

The Internet: what it looks like, how it works, and how it is abused

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What Does the Internet Look Like?



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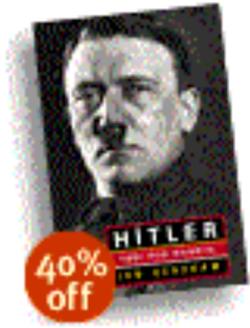
Thursday, January 28, 1999

Text Only

Welcome back, Bill Cheswick. Check out your book recommendations. (If you're not Bill Cheswick, click here.)

What We're Reading

Crowds and Power



The supreme ogre of our waning century, Adolf Hitler has already been the subject of innumerable biographies. None, however, can quite match the magisterial reach of Ian Kershaw's Hitler: 1888-1936: Hubris. In this first installment of a two-volume set, the author takes a fresh look at the dictator's youth--and brilliantly places him in the context of German and Austrian culture.

Check out the Amazon.com Hot 100 and our Bestsellers of 1998.

Today in Music

- 1. Live At Luther College Dave Matthews Band, Tim Reynolds
2. The Miseducation Of Lauryn Hill Lauryn Hill
3. Surfacing [ENHANCED CD] Sarah McLachlan

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Microsoft Visual Basic



Fox Sports Puts Microsoft Technology in the Game

Thanks to a custom application written in Microsoft Visual Basic that runs on typical game days, fans of football on Fox Sports are never in the dark about the latest sports scores. As you get ready for Super Bowl Sunday, go behind the scenes to learn how this piece of television magic works.

[Start-up Program Helps High-Tech Companies Get Up and Running](#)

[Microsoft, 3Com Announce Alliance for Deployment of 'Converged Networks'](#)

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Microsoft and the freedom to



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Business

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Games

Local

Personals, Movies, Events...

Netscape

Products, Y2K, Developers...

News

Impeachment, Tech, Weather...

Personal Finance Beta

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Real Estate

Find a House, Remodel...

Shopping

Thursday - Jan. 28, 1999

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Quote

Symbol Name

ABCNEWS.com

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Greenspan Against Social Security Plan
Yahoo! BuysGeocities

Internet 101

At the heart of the Internet

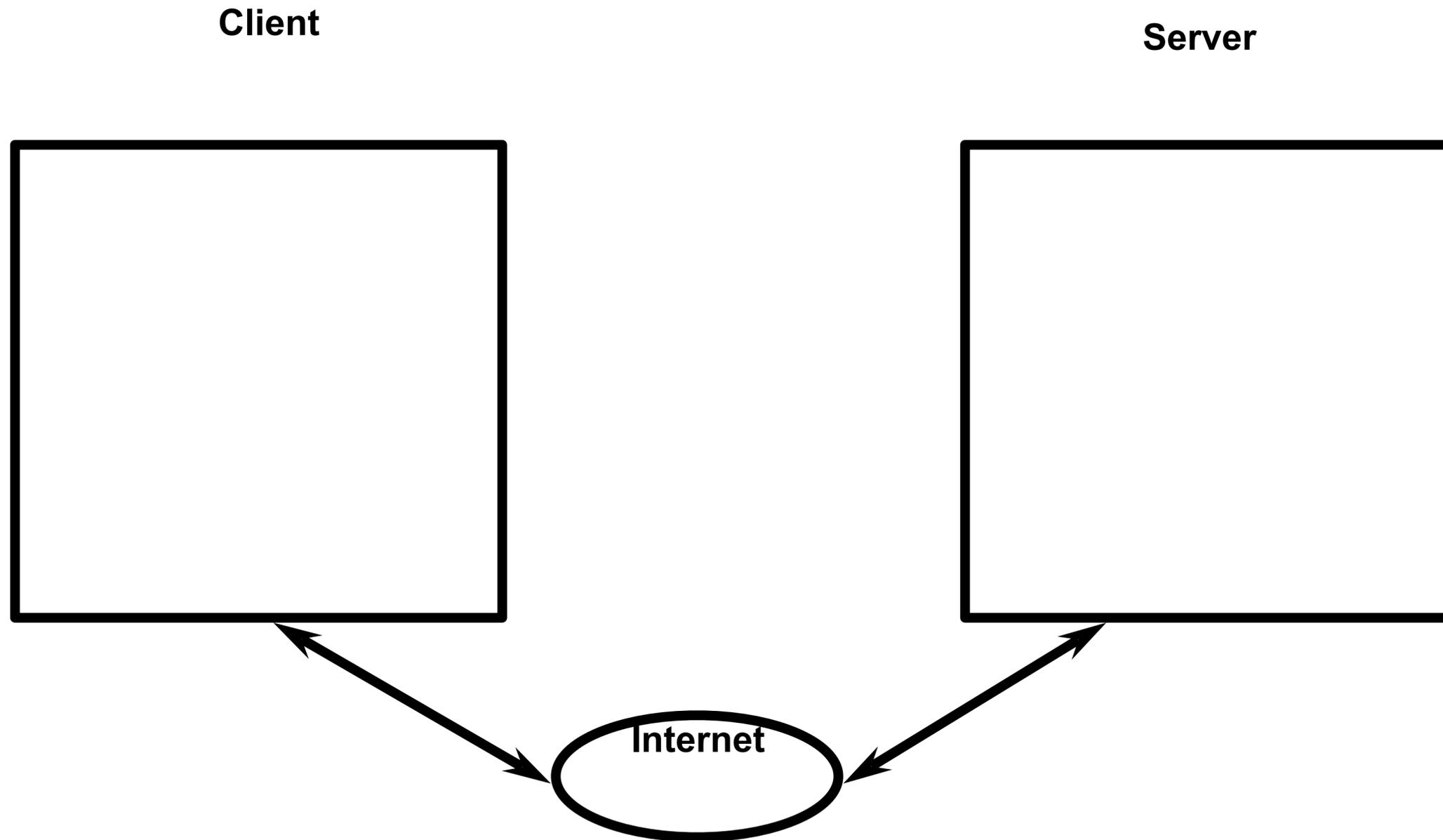
- TCP/IP
- Local area networks
- Wide area communications
 - modems
 - hard-wired lines
- Routers

Clients and Servers

- Clients initiate the call
- Clients are programs
 - web browsers
 - mail readers
- The client's name is usually unimportant

Some Internet Basics

Internet communication

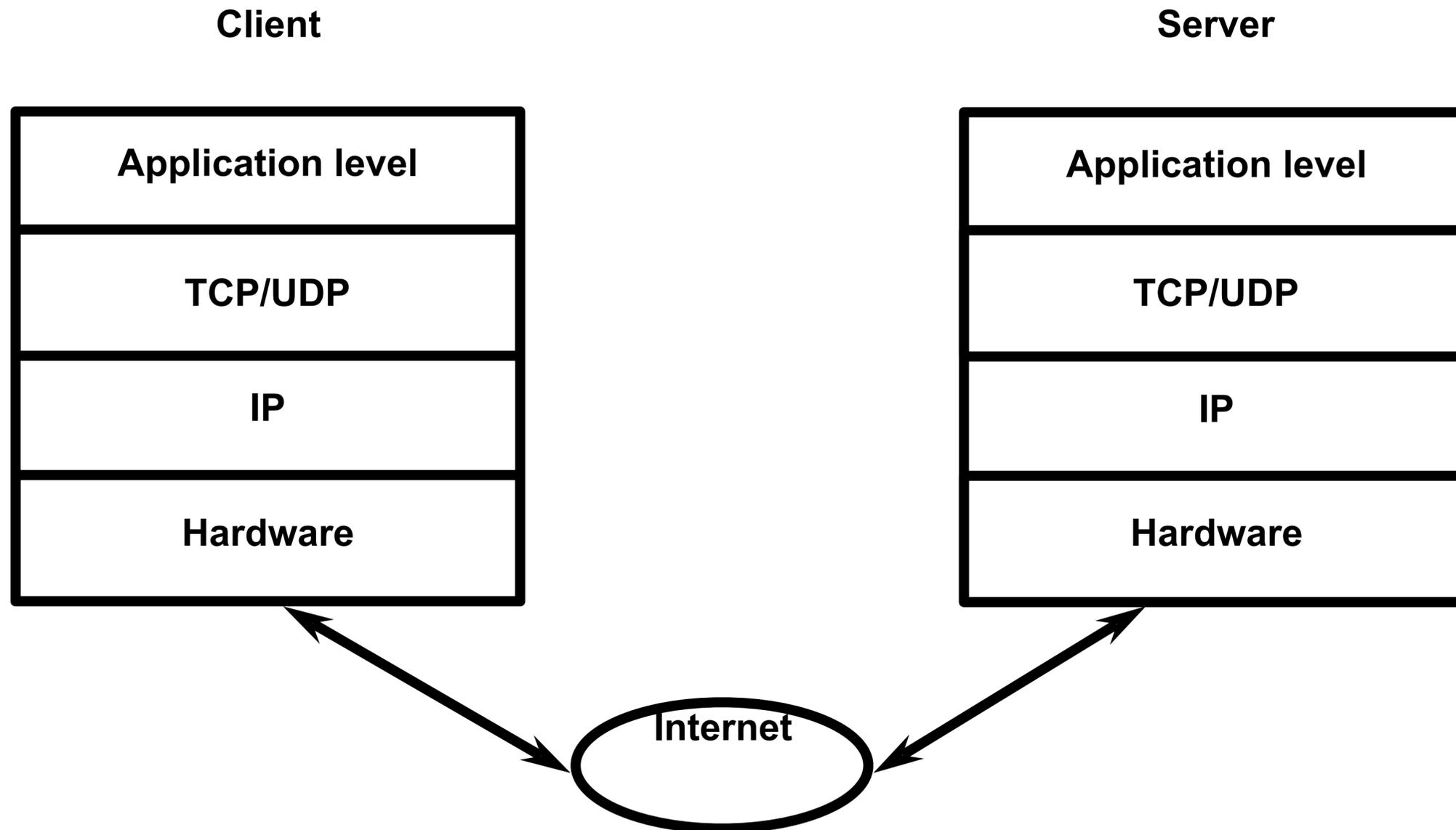


TCP/IP

- A set of protocols, standards, and agreements
- Started by the government (DARPA research)
- A “priesthood” of geeks polished it up
- Running by 1982

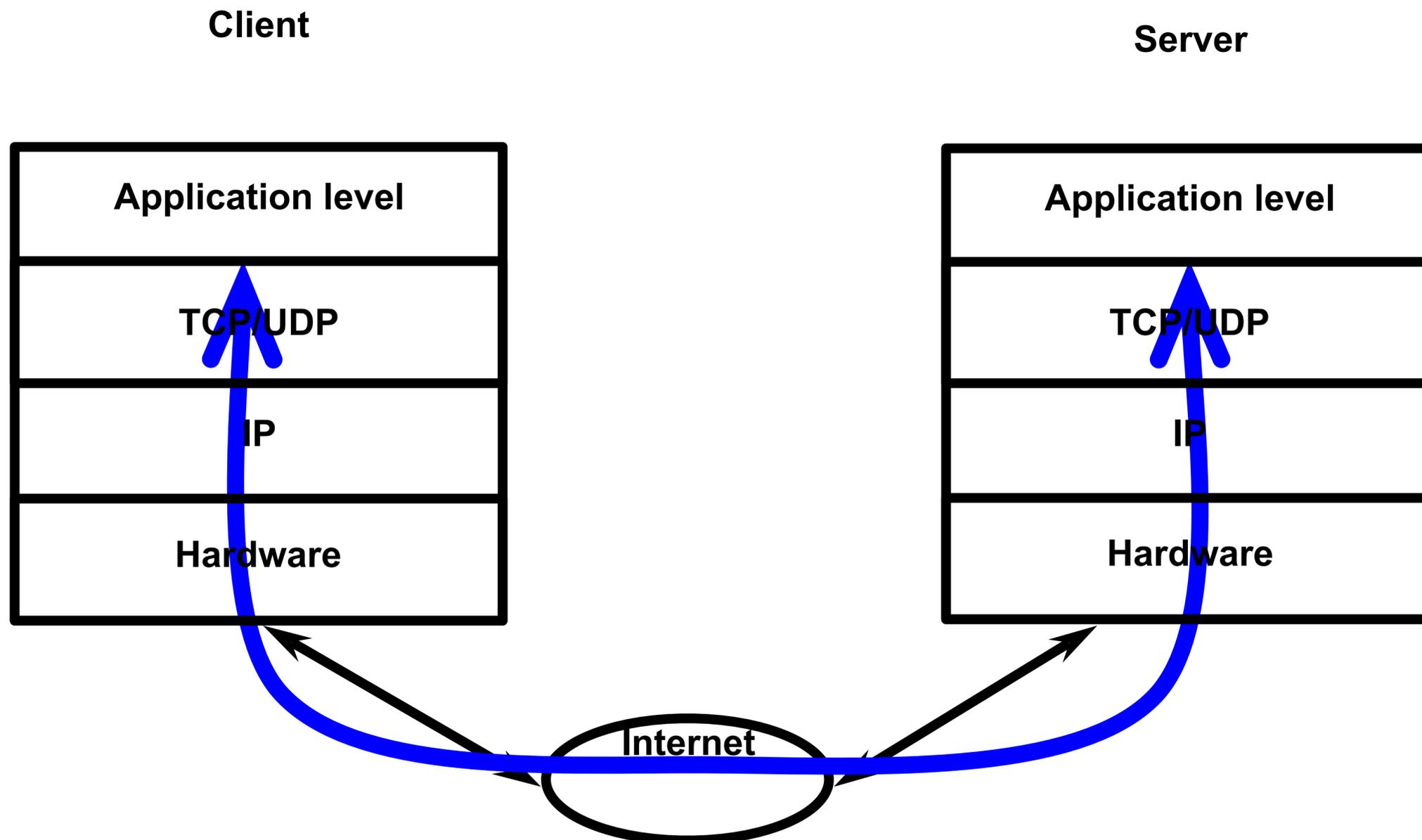
Some Internet Basics

Internet communication



Some Internet Basics

Internet communication



IP Packets

- All Internet traffic consists of packets
- A packet is roughly 64 to 1,500 characters long
- Each packet has a source and destination IP address, and a payload

Sample IP Packet (simplified)

Typical MTU: 1500 bytes



IP addresses

- IPv4: 4 “octets” (32 bits), 3,758,096,384 IP addresses
 - 204.178.16.36
- May be permanently assigned to a host, or dynamically assigned when the host is booted
- IPv6: 128 bits, 3.4×10^{38} , or 5×10^{14} moles!
 - 2601:647:4781:4100::13

Sample IP Packet

Source
Destination
Payload

207.99.106.131
209.185.108.158
“French poetry of Zambian origin”

Sample IP Packets

207.99.106.131

209.185.108.158

**“French poetry
of Zambian
origin”**

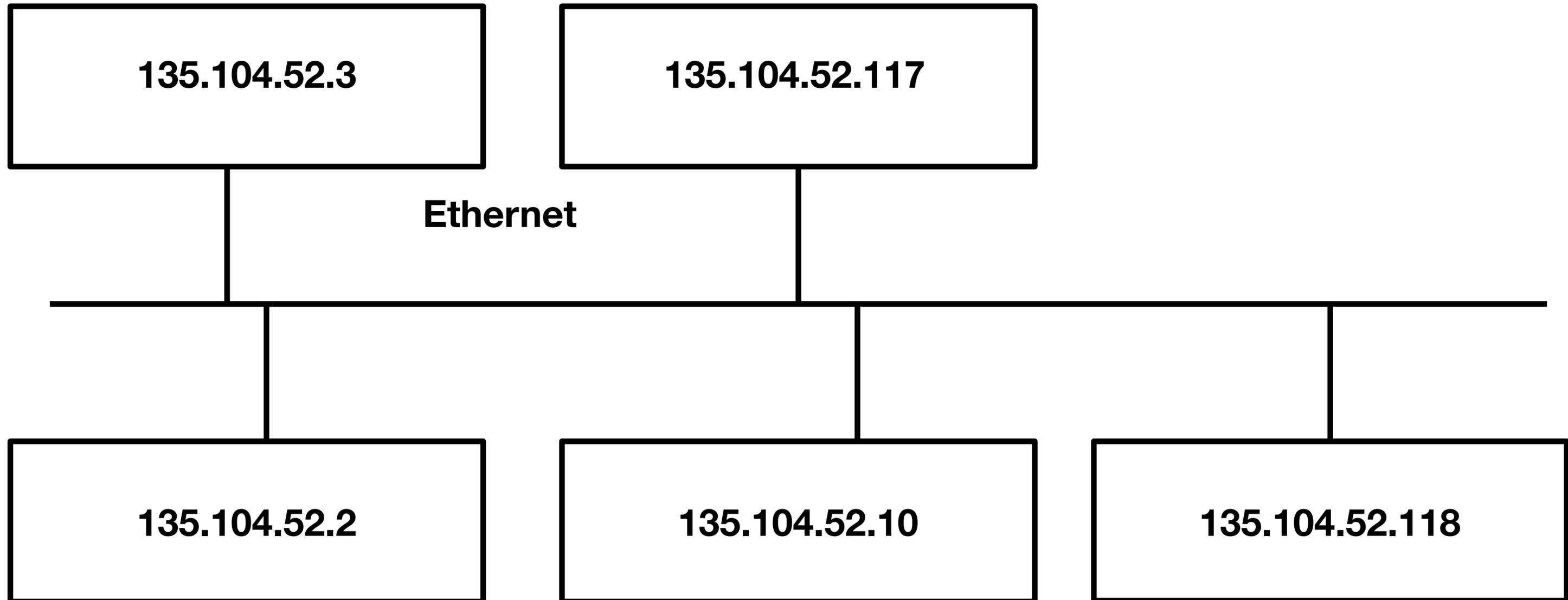
209.185.108.158

207.99.106.131

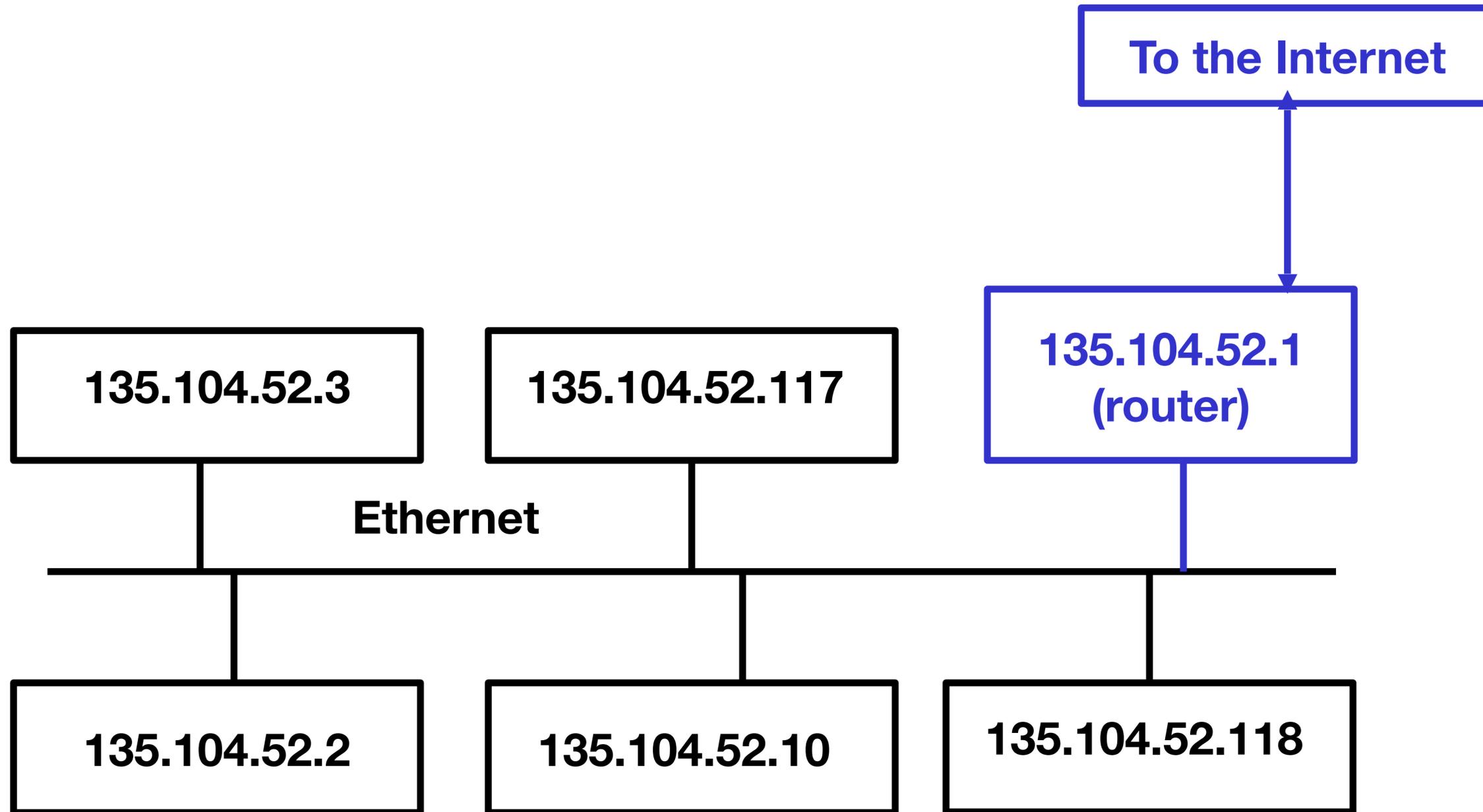
**“47,86 matches
found...
Match 1: ...”**

Network Hardware

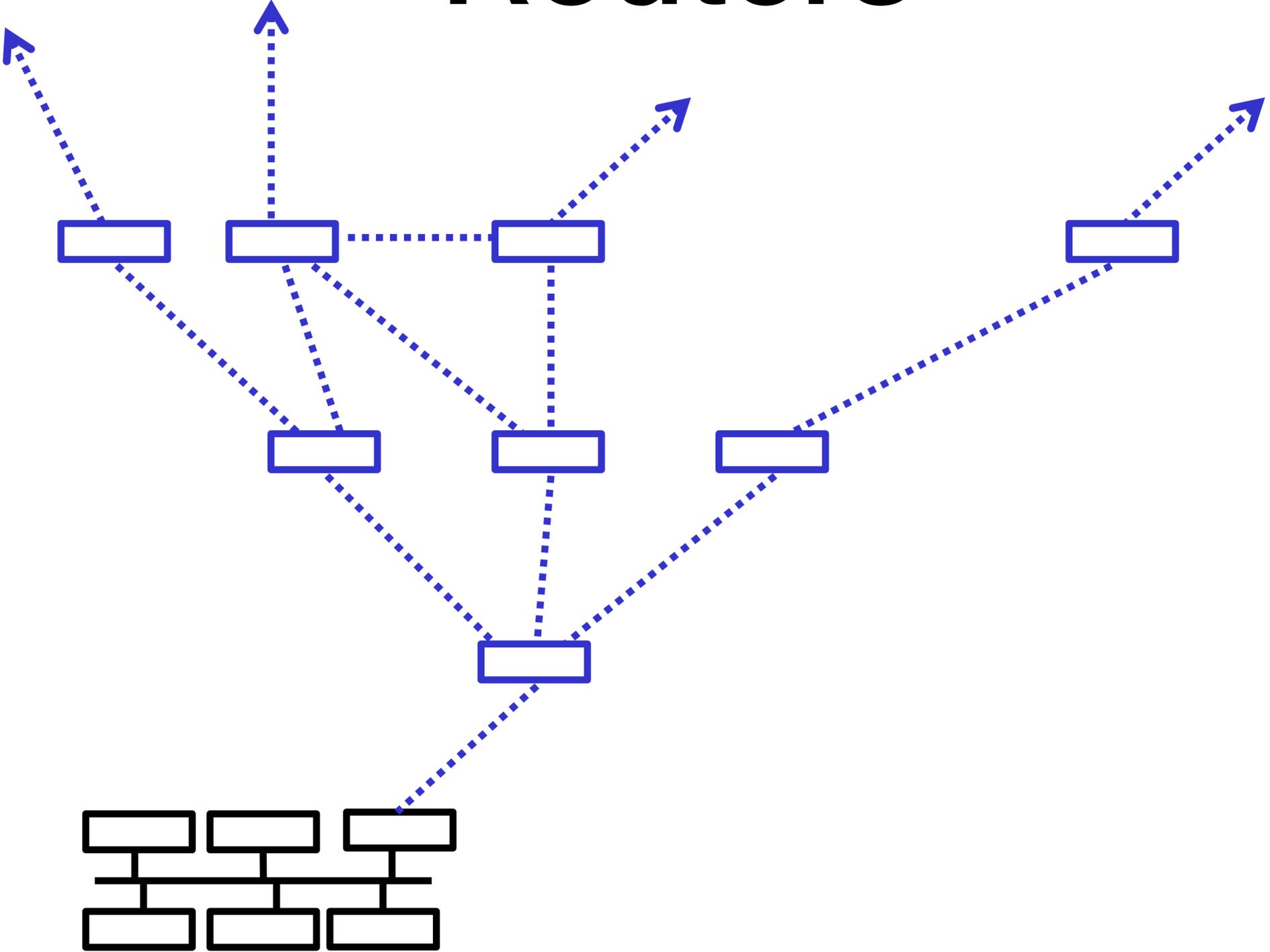
Local area network



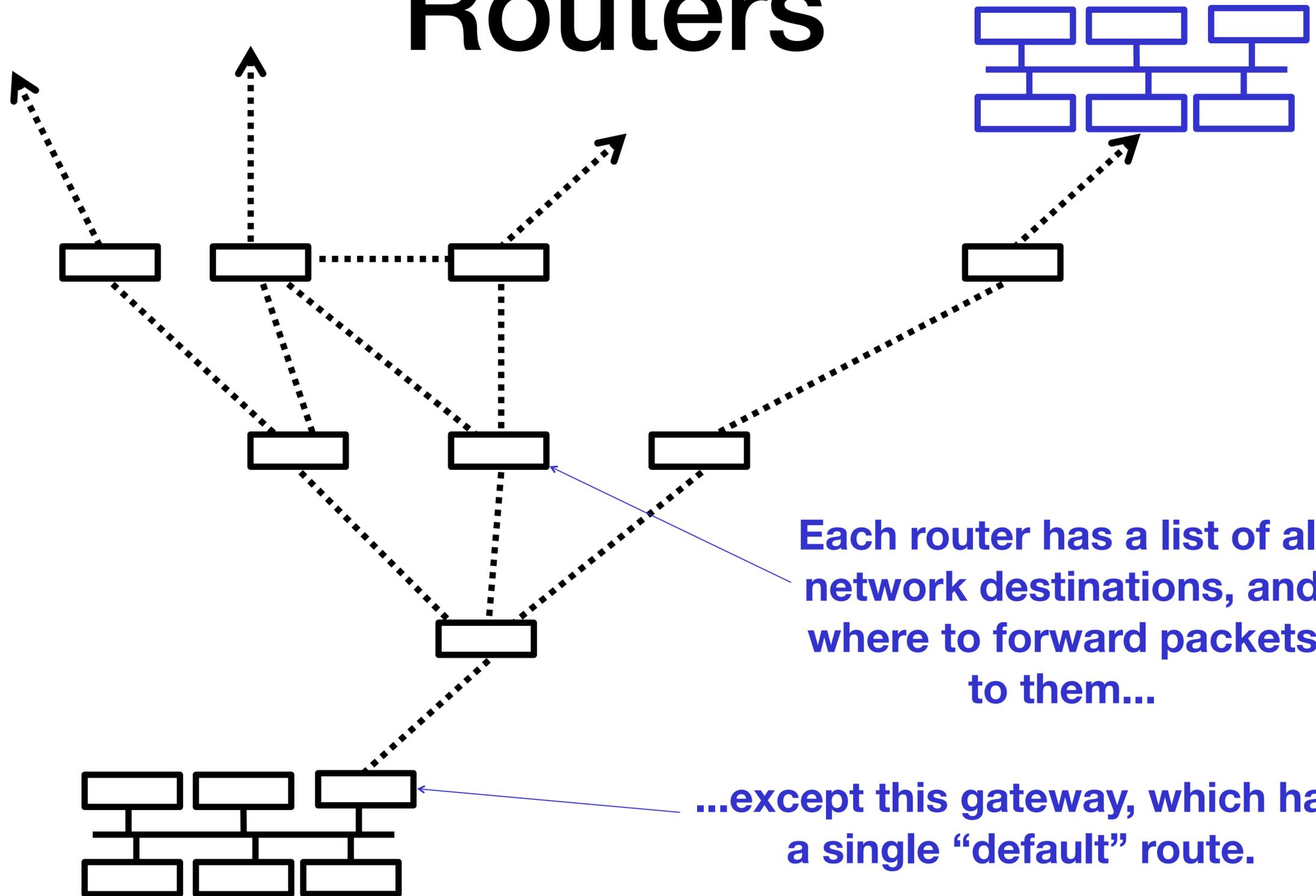
Local area network



Routers

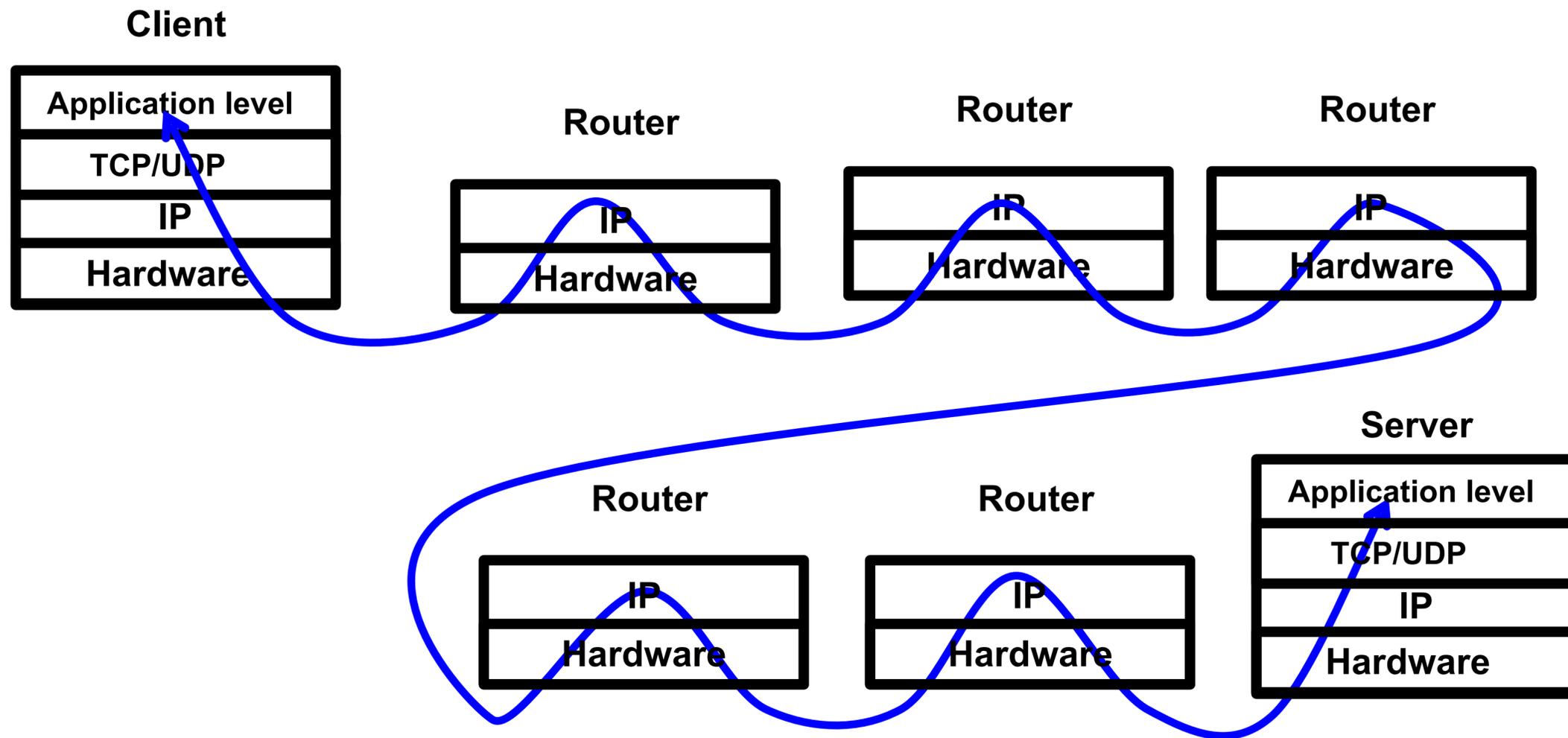


Routers



Some Internet Basics

Internet communication



tracert (in DOS)

- Shows the path to an Internet host
- Can be used to diagnose those mysterious Internet failures and slowdowns

C:\WINDOWS>tracert www.lucent.com

Tracing route to public1.lucent.com [207.140.138.101] over a maximum of 30 hops:

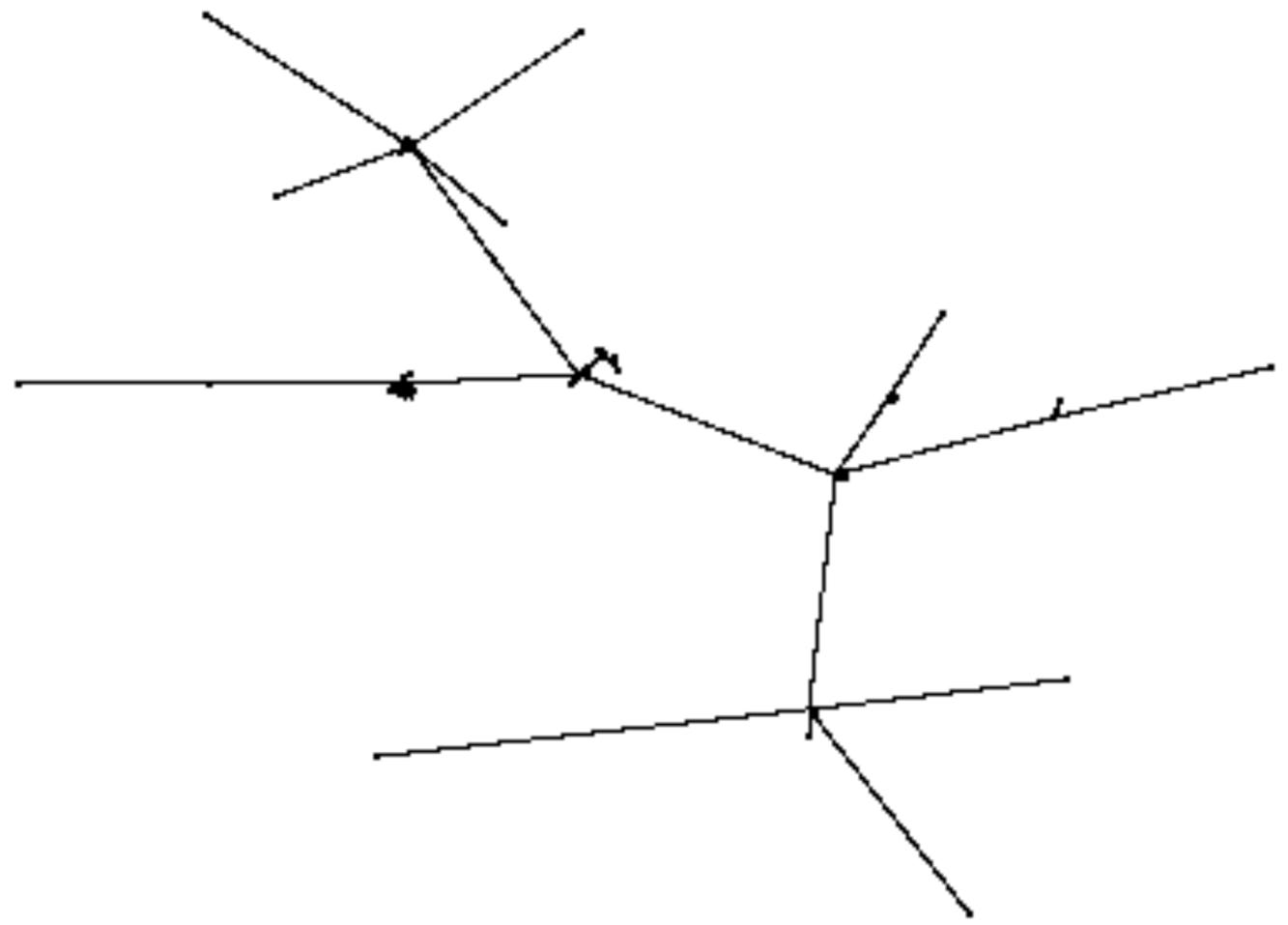
1	*	*	*	Request timed out.
2	*	*	*	Request timed out.
3	10 ms	10 ms	9 ms	nac-brn4-e0.nac.net [207.99.68.254]
4	23 ms	20 ms	21 ms	h2-0-421.frame1.whi.nac.net [209.123.11.89]
5	21 ms	20 ms	20 ms	nac-globalcenter-Fa2-1-100mb.nac.net [207.99.5.1
911				
6	41 ms	27 ms	27 ms	vc37.atm1-0.cr1.DCA.globalcenter.net [206.132.19
1.1621				
7	35 ms	35 ms	32 ms	fe2-0.br1.DCA.globalcenter.net [204.152.166.13]
8	29 ms	31 ms	30 ms	pos6-0-0-155M.cr1.IAD.globalcenter.net [204.152.
166.6]				
9	30 ms	27 ms	28 ms	fe4-1.br1.IAD.globalcenter.net [204.152.166.163]
10	31 ms	29 ms	229 ms	12.127.45.129
11	34 ms	35 ms	40 ms	br2-a350s4.wswdc.ip.att.net [12.127.1.14]
12	37 ms	38 ms	37 ms	12.127.9.126
13	37 ms	38 ms	40 ms	ar4-a300s1.n54ny.ip.att.net [12.127.0.29]
14	37 ms	35 ms	41 ms	12.126.222.246
15	*	59 ms	45 ms	207.140.138.62
16	46 ms	55 ms	76 ms	public1.lucent.com [207.140.138.101]

Trace complete.

C:\WINDOWS>



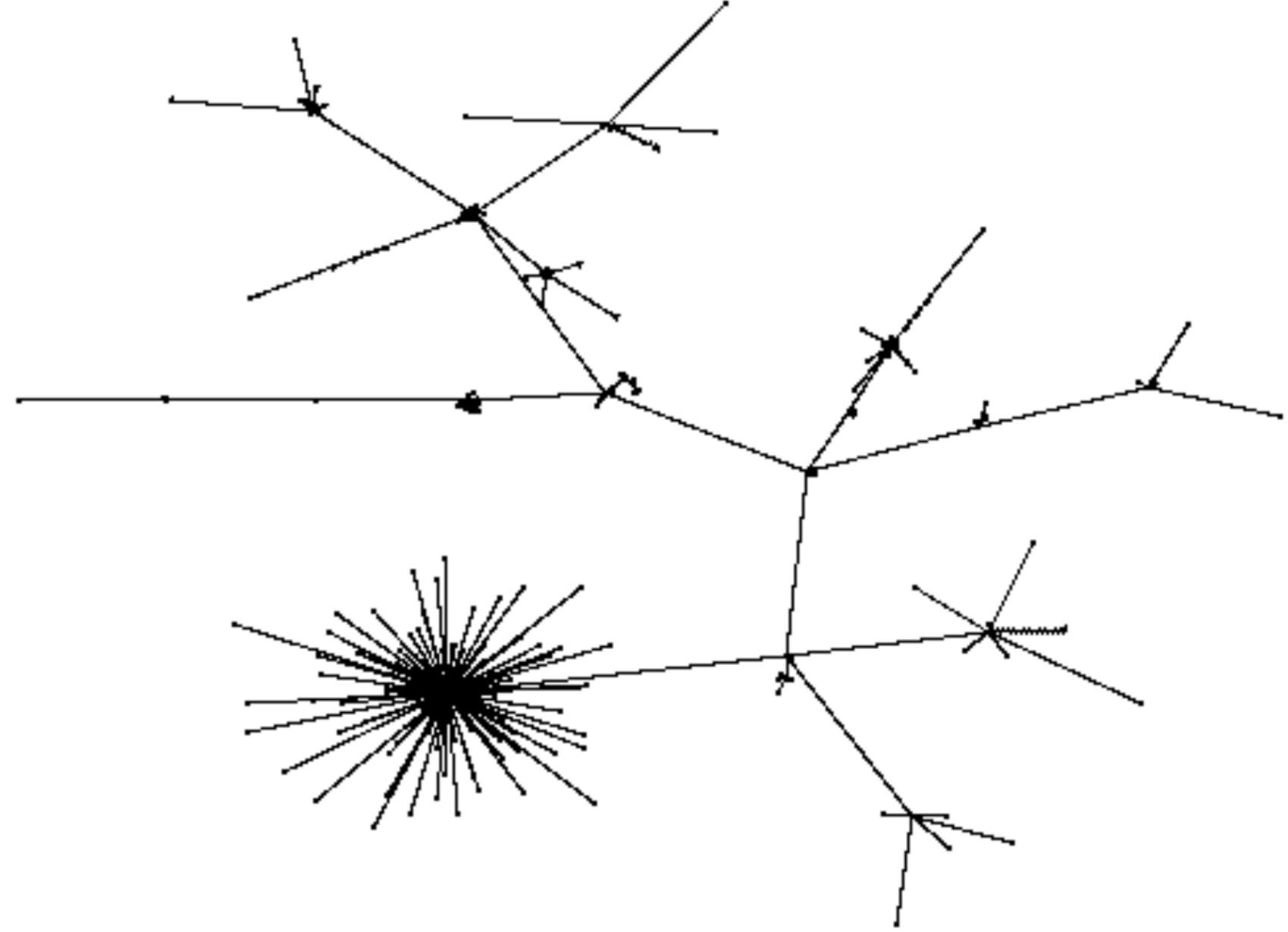
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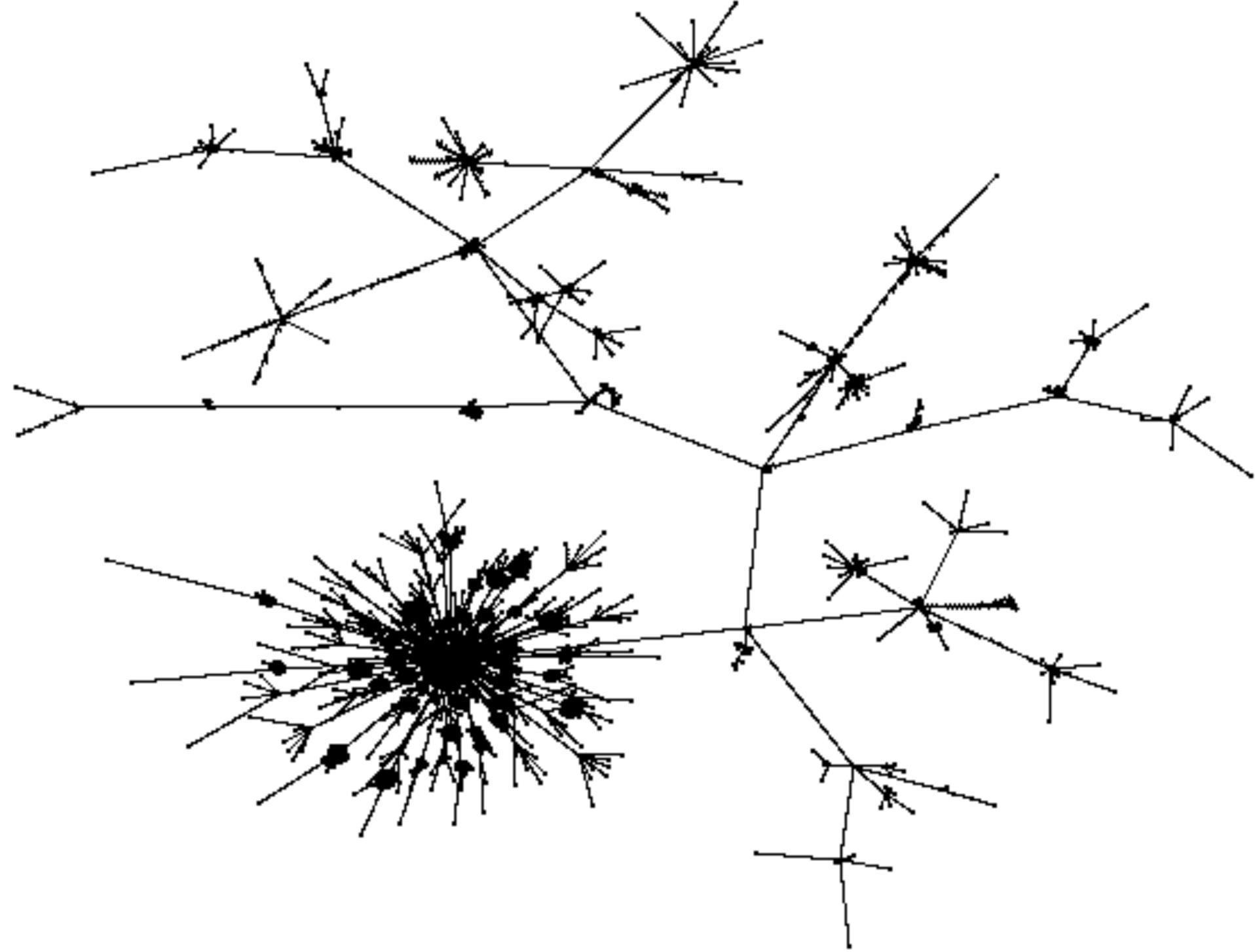
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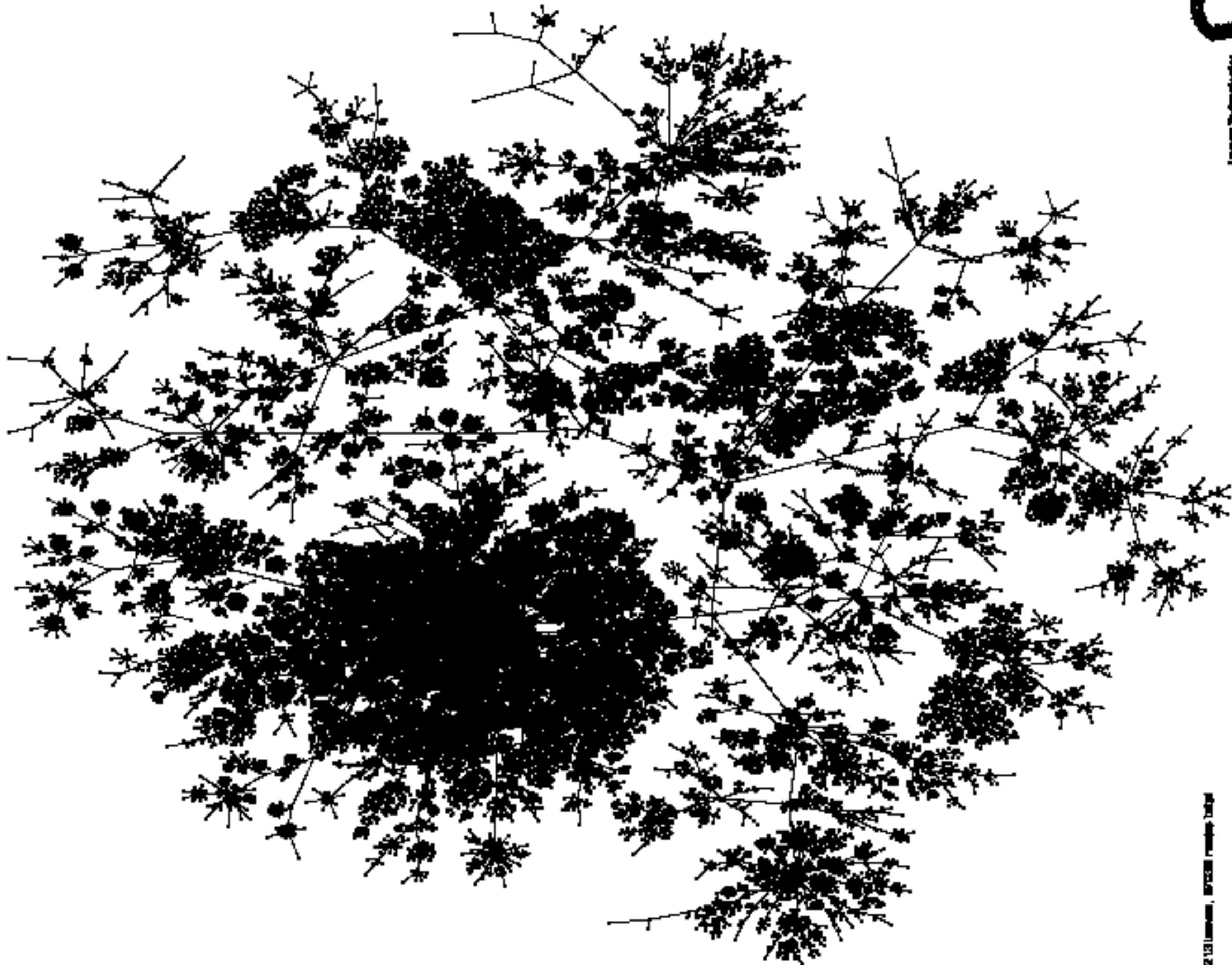


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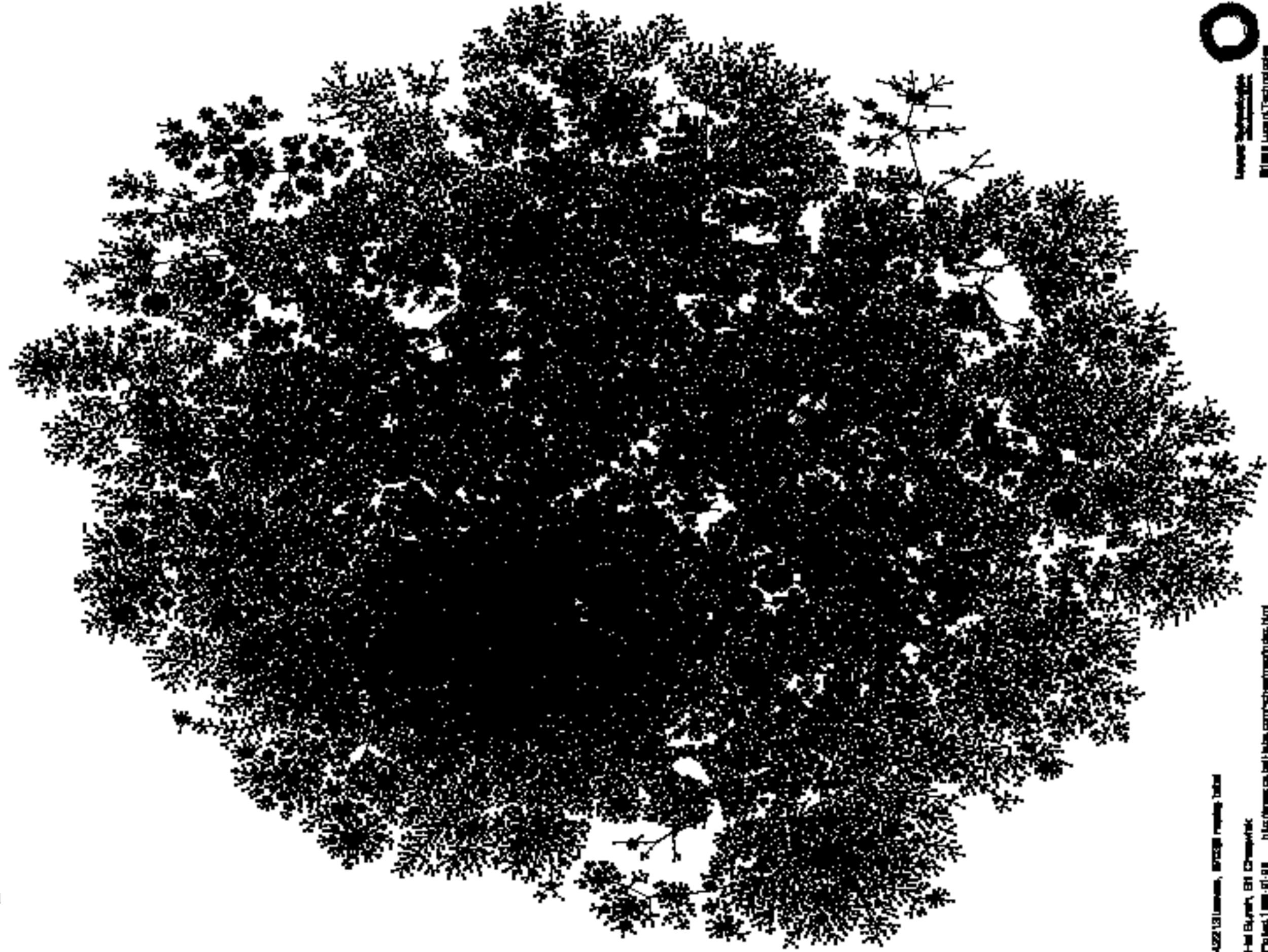
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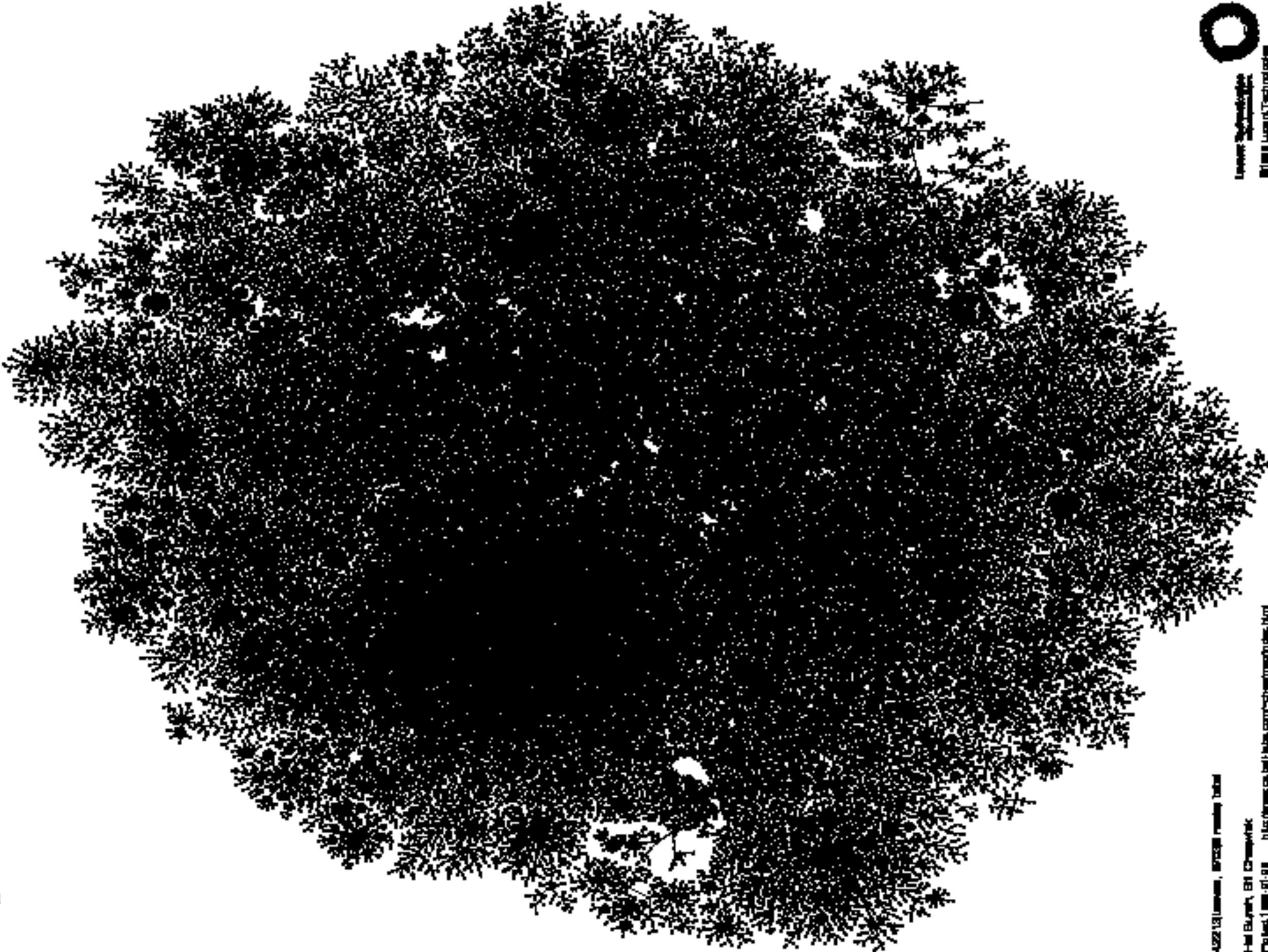
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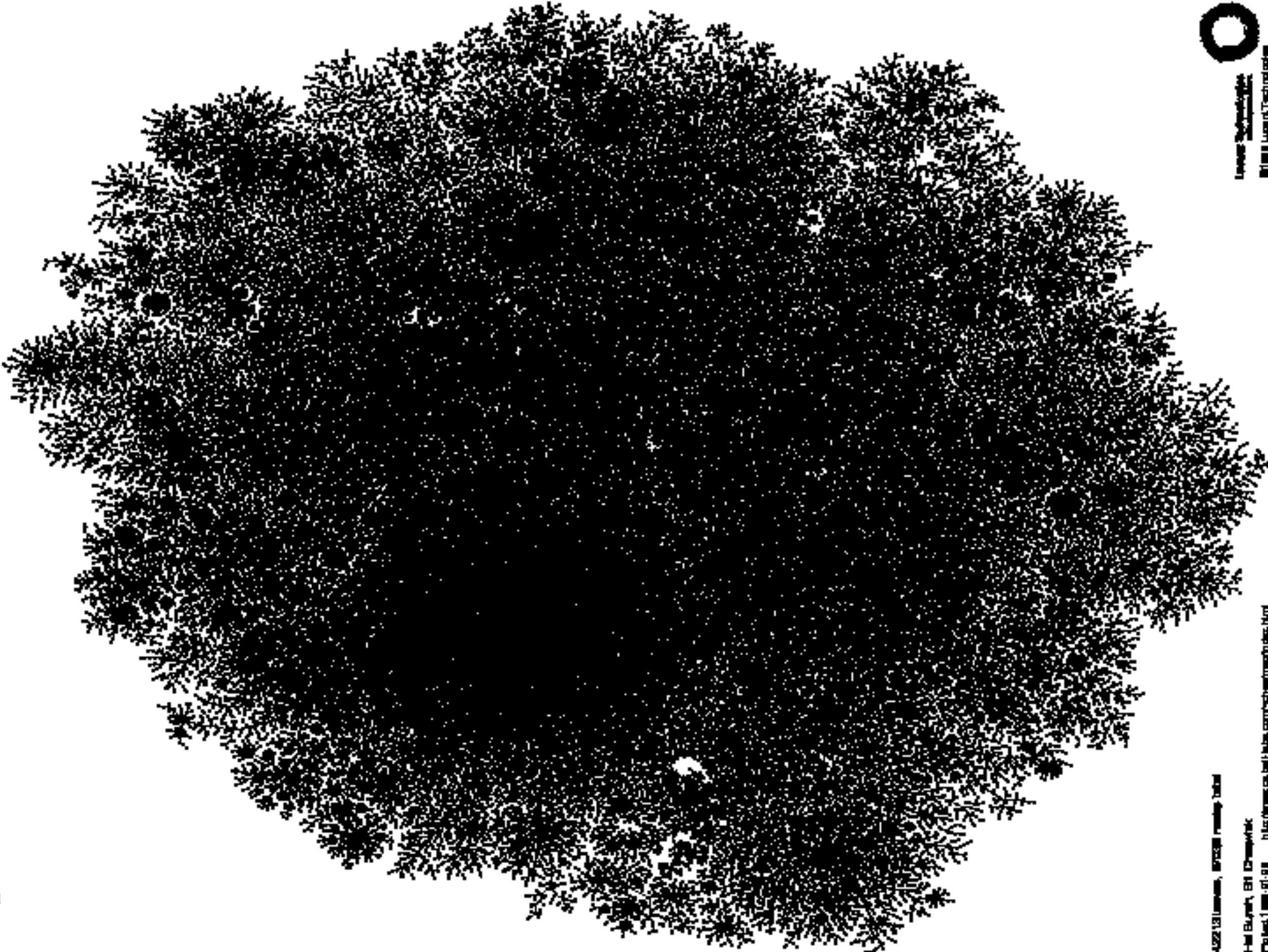
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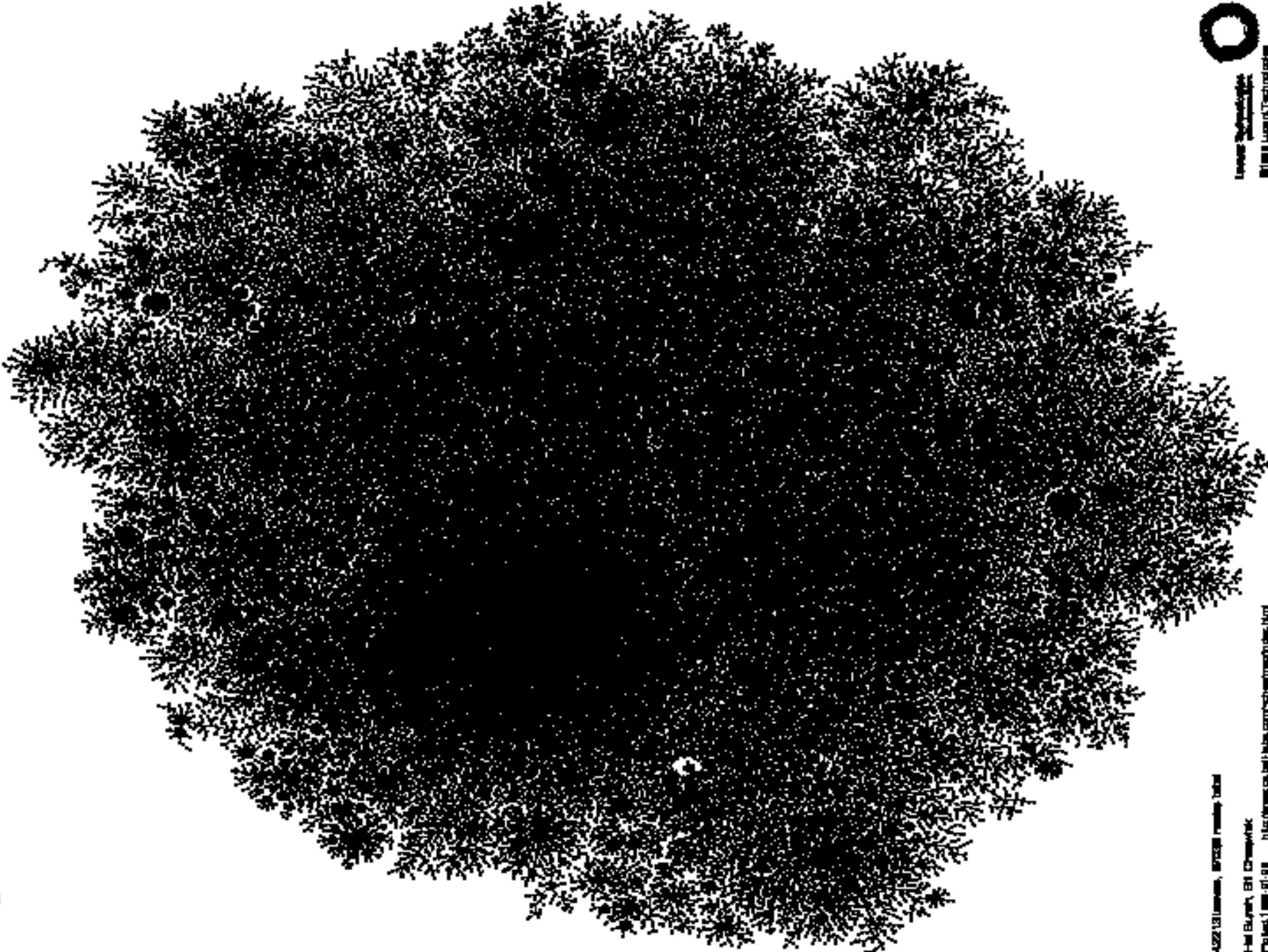
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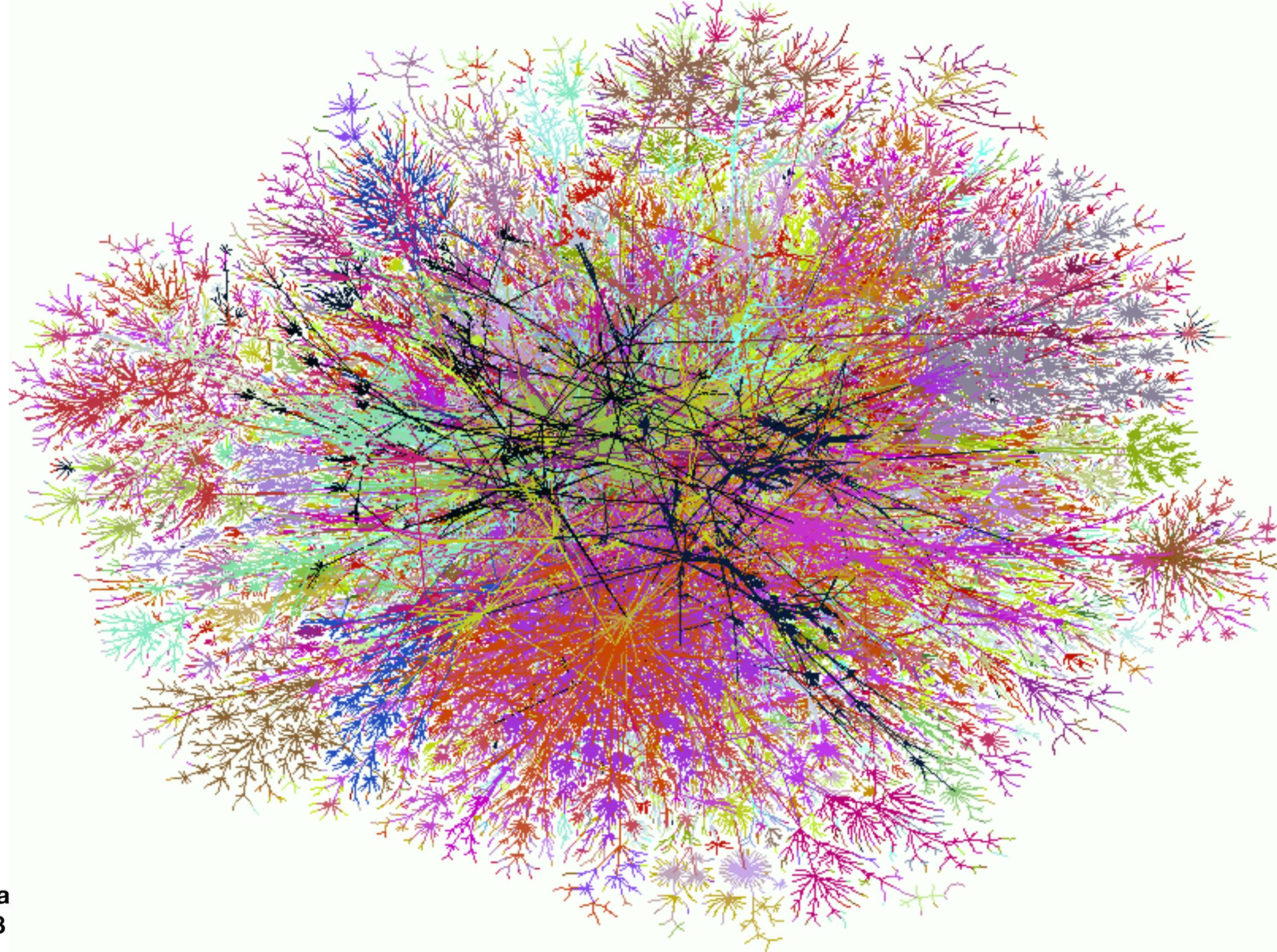


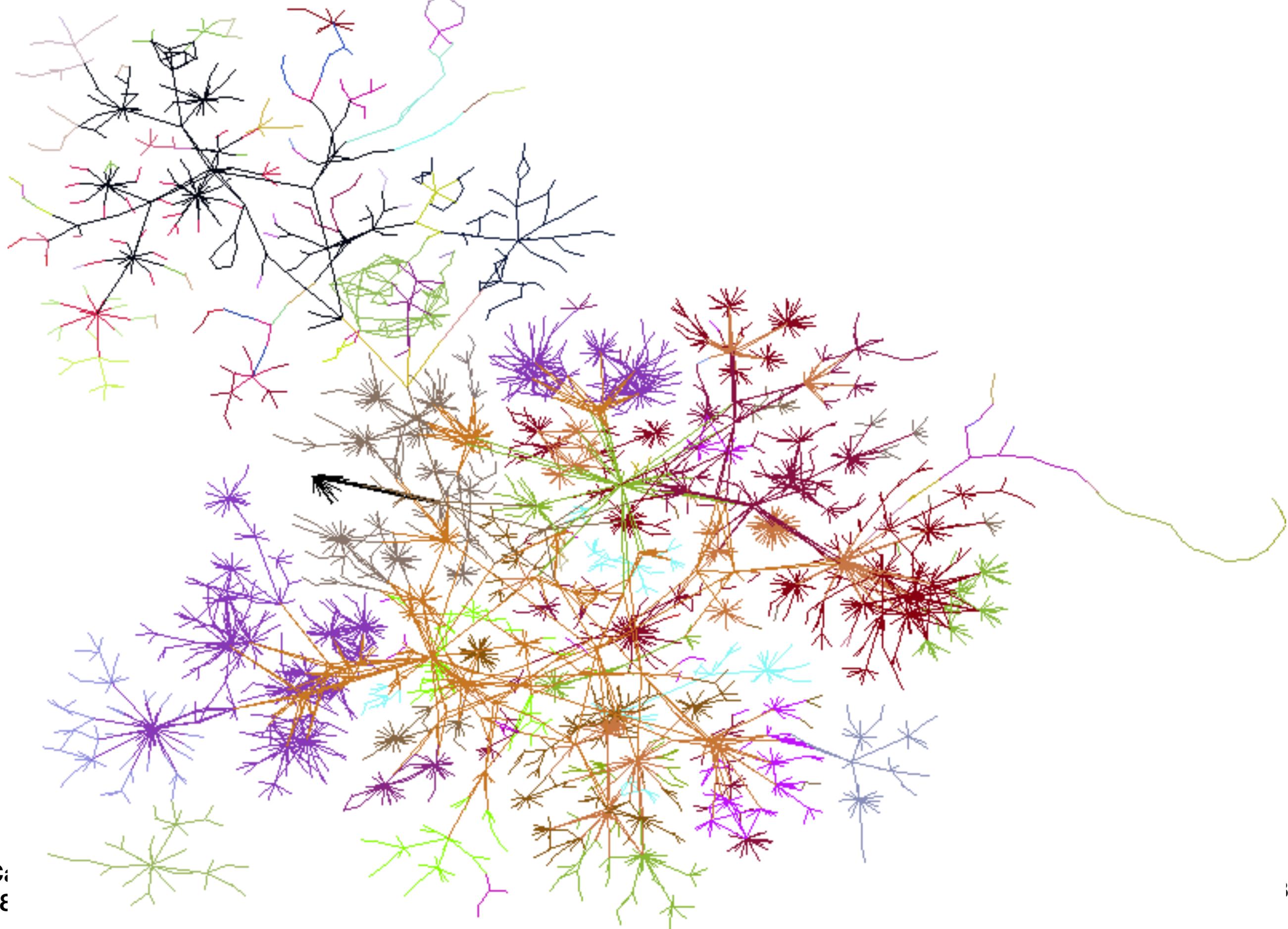
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Routers play hot-potato with packets

- They only need to know the next router for any IP address
- An average packet travels 17 hops on the Internet between client and server
- Maximum number of hops has been somewhere in the high 30s

How do these packets find their way through this mess?

- Master routing lists had some 50,000 entries in 1999.
- Current size: 393,165 (https://www.cidr-report.org/as2.0/#General_Status)
 - The size of this table is a limit to Internet growth
- IP packets may be dropped, duplicated, or arrive out of order

TCP

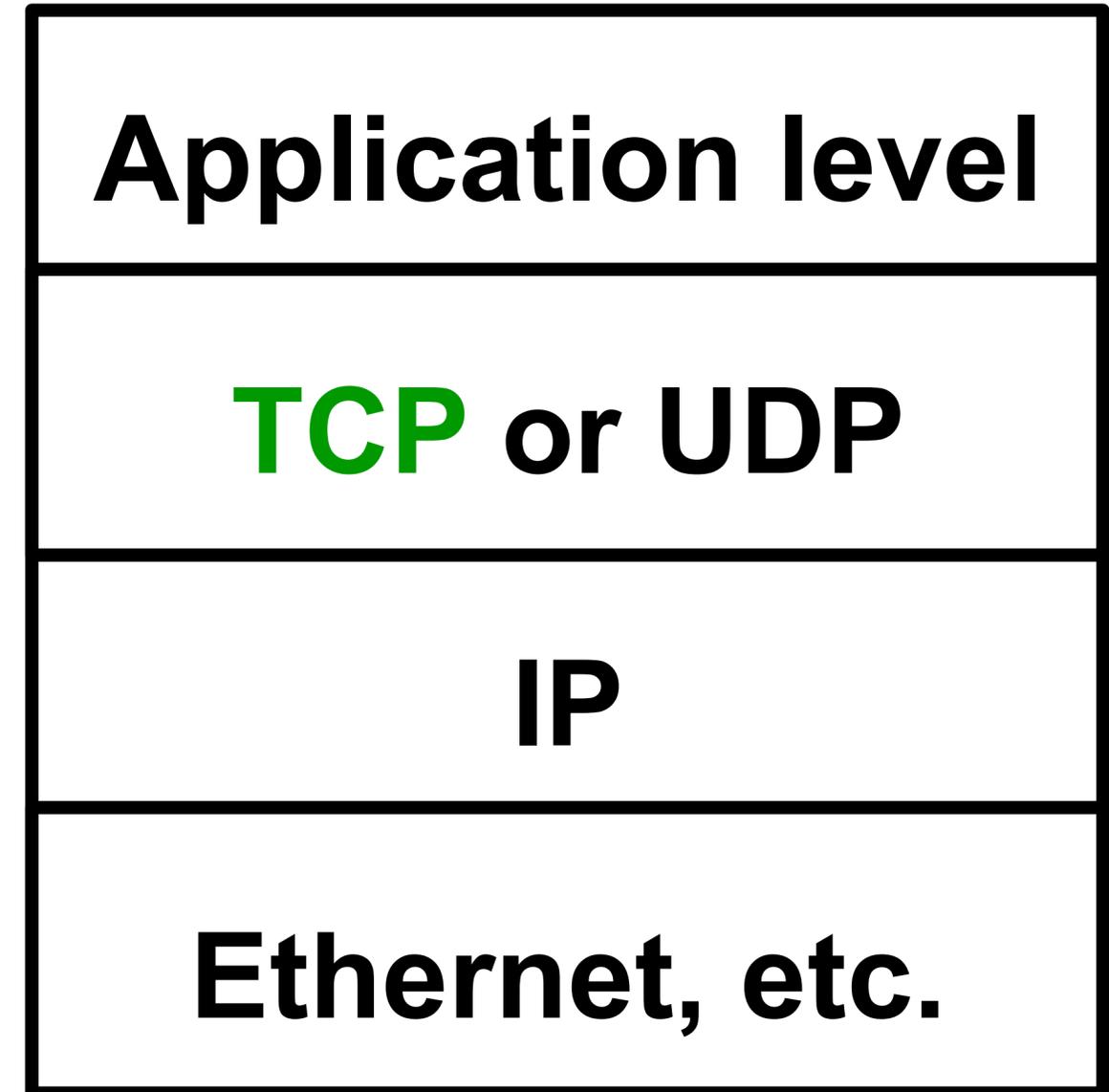
Taming IP

5 Feb 1999

Science Seminar

TCP

- TCP supplies a reliable connection to the other end
- Breaks a stream of data into packets
- Reassembles packets into a stream
- Services 1 - 65535
- do, or time out



TCP services, by the numbers

- 21: ftp
- 23: telnet
- 25: smtp (mail)
- 80: http (web)
- You can make up your own, without permission needed

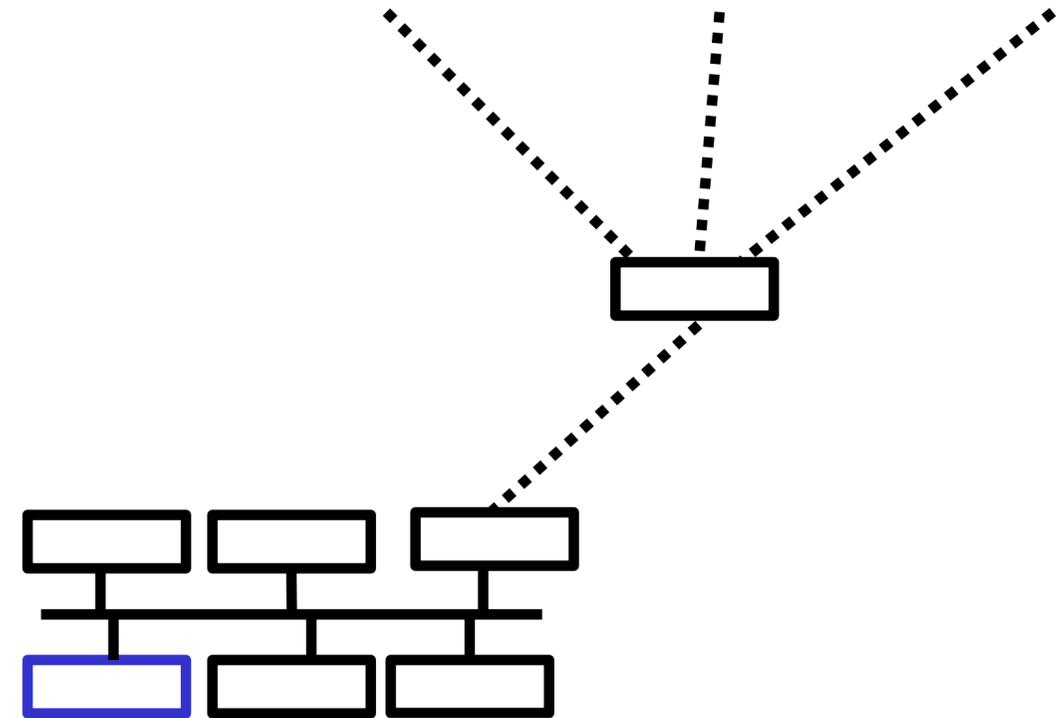
Domain Name Service (DNS)

- ntp.research.bell-labs.com
- www.nasa.gov
- http://198.116.116.10/
- mail.att.net
- www.cheswick.com
- DNS converts names to IP addresses

A Sample Internet session (simplified a bit)

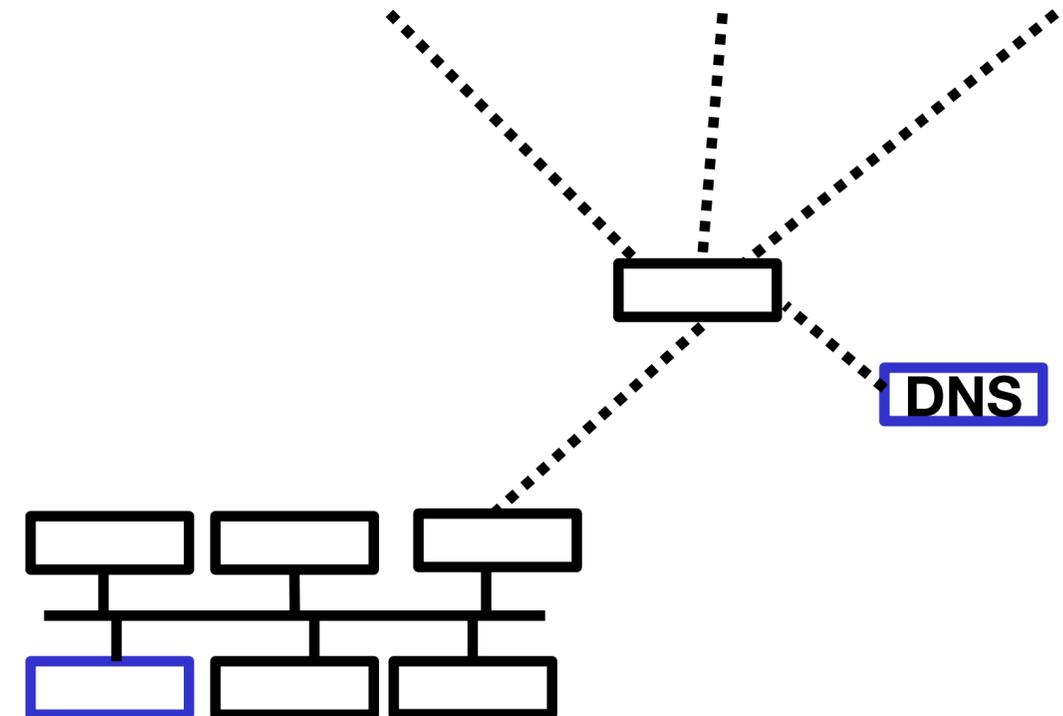
User types URL found on a beer can

- `http://budweiser.com`



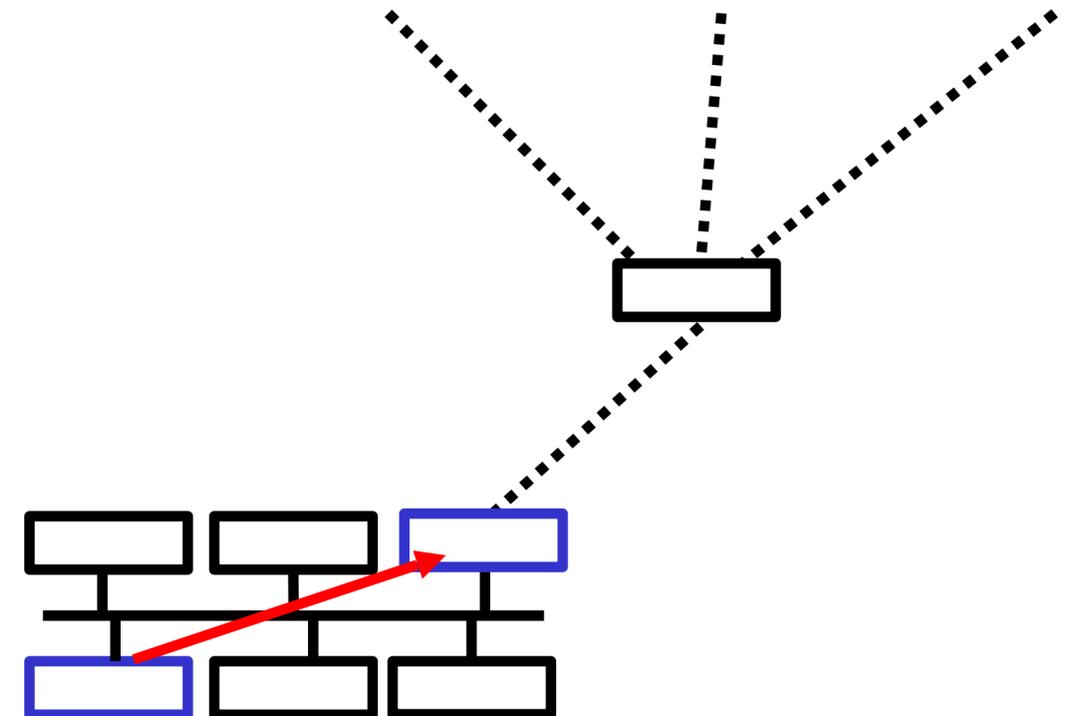
The browser uses the DNS to look up the IP address

- `budweiser.com`
- Answer is `207.87.7.32`

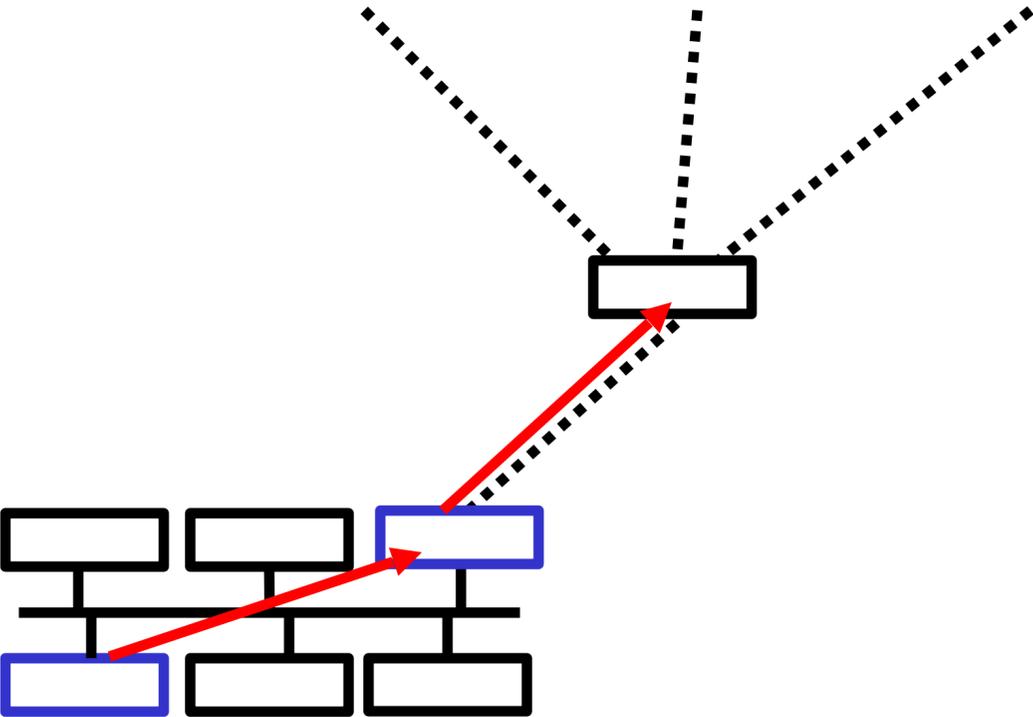


Browser sends request packet to the gateway

- Addressed to 207.87.7.32

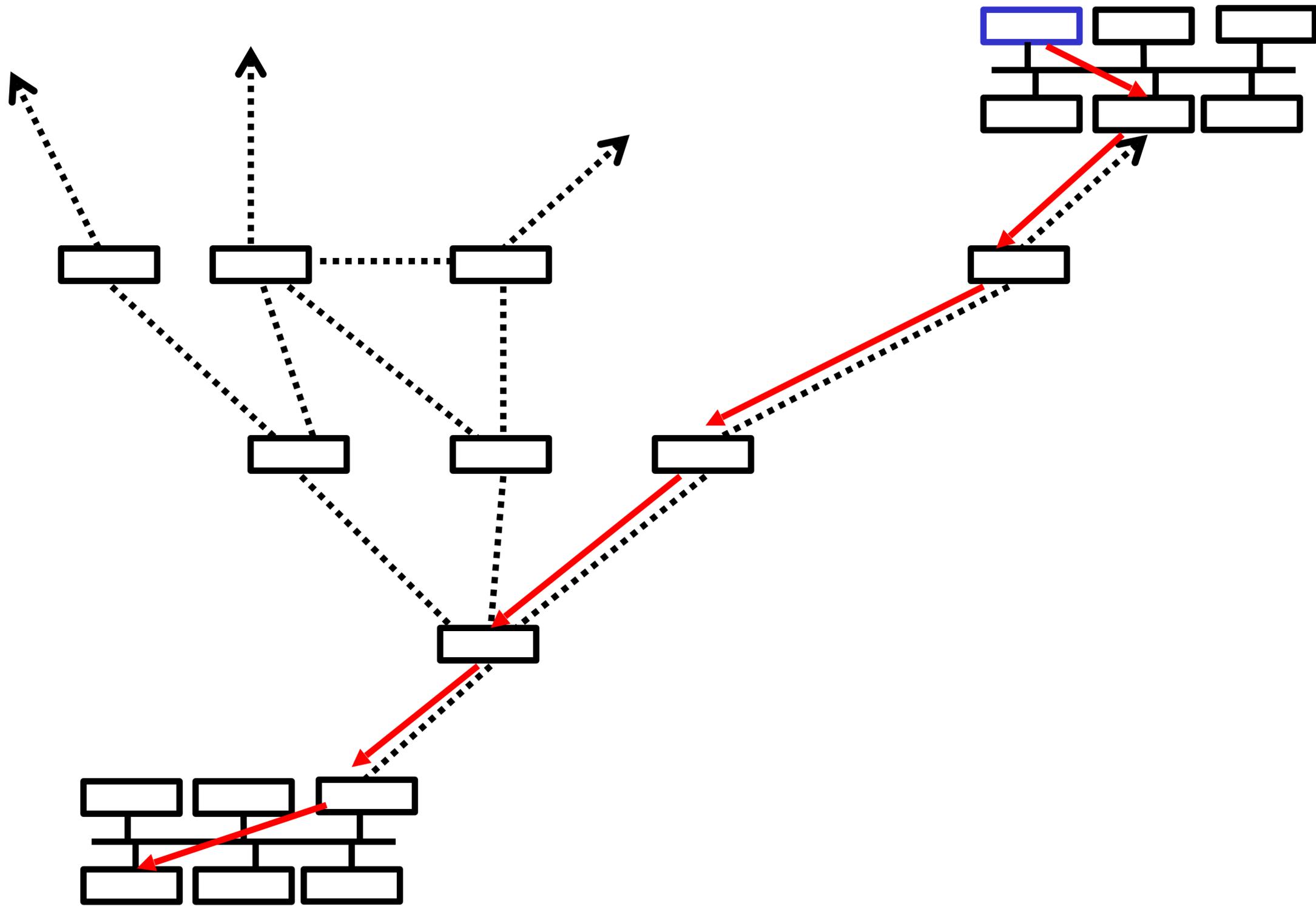


Gateway forwards packet to default route



5 Feb 1999

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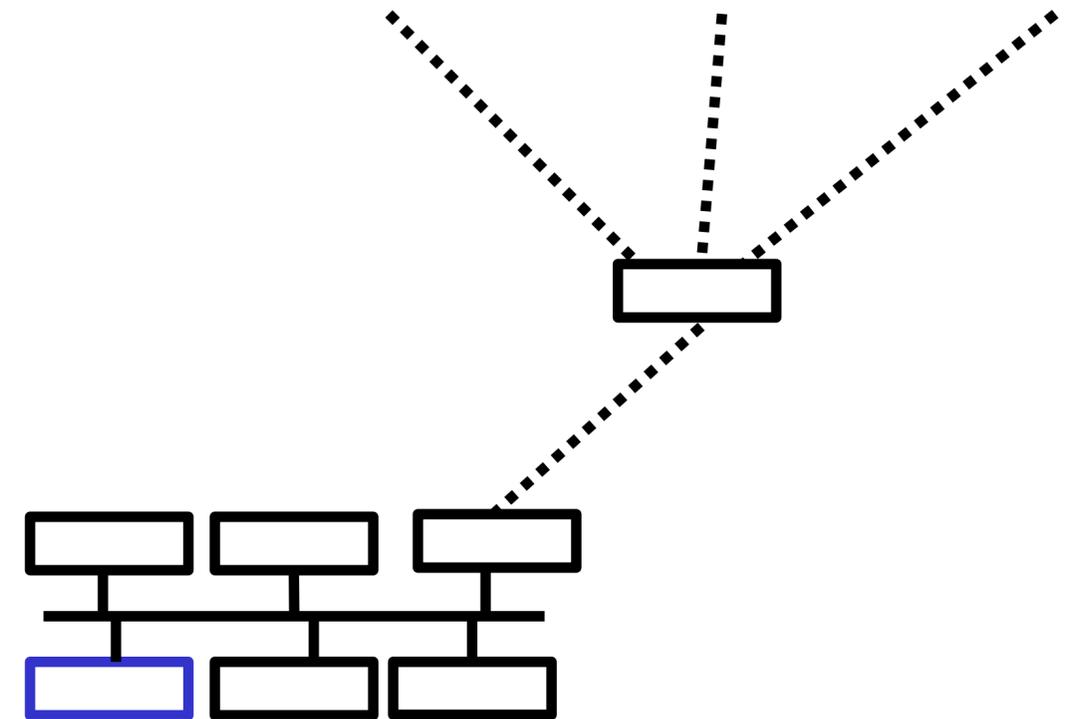


What Can Go Wrong?

(everything)

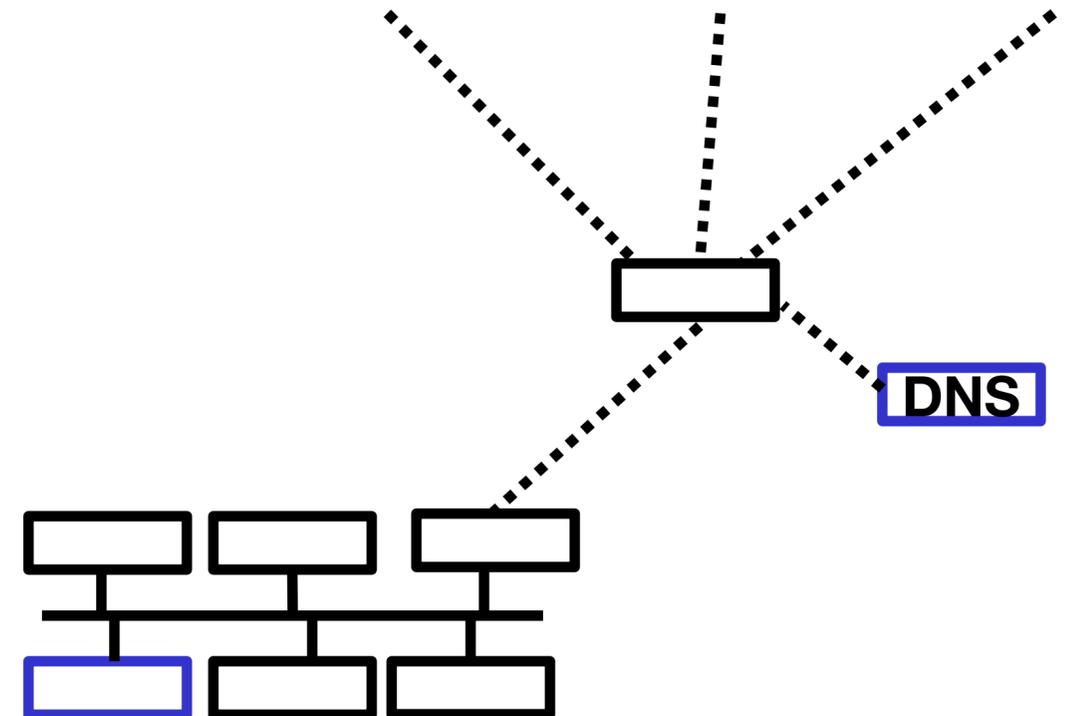
User types the wrong URL

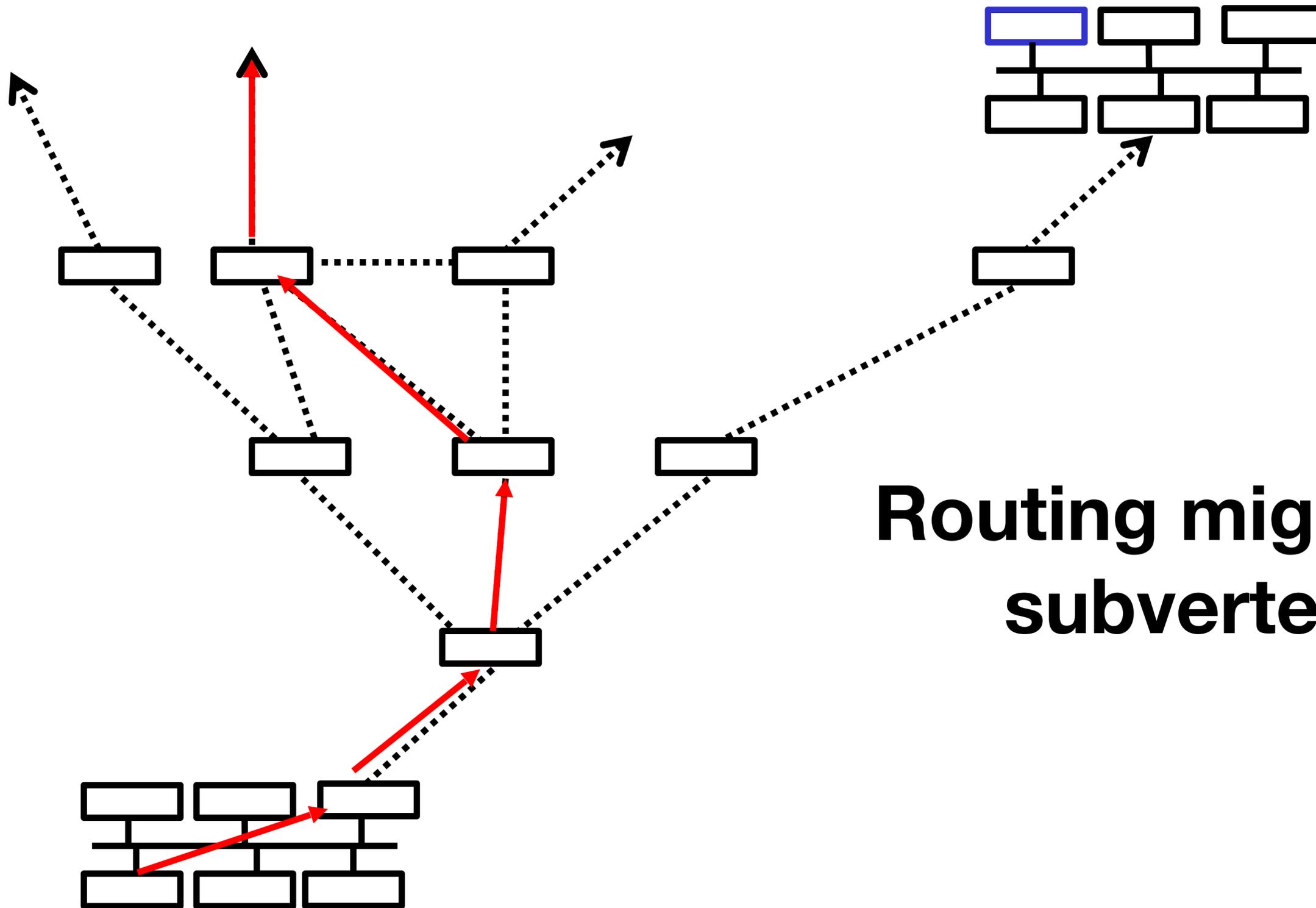
- URLs not suited to speech
- Spelling counts in URLs
- `drudge.com` is not `drudgereport.com`
- `budwieser.com`
- `www.altavista.com` is not `www.altavista.digital.com`
- `micros0ft.com`



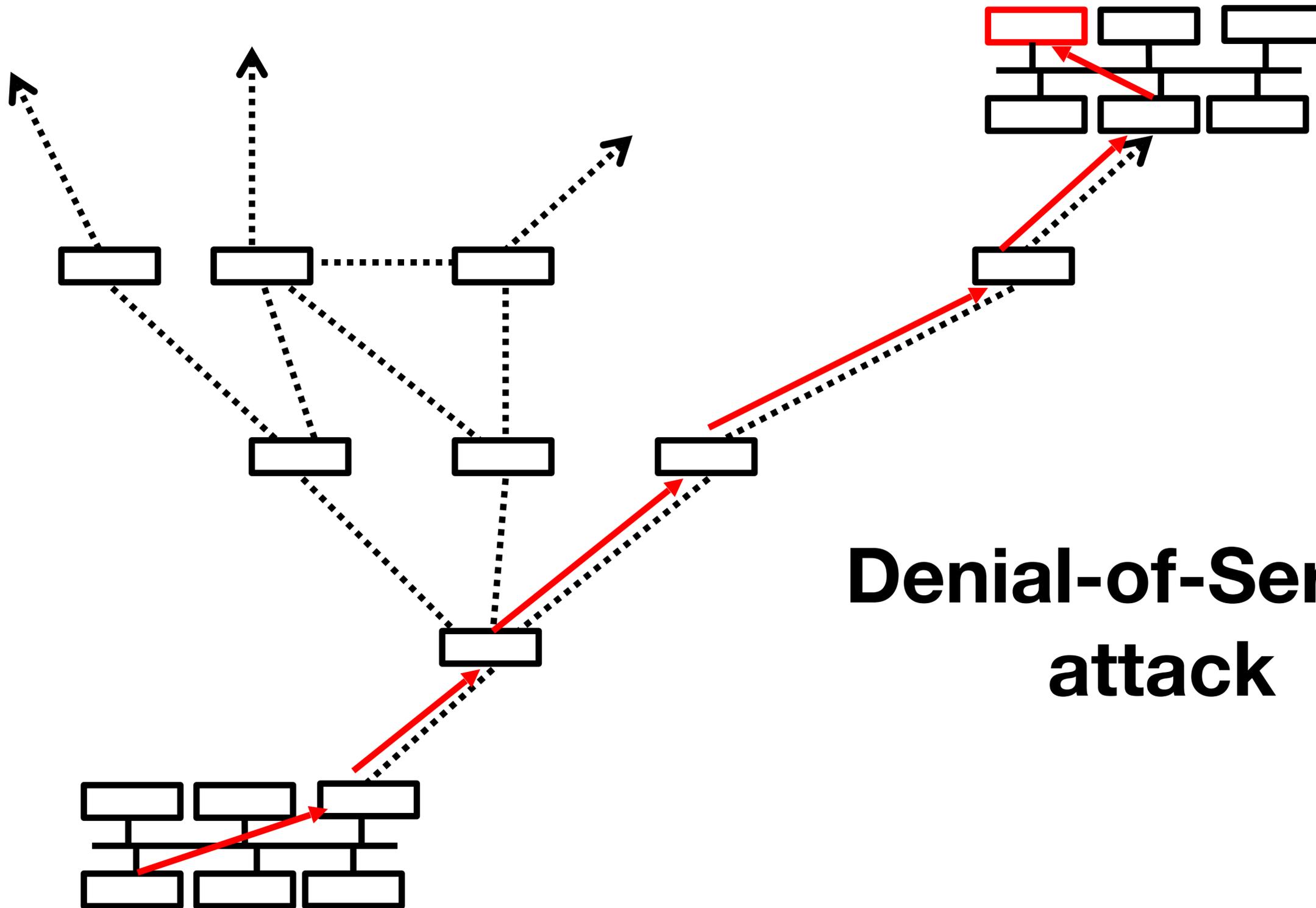
DNS gives an incorrect answer

- Might be hacked or miss-configured
- “Cache poisoning”

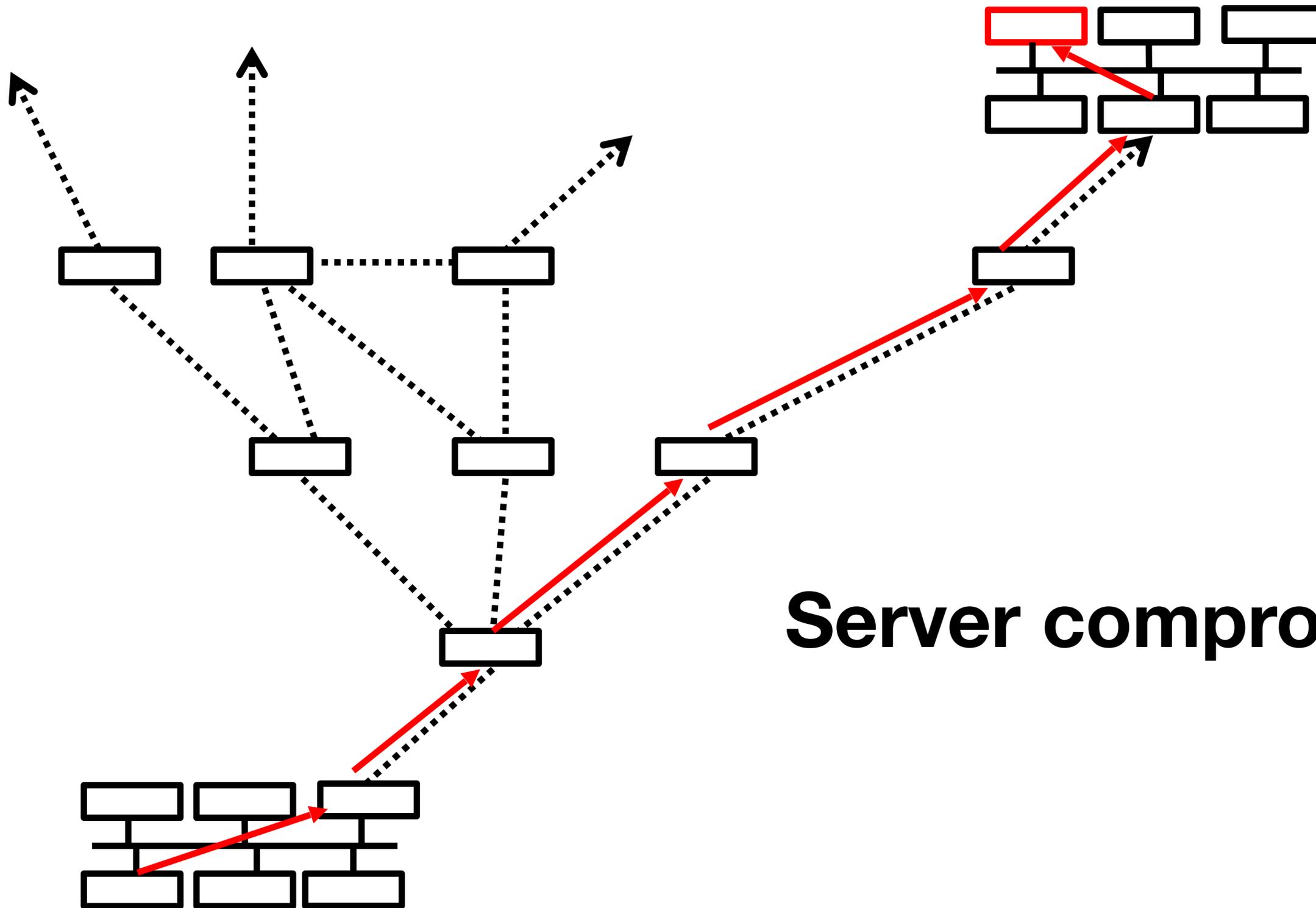




Routing might be subverted

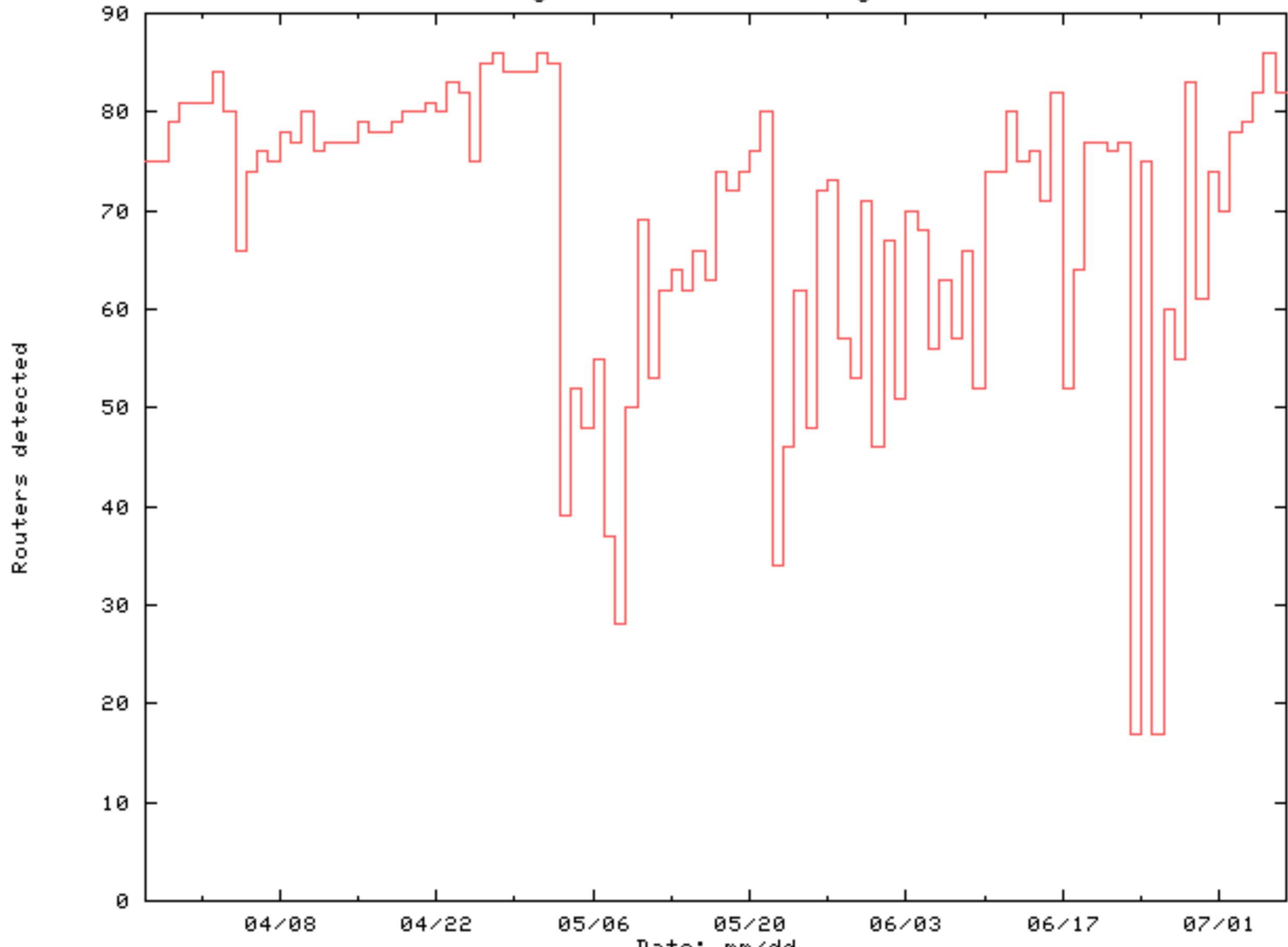


Denial-of-Service attack



Server compromised

Yugoslavia network during war

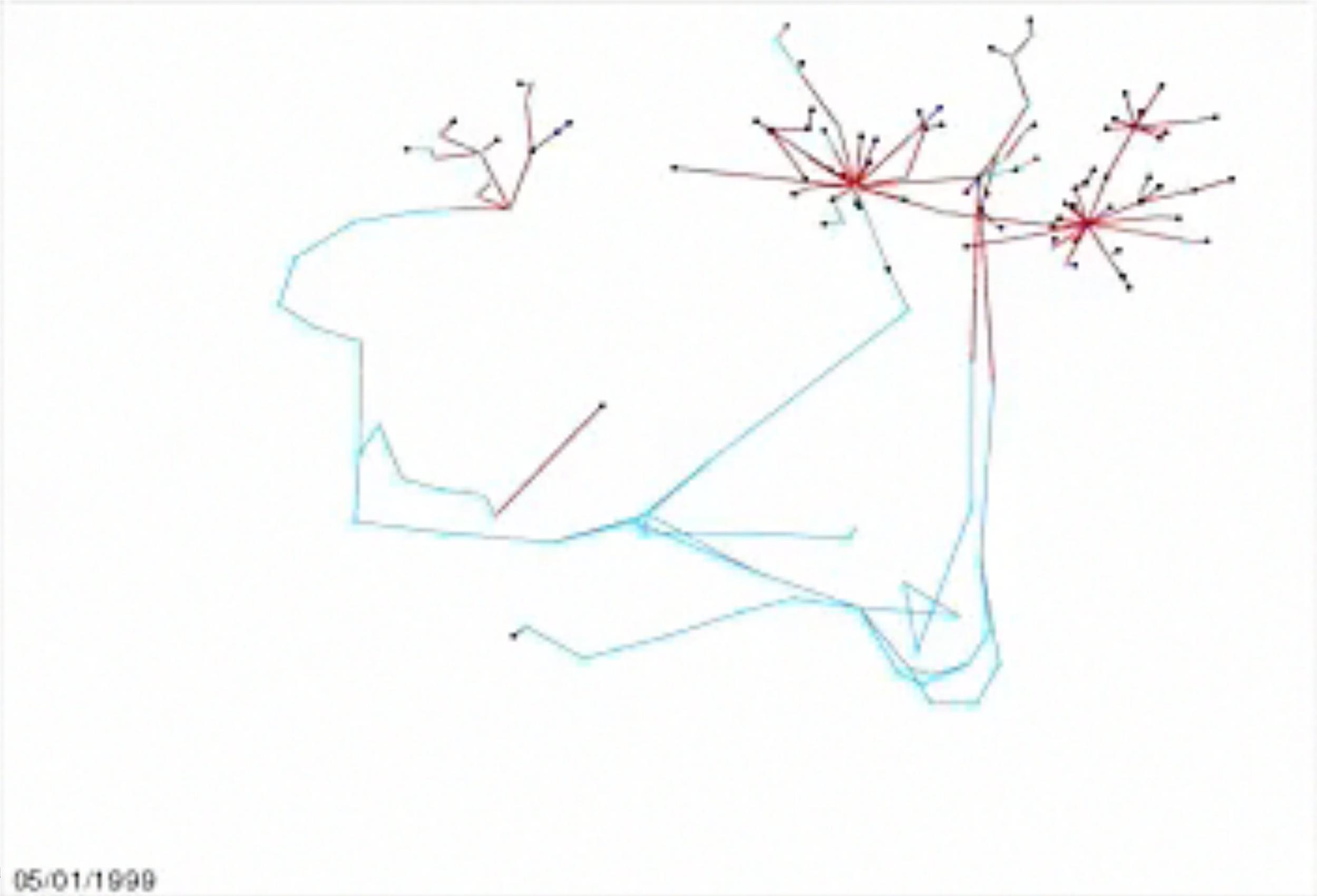


Un film par Steve “Hollywood” Branigan...



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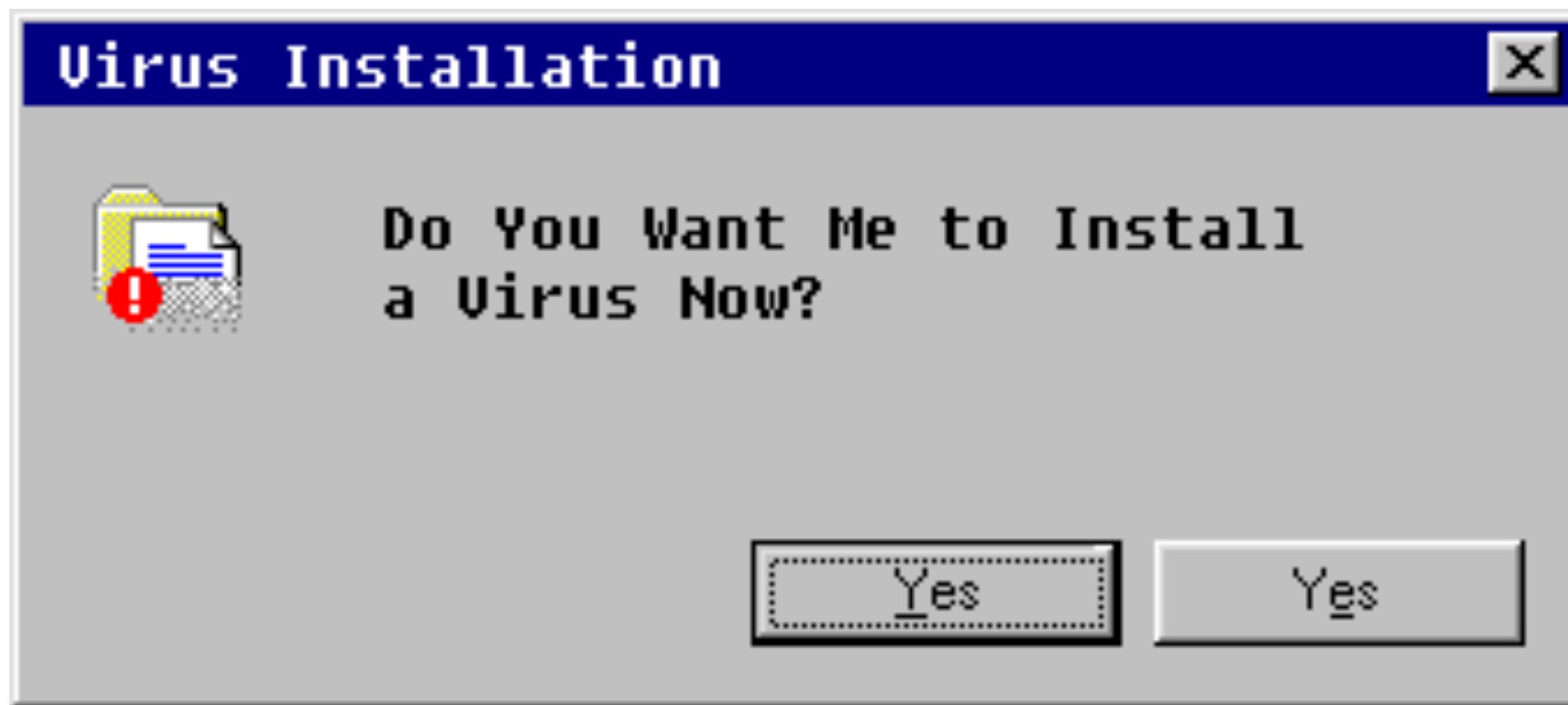
Default TCP services on an SGI workstation

ftp	stream	tcp	nowait	root	/v/gate/ftpd
telnet	stream	tcp	nowait	root	/usr/etc/telnetd
shell	stream	tcp	nowait	root	/usr/etc/rshd
login	stream	tcp	nowait	root	/usr/etc/rlogind
exec	stream	tcp	nowait	root	/usr/etc/rexecd
finger	stream	tcp	nowait	guest	/usr/etc/fingerd
bootp	dgram	udp	wait	root	/usr/etc/bootp
tftp	dgram	udp	wait	guest	/usr/etc/tftpd
ntalk	dgram	udp	wait	root	/usr/etc/talkd
tcpmux	stream	tcp	nowait	root	internal
echo	stream	tcp	nowait	root	internal
discard	stream	tcp	nowait	root	internal
chargen	stream	tcp	nowait	root	internal
daytime	stream	tcp	nowait	root	internal
time	stream	tcp	nowait	root	internal
echo	dgram	udp	wait	root	internal
discard	dgram	udp	wait	root	internal
chargen	dgram	udp	wait	root	internal
daytime	dgram	udp	wait	root	internal
time	dgram	udp	wait	root	internal
sgi-dgl	stream	tcp	nowait	root/rcv	dgld
uucp	stream	tcp	nowait	root	/usr/lib/uucp/uucpd

Social Engineering (cont.)

Click [here](#) to infect your computer.

Another problem with strange programs



Viruses

- Attached to useful programs
- Infect other programs when moved to new systems
- Payloads vary
- There are about 200 new viruses reported *daily*
- Now they are spread by Word documents
 - (executable ?!)

Firewalls



We can protect a community with a guard at the entrance

- Evil services are blocked from external access
- Can let the good guys go out, and keep the bad guys from coming in
- Not perfect, but the economics are good

Questions/Discussion