Modelling Network Latency and Online Video Gamers' Satisfaction with Machine Learning

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***Abstract*—The Gamer's Private Network (GPN) technology improves and stabilizes latency of communication between players and servers in online video games, especially when players are distributed worldwide. Latency is known to be the most critical factor in gaming quality of experience. We investigate GPN latency improvement over normal internet and its relationship to player satisfaction using complex, massive data sets, machine learning techniques, and game *genres* or *types*. The conclusions confirm the added value of GPN technology for players but also quantify how it meets the exact needs of specific game types.**

***Index Terms*—video games, big data analytics, big data search and discovery, deep learning applications, industrial applications**

I. Introduction and Previous Work

The Gamer's Private Network (GPN) technology of WTFast improves normal internet connections between video game servers and players that are distributed worldwide and require stable, low latencies.

Latency reduction is both the heart of WTFast's business and the key quality feature of games networks. This dimension has been studied for many years [1] and in their recent paper [2], Saldana and Suznjevic confirm the necessity of low latency, even above that of bandwidth throughput, for player engagement in almost every kind of online game. The main genres/types for online video games according to [3] are: First

Then we asked how our data analysis can be connected with the genres of games being played, so as to relate networking performance i.e. quality of service, with actual gaming quality of experience. That work provides a hint of the vast and hidden[1] set of factors that make low and stable latency (our measure of quality of service (QoS)), not only a necessary but also a *sufficient* factor for gamer satisfaction or *quality of experience (QoE)*.

II. Dataset and Latency: Quality of Service Analysis

The data used for the analysis described here was the record of the WTFast game sessions in July 2020. The original raw data has 64,000 rows with sixty-eight columns of which fifteen were selected. The total geographical distance between the gamer, nodes (intermediate routers), and the game server was

Fig. 1. Game types, or nodes in the lattice of game genres.

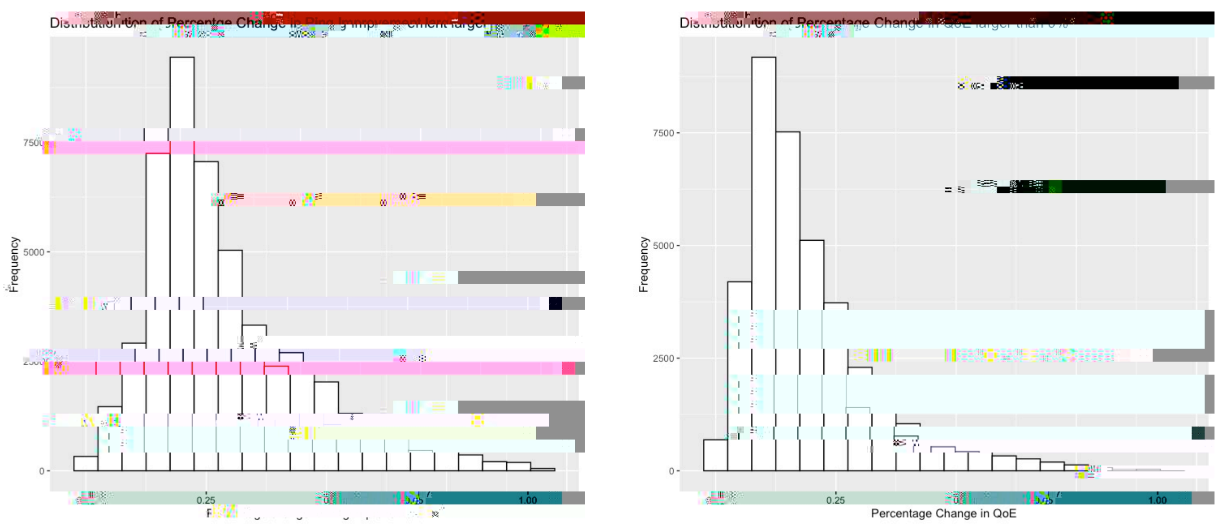

Fig. 2. Histogram of Ping Improvement (provided by GPN over internet) and Delta QoE where it is larger than 0%.

ping improvement. We can conclude that this leftward shift is the effect from game sensitivity to latency.

V. Machine Learning Models for Classifying

same unit. We also used a binning technique on some of these transformed variables to convert them into categorical variables. This categorizing process results in information loss so only the following four variables are categorized: BYTES_UP_TCP, BYTES_UP_UDP, BYTES_DOWN_TCP, and BYTES_DOWN_UDP. To model the impact of these variables on network latency of game sessions, we use these variables as features to classify network latency categories (Very Fast, Fast, Medium, Slow, Ineffective) through a number of ML models based on ping value of the game sessions under the GPN.

Sixty percent of the dataset, which has over forty thousand records, was randomly selected and used as training data for the development of the models. The remaining forty percent were used for testing the models' performance. This sixty/forty percent split is considered typical in machine learning model development.

We developed many ML models for classifying network latency under GPN. These models were built around SVM, random-forest and 4-6 layer neural net algorithms. Many variants of these models were compared for accuracy of classification and the best average accuracy rate is around 91%, thus demonstrating the feasibility of such classification models, as seen in Table I [13]. In addition, the experiments also show that in general random forest models perform better than neural nets and SVM for this data set.

TABLE I
THE BEST MACHINE LEARNING MODELS FOR PING VALUE CLASSIFICATION BASED ON AVERAGE ACCURACY RATE

ML Algorithm	Av. Acc.
Random Forest (Trees: 175, Max. depth: 30)	90.94%
Random Forest (Trees: 200, Max. depth: 30)	90.94%
Multiple Layer Perceptron (Two Inputs Model)	90.12%
Support Vector Machine (Gamma: Scale, C:5)	87.93%

Future work on machine learning will aim at applying the lessons learned in the above experiments for the development of optimal ML models and integrating them into the real-time routing algorithms of GPN, as a kind of latency prevention system in the spirit of [14].

VI. CONCLUSIONS

Video gaming is a niche specialty for data analysis so our data analysis and machine learning experiments appear to be the only ones of their kind, at least in the public domain and with relatively large and detailed datasets.

From the point of view of the routing technology, we confirm the value of GPN for players but quantify its current imperfections in meeting the exact needs of specific game types. We also confirm that high-quality predictors for latency are possible, and that random forest algorithm seems to perform better than neural nets or support vector machines in this setting.

Finally, we have made our first steps in the direction of a rational study of game genres as they relate to latency, with the goal of defining a useful and objective quality of experience of GPN users without infringing on the privacy of their gaming experience.

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