Towards next generation network requirements for next generation gaming*

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ABSTRACT

The deployment of broadband networks and the growth of the number of connected users have caused the proliferation of new highly interactive multimedia multiuser applications (HIMMA). Networked games constitute one of the paradigms of HIMMA applications, specially thanks to the so called *next generation* gaming platforms, which integrate not only the game themselves but a set of additional services in a seamless way (presence, messaging, VoIP, video chat, etc.). This paper introduces a novel approach to evaluating the impact that next generation entertainment platforms produce in network requirements by performing traffic analysis and service characterization of several networked games available for the next generation entertainment system *Xbox 360*.

Categories and Subject Descriptors

C.4 [**Performance of Systems**]: Miscellaneous

Keywords

Networked games, Quality of Experience, multimedia traffic

1. INTRODUCTION

Nowadays, the development of broadband networks and the growth of the number of users have caused the introduction of new applications based on users interaction like video sharing, collaborative work or networked games.

Recent networked games receive the name of *next generation* games and are one of the best examples of interaction among users, integrating interactive high definition gaming, audio, video and other complementary services like presence and friend lists aimed at encouraging user participation. This way, it is necessary to perform an analysis that determines their impact in the network requirements and the creation of design guidelines to support this type of applications in the network.

As a next generation reference system we have chosen *Microsoft Xbox 360* and its online platform *Xbox Live* for being generalist (not bound to specific types of game), supporting several services (messaging, VoIP, video chat, IPTV, etc.) and counting with a large user base [1].

This paper firstly introduces the experimental setup and key points to evaluate during the research. Then, it provides a discussion about initial results based on bandwidth consumption of different games available for the reference system.

2. EXPERIMENTAL SETUP

A test scenario capable of analyzing the following aspects is proposed: architecture (centralized, p2p or hybrid), traffic (bandwidth consumption, packet lengths, etc.), effect of introducing audio and video conference in game, effect of type of game and number of players and effect of network conditions in quality of experience.

The scenario consist of a switch with port-mirroring to which two consoles with camera and headset are connected, as well as a machine with the *netem* network emulator and the protocol analyzer *Wireshark* installed. Additionally, this setup is connected to a broadband Internet connection so other users are accessible through the *Xbox Live* service.

With this scenario, measurements in both *Live* (Internet playing) and ad-hoc mode (LAN playing) are allowed, helping to isolate the network effects if required.

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3. RESULTS AND DISCUSSION

A first result set focused on the impact of introducing audio and video in networked games has been selected to start the discussion of network requirements in the analyzed system. Fig. 1 shows the upload bandwidth consumption of well known games depending on the number of players and active multimedia services (audio, video or just the game). Analyzed games are: the third person shooter *Gears of War* (GoW, the most active title in *Xbox Live* at the time of writing [2]), the racing game *Project Gotham Racing 3* (PGR3) and the pinball game *Pinball FX* (PFX). Currently, only PFX and a few board games like *UNO* and *Backgammon* support videoconference.

In first place, it should be noted the low game traffic of PFX without audio/video (about 2kbps for two players and 5kbps for four players). The reason is that each player plays in a different pinball table and the rest of the players only know his score, thus requiring less bandwidth for the game state. In fact, this is the game where audio and video introduction suppose the biggest impact in network requirements (doubling their bandwidth requirements after activating audio and multiplying by ten in case of introducing video). An apparently strange result is that PFX video in two players mode takes more bandwidth than in four players mode, the reason is that in four players mode the video is smaller to fit the screen and quality reduced.

In the case of GoW and PGR3, game traffic is on pair with other games like *Halo 2* [3], in the range of 15-30 kbps. An interesting point in PGR3 is that upload traffic for eight players is way larger than for two in comparison to GoW. Further analysis shows that, in PGR3 (and actually in PFX too), game related traffic is sent to all players at once from the client, making the bandwidth directly proportional to the number of users. In GoW, one of the players acts as server and receives traffic from all the other users, hence client upload traffic is practically independent on the number of players. In any case, it should be noted that there are no centralized servers to maintain the game state. Relying on a peer-to-peer architecture is viable thanks to the control of user terminals (which can execute signed code only), although puts more stress on user upload links.

While GoW and PGR3 do not support videoconference in game, its introduction would convert the multimedia component in the most significant one inside each packet of the games. In fact, by analyzing the packet length distribution we realize that game, audio and video information, in its case, are transmitted in the same packet flow (most probably to avoid overhead and save bandwidth). Unfortunately, sharing the same data flow for game, audio and video traffic makes the application of quality of service (QoS) mechanisms, like traffic differentiation, impossible. A design based on flow separation would allow next generation networks like the IP Multimedia Subsystem (IMS) [4] to give priority to game state traffic, maintaining the quality of experience for the player even if video packets are lost or delayed.

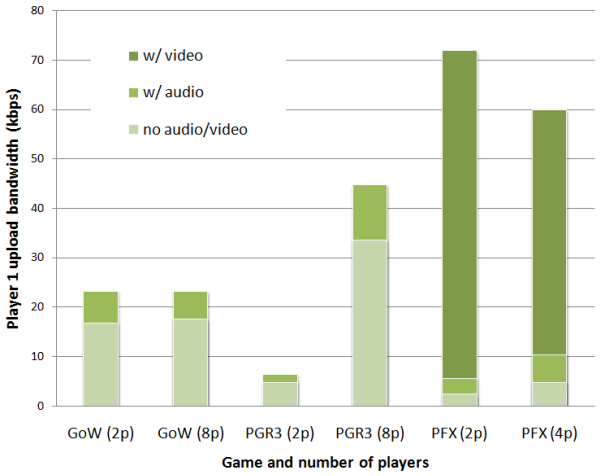

Figure 1: Upload bandwidth requirements

4. CONCLUSION

Although this short discussion has been focused on the average bandwidth and the architecture of the multiplayer solution for each analyzed game, some other important aspects are currently being studied with the proposed scenario like the impact of delay, jitter and other network parameters in the perception of the game quality.

Results will allow the characterization of the most important network parameters to support highly interactive multimedia multiuser applications like next generation games and elaborate network design and application guidelines to make the most of next generation networks.

5. REFERENCES

[1] Gameindustry.biz, *Xbox Live hits 7 million users*, `http://www.gamesindustry.biz/content_page.php?aid=26589`

[2] Xbox Live Blog, *LIVE Activity for week 8/6*, `http://www.majornelson.com/archive/2007/08/11/live-activity-for-week-of-8-6.aspx`

[3] Sebastian Zander and Grenville Armitage, *A traffic model for the Xbox game Halo 2*, In Proceedings of the international workshop on Network and operating systems support for digital audio and video, pages 13–18, 2005.

[4] A. Hernandez, M. Alvarez-Campana, E. Vazquez, and V. Olmedo, *The IP Multimedia Subsystem (IMS). Quality of service and performance simulation*, In Proceedings of the 14th Annual Workshop HPSUA, pages 142–151, 2007.