Intelligence to the Edge
Cees de Laat

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• This space is intentionally left blank
Natuur- en Sterrenkunde
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10^{-6} m

10^{-10} m

< 10^{-15} m

1 m

10^7 m

> 10^{15} m

1e JAAR

2e JAAR

ATOMEN
Kernen
Elementaire Deeltjes

grens
Vlakken

Gebreide informatica

Didaktiek

Fysische grondslagen

H E E L A L

Aarde

Mens

Cellen

Vaste stof
• Specification languages
• Computational Physics
• Advanced Electronics
• Neural Networks
• Computer based learning
• High performance and distributed computing
• Data Acquisition Systems
• Advanced networking
• Internet Applications
History of WFI

• Specification languages
• Computational Physics
• Advanced Electronics
• Neural Networks
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• Data Acquisition Systems

• Advanced networking
• Internet Applications
• EU project REMOT / DYNACORE
  – Collaboratories, virtual control rooms
  – Support science at the home institutes
  – Groupware, Videoconference tools point to point and point to multipoint
  – Corba services, distributed object db
  – www.phys.uu.nl/~dynacore
Physics-UU to IPP-FZJ => 7 kingdoms

- Netherlands
  » Physics dept
  » Campus net
  » SURFnet

- Europe
  » TEN 155

- Germany
  » WINS/DFN
  » Juelich, Campus
  » Plasma Physics dept
The need for AAA

See IRTF
AAA-ARCH
www.aaaarch.org
Policy based networking example

- Experiment
- Macintosh
- Policy based networking switch with > layer 4 AAA functionality
- AAA

Camera
The three QoS scenario's

• **Bureaucracy**
  - Do the advanced applications by hand
  - Long turnaround (rtt ≈ days)

• **Complexity**
  - Automatic application setup
  - Need advanced middleware and probably also bureaucracy

• **Throw Bandwidth at the problem**
  - Might go wrong at bottlenecks
  - Easiest solution
  - Do it yourself services
SURFnet5: Pre-production network

POS framing at 10 Gbit/s

Concentrator (15x)

Telfort’s DWDM network: always two different routes

Hempoint

SARA

POS framing at 10 Gbit/s
SURFnet5 topology
GIGAcluster

Concentrator (15x)

Hempoint
SARA

6 * Linux PC
1 * SUN
3 * 1 Gbit/s uplink
StarLight: The Optical STAR TAP

This diagram subject to change

Courtesy Bill St.Arnaud
Possible STAR LIGHT configuration

- 10 Gbps (8 x GbE)
- 2.5 Gbps (2 x GbE)
- 1 GbE
- STS mapped to GbE

I-wire: 4 x GbE CWDM

GbE transceivers

Optical Mux/Demux

10 GbE transceivers

DTF: 4 x 10 Gbps SONET DWDM

10 Gbps SONET to GbE Demux

STS to GbE Demux

SURFnet 5: 1 x 2.5 Gbps SDH DWDM

Layer 3 Router to connect to smaller networks

CA*net 4: 8 x 10 GbE DWDM

Courtesy Bill St.Arnaud
Changing architecture of the Internet

Old:
- "OSI model"
- IP in the core network
- Switching to the wire centers
- Hubs to connect computers and equipment

New:
- Edge devices layer 4 or higher aware
- Central router-ISP layer 3 connection
- ISP network layer 2 (MPλS)
- Optical core network topology
- Core -> optical switching, DWDM, layer 1

- Classical model turned inside out
- Multihoming -> exploding router tables
Revisiting the truck of tapes

Consider one fiber

- Current technology allows for 160 \( \lambda \) in one of the two frequency bands
- Each \( \lambda \) has a bandwidth of 40 Gbit/s
- Transport: \( 160 \times 40 \times 10^9 \div 8 = 800 \text{ GByte/sec} \)
- Take a 10 metric ton truck
- One DLT contains 50 Gbyte, weights 200 gr
- Truck contains \( 10 \times 1000 \times 5 \times 50 \text{ Gbyte} = 2.5 \text{ PByte} \)
- Truck / fiber = \( 2500000 \div 800 = 3125 \text{ s} \approx \text{ one hour} \)
- For distances further away than a truck drives in one hour (50 km) minus loading and handling 50000 tapes **the fiber wins!!!**

(Ref: passen en meten, W. Lourens, 1988)
Wim is weg

NAVERTELD DOOR ANNIE M. G. SCHMIDT
GETEKEND DOOR ROGIER BOON

OORSPRONKELIJK NEDERLANDS GOUDEN BOEKBAN

DE BEZIGE BIJ