LOCAL AREA

NETWORK

REQUIREMENTS

J. H. SALTZER

MIT

LABORATORY
FOR COMPUTER
SCIENCE

P L A N

1. EVOLUTION TOWARD INCOMPATIBILITY

2. PROTOCOL TRANSLATION

3. WHY SO MANY ARGUMENTS ?

4. INTER - ENTERPRISE CONNECTION

LOCAL NET REQUIREMENTS —

SOURCES

➤ DESKTOP COMPUTER IS INCOMPLETE ◄

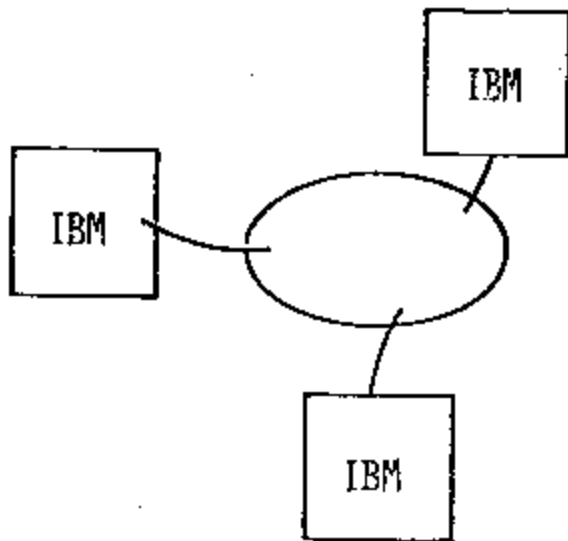(1) ECONOMY OF SCALE ON
      SOME SERVICES:

— QUALITY PRINTER

— CHEAP STORAGE

— GATEWAY TO P.T.T.

— SUPER ARRAY PROCESSOR

(2) INFORMATION SHARING:

— ENTERPRISE DATABASE

— MULTI-AUTHOR REPORTS

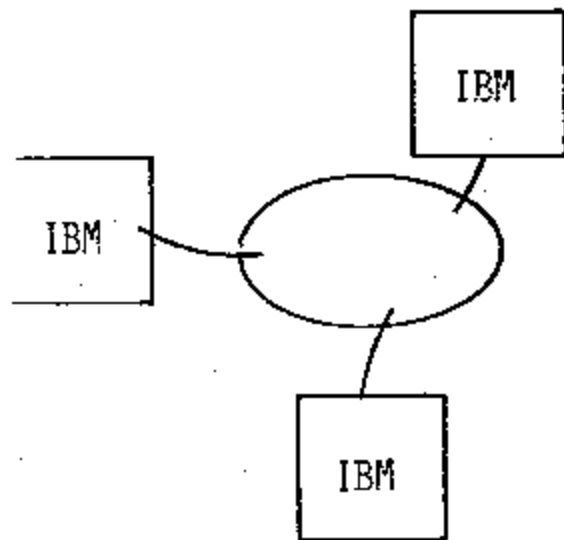— DECISION CONCURRENCE

— BUSINESS COMMUNICATIONS

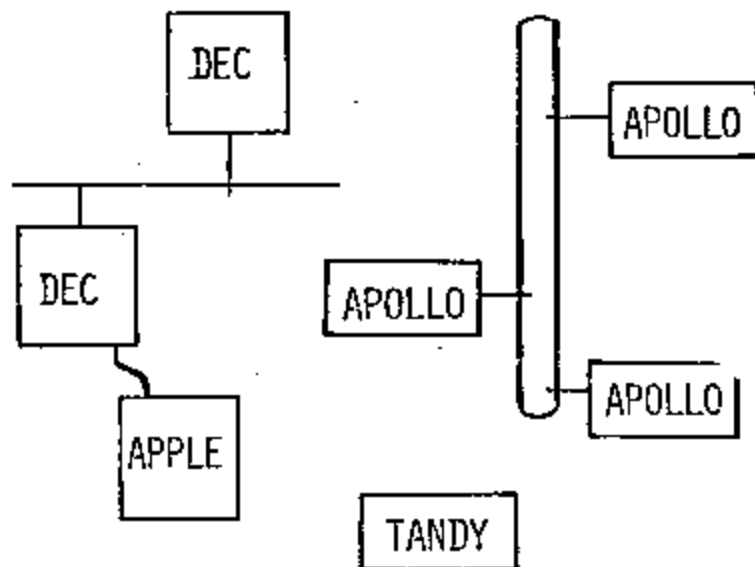# THE EMERGING PICTURE

ADMINISTRATIVE
DP CENTER

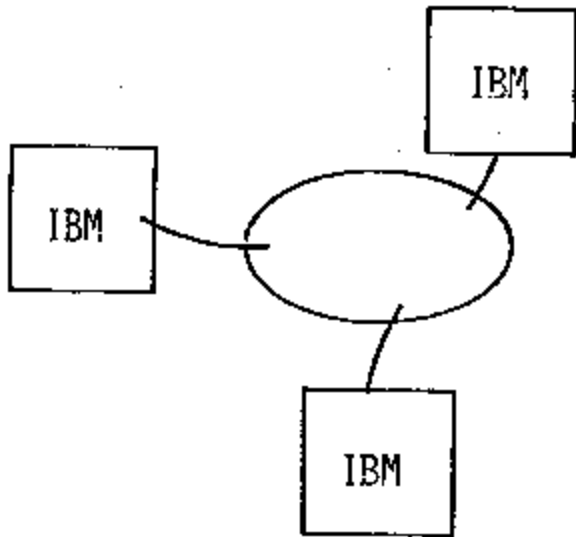# THE EMERGING PICTURE

ADMINISTRATIVE
DP CENTER

ENGINEERING
COMPUTING AREA

THE EMERGING PICTURE
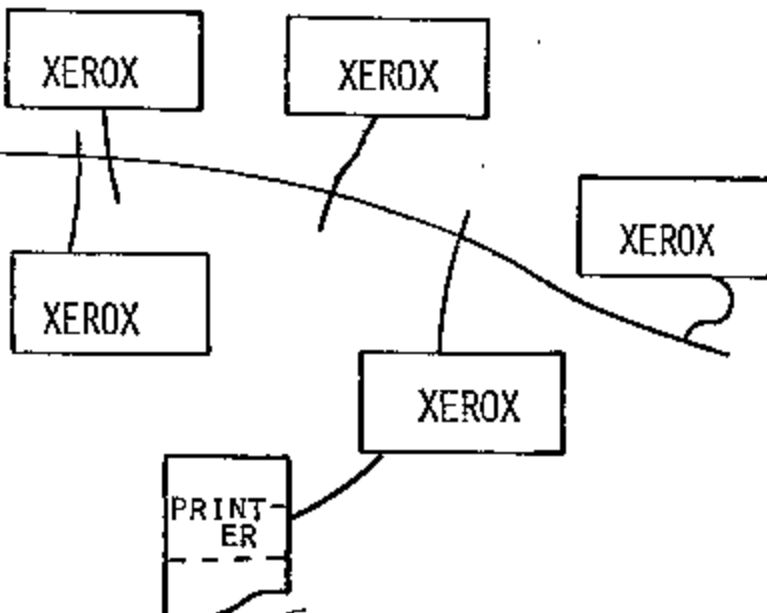
ADMINISTRATIVE
DP CENTER

ENGINEERING
COMPUTING AREA

IBM

IBM

IBM

WORD PROCESSING
DEPARTMENT

DEC

DEC

APPLE

APOLLO

APOLLO

APOLLO

TANDY

XEROX

XEROX

XEROX

XEROX

XEROX

PRINT
ER

THE EMERGING PICTURE

ADMINISTRATIVE
DP CENTER

ENGINEERING
COMPUTING AREA

IBM

IBM

IBM

WORD PROCESSING
DEPARTMENT

DEC

DEC

APPLE

APOLLO

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TANDY

INTERNET

XEROX

XEROX

XEROX

XEROX

XEROX

PRINT
ER

WANG
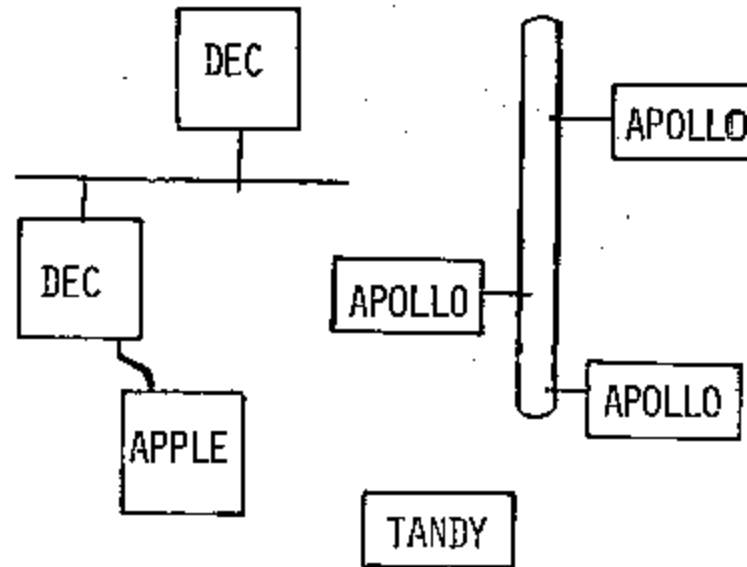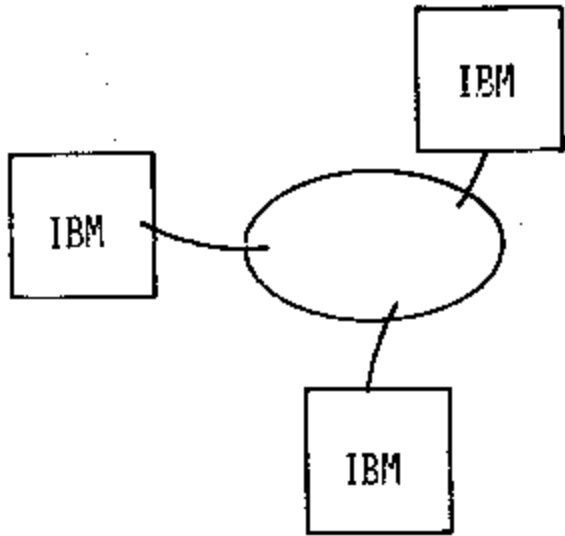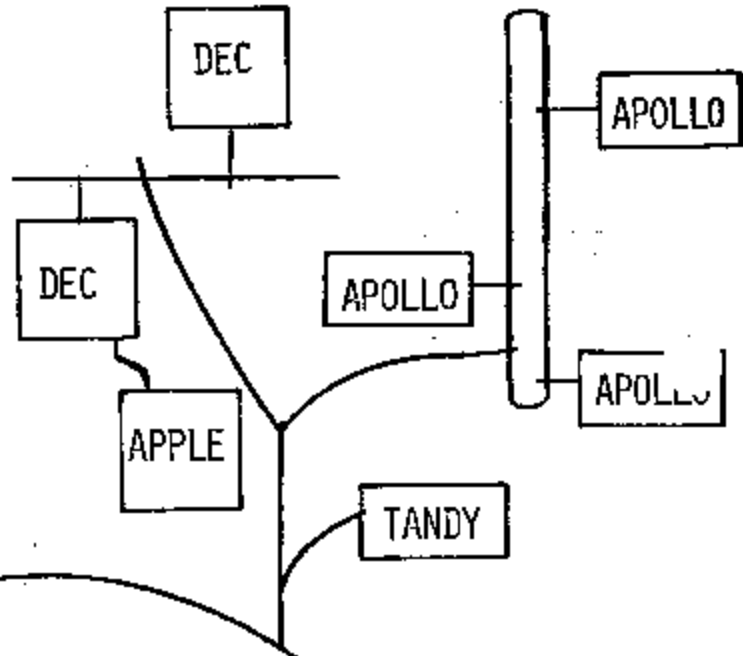
TO
P.T.T.
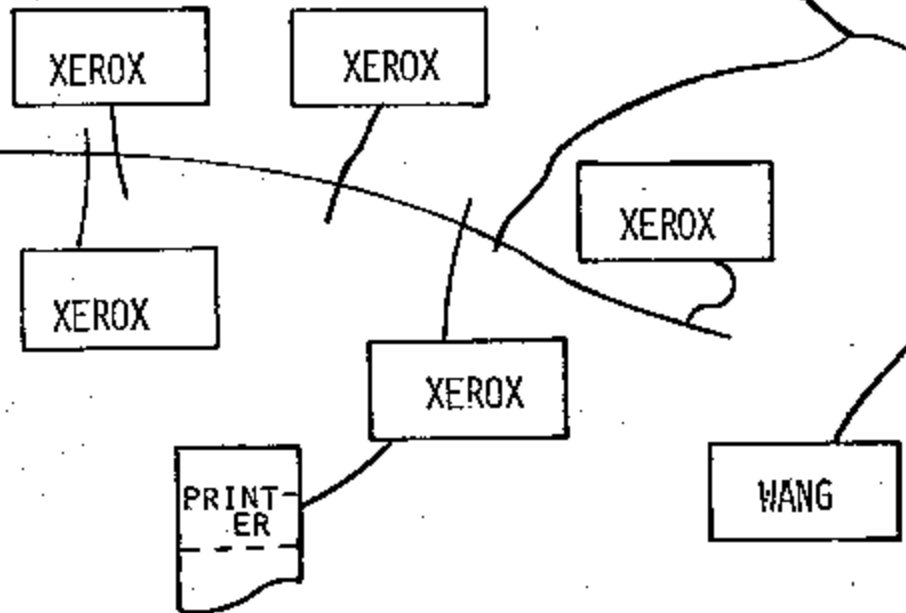
TYPICAL COMMUNICATION EXAMPLES

- ENGINEERS WANT TO USE WP LASER PRINTER

- MAIL AND MESSAGE EXCHANGE

- OUTPUT OF ADMIN DBMS

        ENGINEERING WRITES REPORT
        ⬇
        PRODUCED BY WP CENTER
        ⬇

- ADMINISTRATION USES DATA SERVICE VIA P.T.T.

- ENGINEERING   "   "   "   "   "

                ETC.

WHY ARE THE NETS DIFFERENT ?

1. ## PURCHASER DECISIONS

    — FIRST PRIORITY IS COMPUTING APPLICATION

        (ADMIN/WP/ENG'G)

    — INTERCONNECTION REQUIREMENT IS LESS CLEAR

        — HARD TO MEASURE VALUE
        — SECONDARY CONCERN

2. ## MANUFACTURER DECISIONS

    — TECHNOLOGY CHOICE NOT CLEAR

    — NON INTERCONNECT ⟶ CAPTIVE MARKET

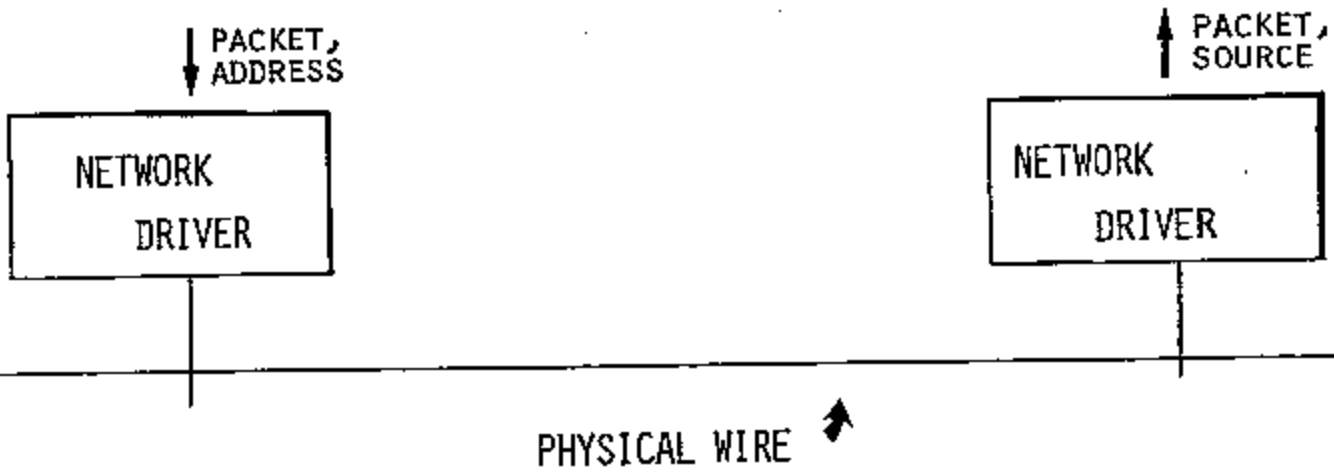➡ AT LEAST A DECADE OF

CONFUSION ! ⬅

INCOMPATIBILITIES

AT THREE LEVELS ——

(1) DIFFERENT MANUFACTURERS HAVE CHOSEN
    DIFFERENT LOCAL NET TECHNOLOGY

    — ETHERNET   — BROADBAND
    — RING   — PABX

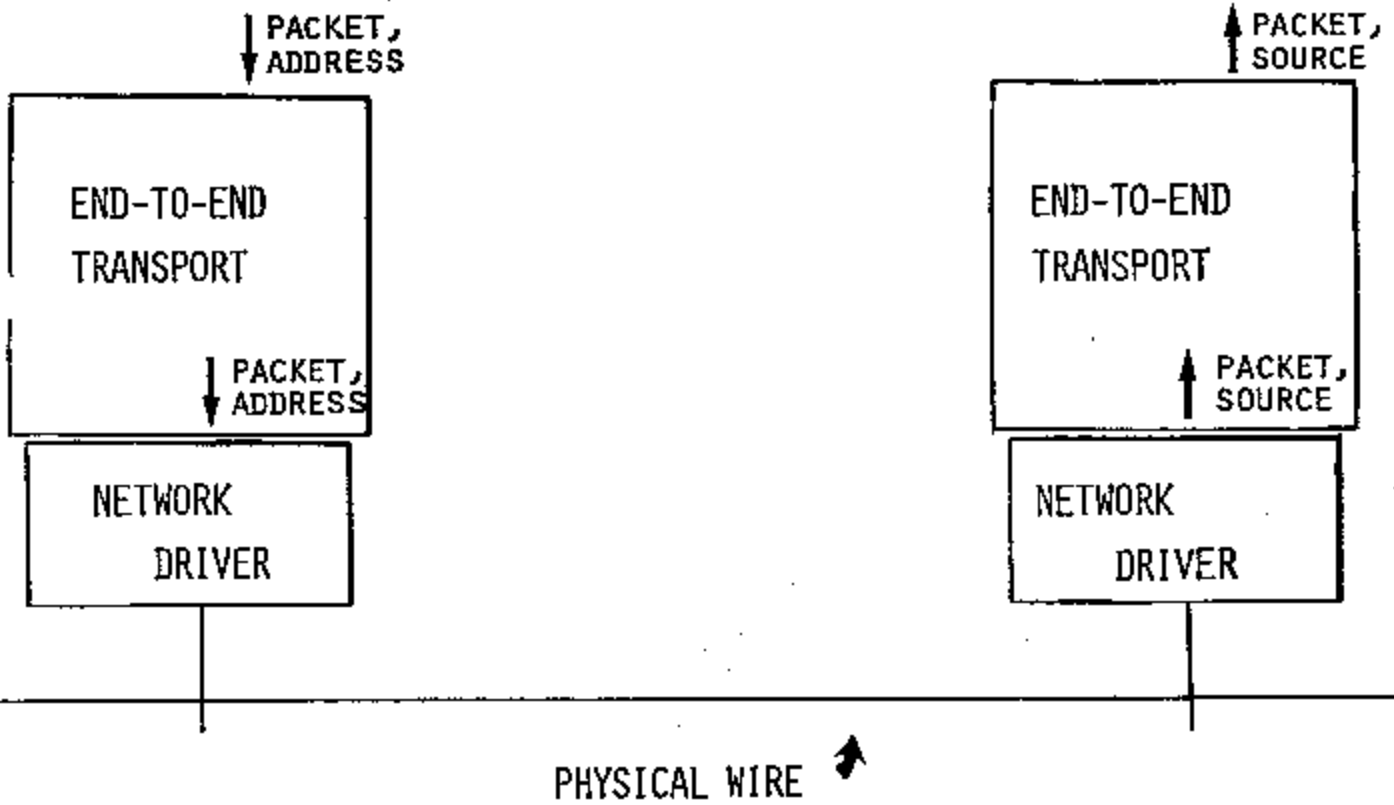(2) EACH MANUFACTURER PROVIDES A COMPLETE
    END-TO-END TRANSPORT SERVICE
        (EACH DIFFERENT FROM NEXT)

(3) INTERPRETATION OF THE DATA IS DIFFERENT
    ON EACH MACHINE

    — CHARACTER CODES
    — 32/36 BITS
    — BYTE ORDER, BIT ORDER
    — PRINTER FORMAT CONTROL

3-LAYER MODEL

PACKET, ADDRESS

NETWORK DRIVER

PACKET, SOURCE

NETWORK DRIVER

PHYSICAL WIRE

3-LAYER MODEL

PACKET,
ADDRESS

END-TO-END
TRANSPORT

PACKET,
ADDRESS

NETWORK
DRIVER

PACKET,
SOURCE

END-TO-END
TRANSPORT

PACKET,
SOURCE

NETWORK
DRIVER

PHYSICAL WIRE

3-LAYER MODEL
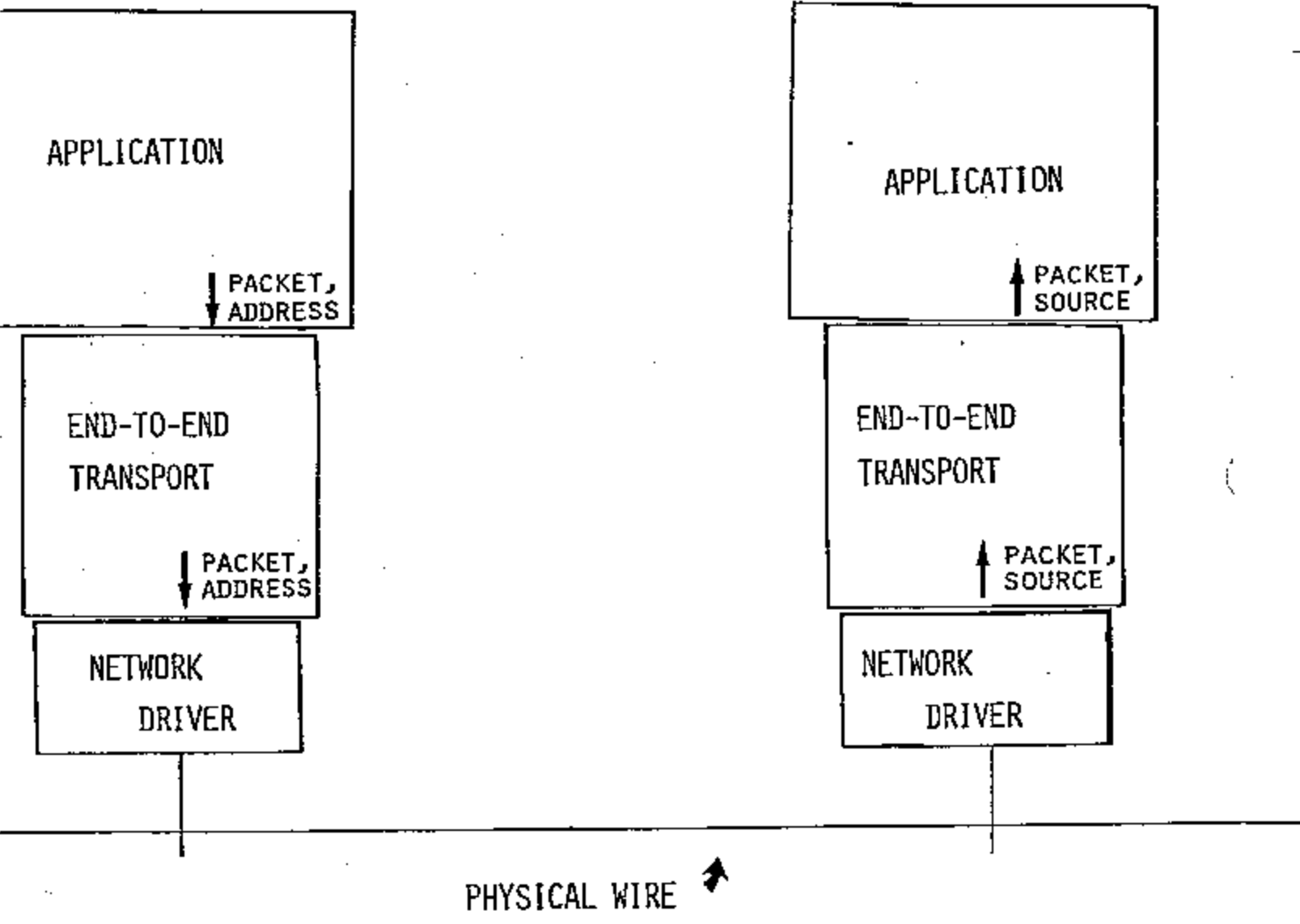
3 - L A Y E R   M O D E L

ISO/OSI
CORRESPONDENCE

↓

| APPLICATION | — 6,7— | APPLICATION |

↓ PACKET, ADDRESS

↑ PACKET, SOURCE

| END-TO-END TRANSPORT | — 3,4,5— | END-TO-END TRANSPORT |

↓ PACKET, ADDRESS

↑ PACKET, SOURCE

| NETWORK DRIVER | — 1,2— | NETWORK DRIVER |
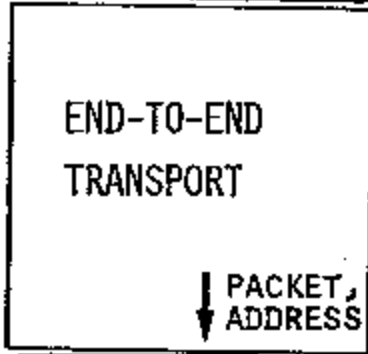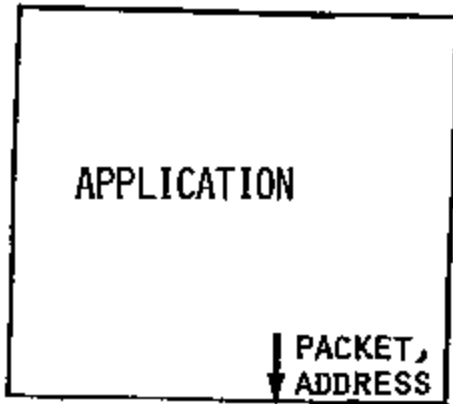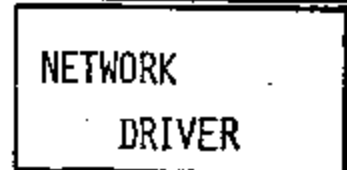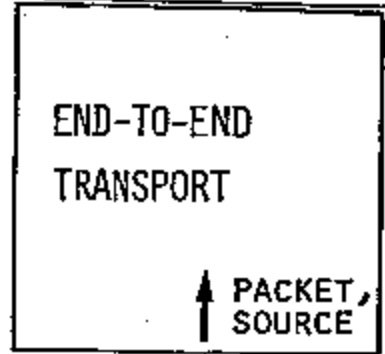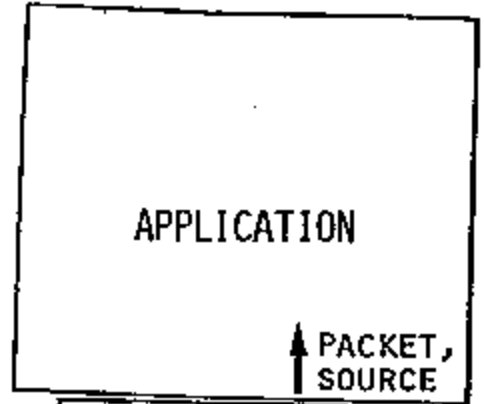
PHYSICAL WIRE ↕

3 - L A Y E R   M O D E L

PHYSICAL WIRE
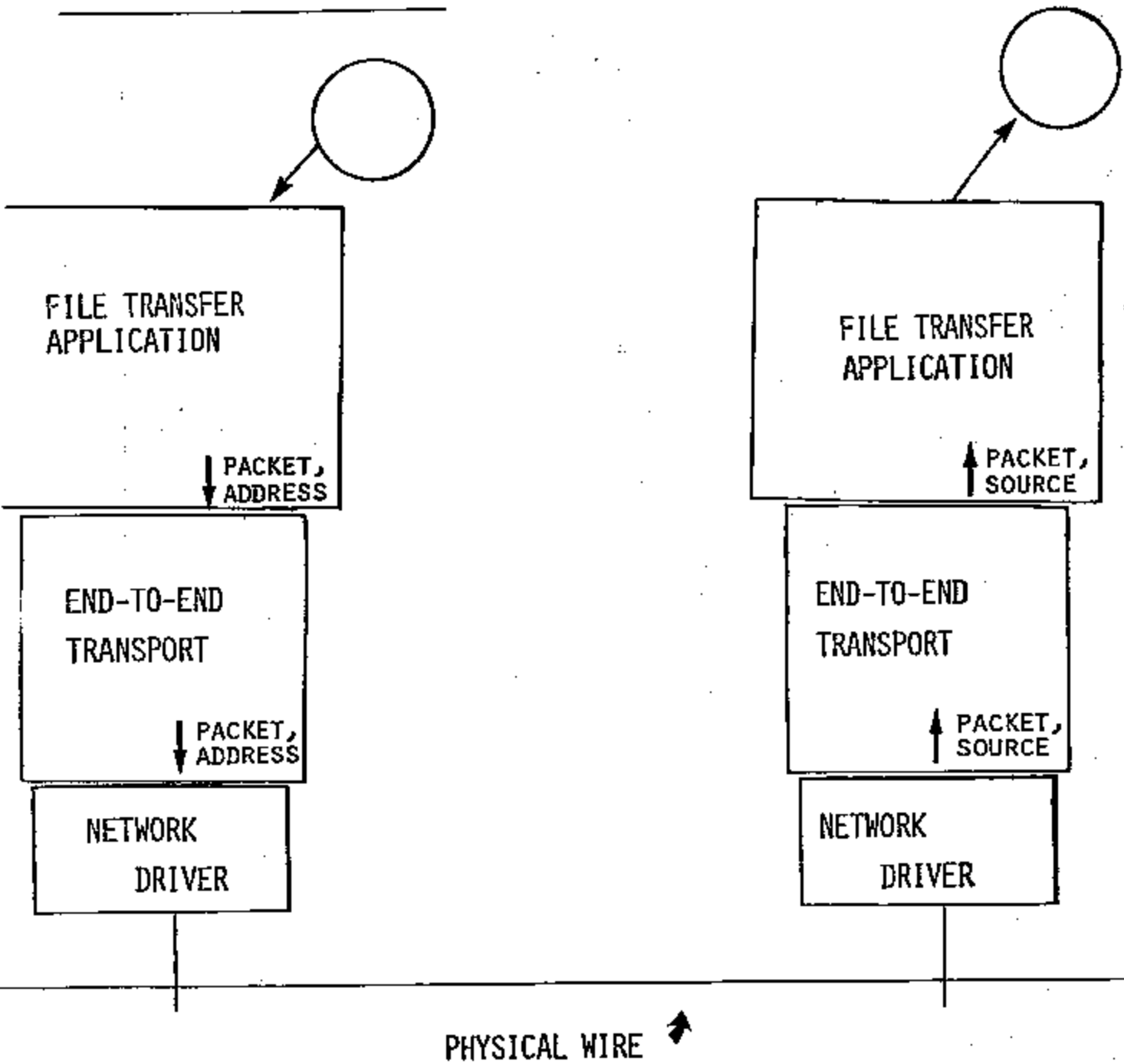
---   TELL OTHER END WHAT NAME TO USE FOR THIS FILE

---   READ DISK

---   MAKE UP PACKETS

---   WRITE DISK

---   CHECK INTEGRITY OF RECEIVED FILE

---   COMMIT TRANSACTION

INTERNET GATEWAYS

APPL

E/E
TRANSPORT

NET
DRIVER
A

E/E
TRANSPORT

NET
DR_A

NET
DR_B

APPL

E/E
TRANSPORT

NET
DRIVER
B

NET A

NET B
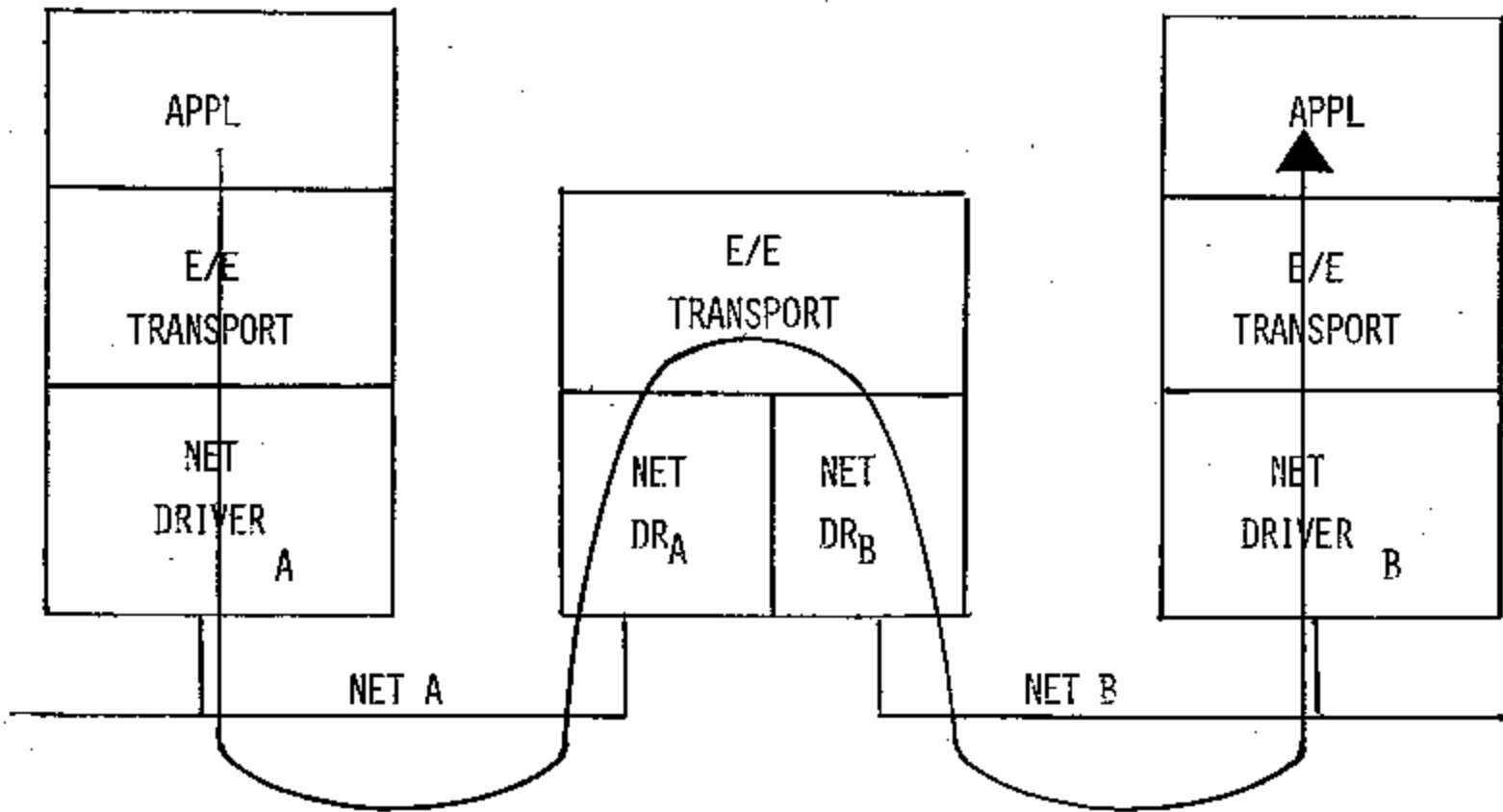
LEVEL I (LOCAL NET TECHNOLOGY)

INCOMPATIBILITY IS EASY TO

BRIDGE, INVISIBILY ....

(EVERYTHING ELSE IS HARD)

HISI
BITS →

FILE   FILE

← XEROX
BITS

HISI WORD PROCESSOR	HISI ↓ XEROX TRANSLATE	ARPA FILE TRANSFER
		ARPA E/E TRANSPORT
		ARPA NET DRIVER

ARPA
E/E
TRANSPORT

ARPA NET DR.	RING NET DR.

ARPANET

RING

XEROX BITS
PACKAGED IN
ARPA PROTOCOLS

FILE

ARPA FILE TRANSFER	XEROX FILE TRANSFER
ARPA E/E TRANSPORT	XEROX E/E TRANSPORT
ETHER NET DRIVER	

ARPA E/E TRANSPORT	
ARPA NET DRIVER	RING NET DRIVER

ARPA E/E TRANSPORT	
RING NET DRIVER	ETHER NET DRIVER

RING NET

ETHER NET

XEROX BITS IN
ARPA PROTOCOLS
ON A XEROX NETWORK

PRINTER

FILE

FILE

ARPA FILE TRANSFER	XEROX FILE TRANSFER
ARPA E/E TRANSPORT	XEROX E/E TRANSPORT
ETHER NET DRIVER	

XEROX FILE TRANSFER	XEROX PRINTER DRIVER
XEROX E/E TRANSPORT	
ETHER NET DRIVER	

XEROX BITS
PACKAGED IN
XEROX PROTOCOLS

PROGRAMS INVOLVED

1.   WORD PROCESSOR

2.   HISI ➡ XEROX TRANSLATOR

3.   ARPA FILE TRANSFER

4.   XEROX FILE TRANSFER

5.   ARPA END TO END

6.   XEROX END TO END

7.   ARPANET DRIVER

8.   RING NET DRIVER

9.   ETHERNET DRIVER

10.   XEROX PRINTER

PROGRAMS INVOLVED

1. WORD PROCESSOR

2. HISI ➡ XEROX TRANSLATOR

3. ARPA FILE TRANSFER

4. XEROX FILE TRANSFER

5. ARPA END TO END

6. XEROX END TO END

7. ARPANET DRIVER

~~8. RING NET DRIVER~~ ➡ TO CHANGE LOCAL NET TECHNOLOGY IS EASY!

9. ETHERNET DRIVER

10. XEROX PRINTER

Q. <u>WHY</u> DIFFERENT END TO END TRANSPORT PROTOCOLS ?

A. SUBSTANTIVE UNRESOLVED DIFFERENCES !

— ADDRESS PLAN, STRUCTURE, SIZE

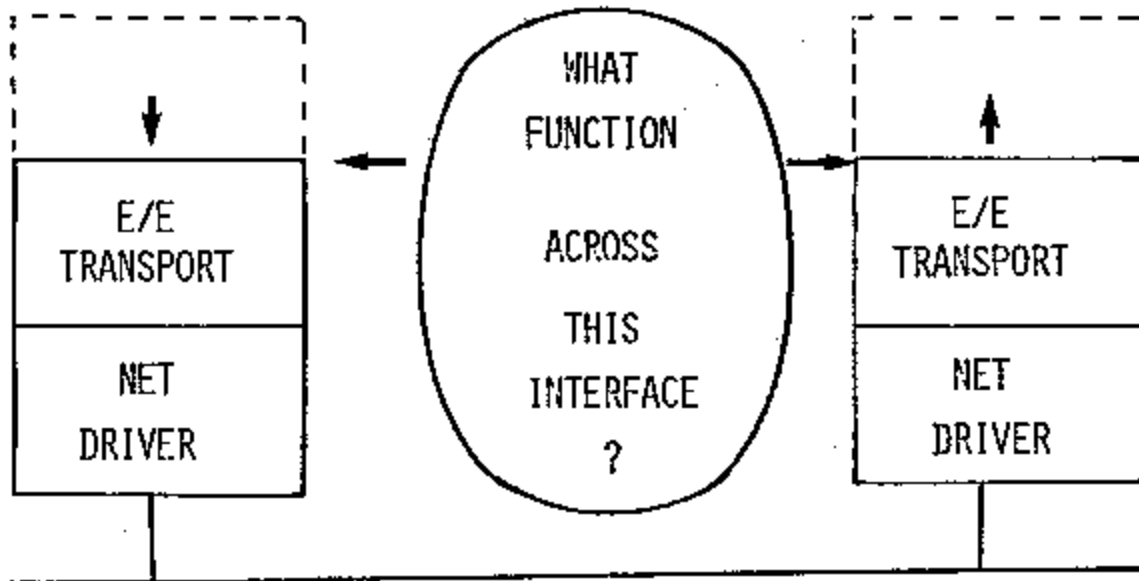— PACKET SIZE, FRAGMENTATION, REASSEMBLY

— FLOW CONTROL, SOURCE QUENCHING, WINDOWS

— CLASS OF SERVICE, DELAY, RELIABILITY, PRIVACY

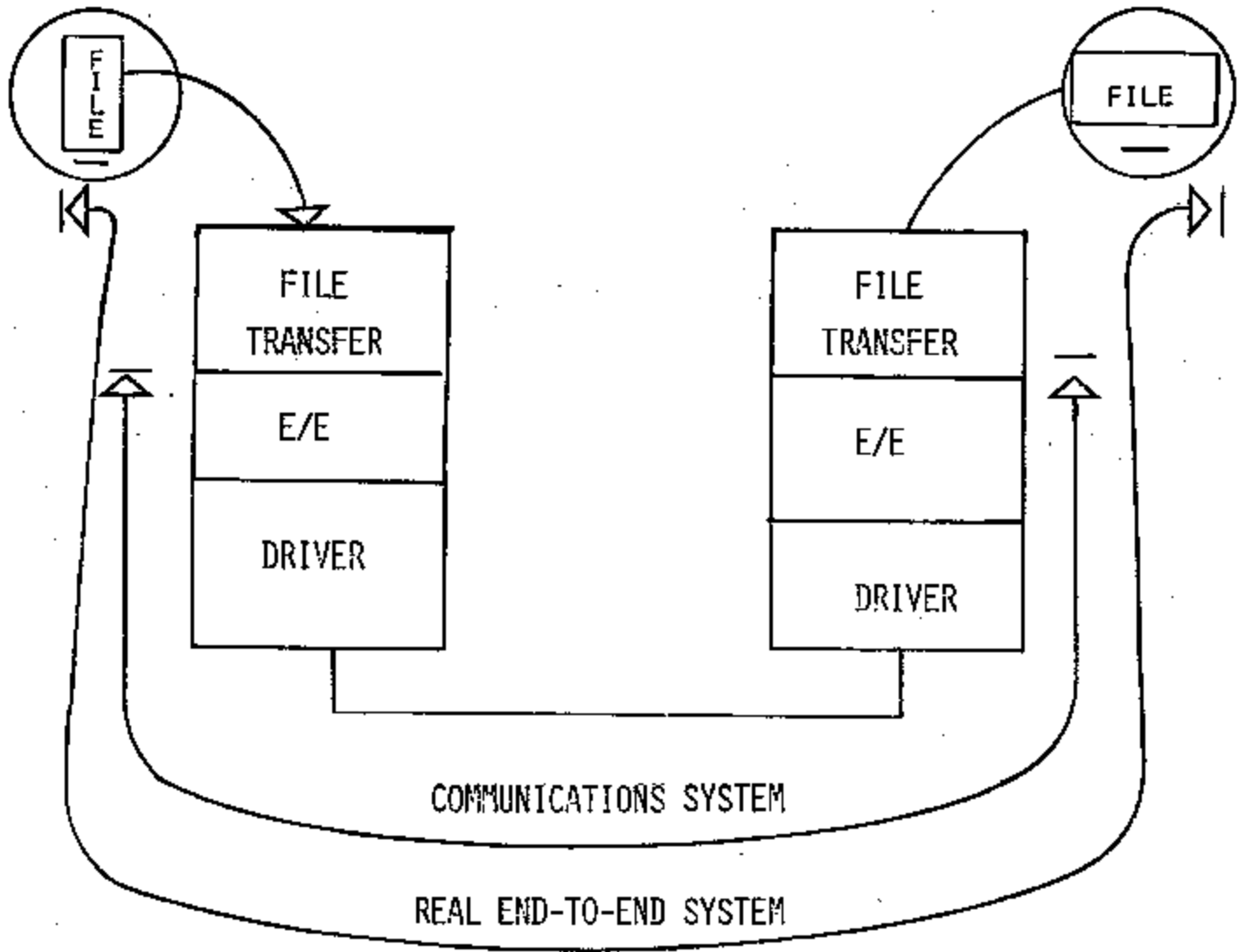— ROUTE CONTROL

— ERROR RECOVERY PROCEDURES

E X A M P L E   O F   A R G U M E N T

1	RELIABLE (NO CHANGED BITS)	SO
		APPLICATION
2	NO DUPLICATE DATA	NEED NOT
		THINK ABOUT
3	FIFO SEQUENCE	DATA
		COMMUNICATION
4	DELIVERY ACKNOWLEDGEMENT	PROBLEMS

TYPICAL APPLICATION-FILE TRANSFER
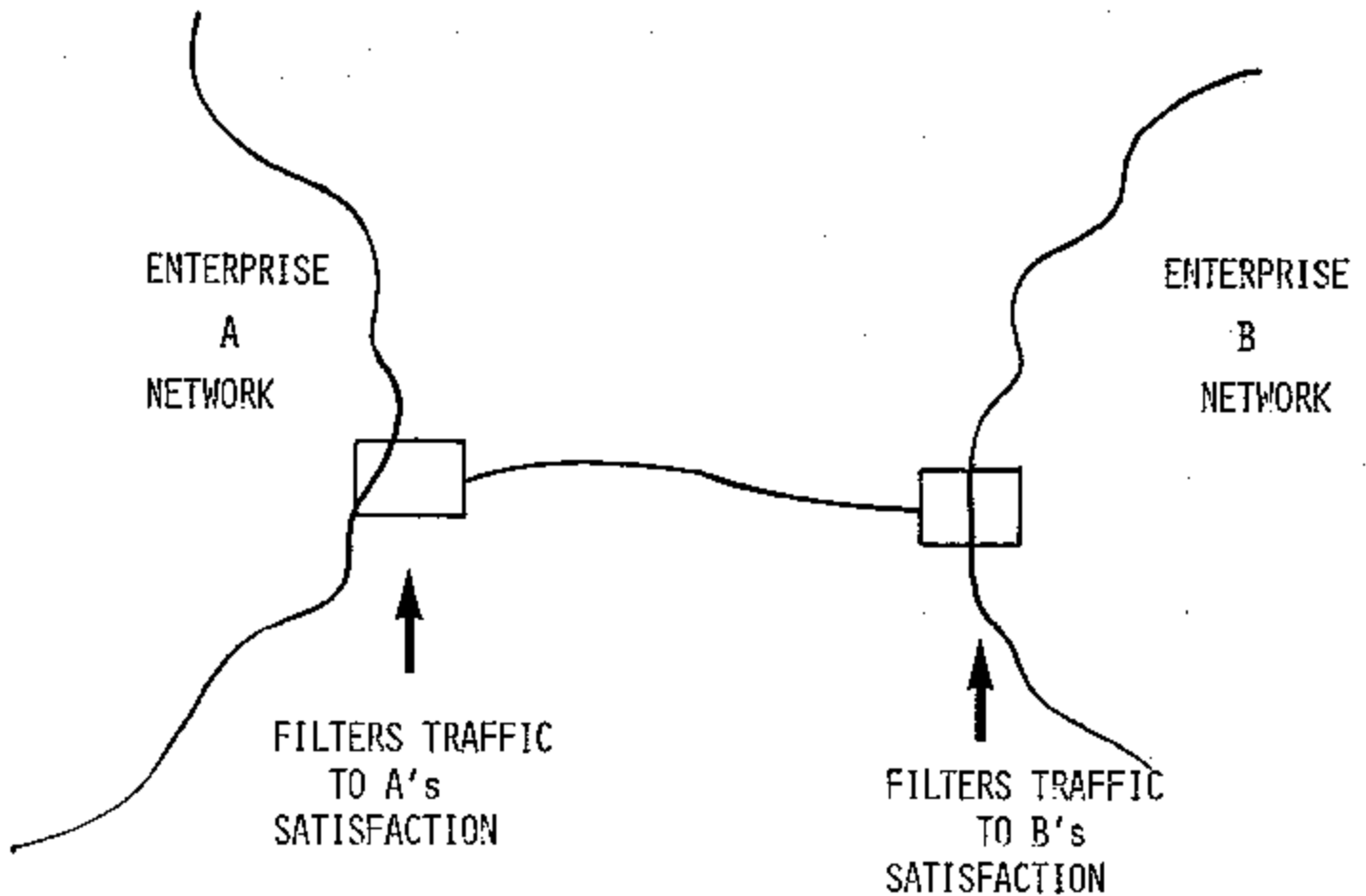
INTER ENTERPRISE GATEWAYS

WHY?

- COMPANY → COMPANY PURCHASE ORDERS

- WIRE TRANSFERS

- PURCHASE OF DATA BASE INFO

- GENERAL MESSAGE SERVICE

EXTRA REQUIREMENTS:

- PRIVACY OF ENTERPRISE DATA

- IMPROPER TRANSIT

- CORPORATE IMAGE

- LIABILITY FOR ACTING ON MSG

- AUTHENTICITY OF ARRIVING MSG

ENTERPRISE
A
NETWORK

ENTERPRISE
B
NETWORK

FILTERS TRAFFIC
TO A's
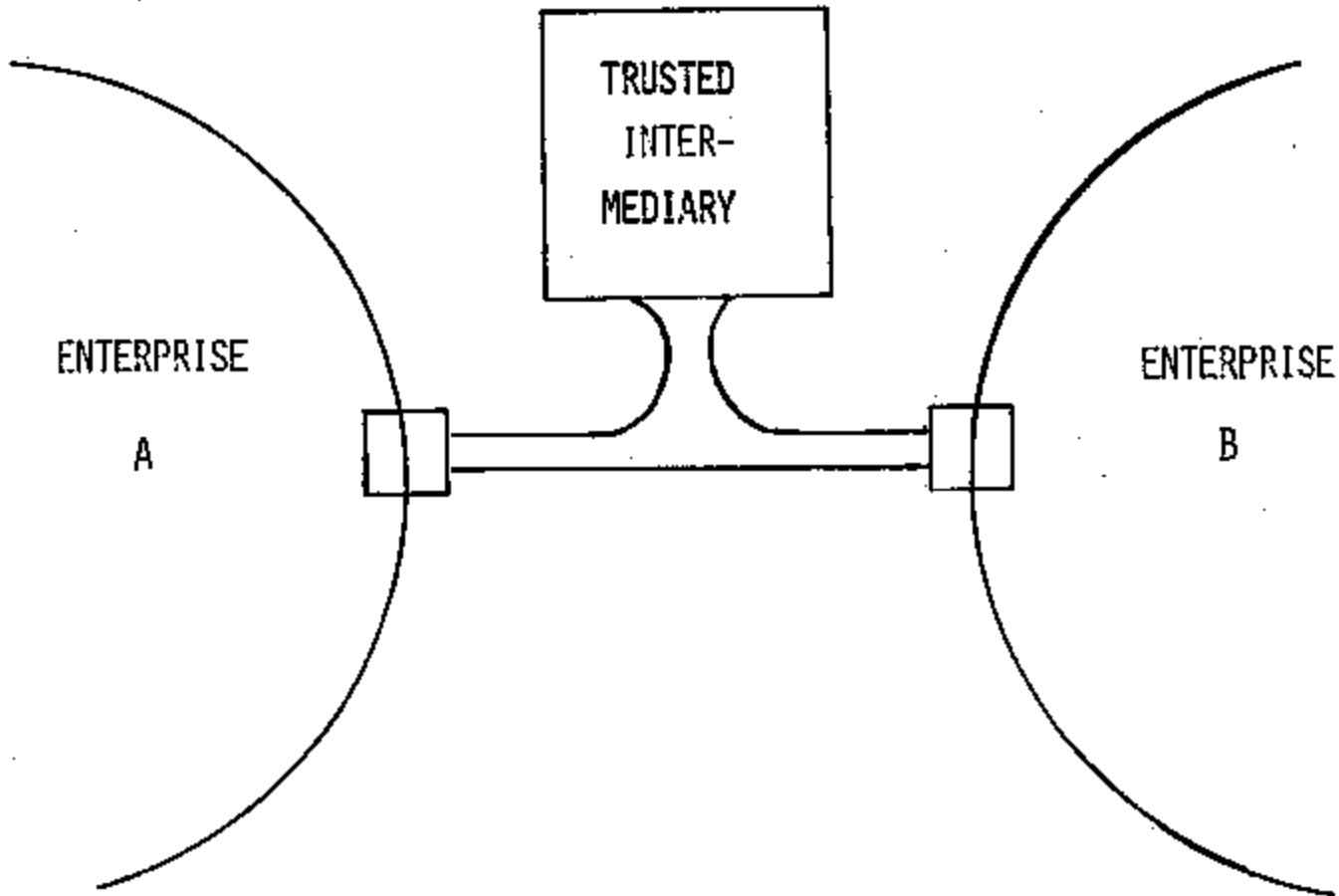SATISFACTION

FILTERS TRAFFIC
TO B's
SATISFACTION

EXAMPLES

— HOLD FOR HUMAN REVIEW

— COPY INTO A LOG

— ACCEPT OR REFUSE, BASED ON SOURCE/DESTINATION

— FORWARD TO <u>DIFFERENT</u> LOCATION FOR INSPECTION

PROVIDES

— AUTHENTICATION

— INTRODUCTION

— BILLING FOR SERVICES RENDERED BY B→A
  OR A→B