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Performance Analysis of the HTTP Protocol on Geostationary Satellite Links

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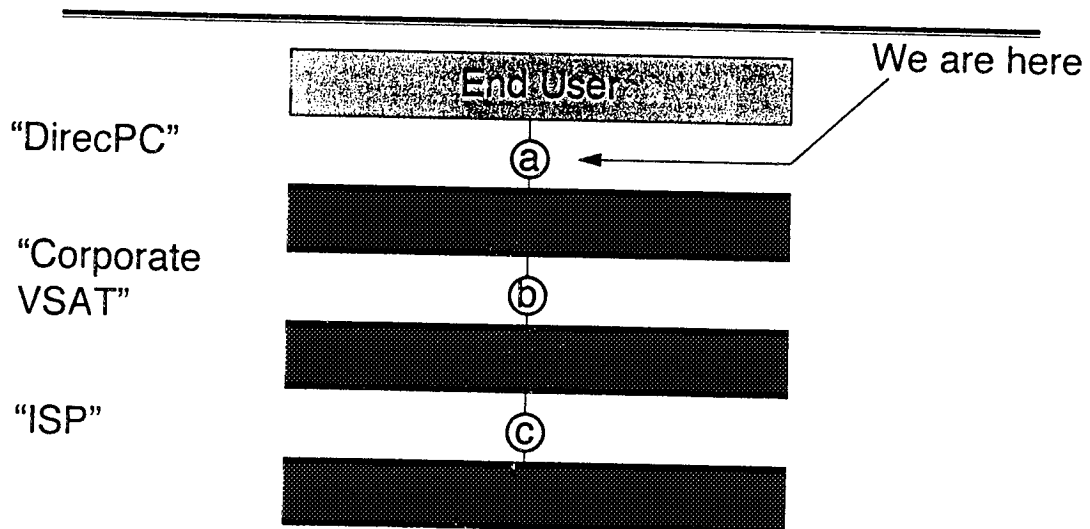
Overview

- Network Reference Points
- The HTTP 1.0 and 1.1 Mechanisms
- Experimental Setup
- TCP and HTTP Configuration
- Results and Future Work

Why HTTP

- The Obvious Answer:
“Millions of Web Browsers...”
- The not-so-obvious Answer:
 - HTTP is a very generic multi-file transfer protocol with content/encoding awareness
 - Very well optimized HTTP servers are available
 - HTTP contains intrinsic proxy support mechanisms that allow regional caching of data

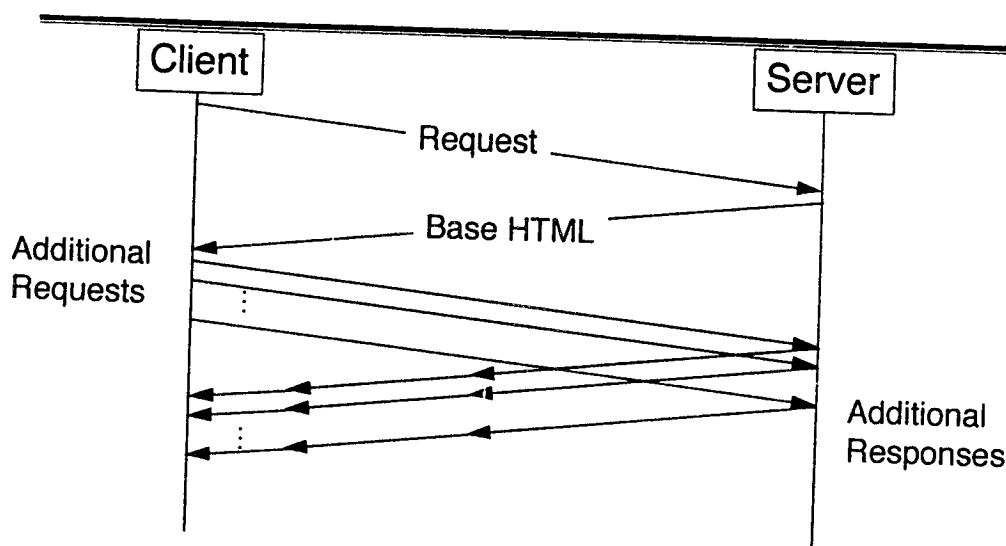
Network Reference Points



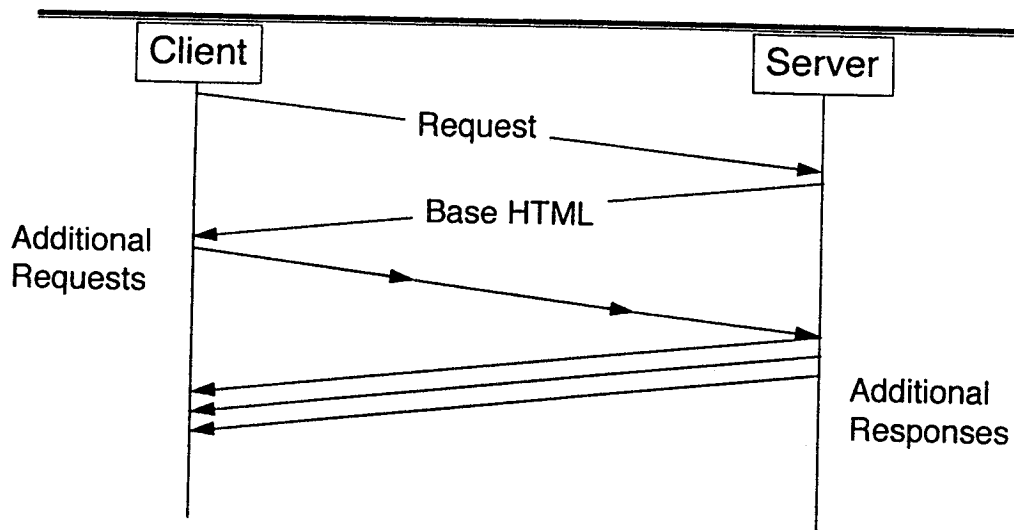
Reference Points cont...

- Interface "a"
 - Very small number of users
 - Traffic is bursty, user wants good response time, protocols dominate performance
- Interfaces "b" and "c"
 - Large and varying number of users
 - Traffic is more random, performance depends on protocols and congestion control; fairness is desirable

The HTTP 1.0 Mechanism



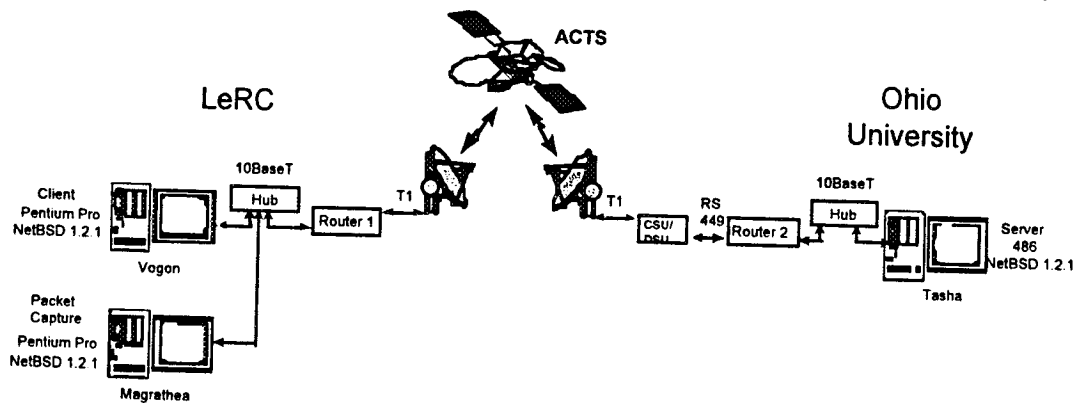
The HTTP 1.1 Mechanism



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The Experimental Setup



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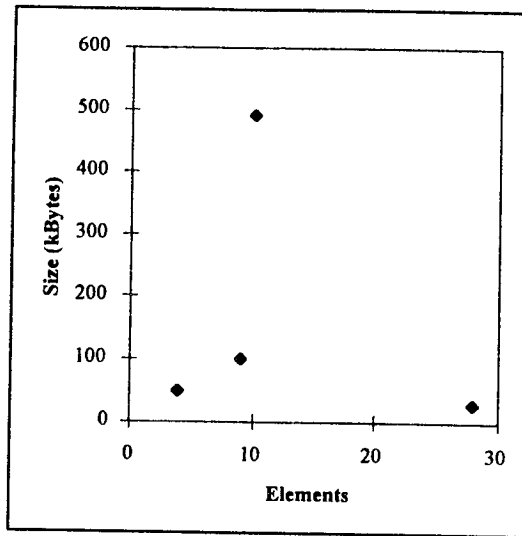
TCP Configuration

- Standard BSD “reno” stack
- Large window support (RFC 1323)
 - experiment uses 8, 16, 64, and 96Kbytes
- Bug fixes in the NetBSD stack
 - Initial window starts with one segment
 - Acknowledgments are generated according to the standard

HTTP Configuration

- Apache Server (HTTP 1.0 and 1.1)
 - Persistent connections in HTTP 1.0
- Netscape browser
- Netscape allows multiple connections
 - experiment uses 1, 4, 8, and 16
- Experimental HTTP 1.1 client
- Increased initial TCP window support

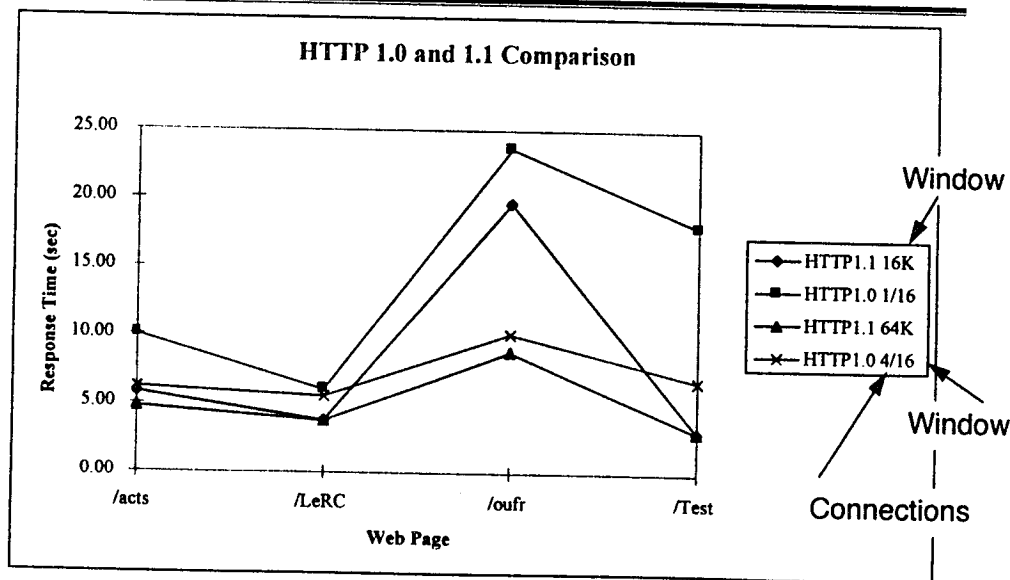
Web Pages



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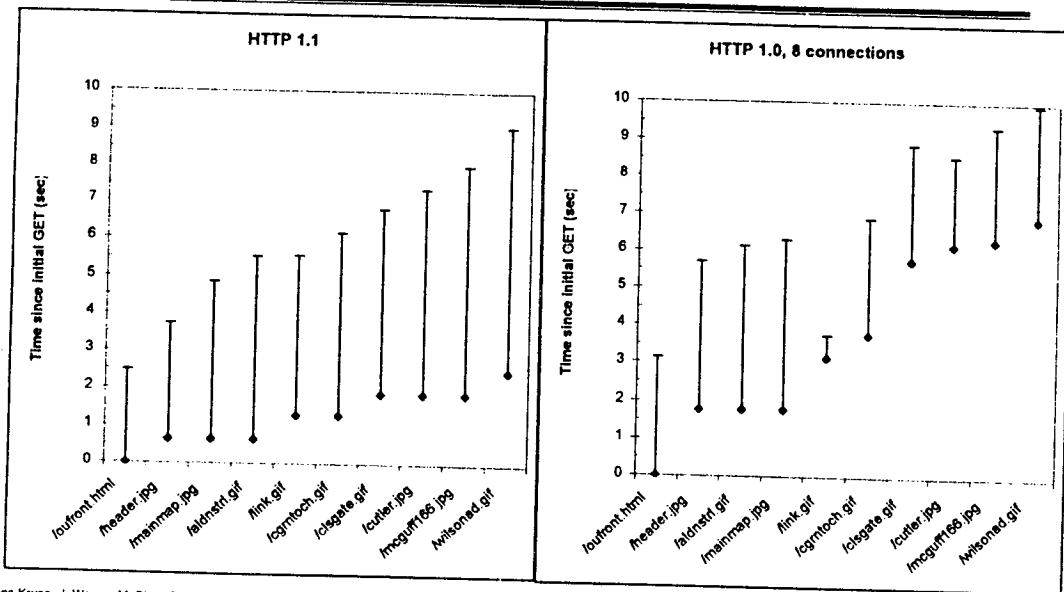
Comparing HTTP 1.0 and 1.1



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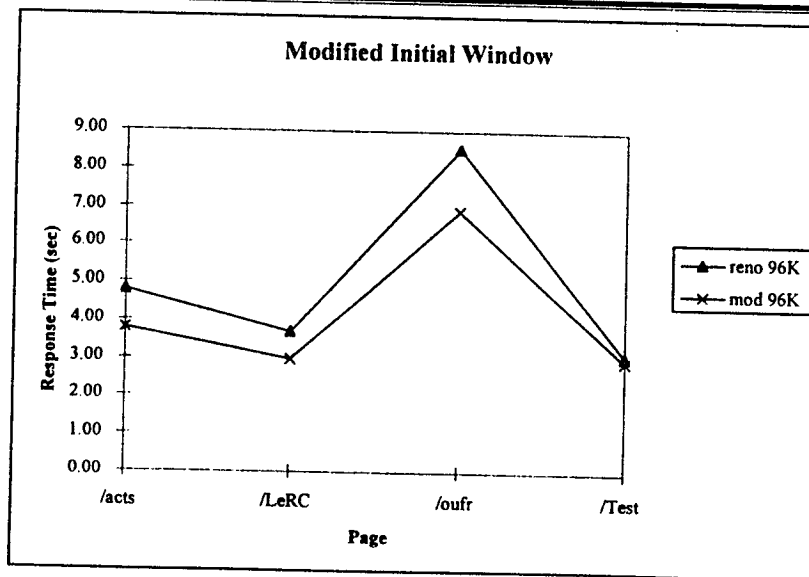
Data Flow Comparison



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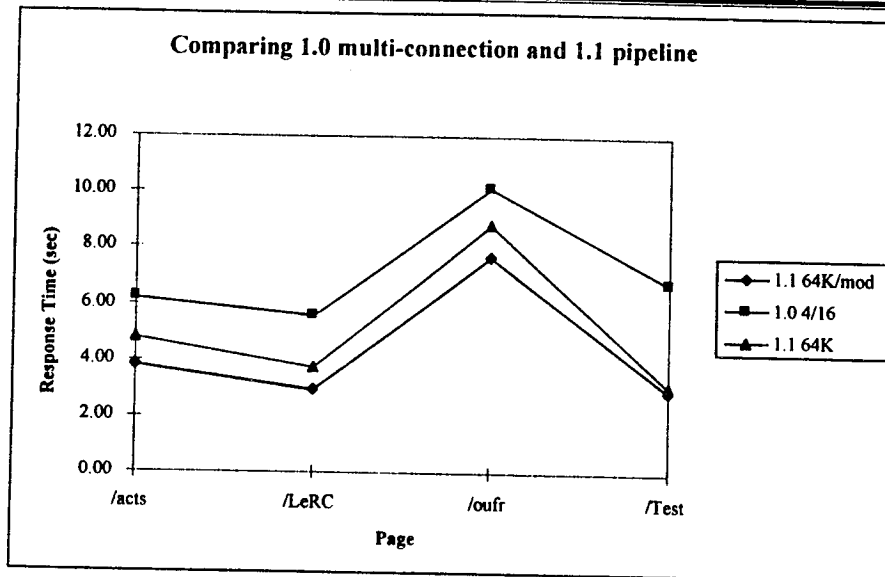
The Larger TCP Initial Window



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What settings are important?



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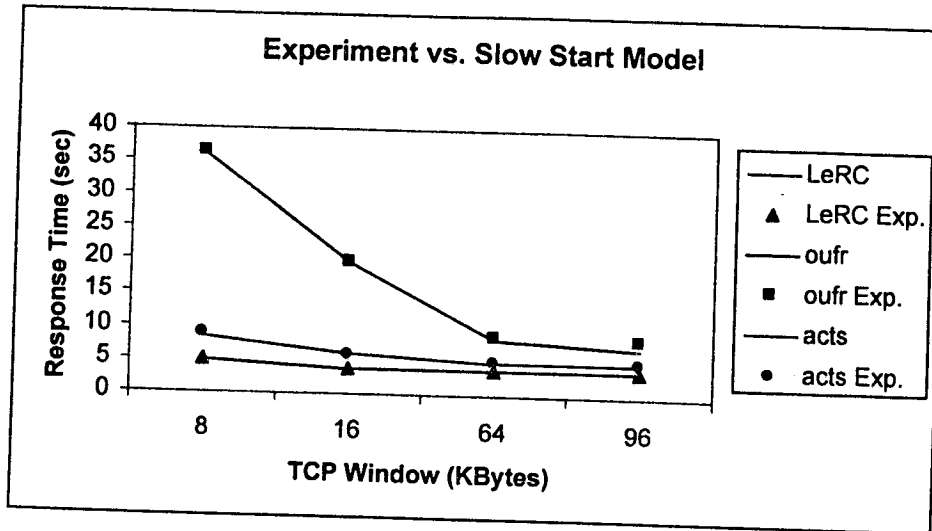
Modeling Slowstart

- Based on Heideman, et al. (IEEE Transactions on Networking Vol. 5, No. 5, Oct 1997).
- Slowstart creates an exponential increase in the data flow, up to the channel bandwidth
- Delayed acknowledgements change the rate of increase
- HTTP 1.0 requires a little extra work, results for HTTP 1.1 are shown here.

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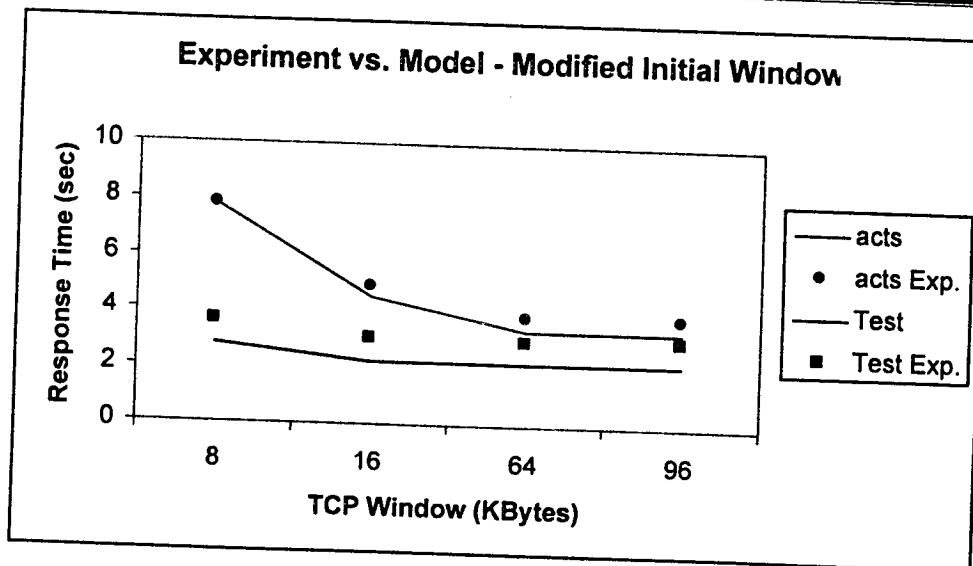
Are there unknown effects?



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Maybe a few ...



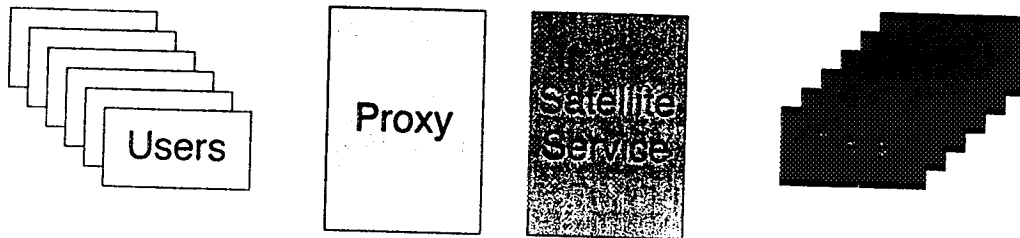
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Implication for the Service Provider

Page	Best Time (sec)	Size (Kbytes)	Rate (KB/Sec)	Utilization	No. of Users	Based on T1 (1.536Mbps) Service
/acts	3.79	100	26.41	14%	7.1	
/LeRC	3.00	49	16.36	9%	11.5	
/oufr	6.89	491	71.23	38%	2.6	
/Test	2.99	29	9.70	5%	19.3	

Desirable Configuration:



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Conclusions and Future Work

- HTTP 1.1 pipelining outperforms HTTP 1.0.
- Performance of HTTP 1.1 can be readily modeled.
- Pipelining will create new application level problems.
- Examine the reference points "b" and "c" by introducing competing background traffic with the TCP flow under study.