One Laptop per Child

USENIX: June 22, 2007
Mary Lou Jepsen

Acknowledgement

Carla Gomez Monroy + all at OLPC +
thousands of other organizations and
individuals making this dream reality

I'm teaching in primary 5

the children are really trying, because they are doing many things in the laptop, of which I, the teacher, cannot do.

"I love my laptop more than my life"

Personal Email from Badmus in Nigeria, May 2007

You can help us

wiki.laptop.org & dev.laptop.org
IRC: freenode #olpc

What it's like

- Opportunity
- Education
- Those not in school
- Teachers

….Kids will own their own laptops

What is: One Laptop Per Child ?

1) A non-profit entity with $25M funding for non-recurring engineering costs

2) About **scale**, **scale**, **scale** being **global** is crucial launch 3-5 million units in first year, as much as 50-150 million units in second year >5 large diverse countries

3) To provide to children: to own, to take home, to use seamlessly

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World Wide Interest

Map: *http://wiki.laptop.org/go/Image:Olpcmap.jpg*
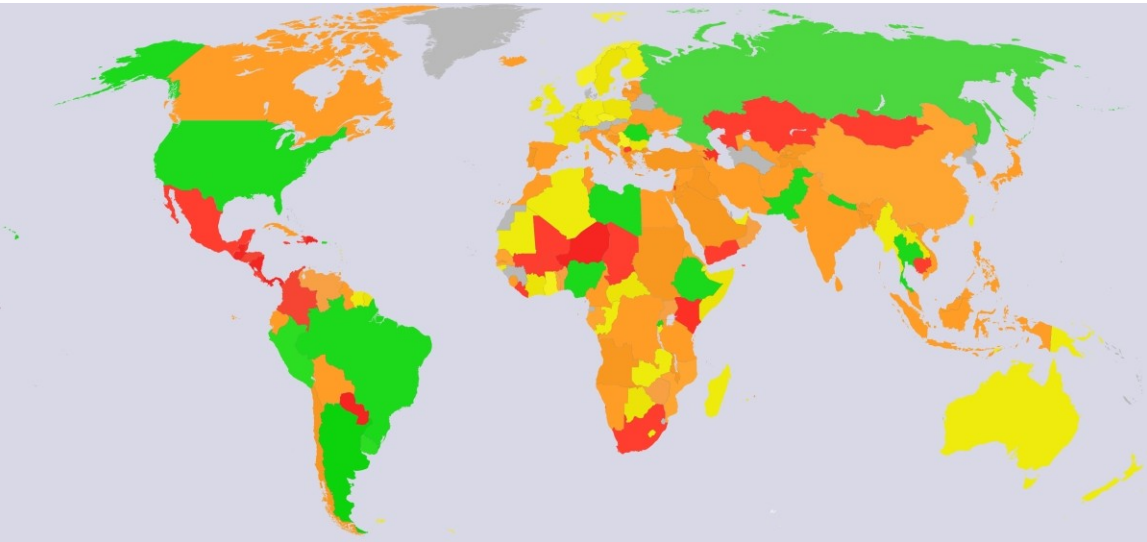
Green = Planned Launch Country
Red = Post Launch Country
Orange = Federal Level Discussion
Yellow = Discussion
Gray = No Active Contact

OLPC Partners and Sponsors

At end of 2005 we planned:

- Always-on and Instant-On
- Extreme low-power
- Mesh-networked
- Sunlight readable high resolution display
- 5 year lifetime
- E-book & Games machine mode
- Droppable, spillable, carry in the pouring rain

But Along the way we continued to invent

- Green
- New computer architecture
- Security
- Sugar
- Bunny ears
- 4X Battery Life
- 50C
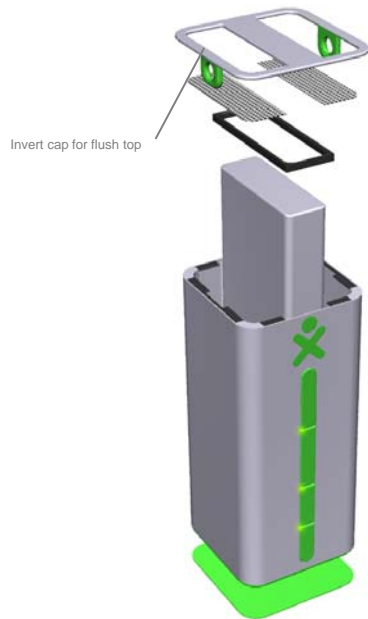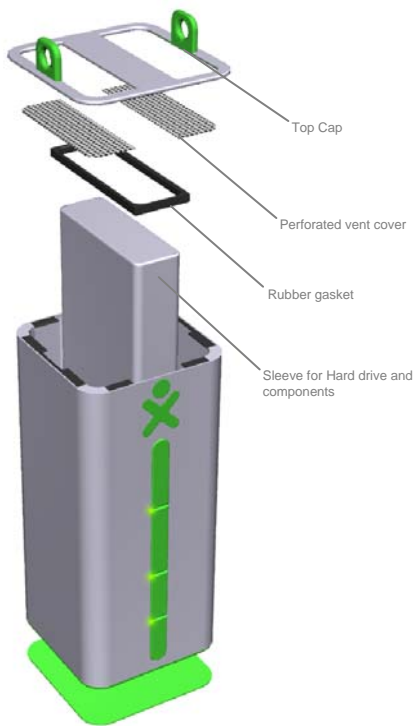- Power input range

And Incidentals

- extra screws in laptop
- analog input through microphone jack
- no caps lock key
- 640x480 still and video camera integration
- Dual mode touchpad
- Slanted desks

- Spill proof keyboard….

And Other Products

- $100 Server
- Multi-battery chargers
- Wifi repeaters
- Active antennae
- Compared to..

Top Cap

Perforated vent cover

Rubber gasket

Sleeve for Hard drive and components

Invert cap for flush top

OLPC Server: Exploded Views

Global Launch

Argentina, Belize, Brazil, Cambodia, Chad, Colombia, Costa Rica, El Salvador,

Ethiopia, Guatemala, Honduras, Kazakhstan, Kenya, Libya, Mali, Mexico

Mongolia, Nicaragua, Niger, Nigeria, Pakistan, Peru, Panama, Paraguay,

Romania, Russia, Rwanda, South Africa, Thailand, USA, Uruguay, Yemen

Millions of Laptops

Basic XO Configuration
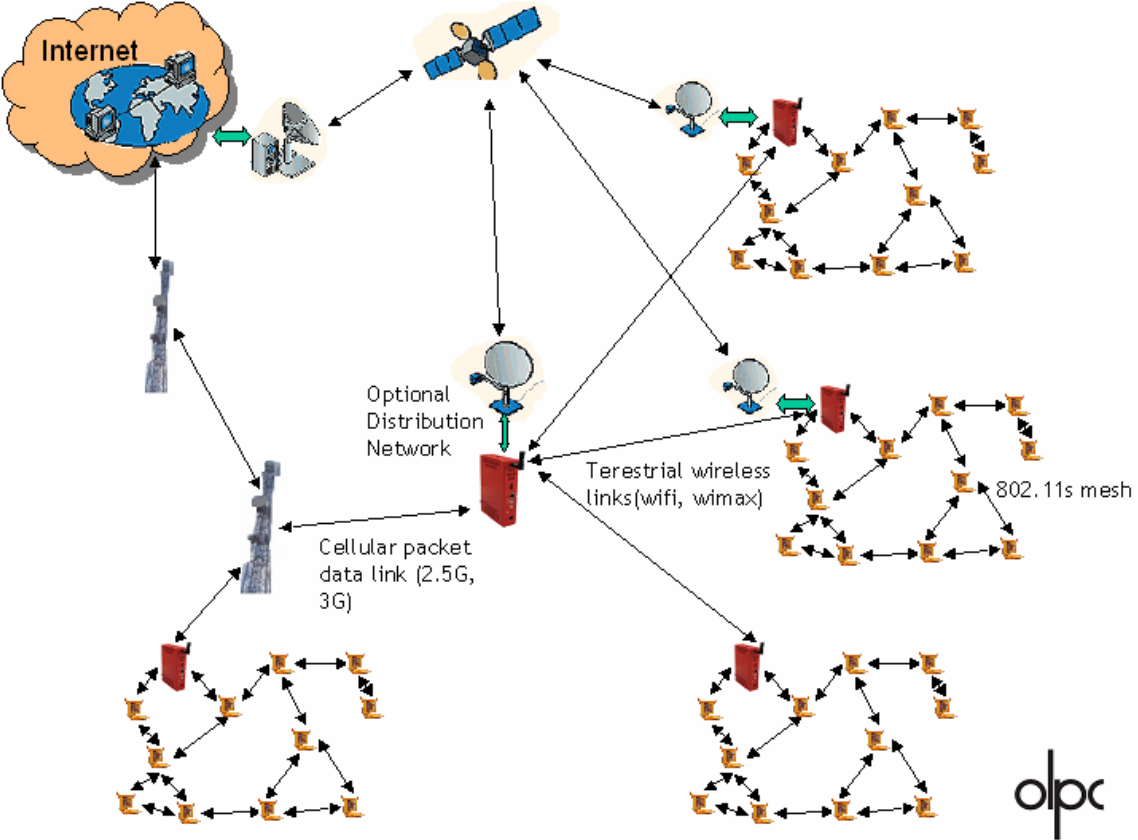
LX-700 AMD x86 CPU
256M DRAM
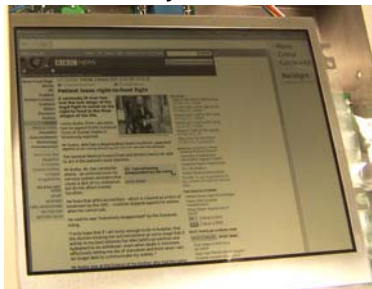1G FLASH
3 USB ports
Rugged
Stereo sound, mic,
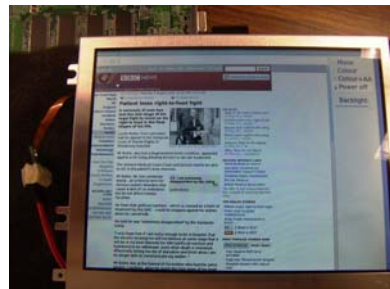2 audio out
Camera: full resolution and video

Internet

Optional
Distribution
Network

Terestrial wireless
links(wifi, wimax)

802.11s mesh

Cellular packet
data link (2.5G,
3G)

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ChiMei/OLPC Dual Mode Display

Mode 1:
SUNLIGHT READABLE
1200x900 (200 dpi)
Greyscale

Mode 2:
BRIGHT at NIGHT
Up to 1024 x 768
Color

1) Extreme low Power [i]

2) Sunlight Readability

3) Ultra-high resolution (200dpi)

4) ~1/3 price of laptop LCD

[i] 1 Watt with backlight on, 0.1 Watt with backlight off, and enables the CPU + much of motherboard to be turned off without user noticing saving further power = ~5% power consumption of typical laptop.
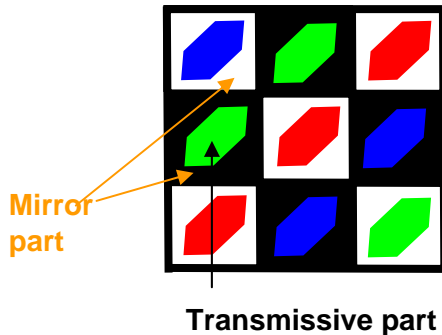
Display Innovation

How the Screen works

Conceptual – to produce new performance

- Pixel layout
- Luminance/Chrominance
- Selective use of color gels
- Electronics
- LEDs

Mirror part

Transmissive part

Pixel Layout

OLPC Method

- 3X luminance as compared to chrominance
    - MPG, TV (pal, ntsc) same principle
- Impact: stunning resolution compared to alternative method:
    - 3X pixels (cost)
    - 4X increase in power
    - No sunlight readability

Standard method
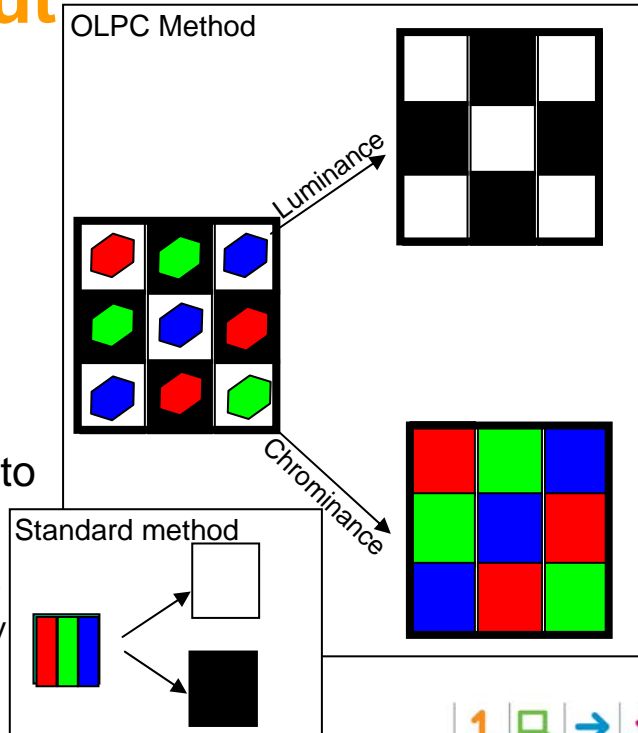
Extreme Low Power:
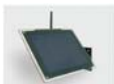
A New Laptop Architecture

- CPU: 2-3Watts just to update the screen

- Turn off CPU + most of the motherboard

- Enabled by rethinking the screen and rewriting the software:

    - Put frame buffer into timing controller
        We had to make a new timing controller chip anyway…
    - Suspend/resume (*1/10th of a second*)
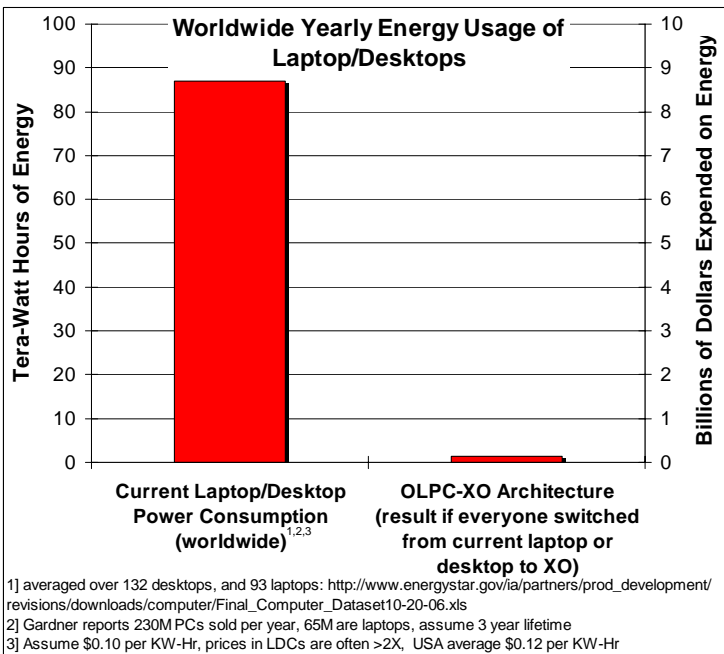   - *Software take advantage of this…all levels*

Power

Gang, Solar, batteries, human power

- Solar Panel of power ratings from 50W-100W
- Waterproof protection
- Virtually unbreakable (No glass)
- Easy to install (No steel structure)
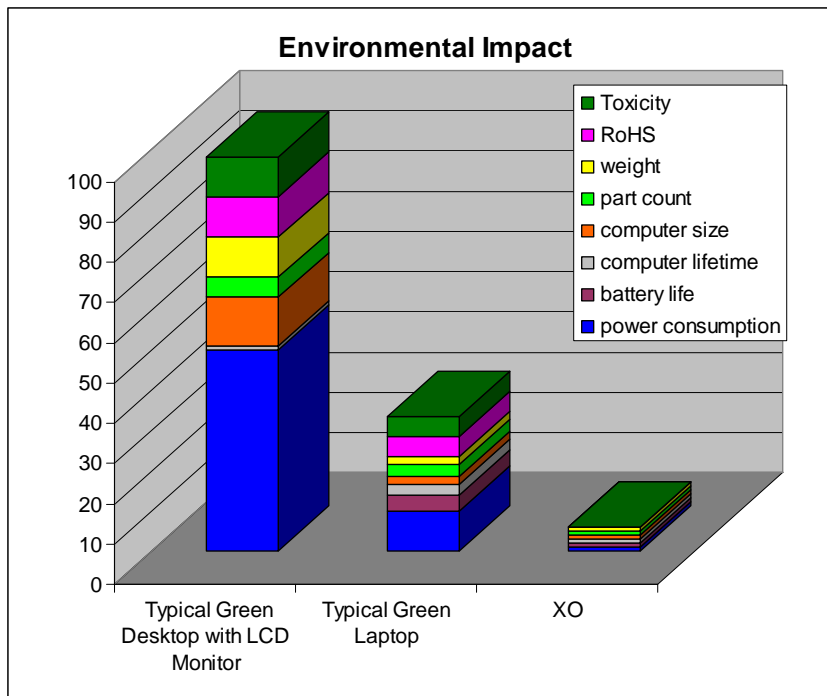- AC dual voltage power supply
- Easy to operate

Power Savings = Money

Worldwide Yearly Energy Usage of Laptop/Desktops

(bar chart)

Y-axis left: Tera-Watt Hours of Energy (0 to 100)
Y-axis right: Billions of Dollars Expended on Energy (0 to 10)

Categories:
- Current Laptop/Desktop Power Consumption (worldwide)[1,2,3]
- OLPC-XO Architecture (result if everyone switched from current laptop or desktop to XO)

1] averaged over 132 desktops, and 93 laptops: http://www.energystar.gov/ia/partners/prod_development/
revisions/downloads/computer/Final_Computer_Dataset10-20-06.xls
2] Gardner reports 230M PCs sold per year, 65M are laptops, assume 3 year lifetime
3] Assume $0.10 per KW-Hr, prices in LDCs are often >2X, USA average $0.12 per KW-Hr

50 Million laptops could be purchased for children in the developing world with energy conservation savings, if everyone in the world simply switched to an XO, or even an XO-like computer architecture.
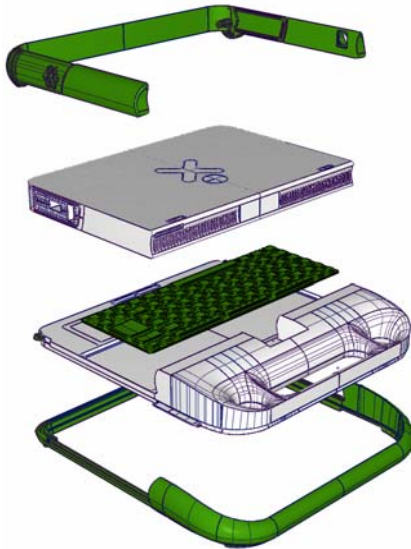
Greenest Laptop ever Made

Environmental Impact

Legend:
- Toxicity
- RoHS
- weight
- part count
- computer size
- computer lifetime
- battery life
- power consumption

Categories: Typical Green Desktop with LCD Monitor, Typical Green Laptop, XO

EPEAT GOLD in Process

(IEEE 1680)

Mechanical Design

- No moving parts
    - No harddrive, no fans
- Droppable
    - Extra rigid shell
    - Bumper (replacable)
    - Shock mounted LCD
- Moisture/dust/dirt resistant
    - Keyboard
    - USB, microphone etc - protected
- Connector reinforcement
- Transformer hinge

Sugar

(1) Sharing and collaboration as part of core experience

(2) Ad-hoc or server-based

(3) Visibility into what others are doing

(4) Learning and building things together

Explore what's going on

Building stuff together
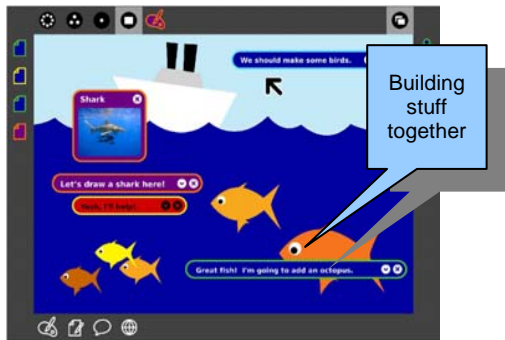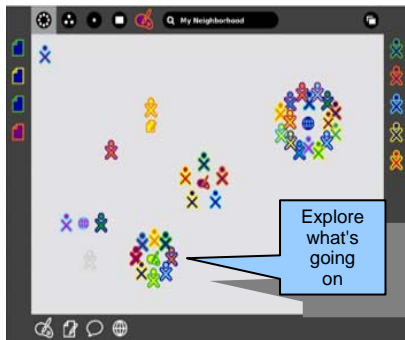
Exploring, expressing, and sharing

- Web browser
- eBook reader
- Chat
- VOIP
- Email
- Multimedia / Music / Video
- Games

- Word processing
- Journal
- Wiki
- Web server
- Graphics
- Programming: Logo; Etoys
- Multimedia creation

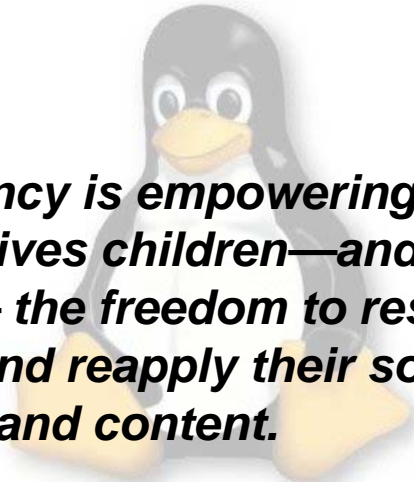# Children will be both consumers *and* creators.

iPod mini
4GB $199
6GB $249

&
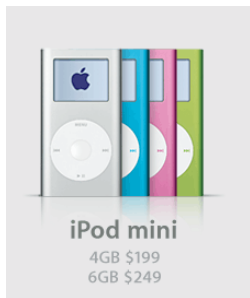
Learning learning by debugging.

Step-on Sensors

Appropriate to appropriate

Transparency is empowering. Open-source software gives children—and their teachers— the freedom to reshape, reinvent, and reapply their software, hardware, and content.
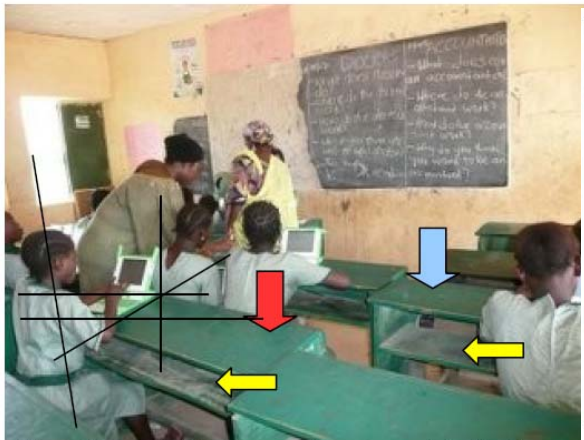
Security

- open design
- no lockdown; low-risk tinkering
- protection for the uninformed user
- secure BIOS
- protection against irreversible damage
- strong authentication between users
- scrutinizable software

1

Maintenance

Robustness

The tall bench (blue arrow) has a small inclination. The short bench (red arrow) has a steep inclination. However, there is another kind, the brown bench. The children store their materials and XOs under the writing board (yellow arrows), with parallel inclination. The black lines represent the inclination.

The floor is concrete and lots of dirt finds its way in.

Economics

Initial and launch:
    Central government funded
    Single big orders
    Developing countries, USA
Subsequently:
    One country paying for another
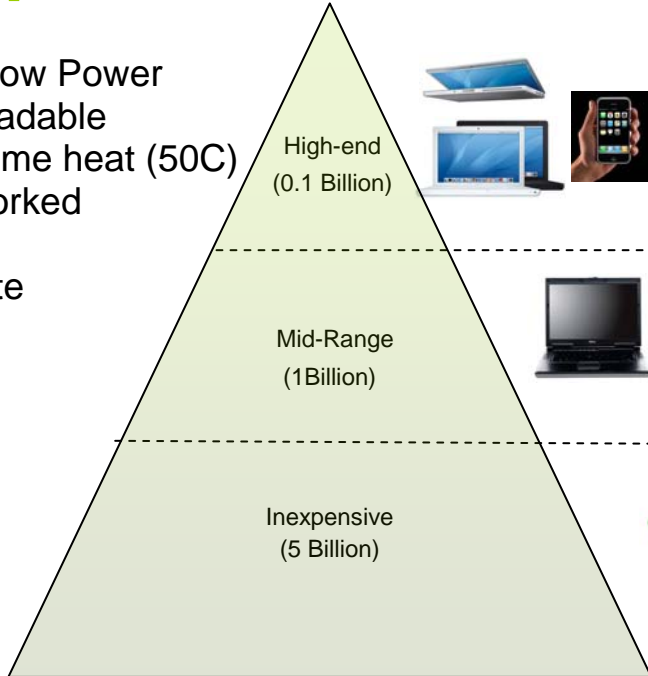   Child-to-child funding
    Commercial subsidy
    Micro-philanthropy
           …….etc.

XO is a platform
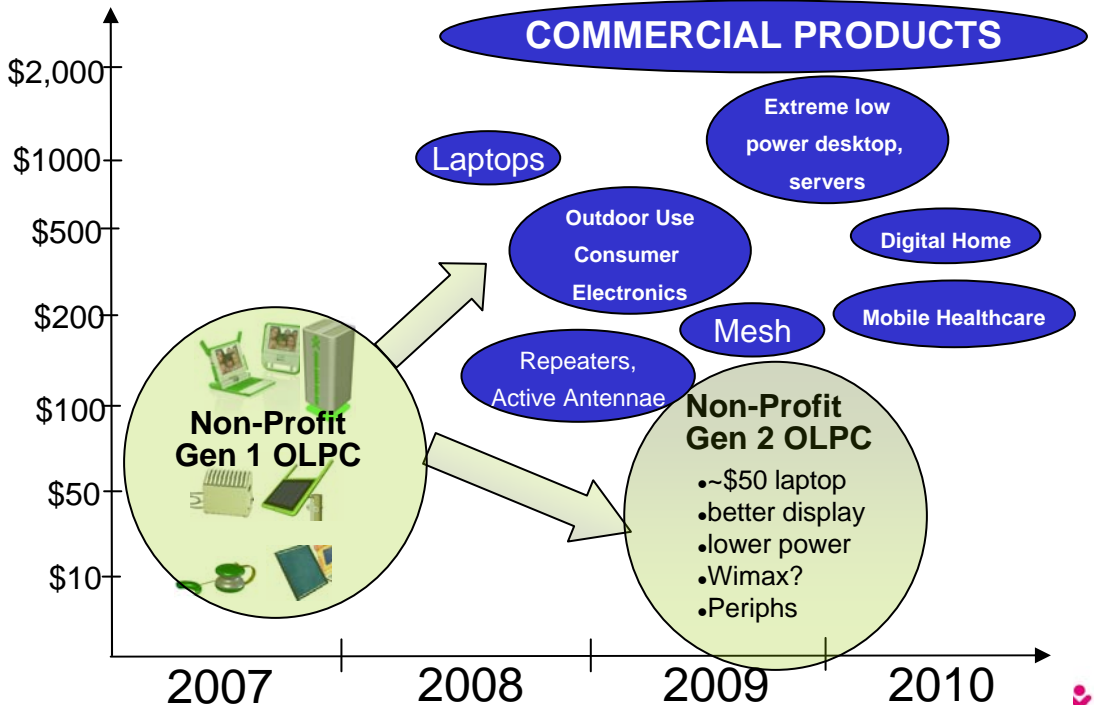
1. Extremely Low Power
2. Sunlight Readable
3. Use in extreme heat (50C)
4. Mesh Networked
5. Green/Eco
6. All solid-state

High-end
(0.1 Billion)

Mid-Range
(1Billion)

Inexpensive
(5 Billion)

OLPC technology useful from low-end to high-end

Roadmap

COMMERCIAL PRODUCTS

- Laptops
- Extreme low power desktop, servers
- Outdoor Use Consumer Electronics
- Digital Home
- Mobile Healthcare
- Mesh
- Repeaters, Active Antennae

Non-Profit Gen 1 OLPC

Non-Profit Gen 2 OLPC
- ~$50 laptop
- better display
- lower power
- Wimax?
- Periphs

$2,000
$1000
$500
$200
$100
$50
$10

2007   2008   2009   2010

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Personal Email from Badmus in Nigeria, May 2007

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