IXGAMES – Implementing Internet Exchange Point, exclusively for Games

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ABSTRACT

An ever-growing number of games is available on the market and more and more features are incorporated each day. The increase in the player base and game enhancements demand that games work on a network with reliable speed and efficient time response. This article proposes a high speed network infra-structure exclusive for games,. This network, called IXGAMES originated from experiments with shared routing through Internet Exchange Point (IXP). IXGAMES opens new business opportunities for operators/ Providers and game companies that, not only will provide financial return, but will also allow them to offer better quality service to their customers.

Keywords

MMORPG. IXP. Games, Pyhton, NS2, NAP

1. INTRODUCTION TO INTERNET GAMES

The use of the Internet, whether for e-mails, sites, e-commerce, or banking is as important today as electricity. The number of transactions which demand high performance and availability are ever increasing on the Internet.

A growing number of games is offered on the market and various features are incorporated each day. To prove this fact, Gardenghi, Pifferi and D'Ângelo (2004) affirm that with the increase in Internet connections, the computer game developers began to create other MMORPG's, adding more and more features. In Figure 1, one can observe the growth in the use of MMORPG's.

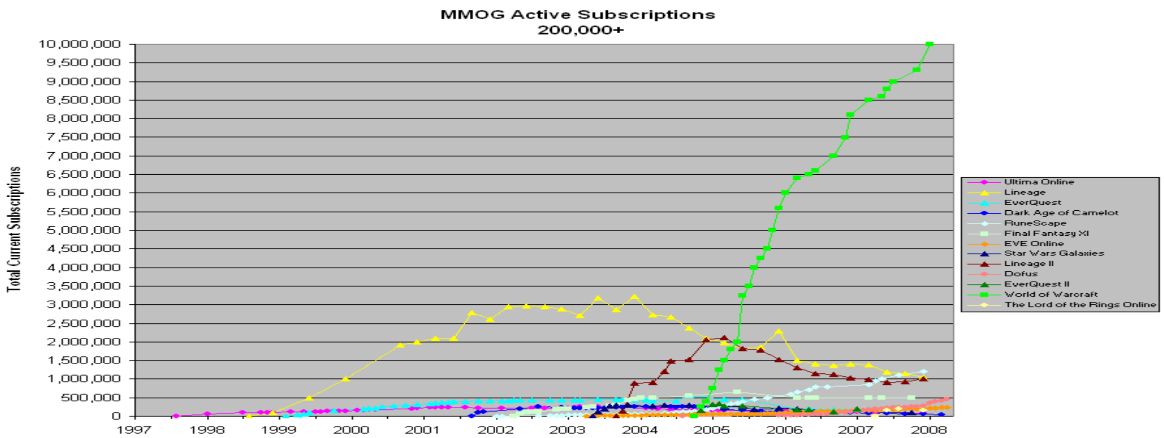

Figure 1. Growth of MMORPG's (2008).

The game market grows exponentially according to what Anido and Penha (2004) affirm: "The electronic game market in the US generates more investments than Hollywood film box offices."

Currently, players' access through the Internet faces two problems: the delay and the large number of simultaneous connections through the server.

The increase in the number of players and game enhancements demand that these games work on a network which does not present slowness, but provides efficient time responses.

There are enhancements on the Internet which are demanding on the bandwidth and may cause delay, for example, in the MMORPG structure. The article *Networked Games* (Henderson; Bhatti, 2003) dealt with the player's tolerance level according to the delay he was exposed to.

The MMORPG structure uses the term *LAG* to identify the amount of time which the user's station is behind the server. Generally, this delay is caused by the connection's low transfer rate or by too many people being connected to the server. This slowness causes players to give up. The message below, in the game in Figure 2, represents the *LAG* parameter for players (Prevention against LAG: half001 and user will be automatically disconnected in 20 seconds.)

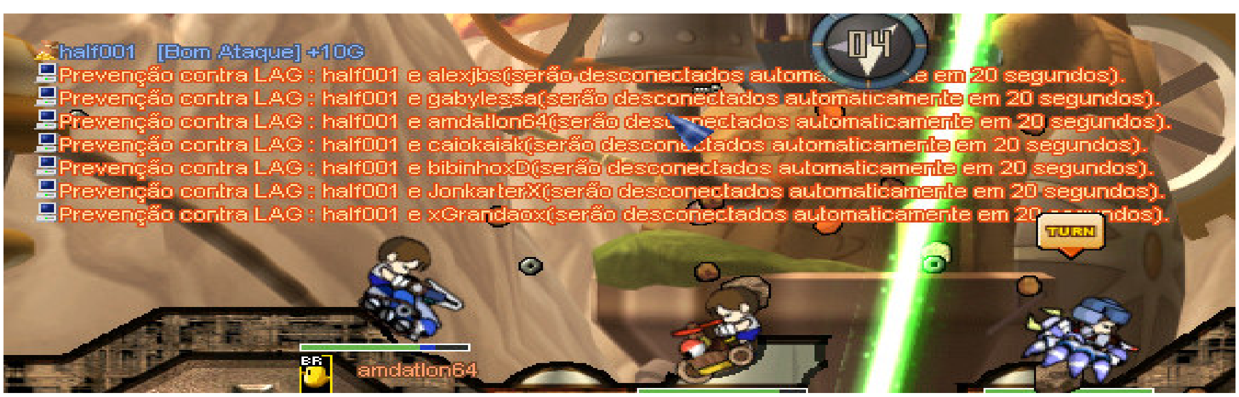

Figure 2. Gunbound (2006).

The games which are delay sensitive generally have high Internet traffic. The implementation of a network infrastructure to function only for a game is financially unfeasible.

In this context, we propose a high-speed structure which is shared by the games users.

2. THE STRUCTURE OF *IXGAMES*

The article *Implementation of a Service Platform of Online Games* (Shaikh et al., 2004) deals with a prototype for the implementation of a network which is shared for games, based on the components and dealing with the performance metrics in certain games. This article proposes an exclusive network for games, based on a shared structure which is routed between operators through a Internet Exchage Point (IXP) and independent balancing structures for each game. In this way, the local structure can be adapted according to the traffic profile and the number of sessions of each game, while the routing structure is shared.

The structure of a *IXGAMES* Network is based on the routing concept to follow line of sight.

Internet Exchange Point – (IXP)

According to Sousa (2004), since the beginning of the Internet, there has been great concern with the congestion of links between servers. In order to relieve this situation, it is fundamental to create a Internet Exchage Point, in other words, a high speed network, where routers can connect in order to exchange the traffic of their clients.

Many providers already use a Internet Echange Point (IXP)). The correct use of a IXP allows for gaining delivery time through the use of alternative routes (redundancy) which are shorter between locations, allowing for significant savings in Internet links, besides the performance gains.

On the Internet, an *Autonomous System – AS* is, in most cases, associated with an Internet service provider which provides an infra-structure of transmission and access for a region. Each AS is recognized by a decimal number used by the BGP routing protocol. The AS can be private or public. If it is public, it should be duly registered by a provider with a licensing organ.

The *Border Gateway Protocol* (BGP) is a protocol of routing between *Autonomous Systems* (Rekhter, 1995), used in the exchange of routes between the IXP participants. Knowledge about the BGP is fundamental for the implementation and operation of a IXP.

The BGP in the IXP is responsible for the set routing policies, in other words, to manage situations such as: (1) A participant does not want to import all the learned routes to his routing table; (2) A participant does not want to announce all the routes of his routing table to other participants; (3) A participant wants to modify information associated with a route.

The traffic control of the entrance and exit of a participant in the IXP is executed through the configuration of the BGP on the routing server and on the participant’s router.

Routing Server

An exchange of the routes on the *IXGAMES* network would be executed by routing servers.

The routing servers are computers which execute a software program which performs the exchange function and processes routes. (Peno Filho, 2000).

The routing server is composed of a server executing an operational system, which is Linux or Solaris in the majority of cases, and a routing module which can be free or commercial. Among servers, Zebra is highlighted, studied in this article, but there are the commercial versions called Gated and Quagga.

The routing server receives the routes, processes them according to the established routing policy and finally distributes them to each participant. The routing servers use the BGP as the routing protocol.

An important factor is that the routing servers do not route packets between networks connected to the IXP. They use the capacity of the BGP, for distributing the routes of the next destination point to the router that announced the route. However, the traffic is exchanged between the participants, as illustrated in Figure 3.

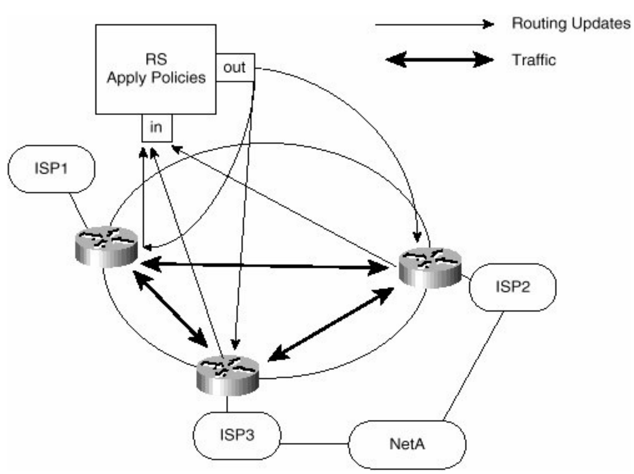

Figure 3. Exchange of routes in the routing server Halabi and Pherson (2000).

The participants of a IXP, which in the majority of cases are providers, make use of it in order to exchange traffic in a direct manner between participants and according to the routing policies implemented for the IXP and for the participants.

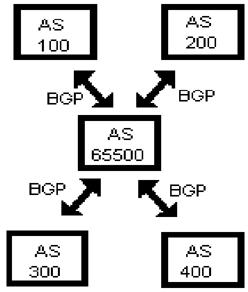

Figure 4. Example of an exchange of participants' traffic.

By analyzing Figure 4, one can observe a central IXP, which receives the routes of all the participants and spreads those which are learned. It is important to note that the traffic of the participants does not go through the IXP, only the table of exchanged routes, which is its function.

By analyzing Figure 5 one can observe the first topology (left) the clients using Internet and the second topology (right) the clients using Internet with IXP with the better delay.

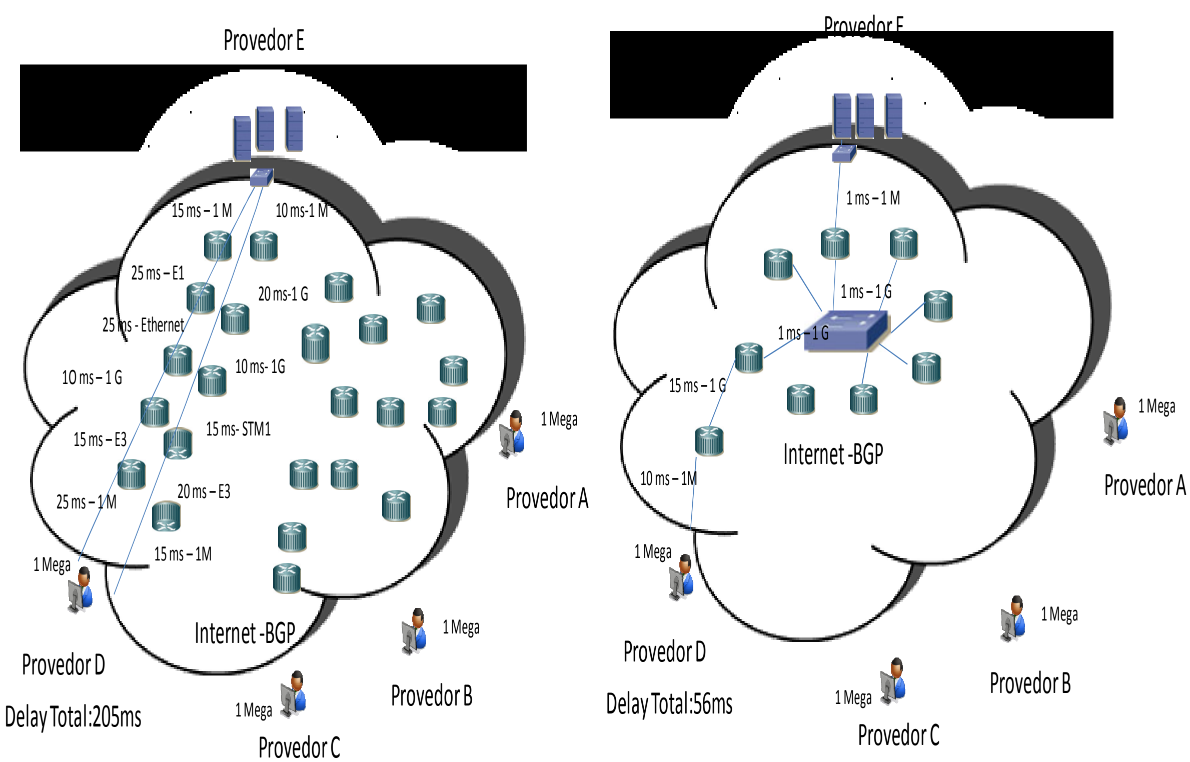

Figure 5. Example of client using the Internet and a IXP.

Zebra – a Routing Server

Zebra, when installed, functions as a router, allowing for the exchange of routes with other routers.

This software is based on a monolithic architecture, which removes processing of routing functions from the CPU, without burdening the server.

Zebra supports the BGP-4 protocol, as well as RIPv1, RIPv2 and OSPF. It is original in its design, since it has a process for each protocol, where each module can be dealt with independently from the others.

Its code is open for alterations. Besides this, it is not commercialized. However, there are already companies which have made routing servers with a Zebra base, including additional functions and gaining the rights to commercialize the service.

As far as hardware goes, the components of a server, such as the processor, RAM memory, network interfaces, power sources, disks, etc., should be analyzed when they are linked to the use of a server as network equipment. The needs of availability and reliability are much more rigorous in the hardware architecture and several things should be considered: the choice of the mother board, as well as the ISA 8 or 16 bit adaptors; the priority of interruptions of the components; the partitioning of the hard disk; interfaces; processor; memory and even the design of the cabinet.

Zebra routing servers have a configuration syntax which is very similar to that of the Cisco manufacturer. Since Cisco is a market standard, this facility extends to the majority of Internet service providers.

3. Experiment with a Internet Exchange Point

In order to propose the infrastructure for *IXGAMES*, a five phase division has been made.

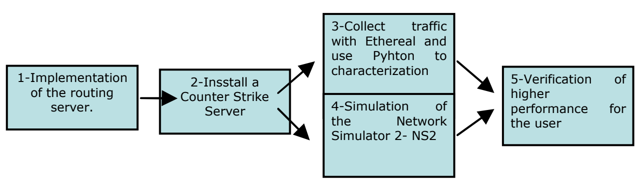

Chart 1. Phases of the Experiment

In the first phase, to begin the experiment, a routing server based on Linux was implemented.

The experiment began with the installation of the *Linux Red Hat* 9.0 on a server with the following configuration:

a) Server *Netfinity* – BM;
b) Pentium 3 – 929 MHZ;
c) 2 18 Gb disks
d) 512Mb of memory;
e) 2 power sources.

In the servers, mirroring of the disks was configured; in other words, *Raid* level 1 in order to have redundancy and data preservation in the case of a disk failure.

After the installation of Linux and the respective updating of the patches, the more recent version available of Zebra – Zebra-03.b. was installed.

In the second phase, a Zebra routing server based on Linux was chosen. A setting of traffic exchange was simulated with a sample of three operators, possible candidates for *IXGAMES,* configuring the routes and the filters. .

The three operators exchanged routes through a routing server as seen in Figure 6. The participants, AS's and the chosen networks are fictitious, or rather, only for analysis of the operation.

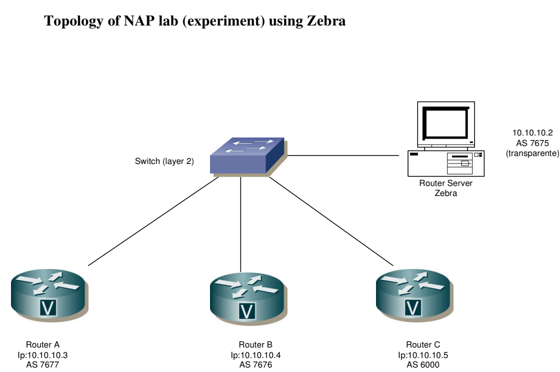

Figure 6. Topology of the lab experiment.

Each participant had its established routing policy announcing its networks so that the routing server would accept them all, and distribute them to all the participants. In this phase, it was necessary to use commands of routing analysis to verify each announcement and analyze the questions below:

a) What is the best configuration for the routing server?
b) Are the participants exporting their networks?
c) Are the participants receiving the networks from the other AS's?
d) Is the routing server being transparent in the announcement of networks?
e) What is the best configuration for each participant?

Equipment utilized:

a) 1 Server *Netfinity* – IBM – installation of Zebra;
b) 1 *Switch* 2924 from Cisco
c) 3 Cisco 2501 Routers.

In each router these announcements were given from each network as seen in Table 1.

Router A **AS7677** **Ip 10.10.10.3**	**Router B** **AS 7676** **Ip 10.10.10.4**	**Router C** **AS 6000** **Ip 10.10.10.5**	**Routing Server** **Ip 10.10.10.2**
120.0.0.0/24	130.0.0.0/8	150.0.0.0/8	1.0.0.0/8
121.0.0.0/24	131.0.0.0/8	151.0.0.0/8	2.0.0.0/8
122.0.0.0/24	132.0.0.0/8	152.0.0.0/8	3.0.0.0/8
123.0.0.0/24	133.0.0.0/8	153.0.0.0/8	4.0.0.0/8
124.0.0.0/24	134.0.0.0/8	154.0.0.0/8	5.0.0.0/8
125.0.0.0/24	135.0.0.0/8	155.0.0.0/8	6.0.0.0/8
	136.0.0.0/8	156.0.0.0/8	7.0.0.0/8
Number of routes: 6	137.0.0.0/8		8.0.0.0/8
	138.0.0.0/8	Number of routes:7	9.0.0.0/8
	139.0.0.0/8		10.10.10.0/24
	140.0.0.0/8		19.0.0.0/8
			29.0.0.0/8
	Number of routes:11		39.0.0.0/8
			49.0.0.0/8
			59.0.0.0/8
			69.0.0.0/8
			79.0.0.0/8
			89.0.0.0/8
			Number of routes :18

Table 1. Block of addresses used in the experiment

Note: The networks announced were not summarized.

After analyzing the experiment of the IXP done in the lab, in the third phase a routing server was installed in a *Data Center*, making it available to eight operators.

Parallel to this, in the fourth phase, an experiment with many clients using IXP and Internet. In this phase was used NS2- Network Simulator 2.

By analyzing Figure 7 one can observe the methodology used with NS2.

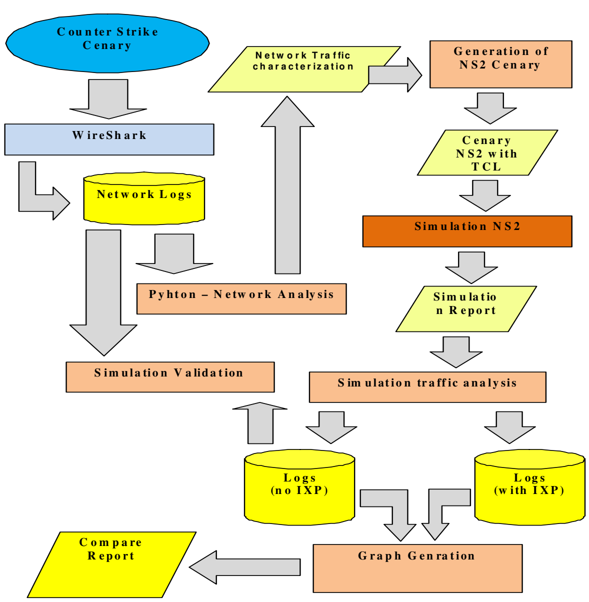

Figure 7. NS2 Methodology

In the fifth phase, we simulated a game user accessing the game through an Internet service provider participating in the IXP and another which did not belong to the structure.

4. RESULTS OF THE EXPERIMENTS

Zebra was chosen as it is the one which is most similar to the Cisco market standard, thus facilitating the operation and maintenance of the IXP's, allowing us to visualize the BGP neighbors in a clearer manner, which emulated a router.

The analysis of the experiments proved that the routing server receives routes from each participant, or rather from router A (AS 7677), B (AS 7676) and C (AS 6000). Table 2 shows the routing server (10.10.10.2) received 6 routes from router A (10.10.10.3), 11 from router B (10.10.10.4) and 7 from router C (10.10.10.5), a total of 24 routes.

It was observed that the routing server announced 18 routes. One can come to this number by analyzing the other results.

Router A received 36 routes, or better the sum of the 11 routes from router B, plus 7 routes from router C and 18 routes from the routing server.

Router B received 31 routes, the sum of the 6 routes from router A, plus 7 routes from router C and 18 routes from the routing server

Router C received 35 routes, or better the sum of the 6 routes from router A, plus 11 routes from router B and 18 routes from the routing server.

```
bgpd# sh ip bgp summary
BGP router identifier 10.10.10.2, local AS number 7675
4 BGP AS-PATH entries
0 BGP community entries
```

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/PfxRcd
10.10.10.3	4	7677	187	190	0	0	0	03:04:07	6
10.10.10.4	4	7676	187	190	0	0	0	03:04:08	11
10.10.10.5	4	6000	187	190	0	0	0	03:04:07	7

Table 2. Networks received on the routing server

In the routing table one can also observe all the networks belonging to each participant and the *next-hop* attribute of each, in other words, the IP address of the participant which it announced proving that the traffic did not go through the routing server.

After the analysis of the experiment carried out in the lab and the elaboration of a test plan the experiment's documentation confirmed the functionality of the Zebra as a routing server for the structure of the IXP.

The structure of the Network Access Point began to be produced in a *Data Center* of an operator, following the same specifications of the routing server of the experiment.

The IXP installed in the *Data Center* had 8 participants, 6 of them used an E1 link (2 Mbps), one used three E1's, giving a total of 6 Mbps, the bigger one used an E3 (34 Mbps). All of the participants are operators which began to send part of their traffic to the IXP.

The installation was extremely successful, meeting all the expected requirements and making performance gains for the clients of the IXP operators possible, by allowing clients to access sites belonging to the other operators.

The *Data Center*, besides the other features, hosts, games. It is well to note that this exchange point was not exclusively for games.

All the clients of the operators which participated in the IXP had fewer hops for the game structure, at high speed, without congestion (control). The path used from the station to the server was shorter and faster, operating with an *Ethernet* type segment.

The *traceroute* command presents the path for the game servers from the user's station. One can see in table 3, the quantity of hops for the game server. In the first column the IXP is used, while in the second it is not.

TRACEROUTE USING IXP	TRACEROUTE WITHOUT THE USE OF IXP
Tracing the route to 200.189.184.11 1 200.215.180.5 0 msec 0 msec 0 msec 2 200.189.184.11 0 msec 0 msec 0 msec Rastreamento concluído.	Rastreando a rota para s200-189-184-11.ipb.diveo.net.br [200.189.184.11] com no máximo 30 saltos: 1 10 ms 14 ms 12 ms 10.13.0.1 2 * 10 ms 13 ms c9060002.virtua.com.br [201.6.0.2] 3 * 10 ms 7 ms c9060005.virtua.com.br [201.6.0.5] 4 10 ms 12 ms 11 ms embratel-G6-0-gacc05.spo.embra tel.net.br [200.178.78.1] 5 20 ms 11 ms 29 ms ebt-G1-0-gacc01.spomb.embra tel.net.br [200.230.242.129] 6 * * * Esgotado o tempo limite do pedido. 7 14 ms 12 ms 14 ms 200.215.180.5 8 13 ms 32 ms 14 ms s200-189-184-11.ipb.diveo.net.br [200.189.184.11] Rastreamento concluído.

Table 3. Paths used for the game

5. TOPOLOGY OF IXGAMES

The article mentioned at the beginning *Implementation of a Service Platform of Online* Games (Shaikh et al., 2004) suggests a prototype of a network infrastructure for games; however, it does not go into routing. It also does not suggest structures of load balancing adapted for each type of traffic.

The proposed structure will have IXP(s) between ISP's *Internet Service Providers* and an infrastructure of servers connected directly through the use of structures of load balancing servers.

Below in Figure 8, the proposed topology is shown based on the experiments.

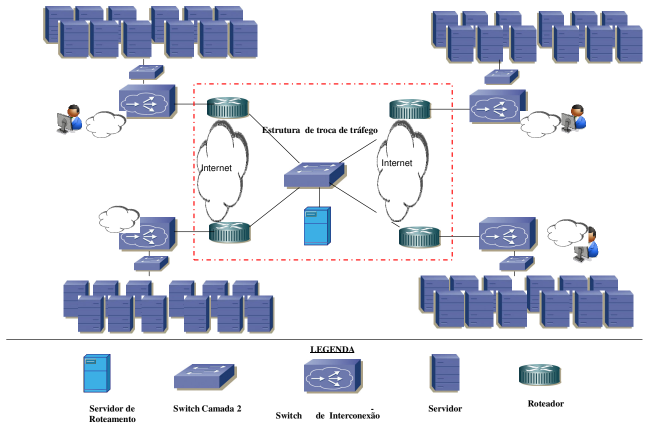

Figure 8. The Topology proposed for IXGAMES.

In the proposed topology, one observes a network exclusively for players, where the providers, which exchange the routes through an IXP, have a redundant connection through the Internet and content switches to balance the servers. This topology could be incremented with items including firewalls &/or redundant equipment, for example, two routing servers, links, routers and new functions such as management and centralized security.

Exploiting the BGP protocol and adjusting the filters will provide an enhancement of the traffic on IXGAMES, while altering the routing policies in a way which would be acceptable to the networks of the clients of the participants. This alteration generates a gain in access speed for the users.

5.1. Participating Operators in the game Network

The operators, candidates to participate in *IXGAMES* should have a permanent connection with the Internet and have an *Autonomous System.*

It is well to note that IXGAMES does not provide an Internet connection, nor does it guarantee the presence or connectivity of a certain Internet service provider.

IXGAMES exchanges announcements between participants, making them learn the routes by inserting them in the routing tables. Each route represents a short-cut which interconnects a participant directly to the others, resulting in a gain of speed in the exchange of traffic and economy in the configuring of their links on the Internet.

6. CONCLUSION

IXGAMES arose from the need to give the market a solution which could give more alternatives to the game market.

IXGAMES was developed from the realization of IXP experiments using Linux and on a study of Pyhton and NS2 which allowed for the participation of various players at the same time, providing efficient time response.

The use of IXGAMES opens a new line of business for operators and game companies, providing financial return. Furthermore everyone will have better quality service by passing on these characteristics to users.

The topology was proposed with a base in shared routing through a IXP and in load balancing servers which are exclusive for each game.

IXGAMES is a brand new network, which has not been implemented yet. Due to the gain in performance, it provides for the implementation of new features in Internet games's.

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