DEVELOPMENT AND SOFTWARE IMPLEMENTATION OF COMPUTER NETWORK ALGORITHM

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Abstract:

In this paper, we consider the problem of modeling computer networks. The description of the basics of computer modeling is given. We have demonstrated the development of the structure of the program. Information model of the computer network is shown, a detailed description of its components is given. The algorithm of the constructed model is given. A generic algorithm for implementation of transfer processes messages in the simulation model on the basis of constructed and marked out a joint venture is shown. The structure of the program is demonstrated. The developed environment for simulation of computer networks allows us to study in detail the processes that occur in computer networks during their creation and subsequent operation. To build models in this environment, the presence of related groups of objects representing certain elements of a real network is provided. The simulation of information exchange processes between model objects is carried out by sequential processing of events, each of which reflects the manifestation of certain processes in the elements of the network under study. The main windows of the software product interface are described. When choosing the right type of equipment in the right drop-down list on the left displays all the devices of the selected category. When you select a device from the left drop-down list it will be an icon of the device. We can combine these virtual devices into a fully fledged network routers, workstations, servers and others. The device can change or display its properties. In the properties window the information can be seen about the device, its parameters and characteristics. Each device we can set according to four points of network activity. During simulation of computer network, the user can do real-time monitoring of network activity. The results can be widely used for modeling various classes of computer networks.

Keywords:

Computer network, traffic loading, protocol.

ACM Computing Classification System:

Network protocols, network algorithms, network types.

Introduction

In today's world there is an active development of both - networks, and the services provided by these networks. This process requires not only the development of new technological equipment, software products and standards, but also the right and effective design of these networks [1].

Computer modeling has been shown to play an essential role in solving both of those, and other tasks. In the process of developing a model that approximates the properties and behavior of the network it makes possible to solve problems of optimization and management. Testing of certain decisions on the models is incomparably cheaper than the real system, and eliminates potential errors.

The aim of the paper was: study of simulation and possibilities of its application. Objectives of the paper were:

- study of the term "simulation" and its basic concepts;
- research capabilities of simulation application to build a computer network model;
- development of a computer program that simulates the operation of a computer network.

1 Basic Concepts of Computer Modeling

At present, the efficiency of construction and use of corporate information systems has become a very urgent task, especially in conditions of insufficient financing of information technology in enterprises.

The criteria for evaluating the effectiveness may reduce implementation costs of information systems and reach the better compliance with the current requirements and the requirements of the near future, with the possibility of further development and transition to new technologies.

The basis of the network is a computer system, which includes components such as a wired network and the active network equipment, computer and peripheral equipment, data storage equipment, system software (OS, DBMS), special software, and in some cases the application software [2].

Using expert evaluations – it is currently the most common approach to information systems. In accordance with this approach, experts in the field of computer technology, active network equipment and cable networks on the basis of their experience and expertise carry out the design of computer systems, providing solution to a specific problem or class of problems. This approach helps to minimize the cost of the design stages and to quickly evaluate the cost of the implementation of the information system. However, obtained expert estimates of the solution, as a rule, are subjective, as well as hardware and software requirements. An assessment of performance only guarantees the effectiveness of the proposed project and computer system under development.

Instead of using expert evaluations may be employed an approach involving the development of the model and simulation (simulation works) behavior of the computing system [3].

2 Development of Own Simulation Program Structure

Based on approaches and techniques of analysis and simulation of networks considered in the first chapter, the creation of prototype information system has main tasks:

Creation of adequate models of computer networks based on three types of data:
- data about the network topology;
- the routes and the characteristics of the traffic flows;
- data processing power of network devices.

Analytical calculation of network parameters for the models.

Carrying out simulation experiment of traffic transmitted
within the constructed network model.

Analysis of the results in order to identify "critical" sections of the network
with low or unstable processing / transmission speed of messages.

The system will allow to evaluate the computer network at the stage of designing or upgrading, but will also be useful for evaluating the effectiveness of already functioning networks and make recommendations for their optimization [4].

3 Information Model of the Computer Network

We consider a computer network consisting of devices of various types in which data packets circulate. Computational model of the network, in general, can be represented as shown in (Fig.1). Here are the basic data objects and relations between them:

Object "network" describes the real computer network
and may include subnet as other objects of this type.

Object "network device" is modeling devices that make up the network.
This is an abstract object, the function of which is to process packets, i.e, their device retention for a time and possible modification of the packet (e.g., change its type). Each instance of the object is characterized primarily by the value of its parameter "type". The types of the network device may include: workstations, communication, peripheral equipment, data transmission channels. Type identifies a particular structure of "network device".

Object "packet processing unit" describes a basic element of the network device responsible for the speed and processing discipline of network packets.

For network devices uniprocessor "processing unit" is modeling CPU work and comprises on its output data (transactions per second).

In multiprocessor devices, each "processing unit" describes a single processor. Data "processing unit" for network transmission channel is a virtual object and characterizes the data rate (bytes (bits) / second).

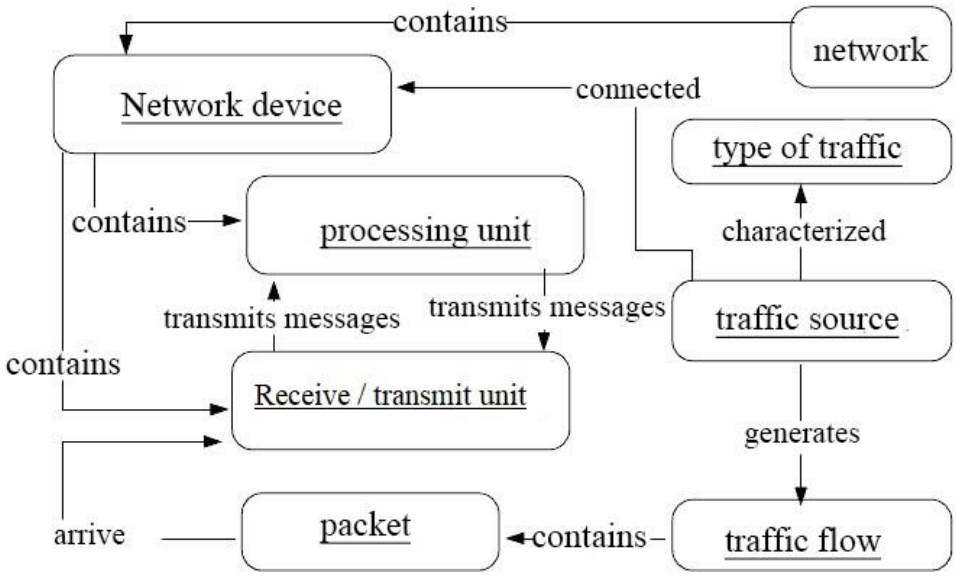


Fig.1. Information network model.

The object "transmission-reception unit" included in the "Network Device" serves to describe the network traffic flow input and output. The unit for reception and transmission network nodes is connected to their network interfaces.

Actually the analyzed network traffic is described by objects "Traffic type", "Source traffic", "Stream" and "Package." Object "Traffic type" contains information about the group of message flows in a network with common parameters. These parameters include:

- used protocols;
- services or applications that generate this traffic (for example, official, video, //p-traffic);
- priority of the traffic type;
- the delay coefficient associated with servicing this traffic type
  (e.g., queries may be served longer than the service traffic even with the same packet size);
- distribution law, characterizing the number of packets generated per unit of time;
- distribution law, characterizing the size of the packets generated per unit of time;

The object "Traffic Source" is the starting point of the same type of multiple traffic flows from one device to multiple. Traffic Source is characterized by "Transmission-reception unit" device with which it is associated "The type of traffic" and the timing of the start message generation, which may be set statically or determined at the time of operation of the device.

All messages are generated by "Traffic sources" in the general case with a different probability to enter multiple recipients (if one destination, then the probability of receipt a message equals to 1).

The object "Flow" is used for a general description of all messages generated by one "Traffic source" and directed to a single "Transfer-receiving unit" node on the same route, i.e., through some uniquely determined "Network device" at a certain time sequence.

Object "Package" describes one network flow package. Detailing to this level is only required for simulation, since its launch is associated with tracking the path of each packet. The result is a traffic statistics as a whole [5].

4 The Algorithm of the Constructed Model

The following is a generic algorithm for implementation of transfer processes for messages in the simulation model on the basis of constructed and marked out a joint venture. An event refers to the movement of the label from one position to another, ie, a plurality of kinds of S = <P1, P2, T, tr, t>, where P1, P2 - respectively are the inlet and outlet positions; T - crossing; tr - the type of traffic; t - the time at which an event occurs. A general algorithm:

```
Determination of the size of the time step for the model.
Determination of number of steps N (simulation time).
Loop through all traffic sources
        All streams cycle
                Calculating routes
        End of Cycle
End of the Cycle;
Getting a list of events for the step.
If the step is zero
        then Formation of the list of events:
                Loop through all the traffic on all source streams
                        Cycle
                                Calculation of events S (P1):
                                Choosing the next hop and the next position (of the route),
                                the time the calculation of t;
                                Adding to the list of S
                        End of the Cycle;
                End of the Cycle;
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Otherwise, if the list is empty and the step is not zero: Go to the next step;
Otherwise:
The cycle of events from the list
Checking on allowed events (corresponding transition)
If the event is allowed - Execution:
Formation of the next event S_{next}
Choosing the next hop and the next position (of the route), the calculation of the moment S_{next}.
Adding to the list
End If
End Cycle; S_{next}
End If;
End of Cycle on i.

The structure of the program is as follows (Fig.2).

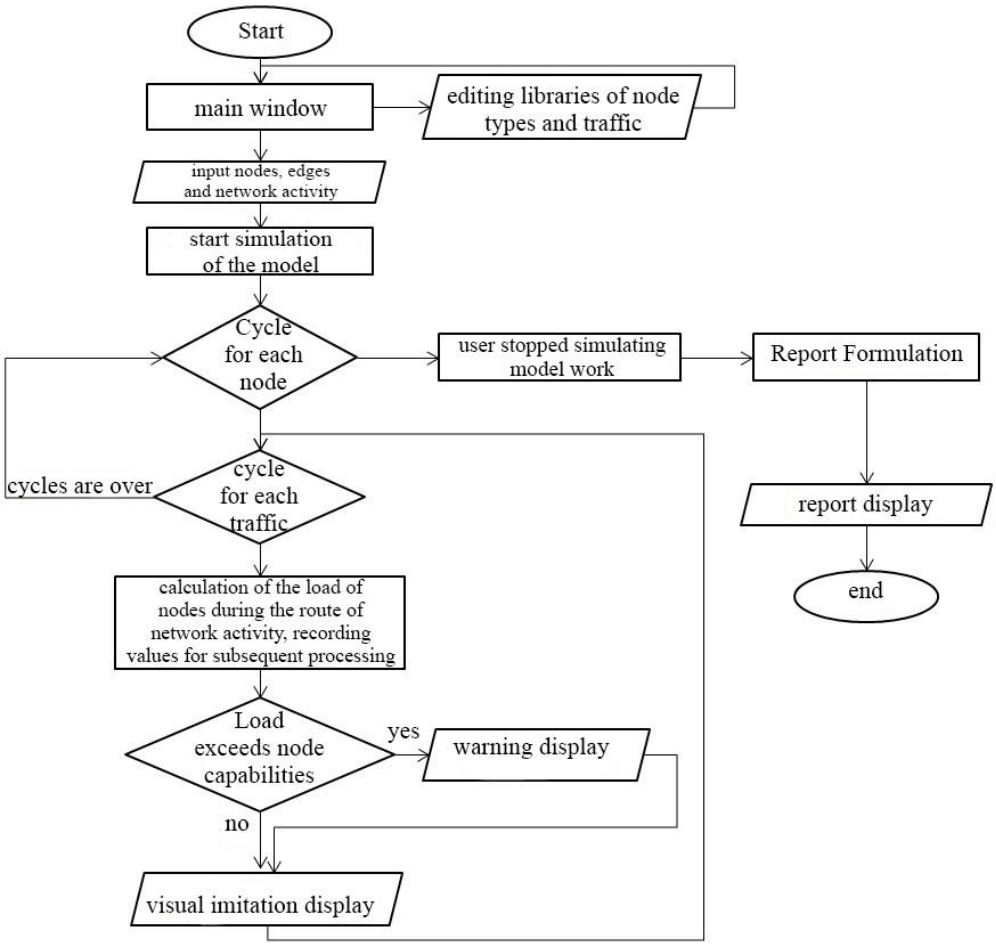


Fig.2. Structure of the program.

5 Process Network Model

(Fig.3) shows the working area of the program «Simulation Analysis». It is located at the top of the simulation tools, being necessary to: selection of equipment, statistics simulation, simulation of control [6].

When choosing the right type of equipment in the right drop-down list on the left, it displays all the devices of the selected category. When you select a device from the left drop-down list, there will be an icon of the device.

Now that we have selected the desired device, we can place it on our field by double-clicking the left mouse button (Fig.4).

Once the right devices are placed, we can connect them. To do this, just click on the selected device with left mouse button - in this case a line appears from the device to the mouse pointer, and then click the left mouse button on the second device with which we want to connect the first. Thus, we can combine devices into a fully fledged network routers, workstations, servers and other devices (Fig.5).

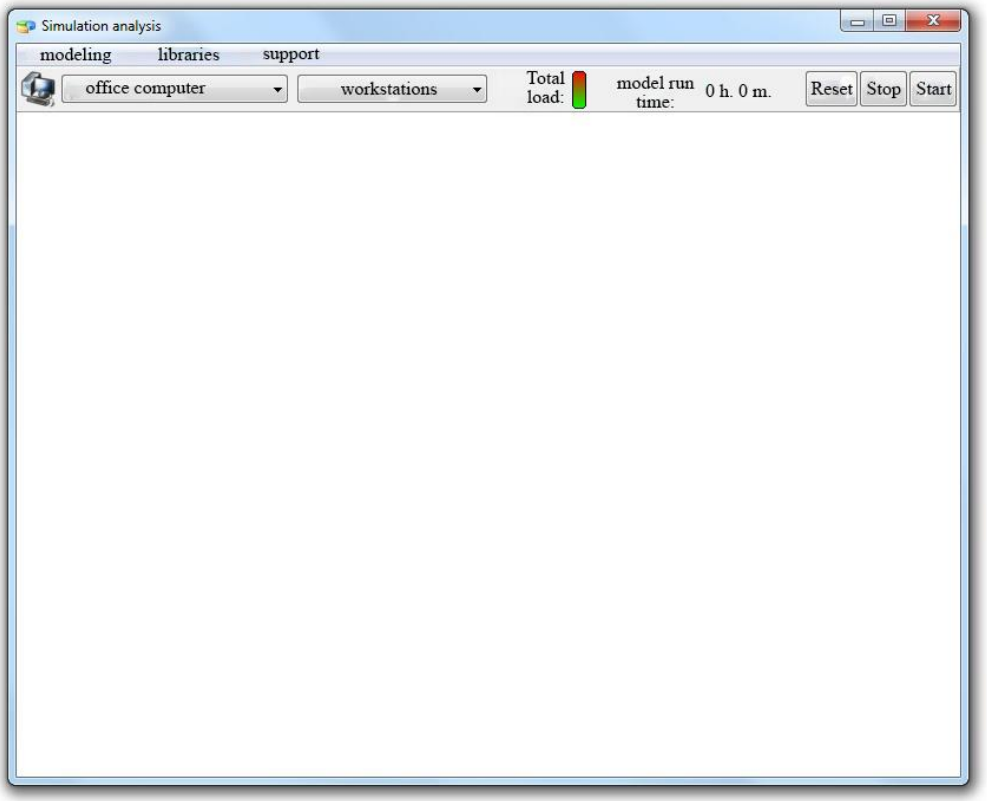


Fig.3. Working field of program.

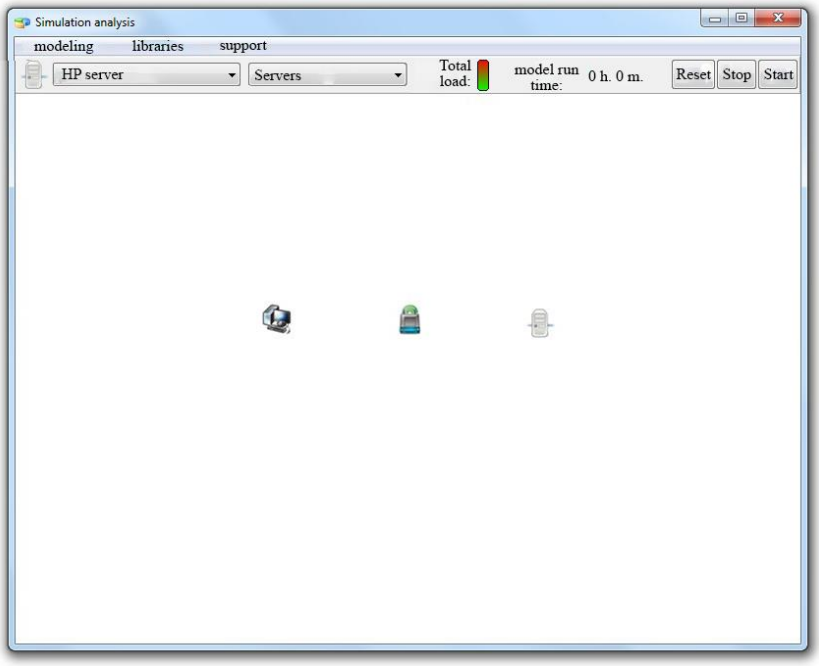


Fig.4. Devices taken on the working area.

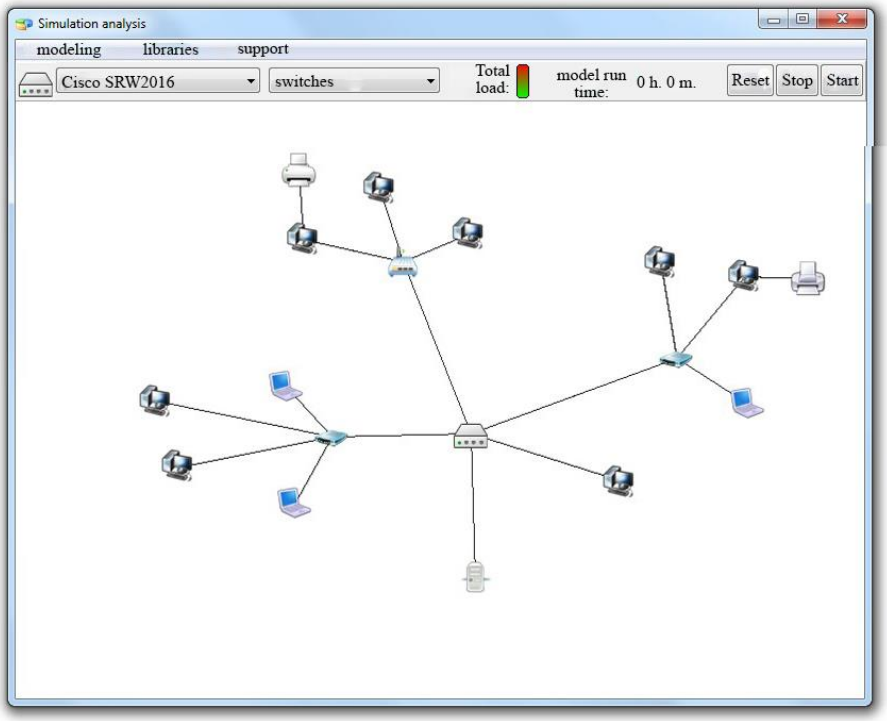


Fig.5.Example of simulated network.

Now we need to push all the necessary devices into the network activity. If we click on the device with the right mouse button, the context menu appears (Fig.6). This can move, delete, or display device properties.

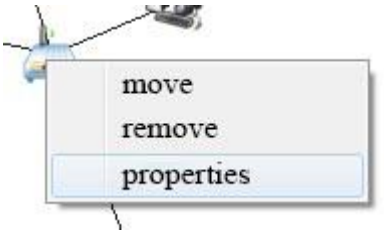


Fig.6. The context menu of the device.

The Properties window displays information about the device, its parameters and characteristics. We can also inspect here the network activity (Fig.7).

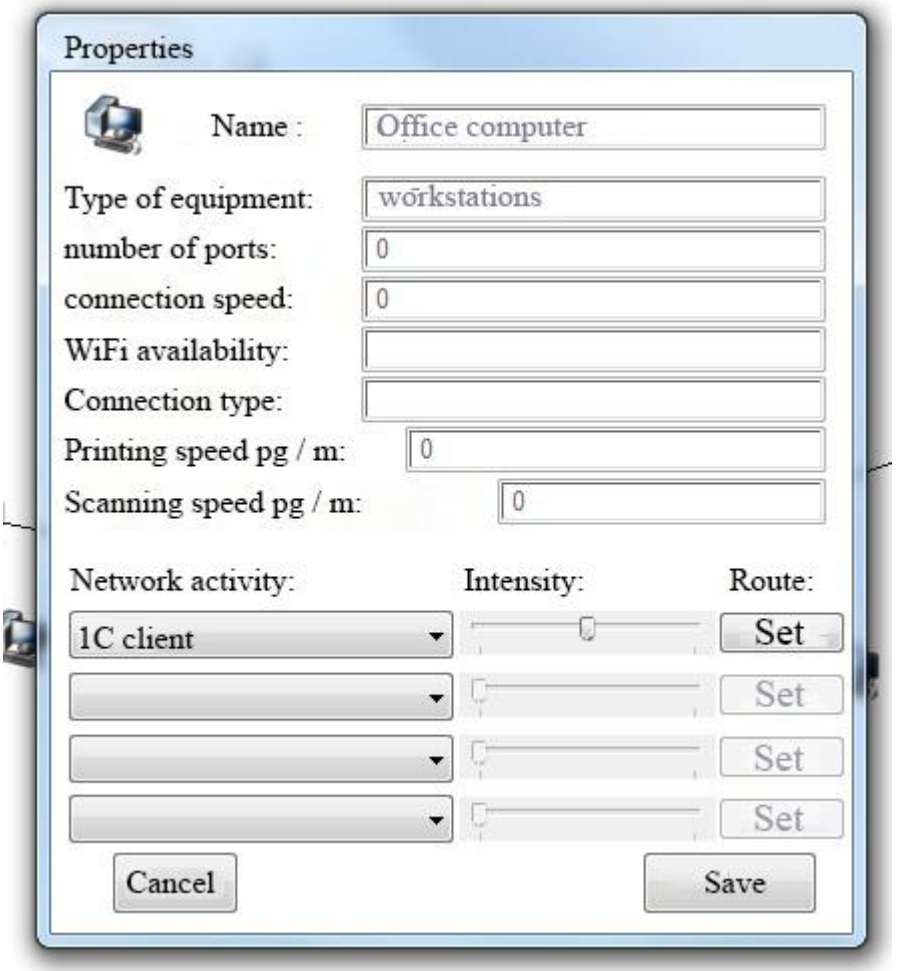


Fig.7. Window with properties of the device.

Each device can be set up to four modes of network activity. To do this, click on the desired drop-down list and select the desired network activity. This may be a client or a server 1C, file sharing, connecting to a remote desktop - in short, everything that is in the library of network activity. Selecting the network activity, we can set the intensity - if it is assumed that the work, for example, in a network 1C will be carried out without interruption, then choose a higher intensity. Here you can set the end point of the route of the package - for more detailed simulation (Fig.8).

Once all the necessary devices are assigned to network activity, we can proceed to the process of operating a computer network simulation in this model. At the right side of the top toolbar, users have access to the control buttons. We can start, pause and reset the simulation.On the left side of the buttons, a statistics is shown (overall network load) and simulation time [7].

During simulation of computer network, the user can make a real-time monitoring of network activity - it is expressed in packets that devices send each other. All this creates a burden on network equipment. In real time you can also look at the current level of load of a device (Fig.9).

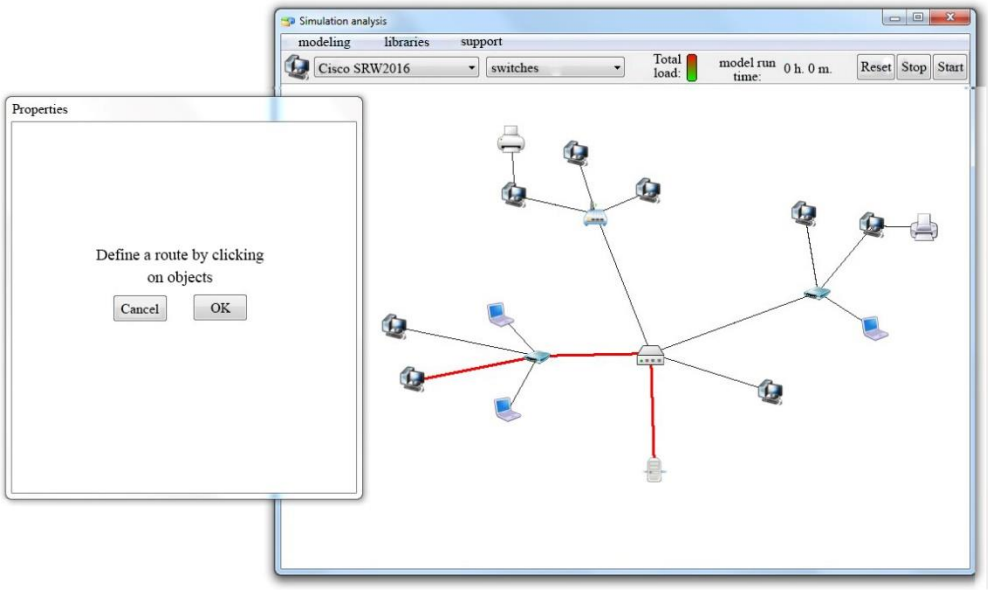


Fig.8. Route of chosen network activity.

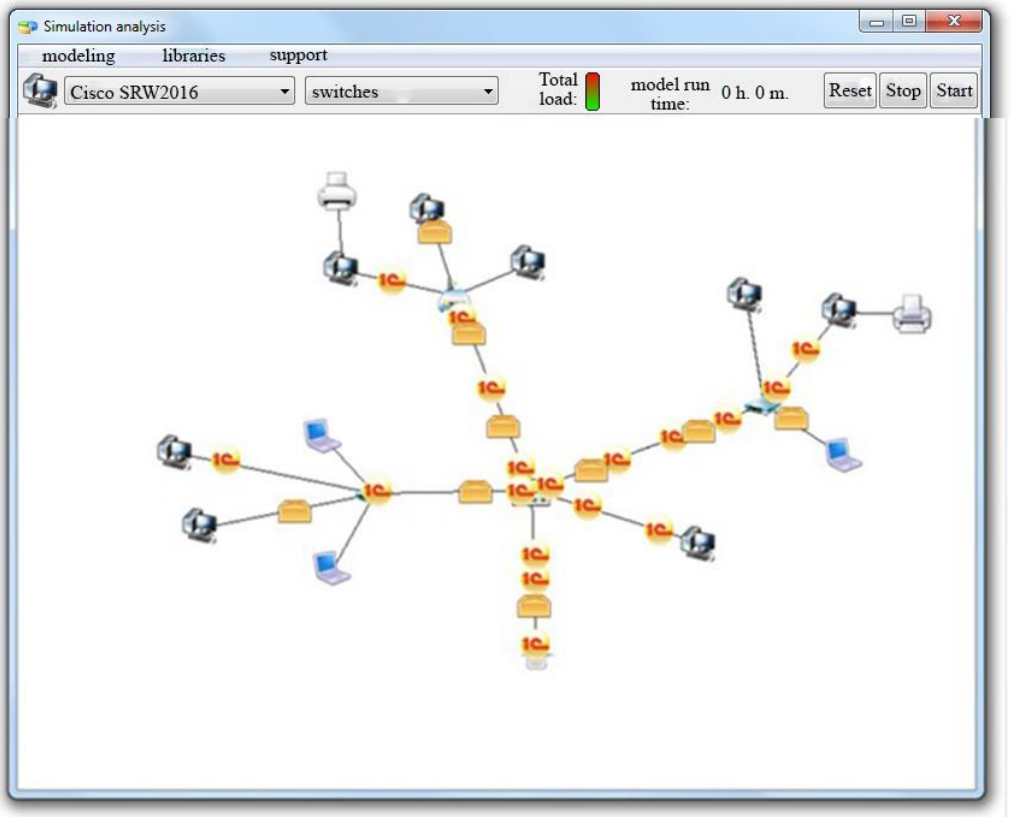


Fig.9. Simulation of network operation in action.

To view a consolidated report on the results of the simulation operation of the computer network, click "Stop". After that, a window appears asking to see the report. Click on "Yes". We will see a summary report with the results of the simulation (Fig.10).

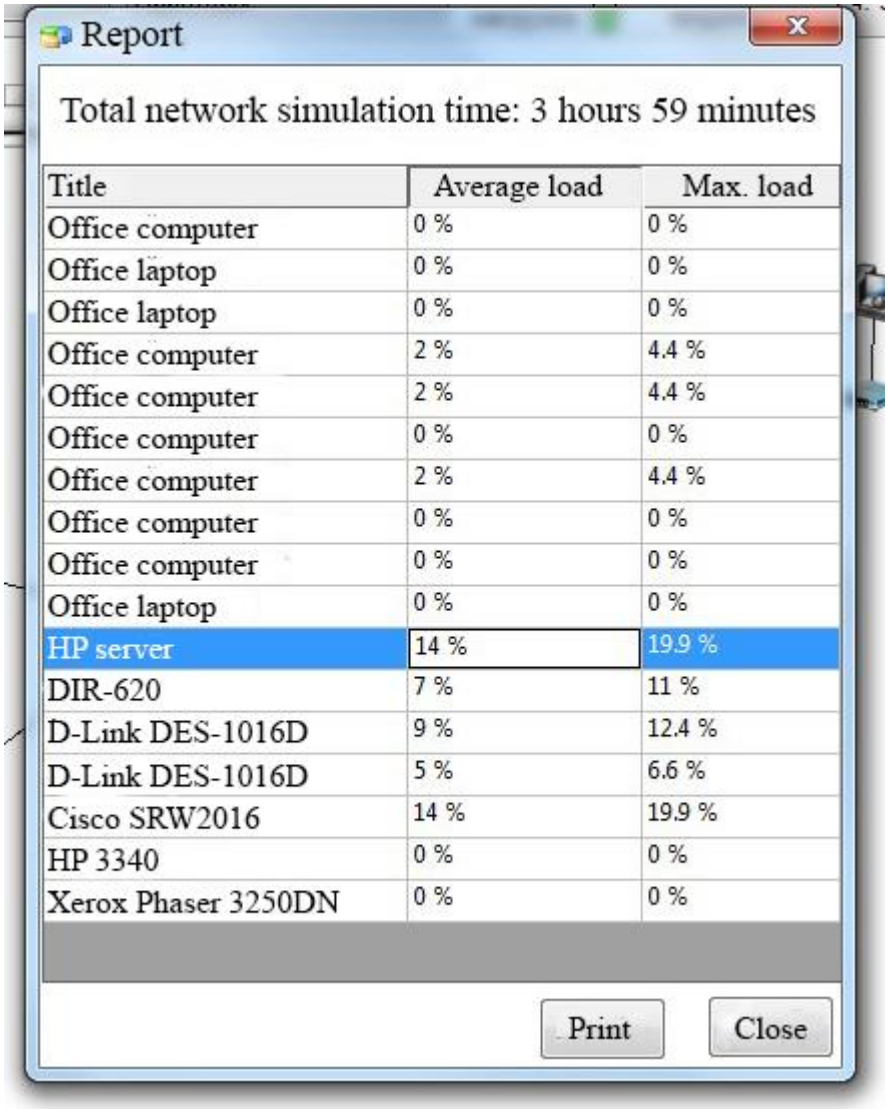


Fig.10. Results of the simulation of the network.

Conclusion

Based on the developed approach, there are opportunities for modeling computer networks. The created approach is implemented and the results of simulation are shown.

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