Transmission Control Protocols for the Internet[1]

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Introduction

The consortium BRICKS (Basic Research in Informatics for Creating the Knowledge Society) is a six-year program partially funded by the Dutch BSIK theme ICT. BRICKS addresses the need for a strong impulse in fundamental research in informatics. Project AFM3 "Formal Methods for Active Networking" focuses on compositional formal techniques and methods for networking protocols.

Specifically, AFM3-2 concentrates on the Transmission Control Protocol (TCP) that is responsible for the bulk of the traffic carried by the Internet. It is therefore very important to gain a deeper understanding of this protocol. Even more, because of the advent of new server-based bandwidth-intensive applications, performance and quality-of-service issues become prominent. Formal specification and verification of TCP using process algebra is one approach towards this goal which will hopefully provide a formal correctness verification of TCP, performance analysis and tools for protocol (re)design.

Research Topic

The core of TCP is a sliding window protocol with variable window size. It is depicted on Figure 1. In addition, it uses several different timers to regulate the traffic flow. The congestion control is employed using several old-fashioned algorithms which are suitable for single-class, non-real-time, point-to-point traffic.

Due to recent advancements in protocol verification an untimed version of the sliding window protocol has been verified. However, this is not sufficient since the timing aspects are not taken into account. Even more, addition of time does not provide means to fully estimate the performance of the specific protocol design. Recent research shows that the packets are distributed according to heavy-tail distributions, which suggests employment of stochastic process theories.

On-going research

Current research focuses on stochastic process theory for description of network protocols. This will comprise the base for formal framework for protocol verification and optimization. Several algebraic aspects of the theory are under a current investigation.

We expect to obtain a suitable stochastic process theory that enables us to begin with optimization and performance analysis of some simpler communication protocols. This should give us some insight into the performance properties of the communication protocols and help us develop more efficient tools for performance analysis, which ultimately lead to description and analysis of TCP.

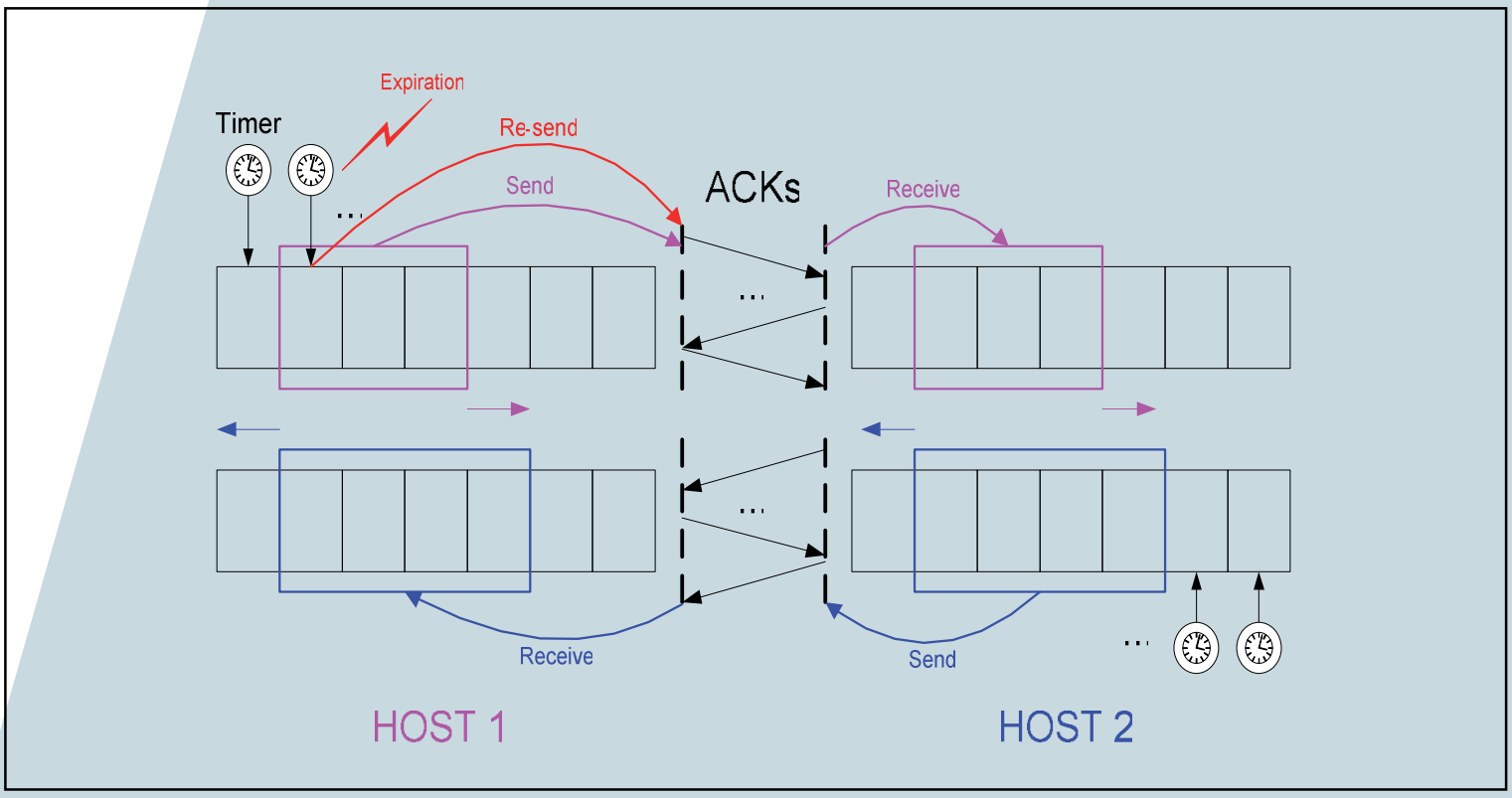

Figure 1: Scheme of a sliding window protocol

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