# Network Analysis of the Sony Remote Play System

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***Abstract*—The market penetration of in-home entertainment systems is playing a crucial role in the diffusion of interactive multimedia services. In this context, thin-client game systems have received a lot of attention, shifting the computational burden of the game play toward the server while the client renders a fat video stream. This paper proposes an analysis of the network characteristics of the Remote Play for PlayStation 4 and PlayStation Vita, providing some insights on the network dynamics of this system under different game types. The measurements involve video games of different genres, analyzing the bitrates, the packet size, capturing the dynamics of the whole streaming session. Results indicate that the service generates a large quantity of big packets downstream and smaller and lesser packets upstream. Gathered data can help to understand if this type of service could be offered through the today's normal Internet connections.**

***Keywords—Online game; Remote play, Network traffic***

## I. INTRODUCTION

Content producers and providers are rapidly adapting, offering new and interactive service provisioning methods, in order to match the consumer demand. In this context, thin client game systems are attracting much attention [1, 2, 3, 4]. This technology enables the user to play with his favorite games using only a thin multiplatform client. Such examples include Steam with its In-Home Streaming for PCs, Sony with its two services, Remote Play for PlayStation 4 and PlayStation Vita and PlayStation Now, OnLive [5, 6]. What commons this services is the underlying idea of shifting the computational burden of the game play toward a remote machine, either local inside the WLAN or somewhere in the Internet, while the client receives and renders a video stream back to the user.

Despite their attractiveness, these types of services did not have a great success when they were launched due to the high costs of the subscriptions and the difficulties caused by the low bandwidth of the Internet connection of the various countries [7]. In order to better understand the problems that these companies have encountered, similar services have been analyzed to classify network traffic and realize what kind of infrastructure is required in order to guarantee a good experience that could match the one offered by a dedicated game machine [8, 9].

Using dedicated tools to measure the network traffic, this paper tries to understand the network characteristics of Sony Remote Play for PlayStation 4 in order to answer the following questions:

- *What are the network characteristics for Sony Remote Play ?* A first important step is to analyze the packet size, the bitrate and the total amount of the stream to understand how these services work.
- *Do the networks characteristics for different games genres differ from each other ?* This information can be useful to understand how to eventually manage different types of games: intuitively, a less *eventful* game needs less bandwidth than an action game.
- *Could the quality of the domestic streaming be reached by similar services that operate through the Internet ?* Analyze the network characteristics could be interesting to evaluate if the quality reached by domestic streaming can be replicated through a normal Internet connection. Indeed, not all the countries have an Internet infrastructure able to handle a large bandwidth.

The rest of the paper is organized as follow. In Section II we describe our testbed creation and configuration. Section III is dedicated to analyze the outcome of our tests. Finally, in Section IV conclusions are drawn.

## II. EXPERIMENTAL METHODOLOGY AND CONFIGURATION

### A. Application Selection

In order to provide a thorough analysis, we select four different games available in the Remote Play platform. The classification of the games used for the experiments is described in [10] and they have been chosen among some of the most famous genres of the industry: first or third person shooters, puzzle games, racing games and action games. This choice is intentional because we wanted to observe the different behavior of the systems in various conditions. Table I describes the selected games, indicating the genres and the graphic complexity.

### B. Measurement Testbed

Figure 1 describes the measurement testbed for the Sony Remote Play. The Netgear access point is connected to the Mikrotik access point that is used as a switch.

TABLE I. PLAYSTATION 4 GAMES FOR SONY REMOTE PLAY

| PC Games | General info | | |
|---|---|---|---|
| | ***Abbreviation*** | ***Game genre*** | ***Graphic complexity*** |
| The Order: 1886 | The Order | Third Person Shooter | Very high |
| Titan Attacks | Titan | Puzzle | Very low |
| Driveclub | Driveclub | Racing | High |
| InFamous: Second Son | Infamous | Action | High |

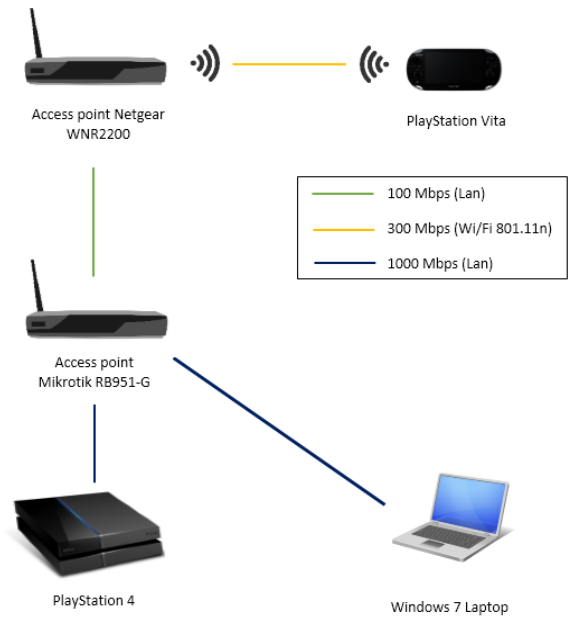


Fig. 1. *Measurement testbed for Sony Remote Play: PlayStation 4 - Firmware v2.04, PlayStation Vita - Firmware v3.36.*

In order to monitor the packet exchange, the whole traffic between PlayStation 4 and PlayStation Vita was replicated to one of the Mikrotik ports and a Laptop with Wireshark installed was put into listening. The PlayStation 4 and Laptop were connected to Mikrotik through a wired connection (Ethernet, 1000 Mbps), the Mikrotik was connected to Netgear through a wired connection (Ethernet, 100 Mbps) and PlayStation Vita was connected to Netgear with a wireless connection (Wi-Fi 802.11n, 300 Mbps).

## III. ANALYSIS

### A. *Streaming services characteristics*

The console was configured with a native rendering resolution of a maximum of 1920×1080 pixels, and a streaming rendering resolution fixed at 960×544 pixels, which depends on the Playstation Vita. No streaming quality settings were applied although we set a capture frame rate limit of 30 fps.

It is worth mentioning that the service uses the H.264 video codec, which nowadays, is one of the most common codec used to transmit video through a network as it provides a very efficient compression without sacrificing too much quality [11].

### B. *Network traffic*

Our measurements show that the Sony Remote Play uses UDP transport for both downstream and upstream traffic. This is an intuitive choice because a streaming service needs a fast transmission protocol without the overhead of reliable transmission protocols such as TCP [12, 13, 14, 15].

Table II depicts a comparison of the downstream and upstream bitrate for the four games under consideration. All the titles use similar amount of average bandwidth but we can still observe some differences.

TABLE II. NETWORK TRAFFIC CHARACTERISTICS

| PS4 Collected Data | Games | | | |
|---|---|---|---|---|
| | ***The Order*** | ***Titan*** | ***Driveclub*** | ***Infamous*** |
| DOWN (Mbps) | 7.67 | 6.88 | 7.64 | 8.62 |
| UP (Mbps) | 0.044 | 0.046 | 0.045 | 0.044 |
| DOWN (Packets/s) | 1055 | 1013 | 1058 | 1160 |
| UP (Packets/s) | 72 | 75 | 71 | 72 |
| DOWN AVG. Packet size (Byte) | 909 | 848 | 903 | 930 |
| UP AVG. Packet Size (Byte) | 77 | 78 | 79 | 77 |

The trend could be attributed to the streaming technology that Sony Remote Play uses, compressing the video stream for each game and genre. As an example, Driveclub uses more bandwidth than Titan with smaller variations during the measurements (Fig. 2 and Fig. 3). Indeed the former has less static and more complex areas than the later one because the background of the scenario is constantly moving. Regarding the downstream, Driveclub has bigger and more numerous packets as it can be observed in the entries "DOWN Packets/s" and "DOWN AVG. Packet size (Byte)" in Table II. The other two games indorse the above sentences because they exhibit a more static scene play.

Different considerations come into play in the upstream traffic. All the considered games use very similar small bandwidth to transmit the input commands from PSVita to PS4, denoting a regular behavior despite the different genres. The confirmation is given by the number and size of the packets that are similar for each game. A realistic hypothesis that could explain this is that the upstream packets are sent with certain regularity despite whether there was a real input or not.

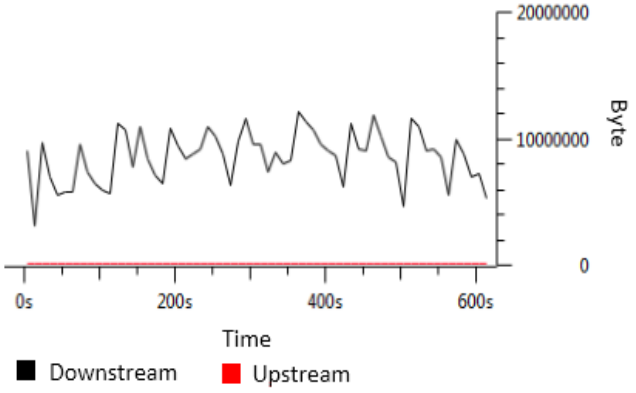


Fig. 2. *Downstream and Upstream flow for the game Titan*

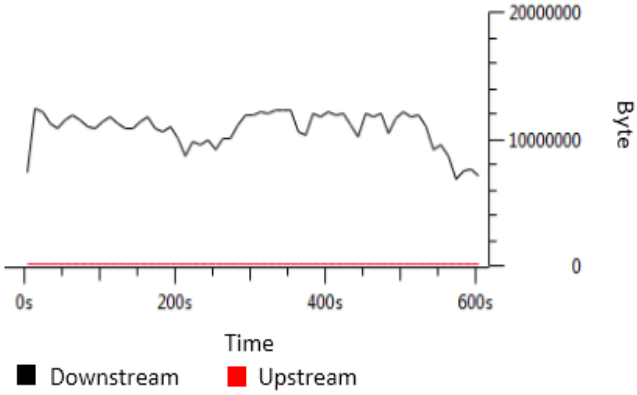


Fig. 3. *Downstream and Upstream flow for the game Driveclub*

### *C. Considerations on the service replication on the Internet*

After providing some evidence regarding the traffic patterns exhibited by the different game genres, we question whether it is feasible to replicate these services in the Internet, while guaranteeing the same gaming experience. From the measurements it is shown that on average 6Mbps are required. While these services are capable of adapting the video bitrate to the perceived network conditions, gaming quality could deteriorate.

Indeed, considering the study realized by Akamai [16] the average broadband access speed is about 3.9 Mbps, with a maximum value of 25.3 Mbps for South Korea. Moreover, another problem arises and it concerns the network congestion [17, 18, 19, 20]. Dedicated and specialized infrastructure is required to address this; however it comes at a cost. An important example in this regard comes from the OnLive service where the company encountered a very difficult moment due to the high cost of the server infrastructure [7].

## IV. CONCLUSIONS

Multimedia interactive services have evolved to become a potential key player in the game market. In our work, we analyzed the Sony Remote Play in-home entertainment system where the game play is enjoyed through a thin, multiplatform console with a video stream fed from a local controller. From the measurements we saw that the service exhibits slightly different behavior in downstream depending on the game genre under consideration. The use of the H.264 video codec plays an important role in this regard. Concerning the upstream traffic, fewer variations occur between the games, evidence that the game system transmits a constant stream of packets despite the fact that there is no real input entered by the user.

Considering the average bandwidth that an enjoyable gaming experience requires, providing a similar service through the Internet seems a challenge. This is due to the low average home access bandwidth and, of course, to the high costs of the infrastructure required. It follows that, for the moment, the game streaming services could not be a sustainable solution that can substitute the dedicated game devices as consoles and PCs.

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