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Implementation of DHCP Failover methodology within the Dominican Republic's small businesses & organizations information technology platform

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Abstract

The implementation of a DHCP server minimizes the errors related to the configuration of Internet Protocol (IP) addresses manually. The most common errors could be typographical errors, address conflicts caused by the assignment of an IP address to more than one computer. These errors make more expensive and costly the maintenance of the information technology platform within an organization. This proposal emphasizes on the benefits of implementing a DHCP server.

In many occasions, the DHCP server fails causing the partial or complete shutdown of the information technology platform within an organization. In the Dominican Republic, many organizations, especially those located in poor communities do not have these kind systems implemented.

This capstone proposal addresses the open issues related to the implementation of the DHCP service within small businesses (PYMEs) in the Dominican Republic and the availability of the DHCP service within those enterprises. This capstone proposes a DHCP failover methodology that could be implemented by many individuals and small businesses within the Dominican Republic.

Introduction

Society is changing and technology is playing a major role in our lives. Information technologies allow the data to reach remote locations in seconds. Information technologies represent a considerable useful and critical tool for the society. According to Minges (1995), information technologies represent an opportunity for developing countries to help improve the lives of their citizens.

Furthermore, Minges (1995) suggests that the effects that these information technologies have in the society are developing a society trend called *Digital Revolution.* The digital revolution basically relies on a big network which is interconnected to millions of smaller private and public interconnected networks that create a global asset called the Internet. A few years ago, a concept called the Internet of Things was introduced and what it means is the idea of interconnecting all components of an individual's life to the Internet.

The idea of the Internet of Things promises to change the lives of the people around the globe. Nonetheless, these information technologies are not being implemented in many developing countries. Many of those countries do not have the proper infrastructure in order to implement those technologies and many other countries do have the proper infrastructure however, those technologies are not being implemented in an efficient and effective manner.

According to Giddens (1990), it is critically important to implement some measures and take actions in order to improve and promote the use of information technologies in the least developed places in the world.

The Dominican Republic is a developing country in which inequalities not only in economic levels but also in education and social levels are present. The Dominican Republic faces many challenges since the government is required to invest considerable big amount of money in order to reduce the digital gap between the big cities such as Santo Domingo and Santiago and small cities such Dajabon and Pedernales.

According to the Economic Commission of the CEPAL (Caribbean and Latin American Economic Commission), the Dominican Republic has been growing at a sustainable rate for the last 20 years

however this economic boom has not reach small cities, especially those communities and cities located close to the border between Haiti and Dominican Republic.

In order to reduce the economic and digital gap those "big cities" such as Santo Domingo and those small and poor cities such as Pedernales and Dajabon, the Dominican government passed a few bills in order to reduce taxes to companies and factories that are willing to move to those poor cities and create jobs. It is a very important bet for the government and many corporations such as Brador (a local manufacturer of gold and silver jewels) however, the lack of skilled laborers and the lack of the proper technological infrastructure represents a big challenge for everyone, the government, the corporations, and the people living in those communities.

During the research period and the elaboration of this capstone proposal, a visit to the Brador corporation located in a small community was made. We interviewed one of the personnel in charge of the IT department within that company and asked him about the DNS and DHCP service. He replied that the company was not running a local DHCP nor DNS server. They were relying on their ISP to serve any DNS or DHCP requests for all 250 of the company's computers. Due to the current electrical conditions in the Dominican Republic, many times the ISP was not able to provide those services.

Literature review

DHCP failover is the replication of a DHCP server which is considered as the primary DHCP server to a partnering DHCP server. Internet Engineering Task Force (IETF) recommends the underlying protocol for DHCP failover (IETF, 2003). The major concept is to share the scope of the DHCP server by a failover system. To load balance and other redundant purposes, the primary DHCP server and the partnering DHCP server can use same subnetting. In a failover environment, DHCP servers share the components and settings of a failover enabled DHCP.

As our problem statement implies, we are intending to solve the existing problems of Internet access in Dominican Republic by assessing the severity of the problem and afterwards proposing a DHCP failover system. Hence, our main concern is to ensure the availability of Internet access without interruption.

The main benefit of DHCP failover is to ensure the high availability which is our aim on this study (Lemon, 2003). We intend to help improve availability of DHCP service to increase the availability of internet access in Dominican Republic.

DHCP failover can ensure the sustainability of a network even when one is down. In our case, if the primary server is down or the partnering sever is down, we are not out of service because of the virtue of DHCP failover as the service still exists as the DHCP failover share the scope of the services. Though there are some disadvantages of redundant DHCP service which is the main backbone of DHCP failover, it is yet considered a great method to ensure high availability (Lin, et al., 2011). There are some proposed novel methods to apply DHCP failover (DHCPF) in solving real world problems (Fan, et al., 2007). We intend to follow the Microsoft manual to set up our DHCP failover as prototype for the Dominican Republic.

Purpose statement

The purpose of this capstone proposal was to identify, discuss and analyze open issues related to the implementation of the DHCP service within small businesses (PYMEs) in the Dominican Republic and the availability of the DHCP service within those enterprises. The purpose of this capstone is to propose a DHCP failover methodology that could be implemented by many individuals and small businesses within the Dominican Republic.

Methodology

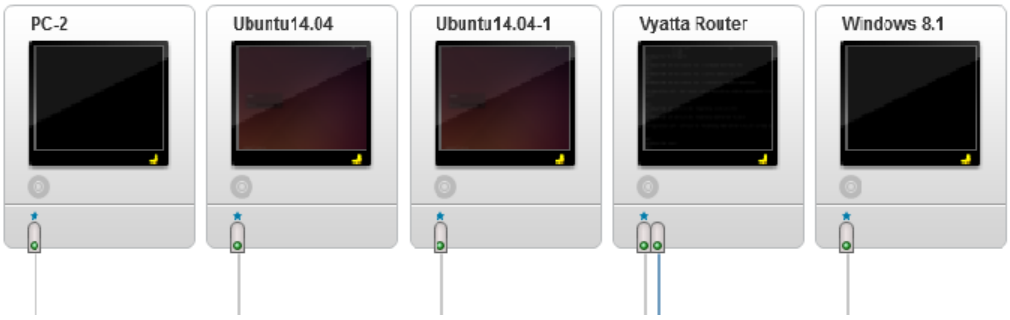
The proposal was implemented by setting up the following component:

- 2 Ubuntu server
  - Primary DHCP Server
  - Secondary DHCP Server
- Clients

- 3 Windows 8 PC's

- Virtualized environment (RLES)

The first step to implement this proposal was to set up the environment.



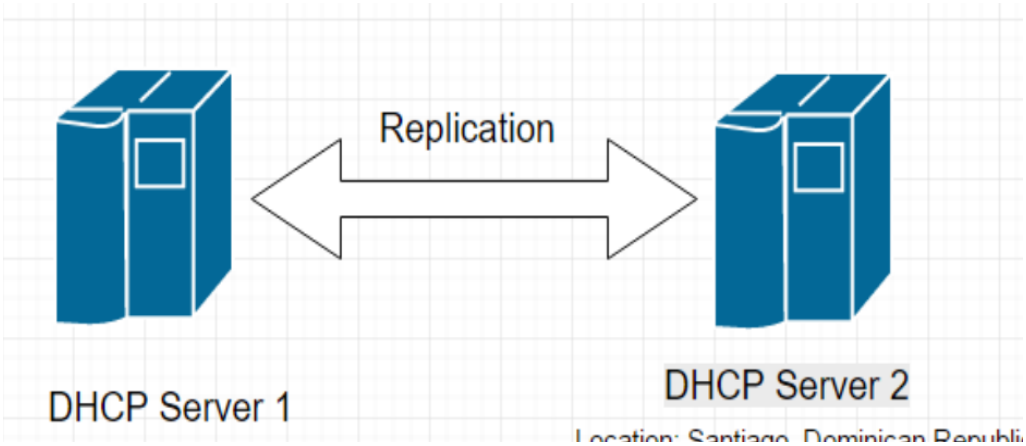
Since this proposal was aimed to be implemented in small cities, communities and small businesses and large businesses that operate in poor locations within the Dominican Republic, Ubuntu was chosen in order to present this capstone proposal.

Ubuntu is the most popular Linux operating system and it is free. It is an Open Source operating system. Another advantage of Ubuntu is the security features that this operating system presents. Ubuntu was chosen in order to make this proposal accessible to limited resources organizations.

The Ubuntu server would be installed within the virtualized environment of RLES which is a platform provided by Rochester Institute of Technology for educational and research purposes.

Three (3) virtual PC's were installed running Windows 8. Those computers served as client nodes.

The basic concept behind this project was to replicate the DHCP service between two servers in order to improve the availability of the DHCP service. When a server fails, for any reason, the other server takes the authority to provide IP addresses and other DHCP server responsibilities.



The information which was being replicated between the two Ubuntu server were:

- Addresses
- Leases Information
- Reservations
- Options

- Policies

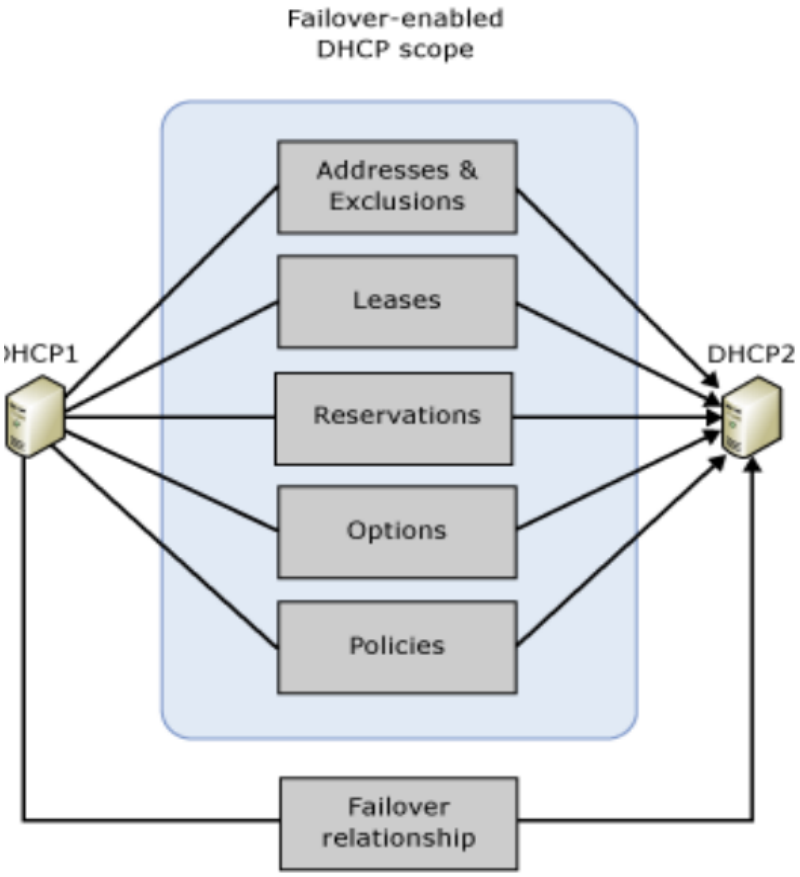


Figure 1: DHCP Failover Enabled Servers.

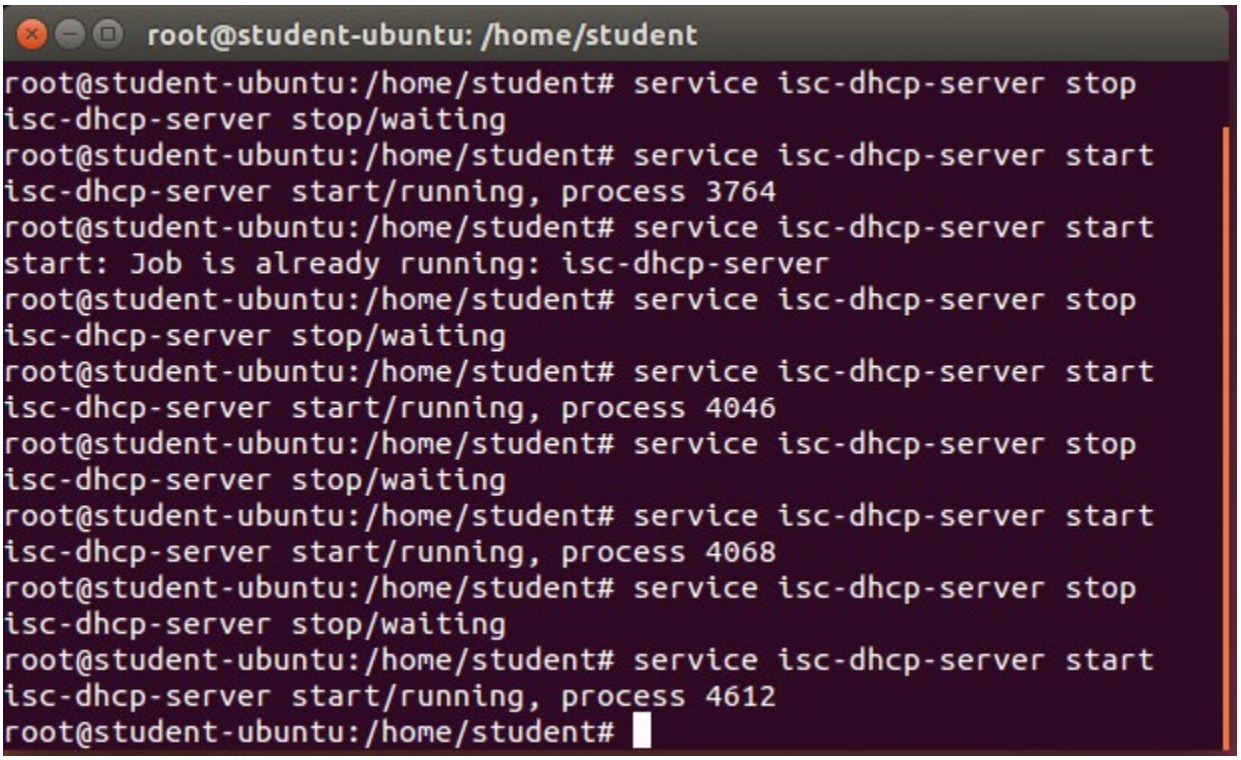
Results

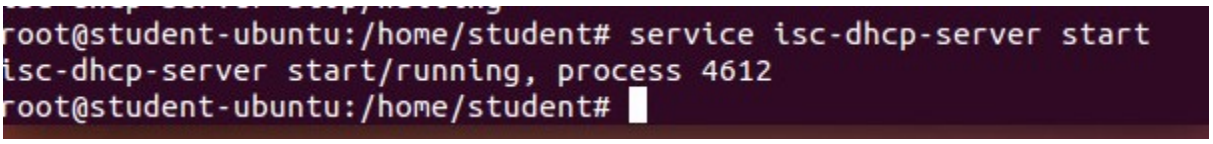
During the implementation process, one of the Ubuntu servers acted as the primary DHCP server and the second one as the slave or secondary.

Primary: Ubuntu 14.04-1

Secondary: Ubuntu 14.04

We started the service on both servers. However, in our implementation only the primary server is performing the functionalities and only the primary server is providing IP addresses. No event is avoiding the primary server to perform its duties.





In order to verify that the server is working properly, a debugging window command was issued so we can verify what is happening in the environment.

In order to check the logs, we checked the syslog file which is located in **/var/log/syslog.**

The following command was issued: **tail –f /var/log/syslog | grep dhcp**

We stopped the service in the primary server.

```
Dec 12 20:15:09 student-ubuntu kernel: [100308.407896] init: isc-dhcp-server mai
n process (4612) killed by TERM signal
```

The secondary server responds on the following manner, overtaking the duties of the primary server:

```
Dec 12 20:15:09 student-ubuntu dhcpd: failover peer dhcp-failover: I move from
ormal to communications-interrupted
Dec 12 20:16:18 student-ubuntu dhcpd: DHCPREQUEST for 10.0.2.177 from 00:50:56:
1:48:3b (W-PC2) via eth0
Dec 12 20:16:18 student-ubuntu dhcpd: DHCPACK on 10.0.2.177 to 00:50:56:01:48:3
(W-PC2) via eth0
Dec 12 20:16:22 student-ubuntu dhcpd: DHCPREQUEST for 10.0.2.176 from 00:50:56:
1:48:3a (W-PC1) via eth0
Dec 12 20:16:22 student-ubuntu dhcpd: DHCPACK on 10.0.2.176 to 00:50:56:01:48:3
(W-PC1) via eth0
```

The client nodes did not see any significant changes. Internet never failed since the only thing that changed was the DHCP server.

Future work

Future work should address the implementation of a DHCP failover system using Docker. The attributes presented by Docker which is considered to be an open platform for developers and for system administrators for the deployment of Linux applications inside a “container”.

Docker is considered to be a simple and feasible solution for system administrators and developers.

Docker allows the creation of clusters and the by using the Docker Swarm through the manager is possible to manage the resources for different hosts. If a manager fails, it should be possible to switch.

Docker Swarm provides some capabilities in order to provide high availability.

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