

6.4_B

Answers: Suggested divisions

Planning networks for the future

Paragraph 1 – Network planning basics

- network throughput – volume of data transferred from source to destination over a specific period – very important in planning network
- factors: bandwidth – width of (data) pipe (Mbps): narrower = less data, wider = more
- latency – delay in time for data/packet to move from origin to destination: small delays = low latency, long delays = high latency

Paragraph 2 – Global and local networking infrastructure

- available bandwidth varies across world: domestic fibre = rapid growth, wireless broadband = limited growth
- international and internal connections dependent on size of cables or of radio signals
- fibre-optic cables most efficient transmission; in the sea connecting continents – continuing to create links between continents and countries

Paragraph 3 – Challenges in global networking

- 2010 onwards, huge growth in video content – ‘video on demand’ services – large amounts of data needs to be transferred
- 2020s rapid demand for synchronous communication: distance working + conference calls – connection quality a key issue – latency >300 ms = problems for VoIP, e.g., overlapping voices, delay hearing voice, long echoes
- team-gaming emerging as growth area – data throughput – but low latency key

Paragraph 4 – CDNs as a solution for content

- content delivery network (CDN) – geographically distributed servers – minimizing latency
- content on servers in different global regions (points of presence (PoPs)) – close to major markets – requests directed to region with lowest latency
- regularly requested content can be included in CDN with less regular content elsewhere

Paragraph 5 – Future developments

- continuing need for ‘always on’ networking – combines wired and wireless – need for increased bandwidth and lower latency
- 5G wireless networking: provides very flexible access for users, 10 times faster than existing 4G networks, great potential, content delivery, but also synchronous interaction
- 5G ideally linked by fibre-optic backbone, but some microwave connections if fibre too difficult or costly

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Answers: Model paragraph

Planning networks for the future

A number of things need to be considered when planning networks. One of the most important is the network throughput. This is the volume of data which is transferred from a network source to a network destination over a specific period of time. Network throughput is affected by a number of factors. A key factor is the bandwidth of the network. This is often referred to as the width of the data pipe and it is measured in megabits per second (Mbps). A narrower pipe means that less data is transferred, while a wider pipe means more data is transferred. Another factor is network latency. This is the time that it takes for packets of data to move from the network origin to the network destination. If the network has low latency, then there are only small delays in transferring the data. If it has higher latency, then there will be longer delays.

The amount of available bandwidth varies considerably across the world. In countries where fibre-optic cable is available in people's homes then there will be a rapid growth in the available bandwidth. However, where the population relies on wireless broadband, there is a much more limited growth of available bandwidth. The amount of available bandwidth in internet connections between countries depends on the size of the cables or the capacity of the radio signals which connect them. Fibre-optic cables are the most efficient methods of data transmission. They can be used in the sea to create links between continents. Cables continue to be laid, creating new links and increasing existing capacity between continents and countries.

The demand for network capacity continues to grow. From 2010 onwards, there was a huge growth in the amount of video content on the networks. 'Video on demand' services meant that large amounts of data needed to be transferred between suppliers and their customers. During the early 2020s, there was a rapid increase in the demand for synchronous communication. This was due to the growth in distance working and in the number of conference calls being made. Connection quality now became a key issue. When network latency was >300 ms this created problems for VoIP (voice over internet protocol), such as overlapping voices, delays in hearing voices and long echoes. Team-gaming in e-sports is emerging as another area where the demand for network capacity is growing. E-sports requires relatively high amounts of data throughput. However, networks with low latency are essential, as milliseconds can make a difference between winning and losing.

One solution to the need for greater network capacity and lower latency was to develop CDNs (content delivery networks). These located network servers in different parts of the world to make the data closer to where it was needed. These geographically-distributed servers minimized network latency. Content was made available in different global regions and local points of presence (PoPs) were created close to major markets. By doing this, requests for data could be directed to the region with the lowest latency. Another feature of CDNs was that only content which was regularly requested would be included on the CDN. Less frequently used data could be made available from a central point.

As networks develop into the future, there are a number of factors to consider. One of these is the continuing need for 'always on' networking. This can be achieved by combining wired and wireless connections which provide increased bandwidth and lower latency. Another factor is the emergence of 5G wireless technology which can provide access for users which is flexible and up to ten times faster than existing 4G networks. These networks have great potential for content delivery and also for synchronous interaction due to their low latency. For best results, 5G should be linked by a fibre-optic backbone. However, if fibre connections are too difficult or costly, then microwave connections can be used instead.