Empirical Measurements of Player QoS Sensitivity for the Xbox Game Halo2

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Abstract-**This technical report complements a previous study on the sensitivity of online gaming players to different network quality of service. It presents preliminary results we obtained regarding the user sensitivity to degraded network conditions and the impact of degraded network conditions on player performance for the Xbox game Halo 2. The results are compared to previous obtained for the games Xbox Halo and Quake 3.**

Keywords- User Sensitivity, Halo 2, Loss, Delay

I. INTRODUCTION

This document complements a previous empirical evaluation of how user sensitivity and playing performance depend on the quality of service in the network [1]. The previous study was based on the Xbox game Halo (first version of the game) and the PC game Quake 3. In this report we measure the QoS sensitivity and performance of players for Xbox Halo 2 (second version), and compare them with the previous results.

Section 2 presents the experimental approach, followed by the preliminary results in section 3. Section 4 concludes and outlines future work.

II. EXPERIMENTAL APPROACH

A. Data collection

We organized a number of game sessions for Halo 2. We had seven players playing each game. For each game the network was configured with either a constant packet loss rate or a constant delay (including zero loss and delay games).

The players were volunteers with different skill levels. The mean skill level was self-described as "intermediate" for online gaming and between "beginner" and "intermediate" for Halo 2 in particular, so actually most of the players were inexperienced.

We chose the map "Beaver Creek" for the trials, because this map is quite simple and has a medium size. At any time the players did not know the actual packet loss or delay values and to avoid a possible bias the sequence was randomly chosen from a set of loss and delay values (see section II.B). With a total of 4 Xboxes, six players were playing on the clients (two players on each Xbox) and one was playing on the server Xbox.

After the game each player had to note the following statistics:

– Perceived quality from 1 to 5, where 1 means bad and 5 excellent

– Opinion whether to continue playing under that conditions or rather leave the game

– Number of kills

– Number of deaths

– Server or client

The players were randomly rotated between games so that each player was playing some games on a client and some on a server. Each game lasted 5 minutes. All the games were done on the same map. The goal was to kill the highest number of other players. Once dead, a player comes back (respawns) to the game after 5 seconds.

B. Testbed setup

We used 4 Xboxes. Three of them were clients connected to a hub. This hub was also connected to FreeBSD PC configured as bridge, which was connected to the server Xbox. Dummynet was used to control the network delay and network loss on the FreeBSD PC.

The testbed is the same as in [1]. The configuration of the FreeBSD machine to use Dummynet was done with the help of [2].
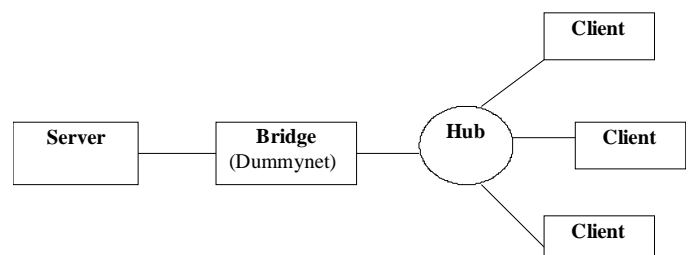

Figure 1: Testbed setup

We used following values for round trip times (RTT) and loss rates:

RTT(ms)	0, 100, 200, 300, 400, 500, 600
Loss (%)	0, 5, 10, 15, 20, 25, 30, 35

Table 1: RTTs and loss rates

These values are the same values used for Quake 3 in [1] because preliminary tests with Halo 2 showed that it can easily handle much higher loss rate than Halo.

In [1] four different trials were done with all the RTT and loss values. For this study only one trial was performed.

The testbed is the same for the new and the two previous experiments from [1], except for the number of players, which is roughly the same (Xbox Halo: 6, Quake 3: 8, Xbox Halo 2: 7). We also used a different map, because the one used for Halo does not exist anymore for Halo 2. However we have chosen a map that has similar properties in terms of size, available weapons etc.

III. EXPERIMENTAL RESULTS

This section shows the same statistics used in [1]. However, we had to omit some of the graphs used in [1] because of a lack of sample values. Because the results in this section are based on far less samples they should be treated with caution although the general trends would probably be similar.
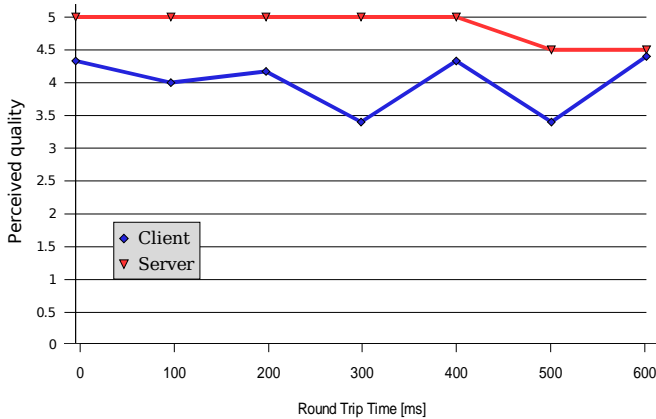
A. Player perceived quality

Figure 2: Mean perceived quality over Round Trip Time

Delay and loss seem to not have a strong impact on the players perceived quality (figures 2 and 3). Although there is a slight negative trend towards high delay and loss players still perceive the game as running nicely for high loss rates and large delays.

Compared to Halo [1], the game seems to have been much improved for network degradations. For Halo, a 2% of loss rate and a round trip time of 300ms imply bad perceived quality (quality level under 3), whereas for Halo 2 the perceived quality is never worse than 3.
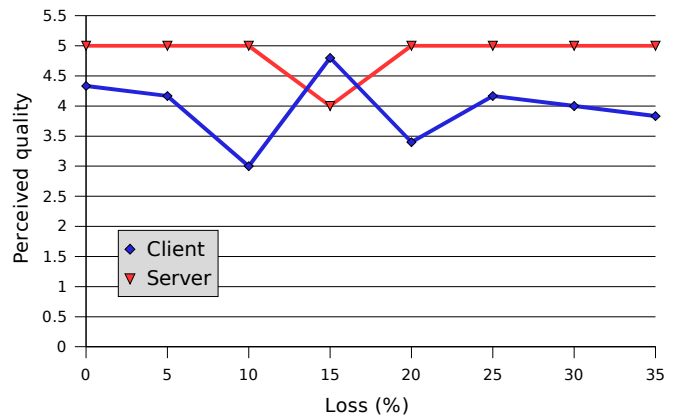

Figure 3: Mean perceived quality over loss

The good performance of Halo 2 in case of loss is similar to what was observed for Quake 3 in [1]. It is surprising however that players seem to have not noticed a quality degradation for high delays. A possible reason could be that Halo 2 is a very slow game compared to Quake 3 and therefore high latencies are less obvious to players. Our small number of samples makes it impossible to reach conclusion yet.

For each game we asked the players to indicate if they would like to stay or leave because of bad conditions. From the 7 players, only one (the most experienced and best performing player) wanted to leave because of bad quality. Actually, his will to leave did not correspond to the worst network conditions, and we assume it was more due to personal feelings.

B. Player performance

The following graphs (figures 4 and 5) show if the network degradations have an impact on player performance.
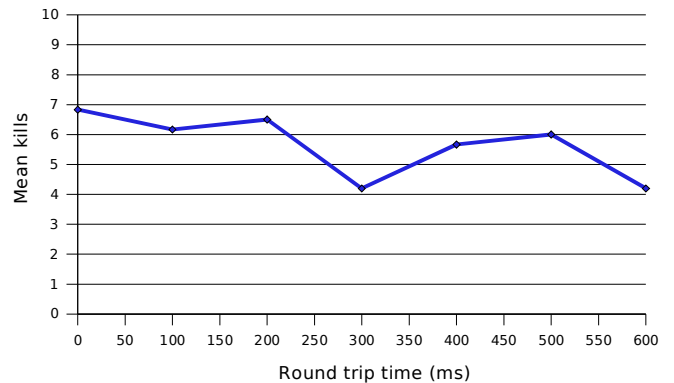

Figure 4: Mean kills over Round Trip Times

Player performance is impacted by both delay and loss similarly to the results found in [1]. Because of the small amount of data we used, we do not have a smooth slope. But the mean number of kills decreases with bad network conditions. The mean amount of kills per game per player over all games is 6.3.
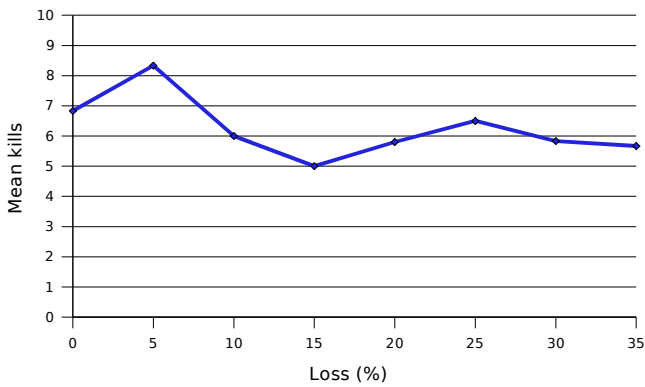
Figure 5: Mean kills over loss rate

In comparison to [1], we have nearly the same decrease for Halo and Halo 2 over RTT. High loss rates were not supported by Halo, whereas Halo 2 is still playable.

The next figures present mean kills per minute for two groups of players: the 3 best players and 3 worst players. We selected these groups for each game, by ranking the players by their number of kills during the considered game. Server players are not taken into account.
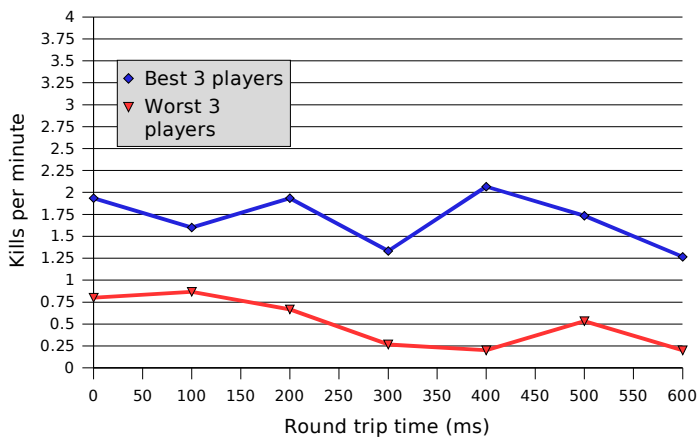

Figure 6: Mean kills per minute for different groups of players over Round Trip Times
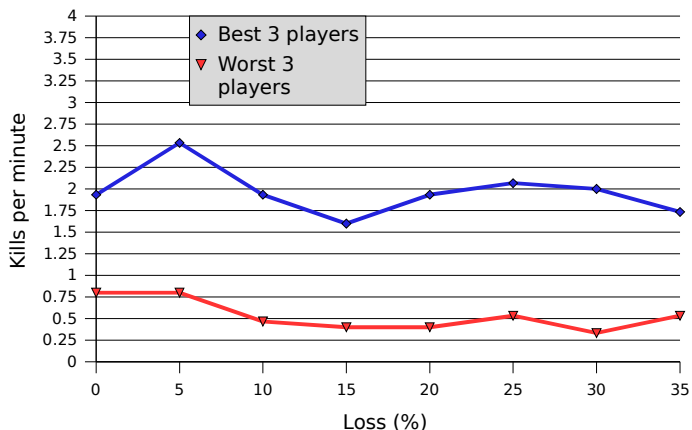

Figure 7: Mean kills per minute for different groups of players over loss rate

It seems there is a decreasing trend for the kill rate for both increasing RTT and loss rate. It also seems that delay has a larger negative impact on both player groups

and better performing players are affected more badly for large delay. Therefore the results seem to be very similar to those found in [1] but the low number of samples causes the graphs to show less clear trends. We do not show statistics for the best player because we have not enough data samples.

C. *Differences from player perception*

We suspect that a player's perception depends on the player's skill level. The next figures show the perceived quality for best players and worst players. This time we selected the groups differently. We used the total number of kills achieved in all the game and ranked the players accordingly. Again server players are not taken in account.
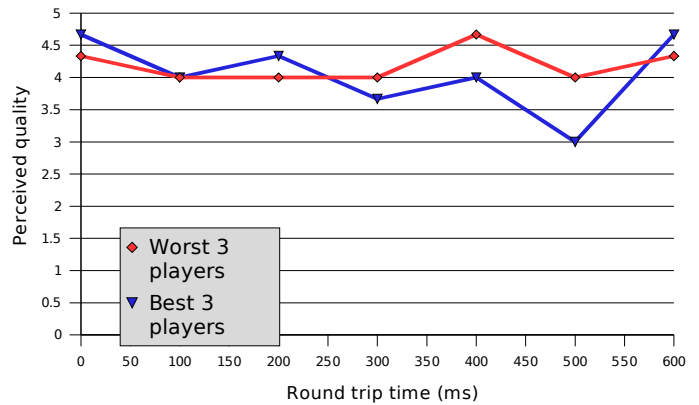

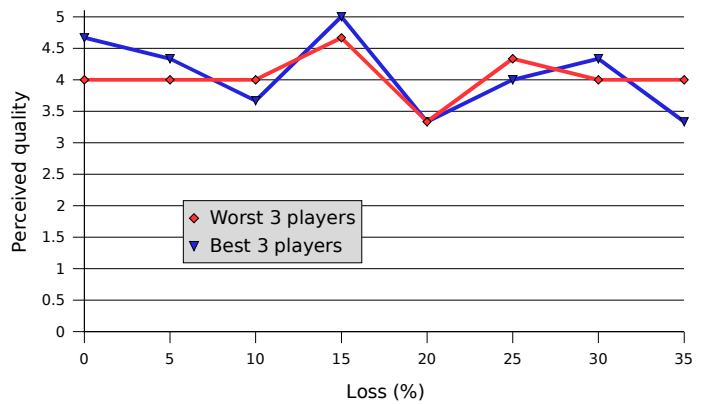**Figure 8: Mean perceived quality for different player groups over Round Trip Time**

Figure 9: Mean perceived quality for different player groups over loss rate

We cannot find any difference between the two groups over RTT as observed for Quake 3 in [1] (figure 8). This may have been caused by the fact that Halo 2 is very slow compared to PC games like Quake 3 or because we only have a very small amount of samples. There is no difference neither between the two groups of players for the mean perceived quality over loss rates. This result is similar to what was found in [1].

IV. CONCLUSIONS

The results we present in this paper are based on a fairly small number of samples allowing us to only conclude on some general trends found. The results for perceived quality indicate that Halo 2 seems to be much more resistant to bad network conditions than Halo. Perceived quality never decreases to less than 3, which means still playable. This is due to the fact that Halo 2 was implemented to support playing over the Internet. It now hides latency by immediately updating the clients state on the display whereas in Halo a state update on the client was displayed after a full RTT between client and server. Also Halo 2 does not suffer from loss with screen freezes or hangs as Halo did.

Because Halo 2 now uses similar mechanisms than Quake 3 to hide latency and loss we would expect similar perceived quality and player performance. While for both games the players perceived quality is not much affected by loss, it is very surprising that Halo 2 players experience no problems at high latencies whereas Quake 3 players do [1]. A possible explanation could be that either our study is biased because all our players were rather inexperienced playing Xbox, or the fact that the game is very slow makes latency less obvious to players. However, the impact of latency and loss on the players performance seems to be similar to what was previously measured for Quake 3.

To improve the quality of the analysis we need to collect more data. At least three more trials (with the same number of games and same delay and loss values) are necessary to get the same number of samples as [1]. We think it is not feasible to have more than 8 players playing at the same time because then some players would only play on a quarter of the screen. Playing on such a tiny screen could reduce their sensitivity and performance.

V. ACKNOWLEDGMENTS

VI. REFERENCES

[1]   S. Zander, G. Armitage, "Empirically Measuring the QoS sensitivity of Interactive Online Game Players ", Australian Telcommunications Network and Applications Conference 2004, Sydney, Australia, December 2004.

[2]   A.M. Pavlicic, "Dummynet on the Genius Bridge Machine", CAIA Technical Report 040429A, April 2004.