LIS-3353

The Internet

What makes “the Internet” unique?

What makes “the Internet” unique?

We had:

- The written word
- The PRINTED word
- The Telegraph
- Radio
- TV
-Telephone (which is pretty close, actually?)

What makes “the Internet” unique?

(Why didn't, e.g. the American Telegraph and Telephone company invent the Internet?)

Good Ol' AT&T

They had the physical network?

Which worked like the following:

Smart Network (circuit switching)

direct “single-wire” connections

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direct “single-wire” connections

A remarkable, complex system...as opposed to...

Well, let’s try it...

Our L'il Internet

1) Pass this note to the person waving their hand.

2) If you can't, then pass it to someone who is closer to them. than you are.

Our L'il Internet

C D B (1/4)

Our L'il Internet

A E E (2/4)

Our L'il Internet

E D F (4/4)

Okay, so how did THAT work?

Dumb Network (packet switching)

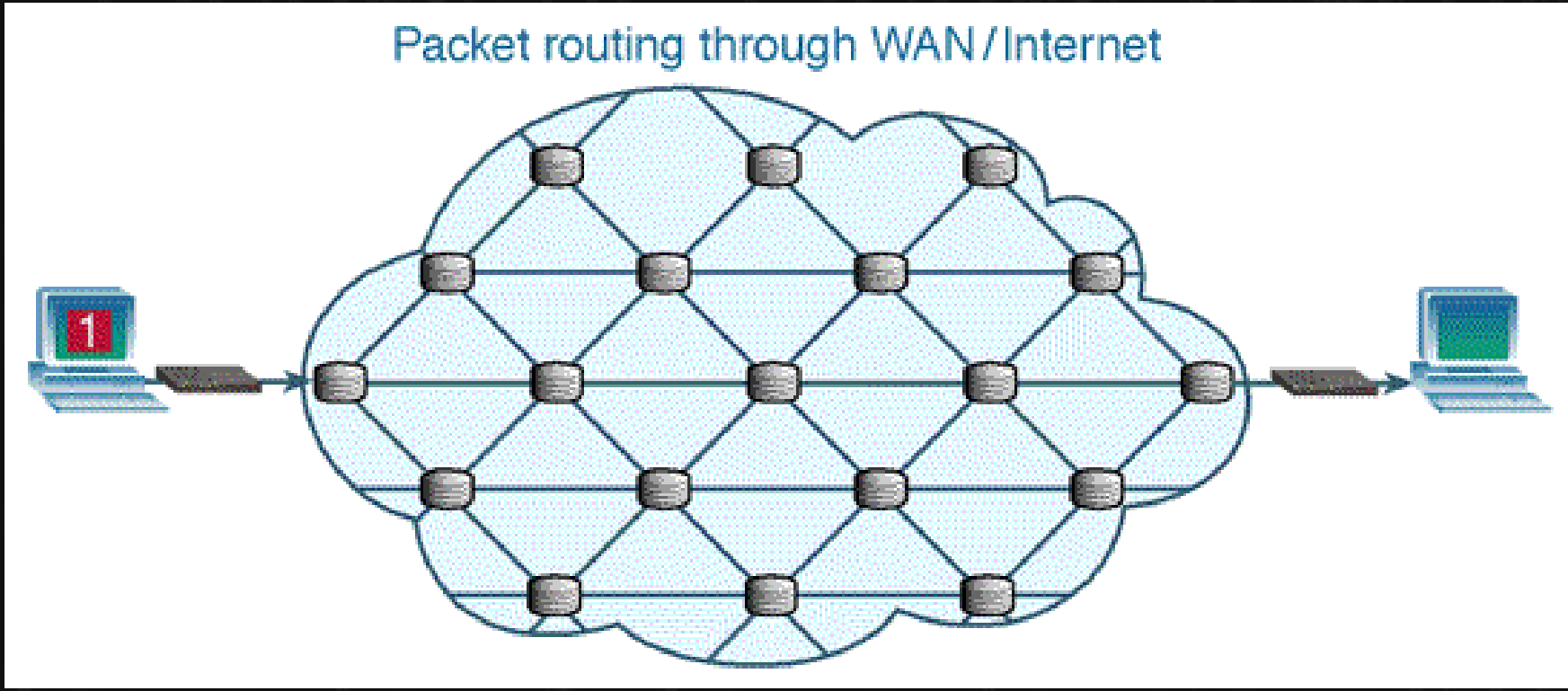
indirect, node based “post-office” connections

Consider how “resilient” this system is
(simple instructions, etc) vs.

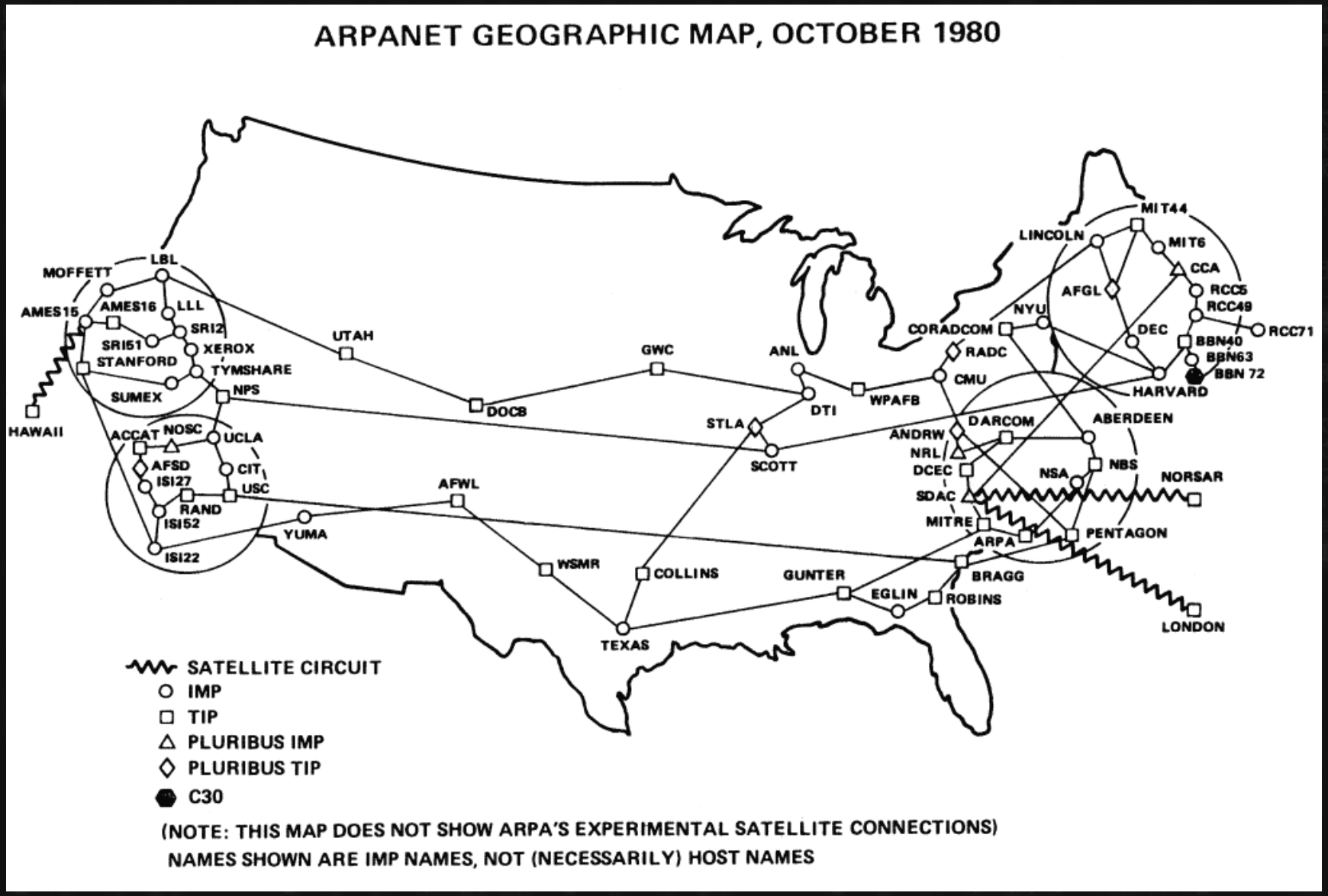
The complexity and brittleness of a “smart” network
(E.g. Susie → John → Fred → Singh → Joe
and then what if a node is absent or moved, etc.

Dumb Network (packet switching)

indirect, node based “post-office” connections



ARPANET


ARPANET GEOGRAPHIC MAP, OCTOBER 1980
MIT44
LINCOLN
MIT6
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RCC49
RCC71
NYU
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DEC
BBN40
BBN63
BBN 72
RADC
CMU
HARVARD
WPAFB
DTI
ANL
GWC
UTAH
DOCB
STLA
SCOTT
ABERDEEN
DARCOM
ANDRW
NRL
DCEC
NSA
NBS
NORSAR
SDAC
MITRE
PENTAGON
ARPA
BRAGG
ROBINS
EGLIN
GUNTER
COLLINS
WSMR
TEXAS
LONDON
AFWL
YUMA
RAND
ISI52
ISI22
AFSD
ISI27
USC
CIT
UCLA
ACCAT
NOSC
HAWAII
SUMEX
NPS
STANFORD
SRI51
XEROX
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LLL
AMES16
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IMP
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PLURIBUS IMP
PLURIBUS TIP
C30
(NOTE: THIS MAP DOES NOT SHOW ARPA'S EXPERIMENTAL SATELLITE CONNECTIONS)
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

Top 3 things about the net:

3) PACKET SWITCHING

Use of a “Dumb” Network:

”Pipes” and “switches”

NOW - What was sent?

A huge number

- (technically, this is DEFINITELY a right answer)

Hex: CDBAEEFAEEDF =

226,202,757,033,695

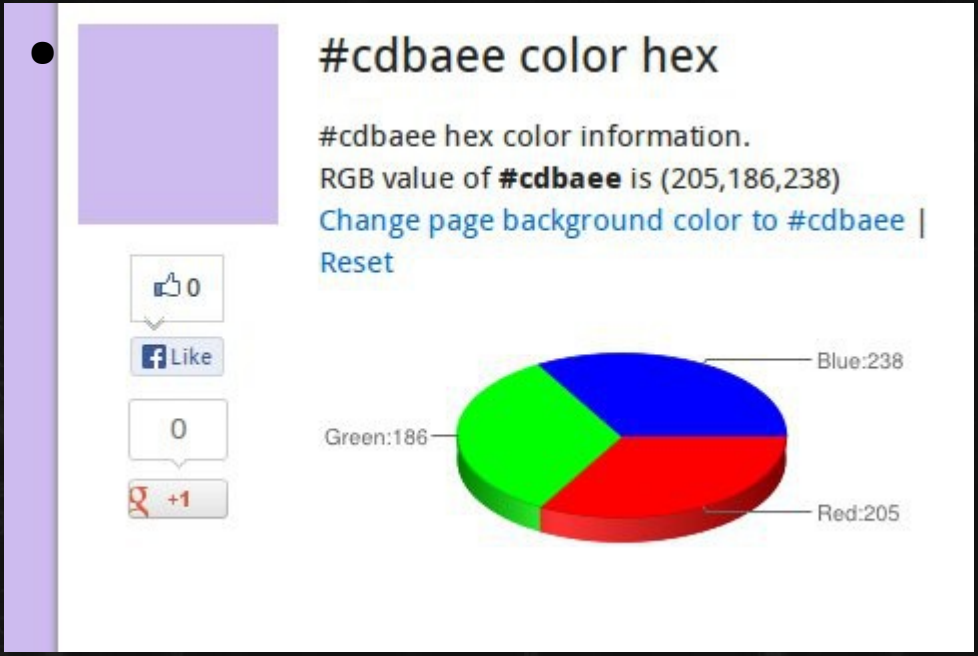
What was sent?

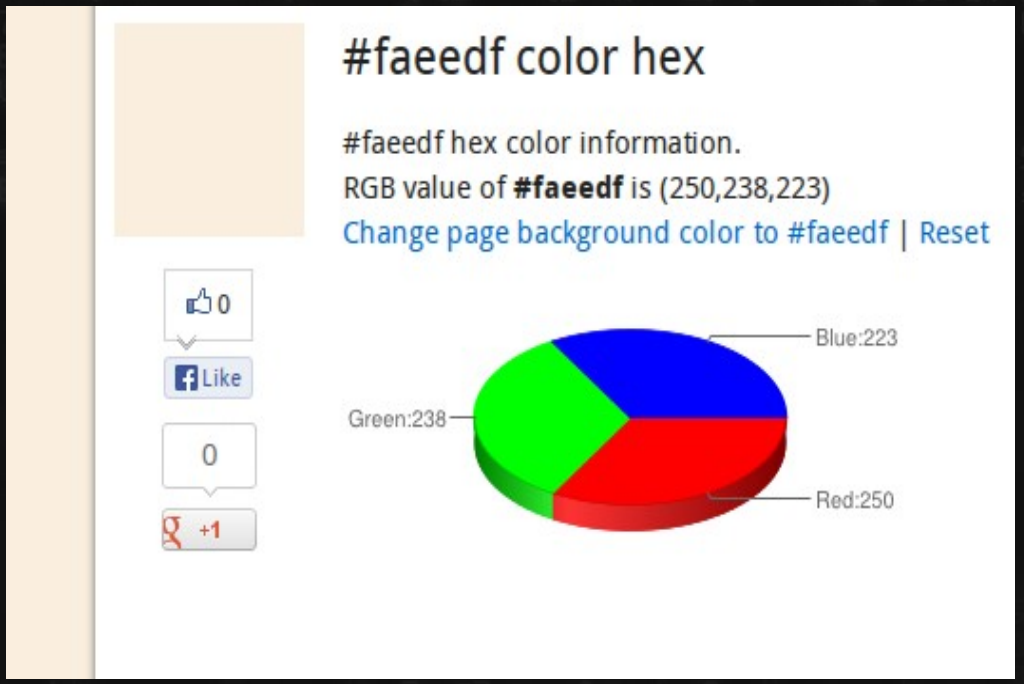
- MAC Address?
- Perhaps a computer was identifying itself.

`CD:BA:EE:FA:EE:DF`

What was sent?

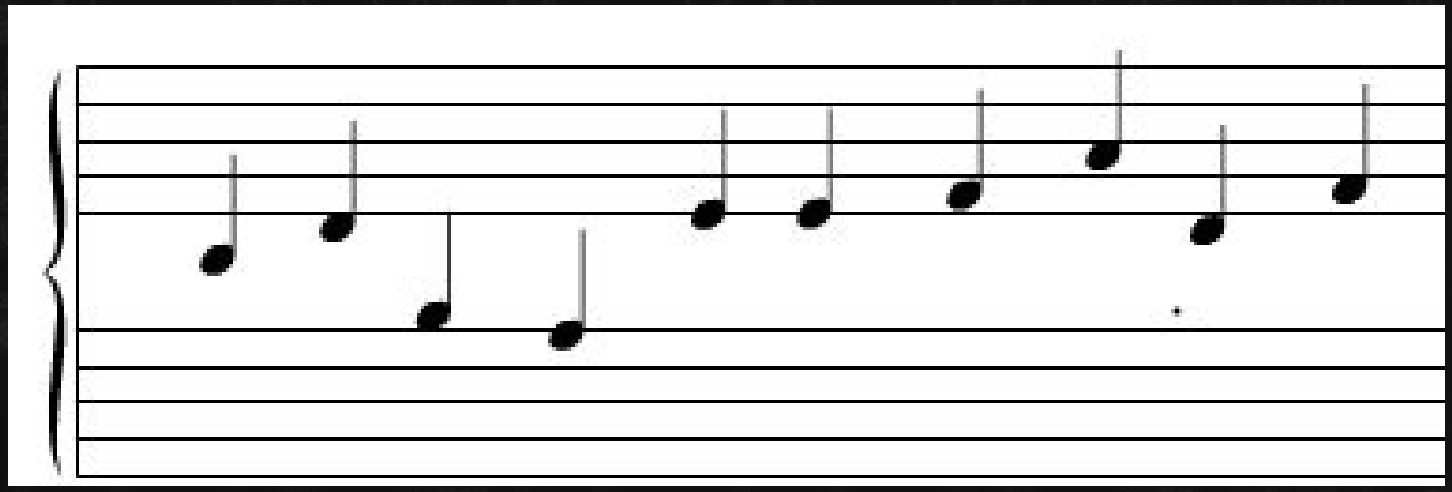
Perhaps, a lovely color scheme...

- 



What was sent?

Music?



What was sent?

Something else?

- 1100110110111010111011101111010111011101101111

What was sent?

Wait – maybe encrypted?

(badly)

Tricky...

C A F E

D E A D

B E E F

Obviously, a restaurant recommendation. (Or not.)

Cafe Dead Beef

Top 3 things about the net:

3) packet switching

2) DIGITIZATION

(literally, turning any “data” into a number)

Top 3 things about the net:

3) DIGITIZATION

(literally, turning any “data” into a number)

NOTE, as demonstrated:
The nodes need not know or care what the data “is”

(Later, we learn that ,in fact, encryption can prevent them from knowing)

But: Phones and other older tech (sort of) had this:

- telegraph?
- Fax Machines (documents)
- Party Lines (group chat)
- Info Hotlines (websites)

But: Phones (sort of) had this:

:

This brings us to a good question:

Who owns the network?

Who owns your telephone and what does that mean?

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Top 3 things about the net:

3) PACKET SWITCHING

Use of a “Dumb” Network:

2) DIGITIZATION

(literally, turning any “data” into a number)

Top 3 things about the net:

3) PACKET SWITCHING

Use of a “Dumb” Network:

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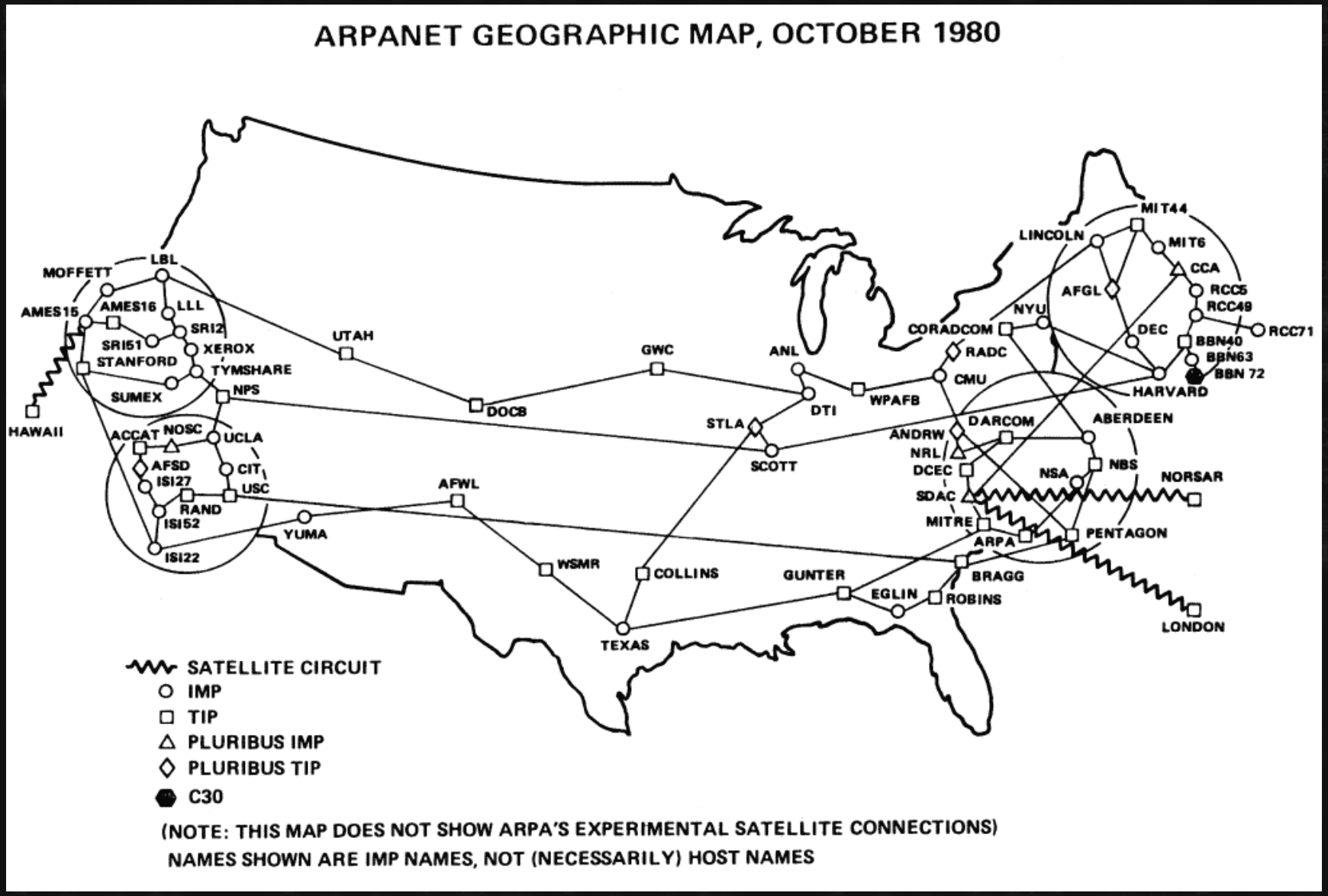
(literally, turning any “data” into a number)

1)…. who owns the internet?

ARPANET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SCOTT
ABERDEEN
DARCOM
ANDRW
NRL
DCEC
NSA
NBS
NORSAR
SDAC
MITRE
PENTAGON
ARPA
BRAGG
ROBINS
EGLIN
GUNTER
COLLINS
WSMR
TEXAS
LONDON
AFWL
YUMA
RAND
ISI52
ISI22
AFSD
ISI27
USC
CIT
UCLA
ACCAT
NOSC
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3 things about the 'net...

DIGITIZATION

+

PACKET SWITCHING

+

PUBLICLY CREATED UTILITY

(somewhat controversial) thoughts on innovation

The public sector (schools, defense, NASA, government) etc. is as inventive and as innovative as private companies...

perhaps, probably more.

(the internet, GPS, touchscreens, digital photography, water filters, invisible braces etc.)

Why didn't the American Telegraph and Telephone company invent the Internet?

Nobody owns the Internet.

Nobody owns the Internet.
(technically)

It's a "protocol" or
"technical agreement"

Nobody owns the Internet.

Consider: “Cable” v. “Telephones” etc., vs. “The Internet”

Side Question:

Who gives you the fastest Internet?

Of course: Who were the “ISPs” in the beginning?

Earthlink, America Online
Juno, “Freenet”
Schools. Libraries. Community centers

Of course: Who were the “ISPs” in the beginning?

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Schools. Libraries. Community centers

What about now?
Comcast, AT&T, Verizon, etc..

3 things about the 'net...

DIGITIZATION

+

PACKET SWITCHING

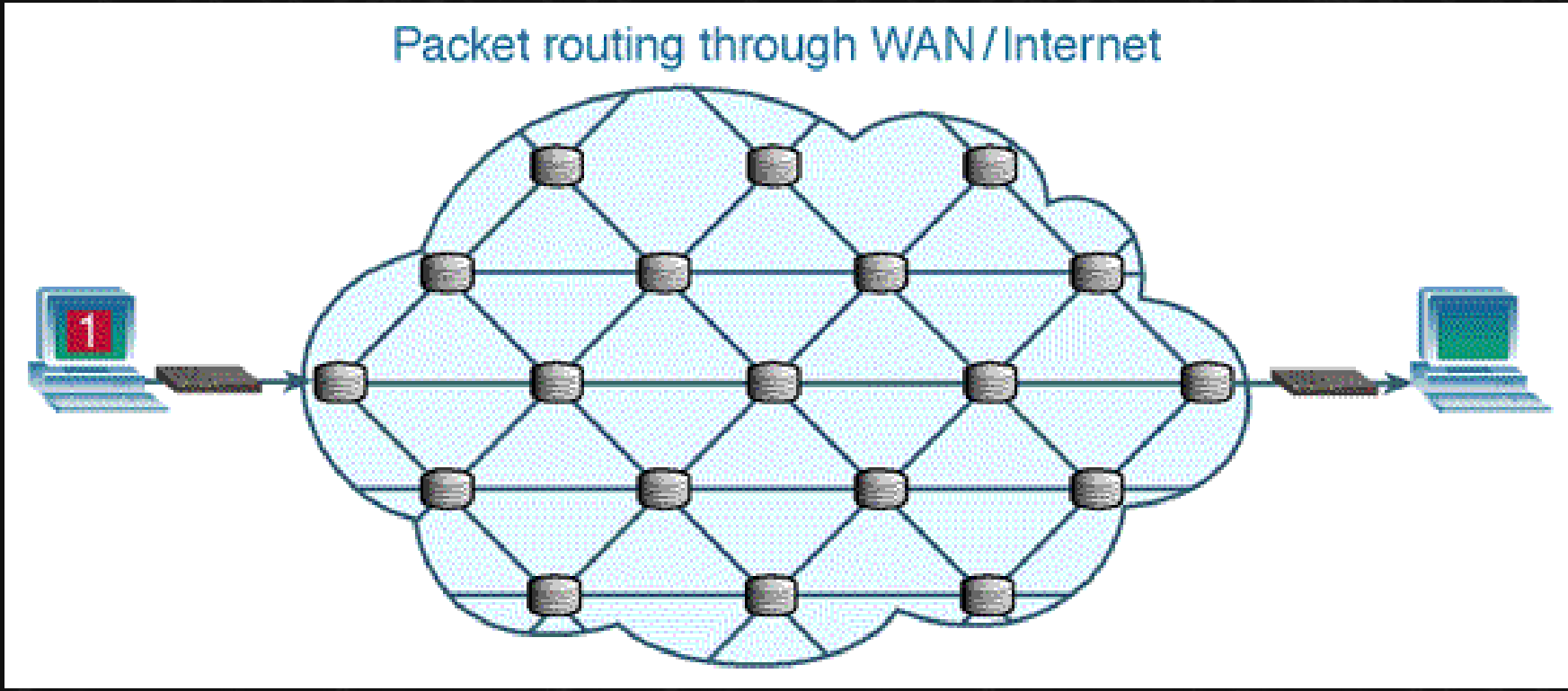
+

PUBLICLY CREATED UTILITY

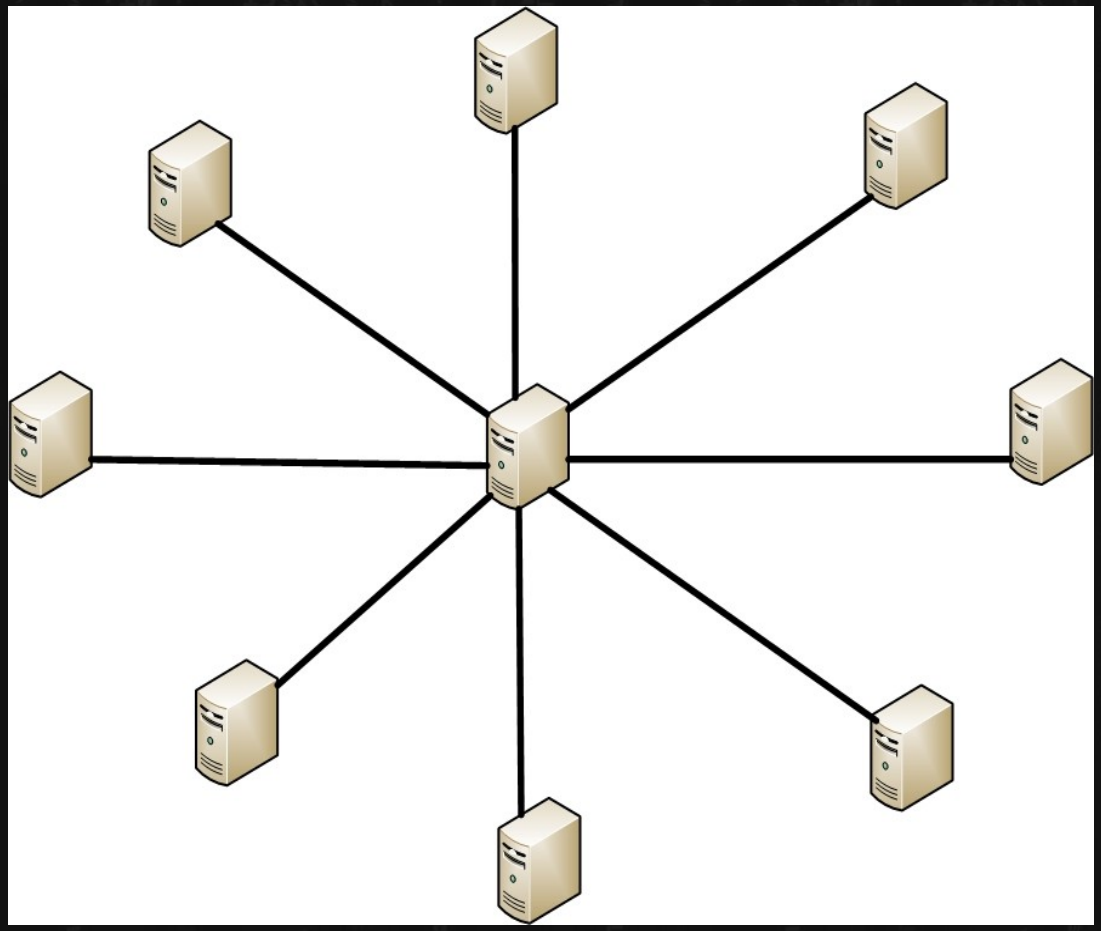
=

Peer to peer node based network

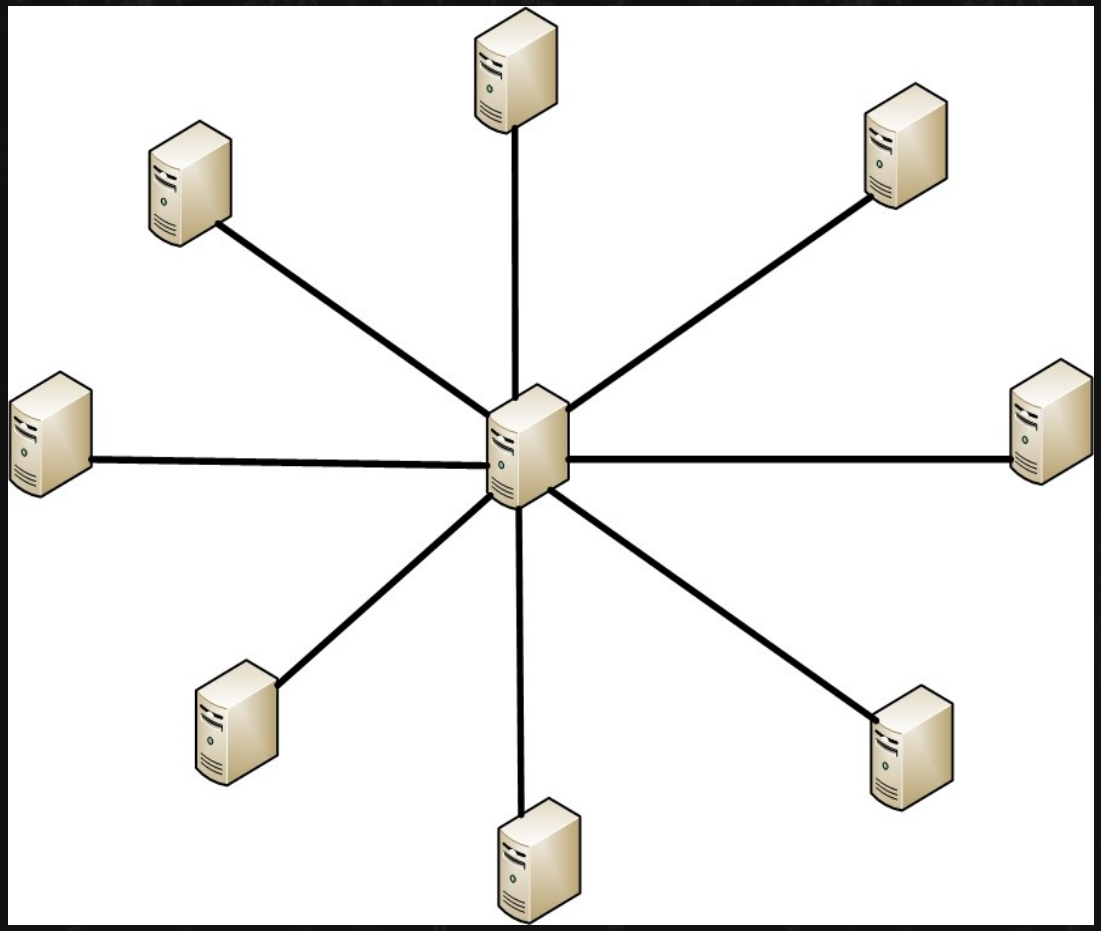
What services/protocols ACTUALLY look like this?



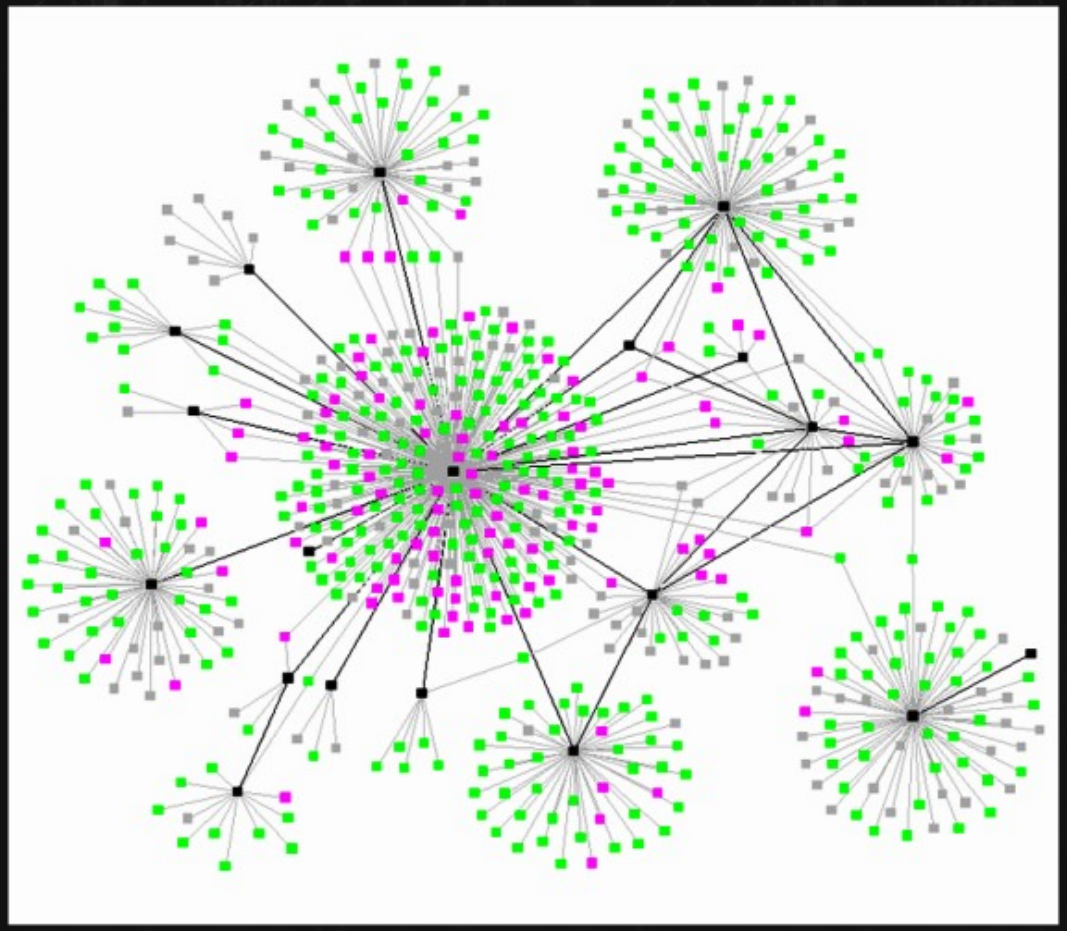
vs. this?



“Hub and Spoke”



...ish



Diversity of layers (OSI)

- Application (HTTP, telnet, etc)
- Presentation (framework MIME)
- Session (pipe,SOCKS)
- Transport (reliable packet delivery, TCP)
- Network (nodes and address, IP)
- Data (PPP)
- Physical (wires, radio, USB)

Diversity of layers...unofficial

Platform? *Ecosystem?* *Use?*
(e.g. Wordpress, Facebook? Apple?

dreams love? Instagram?
Twitter? Black Twitter?
Fortnite? selfies Discord? Hopes Slack?
Mastodon? Etc. etc. etc.)

- Application (HTTP, telnet, “email”)

Diversity of transmission media:

- telephone lines (modem/DSL)
- - tv cable
- - wireless (802.11)
- - satellites
- - radio
- - lasers (pointless, but true)
- - fiber

The “Usual Path”

- Your computer
- Your router
- ISP “station”
- Bigger ISP Station/Backbone

…. etc.

But wait, what does internet?

- Laptops
- Tablets
- Phones
- Routers
- Cars
- Ovens?

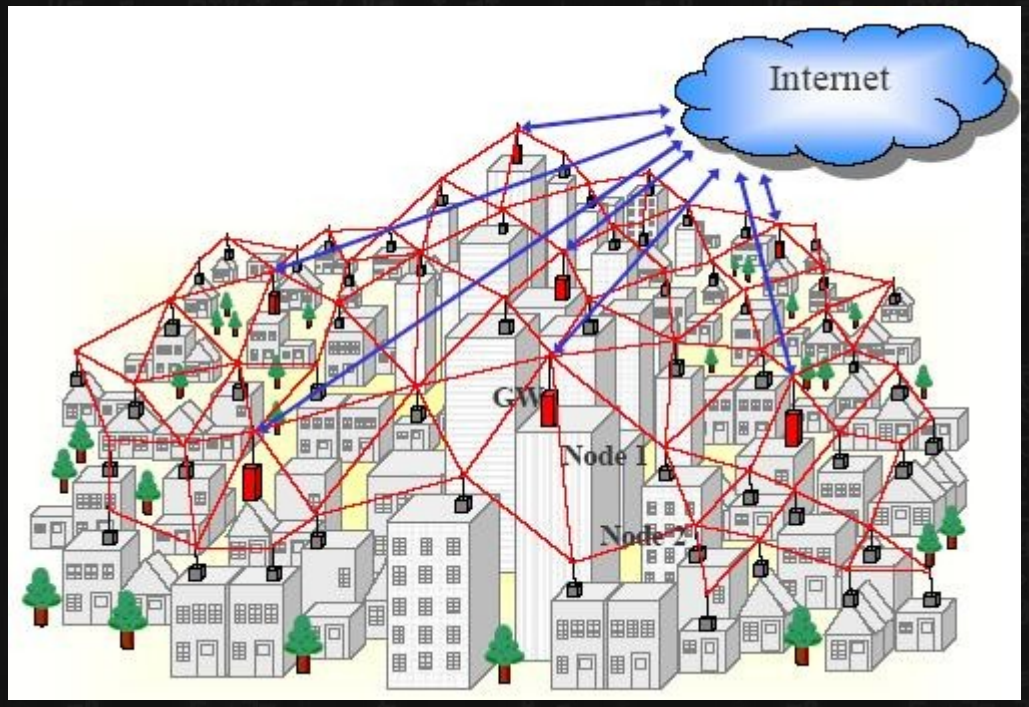
wardrive, and find out yourself – :)

Lampposts?

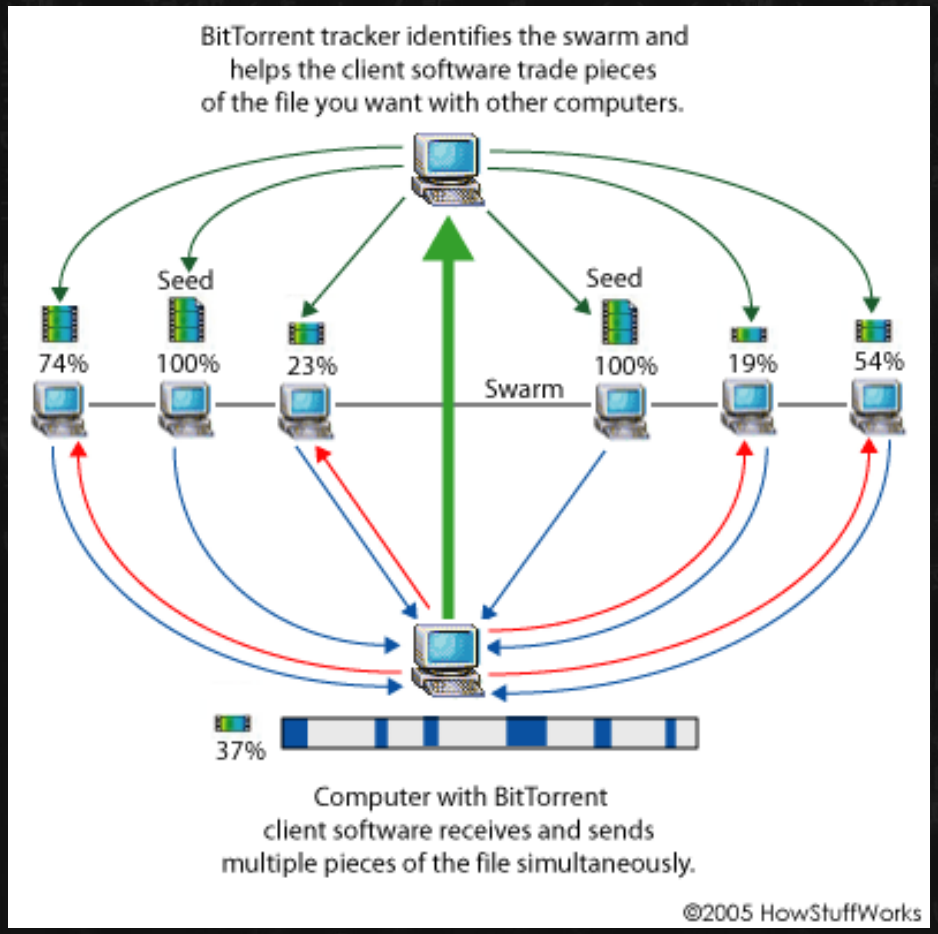
All running you know what...

```
[root@treasure ~]# iptables -L -n
Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
MAC-STOP   all  --  0.0.0.0/0            0.0.0.0/0
RH-Firewall-1-INPUT  all  --  0.0.0.0/0           0.0.0.0/0

Chain INPUT (policy ACCEPT)
target     prot opt source               destination
MAC-STOP   all  --  0.0.0.0/0            0.0.0.0/0
RH-Firewall-1-INPUT  all  --  0.0.0.0/0           0.0.0.0/0

Chain MAC-STOP (2 references)
target     prot opt source               destination
RETURN     all  --  0.0.0.0/0            0.0.0.0/0

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination

Chain RH-Firewall-1-INPUT (2 references)
target     prot opt source               destination
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
ACCEPT     icmp --  0.0.0.0/0            0.0.0.0/0           icmp type 255
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0           state RELATED,ESTABLISHED
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:928
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:139
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:22
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:80
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0           state NEW tcp dpt:21
REJECT     all  --  0.0.0.0/0            0.0.0.0/0           reject-with icmp-host-prohibited
[root@treasure ~]#
```

Mesh Networking



Look familiar?



No Cell or Wi-Fi....