

The Village Base Station: Community Cellular Networks

TIER Research Group, UC Berkeley
tier.cs.berkeley.edu

Cell phones improve peoples' lives, yet traditional cellular telcos lack the flexibility to serve the 1 billion people who still lack access.



The Village Base Station deployed in Desa, a village in Papua, Indonesia.

Cellular phones provide vital communication services across the globe, but upwards of one billion people still live beyond the reach of cellular networks. The primary reason for this is economic—it is simply impossible for traditional cellular telcos to profitably serve many parts of the world. Beyond sparse population density, widespread lack of power and connectivity in rural areas dramatically increase the cost of cellular installations. For example, the GSMA estimates that 95% of the people without cellular coverage in East Africa live in areas also lacking grid power¹, even though power and network are often available through small local firms and entrepreneurs. Fundamentally, traditional cellular operators lack the *flexibility* to operate in challenged areas; their top-down model of deployment fails to utilize local human and technical infrastructure available in rural communities.

Community Cellular enables broader access by lowering costs and power needs for connectivity, while supporting local economic development.

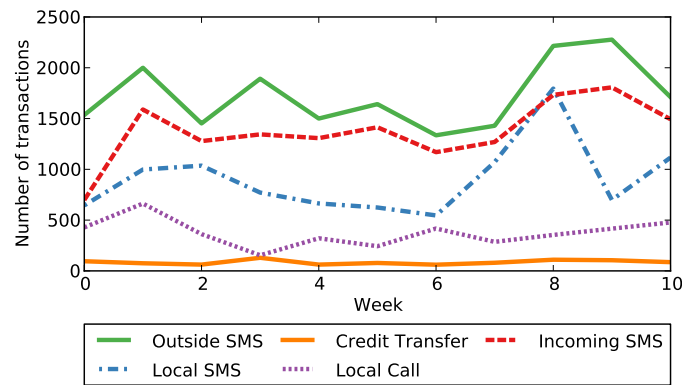
The TIER group at UC Berkeley has developed a new approach to providing rural cellular connectivity: *Community Cellular networks*. Community Cellular networks

- (1) promote local economic development, as they are locally-owned and operated, are financially viable, and keep profits in the community; and
- (2) involve limited capital expenditures, as they build upon existing community infrastructure when available and rely on innovative, low-cost base stations.

The fundamental innovation that enables Community Cellular is our *Village Base Station*, a low-cost (<\$10,000) and low-power (<70W) GSM base station. The Village Base Station is a full “telco in a box”, providing voice and SMS service, as well as key services such as billing, user provisioning, and credit transfer.

Community Cellular using the Village Base Station is already a reality in the village of Desa in Papua, Indonesia, a four-hour drive from the nearest town with phone service. A local for-profit Internet service provider and a local non-profit school jointly operate the network, which is the primary means of communication between the village and the outside world. Since it began service in late February 2013, the network has handled over 70,000 text messages from 160 subscribers. The network operates profitably, generating an average monthly revenue of US\$798 and a monthly average revenue per user (ARPU) of US\$4.99. Additionally, it provides income for local credit resellers, some of whom earn over US\$60 in monthly profit.

¹GSMA, “Powering Telecoms: East Africa Market Analysis”, 2012.



Per week overall usage in the Desa network.

Regulators and incumbents can help broaden rural cellular access by supporting Community Cellular networks.

The Desa Community Cellular network demonstrates the promise of the Community Cellular model. However, this radical re-imagining of rural cellular connectivity is hampered by regulatory limitations and existing cellular carriers apprehension about interconnecting with smaller operators. To help broaden rural cellular access, regulators and incumbent providers should therefore:

- **Provide spectrum for Community Cellular networks.** Community Cellular networks operate in areas incumbent providers do not serve, but they are still subject to the same laws and regulations as any other network. As such, Community Cellular operators need assurances that their networks are legal and won't be shut down by regulators. Fortunately, such rural networks have low spectrum requirements. Setting aside 1-2 GSM channels for community use in unserved areas would be sufficient to support these networks, as their coverage ranges are unlikely to overlap and per-tower capacity needs are low. Policy changes such as these would enable local entrepreneurs to take charge of their own telecommunications.
- **Support small operators interconnecting with existing carriers.** In the Desa network, two-thirds of traffic is with contacts outside the village on other carriers' networks. Like all carriers, Community Cellular networks must have cooperation from other telcos to route phone calls and SMS globally. Scaling Community Cellular networks requires finding friendly operators who can provide numbers and/or interconnect in countries lacking rural connectivity. Providing this interconnect service could perhaps fulfill their Universal Service Obligations.

For more information, please see our published work:

Locally-Owned, Sustainable, Small-Scale Cellular Networks. Under submission, available upon request.

Expanding Rural Cellular Networks with Virtual Coverage. Kurtis Heimerl, Kashif Ali, Joshua Blumenstock, Brian Gawalt, Eric Brewer. USENIX NSDI, April 2-5 2013, Lombard, IL.

The Village Base Station. Kurtis Heimerl, Eric Brewer. ACM Workshop on Networked Systems for Developing Regions (NSDR), June 15th, 2010, San Francisco, CA

Or contact us: Kurtis Heimerl (kheimerl@cs.berkeley.edu), Shaddi Hasan (shaddi@cs.berkeley.edu), Kashif Ali (kashif@cs.berkeley.edu), Eric Brewer (brewer@cs.berkeley.edu), Tapan Parikh (parikh@ischool.berkeley.edu)