Modeling and Analysis of WAP protocol Family

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Abstract

The importance of data networks and multimedia cannot be overestimated in contemporary world, at the dawn of Information Era. Information collection, processing and distribution systems are the key points for applying the scientific knowledge. Specification and verification of communication protocols and boosting their performance became the topics of the day. Due to the development of mobile systems the wireless networks are in good demand.

Thanks to technological advances in wireless data transfer the hardware and software developers offer a wide range of new services like mobile internet. Innovations must be useful, convenient flexible, fast and secure enough with the least possible amount of errors during operation.

One of the ways to provide mobile internet is a WAP stack of protocols. WAP abbreviation translates into Wireless Application Protocol or Wireless Access Protocol. The second reading is more precise in reflecting the meaning of WAP technology, purpose of which is to grant access to information stored directly in the Internet.

We propose a modification for Wireless Transaction Protocol (WTP is the transport layer of WAP) which improves the original flow control algorithm. The work includes new ideas of developing and improving WAP as one of the important technologies.

We use NS2 (Network Simulator) which provides an opportunity to specify such network protocols and simulate their behaviors.

INDEX TERMS: WIRELESS APPLICATION PROTOCOL, NETWORK SIMULATOR, FLOW CONTROL PROTOCOL.

I. INTRODUCTION

People like to communicate, and they develop a lot of ways to “keep in touch”. First it was mail, pigeon, telegraph, telephone, radio, and in the late 20th century came another - fixed telephone networks, the television and radio broadcasting. In the beginning of the 21st century computer networks became the most important way of communication. Wireless networks are one of the methods of communication. They spread worldwide and help people to communicate. There are several protocols which provide access to the wireless internet. One of the most popular is Wireless Access Protocol (WAP) [5]. The most exact definition of WAP technology: to provide access to the information from the internet for the mobile devices which have some specific characteristics:

- small amount of memory devices;
- small size of the phone's screen, as well as the limitations of his keyboard;
- low processor speed;
- low bandwidth of the communication channel;
- possible long timeouts.

WAP was developed to overcome these problems and that is its major difference from HTTP and TCP/IP. Note that the user does not resort to the assistance of additional devices, such as modem. WAP is a protocol that describes the way in which information from the Internet displays on the small screen of mobile phone.

WAP is a stack of protocols which consists of several layers. According the OSI (Open Systems Interconnection) model WAP contains six layers (Application layer, Session layer, Transaction layer, Secure layer, Wireless Datagram Protocol and Bearers). Each layer is intended to perform a well-defined function. We are focusing on the transport layer. We modify the flow control algorithm in WAP using ideas which are the basis of the ARTCP algorithm [1]. This protocol offers a new method of flow control based on rate control of the transfer of segments in the network.

Protocol ARTCP (Adaptive Rate Transmission Control Protocol) borrows some of the mechanisms of the TCP protocol which is the main transport protocol of the internet. Protocol ARTCP differs from TCP standard. Segments are sent to the network not in the form of the burst, but separated by time intervals. Sending rate depends on receiving rate as both parameters are included into the ratio which is changing the principle of system's work. Algorithm has a mechanism of adaptating according to the evolving conditions of a network.

We will check properties of our algorithm with the help of a network simulator. There are two modeling approaches: analytical approach and simulation approach.

We decided to build a model with NS2, which provides an opportunity to specify such network protocols and simulate their behaviors.

II MAIN PART

A. System modeling. NS2.

Simulation is widely-used in system modeling for applications ranging from engineering research, business analysis, manufacturing planning, and biological science experimentation [4].

Network Simulator (Version 2), widely known as NS2, is an event driven simulation tool which is very useful in studying the dynamic nature of communication networks. NS2 provides users with a way of specifying such network protocols and simulating their behaviors.

NS2 suggest two steps of work. The first step is constructing a model with the help of programming on C++, and finally the use of the Object-oriented Tool Command Language (OTcl) for analysis of the model and simulating the network conditions. It allows us to include our C++ programming code to the NS2 environment (Fig.1, Fig.2) [2].

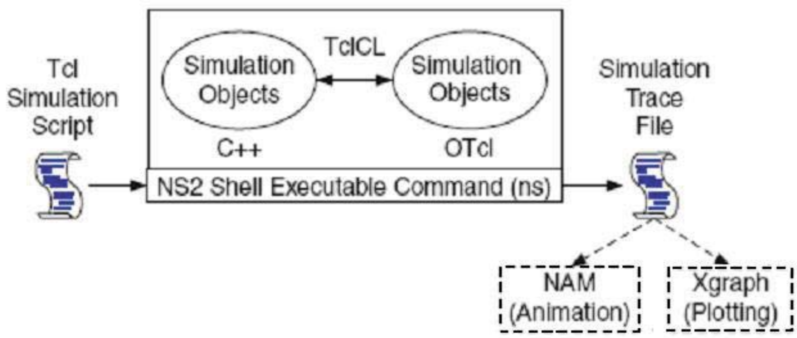

Fig. 1. Basic architecture of NS

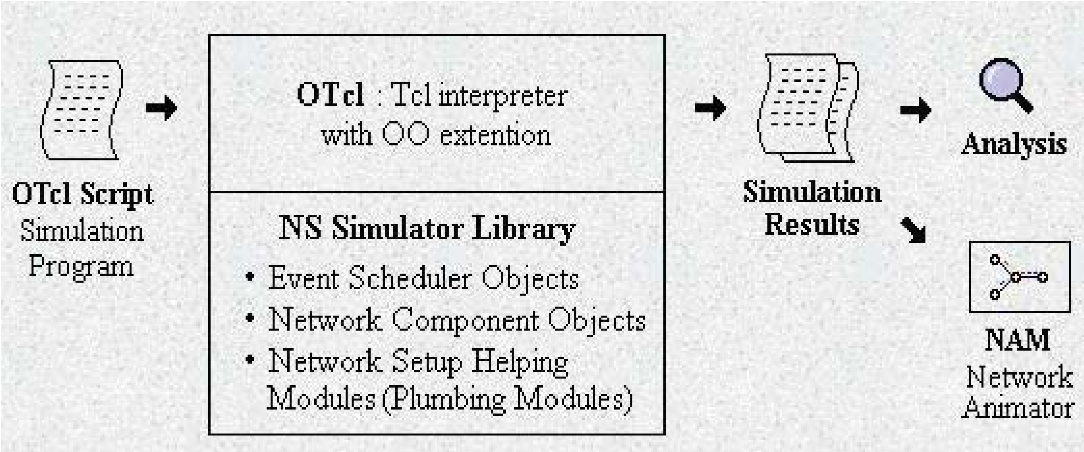

Fig.2. Simplified User's View of NS

We decided that NS2 is the most convenient tool for modeling the network behavior.

B. WTP.

The Wireless Transaction Protocol is responsible for reliable message delivery. Maximum Transfer Unit (MTU) is a maximum size of a packet in networks. If we have a message that is bigger than MTU then WTP fragmentizes this message. There are three classes of operation for this protocol. We are focusing only on class-2 operation for Wireless Transaction Protocol [5]. Flow control in cases of fragmented messages, is performed by sending fragments in groups. Every group of packets requires only one acknowledgement of the group. The last packet of each group contains a special flag. This flag indicates the end of the group and receiver knows when to send an acknowledgment. Size of each group depends on the link characteristics and the device memory. It is necessary to avoid extra packet retransmission and data loss. Receiver sends a negative acknowledgement (NAK) if the end-of-group packet is received whilst intermediate packets are missing. This operation is repeated until the entire group is received and a positive acknowledgment is sent. If timeout occurs, only the last packet of the group is retransmitted, and sender knows what packets have been lost. Wireless Transaction Protocol tries to minimize the number of unnecessary retransmissions [3].

C. Proposed model.

In our model we have three parameters, which we will modify depending on network performance. Let t_s is the time interval between consecutive packets of the group which are sent from the sender SENDER to the receiver RECEIVER. And t_r is the interval between consecutive packets of the group which are received by the RECEIVER. Let P_{am} as the number of packets in the group. In our model there are two types of acknowledgments (ACK is a positive acknowledgment, NAK is a negative acknowledgment) (Fig.3). When receiver sends an acknowledgment it transfers t_r with the help of it. Sender calculates the ratio t_s / t_r . Depending on the result of this ratio sender has several situations for analysis and further actions. The first one $t_s / t_r = 1$ reflects the perfect network conditions. The second one is $0{,}85 < t_s / t_r < 1$. All parameters can be modified by increasing P_{am}, decreasing t_s and timeout:

$k = t_s / t_r$ – the parameter;

$P_{am} = 2 * P_{am}$ (exponentially increase P_{am});

$t_s = t_s / 2$ (exponentially decrease t_s);

timeout = timeout /2 (exponentially decrease timeout);

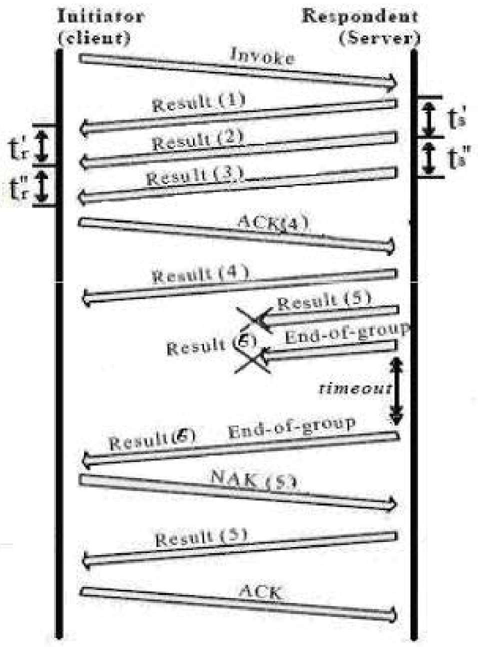

Fig. 3. Scheme of work

We conclude that if 0,70< t_s / t_r <0,85 there is no enough information about network for our algorithm to make a decision how to modify parameters (conditions of a network correspond to the established parameters). The fourth one is t_s / t_r <0,70, so the network is congested, all parameters can be modified by decreasing P_{am}, increasing t_s and timeout:

k= t_s / t_r – the parameter;

P_{am} = P_{am}/2 (linearly decrease P_{am});

t_s = 2* t_s (linearly increase t_s);

timeout = 2* timeout (linearly increase timeout);

III CONCLUSION

With the growth and development of communication systems the economic benefit from increased efficiency of communication protocols (such as WAP) can be very substantial. WAP requires serious improvement. We have developed a new method of flow control, which is based on the management of transmission speed, the number of outgoing information and the waiting time for a response from the recipient.

We concluded that the control algorithms of data streams using the insufficient number of network features. So they faced with the same error: overloading the network, and the subsequent loss or corruption of data. We propose the idea of the analysis of additional characteristics of the network and its subsequent improvement, depending on the incoming data.

We analyzed the transport layer (Wireless Transaction Protocol - WTP) of WAP protocol and concluded that the mechanism of flow control can be flexible and adapt to the conditions of the wireless environment. Wireless channels are characterized by high levels of errors and narrow bandwidth, therefore the network congestion occurs frequently (duration of waiting for a response from the server increases or data is lost). We have studied the weaknesses of the flow control mechanism of several protocols. We have made changes in the structure of the transmitted packets, entered additional information in the packet header, in a number of key functions of the protocol, which are responsible for sending, receiving packages and settings of timeouts.

In the future, we can create a protocol based on verified and analyzed model.

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