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LABORATORY WIFI 1
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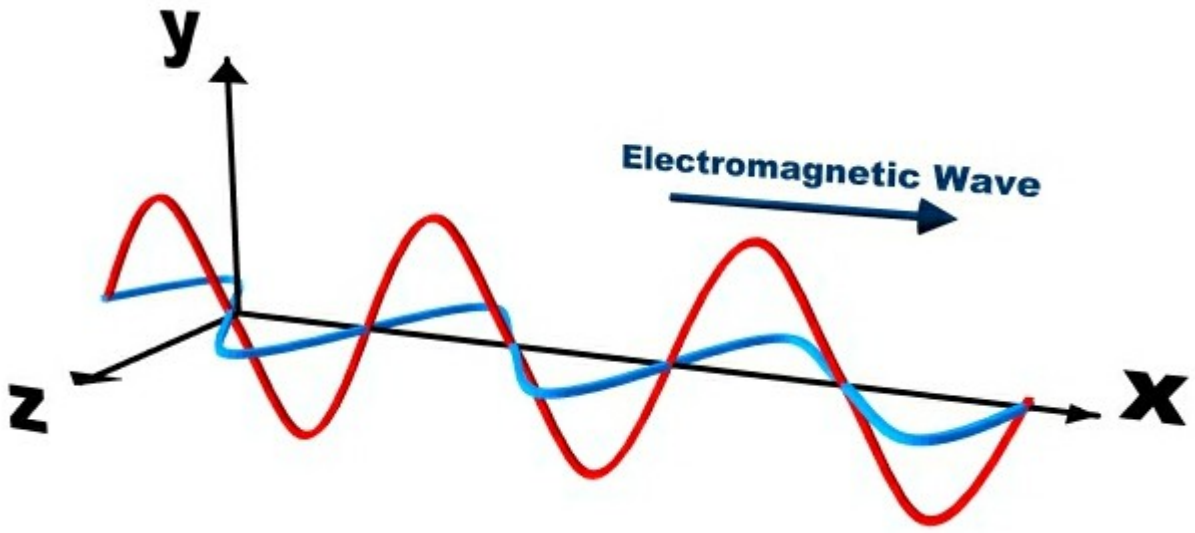
Resume/Goal:
This laboratory asks us to check the speed of transferring a file bigger than 650Mb through wireless connection. (WiFi). This need to be in different ways, with different obstacles on the way and different distances, and a documentation is needed with a detailed explanation of every case.

THE THEORY BEFORE THE LABORATORY

Well everything that we are doing in this laboratory is about the use of electromagnetic waves instead of cable and in the specific frequency between 2.4GHz and 2.5GHz, (the range for WiFi frequencies approximately). 3 things that someone needs to know in order to understand this topic are WiFi devices, Carrier-sense multiple access with collision avoidance (CSMA/CA), and of course the foundations of how are electromagnetic waves working.

WiFi devices:
WiFi access points are considered typically second layer devices. OK, they are working as a medium but in order to be effective is necessary for an WiFi to do a very sophisticated housekeeping that involves MAC addresses, (layer 2 things), so we can't exactly compare them with other layer 1 media like cables, they are bit more than that.
A fun fact that many computer technicians tend to forget is that WiFi access points don't have just one antenna but 2 or 4, (mostly 4), and that doesn't mean that the antennas are used 1 to 1 for every device that is connected to the access point, (that would be wasteful even if the connected devices were less than 4), but they distribute the signal intelligently according to the direction, the range and the traffic. WiFi devices are using many protocols, from the main 802.11g to the encryption protocol WAP2, but the protocol that really makes the difference on the speed of the wireless is the CSMA/CA and even if we are not planning to use it, (because we will use only one connected device so we will not have collision issues), definitively needs to be mentioned.

Carrier-sense multiple access with collision avoidance (CSMA/CA)
Before I say anything about the CSMA/CA protocol I need to point out that collisions happen and they happen all the time, we can minimize them but we can't avoid them completely. CSMA/CA is a wireless version of CSMA/CD, (a protocol that all the participants that are using the same medium are listening before they send), because CSMA/CD was not effective enough for the following reasons:
The nodes can't listen while sending and
The nodes are not in fix position and sometimes they are away from the radio range of some nodes or even worse from the radio range of a WiFi access point, (46m indoors and 92m outdoors for typical Home WiFi router like that I am using). The CSMA/CA is avoiding the collisions with a changing in timer or the frequency, (through MACA) every time that an collision occurs, and it is handling the situation when a node has distance and/or reliability issues.
The reliability issues is what effects the speed, and why the functionality of CSMA/CA can save the day. But in order to understand the issue we need to understand bit more about electromagnetic waves and waves in general.



Electromagnetic waves / electromagnetic radiation

Electromagnetic waves are waves as well with all the necessary properties of a wave, but with the big exception that electromagnetic waves don't need a medium to propagate, (they can propagate through vacuum), and because of that plus the easy to create them and their compatibility with the ways that our electrical/electronic devices are working, makes them our first choice for communications. Electromagnetic waves are plenty and in large variety in nature and according to the range of the electromagnetic spectrum can be for example the light that is visible from eyes to gamma rays or even the microwaves that we are usually using to cook frozen food.
The waves that we decided to use for our communications are the Radio Waves that are having a frequency as high as 300 GHz or as low as 3 kHz.

The main thing that we need to keep in mind is that Radio Waves even if they are not propagating necessarily through a material, they remain waves and they are obliged to follow the same laws of physics that the other waves are following. For example waves can change slightly their frequency though the Doppler effect, they can change speed and direction if they try to propagate though a material that is more tight than air, they can loose their strength, (that causes lose of reliability/speed), and of course they can collide, reflect, and terminate with each other. That is the reason why a re crossing the cables that transferring signal. This causes the magnetic fields that are perpendicular to each other so the interferences are terminated with each other. Fun stuff!

Before we reach the implementation of the laboratory we need to have in mind the golden rule, that is not the speed of the wave that causes the loss of speed of transmission but the actual reliability, (or the lack of it).

THE IMPLEMENTATION OF THE LABORATORY

What we will use

I have already installed a physical server windows server 2012 r2 that supports a network of virtual servers and I have a laptop that is configured and connected to the same network with the 2 virtual domain controllers. There are already shared folders that I can use.
So the only thing that I need to add to this network architecture is an WiFi capable router, (ASUS rt-ac51u dual-band router), and we will be ready to run. For the movie “cocktail 1998”, (700Mb).

What we will check

I will check 5 cases:

1. Distance 2 meter with horizontal alignment with not obstacles. This should run the faster speed.
2. Distance 8 meters with horizontal alignment but with few small obstacles on the way. The monitors of the computers and other items that can be on the neighbor desks.
3. Vertical alignment with the laptop directly down below the router and the desk that holds the router.
4. Distance 10 meters with horizontal alignment and with a wall as an object.
5. Distance 6 meters with vertical alignment with the laptop in the cafeteria of the school directly down below the router the desk that holds the router and the floor that holds the desk.

What we will face

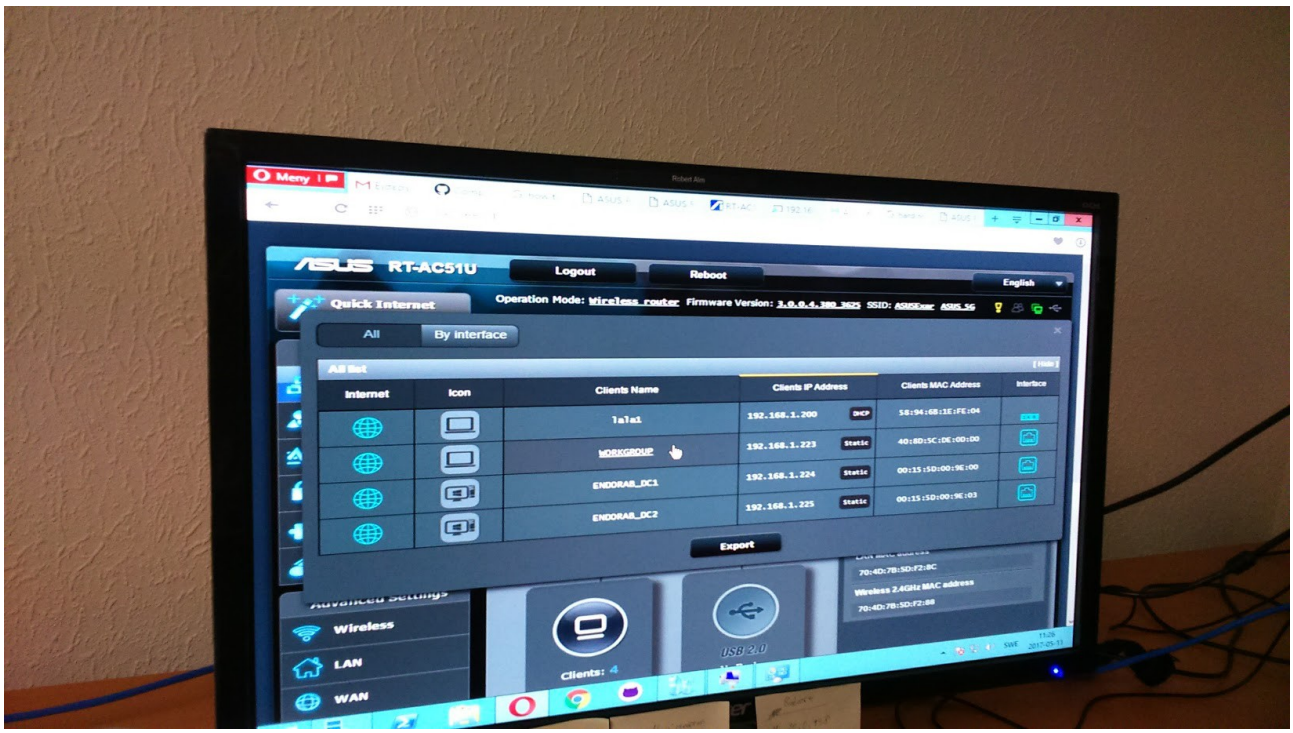
There are many issues that can effect the speed of the transmission. The main enemy of the transmission will be the interferences but the only thing that will do the real difference will be the obstacles that will be between the two nodes. The vertical and horizontal alignment will play some role to the speed of the transmission but I don't believe that we will have the luxury to see huge differences on the transmission.

OTHER PROBLEMS

As I tried to implement the laboratory, other problems arised, so I had to solve them in order to complete the laboratory but in a way that it doesn't give a sloppy result and it doesn't mess with the architecture of my network.

A new router comes to the game.

To be honest I was hopping for a wifi hotspot instead of a router. The router, because it is a router makes the things to look bit different.
My first problem was that the router didn't like my IP addresses and I was forced to let it decide my IP addresses dynamically through DHCP and after that I took the addresses and turned them to static adresses.
The other problem was that I wasn't sure of what is the role that my router has to play to the existed network, and that leaded to other problems.



The problem with the default gateway

Ok. The problem with the default gateway was a small problem, because it was or the one case or the other, (or the main default gateway of the big network 10.20.0.1, or the default of the router 192.168.0.1), it was a bigger problem to compromise somehow with the router on which IP I will use, that to decide which of the two default IP adresses I will use.

A problem that I caused to myself is that I forgot that I had the default ip (10.20.0.1) to my domain network, and I thought that I was using the ip adress of my physical server, (10.20.0.158). My mistake came from my notion that the physical server had to be a router for my virtual network, and my assumption was so strong that I refused to see the things differently.

The theoretical problem behind the router

I can tell that the reasons of almost all of my problems were that I was persistent to set up my router as a part of the big network, (10.20.0.1). That didn't happen and I had to accept my fate to have smaller network inside the bigger one. Instead of using my old IP addresses on the bigger network, (from 10.20.0.158 to 10.20.0.162).

My objection was that this method may lead to a sloppy result, and it felt like a bad practice to migrate from one network to one other just to use access point.

But it seem that it was a good practice because bit more encapsulation is always helpful for reasons of safety and wifi efficiency, and it doesn't really change the architecture of my network.

Ok I had to change my IP addresses, but at least with that action, I protected my IP addresses from collision with other similar IP addresses, (and that is great).

The DNS problem.

The funny thing with the DNS problem was that it was the exactly opposite of the of default IP problem. The optimal DNS IP address was the one that was the most encapsulated one. It wasn't the default DNS IP, it wasn't the IP of the physical server, but it was the address of the virtual server that works as Domain controller for my virtual windows server network.

It is logical that I hadn't in mind to try the default DNS IP as my DNS, because I new that I had to use my active domain, but in my mind it was really unclear if I had to use the IP f the physical machine or the virtual. The answer was the virtual and it is logical because the domain controller of my domain was the virtual server and I understand why I should choose that as my DNS but when I was trying to fix the problem back then I was unable to locate the problem.

THE FIVE TEST CASES

Case 1: Distance 2 meter with horizontal alignment with not obstacles. We reached the speed of 8,38 MB per second

Case 2: Distance 8 meters with horizontal alignment but with few small obstacles on the way. We reached the speed of 151 KB per second

Case 3: Vertical alignment with the laptop directly down below the router and the desk that holds the router. We reached the speed of 11,2 MB per second

Case 4: Distance 10 meters with horizontal alignment and with a wall as an object. We reached the speed of 73,1 KB per second

Case 5: Distance 6 meters with vertical alignment with the laptop in the cafeteria of the school. We reached the speed of 10,3 MB per second

CONCLUSIONS

We can see clearly that the alignment played a specific role to the strength of the signal, and surprisingly enough the signal seemed to be way stronger on vertical alignment instead of horizontal, (the antennas of the laptops and the routers are normally designed to work better on horizontal alignment). I believe that we got this effect because on the vertical alignment were less interferences, (less devices, less other signals, less reflections and so on).

The most interesting part of the results were that the signal was affected more by the distance than the physical obstacles, (for example walls). I believe that in this case as well, the interferences from other antennas and devices, (and their reflections of course), affected negatively the reliability, (and speed eventually), of the signal.