Gaming at the Cloud Edge

Can your network adapt?

The global gaming market is growing rapidly, with gamers spending an estimated $152B in 2019, eclipsing the markets for other forms of entertainment such as film ($43B) and music ($21.5B).[1] This also overtakes the markets for all major North American sports leagues—NFL ($15B), MLB ($8B), NBA ($10B), and NHL ($5B). The gaming market also continues to grow at twice the rate of film and music—10 percent versus five and four percent, respectively. In short, gaming is big business. This dynamic, high-demand market is segmented into two consumption models:

• **Fixed-gaming devices** at 55 percent of the market including consoles—PlayStation, Xbox, Nintendo—and PC/laptops

• **Mobile devices** at 45 percent of the market

This white paper addresses the shift within the fixed-gaming-device segment market toward an edge compute model.

Challenges of the current fixed-gaming-device consumption model

In the current environment, each gamer has their own gaming console/PC, runs their own software, and uses their own gaming controller. Each console optionally can be connected to the network for multi-player gaming services such as Xbox Live. This status quo faces several challenges, the greatest of which includes:

1. Expensive hardware: Gamers use dedicated hardware devices that can require significant upfront costs ranging from $300 to $500. Upgrading to add new capabilities, such as 4K video support, requires buying an entire new console.

2. Game download times: The distribution model for gaming has moved to downloads, replacing physical DVDs. New games can require 10 to 100 GB of content, which may take many hours to download over a residential broadband connection. For example, the current release of Call of Duty requires a 101 GB download, equivalent to streaming 4K video for 14 hours.

3. Lack of mobility: If a gamer wants to go to a friend's house and continue to play using their current platform, they must transport their gaming console to the new location.
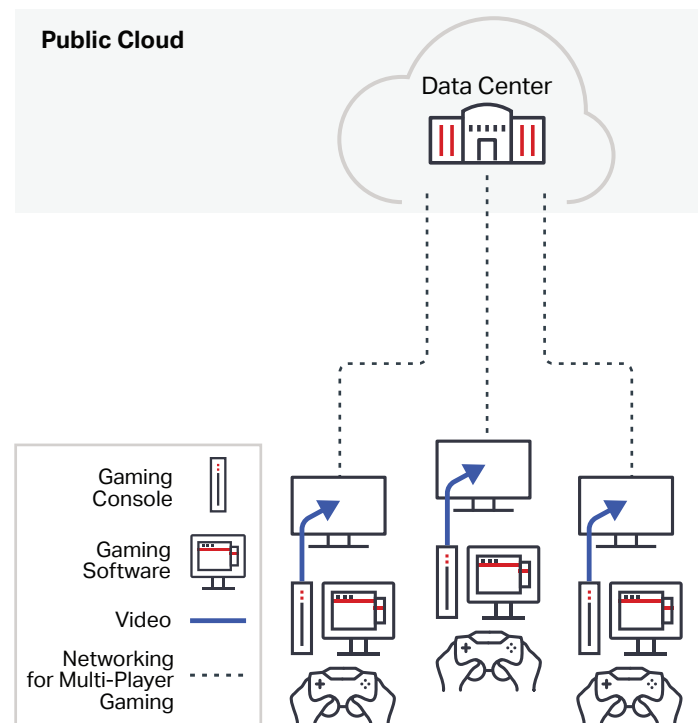

Figure 1. Today's PC/gaming console model

1 https://newzoo.com/insights/articles/the-global-games-market-will-generate-152-1-billion-in-2019-as-the-u-s-overtakes-china-as-the-biggest-market/

Figure 1 illustrates the current gaming model. The technical model is straightforward: the gamer interacts via his/her controller with their laptop/console, and the gaming video is transmitted from the laptop/console to their TV monitor via an HDMI cable. Since all connections are local, performance is optimized.

Cloud gaming model

The industry's solution to address the challenges noted above is to move all the compute/storage/gaming software capacity into the cloud, to be housed in one or more centralized gaming data centers.

A key challenge faced by cloud gaming is the additional latency added to a gaming session when users must access their gaming software from a distant data center. To minimize latency, the gaming industry is engineering its networks with edge computing to locate servers as close to gamers as possible. An example is shown in Figure 2 where network providers such as CenturyLink have announced an initiative to leverage their extensive central office real estate as edge data centers, offering latency as low as five ms.[2]
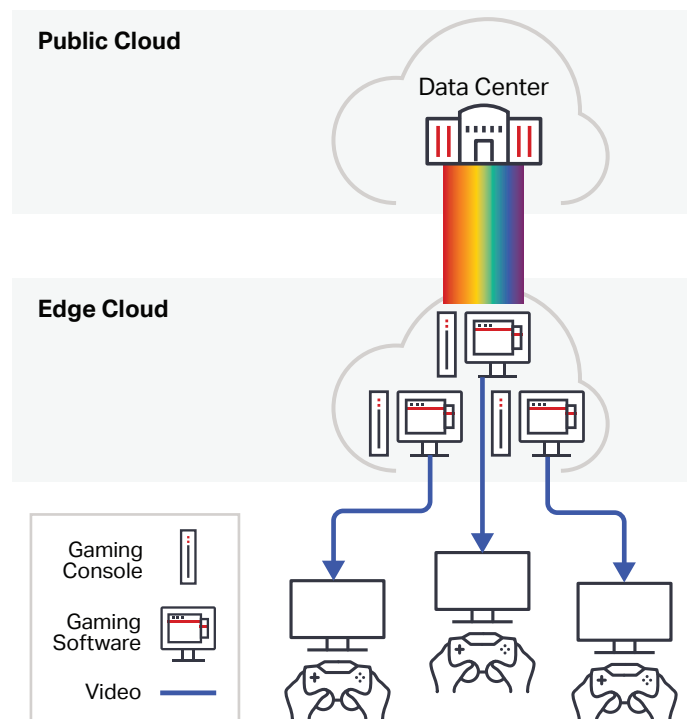

Figure 2. Edge cloud gaming model

However, in an edge cloud gaming scenario, gamers would no longer require dedicated hardware such as a console or a PC. They would continue to play games using gaming controllers, but they would be connected to a video streaming device on their TVs, such as a Google Chromecast.

Here are some of the key players planning on introducing cloud gaming:

1. **Google Stadia:** Their service launched in November 2019. Google is promoting its model over other cloud gaming services by claiming it will provide gaming developers new tools to customize the gaming experience. For example, it will allow gamers to play co-operatively (in teams), whether they are next to each other or in different locations, and to stream games in 4K at 60 frames per second (fps).

2. **Sony PlayStation Now:** Available now, Sony provides access to over 750 PS2, PS3, and PS4 titles gamers can stream right to their PCs. Sony announced a partnership with Microsoft to host a future cloud gaming service in Microsoft's Azure cloud.

3. **Microsoft Streaming Mode and xCloud:** Launching in 2020 with general availability, this will allow any Xbox console owner to play one of their Xbox games remotely on a mobile device. Microsoft is also planning a cloud gaming platform to compete with Google's, although no formal launch date for this service has been announced.

Most of these services do not allow the rental of games, as in the Netflix model. Gamers must still purchase their games, but these games and their updates now reside in the cloud, avoiding the need to repeatedly download gaming content.

Benefits to gamers of a cloud gaming model

1. **No local hardware/software:** Gamers will no longer need to keep buying new consoles—such as PlayStation 2, 3, 4, and 5—to keep up with the latest hardware performance and features.

2. **Mobility:** Gamers can play from any location with a broadband/mobile connection that meets the required SLAs for their games.

3. **Latest games and updates:** Gamers will no longer need to download new games or new versions of existing games. This will reduce gamers' reluctance to try new content and expand the market to casual users.

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2   https://www.rcrwireless.com/20190813/telco-cloud/centurylink-edge-computing-investment

4. Augmented/Virtual Reality (AR/VR): This vision for gaming will allow developers to build gaming content within a real-time 3D map of the world. As such, the industry is building an AR cloud that will deliver the required compute and content resources to enable gamers to have shared gaming experiences within this virtual world.

What are the network challenges posed by cloud gaming?

Centralizing all gaming-related compute/storage in the central public cloud will put a tremendous strain on the network to deliver a performance level similar to the current levels gamers experience on local gaming consoles or PCs. To minimize latency, the gaming industry is engineering its networks with edge computing to locate gaming servers as close to gamers as possible.

As shown in Figure 2, the gamer still interacts via their local controller but in this edge computing model, gaming video from the edge cloud server is now streamed to the gamer's TV from an edge compute DC. To match the performance of a local gaming set-up, both the low latency of these connections

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and the required bandwidth of gaming video, perhaps 4K, will be required to the cloud edge—especially during peak periods.

How does the Adaptive Network™ help achieve cloud gaming services?

The key challenge for network providers is to offer enough network resources during peak periods of cloud gaming usage. The Adaptive Network approach to cloud gaming, enhanced through edge computing, addresses these challenges, as shown in Figure 3.

The Adaptive Network approach for edge computing

Programmable Infrastructure (Connect)

• Multi-vendor network equipment for edge computing DCI sends real-time utilization data, across L0-L3 of the network, to Ciena's Blue Planet® Route Optimization and Assurance (ROA) to identify congestion choke points.

Analytics and Intelligence (Sense)

• At the Analytics and Intelligence layer, network performance data on gaming services, such as latency and buffering issues, would be collected.

• ROA federates network utilization from multiple sources, and synchronizes it with the discovered network data to produce a unified data model, identifying areas of network congestion during period of peak edge compute consumption.
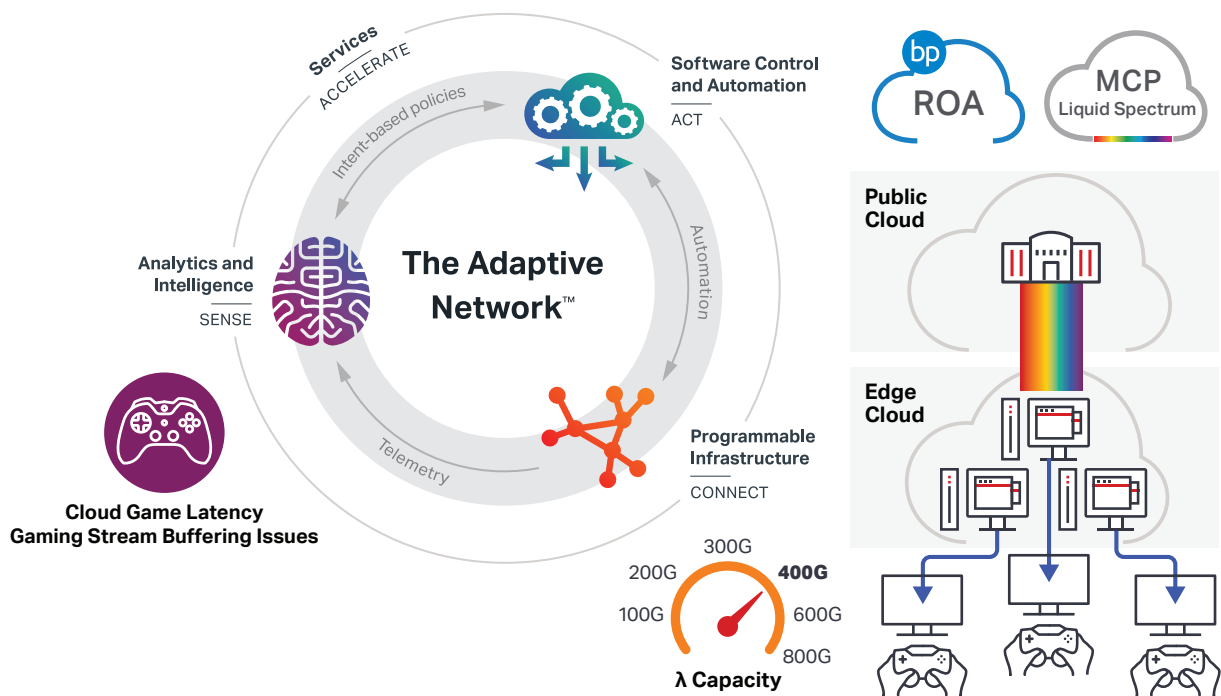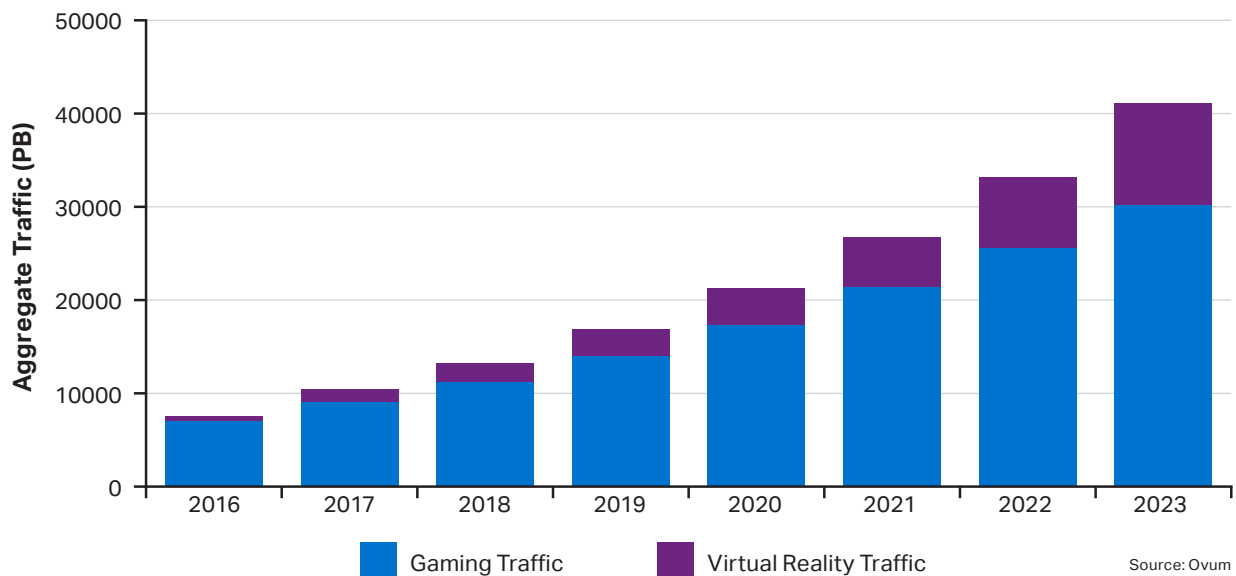

Figure 3. Adaptive Network for edge cloud gaming

Aggregate Gaming Traffic (PB)

Gaming Traffic ■ **Virtual Reality Traffic** ■

Source: Ovum

Blue Planet ROA
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Software Control and Automation (Act)

- At the Software Control and Automation layer, ROA would identify which network routes were suffering from network congestion due to latency.

- Ciena's Liquid Spectrum™ software applications combine highly instrumented, programmable hardware with advanced software applications—allowing network owners to crank up bandwidth as they need it wherever system margin is available. By enabling the Adaptive Network with Liquid Spectrum, network owners will have the ability to securely increase their metro networks by hundreds of Gb/s for the period of time that peak cloud gaming performance is required.

- Blue Planet auto-discovers the L0-L3 network by interfacing with multi-vendor controllers/NMS/EMS/network elements using its Resource Adapter (RA) framework.

- Blue Planet sends a request to L0-L3 layers to activate additional edge compute DCI bandwidth to ease congestion.

There is no doubt that gaming continues to eclipse all other forms of entertainment and is expected to grow at double-digit rates. Yet the full market potential of gaming is unrealized due to the market frictions from the cost of purchasing new gaming hardware, extensive download intervals for new games, and the inflexibility of playing games across multiple devices and locations. Moving gaming into the edge cloud is expected to remove these market frictions, extend the market to more casual gamers, and increase the purchase of new games.

The Adaptive Network is designed to overcome the technical challenges of cloud gaming by leveraging analytics and network intelligence to identify network congestion and latency during peak periods of usage and activate additional network resources on demand. This approach will ensure that the performance of the edge cloud gaming model can scale to meet the demand of this expanding market.

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