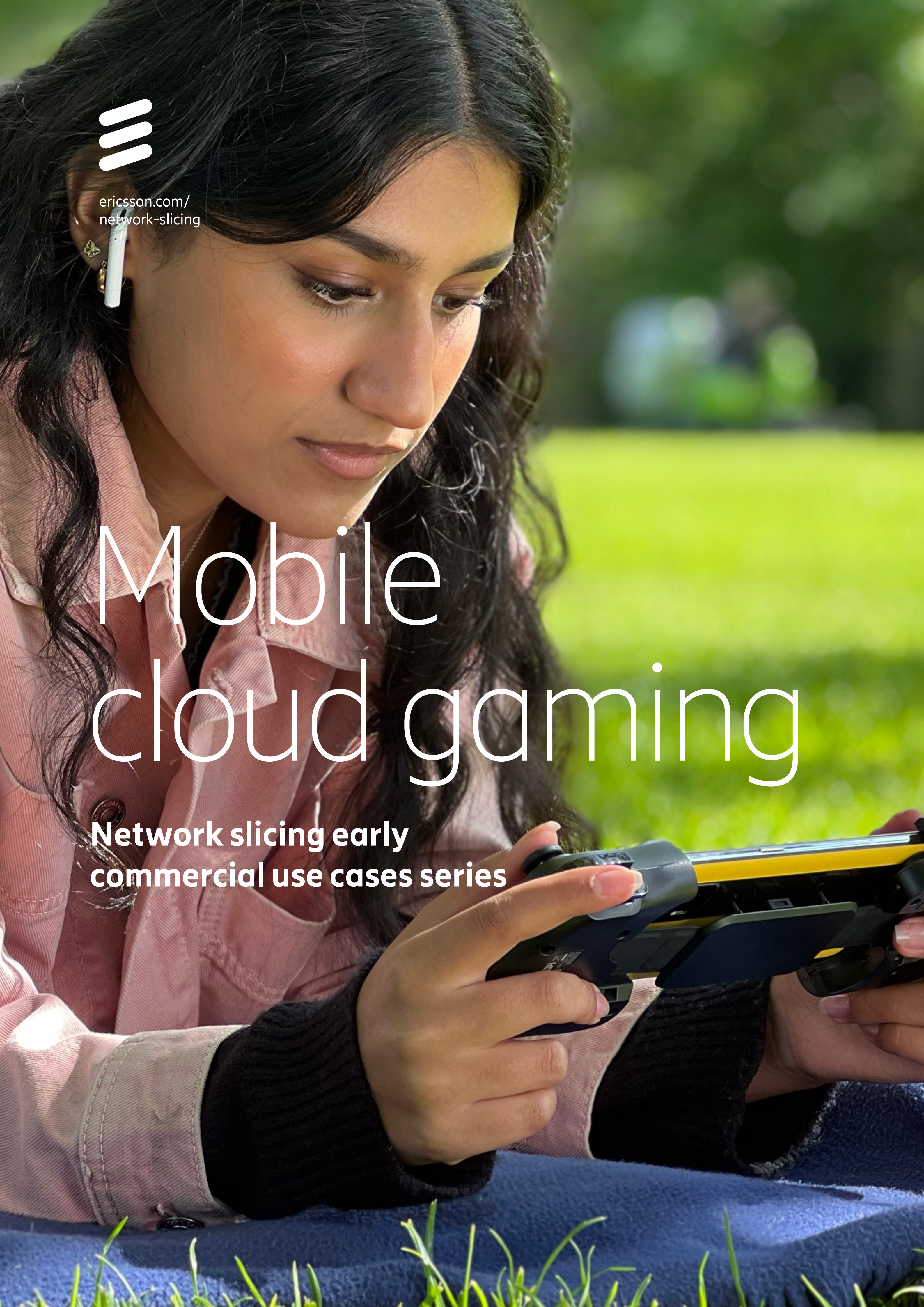


ericsson.com/
network-slicing

Mobile cloud gaming

Network slicing early commercial use cases series

Intro to 5G slicing monetization

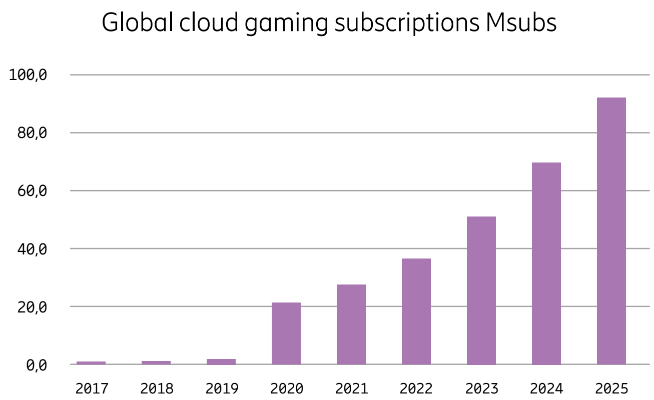
5G standalone is now being rolled out among leading communication service providers (CSPs) where 100 CSPs have committed to 5G standalone and some 25 have launched live networks. Thus the question about how to use 5G as the platform and how to use 5G standalone capabilities for new revenue generating services is top of mind. Network slicing, which has been discussed for several years since the introduction by Ericsson, is seen as a key enabler for 25% of these new 5G services—in particular enterprise services, but also enhanced mobile broadband consumer services like AR/VR and the next generation of mobile gaming.

Several leading CSPs like Deutsche Telekom and Vodafone UK have already made proof-of-concept and public announcements, and it's likely that we will see the first commercial launches of slicing-based services in 2022-2023. Remaining questions in the industry are increasingly about the CSPs' enterprise strategy for industries to target and use cases to support. Alongside them are questions on how to go to market, the business models and who to partner with in the value chains.

In 2021 we published two reports on the commercial value of network slicing and the top 10 industries and their benefiting use cases. One of those areas was media and gaming. This time we will look deeper into the use cases mobile cloud gaming, remote broadcast and production and campus-based services, that we believe have a potential to be in the first wave of commercial deployments.

Now we will cover the mobile (predominantly smartphone) cloud gaming industry, the relevance for slicing, the value chain, business models, a business case, who to partner with and how to offer and evolve mobile cloud gaming services. The vast majority of gamers play on a mobile device and even the hardcore gamers who use fix-connected consoles also play a lot (50%) on mobile platforms. 60% of those who play weekly use a mobile device. In 2020 we counted 2.4 billion mobile gamers globally. (Ericsson Mobility Report 2020). In a ConsumerLab study, based on an online survey with 7,000 consumers, 90% 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.

The assumption and Ericsson's standpoint is that network slicing will have an important role to play for gaming services in general, like smartphone cloud gaming, PC/console cloud gaming, e-sport events and mobile AR/VR gaming. We believe that 5G standalone with slicing will have superior qualities versus other alternatives like Wi-Fi, 4G, 5G non-standalone, with the possibility to offer guaranteed performance for the game being played. This will be particularly needed, as we will see more demanding AR/VR games in the future.



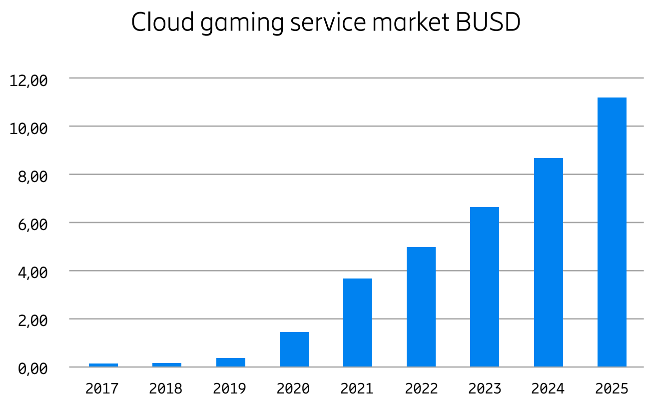


Fig 1 Global cloud gaming subscriber forecast. Source: Omdia

The network slicing proposition in mobile cloud gaming

Cloud gaming over a mobile network significantly raises the bar for the performance requirements like throughput, latency etc. to the point that it may be the key success factor to extend this market. 5G will be the first opportunity where mobile cloud gaming can start for many of the game titles we know today. There needs to be a good network with short distances to the application servers e.g., with edge computing or a small geography. Slicing adds additional performance control to guarantee the user experience, which is desired by many gamers, and will enable premium offerings to gamers. Therefore CSPs need to understand the added value that slicing can offer.

Performance

Slicing with standardized functions in the RAN and Core and possibility to deploy the best network functions, plus assurance functions in OSS where the performance is constantly monitored end-to-end, will provide a high degree of guarantee. A guaranteed mobile performance (20-40 ms latency, >20-25 Mbps) will drive demand. Future AR/VR types of games will require significantly higher speeds and shorter latency possibly <10 ms. This will create an agility to adopt quickly to new services and end-user demands.

Reliability

Slicing can address network jitter, (preferably 0 +/- 10ms std dev), which is a key gaming pain point.

Scalability

The ability to maintain the flexibility of public mobile network to add/remove users with guaranteed quality of service..

Elasticity

Operators can more easily handle busy and off-peak times to provide a consistent experience for gamers. As innovation in AR/VR gaming happens, slicing will make it easier to cope in case of a sudden high demand.

<10ms

Future AR/VR types of games will require significantly higher speeds and shorter latency possibly <10 ms

Benefits for other stakeholders

Game publishers and developers

Possibility to launch games to a wider target audience like casual gamers, as today's console-based market is saturated with less innovation.

Guaranteed performance provides better customer experience and stickiness.

More possibilities for differentiation against competition.

Gamers

A new world of high performance games available on the go rather than only on in-home consoles.

Play without the need for expensive hardware or additional kit, and with guaranteed quality of service.

Depending on business model, access premium network through gaming.

Cloud gaming providers

Increased demand due to guaranteed performance when compared to WiFi.

Bundling into CSP offering creates scale and differentiation.

Create unified cloud gaming experience across end devices and locations.

Games optimization engine

The virtualized/cloud native nature of 5G enables better exposure of network assets. This opens for orchestration of network and user applications. Today the network, especially the RAN is hard to optimize.

E2E orchestration mean optimization can come from across the network.

Trends in mobile cloud gaming

The proposition for 5G mobile cloud gaming is strongest in the casual and regular gamer segment

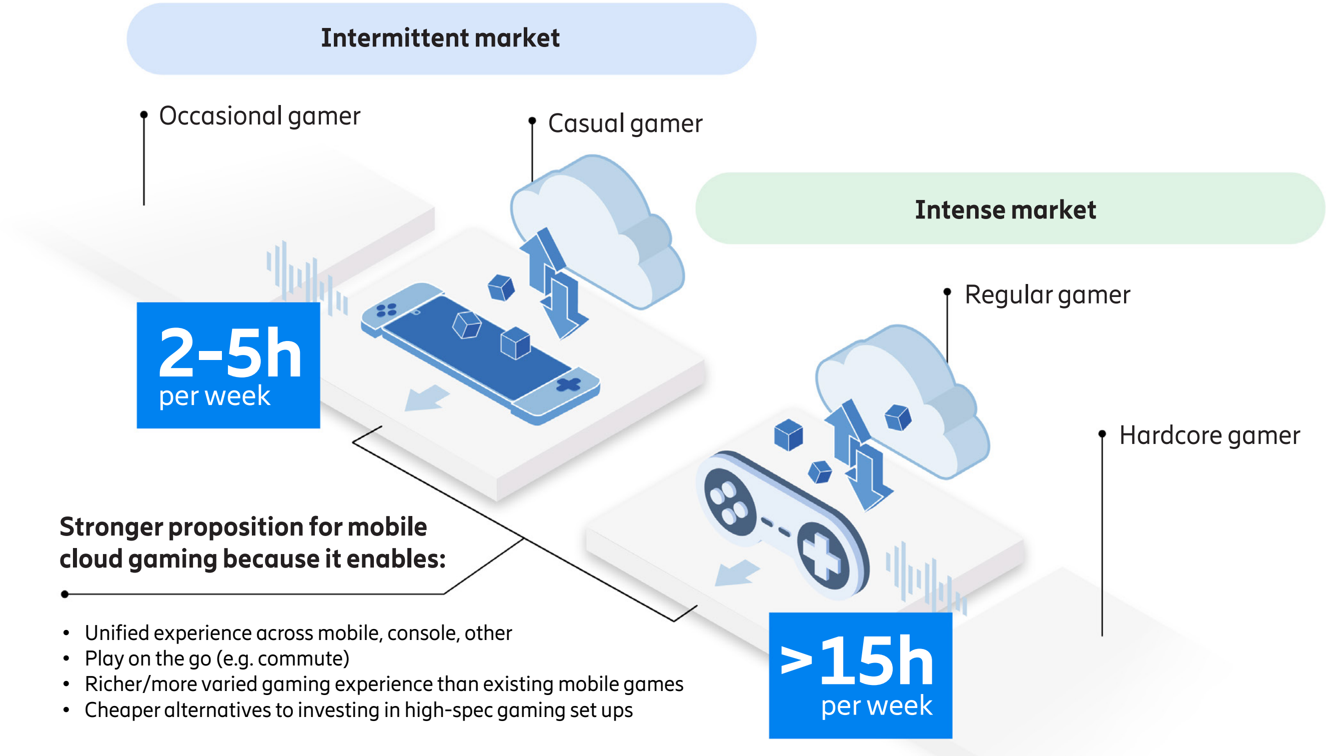


Fig 2 Mobile cloud gaming market segments

Cloud gaming is a new way of consuming video games that is set to grow significantly in the next five years. The ultimate goal is to enable people to play any game on any device as long as they have a good internet connection. This is possible because the games (hardware and software) are hosted in remote data centers, from where the game is streamed to the player's device. Cloud gaming can therefore significantly reduce the cost of retail, packaging, delivery of hardware and improve ease of access for gamers. This in turn puts high requirements on the connectivity network especially in the case of mobile cloud gaming. Today's market is still largely based on download of the game either to a console or a smartphone. Mobile cloud gaming is the case when 5G network will be used either to connect mobile devices like smartphones or tablets or to connect homes via fixed wireless access.

Gamer market segments

Gamers may range from those playing high-end console games several hours a day to someone who sometimes plays games on their smartphone on the train. Therefore, we need to decide which part of the market that may be the best to target here. We have split the cloud gaming market into intermittent and intense.

The intermittent market serves casual gamers (2-5 hours a week) and occasional gamers (up to 2 hours a week), and the intense market serves regular gamers (5-15 hours a week) and hardcore gamers who play more than 15 hours a week. However, what will matter the most in terms of performance requirements are what type of game that is played—e.g., multi-player real-time games such as first-person shooters like Counter-Strike and car racing games will require low latency and low jitter.

5G will expand the market

The smartphone evolution, however, has opened up the segment of casual and occasional gamers driven by the cost and ease of use, who are estimated to stand for 60% of the gaming revenues in the US in 2025 (STL Partners). Therefore, we estimate that 5G, enabled with network slicing, will expand the intermittent gamer segment who may desire easy access to more advanced games, on the go and at an attractive price.

The slicing proposition in the gaming market

Though generally centered around reliability, the proposition for slicing is nuanced across gamer segments. As we showed previously in fig 2, we believe that slicing has the biggest potential for the casual and regular gamer segments. The prime reasons are that slicing offers a guaranteed high-quality experience without the need to invest in additional, expensive equipment like gaming PCs or a console, as well as reliability while on the go. There will also be an ability to easily spin up and down the high-quality service, possibly not tied into lengthy contracts.

The opportunity for the CSP in the value chain

The opportunity

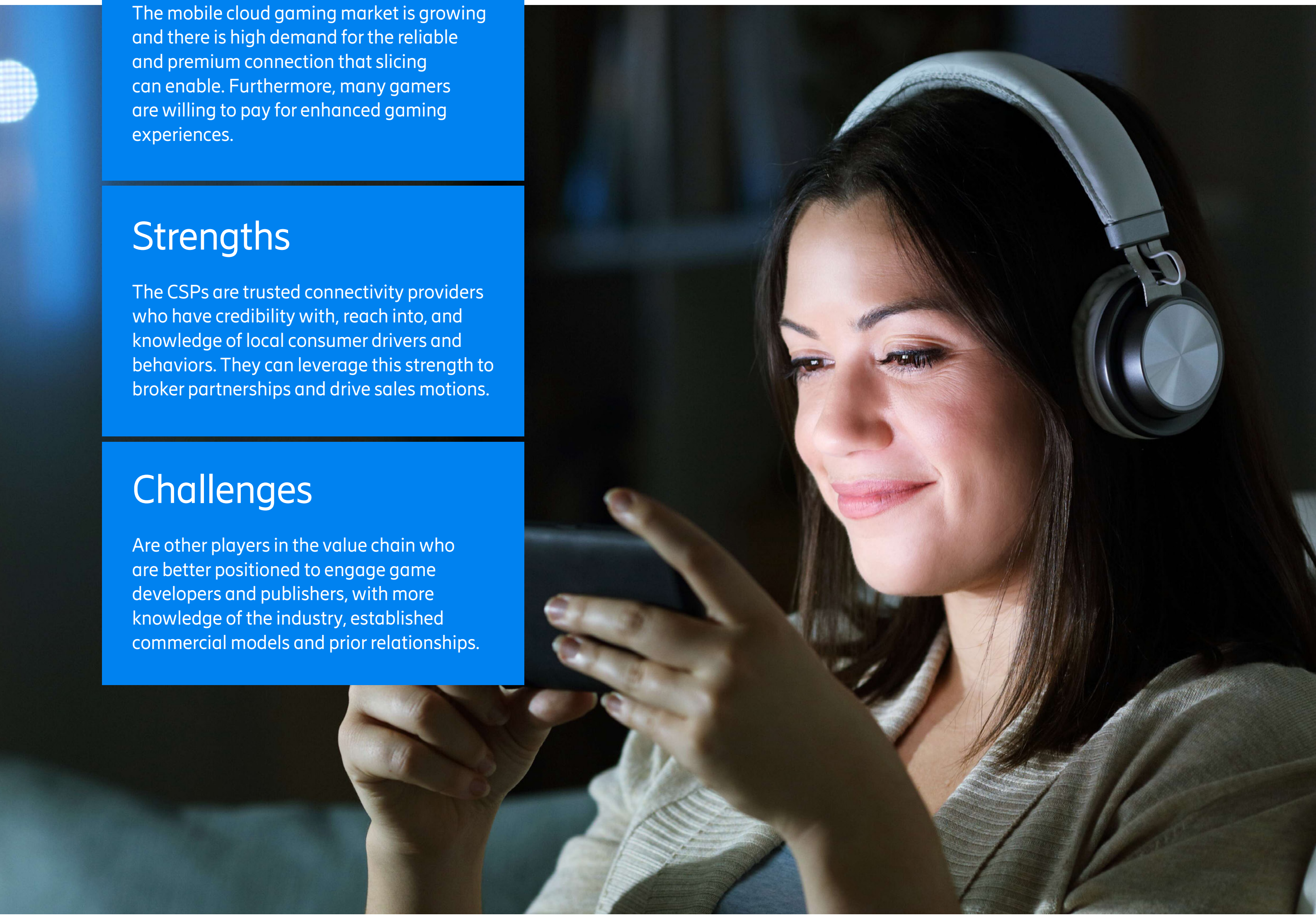
The mobile cloud gaming market is growing and there is high demand for the reliable and premium connection that slicing can enable. Furthermore, many gamers are willing to pay for enhanced gaming experiences.

Strengths

The CSPs are trusted connectivity providers who have credibility with, reach into, and knowledge of local consumer drivers and behaviors. They can leverage this strength to broker partnerships and drive sales motions.

Challenges

Are other players in the value chain who are better positioned to engage game developers and publishers, with more knowledge of the industry, established commercial models and prior relationships.



If we look closer at the CSPs they can be divided into three different categories or archetypes:

Major full-service providers (quality led)

- May be converged local incumbent with limited scale due to volume and or lower average revenue per user (ARPU)
- A strong brand and established, content business and/or strategy focused on gaming demographic

Mid-market leaders

- May be converged local incumbent with limited scale due to volume and/ or lower average revenue per user (ARPU)
- A CSP who has decided to focus less on content and/or gaming
- May be a challenger in a large market with relative low share (e.g., <20%)

Local market challengers

- Smaller, single market CSP, potentially mainly mobile or mainly fixed
- Challenger with limited share, resources and skills, or more specialist provider
- May find a niche to innovate but overall, an industry follower

The cloud gaming value chain

Brief description	Examples companies
Cloud gaming service providers Cloud gaming Rig service; Games on demand (Games + Rig included); Streaming services	• Steam • GeForce • Now • Blacknut
Game publishers and developers Video games publisher; Mobile games publisher; Games developer; Games distributer	• EA Sports • Ubisoft
Game engines and optimisation service Game development platforms; Additional software service to enhance gameplay, e.g. match making	• Epic Games • Unreal Engine • Amazon Luberyard • Kill Ping
Cloud infrastructure Cloud compute; Cloud providers; GPU/CPU; Service	• NVIDIA • Azure
Connectivity Mobile network operators; (Mass market) Internet providers (Telco/ISPs); Gaming ISPs	• Verizon • SK Telecom • Singtel • Zain • Everything Everywhere
End device Screen/ Smart TV; Set-top box mobile; PC; Console; VR headset	• Xbox • Apple/iOS • Android • Oculus • NVIDIA

Fig 3 Mobile cloud gaming value chain segments. Source: STL Partners

In any case, operators should understand the objectives and pain points of potential partners in the value chain in order to understand with whom to partner and why.

We believe that that on top of connectivity, the first three segments have the potential to deliver most value for the CSP. It's not that connectivity isn't valuable, and it's not that we think the top three layers are the most valuable overall. Instead we see that partnership in the top three segments will provide more expertise, gaming-specific knowledge and credibility, capabilities etc for CSPs looking to build out their gaming offering. As for the cloud infrastructure and end devices, these value chain segments tend to be more heavily commoditized and harder to differentiate.

This is driven, in part, by the move towards truly cross platform play—consumers can play on any device running on any underlying infrastructure/connectivity.

If we look closer at the top three segments of the value chain, we see that overall they seek to deliver the best possible content with a supreme quality and user experience. They do face challenges in delivering sufficient quality of service over a mobile network and they don't have access to network assets. This opens opportunities for the CSPs.

Objectives	Pain points
Cloud gaming service providers • Deliver best experience to end customers • Attract as many customers as possible • Differentiate from other gaming offerings • Attract the best content to the platform	• Providing a sufficient quality of service • Attracting intermittent, as well as intense gamers • Keeping content new and exciting
Game publishers and developers • Deliver best experience to end customers • Attract as many customers as possible • Differentiate from other gaming offerings • Attract the best content to the platform	• Building games on best effort performance ratherthan best of breed • Working against different sets of standards in different regions
Game engines and optimisation service • Deliver best experience to end customers • Attract as many customers as possible • Differentiate from other gaming offerings • Attract the best content to the platform	• Limited access to network assets • Variability in the RAN providing inconsistency • Reliance on partner for GTM and scale

Fig 4 Mobile cloud gaming segments objectives and pain points

Possible partnerships for the CSPs
As we described in the previous chapters, there are revenue opportunities for CSPs in several segments of the value chain, but regardless of the CSPs ambitions, they will have to partner with other players, and here we will outline the most important ones. We believe that the top 3 segments have the potential to deliver most value for the CSP.

Relationships with cloud gaming services enables the CSP to bring gaming services to their consumers faster. This is the most important partnership for a CSP with high ambitions. Partners bring knowledge, understanding, and credibility within the space. By partnering with game publishers and developers, the CSP can secure the best, popular and newest content for gaming platforms. CSPs can secure a high-value role as a content aggregator and pool resources to source the best content across the operator group.

Games engines and optimization services may allow the CSP to create a holistic gaming wrap as to address games which require optimization/edge services. Partners bring an intimate knowledge of the technology and how to get the best customer experience, and this understanding will be essential to differentiate offerings.

Potential partner profile
The potential partners to seek are those who are looking to build a presence in a CSP's local market. This could be by moving into a new market with an existing service, or by launching a new service. CSP should seek to partner with players in the value chain who bring either a strong content offering or a new capability to address different market segments.

Figure 5 below outlines with whom the different CSP categories need to partner with to capture opportunities outside the connectivity segment.

Fig 5 **Opportunities in the value chain for CSP categories or archetypes**

As we can see, the CSPs are naturally placed in the connectivity segment, but they have possibilities to capture revenue in most of the other segments as well. The major full-service providers have opportunities in most of the segments in the value chain. They can white label or resell established cloud gaming services brands as a bundle. Some may launch their own services, but that will be more challenging. By offering APIs for slices to optimize performance to game engines, they can partner or build their own PaaS solutions. Edge nodes for applications can be served to cloud infrastructure. Bundle connectivity packages can be created with end device partners.

The mid-market leaders have medium opportunities in some of the segments in the value chain. They can resell cloud gaming services, possibly as white label services.

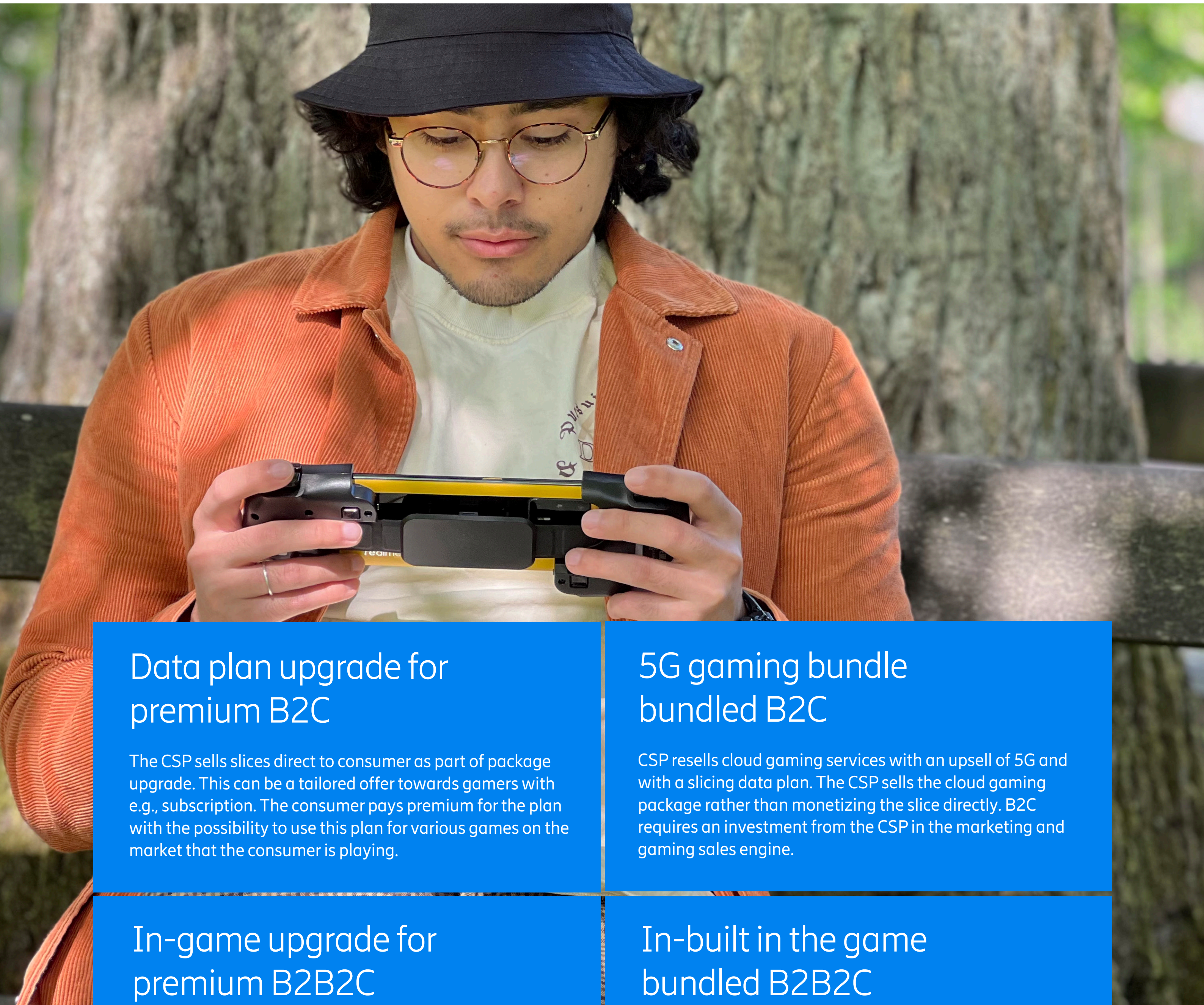
They can partner with game engines and optimization service players to monetize the existing CSP customer base, depending on the types of gamers. Leading CSPs may have the cloud scale to provide edge nodes for applications. Leaders may have the market size and customer base to become effective resellers of end devices.

The local market challengers have medium opportunities in some of the segments in the value chain. They can resell existing cloud gaming services and leverage existing gaming brands. There is probably a limited hardcore customer base for game engines and optimization service deployments, but the B2B customers could be targeted for sales. There could be some scope to monetize edge infrastructure, but this may rely more heavily on partners. There is limited scale and reach into the hardcore gaming segment, which limits the opportunity to resell end devices.reach into hardcore gaming segment limits opportunity to resell end devices.

The business models for mobile cloud gaming

Today's gaming offerings are mainly based on a resell and revenue share model using carrier billing. 20% of CSPs offer special gaming connectivity packages and 3% offer a premium quality of experience (QoE) package with priority, in particular in advanced markets like South Korea, as reported recently in Ericsson Mobility Report.

With slicing, we see opportunities to develop some different business models for mobile cloud gaming that we structure in two dimensions. In the first, either as B2C or B2B2C, and in the second dimension, as a premium service or bundled. Thus, we get four different types of business models.



Data plan upgrade for premium B2C

The CSP sells slices direct to consumer as part of package upgrade. This can be a tailored offer towards gamers with e.g., subscription. The consumer pays premium for the plan with the possibility to use this plan for various games on the market that the consumer is playing.

5G gaming bundle bundled B2C

CSP resells cloud gaming services with an upsell of 5G and with a slicing data plan. The CSP sells the cloud gaming package rather than monetizing the slice directly. B2C requires an investment from the CSP in the marketing and gaming sales engine.

In-game upgrade for premium B2B2C

CSP sells slices to game developers/publishers/platforms, who market the game. The game provider offers a premium upgrade package direct to the consumer in-app or in-game. In-carrier billing is added to the existing plan.

In-built in the game bundled B2B2C

CSP sells slices to game developers/publishers/platforms, who market the games. Any user who downloads the app and streams the game gets access to the telco slice for QoS. The cost of the slice is in-built into the cost of game/service. It scales with the game company (one to many).

Network slicing gaming can be monetized as a consumer service or as an enterprise service

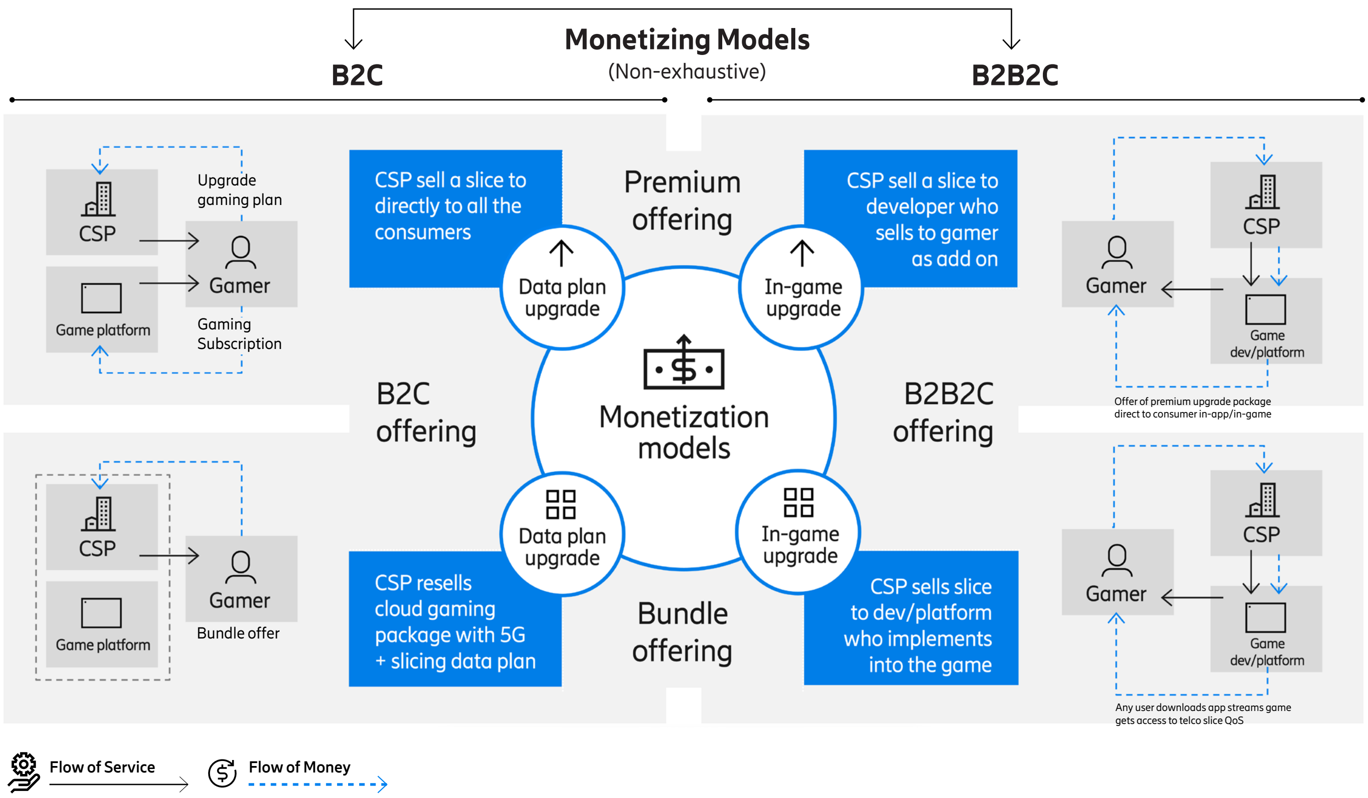


Fig 6 Business models for mobile cloud gaming

The major full service-providers will have greater potential to serve regular and hardcore gamers in B2C, mainly because they have existing media and entertainment offerings and a reliable connectivity provider brand, which brings trust in this intense market. Building their own gaming brand will be challenging, and reselling or partnering with leading providers will likely dominate. The intense gamers are willing to pay for the best experience, and already make significant in-game purchases.

Greater scale means these CSPs are seen as more attractive to developers, and can help build out the offering. There are more resources available for marketing, gaming capabilities, and premium content for hardcore gamers. They have an existing gamer customer base through fixed offerings and a business support system (BSS) for billing, which gives an ability to create a unified gaming experience.

The mid-market leaders and the connectivity challengers have a greater potential to serve the occasional and casual gamers, mainly as B2B2C. This is due to the intermittent market being less focused on premium content and high performance and more on variety of games, so there is less need for strong gaming credentials. They are therefore more willing to buy from a CSP. Intermittent gamers have fewer in-home set ups, and play primarily on mobile already, so there is no need for a fixed solution. They are more likely to spend if offered a 'Netflix-style' gaming package that provides a large variety.

But the lack of a gaming brand means limited credibility with intense gamers. By selling slices through the game companies, they can leverage their scale and gaming expertise. Less investment on upfront marketing and brand building brings greater cost efficiency that is more in line with the strategic objectives.

This means that different CSPs have a predisposition to different monetization models. The major full-service providers have a strong opportunity in all the four models, as they have a strong brand, capabilities, and attractive gaming provider partners. They should consider tailoring their offerings based on the target customer segments.

The mid-market leaders have less opportunity in the premium models, as they have less of brand and fewer attractive game partners, so they should focus more on the resell of games to the mass market. The local market challengers should focus on mass market, which means less scope for "premium" models. A limited gaming brand means they should target bundled models.

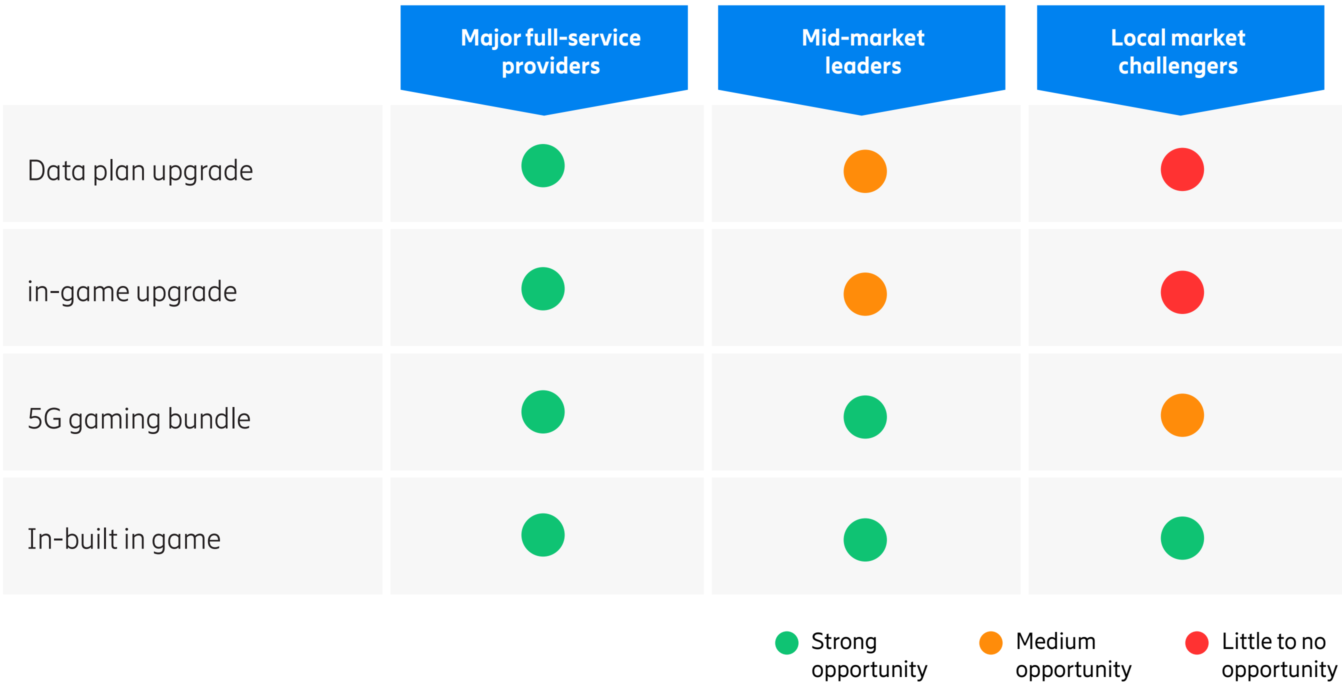


Fig 7 Mapping of business model to CSP gaming category archetypes

Business case analysis for North American CSPs

inCode consulting, a division of the Ericsson Consulting group in North America, evaluated the adoption of cloud gaming among 5G subscribers in the region and the revenue uplift opportunity for mobile network operators.

Leveraging a comprehensive technical and financial model, inCode simulated a 5G network to serve the demand over the next years in a sample market, accounting for the implementation of cloud gaming slices that meet performance and latency requirements of major cloud gaming providers.

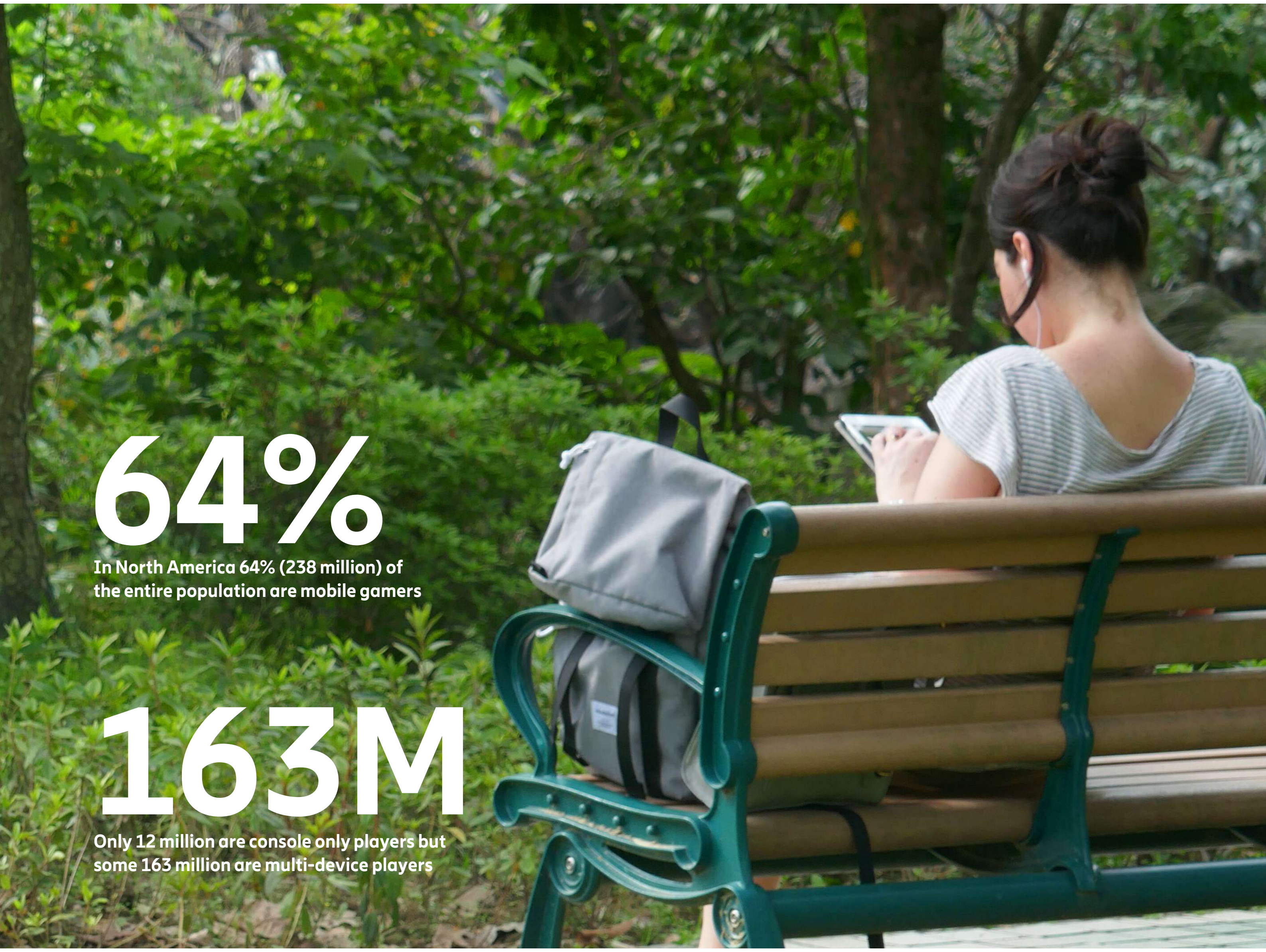
The inCode study tries to answer the following key questions:

1. What will be the market adoption of 5G cloud gaming in North America?
2. What is the subscriber willingness to pay for enhanced connectivity for 5G cloud gaming?
3. What impact will cloud gaming have on the network capacity?
4. What is the operator's incremental revenue due to offering enhanced connectivity for cloud gaming?

Findings reveal that a group of cloud gamers can pay up to $10.99 more for a guaranteed gaming experience on top of their 5G monthly subscription. Therefore, mobile operators can start monetizing their 5G networks and driving up their service revenues by targeting segments of their subscriber base—like cloud gamers—with performance-oriented network slices.

Readers are encouraged to refer to the inCode study "5G Cloud Gaming: Driving Revenue Growth For Mobile Operators" for further understanding on monetization and network impacts.

Go-to-market planning and next steps



As we have seen in this report, there are several commercial considerations for CSPs, such as the choice of the target customer segment, the choice of business model(s), and who to partner with. This will naturally depend on the local market conditions where the CSP operates, the gaming demographics and the popularity of gaming overall, plus competition from others.

In any case, it is crucial to start this journey of 5G monetization by making an analysis and strategy for the type of industries or use cases to support. There is no simple answer to the very common question—which use cases are the best?

The leading CSPs have come to the stage where they have selected initial industries and use cases to explore, and they are now in the phase of finding partners and conducting trials with real network equipment.

Obviously, we believe that mobile cloud gaming will be a popular use case, as it has wide acceptance and adheres to the CSPs' core consumer business. It may very well turn out to be a "must have" service if innovation in gaming, on top of 5G network slicing, leads to very popular games with an appeal to broad consumer segments.

In North America, 64% (238 million) of the entire population are mobile gamers in some sense today, so there is a huge potential. Only 12 million are console-only players, but some 163 million are multi-device players.

First stages of the journey to commercialization

The entire journey can be seen as five stages; Explore, Define & Commit, Build, Launch & Operate and Eco system growth. Here we will cover the first two stages. During the Explore and Define & Commit stages the following activities need to happen:

Define desired role in the gaming ecosystem:

- Define objectives for gaming, e.g., new revenues, connectivity revenues, brand building
- Understand potential strengths and weaknesses in the gaming space
- Map the competitor ecosystem and conduct gap analysis within the market to identify opportunities and threats

The output from these activities would be a heatmap of opportunities tied back to strategic objectives for the CSP within gaming, and 1 to 3 prioritized areas to further develop.

Validate target customer base and model:

- Within the prioritized service area, define target customer base, e.g., B2C: hardcore gamers vs casual gamers, B2B: developers vs gaming services
- Size the potential market within the target customer and right to play
- Validate the proposition and model for slicing within the customer base

The output from these activities would be market sizing within each area to define the scale of the opportunity, and a 'go' or 'no go' decision on the priority area and model.

Engage partners to help build solution:

- Identify, evaluate, and prioritize partners to support gaming objectives, like building new content and scaling
- For slicing, focus on partners that can help to build a gaming-specific UI with reporting to show the value of the slice
- Trials over 5G/slicing to gain proposition proof pointse

The output from these activities would be a long and shortlist of partners to help with both the gaming and slicing offering, the initial engagement with partners, and memorandum of understanding and a reached proof-of-concept.

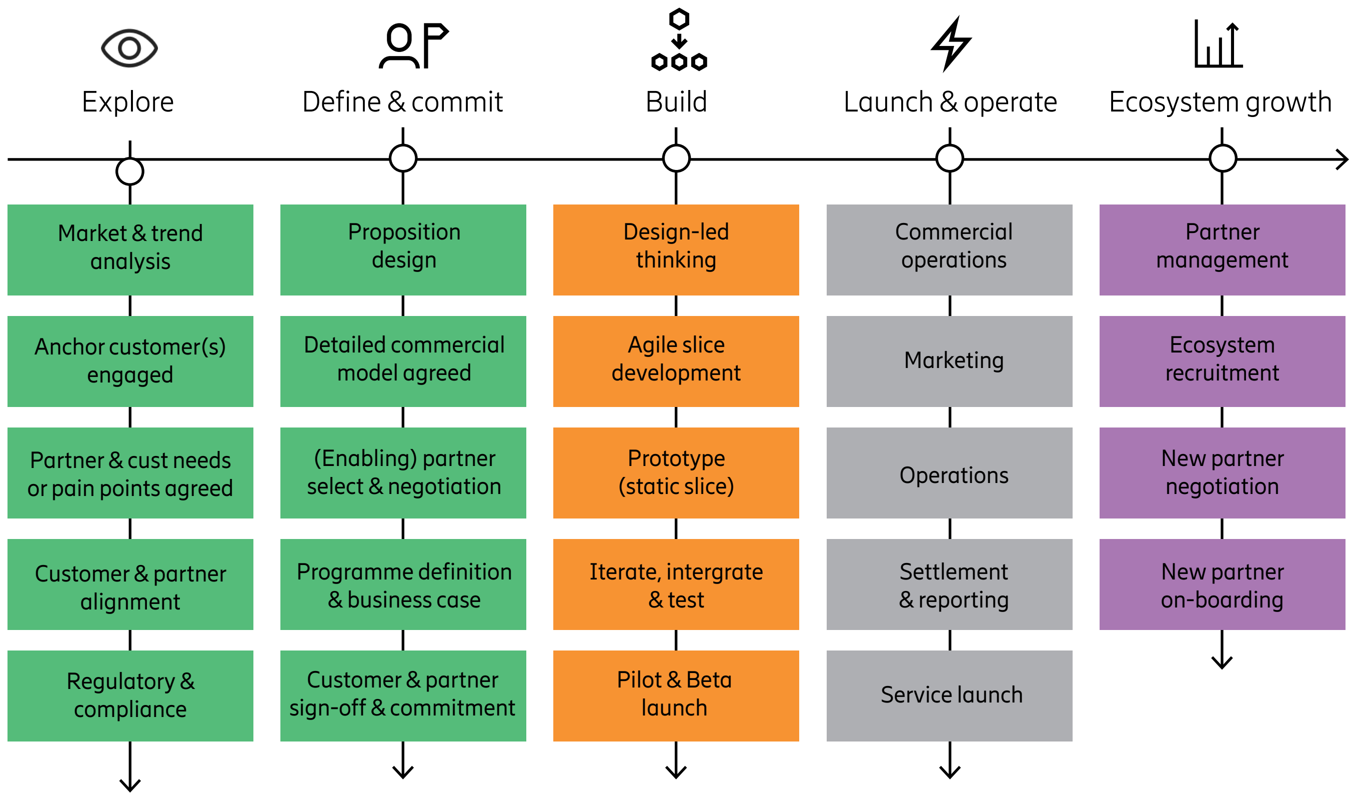


Fig 8 Five Stages to launch and scale slicing based mobile cloud gaming

Telco gaming and/or innovation and/or strategy team
Telco product development team with enabling partner(s)
Slicing operation team
Gaming team

Conclusion

Mobile cloud gaming is estimated to be one of many use cases to come from 5G and one of the first use cases to be explored at scale, and several leading CSP are in trials today.

Our estimations indicate that there is a positive business case, provided that CSPs define their role in the gaming ecosystem and value chain, and validate the target customer base and select business model(s). It is equally important to engage partners to help build a solution and deploy network slicing on top of the 5G standalone network.

The global slicing-enabled revenue for gaming is expected to grow from 8 BUSD in 2025 to 19 BUSD in 2030, with a CAGR of 19%. The CSP-addressable part is 7 BUSD.

For mobile cloud gaming, the CSP-addressable revenue is about 3 BUSD in 2025.

Source: Ericsson and ADL 2021

8Bn

Global expected revenue growth USD in 2025

19Bn

Global expected revenue growth USD in 2030

About Ericsson

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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