Abstract

Project Code: TRG5380023

Project Title: Modelling and Analysis of the Simultaneous Open Procedures of Datagram Congestion Control Protocol

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Project Period: 31 May 2010 – 30 May 2011

Using a formal technique called Coloured Petri Nets (CPNs), this project investigates the simultaneous open procedure of a new Internet transport protocol, the Datagram Congestion Control Protocol (DCCP), published as RFC 5596 in September 2009. The design rationale of RFC 5596 aims to overcome the DCCP weakness when the Server is behind a middle box, such as Network Address Translators (NAT) or firewalls. According to DCCP specification, RFC 4340, published in March 2006, only the Client can initiate the connection while the Server is in the passive listening state. If the Server is located behind Network Address Translator (NAT) or firewall, the packets from the Client will never reach the Server. To overcome this problem Internet Engineering Task Force (IETF) working group suggests “Hole Punching” technique. But this technique requires both Client and Server are able to initiate the connection about the same time. Because of widely deployed NAT, we envisage that the Simultaneous Open will be the typical operation mode of DCCP in the future. Thus it is vital to understand the procedures clearly and ensure that there is no error.

Two software packages called Design/CPN and CPN Tools are used to construct, maintain and analyse a CPN model of DCCP simultaneous open procedures. The difficulty is that the operation in the network layer, which is not specified in DCCP specification, has closely affected the operation of the DCCP entity. State space analysis of the two layers model: the transport and network protocols, causes states exploded severely. This project alleviates the state explosion using prioritized transitions and the sweep-line technique. To gain confidence to the simultaneous-open procedure, analysis result is obtained. So far no error has been found.

Keywords: Coloured Petri Nets, Reachability Analysis, Hole Punching, Network Address Translator.