Web-based Approach to the Network Physical Topology Management

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Abstract: The computer networks need to be managed using network management platforms to operate without fails. The network management systems can automatically create maps of a network to help administrators to monitor this network. Unfortunately such maps represent only a logical layer of the network (e.g. IP-layer). There is no functionality in the management platforms to automatically create the maps of a physical topology of a network. Such physical maps are very important and helpful in network management, especially in the ATM technology. There are some applications available, which try to recognize the physical topology of the ATM network, but they can work only with devices made by one vendor and they are not sufficient to the proper management of the physical configuration of a heterogeneous net. This paper gives a basic idea and solutions to this problem. Authors describe how the automatic recognition of the physical network topology algorithm works and how it is implemented and tested in various heterogeneous ATM networks (MAN and WAN).

Keywords: (Web-based) Network Management, Asynchronous Transfer Mode (ATM), Physical Configuration, Automatic Recognition of the Physical Network Topology, Using SNMP to Manage Public Networks, Management of IP over ATM.

1. Introduction

The broadband computer networks need to be professionally managed to provide users with a reliable and quick way of communicating. Networks administrators use network management systems (e.g. IBM NetView, HP OpenView, etc.), which provide the functionality of monitoring and managing devices and connections in the network. The network management systems automatically recognize the topology of the network and show it on a graphical map. Unfortunately it helps only in the management of the logical configuration layer of networks. In the next section we explain where the problem is and what different applications can do to resolve it.

2. Problem of mapping a logical network topology into a physical topology

The graphical maps of the network topology, which are created in the management platforms, represent the only logical connection between devices (e.g. between routers at IP protocol layer). Unfortunately, in such management systems there is no opportunity to automatically create a physical topological map, which shows all the real devices and the physical connections between them, existing in this network. It can be a substantial inconvenience, especially in the WAN ATM networks, where the logical IP topology is often completely different than the real physical topology [1]. There are some firmware applications (e.g. ForeView) which try to recognize physical topology of the ATM network, but it can work only on the devices made by the same factory (e.g. Fore Systems - Marconi). Another disadvantage of such software is that it does not recognize all the ATM devices and connections automatically. Also the way it shows the recognized topology is not the best, because there are only hierarchical maps, which present a part of the network, so administrators can not see the entire physical topology in one map. The idea of our solution to that problem is described in the next section.

3. Idea of the discovery of physical network configuration

The idea is to create an application which enables to automatically recognize the physical connections topology in any network (especially the ATM-net). Our conception is to make a software, which does not have disadvantages of the existing firmware (see sec. 2) and can work properly even in a large heterogeneous network [4]. Besides, such application should have many new helpful features and be opened for further development in the future.

The algorithm of the automatic physical network topology recognition relays upon different MIB values taken from devices in the net. The server requests many detailed parameters trough SNMP protocol from standard and private MIB. The server uses the returned MIB values to find the physical neighbors of the requested device and their IP addresses. Then the algorithm is called recursively for each device of those neighbors. Eventually the algorithm stops and creates a graph of the discovered network topology.

Each node in such graph represents a device and each edge is a physical connection between the recognized devices.

The process of recognition should start from the concrete node specified by the user (with a name or an IP-address) and finish after the maximal number of recurrences given by another user parameter. This software should be based on the client-server architecture, where the server module runs under the UNIX operating system control and the client part has a user-friendly Web interface. The client should communicate with the server through the net and be able to work properly in many computer systems with a Web-browser. The server should use a SNMP protocol to collect information from the devices [3]. Its main task should be to realize the algorithm of the automatic physical network topology recognition. Also functionality, which allows the server to send a request for details of the device's configuration to the selected device, is very important. The client should be able to connect to the server, let the user set the beginning parameters and start the realization of the algorithm in the server. The client's main task should be to visualize the results of the algorithm as a graphic map of the physical network topology as well as the detailed parameters of devices and their connections. The condition that this software does not have to be integrated with any network management platform and the users can have access to it from any system with a Web-browser (Java enabled) is also very important in this idea.

4. Implementation

The idea described in the previous section has already been implemented for the ATM networks. The application is called "WWWTopoDiscovery" and it is in the testing phase now. This software makes it possible to manage the physical configuration of the ATM networks and it is used in the WAN (POL34/155) and MAN (POZMAN). Its architecture is of a client-server type, where the server is an application of the "C" language written for IBM - AIX operating systems and the client is a Java-applet and can be activated in any environment with a Web-browser. WWWTopoDiscovery allows for the automatic recognition of the physical topology in any heterogeneous ATM network with the q2931 signaling protocol. The client makes a graphical visualization of this topology by creating a map of the discovered devices and their connections (see fig. 2, 3, 4 and 13). Besides, this application has also a functionality, which permits checking the actual state and configuration parameters of the selected nodes (see fig. 5, 6, 9 and 10) or their links (see fig. 7, 8, 11 and 12) and displays the results in the client's module. It uses its own SNMP-agent implementation to make contact with the devices and request various MIB variables from them. There are many variables taken from standards MIB2, AToM-MIB ([2]) and private Fore-MIB and their values are checked, so the user can control not only the general configuration but also the detailed parameters, characteristic for the specific types of nodes or physical connections.

The applet interface is user-friendly. The user has to set only the IP address (or name) of the beginning ATM device to run the algorithm, which will automatically recognize the physical network topology starting from this switch. The user also gives some optional parameters, like the additional community and timeout in seconds (both for the SNMP commands), or change the default value of the maximal number of recurrences for the algorithm. By means of these parameters the user can easily control the size of the recognized parts of the ATM network.

The results of the algorithm, which are sent by the server, are received and visualized by the client's applet as color graphic maps. One is a hierarchical map, which shows only the nearest direct neighbors of the selected node, and the second is the "Total Network View" map, which shows all the recognized devices and connections together. The user can easily distinguish different types of the recognized nodes (e.g. ATM-switches, routers or access devices), which are symbolized with different icons. Also, some useful information is given to the user by means of painting icons with different colors (e.g. when a device is painted blue, it means that the software could not contact with that node's SNMP agent, to check its type and configuration parameters). For the users' convenience there is also a functionality in the client application to save any recognized topology maps to a file. The user has a possibility to load any saved maps from such files to avoid the necessity to run the automatic recognition of the physical network topology algorithm every time.

This application can be very helpful in managing the physical configuration of the heterogeneous ATM network, based on different devices from various producers (e.g. see fig. 5 – Fore Systems switch - ASX and fig. 9 – Cisco router – 7500, both in the same ATM network). The administrators can also manage the network from many remote PCs, and access the parallel server through the Web, even simultaneously. This software is also independent from any network management systems and can be used separately or in co-operation with them.

5. Conclusions

WWWTopoDiscovery realizes all the ideas and conceptions described in section 3 for ATM networks and it can also be developed in many different ways in the future. This application can be adapted to other technologies than ATM (e.g. Ethernet in LAN) or the new MIB variables and a graphical exposure of the devices front panel can be added. For the user's comfort, the recognized topology of the network could be drawn on a bitmap of the real physical area, where this network exists in the background. Besides, the opportunity to manually add new nodes, connections and supplementary names for the devices could be very useful for administrators.

Some screenshots from the WWWTopoDiscovery application are shown below.

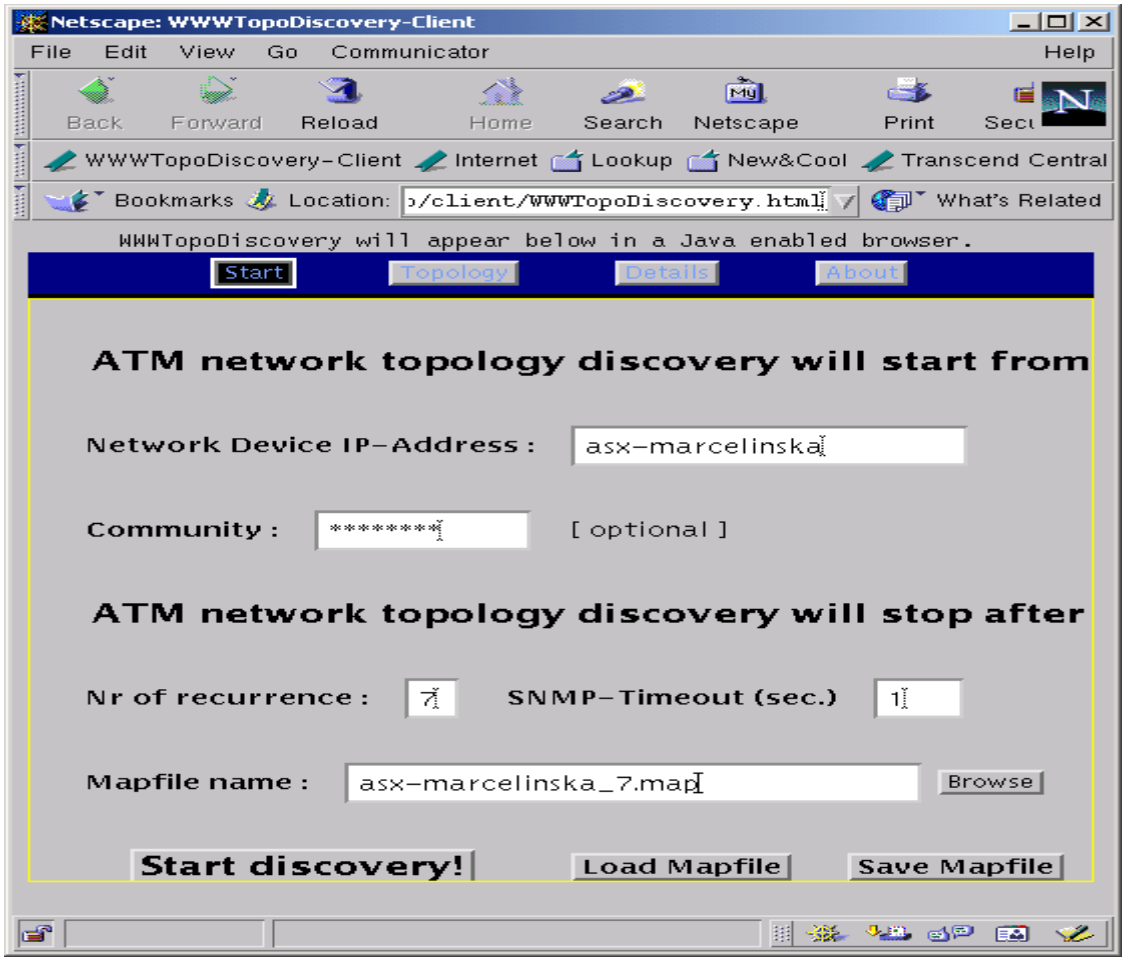

Fig. 1. The view of the start panel of the WWWTopoDiscovery-Client.

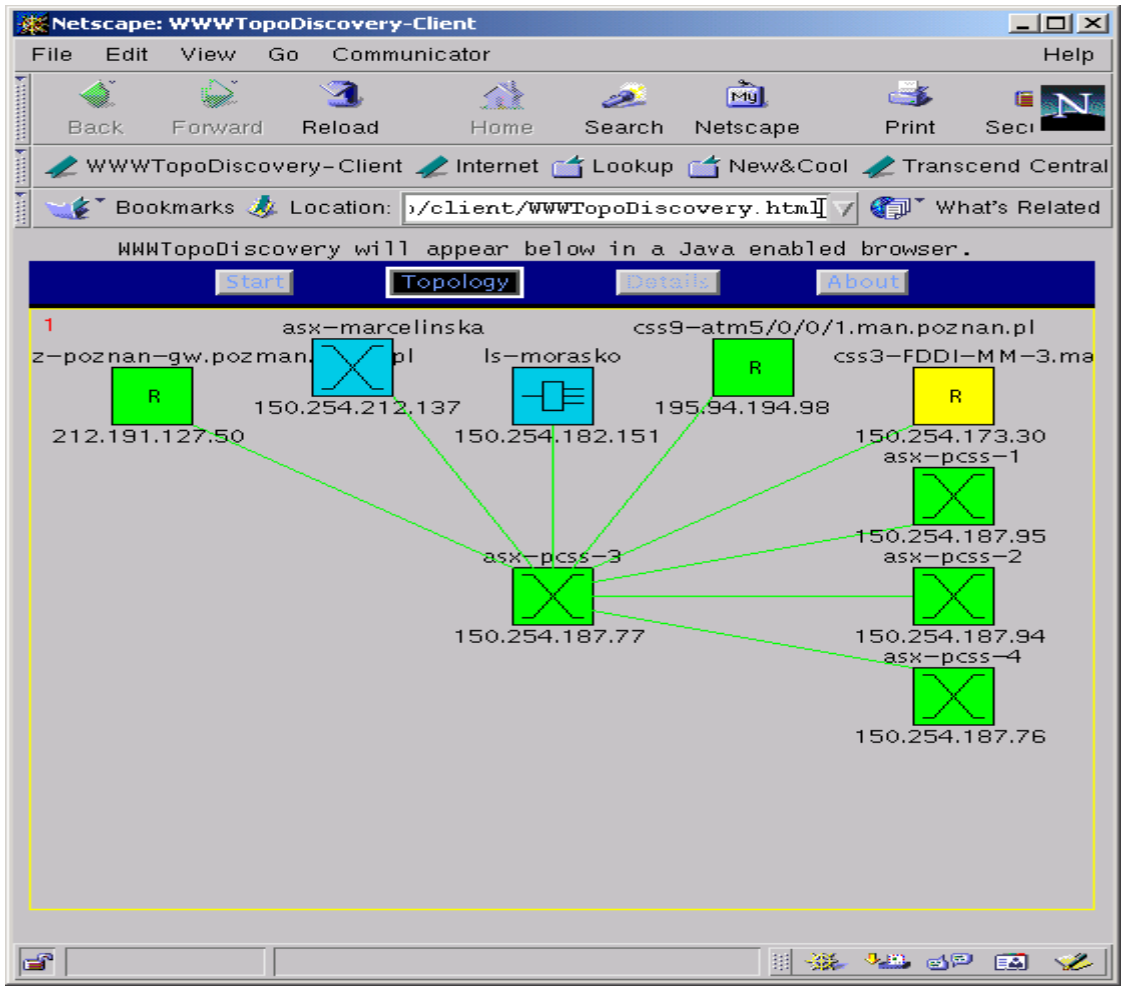

Fig. 2. The top of the tree of the recognized network topology (POZMAN).

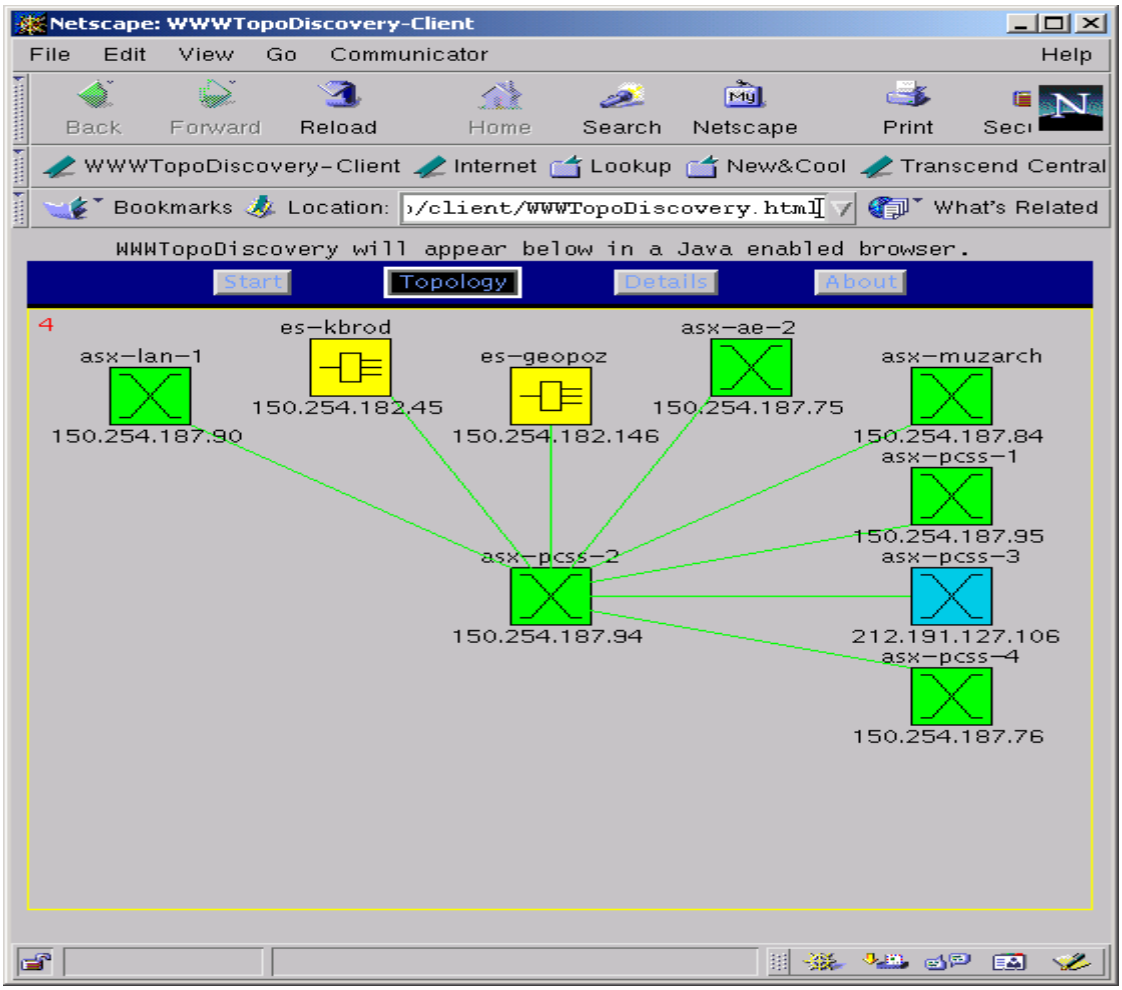

Fig. 3. The 4-th level of an example tree of the recognized network topology (POZMAN).

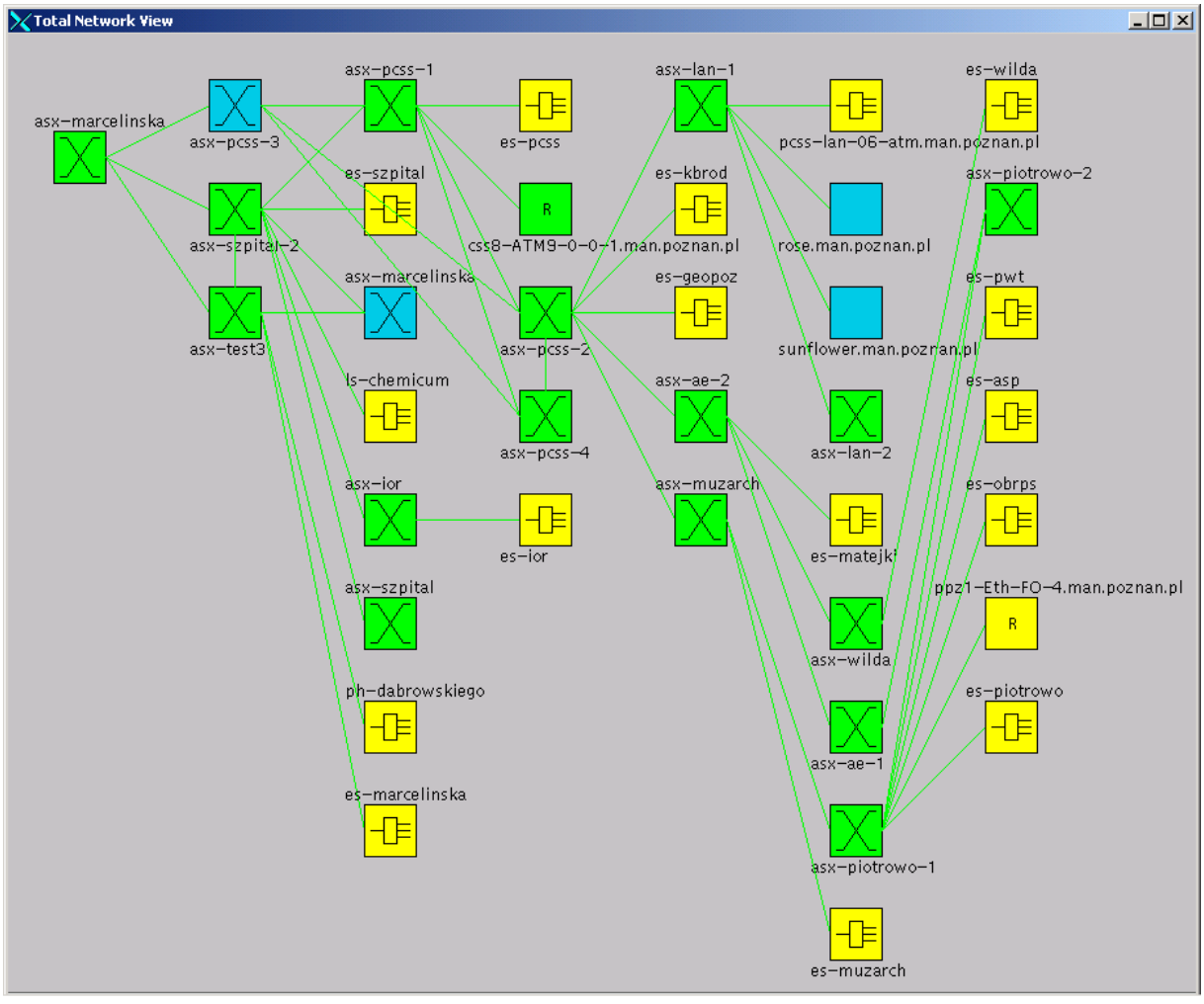

Fig. 4. An example of the total network view (POZMAN).

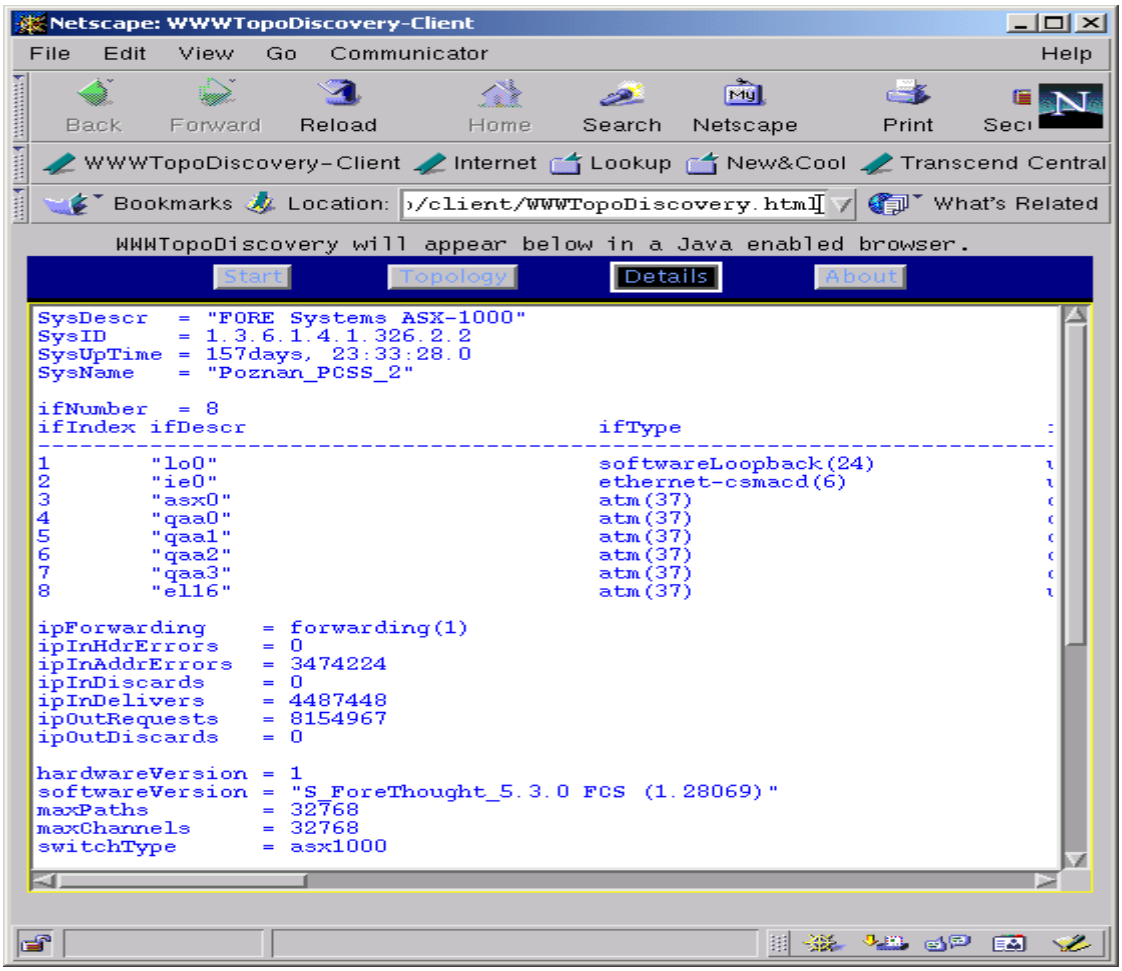

Fig. 5. The part of the Fore Systems ATM-Switch (Marconi) parameters configuration.

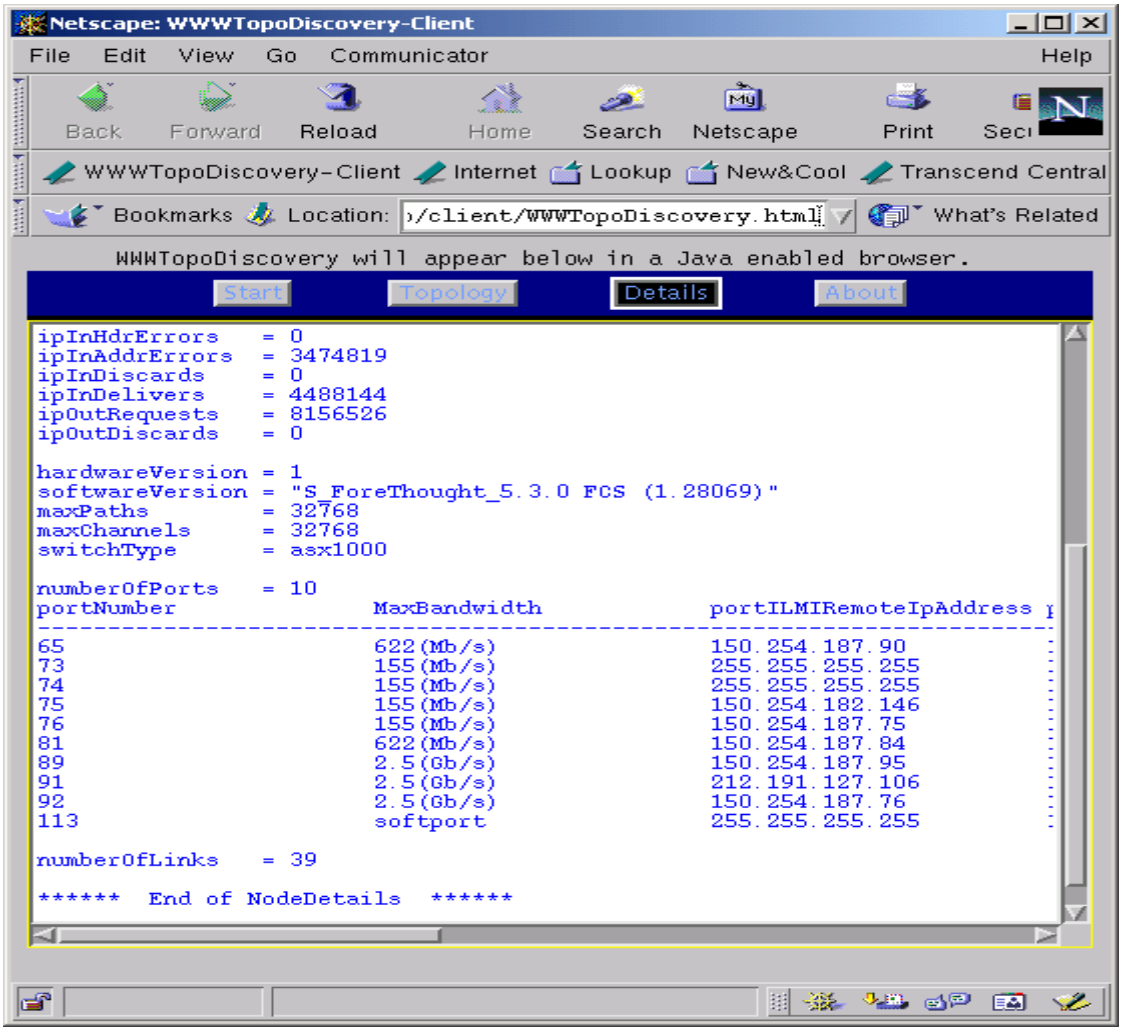

Fig. 6. The next part of the Fore Systems ATM-Switch (Marconi) parameters configuration.

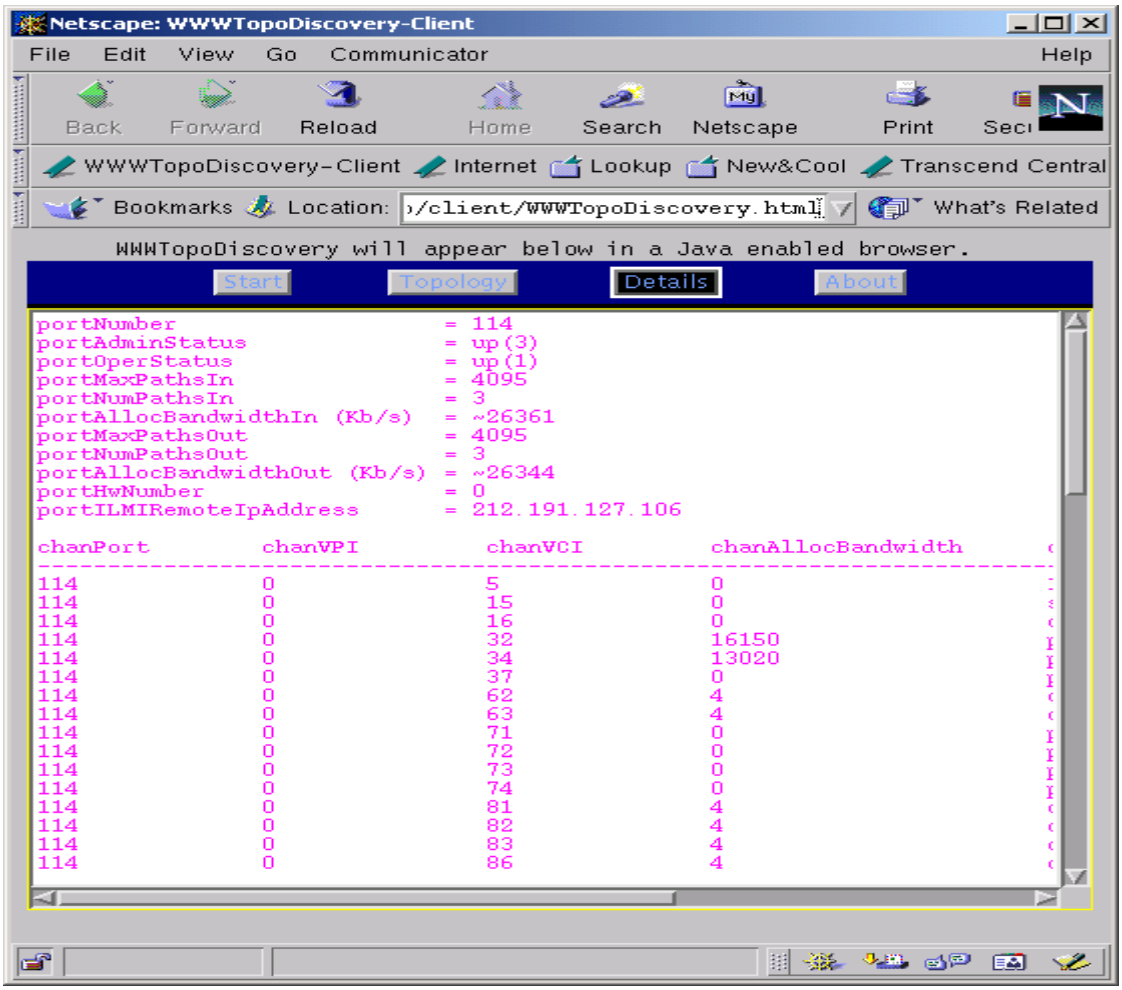

Fig. 7. The part of the Fore Systems ATM-Switch (Marconi) link parameters configuration.

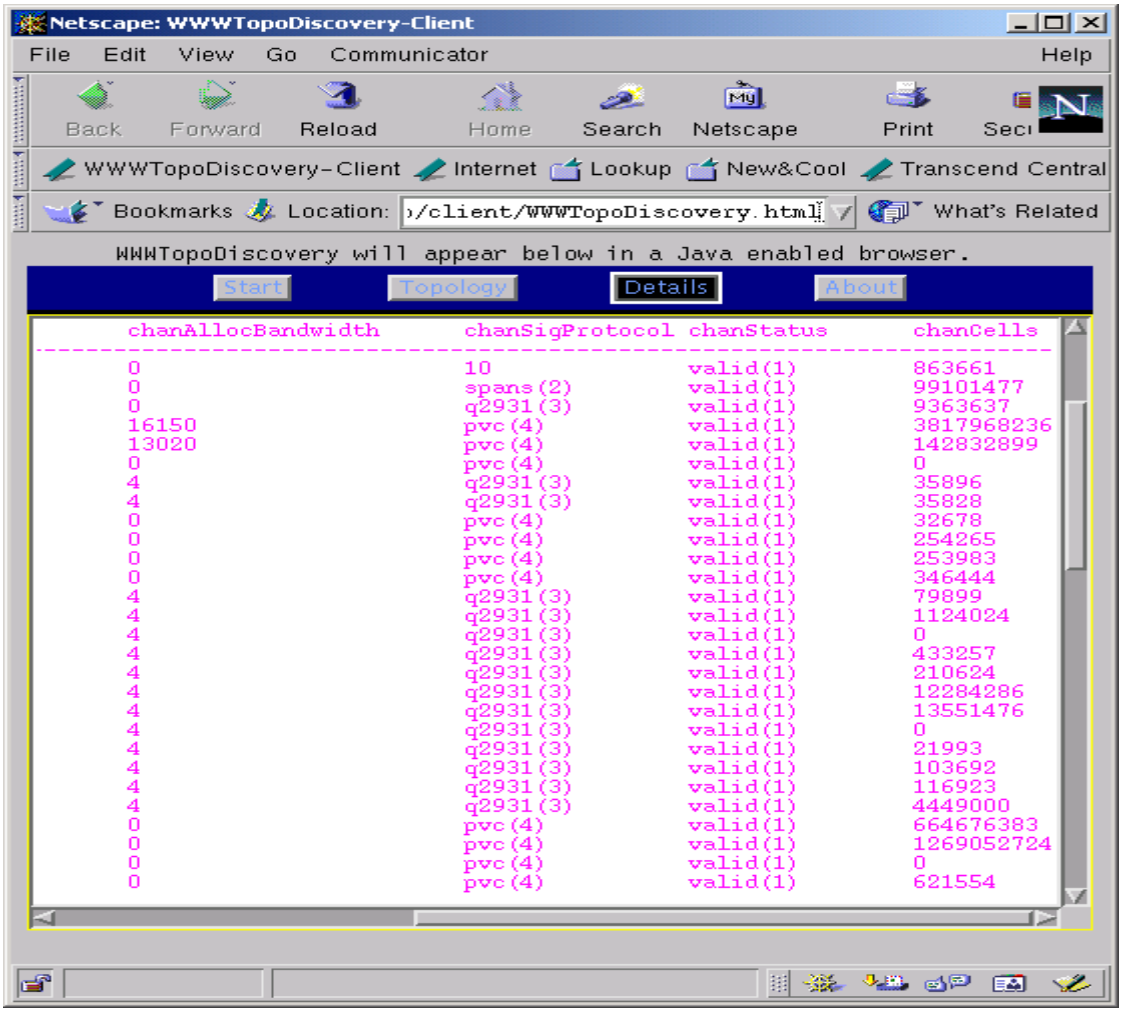

Fig. 8. The next part of the Fore Systems ATM-Switch (Marconi) link parameters configuration.

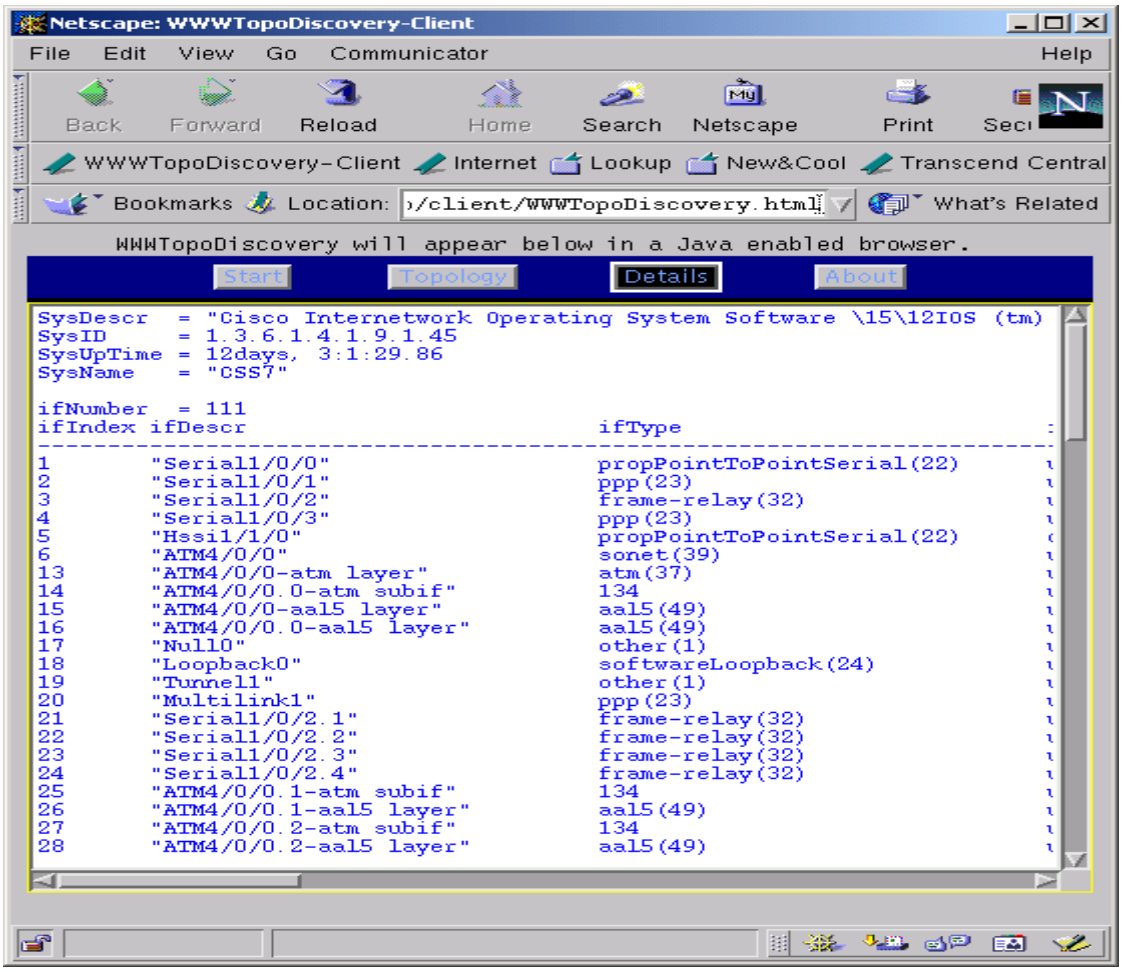

Fig. 9. The part of the Cisco router parameters configuration.

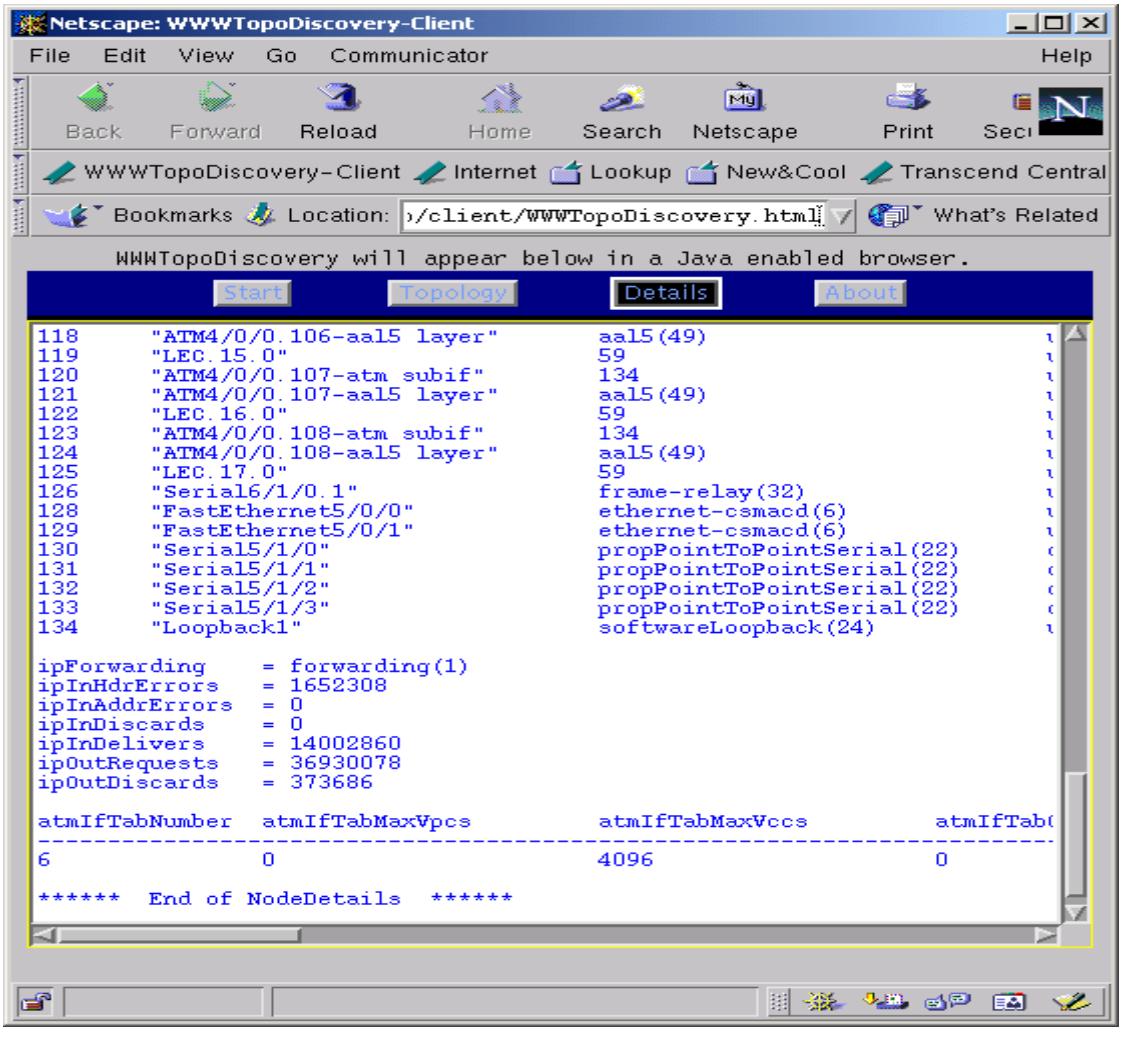

Fig. 10. The next part of the Cisco router parameters configuration.

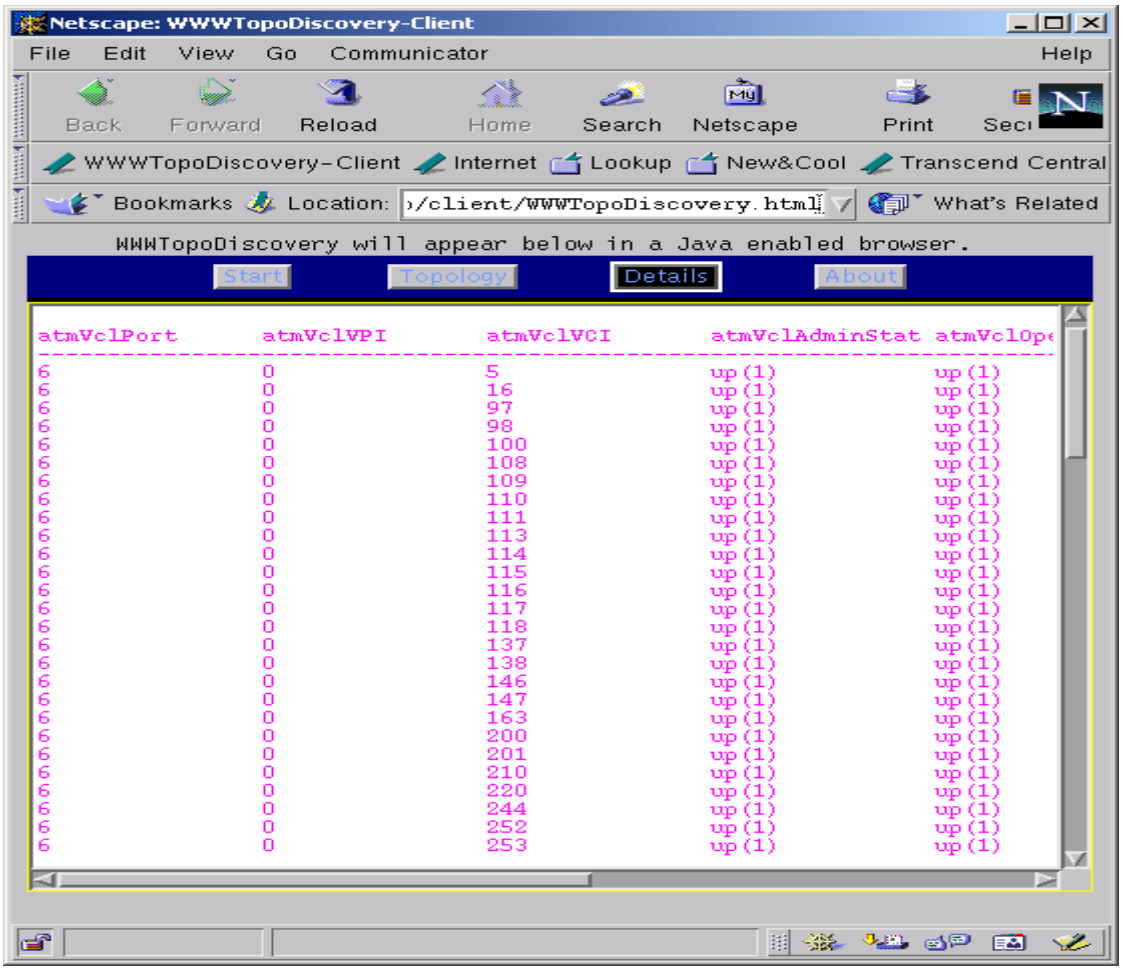

Fig. 11. The part of the Cisco router ATM connection parameters configuration.

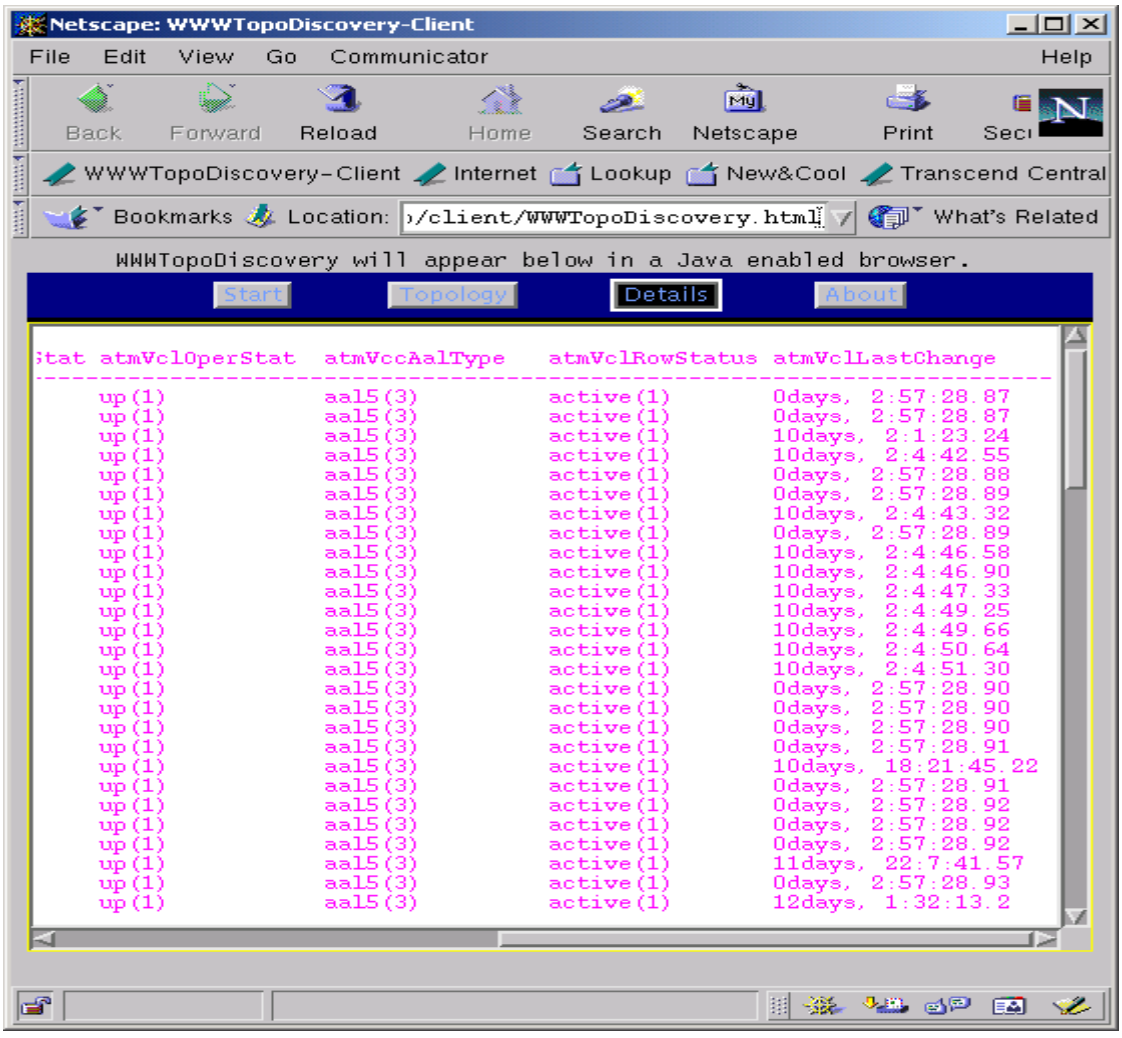

Fig. 12. The next part of the Cisco router ATM connection parameters configuration.

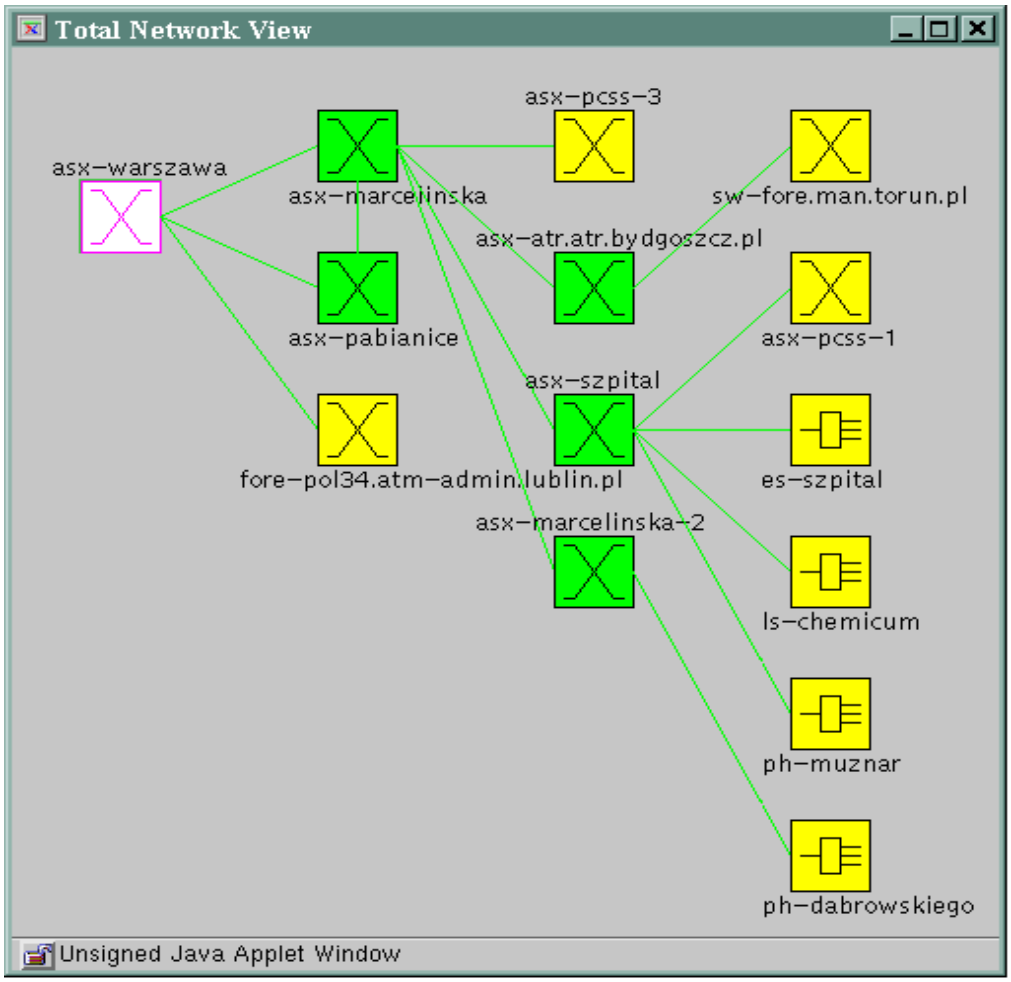

Fig. 13. An example of the total network view (POL34).

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Vitae

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