The GlobalTalk Network

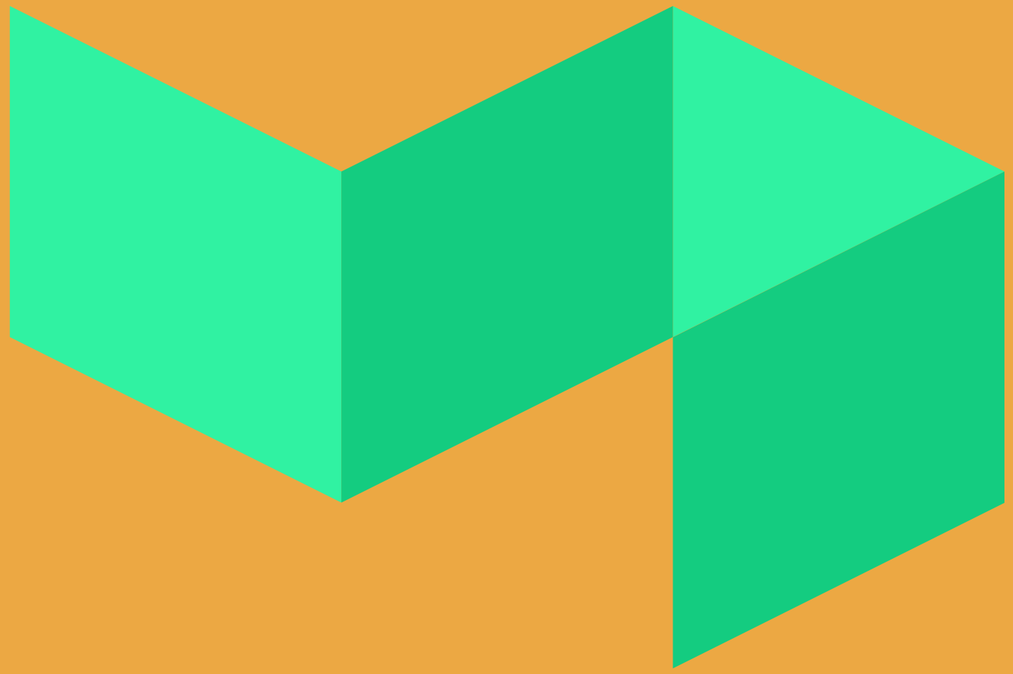
/dev/world/2024, Melbourne

Josh Deprez

Who am I?

— Josh
— they/them
— Retro Mac nerd
— /dev/world fixture?

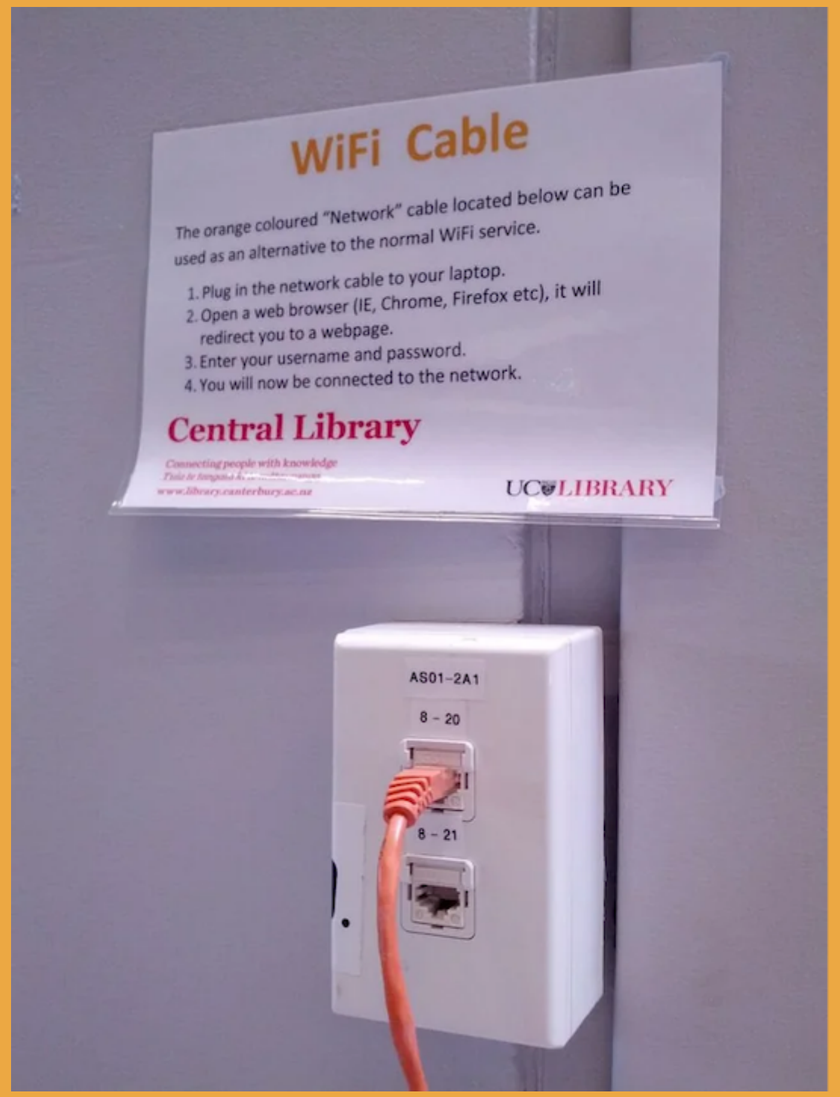
A word from my sponsors



Buildkite

This is a talk about...

Wi-Fi Cables



https://www.reddit.com/r/networkingmemes/comments/12203r5/introducing_the_wifi_cable/

This is a talk about...

~~Wi-Fi Cables~~ Ethernet

This is a talk about...

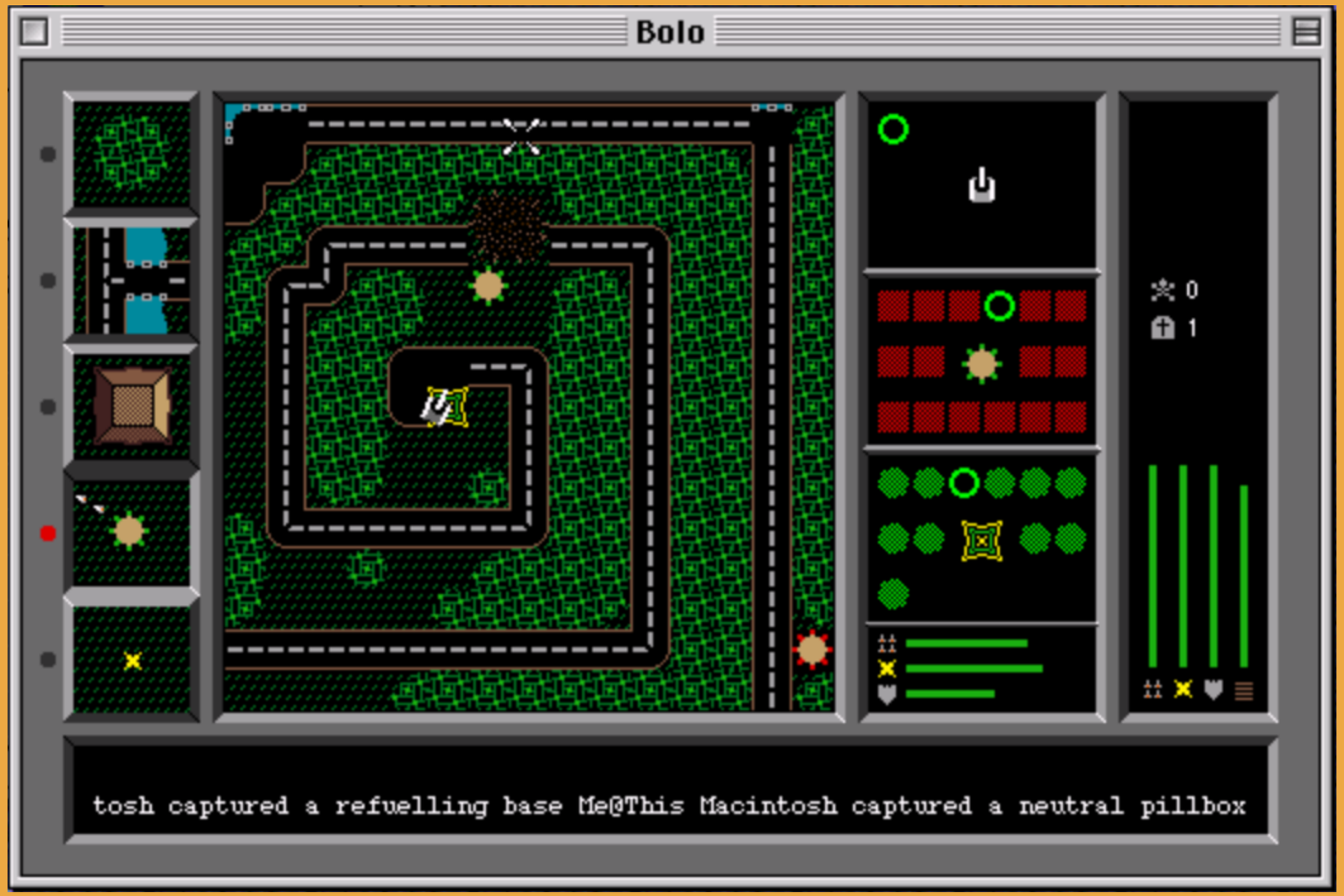
~~Wi-Fi Cables~~ Ethernet *and* AppleTalk

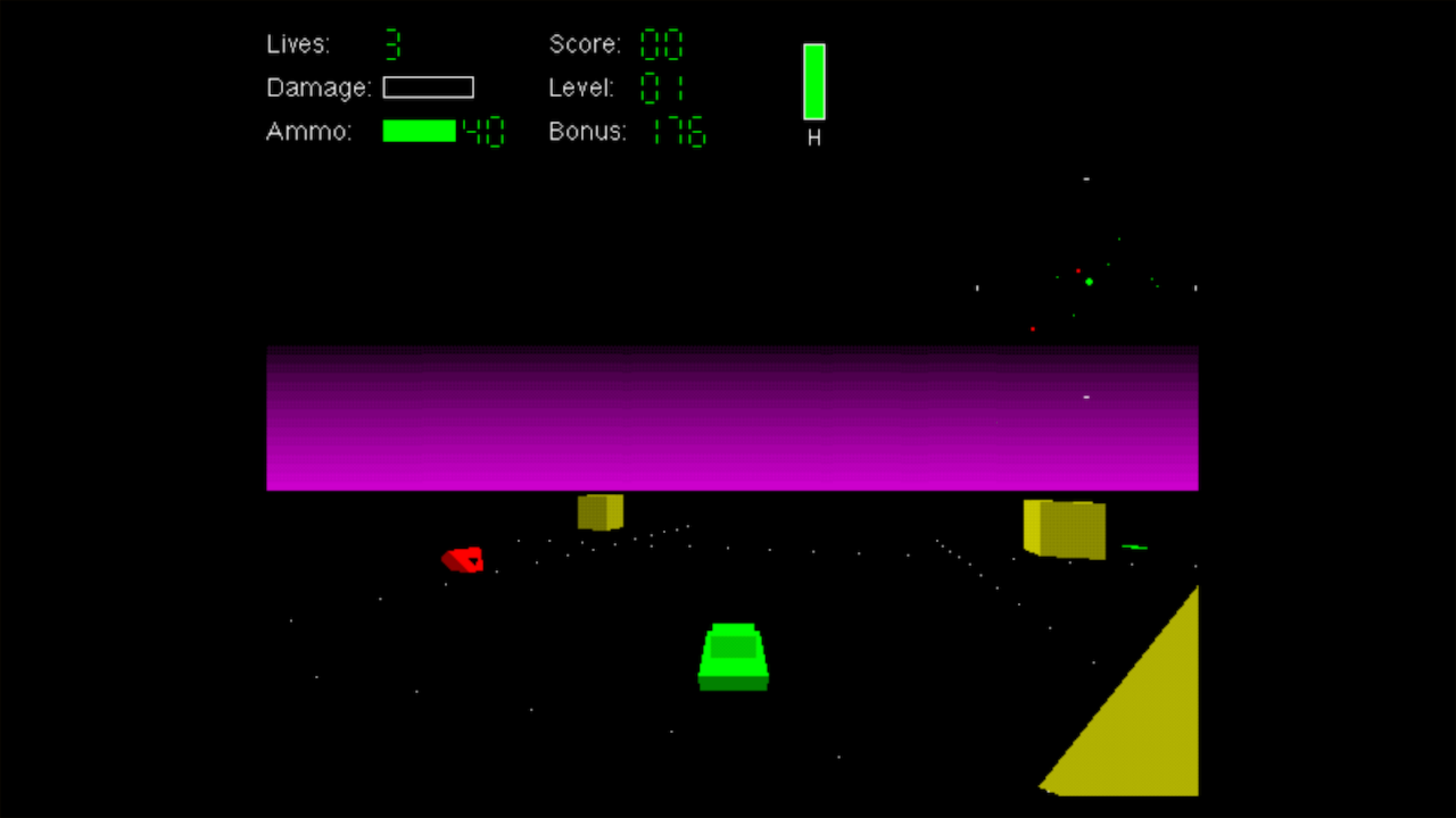
This is a talk about...

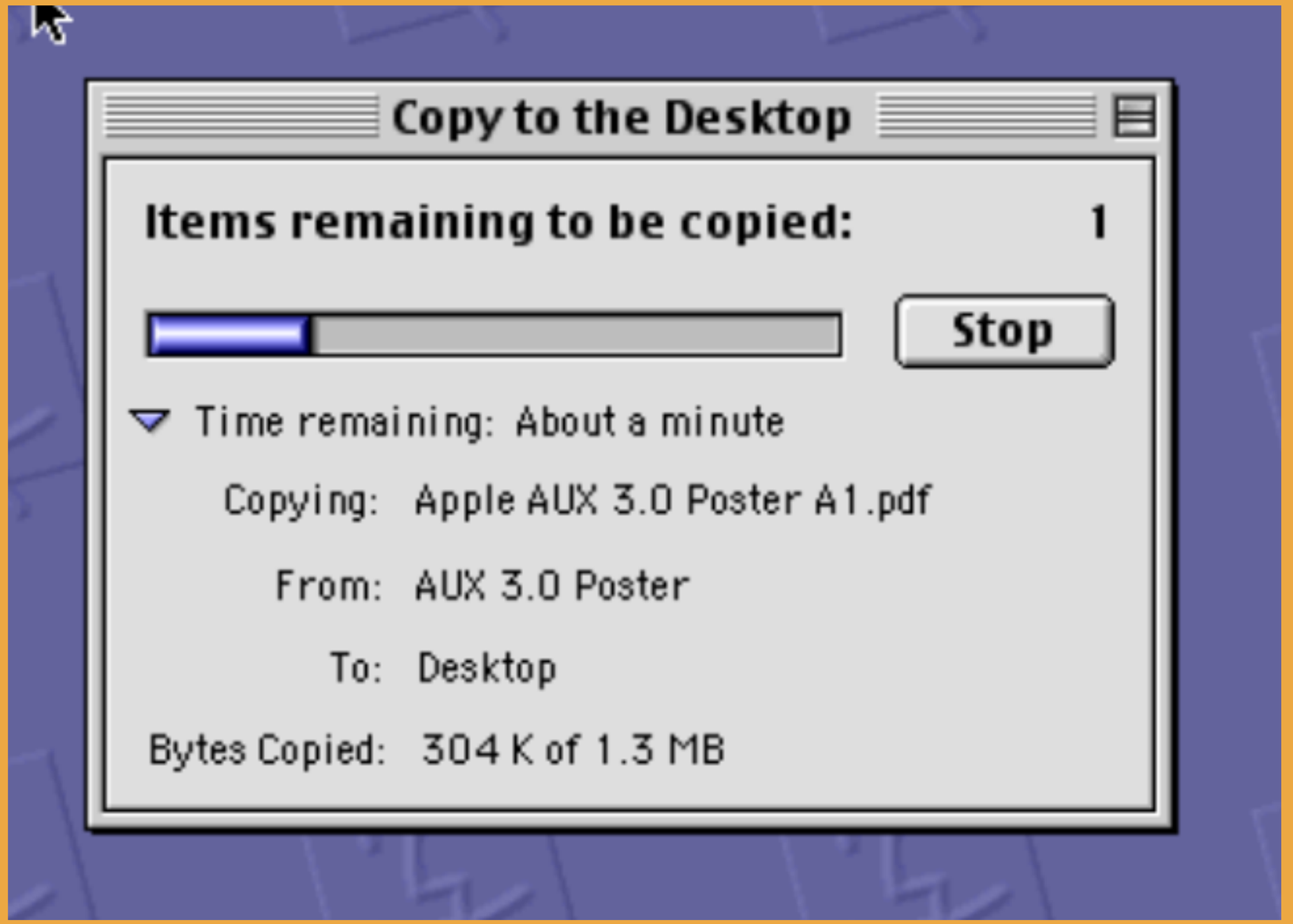
Precise language

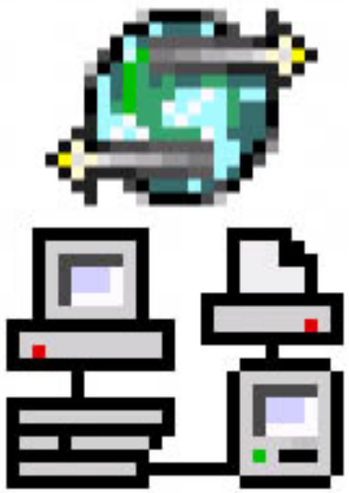
Networks

Protocol


Bolo
0
1
tosh captured a refuelling base Me@This Macintosh captured a neutral pillbox


Lives: 3
Score: 00
Damage:
Level: 01
Ammo: 40
Bonus: 176
H


Copy to the Desktop
Items remaining to be copied: 1
Stop
Time remaining: About a minute
Copying: Apple AUX 3.0 Poster A1.pdf
From: AUX 3.0 Poster
To: Desktop
Bytes Copied: 304 K of 1.3 MB



GlobalTalk

A globe-spanning network of retro Macs

Logo from http://marchintosh.com/globaltalk.html

GlobalTalk

— Started in early March 2024 (#MARCHintosh)
— Loose collection of retro Mac nerds over social media
— A Google spreadsheet

1983

State of computer networking in 1983

- June: Ethernet standardised (IEEE 802.3)!
- Token Ring (IBM) in development
- Various proprietary systems
- Acoustic couplers and modems (300 bit/s)
- "Wireless network"? On what frequency?

Why did we design it?

When this design activity was initiated in late 1983, many barriers prevented the widespread adoption of network technology. No one doubted networking's vast promise; yet its acceptance was proving slower than anticipated.

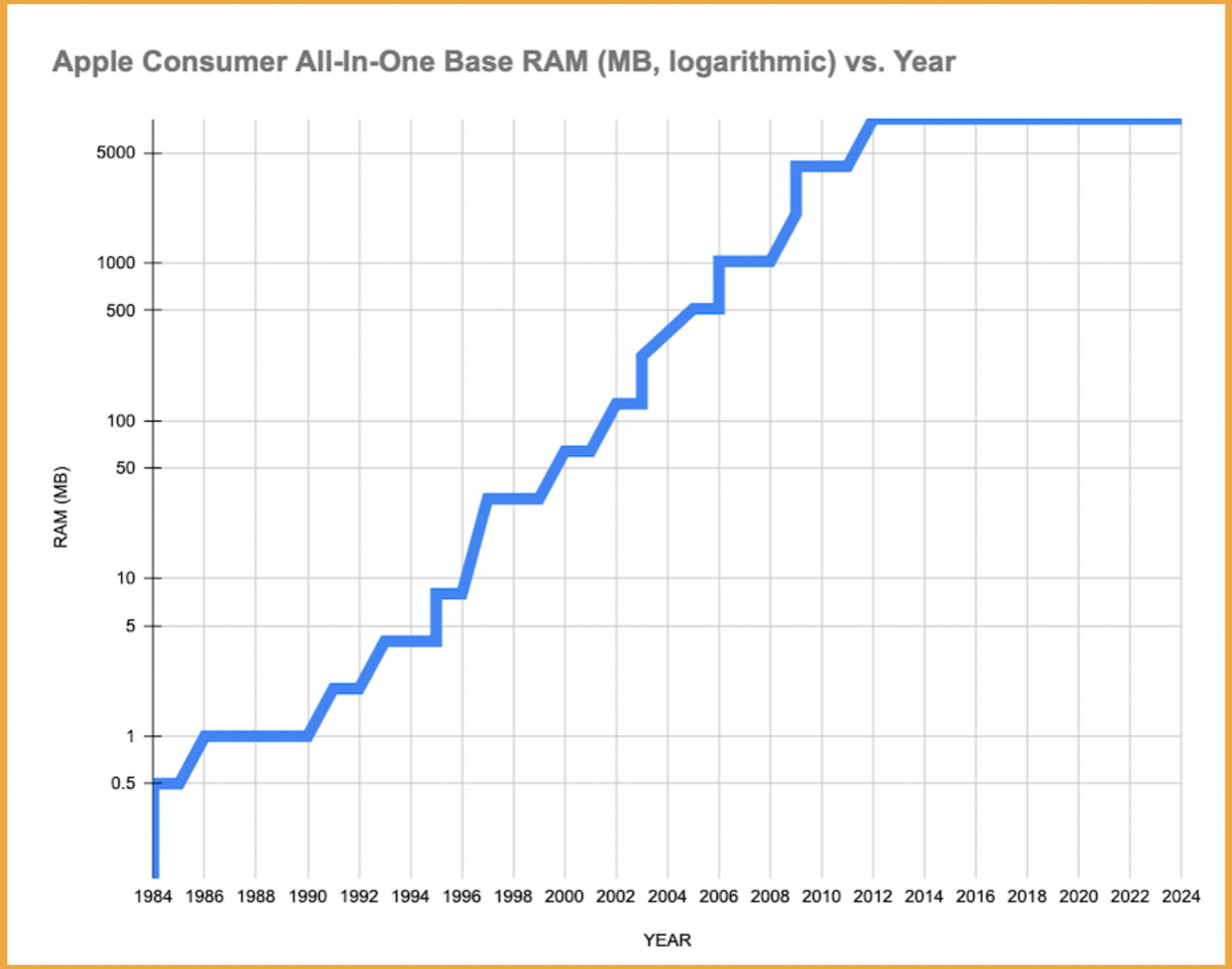
It was expensive (approximately $1000 for each computer) to connect a computer to network systems. This high cost, acceptable for minicomputers and mainframes, seemed prohibitive for the personal computer (itself priced around $1000). Furthermore, the services received by users who decided to pay the high initial price were limited.

Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

More importantly, network systems were foreign appendages, conceived independently of computers and then only as an afterthought. Networks appeared to be celebrations of technology designed with more attention to such issues as data transmission speed than to user convenience. Users of network services had to learn the idiosyncrasies of each particular network. Access to resources through the network had to be obtained in a manner different from that used for local resources resident on the user's computer. The network constituted a hindrance when it should have extended the user's reach.

We could not use existing network protocol architectures to achieve our goal of seamlessly extending the user's computing experience. We chose instead to develop our own architecture in which we would utilize standard technology where appropriate and innovate freely where necessary.

Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley



By @dschaub@mstdn.social

Burrell [Smith]'s third Macintosh design was done in June 1981. The main reason was that he fell in love with a communications chip called the SCC. The SCC could support a built-in local area network, making AppleTalk possible with no additional hardware, as well as providing nice buffered serial ports with interrupts and other hardware features.

— Andy Hertzfeld (undated), *Five Different Macintoshes*, https://folklore.org/Five_Different_Macs.html

1984

1984: The Macintosh launches

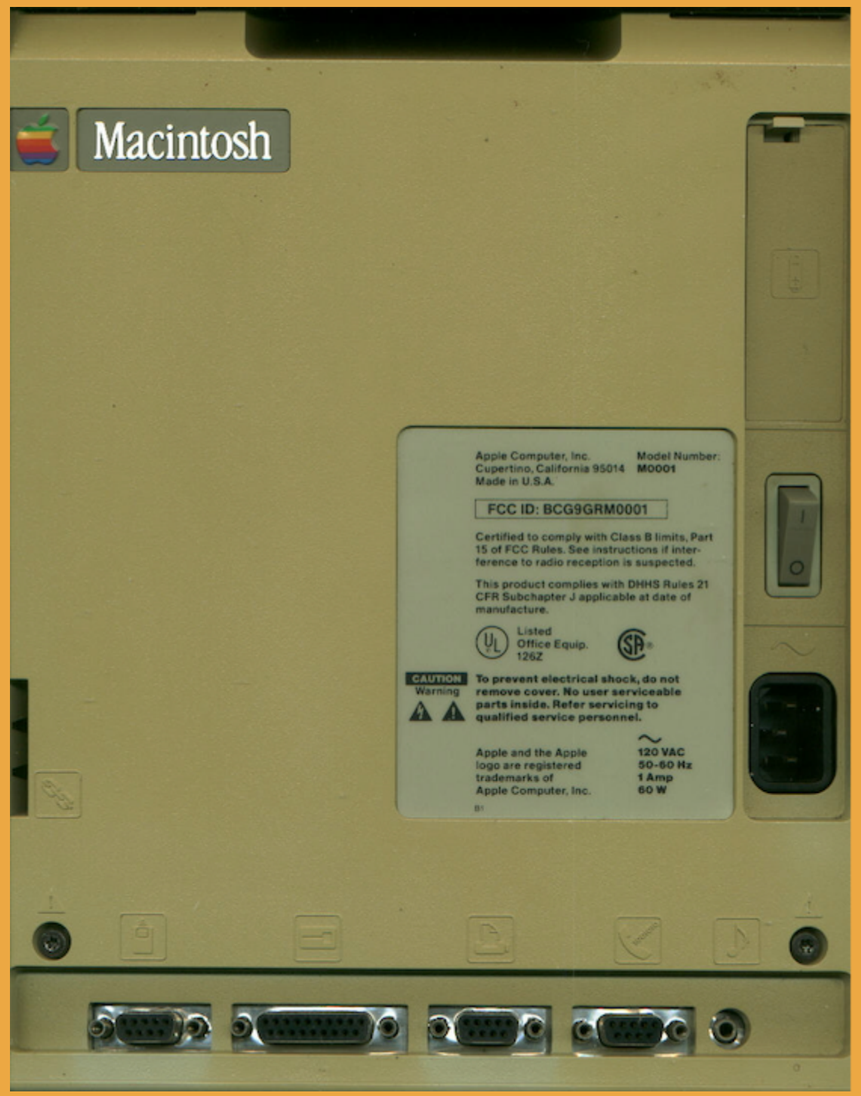
— It included networking capability *built in*
— (mostly)
— (sort of)
— You needed some cables

Hey!

Those aren't ~~Wi-Fi~~ Ethernet cables!


ROHS COMPLIANT


Older Macs don't have Ethernet
Many new Macs don't have Ethernet either



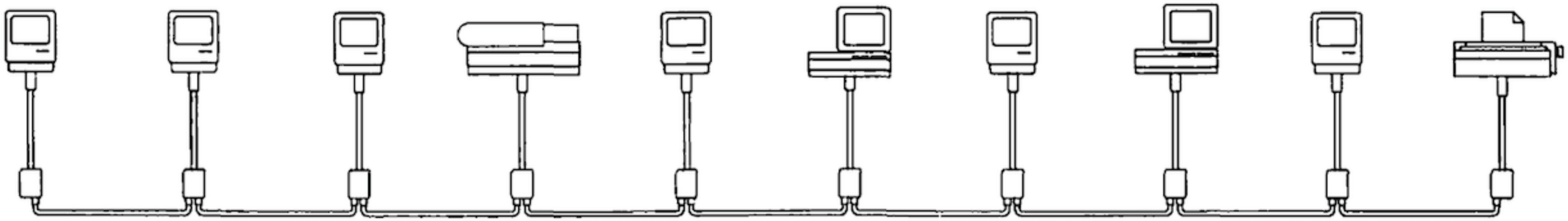
Public domain - Aerialvendetta https://commons.wikimedia.org/wiki/File:AnOriginalMacintoshBackCaseUNALTEREDMACINTOSH.jpg

Public domain - Aerialvendetta https://commons.wikimedia.org/wiki/File:AnOriginalMacintoshBackCaseUNALTEREDMACINTOSH.jpg


Macintosh™ Plus 1Mb
Apple Computer, Inc.
Cupertino, California 95014
Made in U.S.A.
Model Number: M0001A P
220-240V
50-60 Hz
0.5A
60W
©1987 Apple Computer, Inc.
Apple and the Apple logo are registered trademarks of Apple Computer, Inc. Macintosh is a trademark of Apple Computer, Inc.
Certified to comply with IEC 380 by TUV Rheinland
N


Macintosh™ Classic™
Apple Computer, Inc.
Cupertino, California
Made in Singapore
Model Number: M1420
FCC ID: BCGM0420
220–240V~
50–60 Hz
0.5A
EN 60 950: 1988
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
This product complies with DHHS Rules 21 CFR Subchapter J applicable at date of manufacture.
© 1990 Apple Computer, Inc. Apple, the Apple logo, and Macintosh are trademarks of Apple Computer, Inc. Classic is a trademark licensed to Apple Computer, Inc.
825-2665-A
E120SSDM0421X/A

■ **Figure I-2** LocalTalk network

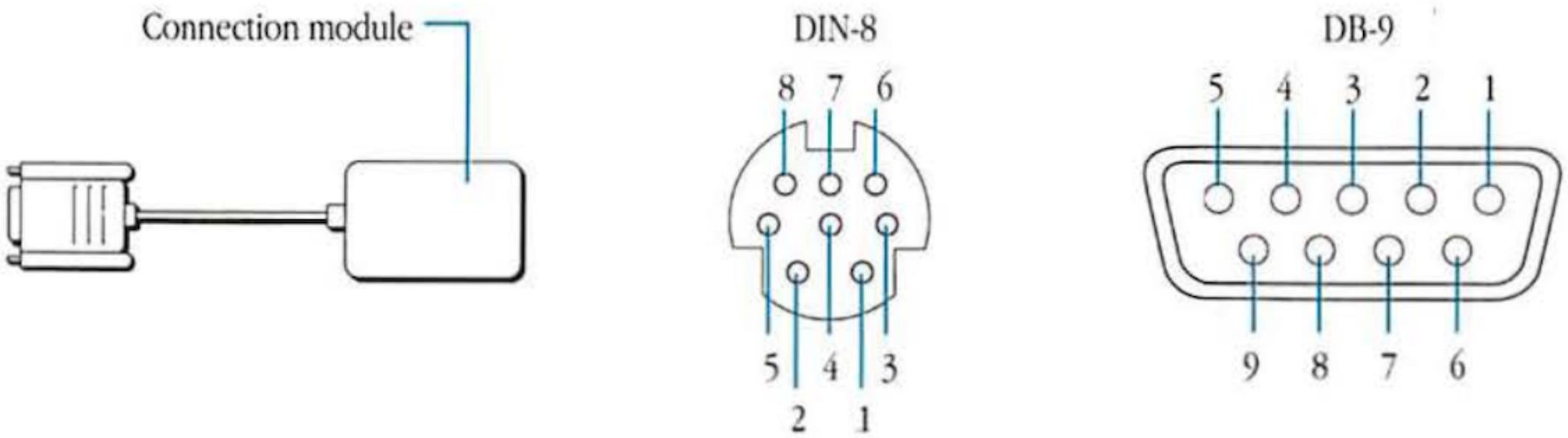


Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

The daisy-chain requires extra hardware

You can't make 1 single network by chaining through both ports

■ **Figure A-2** LocalTalk connection module

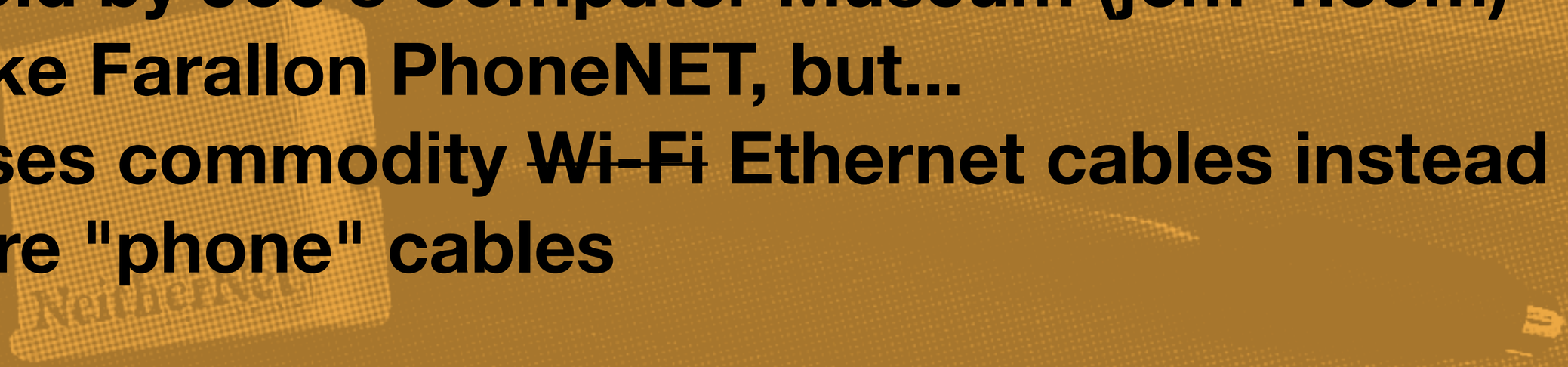


Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

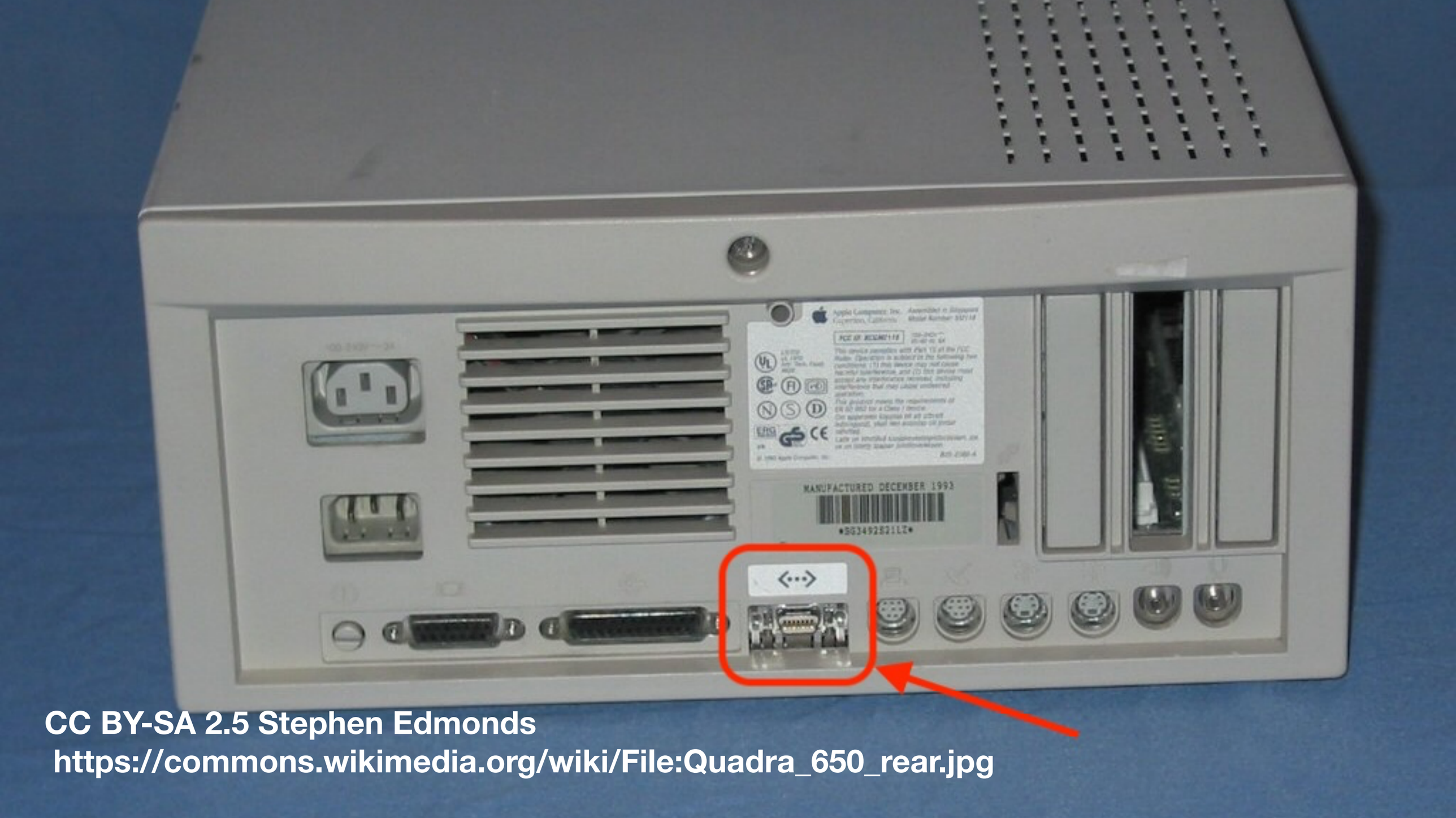

NeitherNet

NeitherNet

- Sold by Joe's Computer Museum (jcm-1.com)
- Like Farallon PhoneNET, but...
- Uses commodity ~~Wi-Fi~~ Ethernet cables instead of rare "phone" cables



Some Macs had Ethernet




Apple® Ethernet
Twisted-Pair Transceiver
Apple Computer, Inc.
Model No: M0437
This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesirable operation.
MADE IN USA

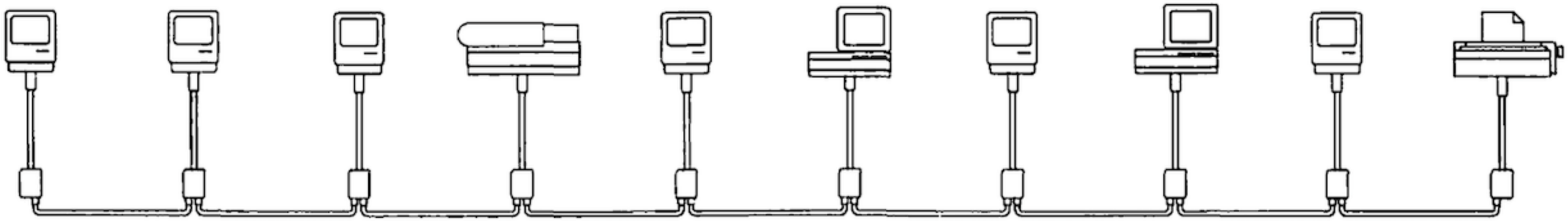
Still from *The Matrix* (1999), Warner Bros.

The Blue Pill

A single LocalTalk network

- 230.4 Kbps
- Up to 254 nodes, up to 300m total length
- No routing, no routers!
- One anonymous zone
- One topology (bus)

■ **Figure I-2** LocalTalk network

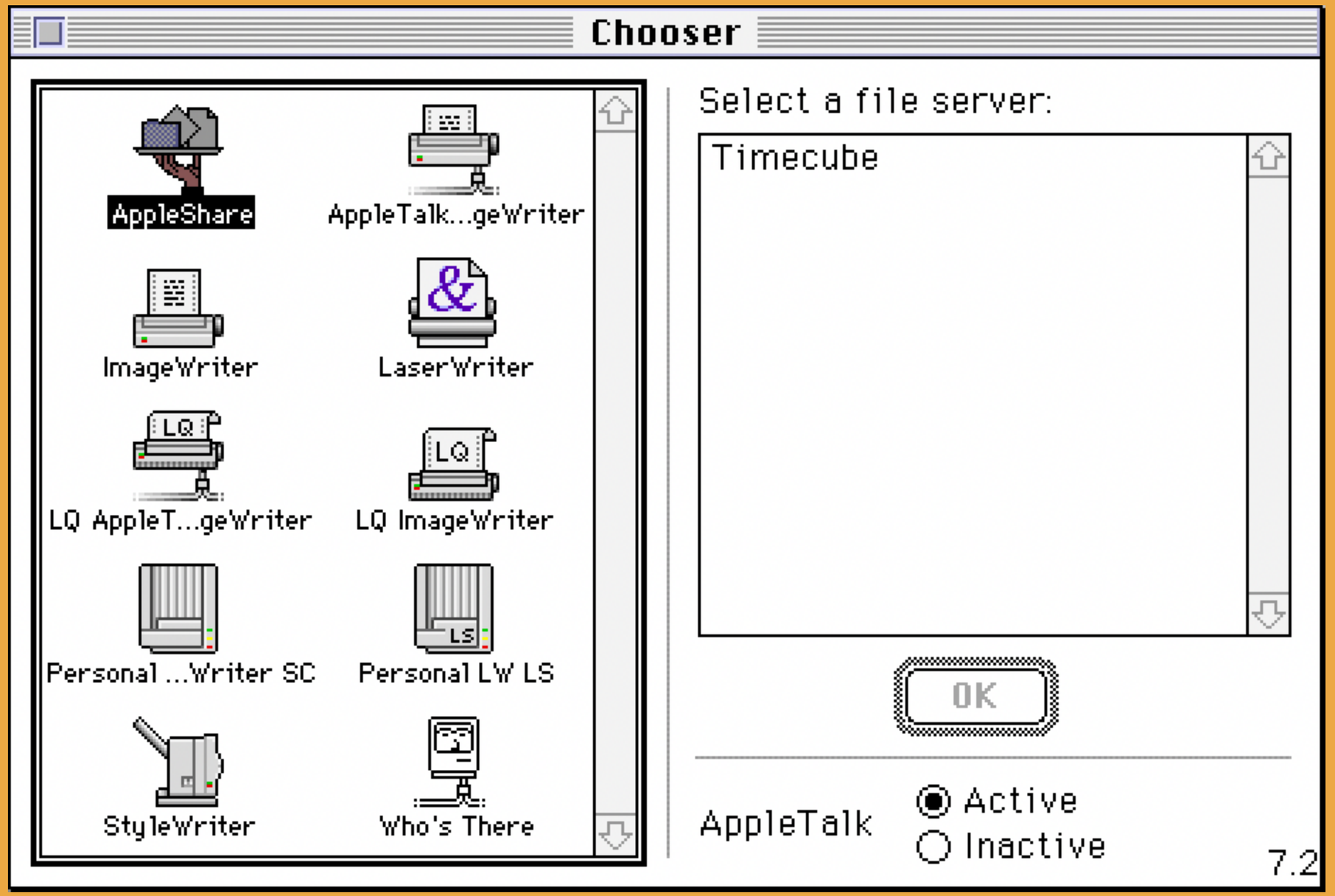


Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

EtherTalk

Same thing, just with Ethernet

- Up to 10 Mbps!
- Supports more nodes
- More topologies


Chooser
AppleShare
AppleTalk...geWriter
ImageWriter
LaserWriter
LQ AppleT...geWriter
LQ ImageWriter
Personal ...Writer SC
Personal LW LS
StyleWriter
Who's There
Select a file server:
Timecube
OK
AppleTalk
Active
Inactive
7.2

The Red Pill

AppleTalk internet

An internet ≠ The Internet

"Internet" is short for "internetwork"

INTERNETWORK PROTOCOL SPECIFICATION

Version 4

Jonathan B. Postel

IEN 54

AppleTalk internets don't use the Internet Protocol

3.3. Internetwork Header Format

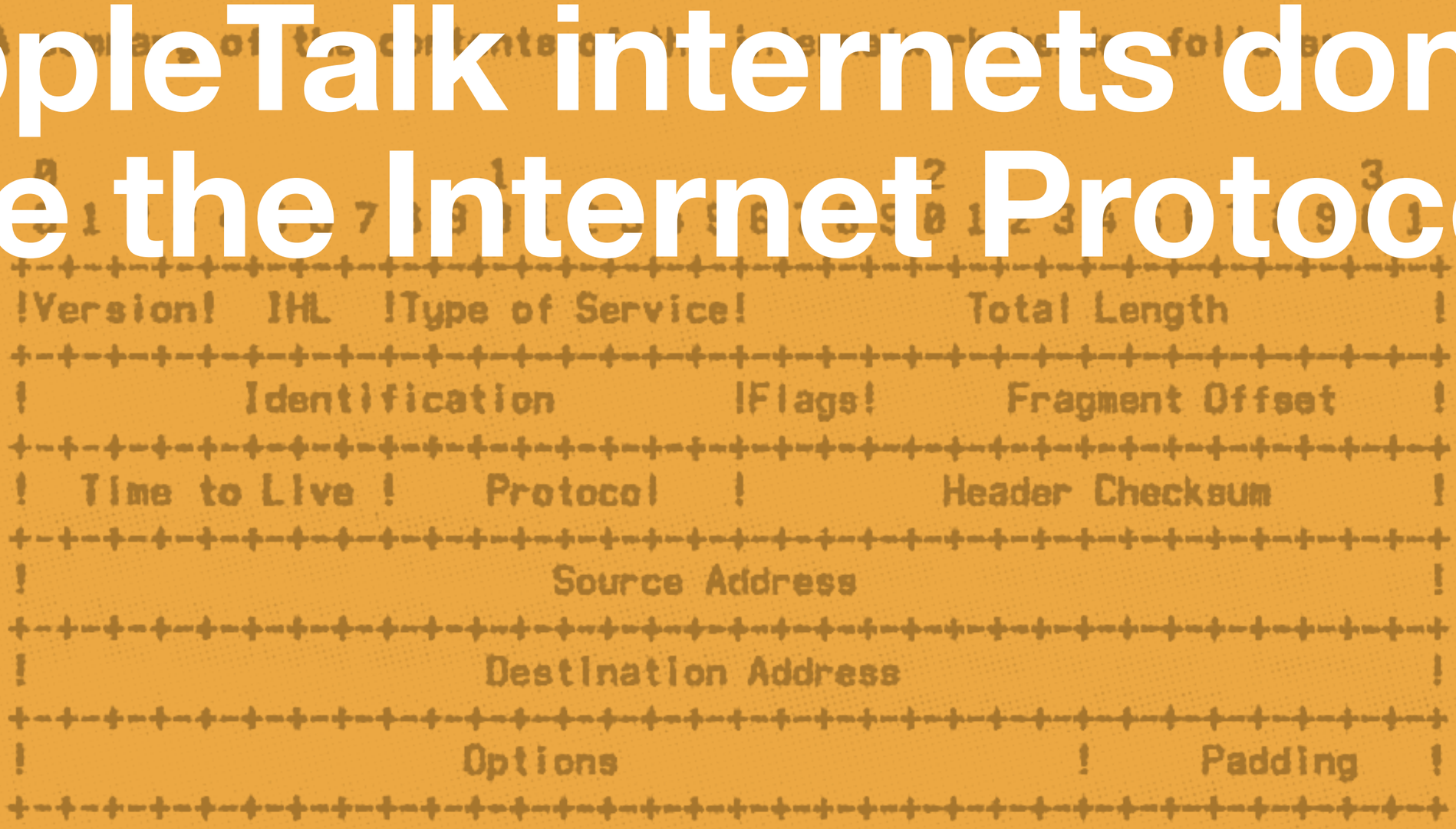


Figure 2.

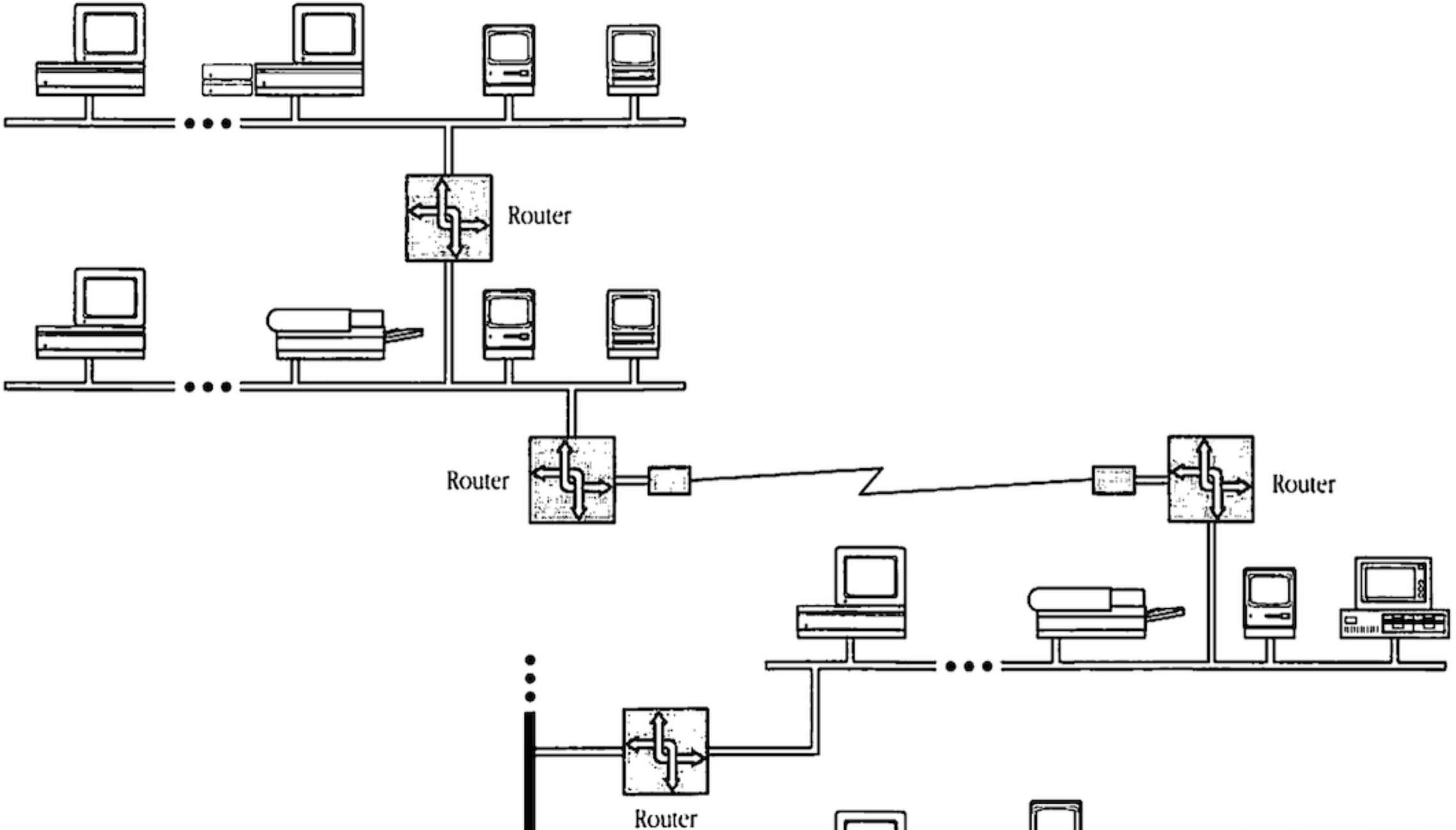
Postel, J.B. (1978) *Internetwork Protocol Specification Version 4*, IEN 54, ISI USC, California

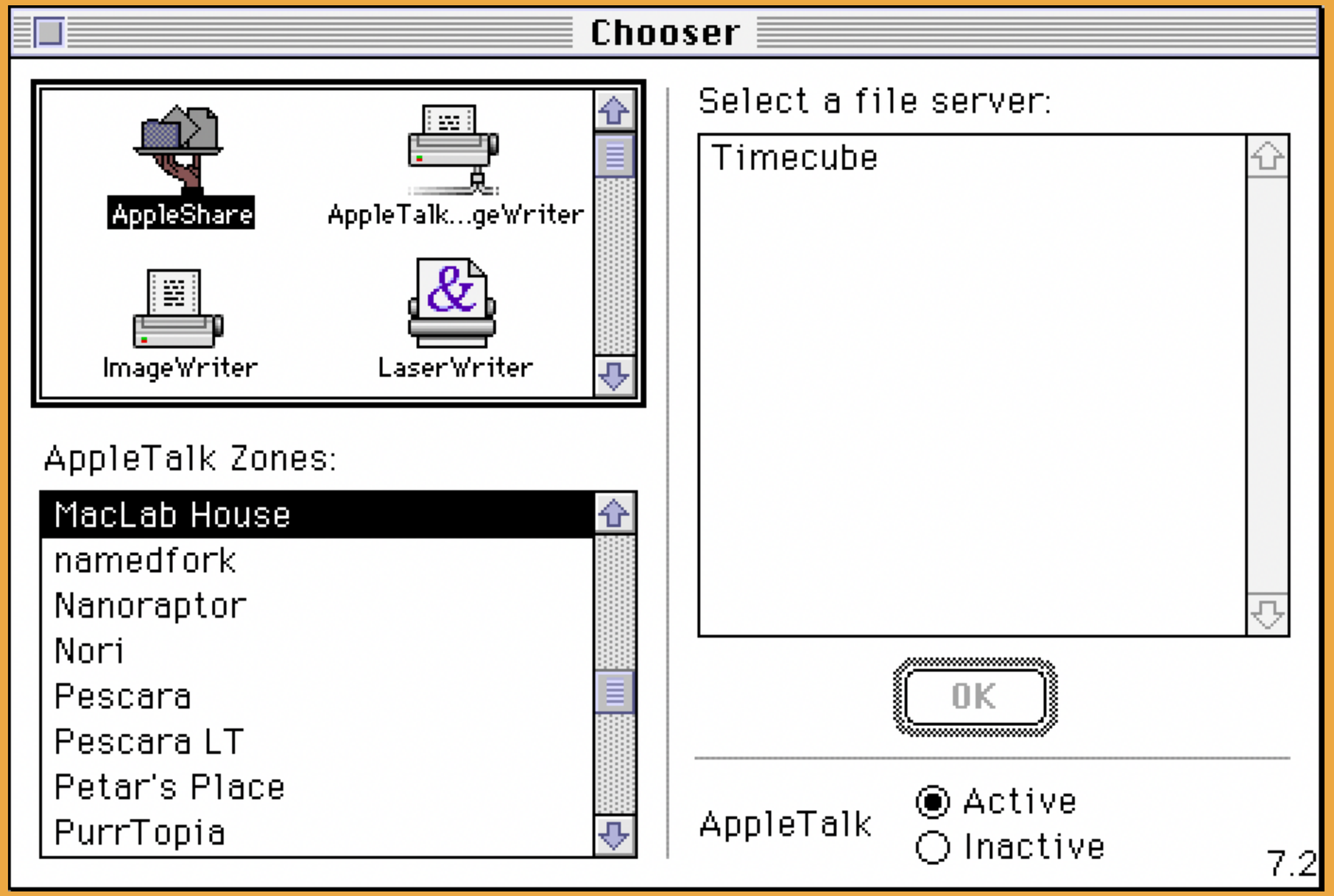
The Red Pill

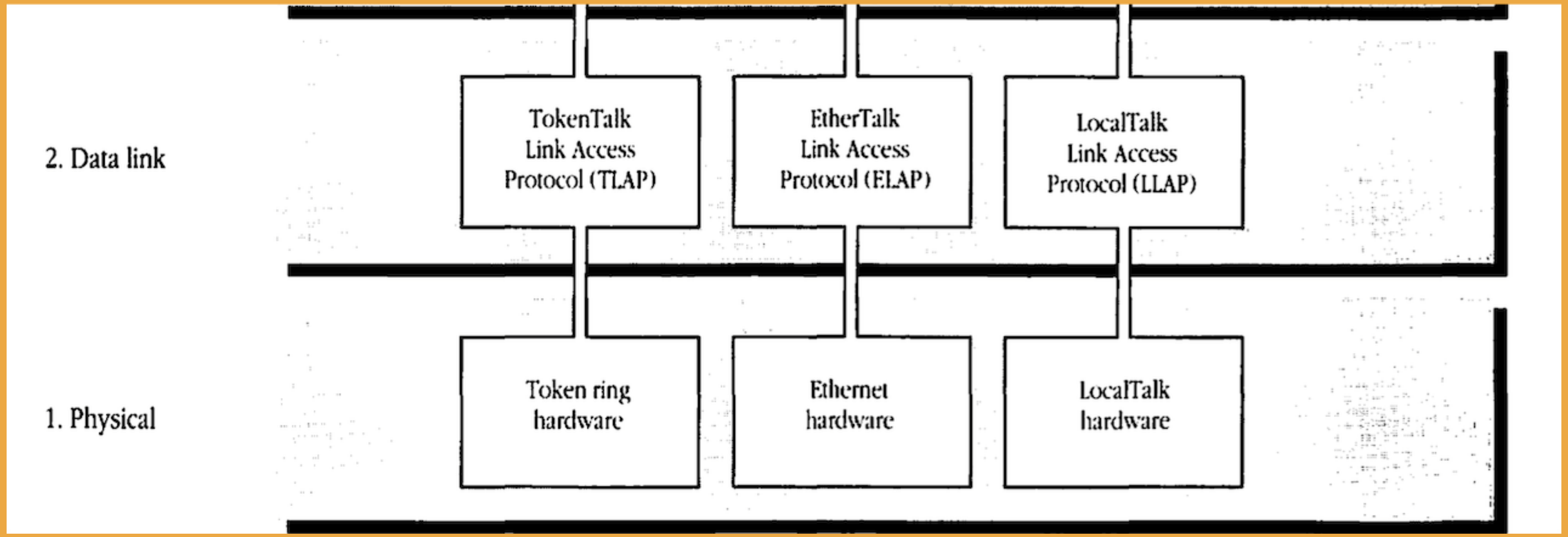
AppleTalk internet

— Up to ~16 million nodes
— AppleTalk *internet routers*
— 254 zones per (local) network

■ **Figure I-3** AppleTalk internet




Chooser
AppleShare
AppleTalk...geWriter
ImageWriter
LaserWriter
AppleTalk Zones:
MacLab House
namedfork
Nanoraptor
Nori
Pescara
Pescara LT
Petar's Place
PurrTopia
Select a file server:
Timecube
OK
AppleTalk
Active
Inactive
7.2



Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

AppleTalk

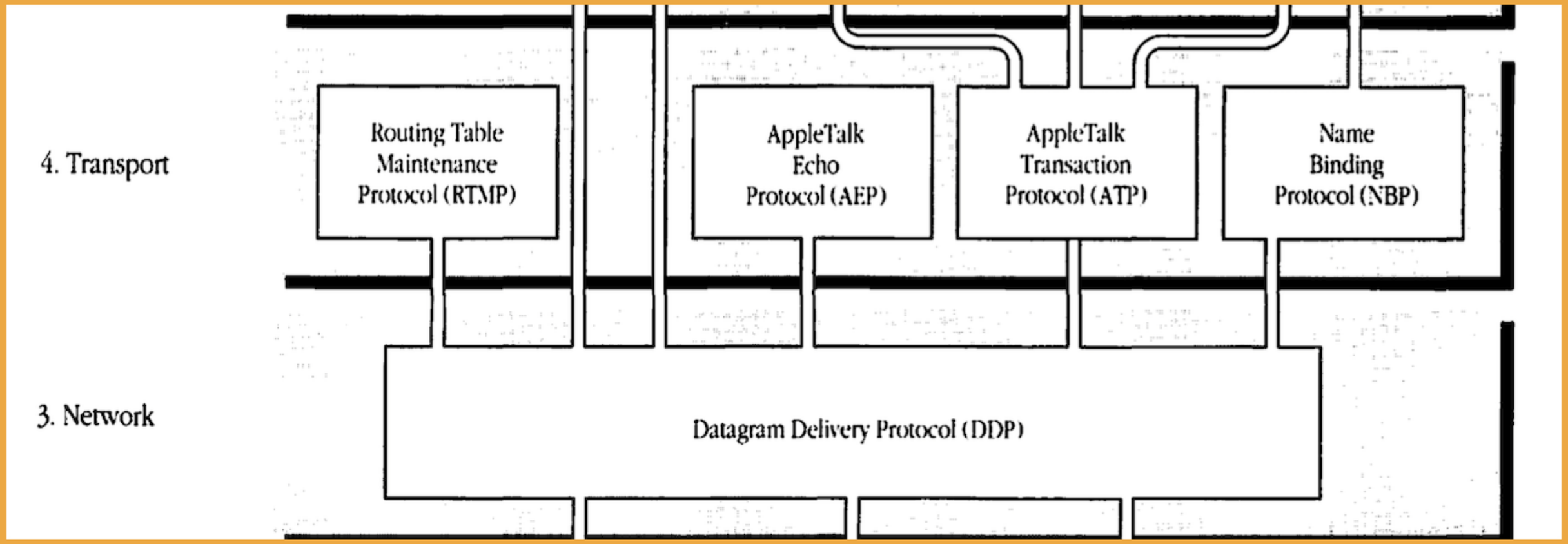
Originally the name for both the physical cabling

(now LocalTalk)

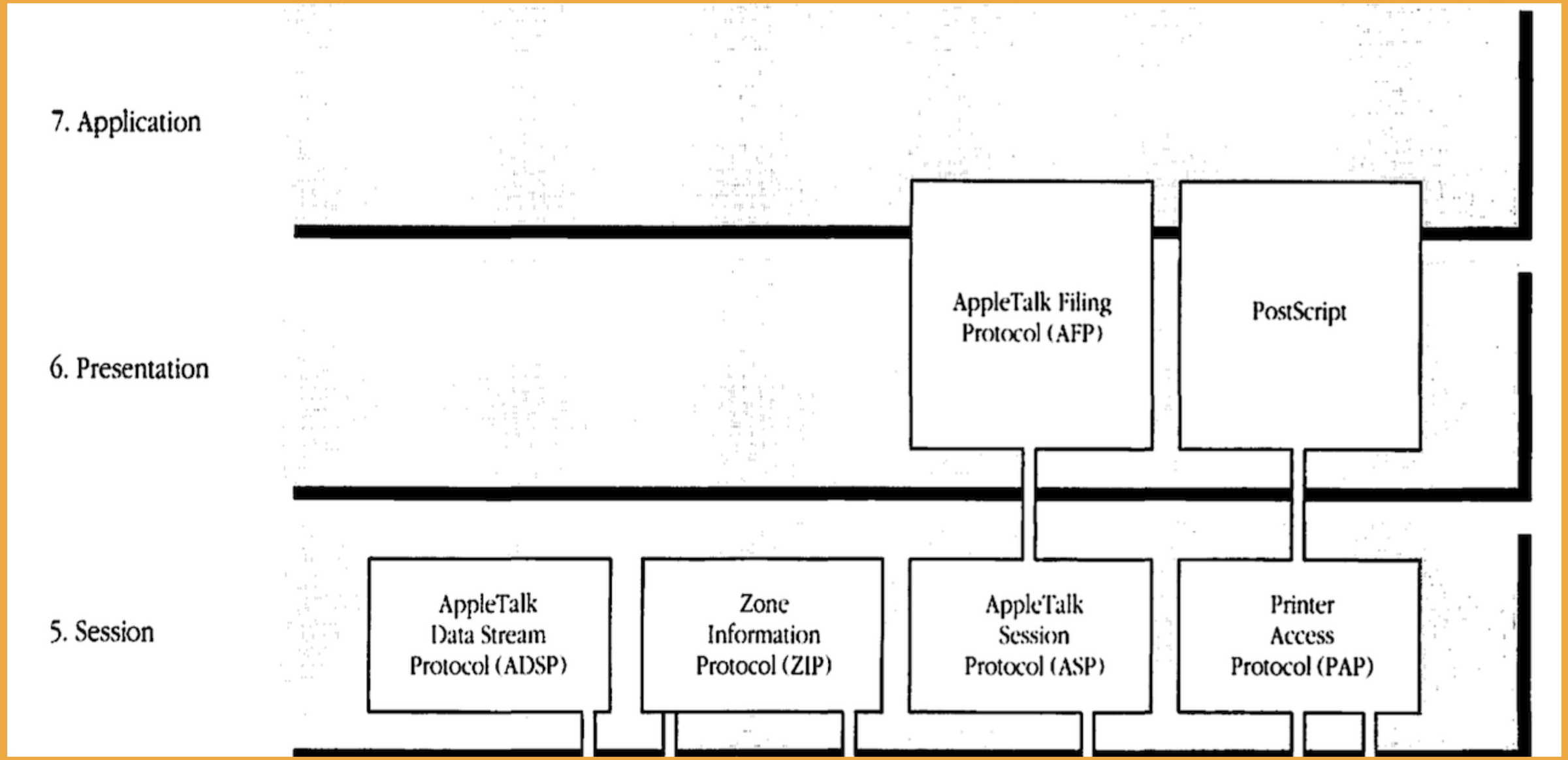
***and* the protocol stack, but later on it referred to the protocol stack only.**

AppleTalk

- LocalTalk: AppleTalk using Modem/Printer ports
- EtherTalk: AppleTalk over Ethernet
- TokenTalk: AppleTalk over Token Ring



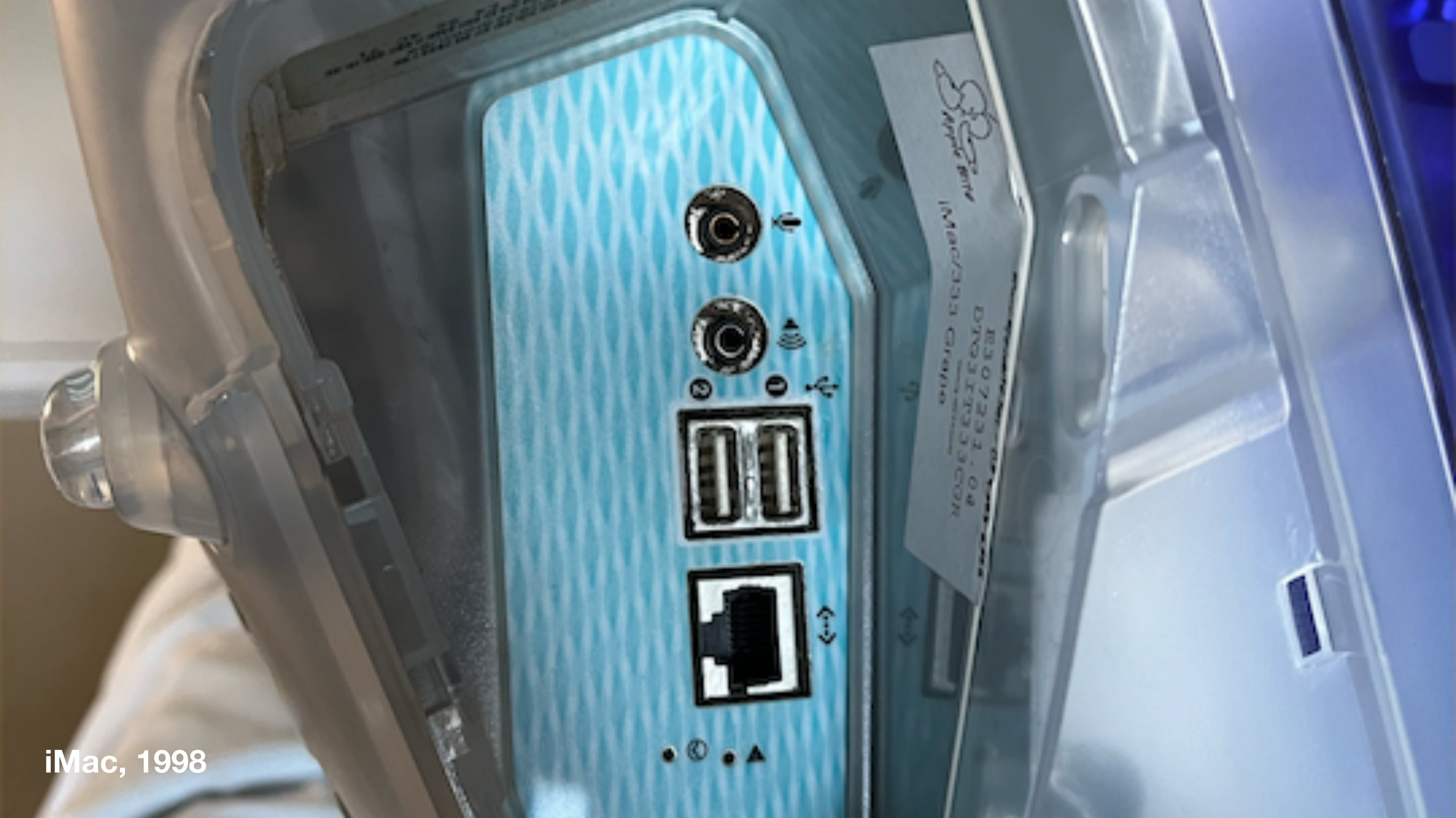
Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley



Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

What happened to AppleTalk?

Macintosh PowerBook G3, 1998

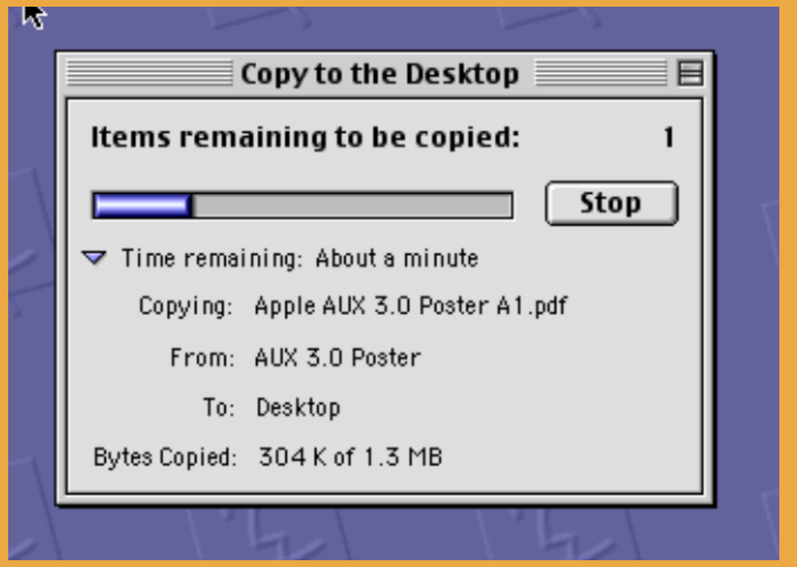


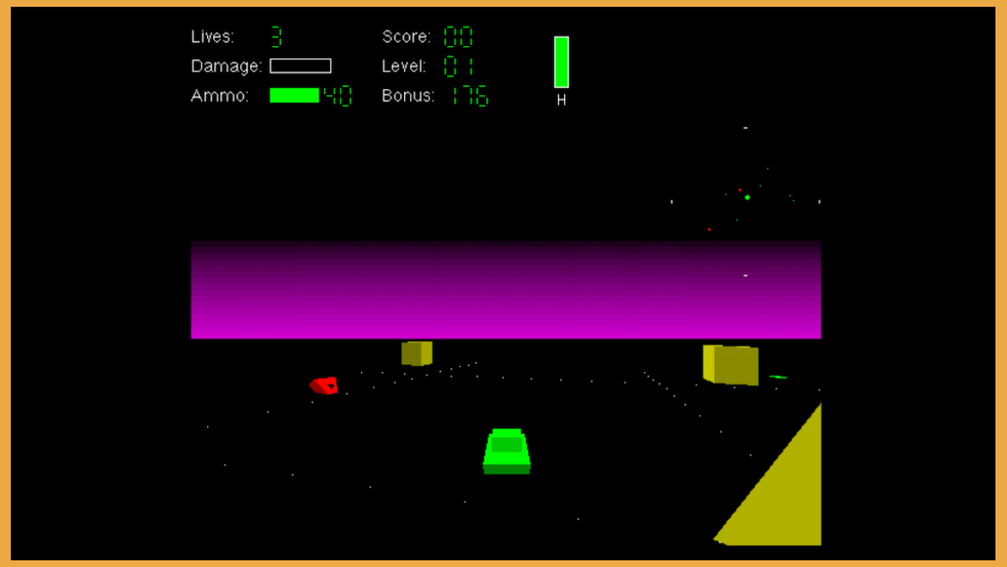
iMac, 1998

What happened to AppleTalk?

- Apple added a TCP/IP stack to the Mac
- Apple made AFP sharing function over TCP/IP
- iMac (1998) and onwards had no mini-DIN ports
- AppleTalk removed in Mac OS X 10.6 Snow Leopard
- AFP sharing removed in macOS 11 Big Sur, incompatible with APFS


Bolo
tosh captured a refuelling base Me@This Macintosh captured a neutral pillbox

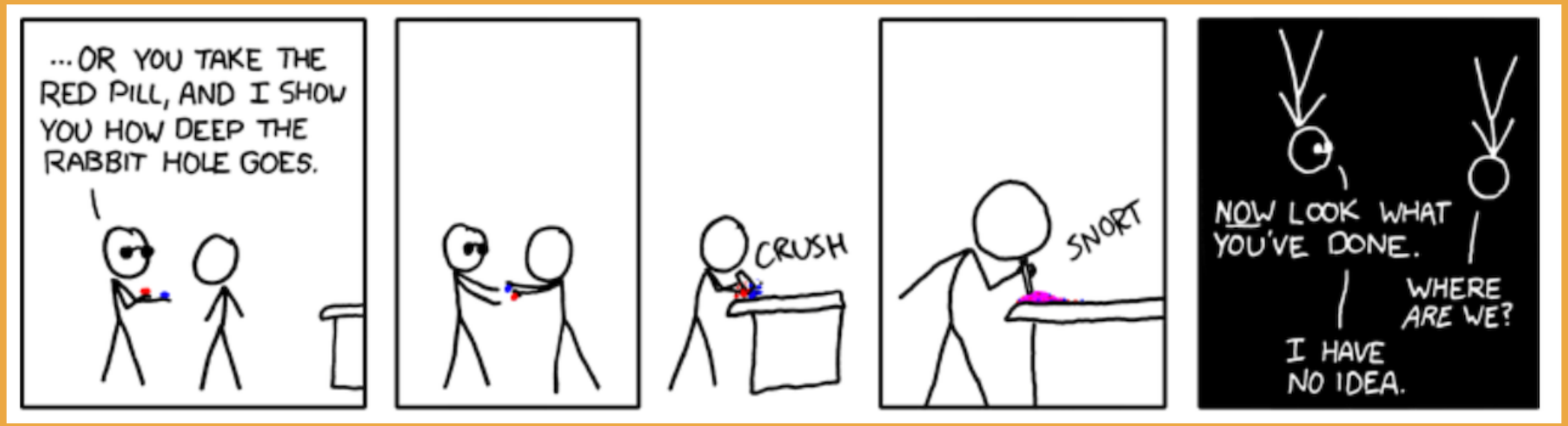

Copy to the Desktop
Items remaining to be copied: 1
Stop
Time remaining: About a minute
Copying: Apple AUX 3.0 Poster A1.pdf
From: AUX 3.0 Poster
To: Desktop
Bytes Copied: 304 K of 1.3 MB


Lives: 3
Damage:
Ammo: 40
Score: 00
Level: 01
Bonus: 176
H

How do we get AppleTalk over The Internet?

The Internet doesn't route AppleTalk packets

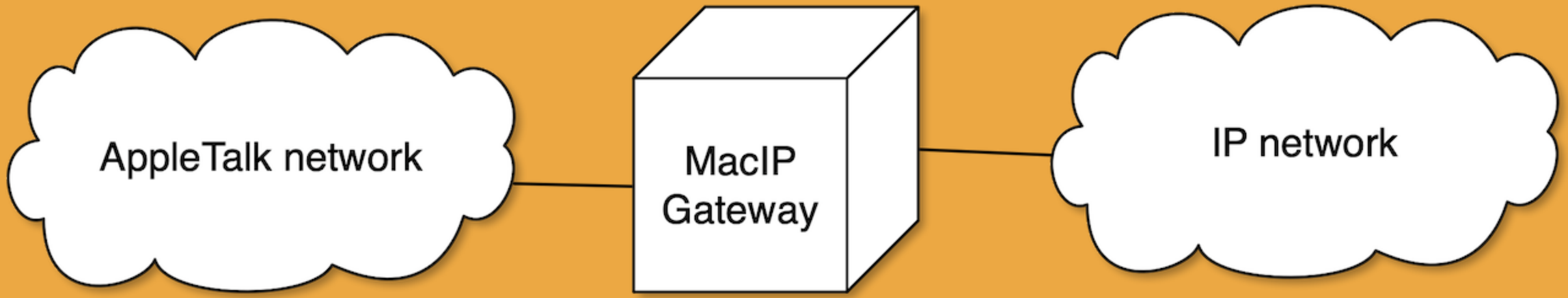
(to be fair AppleTalk doesn't route IP packets)



1985

Stanford Ethernet AppleTalk Gateway (SEAGATE)

which later became MacIP



Network translation

DDP

Hop count: 4 bits

Source network: 16 bits
Source node: 8 bits
Source socket: 8 bits

Destination network: 16 bits
Destination node: 8 bits
Destination socket: 8 bits

Protocol type: 8 bits

UDP and TCP

Source port: 16 bits
Destination port: 16 bits

IPv4

Time-to-live: 8 bits
Protocol type: 8 bits
Source address: 32 bits
Destination address 32 bits

VPN

Tunneling

also known as Encapsulation

Tunneling

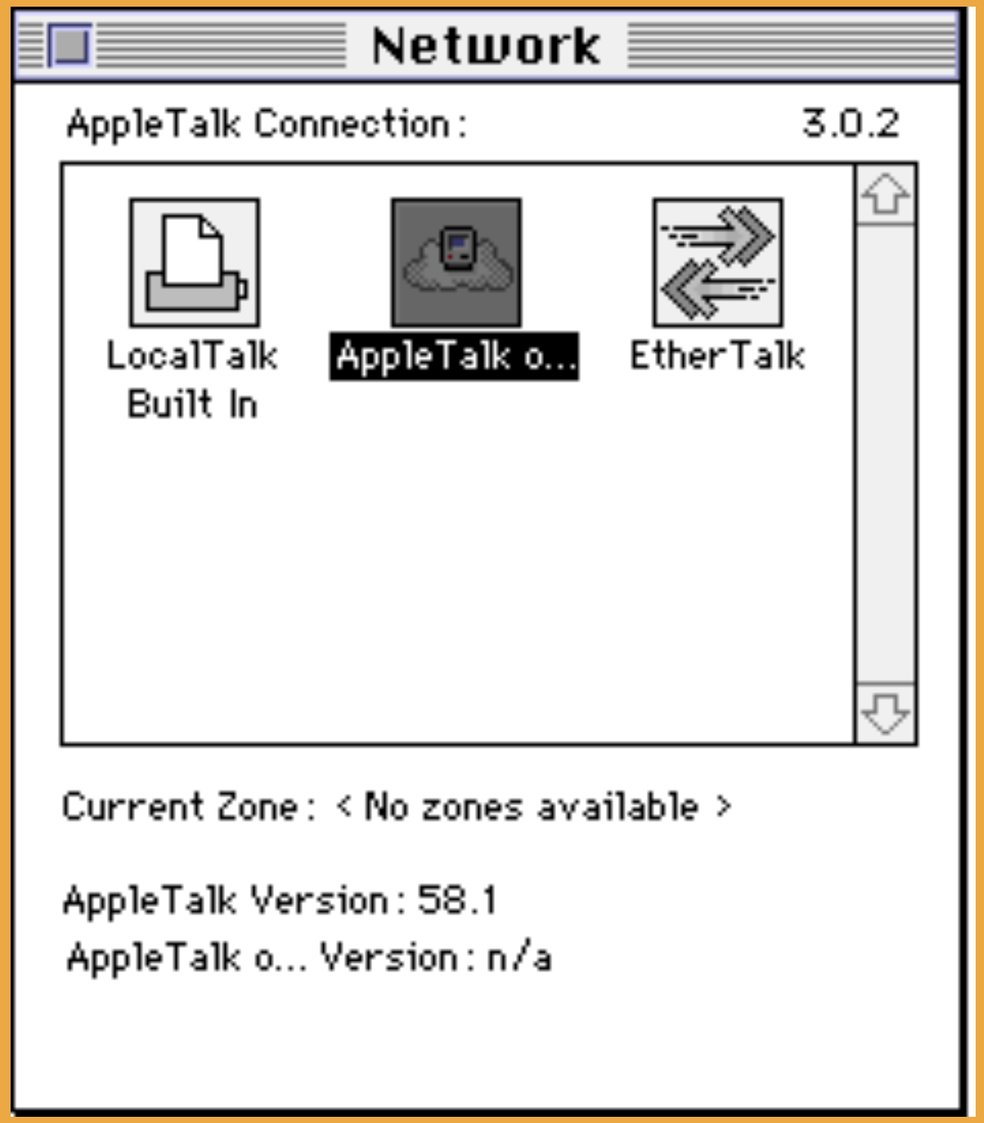
... is to *networking*, as

"Just add another layer of tunnelling/ encapsulation!"

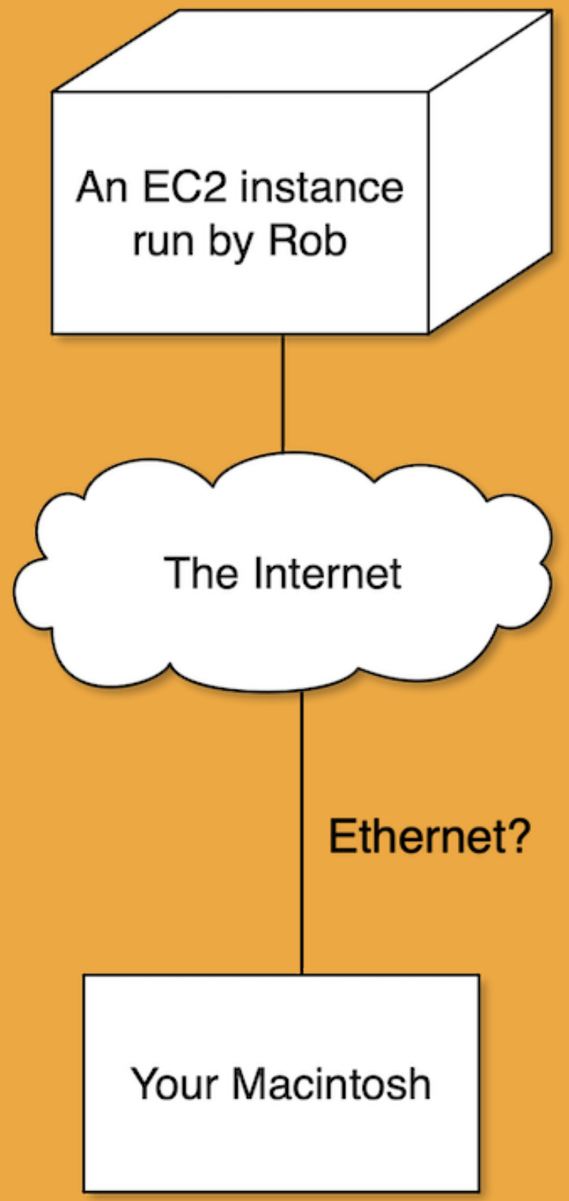
Indirection

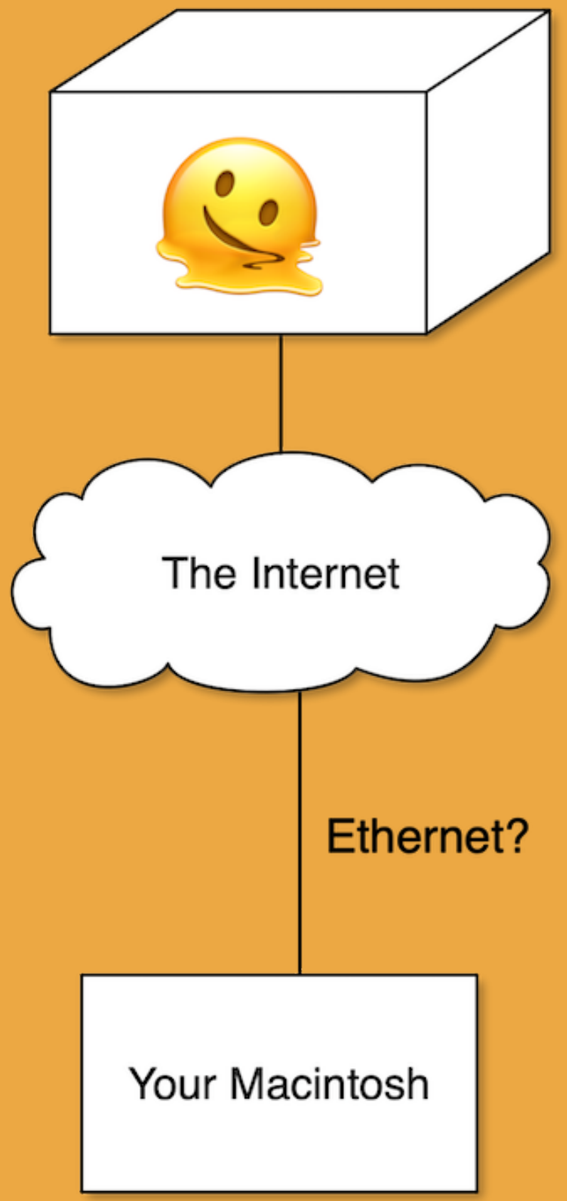
... is to *programming*

"Just add more lookup tables!"



Rob Braun (2013), *AppleTalk over IP*, http://www.synack.net/~bbraun/avpn.html

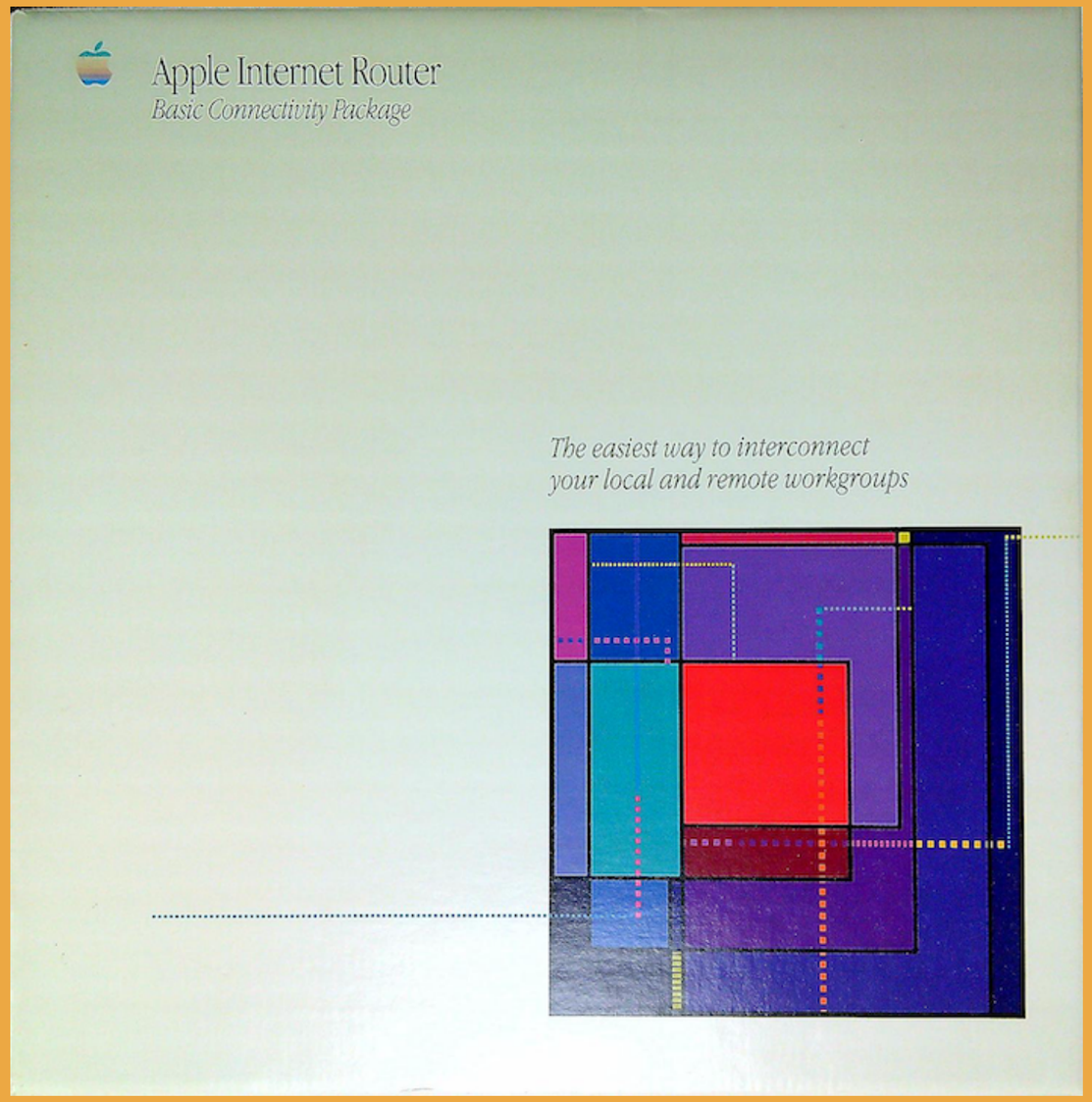

An EC2 instance
run by Rob
The Internet
Ethernet?
Your Macintosh

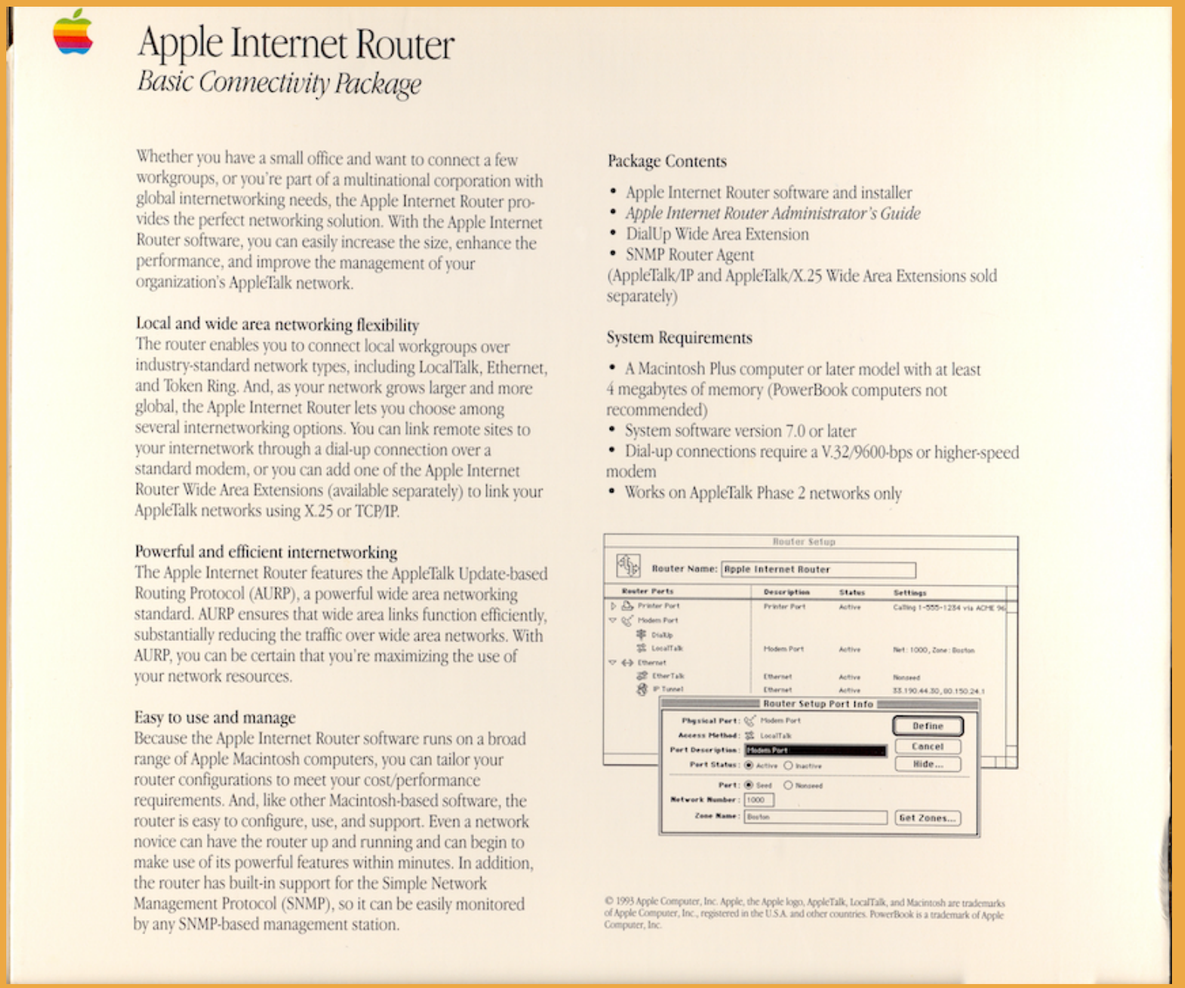

The Internet
Ethernet?
Your Macintosh

Apple

Internet

Router

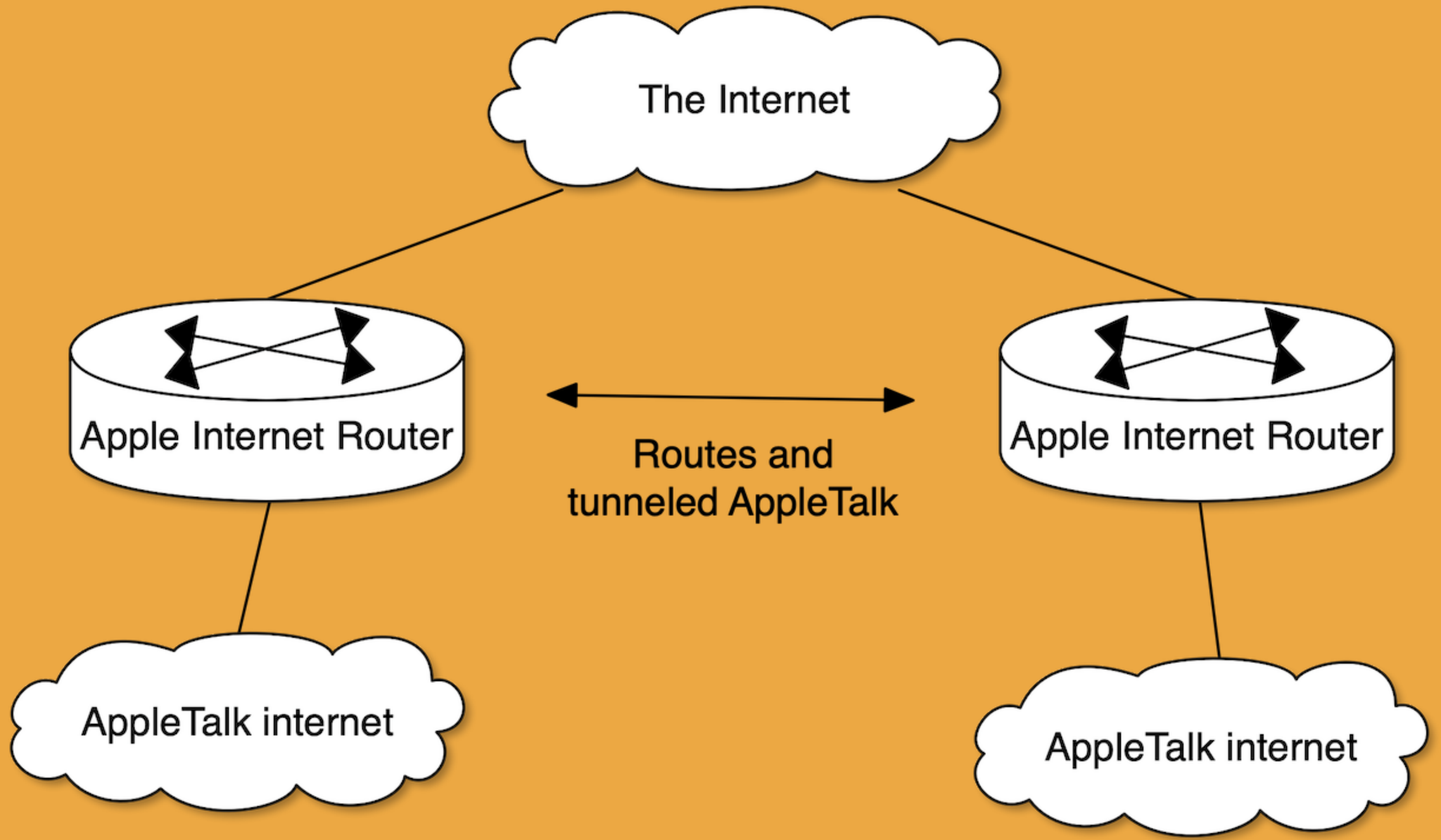




Apple Computer (1993), *Apple Internet Router*

Apple Internet Router *does* use Internet Protocol (and AppleTalk)

Apple Internet Router does *not* let Macs access The Internet


The Internet
Apple Internet Router
Routes and
tunneled AppleTalk
Apple Internet Router
AppleTalk internet
AppleTalk internet

Prepare your Mac

Here's the steps we used to create a working AIR installation. We are using LC form factor machines with Ethernet cards installed in the PDS slot. Other machines may also work but have not been tried. H/t to Dan ???? for figuring out the order of operations!

1. Start with a fresh install of System 7.1.
2. Install System Update 3.0.
3. Install Apple Internet Router 3.0.
4. Install Router IP extension.
5. Install Network Software Installer 1.4.5.

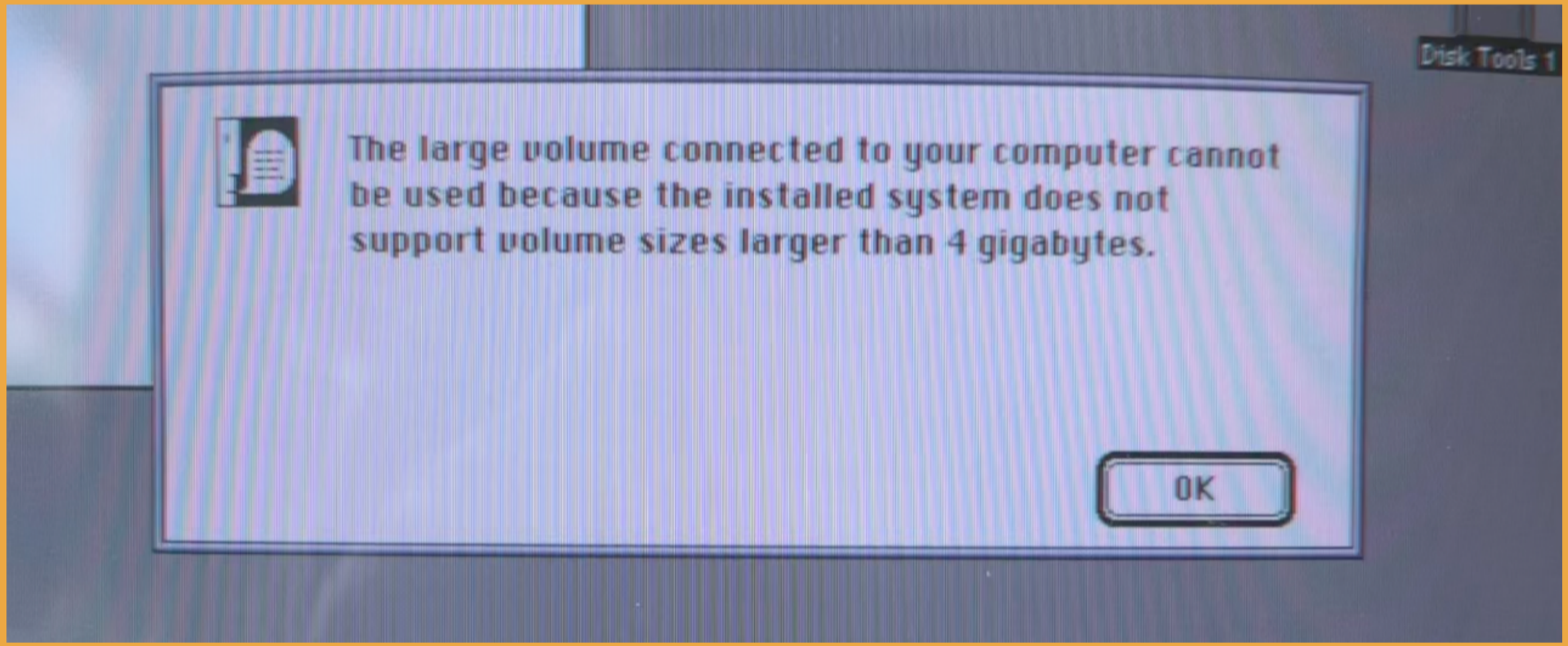
Rickards, P. (2024) *Pushing AppleTalk Across the Internet*, https://biosrhythm.com/?p=2767

Which Mac supports System 7.1?

- Mac Plus: no Ethernet
- Mac Classic: no Ethernet
- "Mystic" Colour Classic: Ethernet and 68040 CPU!
- PowerBook G3: has Ethernet, but too new
- Power Mac G4 Cube: has Ethernet, but too new


Macintosh
Color Classic

I promptly bricked it

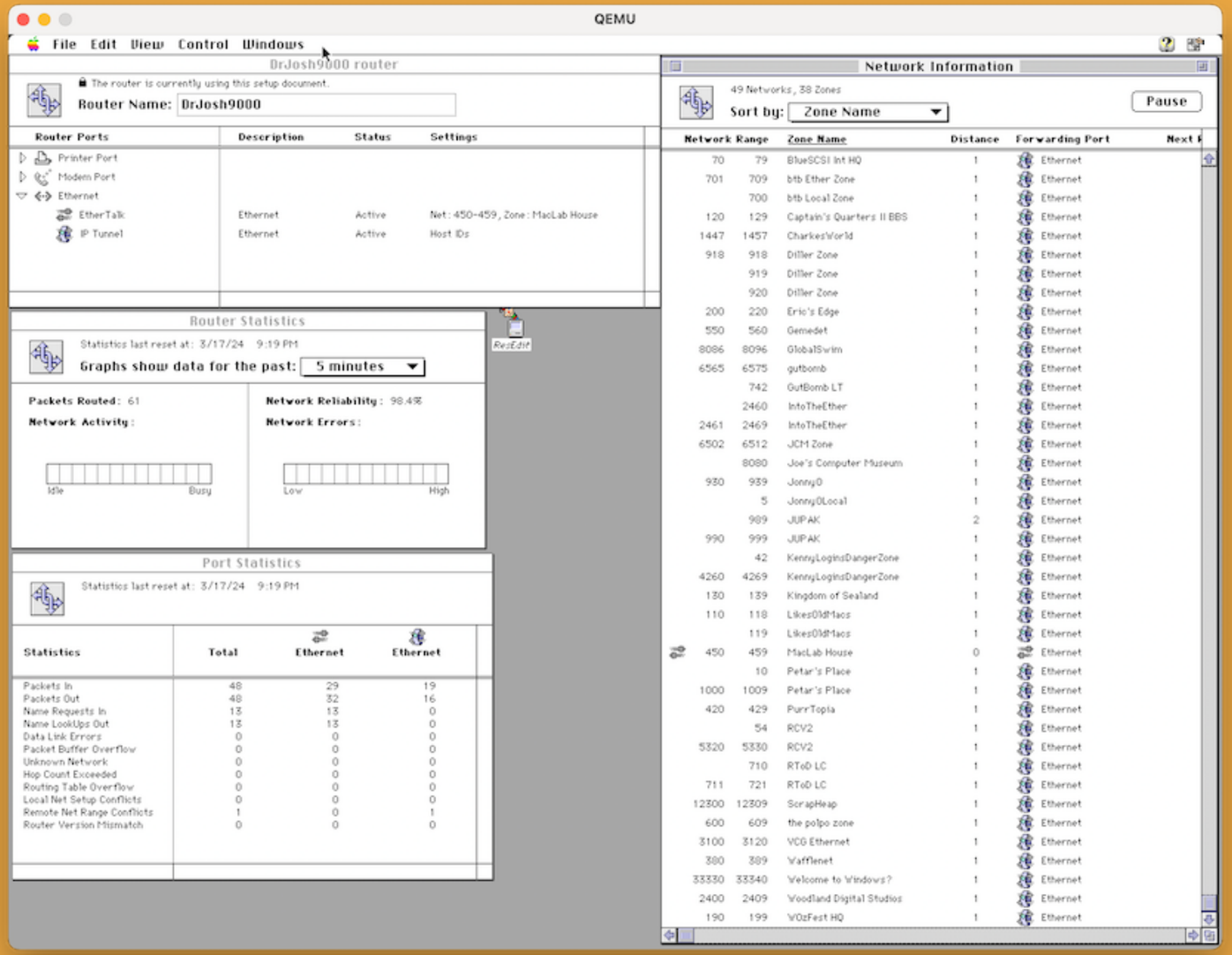


No System 7.1 for Mystic

- Was running Mac OS 8.1
- ✅ 680x0 Macs can only boot from HFS format
- ✅ Internal hard disk is 140 GB
- ❌ Earlier Mac OS only supported disks up to 4 GB
- 😱 This includes Disk Tools disks

QEMU

I guess!?


QEMU
File Edit View Control Windows
DrJosh9000 router
The router is currently using this setup document.
Router Name: DrJosh9000
Router Ports
Description
Status
Settings
Printer Port
Modem Port
Ethernet
EtherTalk
Ethernet
Active
Net: 450-459, Zone: MacLab House
IP Tunnel
Ethernet
Active
Host IDs
Router Statistics
Statistics last reset at: 3/17/24 9:19 PM
Graphs show data for the past: 5 minutes
Packets Routed: 61
Network Activity:
Idle
Busy
Network Reliability: 98.4%
Network Errors:
Low
High
RezEdit
Port Statistics
Statistics last reset at: 3/17/24 9:19 PM
Statistics
Total
Ethernet
Ethernet
Packets In 48 29 19
Packets Out 48 32 16
Name Requests In 13 13 0
Name LookUps Out 13 13 0
Data Link Errors 0 0 0
Packet Buffer Overflow 0 0 0
Unknown Network 0 0 0
Hop Count Exceeded 0 0 0
Routing Table Overflow 0 0 0
Local Net Setup Conflicts 0 0 0
Remote Net Range Conflicts 1 0 1
Router Version Mismatch 0 0 0
Network Information
49 Networks, 38 Zones
Sort by: Zone Name
Pause
Network Range
Zone Name
Distance
Forwarding Port
Next
70 79 BlueSCSI Int HQ 1 Ethernet
701 709 btb Ether Zone 1 Ethernet
700 btb Local Zone 1 Ethernet
120 129 Captain's Quarters II BBS 1 Ethernet
1447 1457 CharkesWorld 1 Ethernet
918 918 Diller Zone 1 Ethernet
919 Diller Zone 1 Ethernet
920 Diller Zone 1 Ethernet
200 220 Eric's Edge 1 Ethernet
550 560 Gemedet 1 Ethernet
8086 8096 GlobalSwim 1 Ethernet
6565 6575 gutbomb 1 Ethernet
742 GutBomb LT 1 Ethernet
2460 IntoTheEther 1 Ethernet
2461 2469 IntoTheEther 1 Ethernet
6502 6512 JCM Zone 1 Ethernet
8080 Joe's Computer Museum 1 Ethernet
930 939 Jonny0 1 Ethernet
5 Jonny0Local 1 Ethernet
989 JUPAK 2 Ethernet
990 999 JUPAK 1 Ethernet
42 KennyLoginsDangerZone 1 Ethernet
4260 4269 KennyLoginsDangerZone 1 Ethernet
130 139 Kingdom of Sealand 1 Ethernet
110 118 Likes0ldMacs 1 Ethernet
119 Likes0ldMacs 1 Ethernet
450 459 MacLab House 0 Ethernet
10 Petar's Place 1 Ethernet
1000 1009 Petar's Place 1 Ethernet
420 429 PurrTopia 1 Ethernet
54 RCV2 1 Ethernet
5320 5330 RCV2 1 Ethernet
710 RToD LC 1 Ethernet
711 721 RToD LC 1 Ethernet
12300 12309 ScrapHeap 1 Ethernet
600 609 the polpo zone 1 Ethernet
3100 3120 VCG Ethernet 1 Ethernet
380 389 Vafflenet 1 Ethernet
33330 33340 Welcome to Windows? 1 Ethernet
2400 2409 Woodland Digital Studios 1 Ethernet
190 199 WOzFest HQ 1 Ethernet

DrJosh9000 router

The router is currently using this setup document.

Router Name: DrJosh9000

Router Ports	Description	Status	Settings
Printer Port			
Modem Port			
Ethernet			
EtherTalk	Ethernet	Active	Net : 450-459 , Zone : MacLab House
IP Tunnel	Ethernet	Active	Host IDs

Network Information

49 Networks, 38 Zones

Sort by: Zone Name

Pause

Network Range		Zone Name	Distance	Forwarding Port	Next F
70	79	BlueSCSI Int HQ	1	Ethernet	
701	709	btb Ether Zone	1	Ethernet	
	700	btb Local Zone	1	Ethernet	
120	129	Captain's Quarters II BBS	1	Ethernet	
1447	1457	CharkesWorld	1	Ethernet	
918	918	Diller Zone	1	Ethernet	
	919	Diller Zone	1	Ethernet	
	920	Diller Zone	1	Ethernet	
200	220	Eric's Edge	1	Ethernet	
550	560	Gemedet	1	Ethernet	
8086	8096	GlobalSwim	1	Ethernet	
6565	6575	gutbomb	1	Ethernet	

Port Statistics

Statistics last reset at: 3/17/24 9:19 PM

Statistics	Total	Ethernet	Ethernet
Packets In	48	29	19
Packets Out	48	32	16
Name Requests In	13	13	0
Name LookUps Out	13	13	0
Data Link Errors	0	0	0
Packet Buffer Overflow	0	0	0
Unknown Network	0	0	0
Hop Count Exceeded	0	0	0
Routing Table Overflow	0	0	0
Local Net Setup Conflicts	0	0	0
Remote Net Range Conflicts	1	0	1
Router Version Mismatch	0	0	0

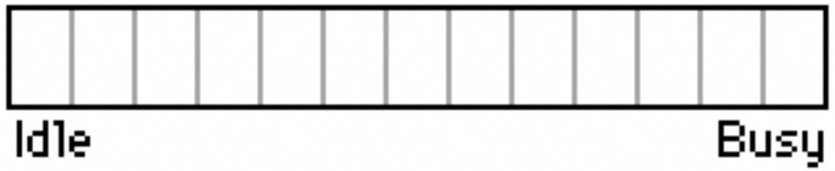
Router Statistics

Statistics last reset at: 3/17/24 9:19 PM

Graphs show data for the past: 5 minutes

Packets Routed: 61

Network Activity:



Network Reliability: 98.4%

Network Errors:

Recommendation for devs

Software should be *observable*

Find a way to diagram the internal state of your app!

Is it 100% safe and secure??

Actually, **NO -** probably not! ¯_(ツ)_/¯ The only way to participate in this is to share your IP address on a spreadsheet and open a port for your router to allow these connections.

You'll also need a Google account so you can request access to the spreadsheet that contains the other networks to connect to. We can't change this, it is what it is. Sorry!

Strosnider, J., McAdams, R., Steve Mac84 (2024) http://marchintosh.com/globaltalk.html

Is Apple Internet Router secure?

Probably not

Why am I not totally pwnd right now?

(Obscurity)

So I decided to write my own "AIR" in Go

jrouter

✨ Josh ✨

@DrJosh9000

10d

Better write some talk slides, hey #DevWorld #GlobalTalk

The GlobalTalk Network

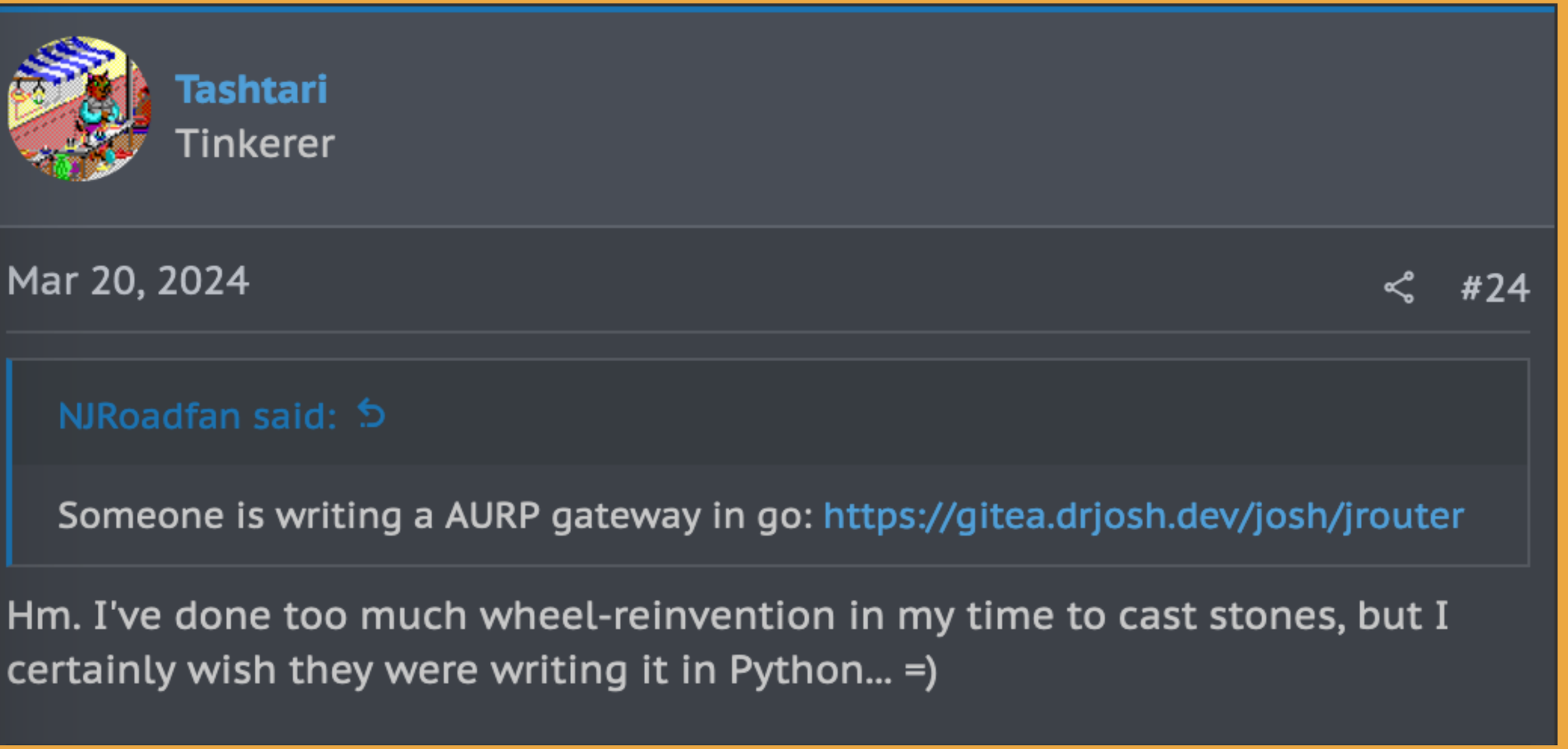
/dev/world/2024, Melbourne

Josh Deprez

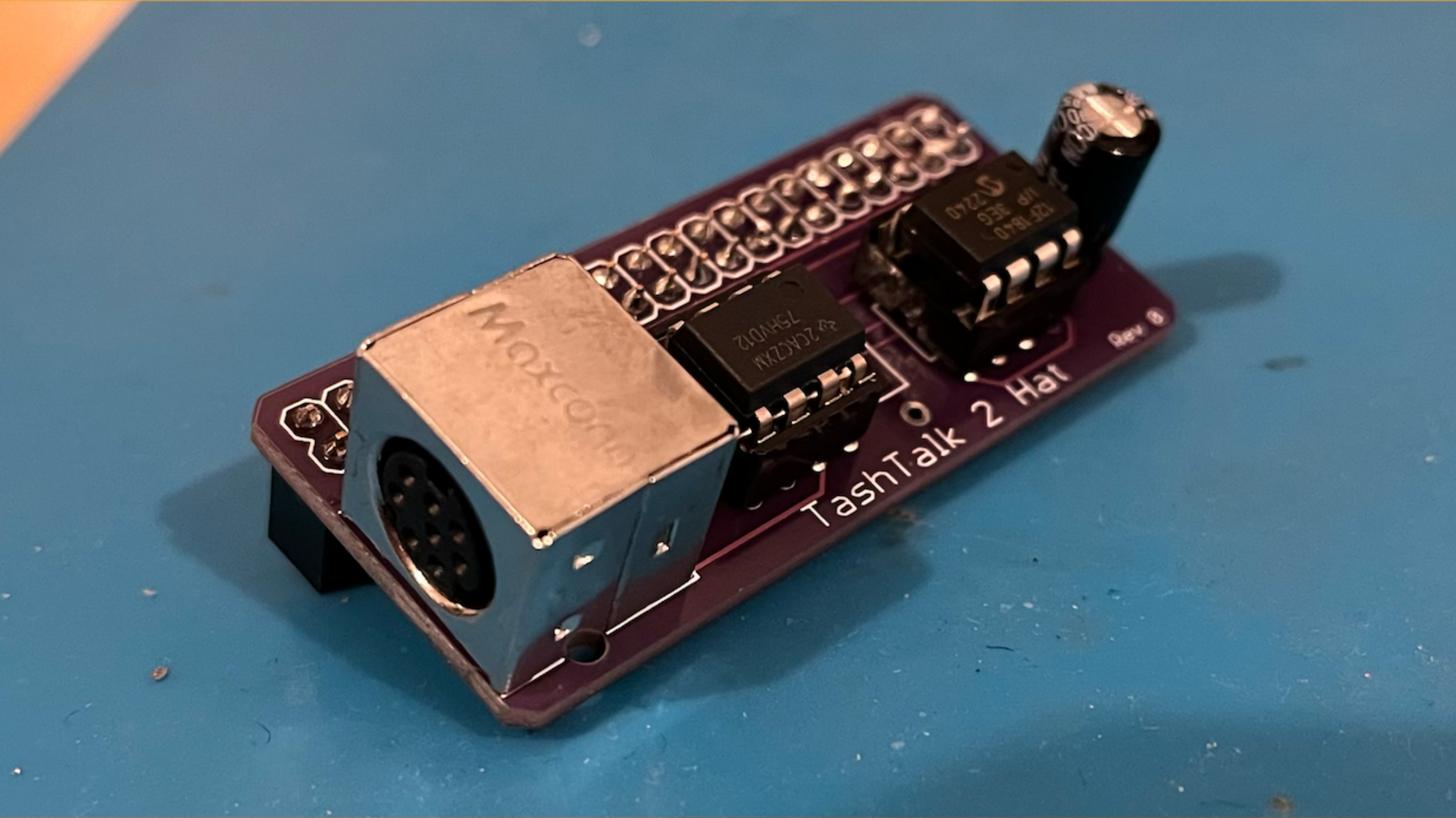
europlus

@europlus@europlus.zone MUTUAL

@DrJosh9000 @ctb31



https://tinkerdifferent.com/threads/globaltalk-global-appletalk-network-for-marchintosh-2024-and-beyond.3392/page-2#post-29150


Moxcon
TashTalk 2 Hat
Rev B

jrouter

- Uses libpcap for raw Ethernet access
- Acts like an AppleTalk router
- Connects to Apple Internet Routers
- Works! (barely)

Where's the diagram? 😡

foreign network system. The headers required by a foreign-network protocol always precede an AppleTalk data packet sent across a multipoint tunnel. A domain header generally immediately precedes the AppleTalk data packet. Figure 2-9 shows the format of an AppleTalk data packet preceded by a domain header.

  <<Figure 2-9 AppleTalk data-packet format with a domain header>>

A domain header consists of the following fields:

Destination DI: The length of the destination DI field in bytes depends on the type of DI.

Oppenheimer, A.B. (1993) *Appletalk Update-Based Routing Protocol: Enhanced Appletalk Routing* https://datatracker.ietf.org/doc/html/rfc1504

Sigh 😔

```
Format of This RFC Document

   The text of this document has been quickly prepared for RFC format.
   However, the art is more complex and is not yet ready in this format.
   We plan to incorporate the art in the future. Consult the official
   APDA document, as indicated below, for the actual art.
```

Oppenheimer, A.B. (1993) *Appletalk Update-Based Routing Protocol: Enhanced Appletalk Routing* https://datatracker.ietf.org/doc/html/rfc1504

✨ Josh ✨
@DrJosh9000

58d

Edit: found by @boredzo
! wiki.preterhuman.net/AppleTalk...

Hey anyone know where I can get the missing diagrams from RFC 1504*? Or Apple's original spec document that it is based on?

(*this one: datatracker.ietf.org/doc/html/...)

#GlobalTalk #VintageApple #MarchIntosh

AppleTalk Update-Based Routing Protocol: Enhanced AppleTalk Routing - Higher Intellect Vintage Wiki
wiki.preterhuman.net

AppleTalk Update-Based Routing Protocol

Enhanced AppleTalk Routing

Apple Computer (1993)

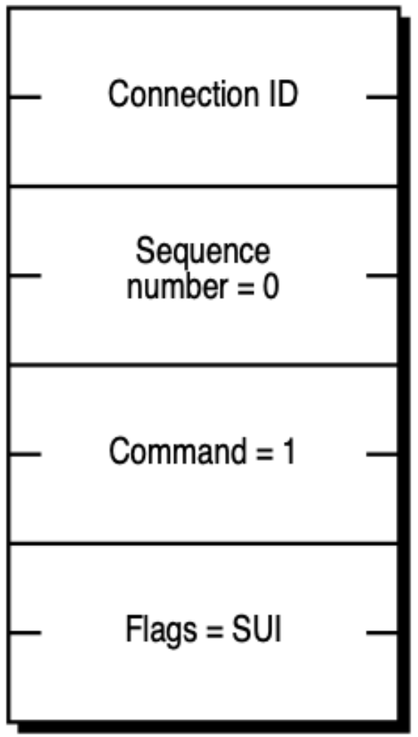


Figure 3-26 RI-Req packet format

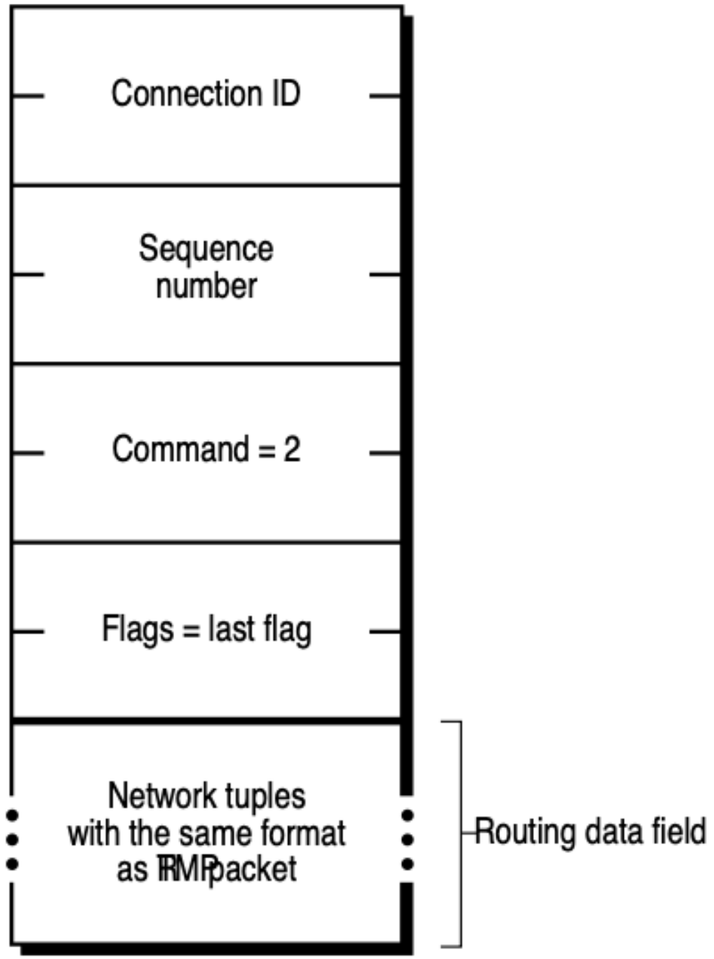


Figure 3-27 RI-Rsp packet format

Apple Computer (1993) ***AppleTalk Update-based Routing Protocol: Enhanced AppleTalk Routing***

AURP

It's like AppleTalk routing but with...

— AppleTalk tunnelled over UDP/IP (port 387)
— ...between Apple Internet Routers...
— ...that share routing data...
— ...using a new protocol that replaces RTMP and ZIP

Data sender ≠ packet sender

Data receiver ≠ packet receiver

AURP was the easy part

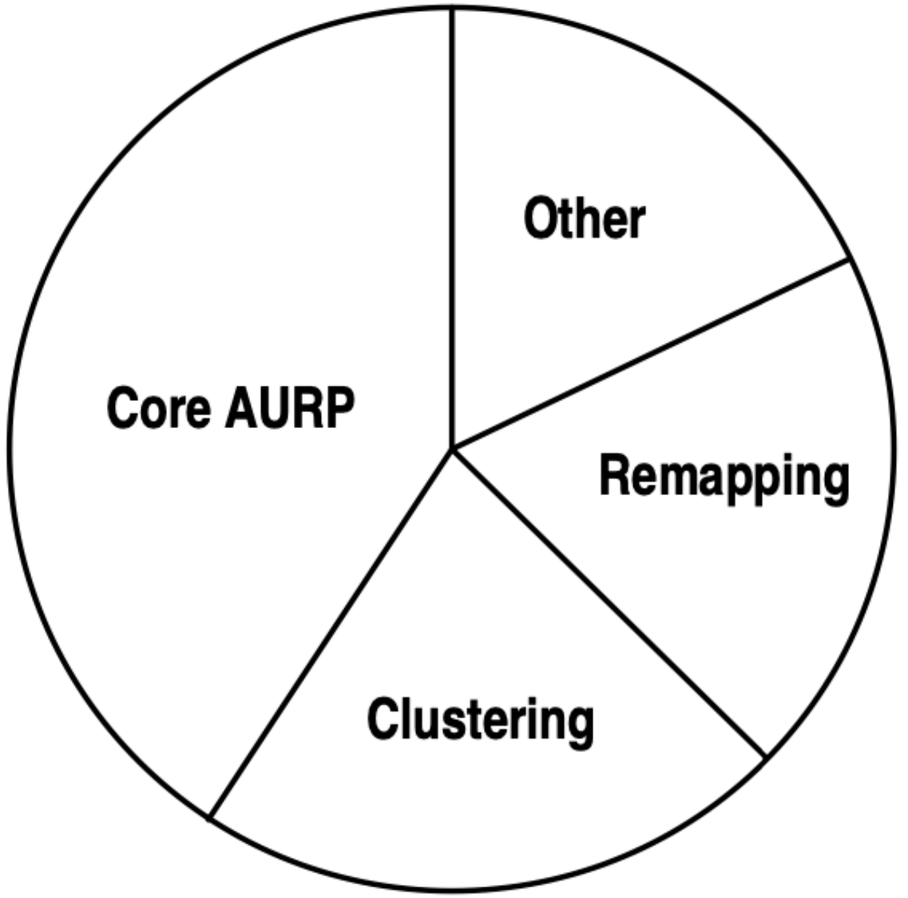
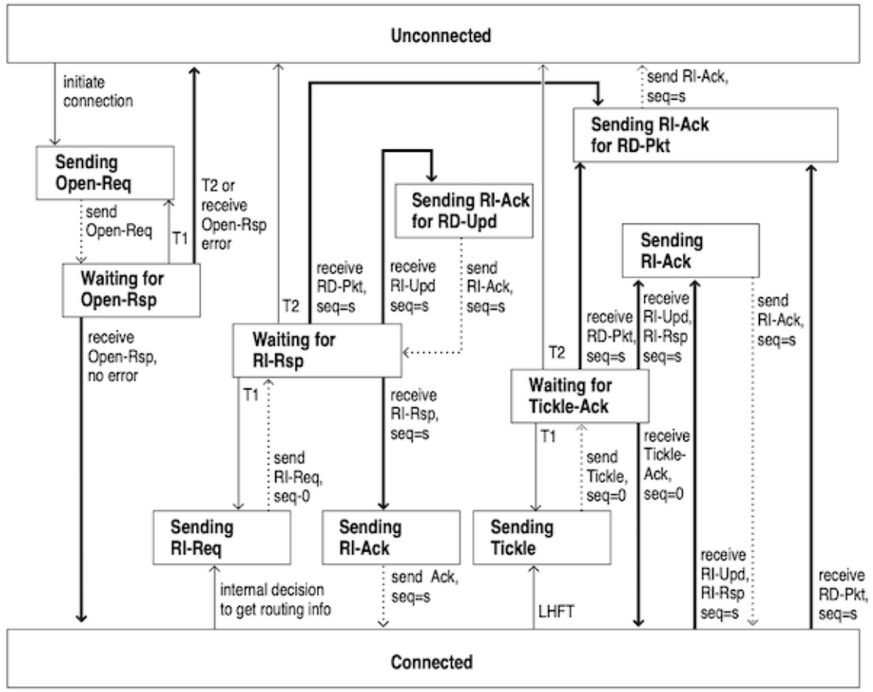


Figure A-3 Implementation effort for AURP

Apple Computer (1993) ***AppleTalk Update-based Routing Protocol: Enhanced AppleTalk Routing***

State diagrams

Figure A-1 shows the state diagram for the AURP data receiver.



⟵ Internally generated event

⟵ Receive packet event

⟵ Send packet event

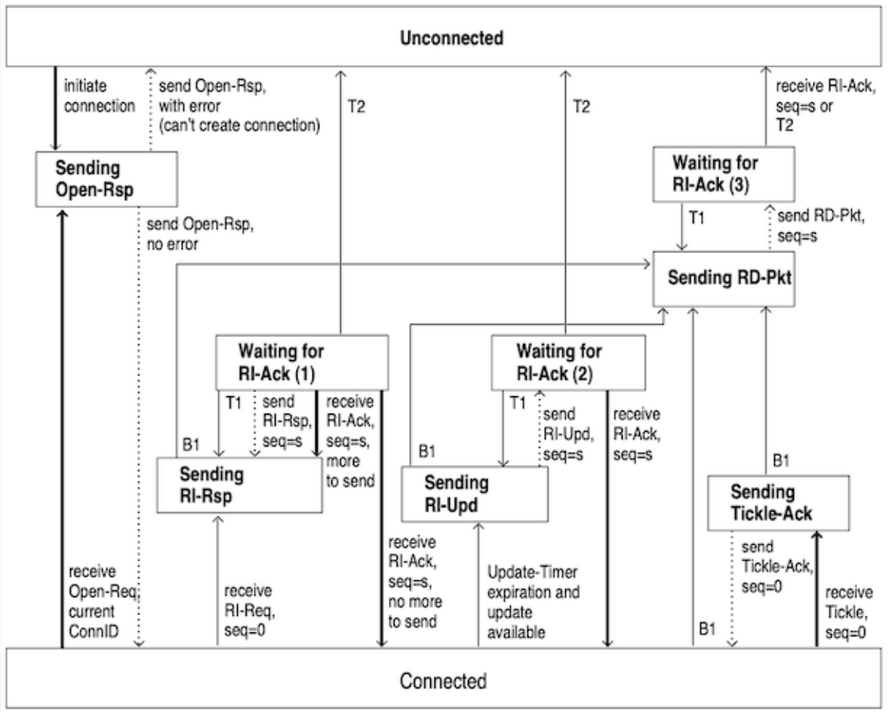
T1 = Send-Retry-Timer expires, retries < max

T2 = Send-Retry-Timer expires, retries = max

LHFT = Last-Heard-From-Timer expires

Figure A-1 AURP data receiver state diagram

Figure A-2 shows the state diagram for the AURP data sender.



⟵ Internally generated event

⟵ Receive packet event

⟵ Send packet event

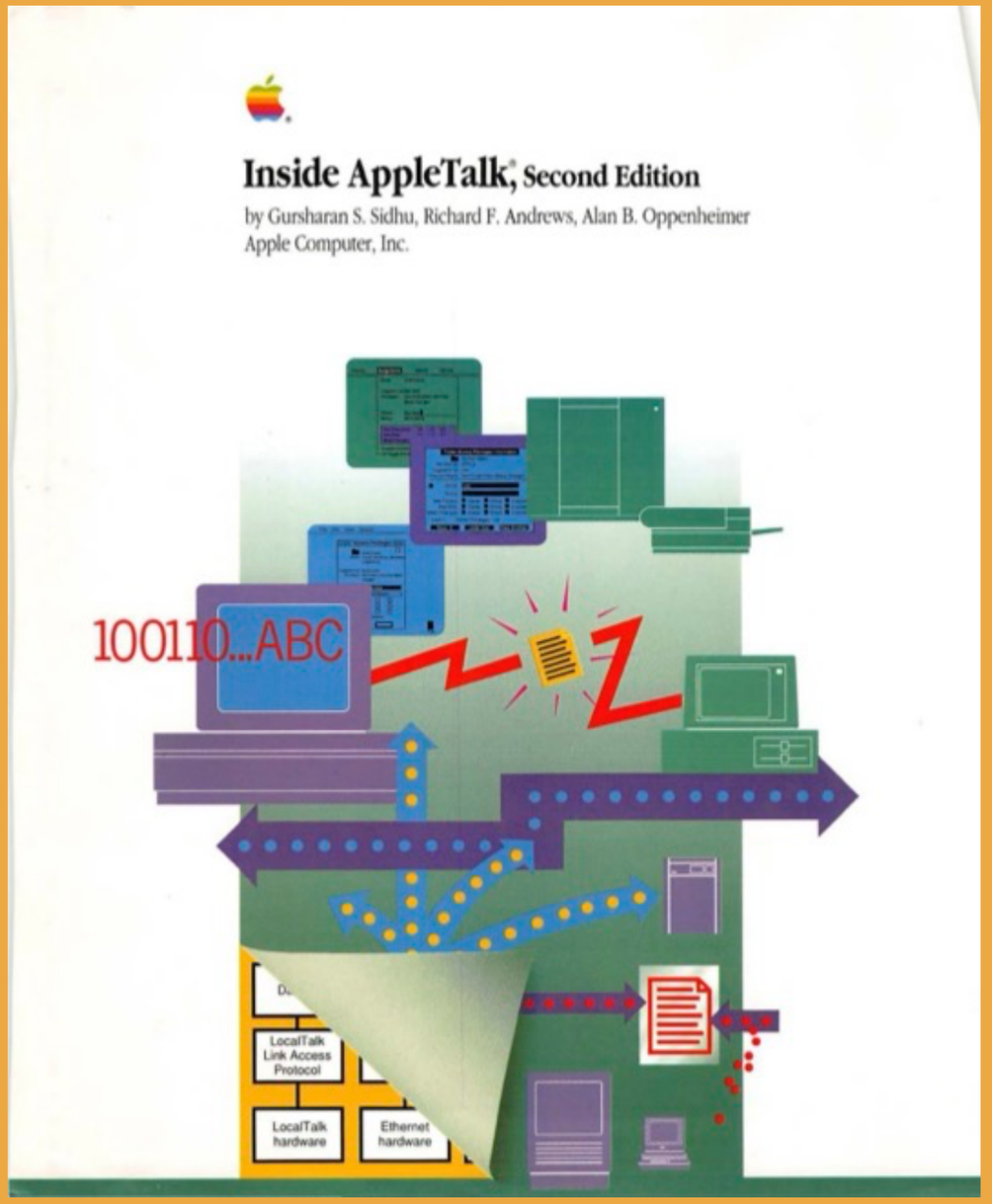
T1 = Send-Retry-Timer expires, retries < max

T2 = Send-Retry-Timer expires, retries = max

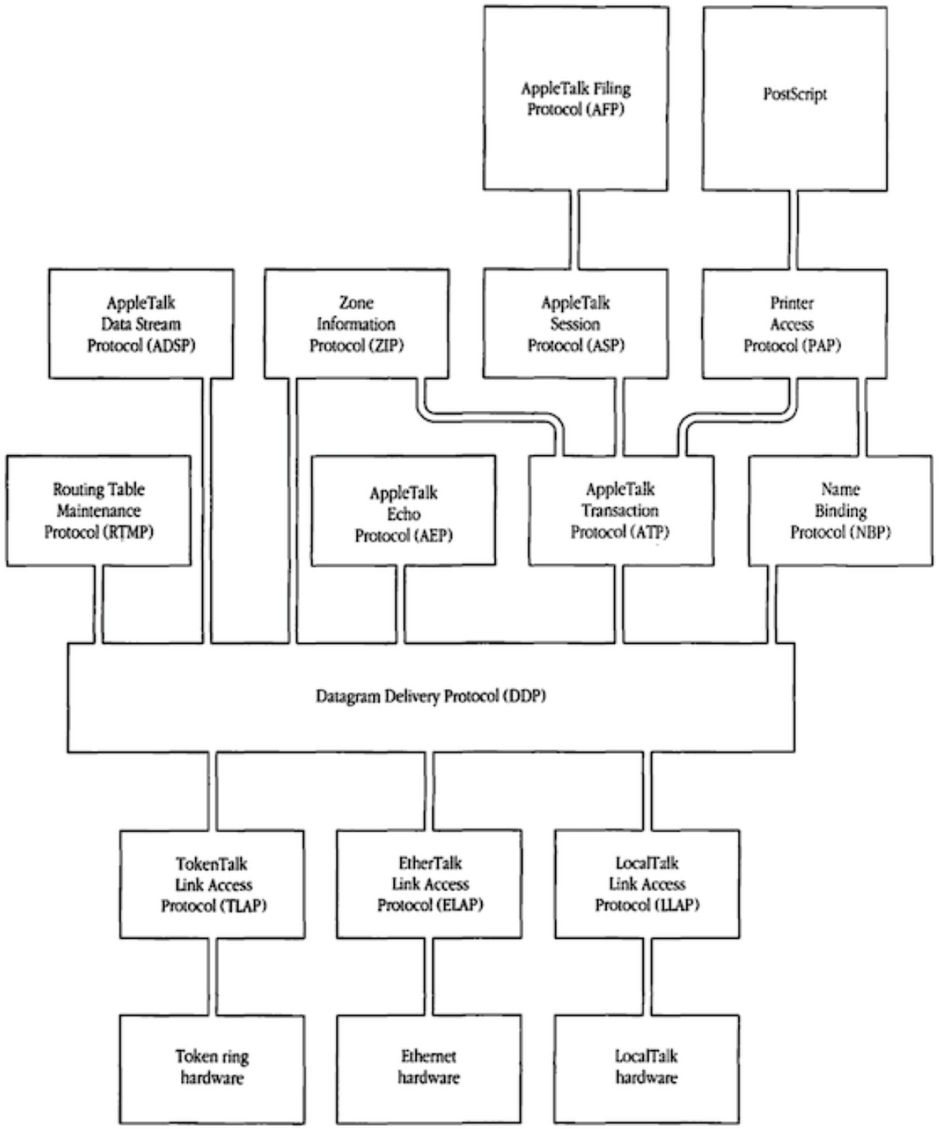
LHFT = Last-Heard-From-Timer expires

Figure A-2 AURP data sender state diagram

Apple Computer (1993) *AppleTalk Update-based Routing Protocol: Enhanced AppleTalk Routing*



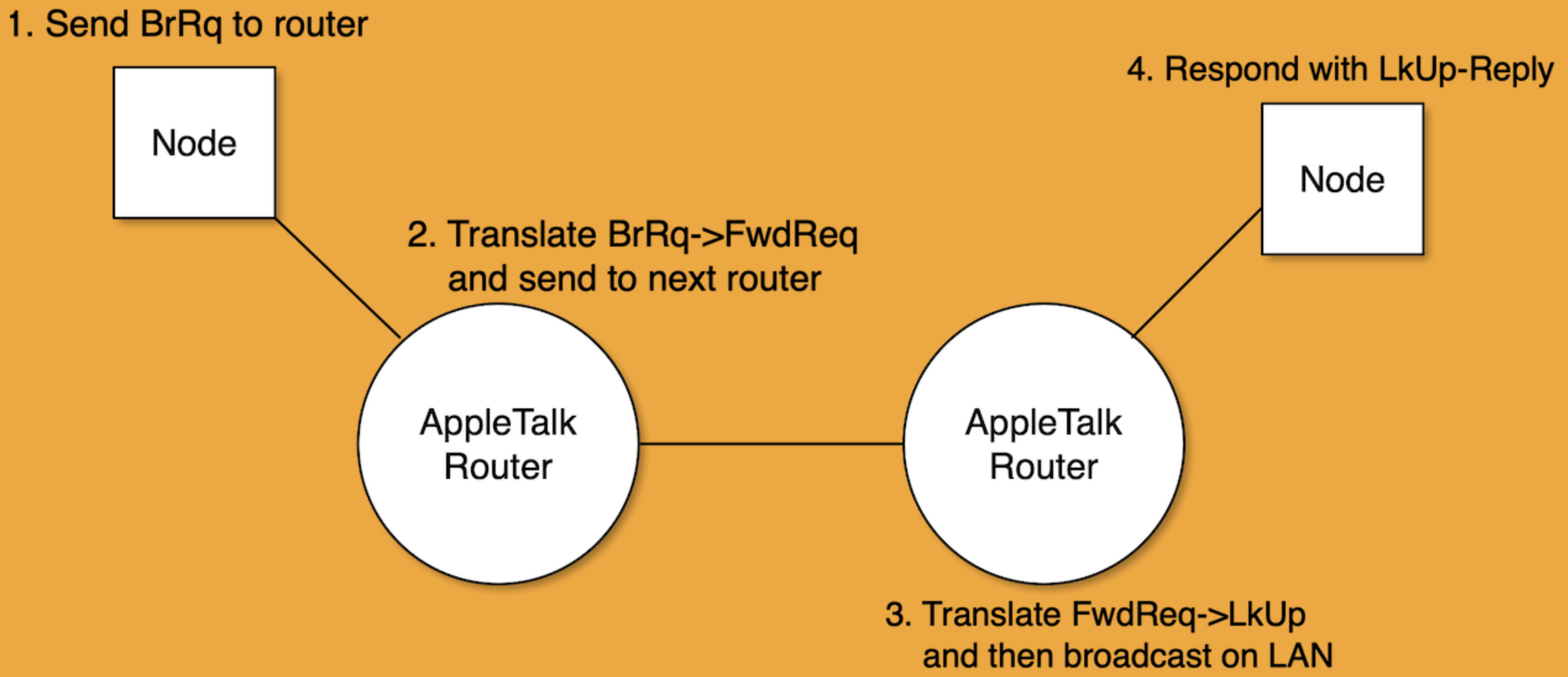
■ **Figure I-7** AppleTalk protocol architecture

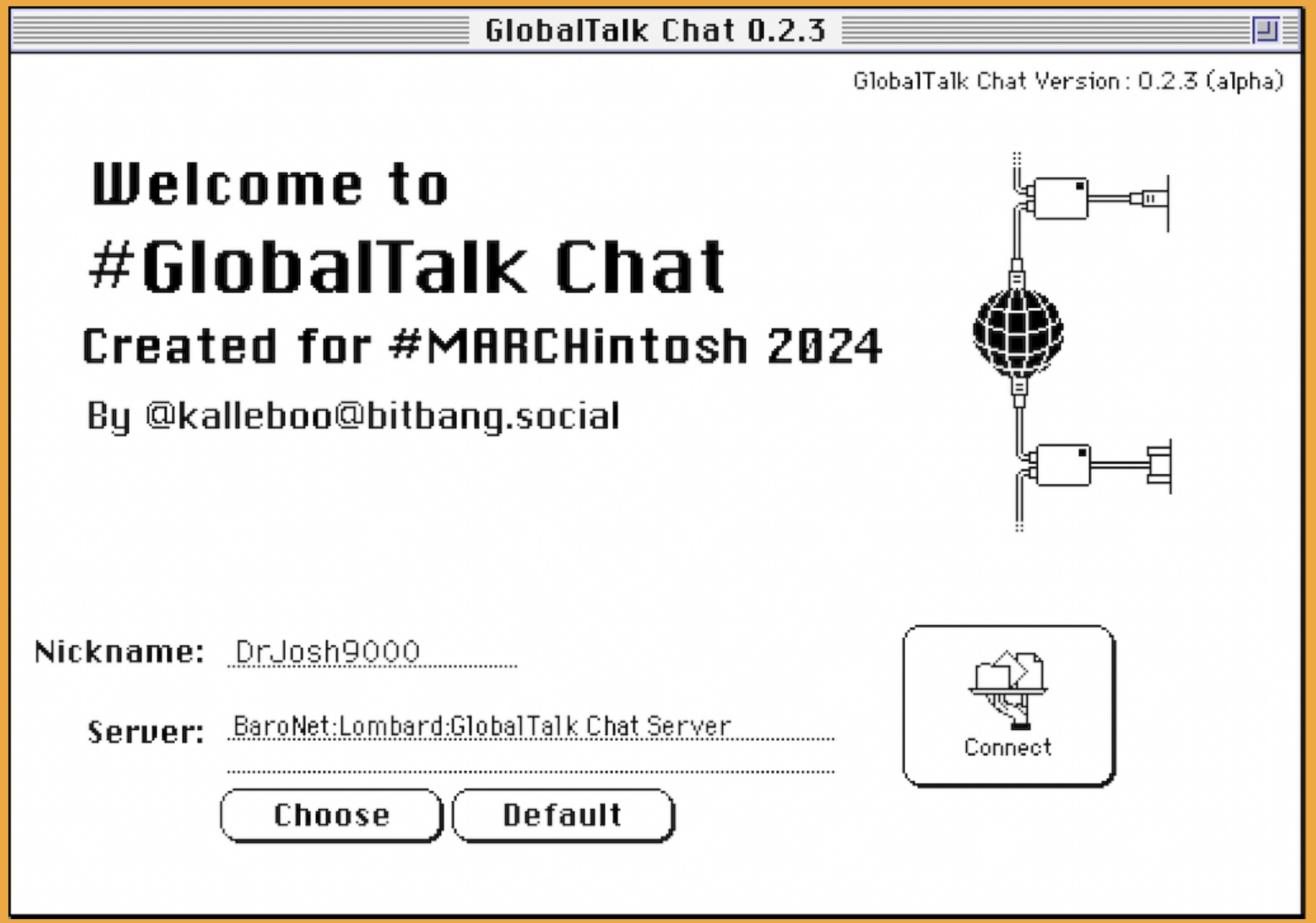


```
CkSum := 0 ;

FOR each datagram byte starting with the byte immediately following the
Checksum field

REPEAT the following algorithm:
        CkSum := CkSum + byte; (unsigned addition)
        Rotate CkSum left one bit, rotating the most significant bit into the
                        least significant bit;

IF, at the end, CkSum = 0 THEN
        CkSum := $FFFF (all ones).
```

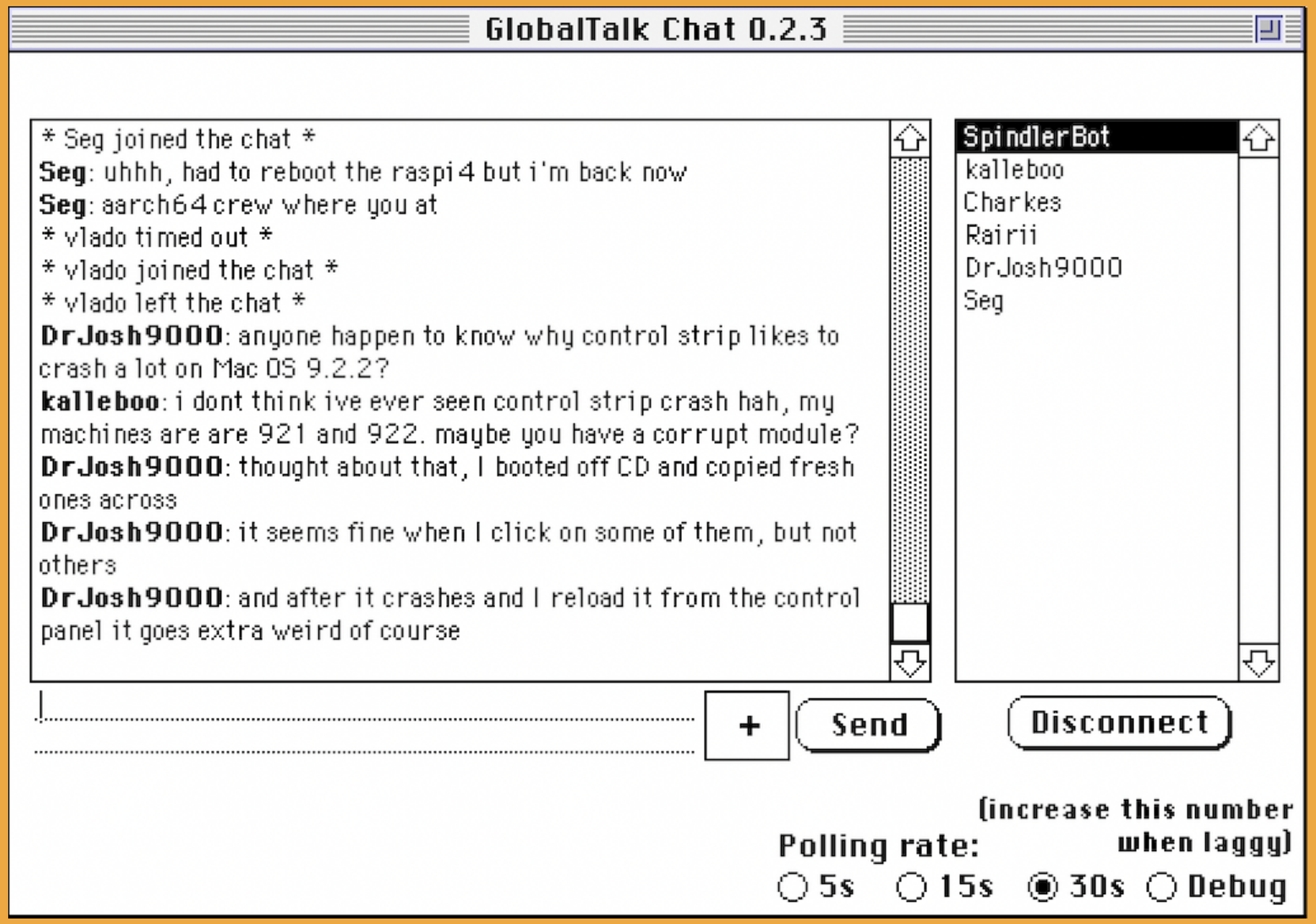
Reception of a datagram with CkSum equal to 0 implies that a checksum is not performed.

Sidhu G.S., et al (1990) *Inside AppleTalk, Second Edition*, Addison-Wesley

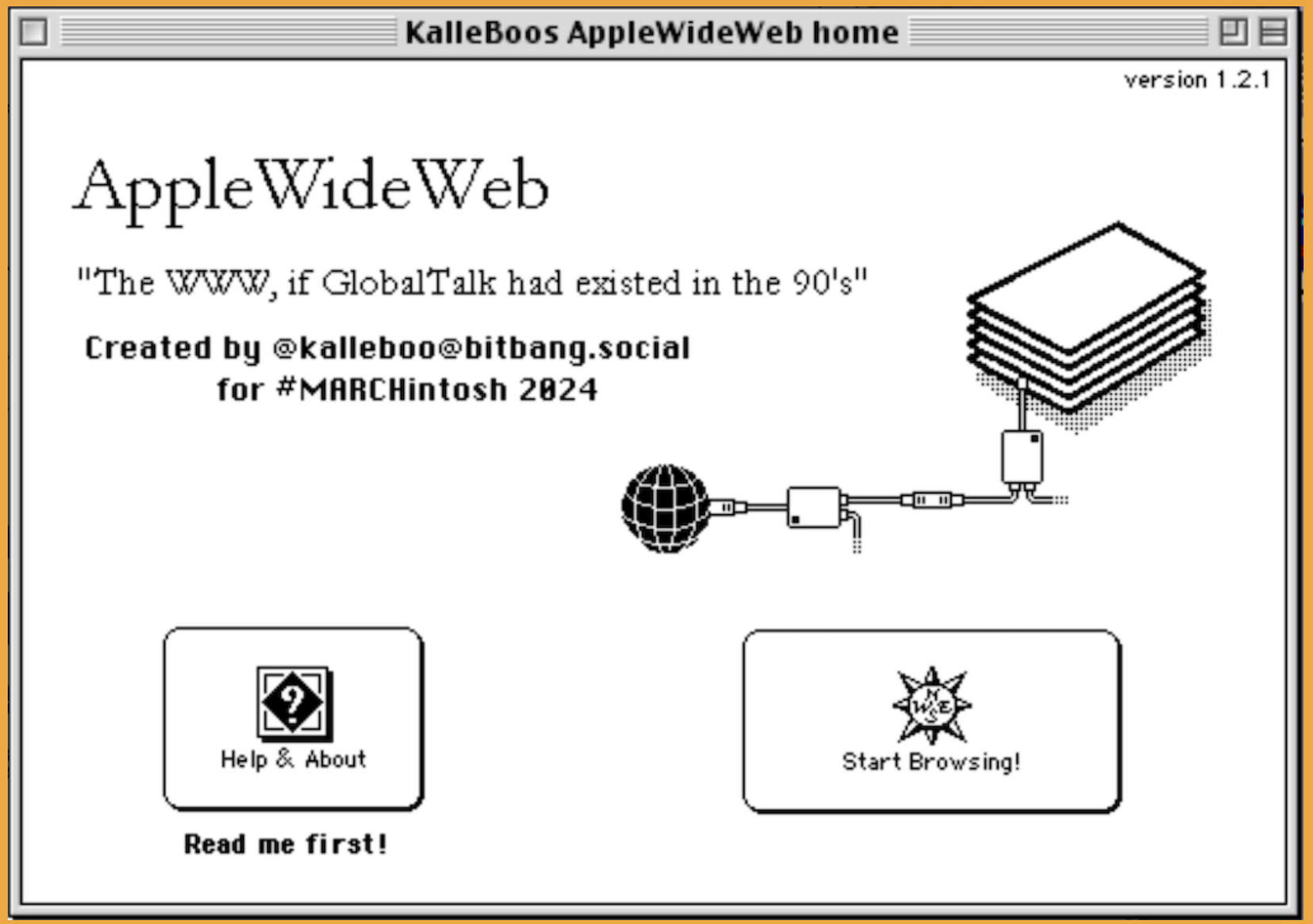

1. Send BrRq to router
Node
2. Translate BrRq->FwdReq
and send to next router
AppleTalk
Router
AppleTalk
Router
3. Translate FwdReq->LkUp
and then broadcast on LAN
4. Respond with LkUp-Reply
Node



@kalleboo@bitbang.social (2024) *#GlobalTalk Chat* version 0.2.3 (alpha)

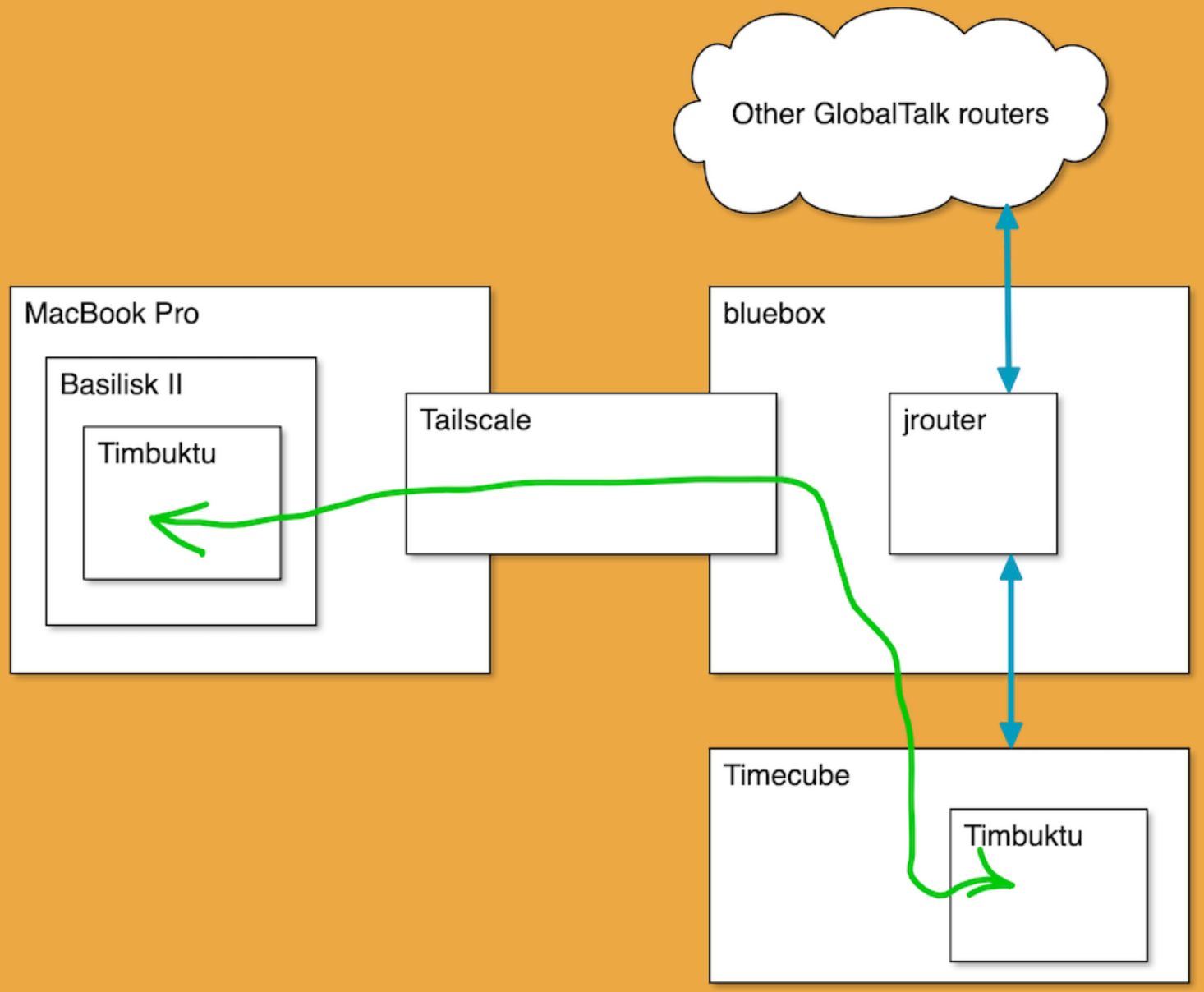


@kalleboo@bitbang.social (2024) #*GlobalTalk Chat* version 0.2.3 (alpha)



@kalleboo@bitbang.social (2024) *AppleWideWeb* version 1.2.1

Demo time


Other GlobalTalk routers
MacBook Pro
Basilisk II
Timbuktu
Tailscale
bluebox
jrouter
Timecube
Timbuktu

Thanks!

Fediverse: @DrJosh9000@cloudisland.nz

jrouter: gitea.drjosh.dev/josh/jrouter

This talk: gitea.drjosh.dev/josh/devworld2024

Mac84 🍏
@mac84tv@bitbang.social

My PC is crashing the #GlobalTalk party! 🤣