Solar-powered Wireless Mesh Networks for Environmental Monitoring

Torsten Braun, Thomas Staub, Benjamin Nyffenegger
Institute of Computer Science and Applied Mathematics
Universität Bern
3012 Bern, Switzerland
braun@iam.unibe.ch, staub@iam.unibe.ch, nyffeneg@iam.unibe.ch

***Abstract*—The paper describes the development and experiences of a solar-power driven wireless mesh network for connecting sensors in rural areas to high-speed fixed networks.**

Keywords: Wireless mesh networks, Green Networking

I. INTRODUCTION

Wireless Mesh Networks can serve in a variety of interesting application scenarios. They can extend the wireless coverage in both urban and rural areas and provide connectivity to human users or sensors. In particular, when being deployed in rural areas, no cable infrastructure for data communication or electricity is available.

II. SOLAR-POWER DRIVEN WIRELESS MESH NETWORK DEPLYOMENT AND OPERATION

In a technology project together with a hardware vendor, the national weather forecasting service and the national education and research network provider in Switzerland we have performed a trial in order to evaluate whether it is possible to deploy and operate a solar-power driven wireless mesh network that can connect a weather station to the national Swiss research and education network [1]. The weather station has been 20 km away from the access point at the fixed network.

The used wireless mesh nodes consisted of custom-off-the-shelf equipment for the node hardware, supply boxes including 65 Ah battery, lightning protector, and charging unit, an 80 W solar panel as well as directional antennas. The 5GHz frequency band has been used in order to minimize interferences with other equipment. The mesh node has been running an embedded Linux operating system (ADAM) that has been customized according to the resource limitations of the node. ADAM [2] provides several features such as self-configuration and self-healing, which are helpful in case of problems and failures, since these nodes might not be easily accessible after initial deployment in harsh environments.

Deployment of the node hardware and solar panels was quite challenging, but successful when considering certain deployment rules and procedures. The deployed network consisted of one node close to the weather station and one node close to the access point of the fixed network. These two nodes could be connected to electricity. Two redundant paths consisting of two intermediate nodes each have been established between the electricity-powered nodes. All four intermediate nodes have been powered by solar energy. The network has been up and running for approximately three months. The only problem encountered with the solar energy was a foggy period of several weeks, after which the battery of two intermediate nodes depleted and nodes stopped operation. This could have been avoided by considering weather forecasts and apply energy-saving modes at the intermediate nodes.

Another problem has been frequent oscillations between the redundant paths due to the used OLSR routing protocol. In a subsequent development, we used 802.11s routing for the mesh network.

III. OUTLOOK

In a follow-up project [3], we have redesigned the node hardware, mainly by adding additional network interfaces (UMTS, omni-directional WiFi) for management operations. Security enhancements to support user-to-node and node-to-node authentication are under development.

Figure 1. Solar-power driven Wireless Mesh Node.

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