Computing and the Developing World
CSEP 590B, Spring 2008
Lecture 3 - Telemedicine
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Administration
• Reading assignment
• Supplementary Readings
• Authentication
  – User: csep590b
  – Password: student

Today’s class
• Kiosk Summary
• High Bandwidth, High Latency Internet
  – Data Muling
• Telemedicine
• Wireless Long Distance Internet

Highlights from Lecture 2
• Internet connectivity
• Kiosk Applications
  – Financial Contribution
  – Social Impact
• Case studies
• Viability of Kiosks
  – Income generation too low

Kiosk Summary
• Holy Grail of ICTD
• Two fundamentally different cases
  – Build down from economic viability
    • Akahaya
  – Build up from nothing
    • LinkNet

Remote Internet Access
• Technology Questions
  – Method of Connection
  – Level of service
    • Bandwidth, Latency, Reliability
  – Cost
• What are the connectivity demands of different applications
Can the internet create rural business opportunities?

Traditional Crafts Marketing
- Is a “direct from the village” internet based traditional craft business viable? Why or why not.

Technology Case Studies

Sneaker Net
- What is the bandwidth of a single DVD carried between Africa and the US?

DakNet
- MIT Media Lab, First Mile Solutions, United Villages
- Ideas
  - High latency connectivity sufficient for many applications
  - Vehicle based transport
    - Rely on regularly scheduled transport
  - Automatic wireless data transfer

System model
- Vehicle has “Mobile Access Point”
- Kiosk has wireless access
- When vehicle in range of kiosk, data is exchanged
- Cost and power are low
- Leverage existing transportation routes
Orissa Pilot, Busses

- Advantages of public busses
- Disadvantages of public busses

Cambodia Pilot

- Internet connectivity for AAfc/JRF schools
  - 250 schools with computers
  - Pilot for 15 schools
- Motor scooters used to carry MAPs
- Costs
  - 15 schools with VSAT: USD 260,376
  - DakNet to share 1 VSAT: USD 39,979

KioskNet

- S. Keshav, University of Waterloo
- Minimum cost kiosk
- Target: $100 PC (aka recycled PC)
- Address
  - Low cost
  - Low power
  - Recycled PCs
  - Minimum maintenance
  - Connectivity

Full system deployment

- Kiosks
  - Low cost computers with Kiosk Controller
- Ferries
  - Mechanical Backhaul
- Gateway
- Proxy
- Legacy Server

Technical Challenges

- Implementation of Delay Tolerant Networks (DTN), Integration with services
- Security model, Public Key Infrastructure
- Support boot from Kiosk Controller
- Maintenance
  - Secure software update integrated with data ferry

Kiosk Summary

Open issues

- If you could fund a Kiosk Research Project what is the problem you would have the project investigate?
The Challenge of Telemedicine

Tiered Health Care

• Teaching Hospitals
• Regional Hospitals
• District Hospitals
• Health Centers
• Health Post

From the readings, what are the three most important problems addressable by ICT?

1.
2.
3.

Important problems (summary)

1.
2.
3.
4.
5.
6.

Telemedicine

• “Telemedicine is the ability to provide interactive healthcare utilizing modern technology and telecommunications”
• Specialist referral
  – You have a bad sore throat
  – Primary care physician arranges remote consultation with ENT specialist
  – Audio video conference with medical records available to the specialist
  – Special equipment – nasalpharyngoscope for real time imaging sent to specialist
  – Facilitate scheduling and travel
  – Primary care physician participates

Usage models

• Real-time
  – In or outpatient specialty consultation
  – Physician supervision of non-MD Clinician
• Store and Forward
  – Teleradiology
  – Images scanned, direct capture, digital camera
  – Dermatology, Ophthalmology, Pathology
• Home Health Telemedicine
  – Disease management
  – Assisted Living
Telemedicine in the developing world

- Generally considering a broader problem
  - How can ICT improve care in remote regions
- Spanning greater divides
  - Travel time
  - Economic differentials
  - Expertise differences
- Constraints
  - Network connectivity
  - Electricity and other infrastructure
  - Financial

Notable projects

- Aravind Eye Hospital
  - Remote exams through mobile van
  - Image based detection of diabetic retinopathy
- Black Lion Hospital, Addis Ababa, Ethiopia and Care Group Hospitals, Hyderabad, India
  - Expert consultation
  - Medical education
  - Fiber optic and satellite communication

Telemedicine Summary

- Key questions:
  - Communication
  - Off the shelf applications?

Upcoming Health Topics

- Medical Records
- Support for health care delivery
- Data Collection

Network connectivity (again)

- High bandwidth, synchronous
- Low bandwidth, synchronous
- High bandwidth, asynchronous
- Low bandwidth, asynchronous

WiFi-based Long Distance Networks

- Goal: inexpensive, high bandwidth connection
- Off the shelf, 802.11 b
- Directional Antennas
  - Modification of MAC layer protocol
- Example projects
  - Digital Gangetic Plains, IIT Kanpur
  - Aravind Eye Hospital, TIER Group, Berkeley
Why 802.11?
• Commodity hardware
  – Inexpensive broadcast
• WiMax / Cellular
  – Expensive infrastructure amortized over large user base
• Unlicensed spectrum

Line of Sight
• Range of 10s of KM
  – Longest range ~ 300 KM
• Towers are a big issue
  – Use existing buildings
  – Avoid trees!

Technical Issues
• Directional antennas
• Modify to support long distance
  – Change acknowledgement protocol
• Error detection / correction important issues
• Interference
  – Does not work well around other access points

Deployment Issues
• Maintaining antennas and relays
  – Antenna configuration
  – Remote equipment
• Development challenges while hacking commodity hardware
• Relying on the network while debugging the network
  – Back channels and recovery mechanisms

Overall evaluation
• Aravind project demonstrates sustained bandwidth
• Utility in a production environment
• Cost effective
  – because alternatives are $$$
• Link throughput 5-7Mbps at 2% loss
  – 256 kbps (each way) for video conferencing
• Other deployments 500 kbps because of lack of clear line of sight

Discussion
• What role do you expect long distance wireless to play in this field?
Next Week

- Umar Saif
  - Rural Networking

- SMS Based Applications
  - Warana Unwired

- Homework Assignment
  - Design Exploration: SMS-based application