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!
• “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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