

OVERCOME: A Systems Approach to Scaling Rural Co-op Efforts to Expand the Fiber Edge
Executive Summary
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Funded by the National Science Foundation and administered by U.S. Ignite, Project OVERCOME included 7 projects focused on increasing access to broadband [1]. One of the projects was focused on Turney in Clinton County, MO [2]. In many ways, Turney represents the many small rural underserved communities on the edge of existing fiber networks that are at risk of missing out on additional investment to improve their access. This work was a collaborative effort that included team members from Missouri University of Science & Technology, Worcester Polytechnic Institute, University of Missouri Extension, Maximize NWMO (a non-profit focused on development in the region), and United Fiber (a subsidiary of a rural electric co-op).

Connected Households to Network. Building off an existing fiber network owned by United Fiber, we installed a millimeter wave (mmWave) point-to-point connection to a grain elevator (the tallest structure in town). From there, we used Ubiquiti hardware to deliver a point-to-multipoint wireless signal. Although we expected to get a 3-mile range from the grain elevator, we were largely limited to a 1-mile range due to line-of-sight issues. Some households were able to be connected from farther away if they were on a hill or along a road. At installation, average speeds were 280/63 Mbps. User-reported speed tests suggest that users observed average speeds of 161/61 Mbps. In aggregate, households used 11-17 TB/month. We observed that most households used a relatively small amount of data and there were a few “power users” who had significant bandwidth needs.

Ultimately, we met our goal of connecting a minimum of 30 households. This involved significant outreach including 2 in-person events to answer resident questions, door-to-door canvassing, and a large sign installation [3]. Connected users received a biweekly email with information about local resources to support internet applications related to employment, entrepreneurship, education, and healthcare. In addition, we hosted a workshop for Clinton County residents and high schoolers on media literacy and misinformation.

Developed Intelligent Router. The primary innovation was the development of an intelligent router to dynamically allocate bandwidth to households to improve quality-of-experience (especially for “power users”) in a bandwidth constrained environment. To support development, we created a simulation called the Extendable Mobile Ad-Hoc Network Emulator (EMANE). EMANE allowed for an easily modifiable environment that did not run the risk of disrupting service to active users of the network. While using EMANE, we discovered that real world (not simulated) traffic was critical to evaluate responsiveness for the system design. When trained on simulated traffic, the system was too slow to properly react to real world trends in user needs. More testing is needed to evaluate the benefit of using this type of dynamic allocation instead of a static bandwidth cap. Example traffic data and scripts for enabling intelligent traffic shaping on a pfSense are publicly available for further open-source development [4].

Evaluated Impact of Access. We conducted a systematic pre-post evaluation to measure the impact of installing higher speed access in an underserved community. Ultimately, we received 89 pre-surveys (29% response rate for Turney households) and 93 post-surveys (86% response rate for connected Turney households). There were two primary findings, (1) changes in using the internet for employment, education, and health could not be directly attributed to the internet intervention and (2) the internet intervention was associated with quality-of-life benefits stemming from the ability to use multiple devices at once and stream video.

This evaluation contributed to research in this area by (a) focusing on social (rather than just economic) impacts, (b) measuring an underserved (rather than unserved) community, which is more challenging, and (c) estimating impacts for a particular community rather than an aggregated area. For future evaluations, we recommend (1) quantifying how much people are using the internet rather than relying on a binary outcome variable, (2) using a combination of recruitment strategies to maximize participation, and (3) limiting data collection to the academic school year to measure impacts on education.

Documented System. Lastly, we discovered a socio-technical reference architecture to guide future community-driven broadband projects and conducted fit-for-use assessments with other Project OVERCOME teams. Developing a socio-technical reference architecture can help diverse stakeholders understand “the problem” and agree on requirements for a solution. We evaluated fit-for-use by interviewing two other Project OVERCOME teams, who indicated that a reference architecture could be used as a project management/communication tool both within and external to project teams.

Learn More:

- [1] <https://www.us-ignite.org/program/us-ignite-communities/overcome/>
- [2] <https://www.maximizenwmo.org/broadband-project-overcome>
- [3] Canfield, C., Low, S. A., Gollnick, C., & Davis, D. (2022). Integrating Research and Extension to Improve Community Participation in Broadband Projects. *Choices: A publication of the Agricultural & Applied Economics Association*, 37(3), 1-7. <https://www.choicesmagazine.org/choices-magazine/theme-articles/making-it-count-applying-science-to-support-universal-broadband/integrating-research-and-extension-to-improve-community-participation-in-broadband-projects>
- [4] https://github.com/Murphyj1098/IntelligentRouter_OVERCOME

Additional publications from this work are forthcoming.

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