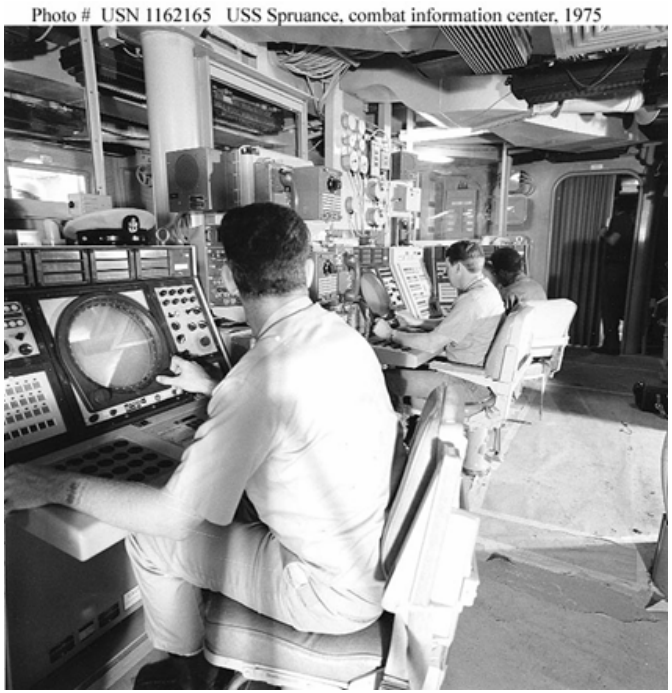
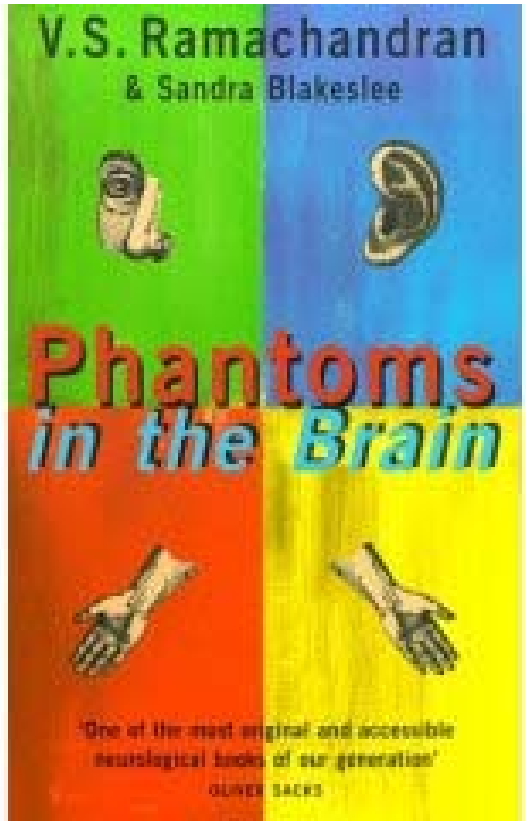
Virtualizing the World

Michael Macedonia



Summary

- Sensors and “virtuality” are redefining our lives
- “Zillions” (sensor data, bots, and humans avatars) will aggregate at compute cores
- Virtual worlds are being created for more than entertainment and will become part of daily experience
- Virtual worlds are real-time converged media environments – video, VOIP, physical simulation, graphics – that demand high performance
- Performance is required at the edge as well as the core
  - Shifting more computing to core is more efficient but will concentrate energy requirements
- At the macro application layer, energy, latency, and bandwidth will pose major challenges

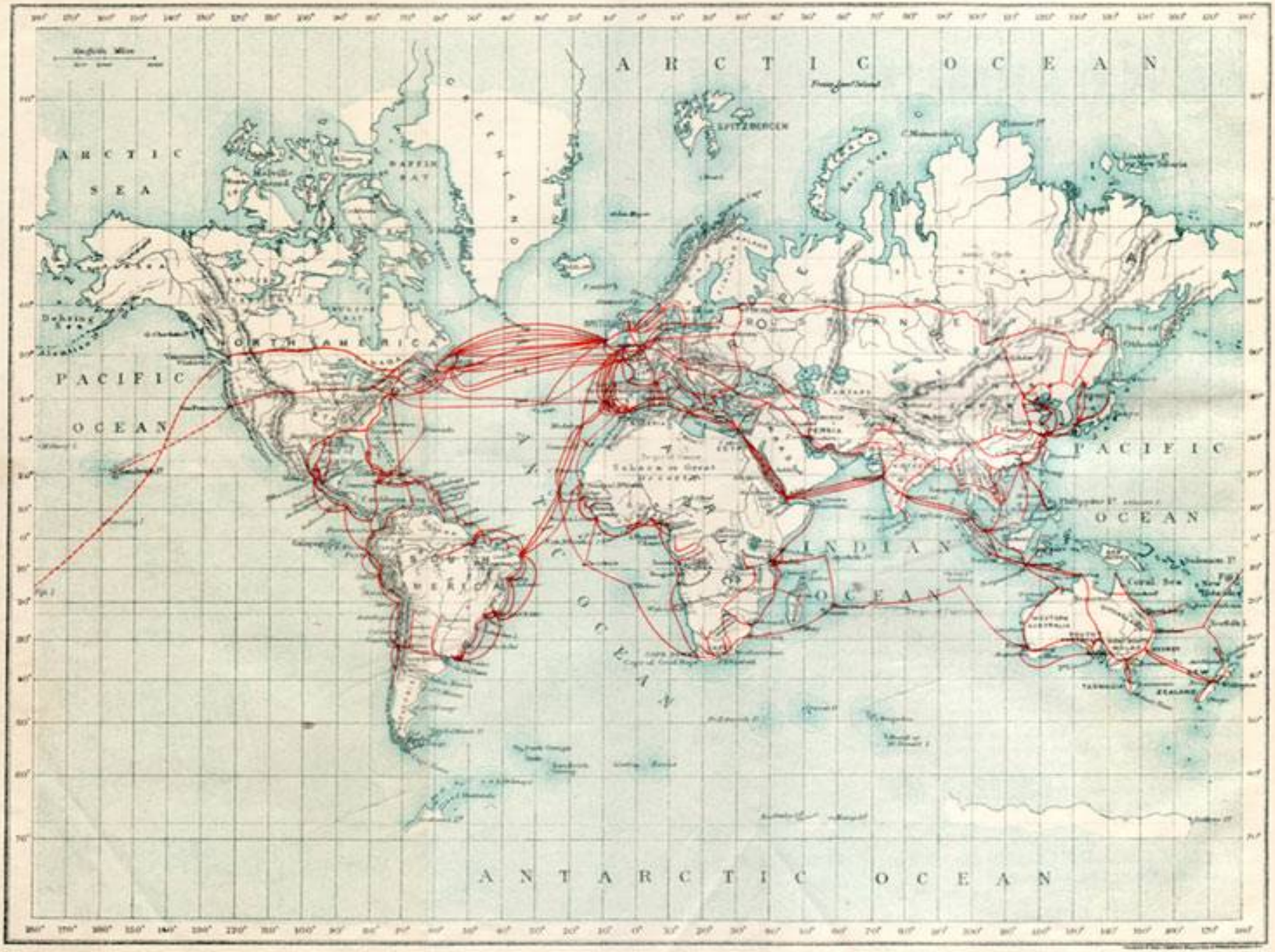

V.S. Ramachandran
& Sandra Blakeslee
Phantoms
in the Brain
'One of the most original and accessible
neurological books of our generation'

Zillionics

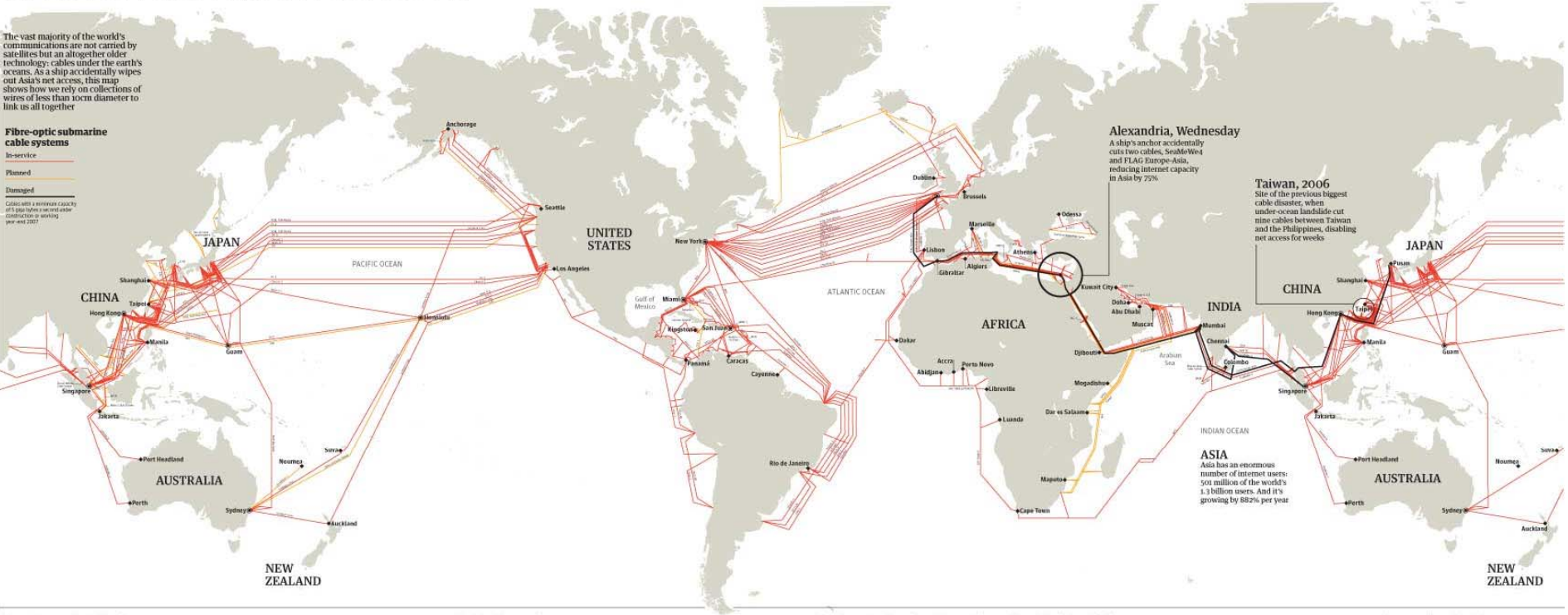
- “Ubiquitous always-on sensors in bodies and environment will transform medical, environmental, and space sciences. **Unrelenting rivers of sensory data** will flow day and night from zillions of sources.“
- Zillionics requires **a new scientific perspective** in terms of permissible errors, numbers of unknowns, probable causes, repeatability, and significant signals.

-- Kevin Kelly

EASTERN TELEGRAPH Co.ʸ SYSTEM AND ITS GENERAL CONNECTIONS.

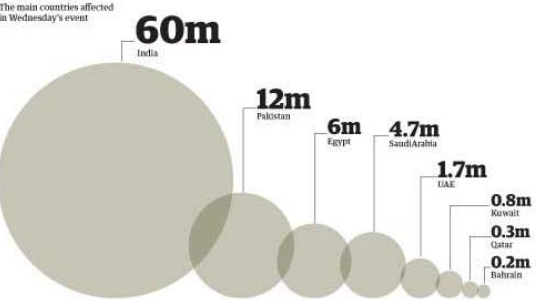


The internet's undersea world



Internet users affected by the Alexandria accident

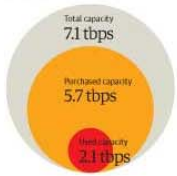
The main countries affected in Wednesday's event



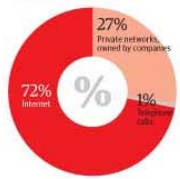
World cable capacity

Submarine cable operators light (turn on) capacity on their systems to sell bandwidth to other carriers. Carriers buy extra capacity, mainly to hold in reserve. On the trans-Atlantic route 80% of the bandwidth is purchased, but only 29% is used

Capacity in terabytes a second



What makes up "used capacity"?



The longest submarine cables

The SeaMeWe-3 system from Norden in Germany to Keoje, South Korea connects 32 different countries with 39 landing points

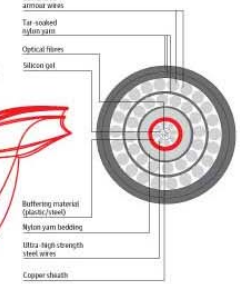
SeaMeWe-3	39,000 km
Southern Cross	30,500 km
China-US	30,476 km
FLAG Europe-Asia	28,000 km
South America-1	25,000 km

The world's cables in bandwidth

The first intercontinental telephony submarine-cable system, TAT-1, connected North America to Europe in 1958 and had an initial capacity of 640,000 bytes per second. Since then, total trans-Atlantic cable capacity has soared to over 7 trillion bps

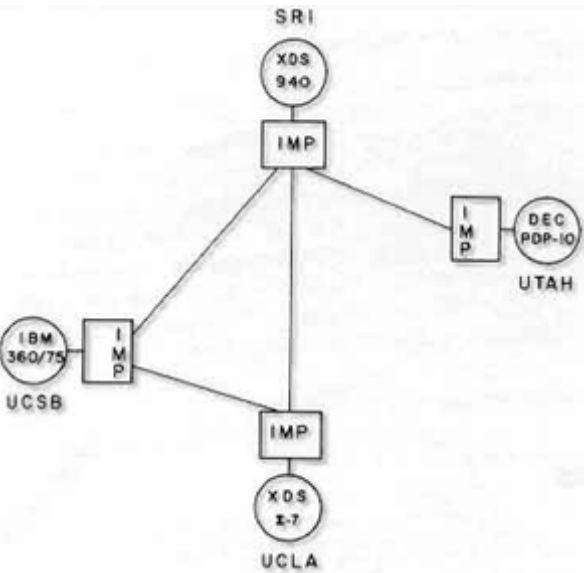
Cross-section of a cable

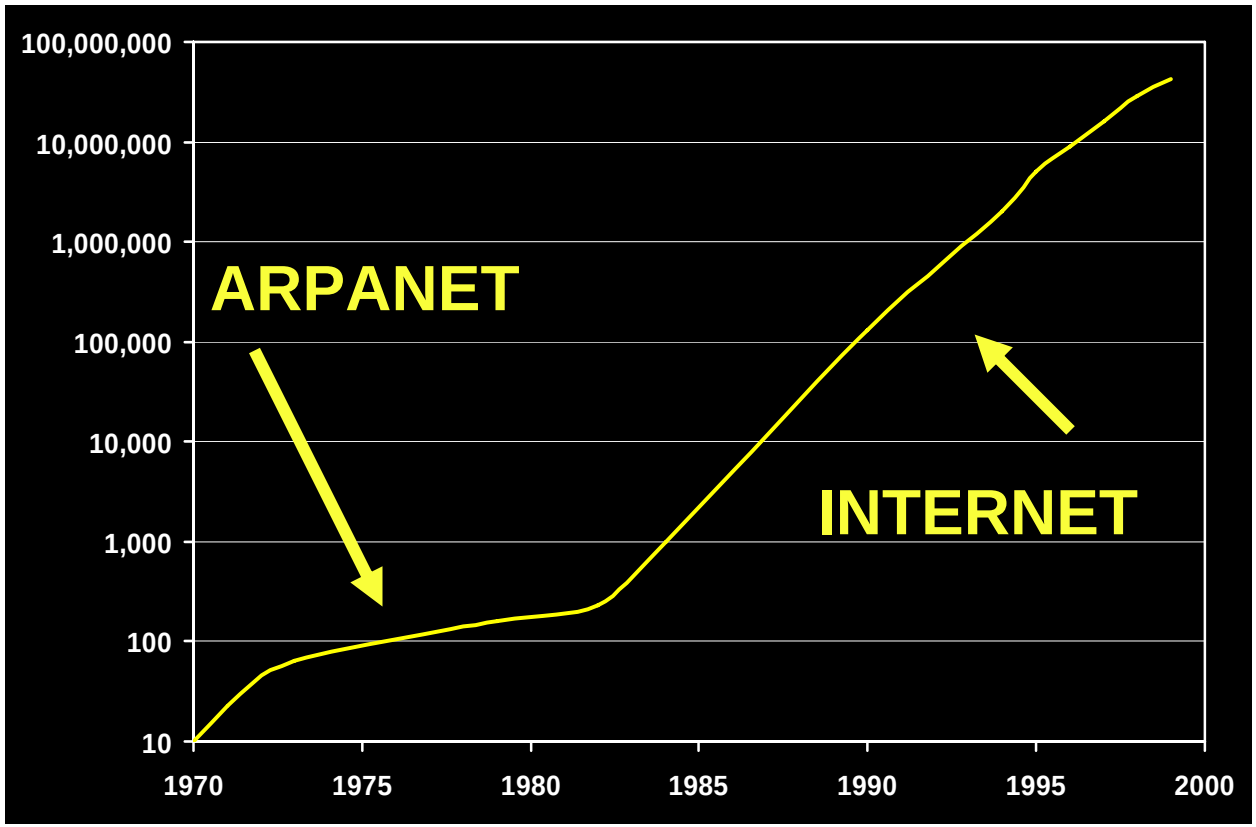
Cables of this strength are typically 69 mm in diameter and weigh over 10,000 kilograms a kilometer. In deeper waters, lighter and less insulated cables are used

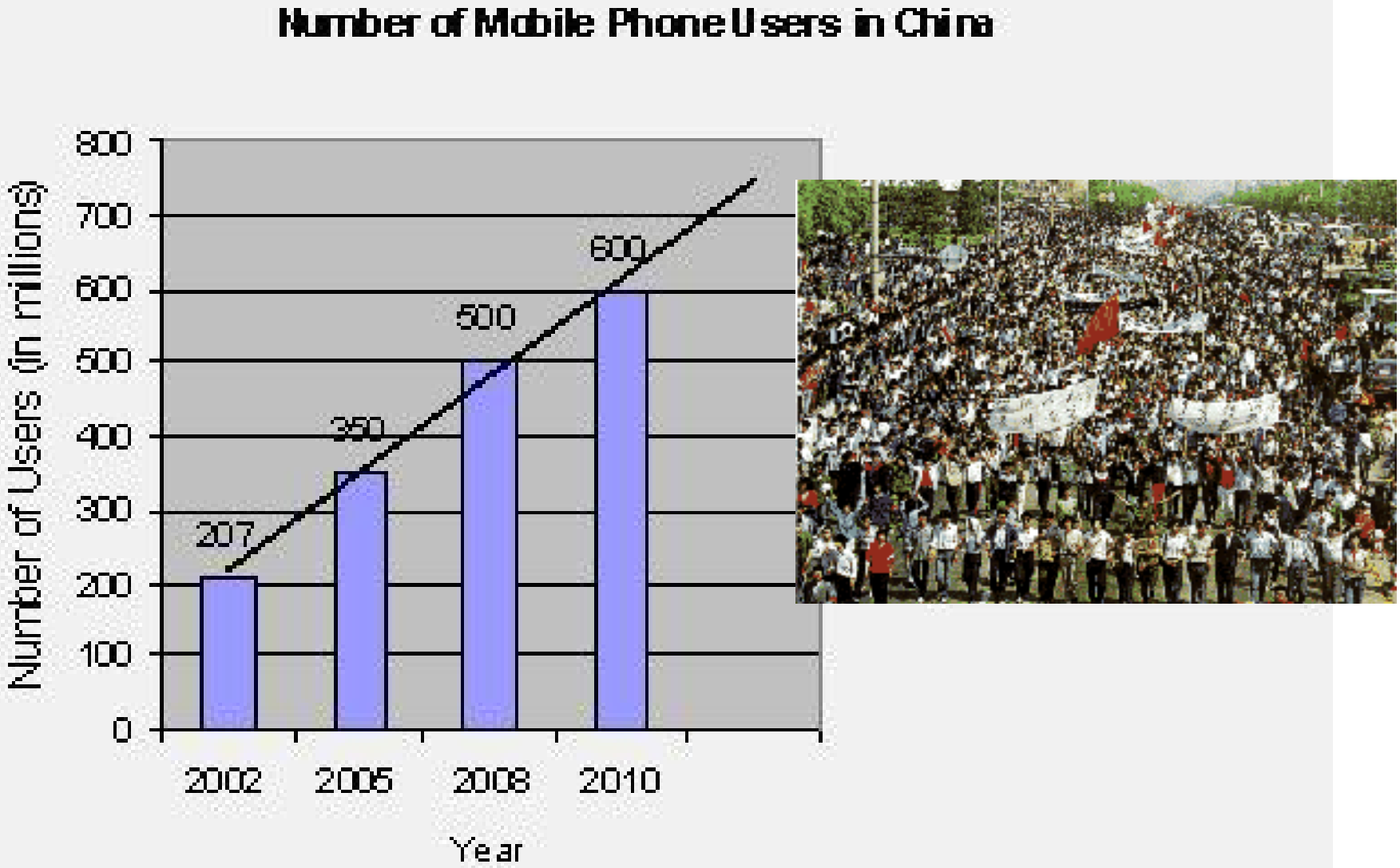


SOURCE: TELEGEOGRAPHY.COM/SUBMARINE-CABLE-MAP-2008; INTERNET STATISTICS FROM INTERNETWORLDSTATS.COM

Internet Growth (Hosts) in Millions



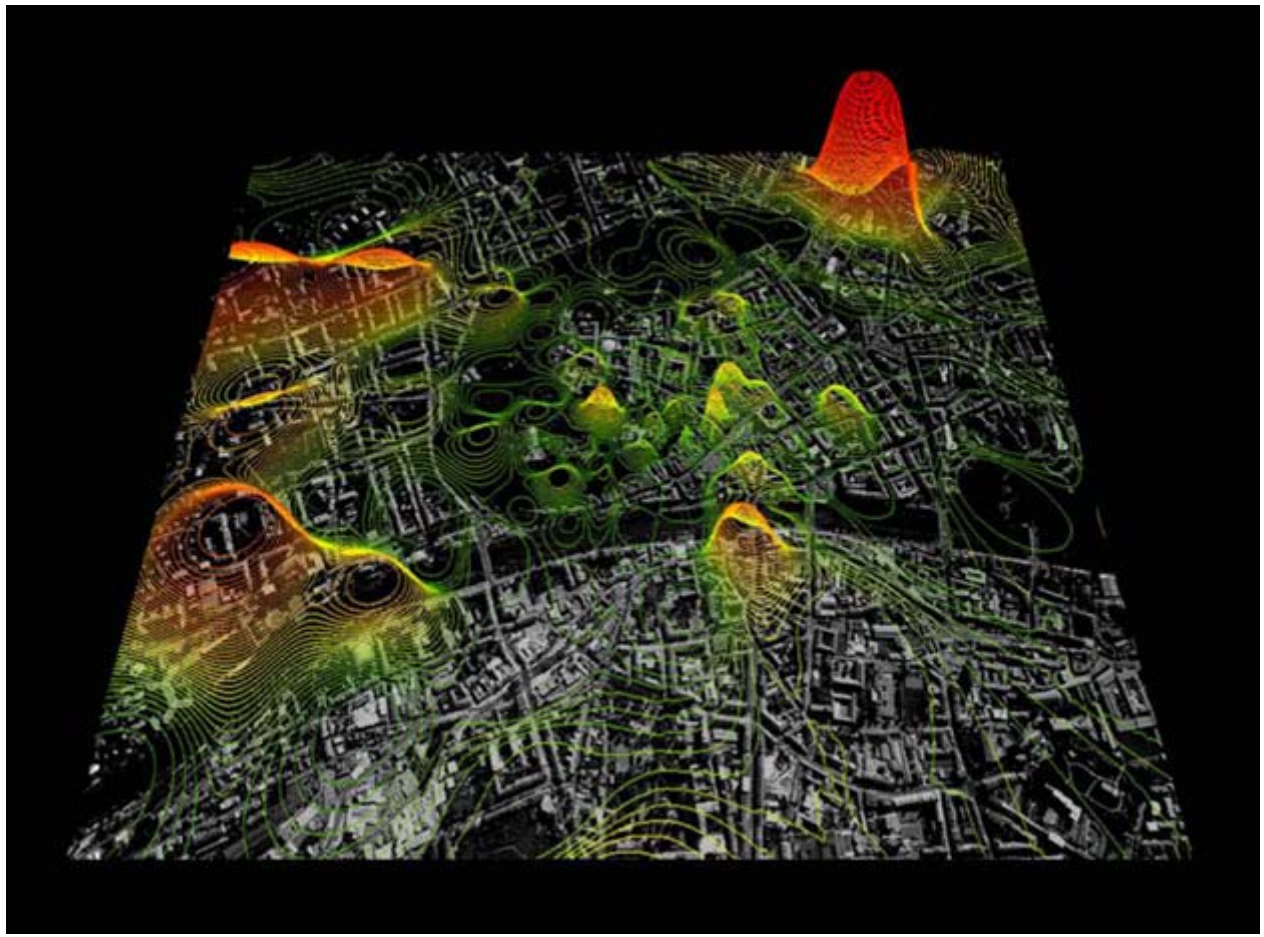



Number of Mobile Phone Users in China
Number of Users (in millions)
800
700
600
500
400
300
200
100
0
207
350
500
600
2002
2005
2008
2010
Year

Sensors Everywhere – How Many?

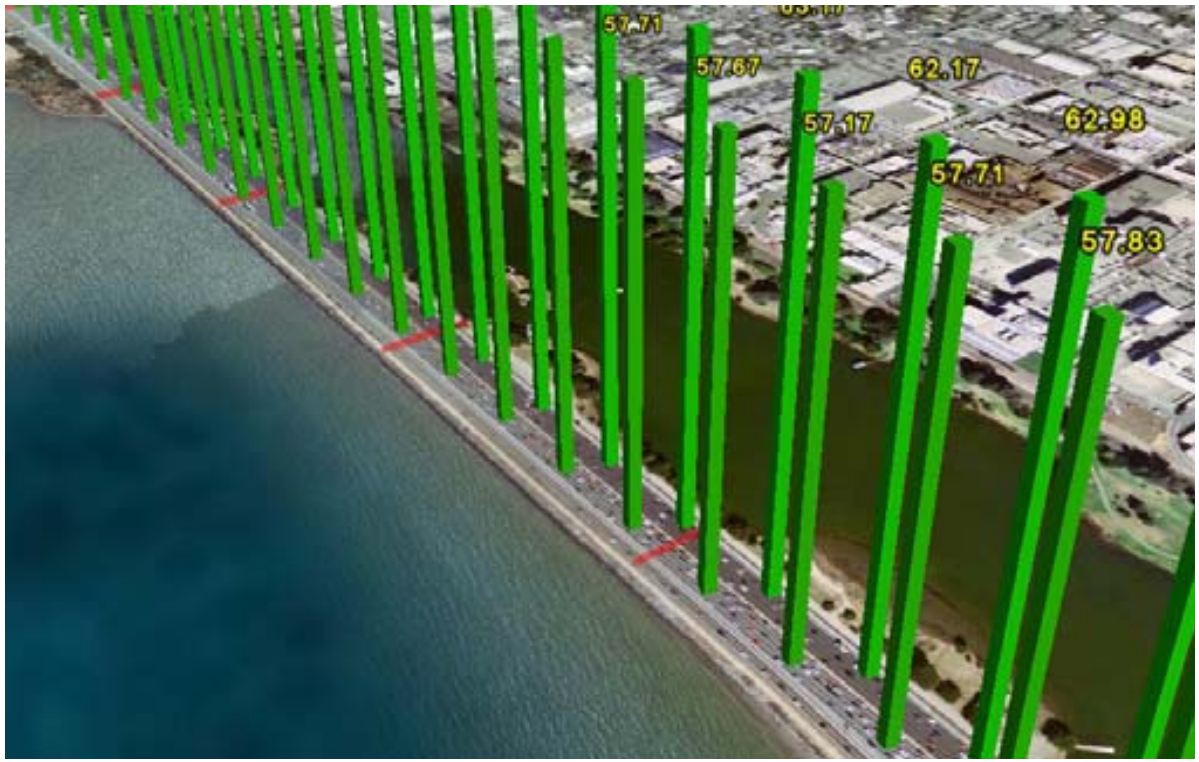
In Casinos …

Real Time Cell Phone Tracking



MIT Mobile Landscape Project Graz, Austria

Tracking Cell Phones on Highways



A Google Earth rendering of collected cell phone GPS data California. Virtual trip lines measuring speed upon crossing of the vehicles are shown in red.

Sensors Overhead Watched by Billions -- Image of Sub In Google Earth

Webcams

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Bucuti Beach Resort Aruba, Sun Jan 20 2008 2:25:33 pm

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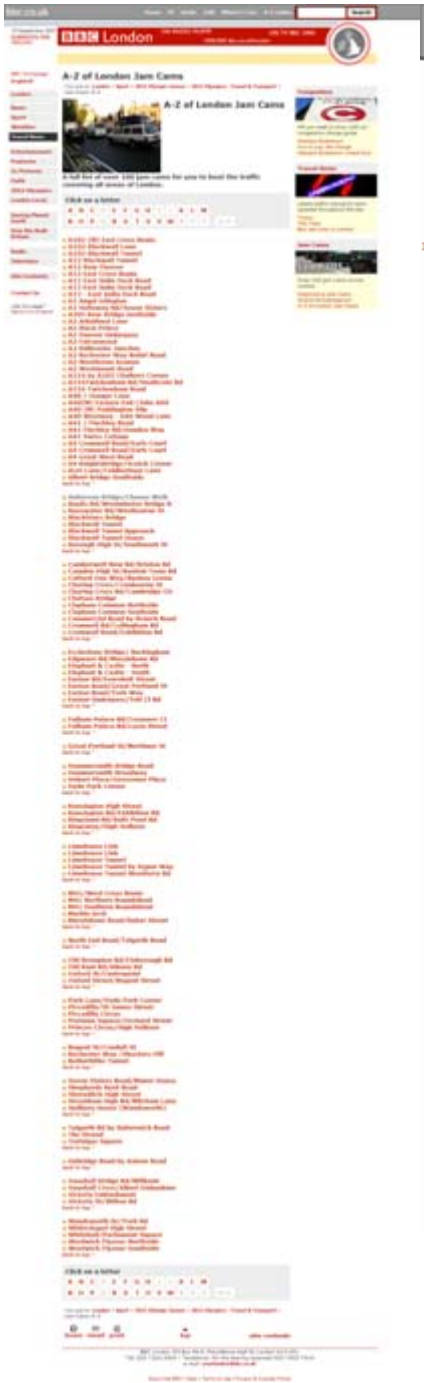
6:31 71°
Explosion Near 41st St
Between Third & Lexington
abc 7



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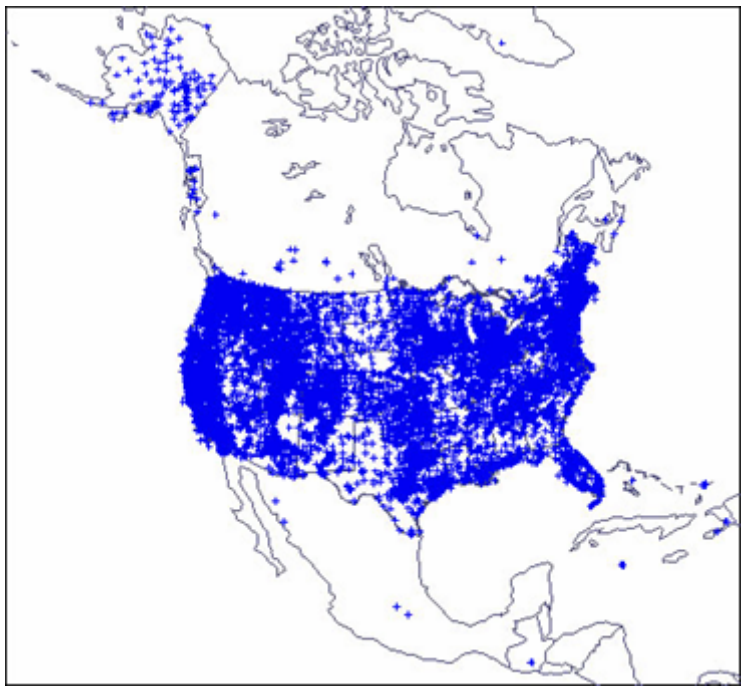
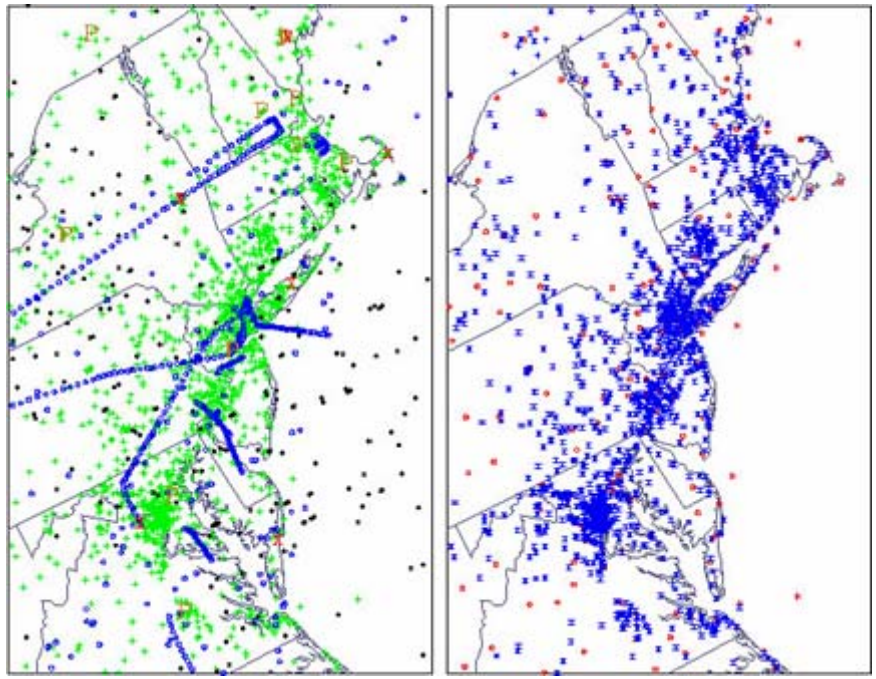
Intelligent Transportation Systems

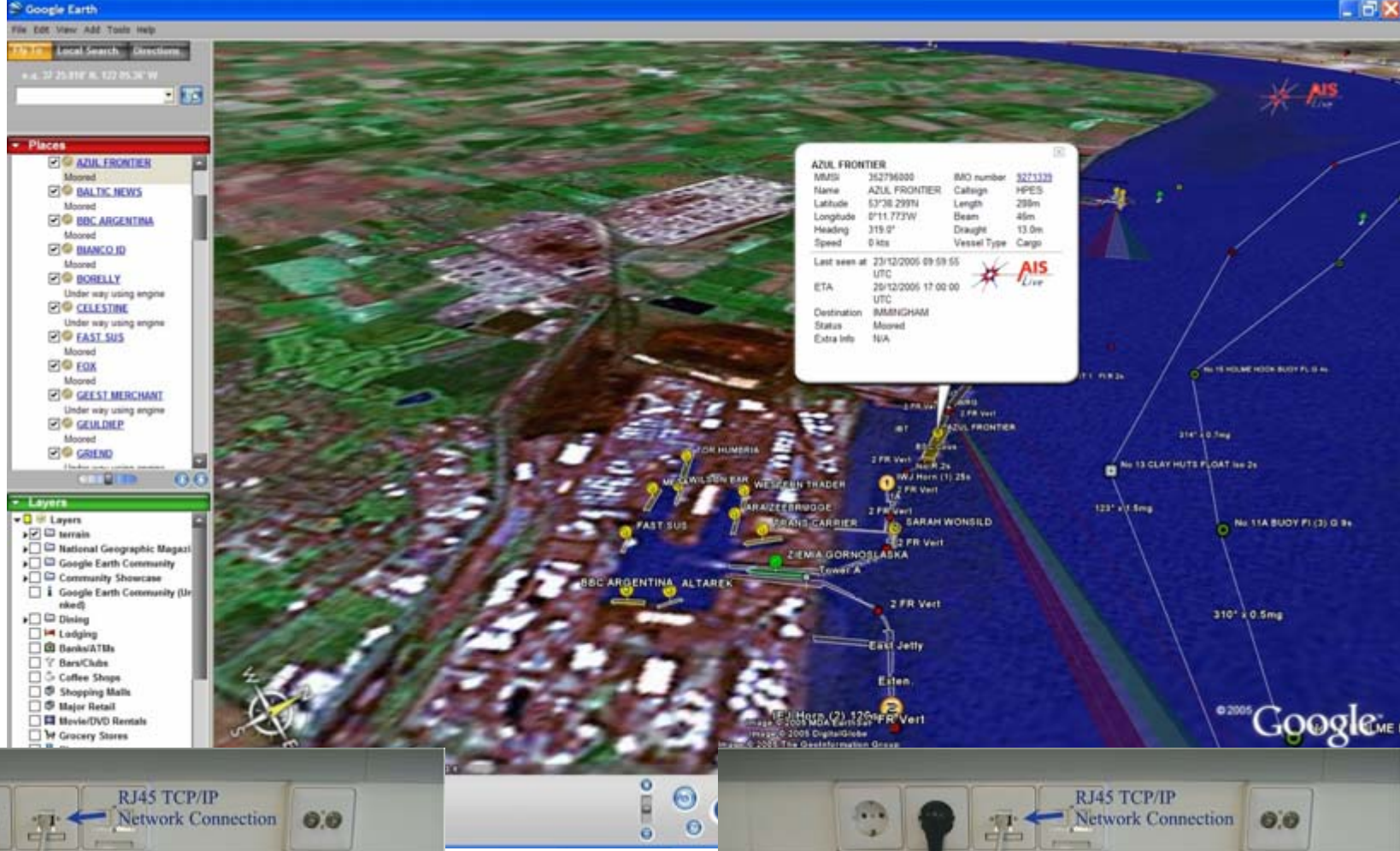
Meteorological Assimilation Data Ingest System (MADIS)

MADIS mesonet stations in the North-American domain on May 26, 2004.





MADIS observations available over the east coast of the U.S. on April 29,2004.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terrain
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Google Earth Community (Un
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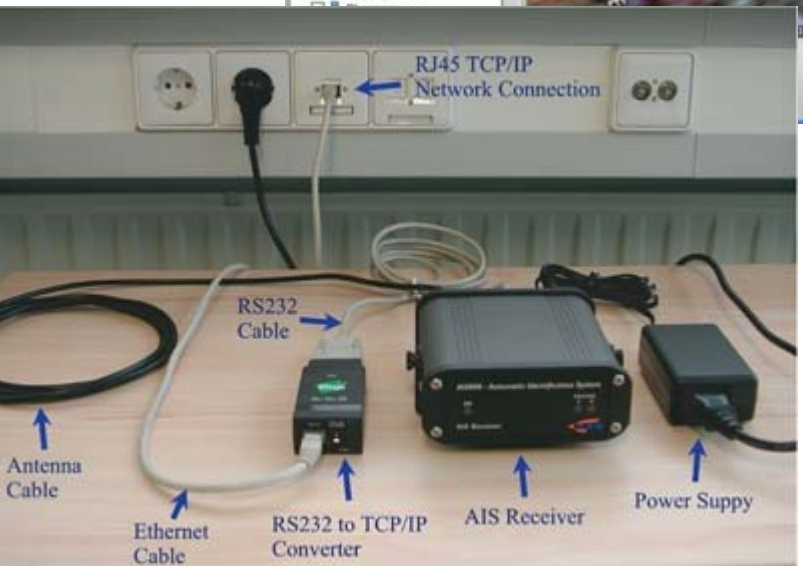
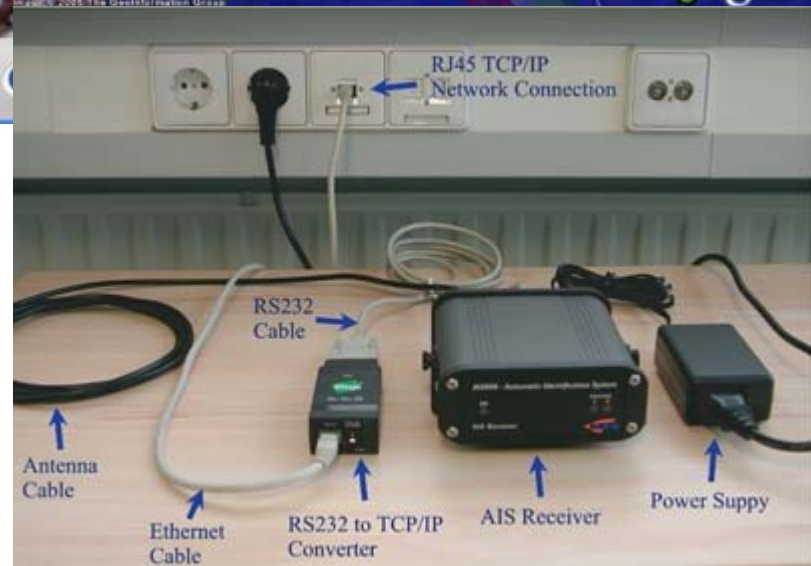
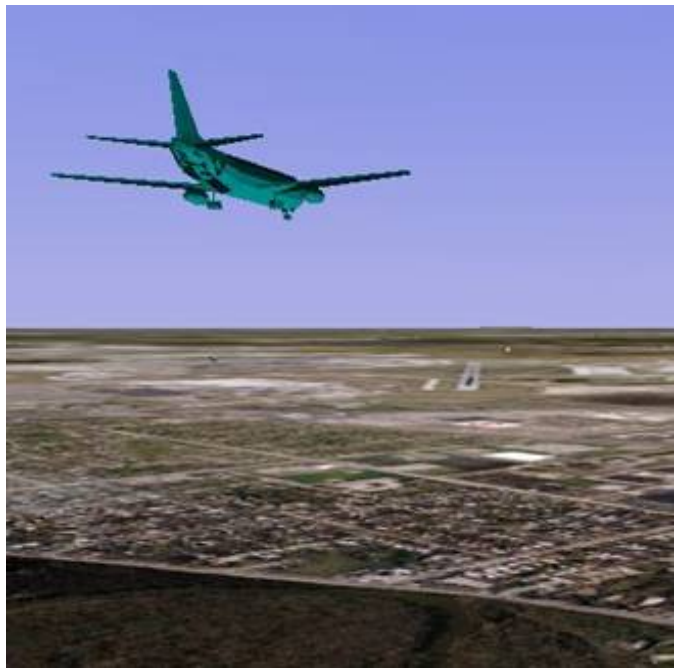
Lodging
Banks/ATMs
Bars/Clubs
Coffee Shops
Shopping Malls
Major Retail
Movie/DVD Rentals
Grocery Stores
AZUL FRONTIER
MMSI 352796000
IMO number 9271339
Name AZUL FRONTIER
Callsign HPES
Latitude 53°38.299'N
Length 288m
Longitude 0°11.773'W
Beam 46m
Heading 319.0°
Draught 13.0m
Speed 0 kts
Vessel Type Cargo
Last seen at 23/12/2005 09:59:55 UTC
ETA 20/12/2005 17:00:00 UTC
Destination IMMINGHAM
Status Moored
Extra Info N/A
AIS Live
TOR HUMBRIA
WESTERN TRADER
FAST SUS
SARAH WONSILD
ZIEMIA GORNOSLASKA
BBC ARGENTINA
ALTAREK
2 FR Vert
East Jetty
Esten
No 13 CLAY HUTS FLOAT Iso 2s
No 11A BUOY Fl (3) G 9s
310° x 0.5mg
©2005 Google


RJ45 TCP/IP
Network Connection
RS232
Cable
Antenna
Cable
Ethernet
Cable
RS232 to TCP/IP
Converter
AIS Receiver
Power Suppy


RJ45 TCP/IP
Network Connection
RS232
Cable
Antenna
Cable
Ethernet
Cable
RS232 to TCP/IP
Converter
AIS Receiver
Power Suppy

Flight Tracking



CIC on Ship

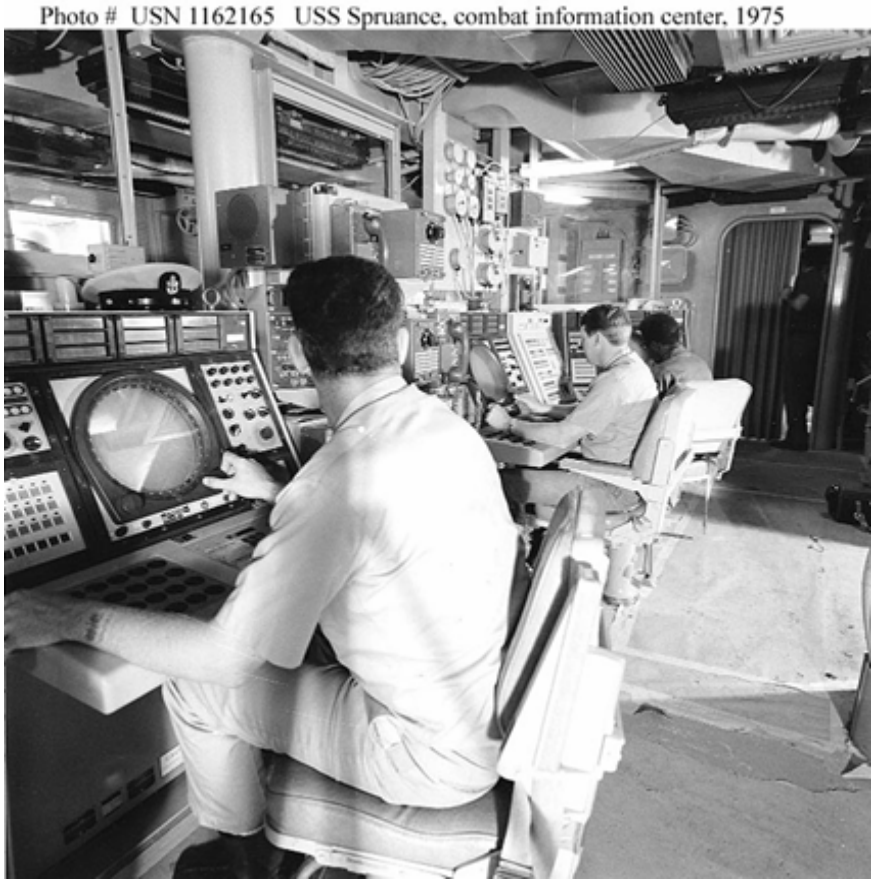
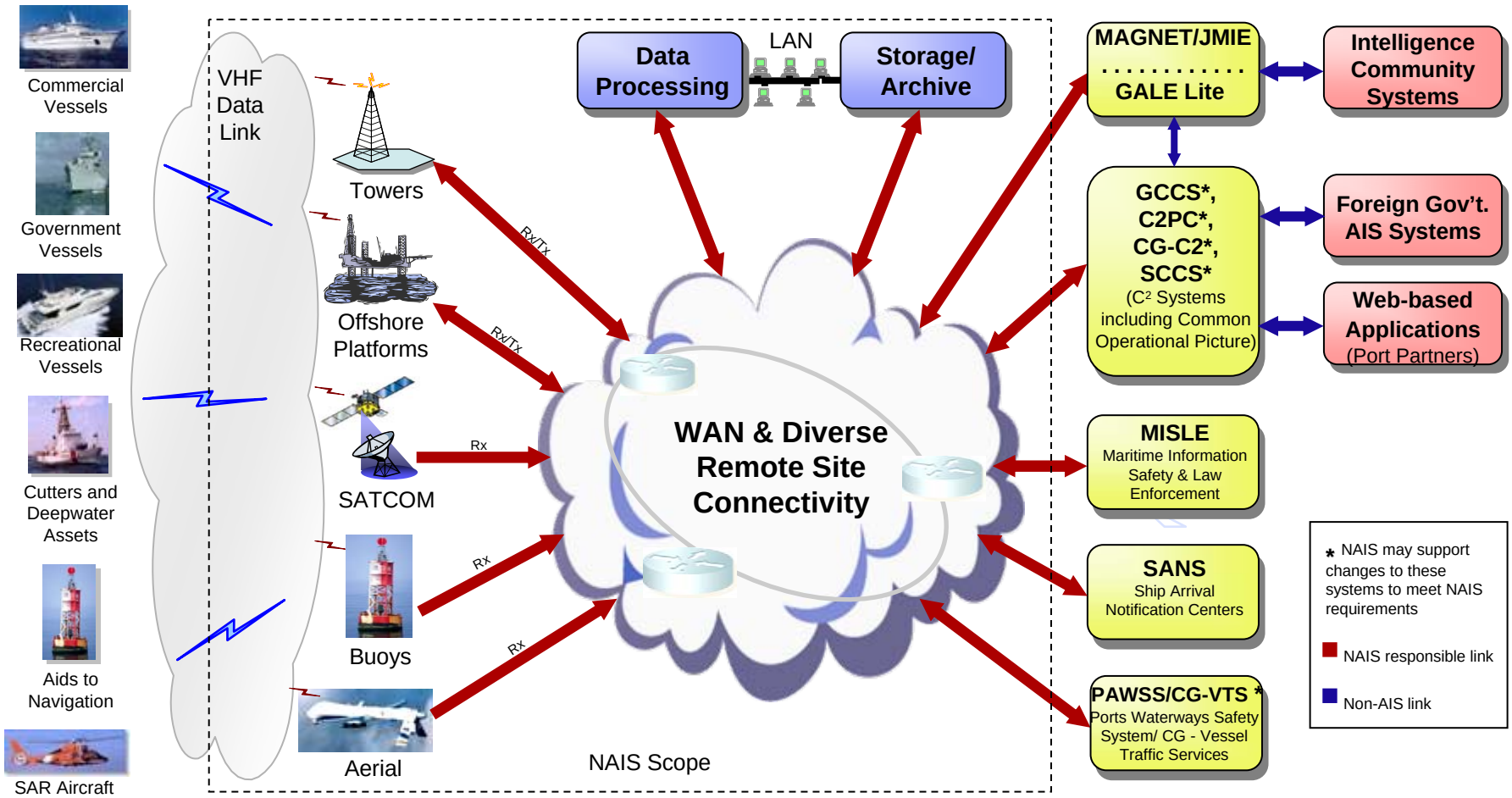
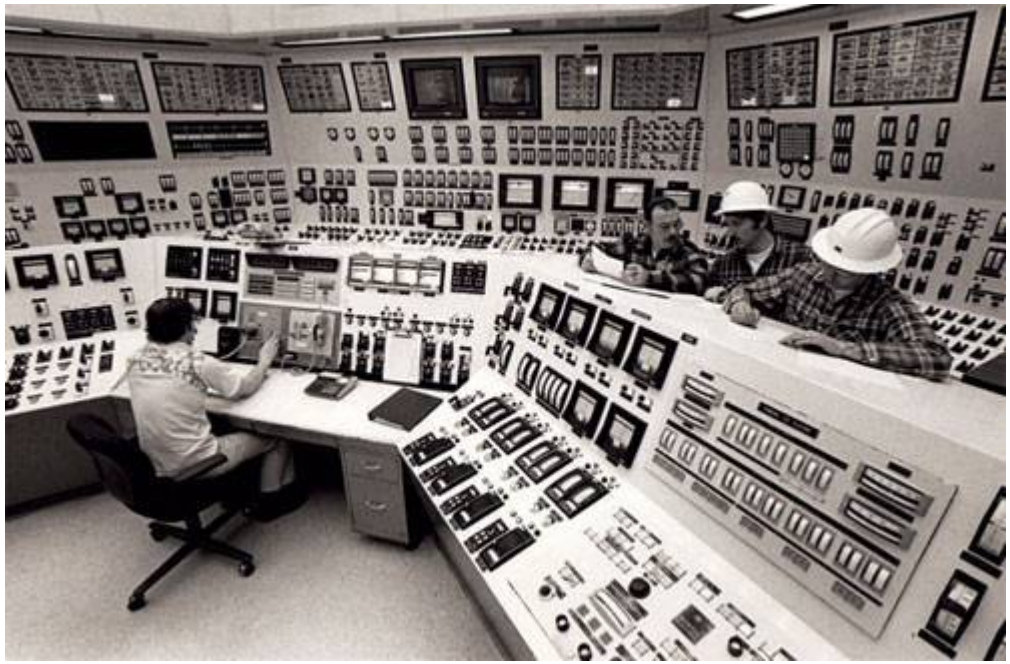


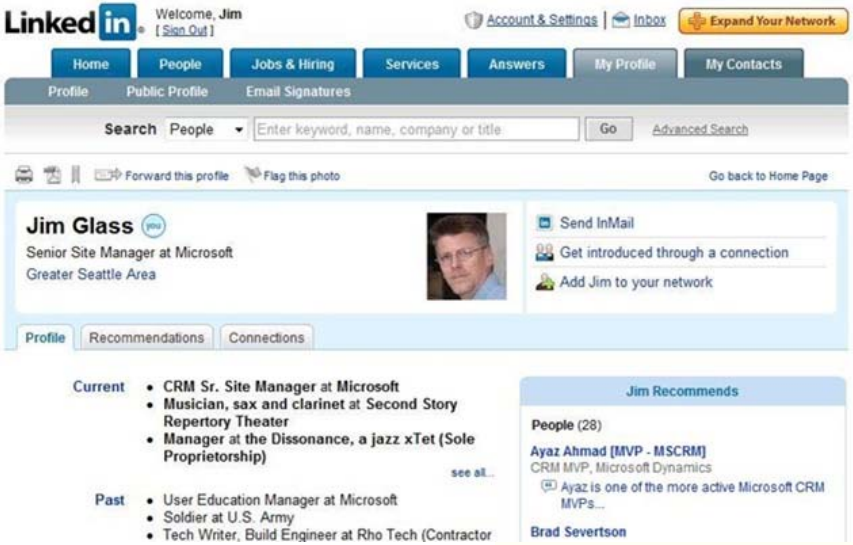
Photo # USN 1162165 USS Spruance, combat information center, 1975

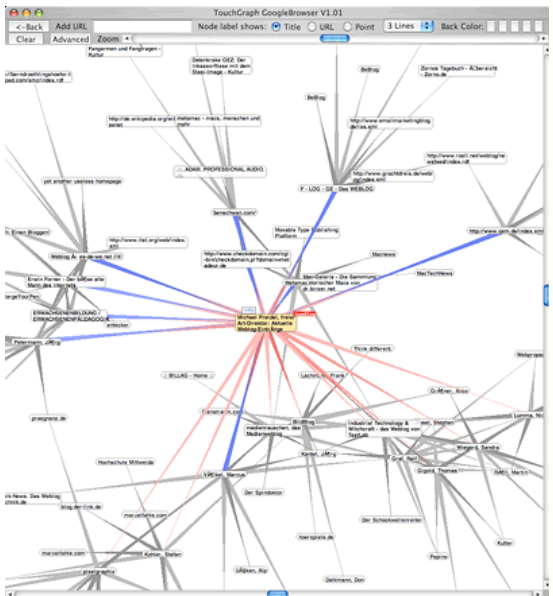
Nationwide AIS System Context Diagram

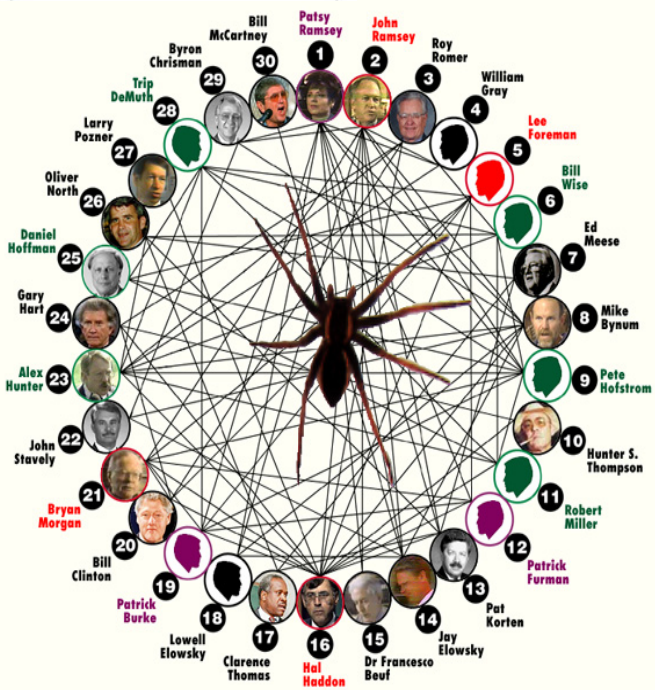


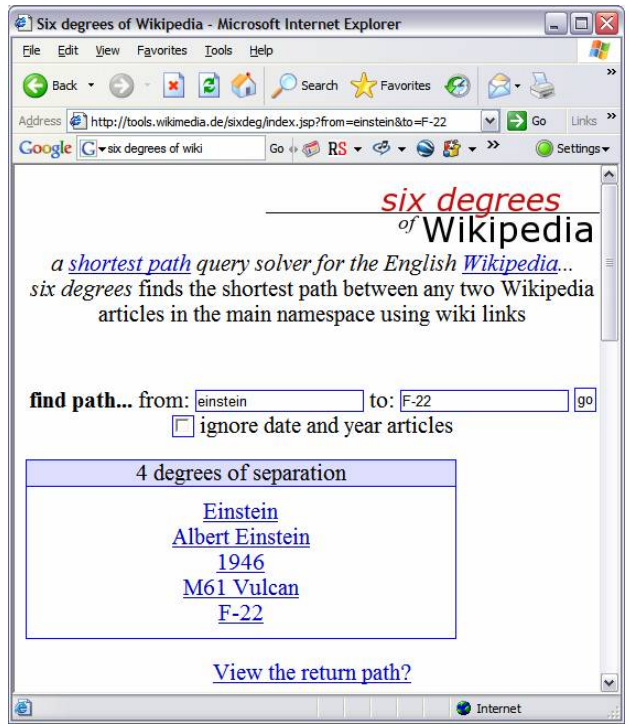


The Dawn of Social Networks

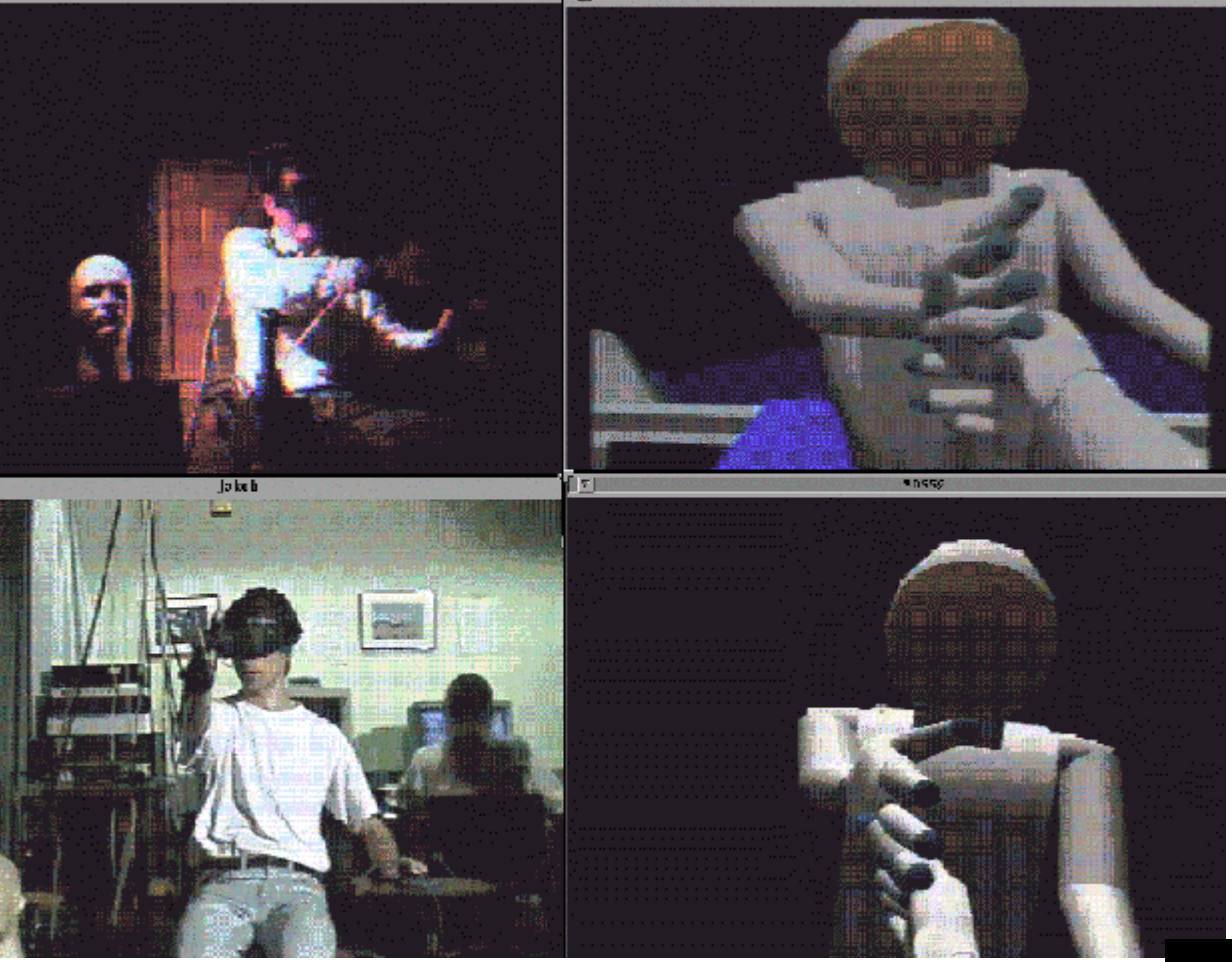








Massive Multiplayer Virtual Worlds



1995

Google Lively

NOAA Real Time Weather in Second Life

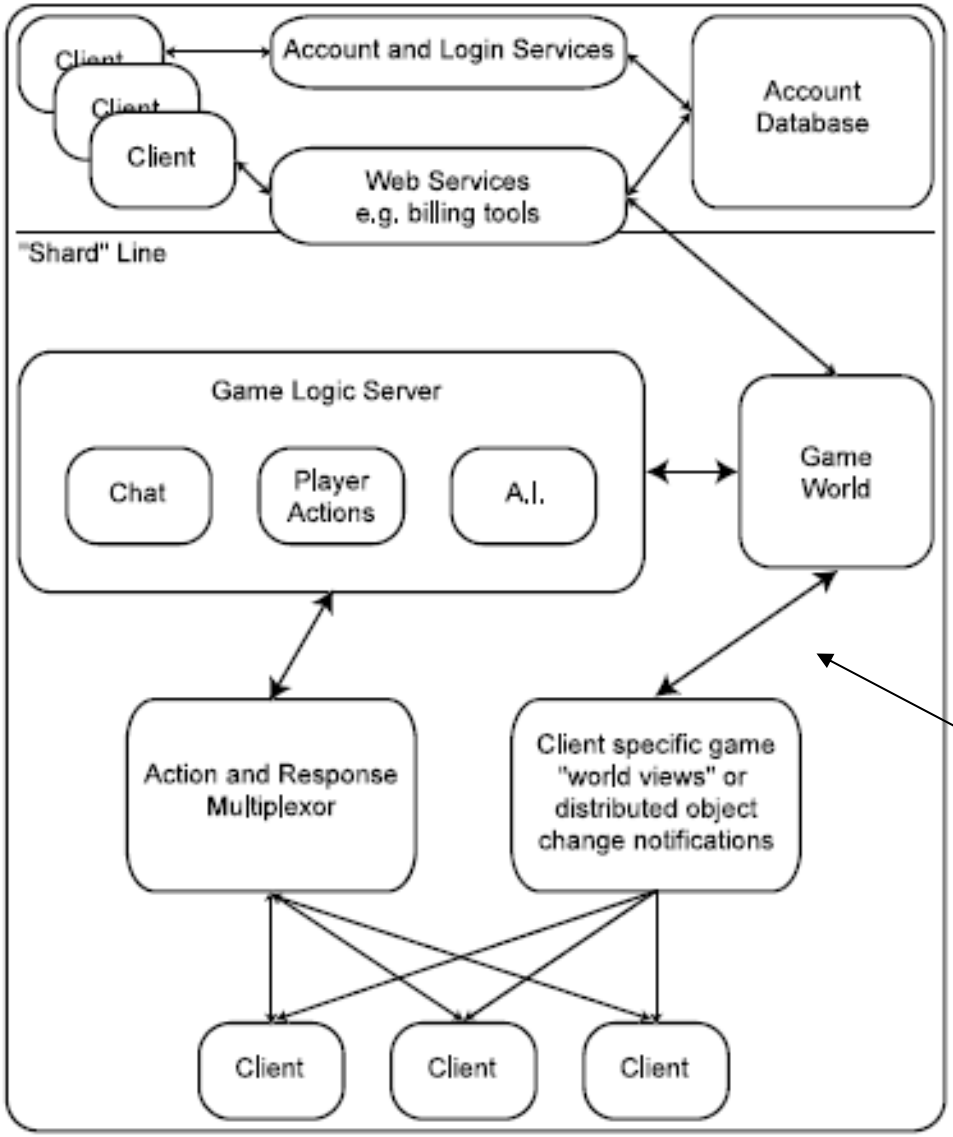
University of Maryland I-95 Project

Forterra OLIVE

Stanford University Medical Center

Virtual Worlds Will Become our Workspace

Find & Process Information



1 CPU/10 Clients

Big Pipes

1-100K concurrent

Source:The Architecture of Massive Multiplayer Online Games

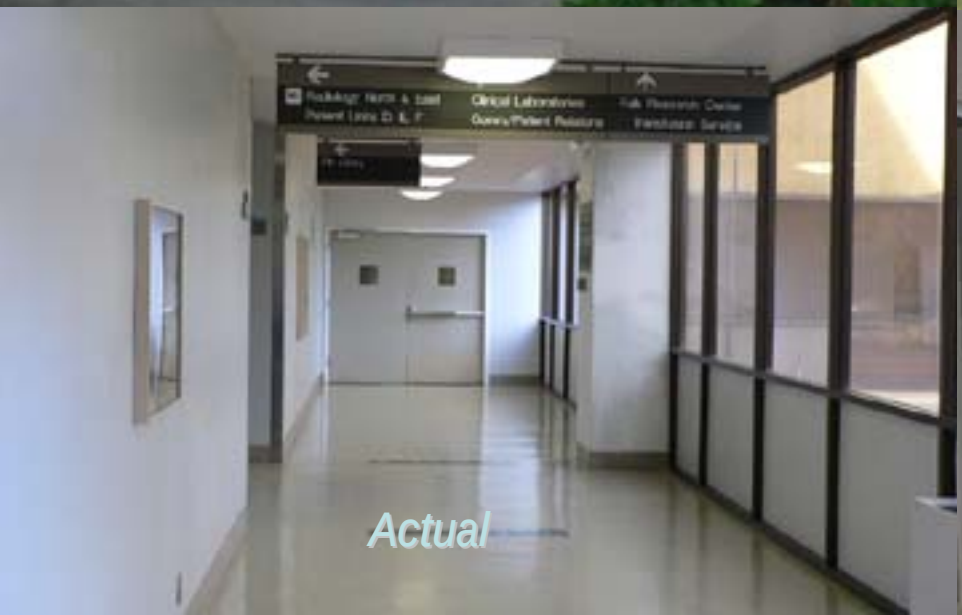
Sladjan Bogojevic, Mohsen Kazemzadeh

Simple Math

- China World of Warcraft
  - 1,000,000 concurrent users
    - Avg 500 Watts
    - 500 MW
  - Server CPU’s aprox 100,000
    - Avg 200 Watts
    - 20 MW
  - Total 520 MW
  - 500 MW per power plant
- There are three VW’s in China that have over 1 million concurrent users
- 3 coal-fired power plants in the last 3 years!

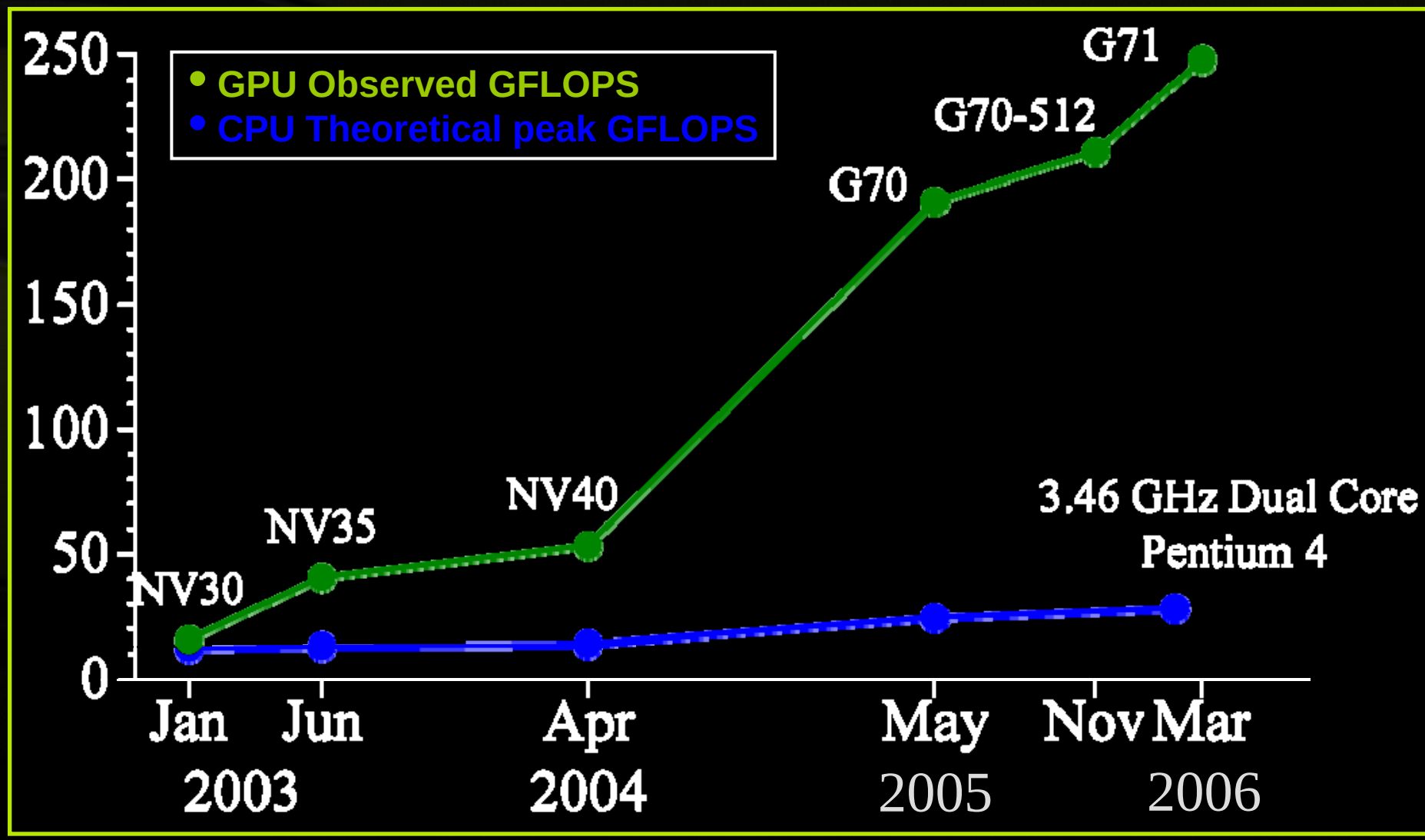
Actual

Virtual


Actual

Virtual

Raw Data Promises High Perf, Too



Nvidia GeForce GTX 200 Graphics Cards Makes Your Gaming Rig Officially Outdated

- “The GTX 280 rocks 240 processing cores and 1GB of RAM, while the 260 comes with 192 cores and 896MB of memory, making them equally adept at generating eye-popping graphics or serious parallel computing and physics crunching.
- “Of course, there is a cost to being maybe the best performing GPU on the planet: besides running US$650 and US$399, respectively (making three-way SLI nearly two grand with the GTX 280), they both require two PCI-E power connections to run and a massive power supply (like 1000w) if you're even thinking about SLI.”

Video in the Virtual World

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9
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YouTube
Stocks
280
Maps
73°
Weather
Clock
Calculator
Notes
Settings
Phone
Mail
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iPod