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
<table>
<thead>
<tr>
<th>Company</th>
<th>Value</th>
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<td>Google</td>
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<tr>
<td>Amazon</td>
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<td>Facebook</td>
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<td>BAIDU</td>
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<td>NetFlix</td>
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<td>Expedia</td>
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**e.g.:**

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<td>Apple Inc.</td>
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Monday 3 January 2011
Internet developments

Speed
Volume

Deterministic
Real-time

Scalable
Secure

... more users!

... more data!
GPU cards are disruptive!

Top 500
#1
#500

20,000,000$
7 year
500$

fastest supercomputer in the world
nr. 500 supercomputer in the world
1 single Graphics Processing Unit
Data storage: doubling every 1.5 year!
Multiple colors / Fiber

Per fiber: \( \sim 80\text{-}100 \text{ colors} \times 50 \text{ GHz} \)
Per color: \( 10 - 40 - 100 \text{ Gbit/s} \)
\( \text{BW} \times \text{Distance} \sim 2 \times 10^{17} \text{ bm/s} \)

New: Hollow Fiber!
\( \Rightarrow \) less RTT!
Wireless Networks

It is a bit freaky with this wireless technology.

Protocol LAN due to the easy comparison and convenience in the digital home. While consumer PC products have 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.
… more users!

… more data!

… more realtime!

Internet developments
... more data!

Internet developments

Google

Data

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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!
Next Generation Wireless LAN Technology
802.11ac 1 Gbps throughput with WiFi

WiFi is one of the most preferred communications 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

The figure shows a cartoon of birds communicating. The text below the cartoon reads:

"It is a bit freaky with this wireless technology."

The text continues:

"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."

COPYRIGHT: MORTEN INGEHANN
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SNE @ UvA

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ATLAS detector @ CERN Geneve

Henk & Ingrid
ATLAS detector @ CERN Geneve
100000 flops/byte

10 Pflops/s

Status 2002!

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.
Status 2011!

4 X 100G Trans-Atlantic + NY-CHI + AMS-GVA

Using 100G Links + Next-Gen. Optical Muxes
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!
Use AAA concept to split (time consuming) service authorization process from service access using secure tokens in order to allow fast service access.
Token Based networking
Service Provider Domain Group

National / Federal Banks

Service Provider Domain Group

MasterCard (210 countries)

How is trust built at a global scale? Can these concepts be reused in the Internet as a selectable Infrastructure Service?

Service Providers

Issuing Banks

Merchant Banks

Service Transaction Trust Layer

Card Holders
1.6 Billion

22.4 Billion transactions / year

Merchants
29 Million

Regulations
Membership rules
Contracts
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Virtual Lab for Neurosciences: Resources

- Instruments
- Grid Access Point
- 3T MRI
- Internet
- Storage Element (SRB)
- Compute Element (Matrix)
- Research Workstation
- VU Psychiatry
- UvA Psychology
- Home

AMC
SARA

Microsoft Meeting, 30 March 2006, UvA
Focus area 1

- Added green power sources
- Plug-in (hybrid) electric cars
- Real-time and green pricing signals
- Smart thermostats, appliances and in-home control devices
- High-speed, networked connections
- Customer interaction with utility

Smart House
The future: smart grids
1. Empirische analyse van GBA
2. Kansrekening, bijv. kans op niet-uniciteit:

\[ 1 - \left( \frac{n-1}{n} \right)^{k-1} \]
SNE-Master

• RP’s
  – 2007-23 CERT noodnet.
  – 2007-41 Onderzoek naar de beveiliging van de wegwerp OV ritten kaart.
  – 2008-33 Slimme meters.
  – 2009-02 Online Banking: Attacks & Defences.
  – 2010-07 Modern Age Burglars.
  – 2010-15 Horse-ID.
  – 2010-34 GPU-based password cracking.
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](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