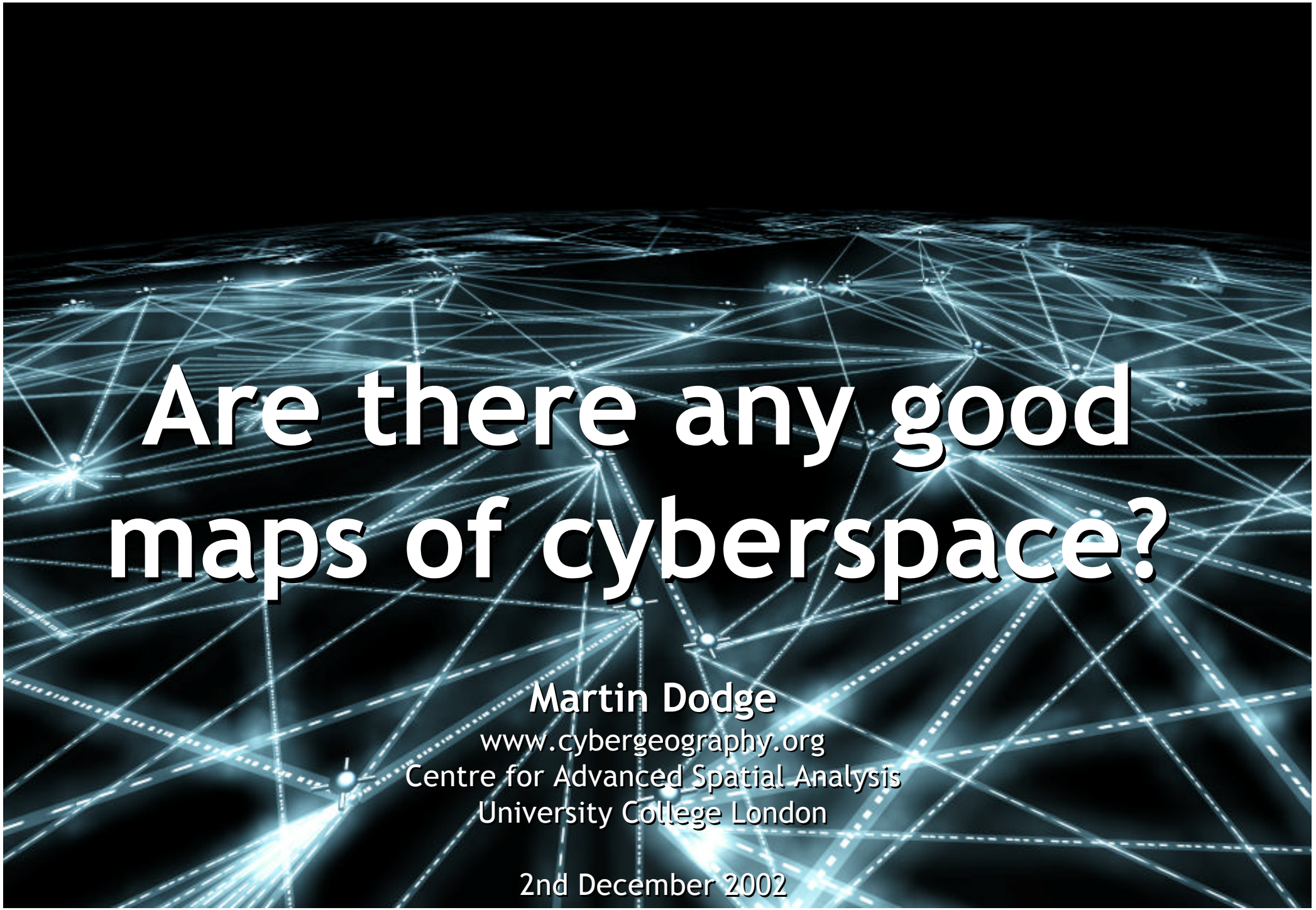
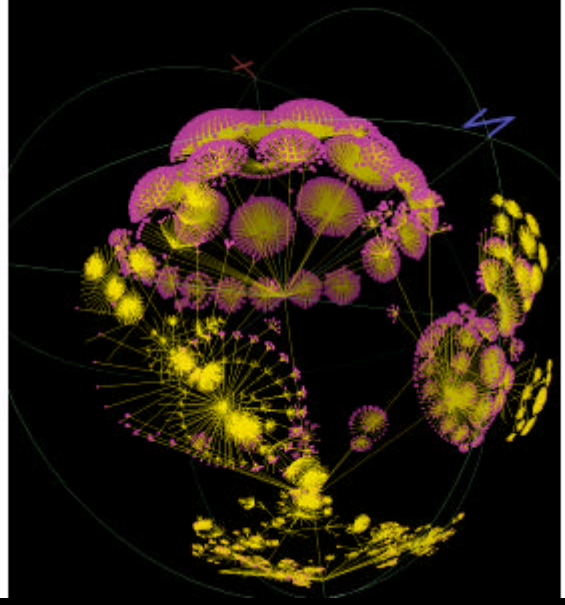


Are there any good maps of cyberspace?

Martin Dodge
www.cybergeography.org
Centre for Advanced Spatial Analysis
University College London

2nd December 2002

Here are some cyberspace maps



But are they any good???

- is it accurate?
- is it interpretable?
- it is useful?
- is it ethical?

the map is a help provided to the imagination through the eyes.
Henri Abraham Chatelain, Atlas Historique (1705)

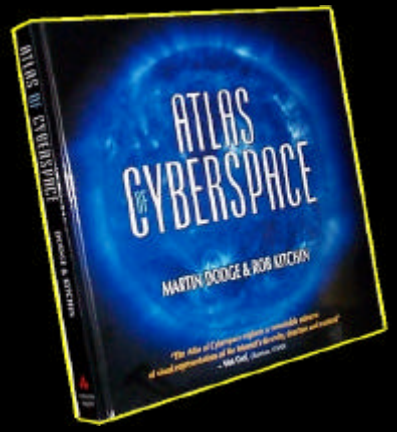
who am I?

- martin dodge like maps
- social geography, computing, GIS
- researcher in Centre for Advanced Spatial Analysis (CASA)
- now also a lowly lecturer in Geography at UCL
- part-time phd in cybergeography at UCL
- geography of the Net, cybergeography, cataloguing of diverse range of maps
- critical appraisal of maps and visualisation
- working with Peacock Maps

BA geography with computing at UKC (1992)

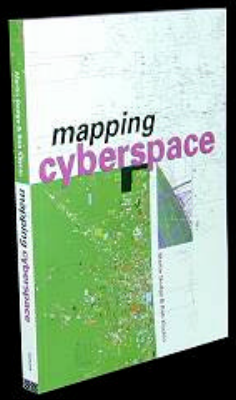
what have I been doing for since graduation??

1996



Oct. 2001

cybergeography



Sept. 2000

Phd Thesis

2003 ?

include standard disclaimer

- I talk about maps
- but I am not a cartographer
- and I am not a programmer or network engineer
- I did NOT make any of the maps in this talk!
- a typical critic

So the talk today

- some boring theory stuff
- bunch of examples of Internet infrastructure mapping
- a whole bunch more information maps
- conclude with some more theory (if I don't run out of time)

understanding cyberspace with maps

- there are many ways to describe and understand cyberspace
- economics, legal, mathematics, art, sociology, etc..
- I'm a geographer, so I believe *maps* enjoy a privileged position
- maps have been powerful visual tools for understanding the world for 1000s of years
- maps have been key in framing our understanding places, their size, shape and the relations between them
- maps have been vital for navigation
- maps vital in war, commerce and government

defining cyberspace mapping?

- cyberspace
  - the conceptual spaces of information and communications flows within the digital infrastructure of computing hardware, software code and high-speed telecommunications networks
  - it is not the technology or infrastructure itself, but the virtual spaces that this enables

- map and mapping
  - maps are graphic representations that facilitate a spatial understanding of things, concepts, conditions, processes, or events in the human world

(Harley and Woodward, *History of Cartography*, Volume 1, 1987)

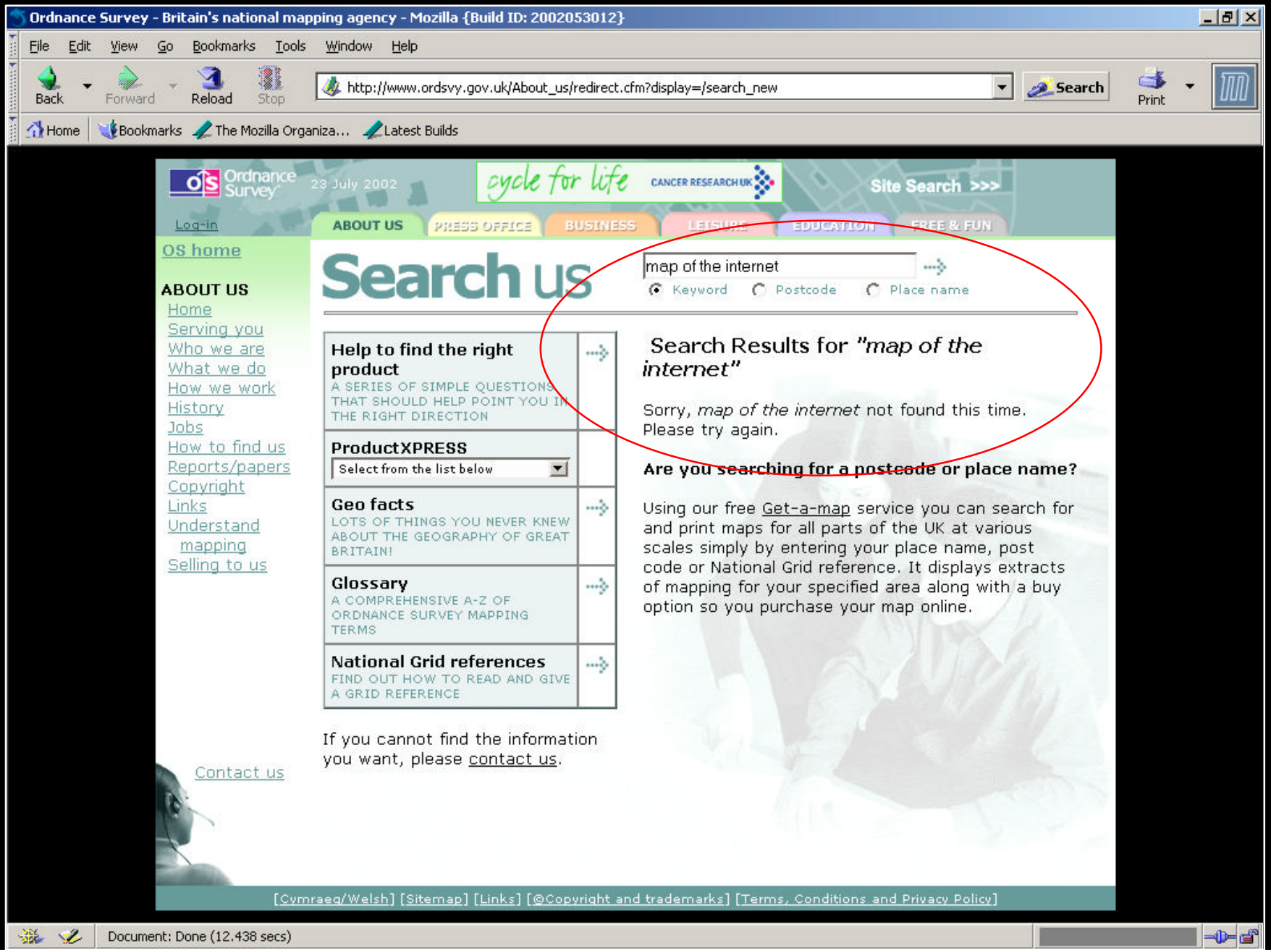
defining cyberspace mapping?

- cyberspace mapping concerned with maps that show some aspect of ICT infrastructure or conceptual digital information spaces

- maps *of* cyberspace, not maps *in* cyberspace

- my framing of the domain of cyberspace mapping is obviously artificial
- cyberspace mapping being done by lots of different people, groups and organisations. but not conventional cartography or GIS industry

who makes them? not cartographers!



but can we really map cyberspace?

- a common question, based on 2 misconceptions
  - maps have to be geographical
  - cyberspace is non-spatial and separate from geography
- challenge the ‘death of distance’ notions
- mapping is much wider than the OS, Times Atlas and A-Z street maps
- it hard to do though
  - cyberspace is new, its rapidly evolving, its fluid and its diverse. a lot of it is (increasingly) private space
  - breaks Euclidean conventions
  - we have very few good examples!
- there is no one true map of cyberspace

why map cyberspace?

- why are these maps interesting and significant?
- maps of cyberspace are important because they can tell us things about cyberspace
- and cyberspace is becoming increasingly important in our lives
- the human desire to explore the unknown
- cyberspace is one of the most significant terra incognita of the 21st century
- revealing what is hidden. making the invisible visible. enhancing our understanding
- maps as a census of cyberspace. feeding into government policy and business decisions

why map cyberspace?

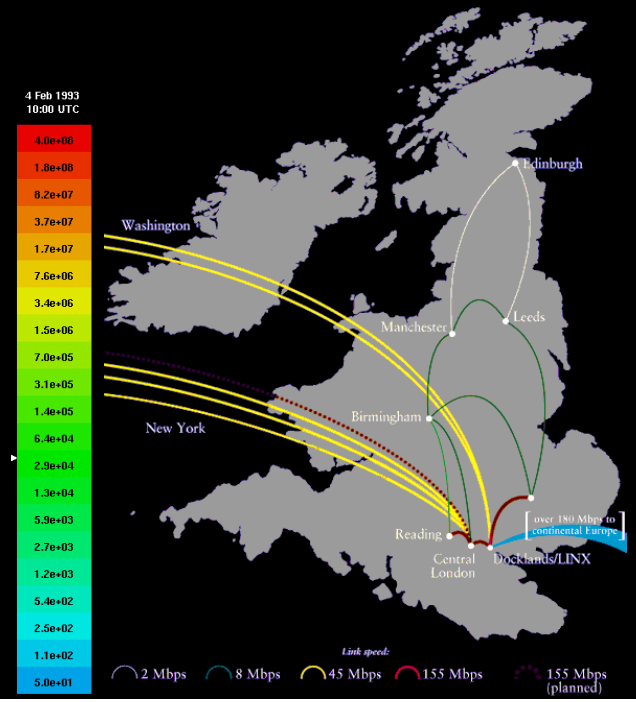
- maps shape our perception and knowledge of cyberspace. maps frame space
- maps also tell us things about the people who made them, and how they view cyberspace
- power, money and control
  - property maps of cyberspace
  - military and policing
  - what you can see, you can control and exploit
  - cartography redux
- increasingly our lives involve visual, CMC, screen-based interaction. who controls the ‘geography of the screen’?

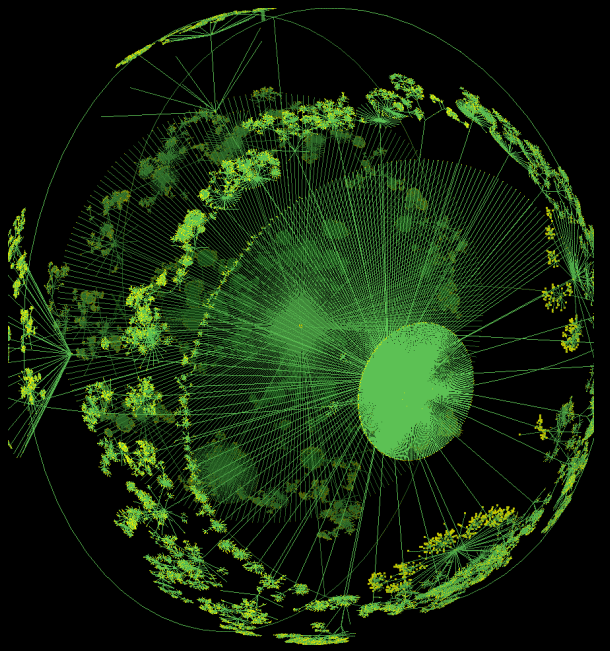
why map cyberspace?

- people are making the maps regardless, so need to get in there and analyse them
- the maps are being used to make important decisions, regardless of their efficacy or ethics
- just because you can map, you do map it
- these are early maps, but like a lot of technology, the first map can set the conditional pathways for the future
- ethical dilemmas for researchers in the Internet and information visualization

Mapping the ‘tin cans and string’

- many aspects of the infrastructure that you can map
- what they show? hubs, network links & traffic flows
- what form? geographic -> abstract; static -> dynamic
- what scale? buildings, company, cities -> global
- function? research, operations, marketing, regulation





why is it hard to map the Internet?

- its new, its complex, its fast changing and fast growing
- diversity of owners, heterogeneous, no one has overall responsibility
- secrecy - network security and commercial confidentiality
- most people don’t care about it
- its just banal technicalities, deterministic assumed to non-political and neutral
- has not been seen as a vital, strategic asset. although this is changing with growing fears of cyber-terrorism

the invisibility problem

logical versus physical network maps

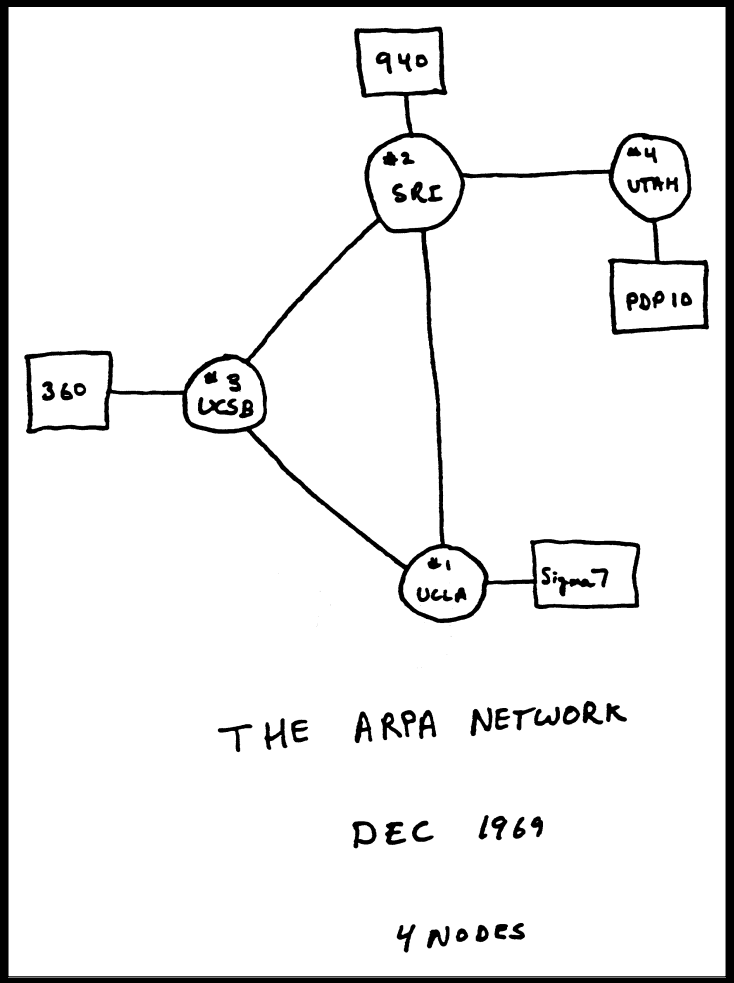
- where do the cables go??
- how do the they interconnect?
- scales of mapping facilities
  - CAD schematics of rooms and buildings
  - street layout of fibre grids
  - city wide
  - regional
  - national
  - continental
  - global grids of glass, undersea cables

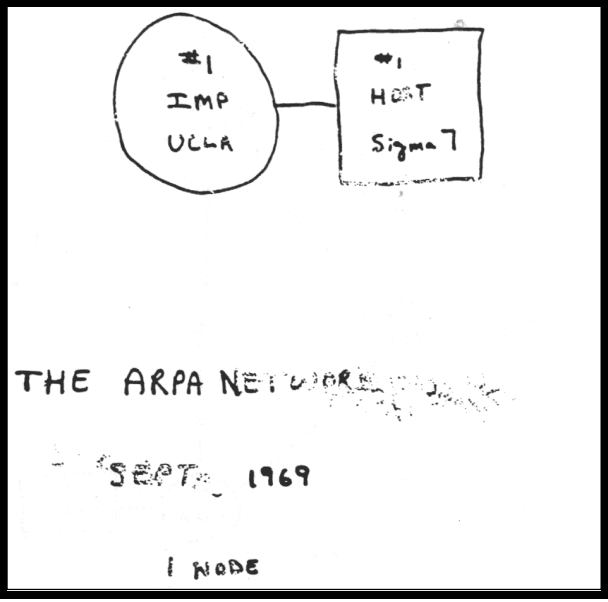
mapping digital communications networks is nothing new! circa 1853

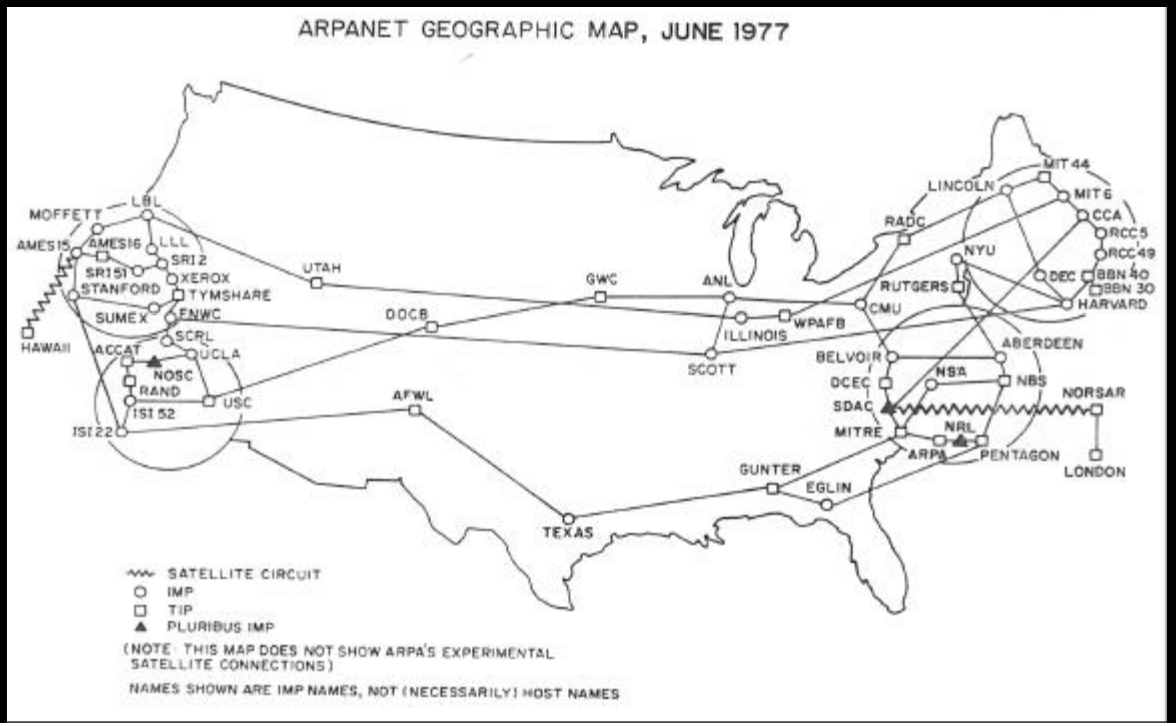
(Source: Library of Congress, http://hdl.loc.gov/loc.gmd/g3701p.ct000084)

its all just nodes and links

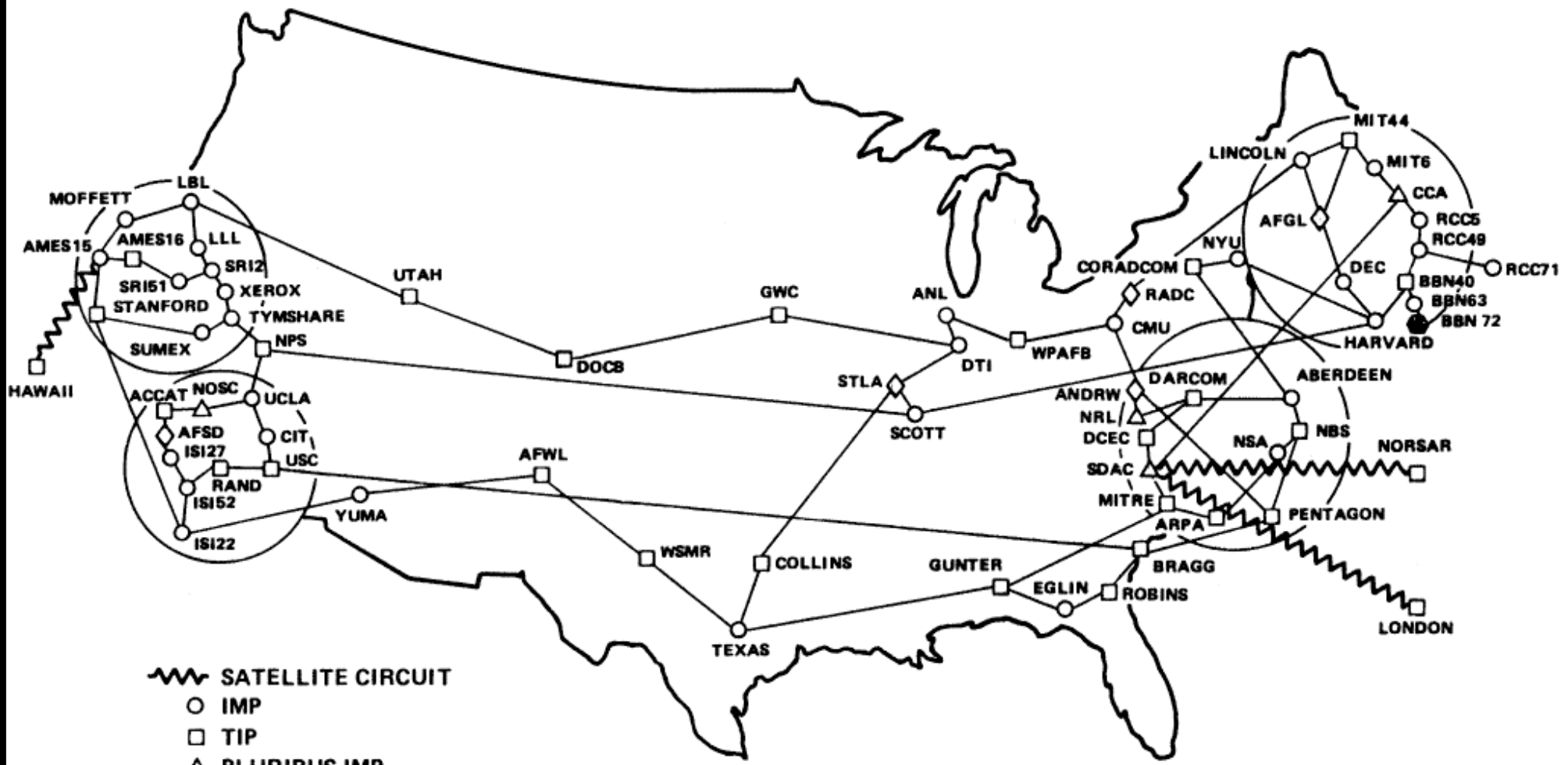
logical maps network, ARPANET (1969-89)







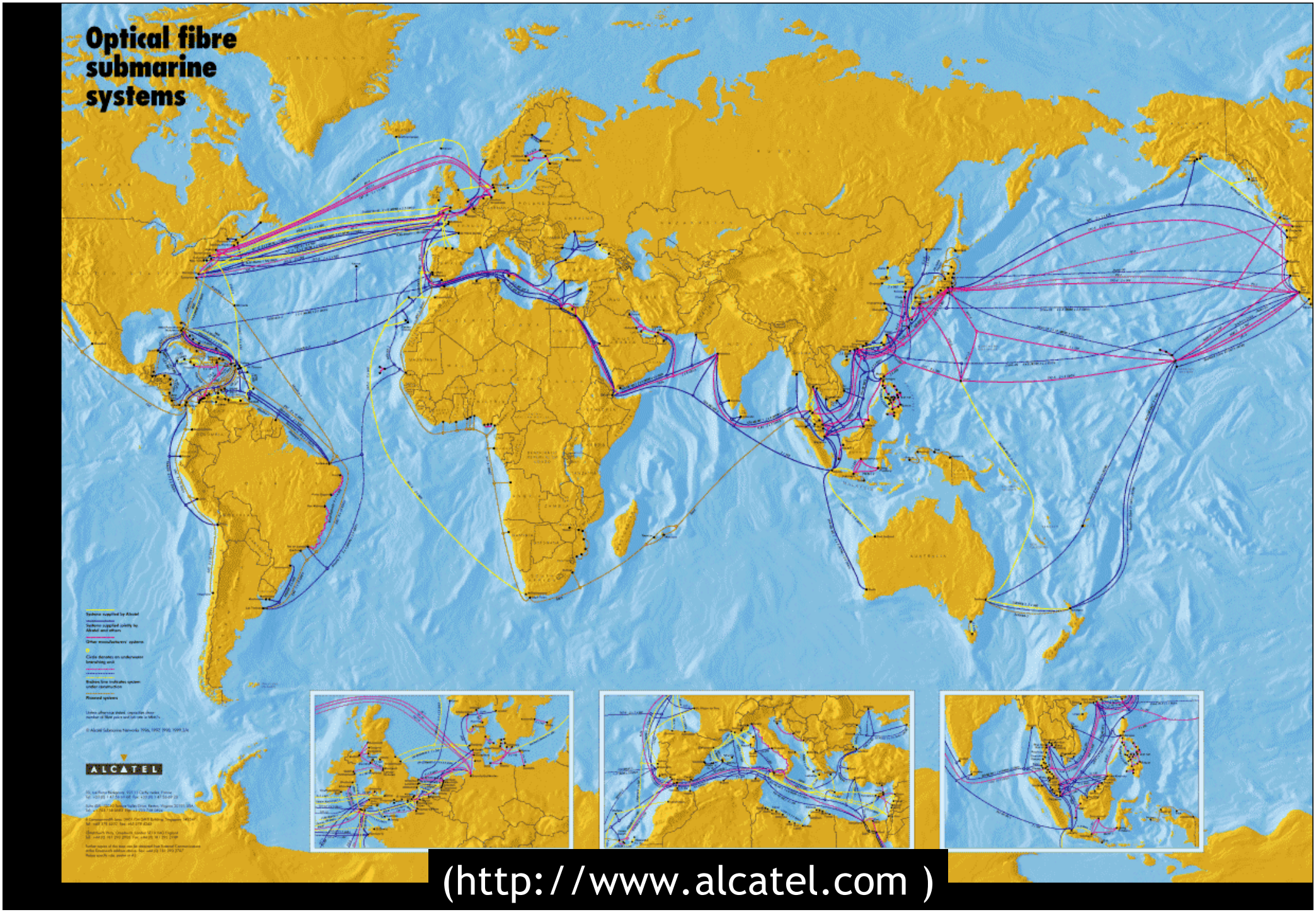
ARPANET GEOGRAPHIC MAP, OCTOBER 1980



(NOTE: THIS MAP DOES NOT SHOW ARPA'S EXPERIMENTAL SATELLITE CONNECTIONS)

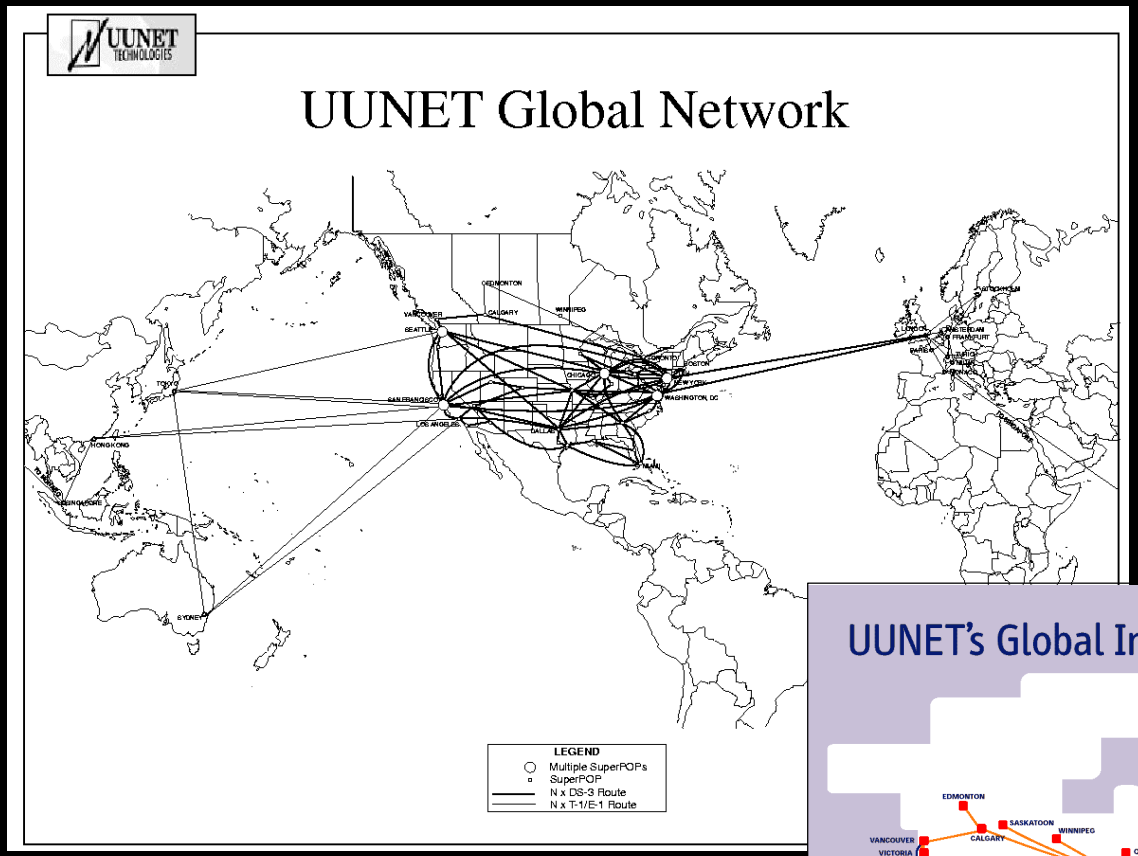
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

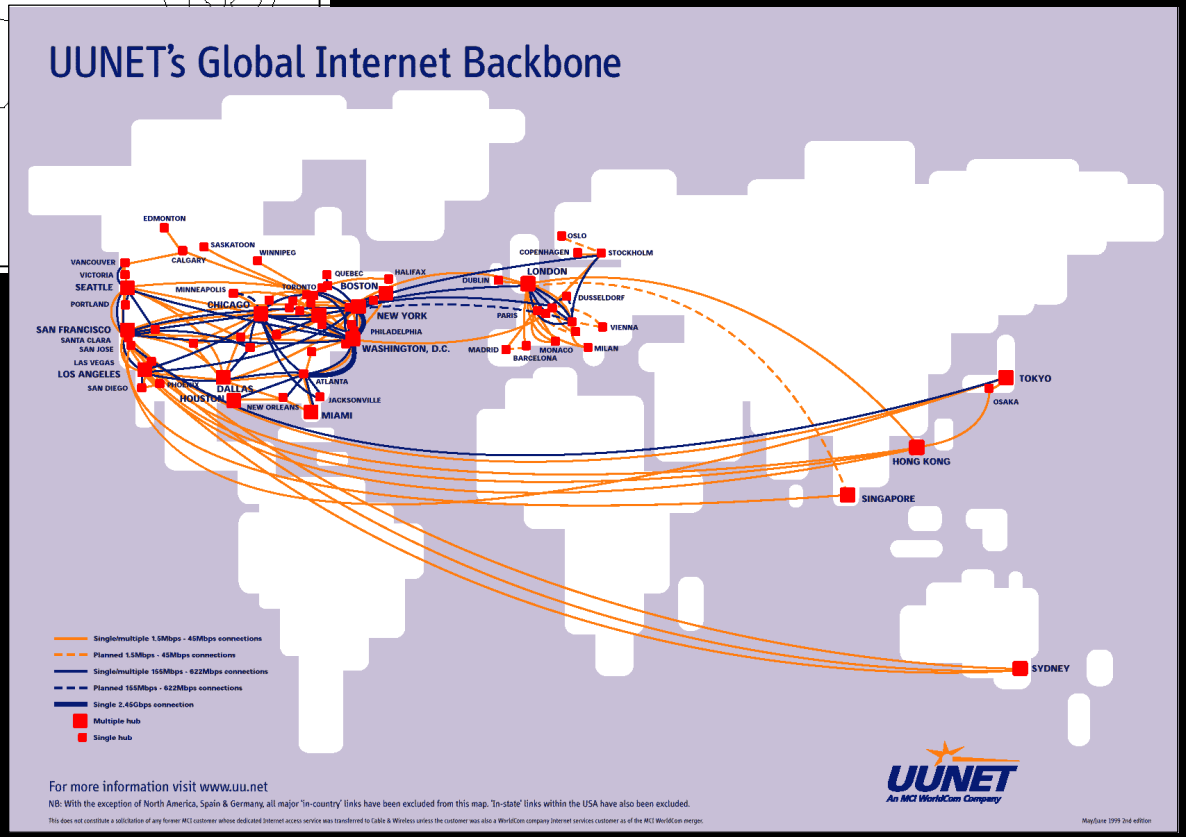
Points for spotting which of these network operators has not filed for bankruptcy this year!!


Optical fibre
submarine
systems
ALCATEL
(http://www.alcatel.com)

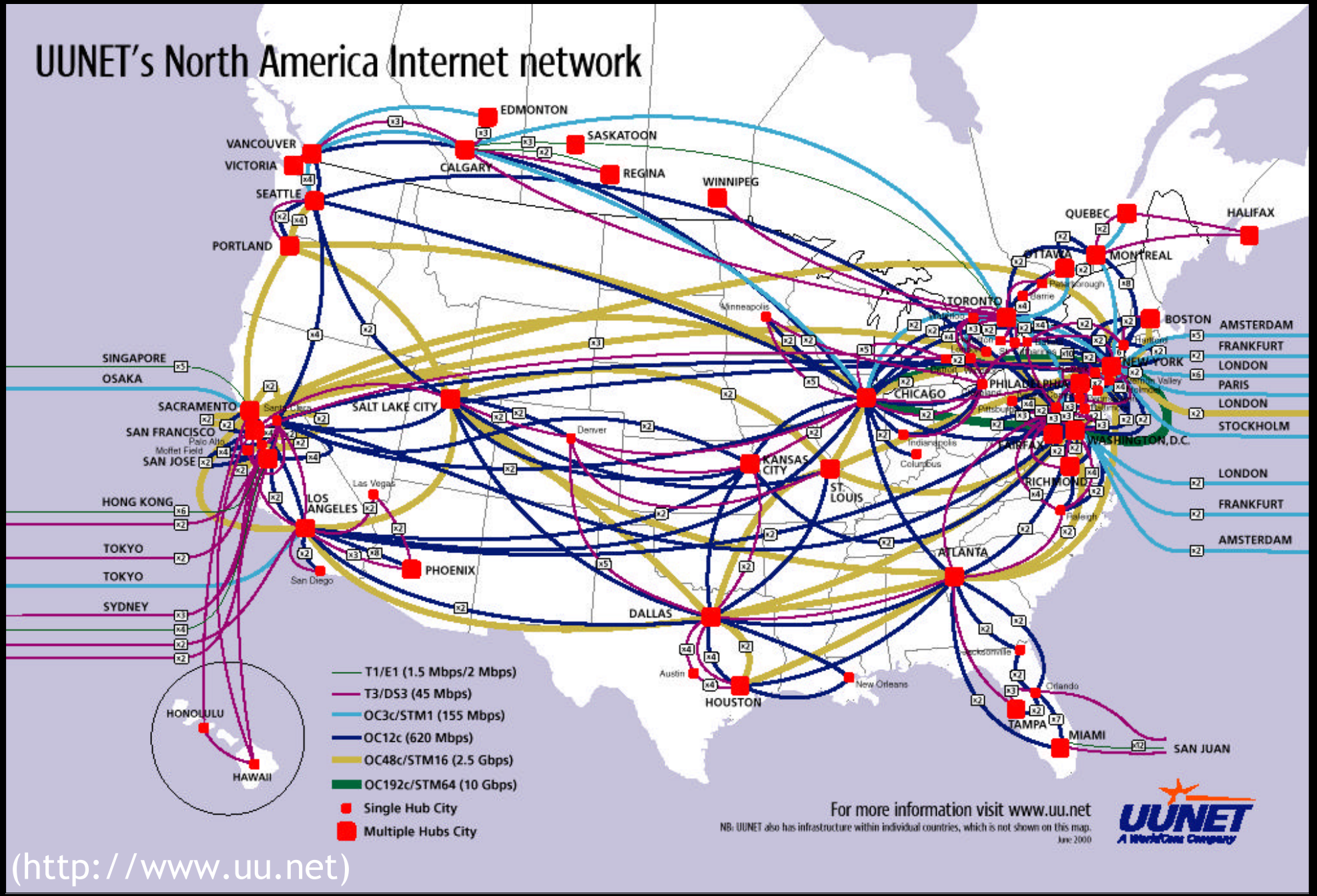
EUROPE
NORTH SEA
OSLO
STOCKHOLM
HELSINKI
RIGA
MOSCOW
COPENHAGEN
DUBLIN
LONDON
AMSTERDAM
BRUSSELS
BONN
PARIS
WARSAW
KIEV
ZAGREB
BUCHAREST
SOFIA
TIRANA
ROME
MADRID
LISBON
RABAT
ALGIERS
TUNIS
TRIPOLI
ATHENS
ANKARA
NICOSIA
BEIRUT
DAMASCUS
TEL AVIV
CAIRO
BLACK SEA
UK-GERMANY 5
SWEDEN-GERMANY 4
SWEDEN-GERMANY 5
SWANSEA-BREAN
UK-BEL 4-5
UK-FRANCE 3
GUERNSEY-JERSEY 4
TAT 11
TAT 12
ITUR
KAFOS
DBFOCS
ROME-PALERMO
S.BENEDETTO-ANCONA
TERMOLI-PESCARA
RIMINI-VENEZIA
GREEK DOMESTIC
SPAIN-MOROCCO
EURAFRICA
MARSEILLE-BEIRUT
SMW 2
SMW 3
FLAG
ITALY-ISRAEL
CADMOS
BERYTAR
ISRAEL DOM
UGARIT
TURCYOS
PALMYRA
CABLE & WIRELESS MARINE

marketing maps

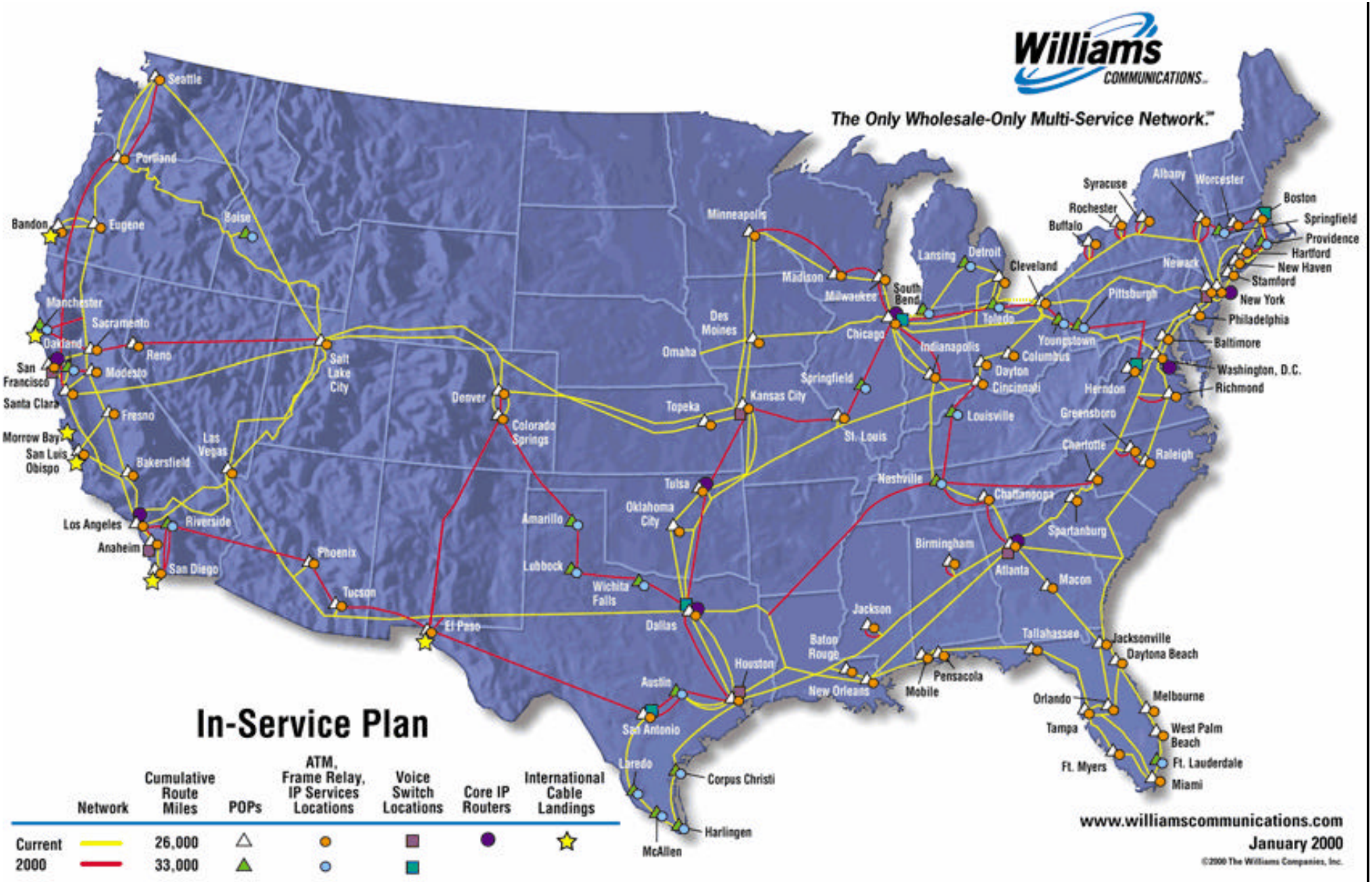




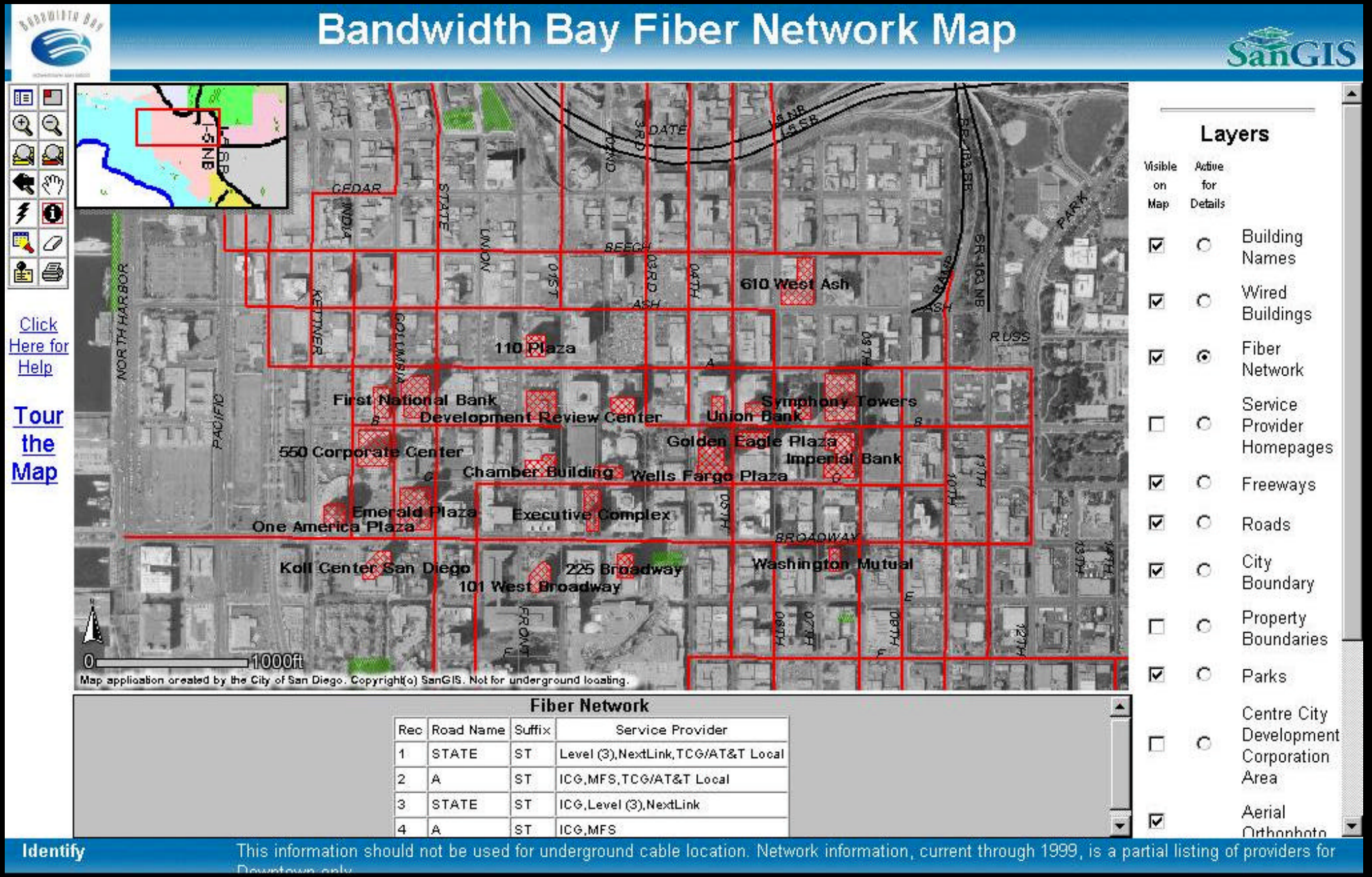
(http://www.uu.net)



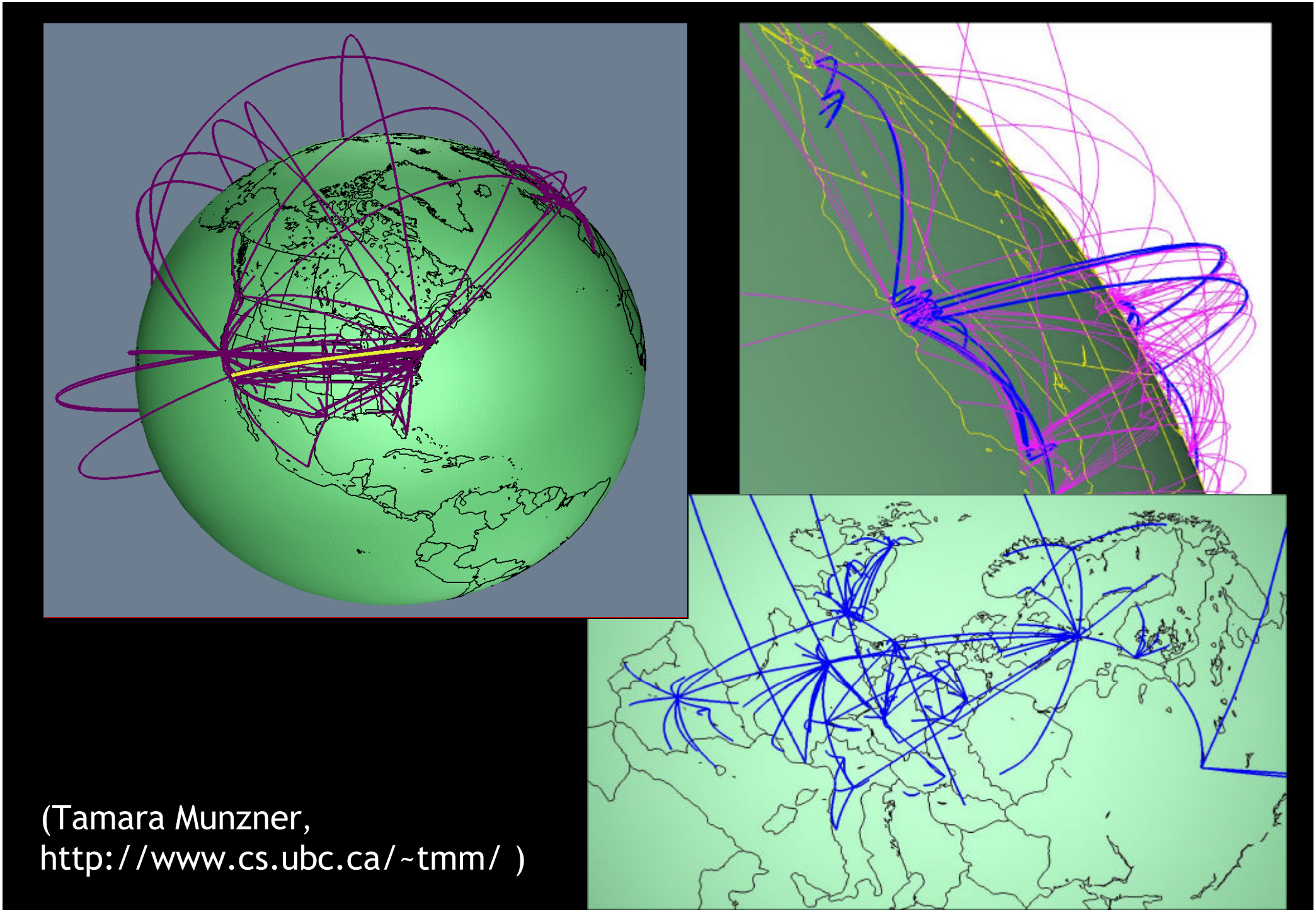
(http://www.uu.net)



(http://www.williamscommunications.com)



(http://www.sangis.org/sangis/intmaps/fibermap.htm)

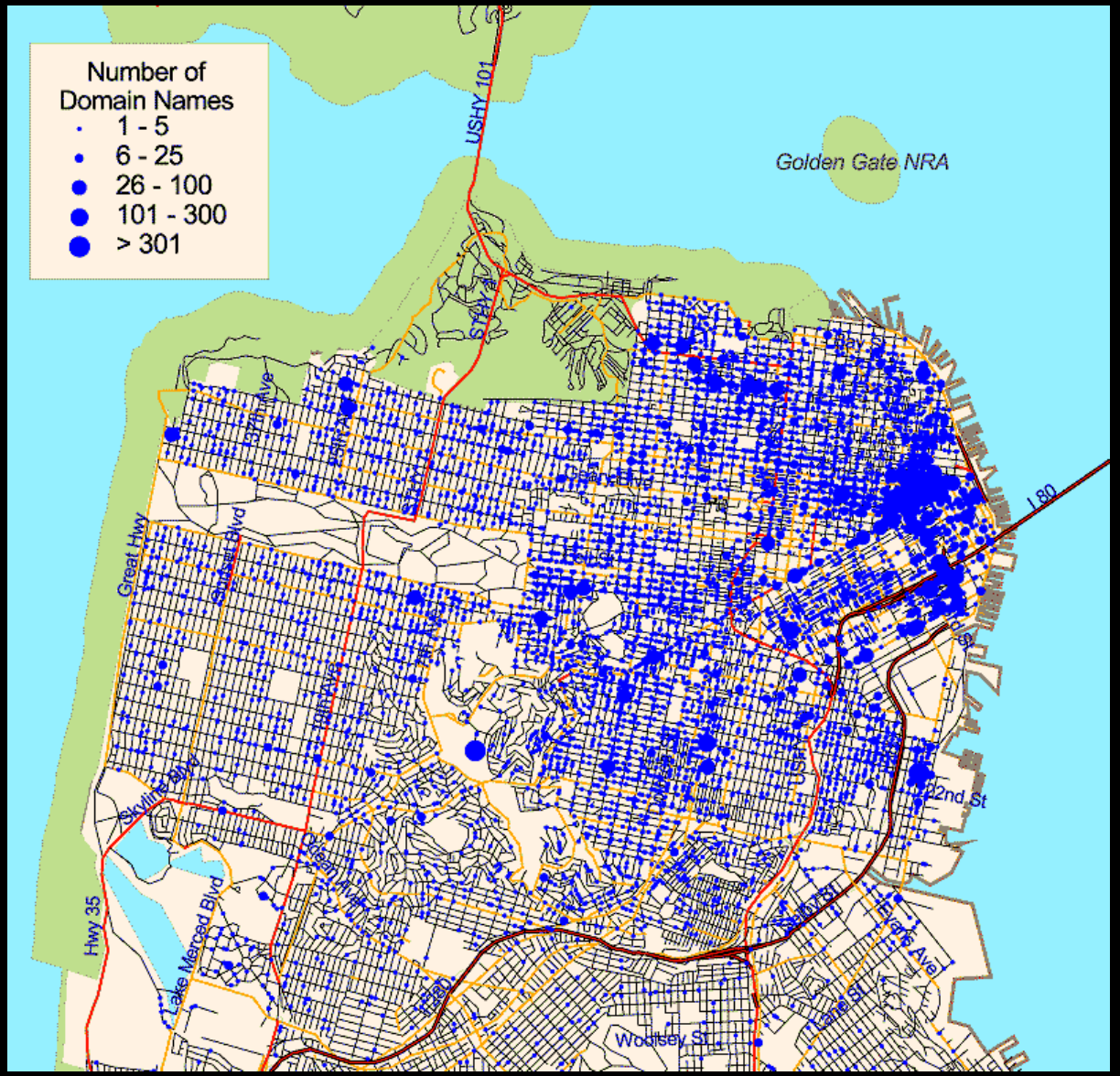


(Tamara Munzner,
http://www.cs.ubc.ca/~tmm/)

Dots on a map

where are all the nodes?

Dotcom domain names in SF



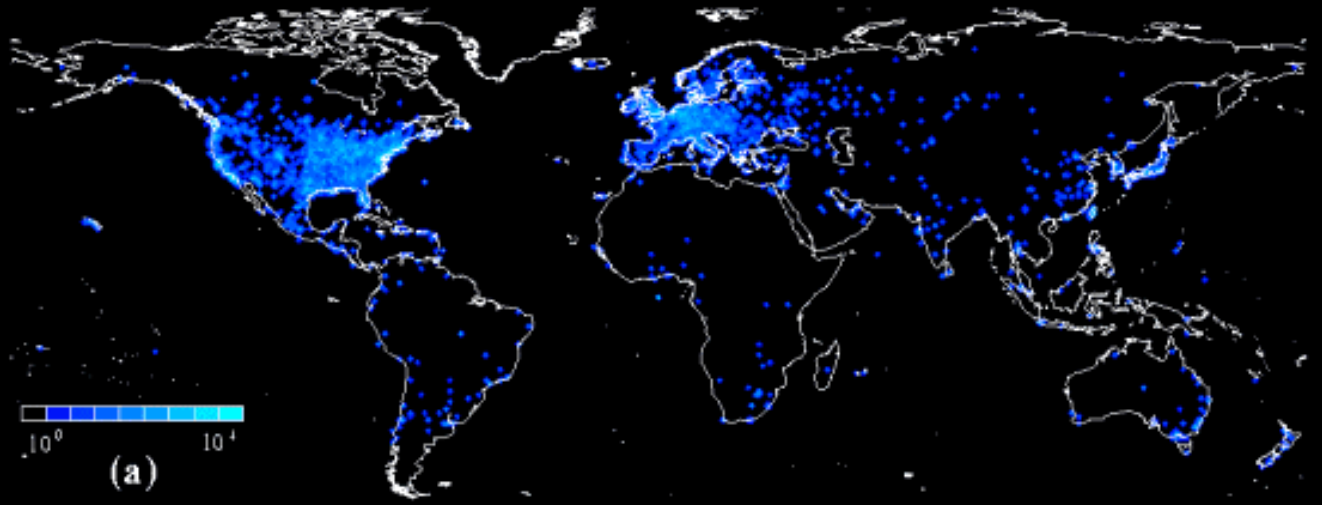
(Matthew Zook, www.zooknic.com)

Wardriving wi-fi hotspots in LA

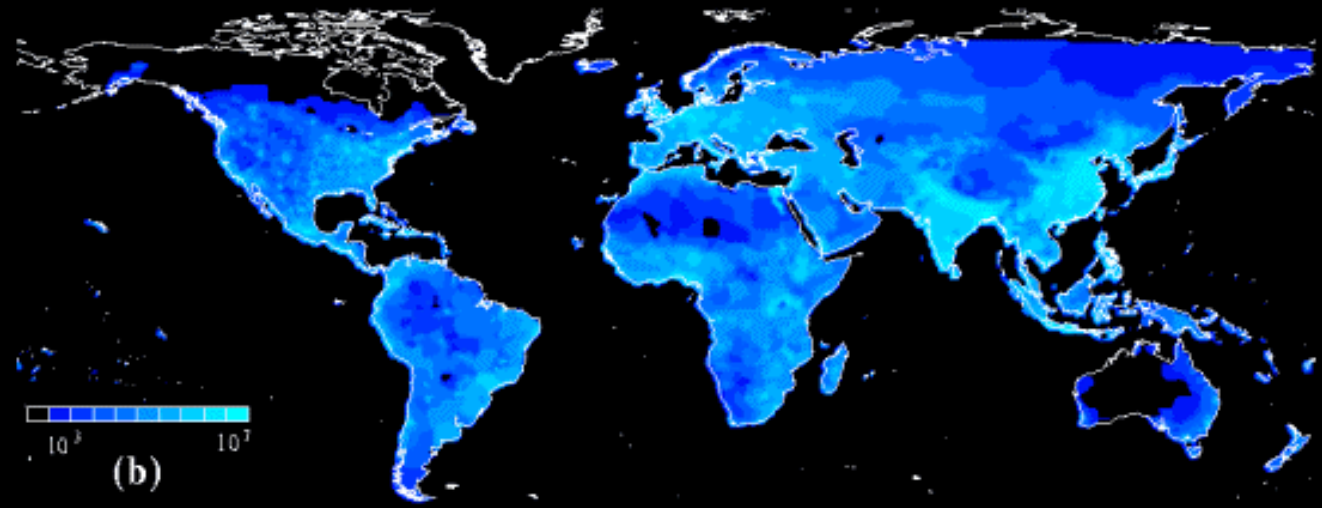
(http://pasadena.net/apmap/)

Global digital divides

Router density



Population density

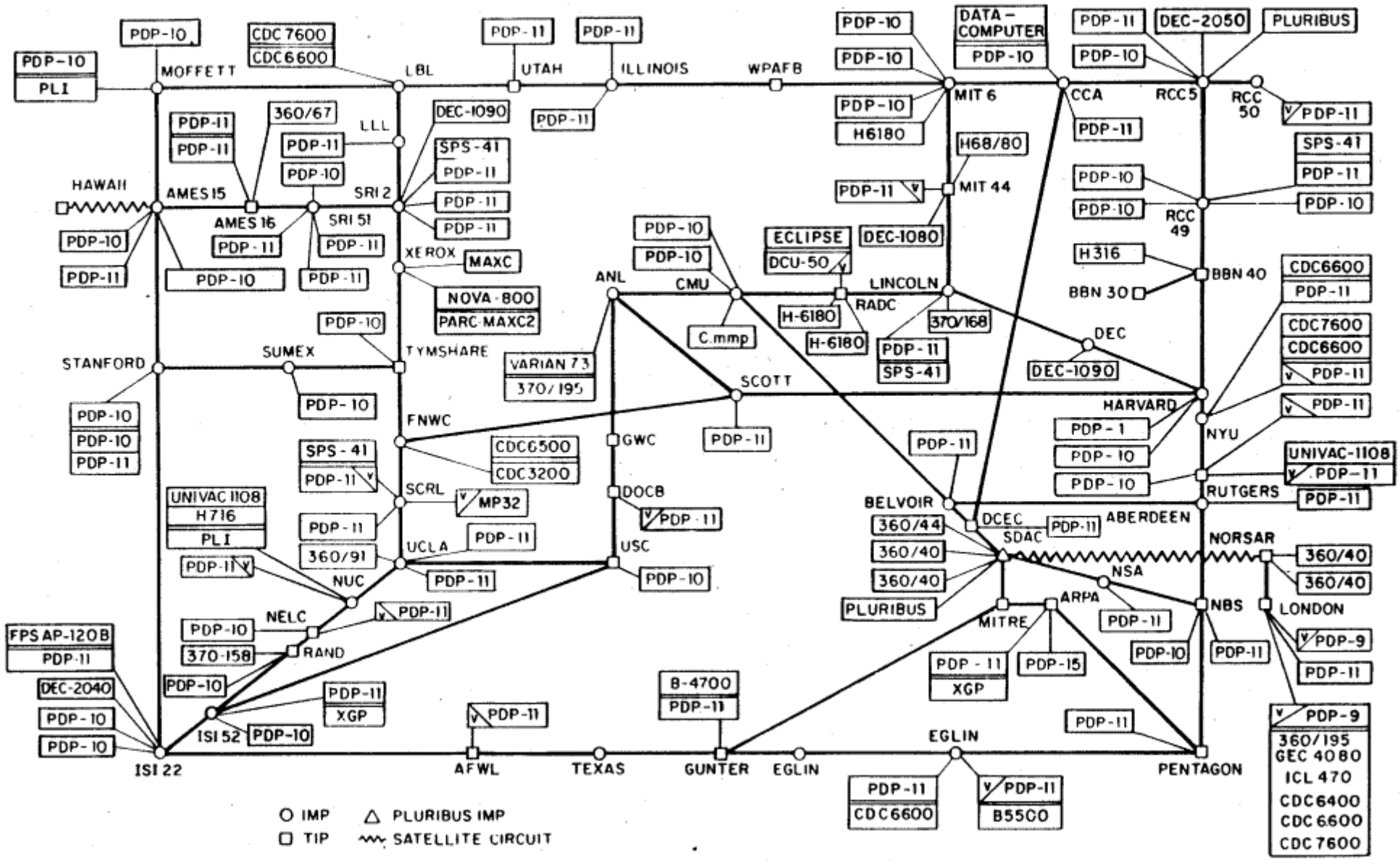


(http://arxiv.org/abs/cond-mat/0107417)

bye, bye to the geographic world

- focus is on topology, not geography
- network engineers don’t care about where things are, but how they are connected
- into the realm of wiring diagrams rather than maps

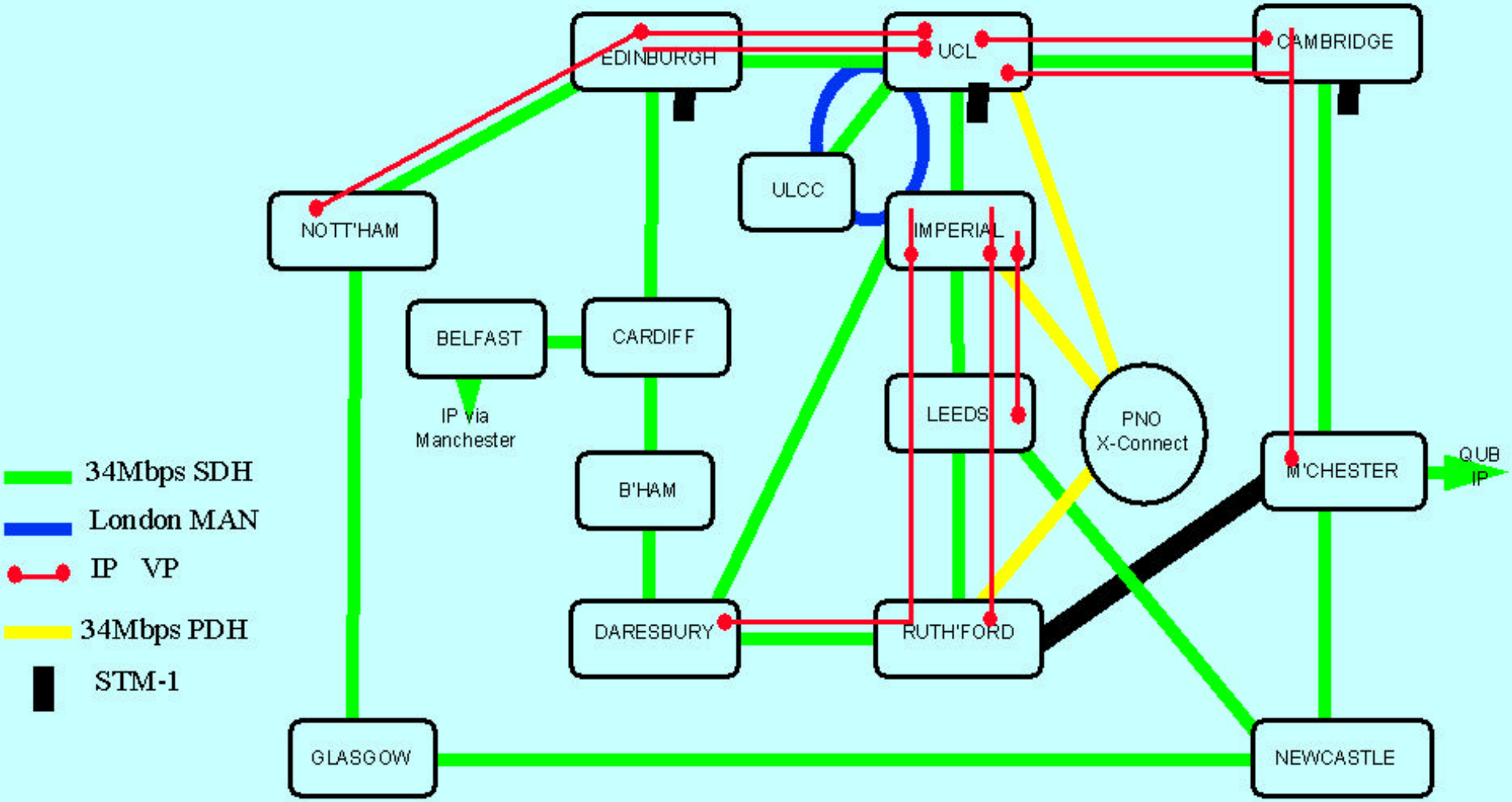
ARPANET LOGICAL MAP, MARCH 1977



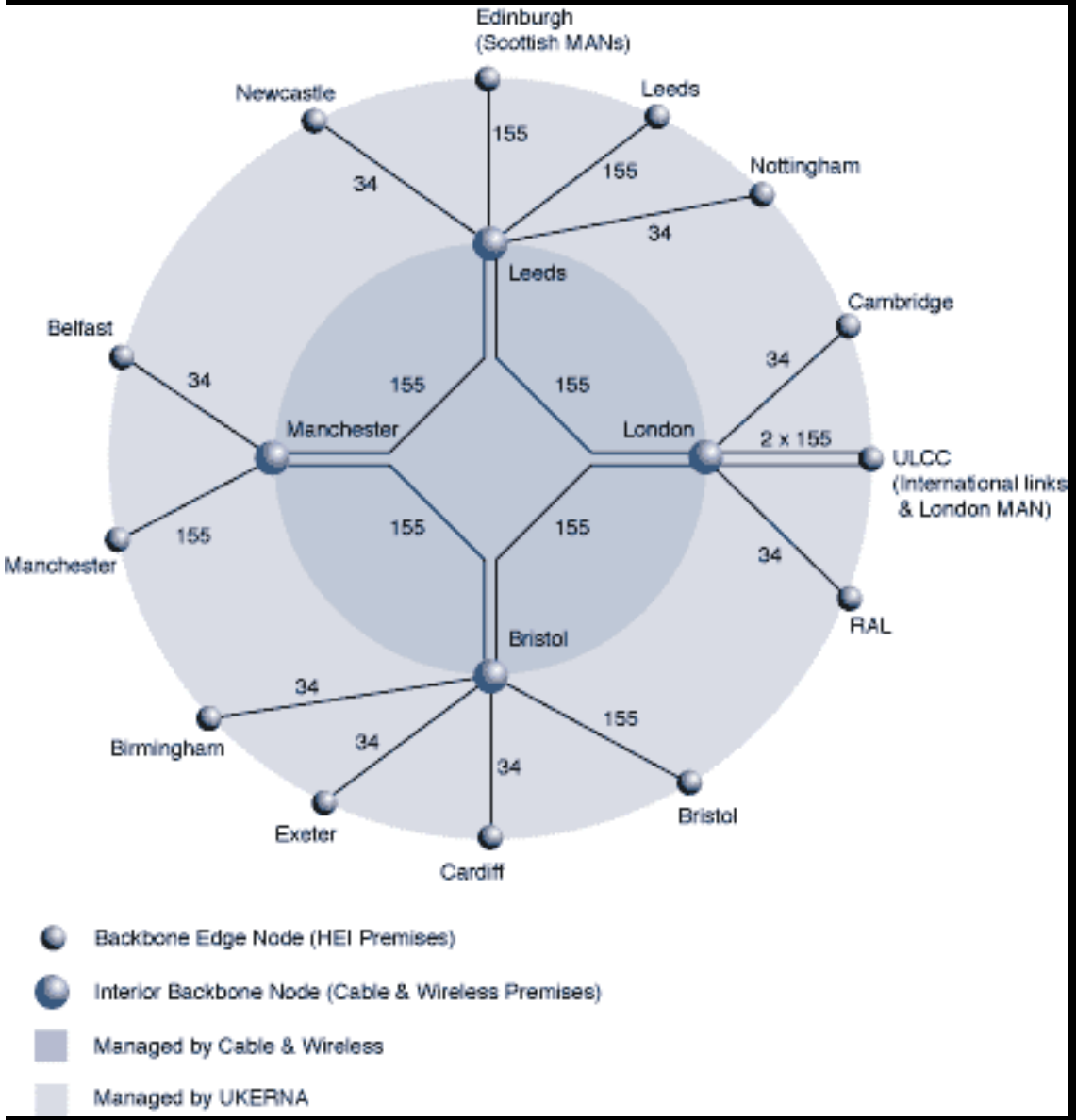
(PLEASE NOTE THAT WHILE THIS MAP SHOWS THE HOST POPULATION OF THE NETWORK ACCORDING TO THE BEST INFORMATION OBTAINABLE, NO CLAIM CAN BE MADE FOR ITS ACCURACY)

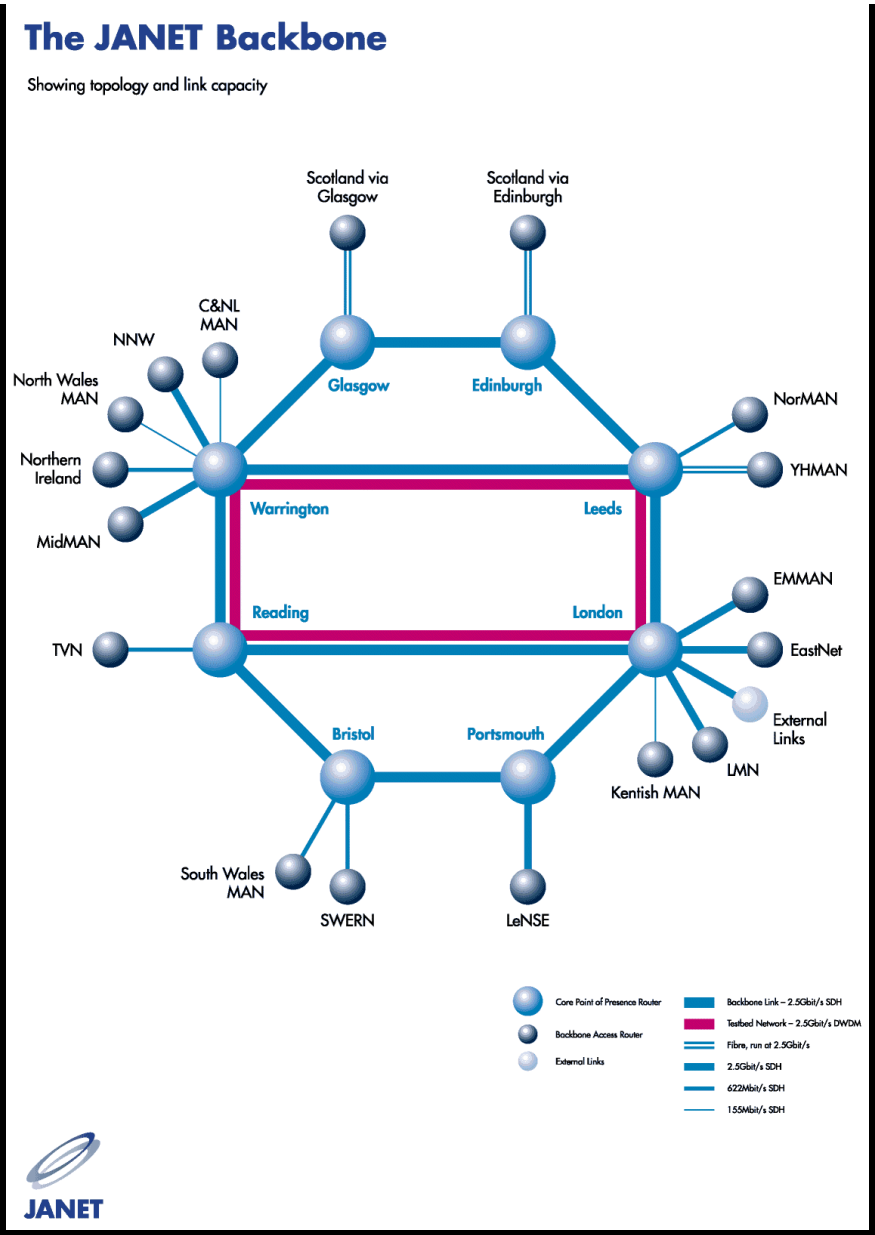
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

SuperJANET ATM Topology

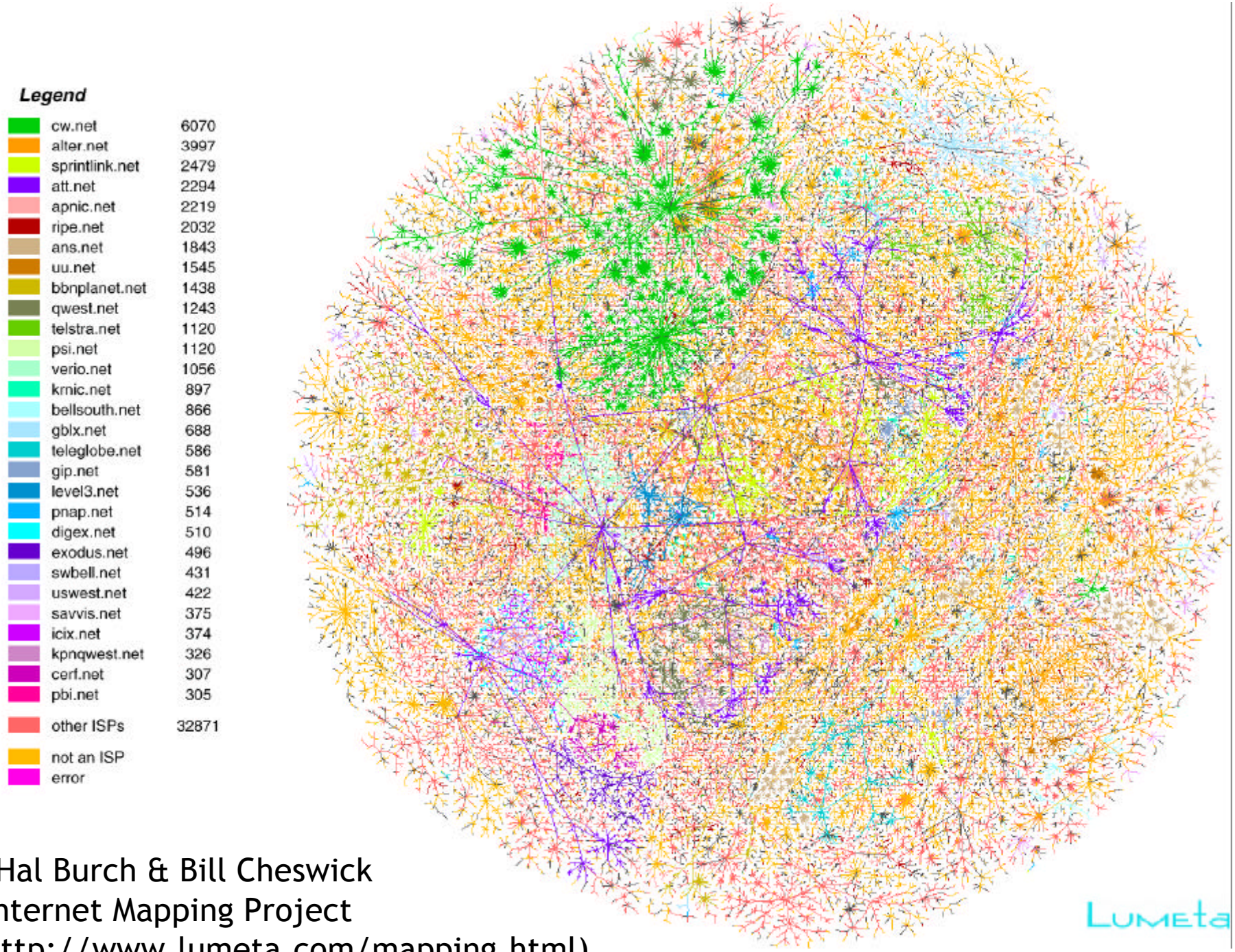


Updated by Baoyu Wang on 27 September, 1996

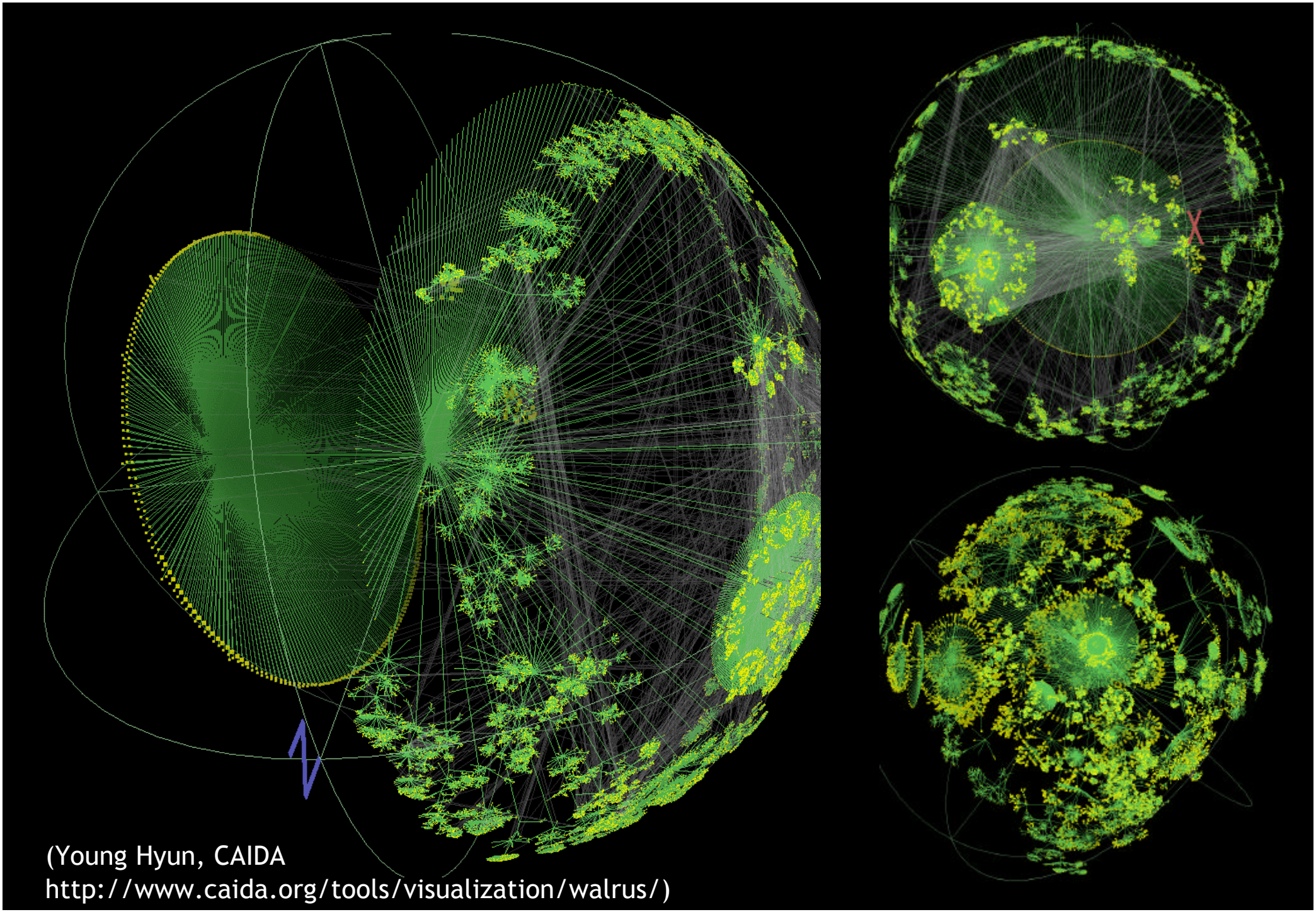




(http://www.ja.net)



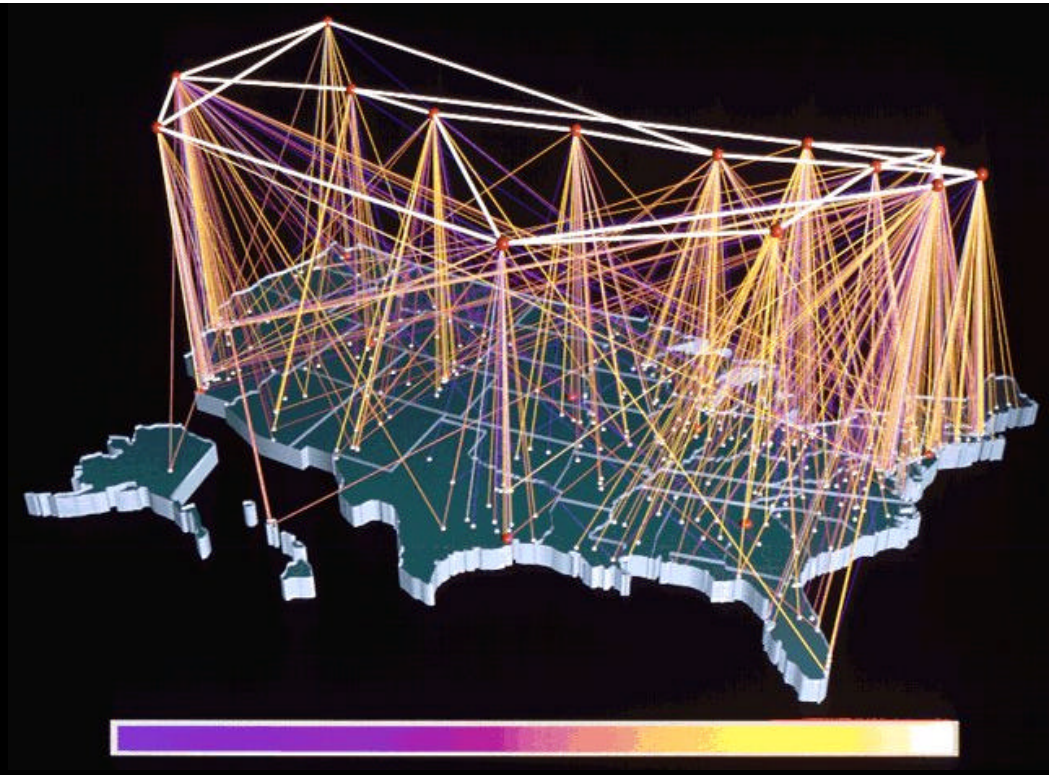
(Hal Burch & Bill Cheswick
Internet Mapping Project
http://www.lumeta.com/mapping.html)


(Young Hyun, CAIDA
http://www.caida.org/tools/visualization/walrus/)

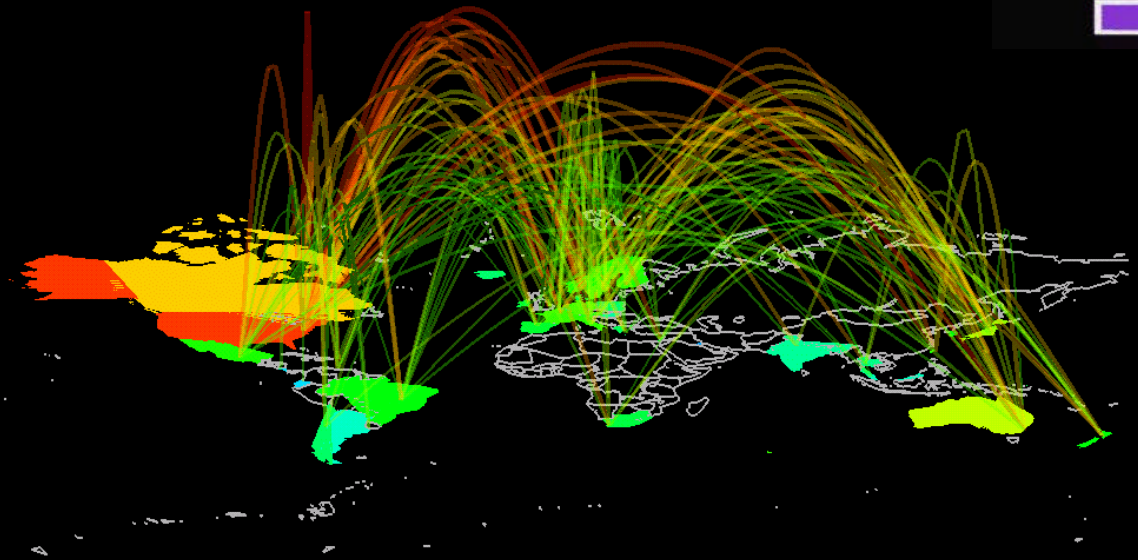
one of the big unknowns - traffic

- there are no good traffic maps of the Internet today
- no one can tell you how much traffic is flowing across the Internet. no one knows how much, or from where to where
- how much of the Internet pipes are running empty?? -> the great telecoms collapse of 2002

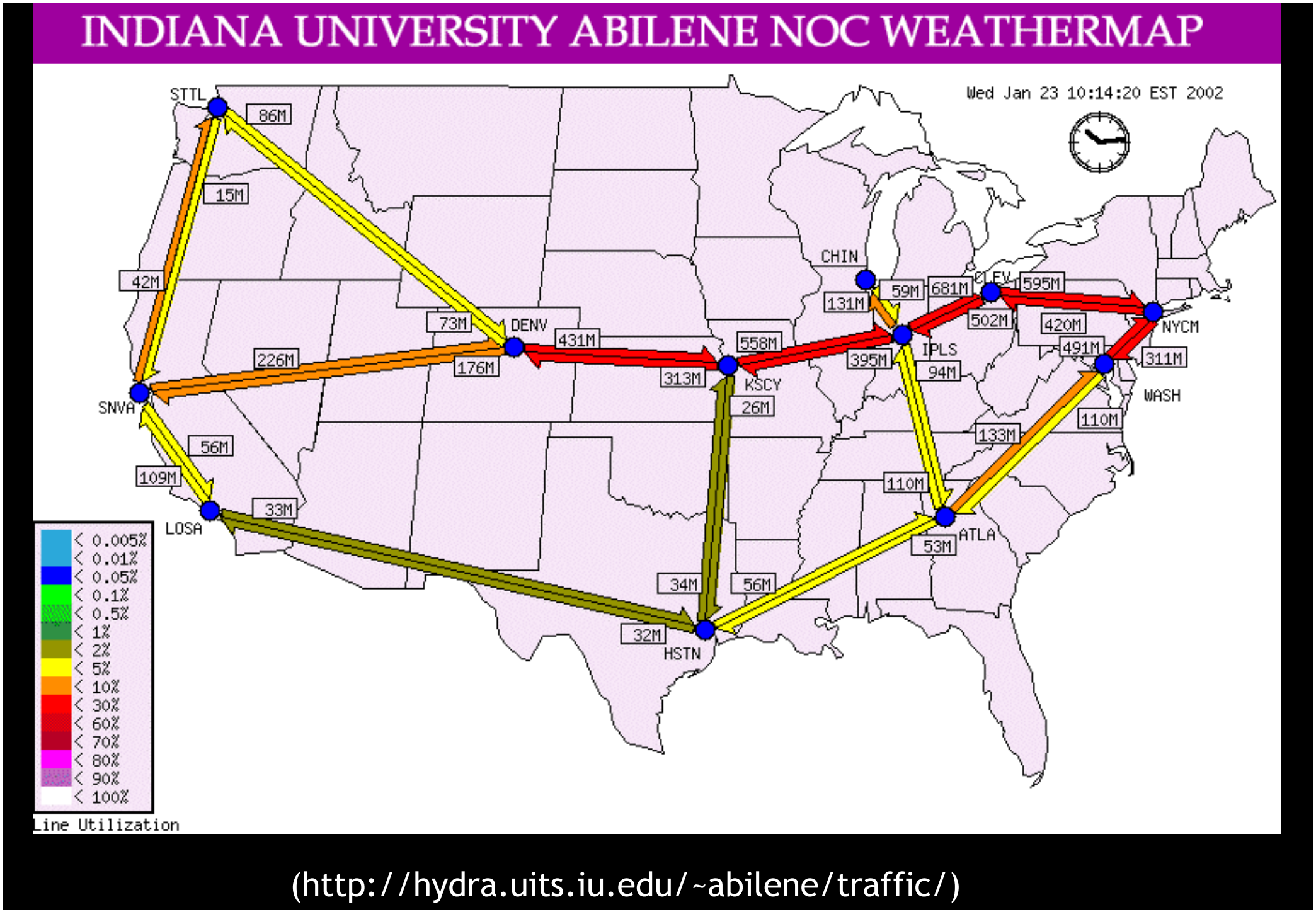
- there a few weather maps of individual networks



(Donna Cox and Robert Patterson,
NCSA, 1992, www.ncsa.uiuc.edu)

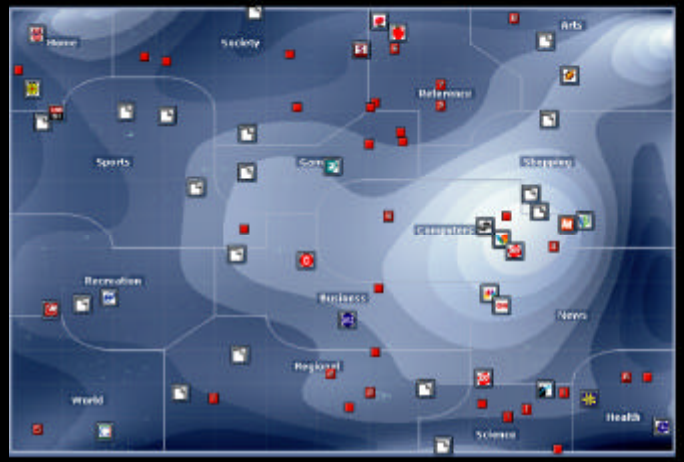


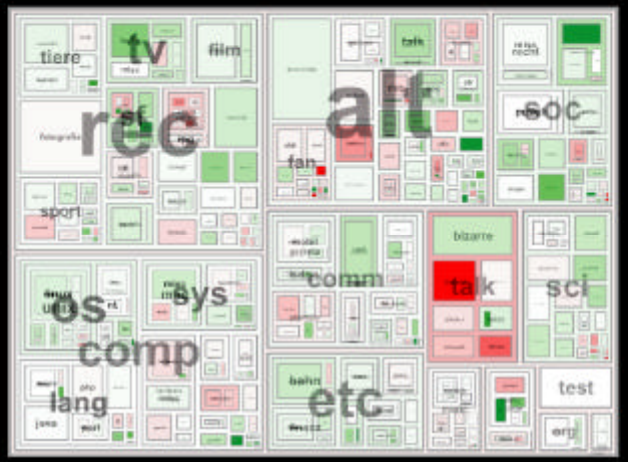
(Stephen Eick and colleagues at Bell Labs,
3D Geographic Network Display, 1996)

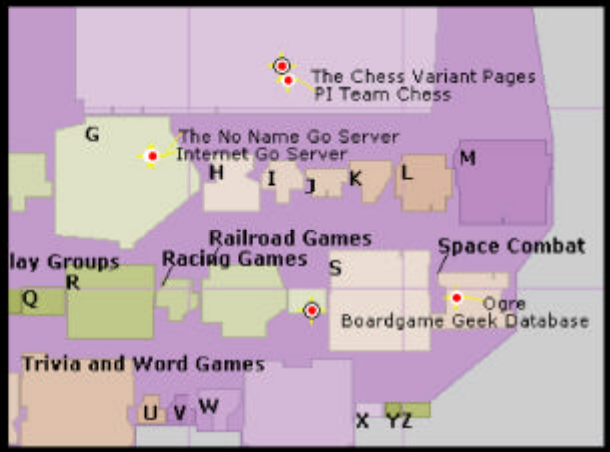


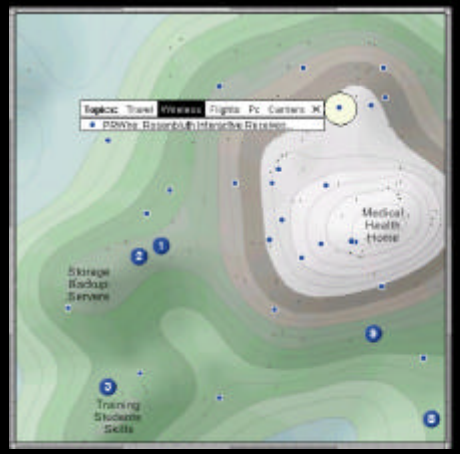
(http://hydra.uits.iu.edu/~abilene/traffic/)

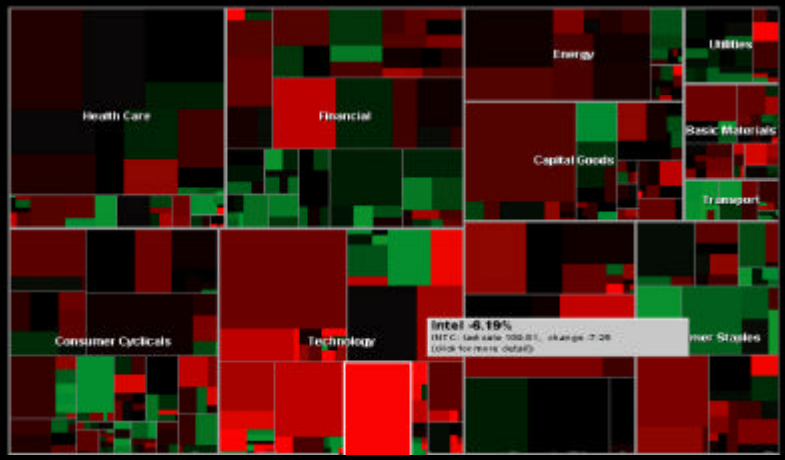
Information Mapping



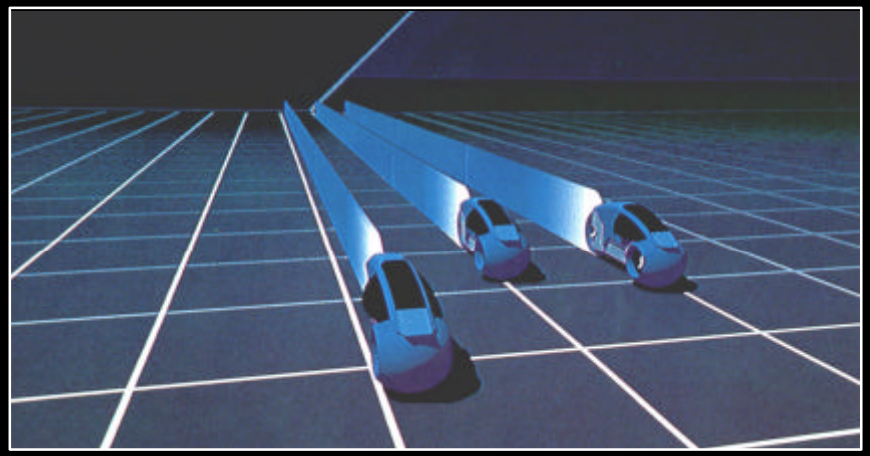


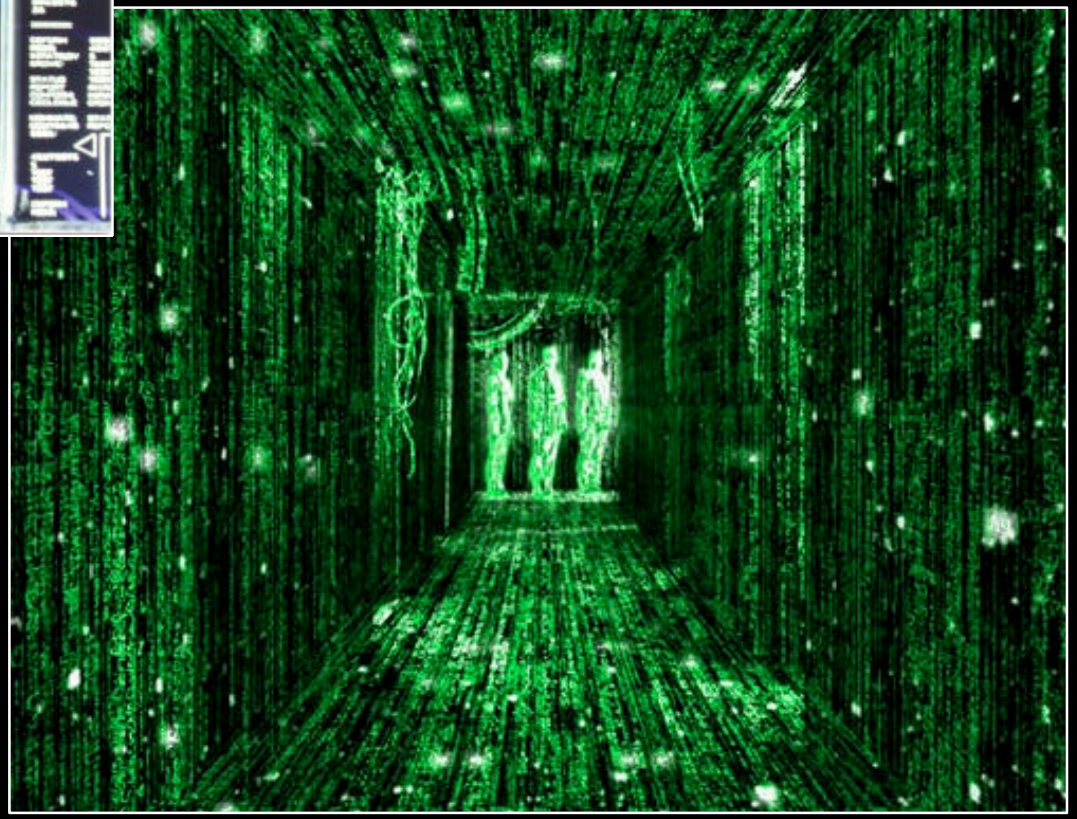


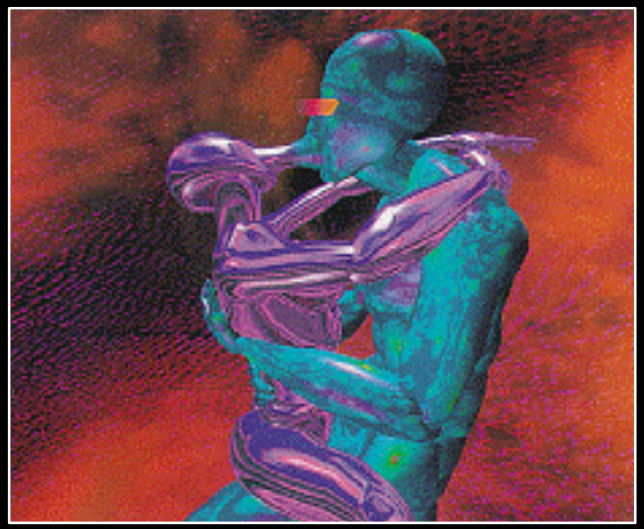




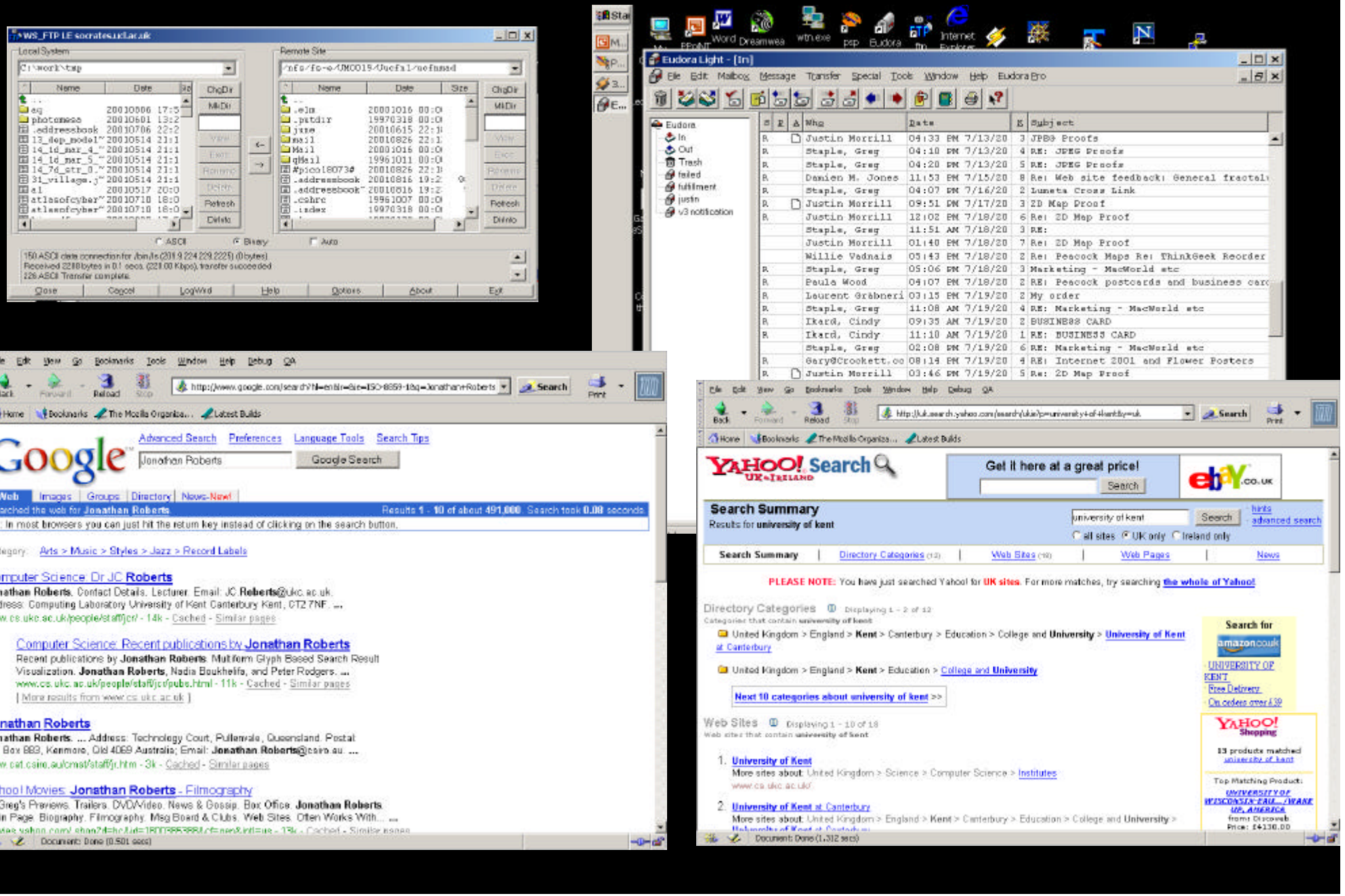
Visualising information space - Hollywood style







how we <u>really</u> navigate online content..

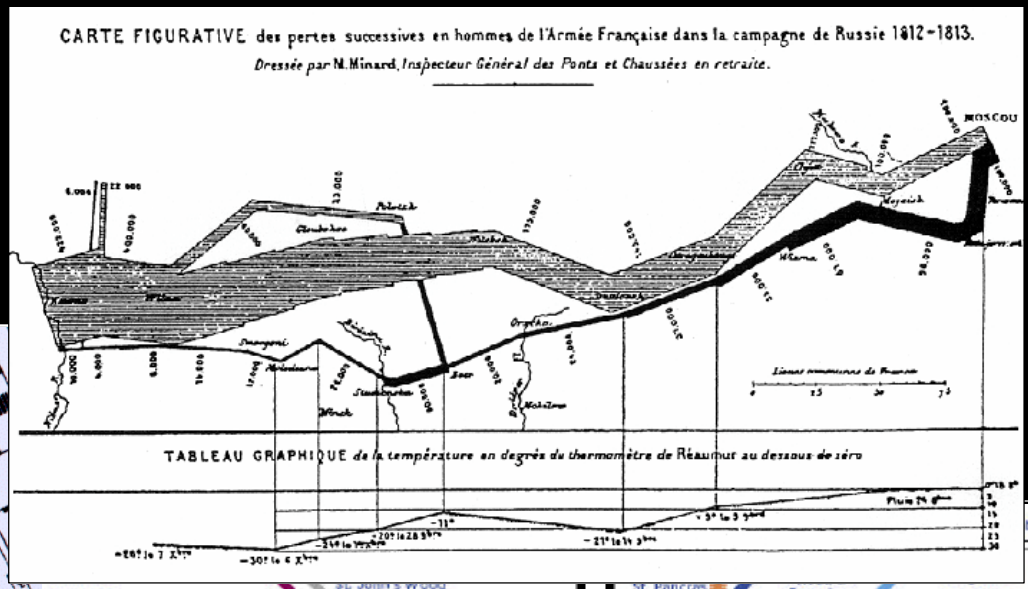


Navigating cyberspace, 2d maps

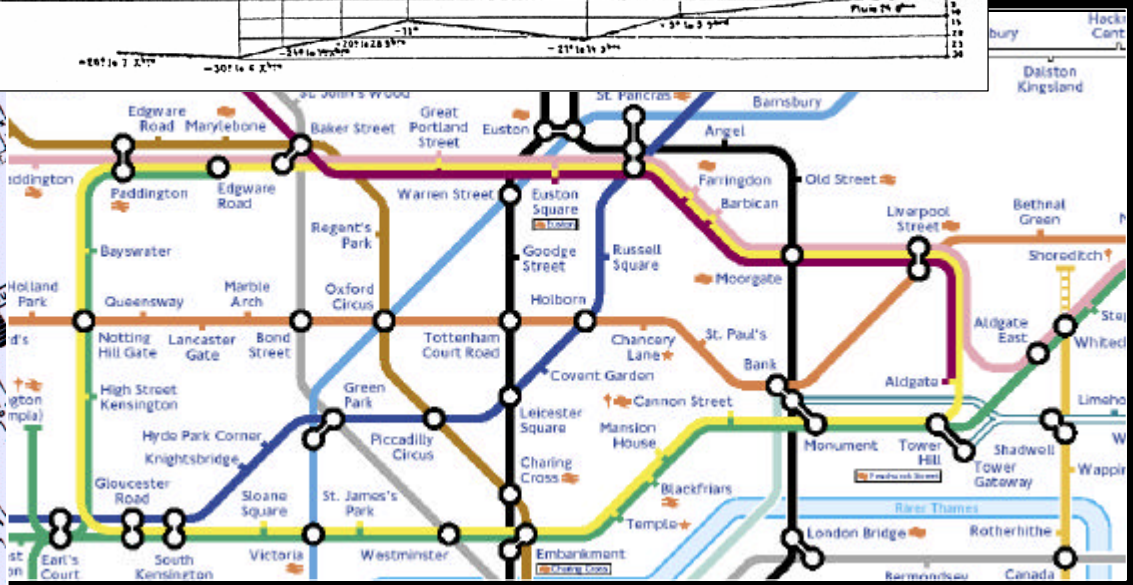
- improving ways to navigate online content by appropriate visualisation
- is there a middle ground between current textual / list type interfaces versus the immersive 3d (cool) interfaces of Hollywood?
- from feedback received, it seems like many people are seeking better navigation tools and interfaces
- experience from cartography can help
- examine the potential of information mapping

Information maps – the ‘classics’

Charles Minard’s
‘Napoleon’ map, from 1861



John Snow’s ‘Cholera’ Map, 1854



London Tube map, based on the design
Of Harry Beck in 1930s

The power of information maps

- the missing ‘up button’ on the browser
- intelligent summarisation and generalisation

- 3 key advantages:
  - a sense of the whole (the birds eye view / big picture) What is there around here?
  - revealing hidden connections / structure
  - support interactive browsing

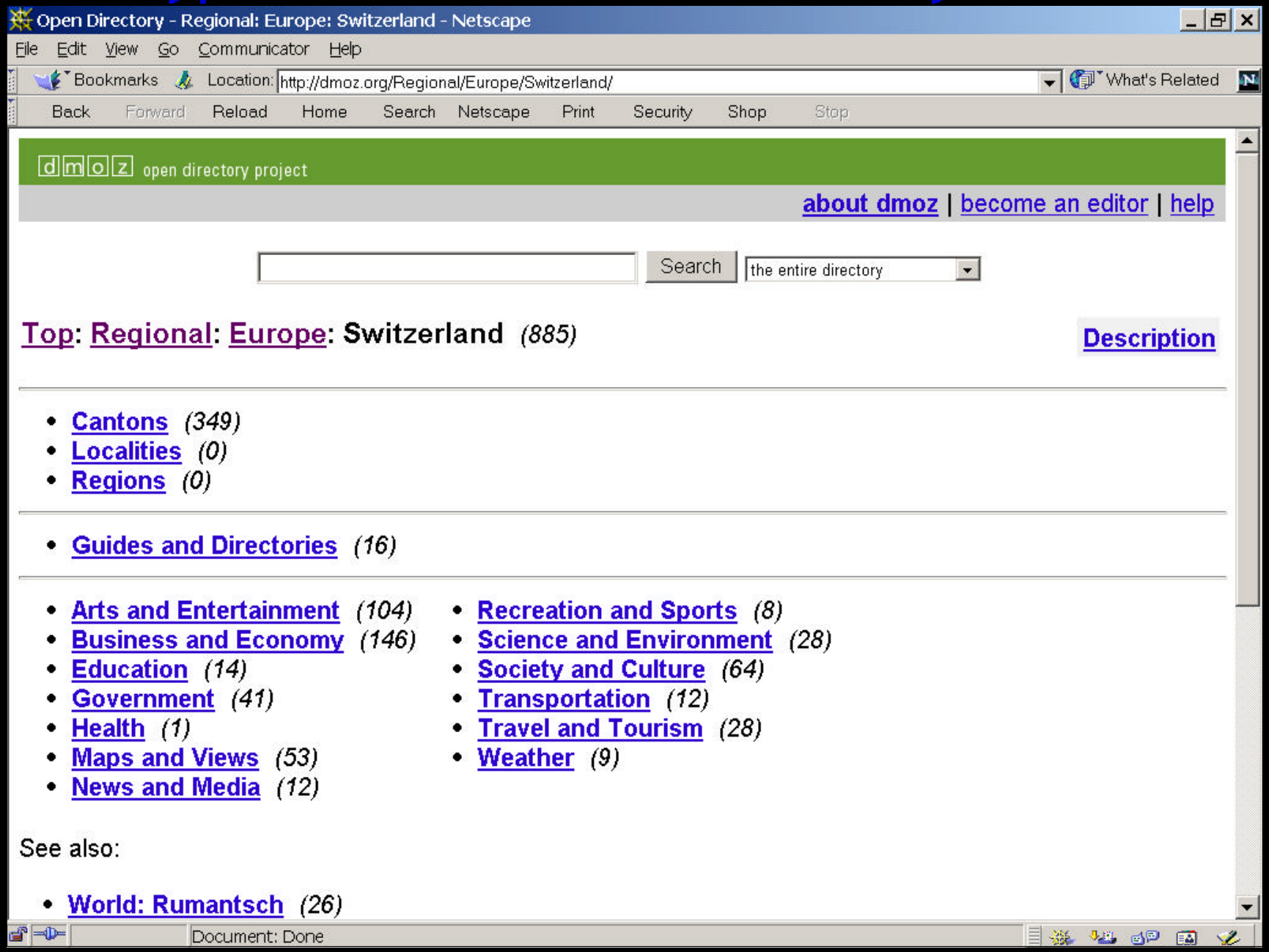
Where is the wisdom we have lost in knowledge?
Where is the knowledge that we have lost in information.

T.S. Elliot, The Rock (1934)

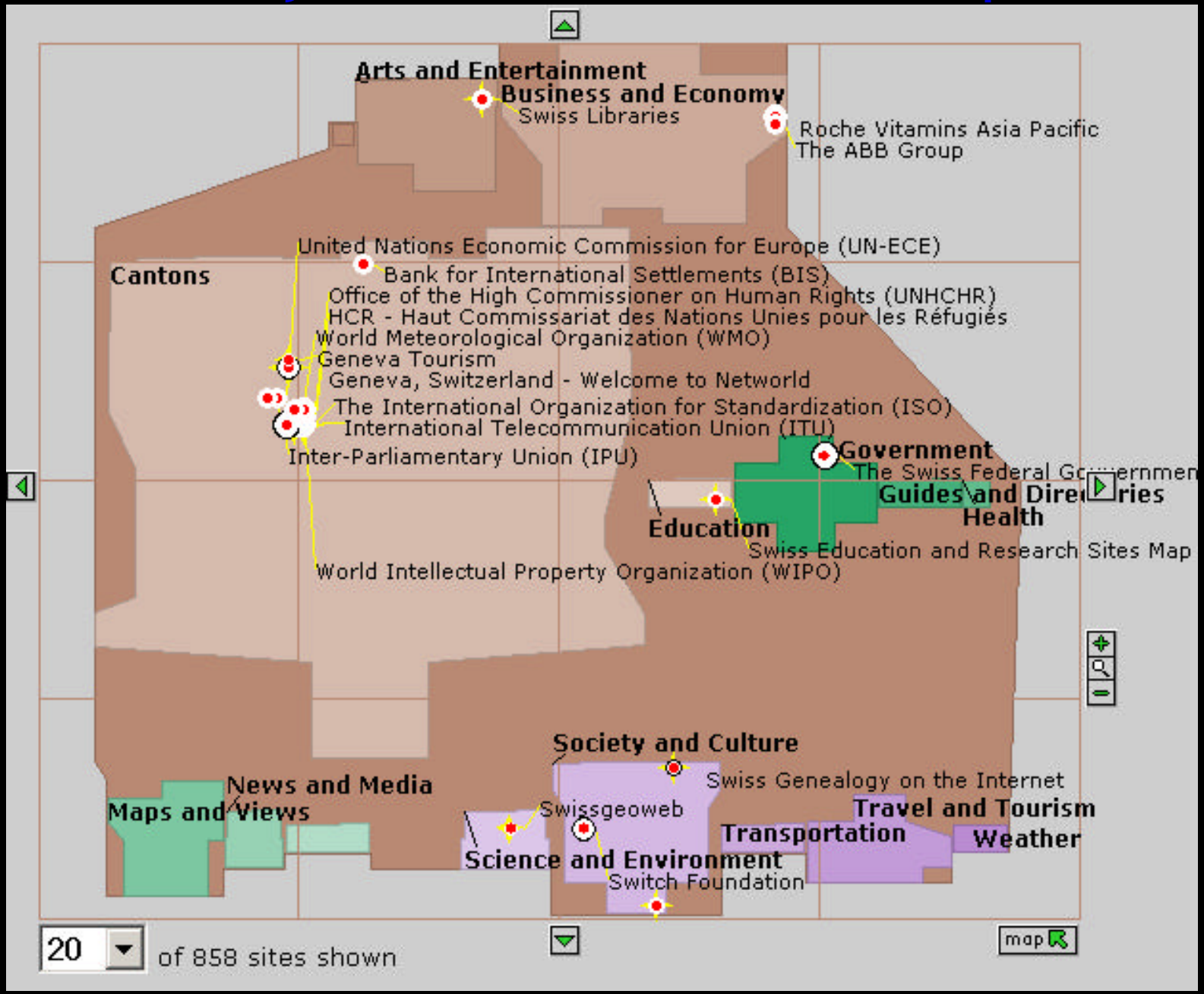
There are a lot of bad information maps and many more interesting but noble failures

Here are a few of the best examples

ODP - typical hierarchical directory of websites

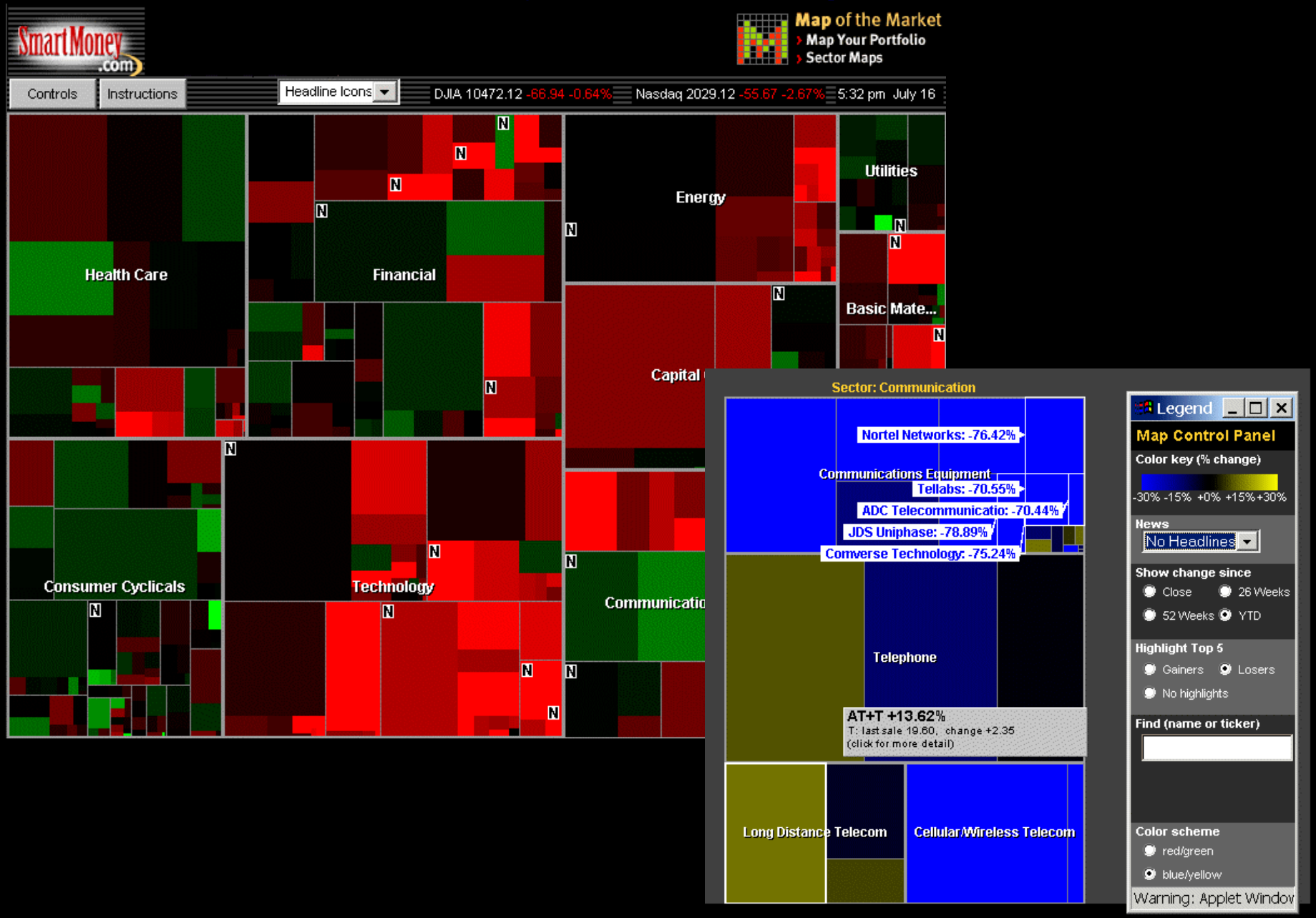


Antarctica Systems' Visual Net : Map.net demo



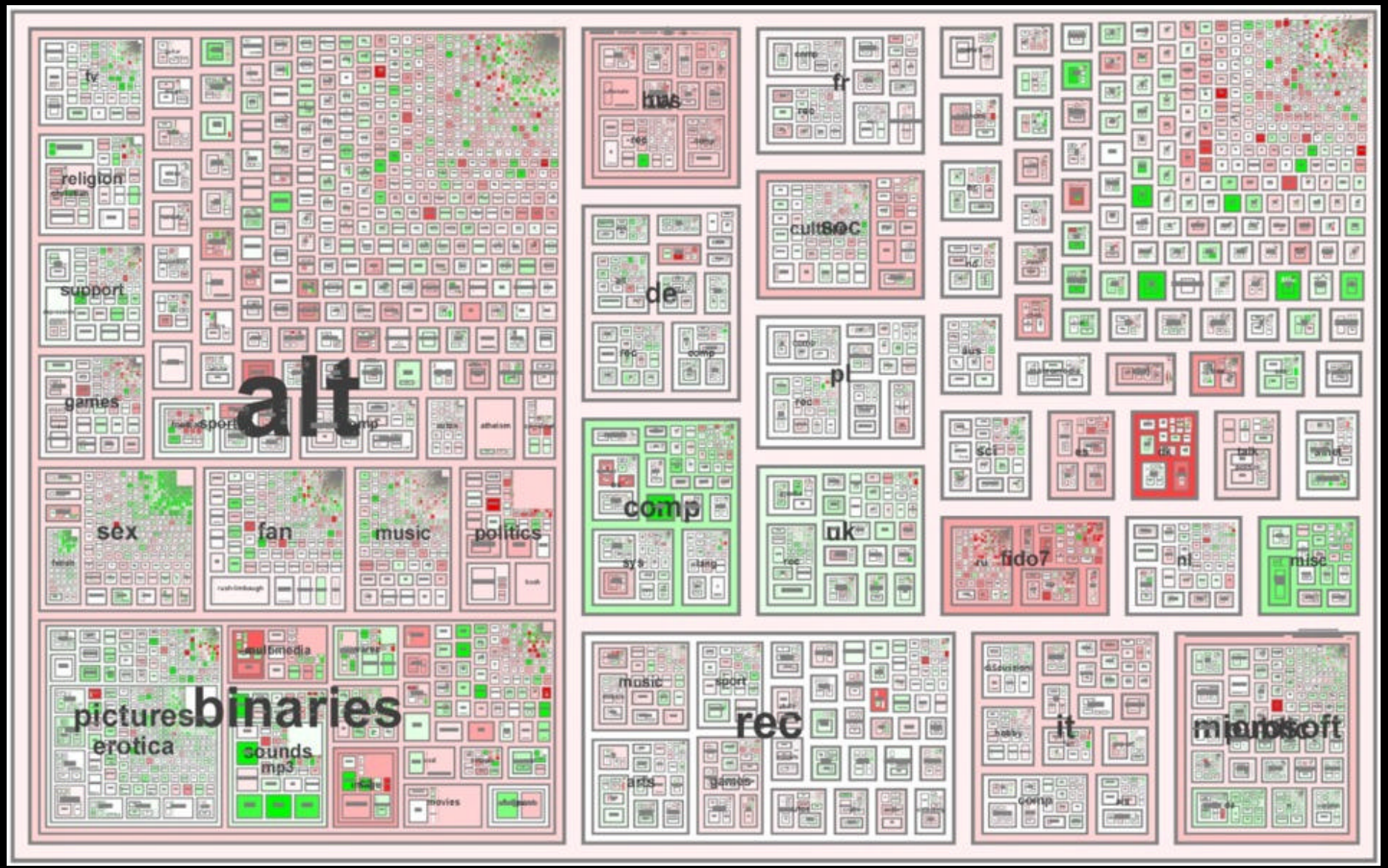
http://www.map.net/

SmartMoney.com - Map of the Market



Social Maps - What are people talking about?

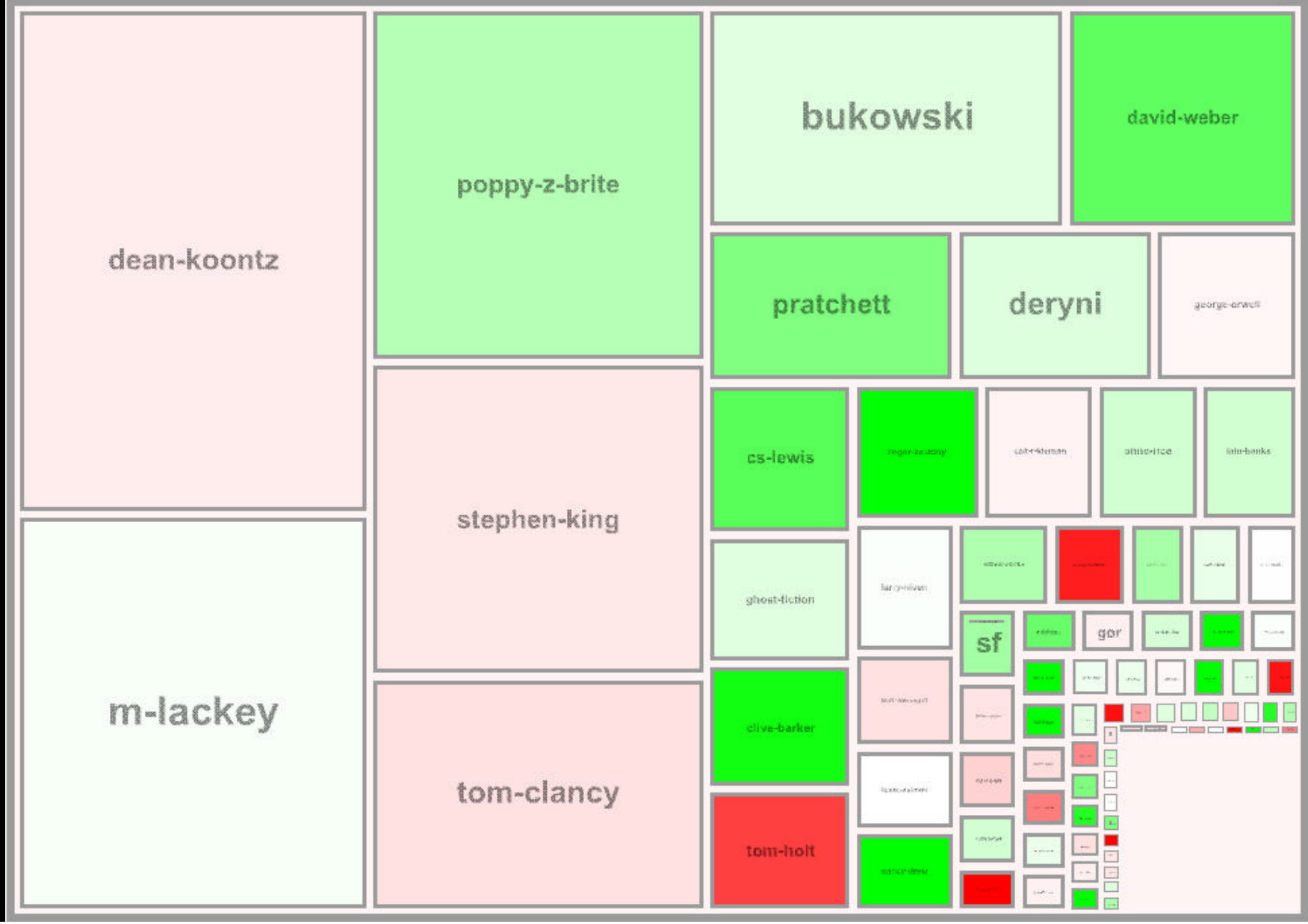
Netscan project by Marc Smith & Andrew Fiore, Microsoft Research



http://netscan.research.microsoft.com/

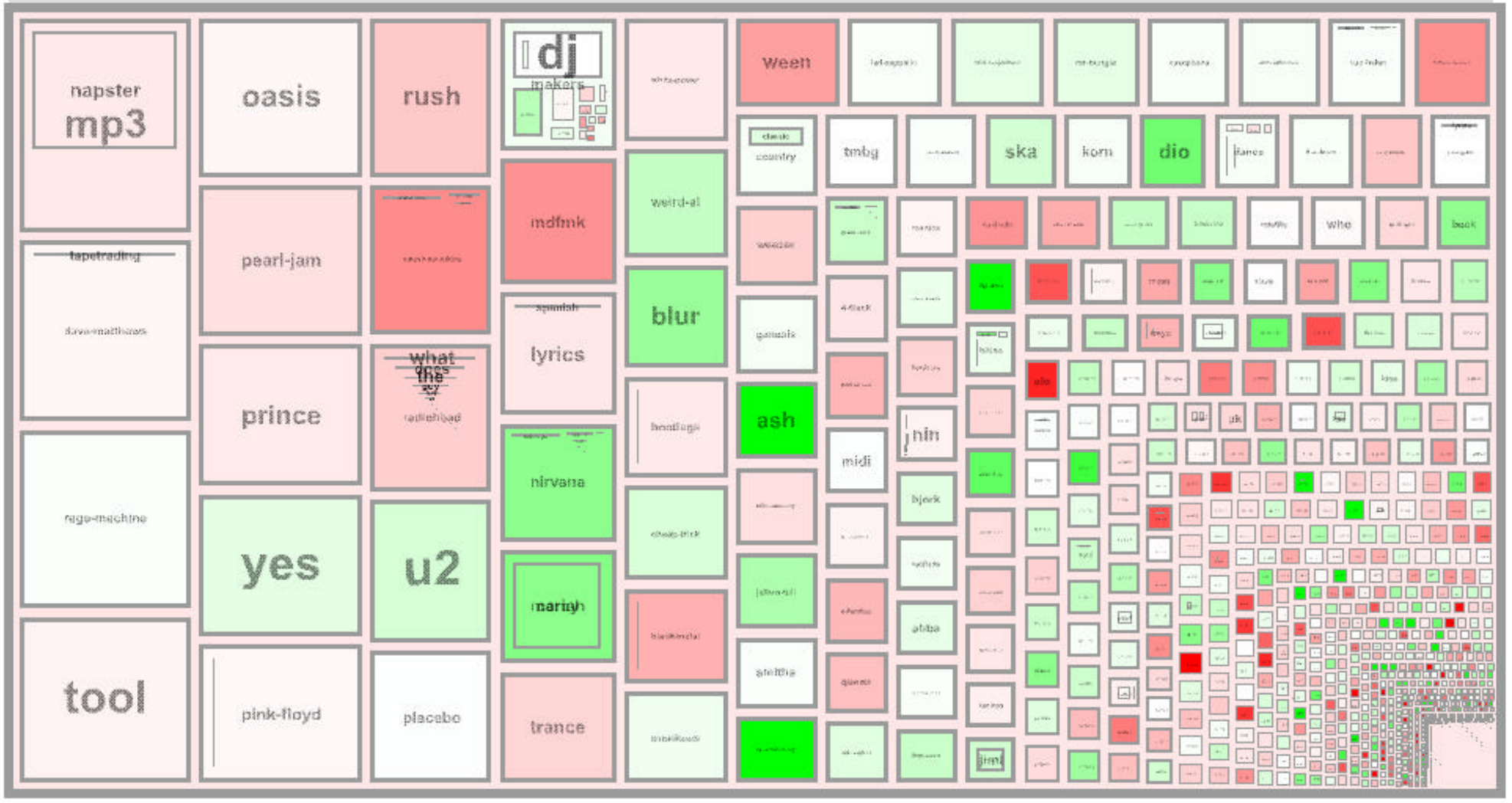
books

Newsgroup Name	Date	Total Groups	Total Messages	Total Posters	Deep red means - 300% change
alt.books	01/01/2001	87	19567	3264	Deep green means + 300% change



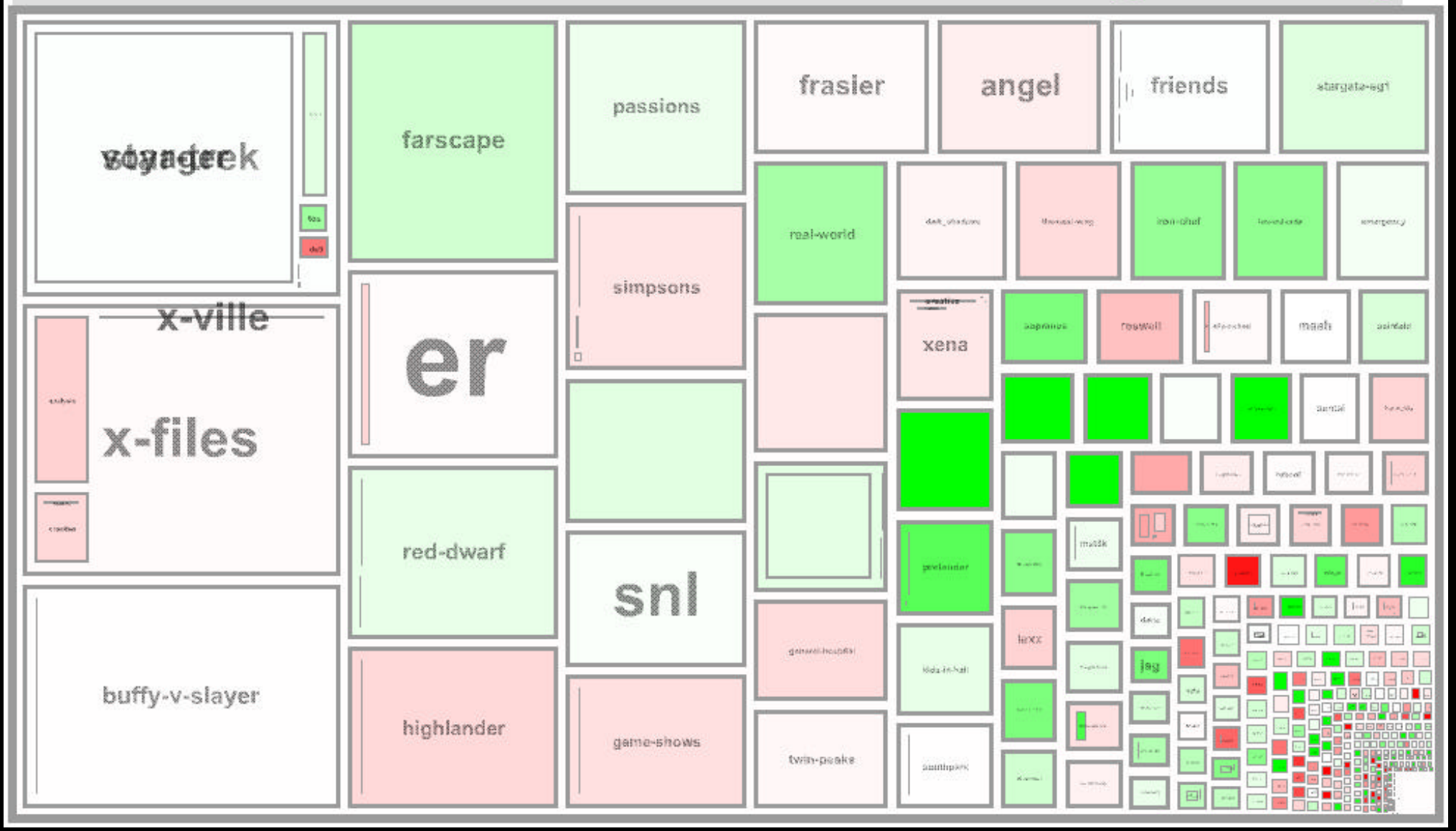
Music

Newsgroup Name	Date	Total Groups	Total Messages	Total Posters	Deep red means - 300% change
alt.music	01/01/2001	807	197736	43757	Deep green means + 300% change

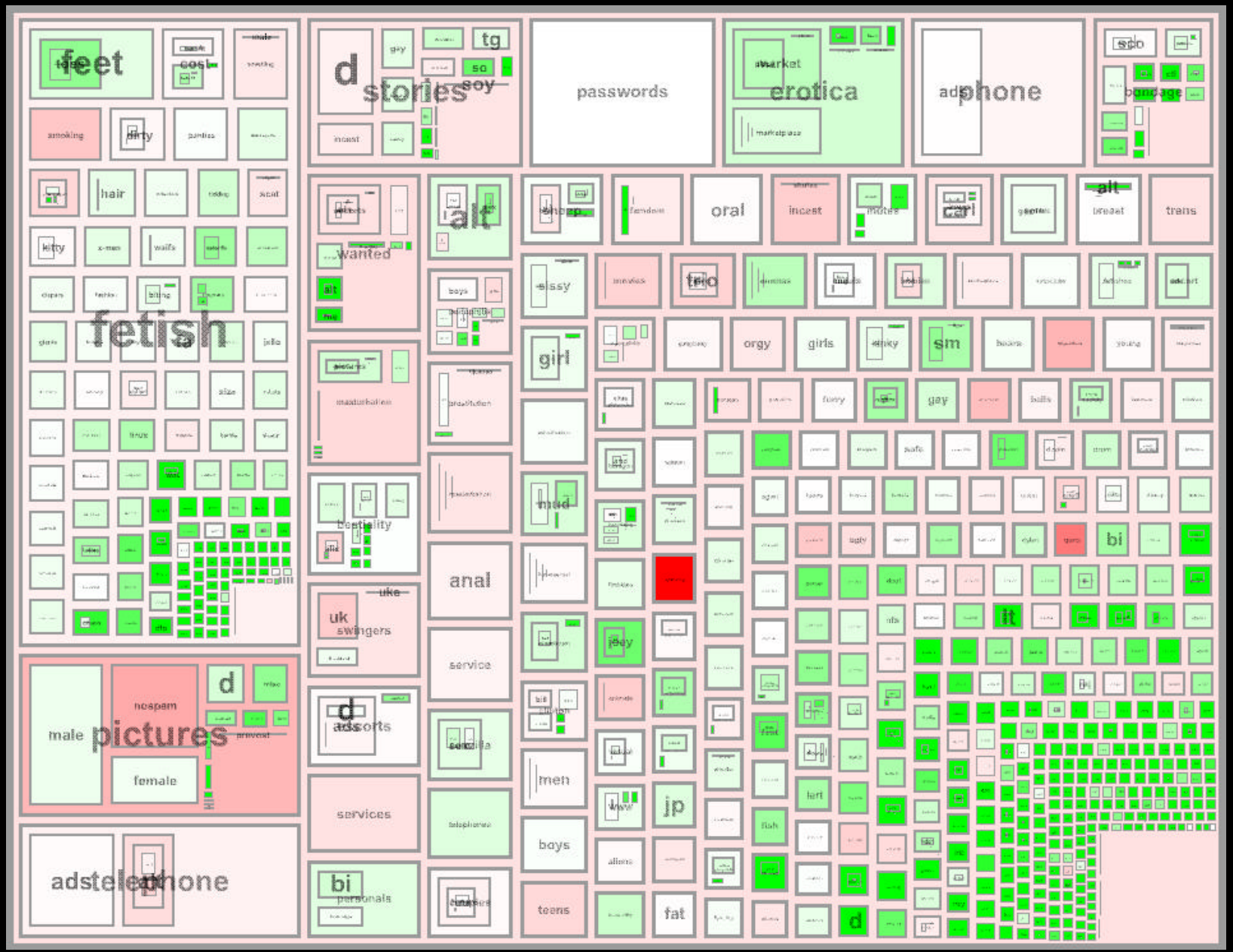


TV

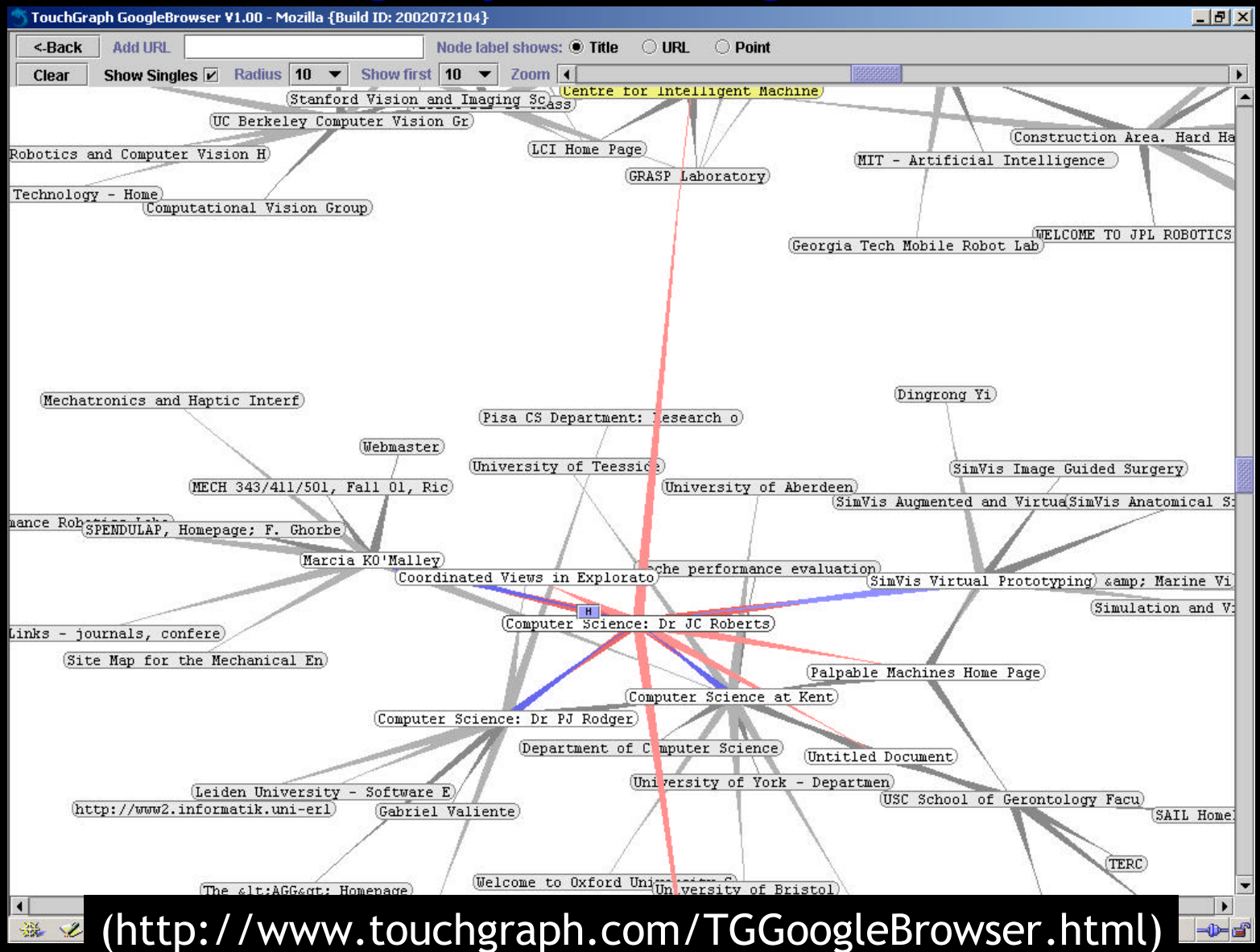
Newsgroup Name	Date	Total Groups	Total Messages	Total Posters	Deep red means - 300% change
alt.tv	01/01/2001	381	134859	19222	Deep green means + 300% change



And of course Sex (the alt.sex newsgroups)



Web hyperlink maps
Touchgraph GoogleBrowser



(http://www.touchgraph.com/TGGoogleBrowser.html)

critical cartography: the new nature of the map

- the power of maps
- maps are not simply about communicating geographic information or representing the landscape
- maps express power; maps create power
- maps are not neutral or objective
- maps are systems of power-knowledge
- maps are subjective, selective distortions
- maps serve the interests of those that make them

critical cartography: the new nature of the map

- maps can be ‘read’ as texts, concerned for the 2nd text, the marginal, the unsaid
- we should worry less about map design, accuracy standards, theories of information transfer, etc, etc (that’s a smoke screen)
- examine more the social implications
- what are the ethics of the maps, the map-maker and their mapping practices
- is it ethical to record and map someone’s web surfing and email interactions?

two key ideas

- maps are subjective
- maps are frames

maps are subjective

- we all know the huge number of subjective decisions we take when making maps
- just think of the last time you did some analysis (manipulation) and visualising in xxxxx package. trace out the number of subjective, and often arbitrary, decisions you make

- plus all the arbitrary defaults set by software designers and programmers
- these all effect the end result. what comes out is your social construction

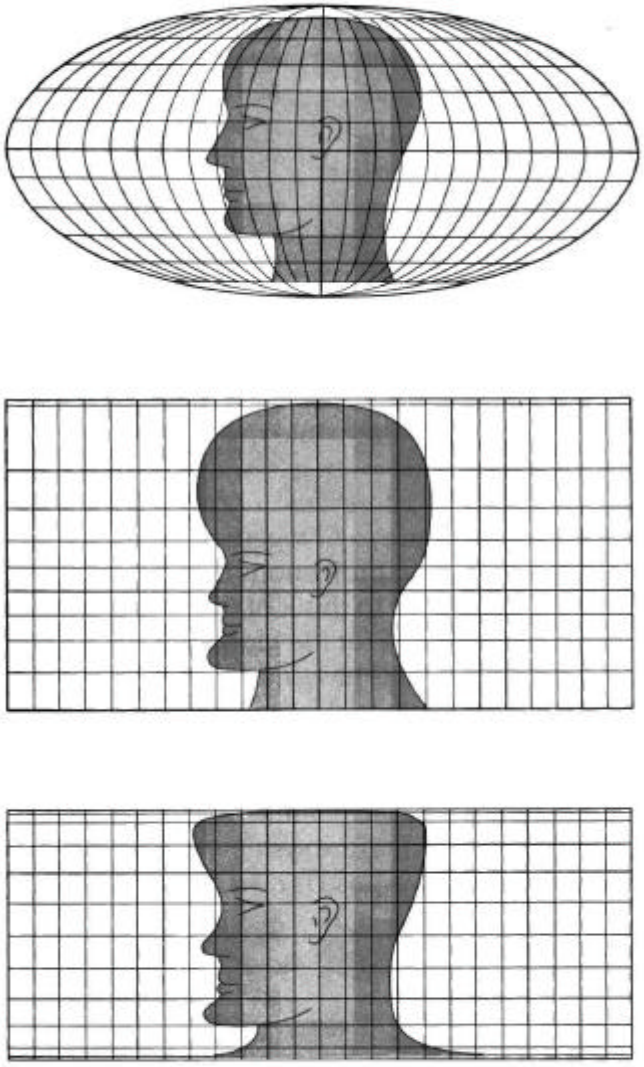
- this is the same for even the most fancy 3d immersive cyberspace map
- this applies to all visualisations

maps are subjective

- subjectivity is inherent
- subjectivity is not wrong. you are not a ‘bad’ person for making subjective maps. not a personal criticism
- the problem is :
  - passing off the map as objective and neutral
  - denying the subjectivity
  - naïve belief that the map is just a mirror of reality
  - this is enhanced with the ‘scientific’ sophistication and hiding behind layers gee whiz tech
  - maps are then used and applied on the assumption that they are objective

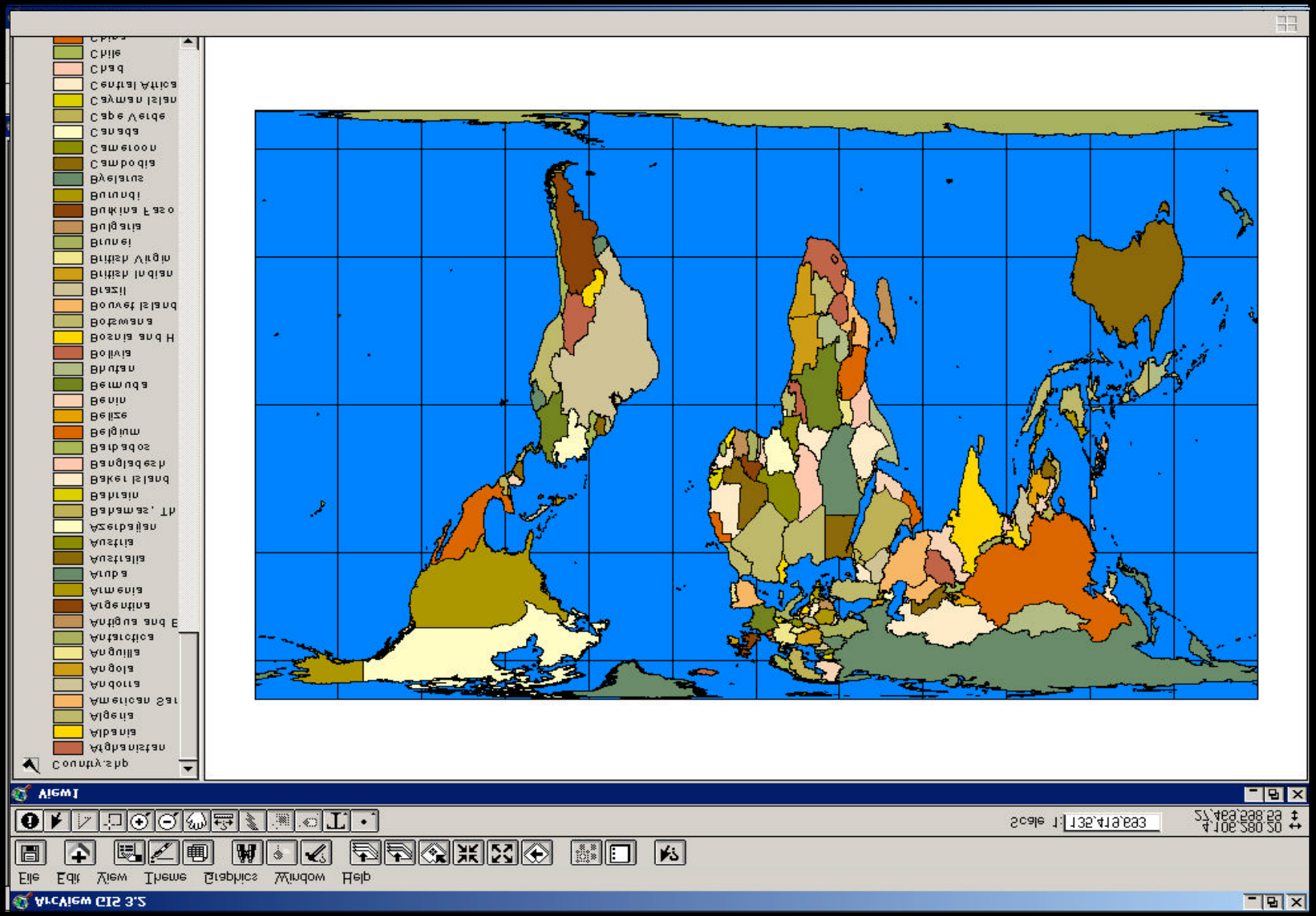
distortion and deception "how to lie with maps"

- most obvious being through
- data selection/omission
- projections
- how are maps of cyberspace deceiving?
- clearly there are many ways to project cyberspace onto a map

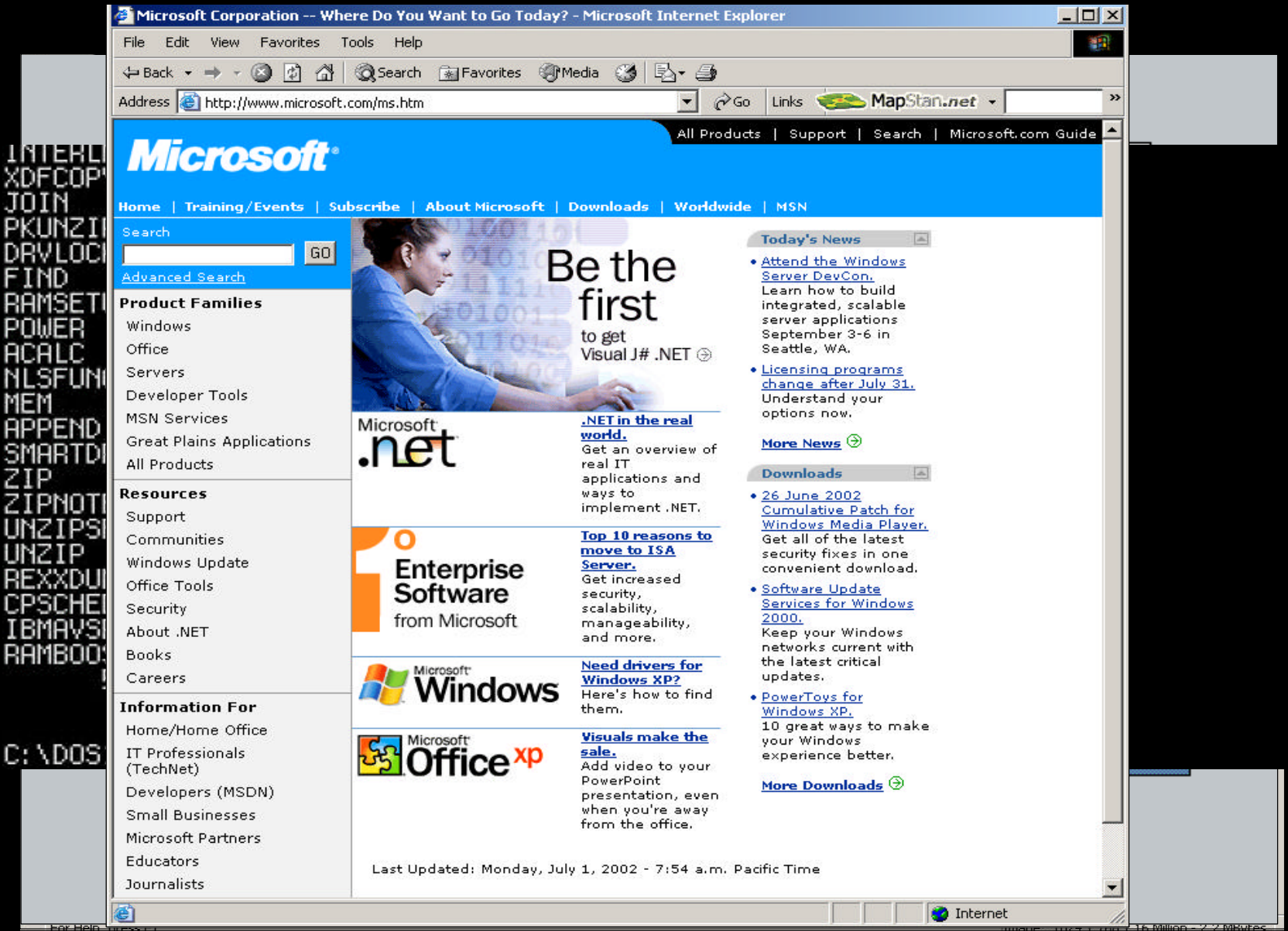


A head drawn on the Mollweide projection (top) has been transferred to Mercator's projection (center) and to the cylindrical equal-area projection with standard parallels at 30° (bottom). Just because the profile looks most natural on Mollweide's projection, that projection is not necessarily "better." The natural profile could have been drawn on any projection and then plotted on the others.

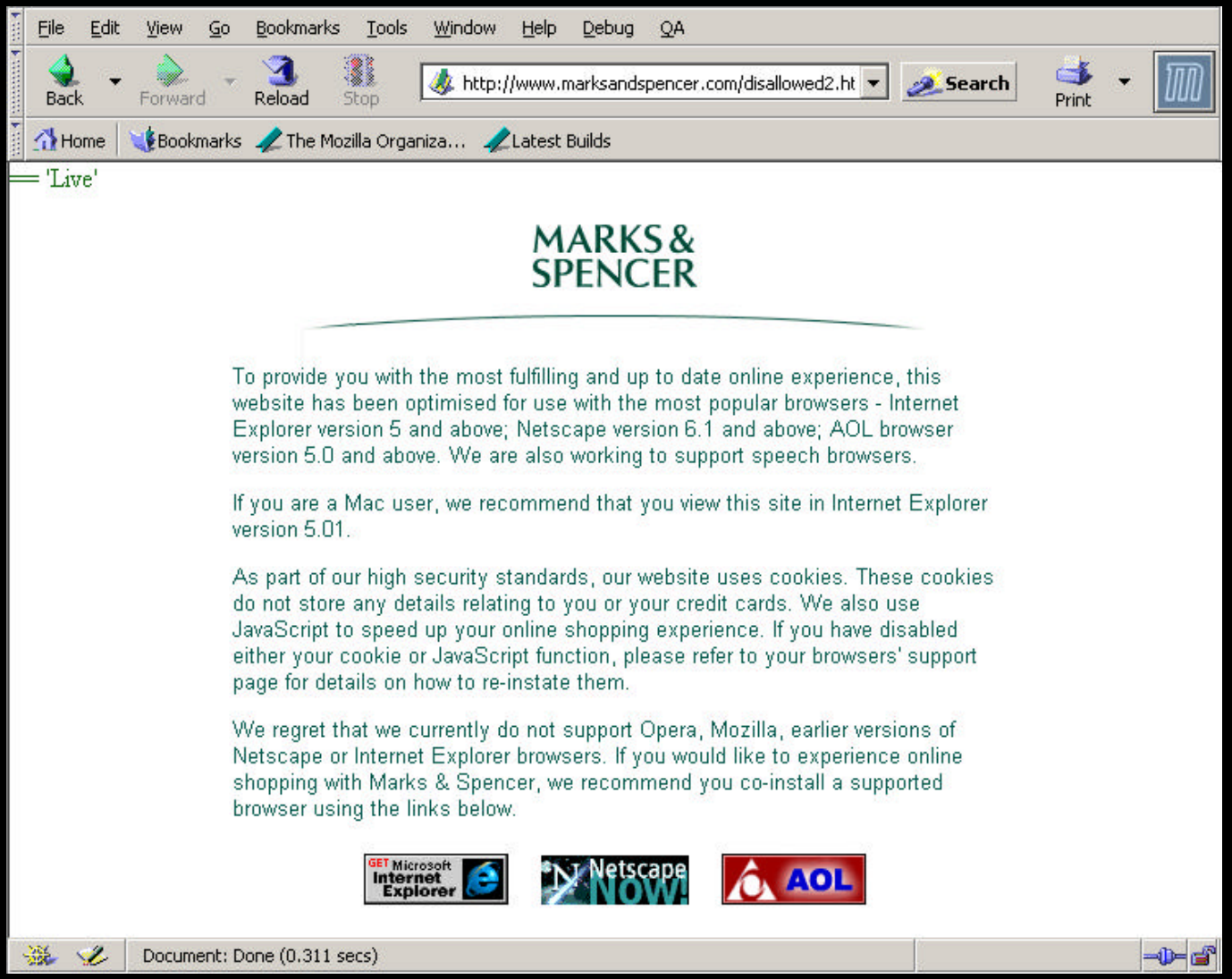
maps as frames of space



interfaces as frames of virtual space



We don’t like your browser, you can’t come in

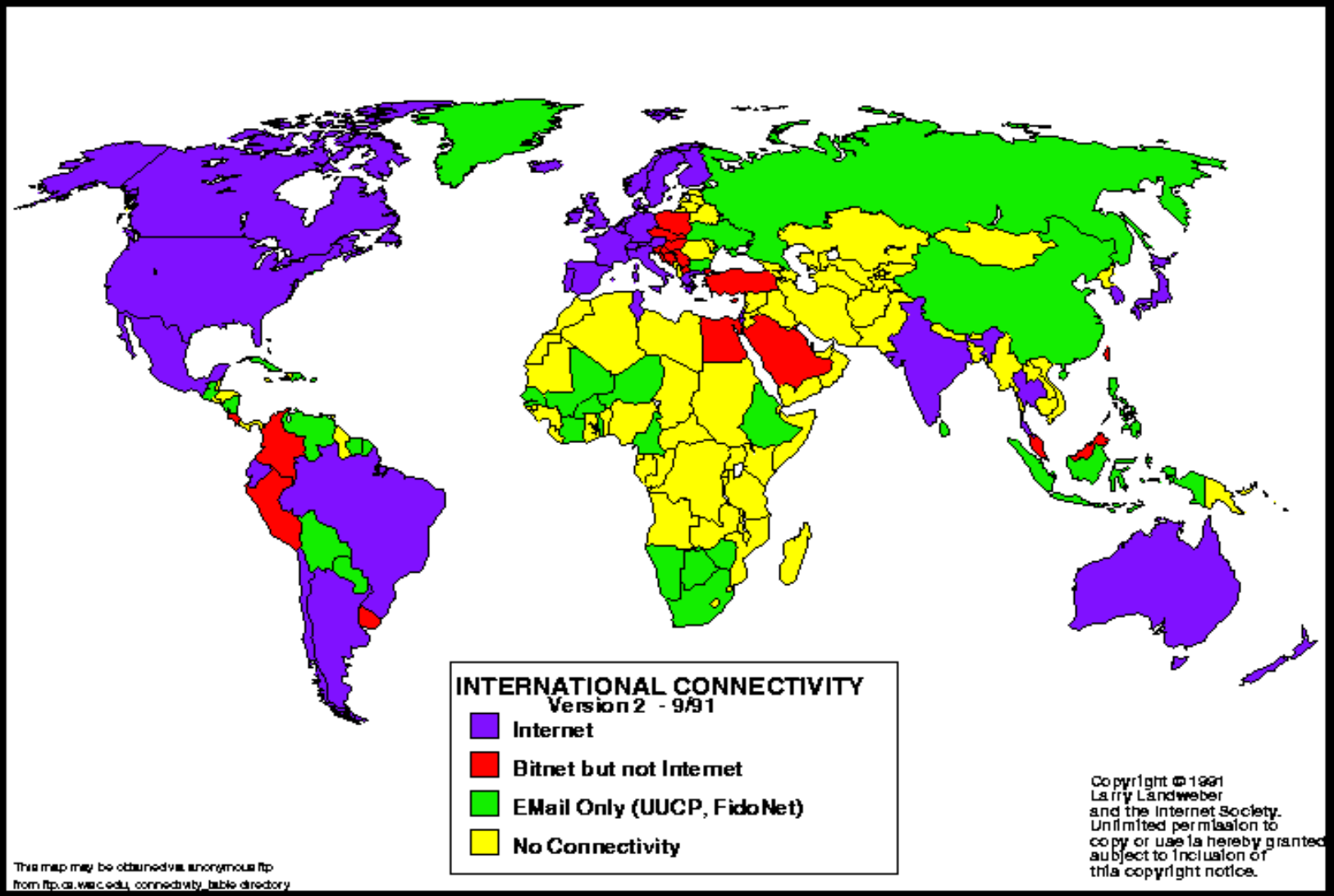


“Exclusively for Everyone (except mozilla users)”

virtual maps make virtual space

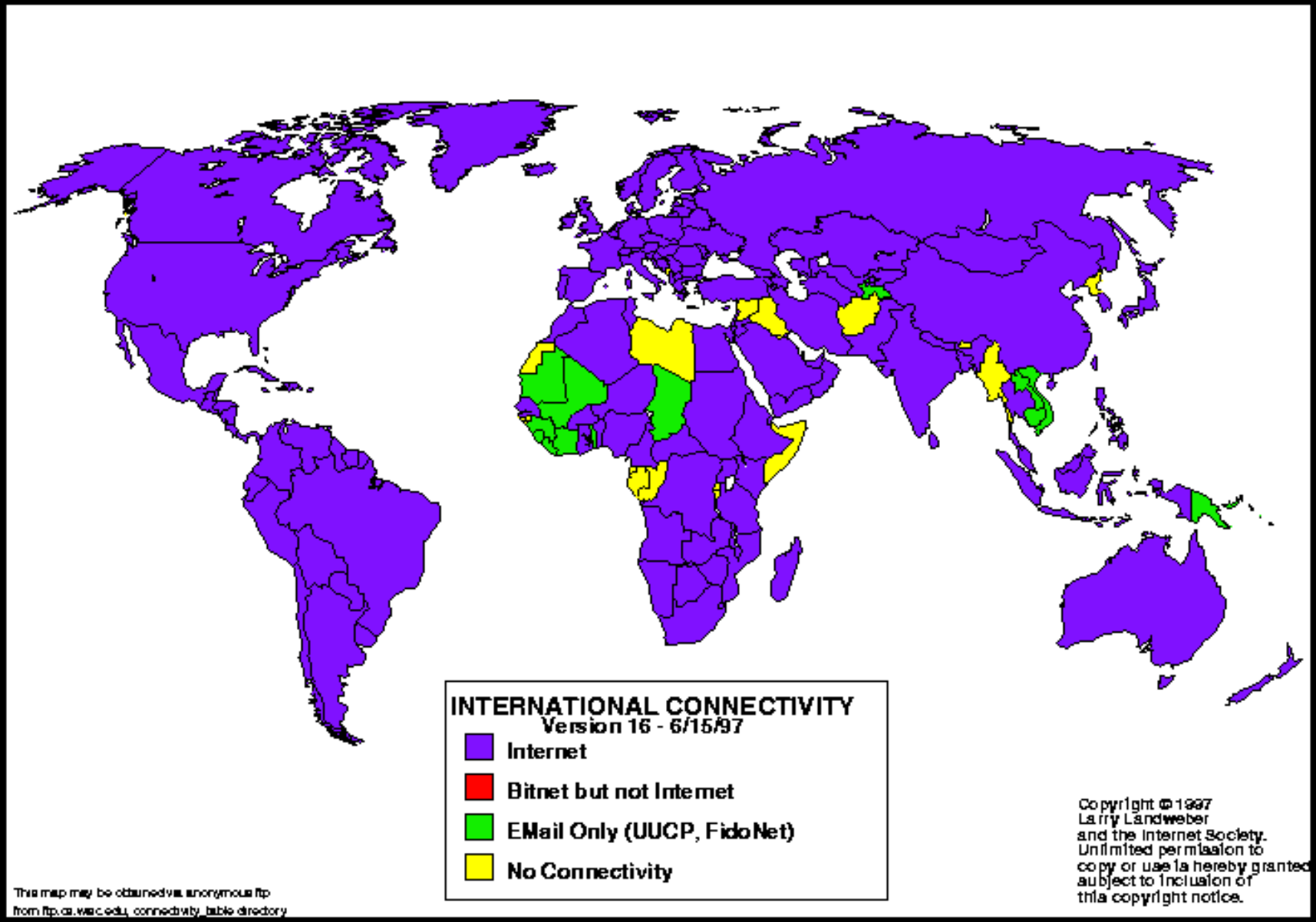
- the map affects what we see and what we can do
- we never know virtual space for ‘real’
- the interface is the space
- map and the territory are one
- those who make the interface, make the space…
- and of course the map they make is subjective and serves their interests
- its easy to take the interface for granted, assuming it is natural and a given. do not recognise its artificiality

Larry Landweber & ISOC national level network connectivity maps from 1990s



(ftp://ftp.cs.wisc.edu/connectivity_table/)

the whole world now pretty much wired??



- questions ?? I would welcome feedback to m.dodge@ucl.ac.uk
- http://www.cybergeography.org for more info
- the slides of this presentation are available at http://www.casa.ucl.ac.uk/martin/ukc_talk.pdf