TCP Proxy Bypass: all the gain with no pain!

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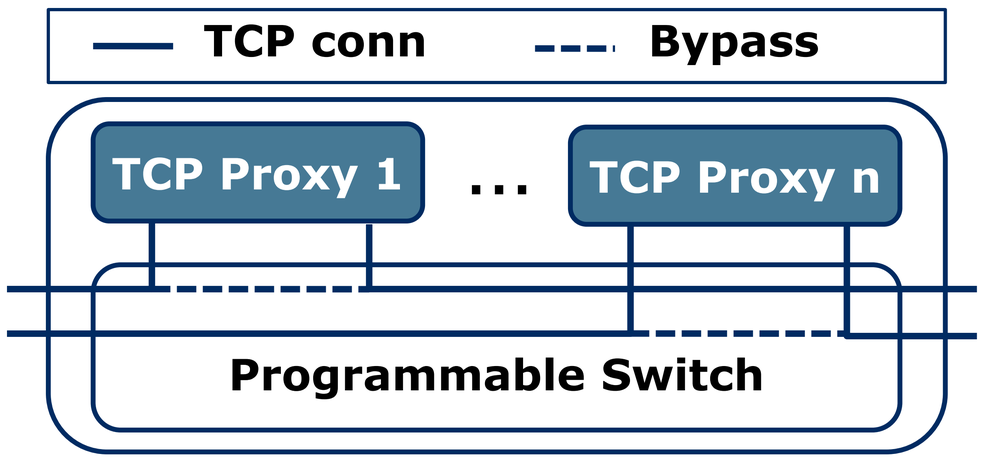
Motivation

- TCP proxies are widely deployed in modern networks [1].
  - Level 7 load balancers.
  - Redirection proxies.
  - Protocol optimizer proxies in celluar networks.
- In many cases, the proxy is only required during the initial phases of the connection.
  - Often TCP connections carry just a single HTTP request [2].
  - With the increase of TLS encrypted traffic only the first few frames of the connection can be (meaningfully) processed by the proxy [3].

Solution

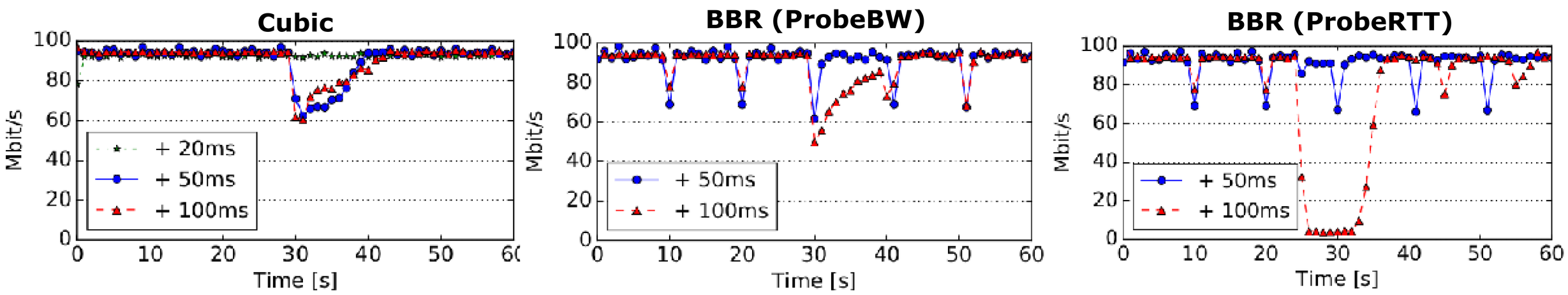
- **Idea:** Can established connections be offloaded from the TCP proxy?
- **Solution:** Use programmable switches to offload an established TCP connection
  - When proxy's operations are limited to relaying packets.
  - Bypass operations:
    - NAPT (Network Address & Port Translation) operation.
    - ACK and SEQ number translation
  - Handle TCP Options:
    - The same set of options has to be negotiated for both client and server.
    - Server side options can be cached and then negotiated with the client.
- **Expected benefit**: Save precious resources by transparently remove a TCP proxy from the data path.

PoC Implementation



- Unikernel TCP proxy (Miniproxy [4]) plus a Programmable Switch (PISCES [5]).
  - The operating system needs to expose additional information at socket level.
  - The switch has to parse and modify TCP header fields, such as TCP sequence and ACK numbers.
- Workflow:
  - The Proxy selects the TCP connections to be offloaded.
  - It waits until there are no in-flights packets on both the client- and server-side connections.
  - The Proxy configures the translation operation in the switch.
  - The switch performs the bypass operations and the packet forwarding for the offloaded connections.
- Considerations on system load:
  - Configuration: proxy as a **virtual machine** and PISCES as **software switch**.
  - Typical configuration **one core assigned for each proxy**, at least one core for the software switch.
  - With all the connections offloaded, the **proxy's CPU cores stay idle**, while the switch resource consumption does not increase.

Impact on congestion control



- TCP flow for 60s over a 100Mbps link. After 30s (25s in rightmost pic.), additional delay is added on the link, summing up to a total RTT value of 100ms for all the cases.
- Removal of a proxy corresponds to a sudden variation of the perceived end-to-end **RTT**.
- To avoid side effects on the connection's throughput, we introduce a gradual synthetic delay, e.g., in steps of 20ms, before performing the connection offload.

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