Updates on TCP Fast Open deployment

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Recap from IETF 100

• Enabled by default in Edge browser on Fall Creators Update (builds 16299+)
  • Now the significant majority of all Windows 10 devices
• TFNO – the middlebox with all possible TFO failure modes
• Passive probing algorithm to minimize disruption to user experience
• Around 26% devices successfully used TFO and did not fallback
• A/B test result - No measurable increase in navigation failures
• Failures are correlated with geography
• Failures are correlated with specific networks
TCP Fast Open – Fallback algorithm

• Limited passive probing
• Probing is limited to “Internet connected” networks and no presence of incompatible 3rd party antivirus callout drivers
• TFO probing needs multiple connections to same server
• Allow only one probe TFO connection to proceed at a time (semaphore)
• When the probe connection is closed, mark success if all of the following hold
  • no RST in response to SYN
  • no SYN timeout
  • no full connection timeout (data packet retransmitted N times to failure)
  • data is exchanged in both directions
  • connection wasn't cancelled
  • no sudden RTT increase
• If a successful probe connection succeeded exercising cookie, success
• If a network hits fallback, persist & never attempt again
• If a network hits success, stop probing & remember for boot session
Shortcomings of the Fallback algorithm

• SYN timeout heuristic makes fallback very aggressive
• Too conservative – doesn’t persist success
• Assumes problems are close to the client and not the server
• Possibly long delays to determine success or fallback due to requiring multiple probe connections to close (reach CLOSED state)
  • long lived HTTP/2 probe connection
  • long timeouts
• Worst case middlebox behavior can still cause connectivity issues
  • i.e. dropping all packets from client IP address upon SYN with cookie request
Improvements in Spring Creators Update

• Persist both success and fallback per network
  • Start off every device to probe again on upgrade

• Fallback only if SYN with TFO option fails and subsequent SYN succeeds
  • Loss of connectivity or server side firewall / downtime will not trigger fallback
  • Probing is no longer restricted to “Internet connected” networks

• Unknown TCP options reflected back!
  • Added this as a fallback condition
Some more data

• In overall population
  • 45% devices complete probing
  • Of these devices
    • 46% succeed, 54% fallback
    • We expect improvements here in future - the aggressive SYN timeout logic is going away

• Particularly poor success rates in some geographies
  • In China, only 3% of probe completed devices succeed, rest fallback
  • In India, only 18% of probe completed devices succeed, rest fallback

• Repeated A/B experiment of TFO on/off on larger retail population - no statistically significant impact on page navigation failures
Looking ahead

• Explore active probing to solve
  • Long delays
  • Minimize impact to user experience
  • Simplify the algorithm

• Augment with some form of happy eyeballs like approach to solve problems closer to the server
  • Unclear if this is really needed based on data so far

• Request other browsers to enable TFO on Windows - no need for any complex fallback logic in the browser

• Should RFC 7413 be Standards Track? Should it document possible fallback algorithms?
Q&A