Senior Design Project in Electrical and Computer Engineering

Improving the Performance of CG TCP/IP Applications Over Mobile Satellite Links

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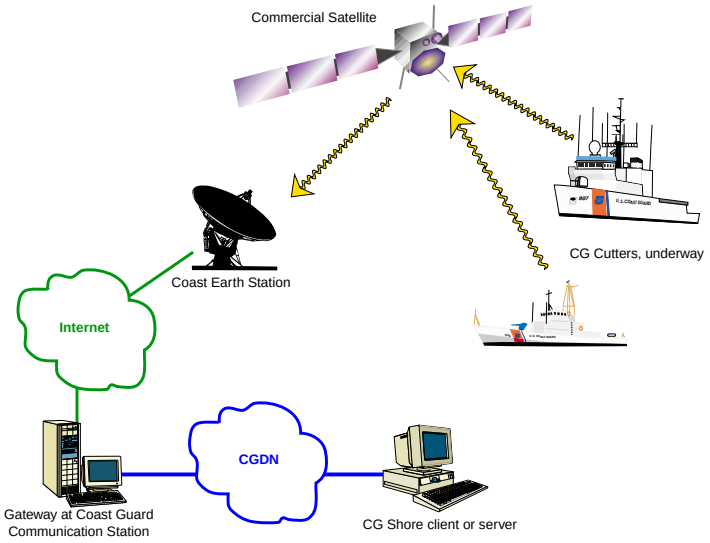
Future Coast Guard Communications Plan



Project Background

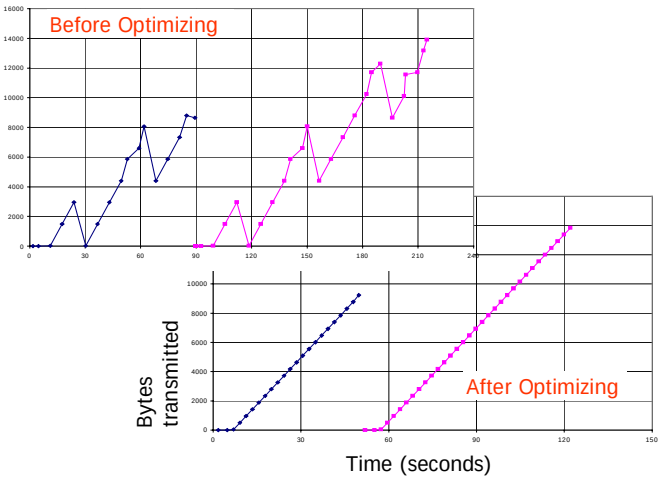
The Coast Guard is transitioning to a Transmission Control Protocol/Internet Protocol (TCP/IP) – based terrestrial network, termed the Coast Guard Data Network (CGDN+). There is a need to extend this network to support Coast Guard cutters and aircraft. Currently the USCG Research and Development Center (R&DC) is researching the use of commercial satellite systems to link Coast Guard cutters and aircraft to the CGDN+. The USCG Academy is doing research in conjunction with the R&DC to analyze and improve the performance of Coast Guard applications over commercial mobile satellite links.

Project Goals

- Build a test bed to simulate various commercial satellite systems such as Inmarsat B and mini-M.
- Evaluate and optimize performance of TCP/IP applications:
  - Email: POP3, EXMAIL, encryption (PGP), attachments vs. body text only, and batching.
  - Web: Performance of HTTP v1.0 and the effects of using Secure Socket Layer (SSL)

Results of HTTP Optimization

The two plots of bytes transmitted versus transmission time at right illustrate performance of HTTP v1.0 with no changes to the TCP/IP stack before and after optimizing. Each dot represents the end of a packet.

We are able to modify only two parameters in the TCP/IP stack: the maximum transmission unit (MTU) size and the initial time-out timer. The default values for these are 1500 bytes and 3 seconds, respectively. The data in the first graph was collected using these default values. The discontinuities in the graph reveal many retransmissions, indicating poor performance. Several packets of data are sent across the link more than once, wasting time and money.

The data in the second graph was gathered after decreasing the MTU size to 500 bytes and increasing the timer to 3 s. More packets are transmitted, but no retransmissions occur. Total transmission time is reduced, resulting in lower operating cost.