

INTERNET-BASED PERFORMANCE SUPPORT SYSTEMS WITH EDUCATIONAL ELEMENTS – SERVER AND NETWORK (IPSS_EE SERVER&NETWORK)

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Internet-based Performance Support Systems with Educational Elements (IPSS_EE) is an innovative approach for task-performance independent eLearning and development of new instruments in instructional design of Internet-based courses for engineering education. The IPSS_EE research is under two-year project (www.ipss-ee.net) within the European program Socrates/Minerva.

Internet-based Performance Support System with Educational Elements (IPSS_EE) is an integrated electronic environment, which is available via Internet and is structured to provide individualized online access to the full range of information, guidance, advice, data, images, tools and software to permit the user to perform a task. The performance-centred approach of thinking up an educational system offers new opportunities for the educational and training organizations and calls principle changes in the instructional design of course materials. Developed IPSS_EE Environment gives up the course designers and teachers a possibility to create IPSS_EE without knowing the theory and organisation behind performance-centred approach.

According to these needs, IPSS_EE server and network topology components have been chosen and described. The minimum configuration is presented, based upon the strong requirements for Server and network hardware. A system, which has to meet some, pointed in the paper criteria, was built around the specific items of protocols, concepts and software.

1. INTRODUCTION

The continuously expanding use of the Internet has provided tremendous possibilities for engineering education, engineering design and analysis. The use of the Internet has opened a door to adopting new ways to teach engineering topics.

IPSS_EE is aimed implementation of innovative approaches for task-performance independent eLearning and development of new instruments in instructional design of Internet-based courses for engineering education - Internet-based Performance Support Systems with Educational Elements (IPSS_EE). As Performance Support Systems, IPSS_EE courses consider the following elements [1]:

- reference information about a task or closely related set of tasks;
- task-specific training;

- expert advice about a task;
- automated tools for task performance (specific software components for task simulation running on the server or client side)

This new approach of thinking up the educational system as an IPSS needs the design and delivery of one task-performance-oriented e-Learning environment with capabilities to support [2]:

1. Data-base on the IPSS_EE Server with five structural items:
 - submitted task performance database item;
 - problems, symptoms, solutions database item;
 - IPSS_EE Modules database item;
 - media database item;
 - expert advices database item.
2. Different languages – Spanish, English, French, German, Bulgarian
3. Large amount of rapidly changed content of the courses
4. Different media processing
5. Specific software components for task simulation running on the server or client side
6. User access to some Server's folders for saving, editing and removing files

According to the specific needs described above and the specific requirements for a large data and different media processing which should meet IPSS_EE SYSTEM, the following IPSS_EE server side software components is used – Fig.1:

- Client – basic instrument for information representation of graphical user interface – Web browser – the system works properly with most java enabled widespread web browsers: Internet Explorer, Opera, Mozilla, Netscape etc.
- Web server – Apache – the most popular web server since 1996
- PHP – middleware – module for Apache web server that enables server side scripting technologies and dynamic content systems.

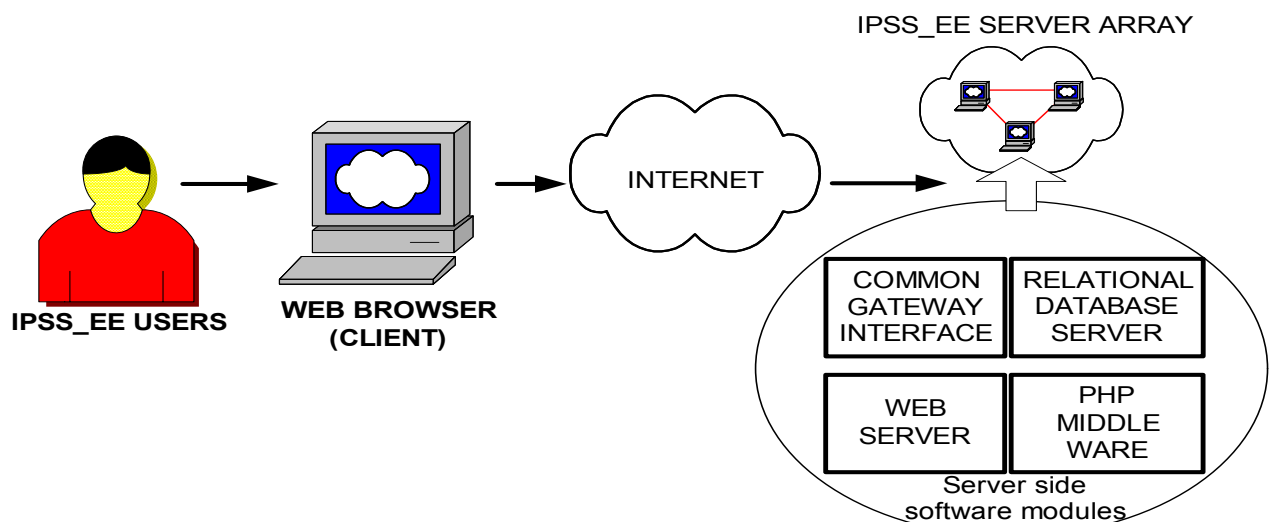


Fig.1

In order to accommodate the growth of Internet use in educational technologies advances in server and networking technologies are needed to improve the quality of services described.

2. IPSS_EE SERVER ARRAY, ROUTER AND NETWORK TOPOLOGY

For the design and practical implementation of IPSS_EE Server Array and network topology the following requirements were taken:

- The server and network hardware has to ensure the 24 hours a day 365 days of a year uptime for the IPSS_EE specific services, as well has to maximize the Price/Performance ratio and to provide best quality of service (QoS).
- The server array has to be protected from unauthorized access from both Internet and internal side of the network
- Load balancing functionality has to be ensured for internal and external traffic to the server array and also for the web servers

According to these requirements a two legged network topology with three independent firewall systems and a restricted De-Militarized Zone (DMZ) for the server array were chosen – Fig.2. To reduce the possibilities for downtime and communication crashes of IPSS_EE server array, two independent Internet service providers (ISP'S) are used. The first one IP address 194.141.27.112 is connected to the university Internet provider acad.bg with 128KB/s leased line. The second one IP address 212.104.97.99 is connected via cable modem to another leased line with speed of 384KB/s to a different Internet service provider. The different services needed are spread over 10 machines with Fedora Core 2 Linux operating system. Firewalls 1, 2 and 3 are implemented with NetFilter IP TABLES software. In the restricted De-Militarized Zone are situated four machines - two web servers for the different domains, MySql database server holding the IPSS_EE database and the Mail Server. Behind the Linux based firewall-3 is placed the internal network of IPSS_EE Laboratory with approx. 15 workstations. Outside firewall-3 is connected SAMBA file server responsible for user access to some Server's folders for saving, editing and removing files as well DHCP server for the IPSS_EE LAB network.

2.1 IPSS_EE LINUX BASED ROUTER SPLITTING THE TRAFIC FROM DIFFERENT ISP'S

The classical approach to realize packet routing and traffic splitting from two independent ISP's is Routing Information Protocol (RIP) and Border Gateway Protocol (BGP). Although these protocols are widely used from ISP's for their outside interconnections they do not offer them for the end users. Very interesting solution is IpRoute 2 protocol, which is a sophisticated system for bandwidth provisioning called Traffic Control. This system supports various method for classifying, prioritizing, sharing, and limiting both inbound and outbound traffic. This approach is not widely used because of suffering of some basic disadvantages:

- The load balancing is not perfect, as it is route based, and routes are cached. This means that routes to often-used sites will always be over the same provider

- There is no load balancing feature for outbound traffic

A new approach using IpRoute 2 allows to precise the load balancing service for both inbound and outbound traffic.

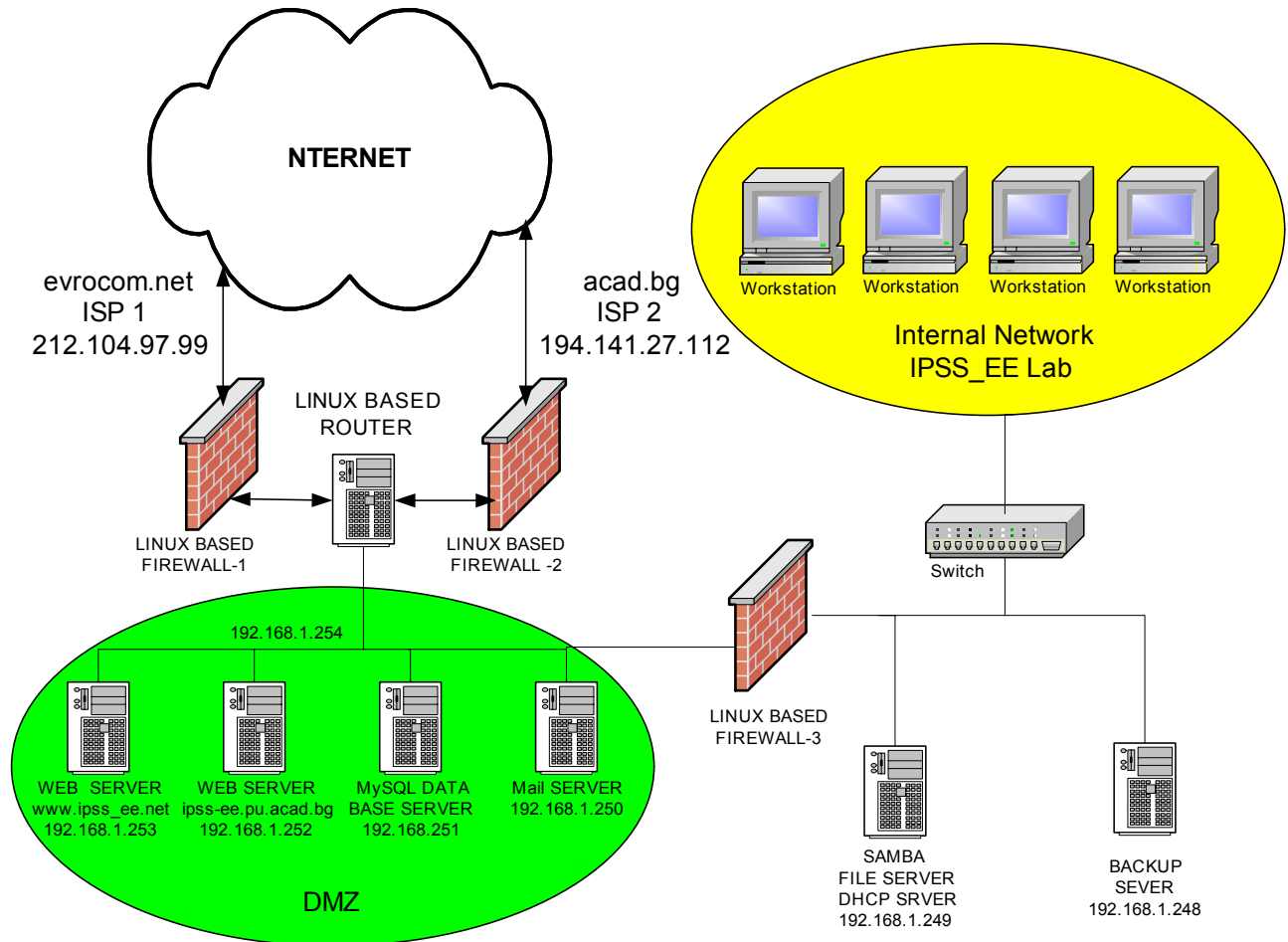


Fig.2

In this case we have to define two kernel routing tables for example T1 and T2. We also have to create a special script for example *flush_route_cache* which will work together with iptables script in our router providing Network Address Translation and will flush the kernel routing cache on a dynamic basis. The time until the cache expires is controlled by the kernel variable `/proc/sys/net/ipv4/route/gc_interval` and defaults to 60 seconds. The bigger this number, the longer it will take until failing routes are not being used again, but the shorter this time, the smaller the chances to find a connection in the cache, loosing time to look up the connection in the routing tables. Reaching a decision when to flush the kernel routing cache is taken by analyzing the log file of Iptraf software, which is configured as a service in the router system. Iptraf stores in its log file statistics for the number of packets transmitted thru the external interfaces of the router, which are connected to ISP's. By special applied

two weighted coefficients w_1 and w_2 we can control the load-balancing feature according to the speed provided from the ISP's. Let's see what happens if only one external line fails: After a certain time, Ethernet will consider the gateway dead and mark it as unreachable. If this is because the link was brought down, the routing cache will be flushed immediately, forcing the next packet to choose a new route, which will get only a working one. Otherwise, the packet could use a route in the cache, which is actually unreachable, causing it to fail: All connections, which are in the cache and which use this route will just, go nowhere. After a certain interval of time, the entries in the routing cache expire, and then the route have to be looked for again, offering only working routes, and things will work again. The practical experience of use of the router and network configuration in IPSS_EE Lab shows that the optimum load for the internal network behind the router must be at least 10 workstations (15 in our case) with a daily download (12h) of some 600MB of HTTP traffic in several hundreds of thousands of connections. Fail-over happened already several times and went by without being noticed by the users.

3.CONCLUSION

The described above IPSS_EE Server array and network was built and setup in IPSS_EE Lab in Plovdiv University. The servers have more than 900 days uptime. They can be reached at <http://www.ipss-ee.net> and <http://ipss-ee.pu.acad.bg>. 10 engineering educational courses exploring IPSS_EE Model have been loaded to the server. From October 2002 until the July of 2004 IPSS_EE System is widely used for teaching engineering courses from universities in Bulgaria, Spain and Netherlands.[3]

4. REFERENCES

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