OLPC System Architecture

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Agenda

• Introduction
• Core Architecture
• Mechanical Design
• Power System Design
• ASIC Architecture
• Power Management
• Software
• Summary / Q&A
Introduction

- One Laptop Per Child
  - A non-profit corporation
  - Creating very inexpensive laptops for kids
  - Focused on education

- OLPC is sponsored by:
  - AMD, Brightstar, eBay, Google, Marvell, News Corp, Nortel, Quanta, Red Hat, SES Astra, etc.

- We sell to governments
  - Governments must donate laptops to kids

- Initial launch countries
  - Brazil, Nigeria, Thailand…
Challenges

• Infrastructure
  – Power
  – Connectivity

• Political uncertainty

• Physical environment

• Effective distribution

• Inefficient software

• Cost
Cost Reduction

• Architected for low cost
  – *Custom ICs*
  – *Consumer Electronics interfaces*
• Large volume is key
  – *Common configuration crucial*
• Direct distribution
• Open source software
• Optimized software
• Power management!
Core Architecture

- AMD Geode GX2-500 CPU
- On-chip LCD interface
- 128MB DDR SD-RAM
- 1MB SPI Serial Flash
- USB 2.0 ports (3)
- SD Card slot
- Integrated wireless
- Audio and video support
- 512MB LPC NAND Flash Storage
  - Compressed JFFS2 filesystem: ~1 GB
Wireless Mesh

- 802.11G-based ➤ IEEE 802.11S
- Extended antennas: +3 dB gain
- On-chip ARM9 CPU + 96K RAM
- Autonomous mesh router
- Complete infrastructure
  - School Server w/DVB-S Receiver
  - Solar-powered Access Points
  - Segmentation: spatial & frequency domain
- 24 hour/day wireless router
LCD Display

- Custom 7.5” TFT LCD
- 1200x900 Resolution: **200 DPI**
- Dual-mode capability
  - Reflective Monochrome
  - Transmissive Color
- Unique pixel structure
- Cost effective
- Ultra low power consumption
Mechanical Design

- Safety first!
  - *No hazardous substances*
  - *Rounded, kid-friendly design*
- Moisture/dust/dirt resistant
- Extra rigid shell
- Internal “mainframe”
- 3D connector reinforcement
- Replaceable bumpers
- Shock-mounted LCD
- Transformer hinge
ONE LAPTOP PER CHILD
Input Devices

• Game Pad/Controller
• Sealed Keyboard
  – Keyboard light
• Dual-Mode Touchpad
  – Capacitive input via fingers
  – Resistive input via stylus/stick
• Internal microphone
  – Sensor mode for learning
• VGA Camera
  – Still, Video, Sensor modes
Power System Design

• Power is unreliable, poor quality
  – Wide-ranging DC input: 10-24V
  – Overrange/polarity/surge protection

• Safety First!
  – NiMH Battery

• 2,000 battery cycles

• Gang charger

• Human power input
ONE LAPTOP PER CHILD
CAFÉ ASIC

• Challenge:
  – *Seek faster storage interface*
  – *Countries desire storage expansion*
  – *Camera for new user interface*

• CAFÉ – Camera And Flash Énabler
  – *Bus-mastering PCI interface*
  – *NAND Flash controller: Storage interface*
  – *Secure Digital (SD) Slot: Expansion*
  – *Camera Interface*
• **Challenge:**
  - *LCD pixel structure impacts system software*
  - *Power consumption too high*

• **DCON - Display CONtroller**
  - *DETTL Interface*
  - *Panel Compatibility*
  - *Mono/Color Mode Support*
  - *Antialiasing*
  - *Self-refresh capability*
DCON Architecture

Conventional System

OLPC System

TFT LCD

AMD Geode

128 MB RAM

TFT LCD

DCON ASIC

AMD Geode

128 MB RAM

1 MB RAM

ONE LAPTOP PER CHILD
Power Management

• TANSTAAFL… NOT!
• OLPC’s Top Priority
• Suspend to RAM
  – CPU shuts down, RAM contents preserved
  – Conventional notebooks: ~10 seconds
  – OLPC: < 100 ms
• DCON: Screen stays active
  – System appears to be running
• User activity: instant wakeup
• Target power consumption: 2.0 Watts avg.
System Software

- Fighting software bloat
  - Focus on improved efficiency
  - Reduced CPU and memory requirements

- System security
  - Tempting hacker target
  - Theft resistance

- Secured LinuxBIOS
- Simple Linux Bootloader
- Linux Operating System
- “Sugar” User Environment
Software Applications

- Journal
- Web browser
- WIKI / WP
- eBook
- Chat
- VoIP
- Email
- Logo
- Etoys
- Video support
- Music manager
- Audio support
- Multimedia
- Search
Thank You!
Questions?