TCP Maintenance and Minor Extensions
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TCP sender clarification for Persist Condition. draft-ietf-tcpm-persist-07.txt

Abstract

This document clarifies the Zero Window Probes (ZWP) described in Requirements for Internet Hosts [RFC1122]. In particular, it clarifies the actions that can be taken on connections which are experiencing the ZWP condition. This draft clarifies what has been till now a misinterpretation of the standard as specified in RFC 1122 [RFC1122] rather than making a change to the standard.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

Section 4.2.2.17 of Requirements for Internet Hosts [RFC1122] says:

> "A TCP MAY keep its offered receive window closed indefinitely. As long as the receiving TCP continues to send acknowledgments in response to the probe segments, the sending TCP MUST allow the connection to stay open.
>
> DISCUSSION:
>
> It is extremely important to remember that ACK (acknowledgment) segments that contain no data are not reliably transmitted by TCP."

Therefore zero window probing needs to be supported to prevent a connection from hanging forever if ACK segments that re-opens the window is lost. The condition where the sender goes into the Zero Window Probe (ZWP) mode is typically known as the 'persist condition'.

This guidance is not intended to preclude resource management by the operating system or application, which may request connections to be aborted regardless of them being in the persist condition, and the TCP implementation needs to, of course, comply by aborting such connections. TCP implementations that misinterpret Section 4.2.2.17 of Requirements for Internet Hosts [RFC1122] have the potential to make systems vulnerable to Denial of Service (DoS) [RFC4732] scenarios where attackers tie up resources by keeping connections in the persist condition, if such resource management is not performed external to the protocol implementation.

This draft clarifies what has been till now a misinterpretation of the standard as specified in RFC 1122 [RFC1122], rather than making a change to the standard.

Section 2 of this document describes why implementations might not close connections merely because they are in the persist condition, yet need to still allow such connections to be closed on command. Section 3 outlines a simple attack on systems that do not sufficiently manage connections in this state. Section 4 concludes with a requirements-language clarification to the RFC 1122 requirement.

2. Discussion on RFC 1122 Requirement

Per Requirements for Internet Hosts [RFC1122] as long as the ACK's are being received for window probes, a connection can continue to stay in the persist condition. This is an important feature because typically applications would want the TCP connection to stay open unless an application explicitly closes the connection.

For example take the case of user running a network print job during which the printer runs out of paper and is waiting for the user intervention to reload the paper tray. The printer may not be reading data from the printing application during this time. Although this may result in a prolonged ZWP state, it would be premature for TCP to take action on its own and close the printer connecting merely due to its lack of progress. Once the printer's paper tray is reloaded (which may be minutes, hours, or days later), the print job needs to be able to continue uninterrupted over the same TCP connection.

However, systems that misinterpret the above section of Requirements for Internet Hosts [RFC1122] may fall victim to DoS attacks, by not supporting sufficient mechanisms to allow release of system resources tied up by connections in the persist condition during times of resource exhaustion. For example, if we take the case of a busy server where multiple (attacker) clients can advertise a zero window forever (by reliably acknowledging the ZWPs). This could eventually lead to the resource exhaustion in the server system. In such cases the application or operating system would need to take appropriate action on the TCP connection to reclaim their resources and continue

to maintain legitimate connections.

The problem is applicable to TCP and TCP derived flow-controlled transport protocols like SCTP.

Clearly, a system needs to be robust to such attacks and allow connections in the persist condition to be aborted in the same way as any other connection. Section 4 of this document provides the requisite clarification, to permit such resource management

3. Description of one Simple Attack

To illustrate a potential DoS scenario, consider the case where many client applications open TCP connection with a HTTP [RFC2616] server, and each sends a GET request for a large page and stops reading the response partway through. This causes the client's TCP implementation to advertise a zero window to the server. For every large HTTP response, the server is left holding on to the response data in its sending queue. The amount of response data held will depend on the size of the send buffer and the advertised window. If the clients never read the data in their receive queues in order to clear the persist condition, the server will continue to hold that data indefinitely. Since there may be a limit to the operating system kernel memory available for TCP buffers, this may result in DoS to legitimate connections by locking up the necessary resources. If the above scenario persists for an extended period of time, it will lead to TCP buffers and connection blocks starvation causing legitimate existing connections and new connection attempts to fail.

A clever application needs to detect such attacks with connections that are not making progress, and could close these connections. However, some applications might have transferred all the data to the

TCP socket and subsequently closed the socket leaving the connection with no controlling process, hereby referred to as orphaned connections. Such orphaned connections might be left holding the data indefinitely in their sending queue.

CERT has released an advisory in this regard[VU723308] and is making vendors aware of this DoS scenario.

4. Clarification Regarding RFC 1122 Requirements

As stated in Requirements for Internet Hosts [RFC1122], a TCP implementation MUST NOT close a connection merely because it seems to be stuck in the ZWP or persist condition. Unstated in RFC 1122, but implicit for system robustness, a TCP implementation needs to allow connections in the ZWP or persist condition to be closed or aborted by their applications or other resource management routines in the operating system.

An interface that allows an application to inform TCP on what to do when the connection stays in persist condition, or for application or other resource manager to query the health of the TCP connection is considered outside the scope of this document. All such techniques however are in complete compliance of TCP [RFC0793] and Requirements

for Internet Hosts [RFC1122].

5. IANA Considerations

This document has no actions for IANA.

6. Security Considerations

This document discusses one system security consideration as described in Security Considerations Guidelines [RFC3552]. In particular it describes a inappropriate use of a system that is acting as a server for many users. That and a possible DoS attack is discussed in Section 3.

The document limits itself to clarifying RFC 1122. It does not discuss what can happen with orphaned connections and other possible mitigation techniques, as these are considered outside the scope of this document.

7. Acknowledgments

This document was inspired by the recent discussions that took place regarding the TCP persist condition issue in the TCPM WG mailing list [TCPM]. The outcome of those discussions was to come up with a draft that would clarify the intentions of the ZWP referred by RFC 1122. We would like to thank Mark Allman, Ted Faber and David Borman for clarifying the objective behind this draft. To Wesley Eddy for his extensive editorial comments and to Dan Wing, Mark Allman and Fernando Gont on providing feedback on the document.

8. References

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