

# COMMUNITY NETWORKS AND INTERORGANIZATION LINKS

- Internal Organization Boundaries
- Protocol Proliferation
- When does Protocol Translation work?
- Crossing External Boundaries



# AUTHORITY BOUNDARIES

INTERNAL:

{ PROTOCOL  
DISASTER  
SCENE!

EXTERNAL:

{ POLICY  
PROBLEMS  
TOO!

## TYPICAL COMMUNICATION EXAMPLES

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- 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 R.T.T.
- ENGINEERING " " " " "

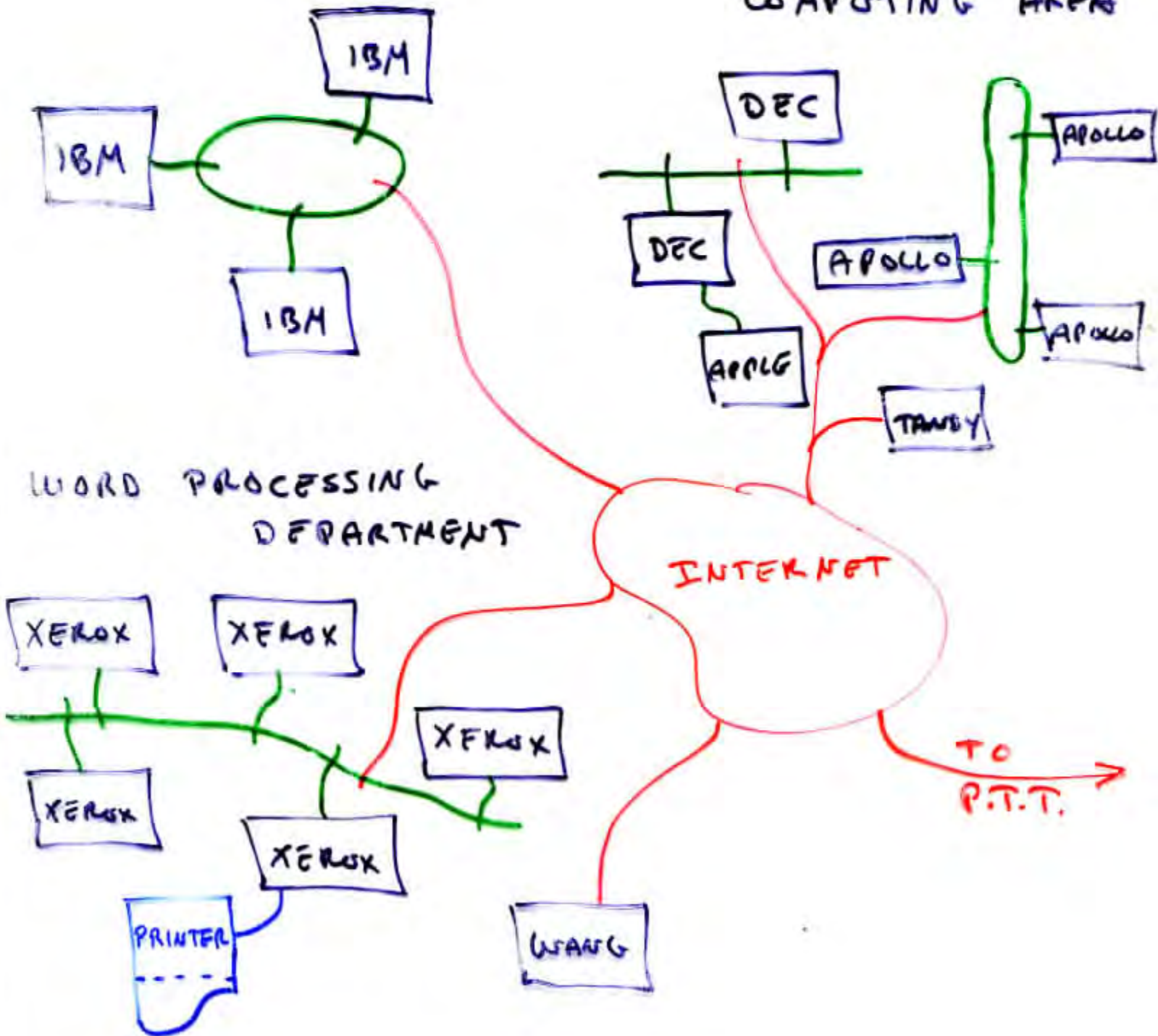
etc.

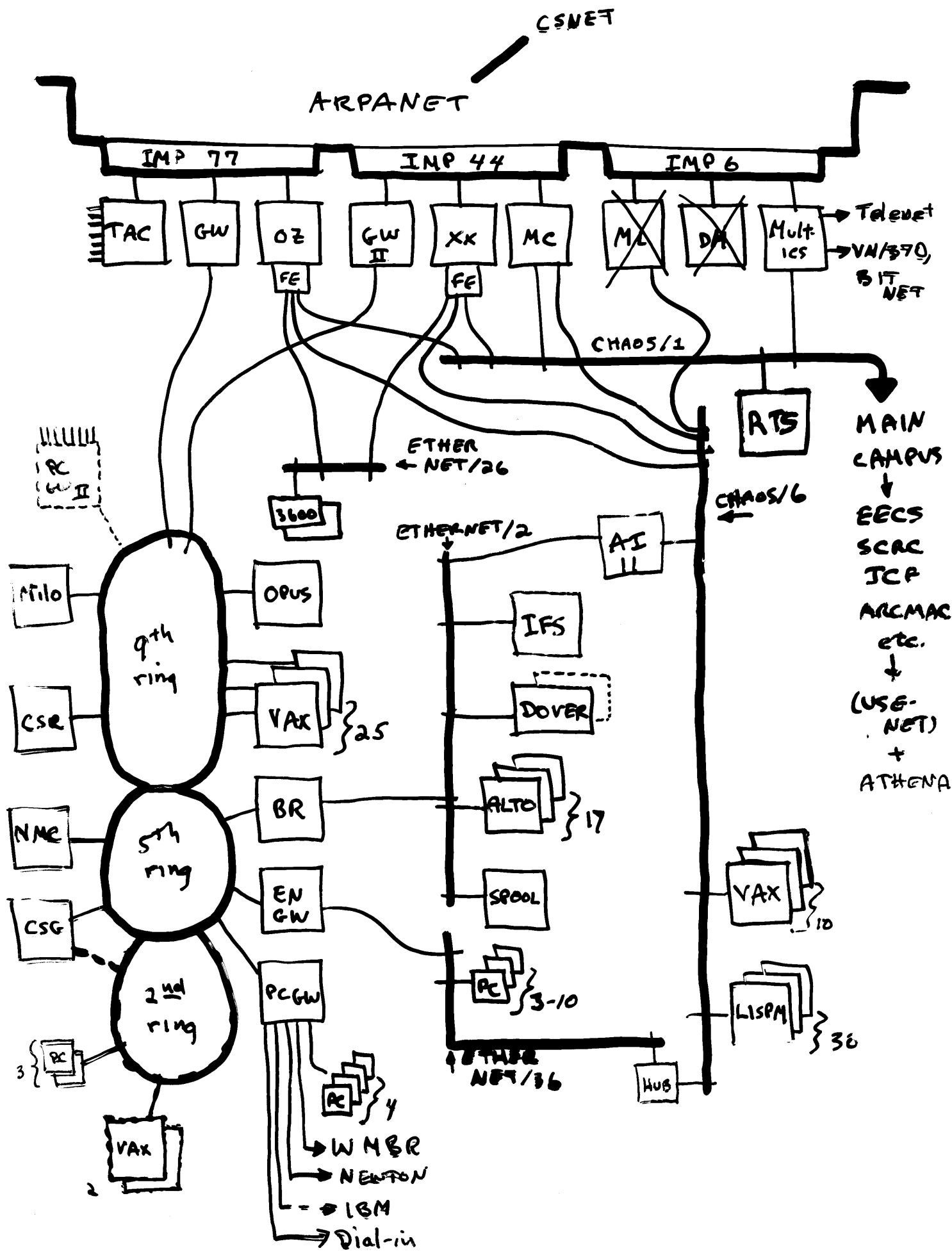


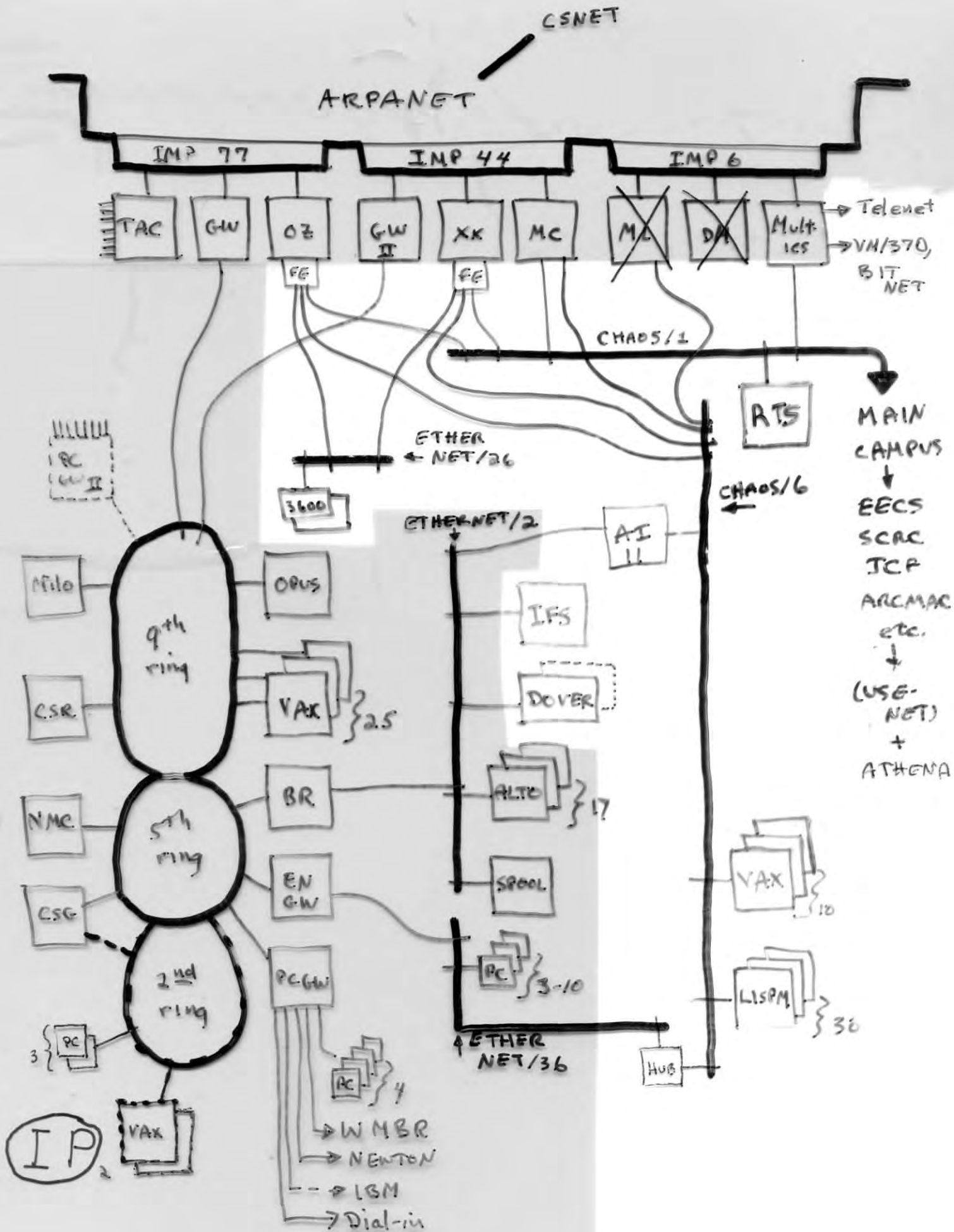
# THE EMERGING PICTURE

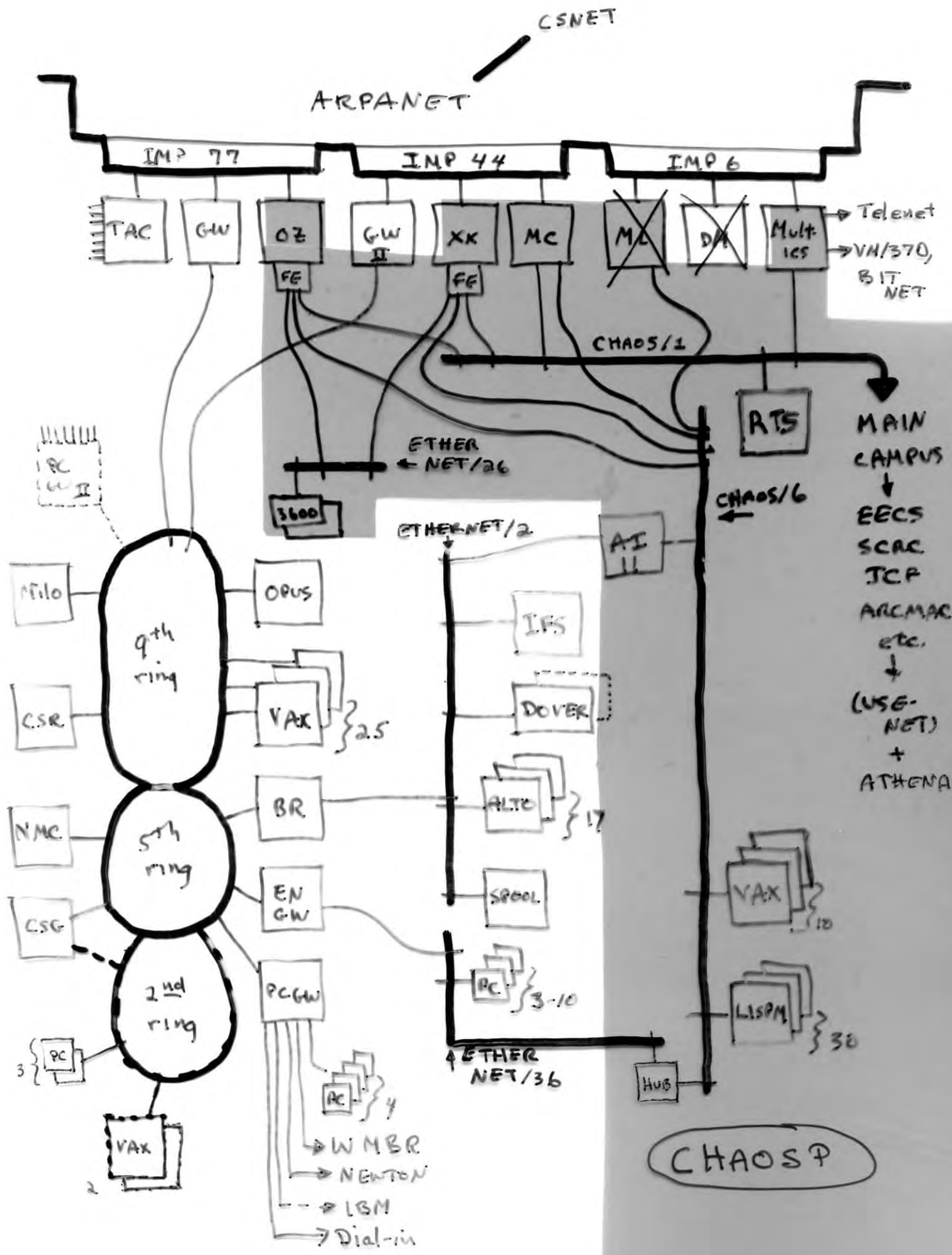
ADMINISTRATIVE  
DP CENTER

ENGINEERING  
COMPUTING AREA

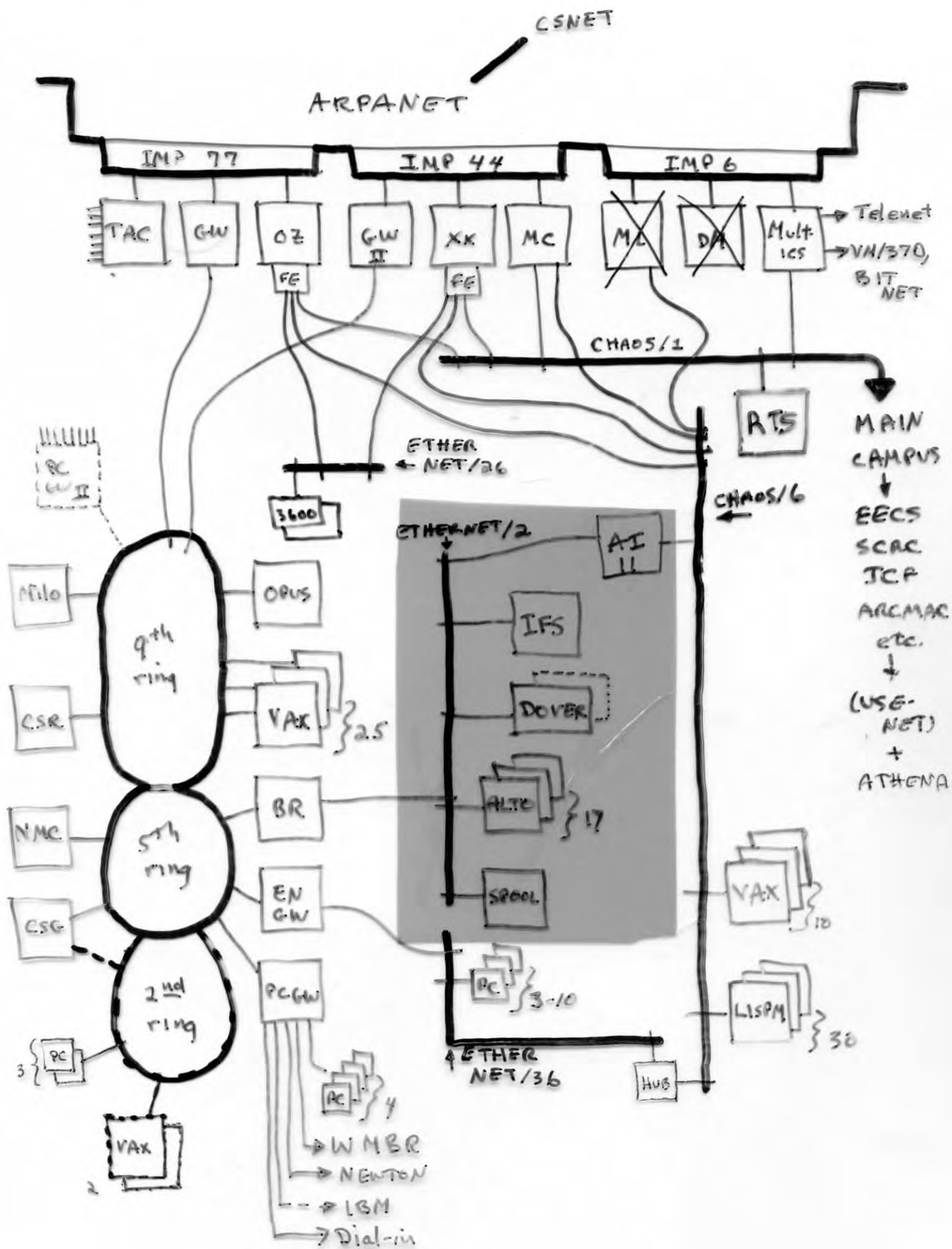












**PROTOCOL FAMILY**

**NUMBER OF M.I.T. HOSTS**

CHAOS P

80

IP/TCP

~~48~~

400 -- 6/85

PUP

20

DECNET

12

XEROX NS

4

RSCS

3

DOMAIN

2

6/83 Estimate

X.25

2

VLC P

1

{ external connections }  
only

Total

172

Implementations

140

Hosts

32

Multi-Protocol Hosts

# WHY ARE THE NETS DIFFERENT?

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## 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! ←

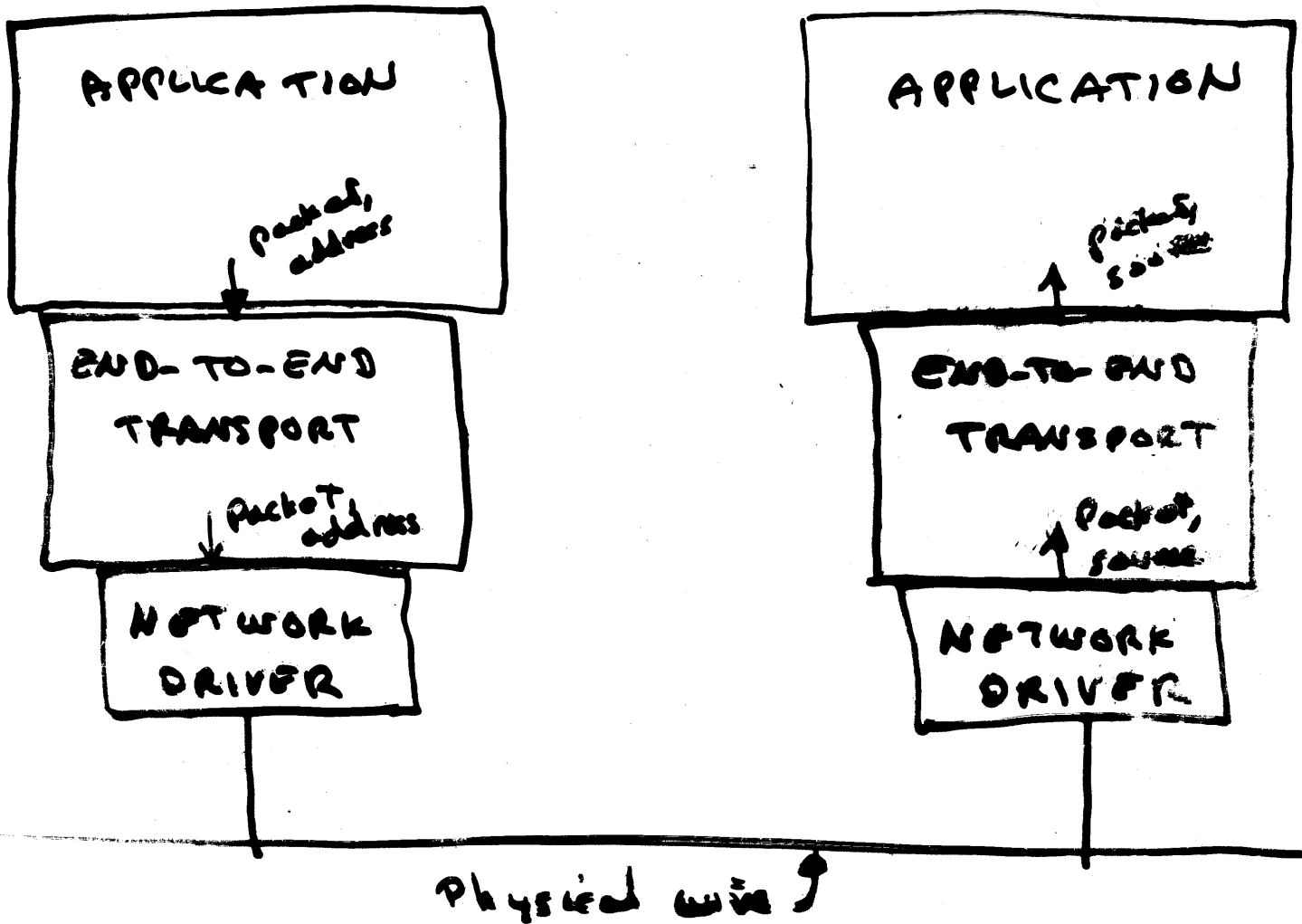
# INCOMPATIBILITIES AT THREE LEVELS -

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- ① DIFFERENT MANUFACTURERS HAVE CHOSEN DIFFERENT LOCAL NET TECHNOLOGY
  - ETHERNET
  - RING
  - BROADBAND
  - 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

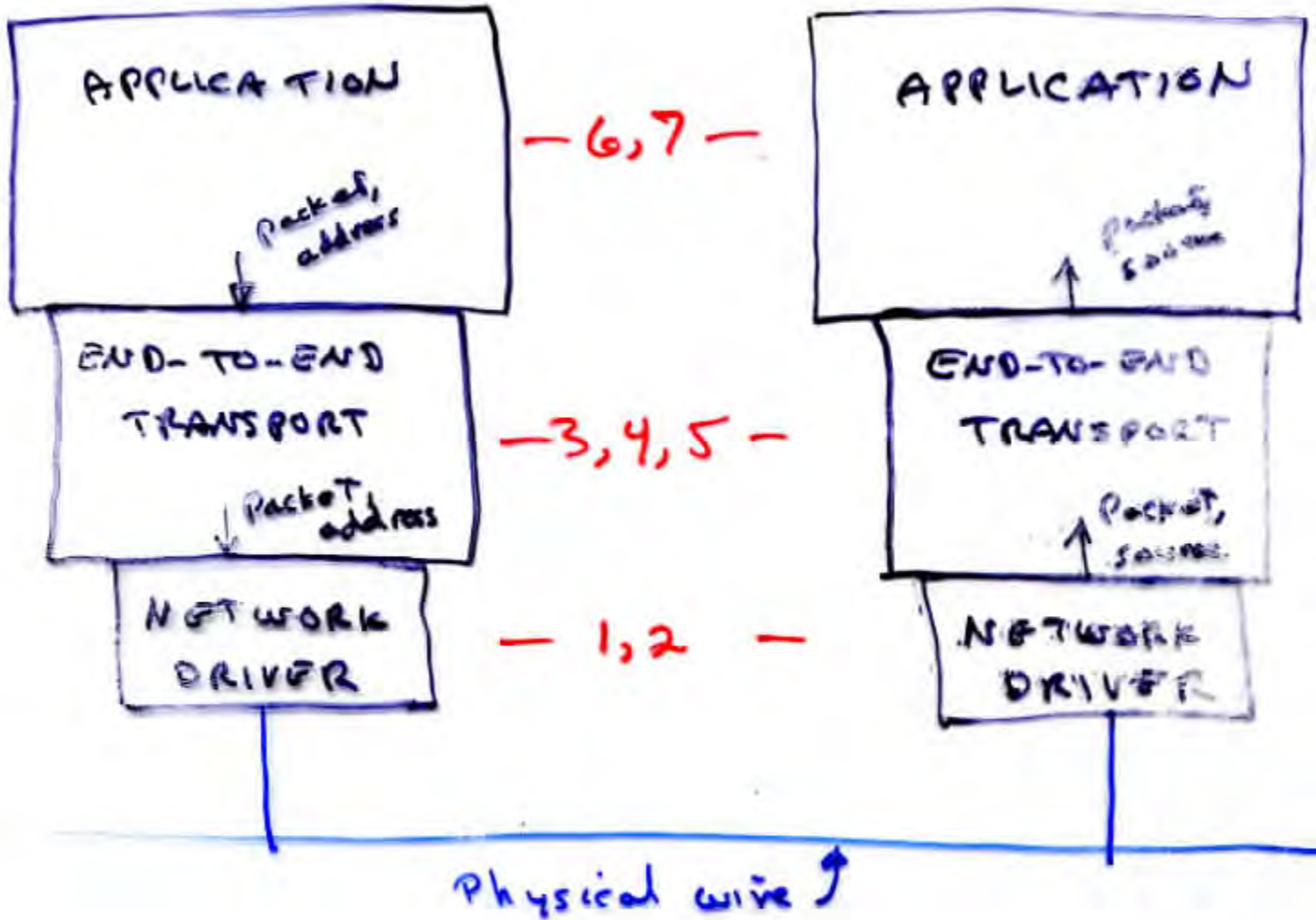


# 3-LAYER MODEL

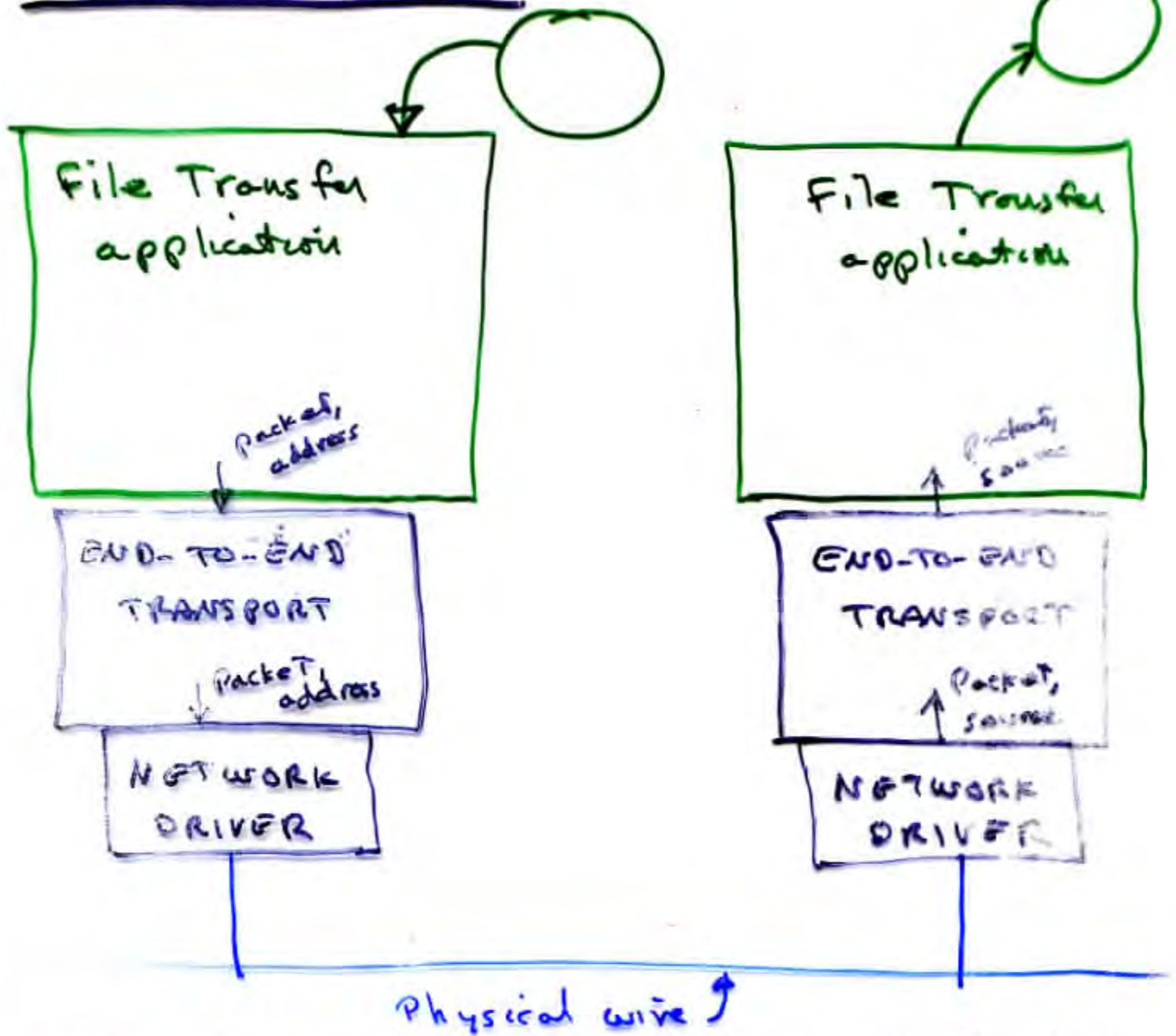


# 3-LAYER MODEL

ISO/OSI  
Correspondence

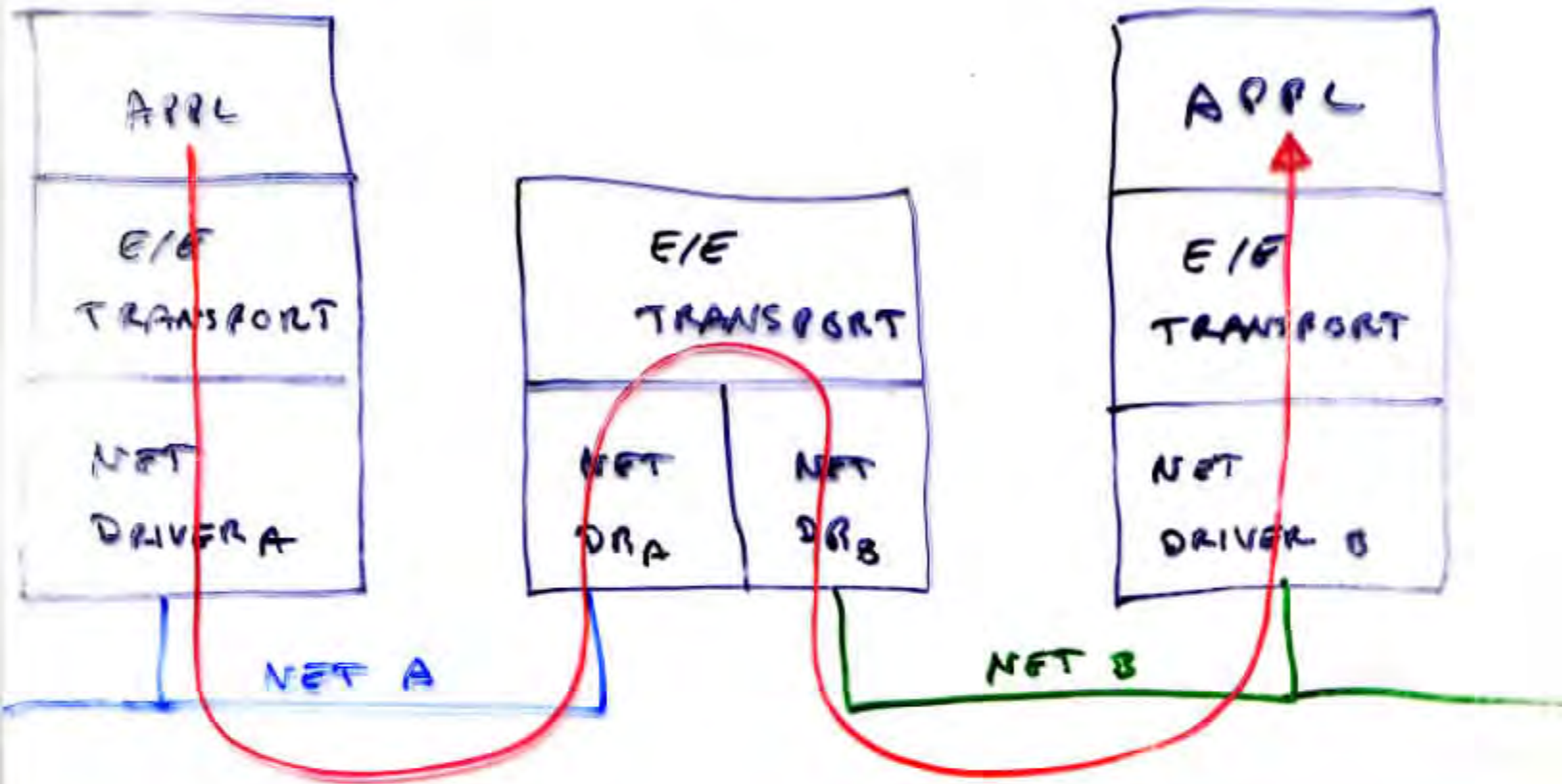


### 3-LAYER MODEL



- 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



→ LEVEL 1 (LOCAL NET TECHNOLOGY)

INCOMPATIBILITY IS EASY TO

BRIDGE, INVISIBLY...

(EVERYTHING ELSE IS HARD)

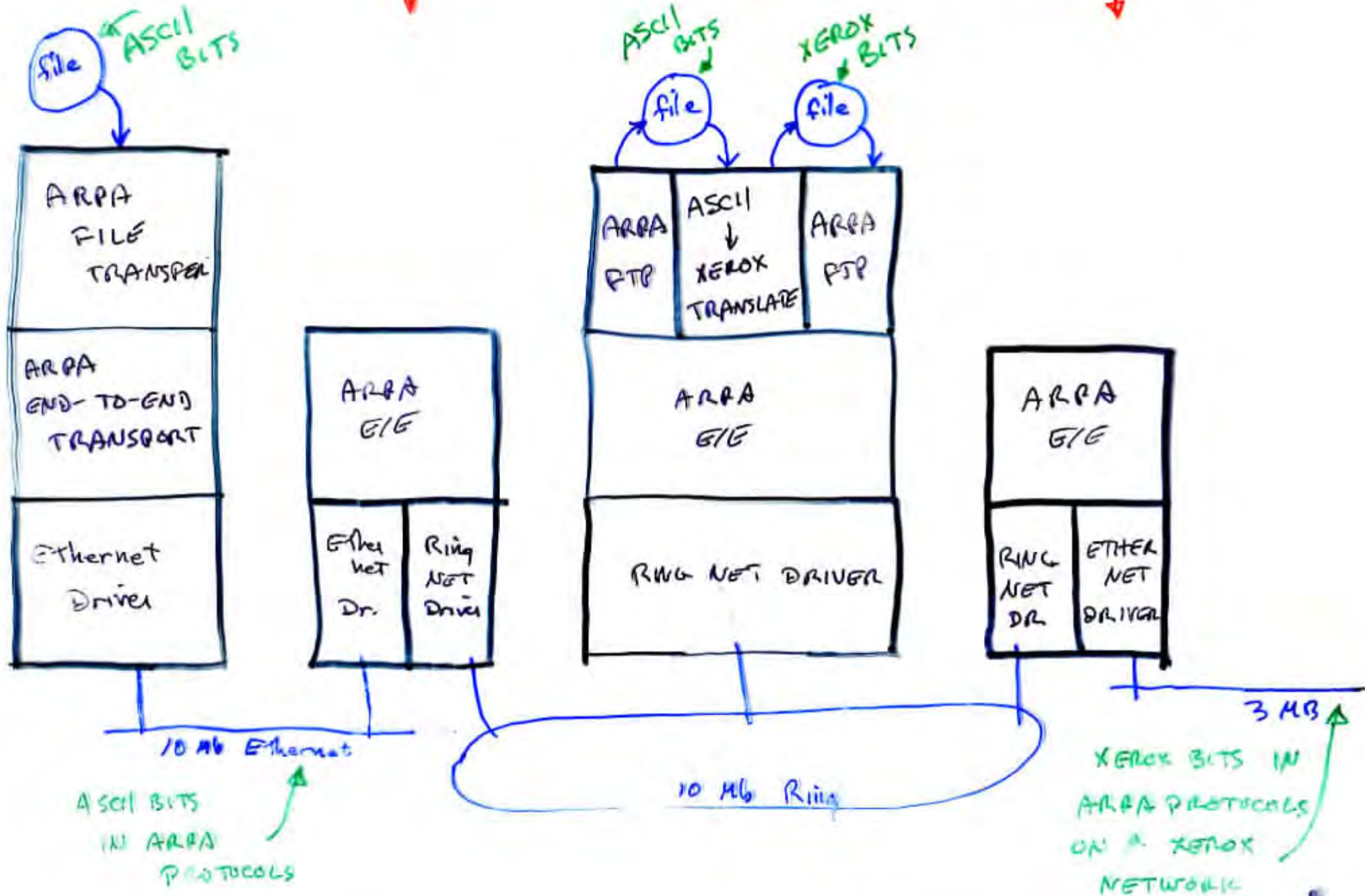


IBM/PC

BRIDGE  
cs/1

VAX 11/250

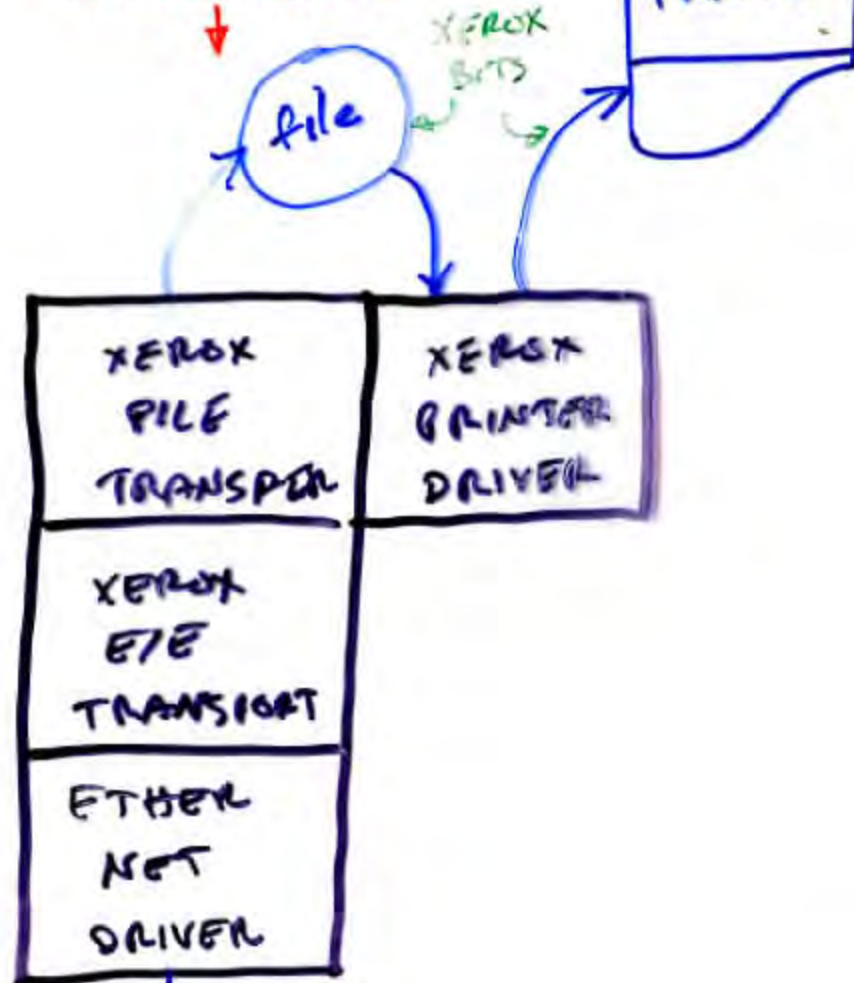
DEC LSI-11/03



XEROX ALTO

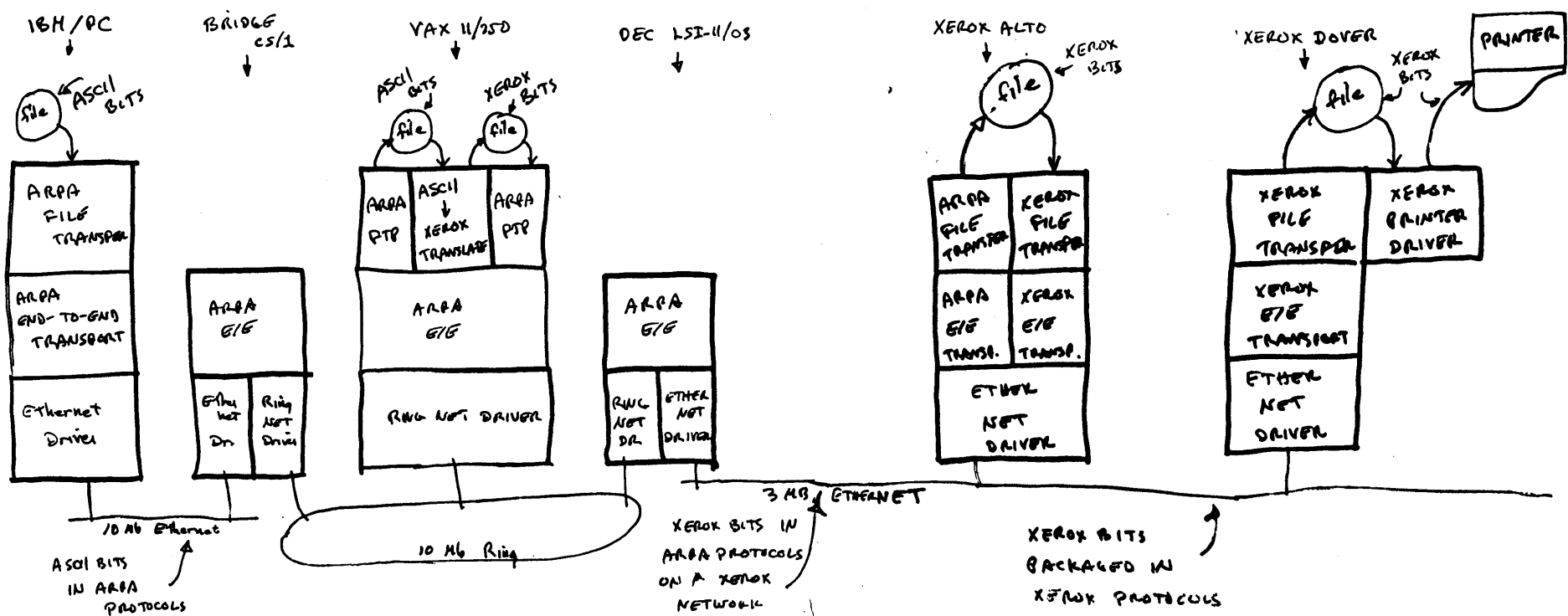


XEROX DOVER



ETHERNET

XEROX BITS  
 PACKAGED IN  
 XEROX PROTOCOLS



Q. WHY 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



# PROTOCOL TRANSLATION FAILS!

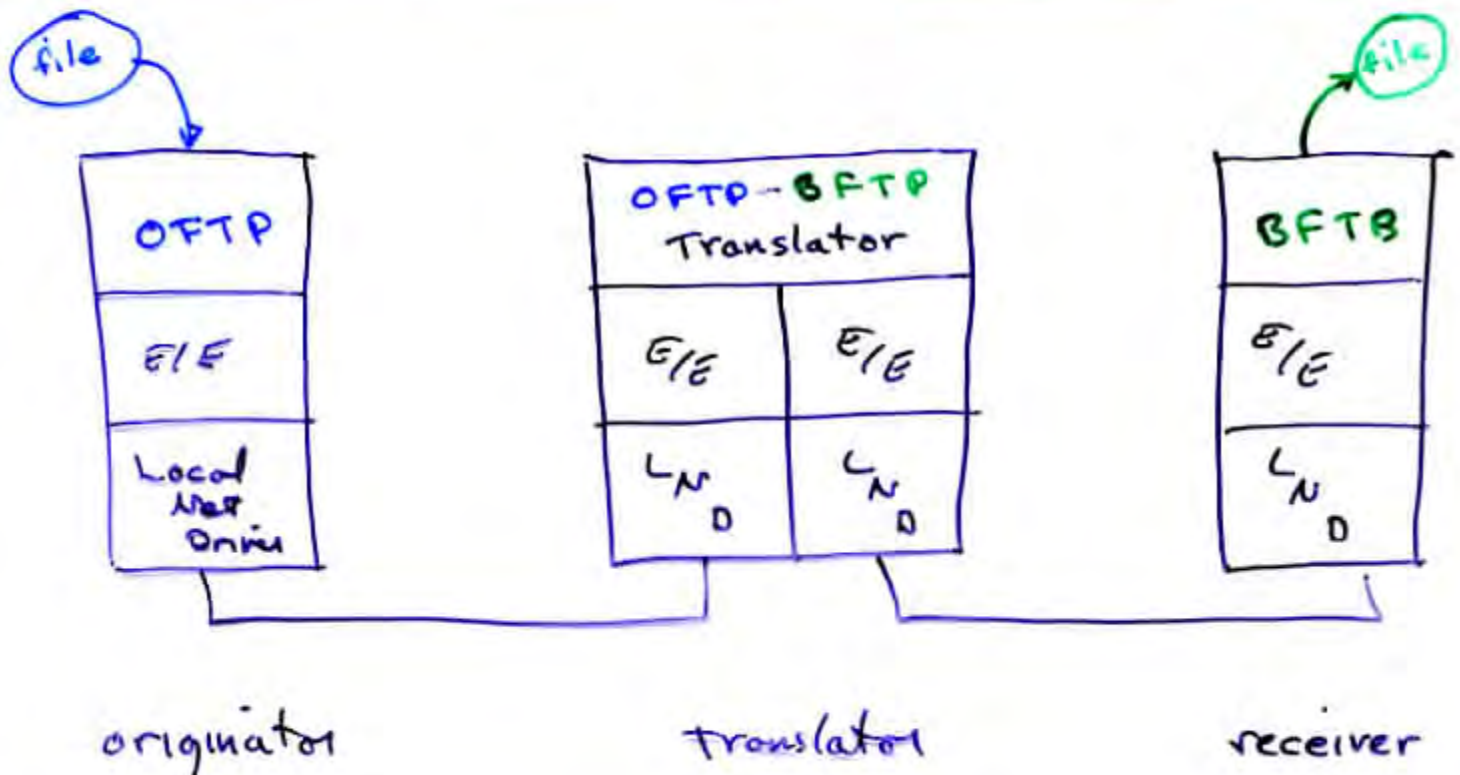
Example: Two file transfer protocols...

## ORDERLY FTP

send inquiry  
wait for ack  
send full packet  
wait for ack  
EOF  $\equiv$  first non-full packet

## BLAST FTP

send inquiry with file size  
wait for ack with data rate  
send bursts of packets  
at that rate  
recv sends ack (and any  
retransmit requests)  
at end



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## Problems

OFTP  $\rightarrow$  BFTP

- 1) OFTP: ACK of last packet means transfer committed.
- 2) BFTP can't send first packet till last OFTP packet is received.
- 3) OFTP sender may give up in disgust waiting for last ack!
- 4) Translator must have storage for largest possible file!

## OTHER HARD-TO-TRANSLATE SUBTLETIES IN FTP

"SEND FILE XYZ TO DIRECTORY JONES ON HOST W"

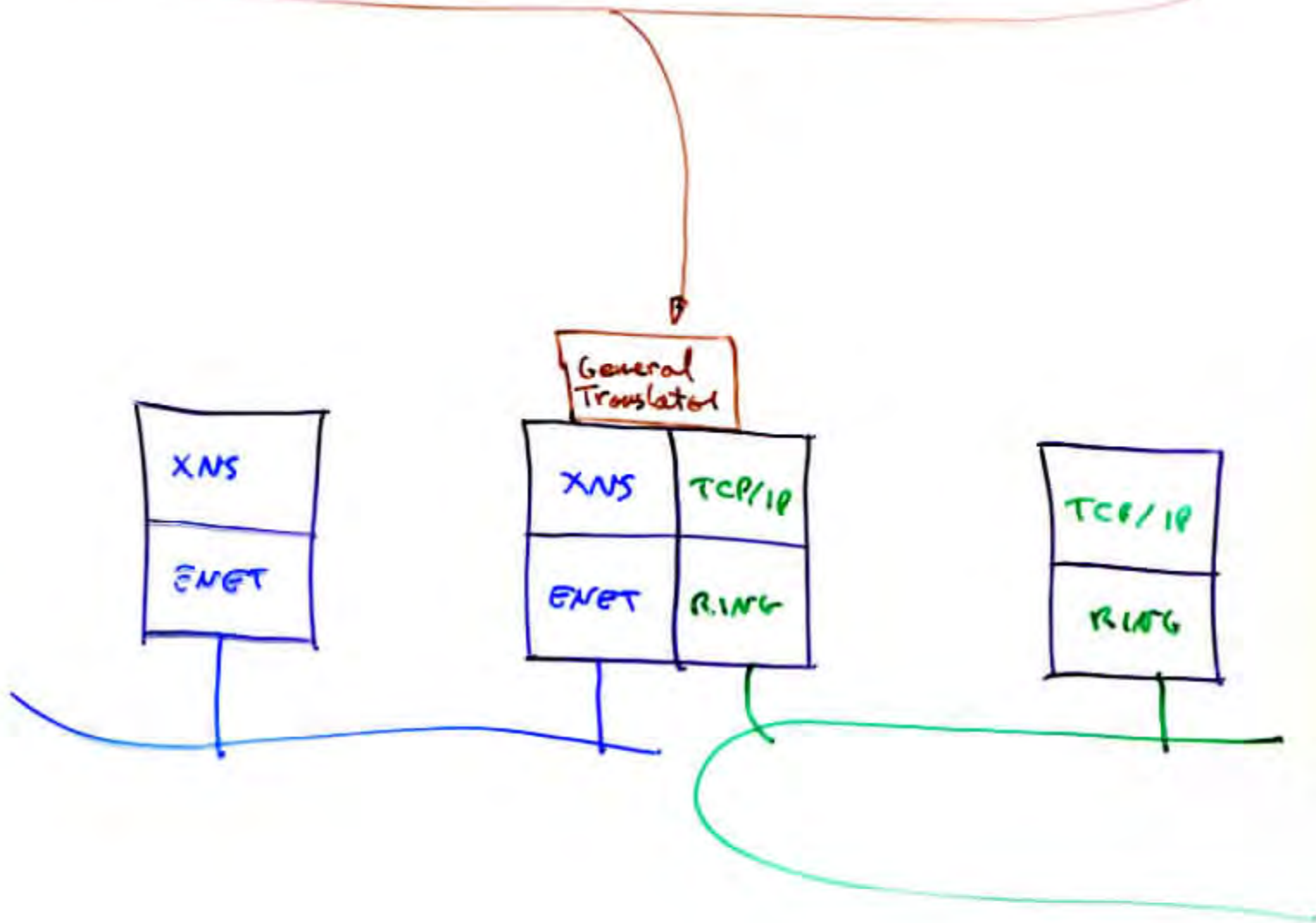
CONVENTION #1: Incoming files → receiving room  
message → recipient  
explicit pickup by recipient

CONVENTION #2: Incoming files → recipient's  
directory  
If file name already in use,  
refuse the file

CONVENTION #3: Incoming file → recipient's  
directory  
Overwrite any old file of same name

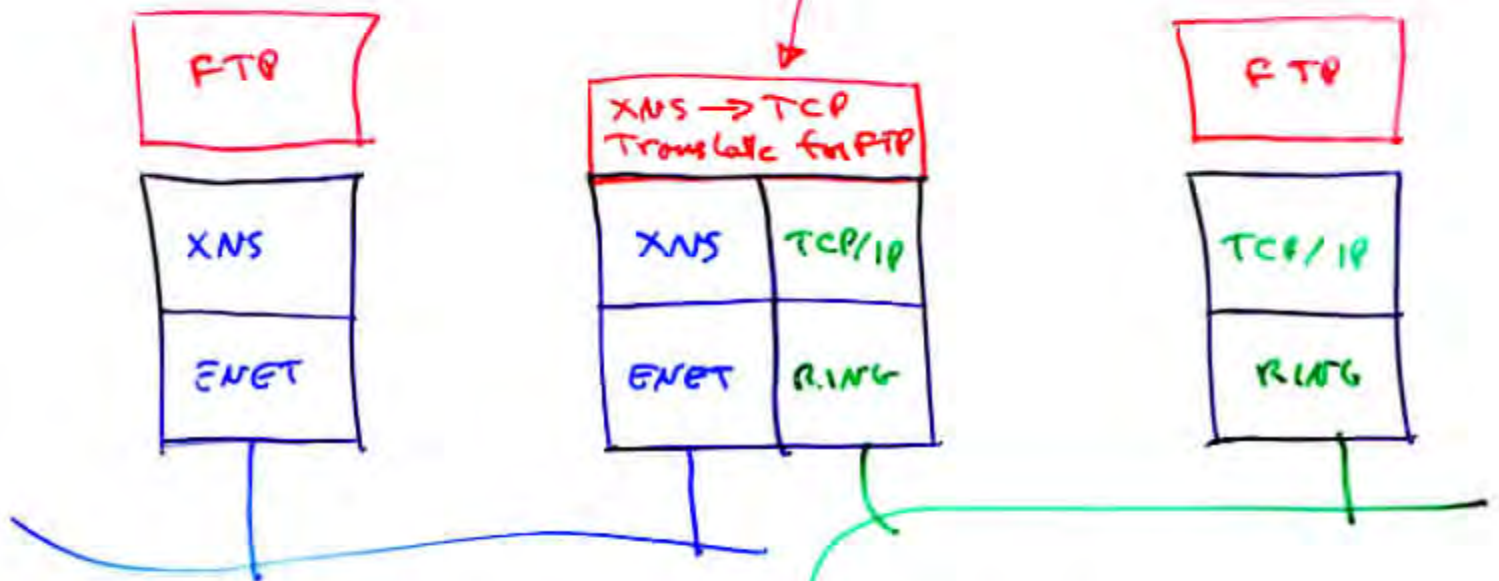


GENERAL TRANSLATOR FOR ANY LEVEL  
FOUNDERS ON SUBTLE  
SEMANTIC DIFFERENCES





SPECIALIZED TRANSLATOR  
WITH KNOWLEDGE OF HIGHER-LEVEL  
APPLICATION CAN SUCCEED



NEED DIFFERENT LEVEL-N TRANSLATOR  
FOR EACH LEVEL-(N+1) PROTOCOL

- e.g. File Transfer
- Remote Login
- Remote Procedure Call

# INTER-ENTERPRISE GATEWAYS

## WHY?

- COMPANY → COMPANY PURCHASE ORDERS
- WIRE TRANSFERS
- PURCHASE OF DATABASE INFO
- GENERAL MESSAGE SERVICE

## EXTRA REQUIREMENTS:

- PRIVACY OF ENTERPRISE DATA
- IMPROPER TRANSIT
- CORPORATE IMAGE
- LIABILITY FOR ACTING ON MSG
- AUTHENTICITY OF ARRIVING MSG

# M. I. T. NETWORK LINKS

(6/83)

- ARPANET → XEROX, DEC, HONEYWELL, FORD, COMSAT, etc.  
↳ CSNET → IBM, HP, etc.
- USENET (UNIX USER GROUP)
- BITNET (IBM UNIVERSITY USER GROUP)
- TELENET (P.T.T. - like)
- TYMNET (P.T.T. - like)
- SYMBOLICS (Corporation)
- IBM (Corporation)\*

\* late summer 1983

# POLICY EXAMPLES

- END POINTS PROVIDE POLICY  
GATEWAY DOES NOT INTERFERE
- NO TRANSIT
- LOG ADDRESSES
- LOG DATA
- ONLY SOME HOSTS MAY PARTICIPATE
- ONLY SOME USERS MAY PARTICIPATE
- MAIL ONLY (No remote login or job entry)
- OUTGOING MAIL HELD FOR HUMAN REVIEW

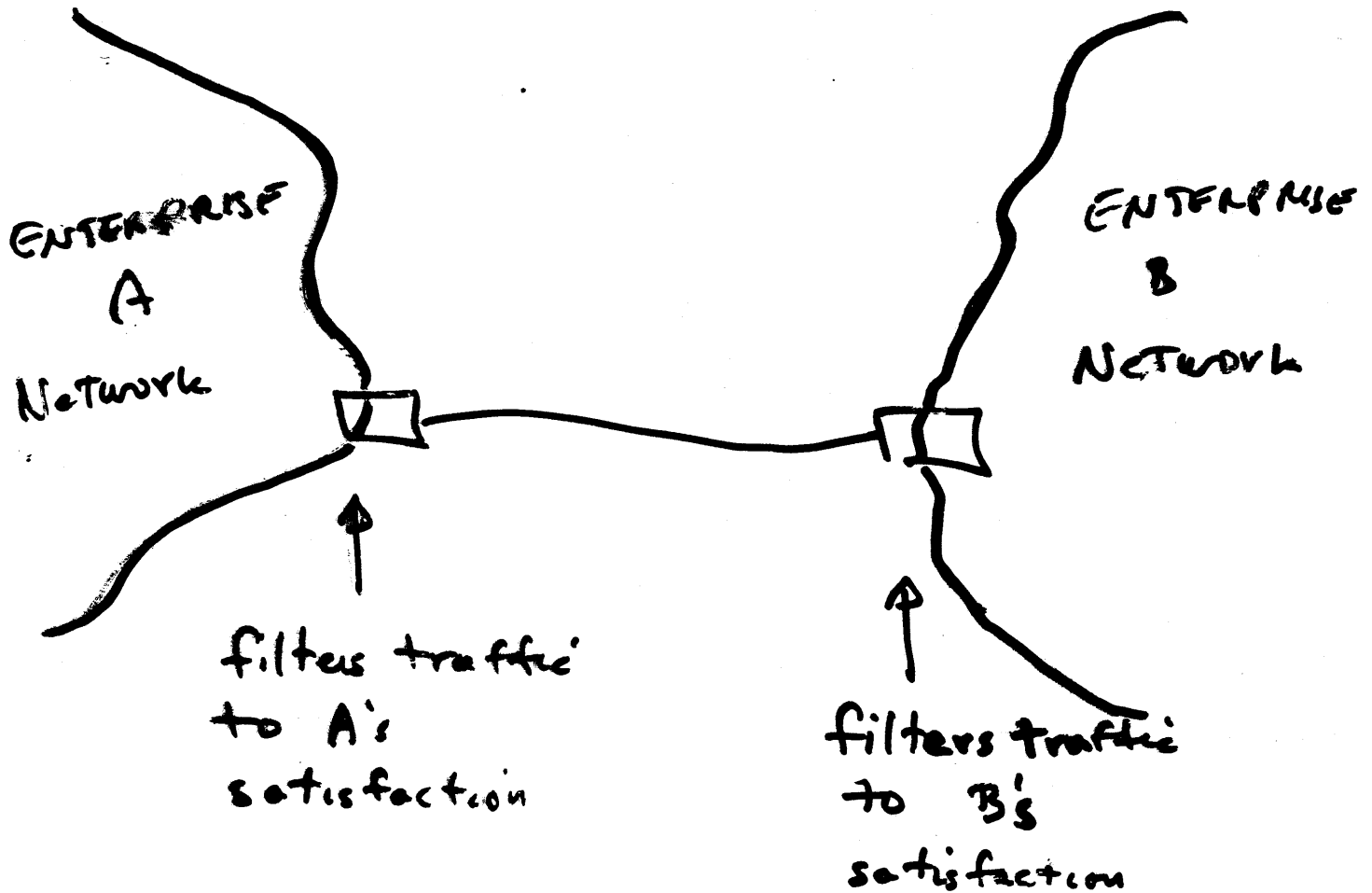
LINK FROM A TO B



TWO POLICIES INVOLVED



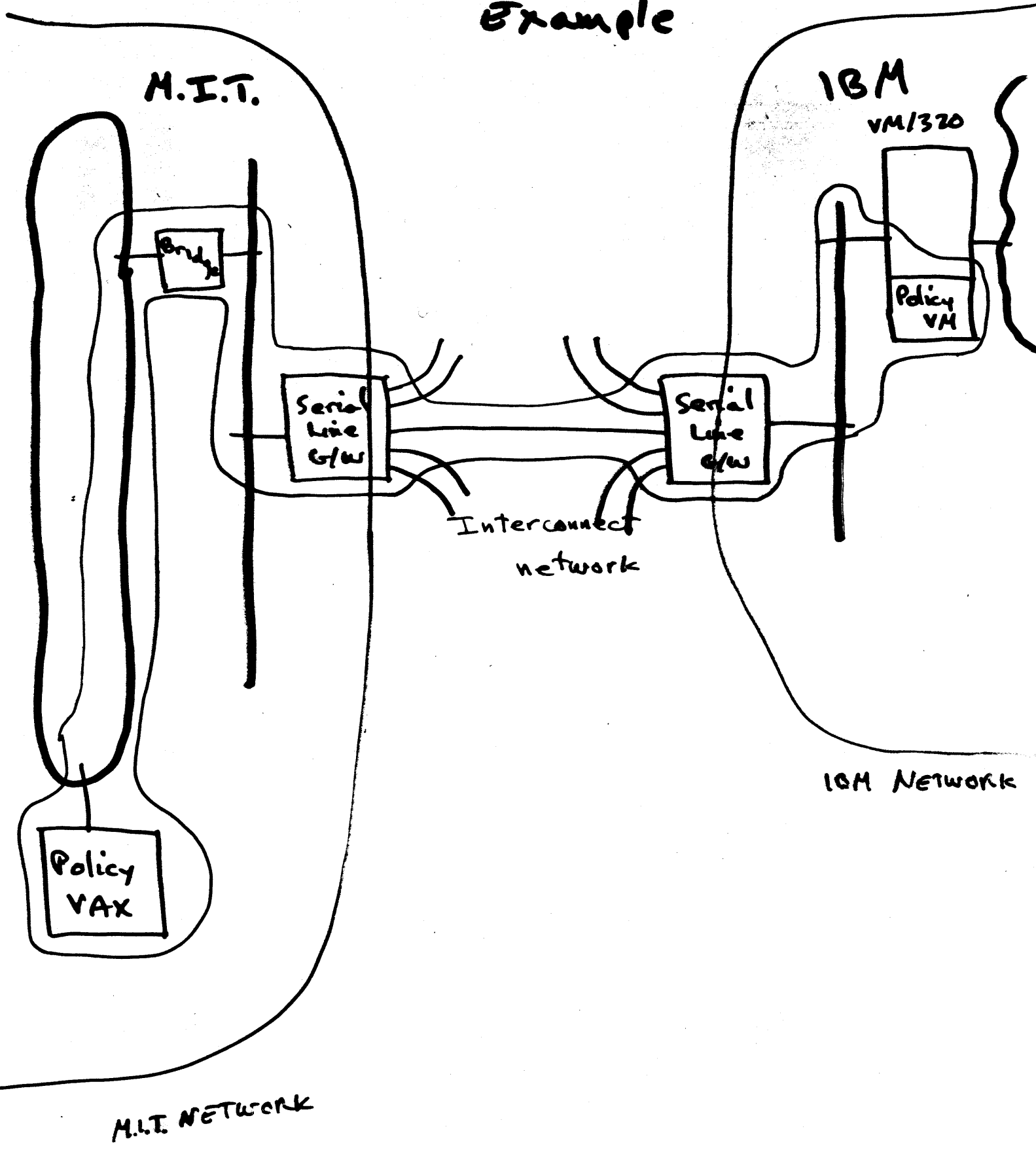
# ① GATEWAYS HAVE FILTERS



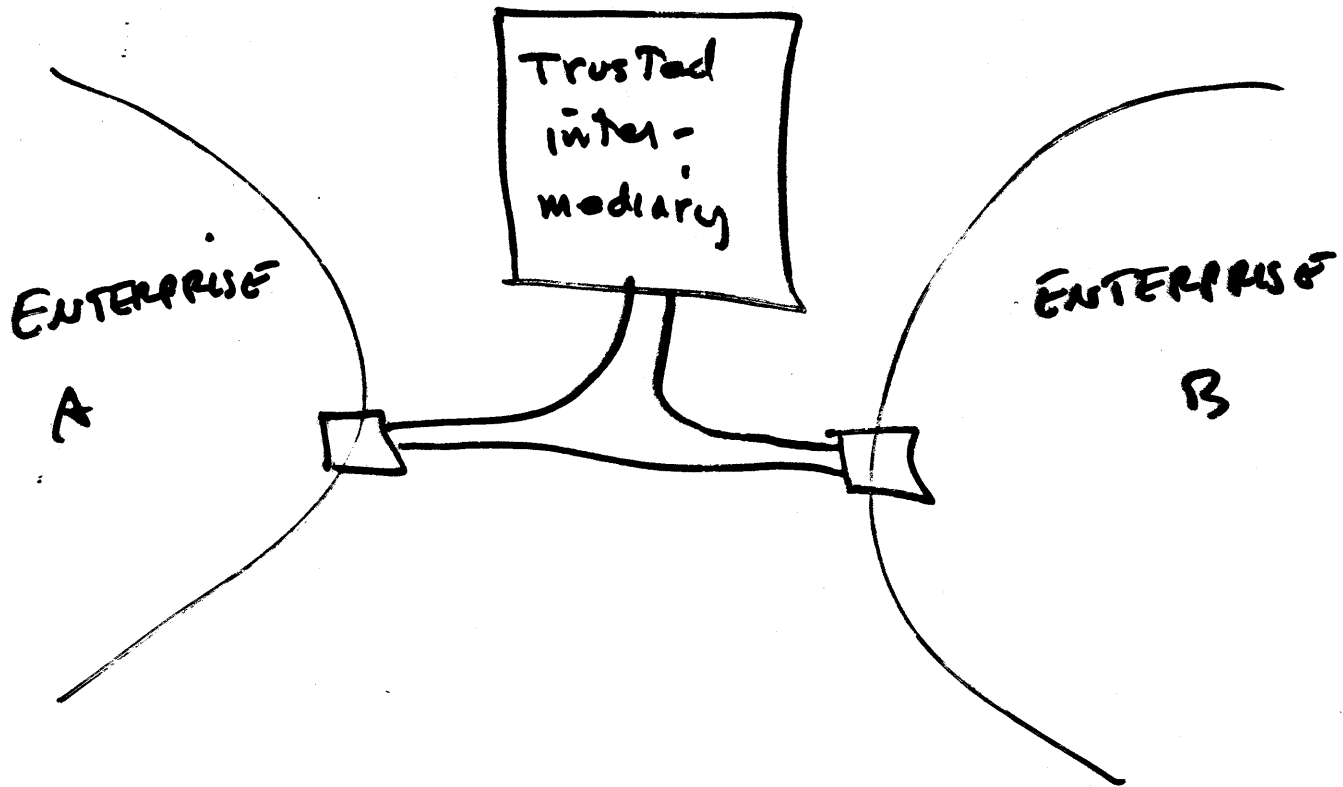
## examples

- hold for human review
- copy into a log
- accept or refuse, based on source/destination
- forward to different location for inspection

# Policy Enforcement Example



## ② TRUSTED INTERMEDIARY



Provides

- authentication
- introduction
- billing for services rendered by  $B \rightarrow A$   
or  $A \rightarrow B$