The Curse of Unreasonably Sized Networks

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SREConCon EMEA 2020

Human Relationships

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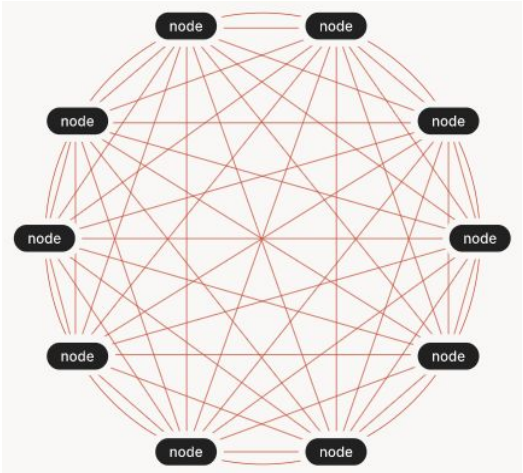
Computer Networks

Good news and bad news about scaling

Metcalfe's Law

"The effect of a telecommunications network is proportional to the square of the number of connected users of the system (n^2)."

(Bob Metcalfe, as recorded by George Gilder)



Brooks's Law

"Communication overhead increases as the number of people increases. Due to combinatorial explosion, the number of different communication channels increases rapidly with the number of people."

(The Mythical Man-Month by Fred Brooks)

Good news and bad news about scaling (2)

Linus's Law (in theory)

"Given enough eyeballs, all bugs are shallow."

(The Cathedral and the Bazaar by Eric S Raymond)

Linus's Law (in practice)

"Google's popular projects had a 27% higher bug fix rate than Google's less popular projects. […] This is an indication of increased bug detection efficiency in popular projects."

(The Corrective Commit Probability Code Quality Metric by Amit and Feitelson)

Law of the panopticon

The more connected a network gets, the more criticism everyone gets.

Dunbar's number

"[…] evidence for the coevolution of neocortical size and social group sizes […] the equivalent group size for our species should be approximately 150 (essentially the number of people known personally as individuals)."

(Discrete Hierarchical Organization of Social Group Sizes by Zhou, Sornette, Hill, and Dunbar)

150

Identity

"Companies smaller than 150 don't bother with name badges."

"In small companies, Alice and Bob handle accounting. In larger companies, it's the accounting department — and maybe you know someone there personally."

(Liars and Outliers and Security, Group Size, and the Human Brain by Bruce Schneier)

Dunbar's number(s)

1
3-5
10-15
50
150
500
3k
15k
50k
150k
>1M

Dunbar's number(s)

	Western Society
1	libertarian enclave
3-5	household
10-15	neighbourhood; homestead
50	hamlet
150	**village**
500	
3k	township
15k	town
50k	borough; district
150k	city
>1M	metro → province → nation → federation

Dunbar's number(s)

	Western Society	**Military**
1	libertarian enclave	soldier
3-5	household	fireteam
10-15	neighbourhood; homestead	squad
50	hamlet	platoon
150	**village**	**company**
500		battalion
3k	township	regiment
15k	town	division
50k	borough; district	corps
150k	city	
>1M	metro → province → nation → federation	

Dunbar's number(s)

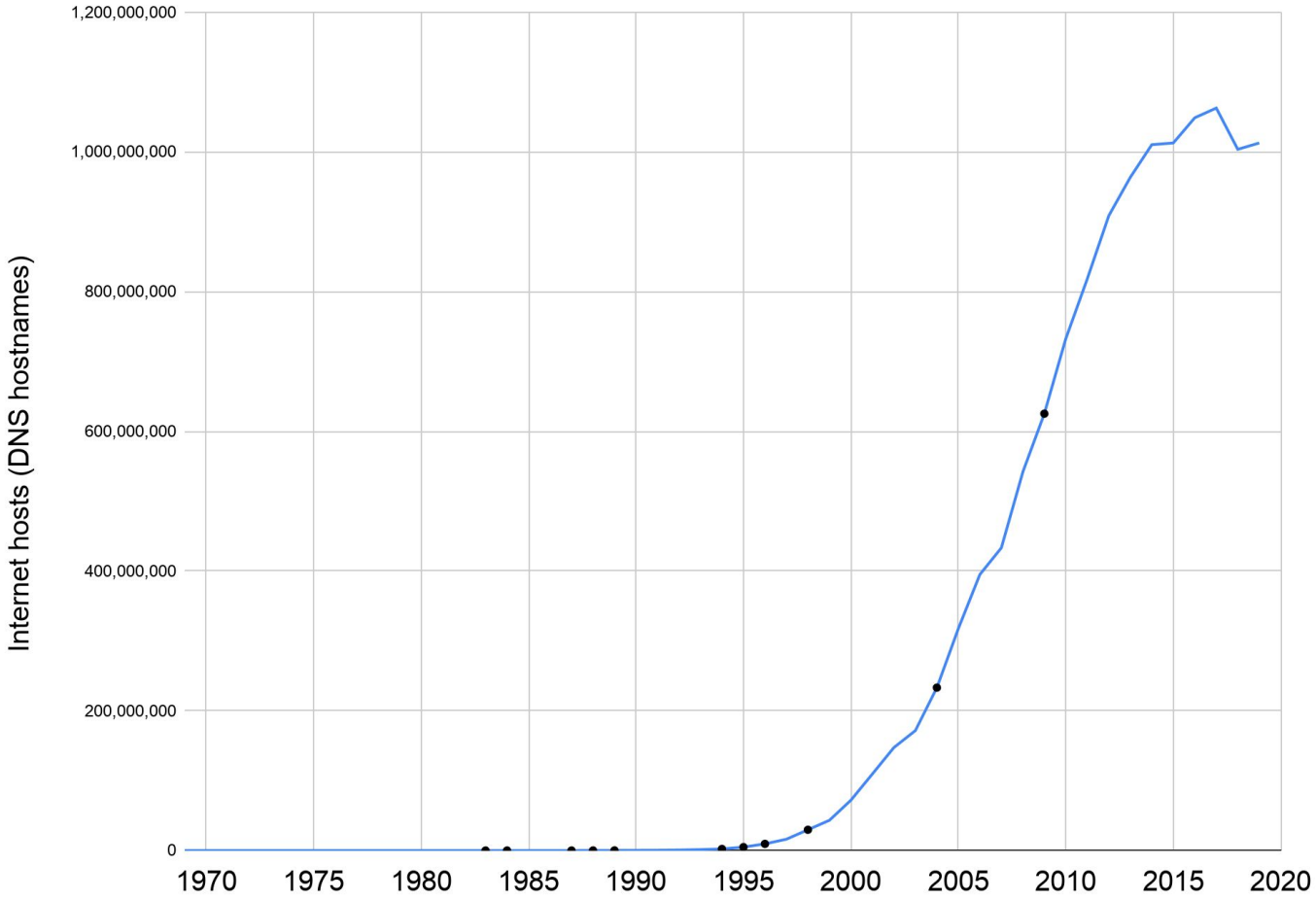
	Western Society	Military	Corporations
1	libertarian enclave	soldier	sole proprietorship
3-5	household	fireteam	partnership
10-15	neighbourhood; homestead	squad	seed stage
50	hamlet	platoon	series A
150	**village**	**company**	**series B**
500		battalion	(S)MB
3k	township	regiment	S(M)B
15k	town	division	enterprise
50k	borough; district	corps	large enterprise
150k	city		megacorp
>1M	metro → province → nation → federation		military-industrial complex

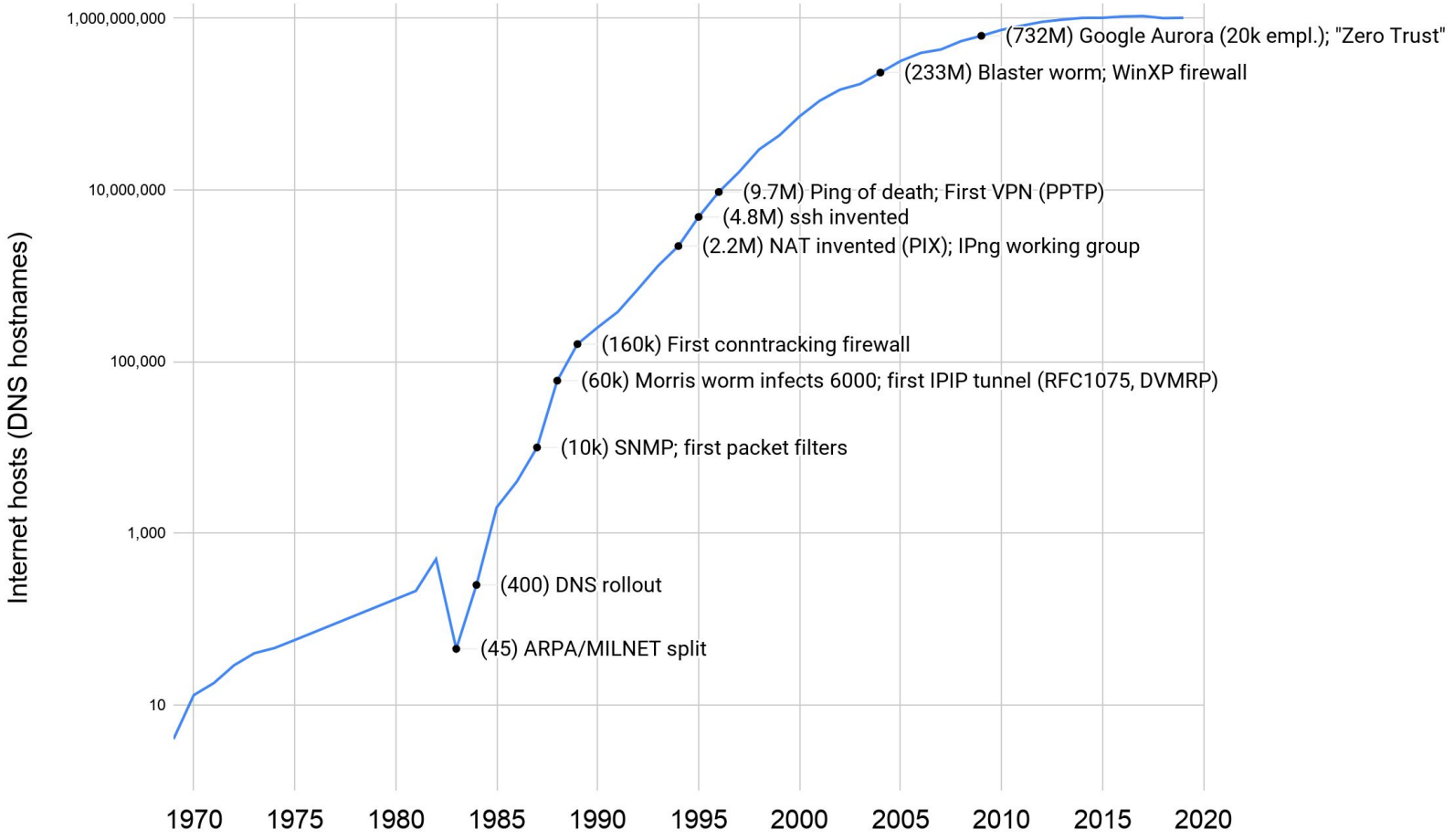
Dunbar's number(s)

	Western Society	Military	Corporations	IPv4
1	libertarian enclave	soldier	sole proprietorship	/32
3-5	household	fireteam	partnership	/30
10-15	neighbourhood; homestead	squad	seed stage	/28
50	hamlet	platoon	series A	/26
150	**village**	**company**	**series B**	**/24**
500		battalion	(S)MB	/22
3k	township	regiment	S(M)B	/20
15k	town	division	enterprise	/18
50k	borough; district	corps	large enterprise	/16
150k	city		megacorp	
>1M	metro → province → nation → federation		military-industrial complex	

Dunbar's number(s)

	Western Society	Military	Corporations	IPv4	Internet growth	
1	libertarian enclave	soldier	sole proprietorship	/32		
3-5	household	fireteam	partnership	/30	1969	US-West
10-15	neighbourhood; homestead	squad	seed stage	/28	1970	US-West + East
50	hamlet	platoon	series A	/26	1975	
150	**village**	**company**	**series B**	**/24**	**1983**	**ARPA/MILNET split**
500		battalion	(S)MB	/22	1984	DNS
3k	township	regiment	S(M)B	/20	1985	
15k	town	division	enterprise	/18	1987	SNMP; packet filters
50k	borough; district	corps	large enterprise	/16	1988	Morris worm
150k	city		megacorp		1989	First conntrack firewall
>1M	metro → province → nation → federation		military-industrial complex		>1993	NAT, ssh, TLS, letsencrypt, …


Internet hosts (DNS hostnames)
1,200,000,000
1,000,000,000
800,000,000
600,000,000
400,000,000
200,000,000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


Internet hosts (DNS hostnames)
1,000,000,000
10,000,000
100,000
1,000
10
1970
1975
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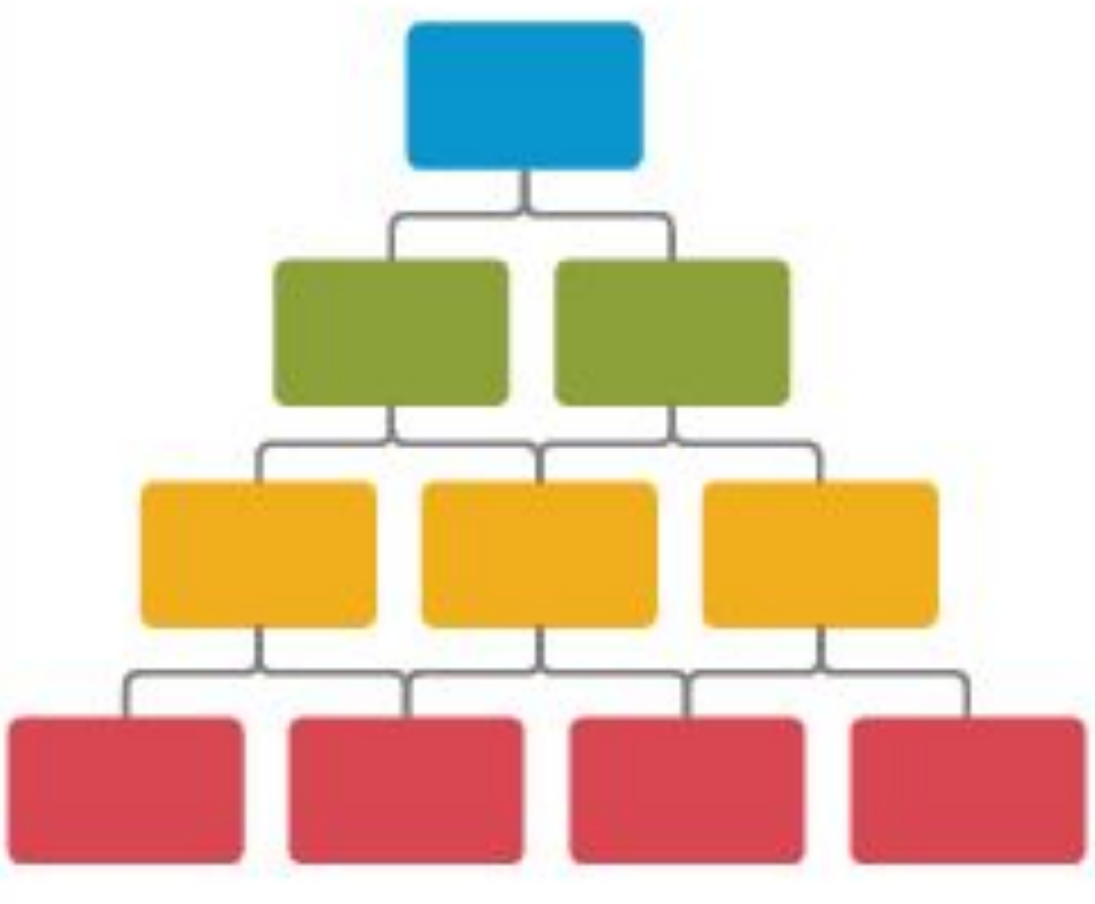
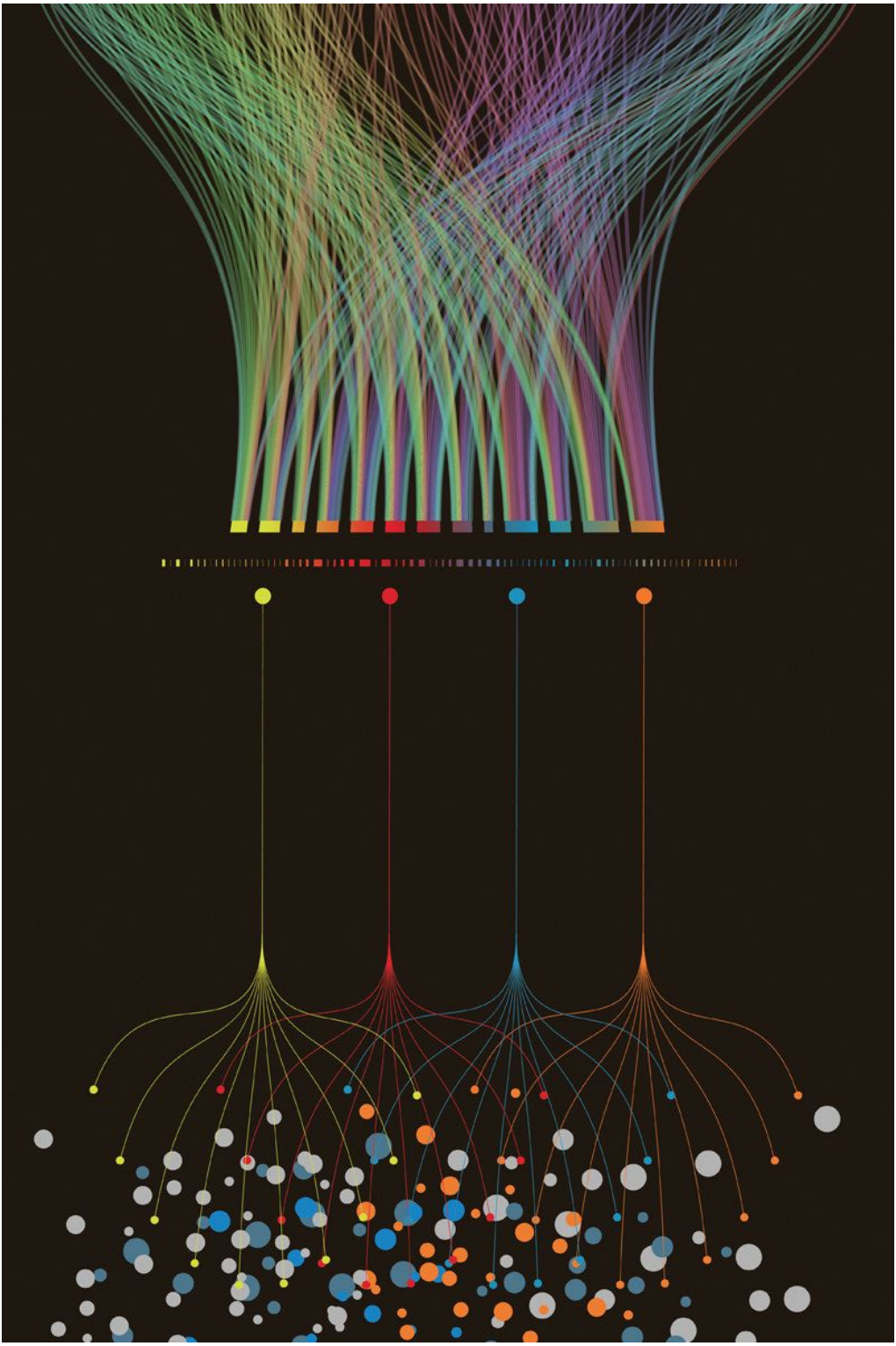
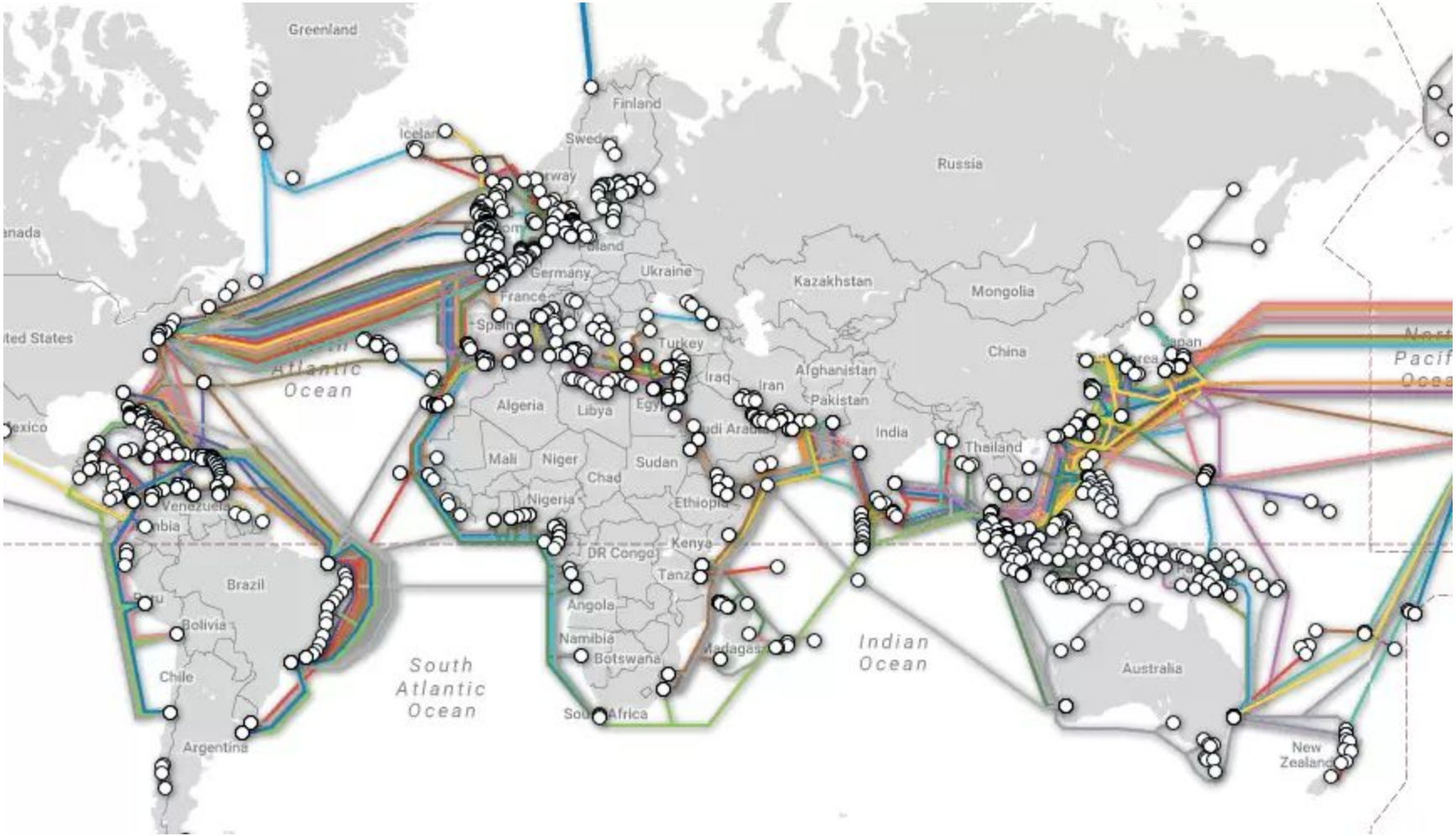
2005
2010
2015
2020
(732M) Google Aurora (20k empl.); "Zero Trust"
(233M) Blaster worm; WinXP firewall
(9.7M) Ping of death; First VPN (PPTP)
(4.8M) ssh invented
(2.2M) NAT invented (PIX); IPng working group
(160k) First conntracking firewall
(60k) Morris worm infects 6000; first IPIP tunnel (RFC1075, DVMRP)
(10k) SNMP; first packet filters
(400) DNS rollout
(45) ARPA/MILNET split

Designing Past 150



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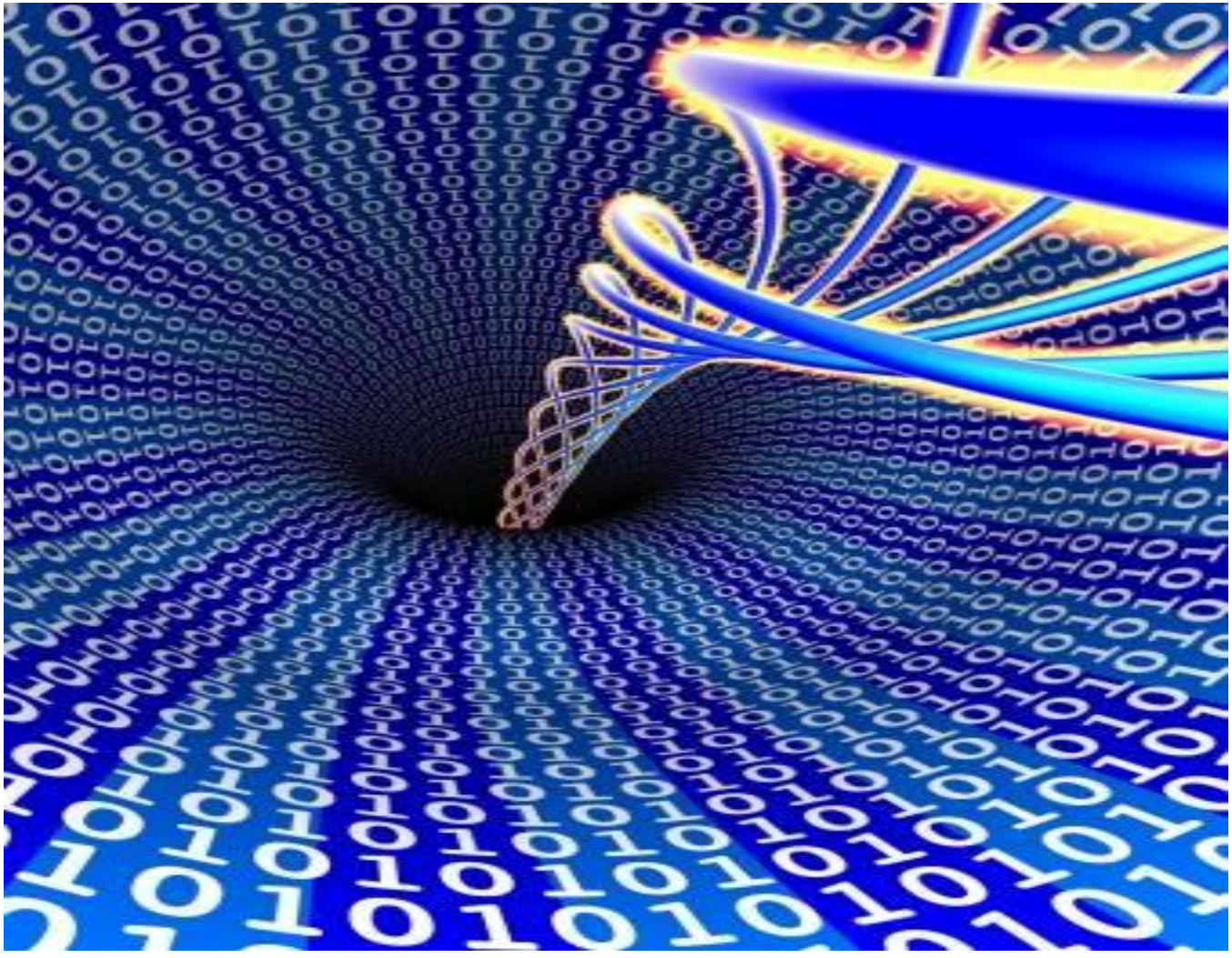
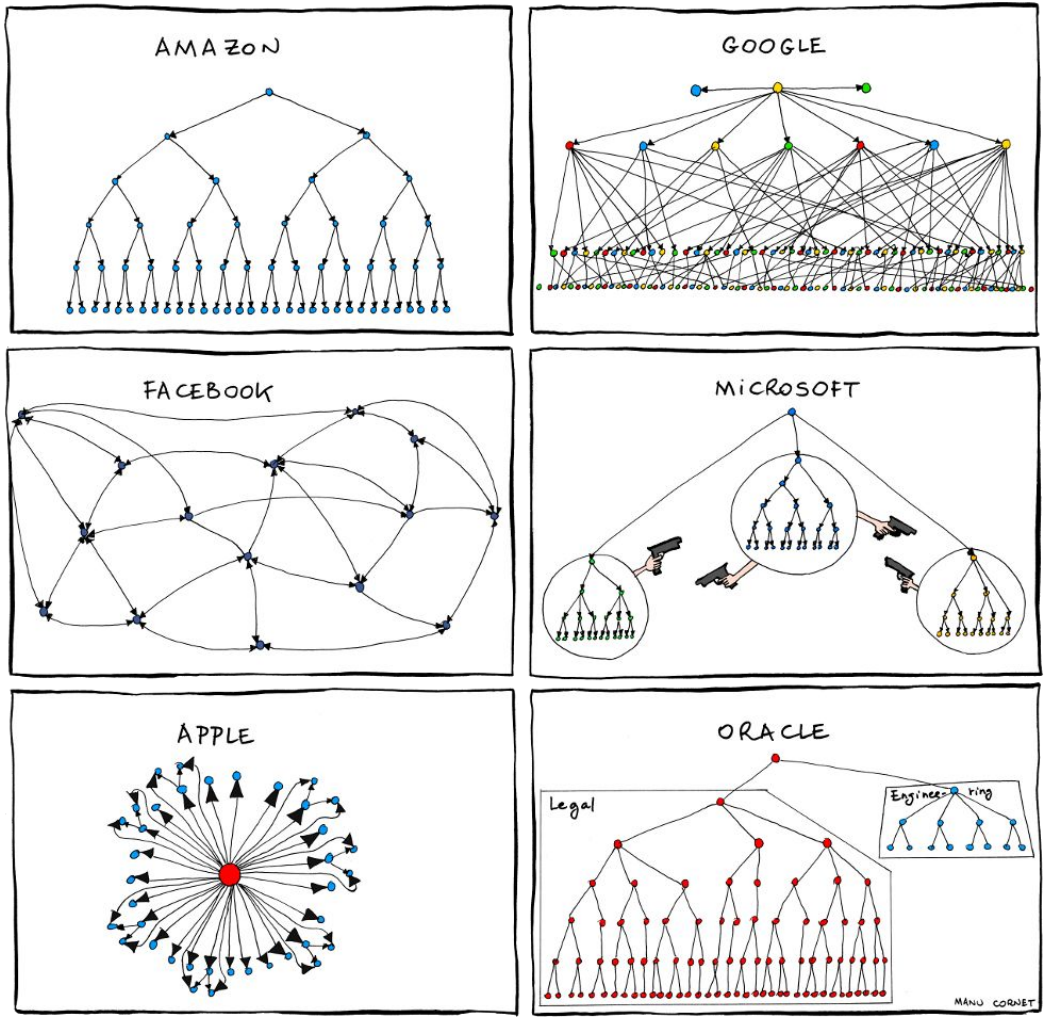
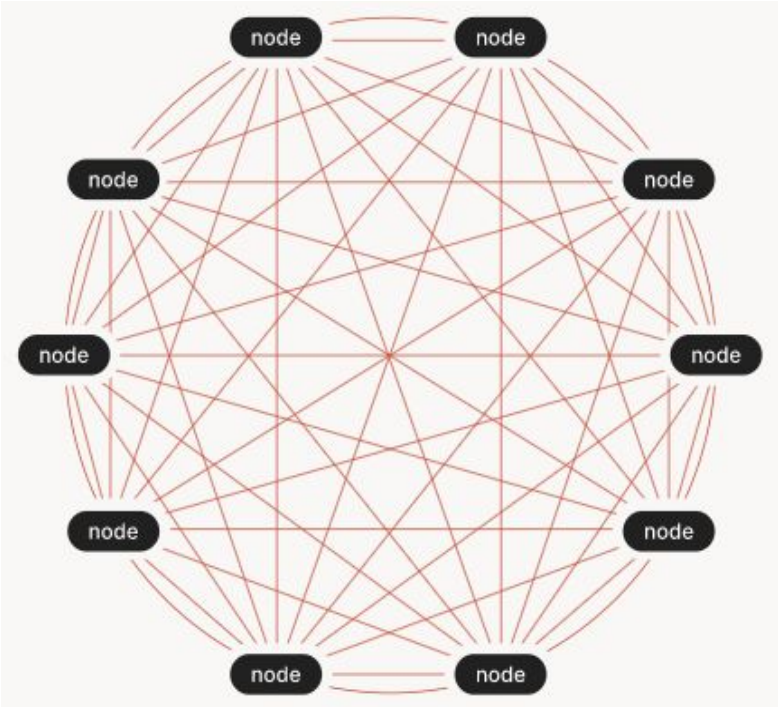
Pakistan
India
Thailand
Algeria
Libya
Egypt
Mali
Niger
Sudan
Chad
Nigeria
Ethiopia
Kenya
DR Congo
Tanzania
Angola
Namibia
Botswana
South Africa
Madagascar
Brazil
Bolivia
Chile
Argentina
Venezuela
Australia
New Zealand
North Atlantic Ocean
South Atlantic Ocean
Indian Ocean
North Pacific Ocean





Manu Cornet
bonkersworld.net (2011)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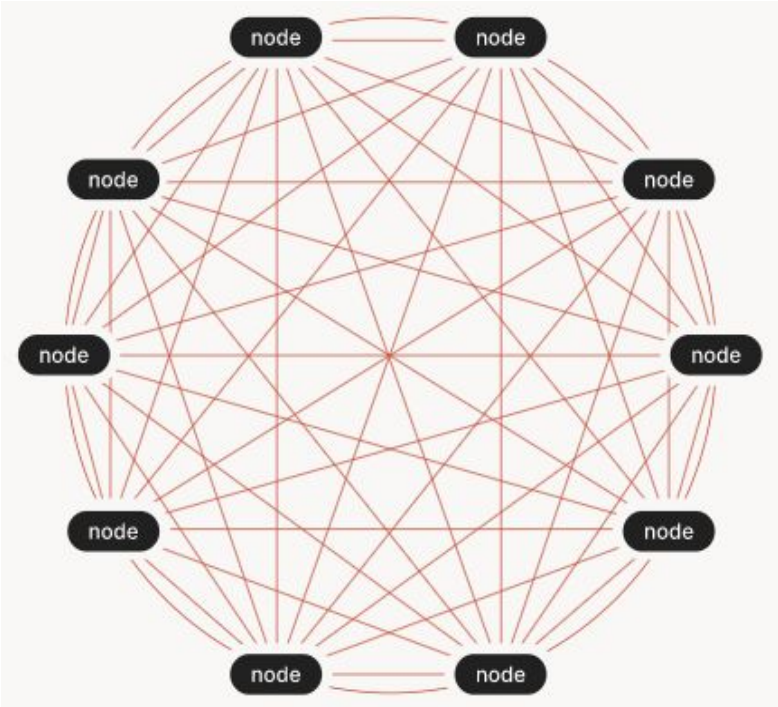
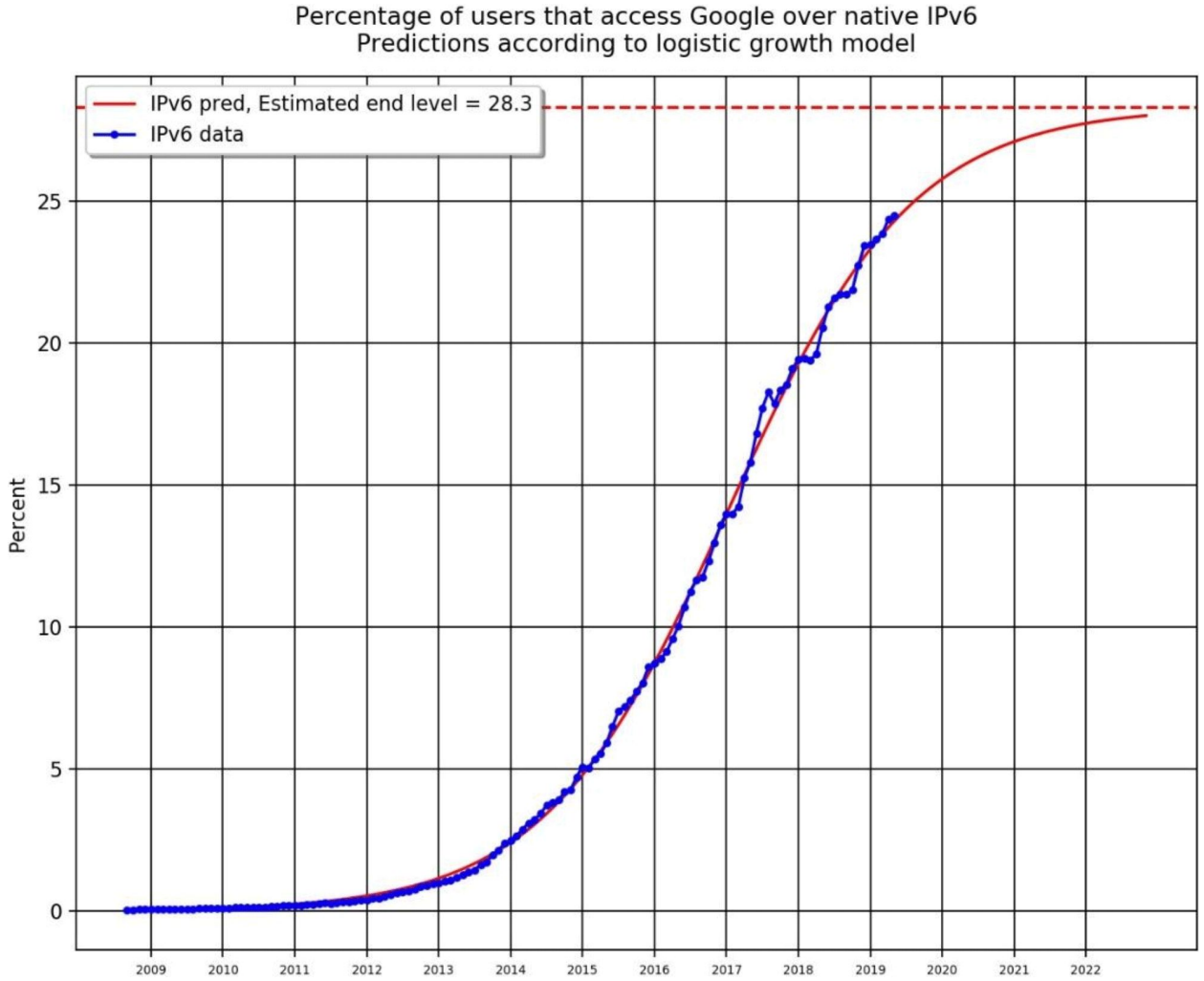
IPv6

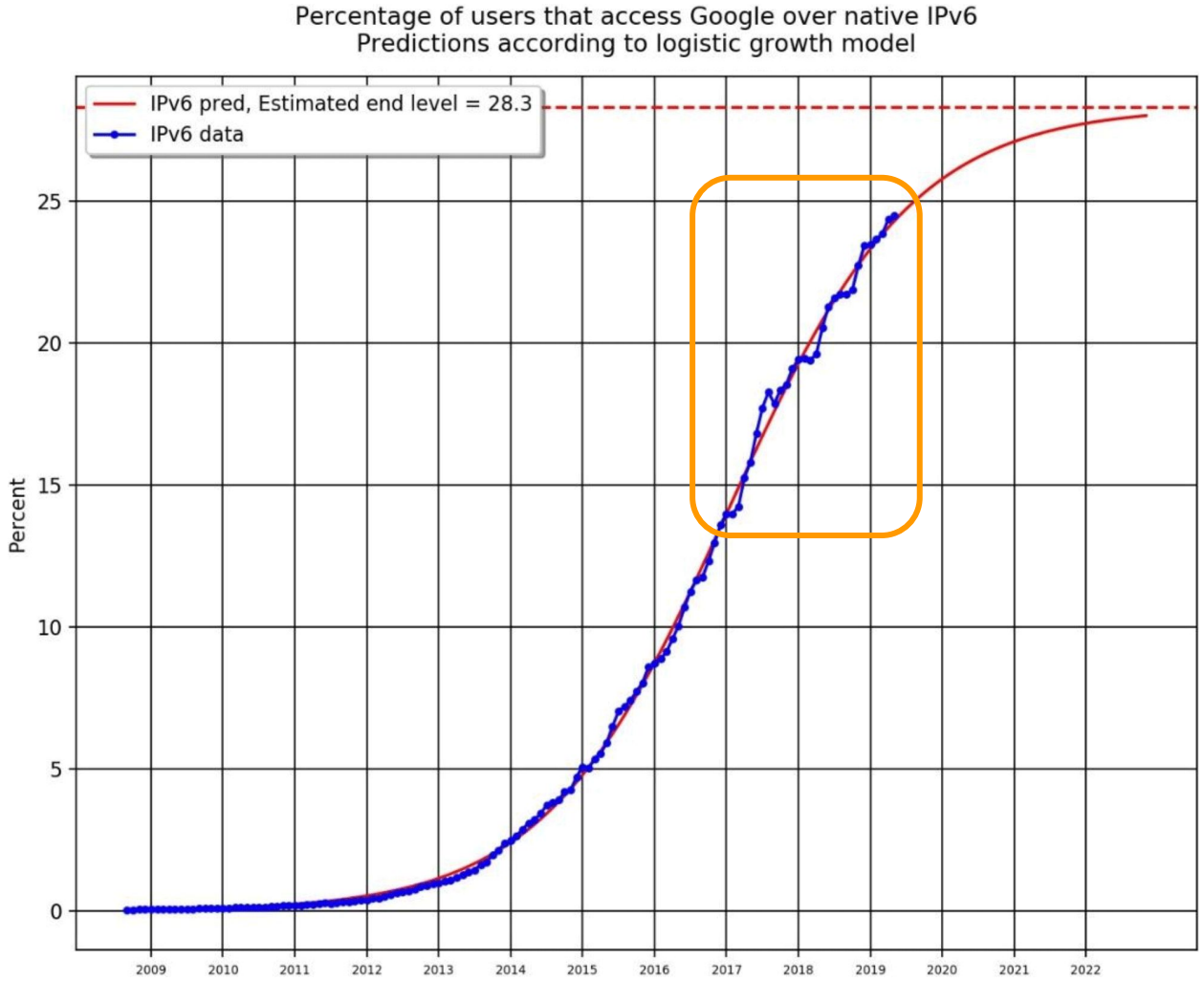


How is IPv6 like String Theory?



Christofer Flinta

[Is 28% deployment really the limit?]



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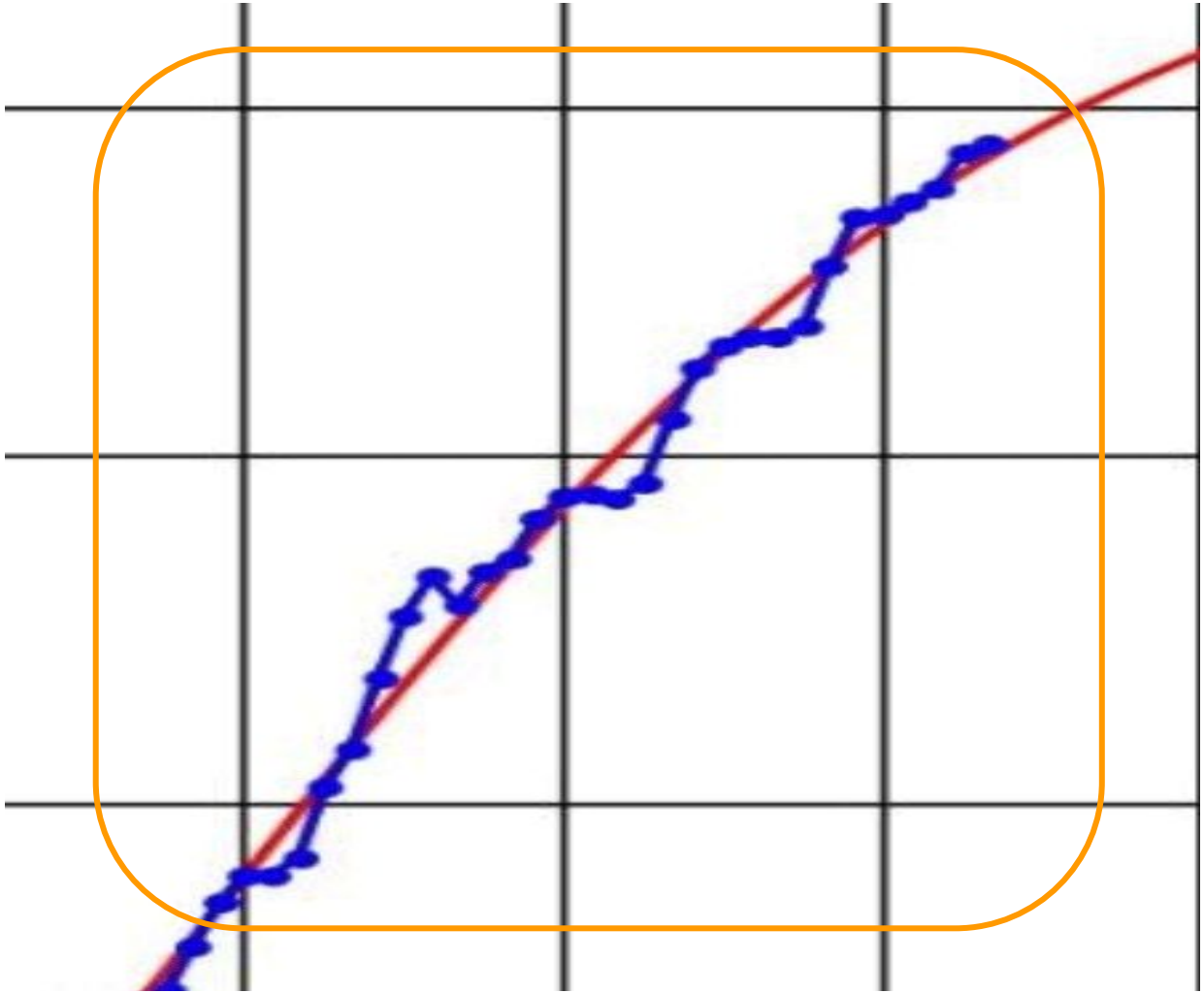
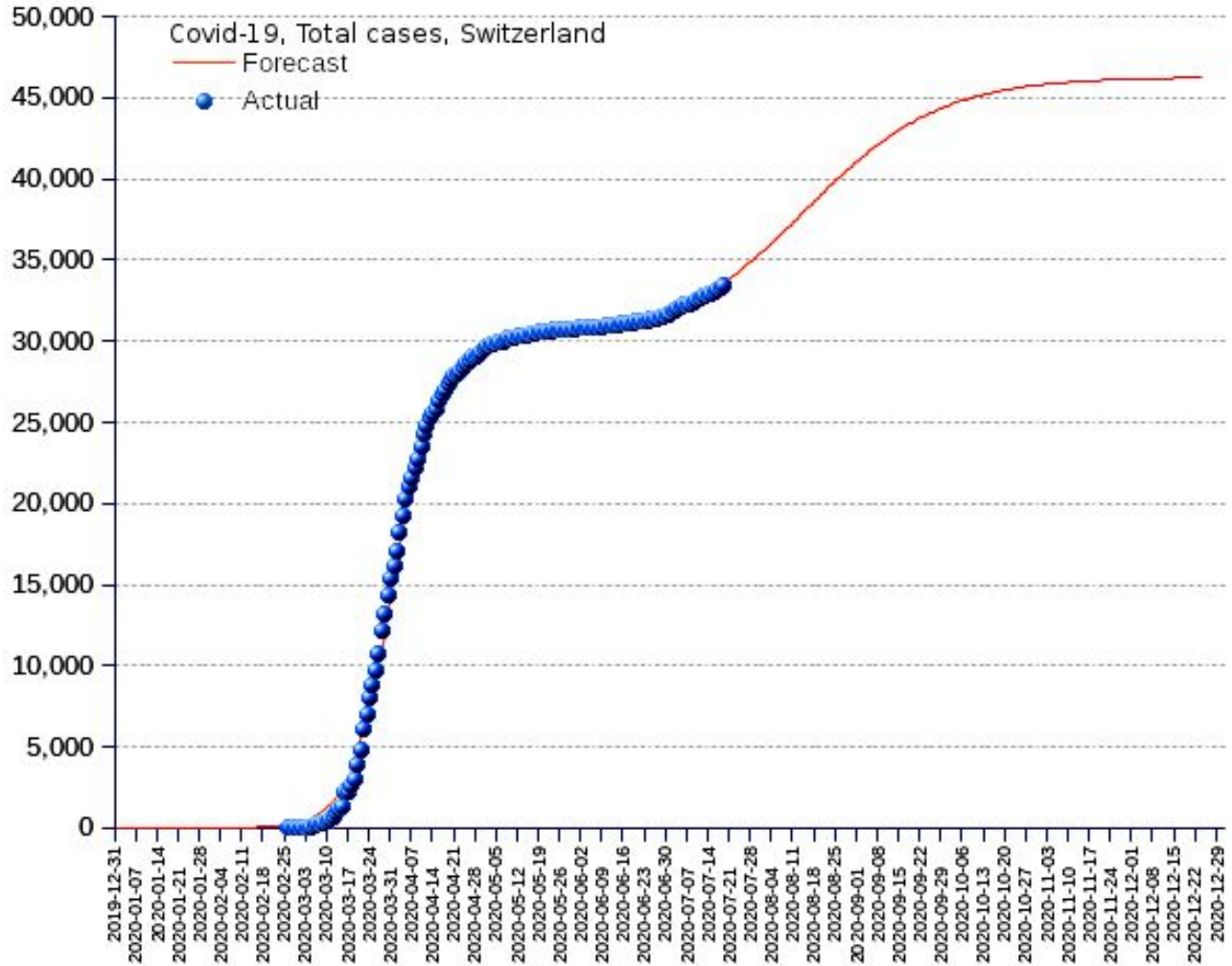


Christofer Flinta
Is 28% deployment really the limit?



areppim.com
Bi-logistic
double S-curve

Architectural Attitude

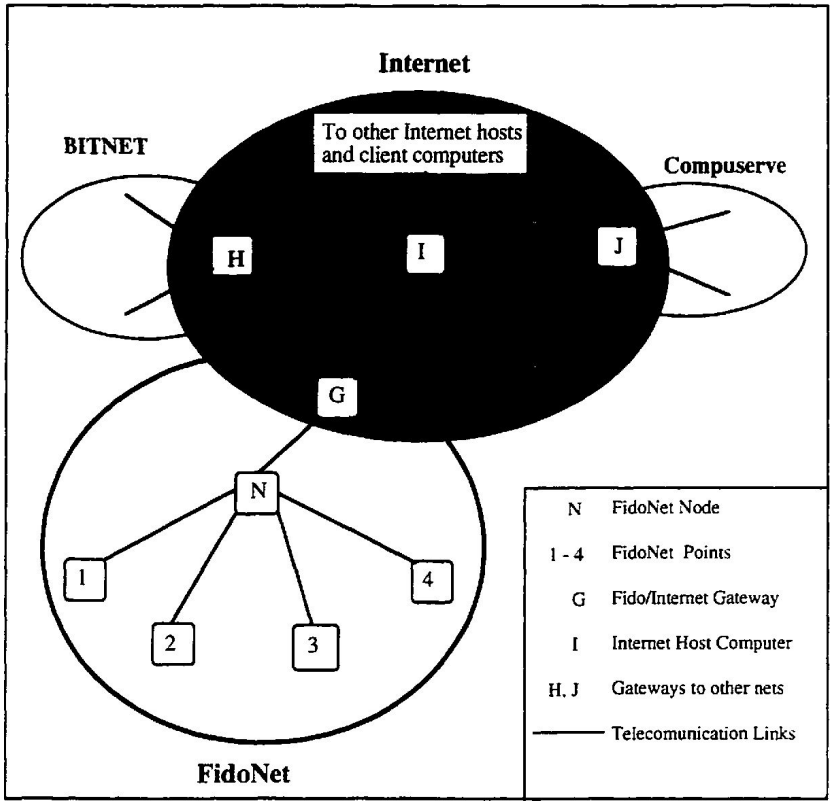
Postel's ~~Law~~ Suggestion

"TCP implementations should follow
a general principle of robustness:
be conservative in what you do,
be liberal in what you accept
from others."

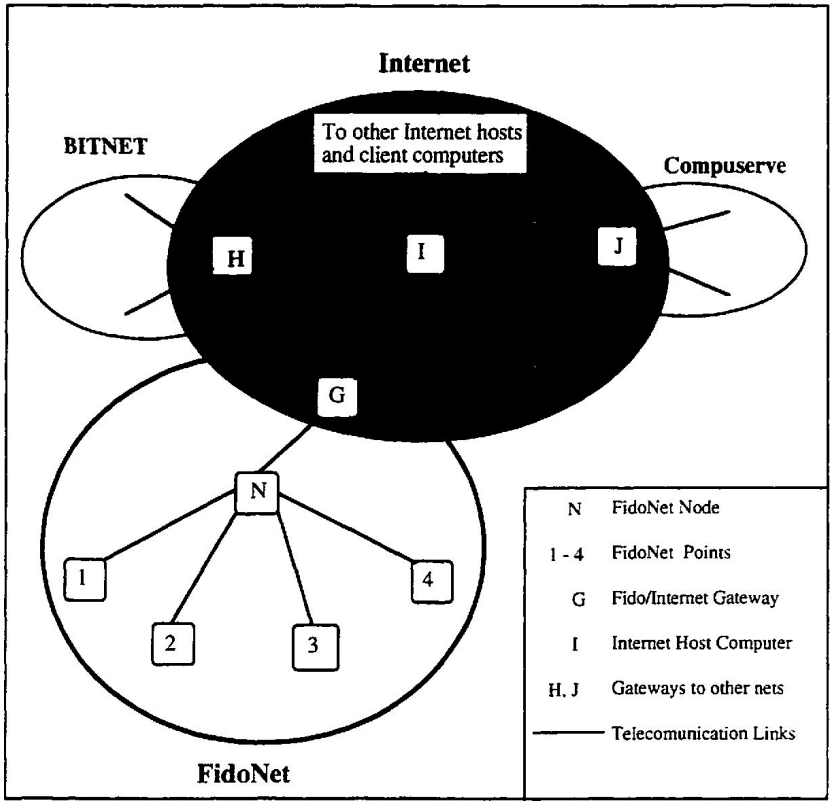
Jon Postel
RFC761 (1980)

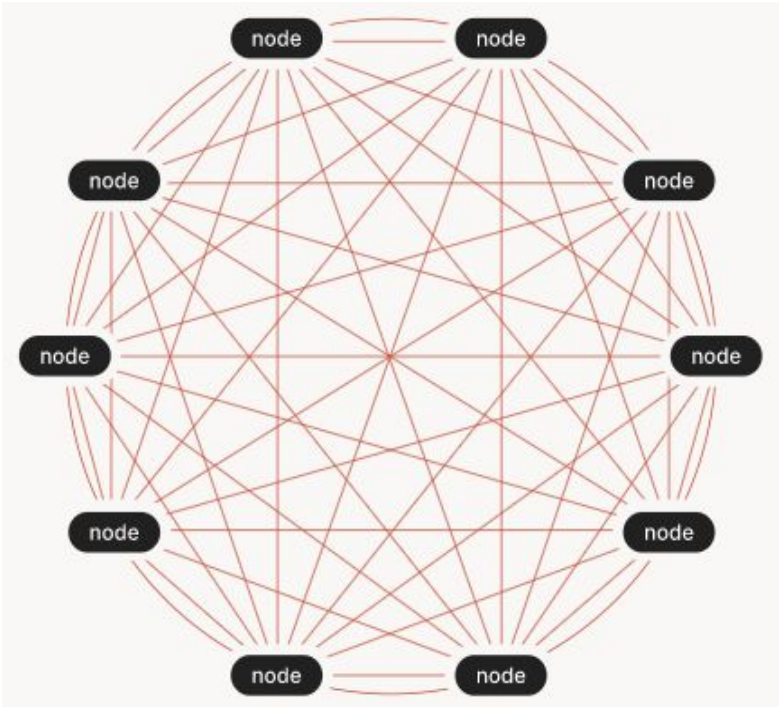
Postel's Actual Law

The only Internet that happens will be the one that follows Postel's Law.



Thank you!


Internet
To other Internet hosts and client computers
BITNET
Compuserve
H
I
J
G
N
1
2
3
4
FidoNet
N FidoNet Node
1 - 4 FidoNet Points
G Fido/Internet Gateway
I Internet Host Computer
H, J Gateways to other nets
Telecomunication Links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