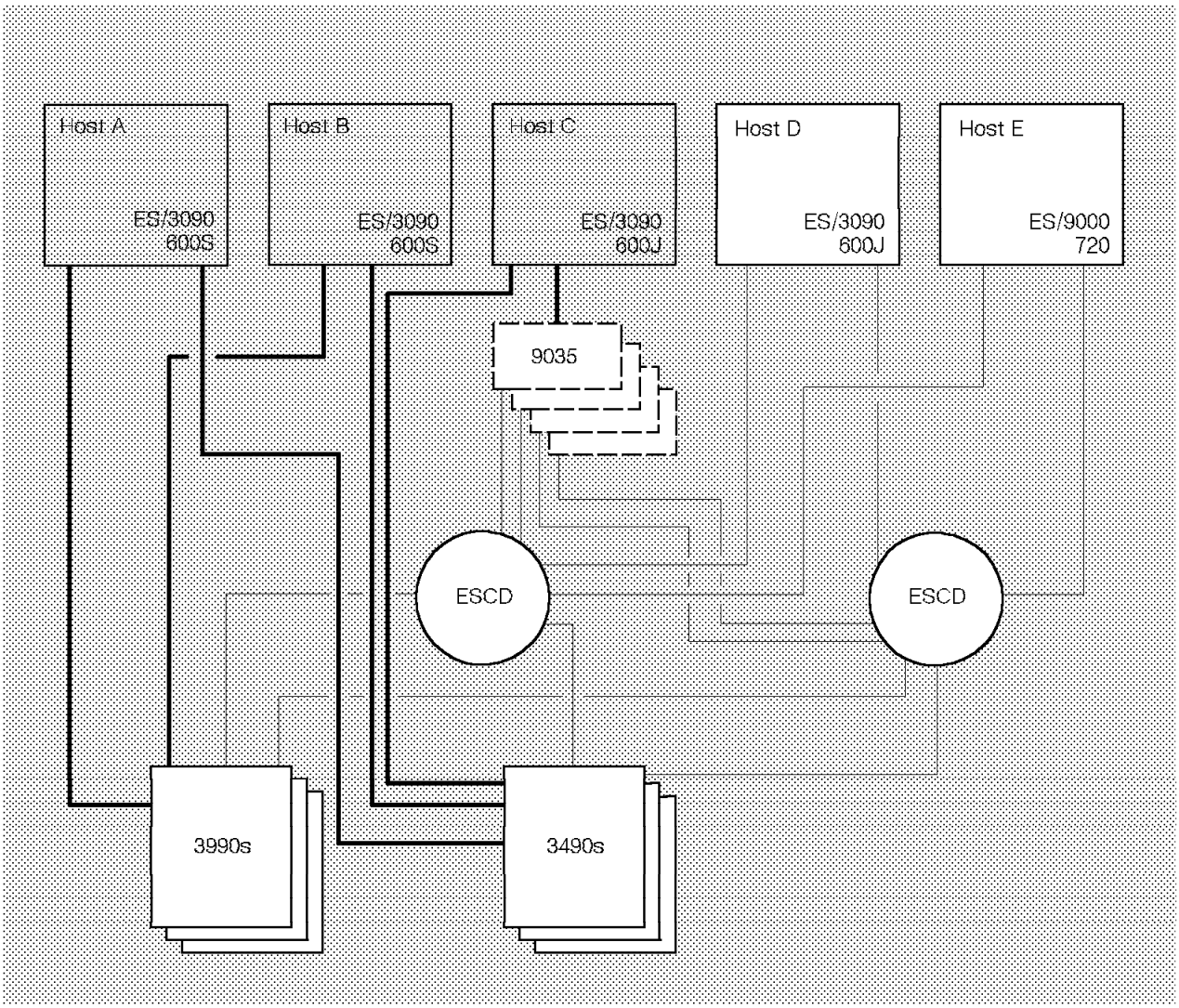


Figure 62. Company B's Phases 3: Upgrading the First ES/3090 600J with ESCON channels

Company B's Phase 3: Installing 3990s with ESCON Capability and Putting Host E into Production

Company B now puts host E into production running host D's workload as indicated in Figure 62.

Company B installs the ESCON port features on the 3990s, providing eight ESCON ports at the 3990 and attachment to host E through the ESCD. Installation of any ESCON ports displaces eight parallel ports, but retains eight parallel ports so that the 3990 can continue to serve hosts A and B. Company B installs 9035s to attach ESCON ports on 3990s to host C's parallel channels. The 3990s are attached to hosts C, D, and E through the ESCDs.

In all cases, each 3990 will have four physical paths to each of the five processors, even though it has only 16 ports. Eight of the channel attachments continue to be used for parallel hosts A and B. Four each of the ESCON ports are connected to an ESCD. Each ESCD has four paths to each processor. (The

paths to the non-ESCON environment on host C, however, provide only parallel channel speeds and protocols.)

Allocating the eight possible 3990 logical paths among the 12 possible physical ESCON paths can be done through the Enterprise Systems Connection Manager on either of the two ESCON-enabled hosts.

Host C is a heavy user of this DASD, so four 9035s have been installed to continue providing four-way pathing to these 3990s.

If Company B wanted to have simultaneous connectivity with applications in Hosts D and E, it would use the ESCM to configure the number of logical paths to each processor (perhaps two each to D and E) since the 3990 has only eight ESCON environment logical paths that it can use. (Later, when the bus-and-tag attachments are no longer needed, it can devote all 16 logical paths to ESCON environment paths. It will still have fewer logical paths than it needs for four concurrent paths to five processors but can use ESCM to configure the paths to where they are desired.)

Company B installs ESCON channels on the ES/3090 model 600J (host D). Attachment of host D′s ESCON channels to the ESCDs allows host D to connect to the 3990s.

At the same time, Company B upgrades the 3490s to have ESCON ports as indicated in Figure 62 on page 190. Upgrading the 3490s with ESCON ports requires the removal of four parallel ports, reducing the connectivity to hosts A, B, and C from two paths each (six total) to four paths between them. Company B could allocate two paths to host C and reduce the paths to hosts A and B to one each. But in practice, Company B will actually configure the 3490s so that not all 3490s are configured to all hosts A, B, and C. Each of these hosts to which a 3490 is attached will have two paths. And hosts D and E have two paths through the ESCDs.

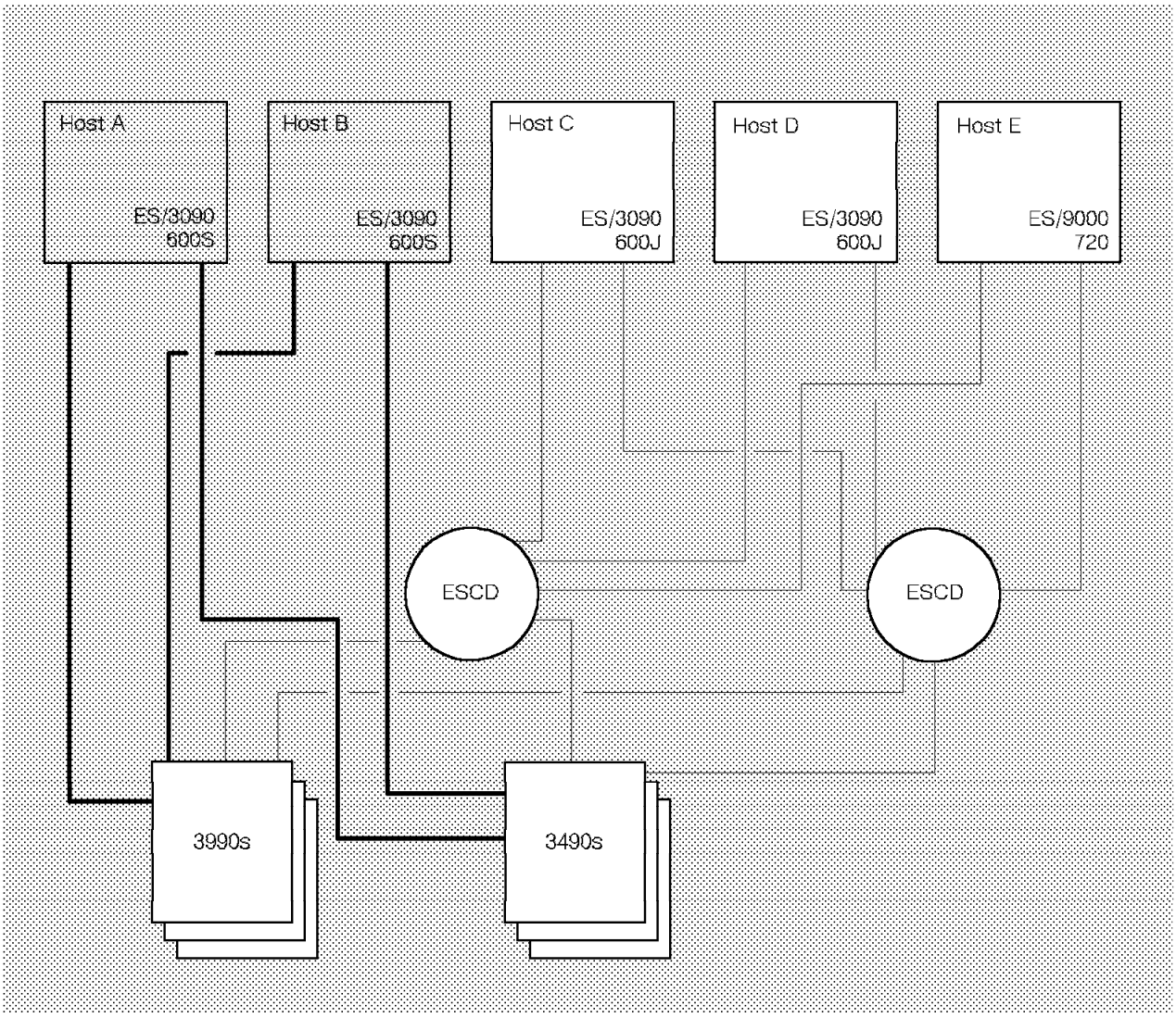


Figure 63. Company B's Phase 4: Upgrading the Other ES/3090 600J with ESCON Channels

Company B's Phase 4: Upgrading the other ES/3090 600J with ESCON Channels

Upgrade of the last of the ESCON-capable processors is nondisruptive to the other processors, since the channel connections are now made to planned spare ports on the ESCDs as indicated in Figure 63.

The 3990 attachment through 9035s is removed. Host C gets connection through the ESCON ports used for attachment to the ESCDs. The 3990 should be reconfigured to release logical paths reserved for 9035 physical paths.

The connectivity problems for attachment of the 3490s are removed at this point. The remaining four parallel ports can attach to hosts A and B. The 3490s in this configuration have 32 logical paths to which the ESCON channels from the three other processors can attach.

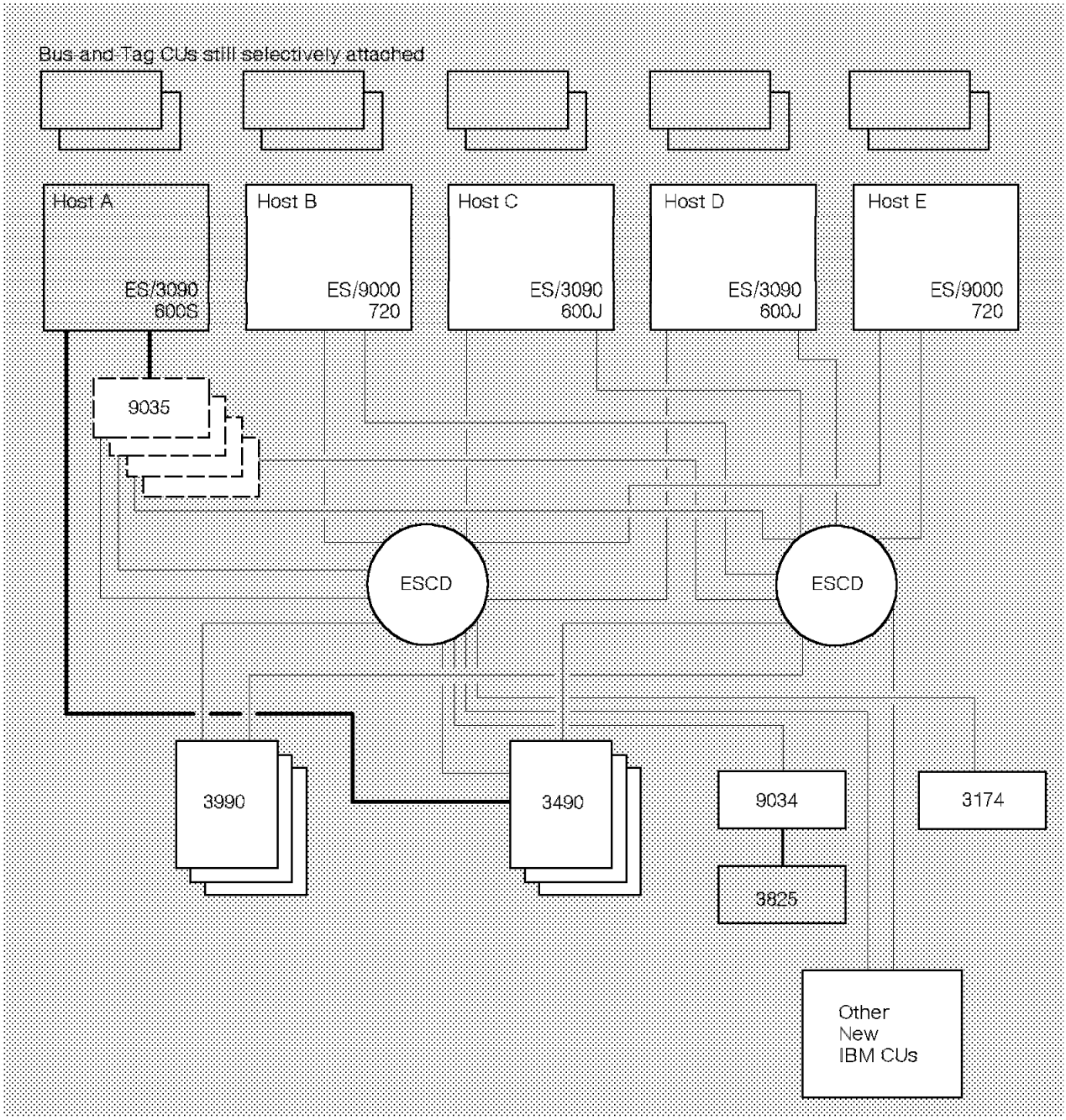


Figure 64. Company B's Phase 5: Replacing the First ES/3090 600S with an ES/9000 720

Company B′s Phase 5: Replacing One of the ES/3090 600Ss with an ES/9000 model 720

Replacement of the ES/3090 600S can be nondisruptive to the other hosts if Company B decides to leave parallel ports on the 3990s. They may not want to do this because the parallel ports limit the number of available ESCON logical paths on the 3990 to eight, rather than the possible 16. Since Company B already has 9035s on the shelf, they can convert the remaining 3990 ports to ESCON and cable the 9035s to host A′s parallel channels (refer to Figure 64).

Company B′s Phase 6: Replacing the last ES/3090 600S with an ES/9000 Water-Cooled Frame Model 720

As Company B replaced hosts with processors that support Enterprise Systems Connection environment, it gained connection benefits:

- The addition of new system images to a control unit is nondisruptive to existing images.
- ESCM allows control of logical paths to control units
- Company B will now be in the position to add new processors, channels, and control units more easily in the future and with less disruption to current users.

An Enterprise Consolidating Several Smaller Images

Company C has two host processors (shown in Figure 65 on page 196):

- One with VSE
- The other with VM/SP running with two main environments:
  - MVS/XA production
  - Programming and office mail applications.

Company C's primary needs are to consolidate these multiple systems' images into one processor with central control of their various hardware and software needs.

Initial Configuration and Plans

Company C has different DASD and tape devices for VSE than it does for the VM and MVS.

For the MVS guest, VM manages the 3880s with 3380 standards and 3420 tapes.

Company C has been searching and not yet committed to a processor solution for this consolidation need.

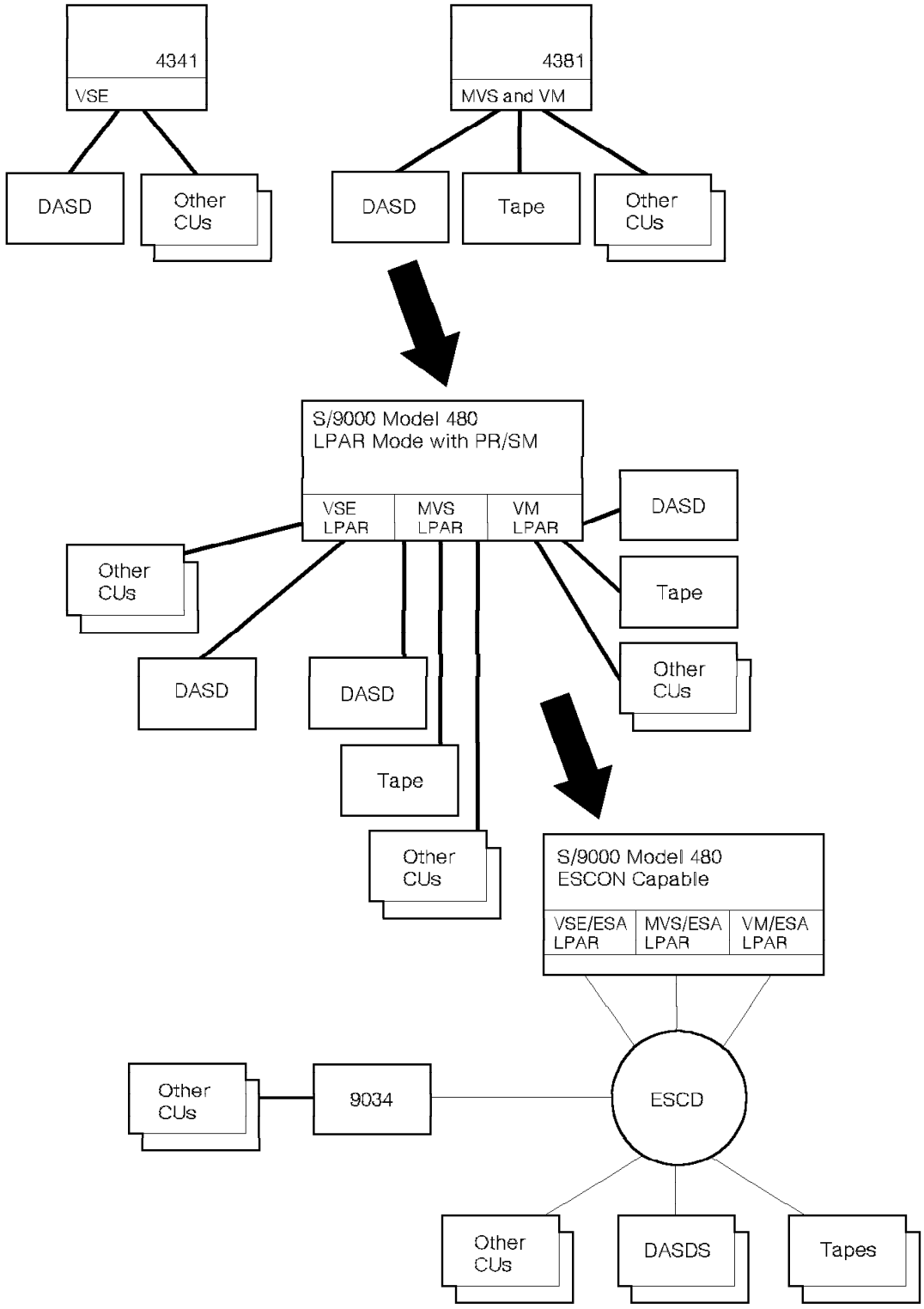


Figure 65. Company C's Migration Plan

New Plans for the ESCON Environment

After considering the ESCON products and the ES/9000 Air-Cooled Frame model offerings, Company C′s information system personnel are planning for LPAR on an ES/9000 Air-Cooled Frame model.

Cabling System: Company A plans to delay installation of fiber optics until later. They have a relatively small computer complex and will be able to run fiber jumper cables later with little trouble.

Processor: Company C decides that the ES/9000 Air-Cooled Frame model will provide a solid bridge supporting the control units from the 4341 and 4381, while offering a pathway to better control unit solutions and Enterprise Systems Connection advantages of fiber and connectivity through the ESCD. The ES/9000 will be ordered with System/370 channels initially, and later will be upgraded with ESCON channels to allow attachment of both existing control units and ESCON-capable control units.

Data Storage: Company C plans to attach the existing DASD and configure it under PR/SM to each of the separate LPARs as appropriate. Then, as they begin to get the SCP levels up to ESA capability, they can upgrade to DASD control units which can be Enterprise Systems Connection attached and shared.

Other Control Units: Company C plans to use existing bus-and-tag 3174, printer, and tape control units in the near term until they complete their migration to the new software levels. As soon as they can, they will migrate to ESCON-capable 3174s, 3490s, and 3990s, allowing them to stabilize on a common control unit solution across system control programs.

Migration Plans: The new plan calls for a three-stage migration to a data center that uses Enterprise Systems Connection capability. The stages are:

1. Installing and testing the existing cabling, hardware, and software on the new ES/9000 Air-Cooled Frame model.
2. Upgrading the SCP levels one by one to their ESA versions.
3. Field-installing ESCON channels on the processor and ESCON-capable control units.

Company C plans to carry out this migration so that productive operation continues with minimal disruption.

Appendix A. Enterprise Systems Connection/390-Support Publications

The publications in this appendix have been grouped as follows:

- Introductory (conceptual) publications
- Planning publications
- Other related publications.

A publication that combines introductory and planning information is listed in both sections.

Within a table, an "I" (I) by an order number indicates that a copy of this publication is included when you order a set of introductory publications (GBOF-3786). A "P" (P) by an order number indicates that a copy of this publication is included when you order a set of planning publications (GBOF-3753).

Introductory Publications

Table 20. ESCON Introductory Publications

Product(s)	Publication	Order Number
Enterprise Systems Connection	*Introducing Enterprise Systems Connection*	GA23-0383 I
ES Connection Analyzer	*Introducing and Planning for the Enterprise Systems Connection Analyzer*	GA23-0384 P
ES Connection Converter (9034)	*Introducing the 9034 Enterprise Systems Connection Converter*	GA23-0361 I
ES Connection Converter (9035)	*Introducing the 9035 Enterprise Systems Connection Converter*	GA23-0392 I
ES Connection Directors (9032 and 9033)	*Introducing Enterprise Systems Connection Directors*	GA23-0363 I
ES Connection Manager	*Introducing the Enterprise Systems Connection Manager*	GC23-0422 I
ES Connection Monitor System	*Introducing the Enterprise Systems Connection Monitor System*	GA23-0387 I
Sysplex Timer (9037)	*Planning for the 9037 Sysplex Timer*	GA23-0365 P
Token-Ring	*IBM Token-Ring Network: Introduction and Planning Guide*	GA27-3677
ES/3090 Processor Complex	*ES/3090 Processor Complex S-Models Functional Characteristics*	SA22-7127
ES/3090 J- and -9000T Models	*Functional Characteristics and Configuration Guide*	GA22-7135
3172 Interconnect Controller	*3172 Interconnect Controller Planning Guide*	GA27-3867
3174 Establishment Controller	*IBM 3174 Establishment Controller Model 12L and 22L Customer Information Supplement*	GD21-0039
3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04	*IBM 3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04 Introduction*	GA32-0125
3490 Magnetic Tape Subsystem Models D31 and D32	*IBM 3490 Magnetic Tape Subsystem Models D31 and D32 Introduction*	GA32-0123
3990 Storage Control	*3990 Storage Control Introduction* *Introduction to Nonsynchronous Direct Access Storage Systems*	GA32-0098 GC26-4519
ES/9000 Processors		
• Models 120, 130, 150, and 170	• *Introducing the System*	GA24-4186
• Processor Complex Models 190, 210, 260, 320, 440, and 480	• *Introducing the Processor Functional Characteristics*	GA23-0380
• Processor Complex Models 330, 340, 500, 580, 620, and 720	• *Functional Characteristics and Configuration Guide*	GA22-7138
• Processor Complex Models 820 and 900	• *Functional Characteristics and Configuration Guide*	GA22-7139

Planning Publications

Table 21 lists the planning publications.

Table 21. ES Connection Planning Publications

Product(s)	Publication	Order Number
ES Connection Analyzer	*Introducing and Planning for the Enterprise Systems Connection Analyzer*	GA23-0384 P
ES Connection Converter (9034)	*Planning for the 9034 Enterprise Systems Connection Converter*	GA23-0362 P
ES Connection Converter (9035)	*Planning for the 9035 Enterprise Systems Connection Converter*	GA23-0393 P
ES Connection Director (9032)	*Planning for the 9032 Enterprise Systems Connection Director*	GA23-0364 P
ES Connection Director (9033)	*Planning for the 9033 Enterprise Systems Connection Director*	GA23-0372 P
ES Connection Links	*Planning for Enterprise Systems Connection Links* *Enterprise Systems Connection Link Fault Isolation*	GA23-0367 P SY22-9533
ES Connection Manager	*Planning for the Enterprise Systems Connection Manager*	GC23-0423 P
ES Connection Monitor System	*Planning for the Enterprise Systems Connection Monitor System*	GA23-0388 P
Processor I/O	*System/360, System/370, 4300 Processors Input/Output Equipment Installation Manual—Physical Planning*	GC22-7064
Sysplex Timer (9037)	*Planning for the 9037 Sysplex Timer*	GA23-0365 P
Token-Ring	*IBM Token-Ring Network: Introduction and Planning Guide*	GA27-3677
ES/3090 Processor Complex	*ES/3090 Processor Complex: Installation Manual—Physical Planning*	SA22-7080
ES/3090 J- and -9000T Models	*Functional Characteristics and Configuration Guide*	GA22-7135
3172 Interconnect Controller	*IBM 3172 Interconnect Controller Planning Guide*	GA27-3867
3174 Establishment Controller	*IBM 3174 Establishment Controller Planning Guide Configuration B*	GA27-3862
3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04	*IBM 3490 Magnetic Tape Subsystem Models A01, A02, B02, and B04 Planning and Migration Guide*	GC35-0116
3490 Magnetic Tape Subsystem Models D31 and D32	*IBM 3490 Magnetic Tape Subsystem Models D31 and D32 Planning and Migration Guide*	GC35-0117
3990 Storage Control	*IBM 3990 Storage Control Planning, Installation, and Storage Administration Guide*	GA32-0100
ES/9000 Processors		
• Models 120, 130, 150, and 170	• *Planning the System*	GA24-4187
• Processor Complex Models 190, 210, 260, 320, 440, and 480	• *Introducing the Processor Functional Characteristics*	GA23-0380
• Processor Complex Models 330, 340, 500, 580, 620, and 720	• *Functional Characteristics and Configuration Guide*	GA22-7138
• Processor Complex Models 820 and 900	• *Functional Characteristics and Configuration Guide*	GA22-7139

Other Related Publications

Publication	Order Number
ES/9000 Processor Complex, ES/3090 Processor Complex: Input/Output Configuration Program User Guide	SC38-0097
IBM Enterprise System/9000 Processor Models 190, 210, 260, 320, 440, and 480 Installation Manual—Physical Planning	GC22-7084
IBM Enterprise System/9000 Processor Models 330, 340, 500, 580, 620, 720, 820, and 900 Installation Manual—Physical Planning	GC22-7083
IBM ESA/390 ESCON Channel-to-Channel Adapter	*
IBM ESA/390 Principles of Operation	*
IBM ES/3090 Processor Complex: Installation Manual—Physical Planning	GC22-7080
IBM General Information Manual: Installation Manual—Physical Planning	GC22-7072
IBM Processor Controller Element—LAN Support: Description/Installation/Operation	GA23-0385
IBM S/360 and S/370 Power Control Interfaces Original Equipment Manufacturer's Information Manual	GA22-6906
IBM System/360, System/370, 4300, and 9370 Processors Input/Output Equipment Installation Manual—Physical Planning	GC22-7064
IBM System/370 Installation Manual—Physical Planning	GC22-7004
IBM System/370 3090 Processor Complex: Installation Manual—Physical Planning	GC22-7074
IBM 3390 Direct Access Storage Migration Guide	G320-9807
International Electrotechnical Commission (IEC) Standard 320	
MVS/ESA Migration Planning: Dynamic I/O Configuration (V4)	GC28-1674
MVS/ESA System Programming Library: System Management Facilities	GC28-1628
Using the Enterprise Systems Connection Analyzer	GA23-0386
Using IBM 3390 Direct Access Storage in an MVS Environment	GC26-4574
Using IBM 3390 Direct Access Storage in a VM Environment	GC26-4575
Using IBM 3390 Direct Access Storage in a VSE Environment	GC26-4576

* Order numbers for these publications were not available at time of this publication.

Glossary

This glossary includes terms and definitions from the *Dictionary of Computing*, SC20-1699. It also includes definitions developed by the American National Standards Institute (ANSI), the Electronic Industries Association (EIA), and the International Organization for Standardization (ISO). ANSI/EIA definitions for optical fiber terms used verbatim are shown by an (A).

A

access method. A technique for moving data between main storage and input/output devices.

active configuration. In an Enterprise Systems Connection Director, the configuration determined by the status of the currently active set of connectivity attributes. Contrast with *saved configuration*.

adapter. (1) A general term for a device that provides some transitional function between two or more devices. (2) In an Fiber Channel Link Environment, hardware used to join different connector types.

address. (1) A value that identifies a register, a particular part of storage, a data source, or a data sink. The value is represented by one or more characters. (2) To refer to a device or an item of data by its address. (3) The location in the storage of a computer where data is stored. (4) In data communication, the unique code assigned to each device or workstation connected to a network. (5) The identifier of a location, source, or destination.

alert. (1) In the IBM Token-Ring Network Manager, a notification appearing on the bottom line of any panel to show an interruption or a potential interruption in the flow of data around the ring. (2) In NetView, a notification about a high-priority event that warrants immediate attention. This data base record is generated for certain event types that are defined by user-constructed filters.

allowed. In an Enterprise Systems Connection Director, the attribute that, when set, establishes dynamic connectivity capability. Contrast with *prohibited*.

APAR. Authorized program analysis report.

application. (1) The use to which an information processing system is put; for example, a payroll application, an airline reservation application, a network application. (2) A collection of software components used to perform specific types of work on a computer.

application program. (1) A program written for or by a user that applies to the user's work, such as a program that does inventory control or payroll. (2) A program used to connect and communicate with stations in a network, enabling users to perform application-oriented activities.

authorized program analysis report (APAR). A report of a problem caused by a suspected defect in a current unaltered release of a program.

B

bandwidth. (1) The difference, expressed in hertz, between the highest and the lowest frequencies of a range of frequencies. (2) In fiber optics, see *modal bandwidth*.

batch. Pertaining to a program or operation that is performed with little or no interaction between the user and the system. Contrast with *interactive*.

blocked. In an Enterprise Systems Connection Director, the attribute that, when set, removes the communication capability of a specific port. Contrast with *unblocked*.

bridge. (1) An attaching device that connects two LAN segments to allow the transfer of information from one LAN segment to the other. A bridge can connect the LAN segments directly by network adapters and software in a single device, or can connect network adapters in two separate devices through software and use of a telecommunications link between the two adapters. (2) A functional unit that connects two LANs that use the same logical link control (LLC) procedures, but can use the same or different medium access control (MAC) procedures. Contrast with *gateway* and *router*.

bus. (1) In a processor, a physical facility on which data is transferred to all destinations, but from which only addressed destinations can read in accordance with appropriate conventions. (2) A network configuration in which nodes are interconnected through a bidirectional transmission medium. (3) One or more conductors used for transmitting signals or power.

byte. (1) A string that consists of a number of bits, treated as a unit, and representing a character. (2) A binary character operated upon as a unit and usually shorter than a computer word. (3) A string that consists of a particular number of bits, usually eight, that is treated as a unit, and that represents a character. (4) A group of eight adjacent binary digits that represent one extended binary-coded decimal interchange code (EBCDIC) character.

C

cable. In fiber optics, see *jumper cable, multifiber cable, optical cable, optical cable assembly,* and *trunk cable*.

chained. Pertaining to the physical attachment of two Enterprise Systems Connection Directors (ESCDs) to each other.

chained ESCD configuration. A system configuration that requires a dedicated connection in one of the ESCDs within that configuration.

channel. (1) A functional unit, controlled by a host computer, that handles the transfer of data between processor storage and local peripheral equipment. (2) The system element that controls a single channel path, whose mode of operation depends on the type of hardware to which it is attached.

channel-attached. Pertaining to attachment of devices directly by data channels (I/O channels) to a computer. Synonym for *local*. Contrast with *telecommunication-attached*.

channel path. A single interface attaching one or more control units.

channel-path identifier (CHPID). In a channel subsystem, a value assigned to each installed channel path of the system that uniquely identifies that path to the system.

channel subsystem. A collection of subchannels that directs the flow of information between I/O devices and main storage, relieves the processor of communication tasks, and does path management functions.

CHPID. Channel path identifier.

CICS. Customer Information Control System.

cladding. In a fiber optic cable, the optical material surrounding the core of an optical fiber. (A) See also *core* and *optical fiber*.

column. A vertical arrangement of data. Contrast with *row*.

command. (1) A request for system action. (2) A request from a terminal for the performance of an operation or the execution of a particular program. (3) A value sent on an I/O interface from a channel to a control unit that specifies the operation to be performed.

configuration. In an Enterprise Systems Connection Director, the physical interconnection capability determined by a set of attributes. The attribute values specify the connectivity control status and identifiers associated with the ESCD and its ports. See also *active configuration, configuration matrix, connectivity attributes,* and *saved configuration*.

configuration matrix. In an Enterprise Systems Connection Director, an array of connectivity attributes, displayed in rows and columns, that can be used to alter both active and saved configurations.

connected. In an Enterprise Systems Connection Director, the attribute that, when set, establishes a dedicated connection. Contrast with *disconnected*.

connection. In an Enterprise Systems Connection Director, an association established between two ports that provides a physical communication path between them.

connectivity capability. (1) Pertaining to a device attachment method that does not require physical reconfiguration of devices or their interconnections. (2) In an Enterprise Systems Connection Director, pertaining to the ability of manipulating link connections to provide device attachment. See also *connectivity control, dynamic connection,* and *matrix*.

connectivity control. In an Enterprise Systems Connection Director, the method used to alter a port's connectivity attributes, thereby determining the communication capability of the link attached to that port.

connector. See *optical fiber connector*.

controller. A unit that controls input/output operations for one or more devices.

control unit. A general term for any device that provides common functions for other devices or mechanisms. Synonym for *controller*.

conversion. (1) In programming languages, the transformation between values that represent the same data item but belong to different data types. Information can be lost through conversion because accuracy of data representation varies among different data types. (2) The process of changing from one method of data processing to another or from one data processing system to another. (3) The process of changing from one form of representation to another; for example, to change from decimal representation to binary representation.

core. (1) In a fiber optic cable, the central region of an optical fiber through which light is transmitted. (A) (2) In a fiber optic cable, the central region of an optical fiber that has an index of refraction higher than the surrounding cladding material. (A) See also *cladding* and *optical fiber*.

COS. Customized Operational Services.

coupler. In an Fiber Channel Link Environment, hardware used to join identical connector types.

Customer Information Control System (CICS). An IBM licensed program that enables transactions entered at remote terminals to be processed concurrently by user-written application programs. It includes facilities for building, using, and maintaining data bases.

Customized Operational Services (COS). Part of the IBM National Service Division (NSD) Site Management Services Portfolio that provides contractual installation planning services.

D

data base. A set of data, part or the whole of another set of data, that consists of at least one file, and that is sufficient for a given purpose or for a given data processing system.

data processing (DP). The systematic performance of operations upon data; for example, handling, merging, sorting, computing.

data streaming. A protocol for transmitting data on a channel. In this protocol, the sender continues to transmit data without waiting for acknowledgement of receipt of the data.

data transfer. (1) The result of the transmission of data signals from any data source to a data receiver. (2) The movement, or copying, of data from one location and the storage of the data at another location.

data transfer mode. The method of data transfer between a host computer and a channel-attached device.

dedicated connection. In an Enterprise Systems Connection Director, a connection between two ports that is not affected by information contained in the link frames. This connection, which restricts those ports from communicating with any other port, can be established or removed only as a result of actions performed by a host control program or at the ESCD console. Contrast with *dynamic connection*.

Note: The two links having a dedicated connection appear as one continuous link.

default. Pertaining to an attribute, value, or option that is assumed when none is explicitly specified.

destination. Any point or location, such as a node, station, or a particular terminal, to which information is to be sent.

destination address. A code that identifies the location to which information is to be sent. Contrast with *origin address*.

device. A mechanical, electrical, or electronic contrivance with a specific purpose.

disconnected. In an Enterprise Systems Connection Director, the attribute that, when set, removes a dedicated connection. Contrast with *connected*.

diskette. A flexible magnetic disk enclosed in a protective container.

diskette drive. The mechanism used to seek, read, and write data on a diskette.

Disk Operating System. An operating system for computer systems that use disks and diskettes for auxiliary storage of programs and data.

display. See *display device, display image,* and *display screen*.

display device. A device that presents information on a screen. See also *display screen*.

display field. (1) An area in the display buffer that contains a set of characters that can be manipulated or operated on as a unit. (2) A group of consecutive characters (in the buffer) that starts with an attribute character (defining the characteristics of the field) and contains one or more alphanumeric characters. The field continues to, but does not include, the next attribute character.

display image. Information, pictures, or illustrations that appear on a display screen. See also *display device*.

display screen. The surface of a display device on which information is presented to a user. See also *display image*.

distribution panel. In an Fiber Channel Link Environment, a panel that provides a central location for the attachment of trunk and jumper cables and can be mounted in a rack, wiring closet, or on a wall. Synonymous with *patch panel*.

domain. (1) The network resources under control of a particular system services control point (SSCP). (2) In SNA, an SSCP and the physical units, logical units, links, link stations, and all associated resources that the SSCP is able to control through activation requests and deactivation requests.

duplex. Pertaining to communication in which data can be sent and received at the same time. Synonymous with *full duplex*.

duplex connector. In an Fiber Channel Link Environment, the component that terminates both jumper cable fibers in one housing and provides physical keying for attachment to a duplex receptacle.

dynamic connection. (1) A connection that is established when needed rather than being predetermined or fixed. (2) In an Enterprise Systems Connection Director, a connection between two ports, established or removed by the ESCD and that, when active, appears as one continuous link. The duration of the connection depends on the protocol defined for the frames transmitted through the ports and on the state of the ports. Contrast with *dedicated connection*.

dynamic connectivity. In an Enterprise Systems Connection Director, the capability that allows connections to be established and removed at any time.

E

electromagnetic interference (EMI). A disturbance in the transmission of data on a network resulting from the magnetism created by a current of electricity.

EMI. Electromagnetic interference.

entry field. An area on a screen or in a window, usually with its boundaries shown, into which a user types information.

ESCD console. The ESCD input/output device used to perform connectivity tasks at the ESCD.

ESCD console adapter. The adapter in the ESCD console that provides the hardware attachment between the ESCD and the ESCD console.

ESCON. Enterprise Systems Connection.

event. (1) An occurrence or happening. (2) An occurrence of significance to a task; for example, the completion of an asynchronous operation, such as an input/output operation.

F

fault. An accidental condition that causes a functional unit to fail to perform its required function.

feature. A part of an IBM product that can be ordered separately by the customer.

fiber. See *optical fiber*.

fiber bandwidth. Synonym for *modal bandwidth*.

fiber optic cable. See *optical cable*.

fiber optics. The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica, and plastic. (A)

Note: Telecommunication applications of fiber optics use optical fibers. Either a single discrete fiber or a nonspatially aligned fiber bundle can be used for each information channel. Such fibers are often called *optical fibers* to differentiate them from fibers used in noncommunication applications.

field. See *display field, entry field, protected field,* and *selection field*.

fixed disk. A rigid magnetic disk used in a fixed disk drive.

frame. Data transported from one node to another in a particular format that can be recognized by the receiving node. Besides data or information fields, a frame uses a delimiter to mark its beginning and end. Usually, a frame also has control fields, address information that identifies the source and destination, and one or more check bits that allow the receiver to detect any errors that occur after the sender has transmitted the frame.

full duplex. Synonym for *duplex*.

G

gateway. A device and its associated software that interconnect networks or systems of different architectures. The connection is usually made above the reference model network layer. For example, a gateway allows LANs access to System/370 host computers. Contrast with *bridge* and *router*.

group. (1) A set of related records that have the same value for a particular field in all records. (2) A collection of users who can share access authorities for protected resources. (3) A list of names that are known together by a single name.

H

help. (1) A choice that allows a user to select various kinds of help information. (2) A standard pushbutton that provides information about the item on which the cursor is positioned or about the entire pop-up window.

help information. Information displayed to assist a user.

host (computer). (1) In a computer network, a computer that provides end users with services such as computation and data bases and that usually performs network control functions. (2) The primary or controlling computer in a multiple-computer installation.

host system. The controlling system in a data communication configuration.

I

ID. Identifier.

identifier (ID). (1) One or more characters used to identify or name a data element and possibly to show certain properties of that data element. (2) In an Enterprise Systems Connection Director, a user-defined symbolic name of 24 characters or less that identifies a particular ESCD. See also *password identifier* and *port address name*.

initialize. To prepare a system, device, or program for operation.

input/output (I/O). (1) Pertaining to a device whose parts can perform an input process and an output process at the same time. (2) Pertaining to a functional unit or channel involved in an input process, output process, or both, concurrently or not, and to the data involved in such a process. (3) Pertaining to input, output, or both.

input/output configuration data set (IOCDS). A configuration definition built by the I/O Configuration Program (IOCP) and stored on disk files associated with the processor controller.

Input/output configuration program (IOCP). The program that defines the I/O configuration data required by the processor complex to control I/O requests.

interactive. Pertaining to a program or system that alternately accepts input and then responds. An interactive system is conversational; that is, a continuous dialog exists between user and system. Contrast with *batch*.

Interactive System Productivity Facility (ISPF). An IBM licensed program that serves as a full-screen editor and dialog manager. Used for writing application programs, it provides a means of generating common display screens and interactive dialogs between the application programmer and the terminal user.

interface. (1) A shared boundary between two functional units, defined by functional characteristics, common physical interconnection characteristics, signal characteristics, and other characteristics as appropriate. (2) A shared boundary. An interface can be a hardware component to link two devices or a portion of storage or registers accessed by two or more computer programs. (3) Hardware, software, or both, that links systems, programs, or devices.

I/O. Input/output.

IOCDS. I/O configuration data set.

I/O configuration. The collection of channel paths, control units, and I/O devices that attaches to the processor unit.

IOCP. I/O configuration program.

I/O interface. The interface that connects channels and control units for the exchange of signals and data.

I/O support processor. The hardware unit that provides I/O support functions for the primary support processor and maintenance support functions for the processor controller element.

ISPF. Interactive System Productivity Facility.

J

jumper cable. In an Fiber Channel Link Environment, a duplex fiber optic cable that provides physical attachment between two devices or between a device and a distribution panel. Contrast with *trunk cable*.

L

LAN. Local area network.

link. In an I/O interface, the physical connection and transmission medium used between a channel and a control unit, a channel and an Enterprise Systems Connection Director, a control unit and a ESCD or, at times, between two ESCDs. A link consists of two conductors, one used for sending and the other for receiving, thereby providing a duplex communication path.

link address. An address assigned at initialization that identifies a channel or control unit and allows it to send and receive frames and perform I/O operations. See also *port address*.

local. Pertaining to a device accessed directly without use of a telecommunication line. Synonym for *channel-attached*. Contrast with *remote*.

local area network (LAN). A computer network located on a user′s premises within a limited geographical area.

Note: Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary can be subject to some form of regulation.

M

maintenance analysis procedure (MAP). A step-by-step procedure for tracing a symptom to the cause of a failure.

MAP. Maintenance analysis procedure.

mark. A symbol or symbols that indicate the beginning or the end of a field, a word, an item of data or a set of data such as a file, record, or block.

master console. In a system with multiple consoles, the console used for communication between the operator and the system.

matrix. In an Enterprise Systems Connection Director, hardware used to establish and remove port connections. See also *configuration matrix*.

Mb. Megabit.

MB. Megabyte.

megabit (Mb). A unit of measure for throughput. 1 megabit = 1 048 576 bits.

megabyte (MB). A unit of measure for data. 1 megabyte = 1 048 576 bytes.

micrometer. One millionth part of a meter. Synonymous with *micron*.

micron. Synonym for *micrometer*.

modal bandwidth. The lowest frequency at which the magnitude of the fiber transfer function decreases to one-half of the zero frequency value. Synonymous with *fiber bandwidth*.

mode. In any cavity or transmission line, one of those electromagnetic field distributions that satisfies Maxwell's equations and the boundary conditions. The field pattern of a mode depends on wavelength, refractive index, and cavity or waveguide geometry. (A)

modem (modulator/demodulator). A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line, and converts the analog signal received to data for the computer.

monomode optical fiber. Synonym for *single-mode optical fiber*.

multidrop (network). A network configuration in which there are one or more intermediate nodes on the path between a central node and an endpoint node.

multifiber cable. An optical cable that contains two or more fibers. (A) See also *jumper cable, optical cable assembly,* and *trunk cable*.

multimode optical fiber. A graded-index or step-index optical fiber that allows more than one bound mode to propagate. (A) Contrast with *single-mode optical fiber*.

N

NetView. A System/370-based IBM licensed program used to monitor a network, manage it, and diagnose its problems.

network. An arrangement of programs and devices connected for sending and receiving information.

O

operating system. An organized collection of programs that controls the overall operation of a computer.

operator. A person who keeps a system running. Contrast with *user*.

optical cable. A fiber, multiple fibers, or a fiber bundle in a structure built to meet optical, mechanical, and environmental specifications. (A) See also *jumper cable, optical cable assembly,* and *trunk cable*.

optical cable assembly. An optical cable that is connector-terminated. Generally, an optical cable that has been terminated by a manufacturer and is ready for installation. (A) See also *jumper cable* and *optical cable*.

optical fiber. Any filament made of dielectric materials that guides light, regardless of its ability to send signals. (A) See also *fiber optics,* and *optical waveguide*.

optical fiber cable. Synonym for *optical cable*.

optical fiber connector. A hardware component that transfers optical power between two optical fibers or bundles and is designed to be repeatedly connected and disconnected.

optical power. Synonym for *radiant power*.

optical receiver. Hardware that converts an optical signal to an electrical logic signal. Contrast with *optical transmitter*.

optical time domain reflectometer (OTDR). A measurement device used to characterize a fiber wherein an optical pulse is transmitted through the fiber, and the resulting light is scattered and reflected back to the input and is measured as a function of time.

Useful in estimating attenuation coefficient as a function of distance, and identifying defects and other localized losses. (A)

optical transmitter. Hardware that converts an electrical logic signal to an optical signal. Contrast with *optical receiver*.

optical waveguide. (1) A structure capable of guiding optical power. (A) (2) In optical communications, generally a fiber designed to send optical signals. (A) See *optical fiber*. See also *cladding, core, fiber optics, multimode optical fiber, optical fiber,* and *single-mode optical fiber*.

option. (1) A specification in a statement, a selection from a menu, or a setting of a switch, that can be used to influence the execution of a program. (2) A hardware or software function that can be selected or enabled as part of a configuration process. (3) A piece of hardware (such as a network adapter) that can be installed in a device to modify or enhance device function.

origin address. A code that identifies the location from which information is sent. Synonymous with source address. Contrast with *destination address*.

OTDR. Optical time domain reflectometer.

P

parallel channel. A channel having a System/360 and System/370 channel-to-control-unit I/O interface, that uses bus-and-tag cables as a transmission medium.

parameter. (1) A variable that is given a constant value for a specified application and that can denote the application. (2) An item in a menu for which the user specifies a value or for which the system provides a value when the menu is interpreted. (3) Data passed between programs or procedures.

password. A unique string of characters, known to the computer system and a user, that must be specified to gain access to a system and to the information stored within it.

patch panel. Synonym for *distribution panel*.

path. In a network, a route between any two nodes.

port. (1) An access point for data entry or exit. (2) A connector on a device to which a cable or other device is attached.

port address. In an Enterprise Systems Connection Director, an address used to specify port connectivity parameters and to assign link addresses for attached channels and control units. See also *link address*.

port card. In an Fiber Channel Link Environment, a field-replaceable hardware component that provides the opto-mechanical attachment method for jumper cables and performs specific device-dependent logic functions.

POST. Power-On Self-Test.

power. In fiber optics, synonym for *radiant power*.

Power-On Self-Test (POST). A series of diagnostic tests that are run each time the computer′s power is turned on.

preventive maintenance (PM). Maintenance performed specifically to prevent faults from occurring.

primary Enterprise Systems Connection Manager. In multiple ESCM environments, the source of ESCM commands.

problem determination. The process of determining the source of a problem.

product data. In an Enterprise Systems Connection Director, information contained within an electrically-erasable programmable read-only memory (EEPROM) module that defines specific hardware characteristics and can be displayed or modified.

prohibited. In an Enterprise Systems Connection Director, the attribute that, when set, removes dynamic connectivity capability. Contrast with *allowed*.

protected field. An area on a screen or in a window in which a user cannot add, change, or delete information.

protocol. (1) A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. (2) In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. (3) A specification for the format and relative timing of information exchanged between communicating parties.

R

radiant power. In fiber optics, the time rate of flow of radiant energy, expressed in watts. The prefix is often dropped and the term power is used. (A) Synonymous with *optical power*.

receiver. In fiber optics, see *optical receiver*.

remote. Pertaining to a system, program, or device that is accessed through a telecommunication line.

replace. To substitute an item for another; for example, to substitute an existing field-replaceable unit (FRU) with another of the same type.

ring network. A network configuration in which a series of attaching devices is connected by unidirectional transmission links to form a closed path. A ring of an IBM Token-Ring Network is referred to as a LAN segment or as a Token-Ring Network segment.

router. An attaching device that connects two LAN segments, which use similar or different architectures, at the reference model network layer. Contrast with *bridge* and *gateway*.

row. A horizontal arrangement of data. Contrast with *column*.

S

saved configuration. In an Enterprise Systems Connection Director, a stored set of connectivity attributes whose values determine a ESCD configuration that can be used to replace all or part of the configuration currently active. Contrast with *active configuration*.

selection field. An area on a display screen that contains a list of choices from which a user can make a selection.

set. To put something, such as a switch, into a particular position.

single-mode optical fiber. An optical fiber in which only the lowest-order bound mode (which can consist of a pair of orthogonally polarized fields) can propagate at the wavelength of interest. (A) Synonymous with *monomode optical fiber*. Contrast with *multimode optical fiber*.

SNA. Systems Network Architecture.

standard. Something established by authority, custom, or general consent as a model or example.

station. (1) An input or output point of a system that uses telecommunication facilities; for example, one or more systems, computers, terminals, devices, and associated programs at a particular location that can send or receive data over a telecommunication line. (2) A location in a device at which an operation is performed; for example, a read station. (3) In SNA, a link station.

storage. A unit into which recorded text can be entered, in which it can be retained and processed, and from which it can be retrieved.

subsystem. A secondary or subordinate system, or programming support, usually capable of operating independently of or asynchronously with a controlling system.

synchronous. (1) Pertaining to two or more processes that depend on the occurrences of a specific event, such as common timing signal. (2) Occurring with a regular or predictable time relationship.

SYSGEN. System generation.

system. In information processing, a collection of machines, programs, and methods organized to accomplish a set of specific functions.

system configuration. A process that specifies the devices and programs that form a particular data processing system.

system generation (SYSGEN). (ISO) The process of selecting optional parts of an operating system and of creating a particular operating system tailored to the requirements of a data processing installation.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks.

T

table. Information presented in rows and columns.

telecommunication-attached. Pertaining to the attachment of devices by teleprocessing lines to a host processor. Synonym for *remote*. Contrast with *channel-attached*.

time-of-day (TOD) clock. System hardware that provides a consistent measure of elapsed time and operates whether the processing unit is in a running, wait, or stopped state.

TOD. Time of day.

token. A sequence of bits passed from one device to another on the token-ring network that signifies permission to transmit over the network. It consists of a starting delimiter, an access control field, and an end delimiter. The access control field contains a bit that indicates to a receiving device that the token is ready to accept information. If a device has data to send along the network, it appends the data to the token. When data is appended, the token then becomes a frame.

token ring. A network with a ring topology that passes tokens from one attaching device (node) to another. A node that is ready to send can capture a token and insert data for transmission.

token-ring network. (1) A ring network that allows unidirectional data transmission between data stations by a token-passing procedure over one transmission medium so that the transmitted data returns to and is removed by the transmitting station. The IBM Token-Ring Network is a baseband LAN with a star-wired ring topology that passes tokens from network adapter to network adapter. (2) A network that uses a ring topology, in which tokens are passed in a sequence from node to node. A node that is ready to send can capture the token and insert data for transmission. (3) A group of interconnected token rings.

topology. The physical or logical arrangement of nodes in a computer network.

trace. (1) A record of the execution of a computer program. It exhibits the sequences in which the instructions were executed. (2) A record of the frames and bytes transmitted on a network.

transmitter. In fiber optics, see *optical transmitter*.

transparent. (1) Pertaining to operations or data that are of no significance to the user. (2) In data transmission, pertaining to information not recognized by the receiving program or device as transmission control characters.

trunk cable. In an Fiber Channel Link Environment, one or more link segments that do not directly attach to an active device. These segments usually exist between distribution panels and can be located within, or external to, a building. Contrast with *jumper cable*.

U

unblocked. In an Enterprise Systems Connection Director, the attribute that, when set, establishes communication capability for a specific port. Contrast with *blocked*.

user. Anyone who works with a computer system. Contrast with *operator*.

V

version. A separate IBM licensed program, based on an existing IBM licensed program, that usually has significant new code or new function.

virtual machine (VM). A functional simulation of a computer and its associated devices. Each virtual machine is controlled by a suitable operating system; for example, a conversational monitor system. VM controls concurrent execution of multiple virtual machines on one host computer.

virtual storage (VS). (1) The storage space that can be regarded as addressable main storage by the user of a computer system in which virtual addresses are mapped into real addresses. The size of virtual storage is limited by the addressing scheme of the computer system and by the amount of auxiliary storage available, not by the actual number of main storage locations. (2) Addressable space that is apparent to the user as the processor storage space, from which the instructions and the data are mapped into the processor storage locations.

VM. Virtual machine.

VS. Virtual storage.

W

write. To make a permanent or transient recording of data in a storage device or on a data medium.

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