Project Proposal: Cost effective Isolated Mesh Networks for Remote Communities

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February 7, 2022

1 Problem Statement

In remote or impoverished communities it is often economically unfeasible to pay for Internet access through conventional means like fiber optics or coaxial cable. Last-mile access tends to be the most expensive part of building out Internet infrastructure. Satellite Internet does not have geographical limitations but it is often slow, high-latency and has data caps. With new satellite Internet companies like SpaceX's Starlink [1], Telesat [2] and Amazon's Project Kuiper [3], there is a new possibility to have high speed Internet to remote communities. While projects are flashy and promise great potential to revolutionize Internet connectivity, they do not address the fact that most people only need so much Internet bandwidth and the cost is still prohibitively expensive. By using satellite Internet as back-haul and using another medium to reach end users, the cost to access the Internet could be further reduced as well as introduce Internet connectivity to communities whom never had the opportunity to experience the Internet due to costs.

But since it is often hard to setup, and quite expensive, there is no current solution to allow a community to set up a mesh network using the single back-haul connection.

2 Previous Work

One of the most prominent usage of mesh-based Internet service providers is NYC Mesh. NYC Mesh uses the OSPF routing protocol [4]. A portion of its network uses AirMax protocol through Ubiquiti equipment, which are proprietary systems [5].

Another Mesh network for the 'last mile' connections is Althea. Althea sits on top of the distance vector routing protocol Babel and suggests 2 additions to the protocol: a verifiable quality metric, and a payment system. The quality metric allows the nodes to verify the neighboring nodes claims of the performance metrics they are advertising. The payment addition adds 2 interactions to each node, first it sets an agreed upon price between nodes that one node must pay to the other for bandwidth used, and secondly it creates a system that allows the payments to be held in escrow. Once the exchange is verified, it can subsequently release the payment to be deposited into a bank, or be sent to a cryptocurrency wallet. Althea's goal is after adding these new features to the routing layer, users can install a piece of equipment and take part in a decentralized ISP, and receive payment for other users using their services.

3 Our Approach

Our approach will focus on using the most economical solutions, using either low cost or existing hardware (laptops, routers etc...), and free open-source software. Using the new satellite Internets as the target implementation we plan on optimizing for the new challenges this kind of technology introduces, including signal loss and atmospheric interference. Some target hardware would be Raspberry Pis, laptops, and unused routers. For software we plan to take advantage of the extensive work done on OpenWRT etc. to provide a technically sound solution. Using metrics for usability and ease of use we will determine the current state of affairs, and look for improvements in areas that we deem to be needing improvement. All of our findings will be shared such that any community searching for a cheap internet solution should be able to consult our findings if they choose to get a satellite internet connection.

This proposal and future developments of our project can be found on our website: `https://csc466-wmn-routing.vercel.app`.

4 Deliverables and Schedule

The following table outlines our expected timeline for this project. As always, the up-to-date version can be found on our website.

Date Range	Activities
February 7 - 21	Research relevant papers and software
February 21 - March 7	Integrate software with hardware or testing harness
March 7	Midterm Update
March 7 - March 21	Connect devices together through test harness and begin tests
March 21 - April 4	Finishing testing and choose best routing protocol and software
April 4	Final Presentation
Middle of April	Final Report

References

[1] "Starlink," Starlink. (), [Online]. Available: `https://www.starlink.com` (visited on 02/06/2022).

[2] "Telesat l global satellite operators." (Dec. 6, 2019), [Online]. Available: `https://www.telesat.com/` (visited on 02/06/2022).

[3] *Kuiper systems*, in *Wikipedia*, Page Version ID: 1058153673, Dec. 1, 2021. [Online]. Available: `https://en.wikipedia.org/w/index.php?title=Kuiper_Systems&oldid=1058153673` (visited on 02/06/2022).

[4] Z. Giles. "Ospf - nyc mesh docs." (Apr. 20, 2020), [Online]. Available: `https://docs.nycmesh.net/networking/ospf/` (visited on 02/06/2022).

[5] O. Morf. "Typical installations - nyc mesh docs." (Mar. 13, 2019), [Online]. Available: `https://docs.nycmesh.net/intro/typical-installs/` (visited on 02/06/2022).