Mobile Satellite Protocol Testbed

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Outline

- Introduction
  - Challenges to interoperability.
- The Mobile Satellite Protocol Testbed
  - Goal
  - The Mobile Satellite Channel
  - Testbed Capabilities:
    + Accurately model the satellite channel using propagation data.
    + Real-time test capability allows qualitative analysis.
    + Modified versions of standard TCP tools provide detailed logs.
  - Testbed Design

- Example Results
Challenges to Interoperability

- **Terrestrial Networks**
  - High bandwidth
  - Low Delay
  - Low Bit Error Rate

- **Satellite Networks**
  - Range of bandwidths (mobile to VSAT)
  - Longer Delays (LEO MEO GEO)
  - Higher Bit Error Rates (mitigated by coding)

- **Mobile Satellite Networks**
  - Low bandwidth
  - Higher BER

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The Mobile Satellite Protocol Testbed

- **Goal:** To assess and compare the various TCP and ATM mods in a mobile satellite environment and to provide the results to manufacturers of TCP and ATM protocol stacks.

- **The Mobile Satellite Channel:**
  - Propagation delay to orbit is considerable (~130ms for CEO).
  - Higher BER than fixed satellite channels
    - Mobiles are power-constrained and have smaller antennas.
    - Coding helps, but low data rate and processing constraints may limit its applicability.
    - The mobile channel is subject to Multipath Fading & Shadowing
Testbed Design

- **Mobile System Being Simulated**

  - Mobile User or Platform (Laptop, PDA, Train, Airplane, etc.)
  - Satellite
  - Groundstation
  - Server or Gateway

- **Testbed Block Diagram**

  - Simulated Mobile User
  - Channel Emulator
  - Groundstation (Server or Gateway)

Testbed Capabilities

- **Hardware channel simulator**, driven by propagation data, provides an inexpensive, accurate, and repeatable platform.
  - Land, Aeronautical, and Marine Mobile channels.
  - Cannot model any IF phenomena (carrier lock, etc.).

- **Qualitative as well as quantitative feedback**.
  - Real measurements are essential to understanding TCP behavior.
  - Real-time simulation allows qualitative analyses that are essential, since many of the driving applications behind the deployment of TCP and ATM over satellites are interactive (http, telnet, e-mail).
TCP Enhancements Being Examined

- **Selective Acknowledgements (RFC 2018)**
  - Provides an option to include selective acknowledgements as opposed to TCP's normal cumulative acknowledgement scheme.

- **Large Windows and PAWS (RFC 1323)**
  - Allows TCP to have more than 65k 01' data in flight at any one time. This may not be necessary for low-rate mobile terminals.

- **Space Communications Protocol Standards (SCPS)**
  - SCPS is an end-to-end protocol developed by NASA for near-earth and deep-space missions, and contains many improvements to TCP that are relevant to the satellite environment.

- **Bellcore’s Protocol Boosters**
  - Bellcore's Forward Error Correcting (FEC) protocol booster provides improved resistance to errors below the network level.
Detailed Analysis of TCP Behavior

Using modified versions of standard TCP analysis tools (tcpdump [Ibl], tcptrace [Ostermann], and xplot [Shepard], we can examine TCP transactions in detail.