IBM

Enterprise Systems Connection Architecture

Putting computing in a new light

Reference Card

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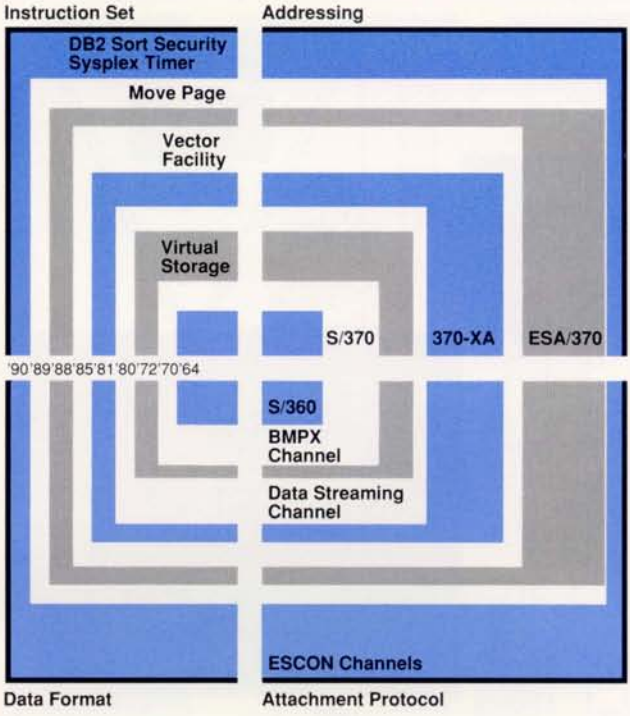
Architecture evolution



Introducing Enterprise Systems Connection Architecture™ (ESCON™)

- ESCON Channels and ESCON Adapters
- Fiber-optic technology
- ESCON hardware/software products
- New IBM services

- **Connectivity**
- **Availability**
- **Distance**
- **Performance**
- **Manageability**

ESCON Architecture

ESCON Architecture is an I/O architecture that utilizes fiber-optic technology and the concept of dynamic connectivity

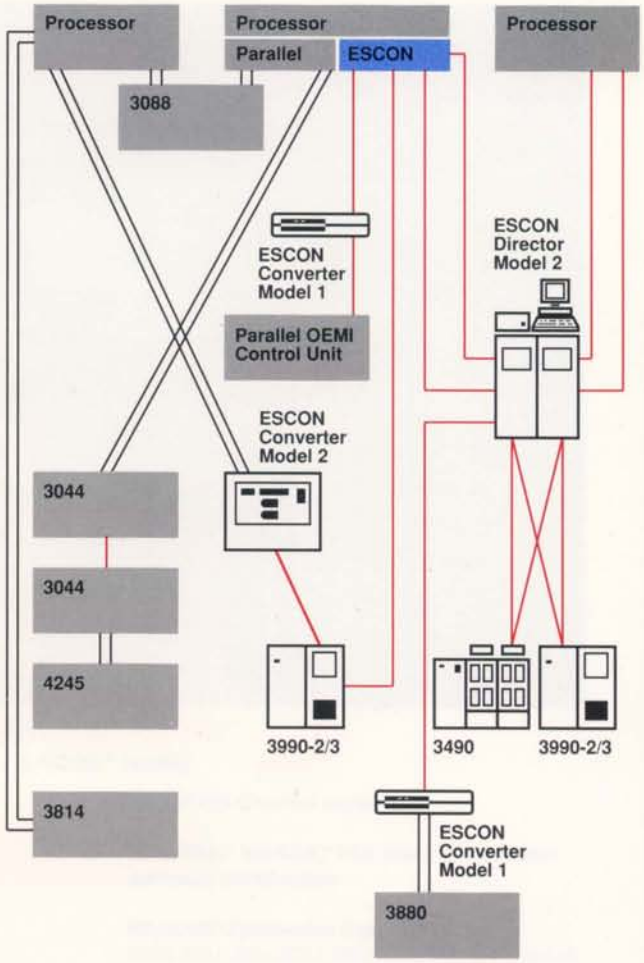
Fiber-optic technology

- Higher data transfer rates (up to 200Mbit/sec.)
- Longer distances (up to 9 km)
- Smaller and lighter
- Higher bandwidth

Dynamic connectivity

- Switched point-to-point topology
- Flexible channel interconnection
- Interconnectivity with other networks

Switched point-to-point topology

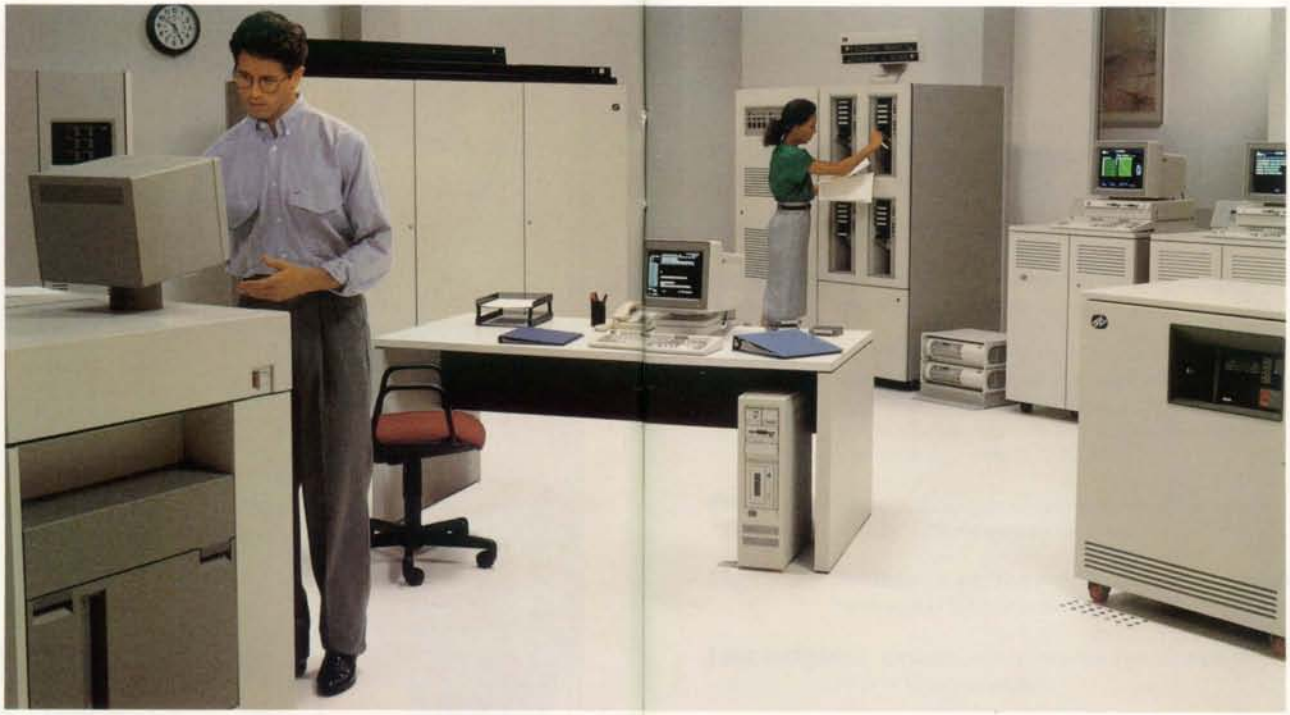


ESCON Channels and parallel channels attached to the same control unit have to be on different images. If you use two ESCDs in tandem, only one will provide dynamic connectivity; the other will be static.

- **New kind of enterprise for the '90s and beyond**
- **Dynamic connectivity**
- **Extended range**
- **Flexibility**

- **Coexistence with bus-and-tag environment**
- **Improved access to multiple hosts**
- **Reduced number of connections and cables**
- **Potential savings in channels and control units**

System family connectivity



ES/9000™ family

All ESCON Channel capable

MVS/ESA,™ VM/ESA,™ VSE/ESA,™ TPF support common architecture

ES/3090™ J processor support
(180J, 200J, 280J, 300J, 380J, 400J, 500J, 600J and all ES/3090-9000T™ models)

Other non-ESCON devices
- ESCC Model 1 (ESCON Channels to parallel OEMI I/O devices)

Other ESCON devices
- ESCC Model 2 (parallel channels to ESCON 3990-2/3)

Fiber-optic technology—basics

Stable technology (uses light-emitting diode [LED] as the light source)

Large bandwidth provides high data rates

Individual link lengths up to 3 km for 62.5-micron fiber (up to 2 km for 50.0-micron fiber)

Cable with two fibers allows for bidirectional light paths. Each fiber core has about the same diameter as a human hair (e.g., a trunk cable may have 72 pairs of fiber and is 12.7mm or ½ inch in diameter and an IBM Jumper Cable has one fiber pair and is 4.8mm or .19 inches)

Trunk cables are highly resistant to harsh environmental conditions (i.e., light, water, temperature and radiation)

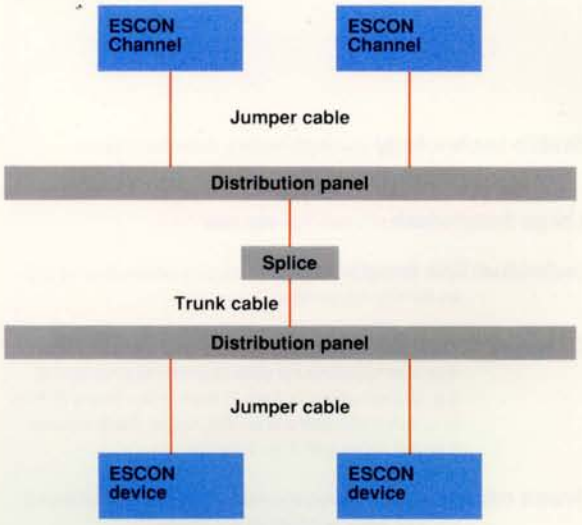
Physically flexible (i.e., IBM Jumper Cable has a minimum installed bend radius of 12mm or ½ inch)

Low weight (i.e., a typical trunk may weigh less than 122 grams per meter or 1.3 ounces per foot)

RAS enhancements

- Not affected by Radio Frequency Interference (RFI), Electromagnetic Interference (EMI), or Radiated Electromagnetic Susceptibility (RES)
- No common ground (signals are not affected by electrical disturbances from ground)
- Does not create an electromagnetic field that can be detected outside the cable
- Small cross talk
- More reliable, lightweight and has easier-to-install keyed connectors

Fiber-optic environment



An **ESCON device** can be an ESCON Channel, an ESCON control unit, an ESCON Director or an ESCON Converter

A **jumper cable** is a duplex (dual-fiber/bidirectional) optical fiber transmission cable used to connect an ESCON Channel to an ESCON device or a distribution panel

A typical **trunk cable** contains multiple optical fibers and is used to connect one distribution panel to another

Fiber-optic cable

Specifications	Jumper cable	Trunk cable
Diameter	62.5/125-micron	62.5/125 or 50.0/125-micron
Number of fibers	2	6 to 144
Use	Indoor only	Outside or within buildings
Splice	Yes (if necessary)*	Yes (if necessary)

*IBM policy is to replace jumper cable.

Environment comparison

Comparison of parallel bus-and-tag and ESCON environments

Characteristics	Parallel (OEMI) bus-and-tag environment	ESCON environment
I/O architecture	System/370™ and ESA/370™ bus-and-tag (parallel bits)	ESCON (serial bits)
Topology	Multipoint and multidrop	Switched point-to-point and point-to-point
Type of cable	Copper	Fiber-optic
Conductors per cable	Up to 40	2
Maximum distance	0.12 km (400 feet)	3 km (9,836 feet), 9 km with 2 ESCDs (with 62.5-micron fiber); 2 km (6,557 feet), 6 km with 2 ESCDs (with 50-micron fiber)
Channel data rate	4.5MB/sec.	10MB/sec.
Cable weight for 122 meters (400 feet)	181 kilograms (400 lbs.)	2.45 kilograms (5.4 lbs.) (IBM Jumper Cable)
Diameter of cable	28.57mm (1.125 inches each; 2 cables required)	4.8mm (0.19 inches) (IBM Jumper Cable)
Control units connectable to a channel	Up to 8	Up to 59 for each ESCD Model 2 connection
Channels connectable to a single control unit	Up to 16	Up to 16
Maximum number of control unit adapters	16 physical (varies by device)	254 logical (varies by device)
Connectivity	Static	Dynamic
Device installation/ removal	Disruptive	Less disruptive

Fiber-optic cables are smaller and lighter, easier to install, less easily disrupted than copper bus-and-tag cables

ESCON Director Model 1 (ESCD)

9033

Functional characteristics

Focal point of Enterprise Systems Connection Architecture
- Implements improved connectivity
- Enables distances up to 9 km*
- Enables configuration growth

High availability
- Fault isolation of attached units from system using ESCON Analyzer

High performance
- Link rate 200Mbit/second
- Multiple concurrent data transfers
- Millions of connects or disconnects/second
- Nonblocking, up to eight simultaneous connections between channel and control unit or channel and channel from another processor

Reconfiguration
- Dedicated ESCD Model 1 console, password-controlled
- ESCM—host control program for management of ESCD

Attachable devices
- ESCON-capable products (3172, 3174, 3490 and 3990-2/3)
- Second ESCD (maximum two ESCDs per path)
- ESCC Model 1 for S/370 non-ESCON control units
- ESCC Model 2 for ESCON 3990-2/3 on S/370 parallel channels

*Assumes 62.5-micron fiber (6 km with 50.0-micron fiber).

ESCON Director Model 2 (ESCD)

9032

Functional characteristics

Focal point of Enterprise Systems Connection Architecture
- Implements improved connectivity
- Enables distances up to 9 km*
- Enables configuration growth

High availability
- Fault-tolerant power and cooling available
- Spare ports provide recovery with minimal disruption
- Fault isolation of attached units from system using ESCON Analyzer

High performance
- Link rate 200Mbit/second
- Multiple concurrent data transfers
- Millions of connects or disconnects/second
- Nonblocking, up to 30 simultaneous connections between channel and control unit or channel and channel from another processor

Reconfiguration
- Dedicated ESCD Model 2 console, password-controlled
- ESCM—host control program for management of ESCD

Attachable devices
- ESCON-capable products (3172, 3174, 3490 and 3990-2/3)
- Second ESCD (maximum two ESCDs per path)
- ESCC Model 1 for S/370 non-ESCON control units
- ESCC Model 2 for ESCON 3990-2/3 on S/370 parallel channels

*Assumes 62.5-micron fiber (6 km with 50.0-micron fiber).

Hardware specifications and characteristics

Specifications for ESCD Models 1 and 2

Functional specifications	ESCD Model 1 (9033)	ESCD Model 2 (9032)
Minimum ports	8	28
Maximum ports	16	60
Increments	4	4
Spare ports	no	0–2*
Max. distance: Channel to ESCD, control unit or 2nd ESCD	3 km with 62.5 fiber 2 km with 50.0 fiber	
Spare power supply	no	yes*
Console	PS/2® or equivalent	
Floorstanding with LED operator panel	no	yes
Rack-mountable	no	no
Link rate	up to 200Mbit/sec.	
Data rate	up to 10MB/sec.	
Concurrent connections	up to 8	up to 30
Audit trail log	yes	yes

*Enhanced availability feature required.

Characteristics and environment for ESCD Models 1 and 2

Physical characteristics	ESCD Model 1 (9033)	ESCD Model 2 (9032)
Width	483mm (19.0")	775mm (30.6")
Depth	713mm (28.1")	650mm (25.6")
Height	225mm (8.9")	1,170mm (46.1")
Weight	38 kg (83.6 lbs.)	205 kg (451 lbs.)
Operating environment	**ESCD Model 1**	**ESCD Model 2**
Temperature	10–40°C (50–105°F)	16–32°C (60–89°F)
Relative humidity	8–80%	8–80%
Max. wet bulb	27°C (80°F)	23°C (72°F)
Power	0.25–0.29 kVA	0.77–1.10 kVA
Heat output	451–519 Btu	1,180–1,980 Btu

Migration support: ESCON Converter Model 1 (ESCC)

Functional characteristics 9034

Coexistence

- System/370 control units utilizing ESCON Channels
- Conversion of fiber-optic protocols to parallel protocols
- One ESCC Model 1 per channel per control unit
- Multidropping of control units downstream acceptable

Attachable devices

- Attaches to an ESCON Channel with or without ESCD
- With ESCD attaches on control unit side only

Extended distances

- See chart on page 16 (varies by control unit type)

Data rate

- ESCC Model 1 has a maximum data rate of 4.5MB/second

Migration support: ESCON Converter Model 2 (ESCC)

Functional characteristics 9035

Coexistence

- System/370 parallel channels utilizing ESCON 3990 Storage Control Unit Model 2 or 3
- Conversion of parallel protocols to fiber-optic protocols
- One ESCC Model 2 per channel per control unit
- ESCC Model 2 can be multidropped from channels

Attachable devices

- Must be directly attached to a S/370 parallel channel
- ESCON 3990 Model 2 or 3

Extended distances

- ESCC Model 2 can be up to 400 feet from the processor
- ESCON 3990 Model 2 or 3 can be up to 3 km with or without ESCD

Data rate

- ESCC Model 2 has a maximum data rate of 4.5MB/second

· Investment protection
· Extended distance
· Reduction in cable bulk

Migration support: ESCC Converter Model 1/ control unit connectivity

ESCC Converter Model 1/control unit connectivity

I/O control units	Distance in km* w/o ESCD	with ESCD
IBM 3990, 1/2/3	1.2	1.0
IBM 3880, 3380 CJ2	0.9	0.7
IBM 3422, 3803, 3480 and 3490	3.0	3.0
IBM 3088 CTC	3.0	3.0
IBM 3203-5, 3262-5, 4245, 4248, 6262 and 3800/25/35/20/27	3.0	3.0
IBM 3172, 3174, 3274, 3720, 3725, 3745	3.0	3.0
IBM 3814/3848	3.0	3.0
IBM 3890/XP	3.0	3.0
IBM 6098/5088	3.0	3.0

*Assumes 62.5-micron fiber (2 km or less with 50.0-micron fiber).

Characteristics and environment for ESCC Models 1 and 2

Physical characteristics	ESCC Model 1	ESCC Model 2
Width	438mm (17.2")	220mm (8.75")
Depth	251mm (9.9")	455mm (18")
Height	112mm (4.4")	180mm (7")
Weight	5.5 kg (12 lbs.)	11.5 kg (25 lbs.)
Operating environment	**ESCC Model 1**	**ESCC Model 2**
Temperature	10–40°C (50–105°F)	10–40°C (50–105°F)
Relative humidity	8–80%	8–80%
Max. wet bulb	27°C (80°F)	27°C (80°F)
Power	.054–.057 kVA	.0745–.0748 kVA
Heat output	96.8–110 Btu	140.8–150.6 Btu

Processor, channels and operating system support

Processor and channel support

	ESCON Channels				
	ES/3090J*	ES/9000			
Specifications	ES/3090 9000T	Models 120-170 one side	Models 190-480 one side	Models 330-720	Models 820-900
Maximum channels/side	64	24**	48**	64**	128
ESCON channels/side					
Minimum	0	0	0	0	16
Maximum	32	24	36**	32	128
Configuration	4-8-16-32	by 1 or 3	by 4	16-32	by 16
CTC capability	YES	YES	YES	YES	YES
Parallel channels/side					
Minimum	16/32**	0	8/12**	16/32**	0
Maximum	64	24**	48**	64**	48
Coexistence	Yes	Yes	Yes	Yes	Yes
Serial channel data rate (MB/sec.)	10	10	10	10	10

*ES/3090J Models 180, 200, 280, 300, 380, 400, 500, 600.
**Model-dependent.

ESCON Manager Version 1.1 operating systems support

MVS/ESA Version 3.1.0E

- Runs in application address space
- Uses VTAM™ for communications
- Dynamic connectivity functions

VM/ESA

- Runs in a virtual machine under Group Control System (GCS)
- Uses VTAM for communications

ESCON software support and Enterprise Systems Connection Manager (ESCM)

Minimum software support*

Product	Version/release level
Operating systems	
MVS/ESA	V 3.1.0E
MVS/ESA SP	V 4.1.0
VM/ESA	V 1.1.0 or V 1.1.1
VSE/ESA**	V 1.1
TPF***	V 3.1
Network products	
VTAM	V 3.3
NetView®	V 1.3
Data management products	
MVS/DFP	V 3.1.1
Other products	
EREP	V 3.4.2
IXP (IOCP)	V 1.0
ICK DSF	R 11.0

*Specific device support and function may require additional software support.
**ESCON Converter Model 1 support only.
***ESCM function is provided, and an ESCD port needs to be attached to a companion MVS system.

ESCM V1.1
Program product on MVS/ESA and VM/ESA

Host control for multiple ESCDs and hosts
- Reconfigures for partitioning, isolation
- Displays/tests configuration information
- Less disruptive installation and service
- Supports migration for static (ESCC Model 1) attached devices

System integrity for switching environment
- Synchronizes physical configuration changes with logical (MVS, VM) configurations

Operational simplification
- Customizable operator interface—NetView console, operating system console, ISPF, API
- Operators work with system resources in their own terms, e.g., system names, device numbers, CU names
- Single commands control entire configuration

3990 and 3490 Control Unit connectivity

IBM ESCON 3990 Models 2 and 3

Up to 16 ESCON Adapters
- Two, four or eight per cluster
- Plant shipment or field upgrade
- Mix ESCON with parallel adapters
- Clusters must maintain symmetrical adapter configurations

Nonsynchronous operation
- Uses ECKD architecture
- Relieves gap timing constraints
- Allows for improved performance

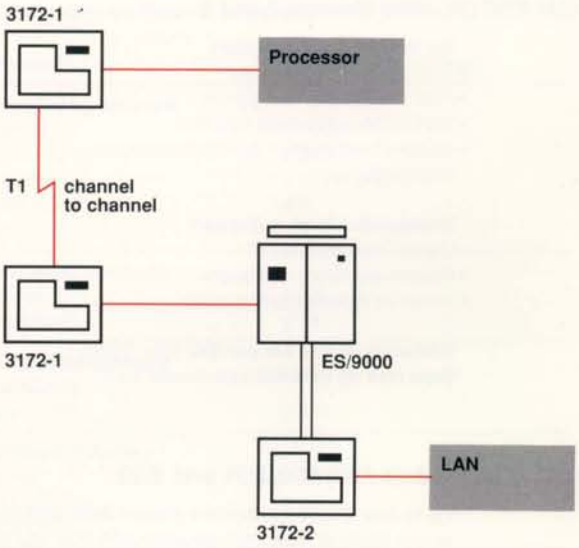
Distance up to 3 km per link (max. 3 links)
Data rate up to 10MB/sec. (Model 3 only)

IBM 3490 Models A01, A02, D31 and D32

Up to four ESCON Adapters (Model A02) and up to two ESCON Adapters (Models A01, D31 and D32)
- One or two per control unit
- Plant shipment or field upgrade
- Mix ESCON with parallel interface
- Control units must maintain symmetrical adapter configurations (A02 only)

Distance up to 3 km per link (max. 3 links)
Data rate up to 4.5MB/sec.

3172 connectivity



IBM 3172 Interconnect Controller

Local = gateway to other protocols (parallel channels)

3172 supports the following local area networks (LANs):

- IBM Token-Ring Network (and LANs meeting IEEE 802.5 Token-Ring standard)
- Ethernet™ Version 2 (and LANs meeting IEEE 802.3 CSMA/CD standard)
- Manufacturing Automation Protocol (MAP) Version 3.0 (and LANs meeting IEEE 802.4 Token-Bus standard)
- PC Network

Remote = channel to channel (ESCON or parallel channels)

3172 supports the following wide area network:

- T1 carriers with data striping

IBM 3174 Establishment Controller

Two ESCON models (12L and 22L—SNA only)

Attachment capability

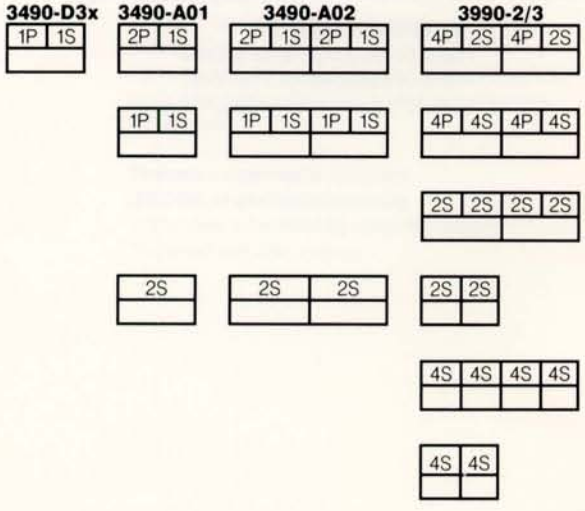
- Up to 64 IBM 3270 Display Stations
- Up to 24 additional ASCII terminals
- Or local gateway to Token-Ring Network

I/O control unit summary

Characteristics

Control unit Model	3172 1	3174 12L/22L	3490 A01/D31	3490 A02/D32	3990 2/3	3990 1	3880 all
ESCON Adapters	1	1	2	4	16	N/A	N/A
Field upgrade	no	no	yes	yes	yes	N/A	N/A
Mix with parallel adapters	no	N/A	yes	yes	yes	N/A	N/A
Data rate in MB/sec.	4.5	1.2	4.5	4.5	device speed w/out cache; 10 w/cache	4.5	4.5
Max. logical paths (multiple host support)	1	8	64	64	16	N/A	N/A
Max. distance with:							
ESCC/channel	3 km	3 km	3 km	3 km	1.2 km	1.2 km	0.9 km
ESCC/ESCD/chan.	3 km	3 km	3 km	3 km	1.0 km	1.0 km	0.7 km

ESCON and parallel adapter implementation options



Dynamic connectivity

- New CTCA facilities
- One channel -----> multiple control units
- One control unit -----> multiple channels
- Improved work-load balancing
- Increased configurability

Increased availability

- Nondisruptive cable plugging
- Less disruptive installations

Greater distance

- Up to 9 km and beyond (with 3172)
- Multiple remote data centers

Performance

- Data rate up to 10MB/sec.
- Link rate of 200Mbit/sec.

Security enhancements

- Physically separated devices

Data center management

- Reduced planning time
- Improved configuration management
- More efficient floor loading and space utilization
- Increased environmental efficiency
- Construction cost avoidance potential

· Direct I/S savings
· Improved service to customers
· New applications/system opportunities
· Enhanced resource utilization
· Orderly migration and growth

Benefit cross-relationship

ESCON benefit groups—values important to customers

Specific benefits provided by ESCON Architecture	Connectivity	Availability	Distance	Performance	Security	Data center management
Fewer control unit adapters	●	○				○
Fewer cables	●	○				○
Efficient load balancing	●	○	○			○
Improved access to multiple hosts and devices*	●		○			
Simplified hardware connections	●		○			○
Reduced installation disruption		●				○
Reduced reconfiguration disruption		●				○
Reduced maintenance disruption		●				○
Reduced cabling time	○	●				○
Minimized data center construction costs	○	○	●			○
Disaster backup	○	○	●		○	○
Easier data center migration	○	○	●		○	○
Remote function	○		●			○
Efficient system usage	○		●			○
Efficient floor-space usage			●			○
Comparable performance at varying distances			○	●		
Secured in-house archiving			○		●	
Reduced configuration planning time	○		○			●
Reduced installation planning time	○		○			●
Reduced floor-space planning time	○		○			●
Increased A/C efficiency	○		○			●
Reduced cable weight/floor loading	○		○			●
Reduced raised floor height	○		○			●
Remote power and environmental sensing		○	○			●

●=primary benefit association; ○=secondary benefit association
*No change with 3880.

Introductory publications

Product	Publication	Order number
ESCON Architecture	Introducing Enterprise Systems Connection	GA23-0383
Fiber-optic products	Planning for Enterprise Systems Connection Links	GA23-0367
ESCDs	Introducing the ESCDs	GA23-0363
ESCC Model 1	Introducing the ESCON Converter	GA23-0361
ES/3090	ES/3090 Functional Characteristics	GA22-7127
3174	3174 Establishment Controller Introduction	GA27-3850
3490	3490 Magnetic Tape Subsystem Models A01, A02, D31 and D32 Introduction	GA32-0125
3990	3990 Storage Control Introduction	GA32-0098
ESCON Manager	Introducing the Enterprise Systems Connection Manager	GC23-0422

Planning publications

Product	Publication	Order number
ESCD Model 1	Planning for ESCD Model 1	GA23-0372
ESCC Model 1	Planning for ESCC Model 1	GA23-0362
ESCD Model 2	Planning for ESCD Model 2	GA23-0364
3172	3172 Interconnect Controller Planning Guide	GA27-3867
3174	3174 Establishment Controller Configuration B Planning Guide	GA27-3862
3490 Models A01-02, B02-04	3490 Magnetic Tape Subsystem Models A01, A02, B02 and B04 Planning and Migration Guide	GA35-0116
3490 Models D31-D32	3490 Magnetic Tape Subsystem Models D31 and D32 Planning and Migration Guide	GA35-0117
3990	3990 Storage Control Planning, Installation and Storage Administration Guide	GA32-0100
ESCON Manager	Planning for the Enterprise Systems Connection Manager	GC23-0423