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Scalable Socket Buffer Tuning for High-Performance Web Servers

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Background

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- Explosive increase of network traffic due to rapid increase of Internet users
  - Many improvements on network to accommodate increasing traffic
    - Link Bandwidth
    - TCP congestion control algorithm
  - Few discussions on endhost improvement
    - Ex. Busy WWW servers receive hundreds of requests for document transfers per second.

The bottleneck of the data transfer processing is shifted from network to endhosts

Send Socket Buffer Assignment

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- Busy Internet servers (WWW, Proxy,…) handle many TCP connections which have different characteristics
  - RTT, packet loss rate, bandwidth, …
- In the original method, the sender host assigns a fixed size of buffer to each TCP connection
  - Fixed size assignment may cause unfair and ineffective usage of send socket buffer
    - Different connections require different size of send buffer according to network conditions

Fair and effective buffer assignment considering network condition is needed for improving endhost performance

Objective

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- Effective allocation of endhosts resources becomes more important
- Propose a novel architecture, SSBT (Scalable Socket Buffer Tuning)
  - High-performance and fair service for many TCP connections at the sender host
    - E-ATBT (Equation-based Automatic TCP Buffer Tuning)
    - SMR (Simple Memory-copy Reduction)

E-ATBT
(Equation-based Automatic TCP Buffer Tuning)

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- Provide fair and effective send socket buffer assignment
  - Estimate an ‘expected’ throughput of each TCP connection by monitoring three network
  - *p (packet loss rate), rtt (Round Trip Time), rto (Retransmission Time Out)*
- Determine assigned buffer size from the estimated throughput
- Max-Min fairness policy for re-assigning the excess buffer
  - Re-assigned to the connections need more buffer the required buffer size of those connection

E-ATBT Method for assigning the send socket buffer

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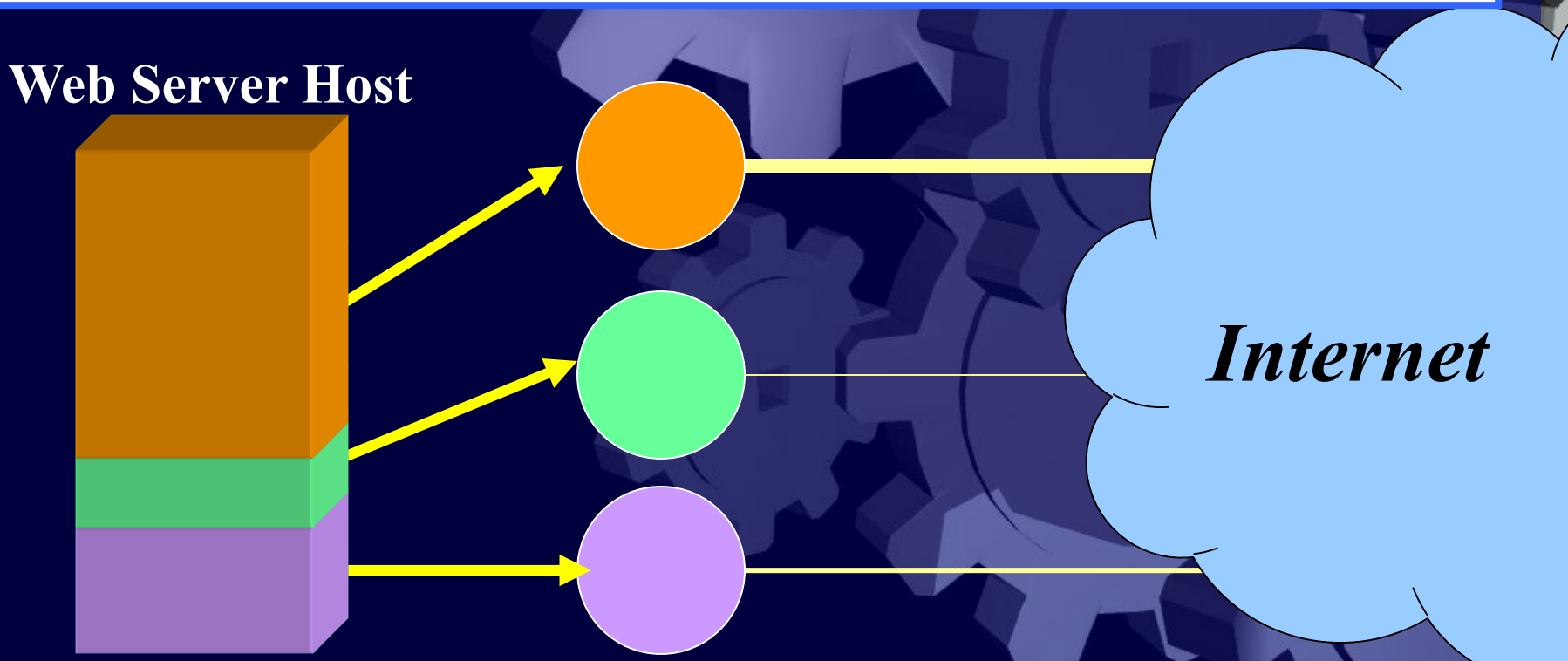
In the E-ATBT, assigned buffer size is determined from the estimated throughput based on the mathematical analysis method



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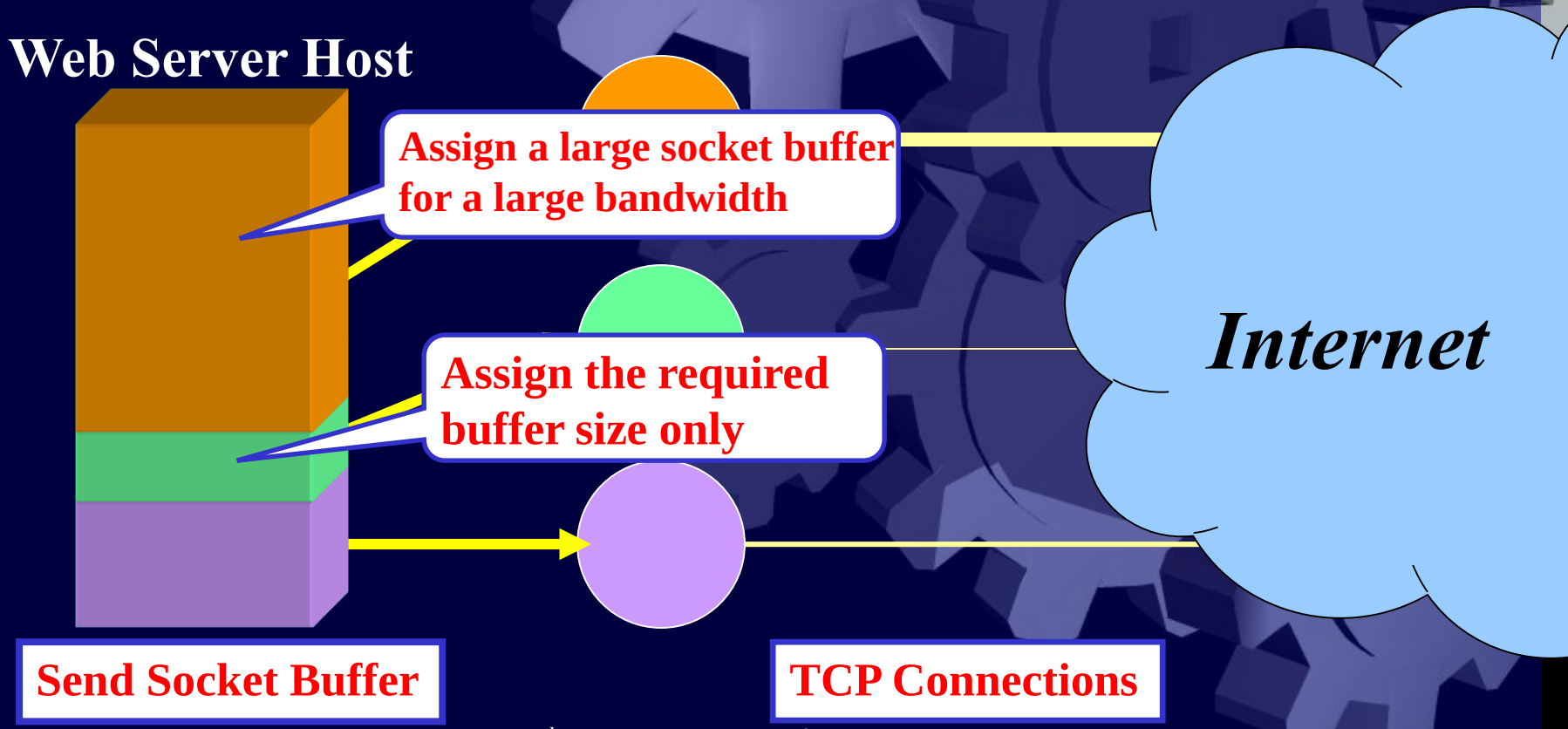

SMR
(Simple Memory-copy Reduction)

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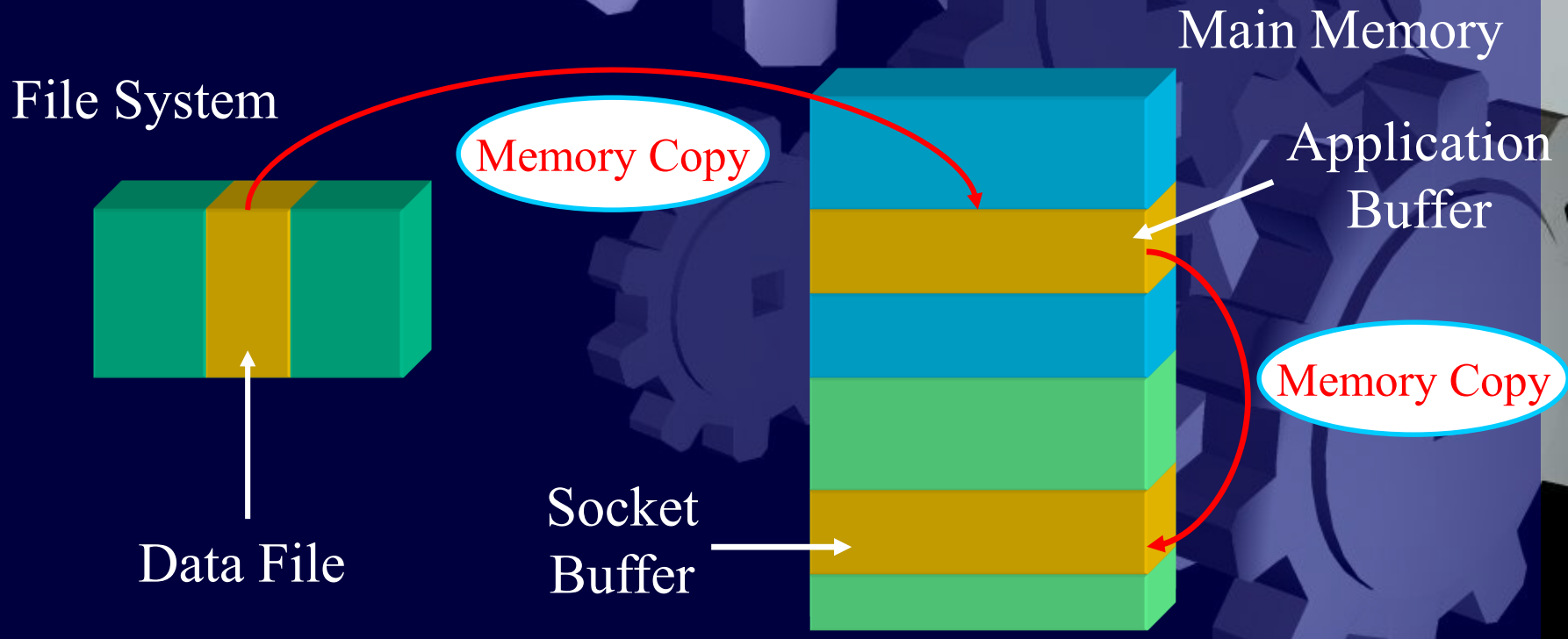
- The original mechanism needs two memory copy operations. A memory copy is a large overhead on endhost processing



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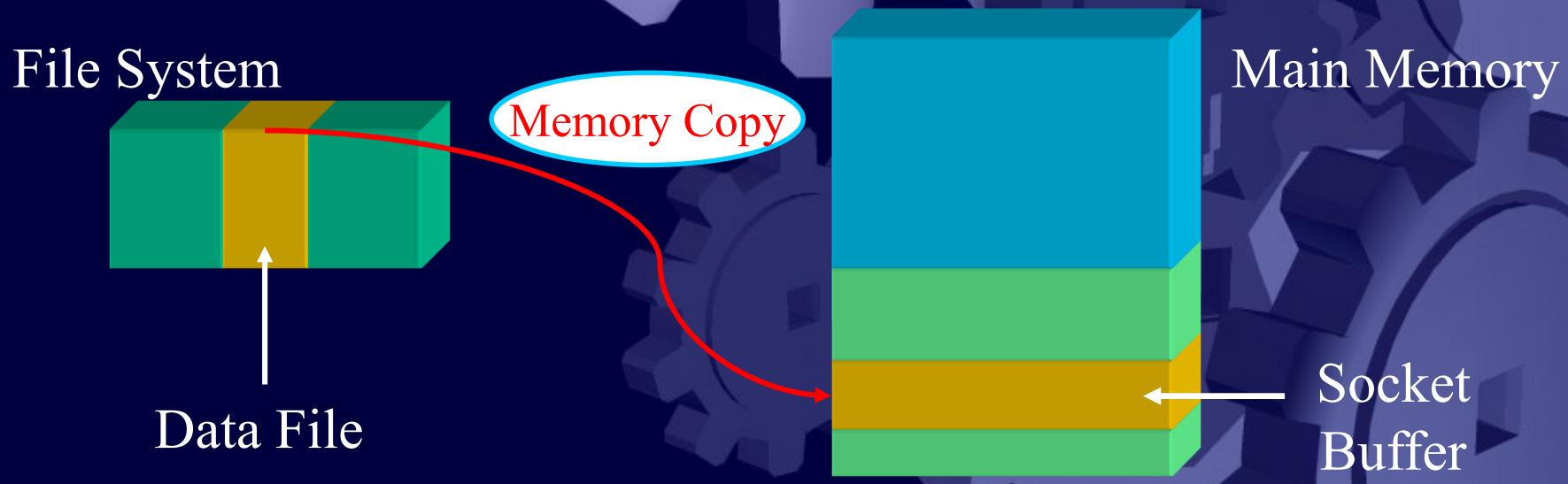

SMR scheme reduces the data transfer overhead at the sender host by reducing the redundant memory copy operations

Implementation Experiments

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- Fair buffer assignment among different connections
  - Time-dependent behavior of the assigned buffer size
- Web server performance evaluation
  - Average performance gain of the SSBT scheme
    - Considering realistic web access traffic [1]
      - Document size distribution
      - Idle time distribution of requests
      - Embedded documents distribution

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[1] P.Barford and M.Crovella, “Generating Representative Web Workloads for Network and Server Performance Evaluation”, in *Proceedings* of ACM SIGMETRICS ’98, 1998

Network topology

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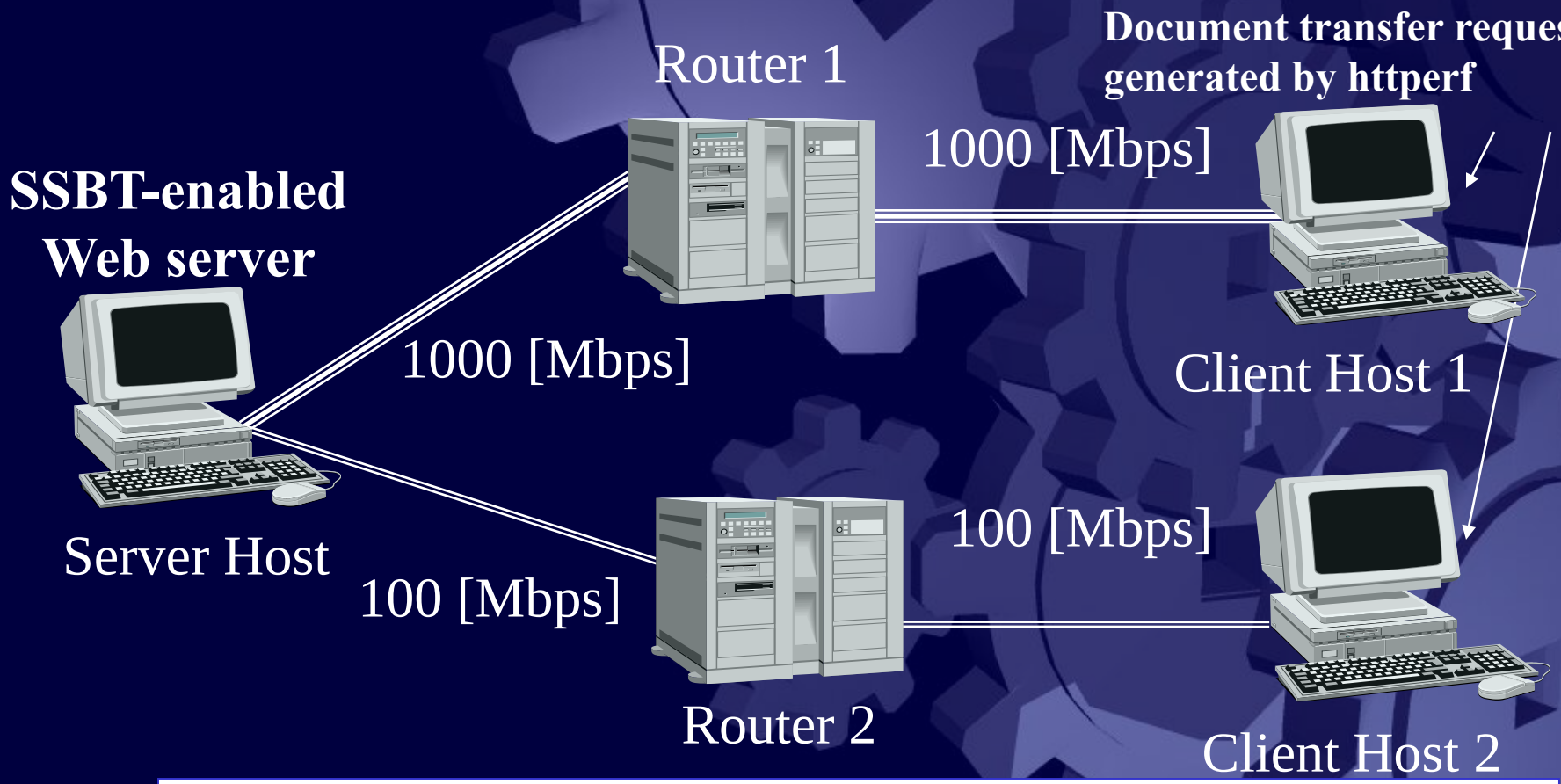
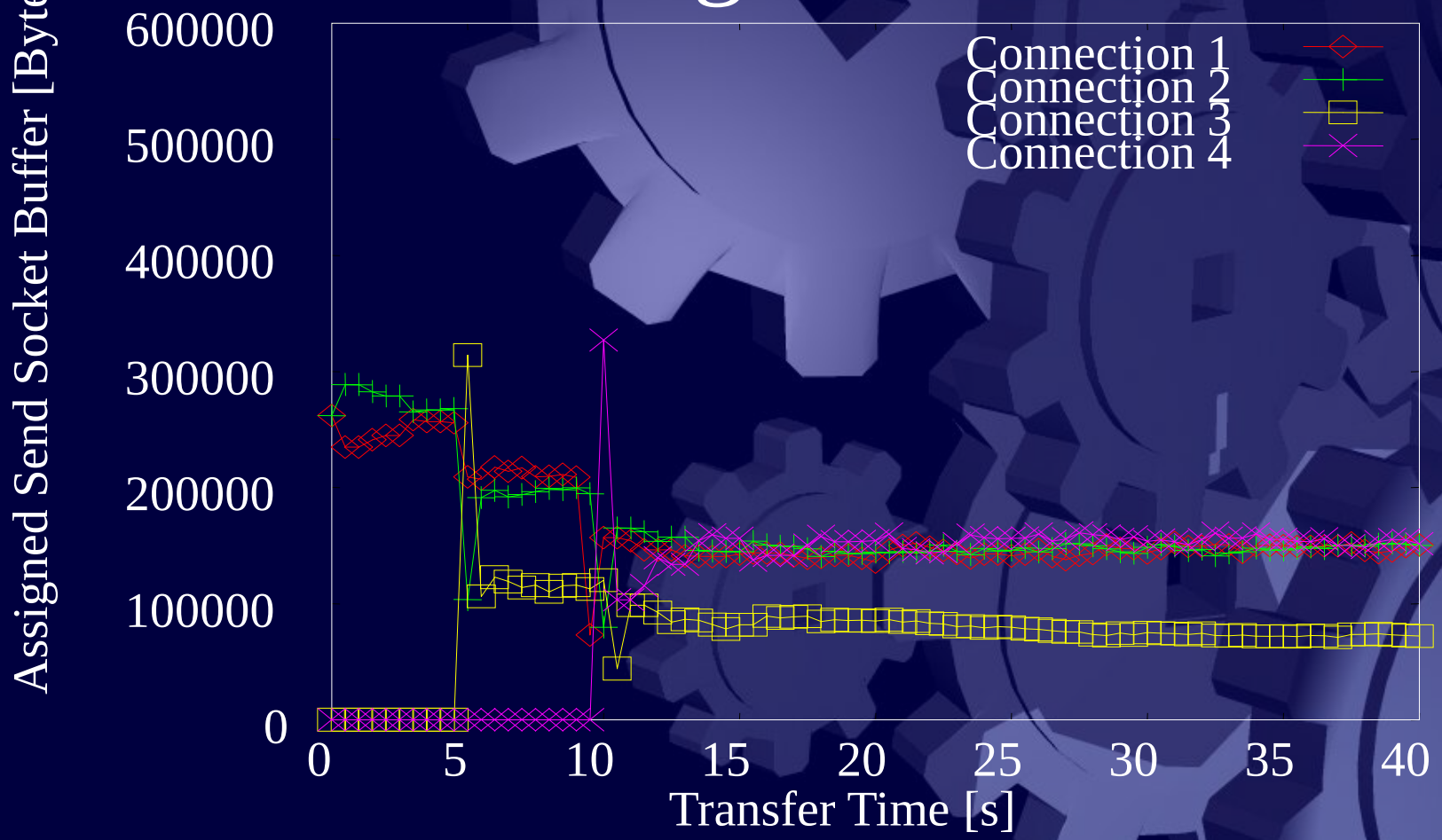


Each client generates the requests for document transfer to the Web server and we measure the data transfer time

Buffer assignment result



E-ATBT can provide a stable and fair buffer assignment

Web server performance

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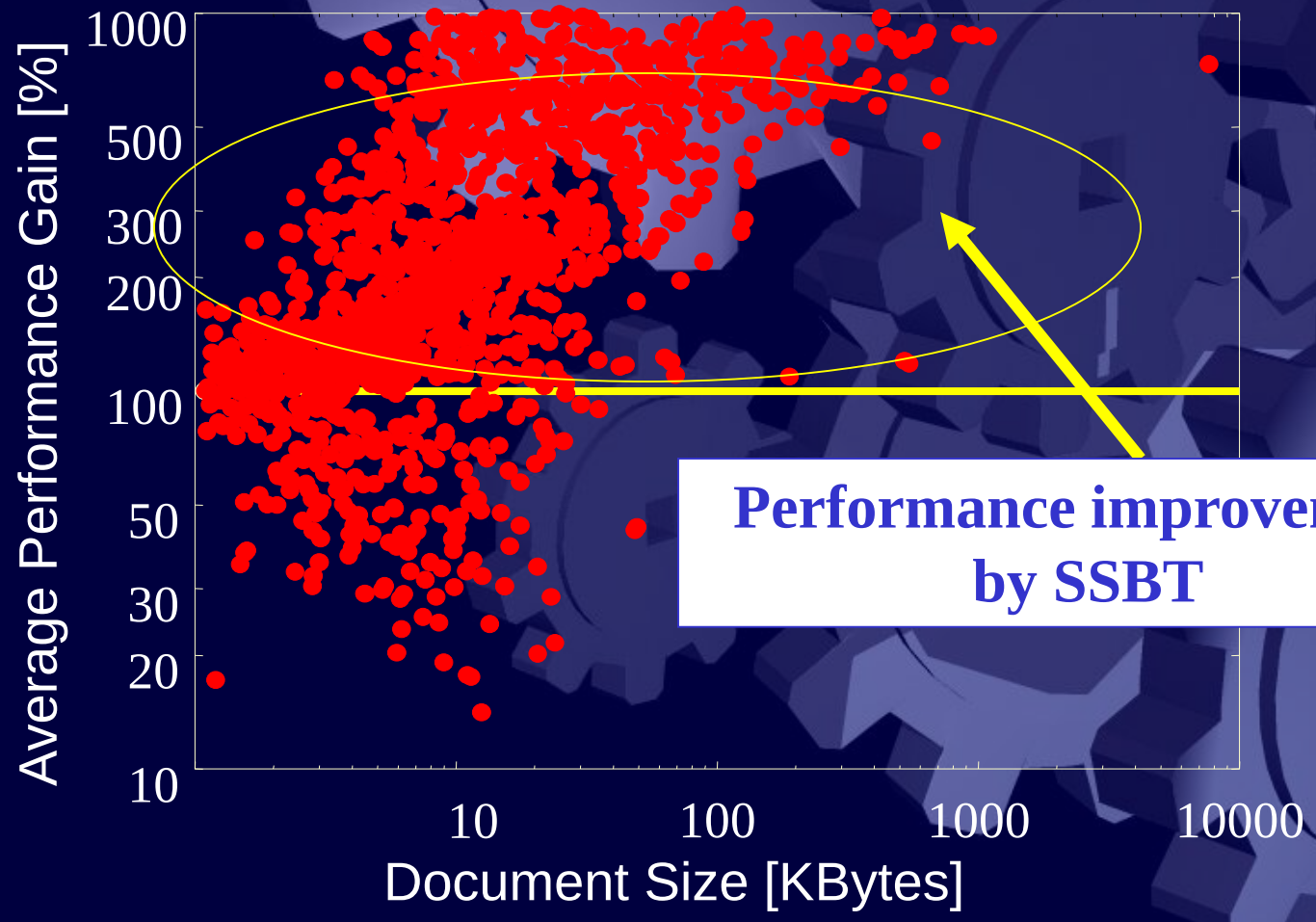
600 Clients, HTTP/1.1



Concluding Remarks and Future Works

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- Proposed SSBT for utilizing the send socket buffer effectively and fairly
- Confirmed the effectiveness of the SSBT algorithm through simulation and implementation experiments and shown SSBT can improve the overall performance of a server
- New resource management scheme for Internet busy server (Ex. HTTP Proxy server)
  - Enhanced E-ATBT for proxy servers
  - Manage the persistent TCP connections

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