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Review

Packet-level traffic analysis of online games from the genre characteristics perspective

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ABSTRACT

Recent online games exert increasing impact on network traffic. While considerable research efforts have been placed on the study of game network traffic, most studies examine either only a small sample of games or games within a specific genre. This paper aims to utilize extensive resources of all notable research studies on online game traffic published over the last decade, and obtain a critical understanding of traffic pattern from game genre perspective. A general classification will be given according to game genres in order to highlight the characteristics pertaining to different game types. Network traffic studies for various game genres will be analyzed individually in the packet level, i.e. interarrival time and packet size. Having highlighted the current research gaps on game network traffic study, this paper will also provide suggestions on areas worthy of future research. The research outcomes from previous studies, despite having some minor discrepancies, have evidenced major commonalities that offer consistent perspectives of online game traffic. These results can be correlated as a guide for general traffic modeling for each game genre that depicts the characteristics of network traffic trends.

Contents

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1. Introduction

The growth of online game traffic over the last decade has placed a notable impact on today's Internet infrastructure, which has drawn the attention of academic researchers across numerous disciplines. Fueled by increasing provisions and consumer uptake of broadband Internet, the market value of online gaming for 2011 is expected to overtake 2003 by approximately 50% (Business Insights, 2009). The term massively multiplayer online game (MMOG) has become extremely popular in recent years. MMOGs extend the gaming experience from being confined to single or a few players to thousands of people who may participate and interact online simultaneously. By 2008, the total active subscriptions of MMOGs reached over sixteen million users (http://www.mmogchart.com). As a result of the rising popularity of MMOGs, there has been a growing impact placed upon Internet traffic. With the ever escalating complexities of the latest games, including essential aspects such as graphics, sound, physics models, and gameplay, more information needs to be transported over the network, of which represents a considerable portion of Internet traffic load. Consequently, increasing efforts have been placed on investigating and characterizing network game traffic patterns in order to evaluate the requirements and provisions necessary for MMOGs.

At present, most studies examine only one or a limited number of games. Research in Ratti et al. (2010) reviewed over 20 different games, but all belong to first-person shooting (FPS) game category, and there exist a range of numerous other different game genres. Hence there is a lack of a broader, more comprehensive classification of online game traffic patterns which takes into account the various types of MMOGs. The main motivation behind this article is thus to incorporate all existing and significant studies in the field of game network traffic in order to produce a more wholesome reflection of the characteristics pertaining to individual game genres. This is achieved by utilizing sample statistics from relevant studies, from where a collective analysis is carried out for specific game types.

Despite the healthy quantity of research that has been published in this area since 2000, most articles tend to focus on the measurement and modeling of network traffic from a network engineering perspective, while comparatively little attention was placed on explaining and justifying why game network traffic behaved in a specific way. Hence, in addition to the comparison and analysis of existing research results, the value of this paper is that it attempts to obtain a critical understanding of game network traffic behavior according to the specific characteristics residing among various game genres.

This paper intends to appeal to a range of potential readers. With the increasing popularity of MMOGs, game network study has become an emerging topic area. Hence, the work in this paper is suitable for general researchers who have just entered the field and wish to obtain a comprehensive overview of game network traffic profiles as means of stimulating further studies. Naturally, network service providers are also likely to be interested as the paper can provide them with a broader reflection of game traffic behaviors for specific game types, and inform of the likely effects of network game traffic on service provision. Game designers may also find practical uses for the outcomes in this paper in terms of the potential impact of the intricacies and requirements of networks on game design.

The purpose of this paper is to review and analyze the existing research on MMOG network traffic studies in order to provide a fundamental tutorial paper for the target readers mentioned above. The following section provides a general classification of MMOG genres. Section 3 explains the research methodology, and explores current research resources in the field of online game traffic. Sections 4–9 analyze network traffic of each game genre based on their unique characteristics. Section 10 gives an overall comparisons for all the game genres that have been studied. Section 11 suggests the possible future research trends in MMOG network area. Section 12 concludes the paper.

2. Genres of massively multi-player online games

Although game network traffic for various games may not share similar characteristics, game traffic models are affected by several parameters. Firstly, traffic intensity is largely affected by a game's style or characteristics. Some games require real-time reactions (such as fast-paced shooting or action games), while others afford players more time to make decisions (such as role playing or strategy games). Secondly, the design of a game can also represent a critical factor in the game's overall performance over a network. An efficiently designed game is more likely to send less traffic across the network in order to avoid any potential bandwidth limitations. Moreover, some researchers have argued that user experience also places a significant impact on traffic characteristics (Szabo et al., 2009; Henderson and Bhatti, 2001). Theoretically, all these parameters may be used to define genres of online games according to their technical or network requirements. MMOGs can be classified into a few different genres including First Person Shooter (FPS) games, Massively multiplayer online role-playing games (MMORPGs), Massively multiplayer online role-playing games (MMORPGs), Massively Multiplayer Online Racing (MMOR) games, sports games, Massively multiplayer online social games (MMOSG), fighting games and puzzle games. Detailed descriptions of all these genres are shown in Table 1.

The network architecture that a game relies on will determine traffic flow and distribution. For server-based games, each game station (i.e. the host PC or game console) exchanges control data and provides updates from a centralized server which could represent a bottleneck. As for games based on peer-to-peer networks, game stations communicate directly with each other, and hence multicast or broadcast features are only used when necessary. Online game networks are mostly server based. Even in a peer-to-peer game network architecture, there has to be at least one server to regulate player registration, as in the case for sports games. Regardless of genre, online game applications tend to use User Datagram Protocol (UDP) to transmit short and frequent data