Question 2

22 marks

A streaming service provides live broadcasts of major sporting events to a global audience. Viewers expect high-quality video and minimal interruptions across various devices.

a) Network Transmission Concepts: (8 marks) Explain the significance of latency and jitter in the context of live video streaming. Describe how each of these network transmission concepts can negatively impact the user experience during a sporting event broadcast, providing specific examples.

b) Quality of Service (QoS) Implementation: (7 marks) Describe two distinct mechanisms a streaming service could implement to provide a Quality of Service (QoS) guarantee for live video streams, ensuring a smooth and timely delivery of content to users.

c) Streaming Protocol Recommendation: (7 marks) Recommend a suitable streaming protocol for delivering high-quality, adaptive live video to a wide range of user devices. Justify your choice by detailing its key features that support this use case.

Marking Guide – Question 2

Part A

Marks	Criteria	Evidence of achievement
1	Defines latency	States latency is the time delay between sending and receiving data over the network.
1	Explains latency impact	Describes how latency causes delays in live streaming, e.g. broadcast lag.
1	Provides latency example	Gives example such as viewers seeing goals several seconds after they occur.
1	Defines jitter	States jitter is the variation in packet arrival times across the network.
1	Explains jitter impact	Describes how jitter causes uneven playback or frame drops.
1	Provides jitter example	Gives example such as video stuttering or freezing during key sporting moments.
1	Contextualises impact	Links latency and jitter to negative user experience in live sport (loss of immersion).
1	Comprehensive explanation	Integrates both concepts, showing clear significance to real-time streaming.

Sample Response

Latency is the delay between sending data from the server and the viewer receiving it. In live sports streaming, high latency means the broadcast lags behind the actual event. For example, a goal in soccer may be seen several seconds late compared to real time, reducing the sense of immediacy and causing spoilers if viewers receive live updates elsewhere.

Jitter is the variation in packet arrival times across the network. Inconsistent delivery leads to uneven playback, such as frames dropping or the video freezing momentarily. For example, during a tennis rally, jitter may cause stuttering, making the action difficult to follow. Both latency and jitter disrupt the real-time nature of sports streaming, damaging viewer engagement.

Part B

Marks	Criteria	Evidence of achievement
1	Identifies first QoS mechanism	Names a mechanism such as traffic prioritisation or bandwidth reservation.
1	Explains function of mechanism	Describes how it ensures timely packet delivery for video streams.
1	Provides example in streaming	Applies mechanism to live sports context (e.g. prioritising video packets).
1	Identifies second QoS mechanism	Names another mechanism such as buffering, CDN use, or error correction.
1	Explains function of mechanism	Describes how it improves reliability or reduces disruption.
1	Provides example in streaming	Applies second mechanism to live sports (e.g. CDN distributing load globally).
1	Clear link to QoS guarantee	Explains how combined mechanisms ensure smooth, timely content delivery.

Sample Response

One mechanism is traffic prioritisation, where video packets are given higher priority over less time-sensitive traffic. This ensures streaming data moves smoothly through the network, reducing buffering during live matches.

A second mechanism is the use of a Content Delivery Network (CDN). CDNs distribute content across servers located around the world, reducing congestion and ensuring that viewers receive data from a nearby server. This lowers latency and balances load during high-demand events such as the World Cup. Together, these mechanisms improve reliability, timeliness, and overall viewing quality.

Part C

Marks	Criteria	Evidence of achievement
1	Identifies a suitable protocol	Names a protocol such as HLS, MPEG-DASH, RTMP, or WebRTC.
1	Justifies suitability	States protocol supports adaptive bitrate streaming.
1	Explains device compatibility	Notes wide support across devices (e.g. phones, TVs).
1	Explains reliability feature	Describes how protocol maintains stream quality despite network variation.
1	Explains scalability	States protocol supports large global audiences efficiently.
1	Provides example in context	Applies features to sports streaming, e.g. HLS adapts to mobile users' network speed.
1	Comprehensive justification	Integrates multiple features, strongly linking choice to global live sports use case.

Sample Response

The most suitable protocol is HTTP Live Streaming (HLS). HLS supports adaptive bitrate streaming, allowing the video quality to adjust automatically to a user's network conditions. This means viewers on mobile phones with weaker connections still receive uninterrupted playback, while those on high-speed connections enjoy high-definition video.

HLS is widely supported across devices, including smartphones, tablets, smart TVs, and desktop browsers, making it ideal for a global audience. It is also highly scalable, as it uses standard HTTP servers and CDNs to deliver content to millions of concurrent viewers. In a sporting context, HLS ensures fans can watch a smooth, high-quality broadcast regardless of their device or internet connection.