MODELING AND IMPLEMENTATION OF AN ECO-OPTIMIZED NETWORK BASED ON VLANS FOR THE REDUCTION OF CARBON FOOTPRINTS

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Abstract
The present work proposes a model of responsible digitalization in the Democratic Republic of Congo, by implementing an eco-optimized network based on VLANs while reducing the carbon footprint, the technologies to be adopted and the energy and ecological efficiency measurement indicators to minimize the greenhouse gas emissions in DRC. The goals of such an architecture are to simplify the infrastructure, increase virtualization, save hardware and software, rationalize the use of the information system, reduce energy consumption and finally reduce the carbon footprint of the information system. With regard to the design of an optimal local network within the Directorate General of Taxes (DGI), we opted to set up a virtual local network (VLAN) that will be adapted to all DGI services. The architecture for the implementation of the optimal network within the DGI is composed of the following elements Seven VLANs for the Central Directorates; One VLAN for the operational services; One core switch (Cisco manageable switch), which enabled us to manage our network; One router with firewall for managing inter-VLAN traffic, and incoming and outgoing traffic for Internet access; Eight distribution switches that can connect equipment in the same VLAN.

1.0. INTRODUCTION

The field of action of IT is very broad in the sense that it extends to all areas of life. The company, however, has numerous information flows, which require better transport and sharing. For a better allocation and sharing of tasks, prior knowledge of this information is imperative. The rate of access to digital services in both rural and urban areas in the Democratic Republic of Congo is very low. The proportion of the population without access to digital services in the Democratic Republic of Congo is higher than the proportion with access, yet the country has enormous potential.

The current President of the Democratic Republic of the Congo has decided to make digital technology his hobbyhorse, and yet from their manufacture to their recycling, our computers are the source of various risks to our environment and health. For several years now, computer hardware and related components, such as cooling systems, data centers, desktop PCs and all electronic devices have been consuming so much energy that they have become a significant part of our overall energy consumption. At the same time, studies have shown that the predicted consumption of workstations and servers in data centers is a major concern for the coming years, based on reasonable energy costs

1.1. Problematics

The core of the reflection of this work is based on the problem of the design and deployment of an eco-optimized local area network within a company in the Democratic Republic of Congo, in this case the General Directorate of Taxes, which is one of the problems linked to the internal structure of a company. Thus, in order to motivate the continuation of this work, questions of the kind listed below will not be dismissed:

- ✓ What kind of digital technology for the Democratic Republic of Congo?
- ✓ Is it really true that the design and deployment of an eco-optimized local area network will improve all the conditions or situations known to the General Directorate of Taxes?
- ✓ How can the design and deployment of an eco-optimized local area network improve all known conditions or situations at the Directorate General of Taxes?
- ✓ Is Green It important in the functioning of the Directorate General of Taxes?
- ✓ How to go green?
- ✓ What are the objectives and key indicators to monitor in order to better control its overall energy consumption?
- ✓ What technological processes should be adopted as part of a sustainable and environmentally friendly approach?

These questions constitute the set of problems that we will attempt to examine in the following lines.

1.2. Hypothesis

In reality, without any real awareness, we have entered an era where information technology is mortgaging our future. It is urgent and imperative to reverse the trend with two objectives: to reduce the energy expenditure of the global information system, and to take advantage of technological advances so as to reduce our carbon emissions in the IT sector [3].

On this, the present work is to allow us to enter and get acquainted with the fundamental notions necessary in green IT by focusing on the design and deployment of an eco-optimized local area network within a company in DRC. This is why the present work is entitled "Green IT: Towards a responsible digital in DRC. Application to an eco-optimized network at the DGI" [4].

1.3. Research methodology and technique

Any scientific work requires certain methods. For the realization of this one, we used the descriptive method to analyze the documents met through the interview technique as well as the analytical method to better know the contents of these documents in order to arrive at the best solution which will consist in conceiving and deploying an eco-optimized local area network using VLAN.

1.4. Interest of the subject

The main interest of our work is to establish a new information system that would allow, on the one hand, the optimal circulation of information in a secure manner and consequent decision making, and on the other hand, to reduce the energy expenditure of the global information system, and to take advantage of the advances in technology so as to reduce our carbon emissions in the IT sector [2]. The implementation of an eco-optimized network within a company such as the DGI makes it possible to easily provide employers with the necessary and sufficient information and also to have centralized access to all or part of the company's vital resources.

2.0. THEORETICAL BACKGROUND

Whatever the words used, we can always address the digital issue through the three pillars (3Ps) of sustainable development, namely:

- ✓ Social (people) ;
- ✓ Environment (planet);
- ✓ Economy (profit).

This work is a first draft focusing on the main keywords of "responsible digital". It is by no means an exhaustive list. Before offering you a detailed vision, here is a summary of the main terms and concepts based on the three pillars of sustainable development: social, environmental and economic [1].

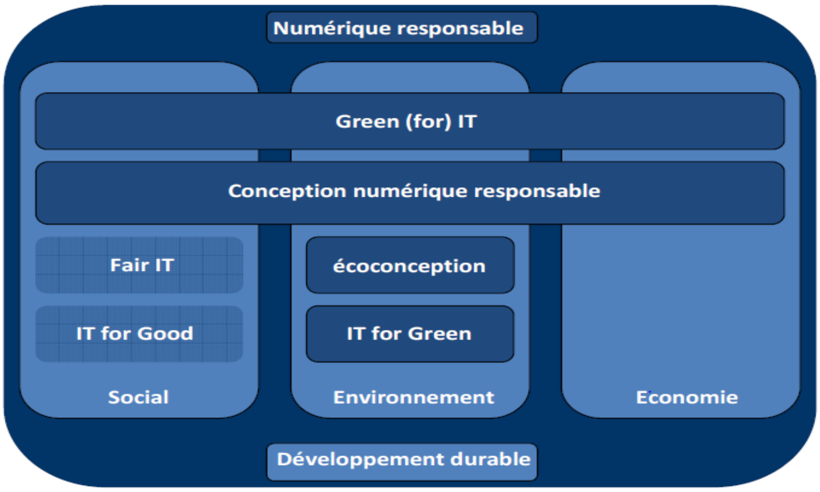

Figure 1. Articulation of the concepts according to the 3 axes of sustainable development.

2.1. Design of an eco-optimized network

With regard to the design of an optimal local network within the DGI, we have opted to set up a virtual local network that will be adapted to all the DGI's services [7].

2.3. Definitions of VLANs

By definition, an Ethernet VLAN (Virtual Local Area Network) is a (logical) virtual local area network using Ethernet technology to group network elements (users, peripherals, etc.) according to logical criteria (function, sharing of resources, belonging to a department, etc.), without coming up against physical constraints (dispersion of computers, inappropriate computer cabling, etc.) [9].

VLANs offer a number of properties, namely:

- ✓ Support for data transfers of up to l Gb/s;
- ✓ Coverage of one or more buildings;
- ✓ They can be extended to the level of a larger network;
- ✓ The membership of a station in several VLANs simultaneously.

3.0. DETERMINATION OF SERVICES

For this part, we will have eight services in the set of services that the DGI comprises, of which these eight services are:

- ✓ Seven departments of the Central Directorates (Human Resources Directorate; Budgetary Management and General Services Directorate; IT Directorate; Studies, Legislation and Litigation Directorate; Taxation and Documentation Directorate; Tax Control Directorate and Recovery Directorate);
- ✓ A service of operational services that deal with the day-to-day management of taxes, including the Directorate of Large Enterprises (DGE) and external services which are the Tax Centers and the Synthetic Tax Centers as well as the Provincial Directorates.

3.1. Proposed architecture of the DGI's eco-optimized network

The architecture for the implementation of the optimal network within the DGI consists of the following elements [10]:

- ✓ Seven VLANs of the Central Directorates (Human Resources Directorate; Budgetary Management and General Services Directorate; IT Directorate; Directorate of Studies, Legislation and Litigation; Directorate of Taxation and Documentation; Directorate of Tax Control and Directorate of Recovery);

- ✓ A VLAN for the operational services that deal with the day-to-day management of tax, including the Directorate of Large Enterprises (DGE) and the external services that are the Tax Centers and the Synthetic Tax centers as well as the Provincial Directorates.
- ✓ A core switch (Cisco manageable switch), which will allow us to manage our network;
- ✓ A router with a firewall to manage inter-VLAN traffic, and incoming and outgoing traffic in case of Internet access;
- ✓ Eight distribution switches that can connect equipment in the same VLAN.

The figure below shows an intuitive representation of this architecture:

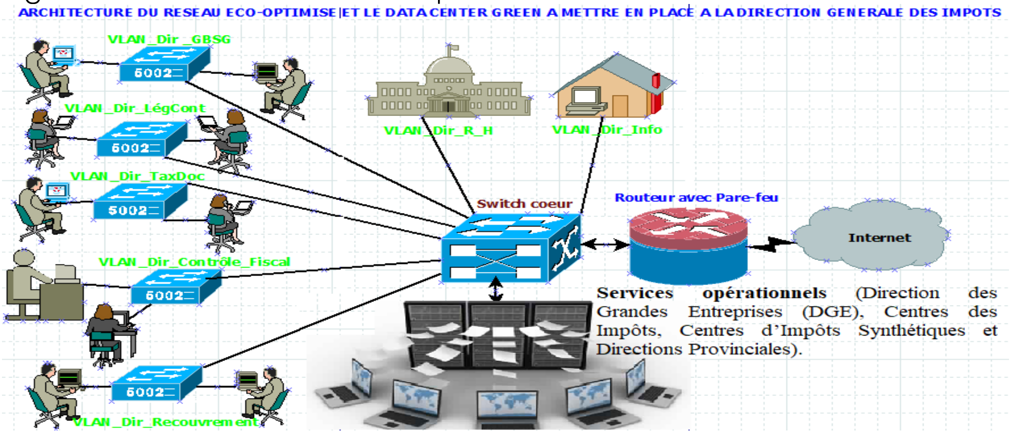

Figure 2. Proposed architecture.

3.2. Deployment and configuration of the network

In this section, we will present the way in which we deployed and configured our computer network. The necessary commands that allowed us to properly configure our optimal network within the DGI are detailed step by step.

The figure below shows the implementation of our optimal computer network in the DGI.

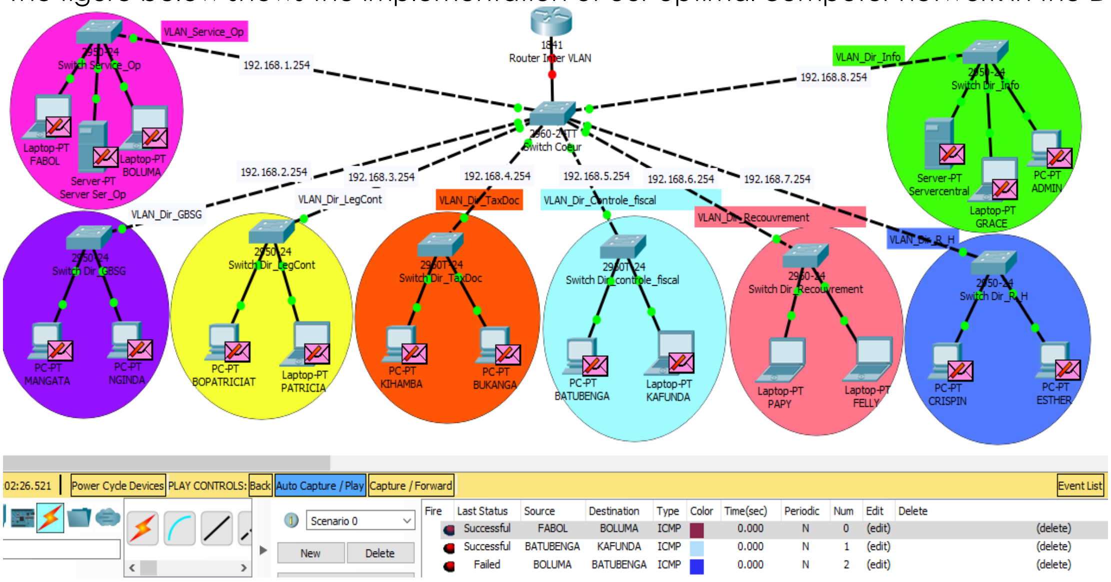

Figure 3. Network to be set up within the DGI.

We can see from this figure that the computers cannot communicate with each other unless they are on the same network. Therefore, we are obliged to configure our equipment first, starting with the switch and then the router.

3.3. Switch Configuration

We will first start with the basic configuration of the terminal and then check the VLAN database for existing VLANs.

```
Switch>enable
Switch#configure terminal
Switch(config)#hostname Switch_coeur_DGI
Switch_coeur_DGI(config)#exit
```

For the moment, we can display the Database of our Switch to see the VLANs that already exist. The figure below shows us the different VLANs that are in our switch and the interfaces they use [11].

```
Switch_coeur_DGI#SH VLAN

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                Gig0/1, Gig0/2
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0
```

Figure 4. VLANs before configuration.

Our switch has a default vlan, VLAN 1, which is called the native VLAN and contains all the default ports.

We are now going to create our eight VLANs and assign them to the ports of our core switch, specifying the access mode for the ports. We have used the access mode between each VLAN, while between the Switch and the router, we have opted for the trunk mode [12]. Here are the different steps of our configuration:

- ✓ Creation and allocation of ports for VLAN 2

Switch_coeur_DGI#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch_coeur_DGI(config)#vlan 2
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_GBSG
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/1
Switch_coeur_DGI(config-if)#switchport access vlan 2
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 3 ports

Switch_coeur_DGI(config)#vlan 3
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_LEGCONT
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/2
Switch_coeur_DGI(config-if)#switchport access vlan 3
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 4 ports

Switch_coeur_DGI(config)#vlan 4
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_TAXDOC
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/3
Switch_coeur_DGI(config-if)#switchport access vlan 4
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 5 ports

Switch_coeur_DGI(config)#vlan 5
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_CONTROLE_FISCAL
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/4
Switch_coeur_DGI(config-if)#switchport access vlan 5
Switch_coeur_DGI(config-if)#no sh

Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 6 ports

Switch_coeur_DGI(config)#vlan 6
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_RECOUVREMENT
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/5
Switch_coeur_DGI(config-if)#switchport access vlan 6
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 7 ports

Switch_coeur_DGI(config)#vlan 7
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_R_H
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/6
Switch_coeur_DGI(config-if)#switchport access vlan 7
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 8 ports

Switch_coeur_DGI(config)#vlan 8
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_INFO
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/7
Switch_coeur_DGI(config-if)#switchport access vlan 8
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Creation and allocation of VLAN 9 ports

Switch_coeur_DGI(config)#vlan 9
Switch_coeur_DGI(config-vlan)#name VLAN_DIR_SERVICE_OP
Switch_coeur_DGI(config-vlan)#exit
Switch_coeur_DGI(config)#int fa0/8
Switch_coeur_DGI(config-if)#switchport access vlan 9
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit

- ✓ Router Port Assignment

Switch_coeur_DGI(config)#int fa0/24
Switch_coeur_DGI(config-if)#switchport mode trunk
Switch_coeur_DGI(config-if)#no sh
Switch_coeur_DGI(config-if)#exit
Switch_coeur_DGI(config)#
We will now check our eight VLANs in the Database, if we have really created them.

```
Switch_coeur_DGI>SH VLAN

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                Gig0/1, Gig0/2
2    VLAN_DIR_GBSG                    active
3    VLAN_DIR_LEGCONT                 active
4    VLAN_DIR_TAXDOC                  active
5    VLAN_DIR_CONTROLE_FISCAL         active
6    VLAN_DIR_RECOUVREMENT            active
7    VLAN_DIR_R_H                     active
8    VLAN_DIR_INFO                    active
9    VLAN_DIR_SERVICE_OP              active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

Figure 5. *The VLANs after configuration.*

We note that our eight VLANs are in the VLAN database, so their creation is done properly.

3.4. Router Configuration

For the moment, we just need to configure our router to allow inter-VLAN traffic without major difficulties.

First, activate the router interface:

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Routeur_Inter_VLAN_DGI
Routeur_Inter_VLAN_DGI(config)#int fa0/0
Routeur_Inter_VLAN_DGI(config-if)#no sh
Routeur_Inter_VLAN_DGI(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
Routeur_Inter_VLAN_DGI(config-if)#no ip address
Routeur_Inter_VLAN_DGI(config-if)#exit
```

- ✓ Encapsulation of the first VLAN :

```
Routeur_Inter_VLAN_DGI(config)#int fa0/0.1
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.1, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 2
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.2.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit
```

- ✓ Encapsulation of the second VLAN :

```
Routeur_Inter_VLAN_DGI(config)#int fa0/0.2
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.2, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 3
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.3.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit
```

- ✓ Encapsulation of the third VLAN :

```
Routeur_Inter_VLAN_DGI(config)#int fa0/0.3
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.3, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 4
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.4.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit
```

- ✓ Encapsulation of the fourth VLAN :

```
Routeur_Inter_VLAN_DGI(config)#int fa0/0.4
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.4, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 5
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.5.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit
```

- ✓ Encapsulation of the fifth VLAN :

Routeur_Inter_VLAN_DGI(config)#int fa0/0.5
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.5, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 6
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.6.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit

- ✓ Encapsulation of the sixth VLAN :

Routeur_Inter_VLAN_DGI(config)#int fa0/0.6
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.6, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.6, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 7
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.7.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit

- ✓ Encapsulation of the seventh VLAN :

Routeur_Inter_VLAN_DGI(config)#int fa0/0.7
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.7, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.7, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 8
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.8.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit

- ✓ Encapsulation of the eighth VLAN :

Routeur_Inter_VLAN_DGI(config)#int fa0/0.8
Routeur_Inter_VLAN_DGI(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.8, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.8, changed state to up
Routeur_Inter_VLAN_DGI(config-subif)#encapsulation dot1Q 9
Routeur_Inter_VLAN_DGI(config-subif)#ip addr 192.168.1.254 255.255.255.0
Routeur_Inter_VLAN_DGI(config-subif)#no sh
Routeur_Inter_VLAN_DGI(config-subif)#exit
Routeur_Inter_VLAN_DGI(config)#end
Routeur_Inter_VLAN_DGI#
%SYS-5-CONFIG_I: Configured from console by console
Routeur_Inter_VLAN_DGI#copy run start

After configuring our Switch and the router, all that remains is to install the network card of each computer while respecting the IP address range reserved for it and the corresponding gateway.

The figure below shows the installation of the network card of the BOLUMA computer on the VLAN "VLAN_SERVICE_OP" as an illustration.

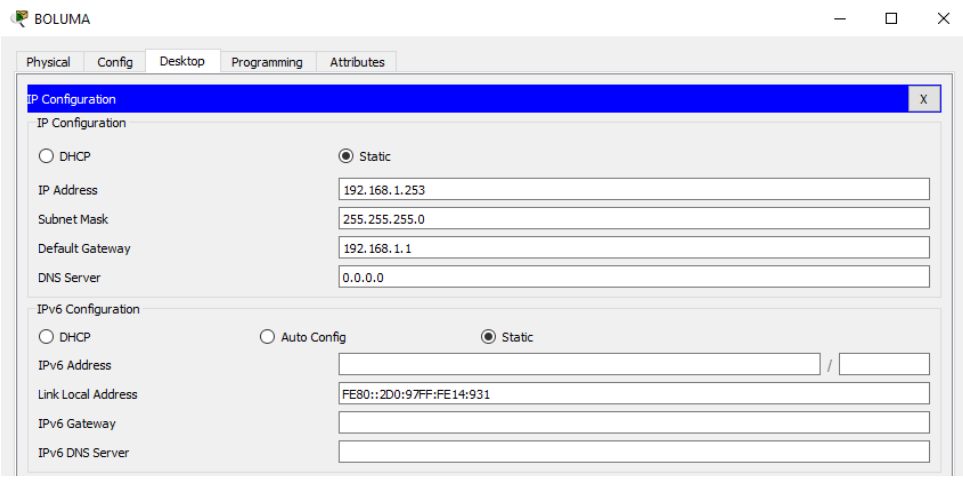

Figure 6. Network card installation.

Now that we have finished deploying our optimal local network in the DGI, we can start using it.

The figure below shows us how our optimal computer network works in the DGI.

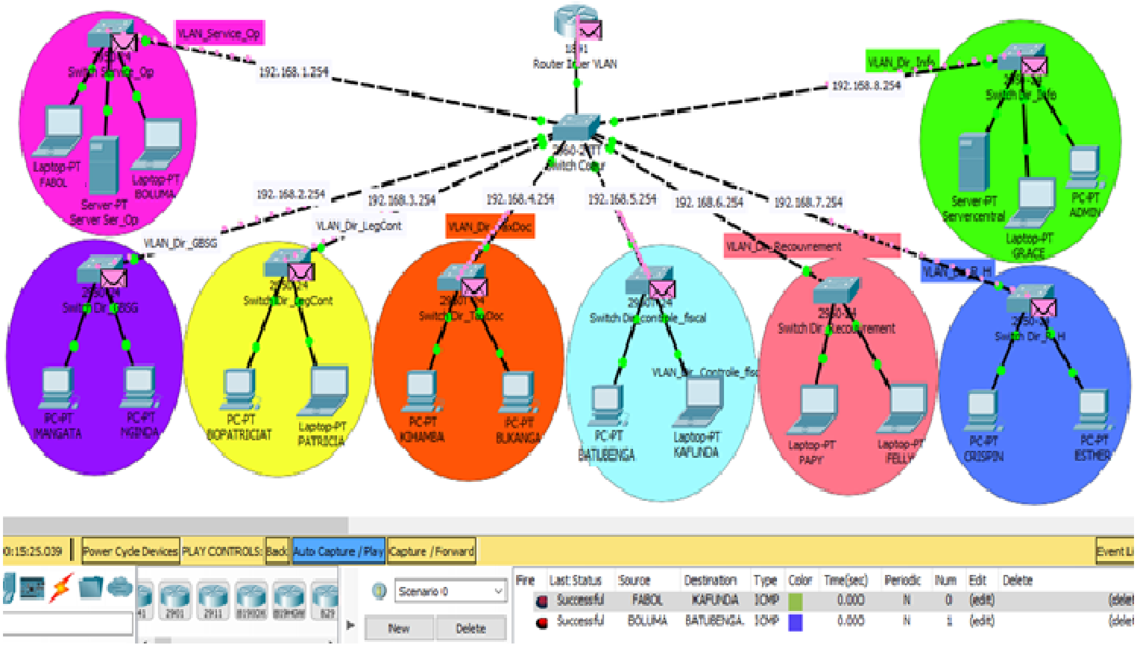

Figure 7. *Network test.*

Now we can see from this figure that the computers manage to communicate with each other without difficulty even if they are not on the same network. So we can say that our objectives have been achieved.

4.0. ARCHITECTURE OF THE ECO-OPTIMIZED INFORMATION SYSTEM TO BE IMPLEMENTED

Information systems departments are faced with multiple challenges [8]:

- ✓ Reducing software acquisition and ownership costs;
- ✓ Responding quickly and better to business expectations;
- ✓ Increase the quality, transparency and security of software;
- ✓ Controlling the relationship with publishers and ensuring the sustainability of solutions.

Our objectives for our system and network architecture are multiple [15]:

- ❖ Simplification of the infrastructure;
- ❖ Increase in virtualization;
- ❖ Savings in hardware and software;
- ❖ Rationalization of Information System use;
- ❖ Reduction in energy consumption;
- ❖ Reduction in the carbon footprint of the Information System.

4.1. Recommendations

As a priority, we recommend focusing the approach on the following 3 actions:

1. Continue to extend the lifespan: from the time of purchase, select equipment that is easy to repair and upgrade, while forging closer links with refurbishes in order to promote the upgrading of IT equipment and/or better value your outgoing equipment [16].
2. Switch to responsible digital service design: the responsible digital service design approach aims to create value by designing digital products and services that are more efficient from an environmental, social and economic point of view, which leads in particular to creating a differentiated and innovative offer [5].
3. Implement a responsible digital strategy and industrialize the approach:
Industrializing the approach can reduce the environmental impact of the information system by a further 10 to 20%. The key challenge lies in educating the company's decision-makers and employees. The approach must be as inclusive as possible, starting with an inventory of the existing situation and identifying ambassadors who will take up the subject [6].

5.0. CONCLUSION

At the end of this work entitled: "Green IT: Towards a responsible digital environment in the DRC. Application to an eco-optimized network at the DGI", which aims to design and deploy an eco-responsible IT platform within the Directorate General of Taxes based on VLANs that reduce carbon footprints, the technologies to be adopted and the indicators for measuring energy and ecological efficiency to minimize greenhouse gas emissions in the DRC. Assuming that early designers and users of computers and hardware were ecologically aware, the goals of this work are to simplify the digital infrastructure, increase virtualization, save hardware and software, rationalize the use of the information system, reduce energy consumption and finally reduce the carbon footprint of the information system [13]. Green IT is recent in its definition and its history is closely linked to nearby events such as the management of electronic waste from 2003 and the increase in energy consumption from 2005. This work enabled us to understand how to deploy an eco-optimized network and choose high-performance, low-energy consumption equipment while taking into account a green data-center for the General Tax Directorate with a view to migrating towards green IT, which will make it possible to reduce energy consumption and ultimately reduce the carbon footprint of the information system [14]. Throughout this work, we have developed promising new techniques and ideas that will allow us in the near future to broaden this research topic and tackle more advanced issues in the field of eco-optimized computer networks and potentially other networks of a similar nature with more generic solutions on sustainable development.

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