# Internet Innovation to support Science
# Privacy security aspects!

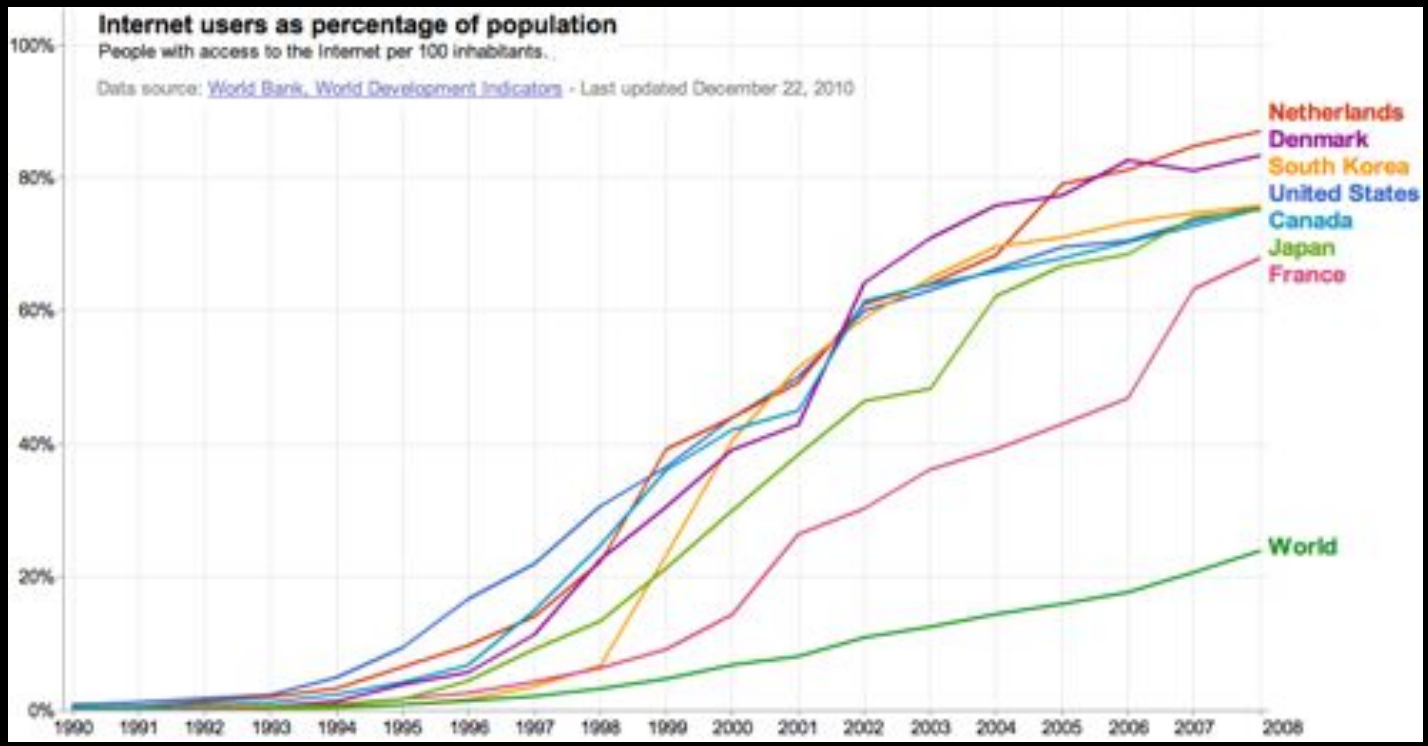

## Cees de Laat


# Internet

## From a network experiment that never ended (Vint Cerf)

- 1974: for the first time the word **internet** (*RFC 675 - Specification of Internet Transmission Control Program) [note -> Open process!]*
- 1981: the **TCP/IP** standard was ready to be adopted (*RFC 791,792,793*)

## To a network for society

- 1989: WWW was born
- 



- Jan 2011 → IANA IPv4 address space depleted! →

June 8th @ UvA

Ipv6day.nl

# Internet is a Billion - Business!

| | |
|---|---|
| Google | 197 |
| Amazon | 83 |
| Facebook | 50 |
| BAIDU | 37 |
| eBay | 36 |
| Yahoo | 22 |
| PriceLine | 21 |
| SalesForce | 18 |
| F5 Networks | 11 |
| CheckPoint | 9 |
| NetFlix | 9 |
| Expedia | 7 |


guardian.co.uk

Monday 3 January 2011

News | Sport | Comment | Culture | Business | Money | Life & style

News > Technology > Facebook

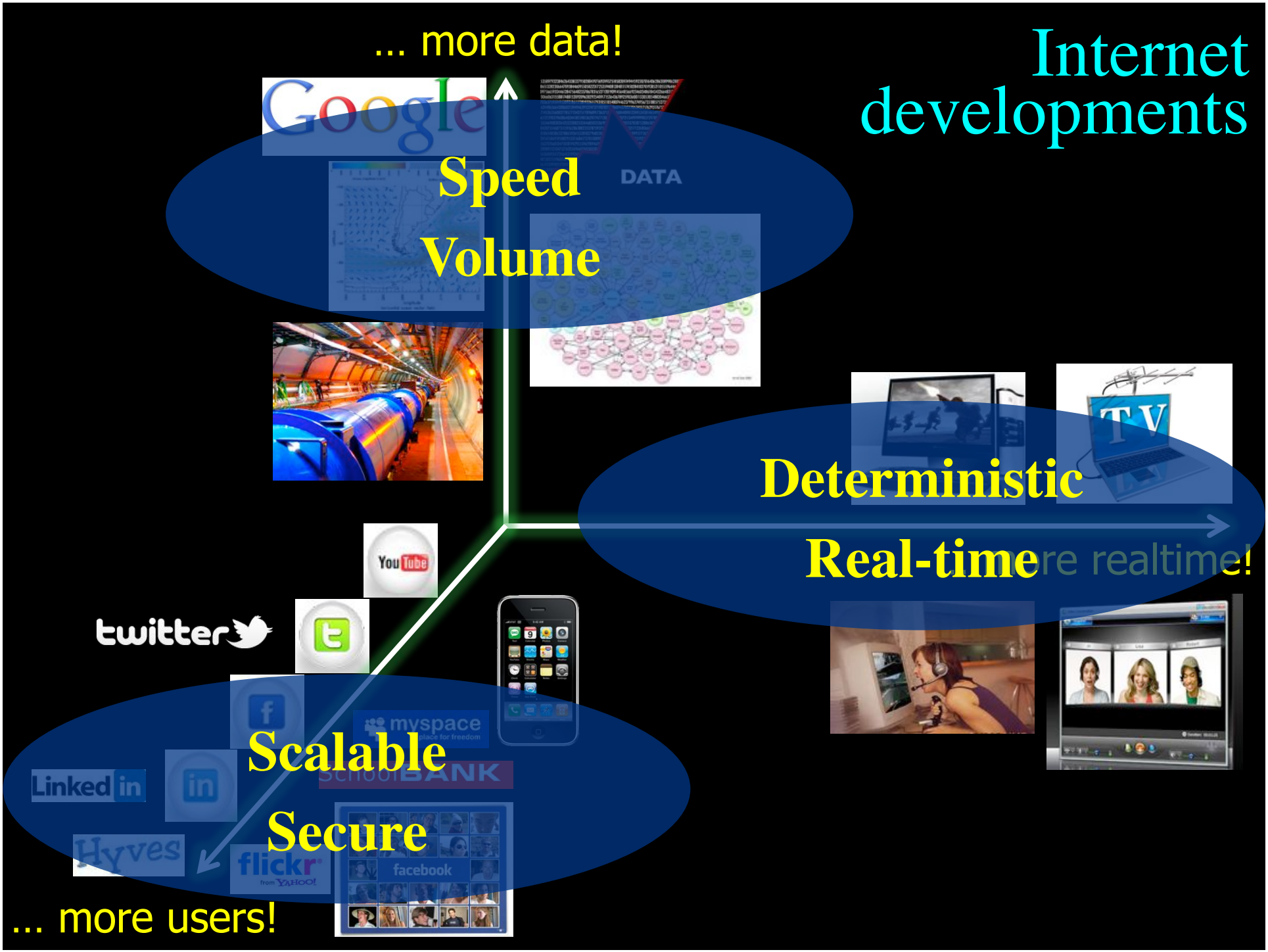
**Facebook's value swells to $50bn after Goldman Sachs investment**

Deal underlines Facebook's power and fuels rumours that Mark Zuckerberg is preparing a stock market flotation

**e.g.:**

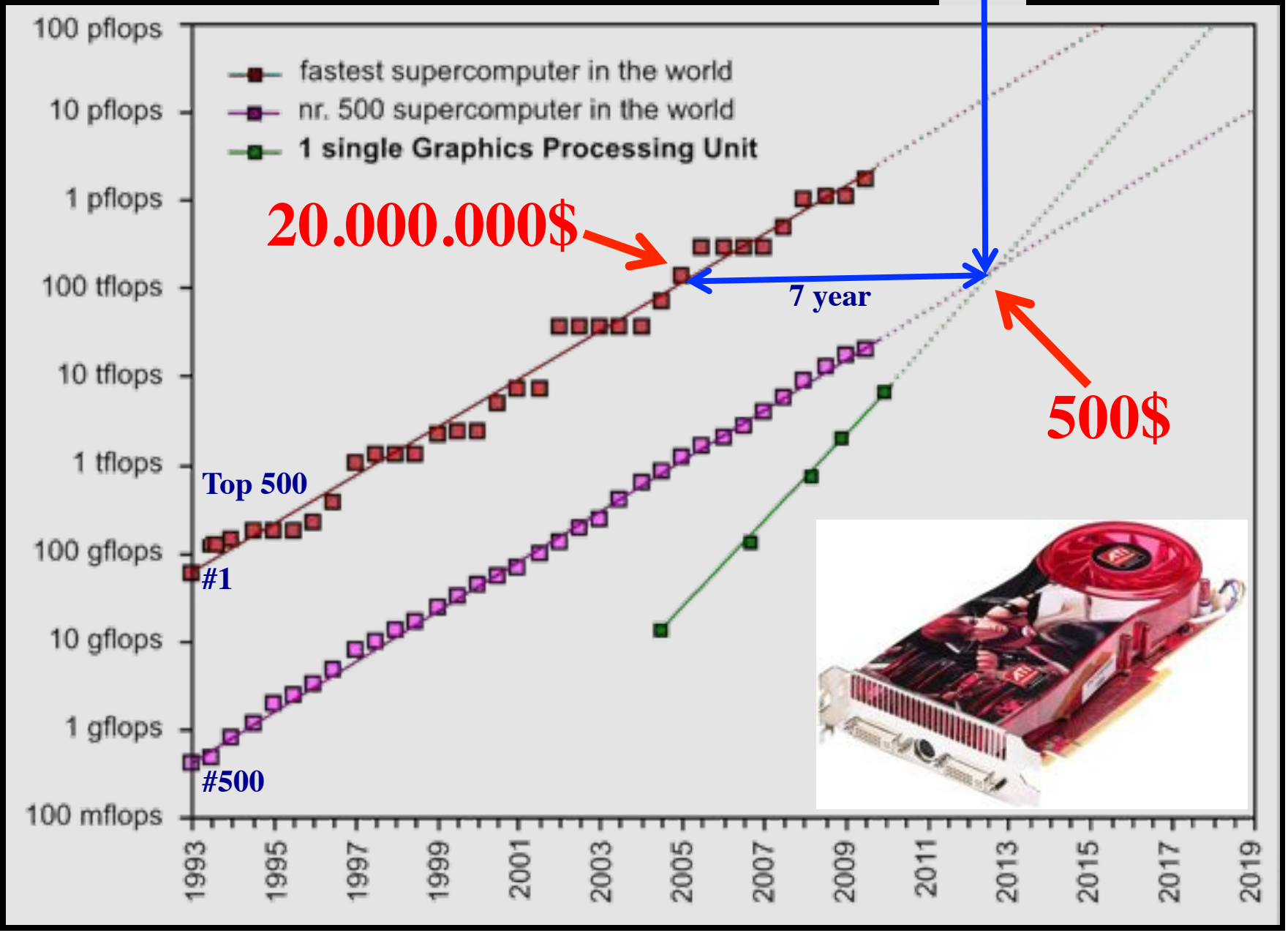
| | |
|---|---|
| Exxon Mobil | 368 |
| Apple Inc. | 333 |

# Internet developments

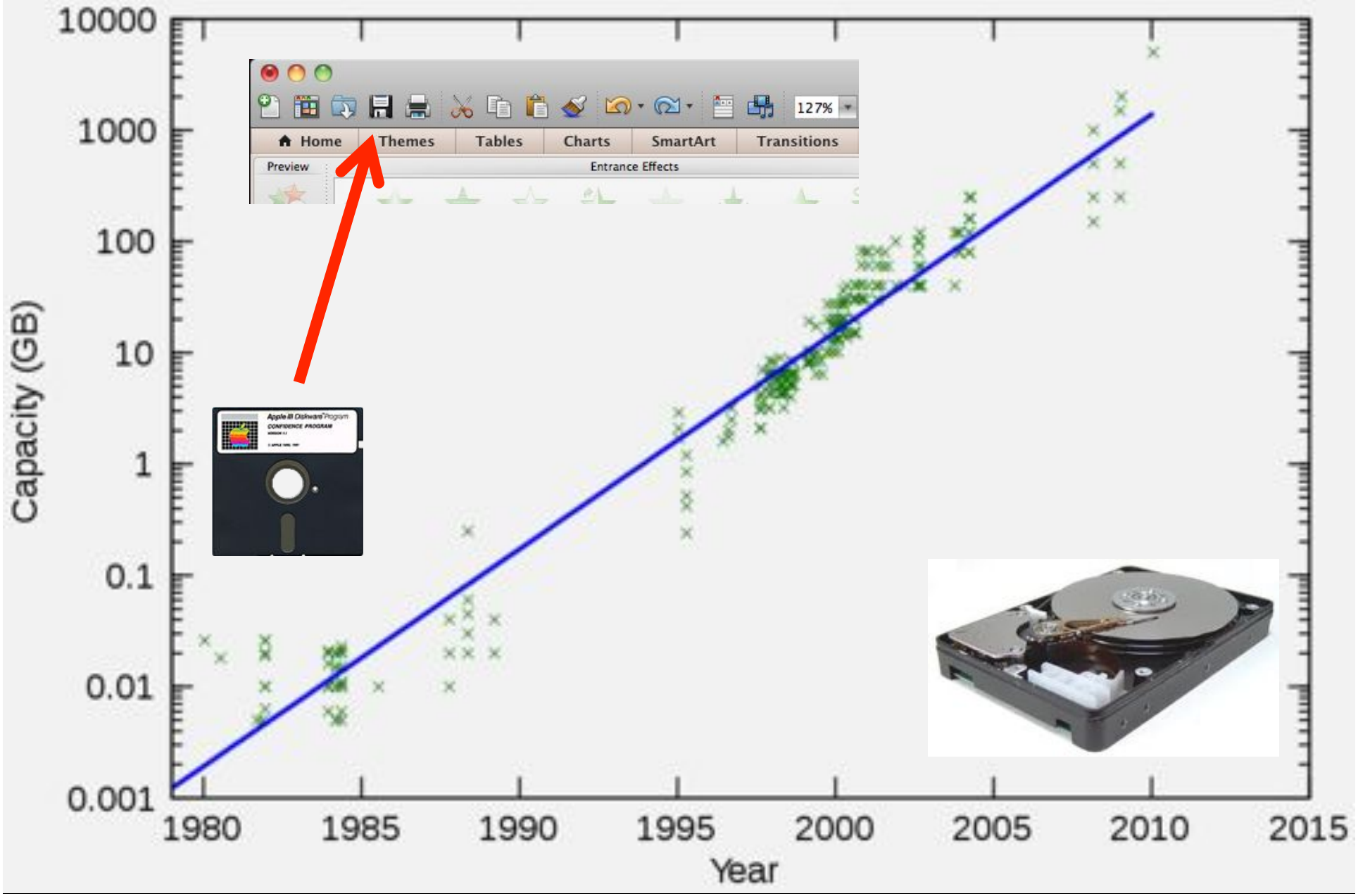



AT&T
9:42 AM
SMS
9
Text
Calendar
Photos
Camera
YouTube
Stocks
Maps
Weather
Clock
Calculator
Notes
Settings
iTunes
App Store

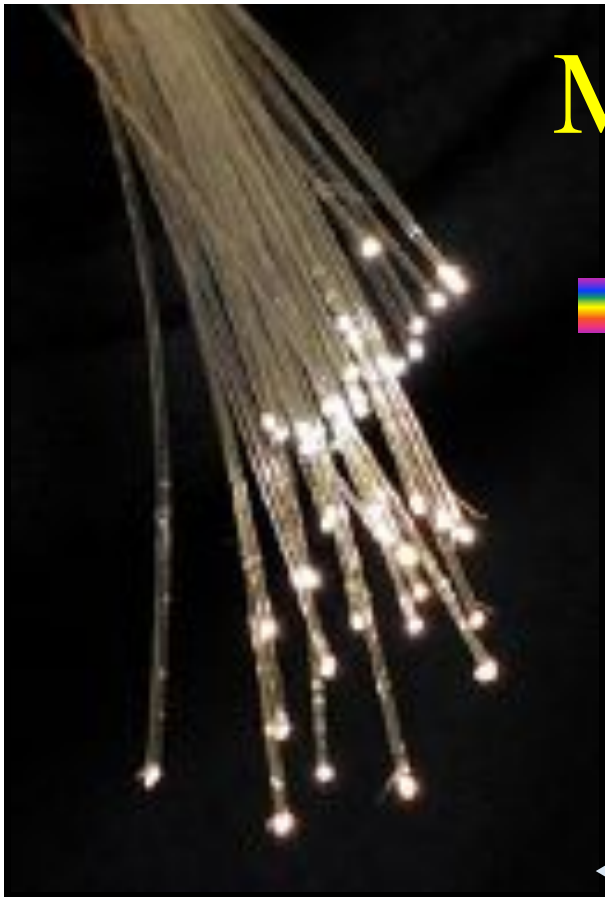
# GPU cards are distruptive!

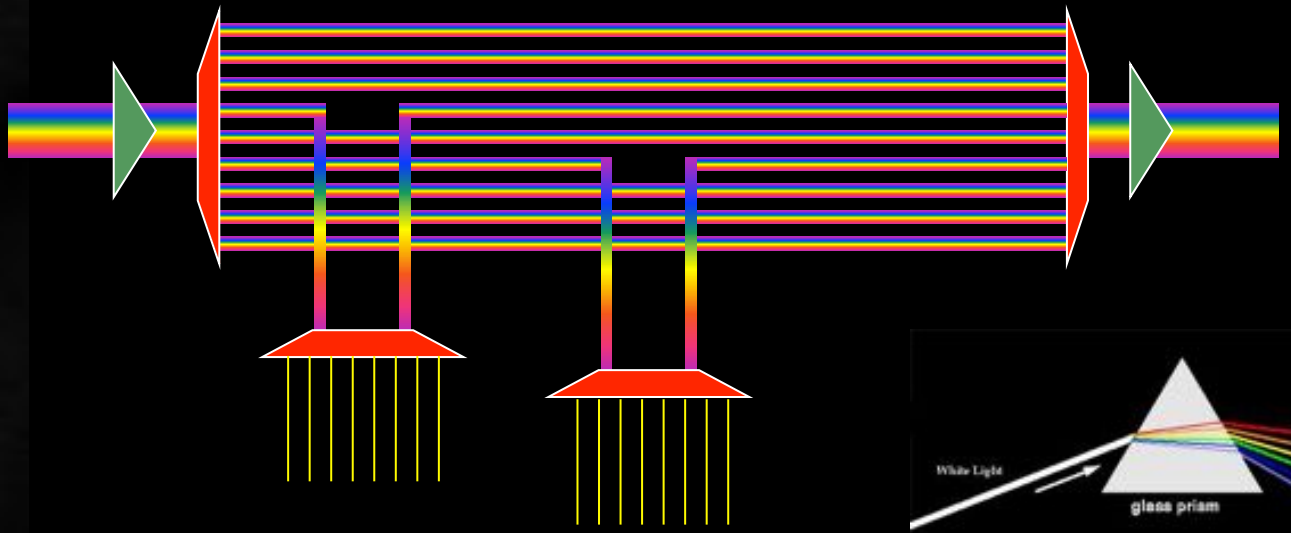


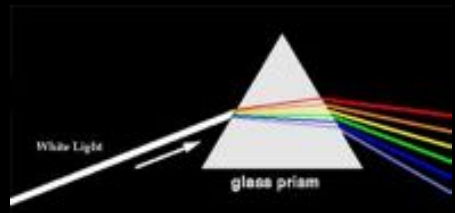
# Data storage: doubling every 1.5 year!

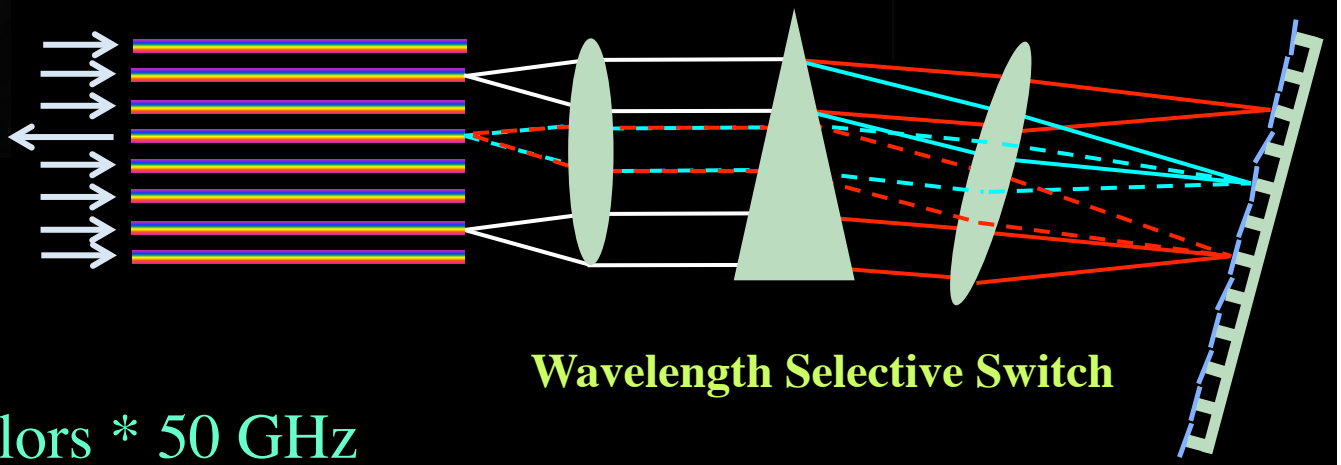


# Multiple colors / Fiber







**Wavelength Selective Switch**

Per fiber: ~ 80-100 colors * 50 GHz

Per color: 10 – 40 – 100 Gbit/s

BW * Distance ~ $2*10^{17}$ bm/s

New: Hollow Fiber!

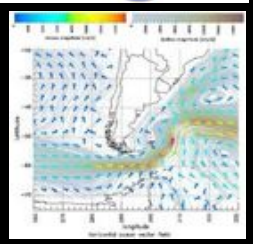
➔ less RTT!

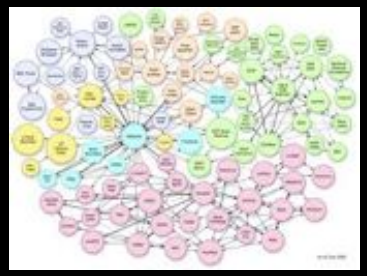
# Wireless Networks


protocol LAN due to the easy comparison and convenience in the digital home. While consumer PC products has just started to migrate to a much higher bandwidth of 802.11n wireless LAN now working on next-generation standard definition is already in progress.

# Internet developments

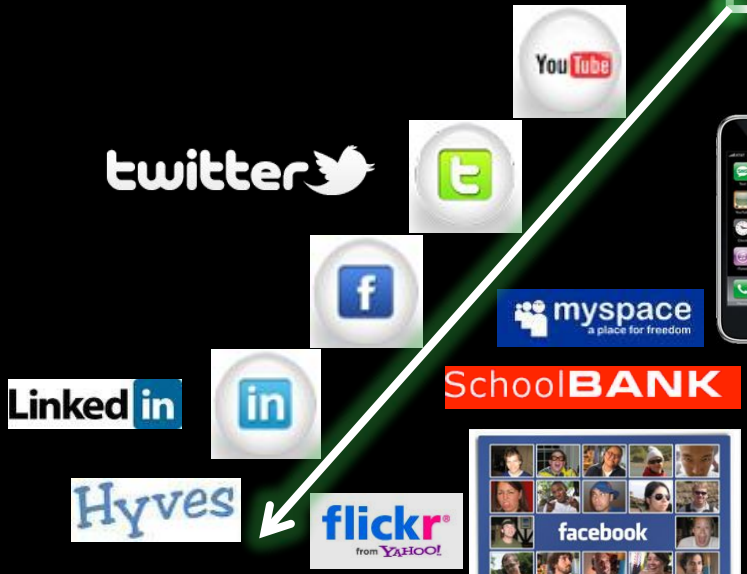
... more data!

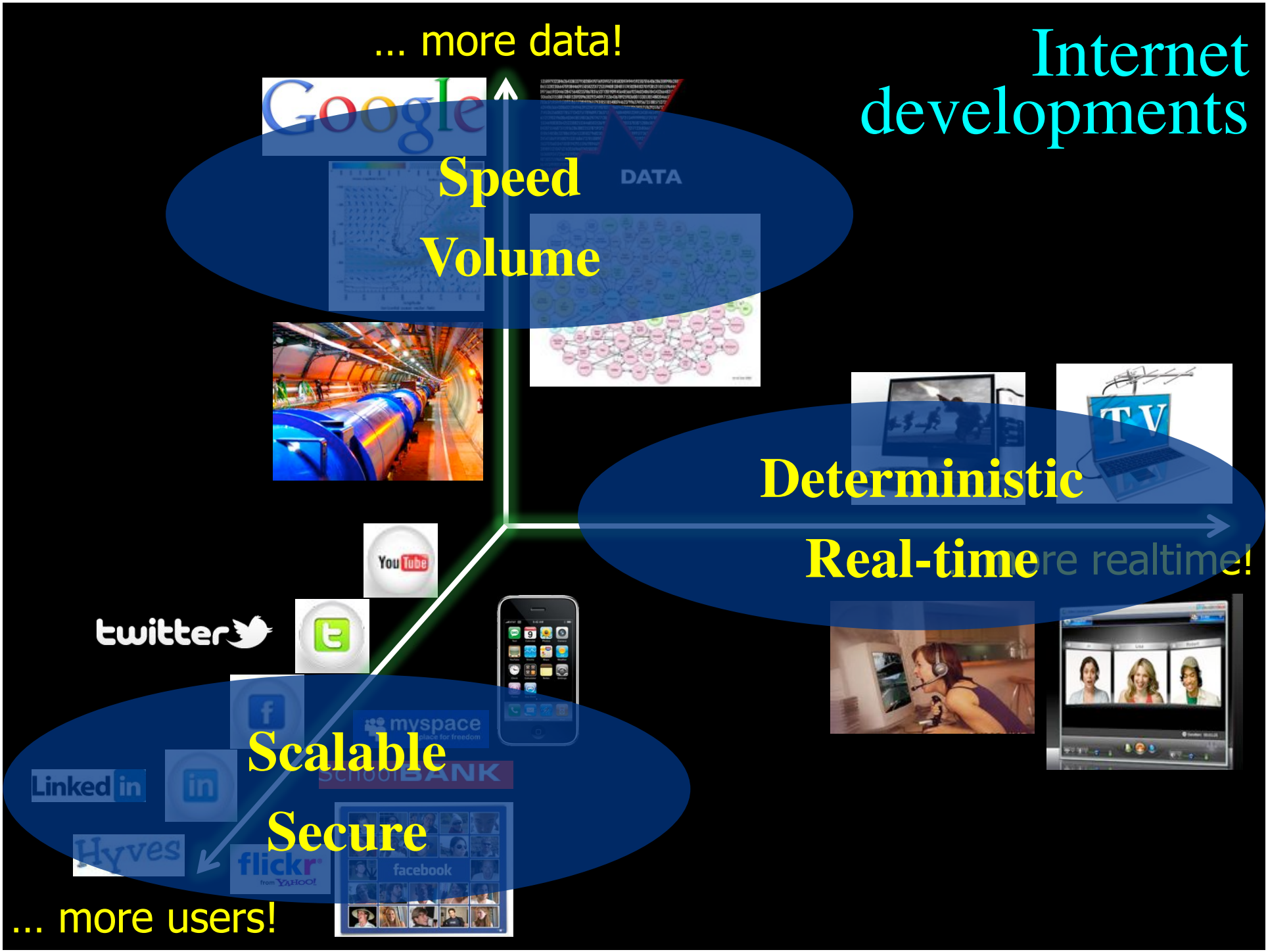

... more realtime!






... more users!

# Internet developments




AT&T
9:42 AM
SMS
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Text
Calendar
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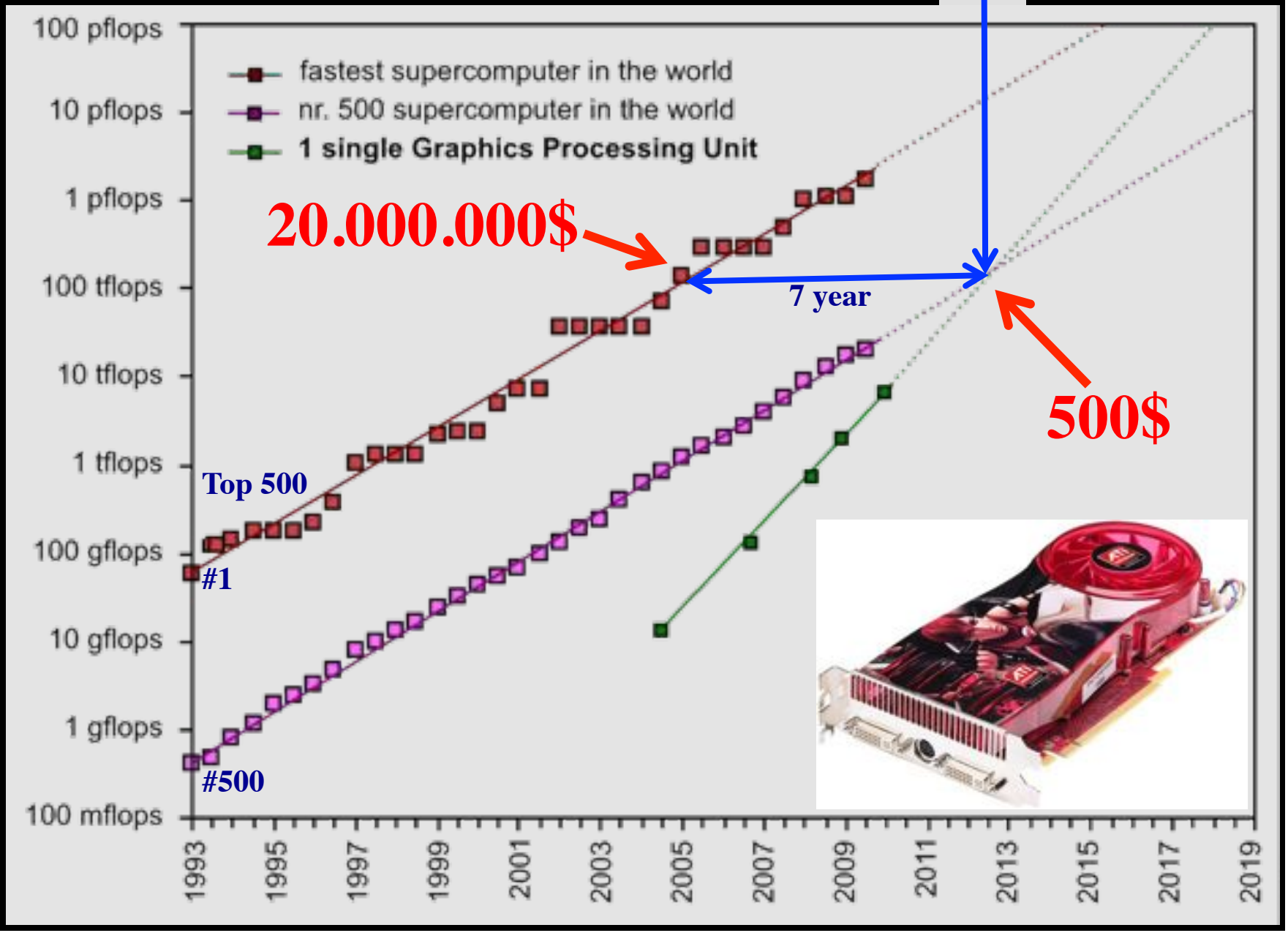

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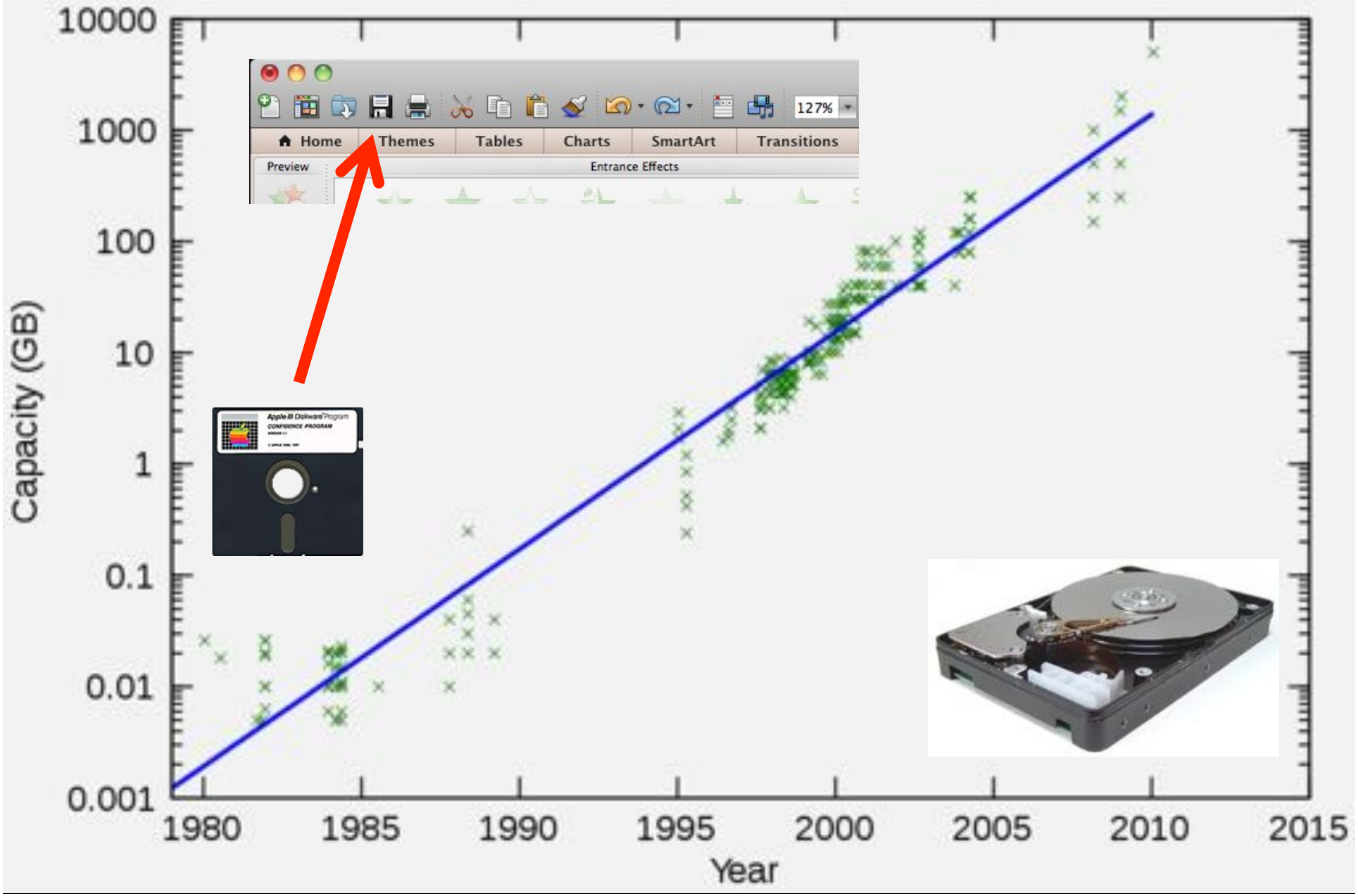

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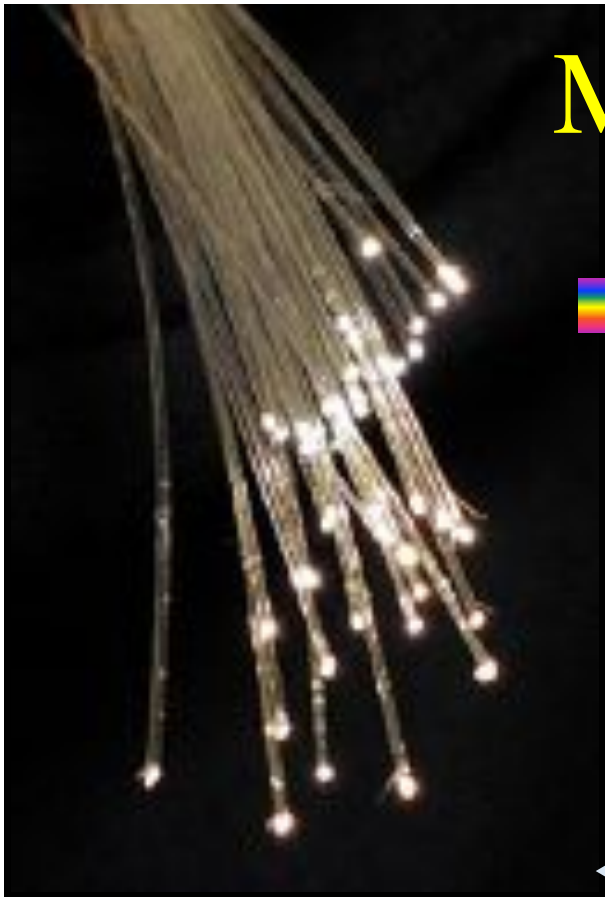

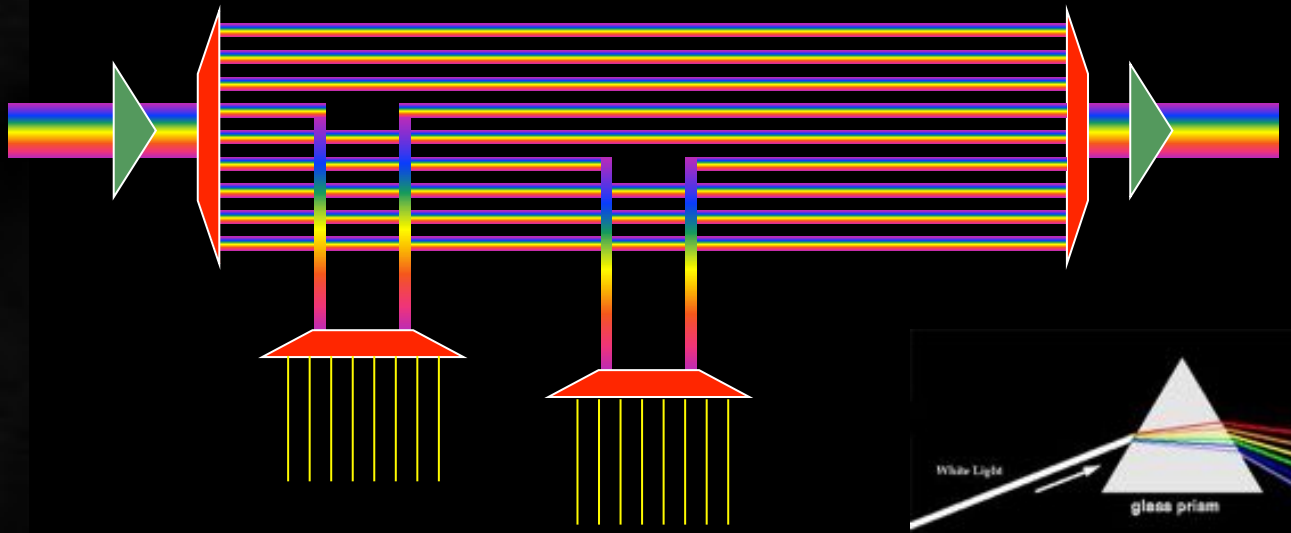

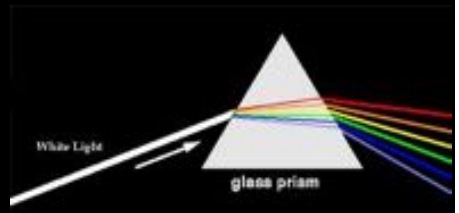


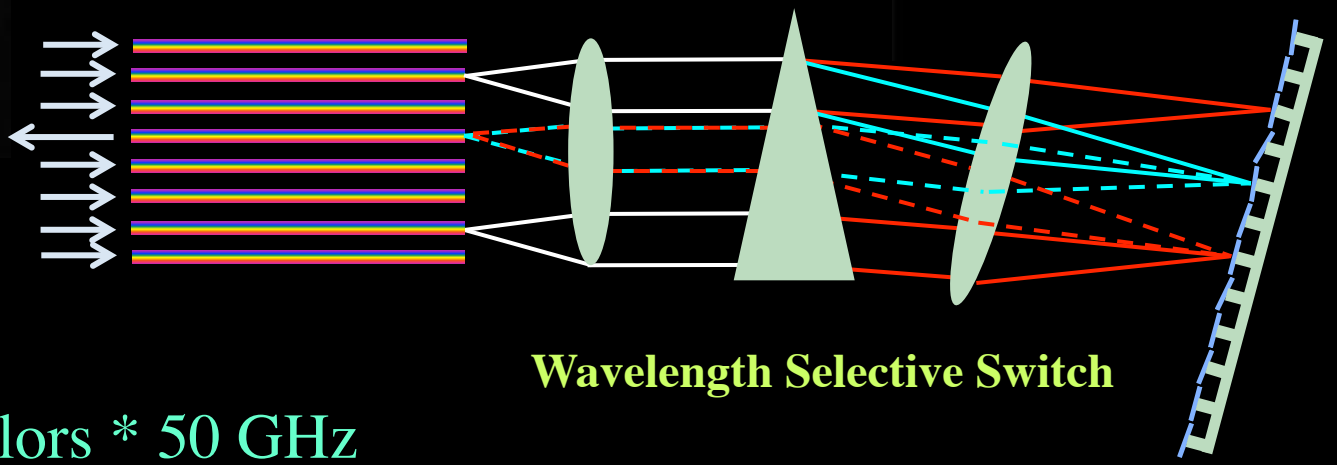

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# Wireless Networks


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SEP 06

## Next Generation Wireless LAN Technology 802.11ac 1 Gbps throughput with

Published By Admin under Network Devices Tags: 1gbps throughput, 1gbps wireless, 1gbps wireless lans, generation, new generation, technologies, technology, throughput, wireless, wireless lan

WiFi is one of the most preferred communication protocol LAN due to the easy comparison and convenience in the digital home. While consumer PC products has just started to migrate to a much higher bandwidth of 802.11n wireless LAN now working on next-generation standard definition is already in progress.

# Wireless Networks


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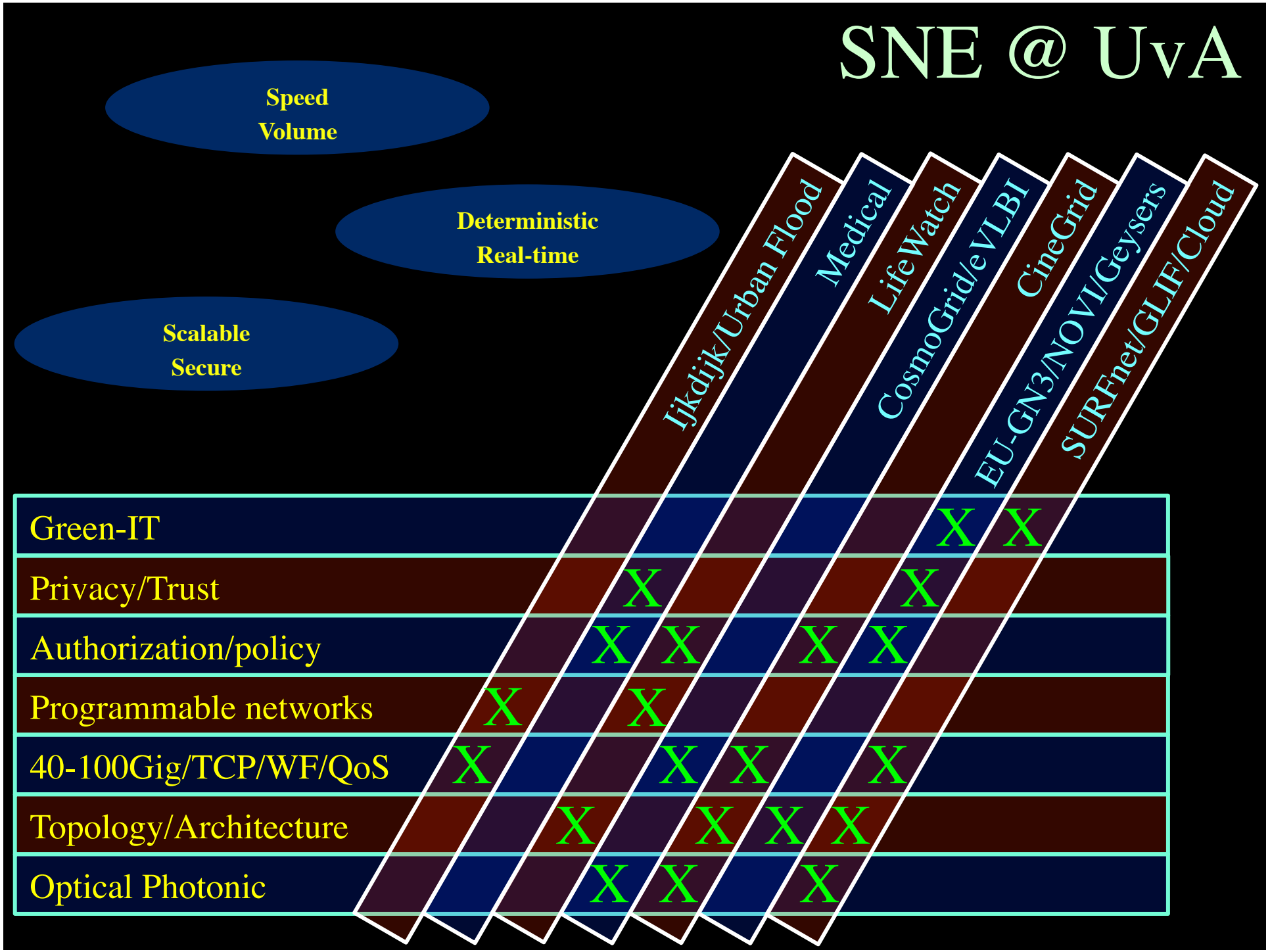
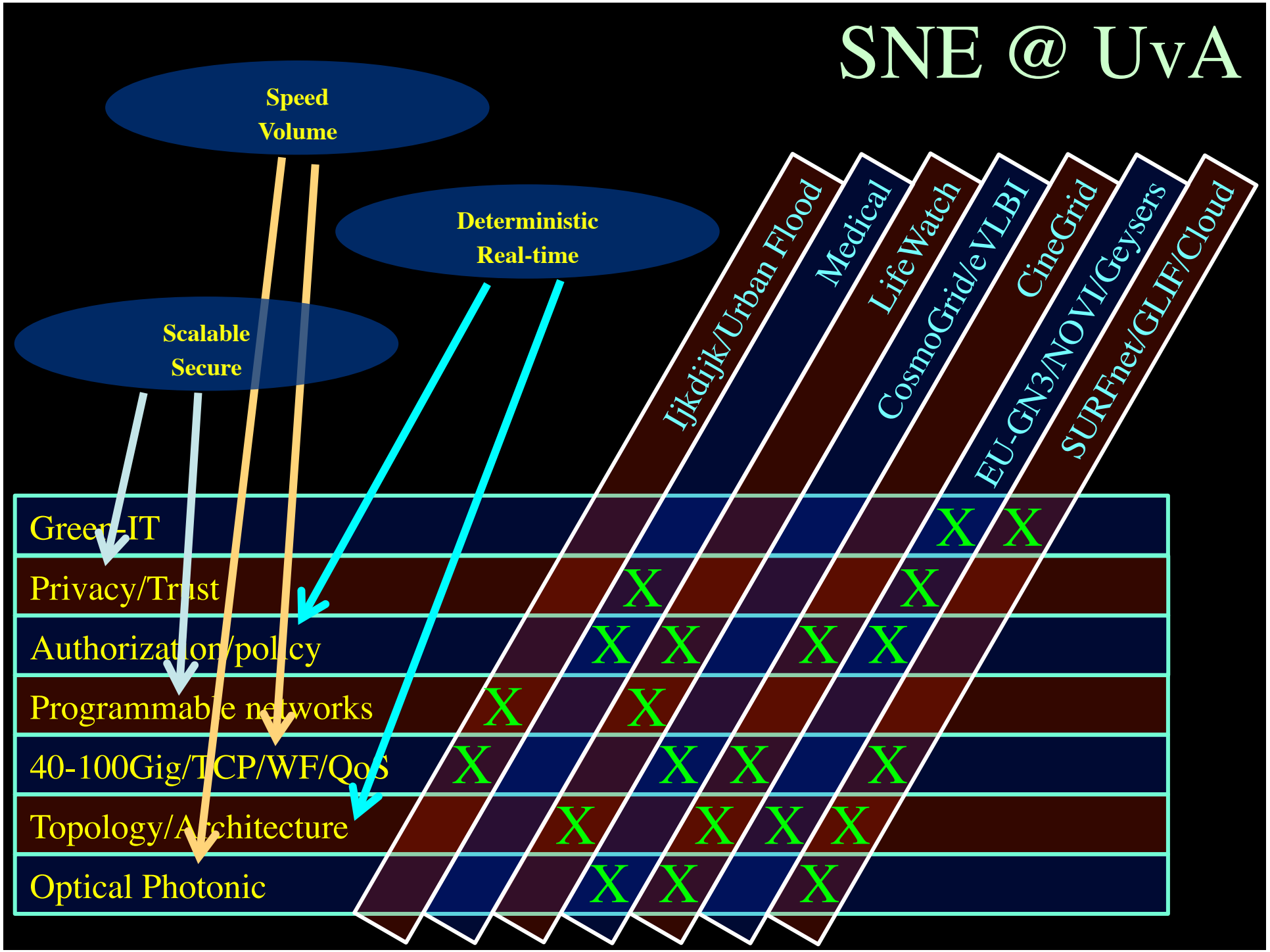

SNE @ UvA
Speed
Volume
Deterministic
Real-time
Scalable
Secure
Ijkdijk/Urban Flood
Medical
LifeWatch
CosmoGrid/e VLBI
CineGrid
EU-GN3/NOVI/Geysers
SURFnet/GLIF/Cloud
Green-IT
Privacy/Trust
Authorization/policy
Programmable networks
40-100Gig/TCP/WF/QoS
Topology/Architecture
Optical Photonic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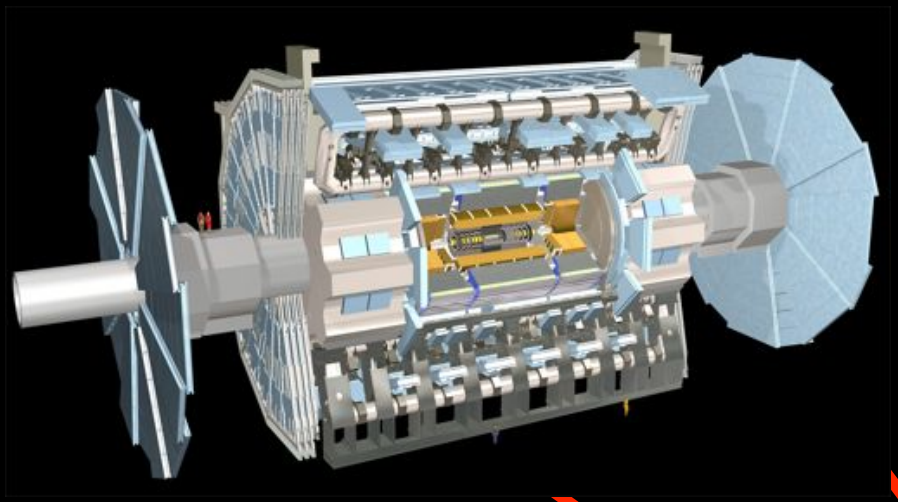
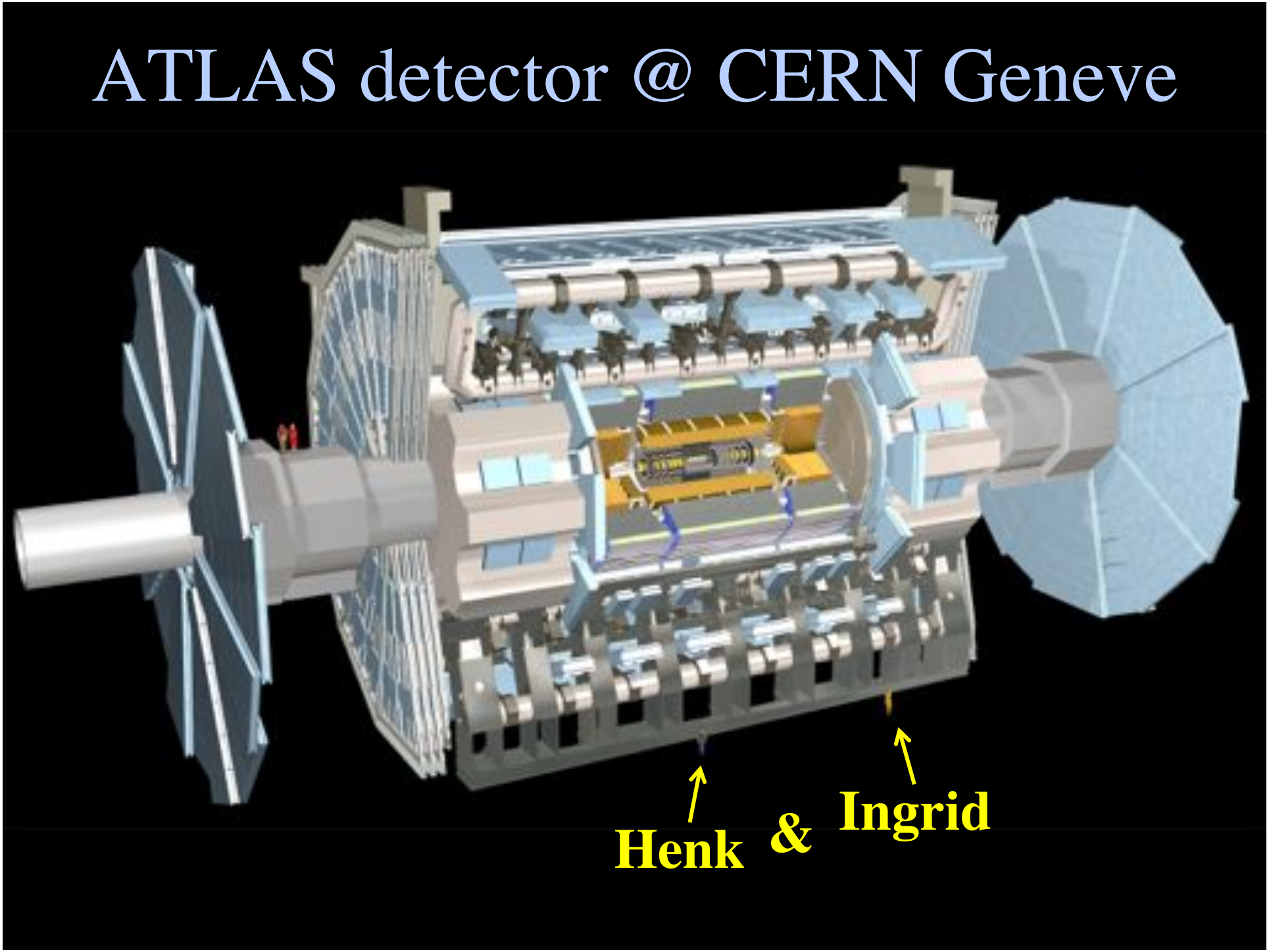


| | Ijkdijk/Urban Flood | Medical | LifeWatch | CosmoGrid/eVLBI | CineGrid | EU-GN3/NOVI/Geysers | SURFnet/GLIF/Cloud |
|---|---|---|---|---|---|---|---|
| Green-IT | | | | | X | X | |
| Privacy/Trust | | X | | | X | | |
| Authorization/policy | | X | X | X | X | | |
| Programmable networks | X | | X | | | | |
| 40-100Gig/TCP/WF/QoS | X | | X | X | | X | |
| Topology/Architecture | | X | | X | X | X | |
| Optical Photonic | | X | X | | X | | |

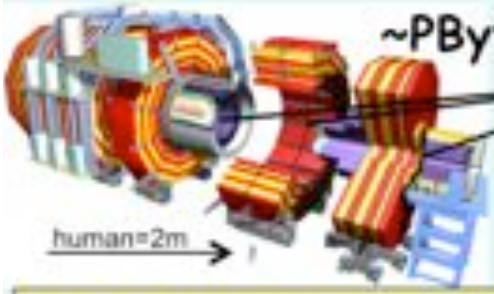
# ATLAS detector @ CERN Geneve



# ATLAS detector @ CERN Geneve

# LHC Data Grid Hierarchy

## CMS as example, Atlas is similar




~PByte/sec

Online System

~100 MBytes/sec

100000 flops/byte

10 Pflops/s

event simulation

Tier 0 +1

HPSS

event reconstruction

CMS detector: 15m X 15m X 22m

12,500 tons, $700M.

Status 2002!

~2.5 Gbits/sec

Tier 1

Italian Regional Center

German Regional Center

NIKHEF Dutch Regional Center

FermiLab, USA Regional Center

...

~0.6-2.5 Gbps

analysis

Tier2 Center

Tier 2

~0.6-2.5 Gbps

Tier 3

Institute ~0.25TIPS

Physics data cache

100 - 1000 Mbits/sec

Tier 4

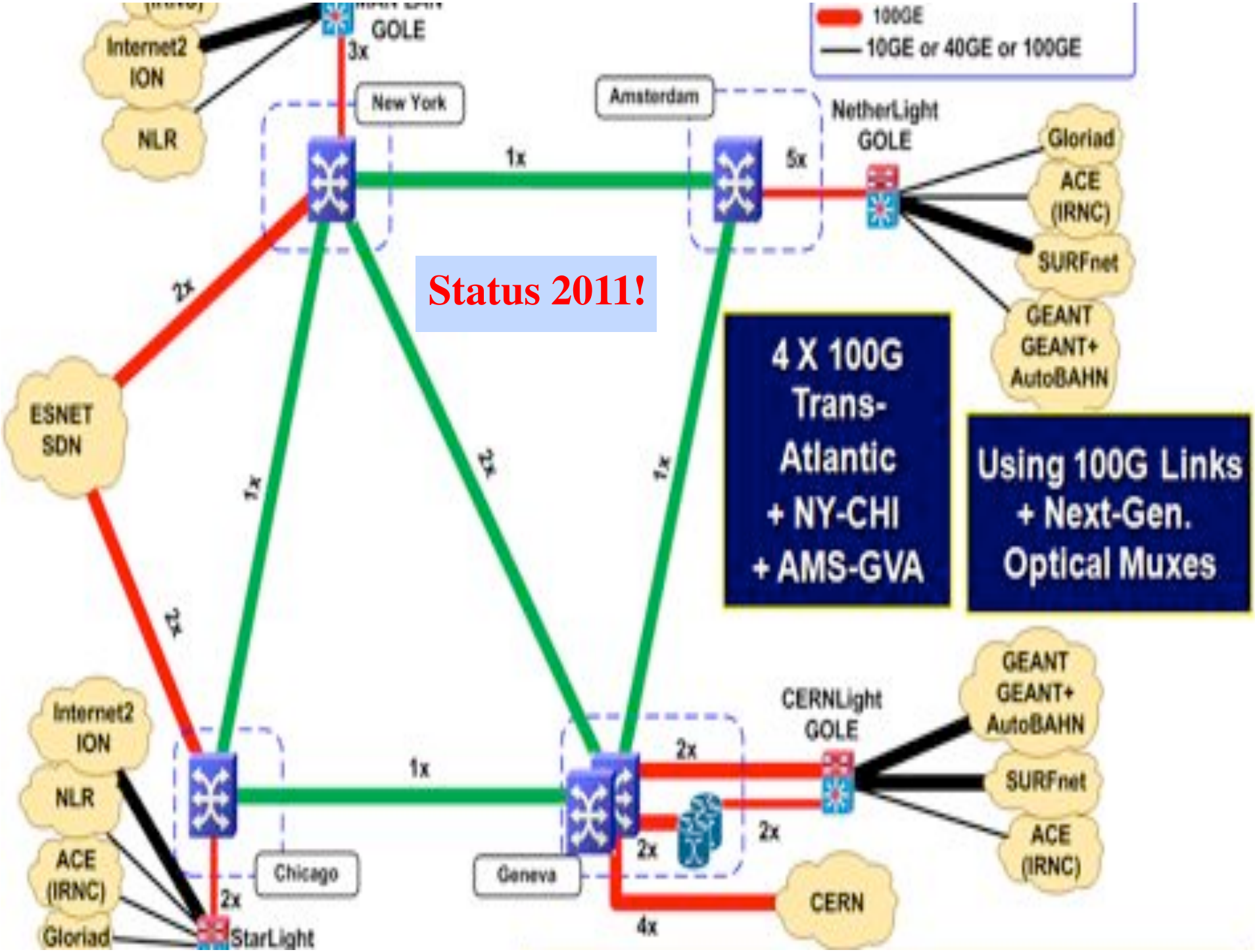
Workstations

Courtesy Harvey Newman, CalTech and CERN

CERN/CMS data goes to 6-8 Tier 1 regional centers, and from each of these to 6-10 Tier 2 centers.

Physicists work on analysis "channels" at 135 institutes. Each institute has ~10 physicists working on one or more channels.

2000 physicists in 31 countries are involved in this 20-year experiment in which DOE is a major player.


100GE
10GE or 40GE or 100GE
Internet2 ION
NLR
GOLE
3x
New York
Amsterdam
NetherLight GOLE
1x
5x
Gloriad
ACE (IRNC)
SURFnet
GEANT GEANT+ AutoBAHN
Status 2011!
4 X 100G Trans-Atlantic + NY-CHI + AMS-GVA
Using 100G Links + Next-Gen. Optical Muxes
ESNET SDN
2x
1x
2x
1x
2x
Internet2 ION
NLR
ACE (IRNC)
Gloriad
Chicago
2x
StarLight
1x
Geneva
2x
2x
2x
4x
CERNLight GOLE
GEANT GEANT+ AutoBAHN
SURFnet
ACE (IRNC)
CERN


In The Netherlands SURFnet connects between 180:

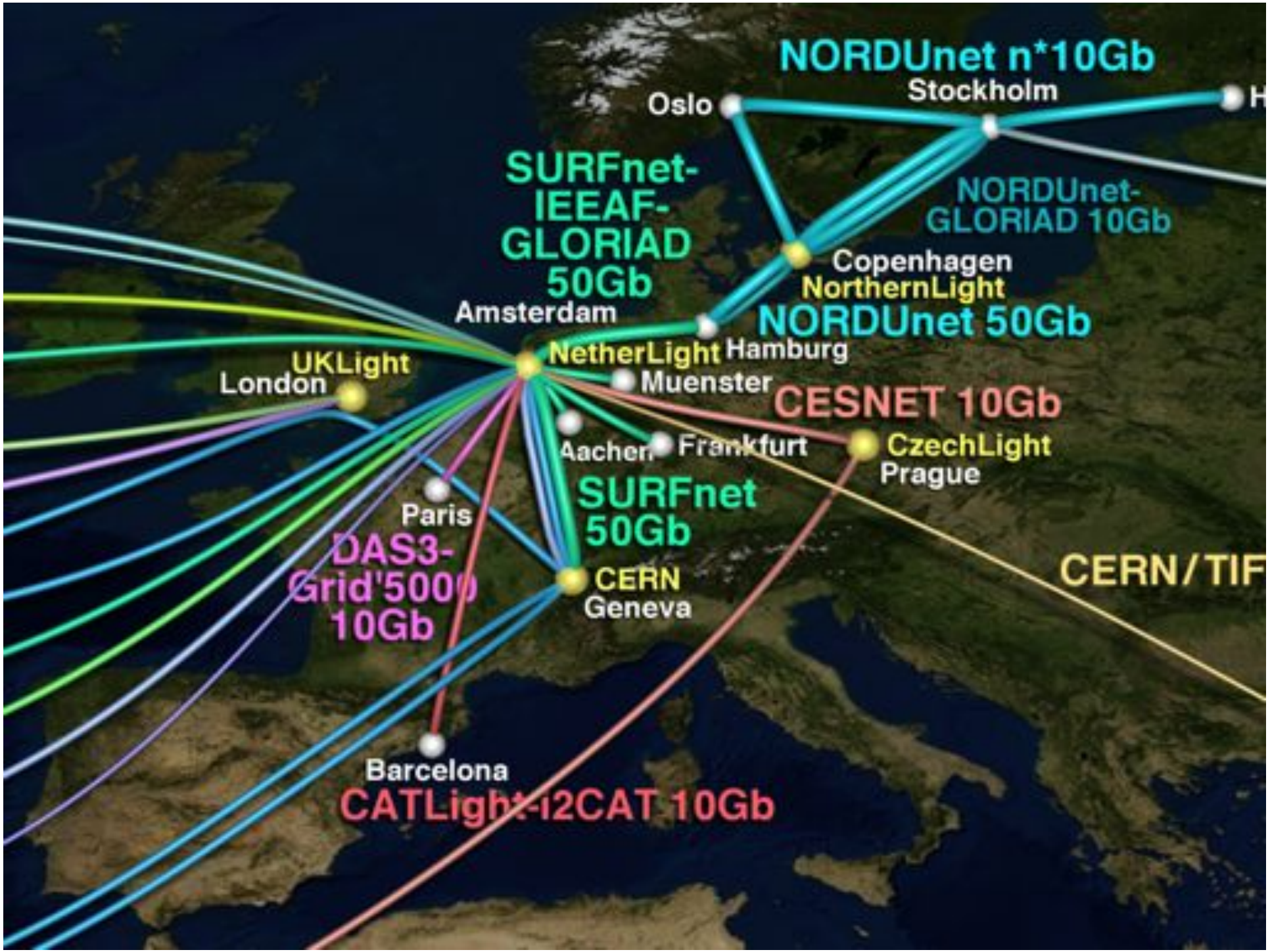
- universities;
- academic hospitals;
- most polytechnics;
- research centers.

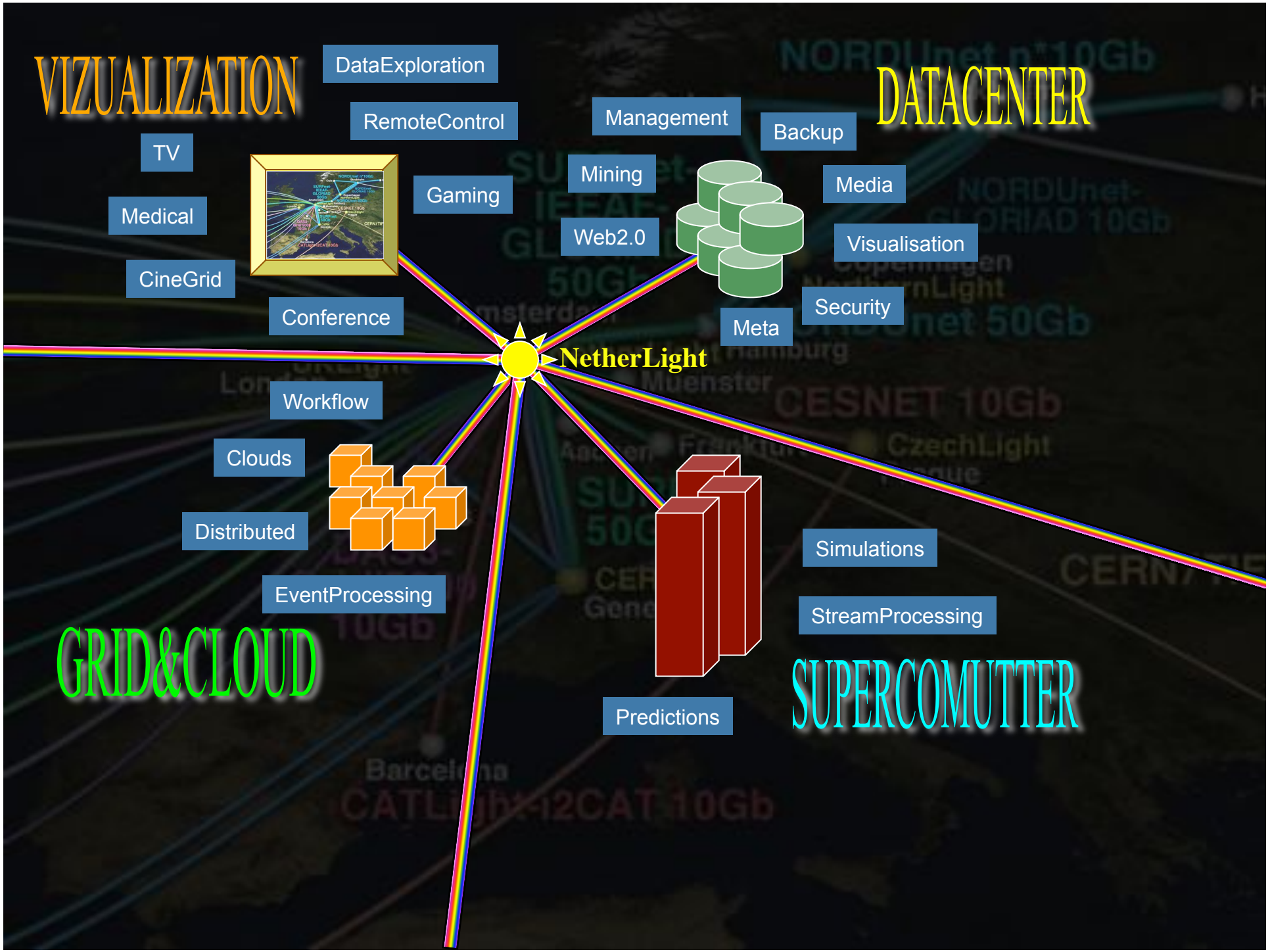
with an indirect ~750K user base

~ 8860 km

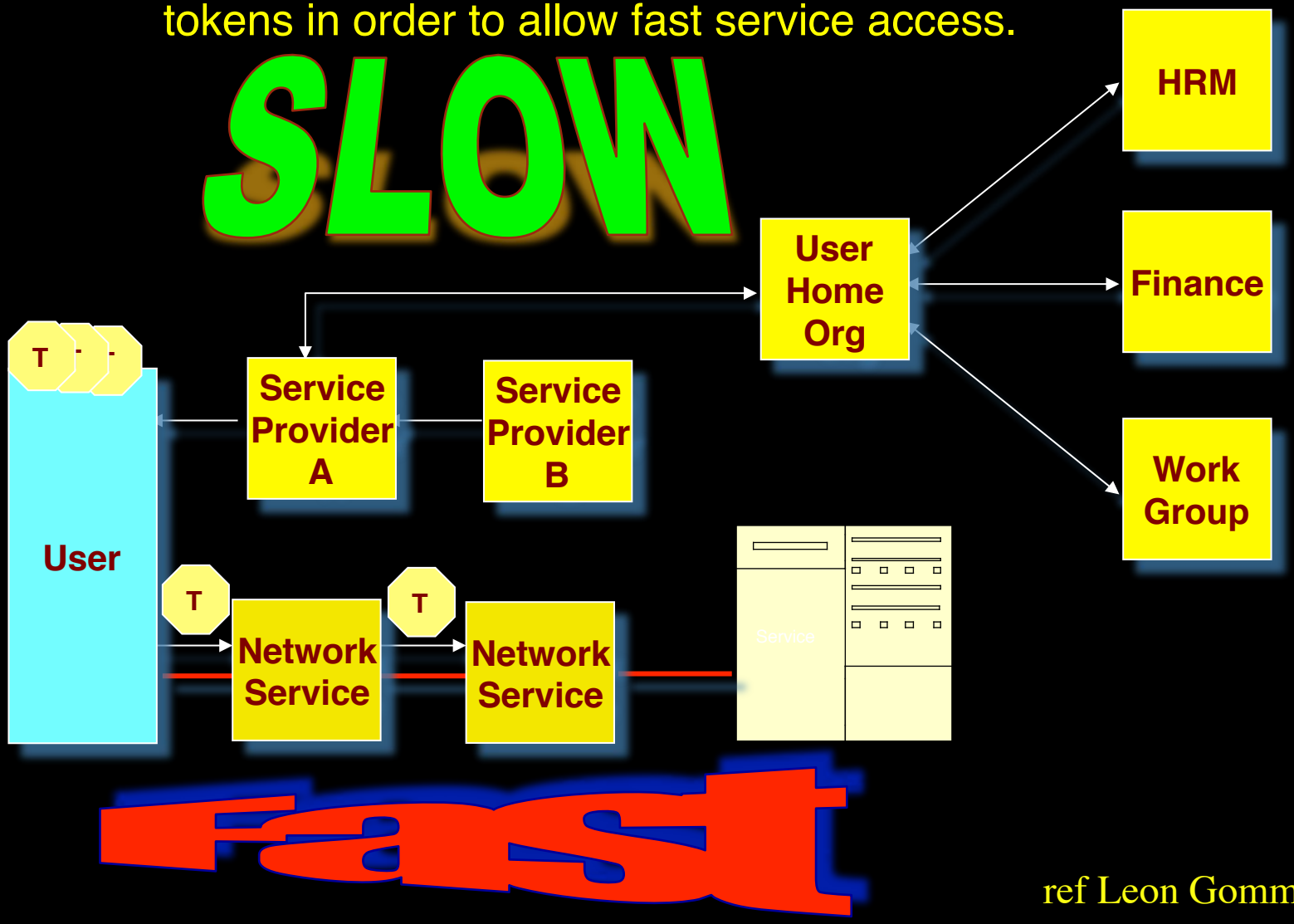
scale comparable to railway system

We investigate: for complex networks!


NORDUnet n*10Gb
Stockholm
Oslo
SURFnet-
IEEAF-
GLORIAD
50Gb
NORDUnet-
GLORIAD 10Gb
Copenhagen
NorthernLight
NORDUnet 50Gb
Amsterdam
NetherLight
Hamburg
UKLight
London
Muenster
CESNET 10Gb
Aachen
Frankfurt
CzechLight
Prague
SURFnet
50Gb
Paris
DAS3-
Grid'500
10Gb
CERN
Geneva
CERN/TIF
Barcelona
CATLight-I2CAT 10Gb

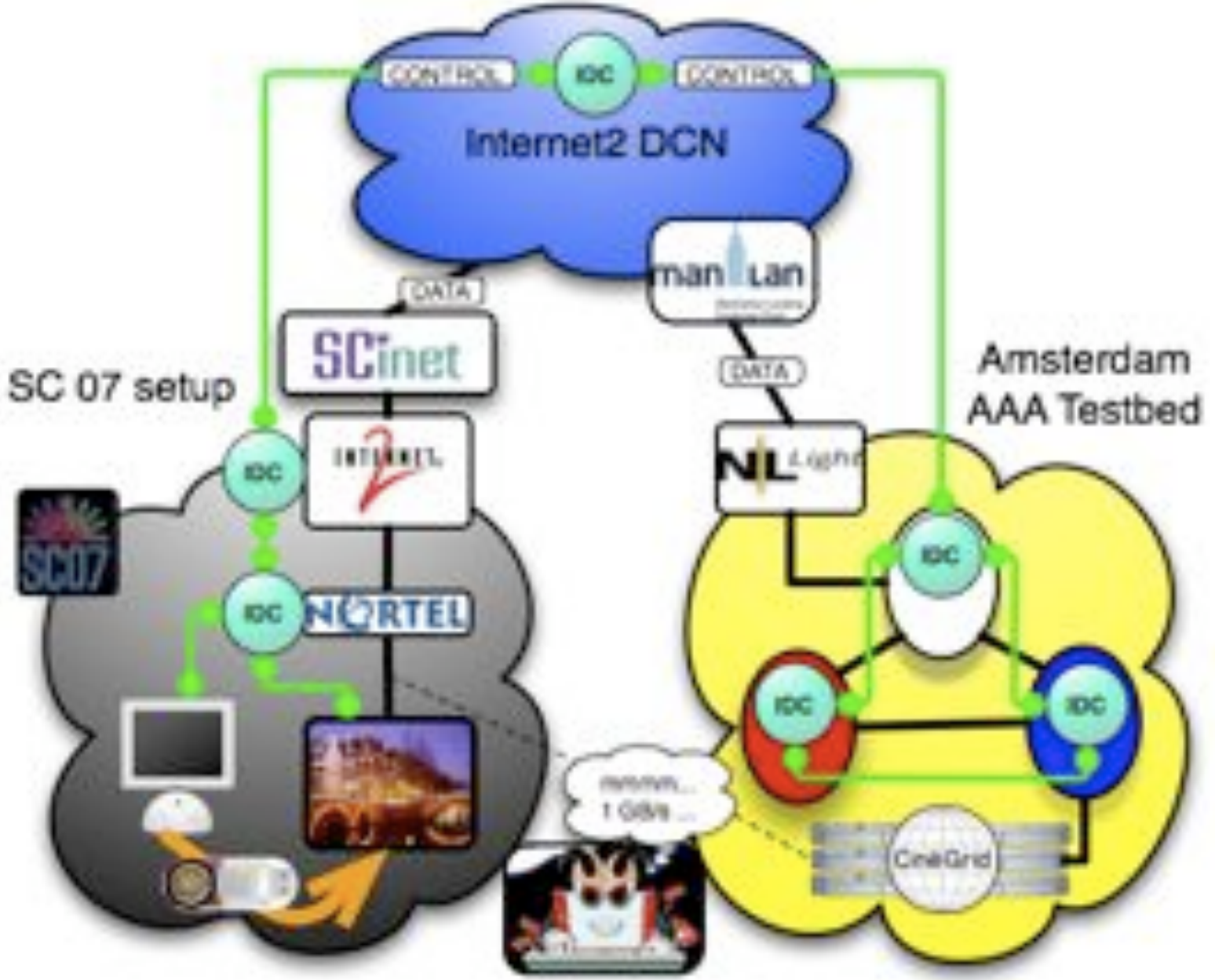

VIZUALIZATION
DataExploration
RemoteControl
TV
Medical
CineGrid
Conference
Gaming
DATACENTER
Management
Backup
Mining
Media
Web2.0
Visualisation
Security
Meta
NetherLight
Workflow
Clouds
Distributed
EventProcessing
GRID&CLOUD
Simulations
StreamProcessing
Predictions
SUPERCOMUTTER

Use AAA concept to split (time consuming) service authorization process from service access using secure tokens in order to allow fast service access.

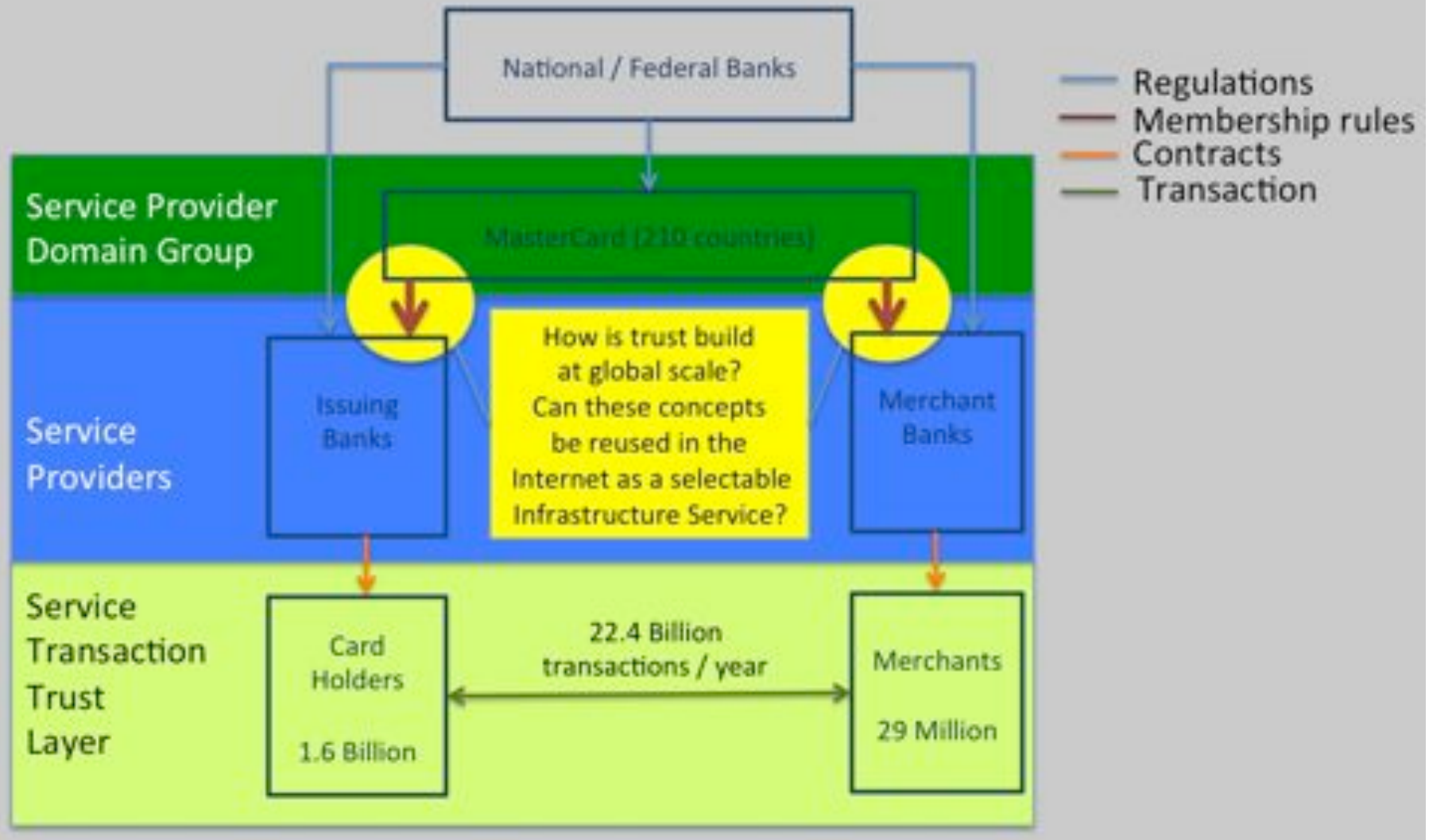



ref Leon Gommans

# Token Based networking



# Service Provider Domain Group



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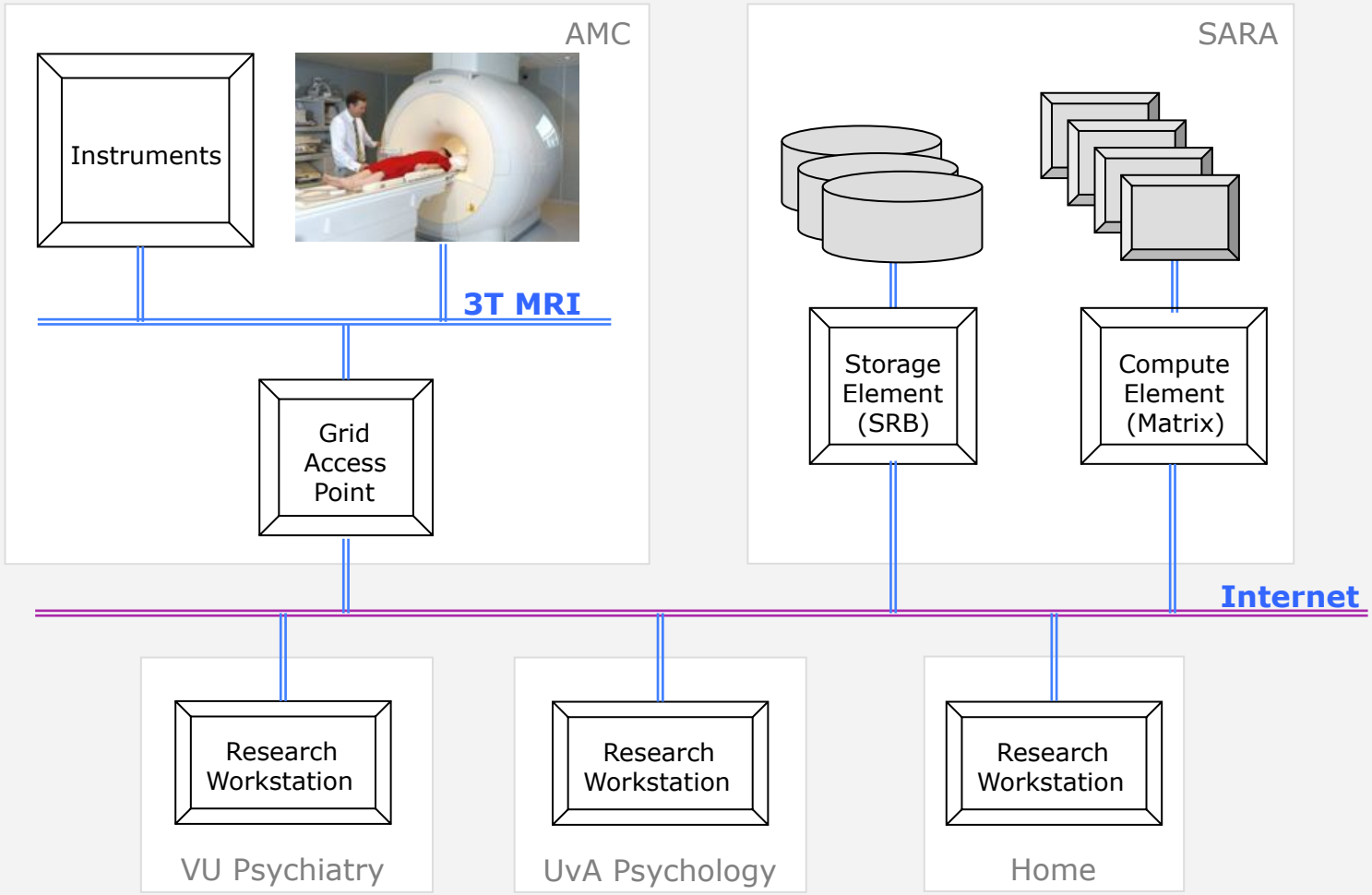
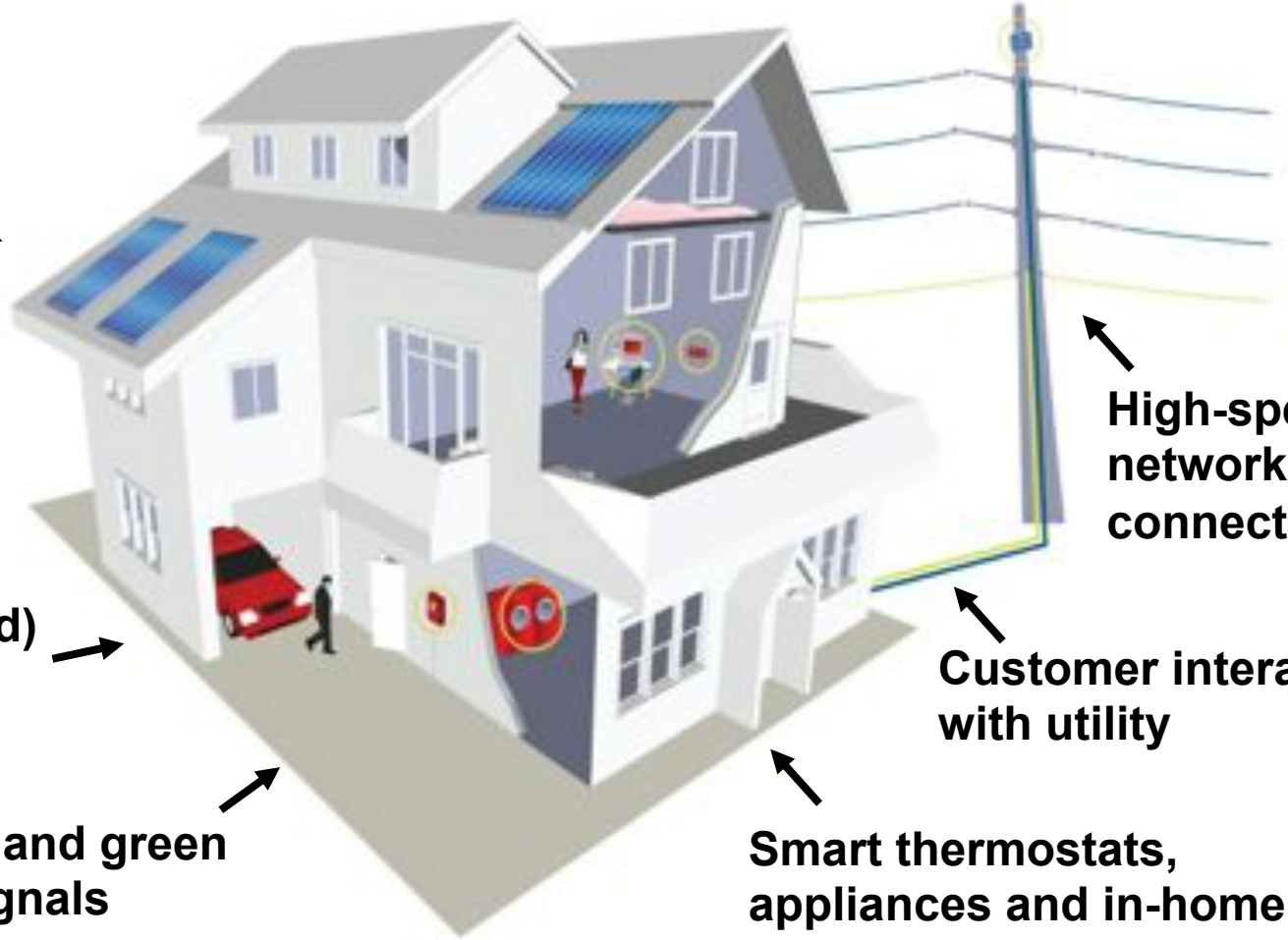
|---|---|---|---|---|---|---|---|
| Green-IT | | | | | | X | X |
| Privacy/Trust | | X | | | X | | |
| Authorization/policy | | X | X | | X | X | |
| Programmable networks | X | | X | | | | |
| 40-100Gig/TCP/WF/QoS | X | | X | X | | X | |
| Topology/Architecture | | X | | X | X | X | |
| Optical Photonic | | X | X | | X | | |

# Virtual Lab for Neurosciences: Resources



# Focus area 1



Added green power sources

High-speed, networked connections

Plug-in (hybrid) electric cars

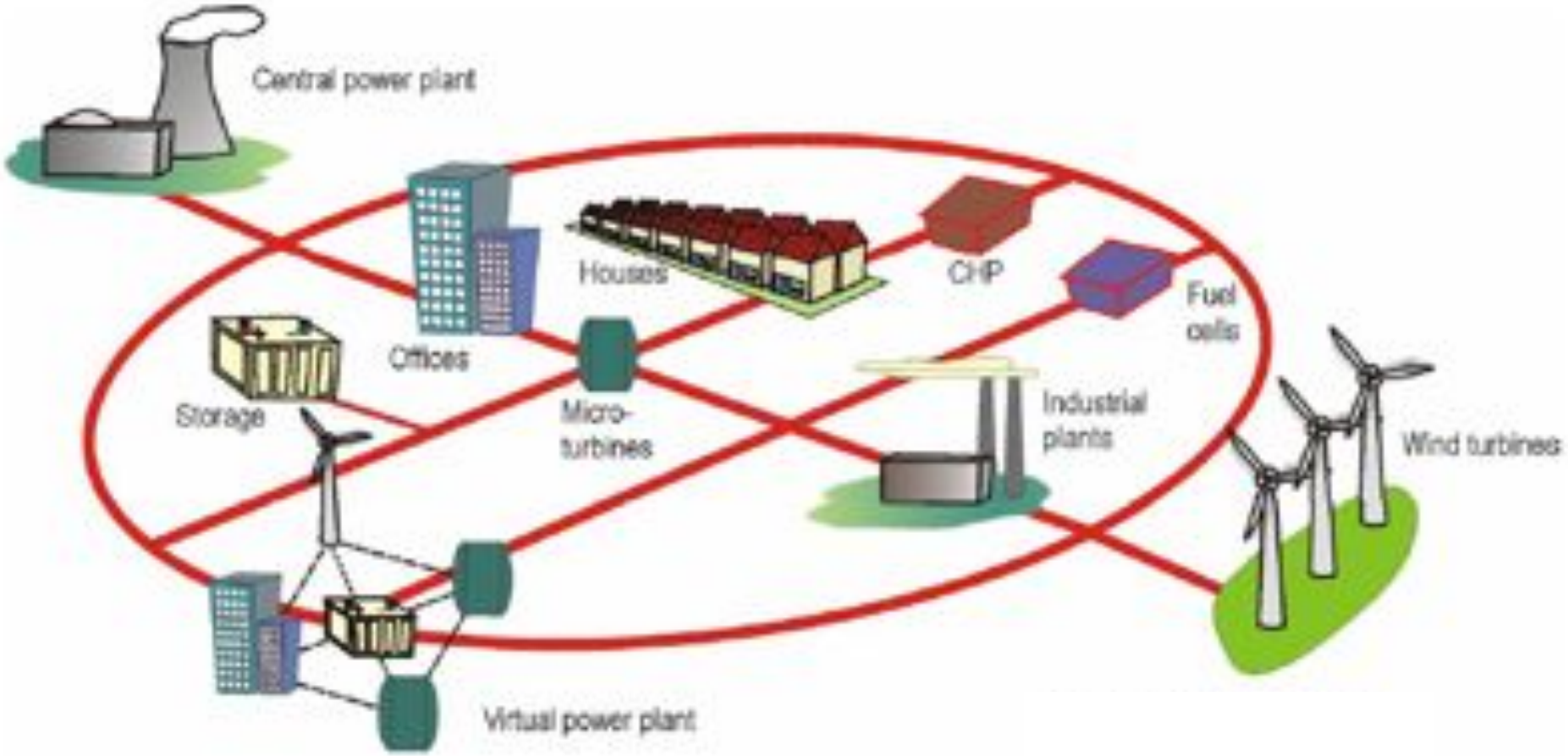
Customer interaction with utility

Real-time and green pricing signals

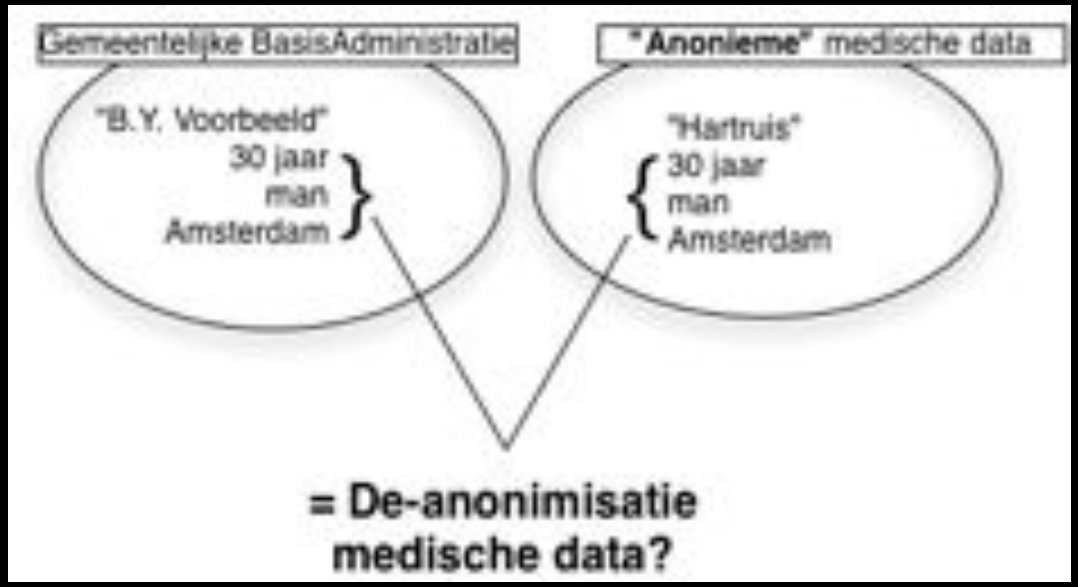
Smart thermostats, appliances and in-home control devices

# Smart House

# The future: smart grids

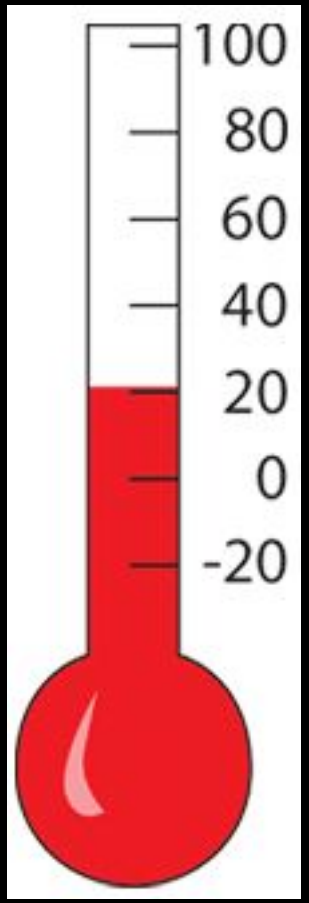


# Anonimiteit of her-identificeerbaarheid




1. Empirische analyse van GBA
2. Kansrekening, bijv. kans op niet-uniciteit:

$$1 - \left(\frac{n-1}{n}\right)^{k-1}$$




Privacy thermometer!

# SNE-Master

- RP's
  - 2005-21 Beveiliging banktransacties.
  - 2005-30 SURFnet Intrusion Detection System (IDS).
  - 2006-22 Beveiliging grote overheids organisatie: CERT procedures.
  - 2006-24 Beveiliging grote overheids organisatie: Vertrouwd Toegangspad.
  - 2007-23 CERT noodnet.
  - 2007-32 Veiligheid van update mechanismen.
  - 2007-41 Onderzoek naar de beveiliging van de wegwerp OV ritten kaart.
  - 2008-18 Security and Reliability of Automated Waste Registration in The Netherlands.
  - 2008-22 Detection of peer-to-peer botnets.
  - 2008-33 Slimme meters.
  - 2008-41 Security en privacy in het Landelijk Schakelpunt.
  - 2009-02 Online Banking: Attacks & Defences.
  - 2009-07 Browser Security.
  - 2009-41 The DFRWS 2009 Challenge.
  - 2010-07 Modern Age Burglars.
  - 2010-15 Horse-ID.
  - 2010-34 GPU-based password cracking.
  - 2011-43 Passive LAN information gathering.
  - 2011-08 PersLink Security.
  - See: http://http://www.science.uva.nl/~delaat/sne-2010-2011/index.html

# Challenges

- Data – Data – Data
  - Archiving, publication, searchable, transport, self-describing, DB innovations needed, multi disciplinary use
- Virtualisation
  - Another layer of indeterminism
- Greening the Infrastructure
  - e.g. Department Of Less Energy: http://www.ecrinitiative.org/pdfs/ECR_3_0_1.pdf
- Disruptive developments
  - BufferBloath, Revisiting TCP, influence of SSD's & GPU's
  - Multi layer Glif Open Exchange model
  - Invariants in LightPaths (been there done that ☺)
    - X25, ATM, SONET/SDH, Lambda's, MPLS-TE, VLAN's, PBT, OpenFlow, ….
  - Authorization & Trust & Security and Privacy

# ECO-Scheduling

EU

SARA

SURF-eSRC

Pieken-in-de-Delta

SURFnet

FES

NWO-NCF

UvA

NWO