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# Mobile cloud gaming – an evolving business opportunity

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Communications service providers and gaming companies are seizing the business opportunities created by devoted gamers' requirements for a consistent and lag-free mobile gaming experience.

The first game streaming services were launched a few years ago. Initially, they were targeted towards console and PC gamers. Today, new opportunities to expand the mobile gaming market and further develop the gaming experience are emerging, with 5G networks and cloud gaming services becoming increasingly accessible on smartphones and tablets. The combined capabilities provided by 5G networks and edge compute technologies will enable game streaming services on smartphones with a quality of experience (QoE) on a par with PC or console, and also open up for innovative, immersive mobile games based on mobility.

## Smartphones dwarf console sales

Although the mobile cloud gaming market is still in its infancy, the wider mobile games market is already large. There are presently more than 2.4 billion mobile gamers globally, where Asia is the biggest market with over USD 41 billion in revenue.<sup>1</sup> Mobile games generate about 50 percent of total global gaming industry revenues.<sup>2</sup> In 2019, 33 percent of all app downloads worldwide were related to mobile games, accounting for 74 percent of all consumer expenditure at the 2 major digital distribution platforms for the Android and iOS operating systems.<sup>3</sup>

Annual volumes of current-generation video game consoles have been 40–50 million units worldwide over the last 3 years. In comparison, over the same time period incremental 4G subscriptions have averaged 685 million. Furthermore, the number of 5G smartphone users is forecast to increase from about 200 million in 2020 to over 3 billion by the end of 2026. The strong growth in smartphone users and the evolving capabilities of 4G and 5G networks open a much larger addressable market for new gaming services.

Market drivers for mobile game streaming services include:

- continued strong growth of smartphone users
- imminent deployment of 5G networks, with high user data rates, network capacity and emerging time-critical communications, or ultra-reliable low-latency communication (URLLC)
- increase of cloud data centers with large compute and storage resources (central, edge)
- increasing partnerships between communications service providers, edge cloud providers and cloud gaming service providers
- new cloud gaming services launched by new and incumbent (console) gaming service providers
- communications service providers launching their own services
- future development of new types of devices, based on AR, VR and XR

## Mobile cloud gaming services from 5G communications service providers rising

Out of 106 communications service providers that have launched commercial 5G service offerings,<sup>4</sup> 22 have announced the availability of mobile cloud gaming services on a separate subscription basis, or as a service bundled with a premium 5G data plan. The majority of offerings, from 19 communications service providers, are subscriptions to a gaming service in partnership with a cloud gaming provider. The number of games included typically ranges from 30 to more than 100. Depending on the gaming service provider, monthly subscription fees typically range from USD 6–18. In addition, a few communications service providers include zero-rating for gaming<sup>5</sup> on some of their premium data plans. Games included in present service catalogs, occasionally marketed as a 5G cloud gaming offer, range from casual games to more complex multiplayer games. Many games presently included can be played over a 4G network and do not require 5G for a good gaming experience. However, immersive games are better experienced over 5G, as these demand higher bandwidths and lower (predictable) latency. An important objective for partnerships between communications service providers and cloud gaming providers is to explore how both 5G and 4G networks need to be managed and optimized to support high QoE.

<sup>1</sup> www.statista.com

<sup>2</sup> www.dotcominfoway.com

<sup>3</sup> App Annie, "The state of mobile 2019".

<sup>4</sup> Ericsson analysis, October 2020.

<sup>5</sup> Traffic generated by the gaming service does not count against the subscriber's monthly data plan.

**Streaming games popular among 5G subscribers in South Korea**

An interesting example of an evolving gaming market is South Korea. It is ranked the fourth largest mobile gaming market after the US, China and Japan, and has a strong gaming culture, with professional gamers dominating in international esports competitions. With smartphone penetration among the highest in the world, smartphones have become the most popular gaming device. According to a 2020 Korean game user report,<sup>6</sup> over 88 percent of mobile gamers play games at least 2–3 days per week, whereas 44 percent play every day. The average time of playing mobile games is 96 minutes per day on weekdays, and 121 minutes per day on weekends. The three main South Korean communications service providers have teamed up with major international gaming service providers, offering subscription-based mobile cloud game streaming services. For two of these subscriptions, it is not necessary to be a mobile subscriber to the specific communications service provider. All three communications service providers also provide access to their own portfolio of streaming and downloadable games,

including streaming VR (through goggles connected to smartphones) and downloadable AR versions, on their own developed platforms. These are free of charge for 5G premium plan subscribers. According to SK Telecom,<sup>7</sup> 5G subscribers are using game apps 2.7 times more often than 4G subscribers. To play games on SK Telecom’s own developed cloud gaming platform, 55 percent of smartphone gamers use Wi-Fi and 45 percent cellular connectivity.

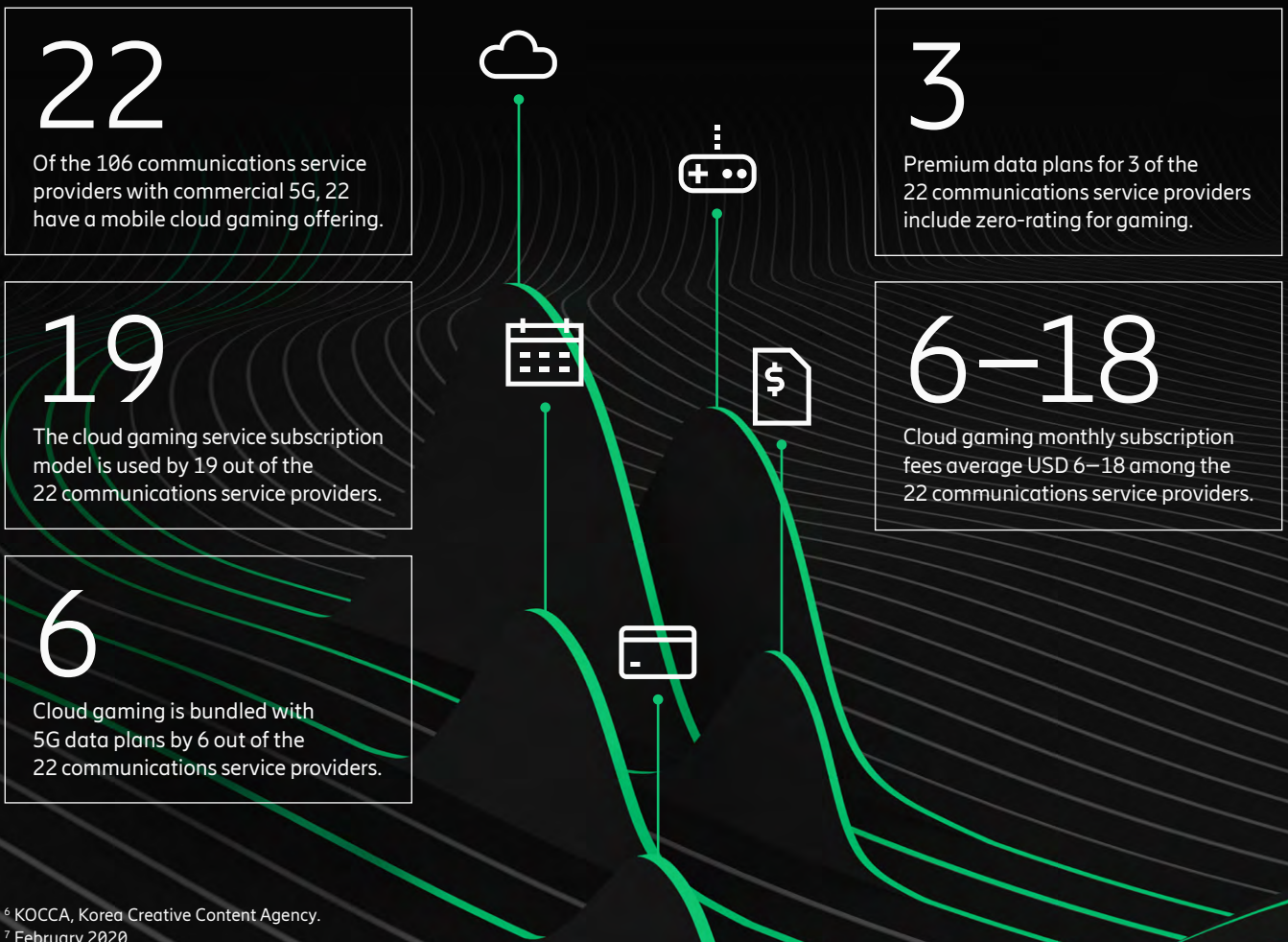
**The cloud gaming subscription model rules**

Today, mobile gaming is dominated by casual gamers, but new segments will be addressable as premium games with high-quality experience become accessible from game publishers and communications service providers, without the need for dedicated and expensive hardware or PCs. One market challenge is to convert casual players to paying subscriptions for gaming services. Subscription-based business models for digital audio and video streaming services have disrupted those industries, with millions of people willing to pay a monthly fee without becoming owners of DVDs or CDs. For the streaming

service provider, it brings predictability in revenues and cash flow. Through digital customer interaction and engagement, the improved customer understanding lets them tailor their offerings per individual subscriber rather than for customer segments. Many gaming service providers are now including a subscription-based business model in their gaming portfolios.

Agreements between communications service providers and gaming service providers vary by market, depending on the scope of collaboration. For example, a communications service provider may have an own-branded game offering, based on a white-label solution from a cloud gaming service provider, or have marketing- and channel-partnership agreements. These agreements may include revenue sharing, but other important business drivers are new customer acquisition and retention, and a differentiating value proposition to entice subscriber migration to 5G. There are also different approaches among communications service providers with own-branded game services; some offer exclusivity to loyal subscribers, while others are open to all mobile users in the market.

Figure 24: Mobile cloud gaming among 106 5G service providers



<sup>6</sup> KOCCA, Korea Creative Content Agency.  
<sup>7</sup> February 2020.

### Advanced gaming performance requirements open up new business opportunities

Advanced gaming use cases with strong network performance requirements will drive a need for premium connectivity and edge computing capabilities. These capabilities could be offered by communications service providers directly to gaming providers, via or jointly with partners. However, this will also require new types of partnerships to jointly address future mobile gaming use case opportunities. Gaming ecosystem partnerships require high flexibility to cater for cost-efficient cooperation, in parallel with a multitude of different gaming partners, all having different requirements and interests.

### Higher network performance requirements as game complexity increases

A large part of total cloud gaming traffic is expected to be transported over fixed networks, as is the case for streaming video. However, 5G mobile and fixed wireless access (FWA) networks are also expected to carry a significant amount of future cloud gaming traffic. To stimulate uptake of cloud gaming services, games service providers would have to adapt to the capability of the mobile network and devices, while maintaining the QoE. This implies that a 4K resolution, real-time video game, streamed over a fixed network connection to a large screen, could be downsized to a 720p video gaming stream over a mobile network, without distorting the QoE for most games played on a smartphone. Streaming games consumes several times more data than a video stream of equivalent quality. This is due to the need for faster video encoding, which helps maintain the required low latency during gameplay, but with a higher data rate. Some cloud-based gaming platform providers recommend 10Mbps reliable downlink throughput as the minimum for current games to be played over a mobile network for a good QoE on a smartphone.

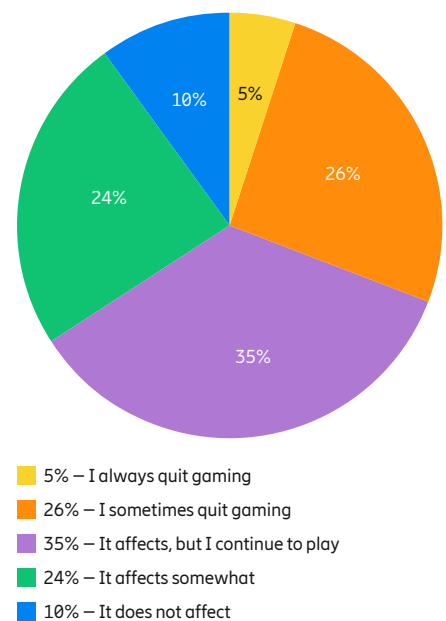
However, other cloud gaming platforms stream fast-paced games with complex graphics that require an average of 15Mbps throughput with peaks of 25Mbps or more. As games become faster and more complex, even lower network latency and higher bandwidth will be required. More time-critical cloud gaming use cases, such as first-person shooter games and fast multiplayer interactions, will require 20–30ms end-to-end network latency, with around 99.9 percent likelihood (reliability) in both uplink and downlink, for a quality experience. For an immersive VR gaming experience, the latency and reliability requirements are even more demanding.

### QoE can be game-changing

Different game genres have different data rates, latency and reliability requirements on mobile networks. A fast-moving, first-person shooter game requires high reliability, low latency (time-critical) communications, compared to a slow-moving strategy game that works well with the best-effort latency typically required for mobile broadband services. Depending on the game genre, there are different expectations for QoE. Higher frame rate versus resolution is typically preferred for first- and third-person shooters, while high resolution is preferred over frame rate for fantasy games not requiring fast reaction times.

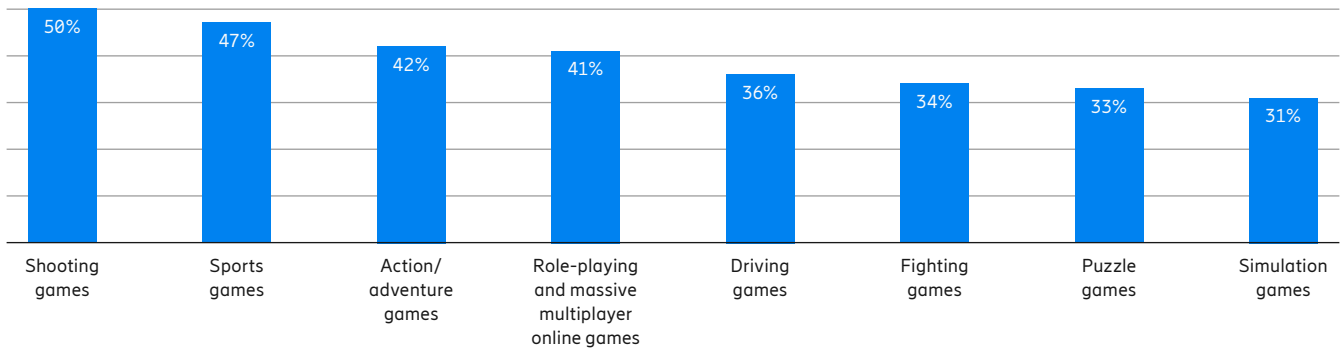
Considering the natural variation in radio channel quality, game video streaming must be adapted to changes in radio network conditions, mobility (handovers), buffering and more to ensure a good QoE for different game categories. In the case of video streaming, data is buffered in the game client to allow for connectivity variation. But for game streaming, the latency between game input and view is important and does not allow for client buffering. Game streaming services can have adaptable qualities, but without large media buffers, unstable network connectivity will impact QoE. The latency requirement for a specific gaming service is dependent on several factors, such as game genre, personal skills and delay acceptance.

Figure 25: Gamers' reaction to gaming lag (network latency)



Source: Ericsson ConsumerLab (2019).  
Base: At-least-weekly gamers aged 15–69 in Brazil, China, France, Japan, South Korea, the UK and the US (7,000 respondents).

Figure 26: Share of gamers experiencing gaming lag (network latency) by game genre



Source: Ericsson ConsumerLab (2019).

Base: At-least-weekly gamers aged 15–69 in Brazil, China, France, Japan, South Korea, the UK and the US (7,000 respondents).

Lag (network latency) is one of the most common issues when playing online games and has a strong impact on the level of satisfaction with the gaming experience. In a ConsumerLab study, based on an online survey with 7,000 consumers, 90 percent of those who play video games at least weekly were negatively affected by lag when playing, with at least 1 in 3 sometimes quitting as a result. Gamers' perceived experience of lag depends on the type of game played; those requiring fast responses experience lag more often in comparison to other genres.

### 5G will enable next-level gaming

Just like video streaming, service providers are developing original content for their subscribers. Cloud gaming providers could be expected to develop "5G original" cloud streaming games, adapted to the specifics of mobile devices (for example, small screens and limited input options), but also to the surrounding environment where a mobile gamer is situated when playing (new types of VR, AR games). By utilizing the full range of sensors on a mobile device, such as the camera, light sensors, GPS, accelerometer and sound, it could sense the environment and contextualize it to adaptively generate new game content, enriching the gaming experience.

New games and gaming platform requirements are becoming more demanding, and solutions that work for regular video streaming are not enough for advanced gaming use cases. As networks evolve to 5G, time-critical communications will take cloud gaming to the next level. Time-critical communications aims for data delivery within a specified latency budget with a required guarantee; for example, 50ms network latency with 99.9 percent reliability. It is fundamentally different from mobile broadband, which maximizes data rates without any guarantee on latency.

Communications service providers can add support for time-critical communications to the 5G NR carriers through software upgrades. The slicing framework in 5G networks can reserve dedicated resources for gaming by configuring and connecting computing and networking resources across the radio, transport and core networks. As networks evolve towards more cloud native design, with better flexibility in placement and deployment of network functions (NFs), parts of the game workloads can be collocated with the NFs to ensure gaming performance requirements are met.

The time-critical communications ecosystem is starting to develop from 2021 with end-to-end network slicing and edge computing. Major functionality growth for time-critical communications is expected over standalone 5G networks beyond 2021.

Cloud gaming represents the full potential of 5G for both consumers and businesses – gamers benefit from enriched experiences, including lighter and more affordable gaming devices, a longer battery life and new immersive gaming experiences, while communications service providers get a wide range of new business opportunities.

Major functionalities for realizing time-critical communications/URLLC in the radio access network include:

- network slicing
- high-reliability link adaptation and scheduling
- uplink configured grant
- RAN rate recommendation
- multiple transmission and reception points
- redundant transmissions
- robust signal transmission formats
- QoS-aware admission and load control
- instant preemption and prioritization mechanisms
- conditional handovers
- dual active protocol stack
- rapid retransmission protocols
- slot aggregation

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