Computer Networks Assignment - I

Visualising Internet Topology

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1 About Internet Topology

The internet is described as network of networks. It connects countless devices across the world. The study of the blueprint that gives an outline of how these devices are connected to each other is known as **"The internet topology"**.

The end systems like mobiles, laptops, desktops, IoT devices etc connect themselves to Internet through Access ISPs. **Autonomous System Number (ASN)** is a globally unique identifier that defines a group of one or more IP prefixes run by one or more network operators.

AS numbers can be both Private or Public. The Private numbers mostly cannot be traced using trace route, it will just show some hops with no information (as ***) or the hops will simply not appear. The ISP drops private address sourced packet within the internet. There are four categories of ASPs:

1. **multihomed**: An AS that maintains connects more than one other as to remain connected to the internet in the event of a complete failure of one of their connections. (For example IITH)
2. **stub**: Connected to only one another AS.
3. **transit**: An AS that acts as an AS between two ASes.
4. **IXP**: Acronym for Internet Exchange Point, it is a physical infrastructure through which ISPs or CDNs exchange the internet traffic between their networks.

Content Providing networks or Content Delivery Networks are specialised systems which are designed to distribute and deliver content. They operate (or edge servers). They can safely be called as **caches** of web content on the edge servers. They store the copies of web content on the edge servers, so that latency and improve load times. Some of the pioneers in CDN industry are:

- **Akamai Technologies**
- **Cloudflare**
- **Streaming and E-commerce Websites**

And finally, **Cloud Services** are seamlessly integrated into the internet ecosystem. These services are hosted in data centres that are spread across various locations. The internet is medium through which users connect to these data centres and utilise the services they offer.

- **Amazon Web Services (AWS)**
- **Google Workspace (formerly G-Suite)**
- **Microsoft Azure**
- **Cloudflare** (yes, it is both CDN and Cloud Service Provider)

2 About the deliverable

The map we designed showcases the internet topology for a network consisting of 5 host devices and 11 destinations. We used the domain logos to denote the end points of transmission and laptop icons to denote the host devices (the starting points of transmission). We also used appropriate icons for indicating routers and data centres. Additionally, we colour-coded the pathways taken for each of the 11 destinations for easier visual comprehension.

We utilised the trace route and looking glass tools to gather the essential details needed for constructing the map. These tools allowed us to trace the path that data takes from the source (host devices) to the destination (websites or online services). By analysing the network hops and the routers involved, we tried to capture the internet pathway as accurately as possible.

We first tried to look for a software that can generate a directed graph from an $\mathtt{n} \times \mathtt{n}$ matrix (Where n represents the total number of internet devices i.e., the sum of number routers, hosts, end points, data centres). Since we were not able to find such a software that can visualise the data the way we wanted, we designed the map manually using a graphic design tool called Canva. We hope that the map serves as a reliable representation of the internet topology for the given network configuration.

Utilities:

- **Cogent Looking Glass** : For performing traceroute from Paris, Hong Kong and Toronto.
- **Canva**: For designing the map.
- **Teminal command** `traceroute`: For performing traceroute from IITH LAN and Mobile Hotspot.
- **Terminal command** `whois`: For finding net range and organisation names for the IP addresses encountered.

For the scripts used, refer to the scripts.txt file we submitted.
For the visualisation image, refer to the visualisation.pdf (for higher picture quality) or visualisation.jpg (for jpg format of the same).