



Anatomy of a Web Connection: A Brief Analysis

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1. Summary / Abstract

This assignment attempts to analyze what happens behind the scenes of a web request in order to load a webpage. For this, we'll start by analyzing the hops needed to establish the connection, and then take a look at what goes into serving the content.

2. The Traceroute

For this assignment, we will analyze tuni.fi, the website for the University of Tampere (Finland), which was chosen due to being in an interesting geographical location and, by virtue of being an university, giving us an interesting **traceroute**¹ to interpret:

Origin: My house in oporto.

```
Tracing route to tuni.fi [130.230.252.63]
over a maximum of 30 hops:

 1    14 ms 15 ms 16 ms 192.168.1.254
 2    *    61 ms 17 ms 10.249.192.1
 3    *    *    *    Request timed out.
 4    14 ms 13 ms 15 ms ga-cr1-bu10-200.cprm.net [195.8.30.245]
 5    57 ms 50 ms 53 ms lon3-cr1-be2.cprm.net [195.8.0.242]
 6    59 ms 60 ms 63 ms 195.66.225.24
 7    58 ms 53 ms 53 ms nl-ams.nordu.net [109.105.97.124]
 8    58 ms 58 ms 58 ms de-hmb.nordu.net [109.105.97.81]
 9    76 ms 74 ms 75 ms fi-csc.nordu.net [109.105.102.168]
10    73 ms 73 ms 79 ms ndn-gw.funet.fi [109.105.102.169]
11    79 ms 79 ms 78 ms espoo2.ip.funet.fi [86.50.255.233]
12    81 ms 77 ms 76 ms hameenlinna1.ip.funet.fi [86.50.255.222]
13    77 ms 77 ms 77 ms hameenlinna2.ip.funet.fi [86.50.255.225]
14    77 ms 76 ms 78 ms tampere1.ip.funet.fi [86.50.255.221]
15    76 ms 75 ms 75 ms surf-gw-xe-0-0-0.cc.tut.fi [130.230.1.238]
16    77 ms 76 ms 77 ms tuni.fi [130.230.252.63]
```

Trace complete.

1. Traceroute is a tool that, via ICMP, will attempt to identify the hops which a request goes through on an IP network. ICMP requests (Operating at Network/Layer 3) are often blocked by firewalls, so a traceroute may also be done over TCP/UDP (Transport/Layer 4)



3. Analyzing the hops:

[ASN/IP Whois Query](#) / [IPIP.NET](#) and [LookIP.net](#) were used when possible/necessary to identify and get more information on the hops when unknown

1. **192.168.1.254**

Location: Oporto, Portugal

My local router/gateway. Identified as local due to being in the 192.168.0.0 network.

2. **10.249.192.1**

Location: Unknown

No information was able to be gathered on this ip. Information was found online towards it being the default gateway for most wireless routers.*

3. **ga-cr1-bu10-200.cprm.net**

Location: Unknown

As we can see (and also using the [websites above](#)), this hop is part of the domain cprm.net, which is [Altice International Backbone](#). Most likely is the entry point to the underwater cables.

4. **lon3-cr1-be2.cprm.net**

Location: London, United Kingdom

Most likely the exit point from the underwater cables.

5. **195.66.225.24**

Location: London, United Kingdom

No hostname was found for this hop, but a [quick lookup](#) reveals where it leads, and that it belongs to an ISP called Avensys Networks.



6. **nl-ams.nordu.net**

Location: Amsterdam, The Netherlands

Now we've finally reached the education network of the Nordic countries, [NORDUnet](#)². This host is registered in Aalborg, Denmark, but its naming suggests it is located in Amsterdam³.

7. **de-hmb.nordu.net**

Location: Hamburg, Germany

Yet another node in the NORDUnet network. Same as above, appears registered in Denmark but the naming points to Hamburg.

8. **fi-csc.nordu.net**

Location: Helsinki, Finland

Having reached our target country, we'll now probably hop off the international connection into the national university network, since this is the last nordu.net node. Side note: [CSC](#) is the Finnish IT center for science, providing IT support/services for academia and companies in Finland. It also manages the funet network, which we will further look into later in the assignment.

9. **ndn-gw.funet.fi**

Location: Stockholm, Sweden

This hop now belongs to Finland's University Network Backbone⁴, which is Finland's equivalent to the Portuguese fcn.pt

10. **espoo2.ip.funet.fi**

Location: Espoo, Finland

11. **hameenlinna1.ip.funet.fi**

Location: Hameenlinna, Finland

12. **hameenlinna2.ip.funet.fi**

Location: Hameenlinna, Finland

13. **tampere1.ip.funet.fi**

Location: Tampere, Finland

2. Fun Fact: nordu.net is one of the two oldest active domain names, alongside DARPA.net, registered on January 1st, 1985

3. In NORDUnet's [Looking Glass](#) we can see the geolocation of each node.

4. Source: [FUNET - Wikipedia](#) More information in [Brief History of Funet](#) (!Interesting! -> A FUNET server was home to the original Linux Operating System! [\[available here\]](#))



The past hops have been just regular routing, getting closer and closer to our desired destination.

14. surf-gw-xe-0-0-0.cc.tut.fi

Location: University of Tampere, Tampere, Finland

And we've nearly reached our destination, having now entered the University's network.

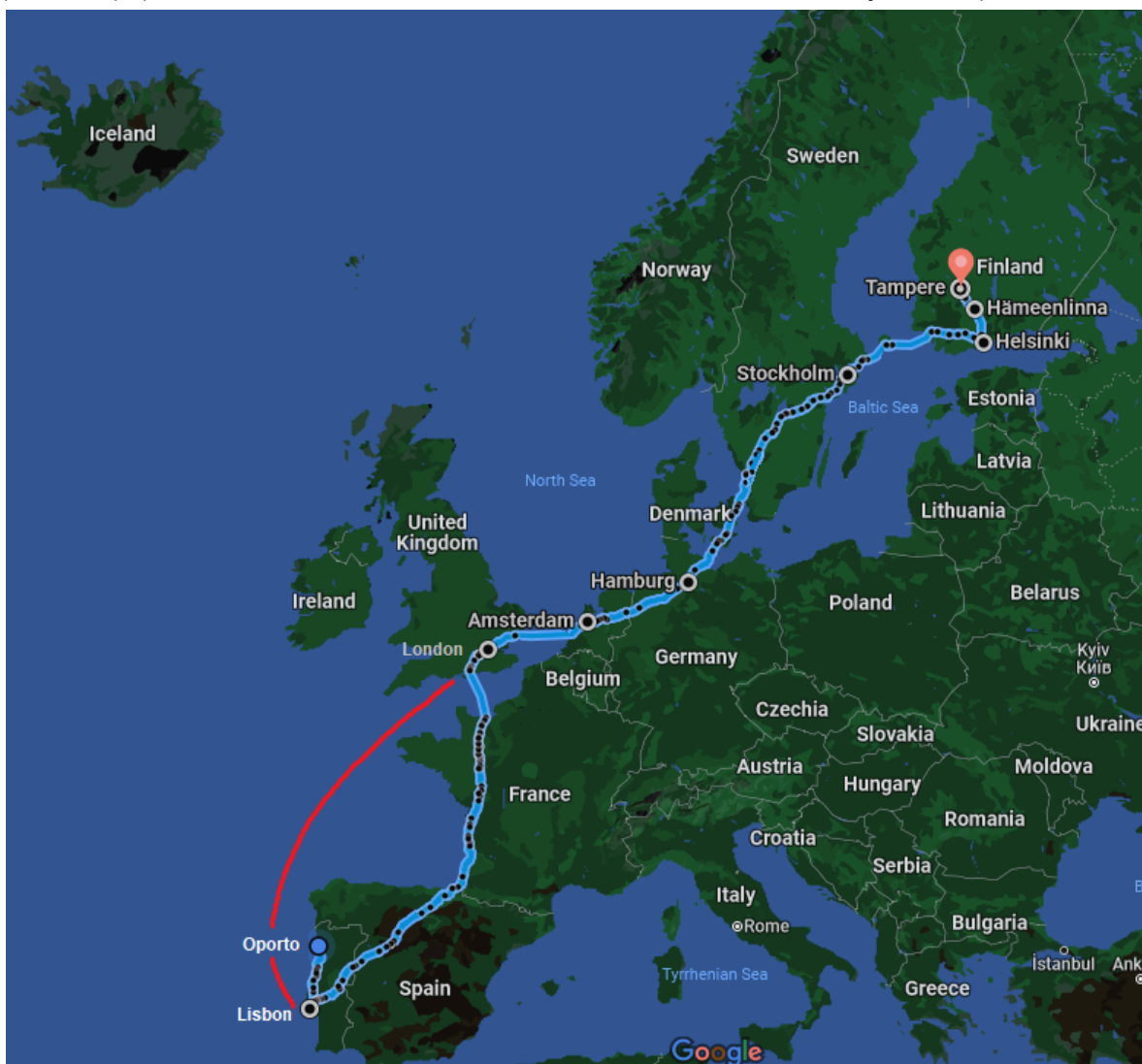
15. tuni.fi

Location: University of Tampere, Tampere, Finland

Our request has reached the server hosting the webpage we wanted!

A small map illustrating the trip that had to be done to fetch the website:

> Merely illustrative, the red line aims to represent the underwater fiber connections that most likely were used (Lisbon-UK). (Not into London, as London isn't connected to Lisbon via underwater fiber cable)





An Alternate Traceroute

Origin: DETI, University of Aveiro

Tracing the path to tuni.fi (130.230.252.63) on TCP port 80 (http), 30 hops max

```
1 192.168.63.253 1.644 ms 2.322 ms 2.006 ms
2 10.1.0.118 2.528 ms 1.528 ms 1.249 ms
3 gt2-vrfineternet-r.core.ua.pt (193.137.173.243) 6.957 ms 3.707 ms 2.678 ms
4 Router41.Porto.fccn.pt (193.136.4.26) 3.645 ms 3.118 ms 3.740 ms
5 Router20.Porto.fccn.pt (194.210.7.108) 8.397 ms 7.733 ms 7.894 ms
6 Router30.Lisboa.fccn.pt (193.136.1.8) 6.834 ms 12.931 ms 8.784 ms
7 Router3.Lisboa.fccn.pt (194.210.6.103) 7.462 ms 6.908 ms 6.712 ms
8 fccn.mx2.lis.pt.geant.net (62.40.124.97) 7.116 ms 6.109 ms 8.919 ms
9 ae4.mx1.mad.es.geant.net (62.40.98.97) 16.754 ms 16.720 ms 15.478 ms
10 ae7.mx1.gen.ch.geant.net (62.40.98.67) 35.563 ms 36.585 ms 37.062 ms
11 ae6.mx1.par.fr.geant.net (62.40.98.183) 46.731 ms 45.820 ms 45.072 ms
12 ae5.mx1.lon2.uk.geant.net (62.40.98.178) 52.049 ms 49.976 ms 50.032 ms
13 ae6.mx1.lon.uk.geant.net (62.40.98.36) 50.526 ms 51.157 ms 51.204 ms
14 nordunet-gw.mx1.lon.uk.geant.net (62.40.124.130) 50.743 ms 52.026 ms
50.587 ms 15 de-ffm.nordu.net (109.105.97.79) 60.702 ms 61.022 ms 63.082 ms
```

From here on, it's the same as the previous trace results, from node 8 to finish.

As we can see, instead of using Altice's infrastructure, we go through:

[ua.pt](#), the internal network of University of Aveiro

[fccn.pt](#), the national IP backbone for portuguese universities

[geant.net](#), the european data network for research/education communities



4. Technology Used

(By Network)



1. Home Network

Equipment: [Technicolor TG789vac v2](#)

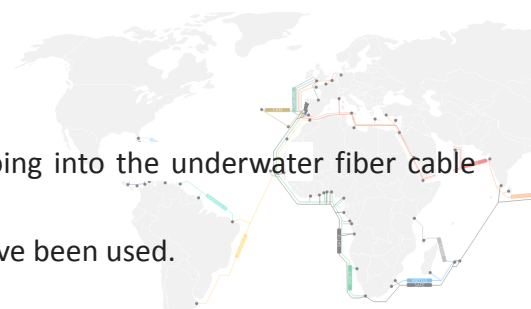
Transport method: 5Ghz Wi-Fi

2. cprm.net

Altice International Backbone⁵

Most likely fiber from Oporto to Lisbon, then going into the underwater fiber cable infrastructure.

One of many possible underwater cables might have been used.



3. nordu.net

Nordic Infrastructure for Research & Education

NORDUnet provides both [optical transport](#) platform is based on the [Ciena 6500 Packet-Optical Platform](#), which is capable of 100Gbps transparent waves and 10Gbps [OTN circuits](#) (used for transport, not for end-users) and a [MPLS Switching Fabric](#) capable of up to 10Gbps, for end-to-end circuits (What's actually used by end-users)⁶

4. funet.net

Finnish University and Research Network

Funet is connected to individual organizations/customers via 1Gbit/s or 10Gbit/s (through the Internet), and is connected to NORDUNet with 220Gbit/s.⁷

5. tut.fi

University of Tampere Network

Tut has a WLAN network that uses mostly 1Gbit/s, with some areas using 100Mbit/s in its internal network, having faster internet and intra-campus connections.⁸

5.Source: [THE SUBMARINE CONNECTIVITY AND THE DATA GATEWAYS](#)

6.Source: [Lambda and Transport Capacity | NORDUnet](#)

7.Source: [Funet – Wikipedia](#) (in Finnish)

8.Source: [FAQ - Networks | Tampere universities](#)



5. What's Involved?

Hops 1-4

Players involved: My own home network/LAN, Internet Service Provider (Altice), Altice's Cable Landing Station (In Lisbon), the exit Cable Landing Station(United Kingdom), Altice International Backbone (CPRM)

Social/Economic implications:

- Altice is the largest Telecom Company in Portugal⁹, a major player in Europe, with a revenue of thousands of billions of euros. As such, and since it owns a large part of the national telecommunication infrastructure (which is essential nowadays), it has a major socioeconomic impact in the national panorama.
- It owns the underwater cables through which the data passes through, which are massive undertakings requiring international cooperation.
- Any data sent through these networks incur in maintenance costs or take up capacity, which translates to costs, which are paid by the consumer via the monthly service fee.

Hop 5

Players involved: Avensys Networks, Altice International Backbone (CPRM).

Hop 6-8

Players involved: NORDUnet (Netherlands, Germany, Finland)

Social/Economic implications:

- NORDUnet is the world's first international and multi-protocol network and started working in 1989, being the first European network to use TCP/IP and connect to an american education network ([NSFNET](#))¹⁰ and to arpanet.
- It was a pioneer in its ip network and was a factor in its success, at a time where the osi protocol was being heavily pushed forward in europe by big players like the European Commission in what became known as the [Protocol Wars](#) (late 1980s-early 1990s). It had an impact still seen today, with the most obvious being the fact that we use the *Internet* and IP is a tool in every computer enthusiast's vocabulary, while only the OSI reference model is still relevant. (NORDUnet, being a multiprotocol network, avoided said Wars, which set other nations back for years)¹⁰.

9. Source: [Altice Portugal - Wikipedia](#)

10. Source: [NORDUnet - Wikipedia](#) and [The History of Nordunet](#)

Further reading: [NORDUNET: THE ROOTS OF NORDIC NETWORKING](#)



Hops 9-13

Players involved: Funet, the Finnish University and Research Network

Social/Economic Implications:

- Yet another early adopter of TCP/IP, its usage started in 1987.
- Funet is very historically relevant due to being the original 'home' of the Linux OS, hosted on a FTP server in 1991¹¹.

Hops 14-15

Players involved: University of Tampere's IT Services and Servers, hosting the website we're requesting.

11.Source: [Brief History of Funet - CSC](#) and [Funet - Suomen tie internetiin - CSC](#) (in Finnish)

6. Behind the Scenes of a Web Session

Since it is a university's homepage, this website has no advertisements. (At least, not in their common banner format) However, via the Network Inspector (F11) we can see it still makes requests to a multitude of trackers.

service.giosg.com	/api/v5/public/trace/	gi...		Blocked By uBlock Origin
service.giosg.com	/api/v5/public/trace/	gi...		Blocked By uBlock Origin
www.tuni.fi	[...ur_alias]-b1d126a2e9e	s...	js	cached
service.giosg.com	/api/v5/public/trace/	gi...		Blocked By uBlock Origin

Being a technology fan, I of course can see the value that modern tools have. Making use of widely collected user data, via these trackers, does have many beneficial uses.

Ranking search results based on what a sophisticated algorithm thinks will interest you most seems like a no-brainer in utility for the user, and showing advertisements that actually cater to the user seeing it has great value in the eyes of those looking to sell you something.

However, some of those uses can range from questionable to outright unethical. When a tech giant can know us, as a person, along with our desires, and based on data collected from millions of people like us create perfectly crafted ads and suggestions that target us in way we can't even understand, we better hope this power is only used to get us to purchase things and not influence our most precious beliefs or manipulate their users into thinking a certain way, without them ever noticing.

So, I think this might be a hornet's nest better left undisturbed, since the costs of unbridled, limitless manipulation, in my opinion, vastly outweigh the utility it might offer.

Getting someone to find their new favourite coffee flavour is not worth risking stable democracies over.

(Some targeting might be desirable, it's not an all-or-nothing situation.)



7. References

Os números correspondem às notas presentes no texto.

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8. Useful Links

[Tampereen yliopisto](#) -> our target website

[ASN/IP Whois Query | IPIP.NET](#) -> tool for hop identification

[LookIP.net](#) -> tool for hop identification

<http://lookingglass.nordu.net/lg.cgi> -> tool for hop identification

<http://ftp.funet.fi/> -> Where the original versions of Linux reside

[NORDUNET: THE ROOTS OF NORDIC NETWORKING](#) -> For more reading on NORDUnet's history