Comparison of Network Models

by Anthony.V. Booth

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TABLE of CONTENTS;

Physical Layer

The NIC cards and everything in between is known as the physical layer and includes all the cables, switches and routers etc etc; It is layer 1 of the OSI model. The physical layer connects to the next (data link layer) using the media access control (MAC) sub-layer, a MAC number like'00-13-D3-24-D5-B1' is a unique 48 bit identification number that is assigned to *all* NIC cards (wired, integrated, wireless or *whatever).*

Looking at the physical layer again, this is basically *everything* that our data runs across between *our* machine and the *destination,* one very interesting feature is called 'tracert' and can be used from *command prompt;*

```
Tracing route to 2.18.112.170 over a maximum of 30 hops


 1   <1 ms   <1 ms   <1 ms  172.16.31.254

 2   27 ms   26 ms   27 ms  host-78-148-64-1.as13285.net [78.148.64.1]

 3   67 ms   29 ms   29 ms  host-78-151-225-23.static.as13285.net [78.151.225.23]

 4   30 ms   31 ms   29 ms  host-78-151-225-80.static.as13285.net [78.151.225.80]

 5   36 ms   36 ms   36 ms  host-78-144-8-49.as13285.net [78.144.8.49]

 6   58 ms   36 ms   35 ms  host-78-144-10-69.as13285.net [78.144.10.69]

 7   36 ms   44 ms   36 ms  ve1010.r1.lon2.uk.atrato.net [80.94.66.13]

 8   36 ms   36 ms   35 ms  eth3-7.core1.lon1.uk.atrato.net [78.152.44.162]

 9   37 ms   36 ms   45 ms  eth1-3.r1.lon1.uk.atrato.net [78.152.44.101]

10   35 ms   35 ms   35 ms  linxnap.netarch.akamai.com [195.66.224.168]


Trace complete
```
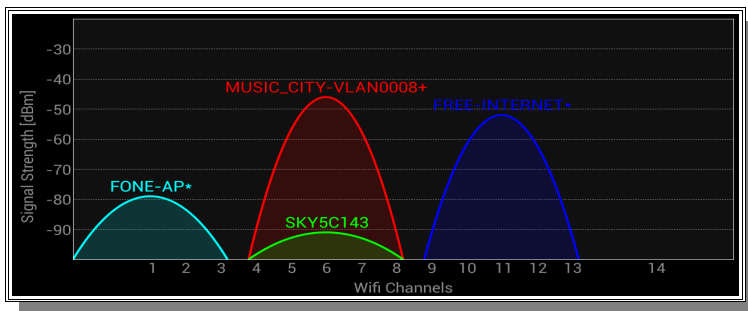
Detailing (above) **Fig** *'Physical'* **1.0**; **the use of tracert** (traceroute)

(tracert to www.cisco.com) – **Detailed** (below) is **Fig** *'Physical'* **2.0;** it is *another* of the aspects of the ***'Physical Layer';*** the 802.11 standard(s) of WLAN 'connections; **IT** carries all the *Packets* of **DATA** from all the layers following to the outside world;

The usage of this feature helps us to *start* to understand the amount of *work* all the hardware is doing with all the *frames* that come in and out of this layer as *data bits* (outward) and data *packets* as we head *up* the model, via the *logical link control* sublayer, *each one* of those hosts is working between the *physical layer* and the *network layer* to *route* our data from point 'a' to point 'b'. The industry standards ("IEEE-ISTO," n.d.) that we will be dealing with on this layer include 802.3 Ethernet, 802.11 Wi-Fi and 802.15 (Bluetooth("Bluetooth Technology Website," n.d.)).

Data Link Layer

The data link layer is also known as the MAC layer, it is layer 2 of the OSI model and relates to the XX:XX:XX:XX:XX:XX hexadecimal numbers that are allocated to all pieces of hardware with a method of connecting physically or wirelessly to a network using NIC cards information is relayed in FRAMES across this layer. The data link layer is just a *part* of the TCP/IP models *network access* layer.

On this layer, we connect from all the 802.3 Ethernet, 802.11 Wi-Fi and 802.15 (Bluetooth) using *data frames* to relay the information other technologies which can be found at the data link layer include Switched Ethernet, ATM (Asynchronous Transfer Mode) and Frame Relay, it is the layer where we connect across layer 2 network switches, hubs – also wireless extenders.

An machine user can connect to a wireless Access Point (802.11) on *this* layer while the *IP address* of the access point can be on an *entirely different network* – or *subnet* of it's *own!* It is at this layer where MAC Address Filtering can be installed in order to restrict access to *authorised hosts only.*

Network Layer

Common network layer protocols include IPV4 and IPV6, Novell internetwork packet exchange, apple talk and CLNS/DECNet; it is layer 3 of the OSI model, and handles information as PACKETS across a net or sub-net work. The TCP/IP models INTERNET layer is the layer across which packets are ROUTED from point to point.

Among the *other* protocols which we will encounter here are ICMP (Internet Control Message Protocol), IGMP (Internet Group Management Protocol), IPsec (Internet Protocol Security), RIP (Routing Information Protocol) and ARP (Address Resolution Protocol).
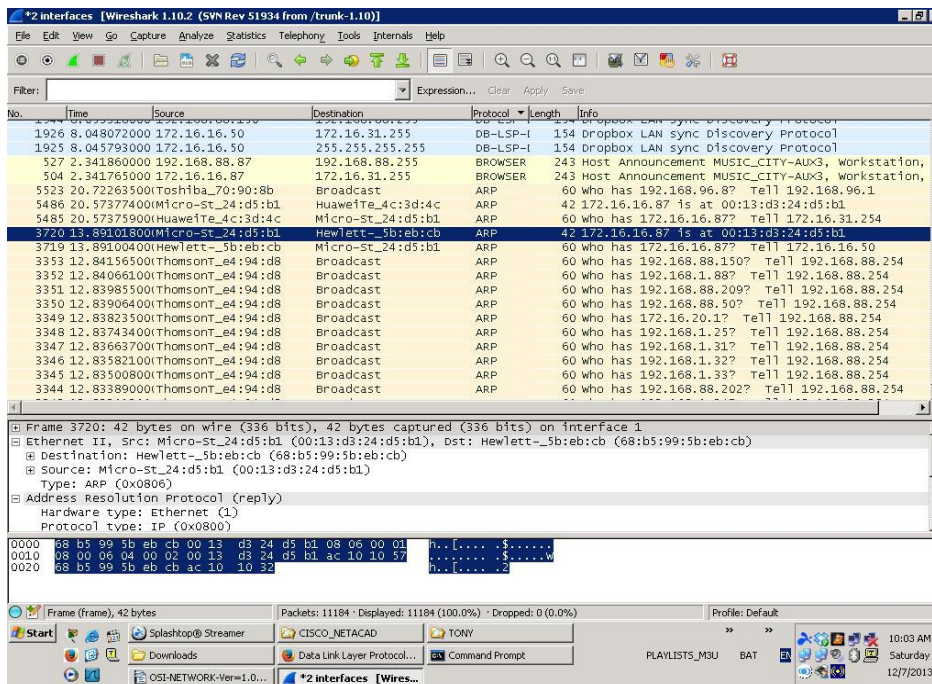
Detailing WIRESHARK;

Among the interesting and useful tools that can be *very* useful in studying not only *this* layer but *all the others* is called Wireshark; it is a network packet sniffing tool that can be used to analyse the functioning (or *mal-functionin)* of any given network. This is the layer where we deal with *subnetting* (IPV4), it is included in the features of a Multi Layer Switch (such as a Catalyst 3560("Cisco Catalyst 3560 Series Switches - Products & Services," n.d.))

Transport Layer

The transport layer is layer 4 of the OSI model and is the BORDER between the network and the actual machines. Protocols used on this layer are TCP and UDP; In the TCP/IP model, this layer is also known as the transport layer. All of these layers and protocols are governed by a collection of 'RFC' documents which can be found at 'http://www.rfc-editor.org/download.html'; 'RFC' stands for '*request for comments'* and are a collection of several *thousand **industry standard documents** any* of which can be *cited/referenced* in any other works that *we* create("RFC-Editor Webpage," n.d.). As I have stated *many* times, the ***fact*** is that **obsolescence** of **industry standards** is our ***biggest problem!!!*** - with millions of tons of I.T equipment making or already made it's journey across that *final* Transport Layer; to ***City Dump!!!***

The transport layer is responsible for establishing a temporary communication session between two applications and delivering data between them.

NETACAD 7.1.1.1

("Home - Networking Academy," n.d.)

Fig '*transport'* **1.0**

Some associated RFC'S;

- **RFC 675**
- **RFC 768**
- **RFC 793**
- **RFC 1122**
- **RFC 2581**
- **RFC 3168**
- **RFC 3540**

Detailed in **Fig** '*transport'* **2.0** is a screen shot of a *wireshark session* that shows a 3-Way TCP handshake taking place; 'SYN' says the host unit, 'SYN,ACK' says the Cisco server, 'ACK' says the host unit – the host unit was at 172.16.29.14 (DHCP Assigned), www.cisco.com were at 2.18.112.170.
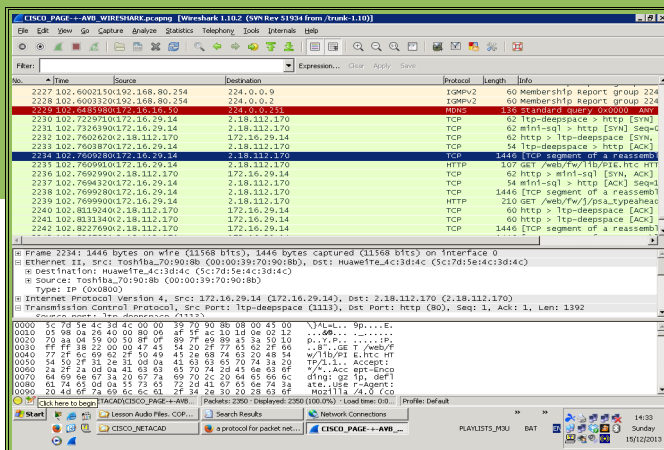

Fig '*transport'* **2.0**

Session Layer

The session layer is layer 5 of the OSI model, it is just another part of the Application layer in the TCP/IP model. Remote procedure calls start here along with streaming of audio and/or video. The session layer takes care of all the logging in and passwords etc etc. Again, this layer is *barely considered* in the TCP/IP model which is *really* geared towards the *network engineeers.* Meanwhile, back in the OSI model, it goes into *detail* about such protocols as X.225, ISO 8327, L2TP, H.245, NetBIOS to name a *few!* The OSI model is *really* geared towards *software engineers.*

Presentation Layer

The presentation layer is layer 6 in the OSI model and is another layer that is just 'bundled in' with the application layer in the TCP/IP model – network engineers are not particularly concerned with this layer. It responds to service requests from the application layer and deals with such tasks as data format conversion as well as encryption and decription. In the OSI model, it is *again* the 'stamping ground' of *software engineers* and goes into such *encryption, decryption* and *data translation* as well as *compression.* X.25 packet assembler/disassembler protocol (PAD) also works here.

Application Layer

When we talk about the application layer (layer 7in the OSI model) we talk about the layer handled by the software applications running on the particular machine; In the TCP/IP model, it is equivalent to the Application, Presentation and Session layers (of the OSI model) all rolled in to one. It is the layer that is of *least interest* to *network engineers* (unless it is weekend). For those who are interested in *detail* there is RFC 1123 have a look at, it is one of the 7000 or more Requests For Comments files detailed elsewhere in this article. It is a *software engineers paradise,* with such protocols as SMTP, POP, IMAP, DNS, SSH, SNMP, also *'classics'* such as FTP, TFTP, BOOTP and dear old *Telnet* (who's absence from the latest ISR's is another 'sign of the times' on the theme of **obsolescence.**

Sub-Netting with Ipv4

Fig *'Sub-Netting'* **1.0;** using ipconfig

Sub-Netting with Ipv4 can be a wee tad **difficult** for the **newcomer!!!** most people have difficulty with all the /24, /28, /8, /16's and **what** they **mean!**- Simply, they are just a count of digital **ONE's** ranging from 8 (bits) to **32;**

```
Windows IP Configuration

    Host Name . . . . . . . . . . . : music_city-aux3
    Primary Dns Suffix  . . . . . . . :
    Node Type . . . . . . . . . . . : Unknown
    IP Routing Enabled. . . . . . . . : No
    WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter NETGEAR_MAIN-STATIC-+-192.168.96.87:

    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . : Realtek RTL8139 Family PCI Fast Ethernet NIC #3
    Physical Address. . . . . . . . : 00-08-54-36-22-0C
    Dhcp Enabled. . . . . . . . . . : No
    IP Address. . . . . . . . . . . : 192.168.96.87
    Subnet Mask . . . . . . . . . . : 255.255.240.0
    Default Gateway . . . . . . . . :

Ethernet adapter VLAN0008-STATIC-192.168.88.87:

    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . : Realtek RTL8139 Family PCI Fast Ethernet NIC #2
    Physical Address. . . . . . . . : 00-08-54-36-22-0B
    Dhcp Enabled. . . . . . . . . . : No
    IP Address. . . . . . . . . . . : 192.168.88.87
    Subnet Mask . . . . . . . . . . : 255.255.255.0
    Default Gateway . . . . . . . . :

Ethernet adapter BLUETOOTH:

    Media State . . . . . . . . . . : Media disconnected
    Description . . . . . . . . . . : Bluetooth PAN Network Adapter
    Physical Address. . . . . . . . : 00-0B-0D-0B-08-DA

Ethernet adapter VLAN0003-STATIC-172.16.16.87-INTERNET:

    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . : Realtek RTL8139 Family PCI Fast Ethernet NIC
    Physical Address. . . . . . . . : 00-13-D3-24-D5-B1
    Dhcp Enabled. . . . . . . . . . : No
    IP Address. . . . . . . . . . . : 172.16.16.87
    Subnet Mask . . . . . . . . . . : 255.255.240.0
    Default Gateway . . . . . . . . : 172.16.31.254
    DNS Servers . . . . . . . . . . : 172.16.31.254
                        172.16.16.50
```

Sub-Netting with Ipv4
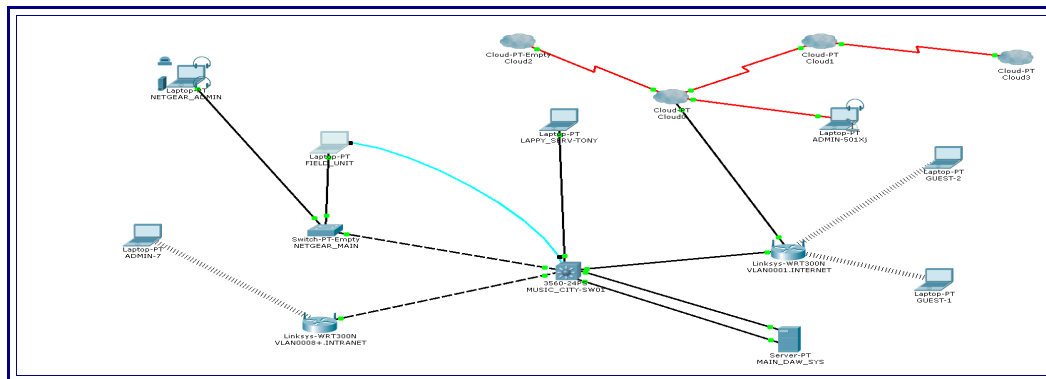## *a small home/office network;*

Fig *'Sub-Netting'* 2**.0;** *a small home/office network, set up on packet tracer; is a* **working replica** *of a* **real system**

There are a few networks detailed here, a network for internet, a network for extranet and an **intranet** *–* the idea behind these different networks is to separate the different data streams such as **internal audio/visual streaming and surveillance camera feeds** from all the **web intensive office applications** that may be running on the network.

LEVEL	NETWORK	SUBNET MASK	GATEWAY
INTRANET	192.168.88.0/24	255.255.255.0	192.168.88.254
EXTRANET	192.168.96.0/20	255.255.240.0	192.168.111.254
INTERNET	172.16.16.0	255.255.240.0	172.16.31.254
FONE_AP	192.168.95.128/25	255.255.255.128	192.168.95.129
AUX_AP	192.168.98.0/24	255.255.255.0	192.168.98.254

.

Fig *'Sub-Netting'* 3**.0;** *a small home/office network, detailing the networks in operation on* **MUSIC_CITY**, *the first network is a 'simple enough'* **class c** *network and is the company* **intranet** *it has typically no internet access and is used typically for* **internal audio/video** *streams; the* **extranet** *is a* **classless** *and* **static** *network that requires a* **static address** *from* **company admin** *in order to connect; it is the home of* **'honey pots'** *and such delights (for hackers); next is the* **internet,** *on this layout, it is an* **open** *and* **classfull** *(class B) network; - it has a* **large** *DHCP pool (around 172.16.29.10-172.16.31.250 – enough for several hundred clients to have internet) -it does* **not need** *and does* **not have** *any* **security.**

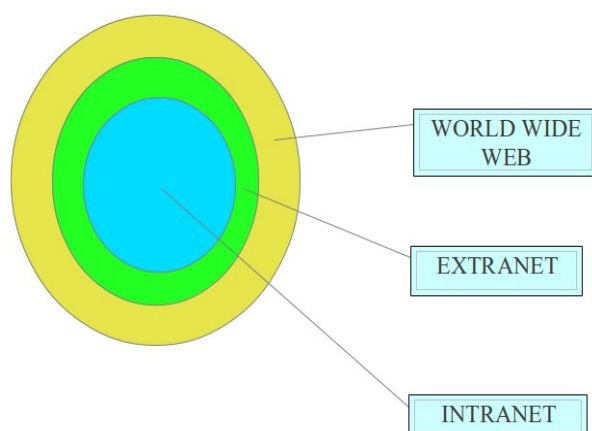# Detailing 'Business in Context' – a model by Needle (1995)

In accordance with this model, businesses can be divided into several concentric rings (with the main activity level in the middle) each of these rings can perhaps be likened to the various corporate network levels of a company.
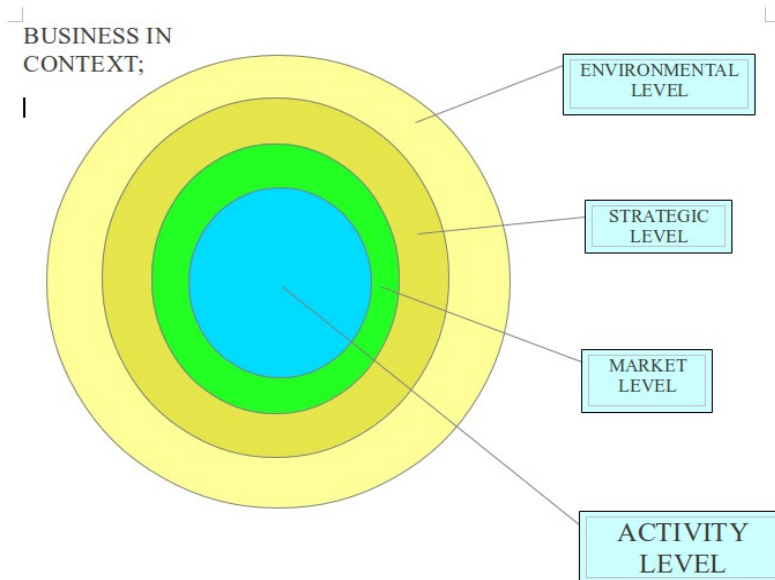
The activity level will be the inside of the company where company secrets about product design, components and/or specific materials + services employed by the company will be kept; this would likely be the company INTRANET.

The next levels are marketing and strategic with the market level being closer to the inside of the company (more to do with what the company produces + sales of said than what products used and purchase of those) – likely these levels would be connected to the company's EXTRANET in any working scenario's; being connected to the outside world **and** the heart of the company. The outermost layer of any company is the environmental level and relates primarily to how the company fits in as a neighbour within the community, a company that habitually creates a lot of dust and noise is less likely to be welcome in a residential or banking area. The ENVIRONMENTAL LEVEL of ANY company is its official face to the world and can be similar to the WORLD WIDE WEB layer of our network model ...tidy corporate web scripts, while relating more also on the strategic and marketing levels, are (just like the companies public areas) like the face of the company – a simple thing like a shoddily put together company website can be just as off putting to the customer as a blocked yet UN-repaired toilet! The environmental level of a company is the way a plastics factory handles its waste, a discotheque contains its noise, a car body repair shop contains its pollution (polyester dust + fumes). In the discotheque, we can pass through the marketing and strategic levels and see agendas such as what food and / or beverages to sell + for what prices. Migrating through market level towards activity level, we pass through sales & marketing + public relations etc; Activity level within most companies is where all the skilled work takes place, from changing the beer barrels at the bar to working as a DJ (the discotheque); re-building peoples cars (Car Body shop).

a small home/office network – (cont'd);

xyz

References

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    http://www.bluetooth.com/Pages/Bluetooth-Home.aspx (accessed 12.12.13).
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    http://www.cisco.com/en/US/products/hw/switches/ps5528/index.html (accessed 12.12.13).
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    (accessed 12.12.13).
RFC-Editor Webpage [WWW Document], n.d. URL http://www.rfc-editor.org/ (accessed 12.7.13).

IMPORTANT NOTE

Please note that this is a NEW EDITION;

...... further to my submission of 12/12/13