THE FUTURE TECHNIQUES OF TCP/IP

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ABSTRACT

The Transport Control Protocol (TCP) and Internet Protocol (IP) are the two useful communication protocols used in computer network today. In this paper we describe the evolution and the basic functionality of the TCP\IP protocol. After reading this article the reader will have a brief knowledge of the origin and evolution of TCP and IP, as well as their structure, operational lifetime and philosophy. We expose the reasons why the first information networks needed to evolve to become what we know nowadays as the internet. Finally a future view is detailed of what the recent studies and tested technologies bring as the best solution to support the growing demands of the users and technological improvements. Multi-bit control feedback, are the key words to describe the future in network communications. Technologies like FAST TCP, delay-based systems and the 4G Mobile Networks based on IP are the most modern researches and the future for all networks communication.

1. INTRODUCTION

The TCP protocol belongs to the Transport Layer in the OSI model which is an abstraction model for computer communication through networks. The task of the TCP protocol is to ensure a reliable communication between two hosts on an unreliable network. In one end it provides a service to the communicating application and in the other end, the IP protocol.

In section II the birth of the protocols is explained both sociological and technological purposes. Since the 1960s the military in collaboration with several different universities in the U.S. started working in the implementation of a global network which purpose was connecting different locations working under different protocols and share information with several kinds of storage systems.

In Section III we explain some basic functionalities of the TCP protocol and how it works. We will concentrate on connection establishment, connection release and the sliding window protocol.

An expert reader may be interested in skipping the whole previous sections to section IV where is explained in detail the most recent discoveries and implementation about TCP and IP. There, some specifications about FAST TCP are detailed; a new estimation about the flux in the network is approached by the concept of delay-based systems instead of packet loss rate.

Section V contains the conclusions reached after discussions about the statements in section IV always minding the history and evolution of the protocols.

2. History of TCP/IP

IP was born to cover U.S. Department of Defense's communication needs. Last years of the 1960s the Advanced Research Projects Agency (ARPA), which is known nowadays as DARPA, started developing in common with some partner universities and the corporate research community the design of standard protocols and started building first multi-vendors networks. The result of working all together was ARPANET, the first packet switching network that was tested in 1969 with four nodes using Network Control Protocol. After the successful test the new born network turned into an operational network called ARPA Internet. In 1974 Vinton G.Cerf and Robert E.Kahn designed TCP/IP protocols.

In January 1980 the Institute of Information Sciences at University of Southern California elaborated a reference document [5] describing the philosophy of the Internet Protocol. It was designed to be used in an environment of computer communication networks oriented to

packet switched systems interconnected between them.

In 1985 ARPANET started suffering from congestion and the National Science Foundation's developed NSFNET to support the previous net which was finally closed in 1989. The NSFNET was based on multiple regional networks and peer networks such as NASA Science Network. By 1986 there was a network architecture connecting campuses and research organizations connected also to super computer facilities. Over the years the speed of transmissions had to be increased and by 1991 the backbone was moved to a private company which started charging for connections and companies like IBM developed ANSNET in parallel which was nor aimed to enrich these companies.

The structure of the information running through the network was designed as blocks of data split in small segments of bits called datagram's. Datagram's are packaged and sent from sources to destinations which are both hosts distinguished by a fixed length address. These datagram's are long enough to be considered a risk of loss of information due to the characteristics of the communications channel, fragmentation and reassembly. The internet protocol covered all needs to provide host-tohost delivery and its limitation such as reliability, flow control, sequencing among others, were not considered.

The internet protocol was meant to interact with local network protocols to transport the required datagram to the next gateway or destination host. It implemented addressing and fragmentation as two basic functions. The datagram contains information about host source and host destination within its header. This information is coded as an address and in order to complete the delivery a path must be chosen. The operational structure isolates every host and its gateway that connects to the global network. These isolated modules take decisions based on common rules to interpret datagram's and make routing decisions as well as other functions. Each datagram is treated as an independent unit on its way through the network. Any trace of logical circuits or connections is banished.

To provide service, four parameters were created: Type of Service, Time to Live, Options and Header Checksum. The first one provides information about the QoS (Quality of Service) available being eligible for example Real Time, Interactive or Bulk. This QoS responds to how gateways manage the transmission parameters for a specific network, the network used by the next node or the next gateway when routing a datagram. Time to Live is a countdown number that indicates how long a datagram is meant to last and after reaching zero it is self destroyed. Options parameter does not represent a vital part of the protocol because gives support to non regular situations in the communications process when errors occur or special routing is needed among others. The fourth parameter created was Header Checksum which gives feedback information about the correct transmission. If this parameter shows an error the whole datagram is discarded and a fundamental characteristic that comes with this error assumption is that IP does not have retransmissions, error control for data but the header checksum or flow control

As computer communication became more and more important, especially for the military at that time. It was realized that a robust communication standard is needed to replace the variety of different local network protocols that were used. A concept for the TCP was first described in [8] where several issues that would be solved where presented. The TCP was declared to be a reliable connection-oriented, end-to-end protocol. It was meant to operate on top of the IP protocol. TCP was first defined in [4].

3. Present TCP/IP

To accomplish its task, both the receiver and the sender must create communication end points, called sockets, or more precisely the communicating processes on each of the senders and receivers machines are creating the sockets. It is trough the sockets that the communicating processes can send and receive data. Each socket has an IP address and a port number. There are some well known port numbers like port 21 for the FTP protocol which with many others is included in the TCP/IP suite. Port numbers below 1024 are reserved for such well known services. A TCP connection is established between two hosts only, which mean that multicasting and broadcasting is not supported. Some features of the TCP include buffering of data, which means that the data passed to TCP may not be sent immediately instead the TCP may buffer it. Hence a larger chunk of

data can be sent. This means that the data is sent as a byte stream and not as a message stream

3.1 The TCP Segment Structure

The TCP uses a segment structure to send data. Each segment contains information for the TCP/IP protocol, as well as the data itself. First we have the IP header with a fixed size of 20 bytes. The IP header contains IP specific information, like the IP address. After the IP header we have the TCP header, also with a fixed size of 20 bytes. Attached to the end of the TCP header is the data itself, the size of the data can be 0 – 65,495 bytes [7].

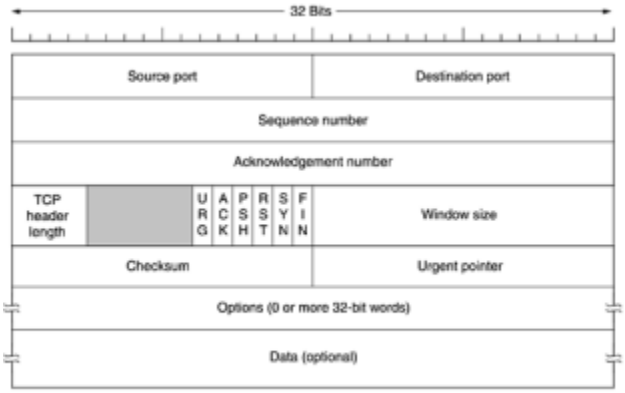

Figure 3.1 TCP header. [7]

First we have the source and destination port fields, these are for the 16-bit port numbers that identify the sending and receiving applications. Sequence numbers are used to ensure that packets arrive in the right order, no packets are missing and to detect duplicates. We will explain this further in the following section. Acknowledgments are used to ensure that packets have arrived at their destination. The TCP header length field basically shows where the data field begins. This is because the options field is variable. After the reserved space, there are six 1-bit fields for different flags

TCP is using a flow control protocol called sliding window. The window size field specifies the number of bytes that may be sent to the receiver. The window size may change trough out the lifetime of a connection. A value of zero means that the receiver doesn't wish to receive more data. This is useful if the receiver becomes overloaded. In the checksum field, a checksum of the whole header including the data is calculated. The urgent data pointer is for the signaling mechanism in the TCP protocol, this field indicates the last byte of the urgent data. The options field is variable and allows adding extra functionality to the header.

Future IP

It is on some developers mind the future of mobile communications an IP based network that will be part of the 4G Mobile Networks. This forces to make improvements to change from the traditional packetswitched networks to a packet based wireless IP network and also is seen as the motor-breath for new communication systems and technologies development. The infrastructures of a wireless network are not so much physically dependent as wired networks, which brings economic and security issues to debate just to come up with a compromise relation between users and operators. As is explained by Kurtansky [3] in his paper, AAAC Arch. stands for Authentication, Authorization, Accounting and Charing Architecture. According to the paper "this architecture has been implemented to facilitate the deployment of a ubiquitous mobile IPv6-based, QoS-aware infrastructure through a flexible and evolutionary AAAC Architecture". In order to give support to both AAAC client and AAAC server [3] focuses on both DIAMETER client and DIAMETER server. Client daemon is in charge of accepting registration requests and forwarding to the server daemon. It uses User Registration Protocol (URP) and DIAMETER protocol. The server daemon has the task of authentication, authorization, and accounting based on the user profile information as show in Figure 3.1

Conclusion

Since the giant step growing of the internet in the late 1990s it has been demonstrated that TCP protocol may evolve into a more flexible protocol. Since upcoming protocols such as modified TCP stacks appeared it has been tested that a balance must to be kept between network sharing with other competing protocols and innovations in these new protocols, in order not to get network congestion collapse. Fast TCP discards the old loss probability model and uses a delay-based model. A

balanced zero-state is set at the delay queue which tries to control flow-level and bandwidth. A multi-bit feedback control system is used to be more accurate than the regular TCP. It is a fact the 4G Mobile Networks will be IP-based and this new concept of communications technology gives a new role to the internet protocol. The complexity of networks evolution grows in parallel to the digitalization era started in the 1990s. The only way to support the strong increase of users demand and the fast technological development lies on a twist on the concept of the future networks. To cover future needs we have to implement a cohesion point from improved actual tools. That is the reason why extreme changes are not accepted. Using IP as the protocol for 4G Mobile Networks is an example of technology improvement with improved actual tools. FAST TCP shows how a twist in the observer perspective, since a scientific point of view, can bring important developments without using new technological advances but a better knowledge of mathematics.

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