classroom of the future

Karl Jeacle
kj@broadcom.ie

Broadcom Eireann Research Ltd
www.broadcom.ie

Introduction

- *The place*
  - Dublin, Ireland
- *The people*
  - Broadcom, an Irish R&D firm
  - (that's `broadcom.ie`, not `broadcom.com`)
- *The project*
  - Connecting schools to the Internet

Dublin, Ireland

- Dublin
  - Capital city, location of pilot network
- Ireland
  - Population: 3.5 million
  - Telephones: 1.3 million, 80% digital
  - 5 major ISPs
  - Most web pages per capita in world?

Broadcom

- Core business
  - Network Management, Advanced Telecommunications Services, Project Management
- Background
  - Founded 1987
  - Shareholders
    - Telecom Eireann, 45%
    - Ericsson, 45%
    - Trinity College, 10%

CoF Project Aims

- Research the area of education and technology
- Help Irish education in applying technology
- Follow-up suggestions from board
- Gain recognition for Broadcom in Ireland

Three phase approach

- Phase 1:
  - Internet access; wire the schools
- Phase 2:
  - Educate the teachers; provide information
- Phase 3:
  - Sponsored educational research

Phase 1

- Three schools in Dublin provided with ISDN access to the Internet
- Broadcom pay ISDN installation & rental
- Broadcom provide network equipment
- Sept 95 - June 97

LB0070

BROADCOM 7

The schools

- Pobalscoil Neasáin
  - `www.psn.ie`
  - primary & secondary
- Goodshepherd National School
  - `www.goodshepherd.ie`
  - primary
- St. Andrew's College
  - `www.st-andrews.ie`
  - secondary

In K-12 terms?

- Primary:
  - Ages 7 to 11
- Secondary:
  - Ages 12 to 17

LB0070

BROADCOM 8

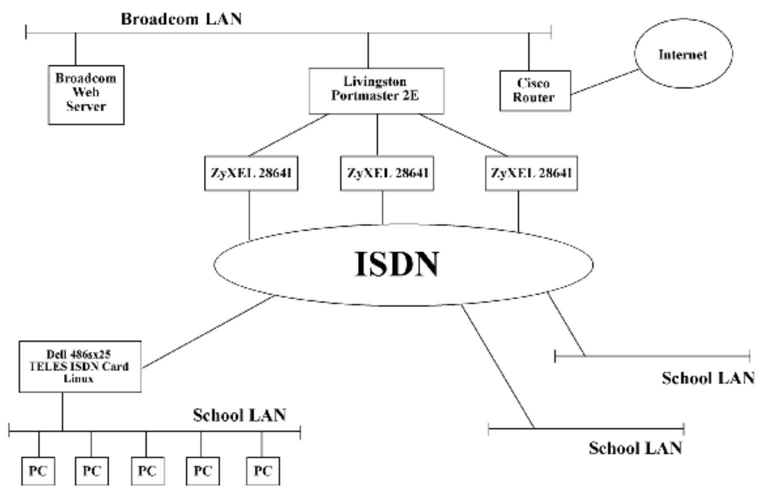
Existing School hardware

- Schools have LANs!
  - Coax & UTP Ethernet
- Student machines:
  - Acorn Archimedes
  - Commodore Amiga
  - Pentium P60 PC

LB0070

BROADCOM 9

New Network Configuration



LB0070

BROADCOM 10

Network Server H/W

- Livingston Portmaster PM-2E
  - 30 port terminal server with PPP etc
- 3 x ZyXEL 2864I
  - Combined V.34 modem & ISDN TA
- 2 x ISDN BRA connections
  - Four B-channels, only three schools
  - 1 x 64K channel per school

Why Linux?

- Cost
  - Limited budget; Free == attractive!
  - Helped forced network direction of project
- Resources
  - Limited computing resources adequate
  - Make use of old office PCs
- "Internet ready"
  - Don't have to buy software with the OS, for application, Linux *is* the application

Linux Configuration

- PCs
  - Dell 486SX 25MHz
  - 8MB RAM, 120MB HD, Ethernet
  - Teles ISDN card (~$150)
- Linux 1.2.13
  - Slackware NFS install
  - Fritz Elfert's isdn4linux package

School software

- In addition to Linux + isdn4linux:
  - CERN web server
    - Acting as a caching proxy server for LAN
  - DNS config
    - Forwarding any DNS requests to Broadcom
  - ISDN config
    - Additional Sync-PPP daemon
    - On-demand IP/ISDN timer setup

Server configuration

- Dell 486DX 33MHz
  - 16MB RAM, 1GB HD, Ethernet
- Apache WWW
- Sendmail
- Majordomo
- IRC server

isdn4linux

- Features
  - On-demand ISDN calls
  - Sync-PPP/IP support
  - Modem/tty emulation
  - Driver for TELES Euro-ISDN card
    - by Jan den Ouden
  - Free, but beta...

Inverse Sendmail

- Linux DNS
  - School MX records, email goes to Broadcom
- Linux sendmail
  - School domains are "expensive"
  - Queue indefinitely for collection
- On school ISDN connect:
  - School remotely execs script on server to initiate processing of mail queue

IP addressing

- Broadcom is not an ISP
  - one (flat) class C network assigned
- School hosts need addresses
  - each LAN uses small chunk of ours
  - convoluted routing and arping
- Better solutions available today!
  - IP Masquerading
  - Register official address space

WWW

- In schools
  - Web servers for proxy caching only
  - HTML tools on student machines
- In Broadcom
  - Apache server for project
  - 3 x virtual servers for schools
  - Schools use FTP to update web pages

LB0070 BROADCOM 19

Mishaps!

- Teachers aren't technicians
  - ISDN & Ethernet
- RS-232 isn't quite standard
  - Surface mounted resistors
- PPP variations
  - ZyXEL/Portmaster move
- Missing ISDN lines
  - Telecom Eireann mix-ups

LB0070 BROADCOM 20

Phase 1 findings

- Linux / ISDN network operational
- Linux is a cost effective solution
- Enthusiastic response from both teachers and students
- Educational benefits include
  - “real world” problem solving
  - publication of students’ work

Teacher reality check

- Practical issues:
  - Cost, cost, cost!
    - equipment, phone bills, maintenance
  - Ease of access to facilities
- Conceptual issues:
  - appreciation & acceptance of technology
  - training - computing/Internet/teaching
  - lack of imagination & motivation

Phase 2

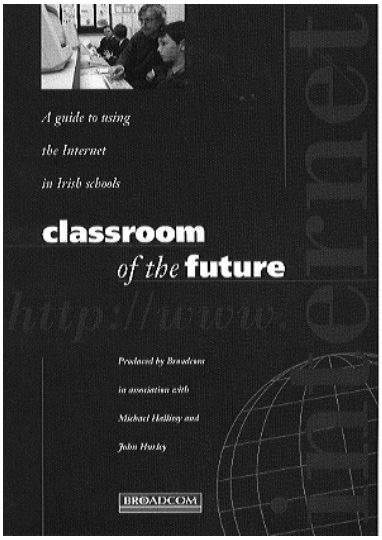
- Aim: To promote the use of the Internet in schools
  - Guidebook
  - Poster
  - Web pages
- Teacher feedback
- Mar 96 - Nov 96

LB0070 BROADCOM 23

Observations

- Many schools already online
  - but often just one teacher or email address
- Few schools are adequately equipped
  - practical issues:
    - 1 computer, 30 kids
    - 30 computers, 1 modem
    - computers and phone lines on wheels
- Enthusiasm, but no direction...

LB0070 BROADCOM 24

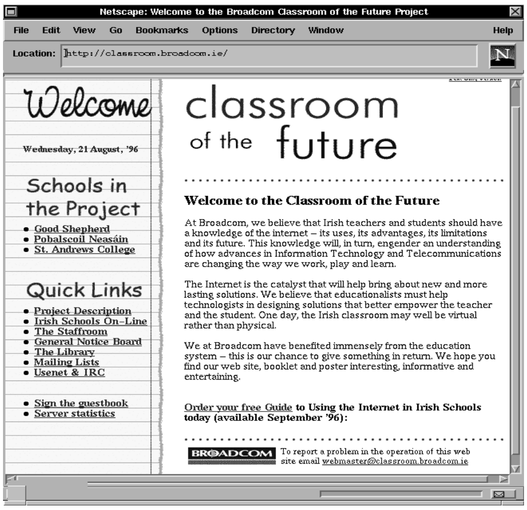


Guide book

- Free to Irish schools
- 45 pages
- A4 size
- Written by teachers
- Edited by Broadcom
- *"A guide to using the Internet in Irish schools"*

Poster

- Free to Irish schools
- Colour, A2 size
- Designed by Broadcom
- Features:
  - What is the Internet?
    - Web, Email, etc.
  - Education URLs
  - Internet history timeline



Web site

- Links to educational resources
- Irish on-line schools directory
- Worksheets

LB0070

BROADCOM 27

Phase 2 findings

- Web site very popular
- High demand for booklet from teachers
  - positive feedback received
- Publicity
  - Newspapers, teacher magazines
  - Internet links, word of mouth

LB0070

BROADCOM 28

Phase 3

- Longer term issues
- Aim
  - To examine the impact of future technology on education in Ireland
- Approach
  - Research project involving both educationalists and technologists
- Jan 97 - Dec 98

Summary

- Investigation
  - ISDN access to schools
- Contribution
  - Web site
  - Guidebook
  - Poster
- Longer term scenarios

Opportunities

- Broadcom is an R&D company
- Beneficiaries
  - Telecom Eireann
  - Ericsson
- This has to be a huge market...
- ...I will make some observations!

LB0070

BROADCOM 31

Keep it simple

- Teachers are not engineers
  - Kids can set up a PC before a teacher can
  - Turnkey systems are essential
- If the system isn't easy to use...
  - "I don't have time for this, I'm here to teach"
  - "It's not in the curriculum, what use is it?"
  - "I don't need anything more than a textbook"

LB0070

BROADCOM 32

Listen to teachers!

- Teachers can be suspicious of commercial involvement
- *Teachers always listen to other teachers*
  - Get teachers to endorse your system
  - Involve a group of schools in a project
- Show them Web66!
  - `http://web66.coled.umn.edu/`

LB0070 BROADCOM 33

Linux is not Win95

- Don't fall into the Amiga trap!
  - Maybe Linux is the best OS in the world, but that doesn't mean that MCIBTYC
- Advocate, but play to strengths
  - Built-in networking
  - Free software
  - Low computing resources required
  - Affordable server system

LB0070 BROADCOM 34

ISDN required?

- ISDN is ideal, if affordable and available
  - Bandwidth
    - 1 x B-channel can support a classroom
    - 2 x B-channels if demand is high enough
  - Characteristic: Instantly online on-demand
- 56K modems
  - 56K receive, 33K transmit
    - US Robotics, http://x2.usr.com/
    - Rockwell, Motorola, Lucent etc

Alternatives

- Not everyone has a LAN
  - One computer classrooms most common
  - Need an "Internet PC on a trolley"
- You don't need a P6 to surf
  - Recycle used office equipment
  - Email is more useful than RealAudio
- Understand the market
  - Provide consultancy & tech support to schools from ground up

Lessons learned

- Linux is free, but it's beta...
  - Great for using at home; but at work?
    - Hacker image can be a problem
- Linux+isdn4linux networking solution
  - much cheaper than "soho/office routers"
    - but what about the days spent recompiling kernels and applying patches?
- Proceed with caution!

More?

http://classroom.broadcom.ie/