Poster and Demonstration of
Expanding Rural Cellular Networks with Virtual Coverage

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Abstract

Cellular phones and related network equipment comprise the world's largest network, providing service to over five billion unique users. Operators of these networks face fundamental trade-offs in coverage, capacity and operating power. These trade-offs, when coupled with the reality of infrastructure in poorer areas, mean that upwards of a billion people lack access to this critical infrastructure [2]. Limited power infrastructure, in particular, hampers the economic viability of wide-area rural coverage.

In our related work to be presented at NSDI '13 [1], we present an alternative system for implementing large-scale rural cellular networks. Rather than providing constant coverage, we instead provide *virtual coverage*: coverage that is only present when requested. Virtual coverage powers the network on-demand, which reduces overall power draw, lowers the cost of rural connectivity, and enables new markets.

We demonstrate our prototype cellular system utilizing virtual coverage: a modified GSM base station and set of Motorola phones to support making and receiving calls under virtual coverage. To support the billions of already-deployed devices, we also demonstrate a small radio capable of adding backwards-compatible support for virtual coverage to existing GSM handsets. As explained in our work, these systems benefit from a maximum of 84% power savings and 83% power cost savings from using virtual coverage.

Demonstration

Our demonstration will consist of the following pieces of equipment:

- A modified Range Networks [3] 5150 GSM Base Transceiver Station (BTS)
- A modified Motorola C155 Handset
- A custom-built integrated circuit

Figure 1: The Wake-up Radio custom IC and 5150 BTS

Specifically, we will first demonstrate the BTS's support for a "low-power" mode; and the actual amount of power saved (using a Watts-up power meter). We will then demonstrate both the modified handset and the custom radio waking the tower from its idle state. Lastly, we will show that each handset is then able to connect to the tower and initiate a communication.

References

[1] K. Heimerl, K. Ali, B. Gawalt, J. Blumenstock, and E. Brewer. Expanding rural cellular networks with virtual coverage. In *Proceedings of the 10th USENIX symposium on Networked systems design and implementation*, NSDI'13, 2013.

[2] H. Horst and D. Miller. *The Cell Phone: An Anthropology of Communication*. Berg Publishers, October 2006.

[3] Range Networks. http://www.rangenetworks.com/. Retrieved 8/2012.