PACKET TRACER
REFERENCE FOR NETWORK ADMINISTRATORS
AND ACADEMY INSTRUCTORS

Prepared by
Cisco Learning Institute

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Introduction

The purpose of this reference is to enable understanding of the Packet Tracer application and its unique implementation of the Packet Tracer Messaging Protocol. Academy instructors and legal main contacts may wish to share this document with their organization's network administration to aid understanding of the security requirements.

In addition, this document looks at some advanced applications of the Packet Tracer multiuser tool and how academies worldwide may wish to use this to enable their students to collaborate.

Packet Tracer continuously undergoes many enhancements in its development process, improving performance and simulation accuracy. Packet Tracer advances the success of the application and ensures Cisco Academies worldwide can use this robust tool in the delivery of learning to many students.

Implementing Packet Tracer

LICENSING AND INSTALLATION

One of the most common questions Cisco receives from academies is regarding the installation and distribution of the Packet Tracer application.

Students who are enrolled in the Cisco Academy can download and install, at home without any intervention from the academy, their own copy of Packet Tracer which is available via Linux and Windows.

If an academy has students who have limited personal access to a suitable internet connection to download this application, a copy can be provided on disc or memory stick and passed on. The student must be an enrolled and active member of the academy for any of the courses Cisco Systems offers.

As with the online curriculum, Cisco Systems encourages all academies to have locally installed copies to reduce the impact on server resources and bandwidth. Academies are welcome to maintain a copy of Packet Tracer for download on local servers, where the access must be restricted to students who are also in a Cisco Academy course.

For installation on 'campus' computers, the Cisco Academy is free to install this application on any/all computers to which a student on a Cisco Academy course has reasonable access. This may be lab computers, classroom computers, as well as open access computers.

Packet Tracer installation methodology includes complete installation to the local drive by default and can be directed to any administrator defined location. With version revisions subsequent installations do

Figure 1 ... Program File Structure

not overwrite, but instead they create a new folder and references in the program files structure (Figure 1).

The installation process does not add any DLL's or registry entries to the host operating system. Subsequent installations will change the 'shortcut reference', where double-clicking on the file will reference the latest version installed.
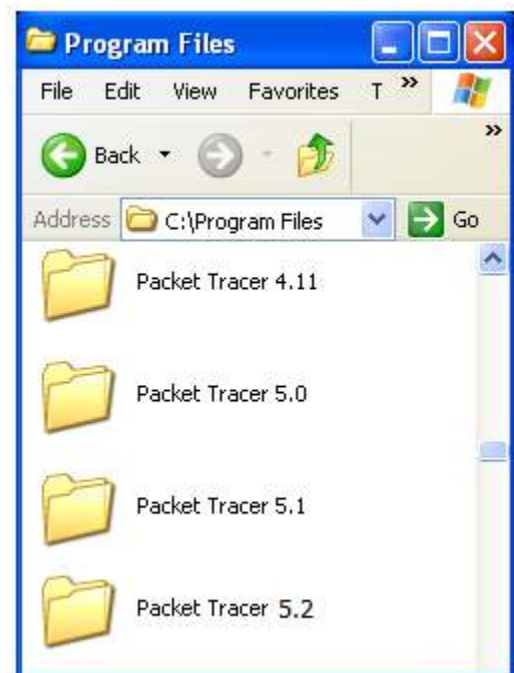
Academies who are in strategic partnerships with other academic institutions, with which they have an agreement to deliver Cisco Academy courses, cannot distribute Packet Tracer to their academic partners for installation on their local computers. The academic computer hosting the Packet Tracer installation must reside on the premises of an organization registered as a Cisco Academy.

PORT ALLOCATION

Understanding that local needs vary according to the local security and infrastructure requirements of each academy and the academic environment in which you operate, the Packet Tracer development team has designed Packet Tracer to work on 'any locally specified port'.

For the IPC tool the default is set at **39000.** This is a feature of Packet Tracer which is open to development by all academy partners and will enable Packet Tracer to integrate into other systems.

The IPC allows future applications released by Cisco Systems, as well as participating academies, to be integrated into Packet Tracer (Figure 2). You can control remote access by simply checking 'allow' or unchecking 'deny'.
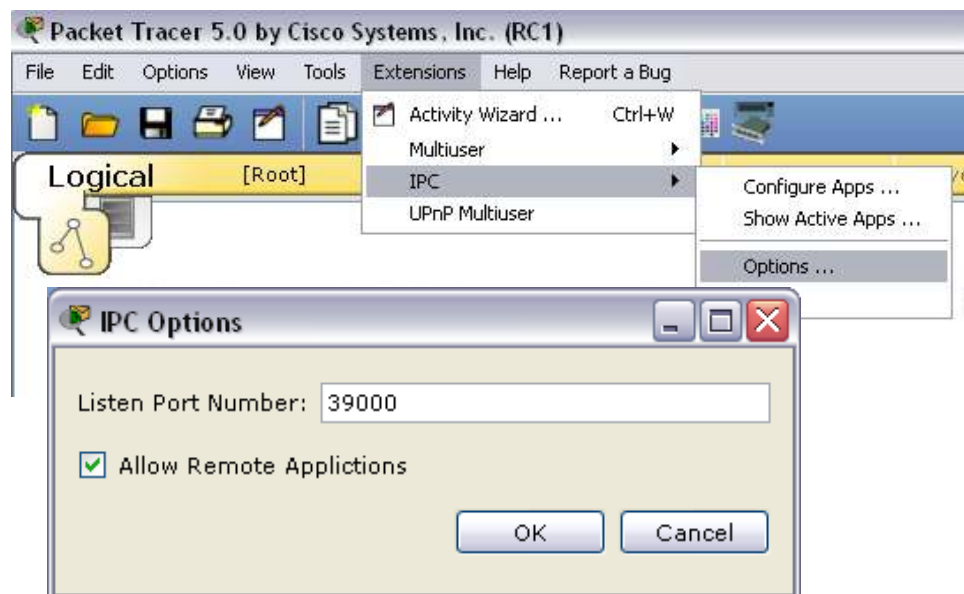

Figure 2 ... IPC Listen Port

The multiuser connection and port allocation is managed by a combination of the remote network – multiuser tool, which is found with all other Network tools, along with the extensions/multiuser/listen menu option (Figure 3).
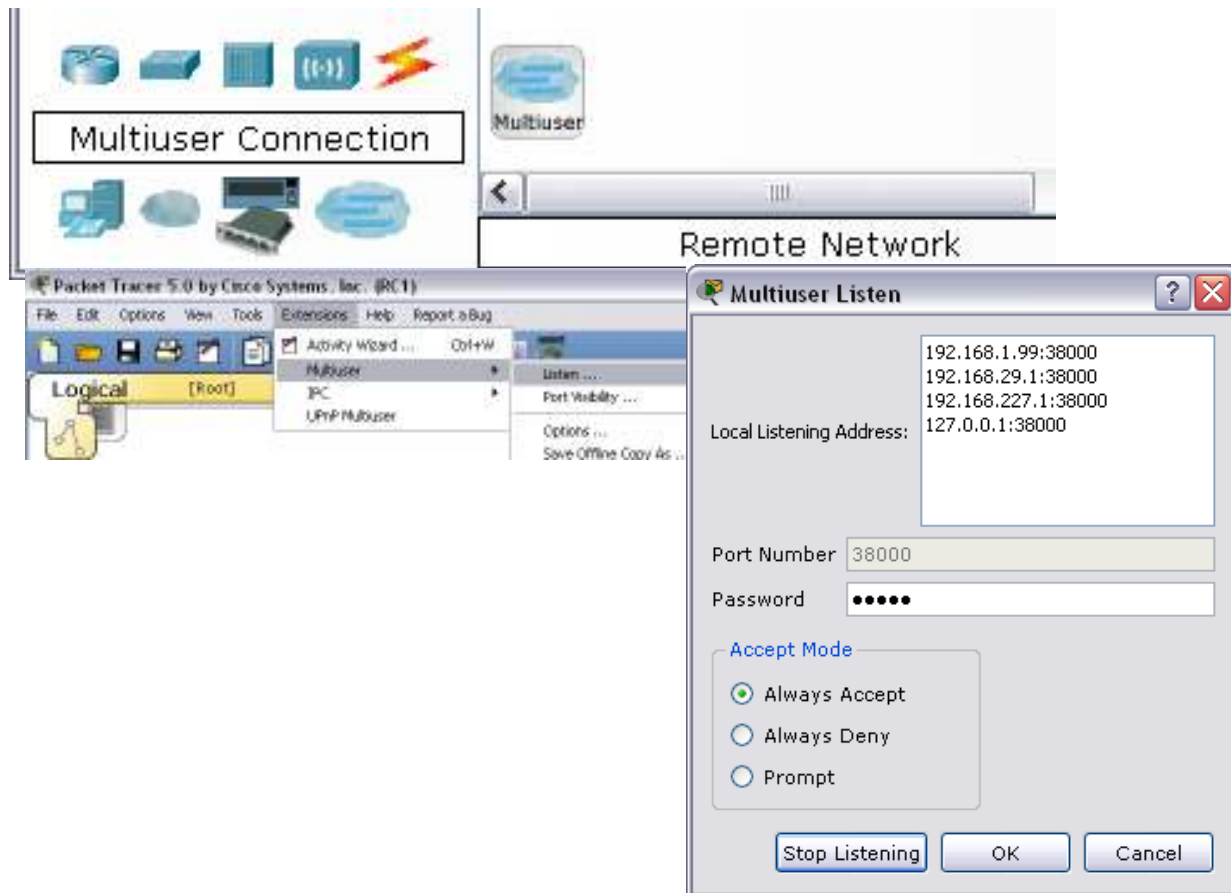

Figure 3 ... Multiuser Access

You may choose the port you wish your system to listen on, but will need to ensure that any static NAT translations externally will pass to the local machine and that any external connections from the client can use a DNS lookup (port 53) to initiate address identification. For additional control, you may wish to deny incoming connections, set Packet Tracer to prompt the user, or if you intend to create a 'server' where access may be trusted, you may wish to select the 'always accept' option.

As many workstations now have a default firewall (such as Windows XP, etc.) you may have to add Packet Tracer and your preferred port to the local list (Figure 4). The same is likely to apply to the corporate firewall or router/switch access control lists.

While the respective defaults are 38000+ and 39000+, your academy is more than welcome to use a port of choice. If you elect to collaborate with another academy it is important to discuss, agree upon and disclose a port which may be used.
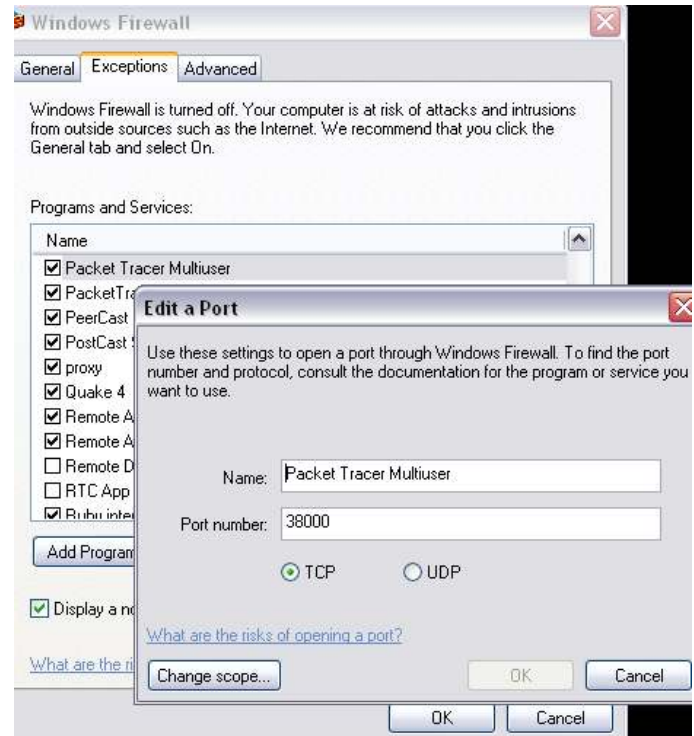

Figure 4 ... Windows Firewall

TRAFFIC LEVELS

Once a link is established between two remote Packet Tracer clients, the level of communication will depend on the level of complexity, yet will always remain at a background level compared to traffic intensive and bursty applications such as web, video and voice traffic.

In its dormant state, each Packet Tracer client sends a keepalive every second containing 8 bytes of data in plain text (this is a sequence of eight periods "**……..**" in each packet of data).

With CDP running and a routing protocol such as EIGRP running on one connection between two Packet Tracer clients, the frequency on a LAN can increase to ½ a second between packets, with the length no greater than 531 bytes for a CDP packet and 186 bytes for an EIGRP packet these again are in plain text (Figure 5).

A.>.....&...........................CIEEE802Dot3Header.CSnapLLCHeader.CCdpFrame.........CCdp DeviceId.....Teraknor.CCdpAddress.............CCdpAddressPacket......172.16.0.1.CCdpPor tId.....FastEthernet0/1.CCdpCapability......CCdpSoftwareVersion.....Cisco IOS Software, 2800 Software (C2800NM-ADVIPSERVICESK9-M), Version 12.4(15)T1, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Wed 18-Jul-07 06:21 by pt_rel_team.CCdpPlatform.....C2800...3.3........... ..

Figure 5 … Packet Dump of Plain Text Traffic

If you run a continuous ping over the same system, the traffic interval changes little, with additional packets coming across at 112 bytes for the ICMP IP traffic. When measured using traffic stat tools, the traffic for two active Packet Tracer clients rarely exceeds 0.2% of the connection which includes any additional background traffic that is being used by the host operating system.

Therefore, if an academy wishes, it could easily establish multiple connections from one point to many other Packet Tracer clients with negligible impact on the overall system's traffic performance.

As is the design of TCP, the traffic is not secure port. MAC and IP address information is exchanged according to the TCP standard, the encapsulated Packet Tracer data, while plain text offers no information which can be used to exploit the host system and is an exchange of simulated network data in a contained environment.

PROTOCOL DETAILS

A major enhancement to Packet Tracer 5 is the ability for academies to develop and add-on applications to the core product. This will enable centers worldwide to take Packet Tracer into their own academic domain and enhance it for local need, with the caveat of sharing these developments with the wider Cisco Academy community.

The Packet Tracer Messaging Protocol (PTMP) documentation, available for download by clicking on the Support File icon to the right of this PDF, describes use of port 38000 for the Multiuser functionality and 39000 for external applications. Code is already available for this platform to use Flash and Java. It is driven via a TCP connection and supports text and binary encoding.

The connection is negotiated then established using Challenge Response Authentication Mechanism (CRAM).
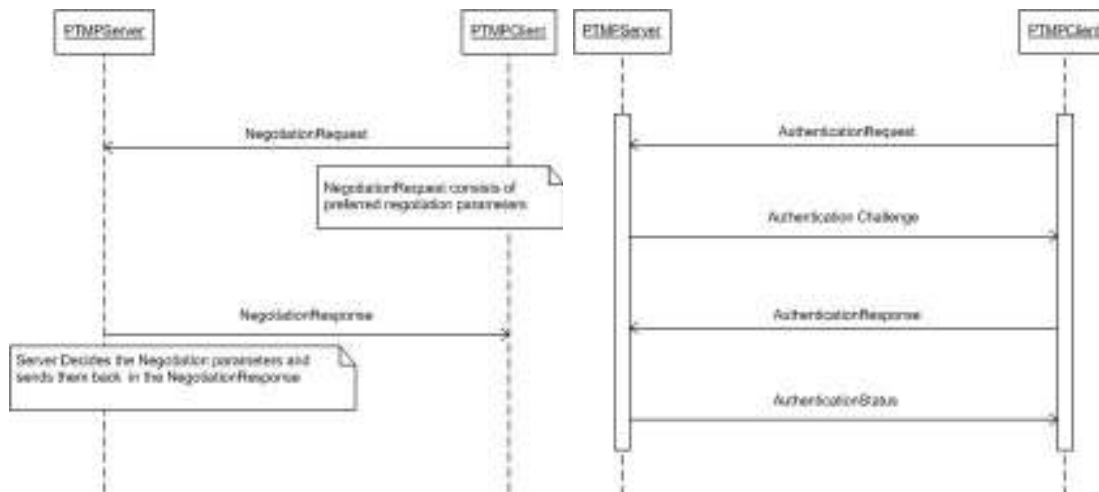

Figure 6 ... PTMP Negotiation

CREATION OF A RELAY SERVER

The versatile nature of Packet Tracer allows an academy to choose many different teaching and technology styles. One which may lead to team exercises, group challenges or distance assessment is a relay server.

The purpose of the relay is to create a system which may be placed in a DMZ or neutral location and enable learners from different academies and systems to work together, without the need to exchange considerable quantities of IP, DNS and port information.

There is no model for the relay server, however, this section sets out an example model which you may wish to implement and then share your experiences with the academy community in the spirit of Web 2.0.

Once you have set your server (which is another Packet Tracer client) to 'always accept' (see Figure 3 earlier in this resource) you could create an environment with multiple meshed switch connections connected to a router which will relay Packet Tracer traffic in and out of the server.
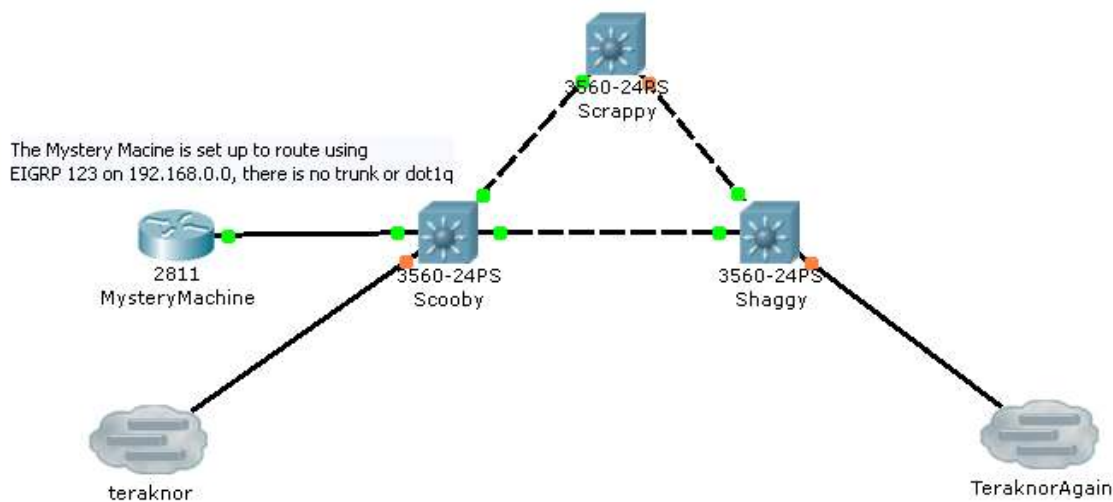

The Mystery Macine is set up to route using
EIGRP 123 on 192.168.0.0, there is no trunk or dot1q

Figure 7 ... An Example Relay Server Structure

With a Class C network core, excluding the IP address of the router interface you could have 253 connections. The three switches will support ((24x3)-1) = **71** external connections. If more are needed, this can be facilitated by subordinate switches on the infrastructure (see Figure 7; the Packet Tracer file is available for download by clicking on the Support File icon to the right of this PDF).

Realistically, could you get 200 students to join a session of this size simultaneously? If so, there would be considerable latency with the threading of the host operating system

as well as potential bandwidth/socket management issues. But, if a center manages this, Cisco Learning Institute and the Networking Academy wish to learn from your experiences and present this as an example of innovative education.

The Packet Tracer client which connects to the relay can be of any device and design, so long as the 'multi-user' facing side is using the same routing protocol. The rest is at the behest of the learner/academic.

Since redistribution and NAT are now supported, students may use unique address ranges as well as repeating addresses across the system (see Figure 8; the Packet Tracer file is available for download by clicking on the Support File icon to the right of this PDF).
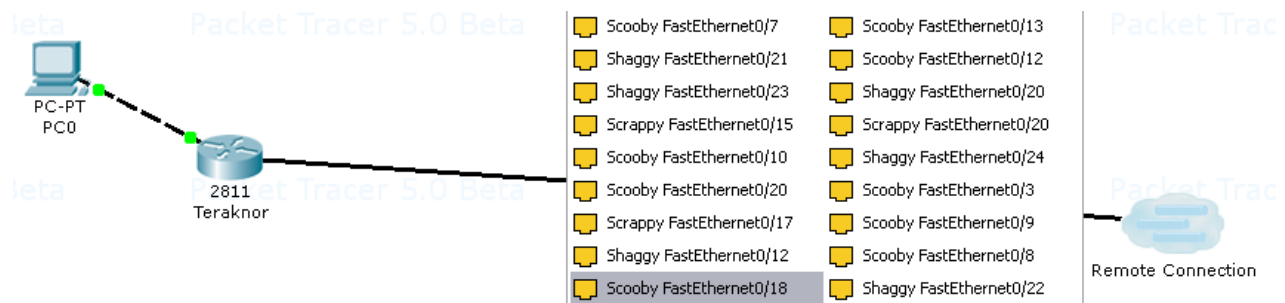

Figure 8 … A Suggested Relay Client System

INFRASTRUCTURE CONSIDERATIONS

Packet Tracer from version 5 onwards is designed to operate as a:

- Standalone client
- Peer client/server
- Server

The **standalone client** is the mode which all academies have become used to in all instances of Packet Tracer up to version 4.11.

With peer client/server you have to consider that you may have students working …

1. In one lab which may be in one switched/routed domain
2. With each other across multiple labs / campuses which may be in more than one switched/routed domain
3. In partnership with other academies locally, nationally or internationally

Point 1 offers no perceived risks, whereas for point 2, internal security, ACL and addressing may have an impact. For point 3, an academy must consider how the external addressing and security systems will map to any internal device hosting Packet Tracer.

This document clearly lists the protocol, port and data load information which should be shared with your local network manager.

You may wish to consider that for the above points 2 or 3, the most secure mechanism is to create your own relay on a computer set in DMZ.

Currently on the Linux or Windows distributions, Packer Tracer is not able to relay 'real network' traffic information. PTMP internally does not carry any information about the initial host computer and vice versa for the destination computer. Therefore, a system hosting Packet Tracer as a relay should not be considered a greater security risk than any other server/host on a network.
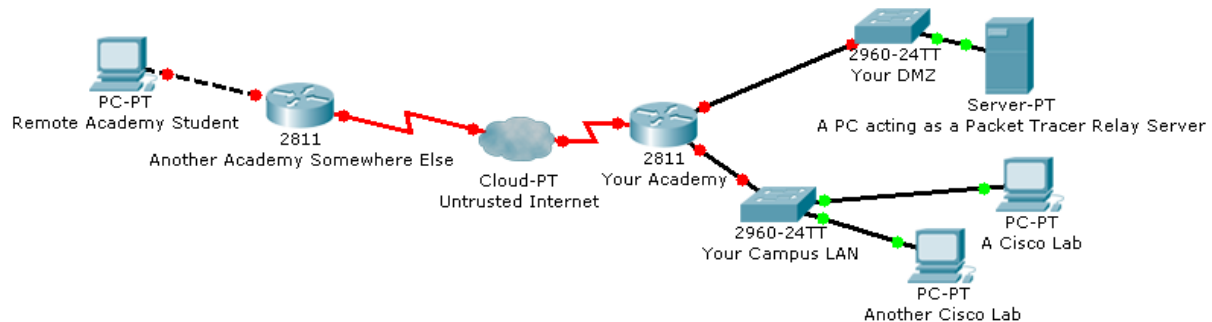
Figure 9 ... Using a DMZ for Internal and External Access to a Packet Tracer Server

Developing Multi User Activities

GETTING STUDENTS TO SHARE

The additional power of Packet Tracer is the ability for students and academies to build complex systems, and with the multiuser functionality, integrate many different complex systems and to eventually build a 'virtual' internet.

Some of the best ideas in education are not those of the educators, but those of the educated. Please harness and encourage this concept in both the context of a local assessment as well as to contribute to the wider Cisco Academy community.

Encourage the students to include their own name/academy with their work as this will be recognized by all who use this application.

COLLABORATION BETWEEN CENTERS

Cisco Systems wishes to encourage centers irrespective of educational level, organization or geo-political boundary to collaborate with each other.

How this may work is entirely up to you.   We just ask that you share the work you have accomplished and how this has benefited your respective students so that we may share them with the larger academy community.

The Cisco Networking Academy Management System has portal for all instructors to share their experiences and ideas (located under the forums link) (Figure 10).
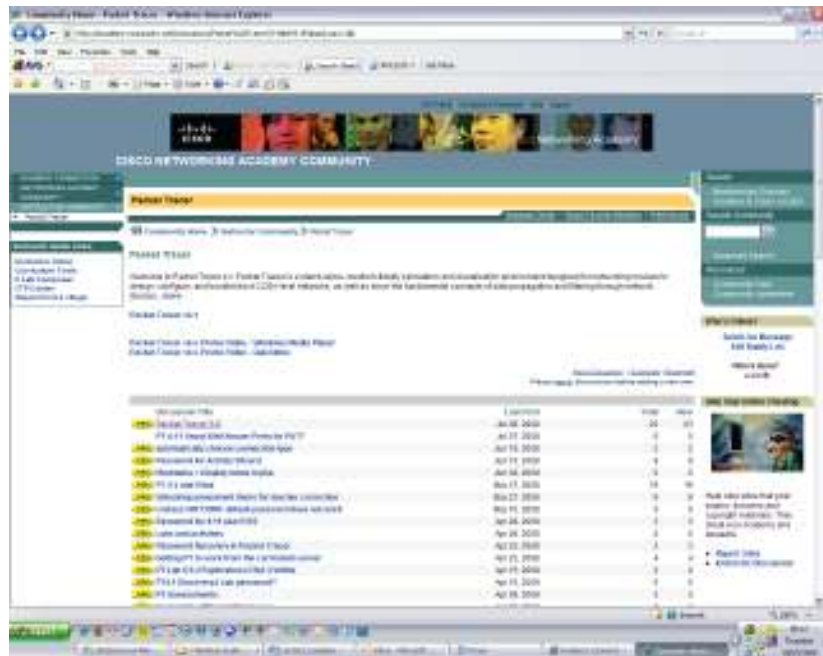

Figure 10 The Academy Forum Portal

ASSESSMENT

While student use of the 'live kit' is still considered essential, Cisco Systems recognizes the benefit offered to academies by using Packet Tracer as an assessment tool to enhance the students learning experience.

The multiuser functionality of Packet Tracer could be used as a challenge exercise. A learner could be given 'blind access' to a system via a Packet Tracer Telnet session, where they then have to fix a range of issues before reaching a goal (which may be a Packet Tracer web server). This idea could be based on time, amount of issues resolved, solutions used, etc.

Alternatively, students may also be encouraged to create a scenario, which their classmate or a remote academy has to access and 'document' or 'fix,' encouraging collaboration and intuitive thinking.