Lab 1:
Computer Network Models and common tools

Objectives:

- Provide some basic knowledge on:

    o OSI and TCP/IP reference model.

    o Layers, protocols, ports and sockets.

- Introduce some common network tools and network applications.

- Using a powerful network simulation - Packet Tracer

OSI and TCP/IP reference model, layers, protocols, ports and sockets.

1. List the name of layers of OSI and TCP/IP model.

Applications, Presentation, Session, Transport, Network, Data-link, Physical.

2. Specify the function of each layer of TCP/IP model.

Applications: Đây là tầng cao nhất trong cấu trúc phân lớp của TCP/IP. Tầng này bao gồm tất cả các chương trình ứng dụng sử dụng các dịch vụ sẵn có thông qua một chồng giao thức TCP/IP. Các chương trình ứng dụng tương tác với một trong các giao thức của tầng giao vận để truyền hoặc nhận dữ liệu. Mỗi chương trình ứng dụng lựa chọn một kiểu giao thức thích hợp cho công việc của nó. Chương trình ứng dụng chuyển dữ liệu theo mẫu mà tầng giao vận yêu cầu.

Transport: Nhiệm vụ trước tiên của tầng giao vận là cung cấp sự giao tiếp thông tin giữa các chương trình ứng dụng. Mỗi sự giao tiếp được gọi là end-to-end. Tầng giao vận cũng có thể điều chỉnh lưu lượng luồng thông tin. Nó cũng cung cấp một sự vận chuyển tin cậy, đảm bảo rằng dữ liệu đến mà không bị lỗi. Để làm như vậy, phần mềm giao thức hỗ trợ để bên nhận có thể gửi lại các thông báo xác nhận về việc thu dữ liệu và bên gửi có thể truyền lại các gói tin bị mất hoặc bị lỗi. Phần mềm giao thức chia dòng dữ liệu ra thành những đơn vị dữ liệu nhỏ hơn (thường được gọi là các Packets) và chuyển mỗi packet cùng với địa chỉ đích tới tầng tiếp theo để tiếp tục quá trình truyền dẫn.

*Network: tầng mạng có nhiệm vụ **xác định việc chuyển hướng**, **vạch đường các gói tin** trong mạng (chức năng định tuyến), các gói tin này có thể phải đi qua nhiều chặng trước khi đến được đích cuối cùng. Lớp 3 là lớp có liên quan đến các địa chỉ logic trong mạng Các giao thức hay sử dụng ở đây là IP, RIP, IPX, OSPF, AppleTalk.*

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Data-link: tầng liên kết dữ liệu có nhiệm vụ xác định cơ chế truy nhập thông tin trên mạng, các dạng thức chung trong các gói tin, đóng gói và phân phát các gói tin.Lớp 2 có liên quan đến địa chỉ vật lý của các thiết bị mạng, topo mạng, truy nhập mạng, các cơ chế sửa lỗi và điều khiển luồng.

Physical: tầng vật lý cung cấp phương thức truy cập vào đường truyền vật lý để truyền các dòng Bit không cấu trúc, ngoài ra nó cung cấp các chuẩn về điện, dây cáp, đầu nối, kỹ thuật nối mạch điện, điện áp, tốc độ cáp truyền dẫn, giao diện nối kết và các mức nối kết.

3.   Socket, Port:

A *socket* is one endpoint of a two-way communication link between two programs running on the network. A socket is bound to a port number so that the TCP layer can identify the application that data is destined to be sent.

An endpoint is a combination of an IP address and a port number. Every TCP connection can be uniquely identified by its two endpoints. That way you can have multiple connections between your host and the server.
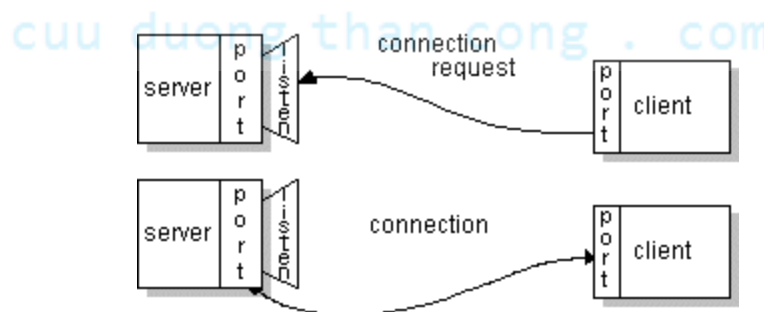

Figure 1: Server-Client Connection

The client and server can communicate by writing to or reading from their sockets.

4. Practice:

Compile and run the client program "client.java" and "server.java". Check the socket information (IP, port number) at each side.

[java.exe] (server)

TCP   127.0.0.1:1234   127.0.0.1:49426   ESTABLISHED

[java.exe] (client)

TCP   127.0.0.1:49402   127.0.0.1:1234   ESTABLISHED

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Which protocol is used at Transport layer?

⚔ *ATP, AppleTalk Transaction Protocol*

⚔ *CUDP,* Cyclic UDP

⚔ *DCCP,* Datagram Congestion Control Protocol

⚔ *FCP,* Fibre Channel Protocol

⚔ *IL,* IL Protocol

⚔ *NBF,* NetBIOS Frames protocol

⚔ *NBT,* NetBIOS over TCP/IP

⚔ *RDP,* Reliable Datagram Protocol

⚔ *RUDP,* Reliable User Datagram Protocol

⚔ *SCTP,* Stream Control Transmission Protocol

⚔ *SPX,* Sequenced Packet Exchange

⚔ *SST,* Structured Stream Transport

⚔ *TCP,* Transmission Control Protocol

⚔ *UDP,* User Datagram Protocol

⚔ UDP Lite

⚔ *µTP, Micro Transport Protocol*

Network Management Tools and Utilities

.1 TCP/IP Tools

- **arp** - Used to manipulate the arp cache.
- **ipconfig** - Displays the configuration settings for the host.
- **nbtstat** - Used to troubleshoot NetBIOS name resolution problems.
- **netstat** - Current connections, routing tables, interface statistics, netlink messages, multicast memberships, and masquerade connections are displayed,...
- **nslookup** - Name server lookup for DNS.
- **ping** - Used to verify that another host may be reached with an ICMP packet.
- **route** - View or modify the local route table.

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- **snmp** - Remote management of network devices.
- **tracert/traceroute** - Traceroute traces a route through routers from one IP address to another.

.2 Network Tools for Workstations

3D Traceroute/mtr:

As its name describes, 3D Traceroute provides some great visual traceroute graphs. Unlike its name, 3D Traceroute also includes many other tools, such as a whois query, ping monitors, and my favorite, a day and night trace. Platform: Windows

PuTTY

PuTTY is a free implementation of Telnet and SSH for Win32 and Unix platforms, along with an xterm terminal emulator. Platforms: Windows, Linux

PACManager

PAC is a Perl/GTK Gnome replacement for SecureCRT/Putty/etc... It provides a GUI to configure SSH/Telnet connections: users, passwords, EXPECT regular expressions, macros, etc. Platforms: Linux

TightVNC/vncviewer

TightVNC is a free remote control software package derived from the popular VNC software. With TightVNC, you can see the desktop of a remote machine and control it with your local mouse and keyboard, just like you would do it sitting in the front of that computer. Platforms: Windows, Linux

WinSCP/scp

WinSCP is an open source SFTP client for Windows. Its main function is the secure file transfer between a local and a remote computer. Beyond this, WinSCP offers basic file manager functionality. It uses Secure Shell (SSH) and supports, in addition to Secure FTP, legacy SCP protocol.

Nmap

As its name implies, nmap is a network mapping utility. Provide nmap with a TCP/IP address, and it will identify any open "doors" or ports that might be available on that remote TCP/IP device. Platforms: Linux

Wireshark

Wireshark (formerly Ethereal) is used by network professionals around the world for troubleshooting, analysis, software and protocol development, and education. It has all of the standard features you would expect in a protocol analyzer, and several features not seen in any other product. Platforms: Windows, Linux, Unix

Nemesis

Nemesis is a command-line network packet crafting and injection utility for UNIX-like and Windows systems. Nemesis, is well suited for testing Network Intrusion Detection

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Systems, firewalls, IP stacks and a variety of other tasks. As a command-line driven utility, Nemesis is perfect for automation and scripting. Nemesis can natively craft and inject ARP, DNS, ETHERNET, ICMP, IGMP, IP, OSPF, RIP, TCP and UDP packets. Using the IP and the Ethernet injection modes, almost any custom packet can be crafted and injected. Platforms: Windows, Linux

Firewall Builder

Firewall Builder is multi-platform firewall configuration and management tool. It consists of a GUI and set of policy compilers for various firewall platforms. Firewall Builder supports iptables, ipfilter, OpenBSD PF and Cisco PIX. Platforms: Linux, Unix.

Cisco Packet Tracer

Figure 2: Cisco Packet Tracer

Cisco® Packet Tracer is a powerful network simulation program that:

- allows students to experiment with network behavior and ask "what if" questions.

- help students understand the complexities of information and communication technologies (ICT).

- gain practical networking technology skills.

As a new curricula and educational tools, Packet Tracer provides simulation, visualization, authoring, assessment, and collaboration capabilities to facilitate the teaching and learning of complex technology concepts.
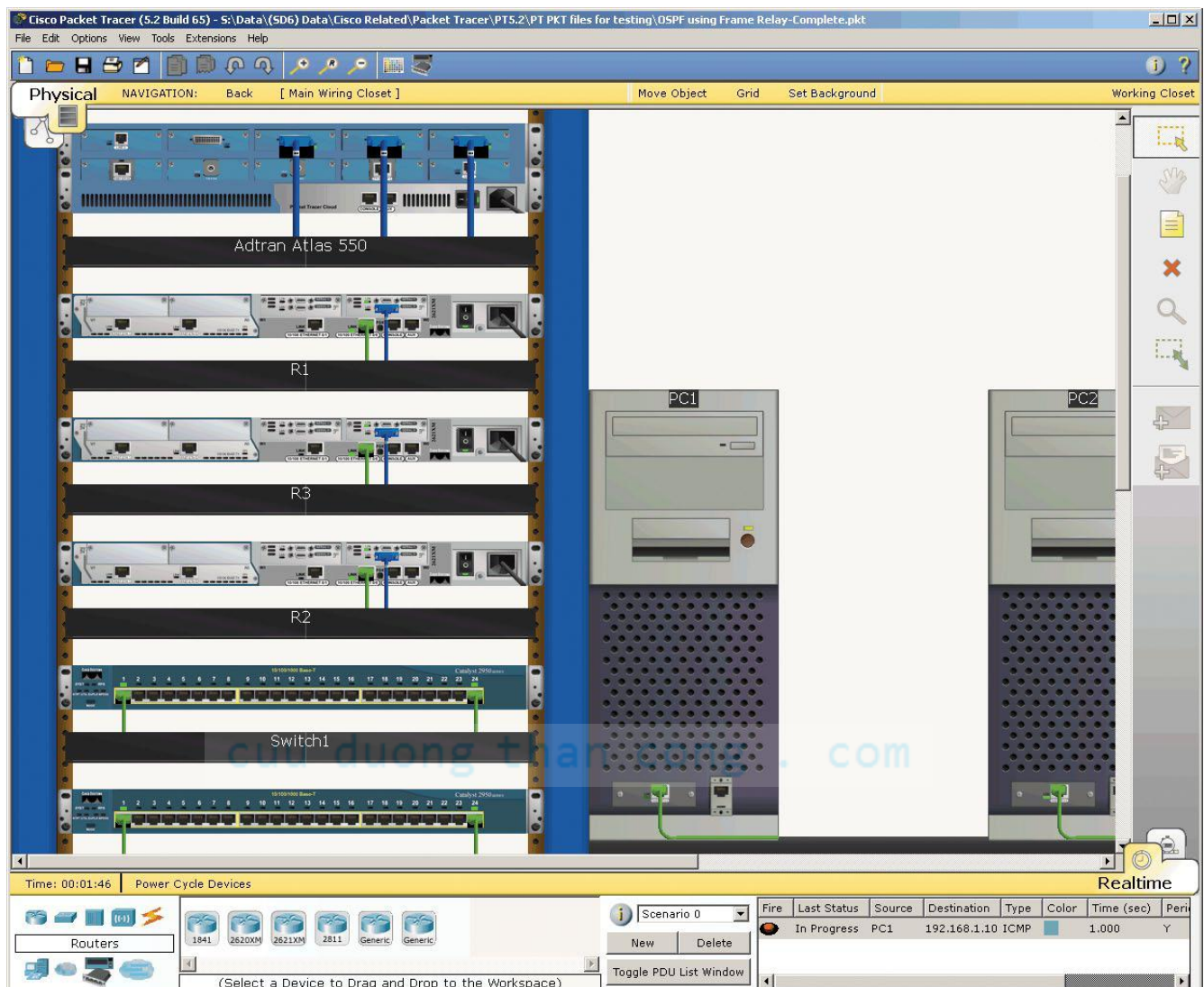

1. **Key Features**

Packet Tracer Workspaces:

Cisco Packet Tracer has two workspaces: logical and physical. The logical workspace allows users to build logical network topologies by placing, connecting, and clustering virtual network devices. The physical workspace provides a graphical physical dimension of the logical network, giving a sense of scale and placement in how network devices such as routers, switches, and hosts would look in a real environment. The physical view also provides geographic representations of networks, including multiple cities, buildings, and wiring closets.

Figure 3. The physical workspace provides a graphical view of the logical network

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Packet Tracer Modes:

Cisco Packet Tracer provides two operating modes to visualize the behavior of a network—real-time mode and simulation mode. In real-time mode the network behaves as real devices do, with immediate real-time response for all network activities. The real-time mode gives students a viable alternative to real equipment and allows them to gain configuration practice before working with real equipment.

In simulation mode the user can see and control time intervals, the inner workings of data transfer, and the propagation of data across a network. This helps students understand the fundamental concepts behind network operations. A solid understanding of network fundamentals can help accelerate learning about related concepts.

Protocols:

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Protocols: Cisco Packet Tracer supports the following protocols:

Layer	Cisco Packet Tracer Supported Protocols
Application	• FTP , SMTP, POP3, HTTP, TFTP, Telnet, SSH, DNS, DHCP, NTP, SNMP, AAA, ISR VOIP, SCCP config and calls ISR command support, Call Manager Express
Transport	• TCP and UDP, TCP Nagle Algorithm & IP Fragmentation, RTP
Network	• BGP, IPv4, ICMP, ARP, IPv6, ICMPv6, IPSec, RIPv1/ v2/ng, Multi-Area OSPF, EIGRP, Static Routing, Route Redistribution, Multilayer Switching, L3 QoS, NAT, CBAL , Zone-based policy firewall and Intrusion Protection System on the ISR, GRE VPN, IPSec VPN
Network Access/ Interface	• Ethernet (802.3), 802.11, HDLC, Frame Relay, PPP, PPPoE, STP, RSTP, VTP, DTP, CDP, 802.1q, PAgP, L2 QoS, SLARP, Simple WEP, WPA, EAP

Podular Devices:
Graphical representations visually simulate hardware and offer the ability to insert interface cards into modular routers and switches, which then become part of the simulation.

Multiuser Functionality:
Cisco Packet Tracer is a network-capable application, with a multiuser peer-to-peer mode that allows collaborative construction of virtual networks over a real network. The multiuser feature enables exciting collaborative and competitive interactions, providing the option to progress from individual to social learning and features opportunities for collaboration, competition, remote instructor student interactions, social networking, and gaming.

Tutorials:
Packet Tracer includes several basic step-by-step tutorials that familiarize users with the product features and explain how to engage in simulations. Additional advanced tutorials are available for download from Academy Connection.

Help:
A help feature is available to familiarize users with the Cisco Packet Tracer interface, functions, and features. The help area includes important notes and tips and provides annotated screenshots to aid understanding.

Activity Wizard:
The Activity Wizard allows users to author their own learning activities by setting up scenarios using instructional text, and creating initial and final network topologies and predefined packets. The Activity Wizard also includes grading and feedback capabilities.
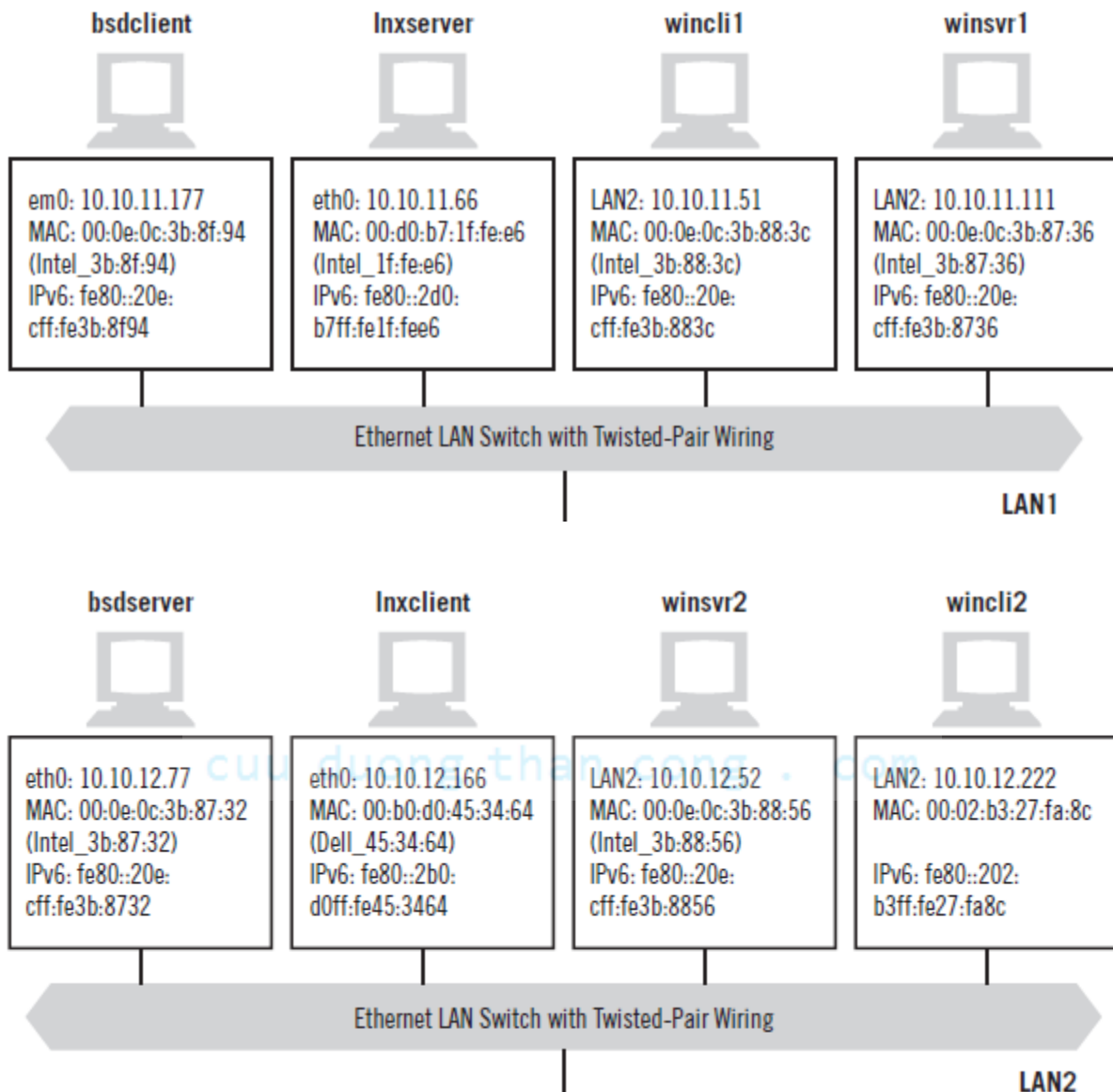
Figure 4. The Activity Wizard enables the creation of customized learning activities

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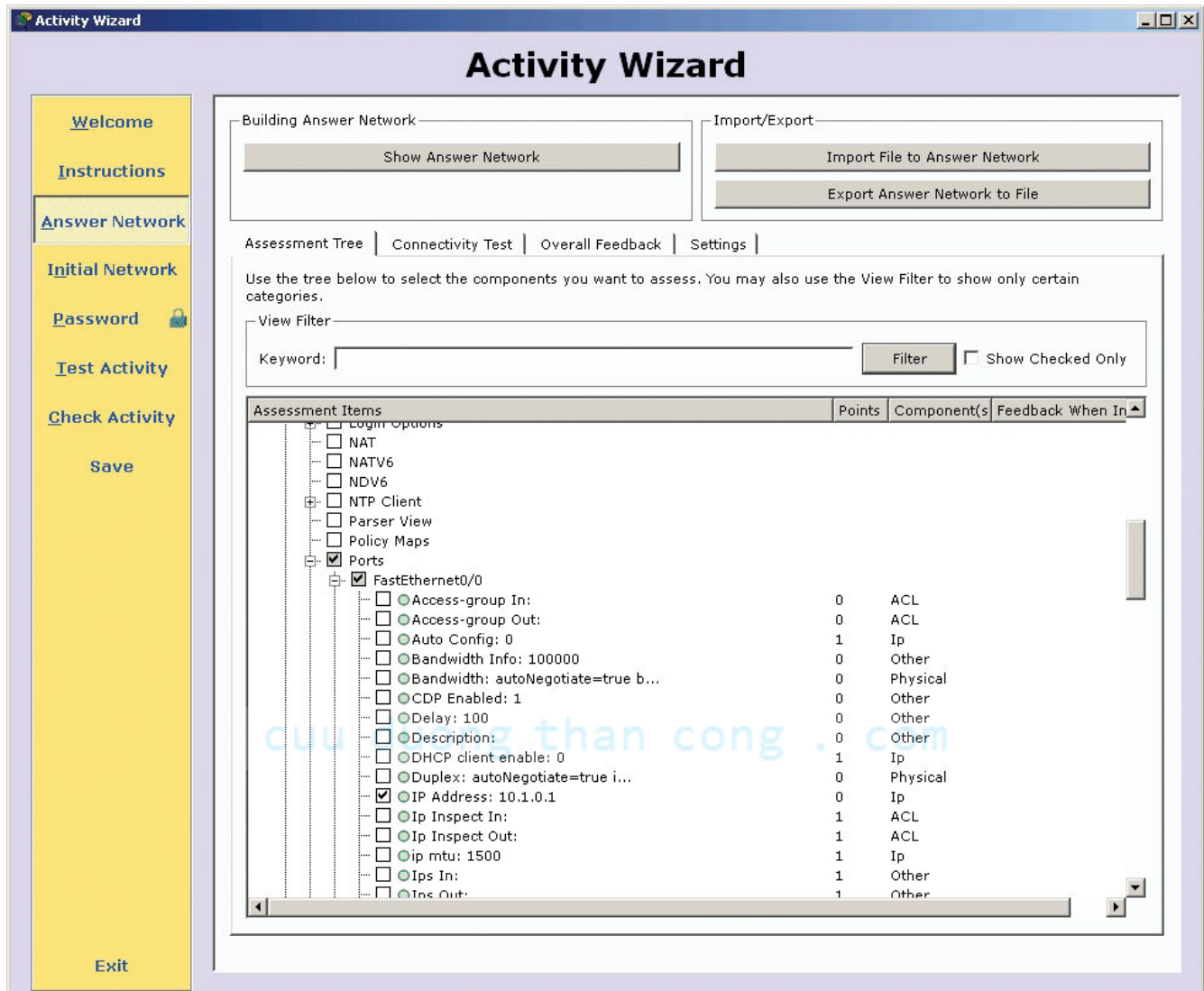
Lab Practice

- Reading Cisco Packet Tracer tutorials
- Building 2 LANs of the Illustrated Network (IN) as following
1. **Network Layout**

bsdclient
em0: 10.10.11.177
MAC: 00:0e:0c:3b:8f:94
(Intel_3b:8f:94)
IPv6: fe80::20e:
cff:fe3b:8f94

lnxserver
eth0: 10.10.11.66
MAC: 00:d0:b7:1f:fe:e6
(Intel_1f:fe:e6)
IPv6: fe80::2d0:
b7ff:fe1f:fee6

wincli1
LAN2: 10.10.11.51
MAC: 00:0e:0c:3b:88:3c
(Intel_3b:88:3c)
IPv6: fe80::20e:
cff:fe3b:883c

winsvr1
LAN2: 10.10.11.111
MAC: 00:0e:0c:3b:87:36
(Intel_3b:87:36)
IPv6: fe80::20e:
cff:fe3b:8736

Ethernet LAN Switch with Twisted-Pair Wiring

LAN1

bsdserver
eth0: 10.10.12.77
MAC: 00:0e:0c:3b:87:32
(Intel_3b:87:32)
IPv6: fe80::20e:
cff:fe3b:8732

lnxclient
eth0: 10.10.12.166
MAC: 00:b0:d0:45:34:64
(Dell_45:34:64)
IPv6: fe80::2b0:
d0ff:fe45:3464

winsvr2
LAN2: 10.10.12.52
MAC: 00:0e:0c:3b:88:56
(Intel_3b:88:56)
IPv6: fe80::20e:
cff:fe3b:8856

wincli2
LAN2: 10.10.12.222
MAC: 00:02:b3:27:fa:8c

IPv6: fe80::202:
b3ff:fe27:fa8c

Ethernet LAN Switch with Twisted-Pair Wiring

LAN2

2. Lab Steps

- Need 2 Cisco Switch 2960 (each Switch at 1 LAN, named SwLAN1 and SwLAN2) and 8 hosts.

- Configure devices creating a basic LAN.

- Configure the hosts with the indicated parameters.

- Connect the devices and hosts.

- Verify connectivity with *ping* command on each LAN.

- Save work to file, naming: *YourStudentCode_CN2Lab1.pkt*

- Send this file by email to Lab Instructor.

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