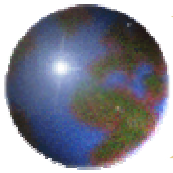


Long Distance Data Backhaul in Ghana

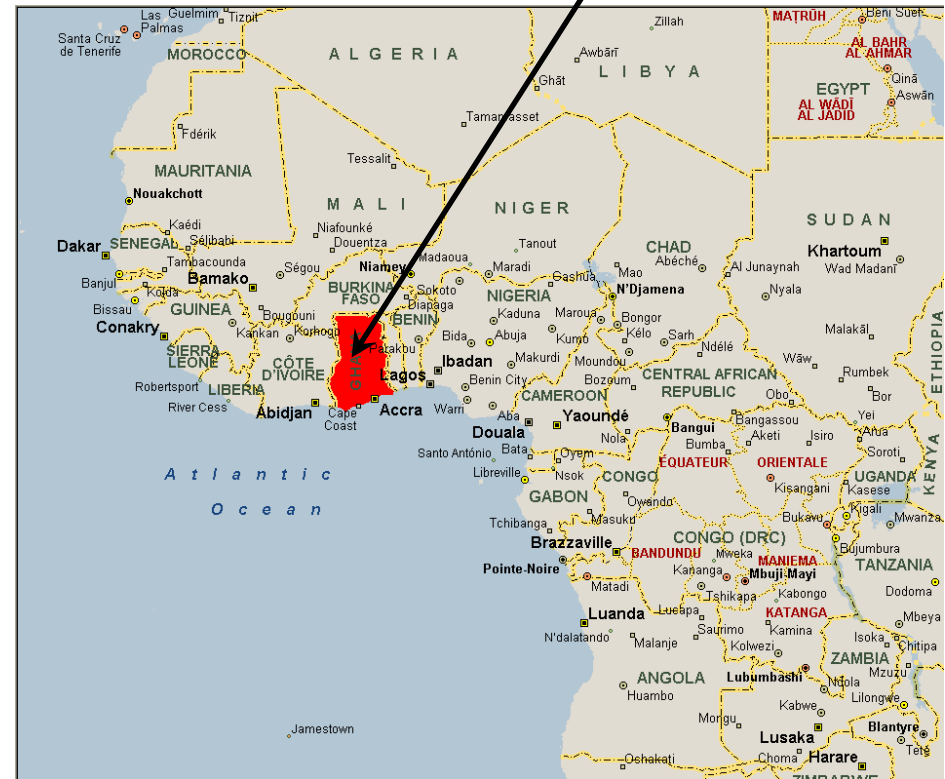
R.J. Honicky
TIER, UC Berkeley
October 29, 2005

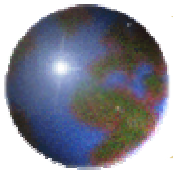


Main Research Questions

Ghana

- What are the central issues and problems with building a terrestrial data network in Ghana/Africa?
- To what extent can we benefit from local fabrication and local expertise, and what does that involve?

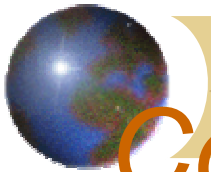




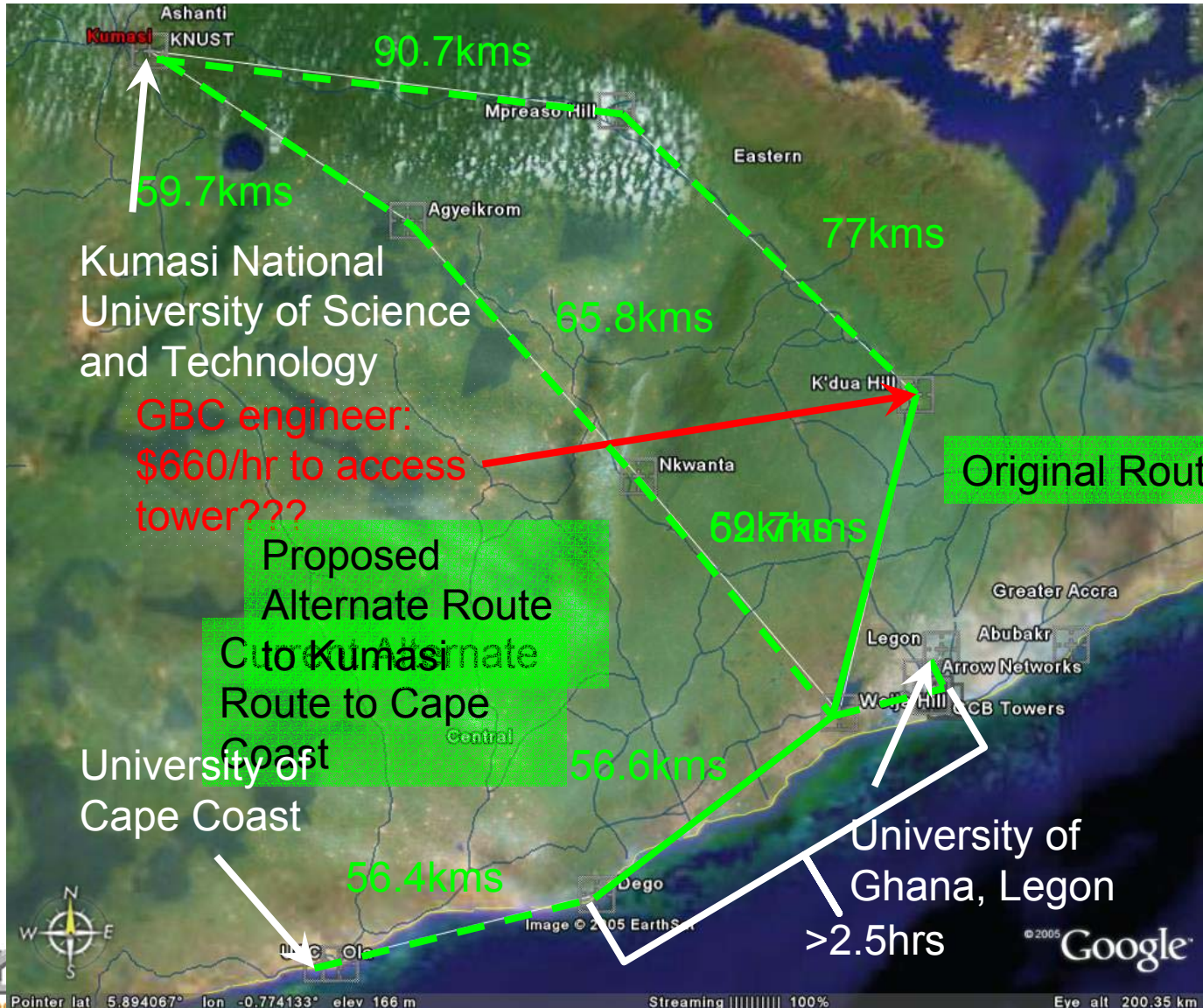
Building a terrestrial network

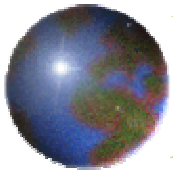
- ✦ The usual suspects
 - ✦ In two weeks, significantly impacted by
 - Power
 - Malaria
 - Corruption
 - Transportation costs
- ✦ Economics generally argue for large towers, and long distance links
 - ✦ Minimize truck rolls
 - ✦ Minimize points of failure
 - ✦ Significant fixed costs for land, power, some installation, local expertise
 - Independent of tower height





Corruption and Transportation



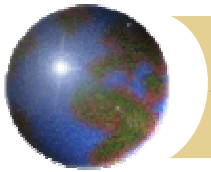


Power and Malaria

- ❖ 2-3 power failures per year of more than 3 days
 - ❖ Need lots of battery capacity to be reliable
 - ❖ Even then, can't make strong guarantees
- ❖ Grid access is difficult on hills
 - ❖ Usually need solar
- ❖ Power also effects local manufacturing
 - ❖ Our antenna maker

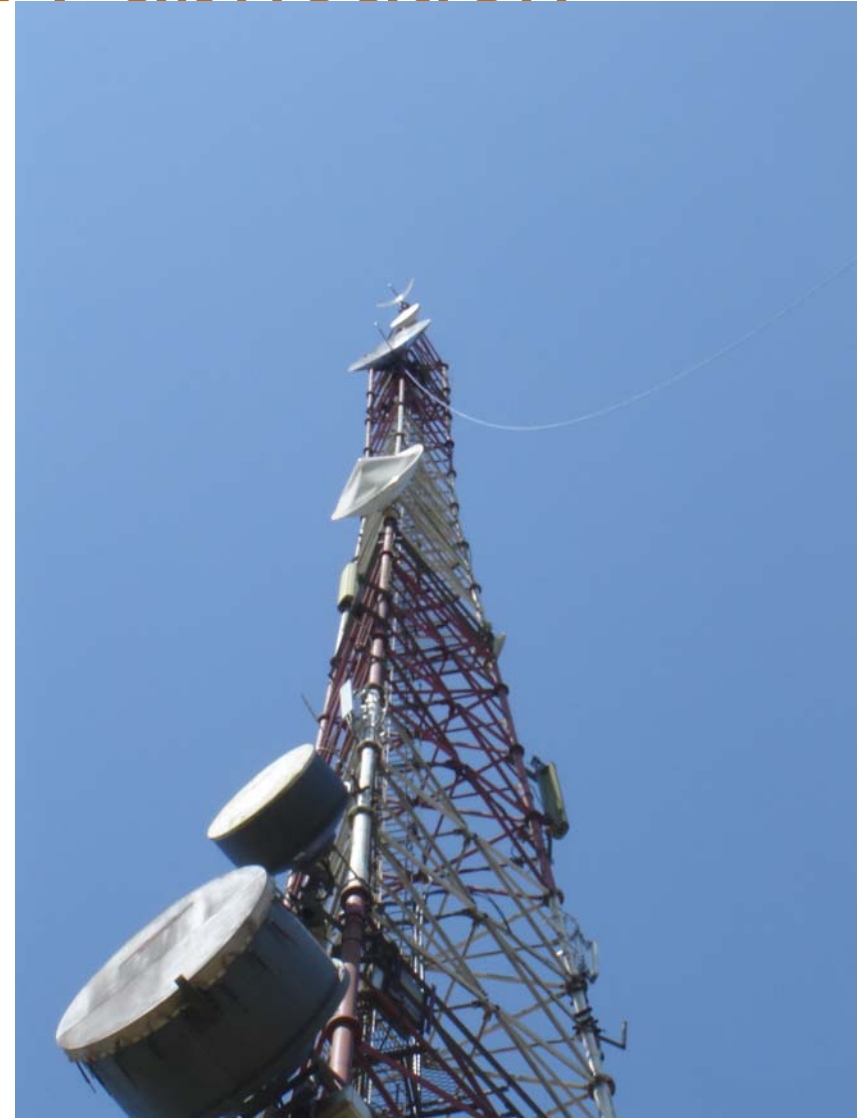


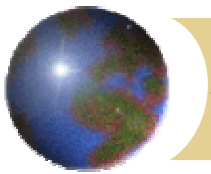
- ❖ Malaria significantly impacts productivity
 - ❖ Our antenna maker



Local Expertise and Fabrication

- ✦ Local expertise was critical
 - ✦ Access to resources
 - Towers, spectrum, other local vendors
 - ✦ Skills
 - Climbing and installation
 - Maintenance
 - Coordination and planning
 - ✦ Thank you Arrow Networks!
- ✦ Local Manufacturing
 - ✦ Skilled antenna vendor
 - Designed and built custom 2.4Ghz antennas
 - Lost power for a week
 - Couldn't weld
 - Got malaria
 - Still delivered 1 antenna
 - Other will be installed by Arrow





Link Results

- ⊕ 24dbi antennas are more than sufficient for 56kms with a good tower
 - ▣ Link quality ranges from -50dbm/-77dmb SNR to -32dbm/-85dbm SNR(!)
- ⊕ Dish gets about 31dbi
 - ▣ Link quality ranges from -40dbm/-77dmb SNR to -26dbm/-85dbm SNR(!)
 - ▣ 90km-120km should be doable w/ a good tower
- ⊕ UDP w/ one ACK
 - ▣ 5.2Mbps, 4.8Mbps (10% loss)
- ⊕ UDP w/ no ACKS
 - ▣ 7Mbps, 6 Mbps (10% loss)
 - ▣ TDMA MAC, Forward Error Correction will be critical
- ⊕ Tall tower has a very significant effect on the signal
- ⊕ Sharing databases among libraries is a good (sustainable) application
 - ▣ £30,000/year subscriptions fees



