

Computing and the Developing World

CSEP 590B, Spring 2008
Lecture 3 - Telemedicine
Richard Anderson

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
 - Akshaya
 - 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.

LUMS
UW
MS



Technology Case Studies

Sneaker Net

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

LUMS
UW
MS



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.

Other problems

LUMS
UW
MS

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!

Height	10	15	21	24	27	30	35
Cost	100	150	800	950	1100	1850	5000

Costs from IITK, Height in Meters, Cost in USD

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

