Networking

Ethernet

TCP/IP

Rational Networking
- hardware
- installation
- commands
- programming

Delta: new features

future plans and possibilities

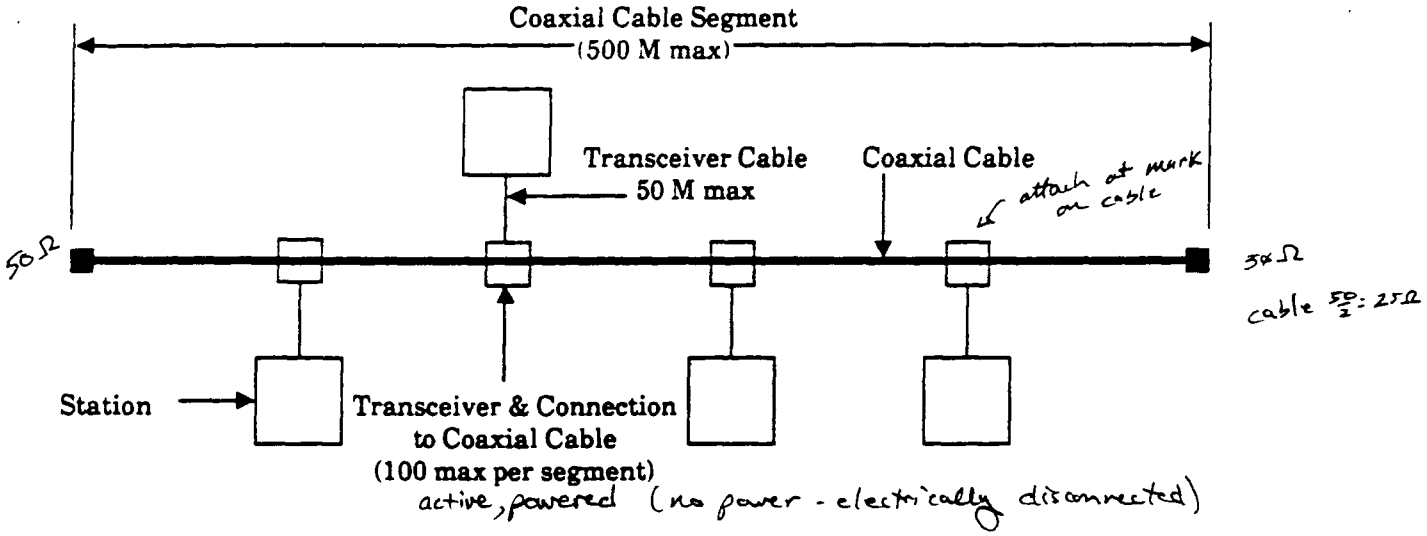


Figure 7-1a: Minimal Configuration

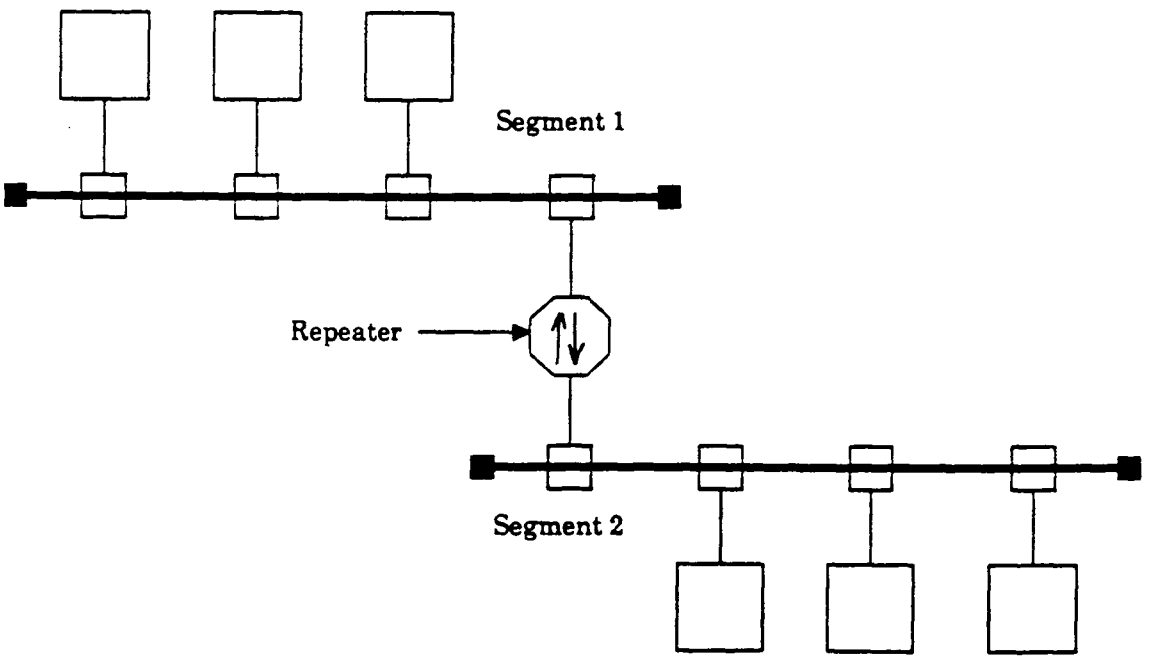


Figure 7-1b: A Typical Medium-scale Configuration

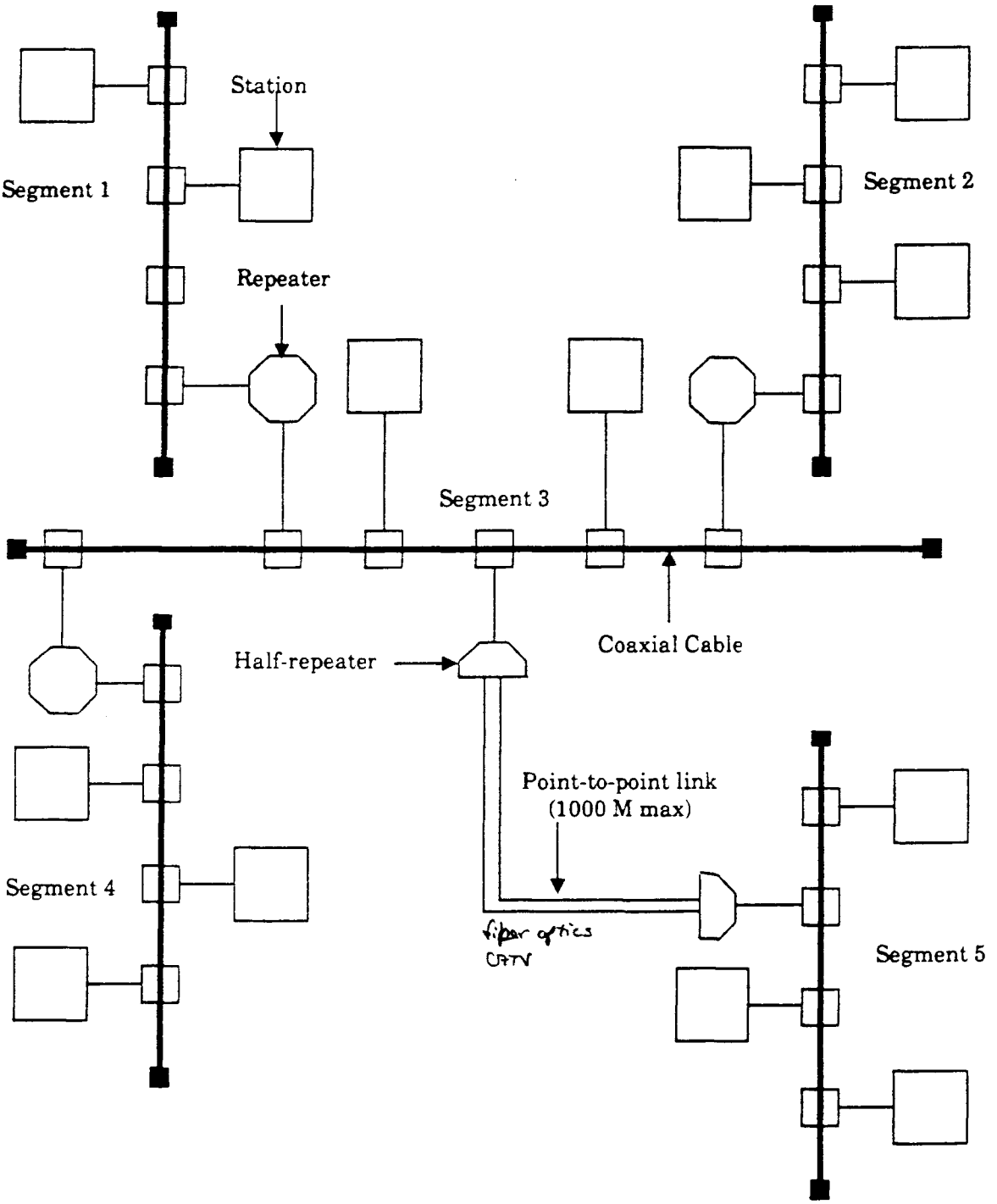
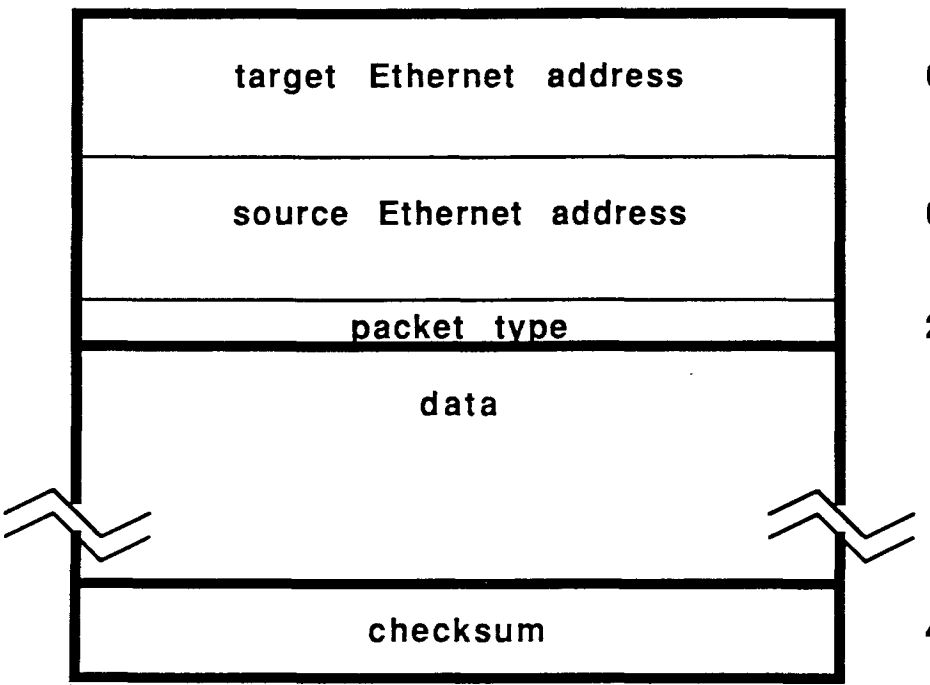


Figure 7-1c: A Typical Large-scale Configuration

max 2 repeaters between any two stations
propagation delays - to detect collisions

3

Ethernet Packet



damaged packet - discarded
higher level will retry - Ethernet doesn't ~~support~~ provide reliable delivery
packet-type allows mix of protocols on same net

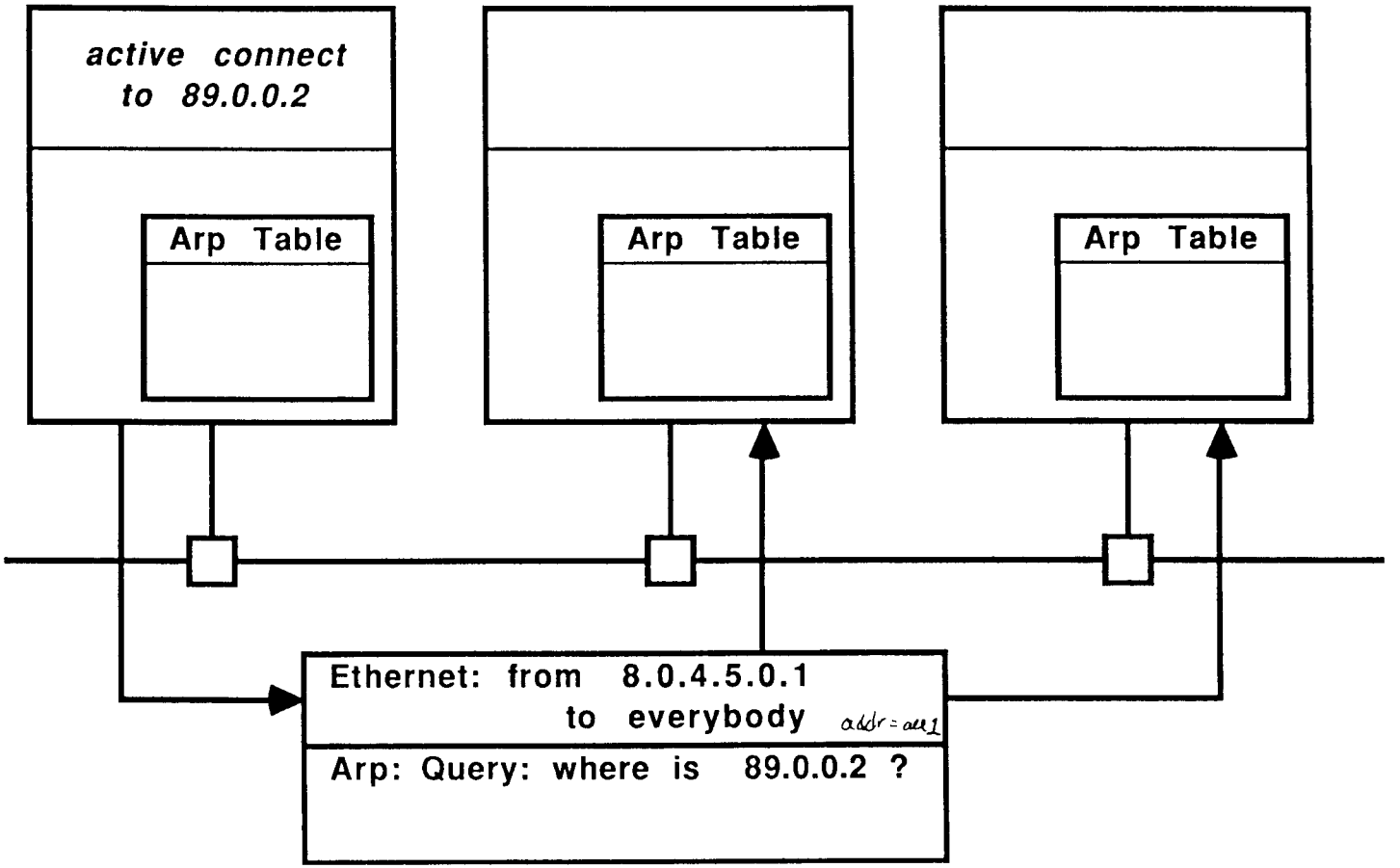
All Ethernet hardware has unique address - assigned by ~~Intel~~, Xerox, — in blocks of 2^{24} per company (also packet types)

ARP: Address Resolution Protocol

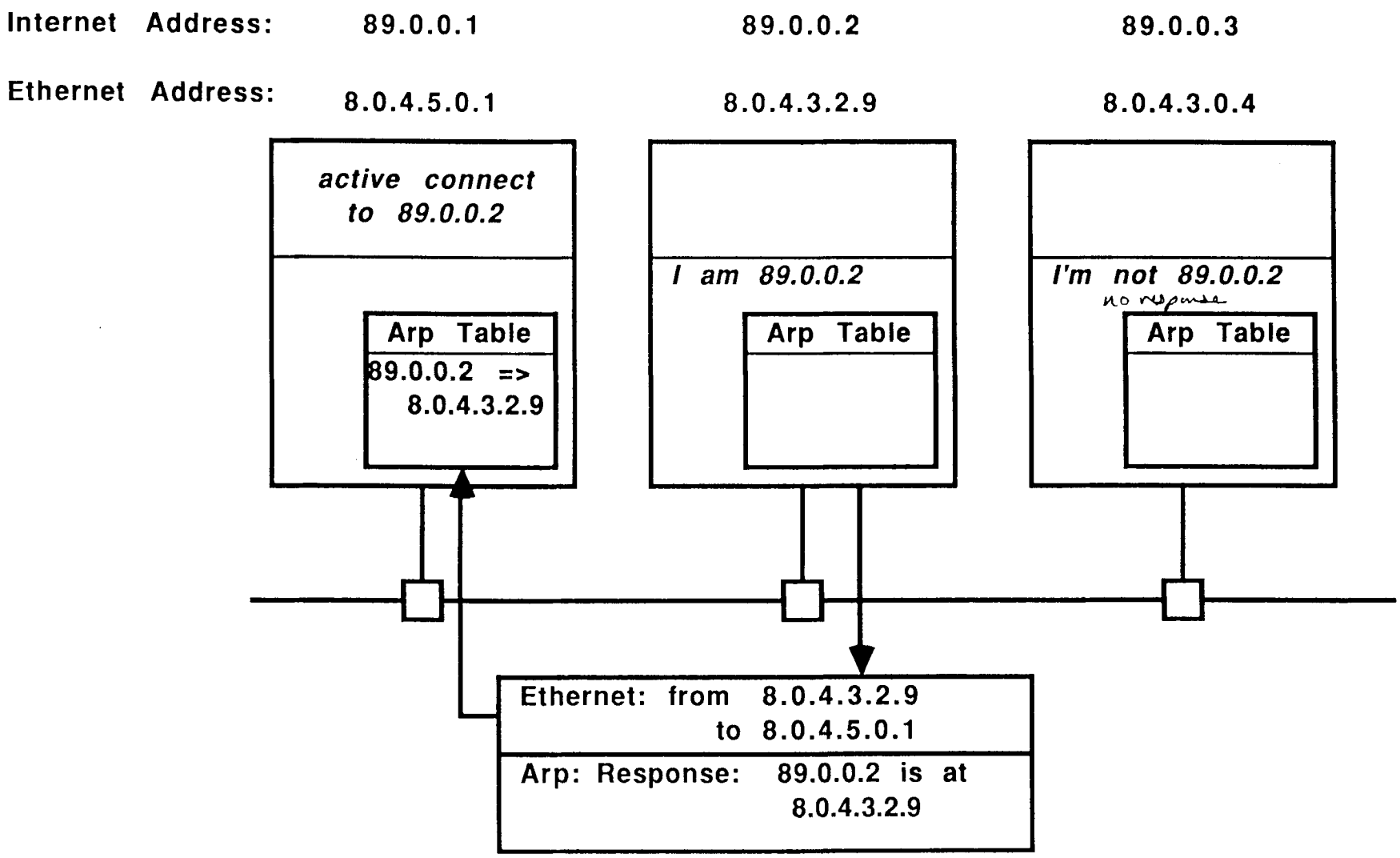
only internet address stored - must find Ethernet address

Internet Address: 89.0.0.1 89.0.0.2 89.0.0.3 4 bytes

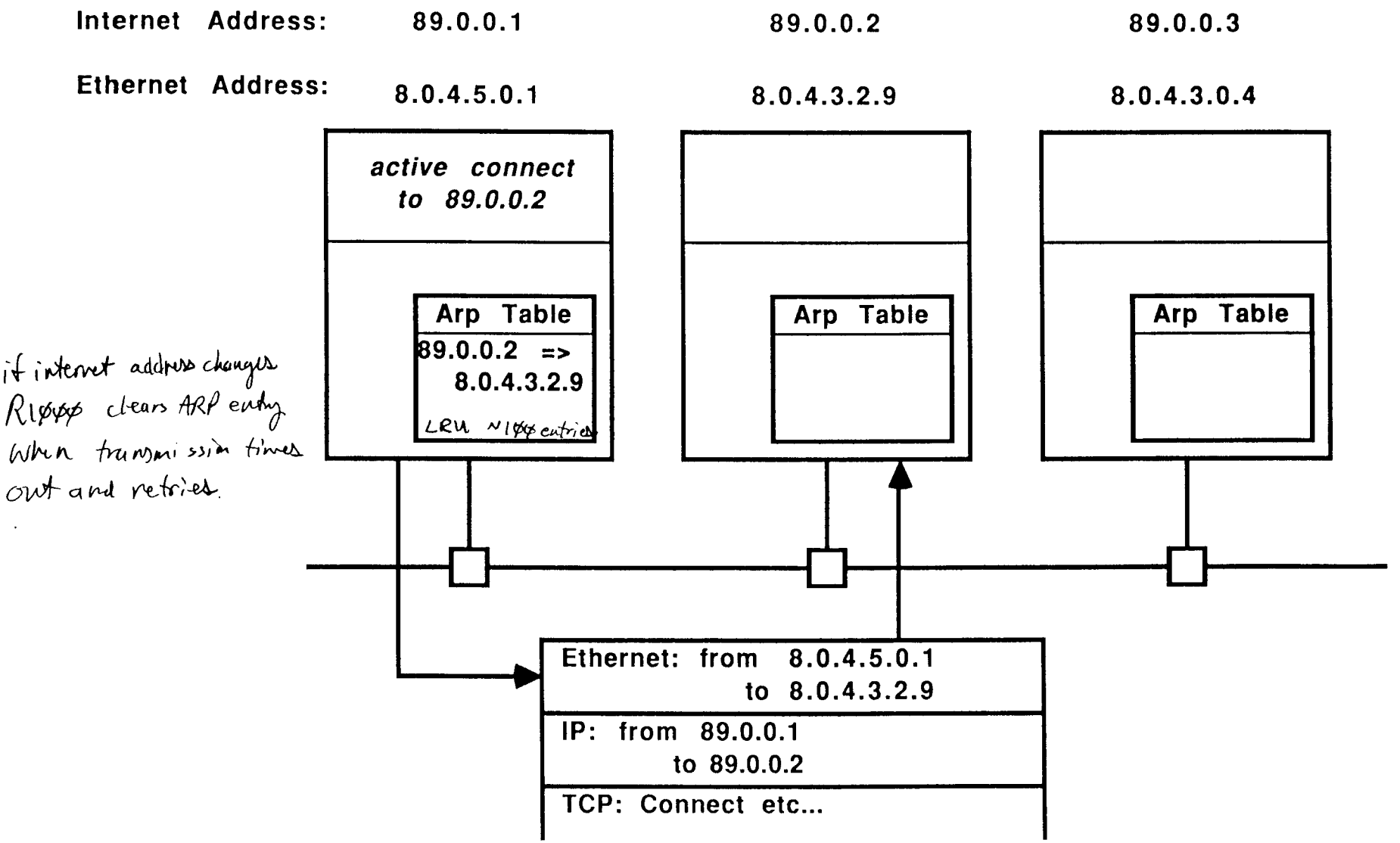
Ethernet Address: 8.0.4.5.0.1 8.0.4.3.2.9 8.0.4.3.0.4 6 bytes



ARP: Address Resolution Protocol

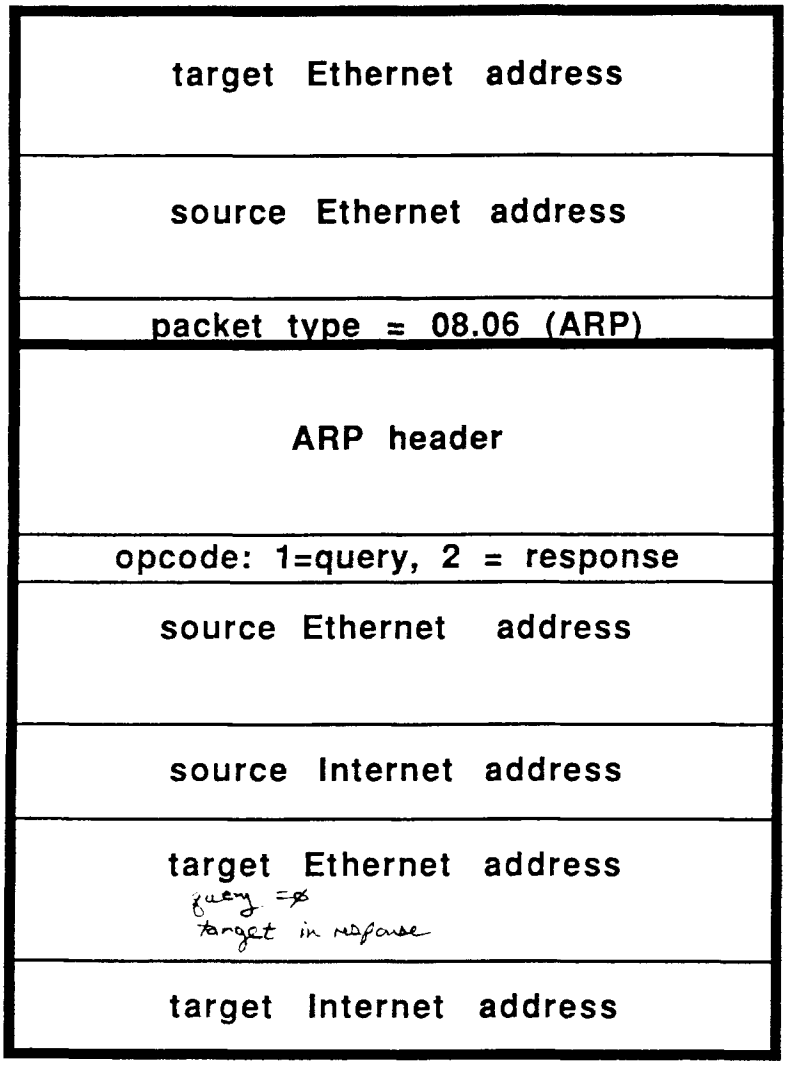


ARP: Address Resolution Protocol

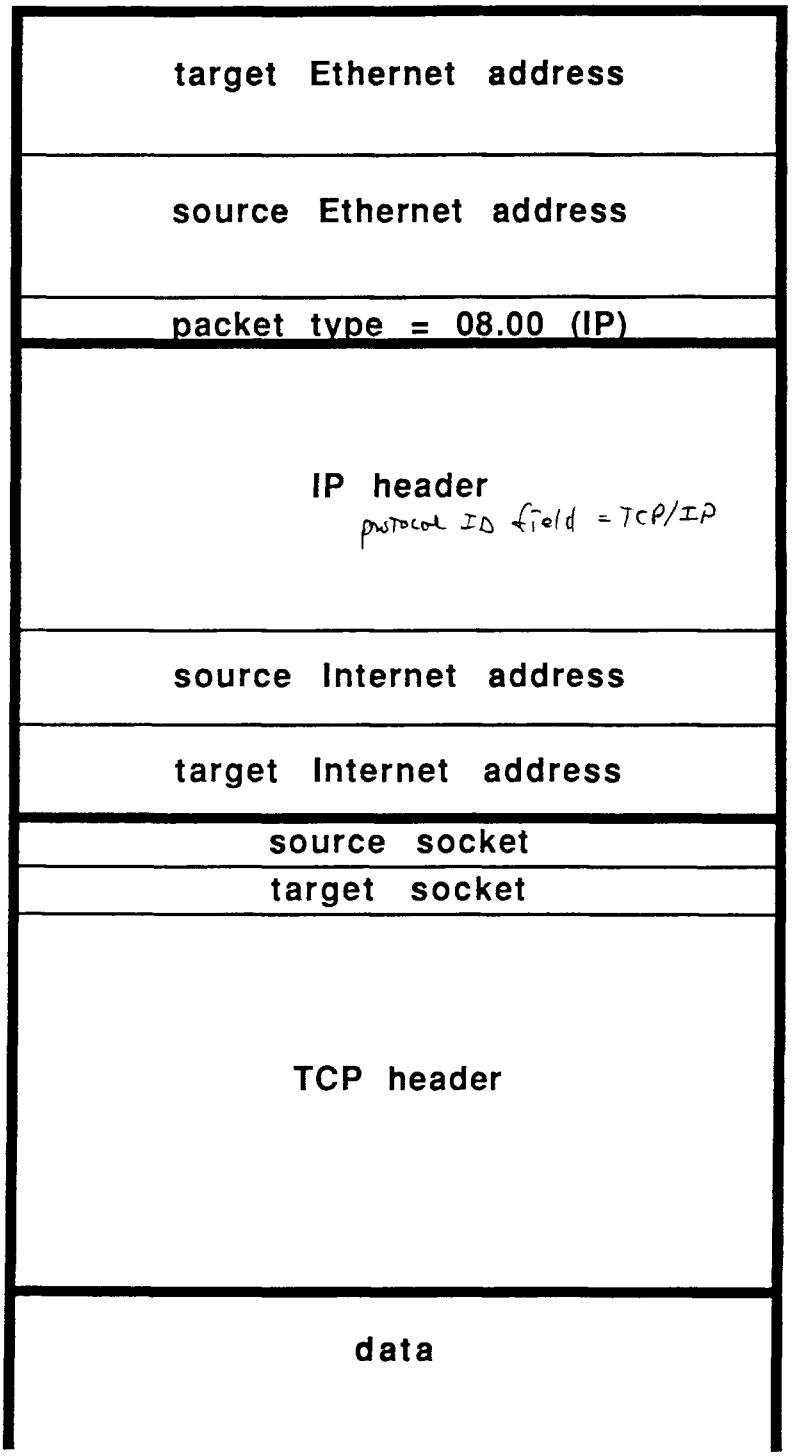


if internet address changes RIØØØ clears ARP entry when transmission times out and retries.

ARP Packet


target Ethernet address
6
source Ethernet address
6
packet type = 08.06 (ARP)
2
ARP header
8
opcode: 1=query, 2 = response
2
source Ethernet address
6
source Internet address
4
target Ethernet address
6
query = ∅
target in response
target Internet address
4

TCP/IP Packet



Configuring A Rational Machine

Standard Files

! Tools.Networking.Exos_8010_3_Sd
code for Ethernet controller

Net-Specific Files

! Machine.Transport_Name_Map
names and addresses of all machines
! Machine.Tcp_Ip_Name_Server (optional)
address of name server
! Machine.Transport_Routes (optional)
addresses of gateways

ethernet would like hex dashed 0A-12-F1-02-67-AC

RARP decimal dotted notation base 10 for each byte 89.4.6.31 max 255.255.

Machine-Specific Files

! Machine.Tcp_Ip_Host_Id
Internet address of this machine
to prevent mistakes, append cluster_id
! Machine.Ethernet_Host_Id (optional)
Ethernet address of this machine
to prevent mistakes, append cluster_id

of machine must match or won't proceed

system_maintenance
show_machine_id options for serial #, rev of all boards

Starting the Network

!Machine.Initialize_Network

1. Tcp_Ip_Boot
2. Ftp_Server.Start
3. start Archive server
4. start customer's servers...

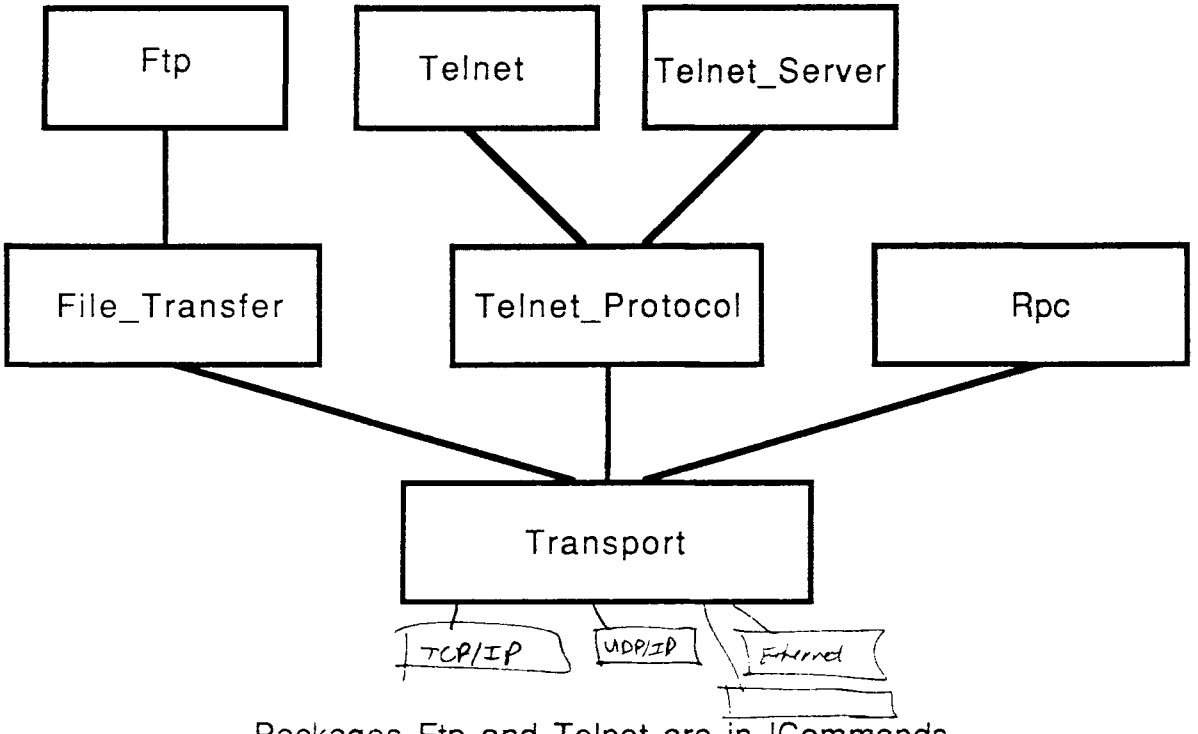
preserve object structure

The Telnet server starts automatically.

Commands

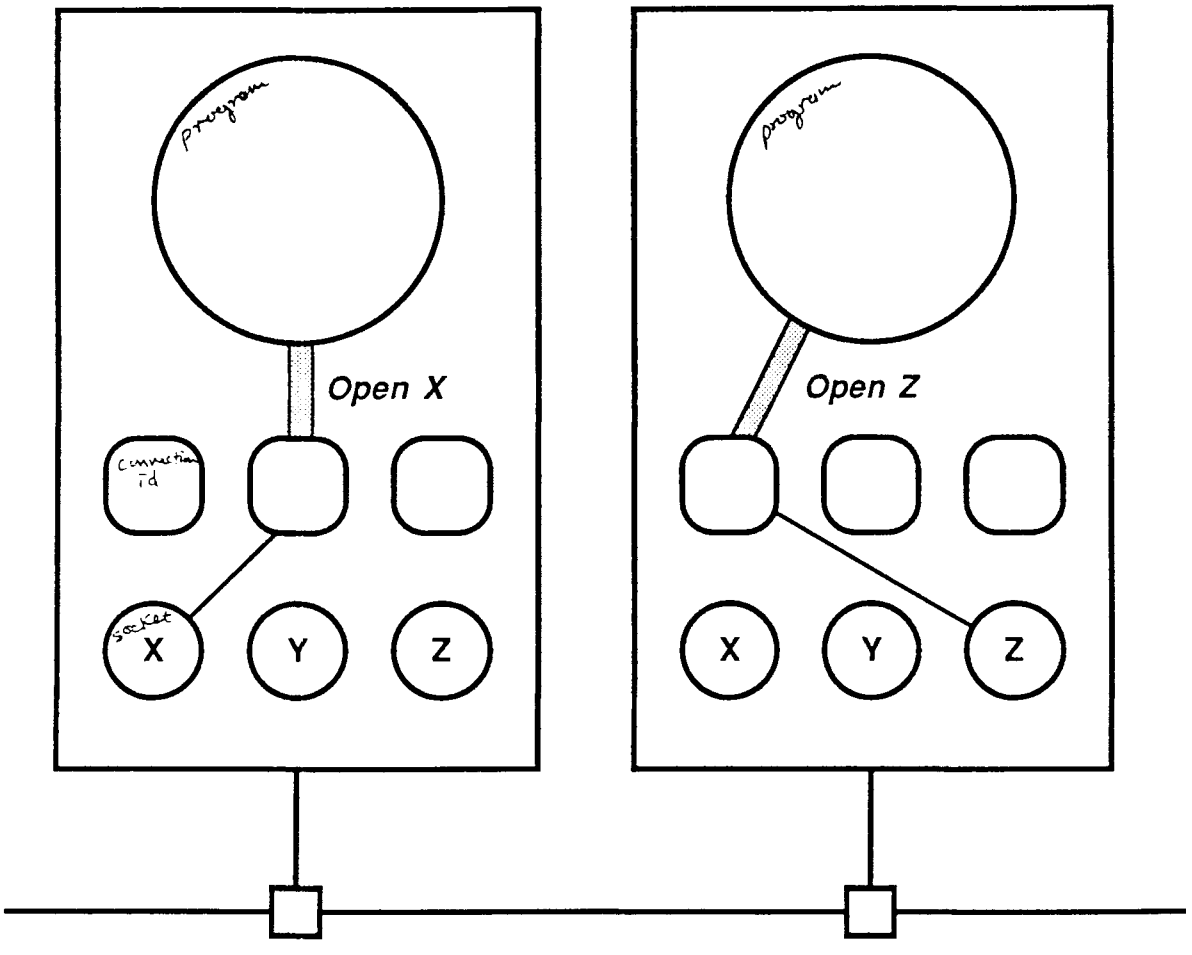
- Commands.Ftp
- Commands.Telnet

Programming



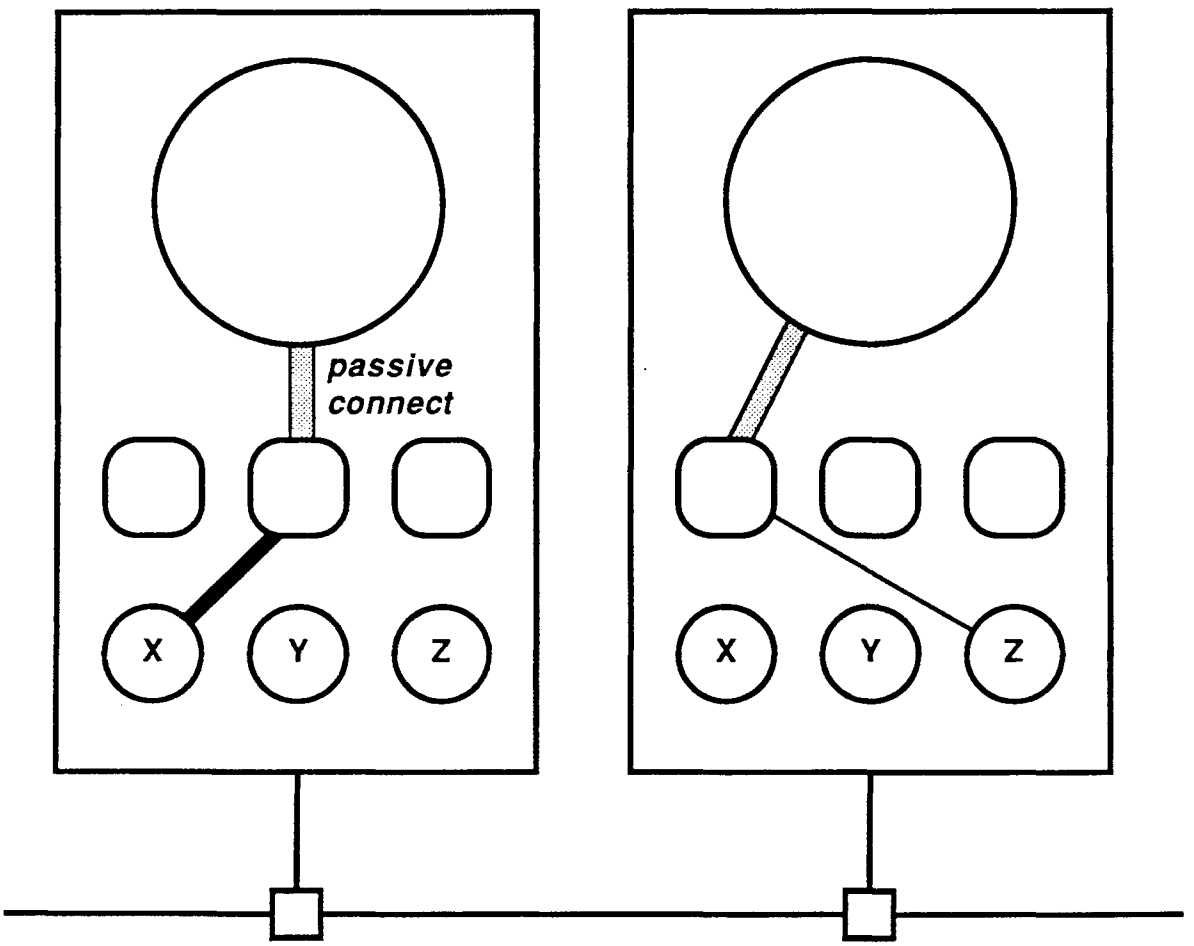
Packages Ftp and Telnet are in !Commands.
All others are in !Tools.Networking.

Sockets & Connections: Open

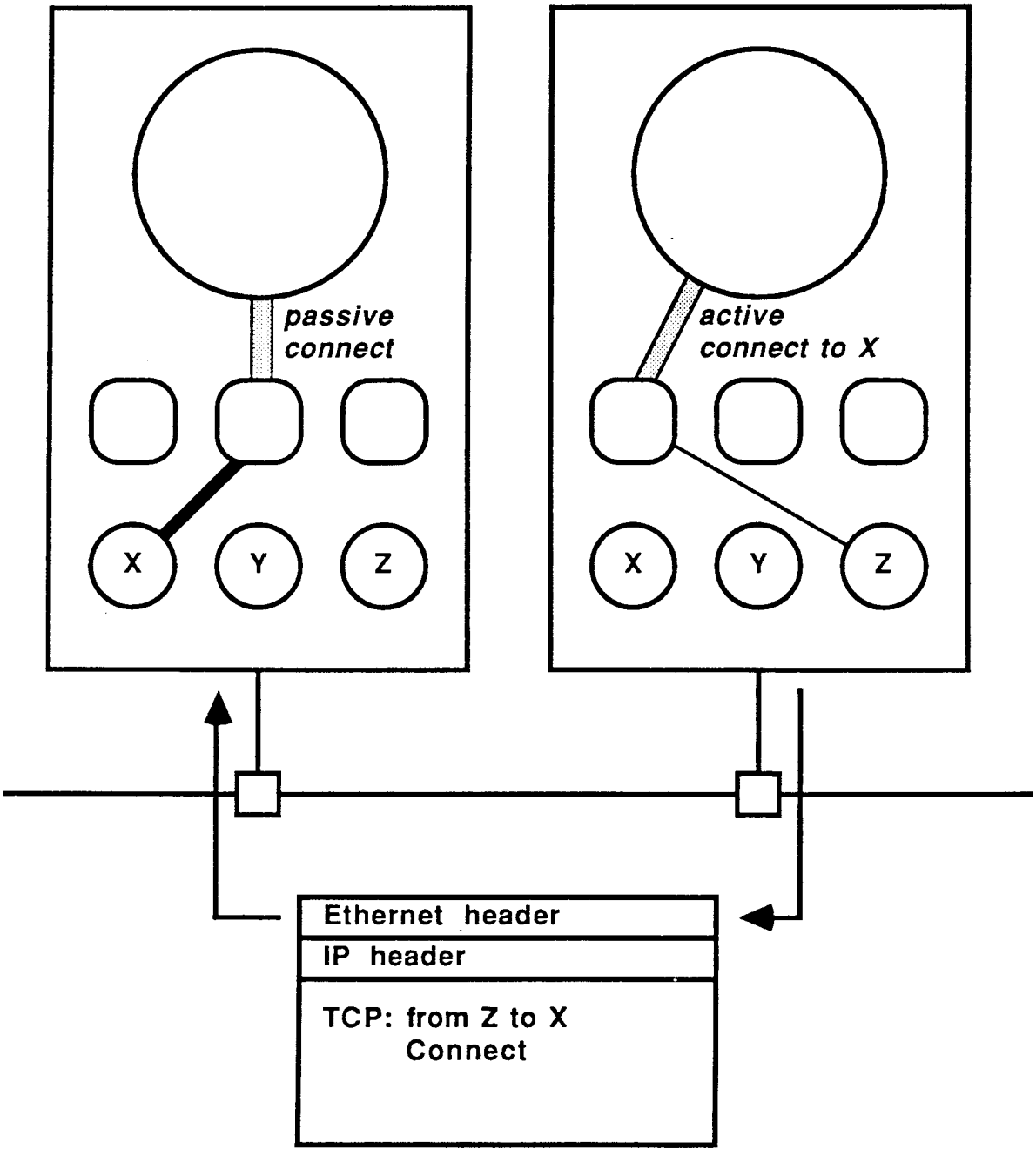


socket: where you build a connection

Sockets and Connections: Passive Connect

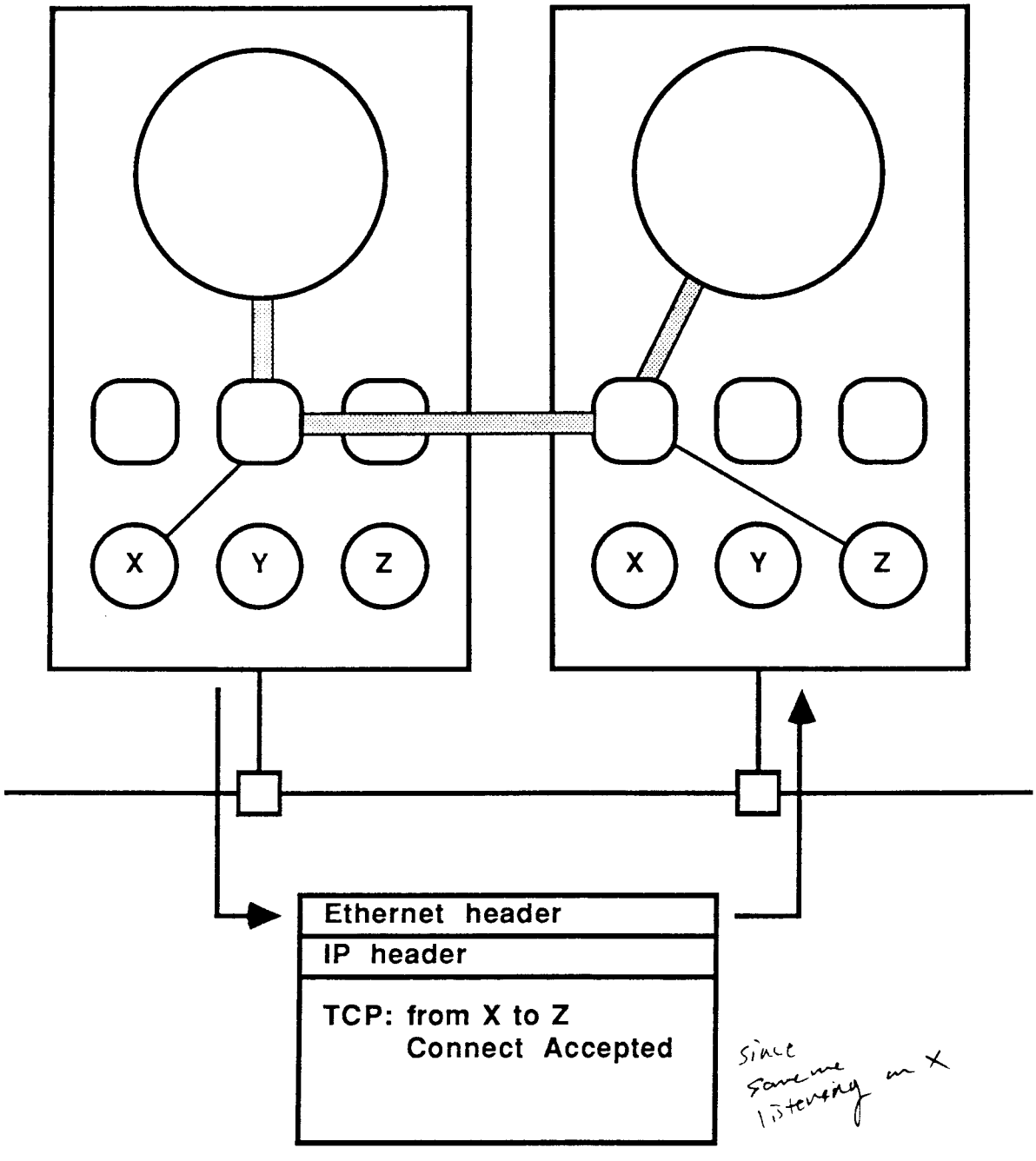


Sockets and Connections: Active Connect

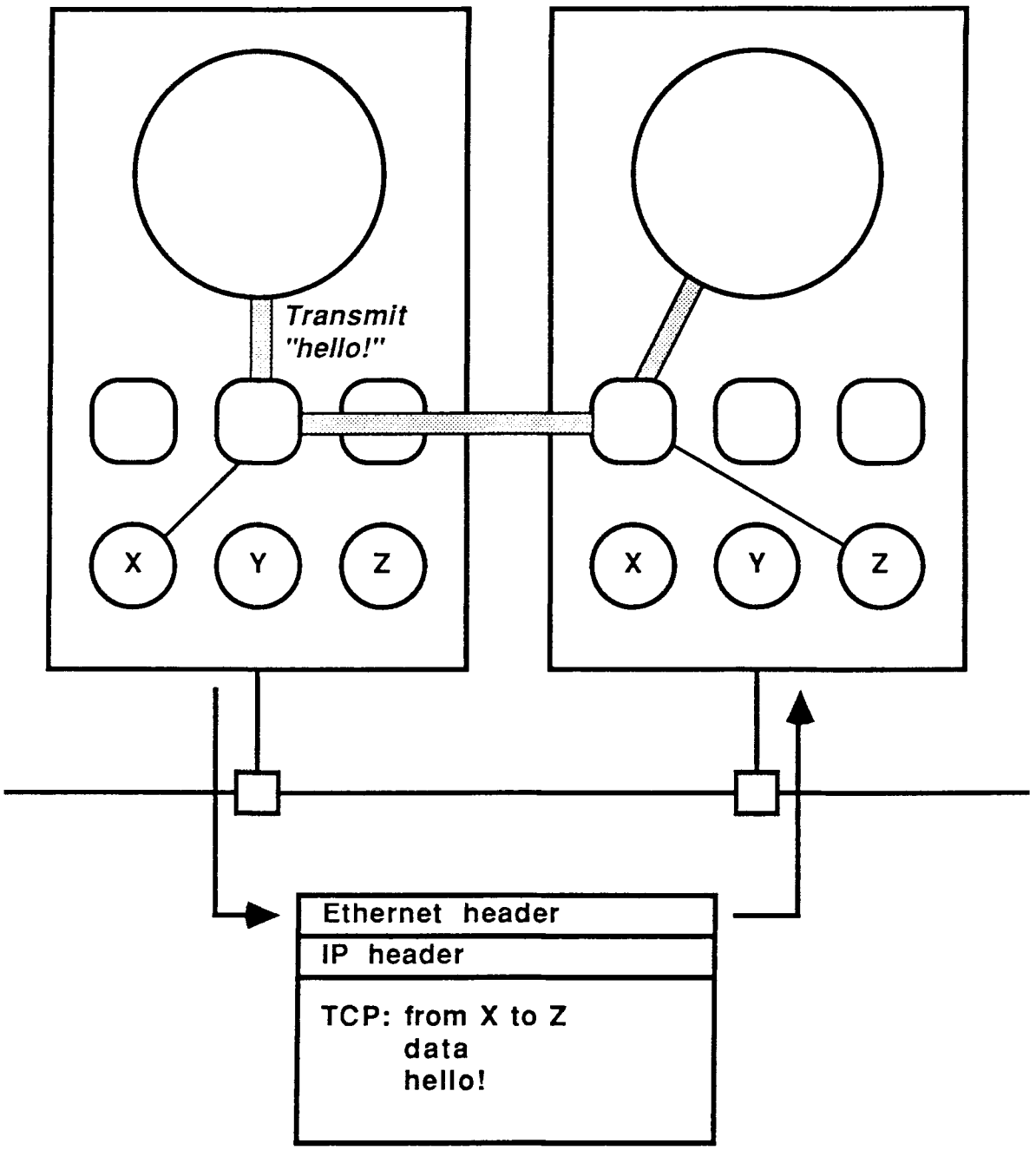


two programs agree on socket id to use

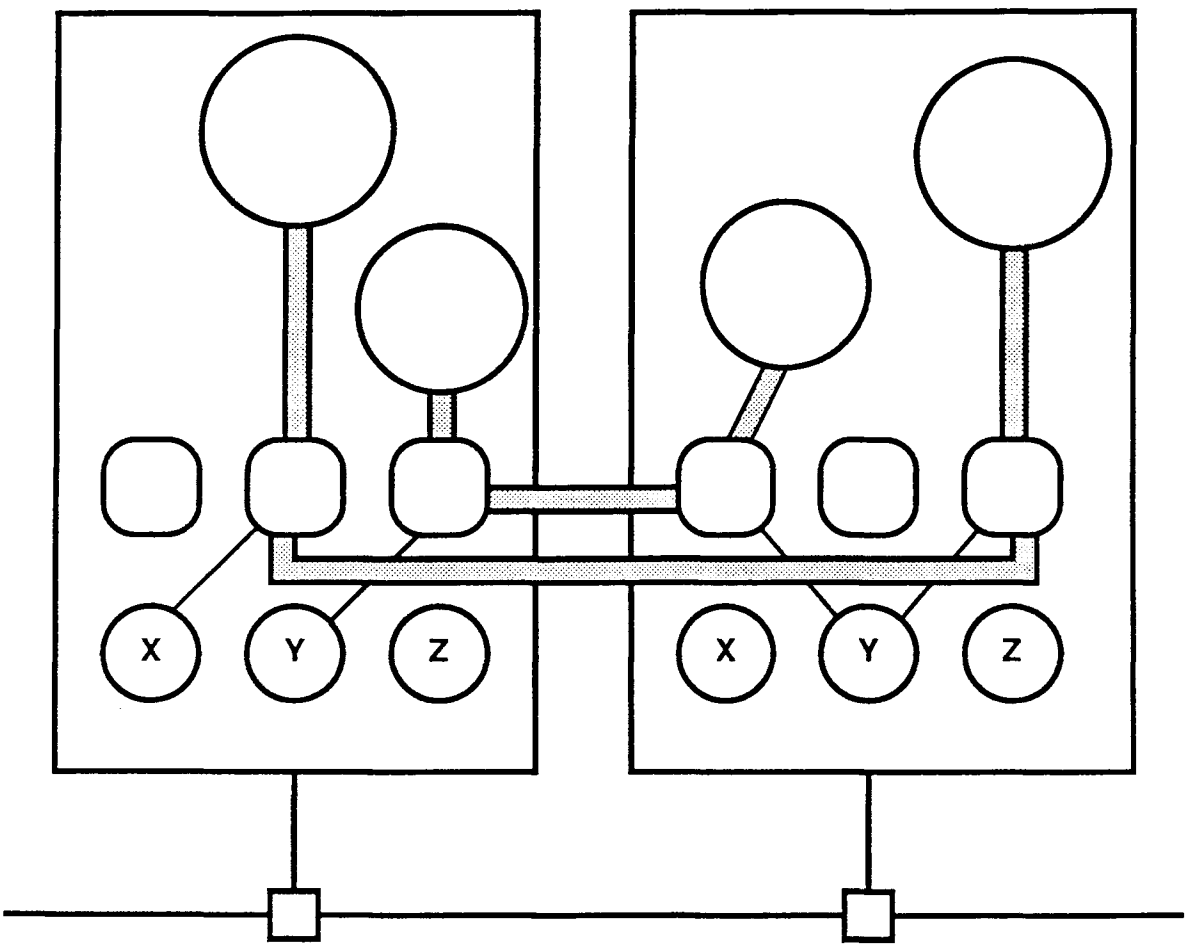
Sockets and Connections: Connection Accepted



Sockets and Connections: Transmit

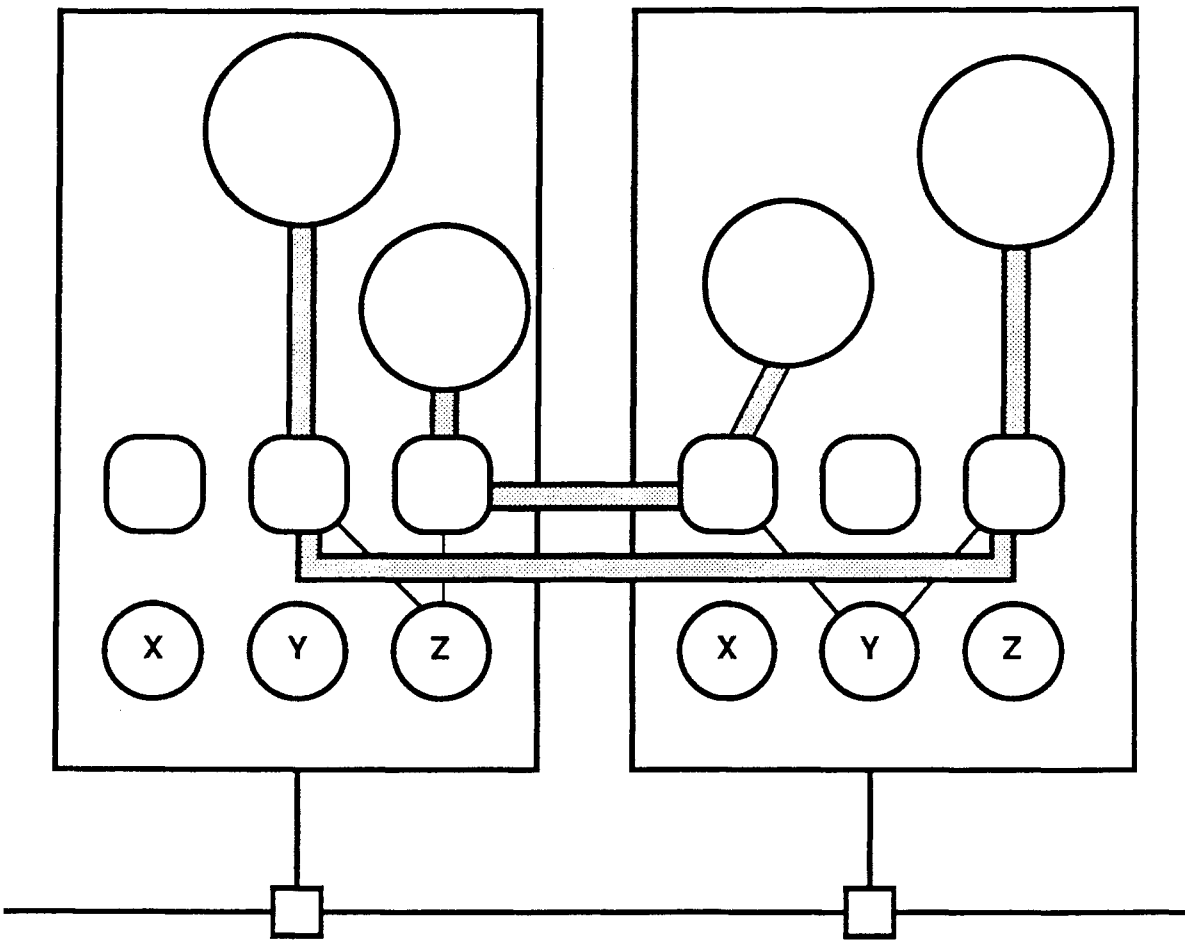


Sockets and Connections



OK to establish connection on same socket only on one side

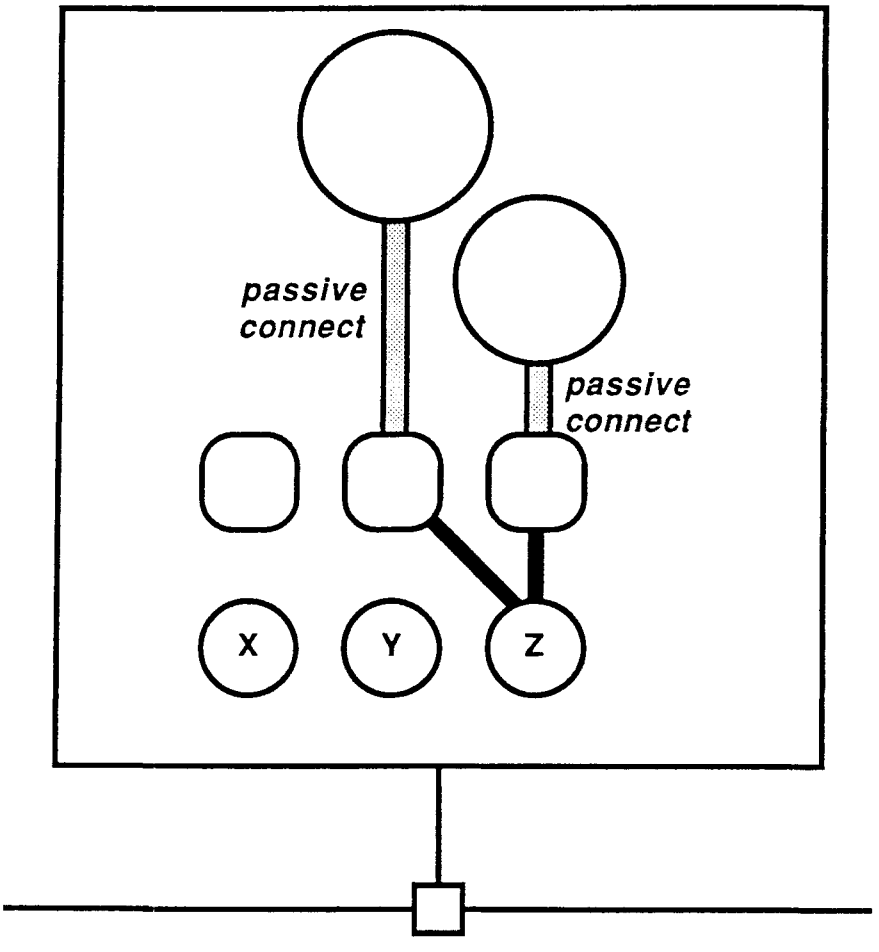
Sockets and Connections: Restrictions



A connection is identified by the sockets at its ends. No two connections may have the same sockets at both ends. In other words, no two connections may have the same value for the 4-tuple

(local host, local socket, remote host, remote socket)

Sockets and Connections: Restrictions



Two programs may not passive connect on the same socket at the same time.

The second program to attempt this will be returned status => Socket_In_Use.

Assigned Sockets

0.0 .. 0.255 assigned by DoD

- 0.20 FTP data
- 0.21 FTP control
- 0.23 Telnet
- 0.42 Internet name server

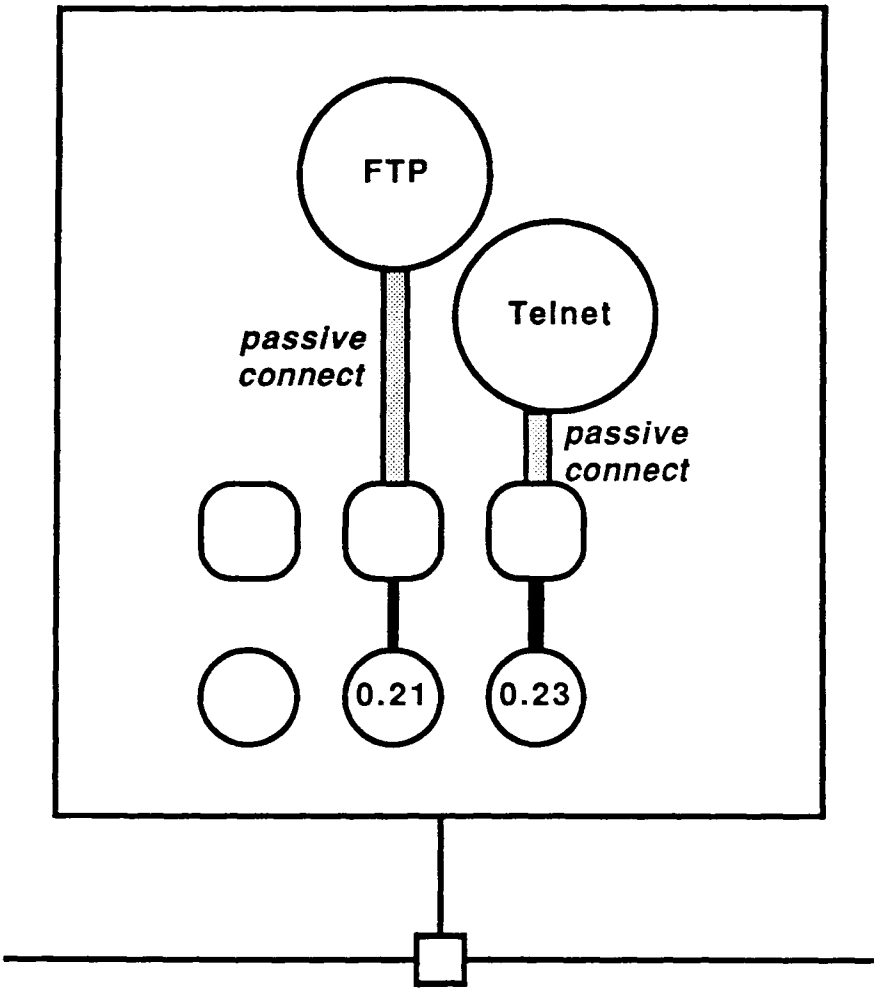
1.0 .. 1.255 assigned by Rational

- 1.0 Archive.Copy (HJL)
- 1.3 Host/Target Debugger (NCE)
- 1.9 Print Queue Server (JMK)
- 1.10 Inter-R1000 Mail (DHB)

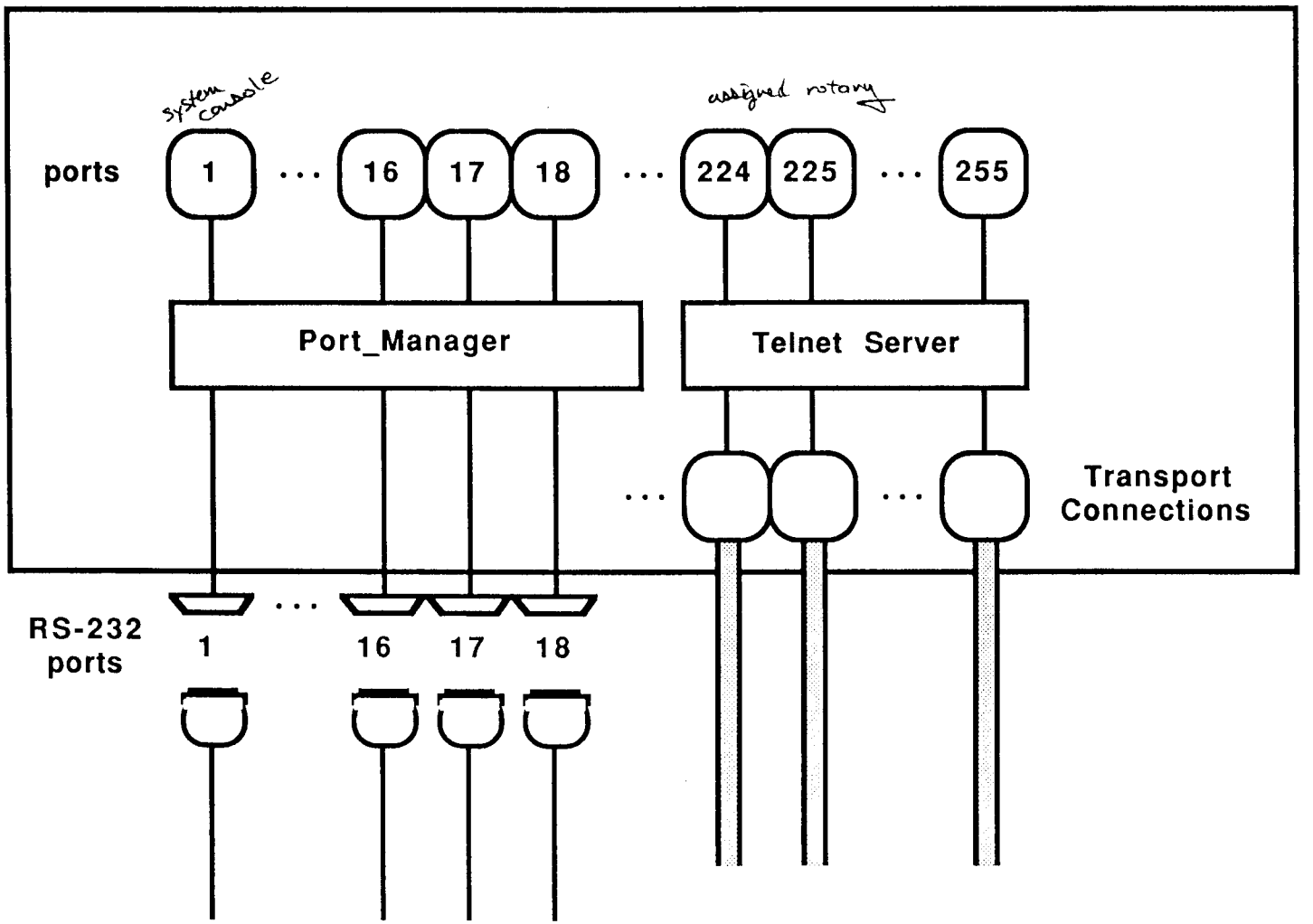
see JMK for new socket assignments

2.0 .. 255.255 for temporary use

Standard Servers



Telnet Ports



Datagram Protocols

- **lower overhead, but no guaranteed delivery**
- **appropriate for single-exchange protocols**

UDP/IP

```
Transport.Open (Network => "UDP/IP",
                Local_Socket => <a TCP socket>,...
Transport.Connect (Remote_Host => <an Internet address>,
                   Remote_Socket => <a TCP socket>,...
Transport.Transmit (Data => <a datagram>,...
```

Ethernet

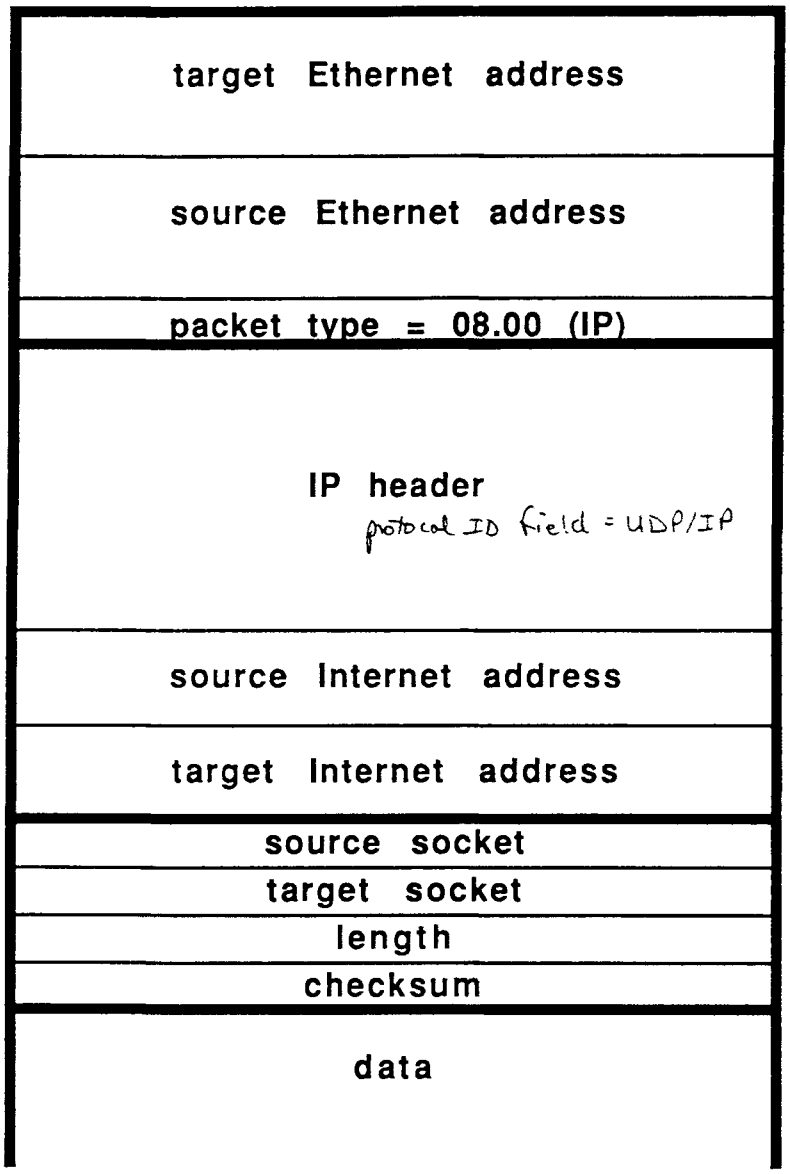
```
Transport.Open (Network => "Ethernet",
                Local_Socket => <receive packet type>,...
Transport.Connect (Remote_Host => <an Ethernet address>,
                   Remote_Socket => <transmit packet type>,...
Transport.Transmit (Data => <a datagram>,...
```

passive connect returns immediately (no effect)

Transport.Remote_Host & Remote_Socket may be used to obtain information about last datagram received

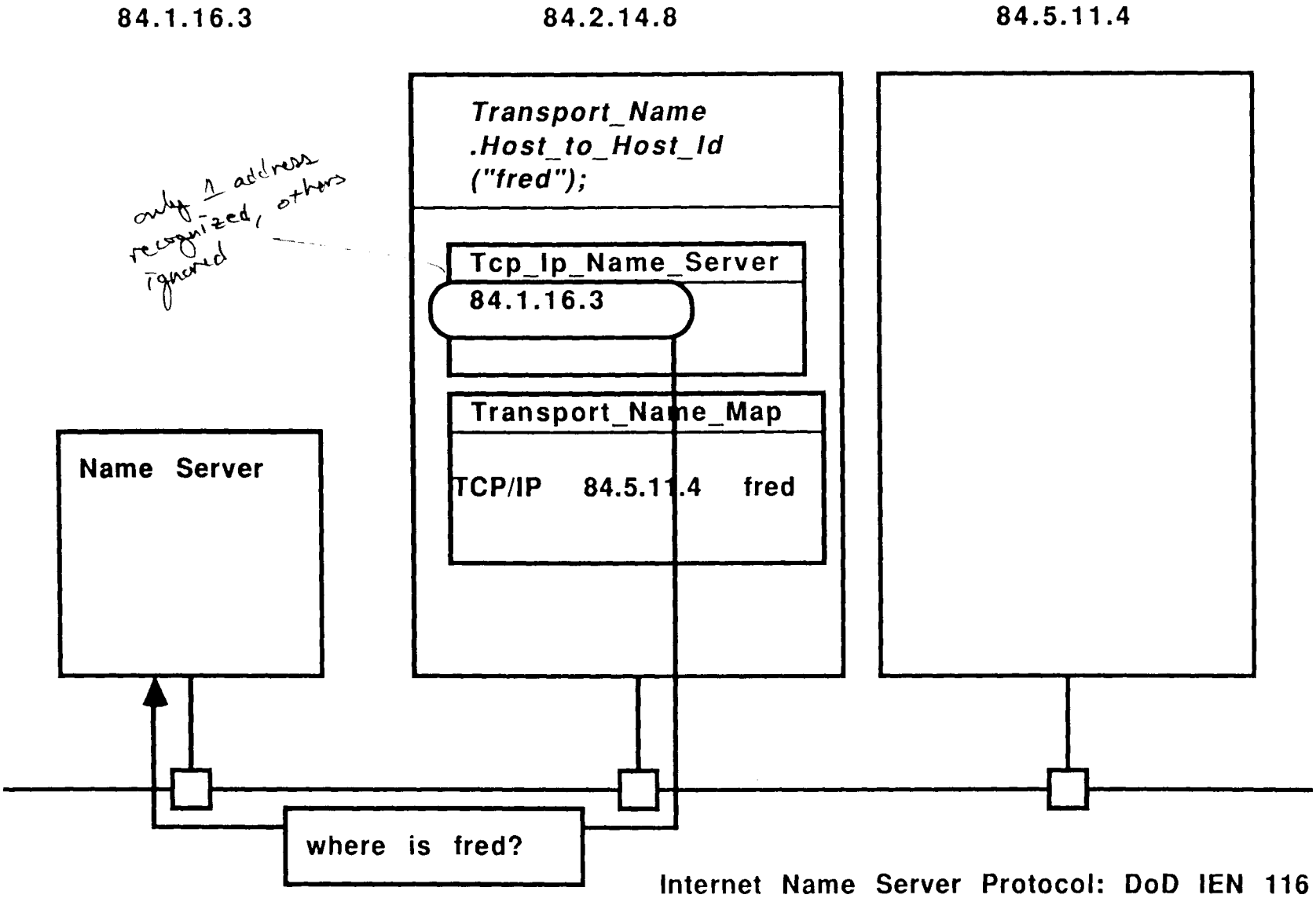
maximum datagram size is 1006 bytes: longer datagrams are truncated.

UDP/IP Packet



1

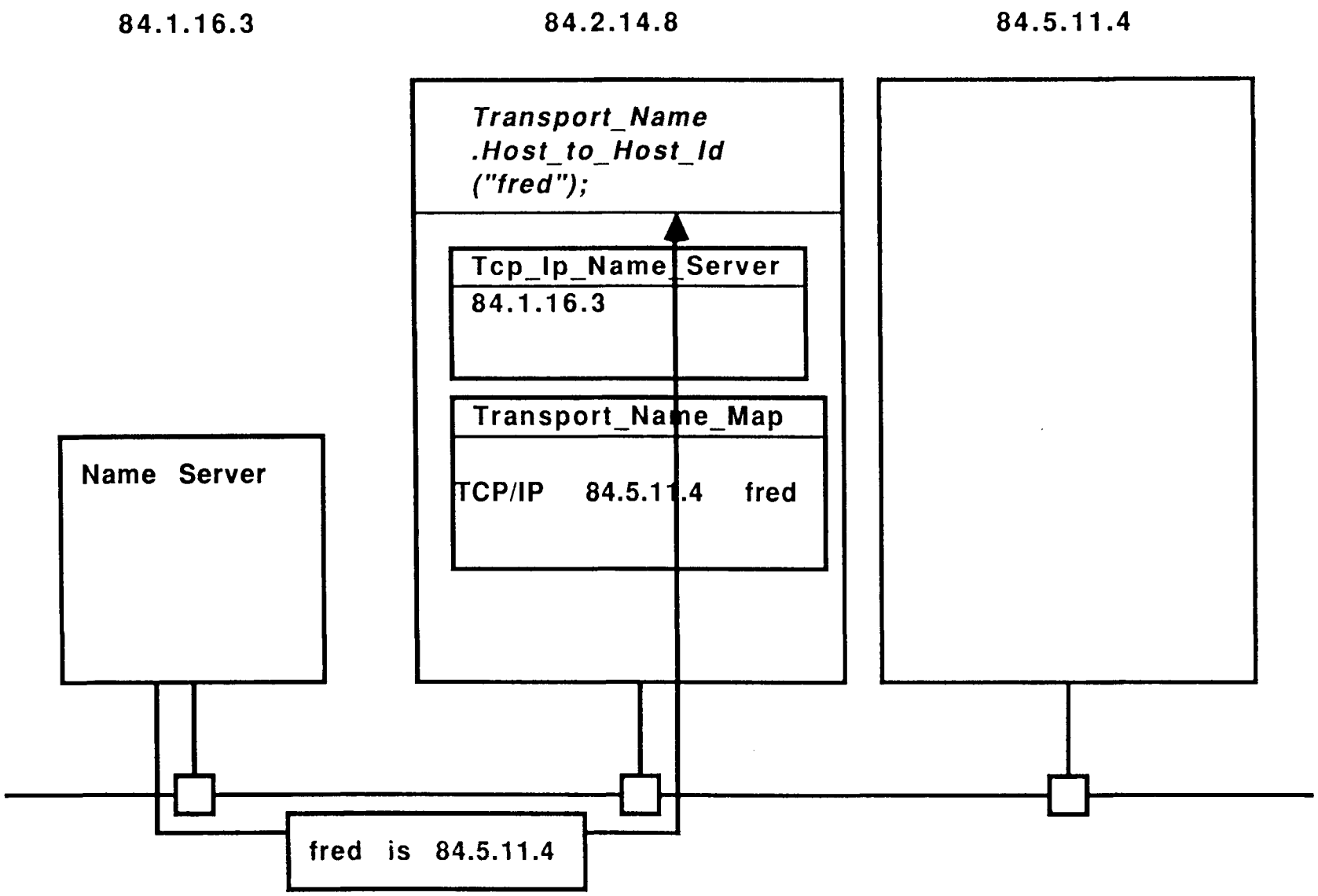
Name Resolution



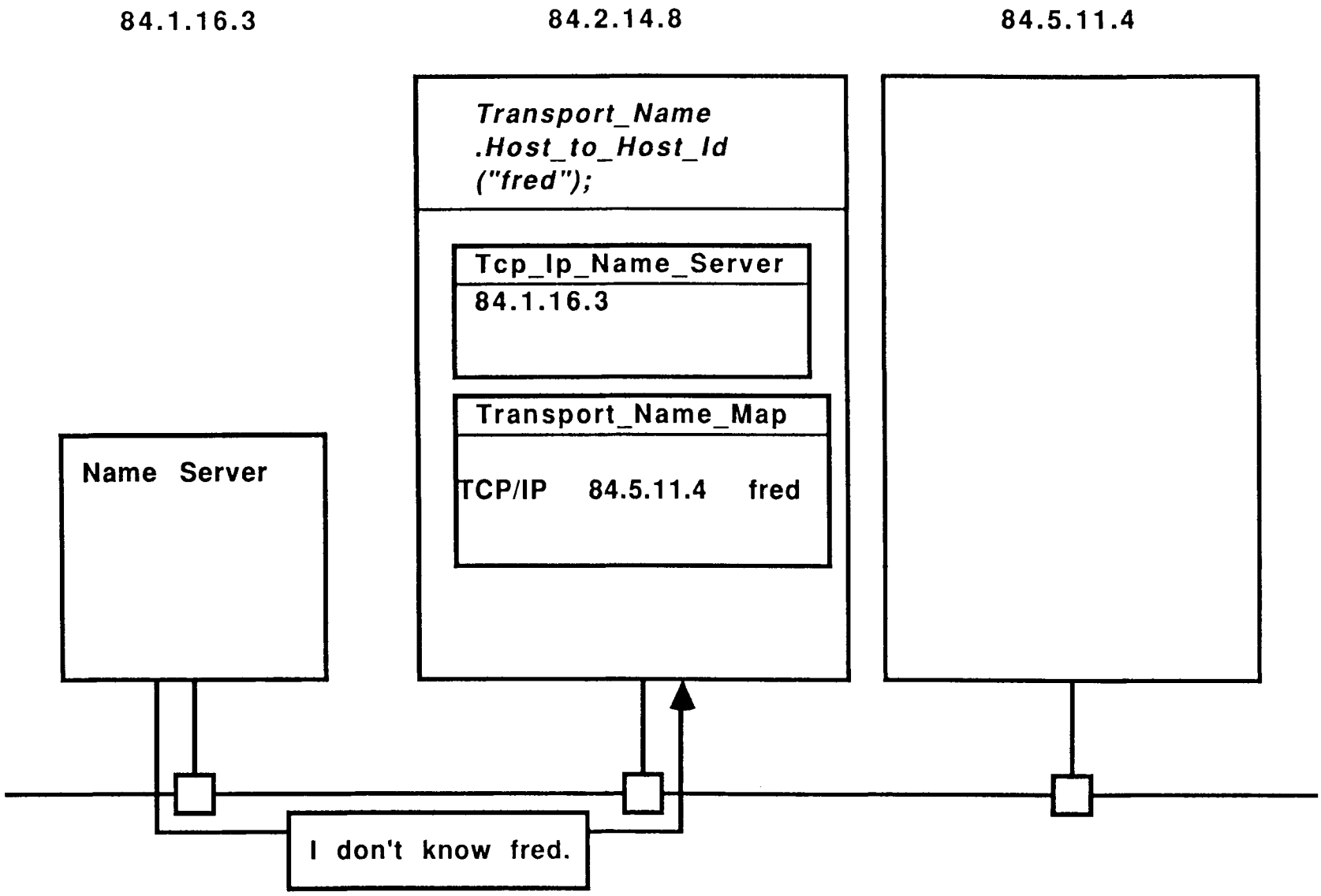
Internet Name Server Protocol: DoD IEN 116

Name Resolution

2

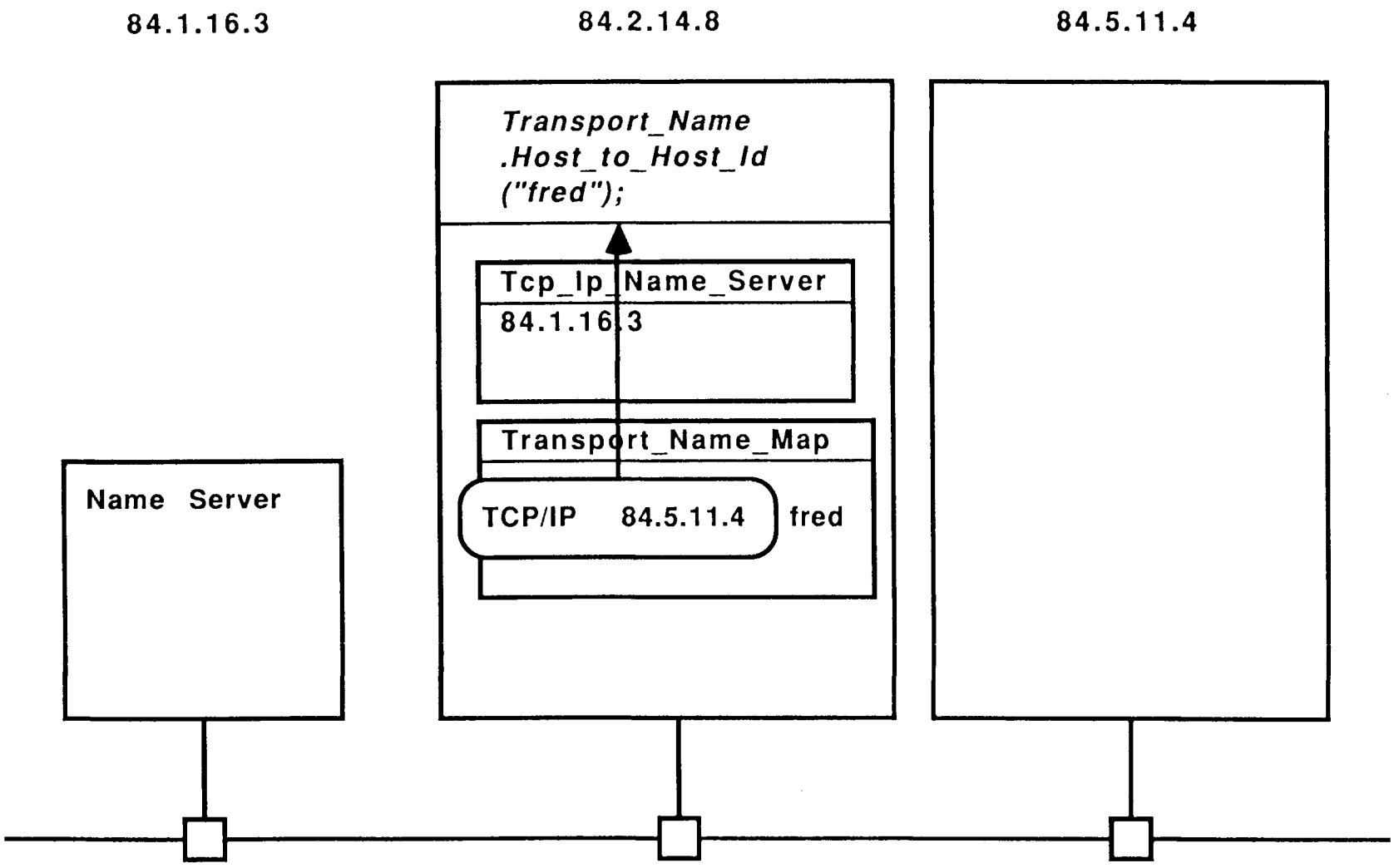


Name Resolution



Name Resolution

4



Troubleshooting

- Who can connect to whom?

  Can you connect to yourself? yes, uses controller (mem→mem) but not net

- Network.Show

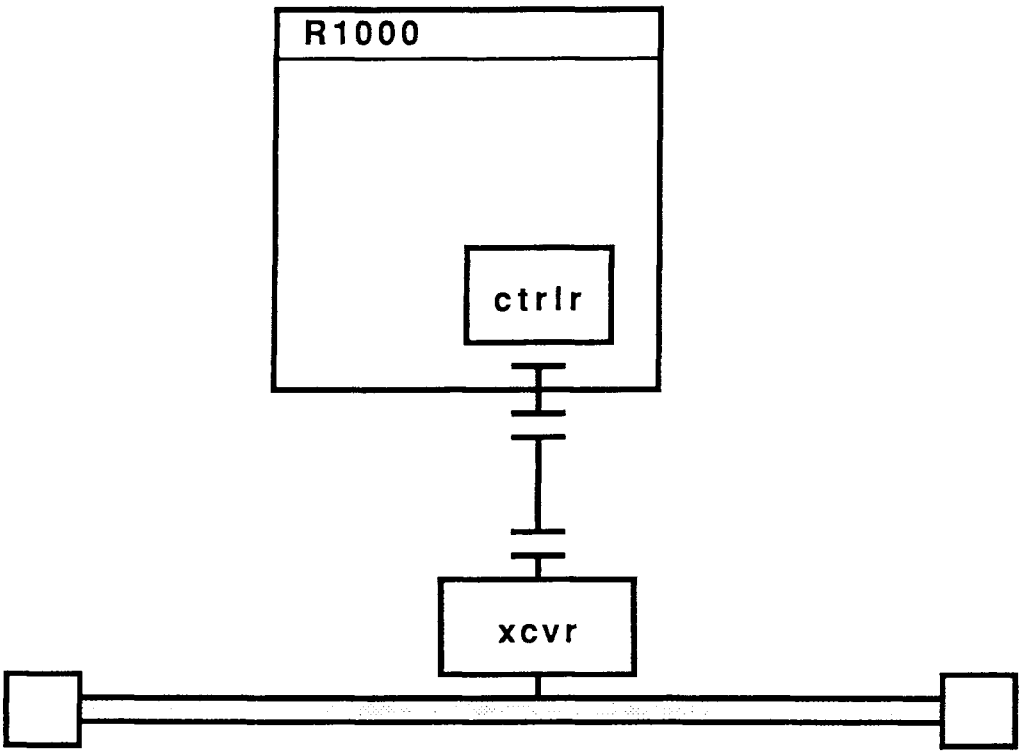
  Are the servers connecting? some yes, some no? any at all?

- Console error messages

  (EXOS codes see Excelan Document) Network.Show all open connections

Users connected via telnet (23) socket

Troubleshooting Hardware



- controller
  Tcp_Ip_Test.Auto
- transceiver cable
  Tcp_Ip_Test.Fcc (with loopback)
  loopback pin 3 to 5; 10 to 12
- transceiver and coaxial cable
  Tcp_Ip_Test.Fcc (with transceiver)
  negative test: remove coax terminators

connect to own machine and tests pattern

out cable thru loop and back

out cable onto net & back

Examining Transport Connections

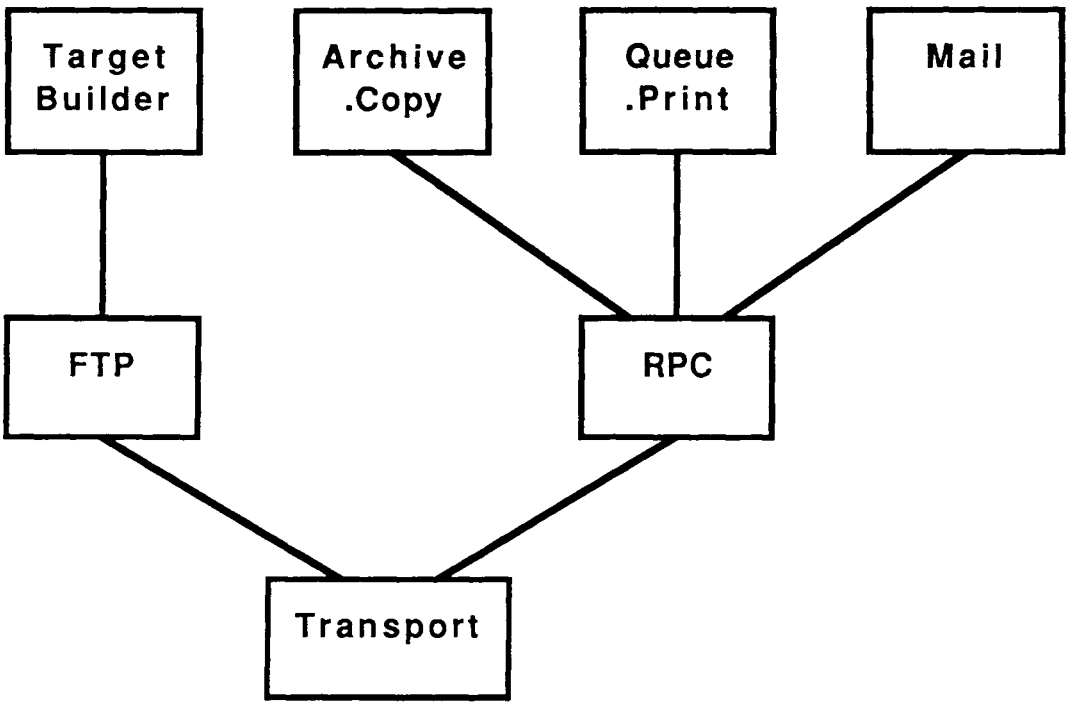
!Commands.Network.Show

job	network	socket	remote host	socket
219	TCP/IP	1.9	connecting	
236	TCP/IP	1.0	connecting	
237	TCP/IP	0.21	connecting	
241	TCP/IP	2.65	89.1.0.236	0.23
4	TCP/IP	0.23	connecting	
5	TCP/IP	0.23	89.2.4.255	89.0
5	TCP/IP	0.23	89.2.8.255	38.11
5	TCP/IP	0.23	89.1.0.236	2.65

print. Queue
Archive
FTP
login via telnet
Telnet
Telnet login
env end

perhaps UDP/IP

Uses of Networking



Delta: new features

- Permanently Elaborated (for speed)
- Increased Capacity

  48 Transport.Connection_Ids (not 32)

  32 Telnet Ports 224..255 (not 240..255)
- Product Authorization
- Internet Routing (gateways)
- RPC Access Control

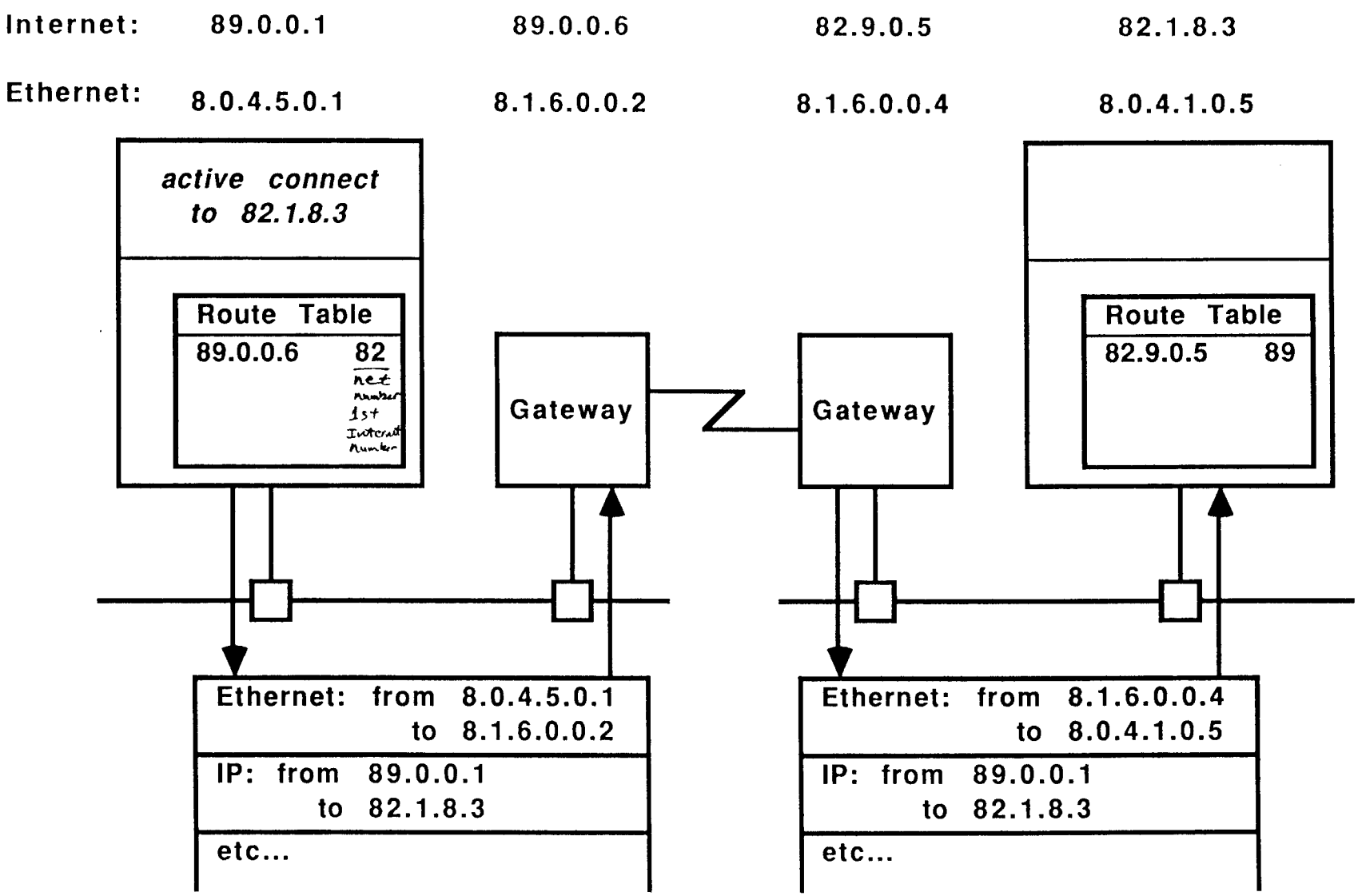
  runs under correct identity for access on remote machines

Product Authorization

!Implementation.Product_Authorization.Show_Registration

Product	Authorization	Notes
Ftp	116A15C...	
Rpc	14EB3F...	
Tcp/Ip	118284A...	
Telnet	13BCEA05...	

Gateways and Routing



Examining the Routing Table

!Commands.Transport_Route.Show

from machine on net 89

127.x.x.x loop back address
get yourself
EXCELAN only

Route	Destination	Network
127	127	IP
89.4.1.255	88	IP
88.64.1.18	89	IP

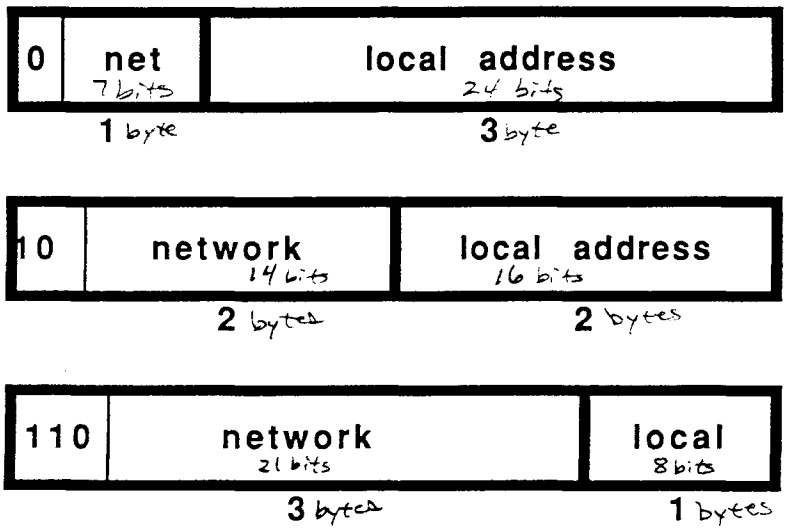
DC office

own network - won't be referenced
- allows same Routing Table on
both sides of gateway

89.4.1.255 87
same gateway
to another net

Table is ordered
and searched in order
can have multiple paths - will rotate thru possible connections

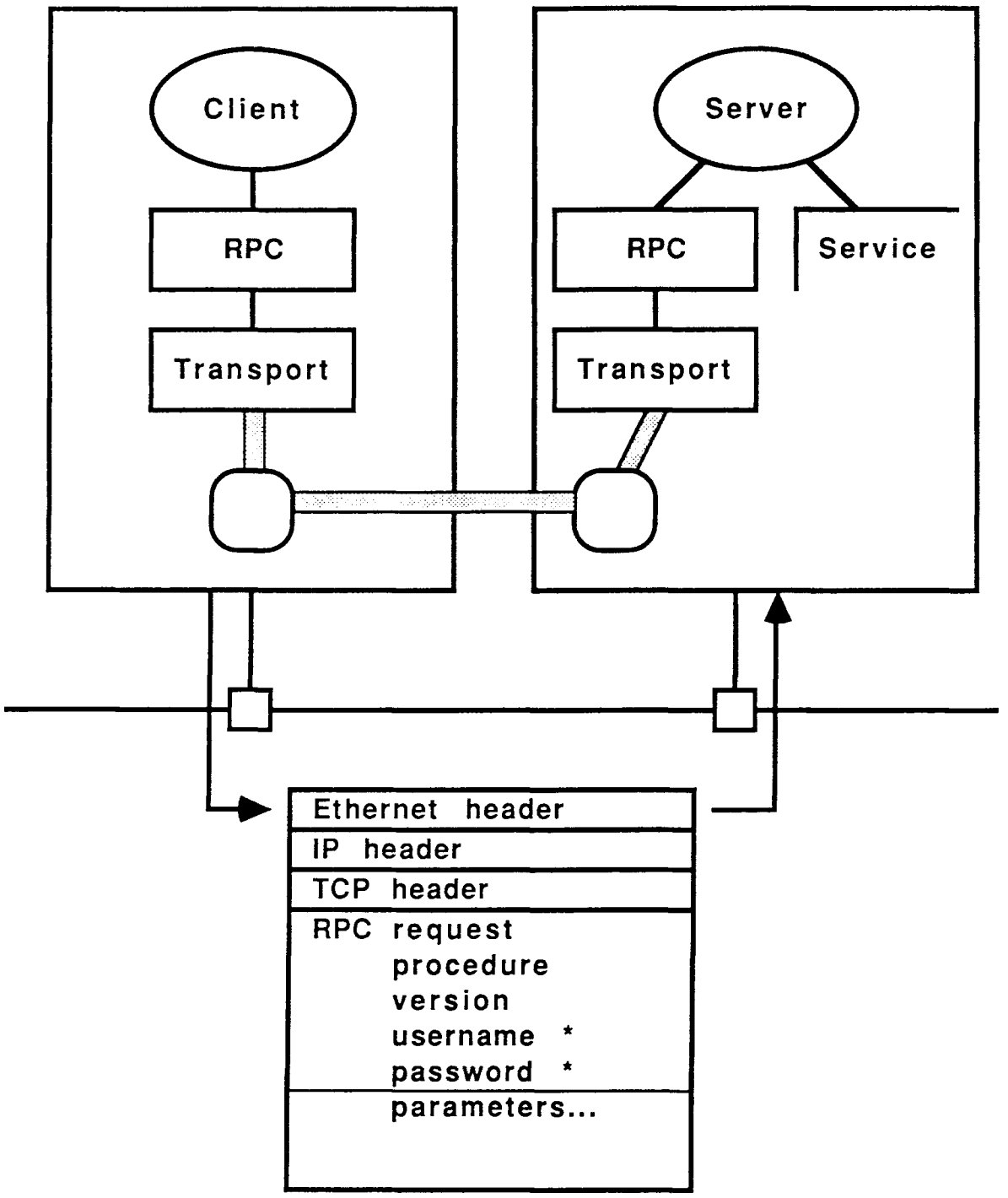
Network Numbers



Each Ethernet should be asssigned a unique network number.

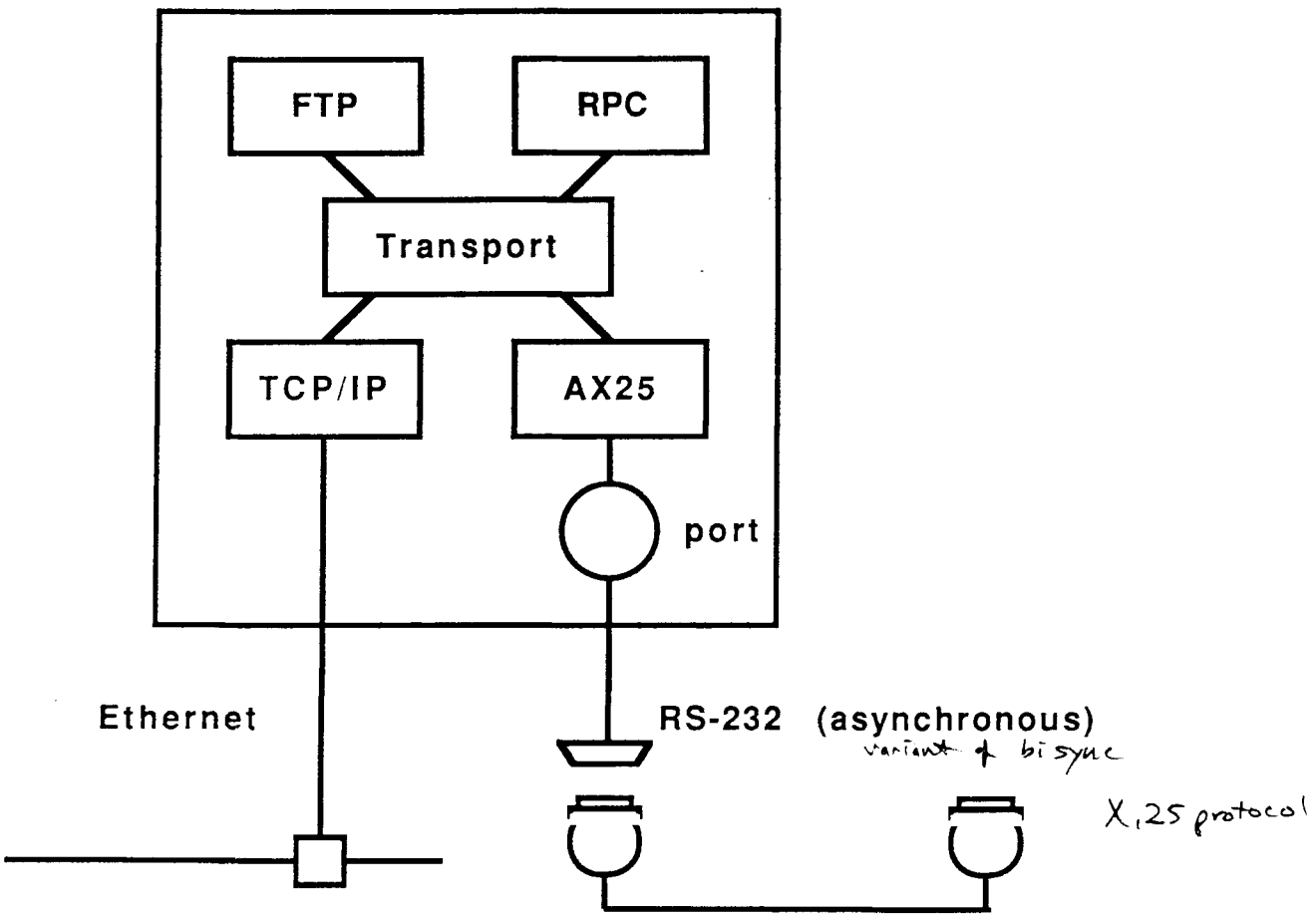
For more detailed information, see DoD RFC 960 (assigned numbers) and RFC 791 (IP).

RPC and Access Control



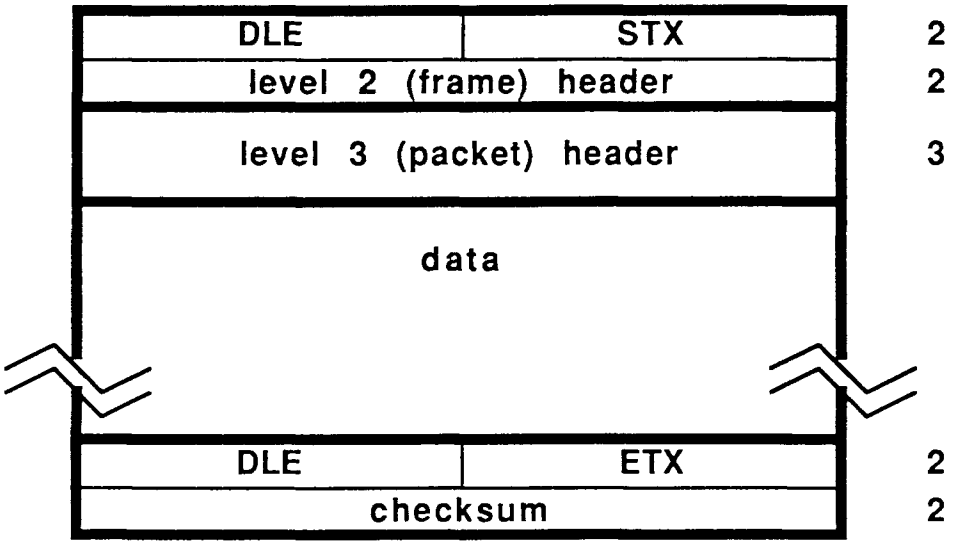
Username and password are new in Delta. The server job sets its identity using this information.

AX25



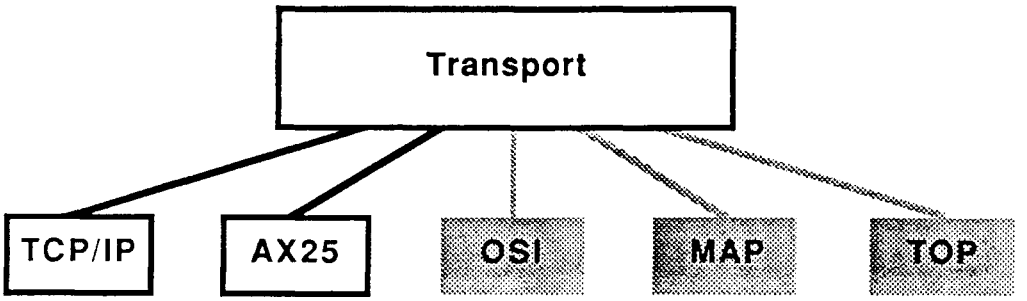
pro	con
cheaper	slower (9600 bps)
	point-to-point
	non-standard

AX25 Packet


DLE
STX
2
level 2 (frame) header
2
level 3 (packet) header
3
data
DLE
ETX
2
checksum
2

FUTURE POSSIBILITIES

New Transport Protocols



CCITT
Open Systems
Interconnect
(no demand)
not much
available

T___ office Protocal
companion to MAP

SNA (LU6)