

A sustainable networking architecture ~ progress on the Ndiyo Project

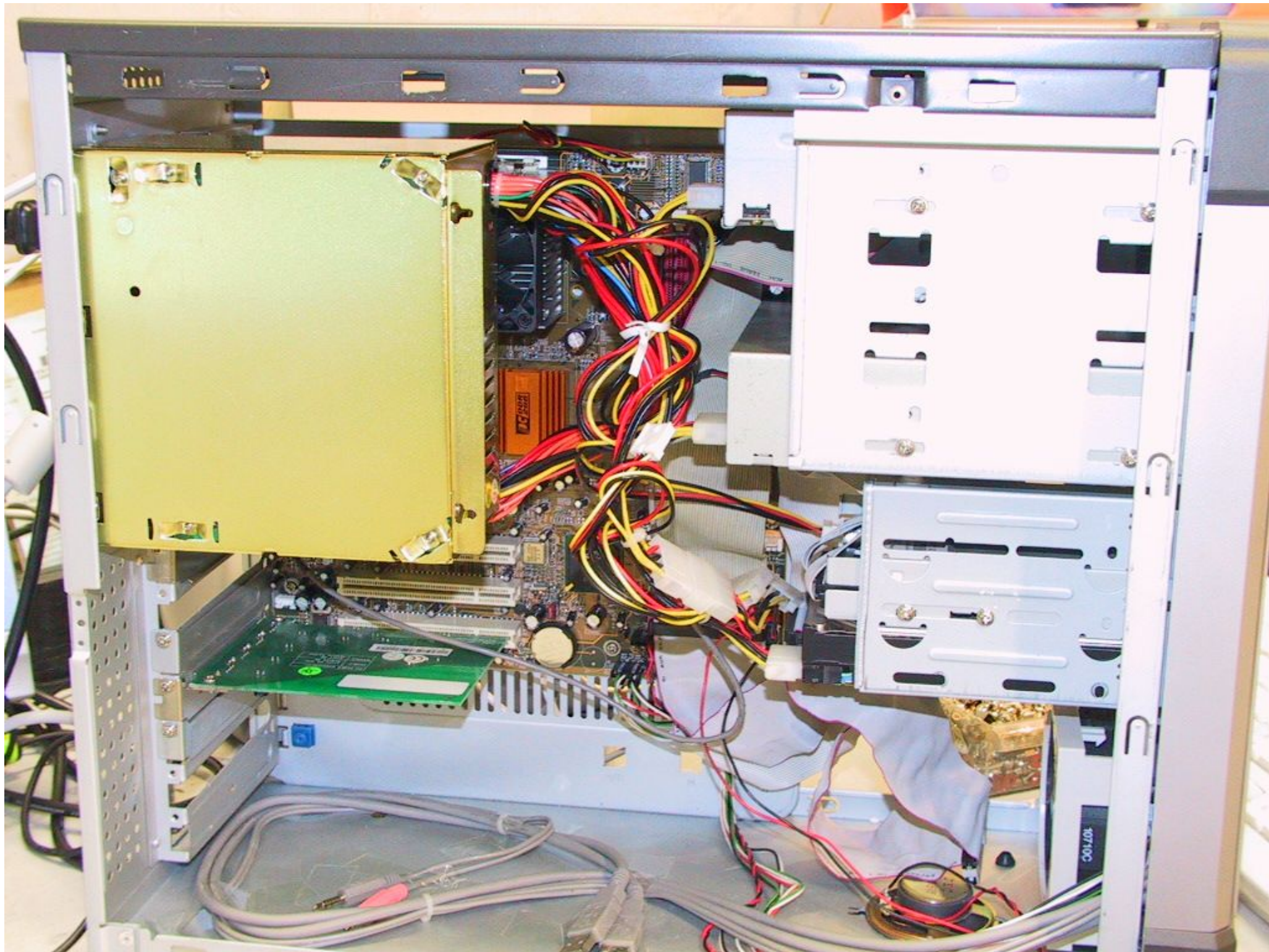
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The problem

- **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
 - Administratively
 - Economically
 - Open (non-proprietary)
- Stimulating development of requisite technology
- Evangelising

Ndiyo approach

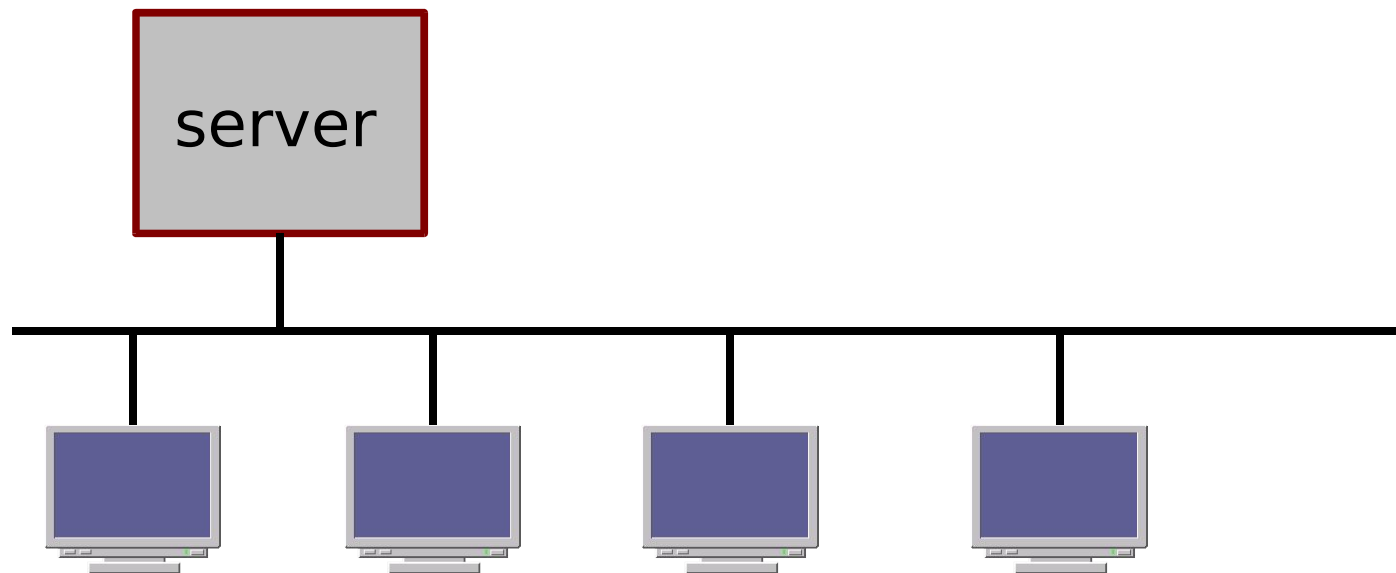
- Not-for-profit
- Freedom to rethink
 - No commercial constraints
- Values
 - Digital divide as 21st-century poverty
 - Ensuring ICT escapes proprietary control
 - Sustainable, decentralised models of income generation (not charity)

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



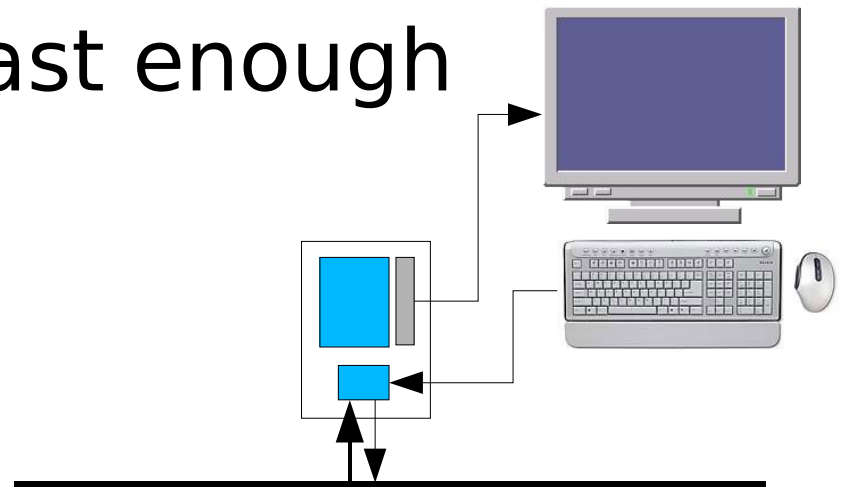
Hardware

Typical thin-client design strategy

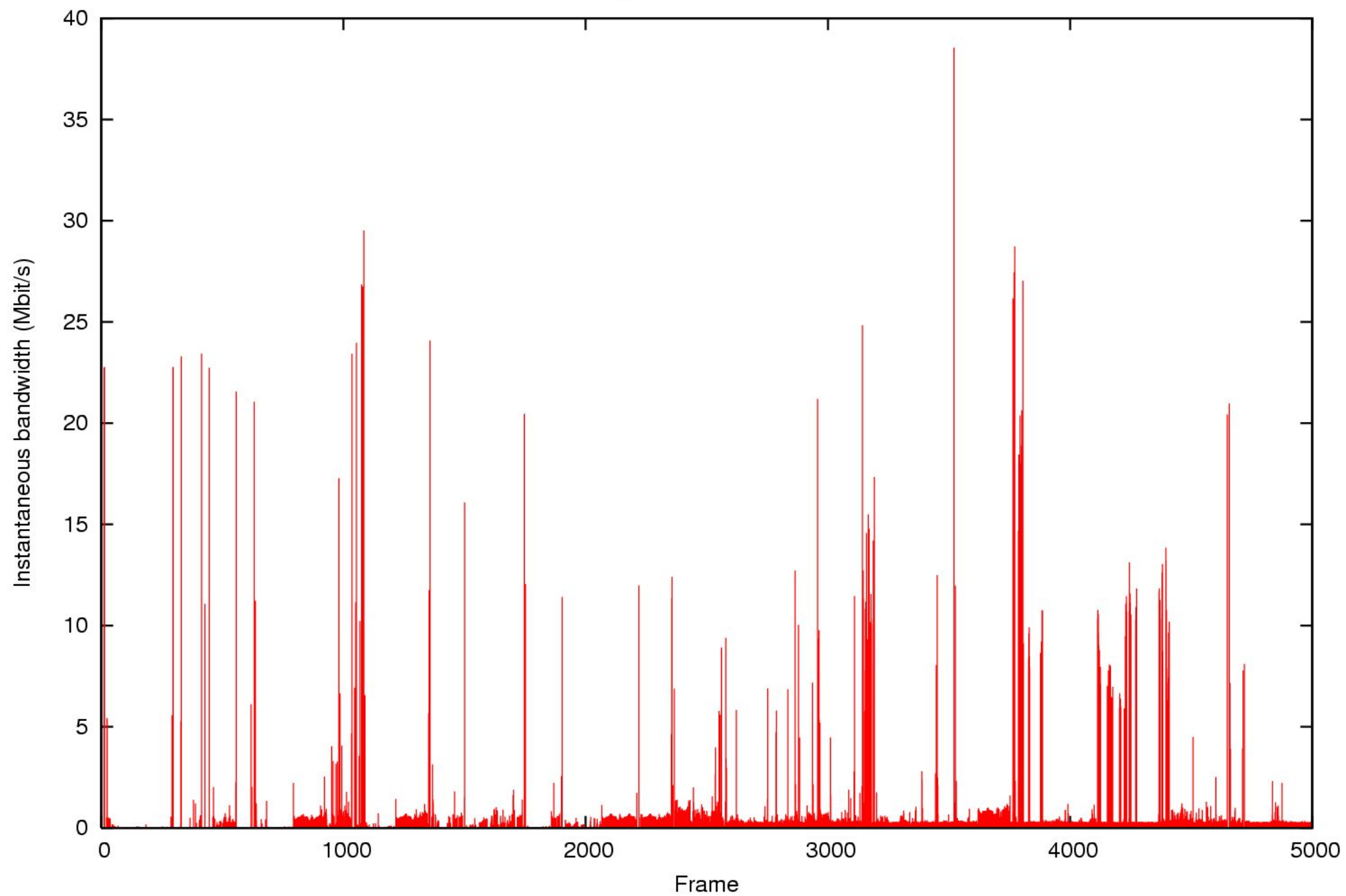
- Take a PC, remove stuff
- Target large organisations with 100s or 1000s of seats
- Require software licenses per seat
(Windows Terminal Server...)

Thin-client computing done right

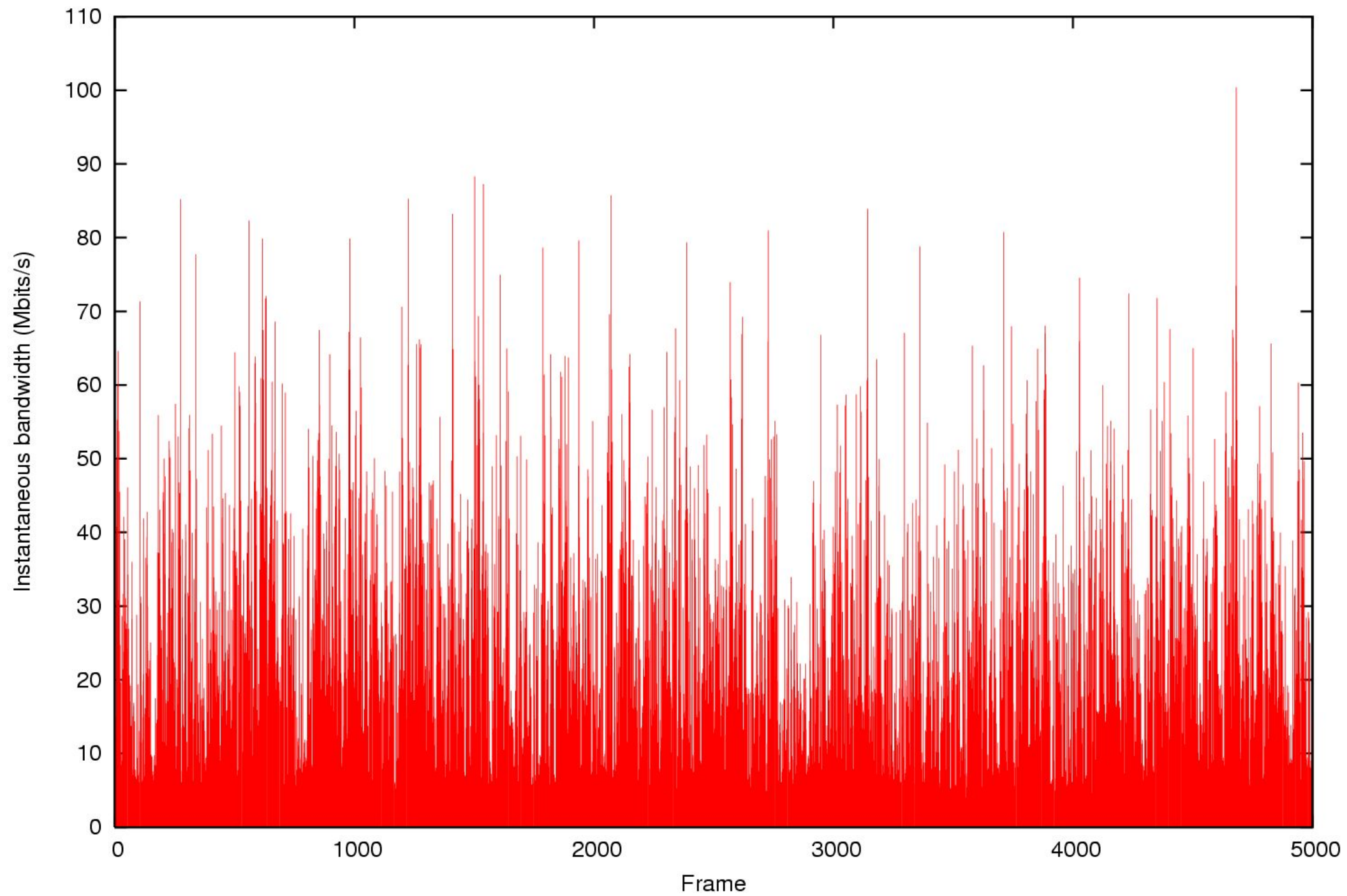
- Start with monitor, see what you need to add
- All complexity at server. Send raw pixels, with simple compression.
 - Convert to VNC/RDP at server.
- 100Mbit ethernet is fast enough to get away with this!



Single user's bandwidth



30 users' bandwidth



- “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

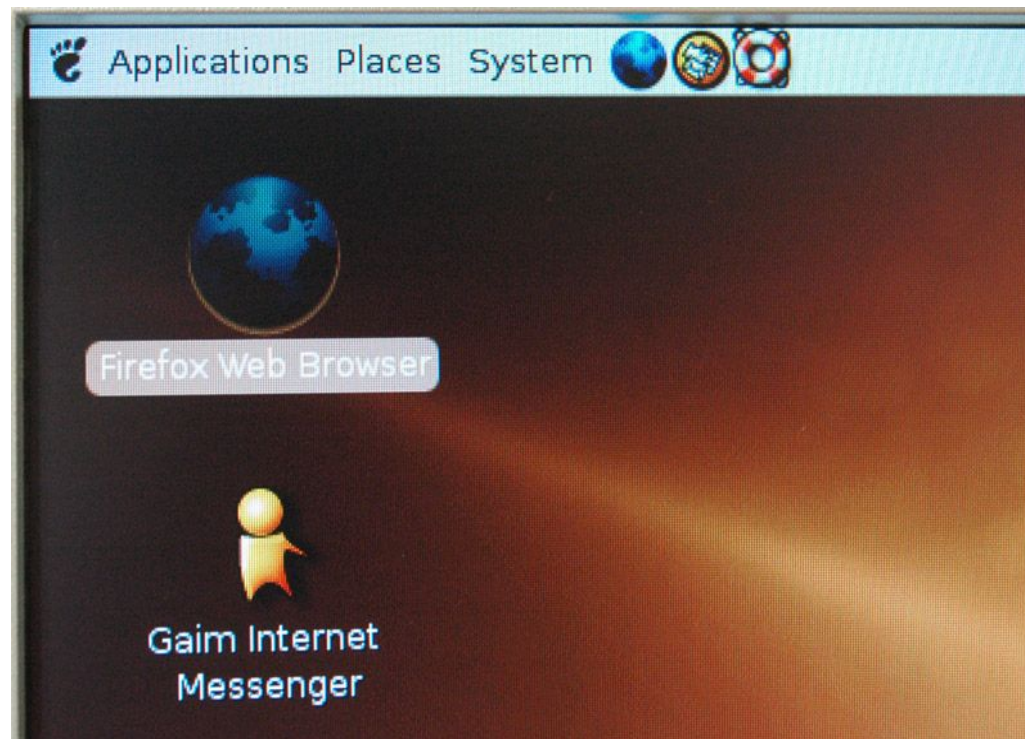
Ndiyo system: hardware

- 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







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 ($\approx 50\%$ 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

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