Fibre Channel Objectives

- **Why?**

Primary Reasons:

1. Increased Computational Power of:

   -Supercomputers (Up to 2400 MIPS)
   -Parallel Array Processors
   -Workstations
   -PCs (e.g., 100 Mhz i80486 or i860)

   AND

   The Desire To Interconnect Existing and Future Systems:

-> Drives the Demand for New, High Performance Standard Interface To Interconnect Computers, Peripherals, I/O Ports, Systems.

2. Physically Small Interface to Support Small Peripherals.

-> Revolutionary Size Reduction Requires Smaller Physical Size.

Secondary Reasons:

3. High Performance Interface and yet Low Cost:

   -Cost Competitive With SCSI-2 and Buffered IPI-2.

4. Way To Construct and Interconnect High Performance Systems.

   ~60 Companies Participating in Development.

5. Allows Longer Distance Interconnects--Up To 10 Km.

fci.g 4-4-91

Seagate

Seagate Technology
8001 E. Bloomington Freeway
Bloomington, MN 55420

Bruce E. Johnson
Consultant
Advanced Concept

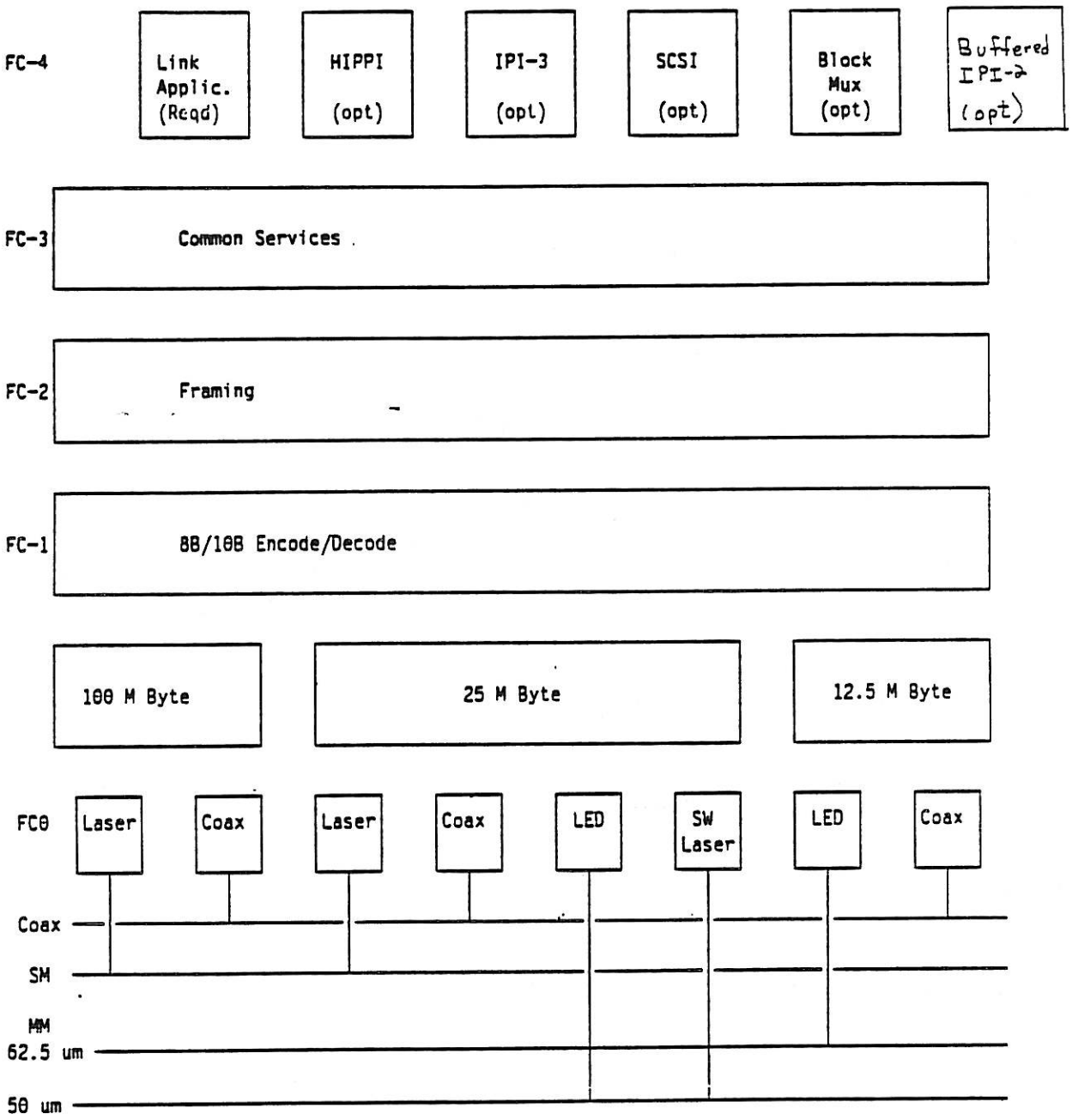

Figure 1. Fiber Channel levels

Fibre Channel defines a broad architecture of functions and numerous implementation choices at the Receiver/Transmitter level. A given implementation may choose to implement only part of the FC-2, FC-3, or FC-4 functions defined. For example, three Classes of Service are defined by FC-2. However, a given implementation may choose to implement only one Class of Service. Optional support characteristics are specified through a "Login" procedure which specifies which optional features are supported by a given Port.

Fibre Channel provides a method for supporting any number of Upper Level Protocols (FC-4s). The Link Application FC-4 is required, whereas others are optional. The FC-4 implemented is not restricted to those identified in figure 1.

	12.5 MB/S 132 Mbaud	25 MB/S 266 MBaud	50 MB/S 531 Mbaud	100 MB/S 1060 Mbaud
10 Km, 1300 nm laser Single Mode Fibre		X	X	X
2 Km, 1300 nm laser Single Mode Fibre		X	X	X
1 Km, 780 nm laser Multi-Mode Fibre		X	X	X
CATV STYLE Coaxial Cable 50m	X	X	X	X
MINIATURE Coaxial Cable 10m	X	X	X	X

Fig. Proposed Fibre Channel Implementation Matrix

Advantages:

1. Most Likely To Result In a Standard Configuration due to Performance and Economics.

2. Fewest Overlapping Capability Configurations.

3. Quicker Adoption of Standard Due To Concentration of Efforts.

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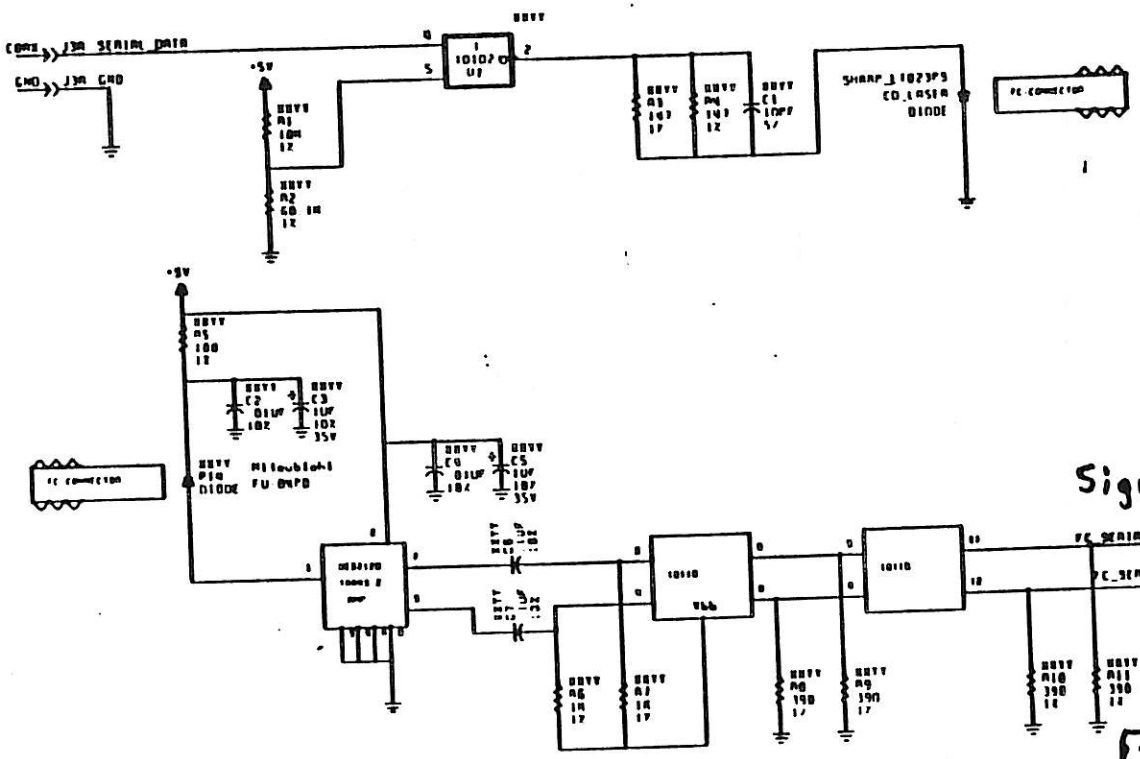

Driver

10102	$2.00
Laser Diode	40.00
Misc.	1.00
	$43.00

Receiver

PIN Diode	$20.00
Signetics TE Amp	5.00
10116	2.00
Misc	2.00
	$29.00

Total = $72.00

25 MB/Sec

SEAGATE PRIVATE

Seagate

266 MHZ FIBRE-CHANNEL
LASER DRIVER
PIN DIODE RECEIVER

C XXXXXXXX

ECAD-A

Fibre Channel Objectives

*Technical Summary Key Transmission Lines Alternatives

Cable Type	Max. Data Rate	Maximum Distance	Physical Size	Cost	Accepted Standard?
1. Unshielded Cu Twisted Pair	200 Mhz	50 ft.	0.39 in O.D.	$.55/ft	Yes
2. Shielded Cu Twisted Pair	150 Mhz	50 ft.	0.57 in. O.D.	$1.57/ft	Yes RS-485 Cable
3. Miniature Cu Coaxial Cable	2 Ghz	30 m	0.083 in. O.D.	$.36/ft	Yes, Computer Clock Distribution
4. CATV Cu Coaxial Cable	4 Ghz	100 m	0.27 in. O.D.	$.08/ft.	Yes
5. Multimode Glass Fibre	10 Ghz	5 Km	62.5 micro meter	$.30/ft.	Yes, in short distance apps.
6. Singlmode Glass Fibre	1 Thz	60 Km	9 micro meter	$.20/ft.	Yes, in TELCO Industry
7. Plastic Fibre	25 Mhz	100 m	200 micro meter	$.05/ft.	In Auto Industry

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105

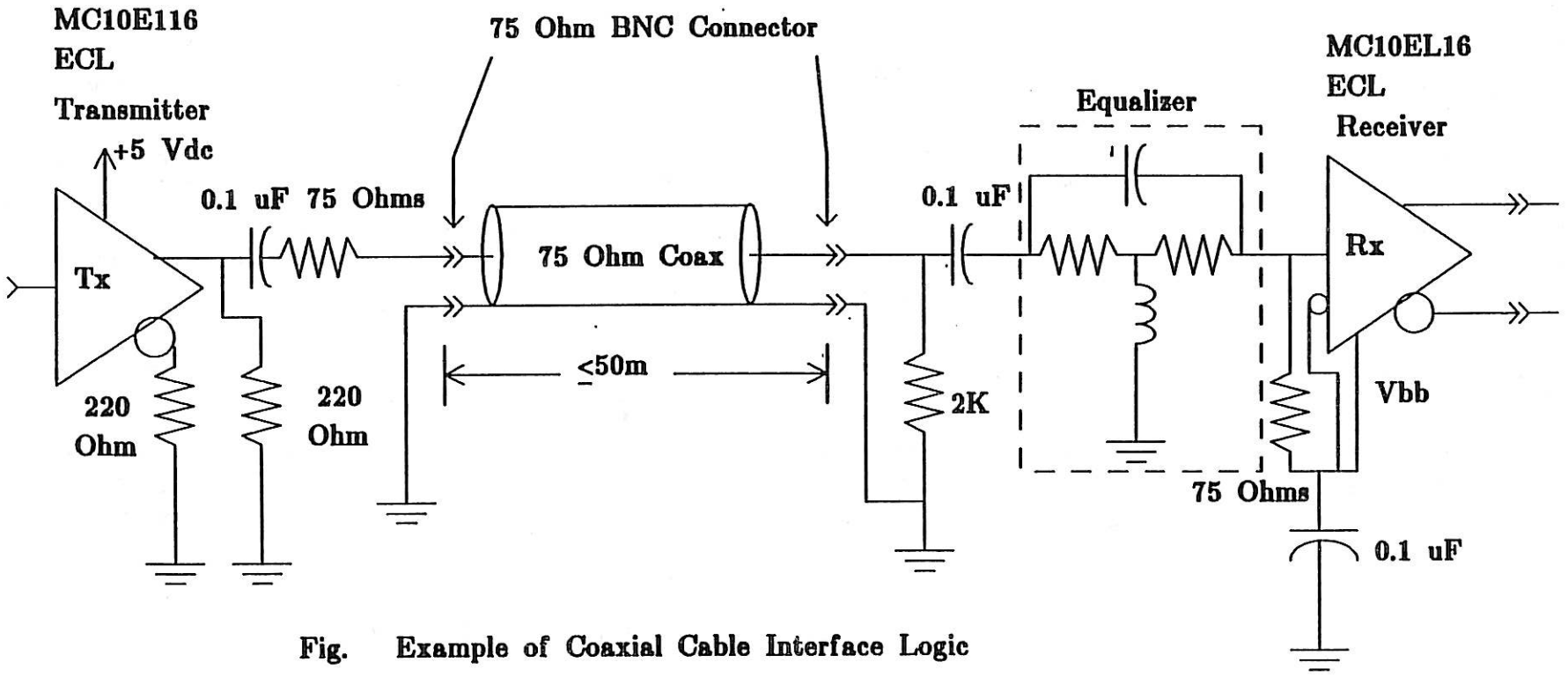


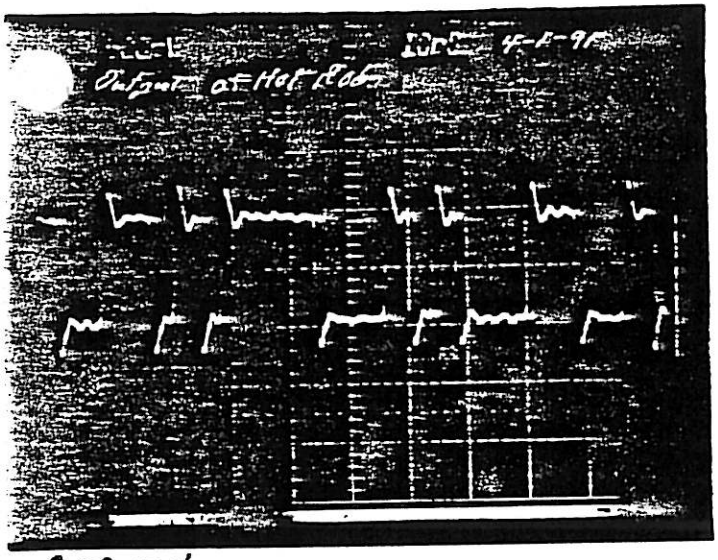
Fig. Example of Coaxial Cable Interface Logic

- Simple, Low-Cost, Yet High-Performance Capability

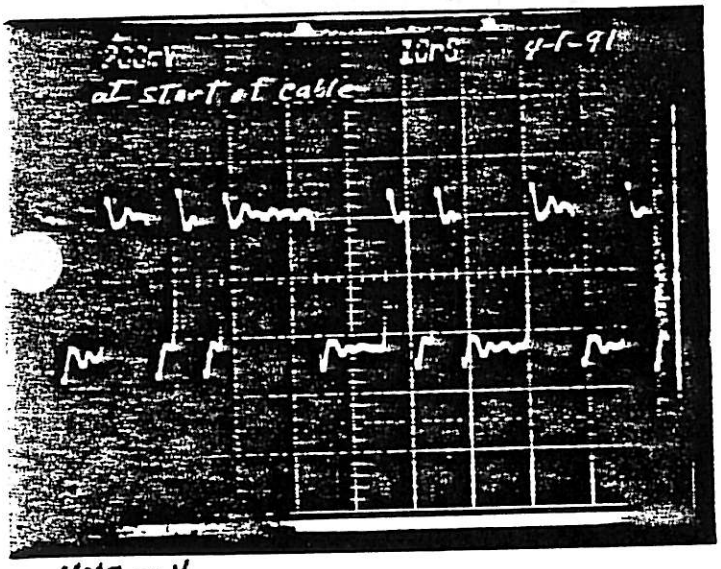
coaxfc.a

bej/4-4-91

250 Mhz Data

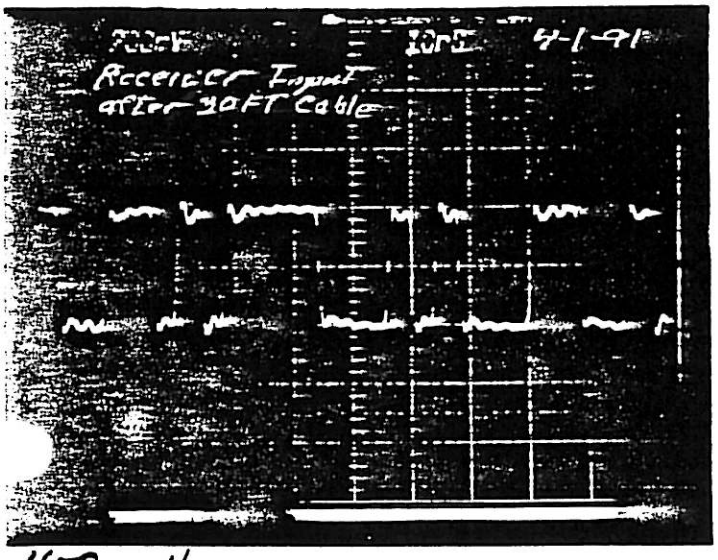


900 mV



440 mV

At Input to Cable



400 mV

At Receiver

No Equalizer

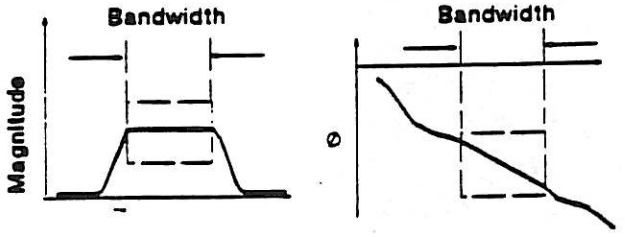
Sources Of Transmission Distortion in Coaxial Cable

- Magnitude Variation with Frequency
- Group Delay Variation with Frequency
- Connector Reflections
- Impedance Mis-Match
- VSWR of Receiver
  -S- Parameters at High Frequency

CRITERIA FOR DISTORTIONLESS TRANSMISSION

Constant Amplitude

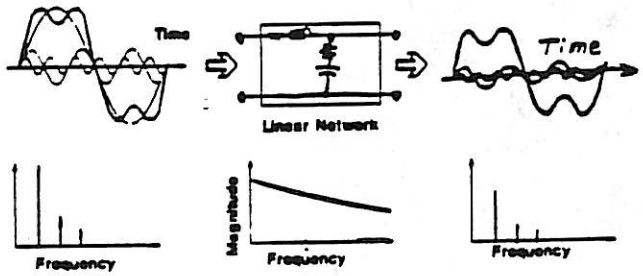
Linear Phase



5423

Coaxial Cable
MAGNITUDE VARIATIONS WITH FREQUENCY

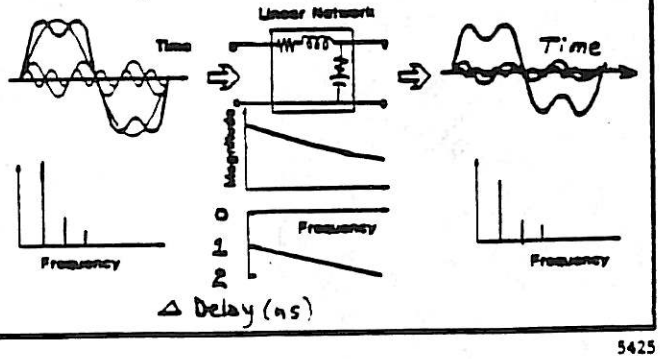
Sin wt + $^1/_3$ Sin 3wt + $^1/_5$ Sin 5wt



5424

Coaxial Cable
Group Delay VARIATION WITH FREQUENCY

Sin wt + $^1/_3$ Sin 3wt + $^1/_5$ Sin 5wt

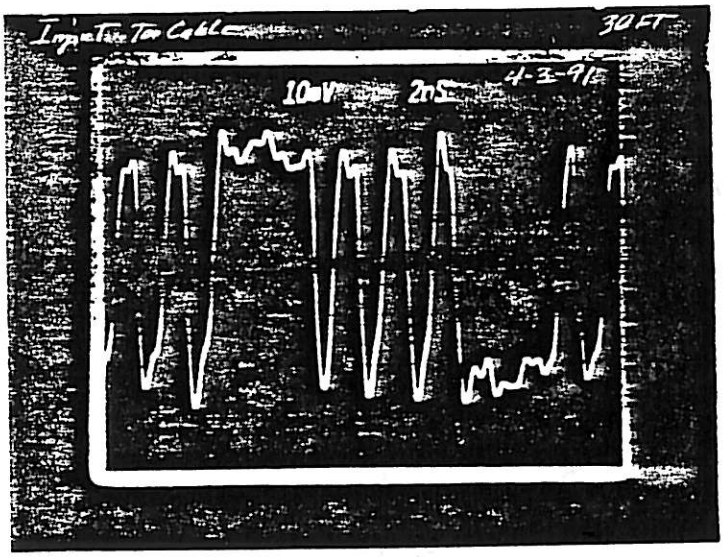


5425

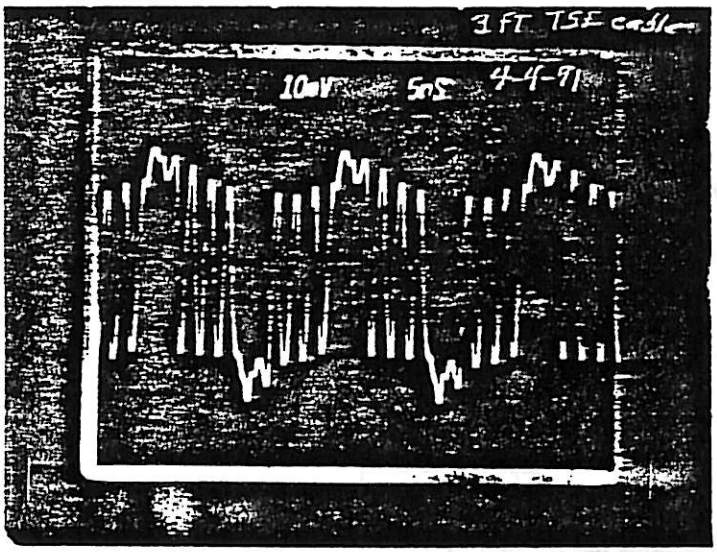
Principal Cause: Skin Effect

1.0 Ghz Data

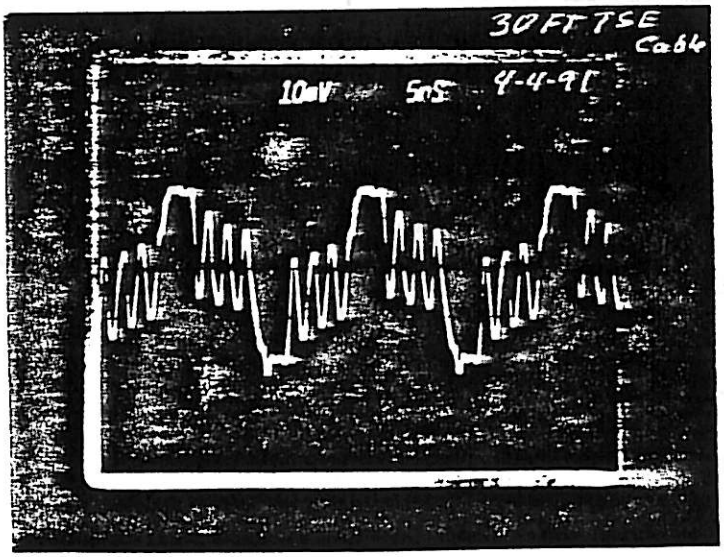
8B/10B Encoded



Input to Cable

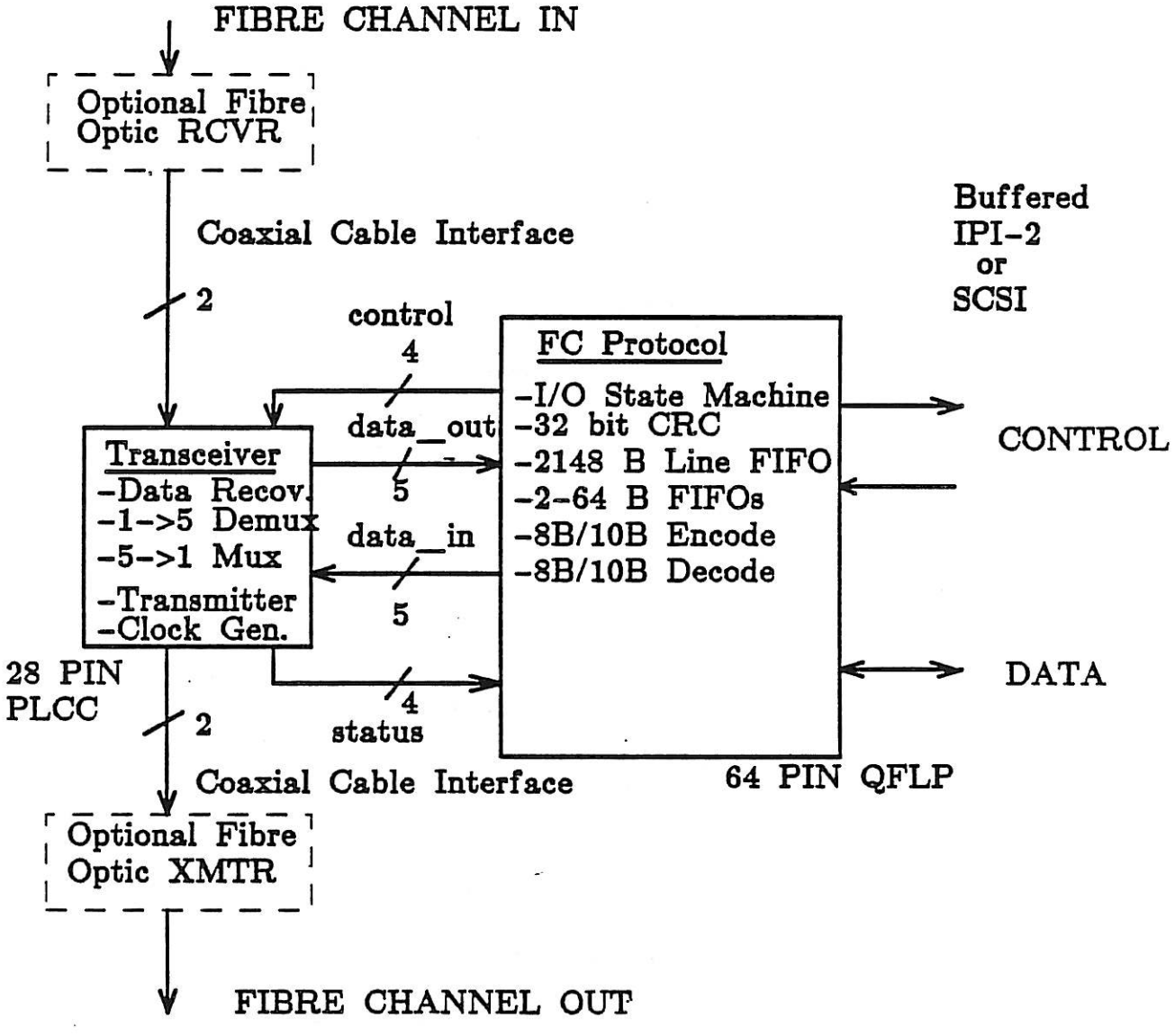


At Receiver, short Cable
(1 meter)



At Receiver, Long Cable
(10 meters)
Tektronix 7104 scope
7A29 plug-in
Hewlett-Packard 10020A
probe with 10:1 divider

Definitely Requires an Equalizer



1. FC Applications At 25 MB/sec or Greater:
   - -Transceiver is Separate, ECL or GaAs part.
   - -Transceiver Could Be Upgraded to 50 MB/sec.
   - -FC Protocol is Separate CMOS Array.

2. FC Applications at 12.5 MB/sec or Lower:
   - -One CMOS or BiCMOS Chip.
   - -AT&T Offers a Similar Chip For FDDI Now.

FIG. 1 FIBRE CHANNEL LSI PROPOSAL

2-4-91
fclsi.c

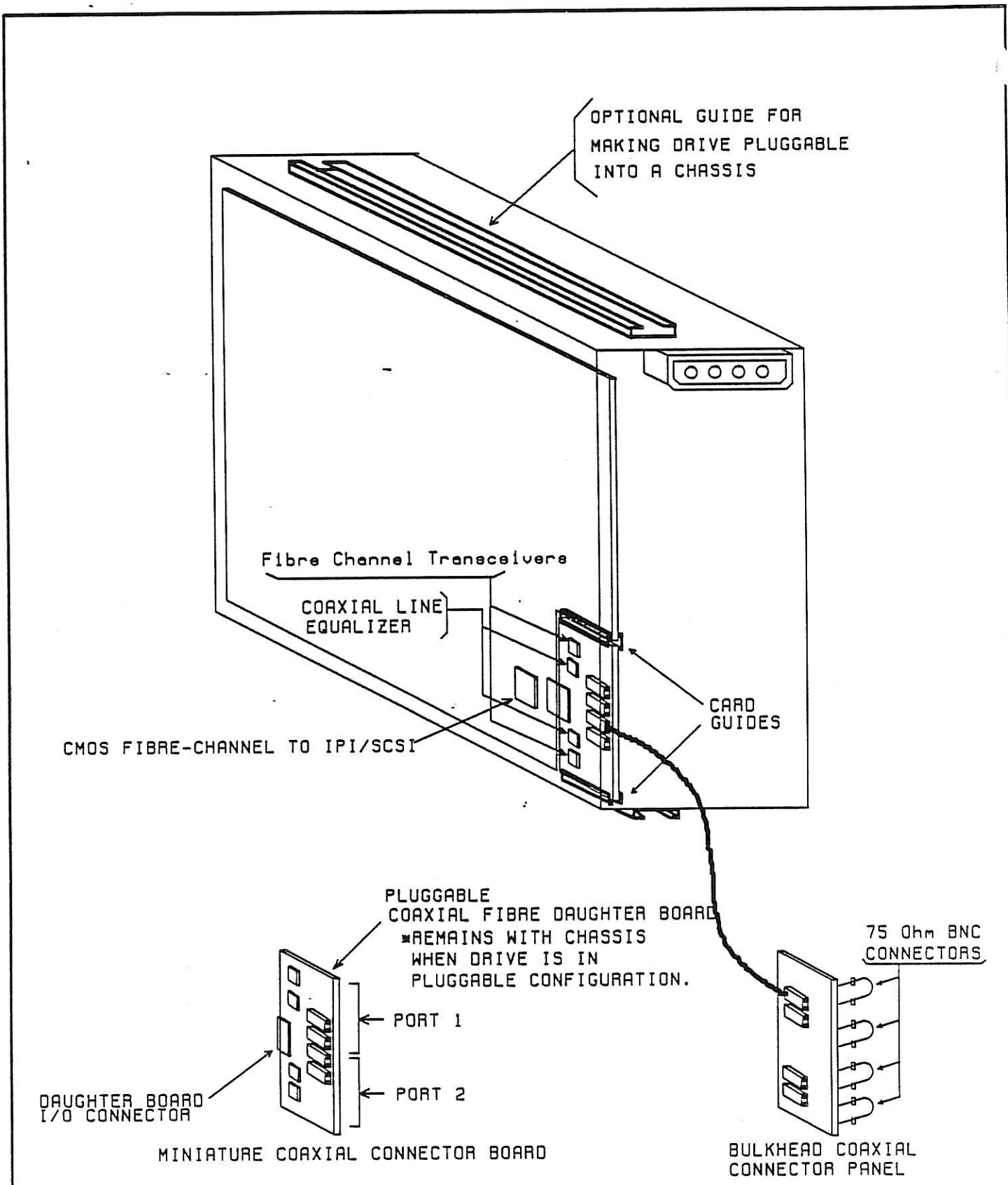


FIG. 1-4 FIBRE CHANNEL DRIVE, COAXIAL CABLE INTERFACE EXAMPLE fcdrive
bej/2-4-91

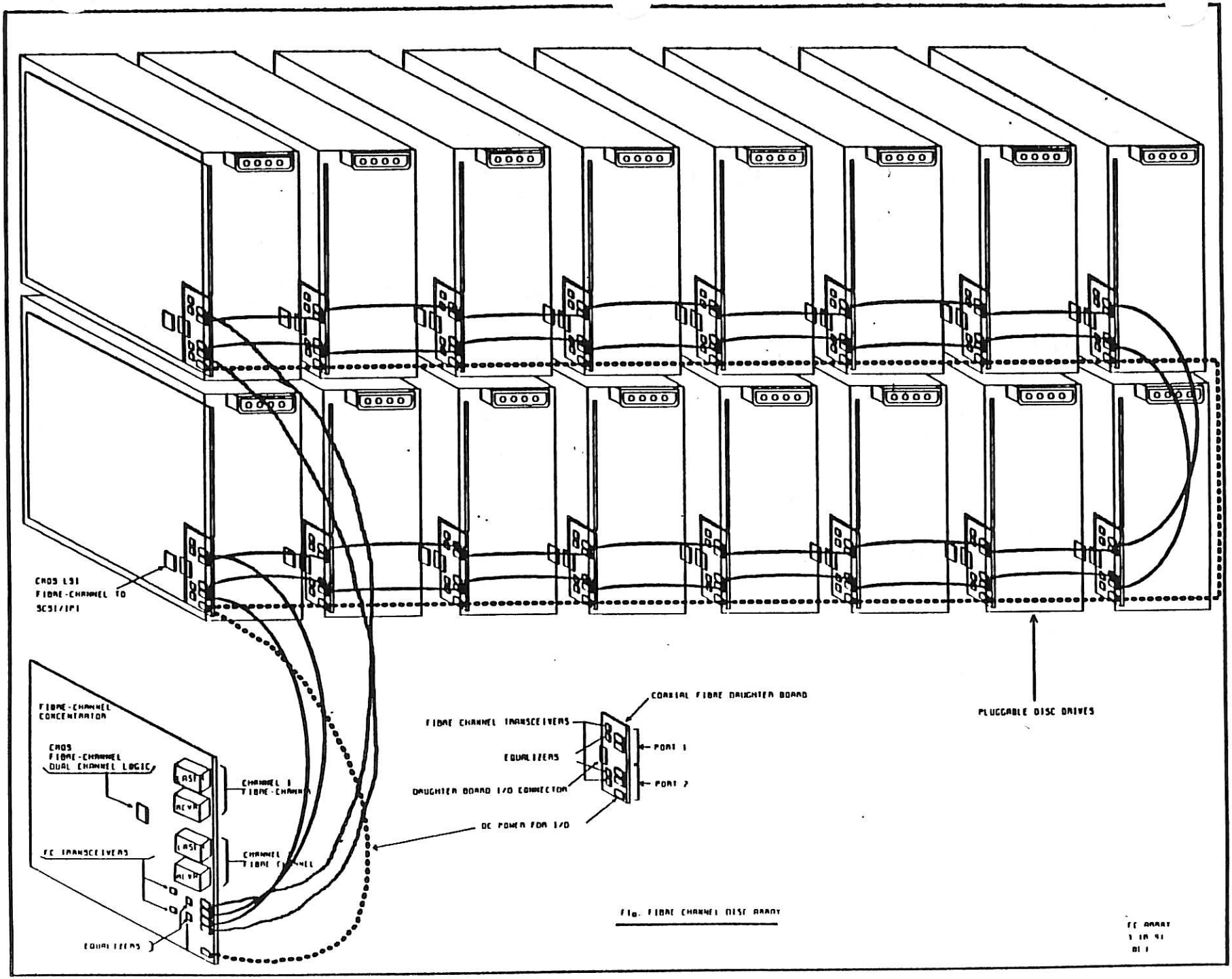


Fig. FIBRE CHANNEL DISC ARRAY

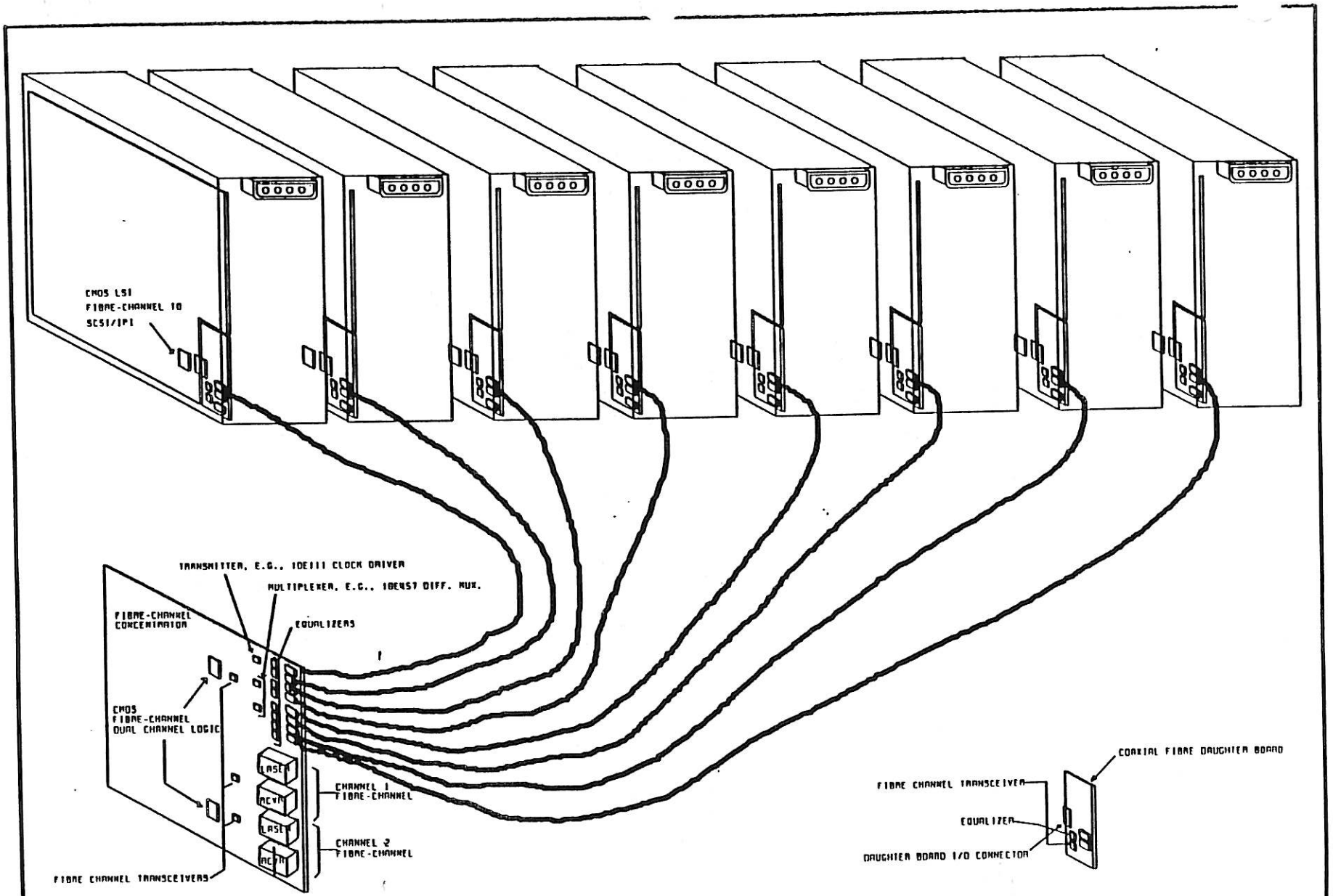


Fig. FIBRE CHANNEL DISC ARRAY

RADIAL INTERFACE CONFIGURATION

FC ARRAY
3-25-1991
RFJ

* SCSI-2 Versus Fibre Channel Costs (Drive Cost)

-Assume High Volume (>100 K/year)

1. SCSI-2 Differential, 20 MB/sec

Item.	Quantity	Description	Total Cost
1.	27	75176B XCVR	$12.15
2.	1	68 Pin Connector	3.50
3.	2	20 pin socket	.80
4.	1	6.8 uf Cap	.35
			$16.80

Does Not Account For Board Space Costs.

2. Optical Fibre Channel, 25 MB/sec

Item.	Quantity	Description	Total Cost
1.	1	FC XCVR	$ 9.45
2.	1	FC Protocol	10.00
3.	1	Laser Driver	2.00
4.	1	Laser Diode	40.00
5.	1	PIN Diode	20.00
6.	1	Trans-Imp Amp.	2.00
7.	1	10H116	2.00
8.	-	Miscellaneous	4.00
			$89.45

3. Coaxial Cable Interface Version Of Fibre Channel 25 MB/sec

Item.	Quantity	Description	Total Cost
1.	1	FC XCVR	$ 9.45
2.	1	FC Protocol	10.00
3.	2	Header	.10
4.	1	Equalizer	1.00
5.	-	Miscellaneous	1.30
			$21.85

Lowest Projected Cost

CONCLUSION: The Coaxial Cable Interface Can Provide a Cost Effective Implementation of Short Distance Fibre Channel.

fccosts/3-27-91

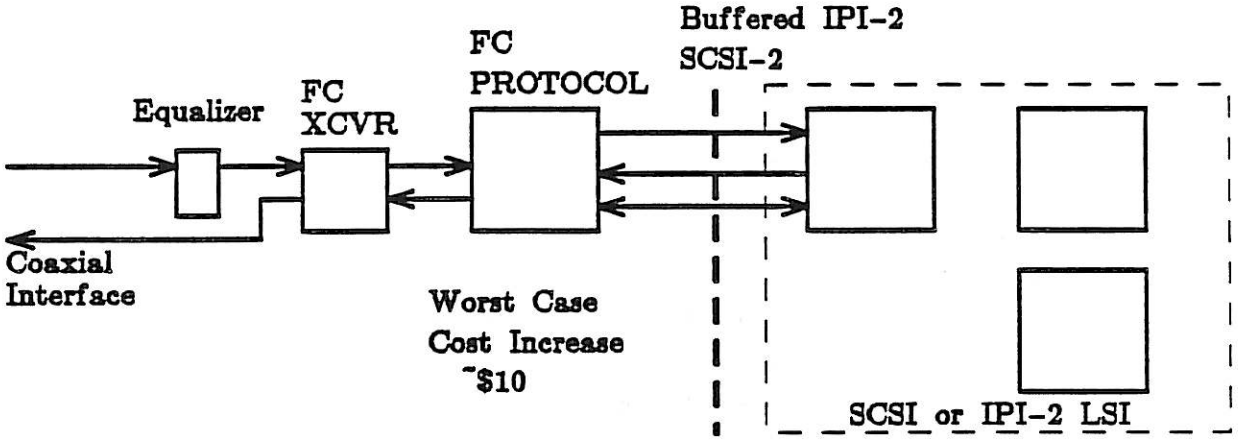


Fig. Stage 1 Fibre Channel LSI Integration (25 MB/Sec)

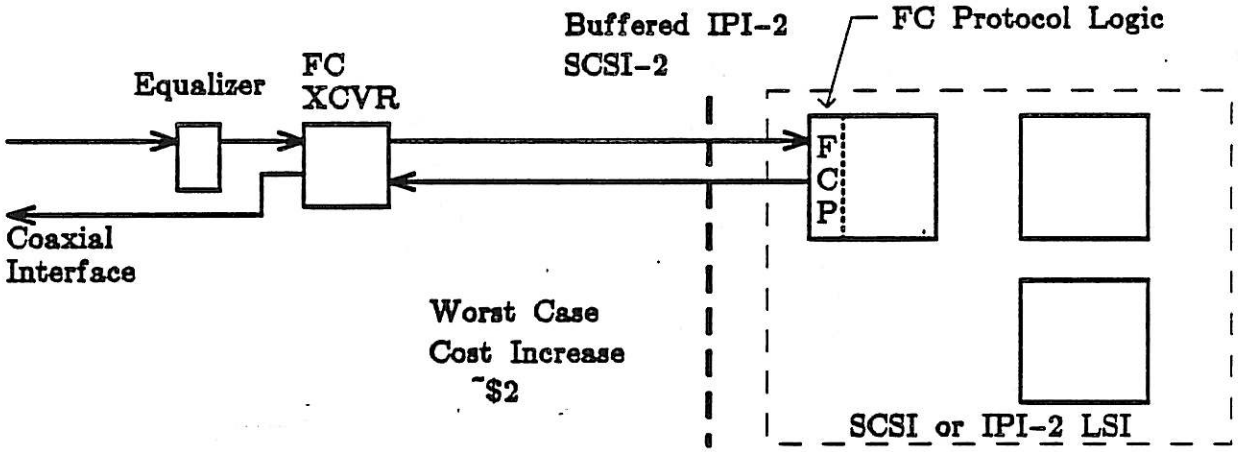


Fig. Stage 2 Fibre Channel LSI Integration (25 MB/Sec)

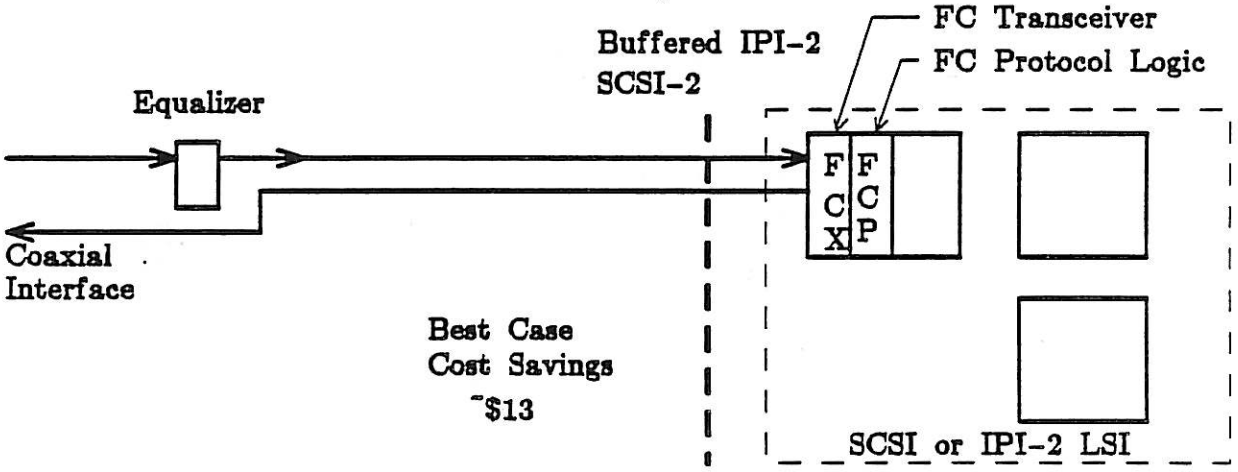
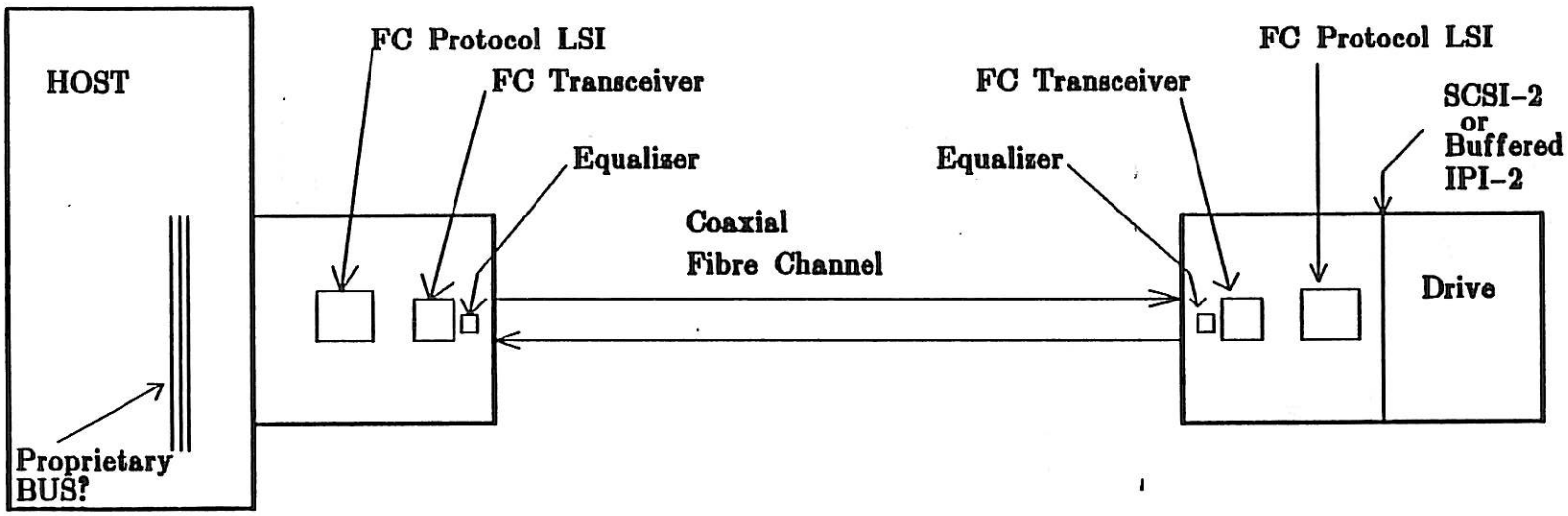


Fig. Stage 3 Fibre Channel LSI Integration (25 MB/Sec)

CONCLUSION: Fibre Channel Should Lower Cost with Future LSI Integration.

fcevolv/4-8-91



Host/Controller Unique

-> Host/Controller Software

-Map SCSI, IPI, HIPPI to FC
-Impact < 25%?

-> FC to Proprietary Bus?

-Unique Buff.IPI-2 LSI

-Unique SCSI-2 LSI

Common

-> Fibre Channel Transceiver

-Industry Std. Part

-> SCSI-2 Protocol LSI

-Seagate Design
-Host or Drive Application

Drive Unique

-> Controlware

-SCSI-2 Impact < 20%?

-Buff. IPI-2 < 20%?

-> IPI-2 Protocol

-Slave LSI is Unique.

LSI Fibre Channel Development Scenario

fcdev/3-27-91

Transmitter: e.g., MC10H116 or Equivalent

106.1 Mhz Clock Rate

PECL Configuration Shown.

Receiver: 10H116 or Equivalent

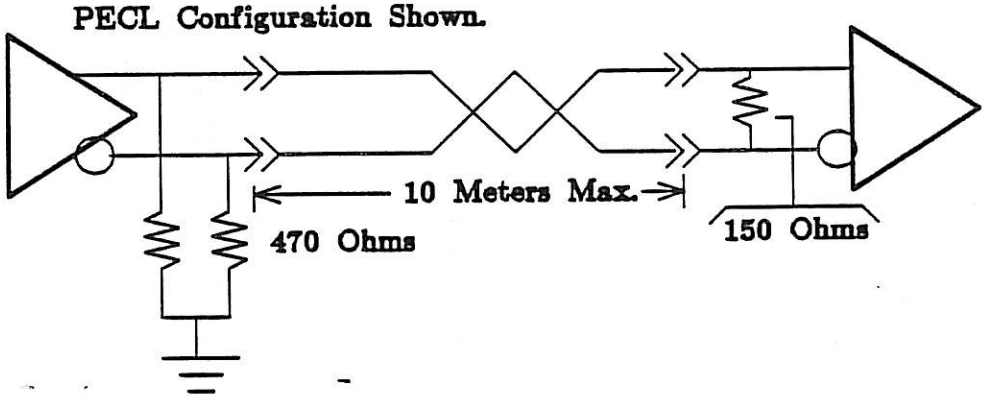
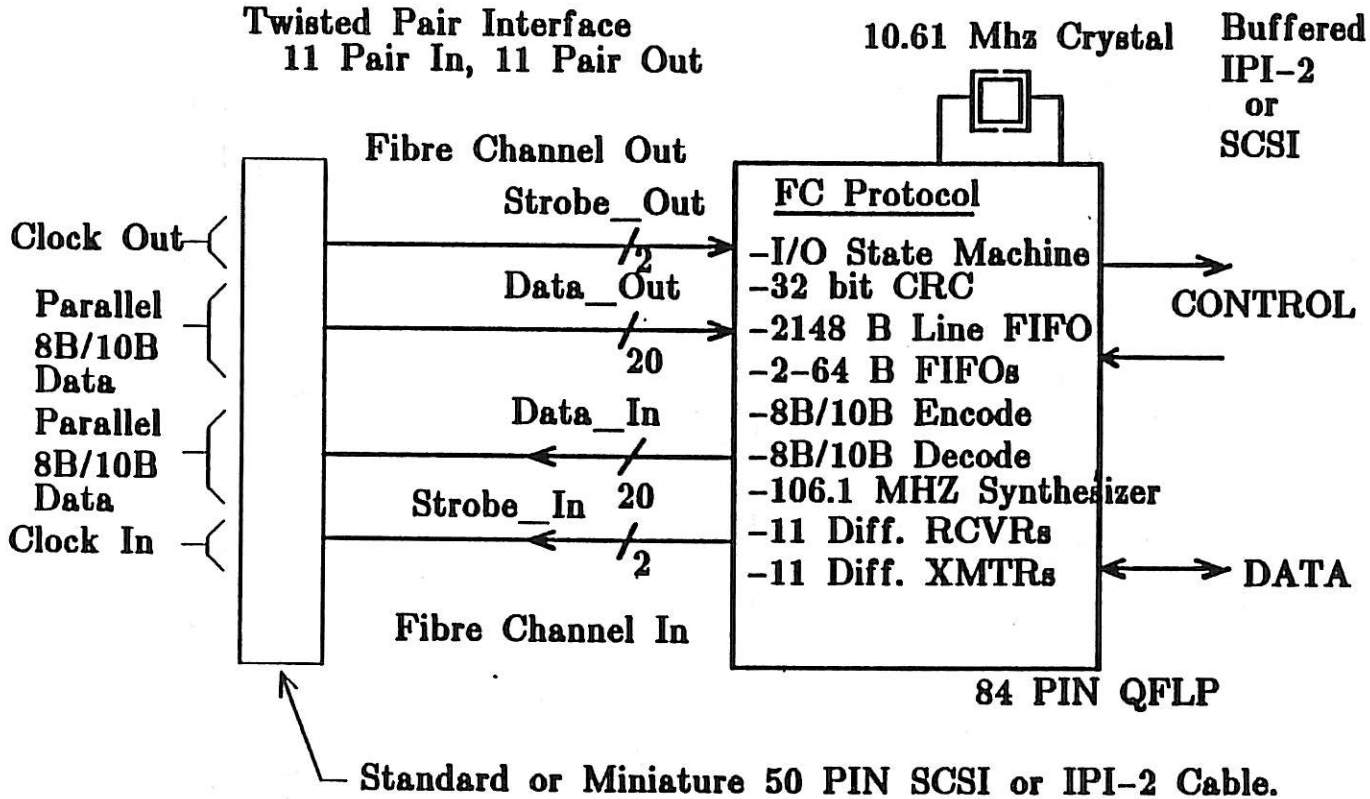


Fig. Line Driver/ Receiver Definition for Twisted Pair FC



- Goal: 100 MBytes/Sec at 10 Meters.
- Allows Creation of Low-Cost 100 MB/Sec Channel LSI.
- Minimal Technical Risk to Implement 100 MB/Sec Rate.
- Differential ECL (PECL) Transmitters/Receivers.
- Possible to Use Existing SCSI and IPI Cables? -Will Be Tested at 100 Mhz Rate.
  -Possible to Define Smaller Cable.

FIG. LOW COST, 100 MB/SEC PARALLEL FIBRE CHANNEL LSI PROPOSAL

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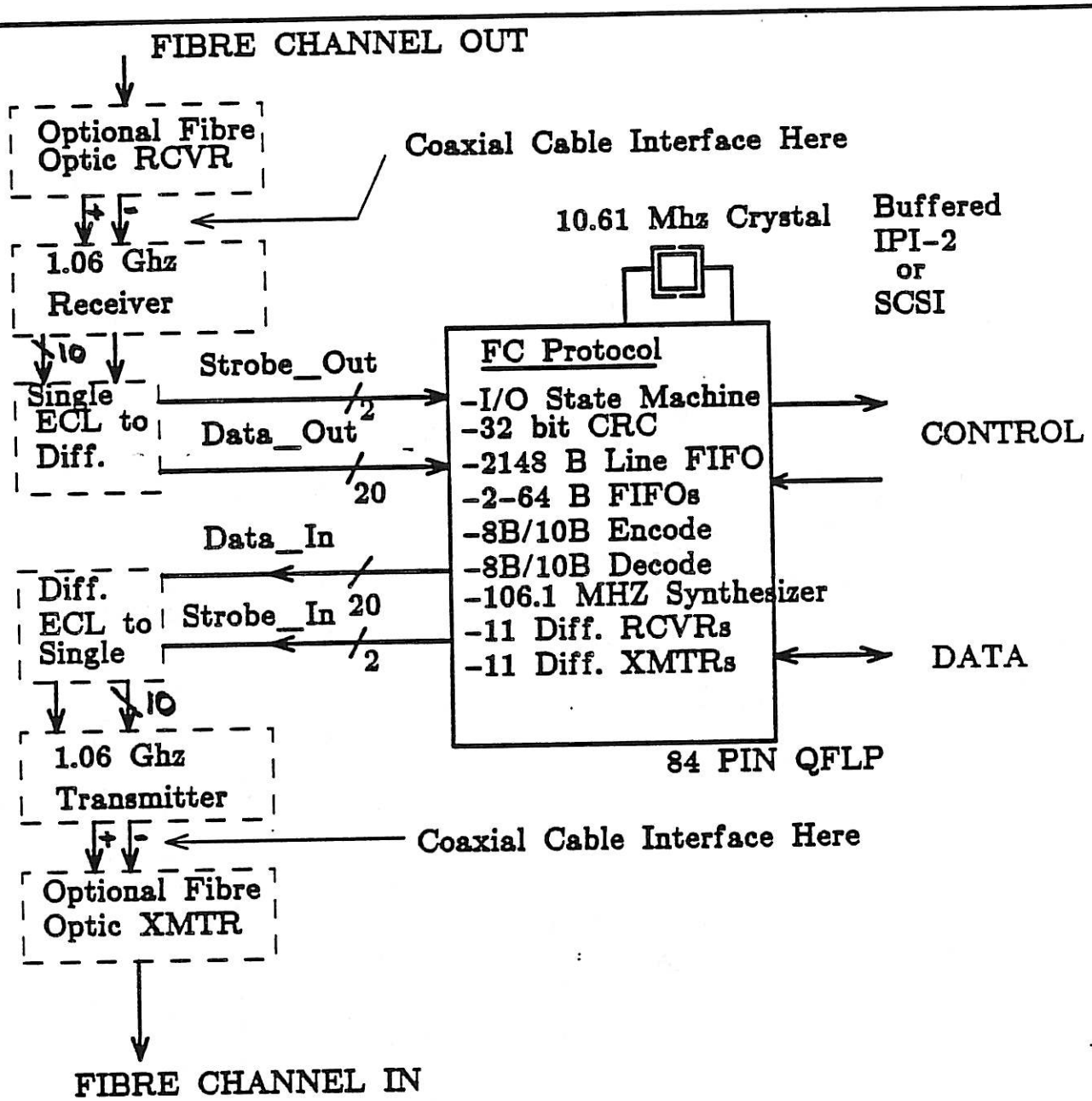

- 10 Bit Wide Bus and Strobe Allows Easy Transition to Serialization Logic.
- System Designer Has Optical, Coaxial, and Parallel Options for Constructing High Performance, 100 MB/Sec Fibre Channel Capability.

FIG. BUILDING BLOCK APPROACH TO FIBRE CHANNEL LSI

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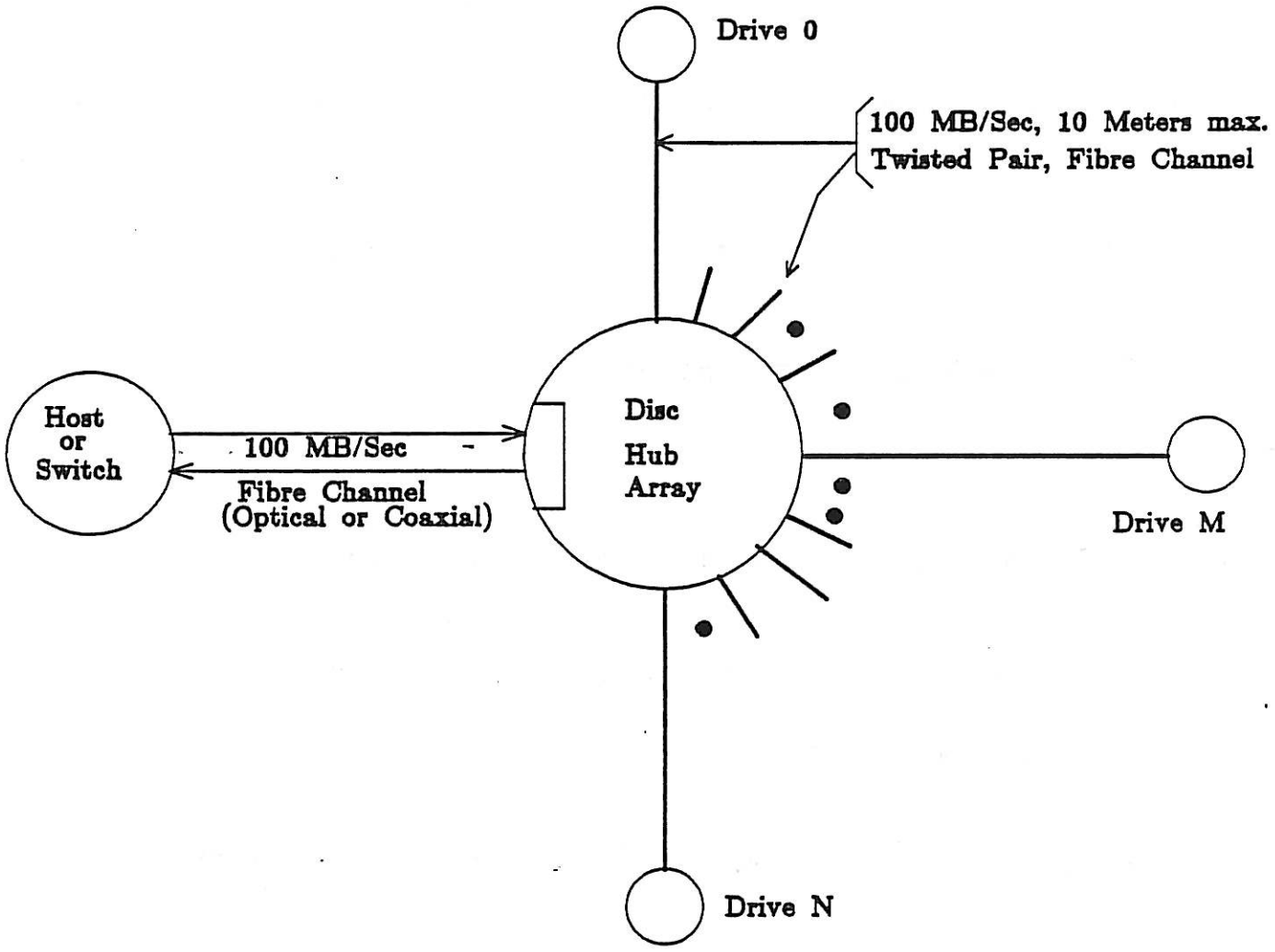

- Use Fibre Channel to Build Disc Arrays of Arbitrary Size and Performance.
- Twisted Pair Fibre Channel Provides Low Cost 100 MB/Sec Implementation.
- Can Also Stripe with 25 MB/sec Coaxial Interface.

Fig. High Performance Interface --Radial Striping with 100 MB/Sec Fibre Channel

fcstripe/4-8-91

Conclusions On Fibre Channel

-> Recognize that Fibre Channel is The Performance Interface of the 90's.

- Offers Performance Benefits along with Space Reduction.
- Offers Performance with Potential of Low Cost Implementation.

-> Fibre Channel Has Very Strong Physical Layer Advantages:

- Powerful Fibre Optic, Coaxial, and Even Twisted-Pair Implementations are Possible.
- Encoding, Link Protocol, and Packetizing Are Very Strong Also.

-> Assuming the Recognition of Compelling Physical Layer Advantages of Fibre Channel, the Following is Needed:

- Computer Industry Support in Mapping Logic Layers of SCSI-2, Buffered IPI-2, IPI-3, and HIPPI.

fcstrat.d/4-8-91