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Author: Prof. Marco Schmidt
Bochum University of Applied Sciences, Germany, marco.schmidt@hs-bochum.de

Dr. Florian Zeiger
Siemens AG, Germany, florian.zeiger@siemens.com
Mr. Hans-Peter Huth
Siemens AG, Germany, hans-peter.huth@siemens.com
Mr. Christof Kaufmann
Bochum University of Applied Sciences, Germany, christof.kaufmann@hs-bochum.de

IP LINK MODEL FOR INDUSTRIAL SATELLITE COMMUNICATION

Abstract

It is well known, that geostationary satellite communication links suffer from high latency due to signal propagation delay between satellite and earth. Thus, flow control of protocols can be affected and needs to be parameterized carefully. This is for example necessary for the Transmission Control Protocol (TCP, an incremental part of the internet protocol suite), which has performance issues with standard parameters in high latency environments. There are a number of other effects observable when internet services are used over geostationary satellite links, such as packet error rates and packet error patterns in combination with latency. Furthermore, many of these effects depend on the time of day or other conditions so it is hard to analyze their influence. Especially for industrial applications it is of paramount importance to understand the link behavior and to solve the complex task of predicting how such link characteristics affect the application end-to-end.

A simple method to analyze the influence of the link characteristics on the end application is the usage of a network emulator. An emulator can mimic the behavior of a satellite link with a quantitative link model. Hence, an end application can be extensively tested with an emulated satellite link to fully understand the influence of packet error rates and latency as experienced with a satellite link. Also worst-case situations can be investigated and link, as well as application parameters can be adjusted accordingly.

This work deals with the modeling of the communication link and the application of this model in an emulator. Extensive measurements with a high bandwidth geostationary satellite link and a reference link were performed. From the measurement data appropriate features are extracted to be used in a machine learning model. The feature set gives insight about the main factors that influence the channel parameters. Different machine learning models are investigated. The trained model is then used to parametrize "netem" - a Linux based tool to emulate different channel properties as delay or packet loss - continuously on a standard computer with two Ethernet ports. This hardware box can then simply be attached in the line to emulate a satellite link. Alternatively "netem" can also run directly on the machine with the test application to avoid network problems.