An Alternative to Data Transmission in the Amazon Region

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ABSTRACT
The low population density in the Amazon and the difficulty of access discourage telecommunication companies to expand their networks to meet the riparian communities. Regatão is a project that seeks to meet this need through the use of boats that navigate on Amazon rivers to connect these remote communities with public networks. The communication in this scenario, extremely dynamic as hostile, has intermittent connectivity, suitable for the implementation of delay-tolerant and disruption-tolerant networks (DTNs) technology. The communities and boats are fixed and mobile nodes of a large ad hoc network.

Categories and Subject Descriptors
C.2.1**[Network Architecture and Design**]: Store and forward networks

General Terms
Measurement, Documentation, Design, Experimentation

Keywords
Amazon, DTN, Ad hoc.

1. INTRODUCTION
The Amazon region covering 5.217.423 km^2, comprises more than half of the area of Brazil's territory. However, its population corresponds to only 12% of the Brazilian population, featuring a human population index of 4%, the lowest in the country. Amazon rivers are roads to the residents of this region causing high traffic of vessels, which play an important role as a means of integrating riparian locales with large cities. Almost all Amazon cities and communities are located on the banks of rivers that account for more than 20,000 km of waterways. Regatão is a research project of Computer Networks and Multimedia Group of Federal University of Amazonas (UFAM). It started with the design of a multihop-based communication between boats and riparian communities, forming a mobile ad hoc network (MANET) [1]. Due intermittent connectivity, the project has been investigating DTN by means of simulation and network virtualization techniques and recently has been planning experimentations on a real testbed.

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2. REGATÃO PROJECT
The main objective of the Regatão project is to provide Internet access to remote communities within Amazon region. As shown in figure 1, there is a very low road density in Amazon which makes rivers the main transport infrastructure of the region.

Figure 1. Amazon River Basin

Boats, ships, ferries and a sort of watercrafts cross the rivers everyday transporting passengers and goods. The project will use these vessels as mobile nodes of an ad hoc network to carry data between large cities, which holds a telecommunication infrastructure, and remote communities along the rivers. To handle the dynamic topology of the network due to the displacement of vessels, the project is based on the concept of DTN [2], conceived to issues of high latency and disruption to data transmissions from probes and spacecraft for space to Earth. The use of DTN, allows asynchronous traffic based on sending messages node-to-node instead of sending packets end-to-end. Mobile nodes (vessels) will have differentiated capabilities, with the possibility of Internet access via satellite channels and communication between nodes through radio links.

Fixed nodes installed in the cities will have a radio interface to connect to mobile nodes and another to connect to Internet. Riparian communities must have a single radio interface for communication to mobile nodes. The project is based on DTN2 [2] for modeling, The Opportunistic Networking Environment (ONE) [3] for stochastic simulation, and virtualization techniques based on Kernel Virtual Machine (KVM) [4].

2. JURUÁ RIVER

The second phase of the project is to implement a real testbed which main goal is the digital inclusion of a small school situated on the bank of Juruá River (figure 2) near the town of Carauari which has telecommunications infrastructure. There is a regular schedule done by school boat that transports students from their houses daily (figure 3).

Source: J. Clèment, 2008

Figure 2. Bank of Juruá River

A wireless router will be installed in the school boat with an updated version of a distribution of Linux operating system that runs applications and DTN protocols required for receipt of messages, custody and forwarding for a fixed node in the school. The unit has an omnidirectional antenna and is powered by 12V battery common in boats. In the absence of power, a solar panel with rechargeable battery system will provide uninterrupted power to the system.

Figure 3. School boat of Juruá River

To implement the fixed node in the school is necessary a wireless router unit equipped with a sector antenna of 120^{o} aperture to cover large areas from the margin. A server computer with enough storage capacity to meet the demands of communication of the school will be connected to the radio unit. DTN protocols and applications allowing Internet services, such as Web access (HTTP), mail (SMTP) and file transfer (FTP) are being implemented in this server.

Figure 4. Inside local school

The requests made by these applications will stored in the server and eventually forwarded to the school boat that delivers the messages to a fixed node in Carauari City responsible to forward them to Internet. The response of the requests returns to school by inverse way.

Ongoing studies have been addressing energy issues for feeding school's equipment since supply is precarious in these regions (figure 4). Real experimentations using buses as mobile nodes are being carried out at UFAM campus to simulate a real environment of Juruá River. The impact of Internet access to this school will be create a new vision of the world to the students and school staff, improving how they will work, how they will communicate and how they will learn.

3. EXPECTED RESULTS

This project aims to attract attention to an existing social demand in the Amazon region. However due to its high scale this is a starting point for scientific research focused on the study of wireless networks with intermittent connectivity, common in Amazon due the large distances between communities, climatic factors and burst in the supply of electrical power. As a direct result we want to show the viability of the project and its benefits through the pilot implementation of Juruá River, minimize the cost of the units with the assessment of appropriate hardware and software and to encourage the academic community to participate in the deployment of a fluvial network for data communication in the Amazon.

4. REFERENCES

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