

READING PASSAGE 2

From Latency to Legend: The Engineering Behind Competitive Multiplayer Games

An examination of the technical infrastructure underpinning modern online gaming

A When a player squeezes the trigger in a game of Counter-Strike: Global Offensive, a cascade of computational events unfolds in milliseconds. A packet leaves the player's machine, traverses the public internet, arrives at a dedicated server, is processed alongside packets from up to nine other players, and a response is dispatched — all before a human being could blink. That this experience feels seamless to tens of millions of daily players is not accidental. It is the product of decades of systems engineering, protocol design, and infrastructure investment that quietly underpins the modern gaming industry.

B The dominant metric in competitive gaming infrastructure is latency — typically measured as round-trip time (RTT), colloquially called "ping". In casual play, latencies below 100 milliseconds are generally acceptable; at the professional tier, engineers strive to maintain RTTs beneath 20 ms. This matters because the *client-side prediction* model, employed by engines such as Valve's Source engine, advances the game simulation locally on each player's machine between server updates. When the server's authoritative state diverges from a client's predicted state — a condition known as a *misprediction* — the engine performs a *reconciliation*, snapping visible positions back to the server's version. At high latencies, these reconciliations become perceptible and frustrating; at low latencies, they remain invisible.

C Managing latency at scale requires careful attention to network topology. Valve's CS:GO infrastructure, for instance, relied for many years on third-party server providers before migrating progressively to Valve's own data centres. The company operates regional clusters across North America, Europe, Asia, and South America, routing players to the geographically nearest server via anycast DNS. However, geographic proximity does not guarantee low latency; internet routing is governed by BGP (Border Gateway Protocol), a decades-old system that optimises for policy and reliability rather than speed. Packets between two cities in the same country can take circuitous routes through distant exchanges, adding tens of milliseconds that geography alone does not predict.

D A further layer of complexity arises from the tick rate — the frequency at which a game server processes the world state and dispatches updates. CS:GO's official matchmaking servers historically operated at 64 ticks per second, meaning the server sampled player inputs and resolved collisions 64 times each second. Third-party platforms such as FACEIT and ESEA offered 128-tick servers, arguing this halved the maximum positional error between samples and improved the fidelity of hit registration. Valve's successor title, CS2, introduced a system called *sub-tick architecture*, in which events such as shots fired or jumps initiated are timestamped at the precise moment they occur rather than at the next tick boundary. This architectural change effectively

decoupled hit registration accuracy from tick rate, addressing a long-standing grievance of the competitive community.

E Anti-cheat represents a parallel technical battleground. In CS:GO, Valve's proprietary system, VAC (Valve Anti-Cheat), operated primarily as a signature-based scanner running on the client machine, identifying known cheat binaries. Critics consistently noted that VAC was reactive rather than preventive — capable of banning a cheat only after its signature had been catalogued. CS2 introduced VAC Live, an always-on system that incorporates behavioural heuristics and, controversially, kernel-level access. Kernel-mode anti-cheat grants the software visibility into the lowest layers of the operating system, allowing it to detect cheats that deliberately evade user-space scanning. The trade-off is significant: kernel-level software runs with elevated privileges that, if compromised, could expose the player's entire machine. This tension between security efficacy and user risk remains an active and unresolved debate within the systems security community.

F The spectator infrastructure surrounding competitive gaming presents its own engineering challenges. Broadcast pipelines for tournaments such as the CS:GO Major Championships must deliver low-latency video to production studios while simultaneously serving delayed streams to viewers — a deliberate offset designed to prevent the use of stream data to gain competitive intelligence, a practice known as *stream sniping*. The production delay is typically 90 to 150 seconds. Underneath this, game-state data is transmitted in real time to overlay systems that render statistics, grenade trajectories, and player health in broadcast graphics. Synchronising these data streams with the video feed requires precision timestamping and careful buffer management, work that falls squarely within the domain of distributed systems engineering.

G Looking ahead, the proliferation of cloud gaming services introduces a structural inversion of the traditional model. Whereas conventional gaming places the simulation on the player's local hardware and uses the network only for state synchronisation, cloud gaming moves the entire simulation to a remote data centre and transmits only compressed video frames to the client. For genres tolerant of 50–100 ms of additional latency — strategy games, narrative adventures — this model is viable. For sub-20 ms genres such as tactical shooters, the physics of light propagation impose a hard ceiling: at the speed of light in fibre-optic cable (roughly 200,000 km/s), a round trip of 3,000 kilometres incurs at minimum 30 ms of latency before any processing, encoding, or queuing delays are added. Until data centres are geographically closer to players than today's infrastructure allows, cloud gaming for competitive shooters remains, in the view of most network engineers, a theoretical rather than practical proposition.

True / False / Not Given

Questions 1–5

Do the following statements agree with the information in the reading passage? Circle or tick your choice.

QUESTION 1

Professional-level gaming infrastructure targets a round-trip latency below 20 milliseconds.

TRUE

FALSE

NOT GIVEN

QUESTION 2

Valve's anti-cheat system, VAC, was primarily designed to prevent cheats before they could be used.

TRUE

FALSE

NOT GIVEN

QUESTION 3

Geographic proximity between a player and a server always guarantees low latency.

TRUE

FALSE

NOT GIVEN

QUESTION 4

FACEIT and ESEA charged higher subscription fees than Valve's official matchmaking service.

TRUE

FALSE

NOT GIVEN

QUESTION 5

Cloud gaming is considered a practical solution for competitive tactical shooters by most network engineers.

TRUE

FALSE

NOT GIVEN

Multiple Choice

Questions 6–9

Choose the best answer, A, B, C, or D.

QUESTION 6

What is a *misprediction* in the context of client-side prediction?

- A** A failure of the server to process player inputs within a single tick
- B** A divergence between the client's locally predicted state and the server's authoritative state
- C** A packet that is lost in transit between the client and the server
- D** An error in the game engine's collision-detection algorithm

QUESTION 7

Why does Valve's CS2 sub-tick architecture improve hit registration accuracy?

- A It doubles the server tick rate from 64 to 128 ticks per second
- B It moves game simulation entirely to the client's local hardware
- C It timestamps events at the exact moment they occur, decoupling accuracy from tick rate
- D It compresses network packets to reduce round-trip latency

QUESTION 8

What is the main risk associated with kernel-level anti-cheat software?

- A It significantly increases game latency for all players
- B It can only detect cheats that have already been catalogued by signature
- C If compromised, it could expose the entire player's machine due to its elevated privileges
- D It prevents third-party applications from running alongside the game

QUESTION 9

Why is a production delay applied to spectator streams at major tournaments?

- A To allow broadcast engineers time to add overlay graphics and commentary
- B To prevent players from using the stream to gain real-time competitive intelligence
- C To synchronise the video feed with statistical data overlays
- D To comply with broadcast licensing requirements in different regions

Sentence Completion

Questions 10–11

Complete the sentences below. Use **NO MORE THAN TWO WORDS** from the passage for each answer.

10. Valve routes players to the nearest server using _____, though internet routing via BGP does not always guarantee the shortest physical path.

11. In cloud gaming, rather than synchronising game state across the network, only compressed _____ are transmitted to the player's device.

Matching Information

Questions 12–14

The reading passage has seven paragraphs labelled A–G. Which paragraph contains the following information? Circle the correct letter A–G next to each question.

QUESTION 12

The engineering challenge of synchronising real-time game data with video for live broadcast.

A	B	C	D	E	F	G
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QUESTION 13

Why cloud gaming faces fundamental physical constraints for fast-paced competitive genres.

A	B	C	D	E	F	G
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QUESTION 14

How the interval between server processing cycles affects the accuracy of in-game events.

A	B	C	D	E	F	G
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ANSWER KEY

For teacher / self-study use. Fold or detach before distributing to students.

Q	Answer	Para	Explanation
1	TRUE	B	Engineers strive to maintain RTTs beneath 20 ms at the professional tier.
2	FALSE	E	VAC was reactive, not preventive; it could only ban cheats after their signatures were catalogued.
3	FALSE	C	The passage explicitly states proximity does not guarantee low latency due to BGP routing.
4	NOT GIVEN	D	Tick-rate differences are discussed but pricing is never mentioned.
5	FALSE	G	Most network engineers describe cloud gaming for competitive shooters as theoretical, not practical.
6	B	B	A divergence between the client's predicted state and the server's authoritative state.
7	C	D	Events are timestamped precisely when they occur, decoupling accuracy from tick rate.
8	C	E	Elevated kernel privileges could expose the player's machine if compromised.
9	B	F	The delay prevents stream sniping — using a live stream to gain competitive intelligence.
10	anycast DNS	C	Accept 'anycast DNS' only. BGP is what does not guarantee speed.
11	video frames	G	Accept 'video frames' only.
12	F	F	Broadcast pipelines, timestamping, and buffer management for synchronisation.
13	G	G	Speed-of-light constraints; min. 30 ms for a 3,000 km round trip before processing.
14	D	D	Tick rate, positional sampling error, and the sub-tick architectural solution.

Approximate IELTS Band Equivalence (14 questions)

Score	14	13	12	11	10–9	8–7	6–5	≤4
Band	9.0	8.5	8.0	7.5	7.0–6.5	6.0–5.5	5.0	<5.0