A sustainable networking architecture ~ progress on the Ndiyo Project

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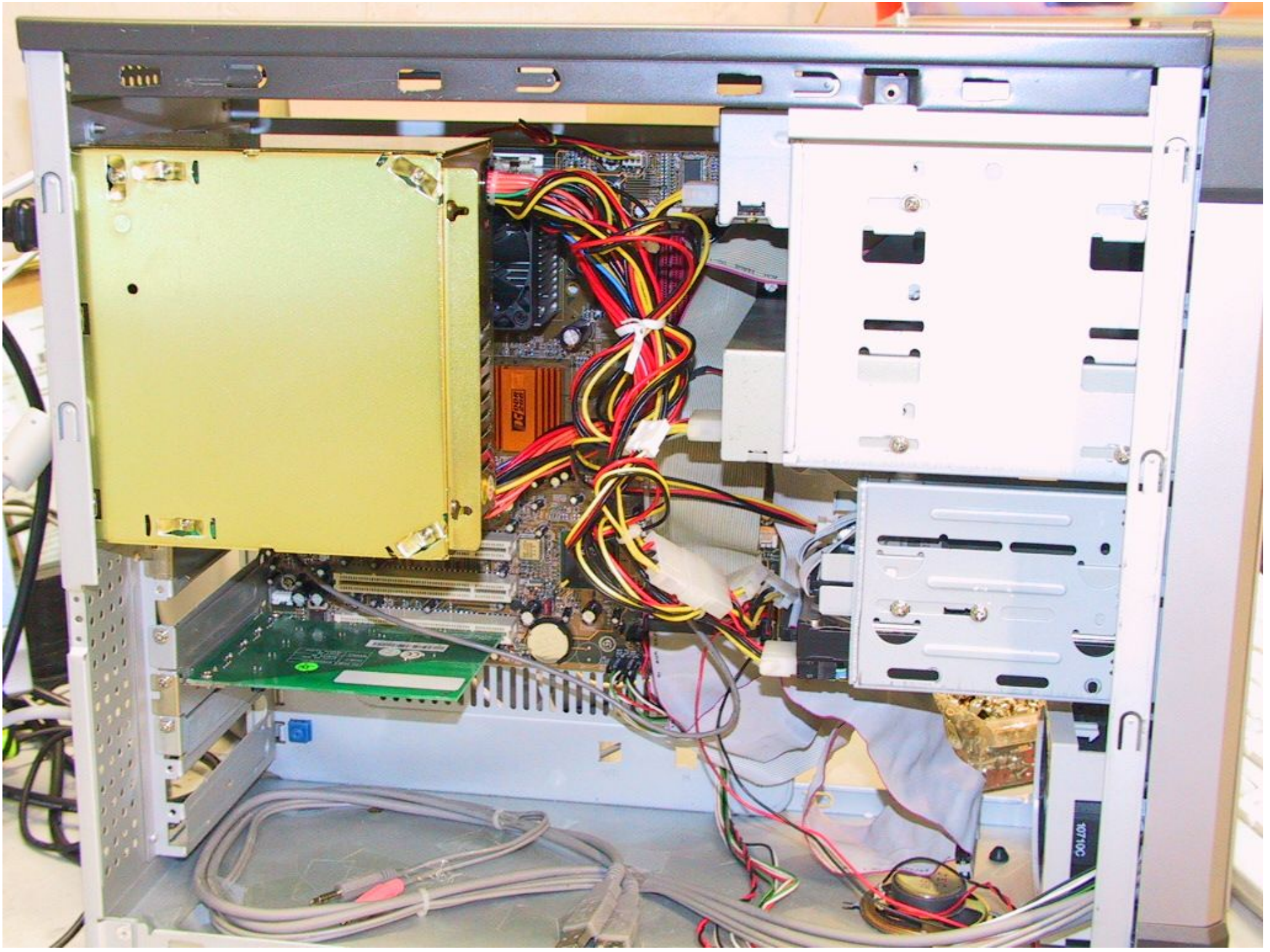
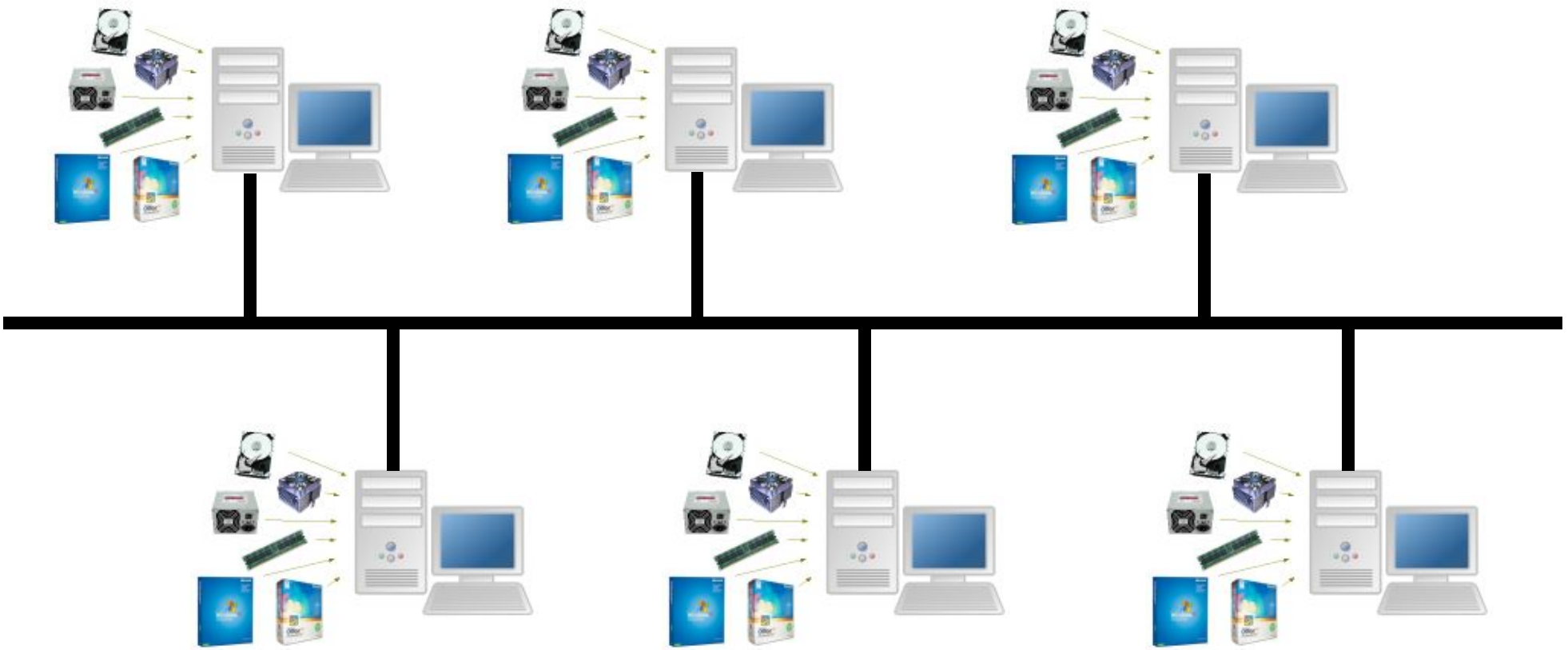
Microsoft
Windows xp
Professional
Microsoft
Office xp
Professional





The problem

- Expensive ($400+ hardware excluding screen; $300+ software)
- Unnecessarily replicated components
  - Frequent hardware failure
  - System administration hassles
- Inefficient utilisation over time
- Inflexible
- Environmentally damaging
- Needs replacing every 3 years!

Not a sustainable way of providing networked computer workstations!

The Ndiyo vision

- Rethinking networked computing to make it
  - Affordable (for the next two billion people)
  - Sustainable
    - Environmentally
    - Adminstratively
    - Economically
  - Open (non-proprietary)
- Stimulating development of requisite technology
- Evangelising

Ndiyo approach

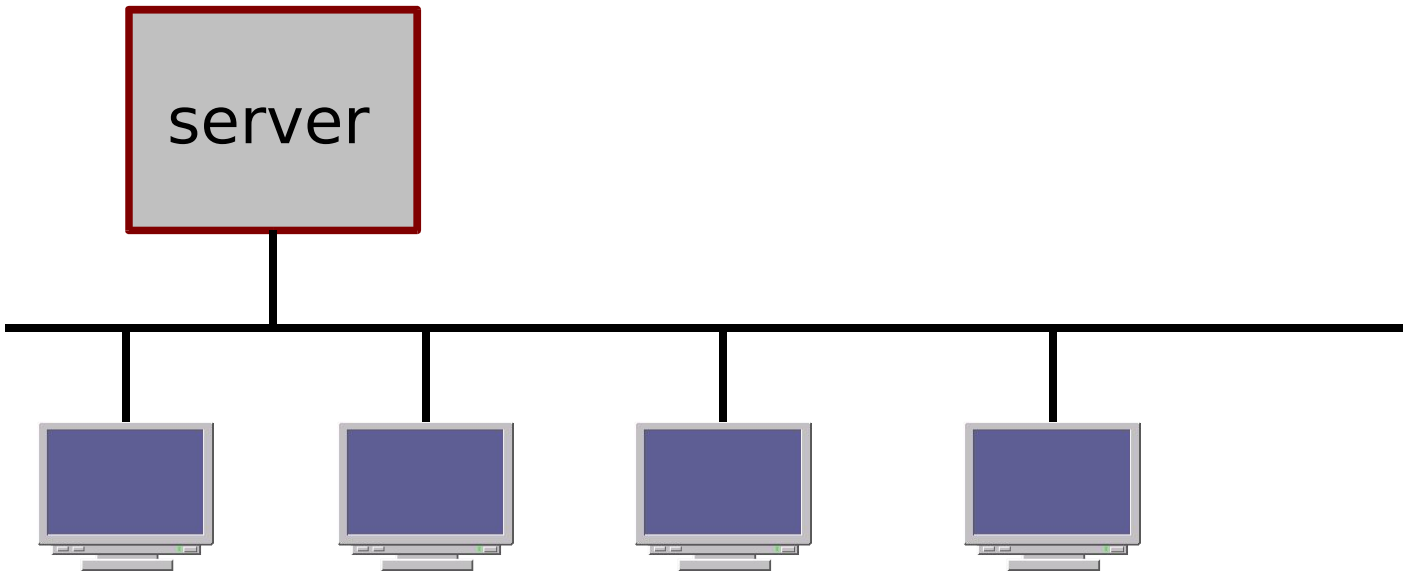
- Not-for-profit
- Freedom to rethink
  - No commercial constraints
- Values
  - Digital divide as 21st-century poverty
  - Ensuring ICT escapes proprietary control
  - Sustainable, decentralised models of income generation (not charity)

Trimming the fat

- Hardware
  - Minimise replication: put all the complexity in one box
  - No need for separate CPUs, HDDs, RAM, PSUs, cases
- Software
  - OSS exists and works: use it!
  - Software installed centrally: reduce administration

Two-pronged strategy

- Thin-client networking with
  ultra-thin-client hardware
- Open Source software



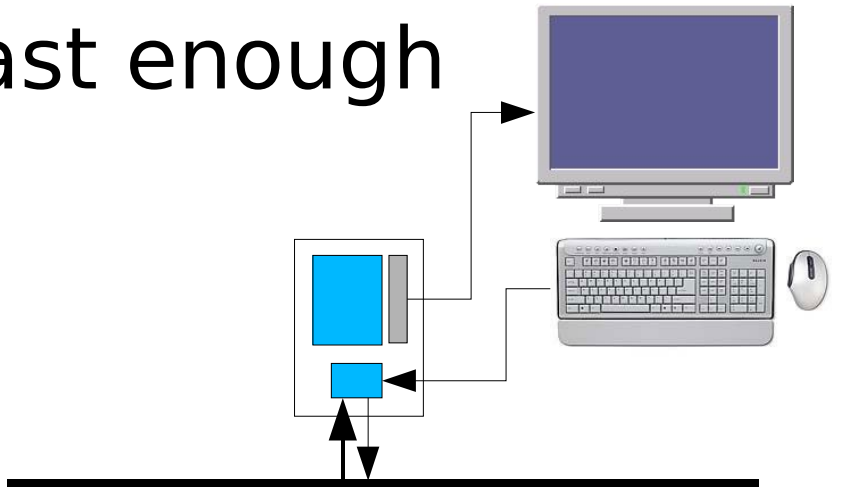
Hardware

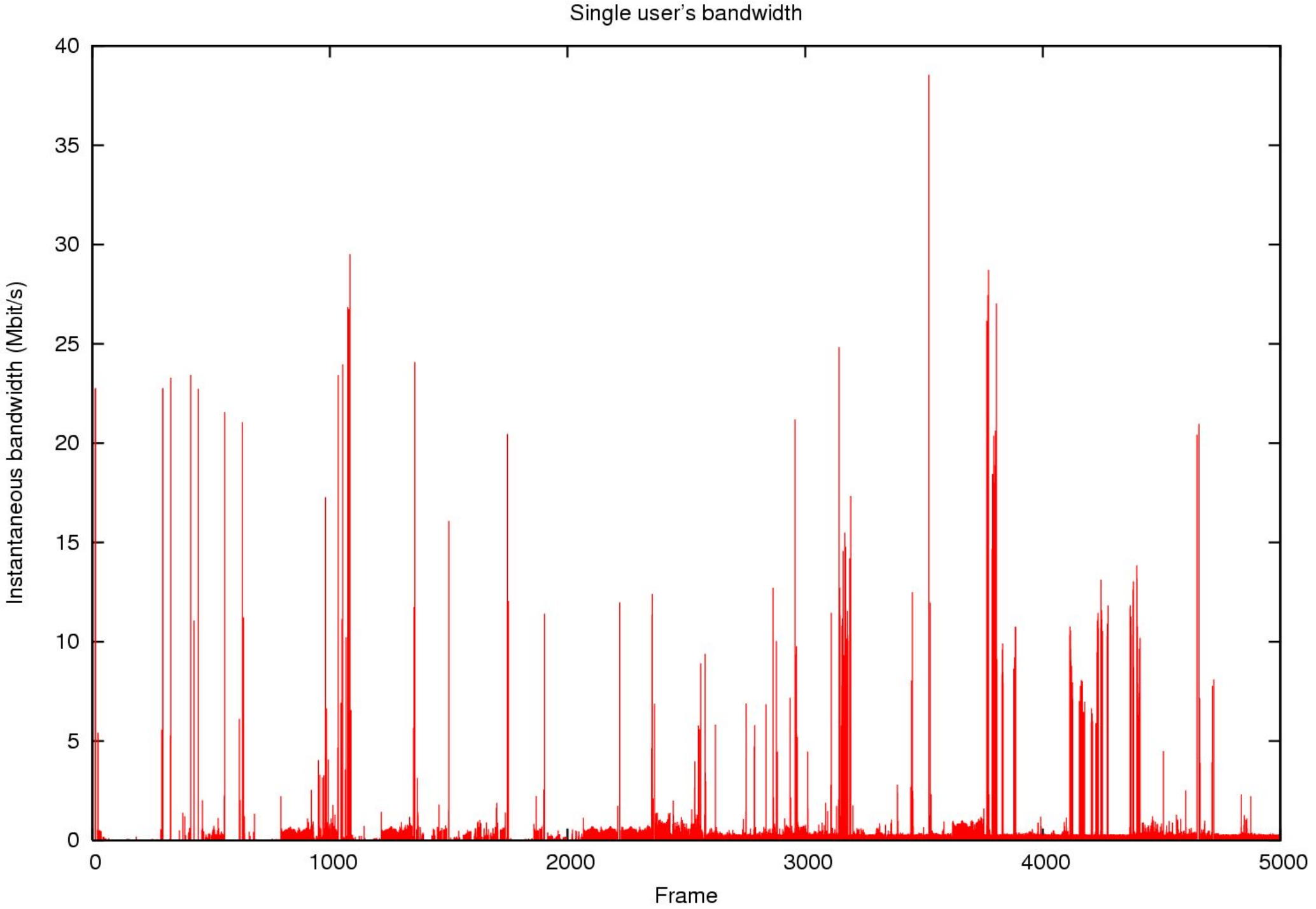
Typical thin-client design strategy

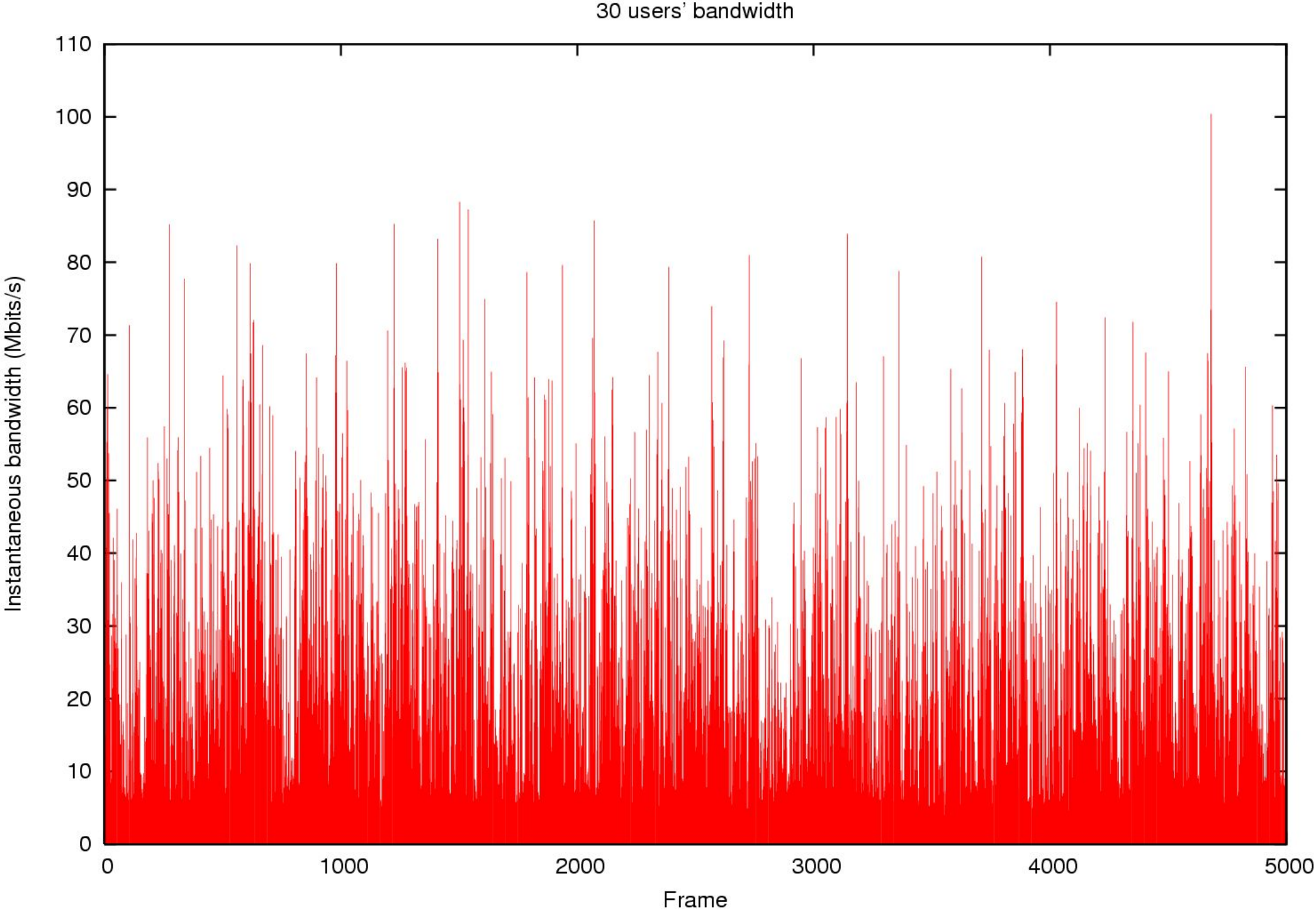
- Take a PC, remove stuff
- Target large organisations with 100s or 1000s of seats
- Require software licenses per seat
  (Windows Terminal Server...)

Thin-client computing done right

- Start with monitor, see what you need to add
- All complexity at server. Send raw pixels, with simple compression.
  - Convert to VNC/RDP at server.
- 100Mbit ethernet is fast enough to get away with this!




Single user's bandwidth
Instantaneous bandwidth (Mbit/s)
Frame
0
5
10
15
20
25
30
35
40
0
1000
2000
3000
4000
5000


30 users' bandwidth
Instantaneous bandwidth (Mbits/s)
Frame
0
10
20
30
40
50
60
70
80
90
100
110
0
1000
2000
3000
4000
5000

- “Network In, Video Out” (*nivo*)
- Current demonstrator:
  - 12 x 8 x 2cm
  - Ethernet, power, keyboard, mouse & VGA ports
  - 2Mb video RAM, FPGA, Ethernet controller
- Next version to add:
  - sound, local USB ports
- Cost: Already sub £100

The vision for hardware

- Nivo becomes a chip inside monitor
- Monitors will have ethernet inputs in addition to VGA/DVI
  - Monitor with just an ethernet port requires less electronics than a standard VGA input

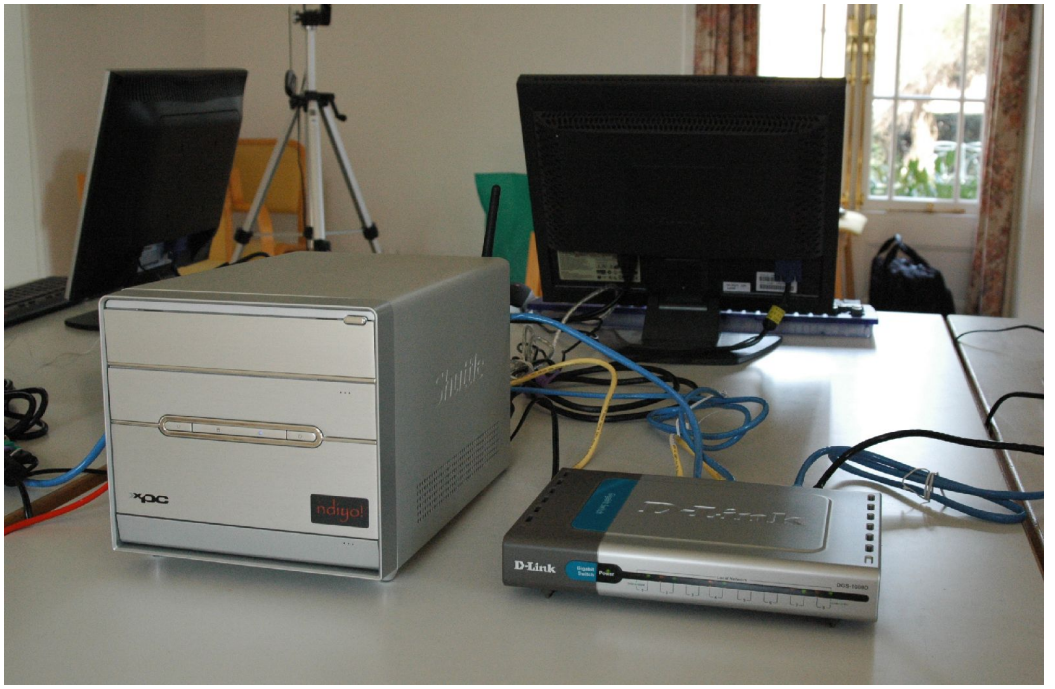
Ndiyo system

Target scenarios

- Internet Café
- School classroom
- Small business

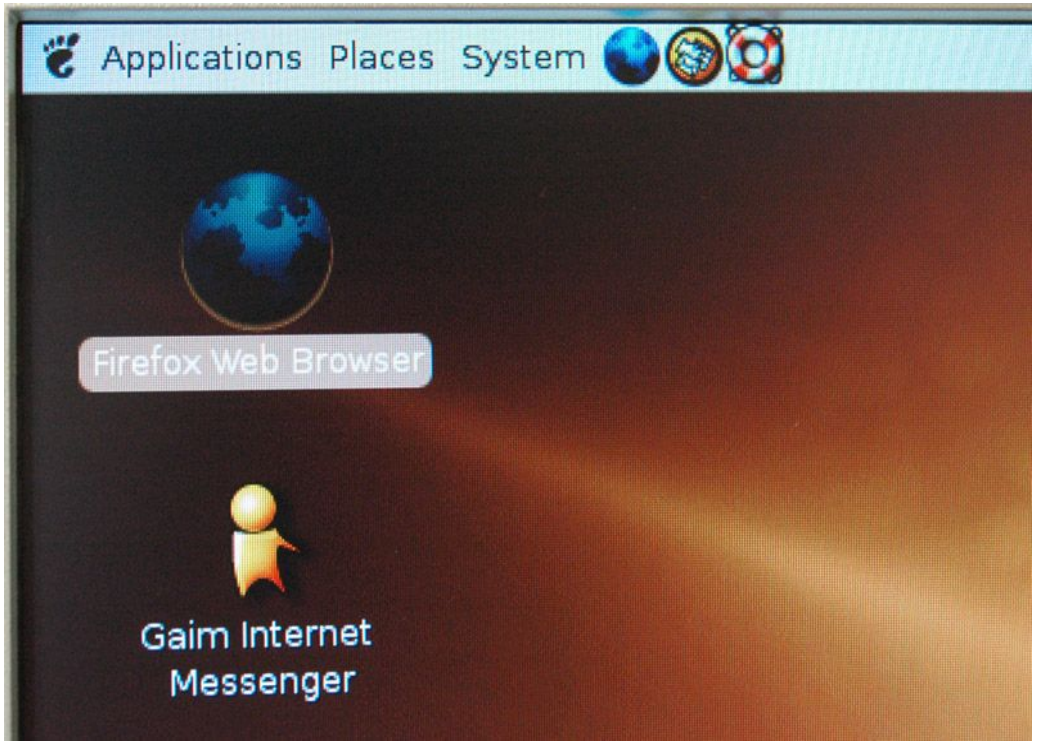
Ndiyo system: hardware

- Cluster of workstations
  - One or more servers
    - Plug and play clustering

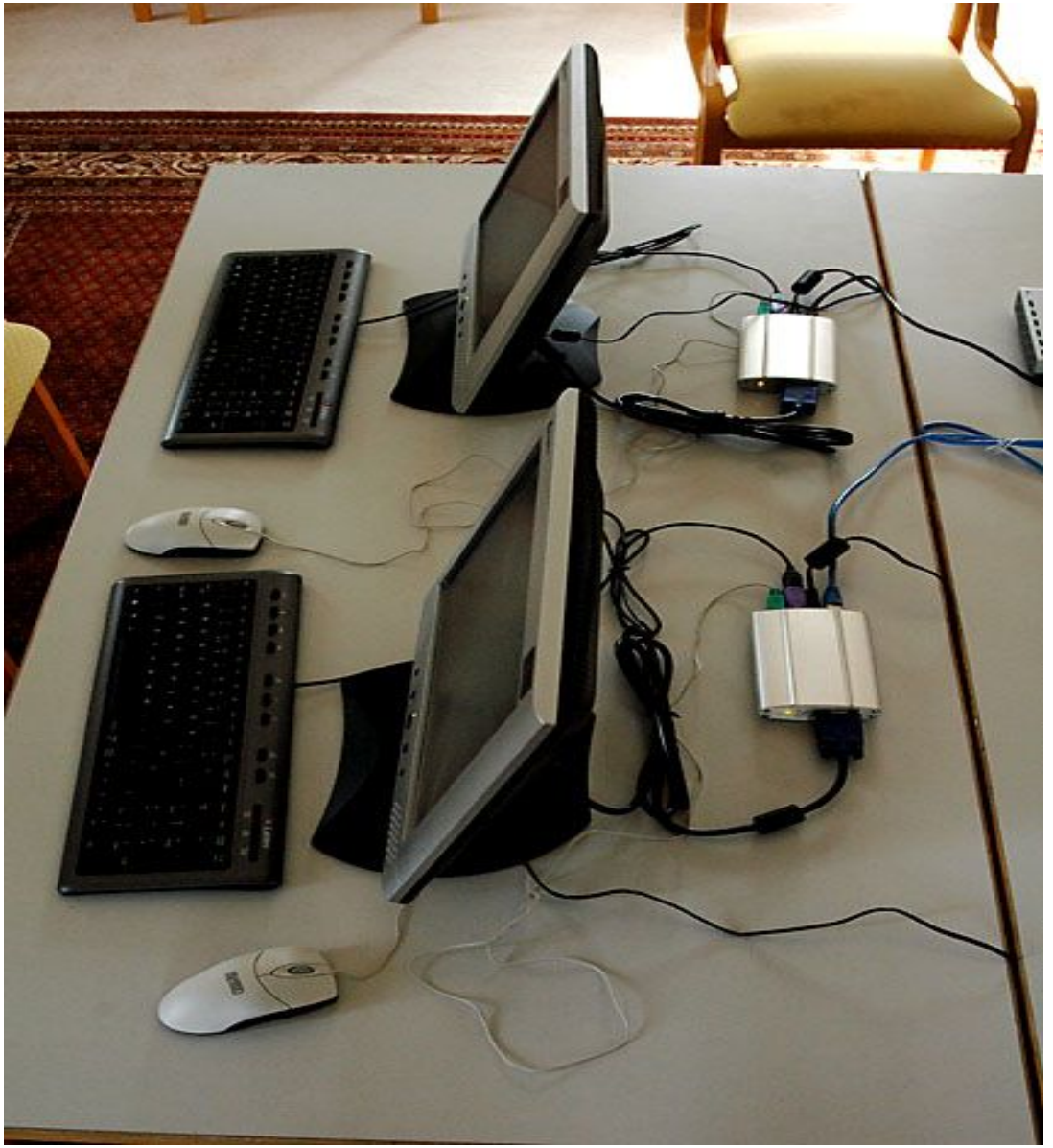


Ndiyo system: software

- Linux OS (Ubuntu) with Nivo driver
- Gnome/KDE desktop
- OpenOffice, Firefox, GAIM, Thunderbird




ubuntu



System capacity

- Application-specific
- 'Office' use (word-processing etc.)
  - 20 clients, Gigabit switch, single server (2GHz, 2GB RAM ~ £800)
- Software development


5 Java developers building and testing large apps,
extreme programming, single 2GHz, 2GB server.
Running continuously since August 2004

Benefits

- Affordability
- Environmental impact
- Administration
- User experience
- Robustness

Affordability

- Lower up-front costs
  - 30/40% of comparable Windows-based network
  - 50% of proprietary thin-client network (e.g. Sun Ray)
- Lower upgrade costs
  - Nothing to upgrade at client end (pixels are pixels!)
- TCO

Environmental footprint

- Manufacture phase:
  - PC with 17” CRT:
    - 260kg fossil fuels (≈50% due to CRT)
  - Nivo in current form
    - 8kg fossil fuels
  - Nivo + CRT + tenth share of PC as server:
    - 40% saving, without shrinking any further
- Use phase:
  - PC base: 100W; 17” CRT: 75W
  - Nivo: 5W

Administration

- Centrally-administered software
- Trivial to add more clients
- Better security

User experience

- A share of a fast server can feel faster than a cheap PC to yourself
- Physically more discreet and flexible

Robustness

- Clients extremely reliable
- Only the server needs a protected power supply
- Clustered servers: plug-and-play redundant storage and failover

Disadvantages

- Currently requires wired ethernet to a server
- No local drives (e.g. flash keys) in current version
- Limited multimedia

Summary

- “One user, one PC” is an unsustainable way to provide networked computing
- Ultra-thin client hardware is a reality, given today’s network bandwidth
- Ultra-thin client + Open Source software provides a robust, more affordable, and more sustainable solution

For more information, please contact
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