# TCP Accelerator

## Improve QoE by taking control of TCP

**Sandvine's TCP Accelerator allows network operators to dramatically improve network efficiency and QoE, without making changes to the network infrastructure.**

## KEY BENEFITS:

- Improved Quality of Experience (QoE): faster data transmissions and increased application performance lead to measurably, consistently better QoE
- Increased Network Performance: higher ratio of goodput to throughput, better resource utilization, reduced retransmissions, and extended legacy infrastructure lifetimes
- Increased Revenue Opportunities: End customers tend to use more data when they are enjoying faster, more reliable connections

The nature of how TCP runs causes three major problems:

- When additional bandwidth is available, TCP may not be fast enough
- When too little bandwidth is available, TCP may be too fast
- When there are many concurrent TCP connections, the collection as a whole behaves inefficiently

For operators, these problems create significant consequences:

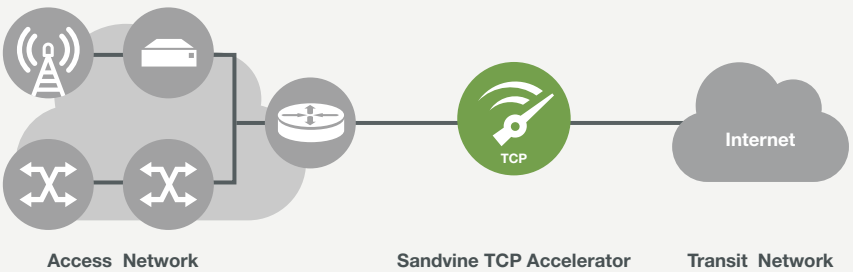
- Network efficiency is harmed, causing performance and return on investment to fall below expectations
- Application QoE is impacted, decreasing customer satisfaction and potentially increasing churn

### ENGINEERED FOR MAXIMUM EFFICIENCY

**TCP Accelerator is engineered to make TCP run better:**

- When additional bandwidth is available, TCP Accelerator ensures TCP doesn't become a bottleneck by accelerating the slow-start phase and by making sure there is always enough data ready to be served
- When too little bandwidth is available (e.g., from congestion, spotty mobile coverage, or a low-speed service plan), TCP Accelerator reduces effective latency by preventing buffer-bloat in access network resources
- By transparently bridging the access network with the transit network, TCP Accelerator is in a position to manage all the network's TCP connections as a collective whole, to ensure maximum efficiency

Figure 1



## TCP DELIVERS

Figure 2

### More Efficient Data Transfers

This graph, showing a single TCP flow, illustrates how the accelerated traffic (blue) gets up to speed more quickly, is faster overall, is more consistent, and recovers more quickly after a genuine packet loss.

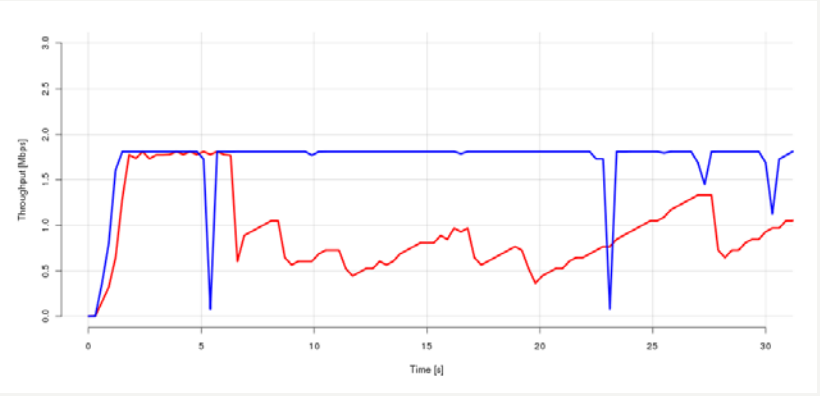



Figure 3

### Faster and More Consistent Round-Trip Times

This graph shows the difference in flow round-trip times when TCP Acceleration (including buffer management) is enabled versus when it is not enabled. In this mobile network, the average round-trip time was cut in half (164ms average versus 320ms average), and round-trip times showed much greater consistency.

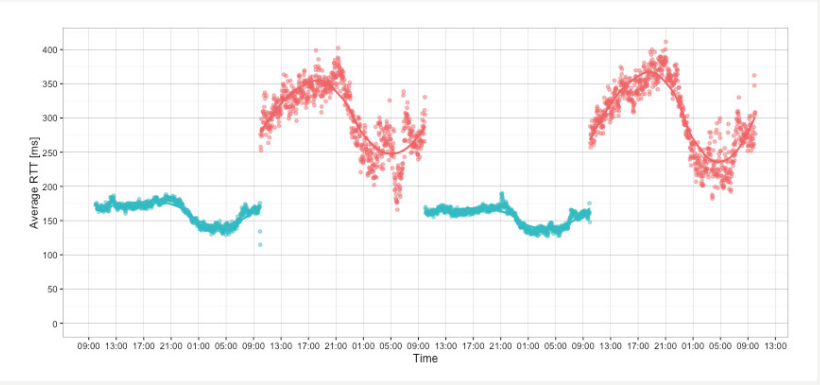



Figure 4

### Fewer Retransmissions

This graph, from a CDMA network, shows the enormous positive effect on retransmission rate: when TCP acceleration is enabled, the retransmission rate is much lower, and much more consistent.

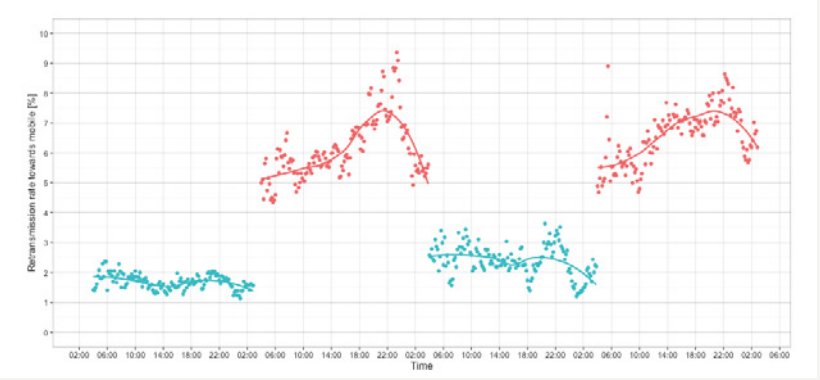
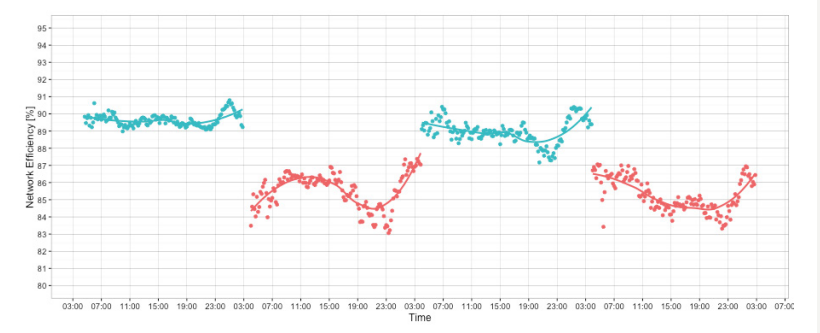



Figure 5

### More Efficient Networks

The graph, also from a CDMA network, shows the overall positive impact on network efficiency as a result of TCP acceleration. In this example, network efficiency (goodput as a percentage of all throughput) improved by 5% and exhibited much tighter consistency.



## KEY FEATURES

### Transparency

TCP Accelerator behaves as a bridge and doesn't terminate the TCP connection, so the acceleration is completely transparent to the endpoints, yielding a number of benefits:

- Connection migration: connections can be migrated from optimized to non-optimized without affecting the connection from the perspective of either endpoint
- Connection resumption: long-lived but inactive connections time-out after a prolonged period of inactivity to recycle state memory; because of transparency, if a connection times out of TCP Accelerator, but then resumes, the connection is able to resume seamlessly
- Sequence number preservation: sequence numbers are untouched, which ensures that the TCP connection state in the client and server will be the same after the TCP handshake
- Step-out for easy upgrades: when acceleration is halted and the stores and forward buffers are cleared, TCP Accelerator can be stopped within minutes, without disrupting traffic
- TCP option transparency: if new TCP options or features are introduced, the endpoints can still negotiate its use (unlike terminating proxies, which would prevent its usage entirely)

### Powerful TCP Acceleration Techniques

TCP represents between 85% to 90% of fixed access internet traffic, and as much as 96% of mobile traffic, and TCP Accelerator applies acceleration to practically all of it, including:

- Uploads and downloads: acceleration is applied to upload and download traffic
- Any application: the default configuration accelerates traffic agnostic of application, protocol, service, etc.
- Encrypted traffic: with more than 70% of traffic now encrypted, it's critical that solutions work with encrypted traffic, and TCP Accelerator does
- HTTP2: fully supported

The only TCP that isn't accelerated is the traffic that shouldn't be accelerated. For instance, if the traffic originates from a specialized device (e.g., a sensor or probe) that should be omitted from TCP acceleration, then TCP acceleration is not applied.

In addition to the buffer management features described below, TCP is accelerated with a combination of techniques, including:

- Two-sided acceleration: most configuration variables can be set separately for the access side and the internet side
- Reduced packet loss effect during slow-start: tunable system for mitigating the impact of TCP packet loss early in the connection, by allowing such packet loss to be ignored for the purposes of adjusting the congestion window
- Congestion control: distinguishes between genuine congestion events and radio glitches (in mobile networks) and handles each accordingly
- Fast retransmit: supports TCP Fast Retransmit, with configurable behavior
- Improved retransmission handling: replaces the standard timeout-based TCP retransmit entirely for the access side of the connection, which has an enormous positive impact on mobile networks (where hand-overs and jitter can cause spurious retransmissions)

Plus, TCP Accelerator is in a position to manage all the network's TCP connections as a collective whole, to ensure maximum efficiency.

### TCP Buffer Management

When high-bandwidth downloads fill the buffers (queues) in the access network, other traffic gets stuck behind and the user experience suffers.

To prevent this scenario—called bufferbloat—in the access network, round-trip times need to be carefully managed; at the same time, a minimum amount of data has to be sent so as not to starve the radio network.

TCP Accelerator manages buffer queues by adjusting the sending rate to correspond to the level of buffered data in the access network. When TCP Accelerator determines that too much data is being queued for a particular user, it sends less data for the user in order to give

time for the queue to shrink. TCP Accelerator learns the base latency for each user, which accounts for the varying radio access technologies and roaming users.

Importantly, TCP Accelerator prevents latency-insensitive applications from being favored over latency-sensitive ones. This approach treats all traffic fairly and has an enormous positive impact on QoE because it ensures sensitive applications aren't starved.

### QUIC Traffic Control

QUIC is a UDP-based, Google provided protocol that has been designed to deliver data at lower latency rates than those of TCP. The protocol has gained some market traction with YouTube and other popular applications using it for transport.

QUIC does not work in a coordinated fashion with TCP, so it can have a serious and negative impact on TCP traffic performance. Left unchecked, QUIC has a tendency to overwhelm the same network buffers used by TCP, degrading the performance of TCP-based services that are on their way to users.

Before choosing a TCP optimization solution, make sure that the solution addresses both TCP and QUIC traffic management to ensure that applications running over both protocols can continue to perform as intended.

### Egress Burst Control

When a large amount of data is released at once from a server close to the core network, this traffic can overwhelm any switch where there is a speed differential (e.g., going from 10G to 1G); the buffers in the switch may be insufficient to accommodate micro-bursts resulting from the speed differential, and as a result they might be forced to simply drop packets. This behavior has a negative impact on the experience of all users on the impacted switch.

To prevent this scenario from unfolding, Sandvine's TCP Accelerator prevents buffer overflow by limiting the amount of traffic sent to a user in a configurable fraction of a second (typically a millisecond). This limiting allows the switch to handle the burst without exhausting its buffers, significantly reducing retransmission rates.

This functionality can relieve a network operator from replacing a huge number of switches.

### Universal Access Support

TCP Accelerator can be deployed in any type of access network, with any combination of access technologies (e.g., Cable, DSL, 3G, 4G, WiFi, Satellite, WiMAX, etc.).

In mobile networks, TCP Accelerator even supports deployment in shared RAN environments with a Multi-Operator Core Network (MOCN).

### Audit Records and Historic Reporting

TCP performance measurements and statistics are logged and can be used for audit purposes or examined for business and operational intelligence.

## ABOUT SANDVINE

Sandvine helps organizations run world-class networks with Active Network Intelligence, leveraging machine learning analytics and closed-loop automation to identify and adapt to network behavior in real-time. With Sandvine, organizations have the power of a highly automated platform from a single vendor that delivers a deep understanding of their network data to drive faster, better decisions. For more information, visit **sandvine.com** or follow Sandvine on Twitter at **@Sandvine.**

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