INTERNET PROTOCOLS

NETWORK ASSIGNEMENT

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Introduction to routing

In internetworking terms, routing is the process of moving a single packet of data from its source to its destination which is normally controlled by routers. Routing is therefore a very important piece of the internet, as it enables messages to be passed from one computer to another which in the end will potentially reach its target machine.
Intermediate devices such as LAN switches or WAP (wireless access points) is also to be found in homes and business – these devices provides interconnections between the localhosts on the local network.
These hosts can reach each other share specific information, without the need of additional equipment – If one of the hosts are to send a packet to a device that is configured with the exact same IP network as the devices that's sending the packet – the process is simple as the packet get forwarded, out of the host interface, through the intermediate device (LAN switch or WAP) and then get received by the destination device directly!

Remote hosts are devices that are beyond the local network – which allows us to connect users and business that's not a part of our local network. Routing and routers is therefore needed, when the source device sent a packet to another remote device.
In short term, "routing is the process of identifying the best path to a destination"[1]

A "default gateway" is known best as the router which is connected to the local network segment, which routes traffic from the local network to remote network devices. A default gateway can also be used as a connection between the local network and the internet, and is often used this way in homes and minor business
If the host device decides to send a packet to a device which is on a different IP network, the packet then needs to be forwarded through the intermediate device (LAN switches or WAP's) and then end at the default gateway.
It needs to go through this route, because the host device does not maintain the routing information beyond the local network itself – but the default gateway does! The default gateway maintains a routing table – which is a data file in the memory (RAM), that stores the route information about the connected network and at the same time is stores information about the entries of remote networks the host device has learned about.
The router (default gateway) then uses the information gained from the routing table, to determine which path is the best to reach those specific destinations.

Sooo… Which router should I get?

As I work in an IT store, which is a frequently asked question. A lot of people would choose to get a cheap 2-3-400 DKK router, while I've had people asking about 2000 DKK routers as well.
The question is though, as people's homes are obviously not the same – and they aren't requiring the same features.

[1] Cisco Networking Academy (6.2-6.2.1.1 Routing)
http://mars.tekkom.dk/cisco/en_CCNA-R-S_ITN/course/module6/index.html#6.2.1.1

A router I frequently recommend is the TP-LINK N750.
It's a router I have really good experience with – as I use it at home, and it just works! It's really simple to setup, and once you have it all going it's not going to budge on you.

The things I really like about it is, that it streams two wireless connections – at once, a 2.4 GHz for devices such as older smartphones, laptops etc. that may not be able to hop onto the 5GHz stream.
The 2.4GHz is streaming at 300Mb/s while the 5GHz is streaming at 450MB/s.
The N750 works really well with the wireless music streaming system, SONOS. A lot of our customers gets sent down from HI-FI KLUBBEN because they experience problems with the routers provided by their internet provider – and a lot of these people are using Stofa as a provider.
Stofa's routers is really bad – sorry to say – which is why we advise people to get either this or one of its bigger brothers, the good thing with Stofa is – that you can make your new router the "main router" through their setup page – This actually does a thing where Stofa can exactly see how many users there is on the network.
(Was brilliant back in the day when you had to pay for each user ☺)

Those persons that come in and ask about a really expensive router, we simply advise them not do buy it. It's not because we can't get them, or we won't sell them – but it's simply not worth the money compared to other solutions that we feature.
The price on the N750 is around 400DKK (some take more, some do less) so it's not an expensive router, but a really efficient one with a lot of features.

Introduction to routing protocols

The routing protocol specific how the routers communicate with each other, how they share information which enables them to select different routes between two connections or redistribution points.
The routers gain knowledge of the topology of the network by sharing information of the networks attached directly to it, and then shares it with the immediate neighbors to then share it throughout the network.

The three major routing protocols is[2]:

- Interior gateway protocols type 1:
  - Link-state routing protocols such as OSPF and IS-IS
- Interior gateway protocols type 2:
  - Distance-vector routing protocols such as routing information, routing, RIPv2 and IGRP
- Exterior gateway protocols
  - Exchanging routing information between autonomous systems such as BGP and Path Vector Routing protocol

[2] Routing Protocol - https://en.wikipedia.org/wiki/Routing_protocol

The third major protocol means two things, either it means that a category of protocols is used to exchange the routing information between autonomous systems – or it means a specific RFC-described protocol.

Static routing

When a router uses a routing entry that is manually configured rather than using the information gained from a dynamic routing traffic – then it's called **static routing**.
Usually these routers are configured manually by the network administrator when he/she is adding entries into a routing table, but this is not always the case.

Compared to dynamic routing, the static routers are fixed and if the network is changed or configured again then the static routers won't change.
To maximize the routing efficiency and also to provide backup if the dynamic routing information won't get exchanged – both dynamic and static routing are usually a part of the configuration.

There are though, some disadvantages by using manually configured static routers.
Some examples can be:

- Error 40
  - In a lot of cases, the static routers are manually configured – as told above – but by manually configuring the routers, there is an increased potential that the input is wrong. Mistakes like a mistype in the network information or that the configuration is incorrect leads to a non-working router.
- Not very efficient
  - As the static routes must be configured on each router that's in place on the network, the configuration time can be very long – this also means that, if there's a need for a reconfiguration this would be very slow and inefficient.
  - Dynamic routing would be the smart choice here, as these automatically propagates the routing changes – which in the end – reduces the need for manual configuration.

Comparison of routing protocols used in enterprises

RIPv2 (Routing Information Protocol Version 2)

RIPv2 is the successor of RIPv1, and the great difference between these two protocols is that v2 had the improvement of not just sending the network address when it sent the routing updates, it also included the subnet mask and the next hop address. All in all this means that RIPv2 can actually advertise non-classful subnets.
Both V1 and V2 is a distance vector routing protocol which uses the hop count as its metric but with a maximum distance of about 15 hops.
V2 is more secure than V1 as RIPv2 supports MD5 authentication, V2 uses multicasts while V1 uses broadcasts.

OSPF (Open Shortest Path First)

The OSPF is being used widely by a large amount of corporate companies, who has decided to use OSPF instead of RIPv2.
When OSPF detects a change in the network, it quickly multicasts the given information to all the other OSPF hosts in the network, so all networks have the same routing table information.
RIP for example, requires the routers to cast the ENTIRE routing table to the neighbors every thirty seconds while OSPF only sends the part which has changed and only when the change has taken place.
Instead of counting hops between the hosts on a large network – as RIPv2 does it – the OSPF bases the path choice on "link states" – which takes into account the additional network information which includes assigned costs metrics which may – or may not – give some paths a higher cost than others.

Even though OSPF is actually built to replace the RIP protocol, is has RIP support built-in, both for the router-to-host communication and to be compatible with some older networks which still uses RIP as the primary protocol.

EIGRP (Enhanced Interior Routing Protocol)

The EIGRP is an upgraded version of IGRP and it also uses the same distance vector technology, the operating efficiency of EIGRP contra IGRP has been improved significantly. Both EIGRP and IGRP is produced by Cisco when their devices needed a protocol with "faster converging abilities, route selection and calculation and the ability to record information from neighboring devices"[3]

Techopedia.com provided the following list of the characteristics of EIGRP:

- Advanced operational efficiency
- Capabilities of both link state and distance vector
- A classless routing protocol
- Unique features including use of Reliable Transport Protocol (RTP)
    - A diffusing update algorithm (DUAL), updates and updated information about neighbors
- Faster converging, because it precalculates routes and does not broadcast hold-down timer packets before converging.

As previously stated, this protocol is developed by Cisco, which also means that the protocol is only available with Cisco routers.
EIGRP is also a dynamic routing protocol, which automatically share the routing information – and makes the life of the network administrator a lot easier, as he haven't got to make the required changes manually to all of the routers.

Routing tables is a standard function of a router, but with the EIGRP you'll also have a Neighbor Table – which keeps a record of the IP addresses of the routers that have a physical line with the router.

[3] EIGRP - https://www.techopedia.com/definition/16186/enhanced-interior-gateway-routing-protocol-eigrp

Conclusion

Obviously you have two main options if you're the network administrator of a company which is static or dynamic.
The static routing option would probably be chosen by the hard working administrator, who wants to be sure that the routers are configured right – manually. He may like the dynamic option but, he knows that if he does the job properly – then there is no need to throw extra money after better equipment.
Choosing the dynamic routing option would be a route a like myself would choose.
I really like the idea that, if I make a changes one place – then the rest follows along nicely.
I'm also really a fan about OSPF that it doesn't need to update the entire routing table, but that it just updates the one part which has actually been changed.

The particular problems with static routing is that, it is very easy to make a failure which in the end may damage the entire network.
This makes the life of a network administrator hard – if it is a large office with many routers – as he has to go through each and every router, let's say that he had done the same configuration to all of them, to check which has an error.

That won't be a problem with the dynamic routing, as it would change it automatically. The only thing you as a network administrator need to make sure of, is that the routers are running the latest firmware and that all cables etc. are connected as they should.

So a guide on how to deal with a decision like this, would be:

- Figure out whether you want the routing to be static or dynamic
  - Pro/Cons for each option
  - Which solution may work best for your company?
  - Do the company have a specific network administrator, do would they need to hire a company to set the system up?
- Figure out which protocol to go for
  - RIPv2, OSPF or EIGRP
  - Should the system update the entire routing table or just the part which has actually been changed?
- Costs
  - Figure out which routers/switches/access points that would be ideal to use in the specific location
  - Would it need to be something expensive, or would it work with something cheap?
- Figure out which internet provider to use
  - Which provider can give the company the best possible solution?
  - Find out how strong and reliable the internet providers routers are
    - Do the company need to use their router?