Hack, Slash, and Chat: A study of players' behavior and communication in MMORPGs

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Abstract—This paper presents an analysis of player behavior in a Massively Multiplayer Online Role-Playing Game (MMORPG). We examine player behavior in terms of when, how much, and what they do in the virtual world. Player behavior is described through previously defined action categories for MMORPGs (*Trading, Questing, Dungeons, Raiding, and Player versus Player (PvP) Combat*) with addition of a new category for text and voice communication within a session. We conduct a player survey and perform measurements on the client side for a group of 104 players of a popular MMORPG - World of Warcraft (WoW), and discover that there are significant patterns in player behavior. Additionally we examine the importance of both voice and textual (chat) communication in MMORPGs, and note that communication makes a significant portion of average player's playtime and that voice communication is used by a large portion of players. We believe that the results of this study may be used for improving the existing and design of new MMORPGs (e.g., building better load balancing algorithms, addition of content that is more interesting for players) with more emphasis on both old and new communication aspects of the game (e.g., inbuilt voice clients, new ways of connecting the players). This work also serves as a starting point for better insight into networking requirements for such applications, which may be useful for service and network providers.

Index Terms—MMORPG, Session Characterization

I. INTRODUCTION

Massively Multiplayer Online Role-Playing Games (MMORPGs) are large virtual worlds where players interact with each other and with the virtual environment. In our previous research [13], [14] we have identified different types of players' actions and grouped them into five categories: *Questing, Dungeons, Raiding, Trading (and Professions related actions), and Player versus Player (PvP) combat*. We have identified the network characteristics for each action category, as well as the session characteristics in terms of ratio of specific action category. MMORPG that served as a case study was World of Warcraft (WoW) by Blizzard Entertainment.

This paper continues the work of examining quantitative properties and time dependencies of a specific action category (daily, weekly, and in the whole time period), using a larger player sample (104 players) and in a different time frame. Namely, our previous measurements were taken at the time when the game was just updated with a new expansion ("Wrath of the Lich King") which brought a large amount of new content. Measurements taken for this work were in a stationary period as related to the game release, where by "stationary" we mean a time period in which the players have, in general, become familiar with the current game content and new content has not been added recently. (Our monitoring period was from May 5, 2009 to June 21, 2009. The previous content patch was applied on April 14, 2009.) We have also introduced and investigated another action category, termed *Communication*, to determine how important is the social aspect of the game, and how much players communicate with each other by using text or voice. Also, the players participated in a survey regarding their use of voice communication through various Voice over Internet Protocol (VoIP) clients (inbuilt in WoW client and independent alike). Measurements were taken on the client side through the use WSA-Logger, our WoW add-on which tracked the player behavior.

We aim to determine players' behavior patterns which can be very significant in modeling MMORPG systems for better performance, utilization of network links, and server infrastructure. MMORPG designers can also use the data about what interests the players mostly, in order to deliver more fun and attractive games. Data about the communication can be used to describe the importance of the social aspect of the game.

II. RELATED WORK

We now briefly summarize the findings in related research work in the areas of session characteristics and social aspects of the MMORPG. An analysis of WoW player's game hours, using a trace sample gathered for almost two years, was done by Tarng, Chen, and Huang [15]. Additionally, they investigate whether it is possible to predict player subscription time. Zhuang, Bharambe, Pang, and Seshan [17] gathered data with the help of a WoW add-on for five months; from that dataset they calculated player availability, inter-arrival times, and geographical distribution of players in the virtual world. Pittman and GauthierDickey [12] also measured geographical distribution of players in WoW. Feng, Brandt and Saha [9] have studied the trace of MMORPG EVE Online which was provided to them by the publisher of the game (CCP). Their research was focused on prediction of the workload and predictability of players' disinterest in the game. Chen and Lei [6] studied player interaction and stated that social

interaction has strong relationship with players' game time. Our approach to player session characterization differs from others in that we determine exactly what the players have done in the virtual world and for how long, as opposed to examining overall session time. We also have higher precision, compared to related work listed here (i.e., 1 second, as opposed to 10 and 5 minutes), as well as accuracy, since we exactly determine the actions taken by a specific player regardless of his/her current game character. Also, our data collection is distributed, as we collect data on players' computers and not on the game server. Importance of MMORPGs' social aspect has been studied intensively. Kang, Ko I. and Ko Y. [10] study the impact of social support of guilds on players' game flow and loyalty. Ducheneaut, Yee, Nickell and Moore [8] study social relations and find that joint activities are not so prevalent, especially in the early game stages. Chen and Duh [7] map social interaction in WoW through self-other relationship. To the best of our knowledge no work has been done in order to quantitatively describe the social component through measuring actual players' communication, time which we by monitoring outgoing messages and the player survey on voice communication.

III. Action Categories

In a MMORPG, the player typically controls a virtual character (avatar) which represents the player in the virtual world. Players may perform a variety of actions, which typically differ depending on the game content. Nevertheless, several key fundamental elements, which are common for the most MMORPGs, may be identified: progression or advancement in player's level, social interaction, in game culture, and character customization. We defined specific action categories in our previous work [13], [14], with focus on player progression, and based on a number of actively participating players, cooperation required, dynamics of player input, mobility of the character, number of active Non-Player Characters (NPCs), combat requirements, and communication aspect. These action categories have been defined for WoW, but are considered to be applicable to MMORGPS in general:

Trading: Exchange of virtual goods, between two players directly or through auction system, and creation of virtual items.

Questing: Solving different tasks given by NPCs for specific rewards (e.g., experience and virtual items). Mostly single player activity.

Dungeons: Combat between small group of players and hostile NPCs, in specific instances (i.e. isolated portion of the virtual world replicated for each group of players) which allow no interruption or help from players outside that group. Primary small group activity.

Raiding: Fighting among large group of players and more difficult and complex NPCs. Similar to *Dungeons* but larger on all scales. As the complexity of the task increases so does the value of the prizes, therefore *Raiding* yields the best rewards.

PvP combat: Combat between players in instanced or not instanced battlefields. Player count may vary significantly.

In order to determine the importance of communication we have defined a new action type, termed *Communication*. We take that the player is communicating when messages are sent through the inbuilt chat client. Received messages are not looked at, as the player is by default subscribed to (joined in) many chat channels in which he may (or not) participate but the messages are always received. As players chat with each other most of the time during play, their communication is typically interleaved with other action categories (e.g., the portion of the time that players spent in *Questing* category is also a time they spent communicating).

Additionally, in our previous research we have identified some parts of the data as remaining uncategorized and for that we introduced an *Uncategorized* action category. Within this action category we further identify: 1) the time spent inactive, or Away From Keyboard (AFK), and 2) actions not belonging to any other category. The latter include actions of continuous killing monsters for profit, gathering virtual items (e.g., ore for smelting, or herbs for potion making), exploring, or chasing achievements (e.g., gathering and eating one hundred specific chocolates).

IV. Methodology

For data gathering we used our add-on for WoW named WoW Session Activity Logger (WSA-Logger). WSA-Logger is developed using ACE3 framework [2] and Blizzard Entertainment's WoW Application Programming Interface (API) [3]. The measurement was done during a student project by which the participating students got extra credit for the course. The task of each student was to find five or more WoW players who would agree to participate in this research by installing WSA-Logger, to collect and organize data gathered by the add-on in their group, to perform a survey on their player sample, and write a report which summarized their findings. The total number of players in the survey was 104. No personal data about the participating players other than their age was gathered. This resulted in an (on average) younger player sample than the general population of MMORPG found by Williams et al. [16], as shown in Table I (average age 24 compared to average age 33, respectively). The biggest issue with distributing the add-on was the trust of the players who feared for the safety of their accounts. This was resolved by opening the source code of the add-on. Data about the characteristics of VoIP communication has been gathered through a simple survey which was done once per participating player. The questionnaire contained questions related to usage of VoIP

TABLE I
Players' sample age comparison

Age range	Our sample	Williams et al.
Teens 12-17	6.73%	6.45%
College-age 18-22	43.27%	12.40%
Young adult 23-29	38.46%	26.27%
Thirties 30-39	8.65%	36.39%
Forties 40-49	1.92%	12.40%
Fifty or older 50-65	0.96%	4.80%

tools in general, and with respect to each action category.

The add-on's function is to log the events fired by the WoW API when a certain action is performed in the virtual world. For example, the *Auction_House_Show* event is fired once the auction interface (used for trading) is displayed and the WSA-Logger notes the date, time, and player action type as *Trading*. The complete list of events is listed in WoW API [3]. More about the functionality of WSA-Logger can be found in our previous work [13].

Compared to the previous versions, the functionality of WSA-Logger has been extended. All outgoing messages are now tracked, which enables us to analyze how much players communicate. The downside is that the log files generated by the add-on have significantly increased in size. Second modification was made in order to increase the precision of the add-on. The previous version tracked time based only on *GetGameTime()* method from WoW API, which only returned time in hours and minutes. By using an additional library [1], we have increased the precision to one second. The only disadvantage of the library is that for the very first minute of the session, seconds are not tracked [1]. Compared to other work in this area, this is currently the highest achievable event monitoring precision.

For the action categorization, we developed a log file parser in Java. We define a "session segment" as a part of the playing session in which the player performs only actions from a specific category. Session segments of *Dungeons*, *Raiding*, and instanced *PvP combat* have been labeled with their start and end time (there are specific events labeling entrance and exit from the instanced areas), and segments of *Questing*, *Trading*, *Communication*, and non-instanced *PvP combat* are noted as chain of events. So, one *Raiding* segment is represented with the time between entrance and exit of the raiding instance. If a player has entered a raiding instance subsequently, it is treated as one *Raiding* segment. For non-instanced categories, such as *Trading*, an action specific session segment is defined as the time between the

first and the last event in the chain of events of the same category. Time between two events of different categories is labeled as belonging to the second category, as we assume that the change of context occurs when the player performs last action in the sequence of actions of one type [13]. If the time between two events of a specific category is larger than 5 minutes, that period is labeled as *Uncategorized*.

Action category *Communication* differs from the previously defined five categories in that it is interleaved, i.e., it happens in parallel with other actions. Thus, it is also monitored in parallel with all other actions, by collecting outgoing messages. If the time between sending two messages is shorter than 5 minutes, it is added to the ongoing communicating session, and if it is longer, it is discarded. A given *Communication* session is considered to end when no messages are sent for five minutes.

Figure 1 illustrates how the duration of a specific action category within a session is determined. Part a) shows sequential actions. The following example illustrates the relationship between events in WoW API and action categories. Players enter the instance ($\underline{a_1}$) of *Dungeons* category (action type 1 in the figure). After defeating the opponents and exiting the instance ($\underline{a_1}$), players go into town to perform some *Trading* actions (action type 2). They repair equipment ($\underline{a_2}$), sell unneeded items (a_2), and store the needed ones in the bank ($\underline{a_2}$). The time period between exiting the instance and repairing is shorter than the timeout period, so it is assigned to the latest action category. After the player has stored the items in the bank, the player rest for a while. The time between him starting the next action ($\underline{a_3}$) turns out to be longer than the timeout period and it is thus labeled as *Uncategorized*. Part b) shows Communication as an interleaved action. For example, while in a dungeon (period $\underline{a_1}$–$\underline{a_1}$), the players encounter a hard NPC opponent and are discussing the tactics to defeat it (period $\underline{c}$–$\underline{c}$). This time period is assigned to *Communication* while at the same time being a part of *Dungeons*. Later, while in town, the players start to chat and that initiates the second communication segment (another *Communication* period in parallel to action type 2 and beyond).
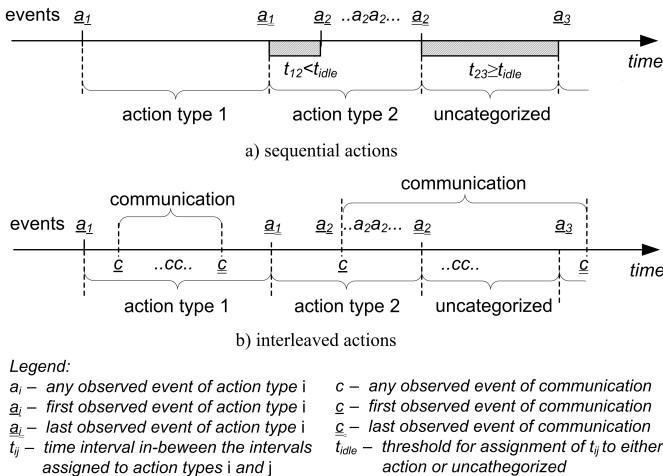

Fig. 1. Determining the duration of a specific action within a session

V. RESULTS

From the data we gathered with WSA-Logger we extracted the statistical characteristics of all action categories, the session duration time, the behavior of players during the day, during the week, and during the whole monitored period. From the data gathered throughout the survey we extracted the values about usage of VoIP clients and how often people use voice communication depending on the action category.

A. Importance of communication

The acquired data consists of 11775 individual sessions. We define a session as comprising all events and player's

actions during the time between login and logout of a specific character. Note that one player may have a number of alternative characters which can be either played as such or, more often, used for storing and trading virtual items (e.g., one of the participating players has 5 alt (alternative) characters specifically for storing and trading purposes, while he actively plays only one character, his "main"). The mean session time is 56.17 minutes with the longest session lasting over 16 hours, which is consistent with the results of our previous research with average value of 54.92 minutes [13]. The median is 25.41 minutes. Related work states different medians of session length of 1.8 hours and 50 minutes, but with different measurement precision: 10 and 5 minutes, respectively [15], [17]. Pittman et al. [12] found that more than 50% of sessions are shorter than 15 minutes, by using *friends* list to achieve granularity of approximately 30 seconds. The difference of the times in the literature can stem from the precision of a particular measurement. In order to disregard effects of disconnecting, reloging, and using alts, we treated all sequential sessions that had less than 5 minutes between player's logout and a new login as one session. By applying this method, the median time increased to 71 minutes. If we disregard all sessions lasting under 10 minutes, it was increased to 90 minutes. Statistical time characteristics of a specific category can be observed in Figure 2, which consists out of two parts, first illustrating the lower values and second illustrating overall values with maximum values included.

In our effort to better determine the time characteristics of a specific action category and decrease the effect of interleaving actions (e.g., handing in quests that yield honor points which can be tracked as *Questing* and *PvP combat*), we have added some limitations to the minimum value of a specific category.
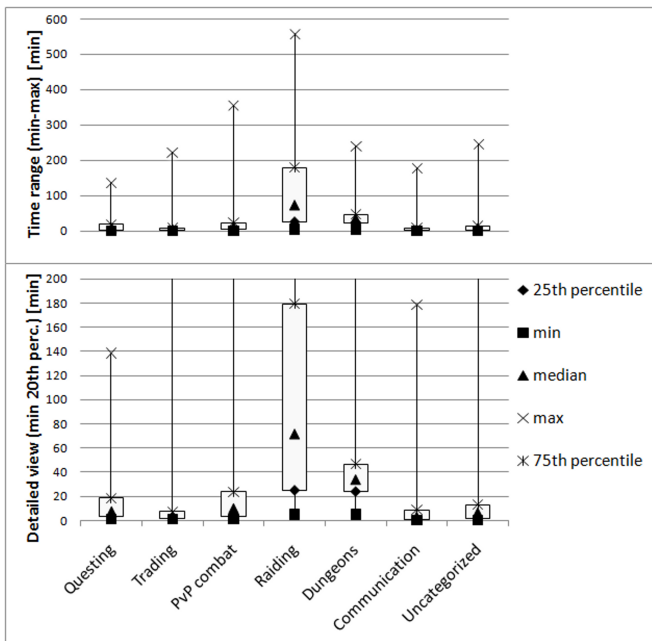

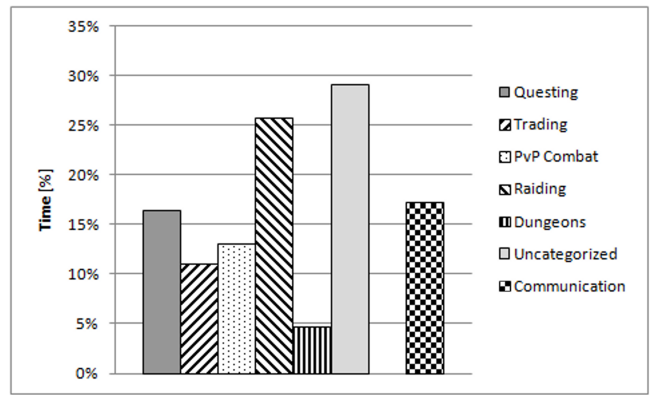Fig. 2.   Statistics of time length for particular player actions

Fig. 3.   Percentage of time spent playing per category

Minimal values for *Dungeons* and *Raiding* were set to five minutes, as it is almost impossible to reach and defeat main NPC enemies in those instances in less time. Limits on other actions were set to one minute. Related to our previous research [13], *Dungeons* tend to be shorter, probably due to the fact that game content is not new anymore, and players are generally more powerful (i.e. players got better equipment), so they can complete tasks in less time. On the other hand, *Raiding* has longer duration. As players hit the level cap they can only improve through obtaining better equipment, first from dungeons and after that only through raiding, which results in longer raiding sessions. The rest of the activities have similar or slightly shorter times. The same relations amongst categories remain with *Raiding* as the longest activity, followed by *Dungeons* and *PvP combat*. As we can see from Figure 3, we have more than 70% of the session time categorized. The results show that players have spent most of their playtime raiding, followed by communicating. It should be noted that *Communication* is an interleaved activity (i.e. the time spent communicating is also a portion of time of each other category). Written (text chat) communication has been tracked by noting every outgoing message. WoW client has simple and effective chat mechanisms. There are several chat commands which enable communication amongst players. Communication command */say* is used to communicate with people who are nearby in the virtual world, */yell* is a similar command allowing the people on a larger virtual territory to see the message. Players joined in a guild can always communicate with each other, no matter of their position in the virtual world through a specific, guild-only channel. Players can also use private chat channels to talk to each other. In general, there are many channels and players can easily create new ones. In addition to text messages, there are "emotes", messages which are done by the virtual character (e.g., */wave* causes the character to wave). We tracked all channels as well as the emotes, and have recorded 456228 messages. Results depicted in Figure 4 show that message sending is, in general, bursty. According to the player survey results, voice communication is used by more than 94% of the participating players. Players were also asked which program they use for
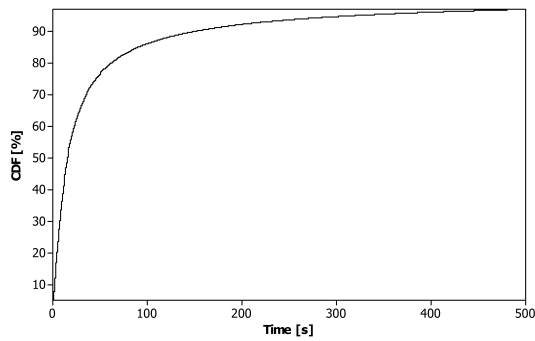
Fig. 4. CDF of time between sending two subsequent messages

Fig. 6. Proportion of action categories through hours of a day

voice communication (multiple answers were allowed). The most popular program in the observed player group is Ventrilo (75%), followed by Team Speak (21%). Approximately 11% of players use Skype. It is also interesting to note that only 16% of the players use VoIP client that is inbuilt into WoW - Voice Chat, indicating that the Blizzard's VoIP solution is not well accepted among the players, although it was deployed almost a year ago. One of the disadvantages of the inbuilt voice chat is that it is disabled when a player exits WoW client, so if a player is disconnected from the game server during combat, voice communication is interrupted as well. For players, it is often useful to maintain communication even when they are disconected from the game server, especially when difficult encounters have been completed and rewards are about to be distributed. Hence, most players tend to use independent programs, even at additional cost. In our survey, the players were asked how often they use voice communication depending on the action category. Importance of voice communication across action categories is shown in Figure 5. We can see that almost 70% of players always use voice communication while raiding, followed by *PvP combat* with almost 15%. Many raiding guilds have voice communication as mandatory, which may be one of the reasons for such high use of it while raiding. Players that participate in highly organized *PvP combat* (i.e. arena combat, or premade groups for battlegrounds) also often use voice communication for better coordination, which explains
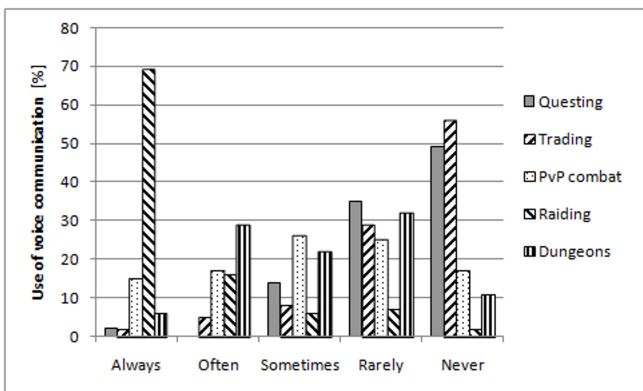
why *PvP combat* has second highest voice communication usage. *Questing* and *Trading* are simple and not group-based activities, which explains the fact that almost half of players never use voice communication in these situations.

B. Patterns of player behavior

Daily patterns are shown in Figure 6. *Raiding* shows the strongest pattern as it requires a highest number of specifically designated and organized people. It is usually done by guilds (i.e., player organizations) which tend to be rather small, with average size of 16.8 and 90th percentile of the distribution of 35 players [8]. Also, *Raiding* needs a group of 10 or 25 members (even 40 in original WoW without expansions) so that is how many people in the guild need to be present in order to start the raid. As opposed to *PvP combat* in which large groups of players are entering battlegrounds with the help of the game mechanics, in *Raiding* players need to organize themselves to play. As shown in Figure 6, *Raiding* shows a significant incline around 18:00 and starts to decline around 23:00, corresponding to the availability of players. This could be expected since the average player's age in our sample is 24, so it may be presumed that most of them work or attend classes during the day.

In Figure 7 weekly patterns are illustrated and we notice slightly higher overall playtimes on Sundays and a specific weekly raiding pattern. Thursdays have highest *Raiding* activ-

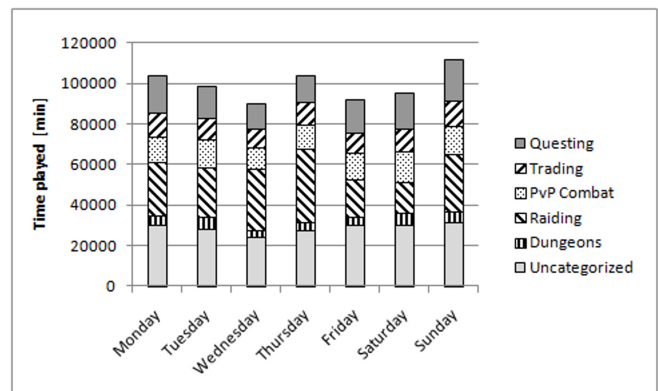
Fig. 5. Usage of voice communication per category

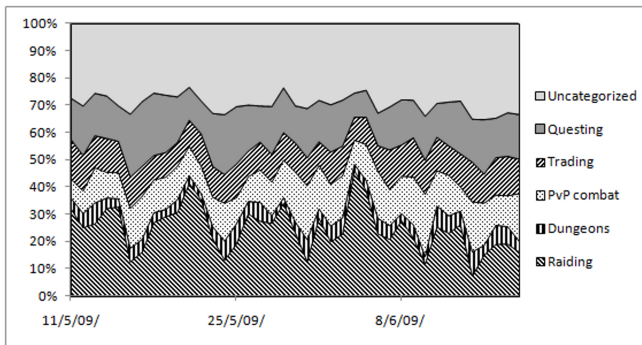Fig. 7. Proportion of action categories through days of a week

Fig. 8. Proportion of action categories through whole monitored period

ity, which has lower values on Fridays and Saturdays. The rest of the activities are evenly divided across days of the week. The proportion of a specific action category throughout the whole measured period is shown in Figure 8. The weekly pattern is easily discernible in the graph. For an interested reader, one can compare and see that this period is indeed "stationary", as opposed to the period we examined in our previous research [13].

VI. SUMMARY AND CONCLUSION

We have performed player action categorization using a group of 104 players playing WoW, a popular MMORPG through our add-on WSA-Logger. We have also tried to evaluate the importance of player to player communication, both in written (chat) and vocal (VoIP) form. Our summarized findings are as follows:

- Patterns in daily and weekly activities which can be used to enhance already proposed [4], [5], [11] virtual world partitioning mechanisms.
- Importance of VoIP communication for players is high, which suggests the need for high quality VoIP solutions.
- Characteristics of written communication serve as a quantitative proof that the social component is an important parameter affecting overall MMORPG popularity.
- Percentage of certain actions categories in a MMORPG should point the developers to focus on the content which is the most interesting to the user.

We also discovered significant differences amongst players (e.g., there were players that spent almost 80% of their time in *PvP combat* while others had under 2% in this category), and in our future work we will aim to understand why some players spend so much time in specific categories and how this affects the network traffic characteristics. Designing a model of player specific traffic generator, which will reflect the behavior of certain player types on the traffic generated by them, is our next goal.

VII. ACKNOWLEDGMENTS

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