

**IMPLICATIONS FOR THE STUDY
OF WIDE AREA NETWORKS
AND PAINTINGS IN THEIR
STEPS FRACTALS**



UNIVERSIDAD DE GUADALAJARA

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PREFACE

The art organizes everything by parts. The authors of this work are implacable authors of some dawns, evenings and nightfalls that bring a fresh change to the Homo Sapiens at any place of the planet. Their valleys, volcanoes, atmospheres, are not only theirs, they are of all of us. They are of the whole world. They will be of the future world. The future generations will enjoy their discoveries, of what today they copy from the nature that surrounds us. The landscape, suddenly becomes difficult to rescue but with the knowledge and dexterity characteristic of the authors of this beautiful book, one proves that, in all the five continents, new aesthetics and semiology transformations, are generated.

IMPLICATIONS FOR THE STUDY OF WIDE AREA NETWORKS AND PAINTINGS IN THEIR STEPS FRACTALS.

of the landscape painting, demands an imagination effort. The authors go developing dimensions with colors and give organic forms arranged to them while they paint. They recognize that the essence of life, increases, it transform and changes in the synergetic objects that they paint in the solid, liquid and gaseous states. They allow in their representations that those parts are logically adequate, so that there is harmony in their painting. The parts that they organize, require a structural setting that is adapted to the variations of functional requests and allows to give extension and relation to the organic structures that the authors paint in the pattern, continuity that they search and study in the nature.

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DEDICATION

To family.

To my brothers, my sister, friends, grand- fathers (Roberto Arturo Vasquez Pereira, Victor Ceron Martinez Madrigal), grandmothers (Laura Escobar Henao, Francisca Rosa Vasquez Perez), great-great-grand-fathers, great-great-grandmothers, relatives, family, humanity, cosmos. To Dr. Fabio Vasquez Escobar To the Most Excellent Bishop Gerardo Martinez Madrigal. To the Most Excellent Bishop Guillermo Escobar Velez. To the Excellent Ambassador Raul Vasquez Velez. To the Excellent Ambassador Lucelly Garcia Tobon.

To Marco Tulio Duque's School, Conrado Gonzalez Institute, IDEM Fray Julio Tobon Betancu, Colombian Polytechnic, National University, Autonomous Latin-American University, SEP, University of Antioch, Bolivian Pontifical University, UNAM, UAG, UNISARC, Sao Paulo University, Free University, Salvador Duque School, University EAFIT, University of Sydney, University of Helsinki, University of Tampere, University of Cape Town, TEC; University of Guadalajara, UCLA, MIT, University of Houston, Harvard University, Yale University, Oxford University, Linguaphone Institute, Cambridge University, Scranton University, UNESCO, DOMETAL, RIOTEX, COLTEPUNTO, Company of Packings S.A., Technological Institute. Pascual Bravo., Modern Institute of Education, ASSTI, ESAP, Colombian Polytechnic Jaime Isaza Cadavid, Montessori School, SENA, University de San Buenaventura, International Center of Cambridge, The St. Lukas Academy, Bamberg University, Pekin Normal University, Who's Who in the World, American Biographical Institute, The Marquis Publications, Editorial Papiro, Colombian Polymers, VIAMACOL, Rotary International, Biographical

Institute of United States of America, Superior Academy of Technical Industrial Services, National Service of Learning, Reforestation Company La Floresta, Casa de Reyes, Engineering School of Antioch, The Southern African Comparative and History of Education Society, University of Paris, Hospital El Carmen de Viboral, Beijing Normal University, Tokyo University, Waseda University. University of Guadalajara.

To the schools, institutions and universities of the five continents that offered me the opportunity to recreate, relearn, reinvent, rethink and study.

And to the whole last, present and future humanity that consecrates the cultivation of the right values, the positive visions, and life, is a great company, the post modernity, the fractality, the harmony of the societies and universal cosmos.

GRATEFULNESS AND RECOGNITIONS

To the whole last and present humanity
and their universal cosmos.

Recognition also to the Dr. Marco Antonio Cortés Guardado, General Rector of the U. de G.; to the Dr. Maximilian Andrew Greig, Rector CUC, U. de G.; to Dr. Remberto Castro Castañeda, U. de G.; to Dr. Jorge Tellez Lopez, U. de G.; to Dr. Victor Manuel Gonzalez Romero, U. de G.; to Bachelor Raul Padilla Lopez, U. de G.; M.C. Tonatiuh Bravo, U. de G.; Dr. Raul E. Tamayo Gaviria, Professor Vagn Lundsgaard Hansen, Professor Ching-Lin Hu, Professor Byung-Jin Lee, Professor Erwin H. Epstein, Professor Shin'ichi Suzuki, Dr. David Turner, Dr. Medardo Tapia U., MRS. Guadalupe Gonzalez de Turner, M.C. Jesus Cabral, U. de G.; M.C. Maria Morfin, U. de G.; Bachelor Maria Antonia Abundis, U. de G.; Bachelor Arturo Fernandez, U. de G.; Bachelor Javier Fernandez, U. de G.; M.C. Patricia Medina, U. de G.; Dr. Alfredo Cesar Dachary, U. de G.; Dr. Stella Arnaiz, U. de G.; to MRS. Barbara Bush, to Dr. Fabio Vasquez E., to Dr. Humberto Martinez V., to Dr. Guillermo Esquivias L., for their observations and comments.

INTRODUCTORY COMMENT

1.-INTRODUCTION

Today the communication techniques have gone improving just as it have develop new communication courses too, now the WAN nets are very important because they reduce bounds and made that the communication be more easy in far away places, allowing increase the capacity and velocity of the communication bits systems.

This manual has general information about WAN nets just as subnetting exercises and this nets configuration.

All the information been in this manual was develop during the 2013-1 period in this sixth semester of the Engineer in Computer systems university course whit the professor support of the Dr. Felipe A. Gonzalez Gonzalez and every his knowledge's contribution.

2.- OBJECTIVES

The principal objectives in this manual is reinforce the basics knowledge's of wide area net just as strengthen the practice of the subnetting exercise and made the configuration process and the carried activities during the semester where the chair has done.

Basic aspects of wide area networks

Wide Area Network

A wide area net or WAN, is a computer network that cover a relative big geographic area. Normally, a WAN covers two or more local area network.

The connected computers to a wide area network normally are connected by publics networks (phone network) the biggest WAN is Internet.

Router

Router is also well known like a packets router. It's a device that brings connectivity for network level or three levels in OIS model. Its principal function consist in send or set data packet of a network to other, means, interconnecting subnets, understanding that subnet is a IP machines group that could communicate without a Router's intervention (by bridges), and as well it has different network prefix.

LAN and WAN differences

LAN:

- *Diffusion Channels
- *Few miles
- *Some Mbps velocity

-
- *One organization
 - *Freedom to choose the physical Communication way
 - *Reliable channel (mistake rate 1000 less than WAN)
 - * Simple Structure for mistake operation

WAN

- *Point to point channels (except satellites)
- *Including whole countries
- *Velocity less than 1Mbps
- *Some organizations
- *Obligation to use public services (for example Telephone network)
- * Unreliable channel
- *Hard structure for mistake operation

CSU/DSU

A CSU/DSU is a digital interface device, sometimes two far away digital devices that adapt the physical interface of a DTE device (like a terminal) to the DCE advice (like a switch) in a carrying commuted network. Sometimes, CSU/DSU joins to the router.

The way how a connection CSU/DSU advice does is: from the Internet services provider (ISP) TELMEX the signal goes to the CSU/DSU by optic fibre, from there by a Cisco V. 35 cable with DCE-DTE connections made it far to the Router, there it starts to distribute the net.

This is the kind connection that is implemented in the Academic Multidisciplinary Mante Unit and other companies it has been implemented too. This connection could be seen in the 3.2. Illustration

The connection that has been implemented in the Academic Unit is similar to the houses and little offices connections but in this case the signal down from the cloud (Internet Telmex) doesn't arrive to a CSU/DSU advice, but it arrives to a telephone flush which in its turn has connected into a microfilter it's a little advice that reduces the interferences between ADSL signal and telephone signal allowing use telephones, modems, fax, etc. in the same line and plug with the ADLS service. Afterward it connected to a router- modem by a same microfilter port and even a telephone or fax from other port. We can appreciate this connection in 3.3 illustration

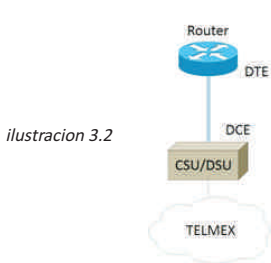
DCE/DTE

A serial connection has with data terminal equipment (DTE) at one end of connection and data

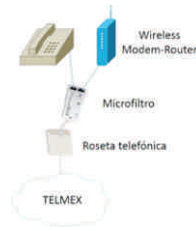
communication equipment (DCE) in the other end. The connection between both DCE is the network transmission of the WAN service providers. The signal is receiving in the DCE remote, which decodes the signal again in a data sequences. It sequence is sending, in its turn, to the DTE remote.

There have been developed a lot rules which allow DTE be communicate with DCE. Electric Industrial Association (EIA) and the Telecommunication Standardization Sector of the International Telecommunications Unit (UIT-T) have been active worked developing those standards.

UIT-T refers to DCE as the equipment that finish the data circuit. EIA refers to DCE as the equipment of data communication.



ilustracion 3.2



ilustracion 3.3

IP Direction

IP direction is a numeric label that identifies logically hierarchically an interface (communication/connection element) of a device (typically a computer) into a network that use a IP (Internet Protocol) corresponding at the OIS Model network.

IP Directions types

There are three IP directions types that an organization could receive from Internet Corporation for Assigned Names and Numbers (ICANN): type "A", type "B" and type "C"

IP consist in 4 octets of 8 bits each one. The value of the first octet is that determines the IP type. The table 3.1 details the proprieties of each type.

Type	Initial Range	Final Range	Representation	Hosts	Mainly Destined
A	0.x.x.x	126.x.x.x	N.H.H.H	$2^{24} = 16,777,216$	Government
B	128.0.x.x	191.255.x.x	N.N.H.H	$2^{16} = 65,536$	Shops
C	192.0.0.x	223.255.255.x	N.N.N.H	$2^8 = 256$	Homes

Public IP direction

They are visible in the entire Internet. A computer with public IP is accessible (visible)

from any other computer connected to internet. For connect to internet is necessary a public IP direction.

Private IP direction

Private IP directions (reserved) are visible just for other hosts from his own network or from other private networks interconnected by routers. They are used in the companies for the job contents. The computers with private IP directions can access Internet by a router (or proxy) which has a public IP. However, since Internet it doesn't access into a computer with private IP directions.

Advantages

- It's harder identify the user using this IP
- Reduce the operations cost for the Internet services suppliers (IPS)
- For IPS the equipments are more simple

Disadvantages

- Its requires to depend of services rerouted a host into a IP
- It's unlocatable, in few hours could be some IP changes

STABLE IP DIRECTION

A stable IP direction is an IP which is assigned by the user, as well given by the ISP suppliers in the first connection. The stable IP today in the market of Internet Access have a mensual cost extra. This IP are assigned for the user after to receive the supplier information or as well given by the supplier in the first connection moment. This allow to the user mount web servers, FTP, etc. and lead a domain to this IP without having to keep update the DNS server each time that change the IP like dynamics IP.

Advantages

- It's easier identify the user that is using this IP
- Its allow to have services guided directly to the IP
- Never change.

Disadvantages

- They are more vulnerable to the attach because the user can't get other IP
- It's more expensive for ISP because these IP couldn't using the 24 hours daily.

NIC

Network Information Center is part of the internet DNS that keep the database of domains names and convert them to IP direction. Each NIC is an organization which controls the name register of the domains into the levels what correspond.

LACNIC

Latin America & Caribbean Network Information Centre

It is the Internet regional register for Latin America and Caribbean. It manages the IP directions version 4 and 6, Numbers of Freestanding Systems, Reverse DSN, and others net

sources for regional network.

LACNIC was established at 2001. Its administrative offices are in Montevideo, Uruguay and the technological complex of the assignment is provided for Management Committee of Brazil (São Paulo Brasil). Before its foundation, the IP services registers for the regional were provided by the American Registry Internet Numbers (ARIN)

Principal WAN Net Activities

- a. Subnetting
- b. Configuration
- c. Administration

Subnetting

Subnetting function is divide a IP network in logical subnets (smaller networks) for each one of them works to sending level and reception of packages as an individual network, even all of them belong to the same physical network and the same domain. The subnetting allows a better administration, traffic control and security to segment the function network.

Subnet Mask

The subnet mask or nets is a data combination that serves for limit the area of a computer network. Its function is indicate to the devices what part of the direction is the number of the network, including the subnet, what part is the host corresponding

MAC direction

In the computers network, the MAC direction (Media Access Control) is an identifier of 48 bits (6 hexadecimal blocks) that corresponds as a unique way for a card or a network device. It has known like physical direction and is once per each device

SOHO Router

The routers are used on private homes and they are known like SOHO (Small Office, Home Office). Those devices allow some equipment have broadband access by a private virtual network and secure.

Network Direction

It's a standard way refers a network. For example, it could does reference to the network in the 10.0.0.0 net. That is more appropriate and descriptive way referring to a network using the word "the first network". Every host of 10.0.0.0 net have the same network bits. Into the IPv4 Direction range of a network the lowest saving for the network direction. This direction has 0 bits for each host in the portion of direction host.

Broadcast Direction

The IPv4 broadcast direction is a special direction for each network allowing the

communication in every host in this network. For send data to all hosts in a network it could send just one package to the broadcast direction network. It uses the higher direction in the network broadcast. It is the direction which host proportion bits are all 1. For the 10.0.0.0 network with 24 net bits, the broadcast direction would be 10.0.0.255. This direction is known as guided broadcast.

1. Net division in subnets (Subnetting)

4.1 Subnet Concept

On 1985 be defined subnet concept or division of a net number type A,B, C, in more little parts. This concept is introduced for care some problems have started to produced with the directionally classification of the two levels.

The subnets division is a method for manage the IP directions. It consists dividing the complete network directions types in smaller parts. With the subnets division, the network isn't limited to the network mask for type A, B, C and it bring us more flexibility in the network design.

4.2 Net division in subnets importance

The nets could be dividing in smaller subnets this is very important getting more achievement of them also have with this flexibility the subnets division allows the network manager brings broadcast contention and down level security in LAN. The subnets division also brings security because the access to other subnets is available just by a router services.

The IP directions types could take 256 to 16.8 millions of hosts according its type. The subnets creation process started asking "borrow" to the host range the bits necessities for the subnets required. It should have special care in this action because it should be fewer two bits in the host range. The most bits able to this purpose in type A is 22, type B is 14 and type C is 6.

5. - Subnetting exercise

In the exercise is indicated the amount of bits given with that we'll work for carrying out this exercises will use the resultants values of raising the number 2 to the exponents of 0 until 16 this is showed in the box 4.1

2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}	2^{11}	2^{12}	2^{13}	2^{14}	2^{15}	2^{16}
1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536

5.1- exercise: realize the subnetting of direction of network: 140.200.0.0: with 3 bits given. With this direction of net the first step is identify the class of IP address. With help of the previous notes we can know that is a class B, since this has a range from the 189 to 191 in the first octet, and this class has two octets of network therefore the next step is turn the IP address to binary by class, this step was developed by the researchers. With the aim of facilitating the next steps and that the division of network is done of easier way, in this method are represented the octets of network (N) as one and the two octets of hosts (H) as zero, how show it now

1 1 1
1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Once that it converting to binary for class the next step is obtain the number of nets, the formulates to use is $2^n - 2 = 2^3 - 2 = 8 - 2 = 6$. The amount on total nets is 8, and the amount of networks usable is 6. These values will be annotating en the box 4.1.1

The next step is to get the value of m, for doing this will count all the zeros of the address in binary by class, except the borrowed zeros.

In this case $m=13$

Formulates for getting the hosts is the next: $2^m - 2$

Substituting: $2^{13} - 2 = 8192 - 2 = 8190$

Later for getting the range (f) we will count the amount of zeros that remain from octet to which it asked borrowed, this step was developed by the researchers too. As in this case lost 3 bits borrowed. The remain are 5, then, we have: $2^f = 2^5 = 32$ Then the range will be 32 With this date we can to carry on to developed all them:

< ⁰	140.200.0.0
< ¹	140.200.31.255
< ²	140.200.32.0
< ³	140.200.63.255
< ⁴	140.200.64.0
< ⁵	140.200.95.255
< ⁶	140.200.96.0
< ⁷	140.200.127.255
< ⁸	140.200.128.0
< ⁹	140.200.159.255
< ¹⁰	140.200.160.0
< ¹¹	140.200.191.255
< ¹²	140.200.192.0
< ¹³	140.200.223.255
< ¹⁴	140.200.224.0
< ¹⁵	140.200.255.255

Clase	B
Bits Prestados	3
Hosts Totales	8192
Hosts Utilizables	8190
Redes Totales	8
Redes Utilizables	6
Rango	32
Máscara	255.255.224.0

Network address

Broadcast address

Getting subnet mask

For getting subnet mask we will add up the value of the bits of each octet, remember that this value go of 1 until 128 from right to left. In the case of a third octet only we'll add up the values of bits that were borrowed.

128 64 32
1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

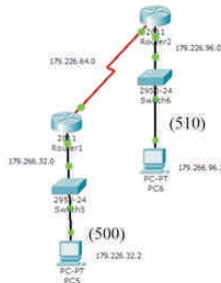
The sum would stay of the following way:

The first two octets: $128+64+32+16+8+4+2+1=255$. Third octet: $128+64+32=224$.

For the last one octet, the result will be zero. Then our subnet mask will be the results of the sum of octets values separated for point, in this case will be of the way: 255.255.224.0 And this is our subnet mask.

For getting the bits from subnet mask will sum the amount of one from 2 net octets (N) plus 3 bits of third borrowed octet. The result will be 19 bits.

5.2- exercise: realize subnetting of the address net **179.226.0.0**, following the next topology:



This is an exercise of class B.

Let's look the topology that show us that we need 3 nets, then just will use 3 bits borrowed, insomuch that, if we use 2^3 will get 8 less 2 and will be 6 available nets, and this way we will satisfy the nets of the topology.

First step: become form binary to class.

1 1 1
 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Previously in the exercise 4.1 we look from where to get each one of the variables n, m and f , in this exercise is the same thing $2^n - 2 = 2^3 - 2 = 8 - 2 = 6$ Those are the total nets and useable nets $2^m - 2 = 2^{13} - 2 = 8192 - 2 = 8190$. Those are the total hosts and usable hosts, therefore will satisfy to 500 and 510 hosts of the Ethernet's net. $2^f = 2^5 = 32$

Clase	B
Bits Prestados	3
Host Totales	8192
Host Utilizables	8190
Redes Totales	8
Redes Utilizables	6
Rango	32
Máscara	255.255.224.0
Bits de máscara	19 bits

Getting nets

- \leftarrow^0 179.226.0.0
- \leftarrow^1 179.226.31.255
- \leftarrow^2 179.226.32.0
- \leftarrow^3 179.226.63.255
- \leftarrow^4 179.226.64.0
- \leftarrow^5 179.226.95.255
- \leftarrow^6 179.226.96.0
- \leftarrow^7 179.226.127.255
- \leftarrow^8 179.226.128.0
- \leftarrow^9 179.226.159.255
- \leftarrow^{10} 179.226.160.0
- \leftarrow^{11} 179.226.191.255
- \leftarrow^{12} 179.226.192.0
- \leftarrow^{13} 179.226.223.255
- \leftarrow^{14} 179.226.224.0
- \leftarrow^{15} 179.226.255.255

→

Getting subnet mask Like previously exercise, for getting the subnet mask will add up the value bits of each octet; remember that those values are from 1 until 128 to the right to left. In the case of third octet just we'll add up the borrowed bits

Note: To page 25, the reader is left between the mentioned interpretation and paints for the reader to generate their own ideas and creative about. This is an exercise in creative writing and painting to generate new ideas.

1 128
 1 64
 1 32
 1 16
 1 8
 1 4
 1 2
 1 1
 . 128
 1 64
 1 32
 1 16
 1 8
 1 4
 1 2
 1 1
 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

For First two octets: 128+64+32+16+8+4+2+1=255 Third octet: 128+64+32=224

And the last one octet, that it's not usable the result will be zero.
 Then this is our subnet mask 255.255.224.0 For getting the bits from subnet mask will add up the amount of one from 2 net octets (N) plus 3 bits of third borrowed octet. The result will be 19 bits.

5.3- Exercise: realize subnetting of the address net 179.226.0.0, with 4 borrowed bits.

This is an exercise of class B Let's change to binary by class.

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Previously in the exercise 4.1 and 4.2 we look the way to get a variables n, m, and f, in this case is look like.

$2^n - 2 = 2^4 - 2 = 16 - 2 = 14$ Those are the total nets and usable nets $2^m - 2 = 2^{12} - 2 = 4096 - 2 = 4094$ Those are the total hosts and usable hosts.

Getting nets

Clase	B
Bits Prestados	4
Host Totales	4096
Host Utilizables	4094
Redes Totales	16
Redes Utilizables	14
Rango	16
Máscara	255.255.240.0
Bits de máscara	20 bits

- \wedge_0 179.226.0.0
- \wedge_1 179.226.15.255
- \wedge_2 179.226.16.0
- \wedge_3 179.226.31.255
- \wedge_4 179.226.32.0
- \wedge_5 179.226.47.255
- \wedge_6 179.226.48.0
- \wedge_7 179.226.63.255
- \wedge_8 179.226.64.0
- \wedge_9 179.226.79.255
- \wedge_{10} 179.226.80.0
- \wedge_{11} 179.226.95.255
- \wedge_{12} 179.226.96.0
- \wedge_{13} 179.226.111.255
- \wedge_{14} 179.226.112.0
- \wedge_{15} 179.226.127.255
- 179.226.128.0
- 179.226.143.255
- 179.226.144.0
- 179.226.159.255
- 179.226.160.0
- 179.226.175.255
- 179.226.176.0
- 179.226.191.255
- 179.226.192.0
- 179.226.207.255
- 179.226.208.0
- 179.226.223.255
- 179.226.224.0
- 179.226.239.255
- 179.226.240.0
- 179.226.255.255

Getting subnet mask

Like previously exercise, for getting the subnet mask will add up the value bits of each octet; remember that those values are from 1 until 128 to the right to left. In the case of third octet just we'll add up the borrowed bits

1 128
 1 64
 1 32
 1 16
 1 8
 1 4
 1 2
 1 1
 . 128
 1 64
 1 32
 1 16
 1 8
 1 4
 1 2
 1 1
 . 128 64 32 16
 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

The sum will be the next way 128+64+32+16+8+4+2+1=255

Third octet: 128+64+32+16=240

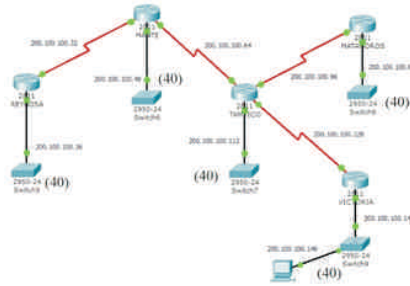
Last one octet, that t it's not usable the result will be zero.

Than our subnet mask is:

255.255.240.0

For getting the bits from subnet mask will add up the amount of one from two octets net (N) plus 4 bits of third borrowed octet. The result will be 20 bits.

5.4- Exercise: realize subnetting of the address net 200.100.100.0, following the next topology



Note: this exercise it's a subnet not applicable, because the topology ask for 40 hosts for each Ethernet net therefore won't satisfy with the gotten nets in this exercise. This exercise only is included at the manual; it's very important look the necessity's hosts on the time to do the subnet.

This net is class C.

First step is become to binary by class

1 1 1 1
 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

The topology says us that we need 9 nets, and then to n will give 4 values $2^n - 2 = 2^4 - 2 = 16 - 2 = 14$. Those are the total nets and usable nets. $2^m - 2 = 2^4 - 2 = 16 - 2 = 14$. Those are the total hosts and usable hosts. For this reason the exercise is not applicable, because we need 40 hosts for Ethernet net. $2^5 = 2^4 = 16$.

Getting nets

Clase	C
Bits Prestados	4
Host Totales	16
Host Utilizables	14
Redes Totales	16
Redes Utilizables	14
Rango	16
Máscara	255.255.255.240
Bits de Máscara	28 bits

\wedge_0	200.100.100.0	\wedge_8	200.100.100.128
	200.100.100.15		200.100.100.143
\wedge_1	200.100.100.16	\wedge_9	200.100.100.144
	200.100.100.31		200.100.100.159
\wedge_2	200.100.100.32	\wedge_{10}	200.100.100.160
	200.100.100.47		200.100.100.175
\wedge_3	200.100.100.48	\wedge_{11}	200.100.100.176
	200.100.100.63		200.100.100.191
\wedge_4	200.100.100.64	\wedge_{12}	200.100.100.192
	200.100.100.79		200.100.100.207
\wedge_5	200.100.100.80	\wedge_{13}	200.100.100.208
	200.100.100.95		200.100.100.223
\wedge_6	200.100.100.96	\wedge_{14}	200.100.100.224
	200.100.100.111		200.100.100.239
\wedge_7	200.100.100.112	\wedge_{15}	200.100.100.240
	200.100.100.127		200.100.100.255

Getting subnet mask

Like previously exercise, for getting the subnet mask will add up the value bits of each octet; remember that those values are from 1 until 128 to the right to left. In the case of third octet just we'll add up the borrowed bits

128 64 32 16 8 4 2 1 . 128 64 32 22 16 8 4 2 1 . 128 64 32 16 8 4 2 1 . 0 0 0 0 0 0 0 0

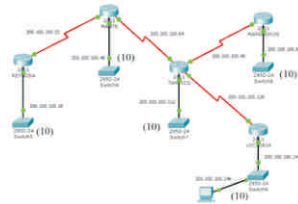
The sum will be to the next way: First 3 octets: $128+64+32+16+8+4+2+1=255$. Fourth octet: $128+64+32+16=240$. Then this is our subnet mask 255.255.240.0

For getting the bits from subnet mask will add up the amount of one from 3 net octets (N) plus 4 bits of fourth borrowed octet. The result will be 28

Remember that this exercise is not applicable, because not satisfy the necessity of hosts of each

net.

Exercise: realize subnetting of the address net 200.100.100.0, following the next topology:



This exercise is similar to 4.4. Now will use the same exercise, but with a necessity lower of hosts perfectly for the address class net type C. First step is converting to binary by class:

1 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 0

The topology says us that we need 9 nets, and then to n will give 4 values.

$2^n - 2 = 2^4 - 2 = 16 - 2 = 14$ Those are the total nets and the usable hosts.
 $2^m - 2 = 2^4 - 2 = 16 - 2 = 14$ Those are the total hosts and the usable hosts. In this case it will satisfy the necessity of each net. $2^f = 2^4 = 16$.

Obtaining of the mask of sub-net.
 To be equal than in the previous exercises, in order to obtain bits the mask of sub-net to sum the value of the bits of each octeto, to remember than these value they go to from 1 a 128 of right a left. We will add in the event of the fourth octet only the values of the bits that were asked for rendered.

128 64 32 16 8 4 2 1 . 128 64 32 16 8 4 2 1 . 128 64 32 16 8 4 2 1 . 128 64 32 16 8 4 2 1 . 0 0 0 0 0 0 0 0 0

The sum would be left of the following way: For the first three octets: $128+64+32+16+8+4+2+1=255$ For the fourth octet: $128+64+32+16=240$. This is then our mascara of sub-net: 255.255.240.0 in order to obtain bits of the mascara we will sum of sub-net the quantity of some of the three octets of net (N) which asked plus the four bits of the fourth octet lent the result is 28 bits.

5.6 Exercise: Selling off the Subnting of the address of net: 10.10.10.0, with 6 rendered bits. This is an IP of class A.

First step is to convert to binary for class:

1 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 0

$2^n - 2 = 2^6 - 2 = 64 - 2 = 62$ These are the total nets and usable nets.
 $2^m - 2 = 2^{18} - 2 = 262142$ The total hosts and usable hosts are these $2^f = 2^2 =$

Class	A
Lend Bits	6
Total Host	262,144
Utilize Host	262,142
Total Nets	64
Utilize Nets	62
Rank	4
Máscara	255.255.0.0
Máscara of Bit	14 bits

Table 4.6.1 Result of the subnetting 4.6

< ¹⁶	10.64.0.0	< ³²	10.128.0.0
	10.67.255.255	< ³³	10.131.255.255
< ¹⁷	10.68.0.0		10.132.0.0
	10.71.255.255	< ³⁴	10.135.255.255
< ¹⁸	10.72.0.0		10.136.0.0
	10.75.255.255	< ³⁵	10.139.255.255
< ¹⁹	10.76.0.0		10.140.0.0
	10.79.255.255	< ³⁶	10.143.255.255
< ²⁰	10.80.0.0		10.144.0.0
	10.83.255.255	< ³⁷	10.147.255.255
< ²¹	10.84.0.0		10.148.0.0
	10.87.255.255	< ³⁸	10.151.255.255
< ²²	10.88.0.0		10.152.0.0
	10.88.0.0	< ³⁹	10.155.255.255
	10.91.255.255		10.156.0.0
< ²³	10.92.0.0		10.159.255.255
	10.95.255.255		
< ²⁴	10.96.0.0		
	10.99.255.255		
< ²⁵	10.100.0.0		
	10.103.255.255		
< ²⁶	10.104.0.0		
	10.107.255.255		
< ²⁷	10.108.0.0		
	10.111.255.255		
< ²⁸	10.112.0.0		
	10.115.255.255		
< ²⁹	10.116.0.0		
	10.119.255.255		
< ³⁰	10.120.0.0		
	10.123.255.255		
< ³¹	10.124.0.0		
	10.127.255.255		

Obtaining of the nets:

< ⁰	10.0.0.0	< ⁸	10.32.0.0
	10.3.255.255		10.35.255.255
< ¹	10.4.0.0	< ⁹	10.36.0.0
	10.7.255.255		10.39.255.255
< ²	10.8.0.0	< ¹⁰	10.40.0.0
	10.11.255.255		10.43.255.255
< ³	10.12.0.0	< ¹¹	10.44.0.0
	10.15.255.255		10.47.255.255
< ⁴	10.16.0.0	< ¹²	10.48.0.0
	10.19.255.255		10.51.255.255
< ⁵	10.20.0.0	< ¹³	10.52.0.0
	10.23.255.255		10.55.255.255
< ⁶	10.24.0.0	< ¹⁴	10.56.0.0
	10.27.255.255		10.59.255.255
< ⁷	10.28.0.0	< ¹⁵	10.60.0.0
	10.31.255.255		10.63.255.255

$$2^n - 2 = 2^6 - 2 = 64 - 2 = 62$$

$$2^m - 2 = 2^{18} - 2 = 262144 - 2 = 262142$$

$$2^l = 2^2 = 4$$

Obtaining of the mask of sub-net.

To be equal than in the previous exercises, Getting the mask from sub-net. We will add up the value of the bits out of every octet, to remember Than these value they go to from 1 a 128 of right a left. We will add in the event of the third octet We will add up The values of the bits that were asked for rendered.

		< ⁵⁶	10.224.0.0
			10.227.255.255
< ⁴⁰	10.160.0.0	< ⁵⁷	10.228.0.0
	10.163.255.255		10.231.255.255
< ⁴¹	10.164.0.0	< ⁵⁸	10.232.0.0
	10.167.255.255		10.235.255.255
< ⁴²	10.168.0.0	< ⁵⁹	10.236.0.0
	10.171.255.255		10.239.255.255
< ⁴³	10.172.0.0	< ⁶⁰	10.240.0.0
	10.175.255.255		10.243.255.255
< ⁴⁴	10.176.0.0	< ⁶¹	10.244.0.0
	10.179.255.255		10.247.255.255
< ⁴⁵	10.180.0.0	< ⁶²	10.248.0.0
	10.183.255.255		10.251.255.255
< ⁴⁶	10.184.0.0	< ⁶³	10.252.0.0
	10.187.255.255		10.255.255.255
< ⁴⁷	10.188.0.0		
	10.191.255.255		

128	64	32	16	8	4	2	1		128	64	32	16	8	4
1	1	1	1	1	1	1	1	.	0	0	0	0	0	0
								.	0	0	0	0	0	0
								.	0	0	0	0	0	0
								.	0	0	0	0	0	0
								.	0	0	0	0	0	0
								.	0	0	0	0	0	0
								.	0	0	0	0	0	0
								.	0	0	0	0	0	0

The sum would be left of the following way:
 For the first octet:
 128+64+32+16+8+4+2+1=255
 For the second octet:

128+64+32+16+8+4=255
 This is then our mask of sub-net: 255.252.0.0

in order to obtain bits of the máscara We will sum of sub-net The quantity of some of the three octets of net (N) Which asked plus the four bits of the fourth octet lent The result is 14 bits.
 128+64+32+16+8+4=255

$$128+64+32+16+8+4=255$$

For the second octet:

$$128+64+32+16+8+4=255$$

This is then our mask of sub-net: 255.252.0.0

In order to obtain bits of the máscara We will sum of sub-net The quantity of some of the three octets of net (N) Which asked plus the four bits of the fourth octet lent The result is 14 bits.

5.7 Selling off the Subnetting of the address of net: 148.200.0.0 / 21

The /21 indicates the bits of mask that it has the address of net.

The first step is to convert to binary for class:



1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

As they are 21 bits of mask then for logic bits Than himself ask lent 5, the bits of mask they add of left a right the first two octets of net (N) more the bits than ask lend of Third octet. Then if in the two first octets they are 16 bits In order to complete 21 bits. We have not enough 5, then the rendered bits 5 will be n .

$$2^n - 2 = 2^5 - 2 = 32 - 2 = 30. \text{ These are the total nets and usable nets}$$

$$2^m - 2 = 2^{11} - 2 = 2048 - 2 = 2046. \text{ The total hosts and usable hosts are these.}$$

$$2^f = 2^3 = 8$$

Obtaining of the nets:

< ⁰	148.200.0.0	< ¹⁶	148.200.128.0
	148.200.7.255		148.200.135.255
< ¹	148.200.8.0	< ¹⁷	148.200.136.0
	148.200.15.255		148.200.143.255
< ²	148.200.16.0	< ¹⁸	148.200.144.0
	148.200.23.255		148.200.151.255
< ³	148.200.24.0	< ¹⁹	148.200.152.0
	148.200.31.255		148.200.159.255
< ⁴	148.200.32.0	< ²⁰	148.200.160.0
	148.200.39.255		148.200.167.255
< ⁵	148.200.40.0	< ²¹	148.200.168.0
	148.200.47.255		148.200.175.255
< ⁶	148.200.48.0	< ²²	148.200.176.0
	148.200.55.255		148.200.183.255
< ⁷	148.200.56.0	< ²³	148.200.184.0
	148.200.63.255		148.200.191.255

Class	B
Lend Bits	5
Total Host	2048
Utilize Host	2046
Total Nets	32
Utilize Nets	30
Rank	8
Mask	255.255.248.0
Mask of Bit	21 bits

As they are 18 bits of mask then for logic bits Than himself ask lent 2 the bits of mask they add of left a right the first two octets of net (N) more the bits than ask lend of Third octet. Then if in the two first octets they are 16 bits In order to complete 18 bits. We have not enough 2, then the rendered bits 2 will be n .

$$2^n - 2 = 2^2 - 2 = 4 - 2 = 2. \text{ These are the total nets and usable nets.}$$

$$2^m - 2 = 2^{14} - 2 = 16384 - 2 = 16382. \text{ The total hosts and usable hosts are these.}$$

$$2^f = 2^6 = 64$$

Obtaining of the nets:

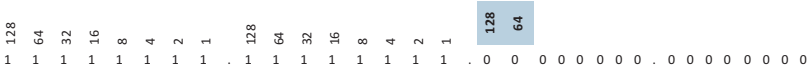
Class	B
Lend Bits	2
Total Host	16384
Utilize Host	16382
Total Nets	4
Utilize Nets	2
Rank	64
Mask	255.255.192.0
Mask of Bit	18 bits

- <⁰ 172.192.0.0
- 172.192.63.255
- 172.192.64.0
- <¹ 172.192.127.255
- 172.192.128.0
- <² 172.192.191.255
- 172.192.192.0
- <³ 179.192.255.255

Table 4.8.1 Result of the subnetting 4.8

Obtaining of the mask of sub-net.

We will add up the value of the bits out of every octet in order to get the mask from sub-net, to remember Than these value they go to from 1 a 128 of right a left. We will add in the event of the third octet We will add up The values of the bits that were asked for rendered.



The sum would be left of the following way:

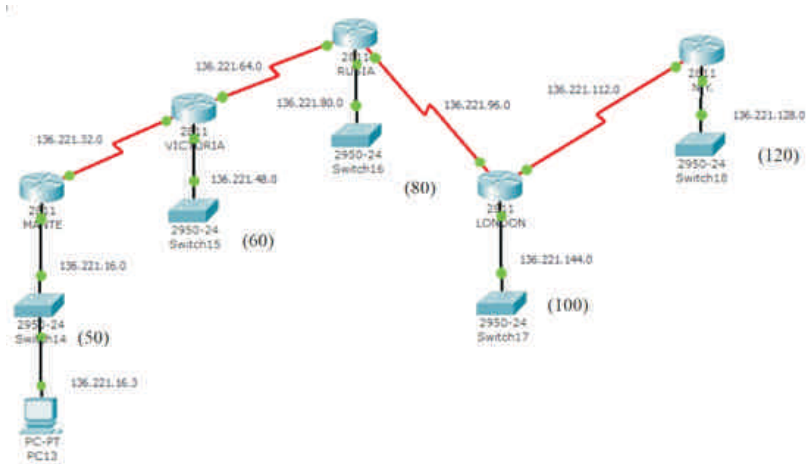
For the first two octets:
 $128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255$

For the third octet:
 $128 + 64 = 192$

For the latter octet, the fact that the result is not utilized will be zero.

This is then our mask of sub-net: 255.255.192.0.

5.9 Exercise: Selling off the subnetting of the address of net: 136.221.0.0. Taking the following topology into account.



Topology of net of exercise 4,9

We can observe in this topology need of the 9 needs with con several host each the maximum of hosts That 120 for net require music themselves. Then like they require 9 Nets the bits that they take rendered of the octet 4 owed will come from hosts when 2 will lift the fourth potency The result will be 16 total nets and 14 usable, with this the need of nets will get satisfied .

This address according to the beginning of the first octet of net comes from classroom B.

First we converted to binary for class:



1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Now we will obtain variables n, m y f .

$2^n - 2 = 2^4 - 2 = 16 - 2 = 14$. These are the total nets and usable nets.

$2^m - 2 = 2^{12} - 2 = 4096 - 2 = 4094$. The total hosts and usable hosts are these.

$2^f = 2^4 = 16$

Obtaining of the nets:

Class	B
Lend Bits	4
Total Host	4096
Utilize Host	4094
Total Nets	16
Utilize Nets	14
Rank	16
Mask	255.255.240.0
Mask of Bit	20 bits

Table 4.9.1 Result of the subnetting 4.9

Obtaining of the mask of sub-net.

We will add up the value of the bits out of every octet in order to get the mask from

sub-net, to remember. Than these value they go to from 1 a 128 of right a left. We will add in the event of the third octet. We will add up. The values of the bits that were asked for rendered.

\wedge_0	136.221.0.0	\wedge_8	136.221.128.0
	136.221.15.255		136.221.143.255
\wedge_1	136.221.16.0	\wedge_9	136.221.144.0
	136.221.31.255		136.221.159.255
\wedge_2	136.221.32.0	\wedge_{10}	136.221.160.0
	136.221.47.255		136.221.175.255
\wedge_3	136.221.48.0	\wedge_{11}	136.221.176.0
	136.221.63.255		136.221.191.255
\wedge_4	136.221.64.0	\wedge_{12}	136.221.192.0
	136.221.79.255		136.221.207.255
\wedge_5	136.221.80.0	\wedge_{13}	136.221.208.0
	136.221.95.255		136.221.223.255
\wedge_6	136.221.96.0	\wedge_{14}	136.221.224.0
	136.221.111.255		136.221.239.255
\wedge_7	136.221.112.0	\wedge_{15}	136.221.240.0
	136.221.127.255		136.221.255.255

128 64 32 16 8 4 2 1 128 64 32 16 8 4 2 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

The sum would be left of the following way:

For the first two octets:

$$128+64+32+16+8+4+2+1=255$$

For the third octet:

$$128+64+32+16=240$$

For the latter octet, the fact that the result is not utilized will be zero.

This is then our mask of sub-net: 255.255.192.0.

5.10 Exercise: Selling off the Subnet of the address of net: 195.200.72.142 with 4 rendered bits and indicating to that the sub-net belongs this same.

This address of net comes from class C.

First step is to convert to binary for class:

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

As topology says us that they need 9 nets. Then we will give n a value of 4 in order that the need of nets may get satisfied:

$2^n - 2 = 2^4 - 2 = 16 - 2 = 14$. These are the total nets and usable nets.

$2^m - 2 = 2^4 - 2 = 16 - 2 = 14$. These are the total nets and usable nets

$2^f = 2^4 = 16$.

Class	C
Lend Bits	4
Total Host	16
Utilize Host	14
Total Nets	16
Utilize Nets	14
Rank	16
Mask	255.255.255.240
Mask of Bit	28 bits

\leftarrow^0	195.200.72.0	\leftarrow^8	195.200.72.128
	195.200.72.15		195.200.72.143
	195.200.72.16	\leftarrow^9	195.200.72.144
\leftarrow^1	195.200.72.31		195.200.72.159
	195.200.72.32	\leftarrow^{10}	195.200.72.160
\leftarrow^2	195.200.72.47		195.200.72.175
	195.200.72.48	\leftarrow^{11}	195.200.72.176
\leftarrow^3	195.200.72.63		195.200.72.191
	195.200.72.64	\leftarrow^{12}	195.200.72.192
\leftarrow^4	195.200.72.79		195.200.72.207
	195.200.72.80	\leftarrow^{13}	195.200.72.208
\leftarrow^5	195.200.72.95		195.200.72.223
	195.200.72.96	\leftarrow^{14}	195.200.72.224
\leftarrow^6	195.200.72.111		195.200.72.239
	195.200.72.112	\leftarrow^{15}	195.200.72.240
\leftarrow^7	195.200.72.127		195.200.72.255

Table 4.10.1 Result of the subnetting 4.10

This exercise's address of net belongs to the sub-net 8.

Obtaining subnetwork's mask.

In the same way like previous exercises, for getting the subnetwork's mask we will add up the value of the bits from each octet, remember that this values are going from 1 to 128, right to the left. In the case of the 4th octet we are going to add up only the value of the bits that were borrowed.

128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	.	1	1	1	1	1	1	1	1	.	1	1	1	1	1	1	1	1	.	1	1	1	1	1	1	1	.	0	0	0	0	0	0	0	0	

The sum will finish in the next way:

For the first three octets:

$128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255$

For the 4th octet

$128 + 64 + 32 + 16 = 240$

So, this is our subnetwork's mask: 255.255.240.0

For getting the bits from the subnetwork's mask we are going to add up the quantity of one of the three network's octets plus the four bits from the fourth octet that were borrowed. The result is 28 bits.

5.11 Exercise: Make the "subneteo" of the network's address: 172.69.100.24 / 21 and indicate to which subnetworks belongs to.

Like we already saw in previously exercises, the number showed after the slash indicates the bits of the mask that have the network's address, in this case 21.

The first step to turn to binary for class:

1 1 1 1 1
 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Like there are 21 bits of mask, so, for logic the bits that will be borrow are 5, because the bits of the mask are added up from left to the right in the first two network's octets (N) plus the bits that are borrow from the third octet. Then, if in the first two octets are 16 bits to complete 21, we are missing 5, so the bits that we are going to borrow n are 5.

$$2^n - 2 = 2^5 - 2 = 32 - 2 = 30. \text{ These are the total networks and usable networks}$$

$$2^m - 2 = 2^{11} - 2 = 2048 - 2 = 2046. \text{ These are the total hosts and usable hosts}$$

$$2^f = 2^3 = 8$$

Class	B
Borrowed bits	5
Total Host	2048
Usable Host	2046
Total networks	32
Usable networks	30
Range	8
Mask	255.255.248.0
Mask's bits	21 bits

Square 4.11.1 Results of the "Subneteo" 4.11

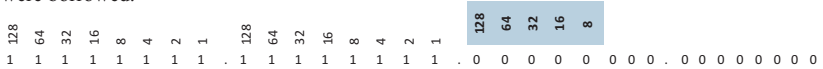
OBTAINING THE NETWORKS.

		172.69.128.0
< ⁰		172.69.135.255
		172.69.144.0
		172.69.143.255
		172.69.144.0
< ¹		172.69.151.255
		172.69.152.0
< ²		172.69.159.255
		172.69.160.0
< ³		172.69.167.255
		172.69.168.0
< ⁴		172.69.175.255
		172.69.176.0
< ⁵		172.69.183.255
		172.69.184.0
< ⁶		172.69.191.255
		172.69.192.0
< ⁷		172.69.199.255
		172.69.200.0
< ⁸		172.69.207.255
		172.69.208.0
< ⁹		172.69.215.255
		172.69.216.0
< ¹⁰		172.69.223.255
		172.69.224.0
< ¹¹		172.69.231.255
		172.69.232.0
< ¹²		172.69.239.255
		172.69.240.0
< ¹³		172.69.247.255
		172.69.248.0
< ¹⁴		172.69.255.255
		172.69.255.255

The network's address in this exercise belongs to the subnetwork 12.

Obtaining subnetwork's mask.

In the same way like previous exercises, to get the subnetwork's mask we are going to add up the value of the bits from each octet, remember that these values are going from 1 to 128, from right to the left. In the case of the third octet we are just to add up the values of the bits that were borrowed.



The sum will finish in the next way:

For the first two octets:

$$128+64+32+16+8+4+2+1=255$$

For the 3th octet

$$128+64+32+16+8=248$$

For the last octet, that is not used the result will be zero.

Then, this is our subnetwork's mask: 255.255.248.0

Exercise: Make the "subneteo" of the network's address: 149.100.100.122 and indicate to which subnetworks belongs to, remember that you need 20N (300) H, it means 20 networks with 300 hosts.

We can identify the address like class B. the first step is to turn to binary for class:



The value that we will give to N, like we have already seen, depends of the number of networks needed. In this case it needs 20 networks, so if we see the square 4.1 we will realize that the necessary bits to this network are 5.

$2^n - 2 = 2^5 - 2 = 32 - 2 = 30$. These are the total networks and usable networks that we need to satisfy the necessity of 20 networks.

$2^m - 2 = 2^{11} - 2 = 2048 - 2 = 2046$ These are the total hosts and usable hosts, in the same way, we satisfy the 300 hosts.

$$2^f = 2^3 = 8$$

Class	B
Borrowed bits	5
Total hosts	2048
Usable hosts	2046
Total Networks	32
Usable Networks	30
Range	8
Mask	255.255.248.0
Mask's bits	21 bits

Square 4.12.1 Results of the "Subneteo" 4.12

OBTAINING THE NETWORKS

			149.100.128.0
		√ ¹⁶	149.100.135.255
			149.100.136.0
√ ⁰	149.100.0.0	√ ⁸	149.100.64.0
	149.100.7.255		149.100.71.255
	149.100.8.0		149.100.72.0
√ ¹		√ ⁹	149.100.79.255
	149.100.15.255		149.100.80.0
	149.100..16.0	√ ¹⁰	
√ ²			149.100.87.255
	149.100.23.255	√ ¹¹	149.100.88.0
	149.100.24.0		149.100.95.255
√ ³		√ ¹²	149.100.96.0
	149.100.31.255		149.100.103.255
	149.100.32.0	√ ¹³	149.100.104.0
√ ⁴			149.100.111.255
	149.100.39.255	√ ¹⁴	149.100.112.0
	149.100.40.0		149.100.119.255
√ ⁵		√ ¹⁵	149.100.120.0
	149.100.47.255		149.100.127.255
	149.100.48.0		
√ ⁶			
	149.100.55.255		
	149.100.56.0		
√ ⁷			
	149.100.63.255		

The network's address in this exercise belongs to the subnetwork 12.

Obtaining subnetwork's mask.

In the same way like previous exercises, to get the subnetwork's mask we are going to add up the value of the bits from each octet, remember that these values are going from 1 to 128, from right to the left. In the case of the third octet we are just to add up the values of the bits that were borrowed.

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

The sum will finish in the next way:

For the first two octets:

$$128+64+32+16+8+4 +2+1=255$$

For the 3th octet

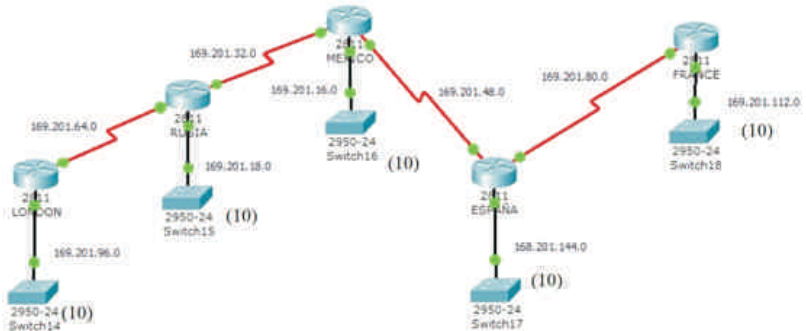
$$128+64+32+16+8=248$$

For the last octet, that is not used the result will be zero.

Then, this is our subnetwork's mask: 255.255.248.0

For getting the bits from the subnetwork's mask we are going to add up the quantity from one of the two network's octets plus the five bits from the third octet that were borrowed. The result is 21 bits.

5.13 Exercise; make the "subneteo" of the network's address 169.201.0.0 according to the next topology.



In this topology we can see that it requires 9 networks with 10 hosts each one. Then, like we requires 9 networks the bits that are going to be borrow from the octet of the hosts will be 4 because when we raise 2 to the fourth power the result will be 16 total networks and 14 usable, with this we will satisfy the networks needed.

This address according to the beginning of the first network's octet is class B.

At first, we turn to binary for class:

1 1 1 1

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Now we will get the variables *n*, *m* and *f*

$2^n - 2 = 2^4 - 2 = 16 - 2 = 14$. These are the total networks and usable networks.

$2^m - 2 = 2^{12} - 2 = 4096 - 2 = 4094$. These are the total hosts and usable hosts.

$2^f = 2^4 = 16$

Class	B
Borrowed bits	4
Total hosts	16
Usable hosts	14
Total Networks	4096
Usable networks	4094
Range	16
Mask	255.255.240.0
Mask's bits	20 bits

Obtaining networks

\wedge^0	169.201.0.0	\wedge^8	169.201.128.0
	169.201.15.255	\wedge^9	169.201.143.255
	169.201.16.0		169.201.144.0
\wedge^1			
	169.201.31.255	\wedge^{10}	169.201.159.255
	169.201.32.0		169.201.160.0
\wedge^2			
	169.201.47.255	\wedge^{11}	169.201.175.255
	169.201.48.0		169.201.176.0
\wedge^3			
	169.201.63.255	\wedge^{12}	169.201.191.255
	169.201.64.0		169.201.192.0
\wedge^4			
	169.201.79.255	\wedge^{13}	169.201.207.255
	169.201.80.0		169.201.208.0
\wedge^5			
	169.201.95.255	\wedge^{14}	169.201.223.255
	169.201.96.0		169.201.224.0
\wedge^6			
	169.201.111.255	\wedge^{15}	169.201.239.255
	169.201.112.0		169.201.240.0
\wedge^7			
	169.201.127.255		169.201.255.255

Obtaining subnetwork's mask

In the same way like previous exercises, to get the subnetwork's mask we are going to add up the value of the bits of each octet, remember that these values are going from 1 to 128, from right to the left. In the case of the third octet we are just to add up the values of the bits that were borrowed.

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The sum will finish in the next way:

For the first two octets:

$$128+64+32+16+8+4+2+1=255$$

For the 3th octet

$$128+64+32+16=240$$

For the last octet, that is not used the result will be zero.

So, this is our subnetwork's mask: 255.255.240.0

For getting the bits from the subnetwork's mask we are going to add up the quantity from one of the two network's octets plus the five bits from the third octet that were borrowed. The result is 20 bits.

6. CONFIGURATION OF CISCO ROUTERS.

Cisco 800 series Routers

This serie includes the next models:

- Cisco 892 Integrated Services Router
- Cisco 891 Integrated Services Router
- Cisco 888 Integrated Services Router
- Cisco 887V Integrated Services Router

- Cisco 887VA
- Cisco 887 VA-W
- Cisco 886 VA
- Cisco 886VA-W
- Cisco 881
- Cisco 880 3G
- Cisco 880G
- Cisco 867VAE
- Cisco 866VAE
- Cisco 861
- Cisco 819
- Cisco 812 CiFi
- Cisco C892FSP
- Cisco C881W

Routers from the 800 series that are not to the sale anymore:

- Cisco 887 Integrated Services Router
- Cisco 886 Integrated Services Router
- Cisco 878 Integrated Services Router
- Cisco 877 Integrated Services Router
- Cisco 871 Integrated Services Router
- Cisco 867 Integrated Services Router
- Cisco 857 Integrated Services Router
- Cisco 851 Integrated Services Router
- Cisco 837 ADSL Broadband Router
- Cisco 836 ADSL over ISDN Broadband Router
- Cisco 831 Ethernet ISDN
- Cisco 828 G.SHDSL Router
- Cisco 827 H.ADSL Router
- Cisco 827 4V ADSL Router

- Cisco 815 Integrated Services Router
- Cisco 813 ISDN Router
- Cisco 806 Broadband Router
- Cisco 805 Serial Router
- Cisco 803 ISDN Router
- Cisco 802 ISDN Router

✓ **Mod. 806 Broadband Router.**

VPN safe Access and manageable with the power of technologies of CISCO IOS to small offices and remotes workers

The broadband router CISCO 806 is a router from Ethernet to Ethernet that provides safe Internet Access and Access to the corporative network with the Digital Subscriber Line (DSL) and the wire modems. The Cisco 806 router includes a firewall State full Inspection software of optional code VPN IP, Triple Standard Digital Encryption Security (3DES IPSec) and the quality of the service (QoS) for voice and Management of traffic of video. With the proved reliability of IOS ® Software, The 806 Cisco Router is easy to install and offers one solution of safe access and is manageable to the tele-workers and small remotes offices.

The 806 Cisco Router is ideal for tele-workers or small remote offices (it's recommended 20 users at Maximus), because it fills the requirements of business of critic missions, including:

- Security in the empresarial class to Internet Access and VPN.
- The implementation costs and low life cycle.
- Voice, Video and traffic management
- Proved Reliability and management capacity of Cisco IOS.

The 806 Cisco router benefies to all sizes companies. The small ones and middle ones companies can use the 806 Cisco router to provide multiusers safe access with attainable connections of broad band. The companies could use the 806 Cisco Router to standardize in one safe device and manageable to connect tele-workers or agents to the corporative network. The services suppliers and systems integrators could use the 806 Cisco Router to provide controlled access from distance and security services. You can see this router in the illustration 5.1.1

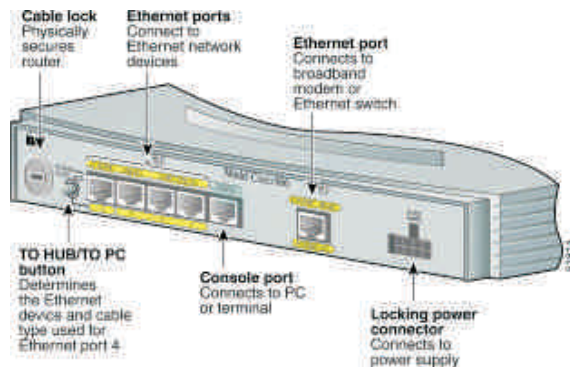


Illustration 5.1.1.1 Rear of a Router.
Cisco 1700 Series Modular Access Router.

Models included in this series are:

- Cisco 1760 Modular Access Router
- Cisco 1751 Modular Access Router
- Cisco 1750 Modular Access Router
- Cisco 1721 Modular Access Router
- Cisco 1720 Modular Access Router
- Cisco 1712 Security Access Router
- Cisco 1711 Security Access Router
- Cisco 1710 Security Access Router
- Cisco 1701 ADSL Security Access Router

Cisco 1721 Modular Access Router

Cisco 1721 is a modular router optimized for data-access applications, providing companies the most comprehensive functionality and flexibility to deliver secure Ethernet and Intranet access to the router. The router offers a wide range of WAN access options, high-performance routing and quality in the service, the routing inter-virtual LAN and the VPN access with understanding firewall. With Cisco IOS Technology, the cisco 1721 offers high reliability and flexibility of the WAN interface card interchangeable, integrated security that includes Hardware VPN – based encryption and firewall state inspection, and the business class DSL with a higher quality of service to ensure the high performance levels are guaranteed.

Benefits Key

Modular profitable device optimized for data access applications , offers a wide range of WAN access options , high performance routing , VIAN routing and VPN access with firewall options . Provide business- class DSL , ADSL and G.SHDSL technologies with a greater quality of service . The illustration 5.1.2 shows in detail each part of this router.

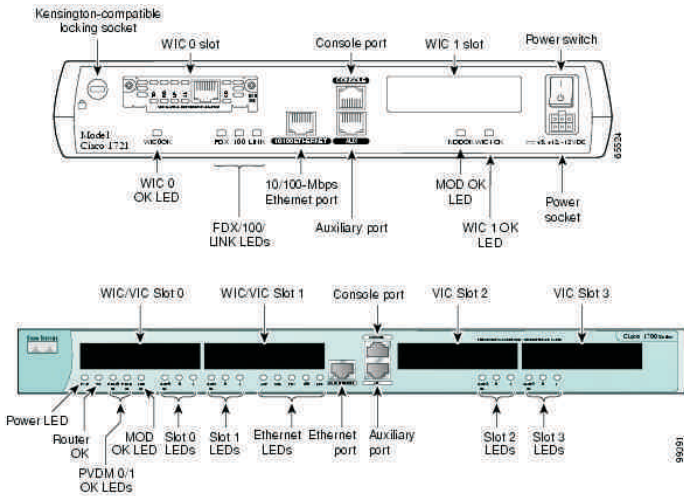


Illustration 5.1.2 Parts of a Router 1751.

Cisco 1751 Modular Access Router

Optimized for integration of multiple services of voice, video, data, and fax's traffic, Cisc 1751 is a modular device that provides to companies with the most complete functionality and flexibility offering Ethernet Security , intranet access and datas / voice's integration . The router offers a wide range of WAN access and interface options, voice over IP performance routing with the bandwidth management, routing intervirtual LAN and VPN access with firewall options. Benefits of multiple accesses are available to companies incorporated of voice, video, data and fax now or in the future. Main advantages

Multiservice solution a viable option for small and medium size enterprices and small branches. A modular device optimized for voice/data/video/ fax/ integration of multiple services .

Offering a wide range of WAN access and interface options, voice over IP performance routing with the bandwidth management, routing VLAN and VPN access with firewall options.

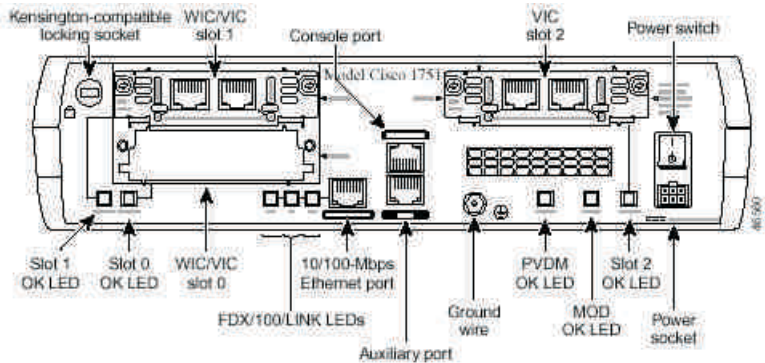


Illustration 5.1.3. Shows the rear of the router Mod 1751

6.2 Boot Process for a Cisco Router :

The internal architecture of a Router Cisco support components that plays an important role in the start up process. The internal components of the router's configuration are :

RAM/DRAM : stores routing tables , the ARP cache of fast switching , the buffering of packages and the queue of packets. The RAM also provide temporal memory and/or work for configuration file router while the router itson . The RAM contents its lose if it produce a switch-off or if the CPU is restarted.

NVARM: The RAM non-volatile stores copy of complete support of the configuration file. The RAM content its preserved during a power outage or electrical, the CPU is restarted.

FLASH: ROM erasable, reprogrammable that retains the image and the microcode for the operative system. The flash enable updates of software without removing and replacing the processor chips. The flash content its conserve during switch-off or reboot. Flash memory can store multiples versions of Software .

ROM: Contains power-up diagnostics about steps program and Software Operating System. The updates require removal and replacement of pluggable chips on the CPU.

INTERFACES: Network connections on the motherboard or on separate interface modules across the renaming of the which packages entering and leaving a router.

Steps to turn on a Router.

After the power on selftest of the router , occur the following events as they initial the router.

Step 1.- The generic bootstrap loader ,which is located in the room , executes on the CPU card . A bootstrap is a simple operation by default to load instructions which in turn cause other instructions to be loaded into memory, or cause entry to other modes of configuration.

Step 2.- The operating system (Cisco IOS) can be found in one of several places. It reveals the location in the field to start the configuration record. If the boot field indicates a flash or network load , boot system commands in the configuration file indicate the exact location of the image.

Step 3.- The operating system image is loaded . When it's loaded and running, the operating system locates the Hardware and Software components and displays the result on the console terminal.

Step 4.- The saved con figuration files in NVRAM is loaded into main memory and executes line by line. These configuration commands start routing processes, provide addresses for interfaces

establishing the characteristics in the media, etc.

Step 5 .- If there is not valid configuration in NVRAM, the operating system executes a configuration routine with initial questions called system configuration dialog, as known as initial configuration dialog.

6.3 The IOS Cisco

Cisco IOS (originally internet work Operating System) is the software used in the vast majority of routers and switches-off. IOS is a package of routing functions, commutation, Ethernet work and telecommunications that is tightly integrated with a multitasking operating system.

The command –line interface or IOS (IOS CLI) provides a fixed set of commands for multiples words. The package available is determined by the “mode” and level of privileges of the current user. The “Global configuration” mode provides commands to change the system configuration and the interface configuration mode to turn provides command to change the settings for a specific interface. To all of the commands are assigned a privilege level of 0 to 15 and can be accessed by users with the necessary privileges. Through the CLI, you can define the available commands for each level of privilege.

6.3.1 The different modes of users on the IOS

User mode: Allows you to query the information related to a router without being able to change. The shell is the following :

```
Router >
```

User Privilege: Allows you to view the status of the router and import or export images os IOS . The shell is the following :

```
Router #
```

Configuration mode interface: Allows you to use script configuration interfaces (addresses, IP, masks, etc...). The shell is the following :

```
Router ( config ) #
```

Mode –Line configuration: Allows you to configure a line (example : access to the router by telnet). The shell is the following :

```
Router (config- line ) #
```

Spatial mode: RXboot mode of maintenance that can serve as, especially, to restart the router passwords. The shell is the following :

```
Rommon >
```

6.4 PROTOCOLS

6.4.1 Router Protocols

A routed protocol allows the router will send data notes between different Networks. Is a Protocol of level 3 decking to transfer information from one device to another in the form of a network. Routing protocol is the datagram of level 3 that takes information from the application in addition to information on the higher levels.

Features: A router protocol allows the router will send data between nodes of different networks. For a protocol to be routable, must support the ability to assign to each individual device a number of network and one of the hosts.

Routing Protocol is the implementation of a routing algorithm in the software or hardware. A routing protocol an algorithm the application of routing in the software or hardware.

Advantages:

- Is easier to configure (comparatively to others products).
- It's an open protocol (supports derived versions although not necessary compatible).
- It's supported by most of manufacturers.

Disadvantages:

Its main disadvantage is that, in order to determinate the best metric, only takes into account the number of hops, downloading other _____. It's not designed to solve any problem of routing. The RFC 1720 (STD 1) describes these technical limitations of RIP serious and the IETF is evaluating candidates to replace it, within which OSPF is the favorite. This change is hampered by the wide expansion of RIP and need appropriate arrangements.

6.4.2 Routing protocols

Routing protocols are the set of rules used by a router when it communicates with other routers to share routing information. This information is used to build and maintain the routing tables.

Features:

Routers must maintain routing tables and ensure that others routers know of changes in the topology of the network. This function is carried out using a routine protocol to communicate the information of the network to other routers. When the package arrives at an interface, the router must use the routing table to set the destination. The routers send the packets to the appropriate interface, add information necessary framing for that interface, and then transmits the frame.

Advantages:

Only changes in the state of the link are sent. Which significantly reduces the bandwidth required. Although the changes are sent to all routers associated with the interconnection simultaneously, the convergence time is reduced. Significantly provide control and flexibility for routing

information cross the renaming of the interconnection.

Disadvantages:

Increases the complexity of the installation, increases the internal processing requirements (memory of the CPU). The routing protocols can be classified into two types, distance vector and link state.

Distance vector:

The vector distance means that the routers are published as vector of distance and direction . This distance is defined in terms of metric like the hop count and the address is simply the next – hop router or the output interface. The distance vector protocols generally use the Bellman Ford algorithm for the determination of the best path.

Link status:

Unlike the operation of the protocol of the distance-vector routing, a router configured with a link-state routing protocol can fall a full view or Topology of the network to gather information from all other routers. To continue, the use of a routing protocol Link state is like having a complete map of the network topology. The signs along the route from source to destination are not necessary, because all the routers on the link state use a map to the same network.

A router uses the link state information of link state to create a map of the Topology and select the best route to all the destination networks in the Topology.

Some of the most common protocols for routing include RIP, IGRP, EIGRP, OSPF, IS-IS and BGP. Bellow will explain two of them: RIP and EIGRP

RIP Protocol

RIP (Routing Information Protocol) is one of the routing protocols used by older IP based devices . It's originally implementation was for the XEROX pup protocol at the beginning of the 80's, won popularity when was distributed as the routing protocol. For the implementation TCP/IP. RIP is a distance vector protocol that uses the account of routers hops as metric. The account of hops maximum of RIP is 15. Any path that exceeds 15 hops is labeled as unreachable with the establishment of the account of jumps in 16.In RIP routing information is propagated from one router to the other neighbors by means of dissemination of IP using the protocol UDP and port 520.

The rip protocol version 1 is class routing protocol that does not support the publication of information of the net mask. The RIP protocol is a protocol without class that supports CIDR and VLSM, summary of routes and security through simple text and md5 authentication.

It's should be noted:

- RIP is a routing protocol based on distance vector. The RIP uses the number of metric data as to the selection of routes.
- The RIP routing updates disseminated by means of the ro
- The maximum numbers of hops allowed in RIP is 15.
- The RIP routing updates disseminated by means of the routing table complete every 30 seconds by default.
- RIP may perform balance of download to a maximum of six equal cost routes (the specification by omission of four routes).
- RIP requires that you use a single network mask for each network number of main class that is announced. The mask is a subnet mask of fixed length. The standard rip-1 does not contemplates triggered updates .
- RIP 2 allow subnet masks variable length (VLSM) in the interconnection. (The standard rip 2 allow triggered updates unlike the rip-1 the definition of the maximum number of parallel paths allowed in the routing table empowers RIP to carry out the load balancing.

Syntax of the configuration of the RIP.

```
Router(config)#routerrip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 200.200.1.0
Router(config-router)#version 2
Router(config-router)#maximum-paths 6
```

Network specifies the networks directly connected to the router that will be announced by RIP.

Version adopt a value of 1 or 2 specify the version of RIP is going to be used. If not specified the version, The IOS software adopts as the default sending RIP version 1 but receives updates of both versions, 1 and 2.

Maximum Paths (optional) enables the load balancing.

EIGRP Protocol

EIGRP protocol (Enhanced Interior Gateway routing protocol). Is a routing protocol vector of distances and a routing protocol of link state, owned by Cisco Systems, which offers the best of the vector algorithms of distances and the condition link. It's considered an advantaged protocol that is bases on the characteristics normally associated with the protocols of the state link. Some of the best features of OSPF as a partial updates and the detention of neighbors, are used in a similar

manner with EIGRP. But does not guarantee the use of the best route, is quite used because EIGR is somewhat easier than configure that OSPF. EIGRP improves the convergence properties and operates more efficiently than IGRP. This allows a network has enhanced architecture and be able to maintain the current investments .

The most relevant features of EIGRP are:

- 1.- Reliable transport protocol (RTP)
- 2.- Updates limited
- 3.- Algorithms of updates by diffusion (DUAL)
- 4.- Establishments by adjacencies .
- 5.- Tables of neighbors and topology.

Routers EIGRP maintain routing information and at disposal of the RAM, so they can react quickly to changes. Like that OSPF, EIGRP saves this information in multiple tables and databases, routes are given a state and can be tagged to provide additional useful information.

EIGRP maintain the following three tables :

Neighbors table: Each router EIGRP maintains a table of neighbors that lists adjacent routers . This table can be compared with databases used by OSPF adjacency. There is a table of neighbors for each protocol that supports EIGRP .

Topology tables: The table of topology consists of all the routing tables EIGRP received from neighbors . EIGRP takes the information provided in the neighbor table .

Network Specific the networks directly connected to the router that will be announced by RIP.

Version adopts a value of 1 or 2 to specify RIP's version that is going to be in use. If the version is not specified, the software IOS adopts as predetermined option the sending of RIP version 1 but it receives updates of both versions, 1 and 2.

(Optional) Maximum-paths enables balanced of load.

Protocolo EIGRP

EIGRP (Enhanced Interior Gateway Routing Protocol)

It is a protocol of routing vector distance and a protocol of routing of link-state, property of Cisco Systems, which offers the better of the algorithms of vector of distances and of the condition of link. It is considered to be an advanced protocol that is based on the characteristics normally associated with the protocols of the condition of link. Some of the OSPF's best functions, as the

partial updates and the neighbors' detection, are used in a similar form by EIGRP. Though it does not guarantee the use of the best route, it is used widely because EIGRP is slightly easier to configure than OSPF. EIGRP improves the properties of convergence and produces with major efficiency than IGRP. This allows that a network should have an improved architecture and could support the current investments in IGRP.

1- Reliable Transport Protocol (RTP), 2-Limited Updates, 3- algorithm of update for diffusion (DUAL) 4-Establishment for adjacencies 5-neighbors' Tables and topologia. The routers EIGRP support information of route and topology.

The routers EIGRP support information of route and topology to disposition in the RAM, in order that they could react rapidly to the changes. As OSPF, EIGRP guards this information in several tables and databases.

The routes receive an state and can be labelled to provide additional information of usefulness.

EIGRP supports the following three tables:

- Neighbors' table

Every router EIGRP supports a neighbors' table that enumerates the adjacent routers. This table can be compared with the database of adjacency used by OSPF. A neighbors' table exists for every protocol that EIGRP admits.

- Table of topology

The table of topology consists of all the tables of routing EIGRP received from the neighbors. EIGRP takes the information provided in the neighbors' table and the table of topology and calculates the routes of minor cost towards every destination. EIGRP traces this information in order that the routers EIGRP could identify and commute to alternative routes rapidly. The information that the router receives from the neighbors is used to determine the route of the successor, who is the term used to identify the principal route or the best. This information also interferes to the table of topology. The routers EIGRP support a table of topology for every protocol configured in the network (as IP, IPv6 or IPX). The table of enrutamiento supports the routes that are learned in a dynamic way.

- Table of routing

The table of routing EIGRP contains the best routes towards a destination. This information is recovered from the table of topology. The routers EIGRP support a table of routing for every network protocol.

Syntax of EIGRP's configuration

```
router(config)#router eigrp 240
```

```
router(config-router)#network network-number
```

```
router(config-if)#bandwidth kilobits
```

```
router(config-router)#eigrp log-neighbor-changes
```

router eigrp 240 It specifies EIGRP as protocol of routing for the system

autonomous 240 This value varies from 1 to 65535

network. Specify the networks directly connected to the router that will be announced by EIGRP.

Bandwidth. The process of routing uses the command bandwidth to calculate the metrics and

it is suitable to configure the command in order that it coincides with the speed of the interface.

log-neighbor-changes enables the record of the changes of neighbors' adjacency to monitor the stability of the routing system and to help to detect problems.

In IOS's current versions EIGRP adds to the network command the correspondent wildcard this allows the protocol the identification of subnetworks:

```
router(config)#router eigrp 240
router(config-router)#network 192.168.16.0 0.0.0.255
```

Some commands EIGRP for verification and control are:

Showiproute

Shows the routing table

Showipprotocols

Shows the protocol parameters

Showipeigrpneighbors

Shows the information of EIGRP neighbors

showipeigrptopology

Shows the table of EIGRP topology

debugipeigrp

Shows the information of the packets

The metrics

The metrics is a value used by the routing protocols to assign costs in order to reach any remote network, every protocol uses his own metrics, for example RIP uses the jumps counting, EIGRP that is a property of cisco uses a combination of bandwidth and delay, On the other hand OSPF uses the bandwidth. The jump count that RIP uses is the simplest metrics to understand, which means, the jump count refers to the quantity of routers that it must cross a packet to reach the network of destination. The metrics enters function when the router learns more than one route towards the same destination, for such the protocol of routing must evaluate and differentiate between the available routes and to select the route with the lowest metrics.

Static routing

RIPv2, RIP, EIGRP, OSPF

RIPv2: Interior Routing protocol by distance sector

IGRP: Interior routing by distance vector

OSPF: Interior routing protocol of link state

IS-IS: Interior routing protocol of link state

EIGRP: Advanced protocol of interior routing by distance vector developed by cisco

BGP: Exterior routing protocol of vector of route. It is a protocol of vector of route that can use many attributes to measure the routes.

Split Horizon

What is and what is the function of Split Horizon?

A Split horizon (divided horizon) takes place when a router tries to send information about a route again in the direction from where it came. For example: The Router 1 initially public that has a route towards the Network A. As result, there is no motive for the Router 2 to not include this route of return towards the Router 1 because the Router 1 is the nearest to the Network A The norm of

Split horizon establishes that the Router 2 must eliminate this route of anyone of the updates that it sends to the Router 1.

The norm of Split horizon helps to prevent the loops of routing. For example, let's suppose that the interface of the Router 1 towards the Network A stops working. Without the Split horizons, the Router 2 continues informing the Router 1 that can come to the Network A (across the Router 1). If the Router 1 is not sufficiently intelligent, it can end selecting the route of the Router 2 as an alternative for the direct connection that has failed, provoking a loop of routing. Though the waits should anticipate this, the Split horizons are implemented in IGRP as a way of supplying additional stability of protocol.

Protocols that use divided horizon

- RIP
- IGRP
- EIGRP
- VPLS They use the technology of divided horizon to avoid the cycles in the plan of re-sending

6.5 Basic configuration of a Cisco router

6.5.1 change the name of the router

The name of the router can be modified in order to be able to differentiate it in the network or networks. The command will be executed in way of global configuration.

```
Router(config)#hostname<Name>
```

A different name will appear in the prompt in meetings HyperTerminal or Telnet.

- Before
Router >

- After
Name >

6.5.2 Configuration of the Ethernet interfaces of the Router

Now, we must do that they communicate both networks connected to the Router. Let's suppose that the name of the interface connected to a computer is Fast Ethernet 0/0 and that of the one connected to the computer 2 is Fast Ethernet 0/1, being in global configuration mode.

Here the commands to input:

- **Interface fastEthernet 0/0:**

```
Router (config) # interface fastEthernet 0/0
Router (config-if) # ip address 192.168.1.1 255.255.255.0
Router (config-if) # no shutdown
Router (config-if) # exit
```

- **Interface fastEthernet 0/1:**

```
Router (config) # interface fastEthernet 0/1
```

```
Router (config-if) # ip address 10.0.0.1 255.0.0.0
Router (config-if) no shutdown
Router (config-if) exit
```

This is all in relation to the configuration of the interfaces. Both networks should communicate now between them. We can verify it with a ping command of a PC of a network towards a PC of another network.

To save the current configuration we will use the command write from the privileged mode.

If the interface that is going to be configured is serial, the procedure that follows is the same, but only the command clockrate will be added with the speed of synchronization for example 64000.

6.5.3 Configuration of passwords in the Router Cisco

Turning on the router Password

The first thing that it is necessary to do is to connect in privileged mode, then in the mode of global configuration to effect this manipulation:

```
Router > enable
Router # configure terminal
Router (config) #
```

Once in global configuration mode, it is necessary to enter the mode of configuration of line typing on the following

```
Router(config)#line console 0
```

In the mode of configuration of line we type the wished password followed by the command login.

```
Router(config-line)#password <contraseña>
Router(config-line)#login
```

we can now leave the configuration of line mode with the command exit, later we do the same thing to go out of the global mode, and already being in privileged mode we save the configuration with the command write.

```
Router(config-line)#exit
Router(config)#exit
Router#write
Router#exit
Router>
```

Password to the Privileged access

This part explains how to put a password to the privileged user.

The first thing that it is necessary to do is to connect in privileged mode, then in mode of global configuration to effect this manipulation:

```
Router> enable
Router# configure terminal
Router(config)#
```

Once in mode of global configuration, it is necessary to type a command to put a password:

```
Router (config) * enable password <password>
```

The next time that a user tries to connect in privileged user mode, will be requested him a password.

Configuration of the Telnet Access to Router.

Since the configuration with the cable of console and HyperTerminal is not practical, it is possible to allow that the administrators should connect to the router via a Telnet session from any PC of one of both networks.

We start in mode of global configuration, then in mode of configuration of line VTY:

```
Router > enable
Password?:
Router # configure terminal
Router (config) # line vty 0 4
```

This will configure the possibility of 5 telnet sessions simultaneously in this router.

We come now to the prompt of configuration of line. To activate Telnet, we have to put a password to the line:

```
Router (config-line) # password contraseña
Router (config-line) # exit
```

We save the configuration with the command write.

6.5.4 Commands of information in Cisco Routers

The commands of information allow to show the information relative to the router. They all begin with the prefix show or sh. The majority must be executed from the privileged mode.

Show the file of current configuration of the router:

```
show running-config
show run
sh run
```

Show information about the configuration of hardware of the system and about the IOS:

```
showversion
shversion
```

To show the active processes:

```
showprocesses
```

show the protocols configured of the layer 3 of the model OSI:
showprotocols

show the statistics of memory of the router:
showmemory

show information and statistics on an interface:

show interfaces name_interface
sh interfaces name_interface
shintname_interface

1. PACKET TRACER® CISCO

After realizing the exercises of division of networks, some of them were practised in the software PacketTracer from Cisco, in which simulations can be carried out by the devices of network as if one was working physically in real life.

7.1 What is Packet Tracer?

Cisco Packet Tracer is a software property of Cisco System, Inc., designed for the simulation of networks based on the equipments of the mentioned company. Together with the didactic materials designed for such, it is the principal tool of work for tests and simulation of practices in the training courses of Cisco System. For his utilization there is needed the acceptance of the user's license and the authorization of the owner across the entities named "academies" that are authorized for the imparting of the mentioned courses.

7.2 The work environment of Packet Tracer

In Packet Tracer's working space they find different zones:

- Zone of menus. It is the area where they find the typical options of all the programs for the management and the configuration of the software.
- Selector of presentation. It allows to change between logical scheme and physical scheme at the moment of presenting the devices. The habitual thing is to work with the logical scheme.
- Working space. It is the zone where there will place the devices that shape the network
- Toolbar. It provides tools to select devices, to move the working space, to analyze specific parameters of the devices (the magnifying glass), to generate units of information of protocol simple or complex.
- Selector of operation modes. To change between the way of Real time or the Simulation mode, which allows us a more detailed analysis of all the PDU of the different protocols that intervene in a communication in the network.
- Selector of scenarios. It serves to effectuate different analyses on the same network.
- Area of state of the scenario. It shows the UDP that have intervened in the effectuated analysis, be real time or in simulation mode, for each of the scenarios or situations in that it has been operated the network.

· Area of devices. It is the zone that allows to select the devices that are going to be included in the working space, as well as the connection between these. The left zone gathers the devices for groups and the right zone of the area offers the included devices, in agreement with the numeration used by Cisco System.

In the illustration 7.2.1 we observe the environment of work of the Packet Tracer.

7.1 How to create a topology in the Packet Tracer

The way of operating of Packet Tracer is very simple since it is very intuitive program. The first operation will consist of selecting the devices that form the network, for it the corresponding group will be selected: from left to right and from up to down: Routers, Switches, Hubs, wireless Devices, Connections, final Devices, WAN's Emulation, personalized Devices and multiuser connection. In the illustration 7.3.1 we can observe the available routers in the Packet Tracer.

Each of the eligible devices corresponds with a device made by Cisco System, except the so called Generic devices. The election of the devices can be done one to one (indicating it in the group and doing click in the scenario to place it) or if it's about several similar devices, indicating in the group simultaneously pressing the Ctrl key.

The connection of the different equipments can be realized choosing personally the type of connection or by means of the tool of connection to automatic way. In any case, it is necessary to indicate on the devices to connection, if the case needs it, we will be given the possibility of choosing the type of interface.

8. CONCLUSIONS

8. During the period the lesson of wide area networks took place we were able to obtain many knowledge, between them to know wherefrom there come the IP addresses that have the networks, this is done when "subnetting", another of the knowledge that were acquired it is to know how a WAN network is composed, the devices that are involved, etc., also we learned to configure the Routers and to connect them in order that they could configure the WAN network, all that with the aim to achieve that the communication is done from a place to another by means of the use of these devices of network and to achieve thus an ideal configuration.

Note: To page 25, the reader is left between the mentioned interpretation and paints for the reader to generate their own ideas and creative about. This is an exercise in creative writing and painting to generate new ideas.

OBSERVATION:

Rhochrematic process in electromagnetism pedagogy.

Discreet Variable

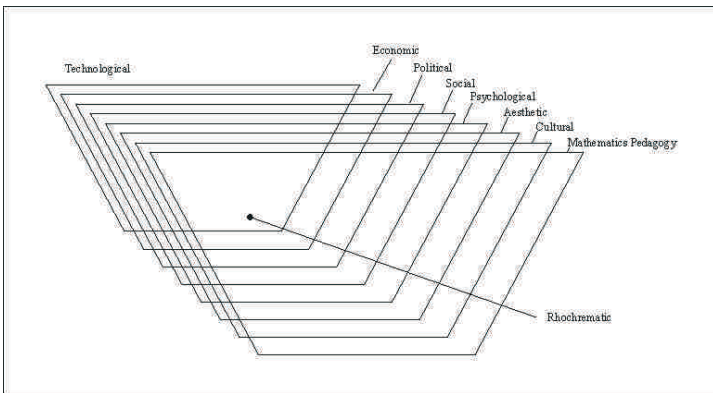
$$\sum_{b1}^{a1} x1 + \sum_{b2}^{a2} x2 + \dots + \sum_{bn}^{an} xn + \dots + \sum_{bk}^{ak} xk$$

Continuous Variable

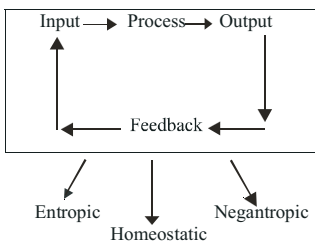
$$\int_{b1}^{a1} x1 + \int_{b2}^{a2} x2 + \dots + \int_{bn}^{an} xn + \dots + \int_{bk}^{ak} xk$$

Integrating the Rhochrematic process in electromagnetism pedagogy.

Integration System



Rhochrematic → The Process of Reprocess
Process System



$n_1 \dots n_2 \dots n_n \dots n_k$ with Discret Variable and
Continuos Variable in the System

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IMPLICATIONS FOR THE STUDY OF WIDE AREA NETWORKS AND PAINTINGS IN THEIR STEPS FRACTALS.



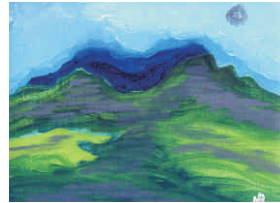
Phase 1



Phase 5



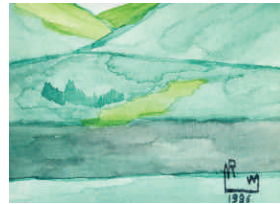
Phase 2



Phase 6



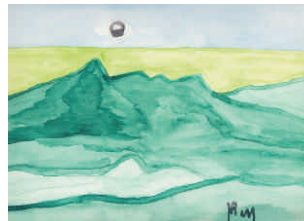
Phase 3



Phase 7



Phase 4



Phase 8

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