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Aspects of Networking in Multiplayer Computer Games
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This paper, published in 2002, was written in attempt to shine the academic light on problems with multiplayer computer games (MCGs) as according to the paper, previously there almost was no publicly available research with respect to networking and MCGs. The paper covers topics from network resources, to methods of distribution, to scalability issues and finally security in gaming from the network perspective. None of these areas are covered in sufficient detail, nonetheless the paper does achieve its goal of brining attention to them.

The section on network resources highlights that bandwidth, latency and computational power are the primary resource limitations for MCGs. The paper mentions that acceptable latencies are between .1 and 1 second but later contradict that to say different applications have different latency requirements. The section on computational power is incredibly small, cites another source and doesn't seem to contribute any of their own work, other than making an unjustified claim that packet delivery demands are unlikely to be met in the future.

The distribution concepts section lists three methods for synchronizing between players in a game. These are a simple central server method, peer to peer method, or a hybrid approach involving multiple servers which may be connected in a peer to peer fashion each serving a small portion of clients. These concepts are not new in this paper however, they do discuss how consistency and responsiveness vary across each approach.

The middle of the paper is where it actually gets interesting, though it's hard to tell if they are merely drawing attention to works of others or if these ideas are their ownl my estimate is the former. Anyhow, the interesting concepts are interest management where players' clients only request, or receive a subset of information, from the server(s) and dead reckoning in which updates are delayed, thus saving bandwidth, and activities are estimated based on past data.

The next section of the paper discusses scalability and Amdahl's Law. Again this presents nothing new, but rather just looks at it from the perspective of MCGs. The last section talks about security in MCGs and how one might prevent cheaters from performing replay attacks or directly modifying packets to their advantage. The authors' final suggestion was to use encryption thereby making the data difficult to modify. This suggestion is somewhat odd considering that they already mentioned the computational ability of the machines to be a limiting factor, not to mention added delay in encrypting and decrypting packets at each end.

Overall the paper brings light to concepts, which I would guess any MCG developer would figure out nearly immediately during testing. The paper would indeed save such developers a little time in the event they happened to come across this paper and wasn't already aware of the cited resources.

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A Traffic Characterization of Popular On-Line Games
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This paper presents an interesting measurement study completed in 2002 on traffic patterns in the first person shooter game Counter Strike. This paper is of particular interest to me as I played a considerable amount of Counter Strike just a few years after this data was collected and thus could relate and agree with many of their findings. One initial negative comment I have about the paper has to do with its 2005 publication date. It appears that this is a journal paper follow up to a previous paper with the addition of looking at a few other multiplayer first person shooters. While it's great the authors added that, the data collected for the additional parts was also from 2002 thus dating all the collection at over 2.5 years. Perhaps the fact that these games are still highly played made this point negligible.

The paper starts by discussing their choice of Counter Strike for a measurement study and their server setup. They immediately dive into how much data was collected and some of the basic stats from the data. The authors were quick to point out the relationship between number of packets in v. number of packets out as compared to the avg. size of packets in v. the avg. size of packets out from their server. This is a key point in their paper in that it shows the server has the ability to aggregate updates that are pushed to all users, whereas the clients are sending many tiny updates to the server.

The paper goes into detail about patterns broken down at different resolutions and correctly justifies anomalies through the different time dependent actions in the game such as map changes, or 50ms updates. The paper continues by looking at packet loads and bandwidth and then makes another key point which, is that gaming traffic is significantly different than the average internet traffic.

In one part of the paper, the authors look at the failure rate of players and speculate that some players could have been kicked early on due to excessive friendly-fire. What I find odd is that they didn't provide a number to what percentage of users this accounted for. Not only do they have the raw traffic logs but in the paper they mention they have the logs from the counter strike server which I know for a fact lists times of joins and kicks. While not computing this value isn't incredibly important, it does show a slight lack of effort on the author's part.

Near the end of the paper the authors compare with other first person shooters seems to only validate what they have already done, but again it would have been more interesting to look at traffic from none first person shooter games such as Diablo or Star Craft. Of course these games don't provide the ability for anyone to run their own servers thus making data collection a bit difficult.

In the last part of the paper the authors make suggestions for ISPs with respect to how games are affected by routing infrastructure. Again the biggest point they make

is that games send a lot of small packets, which I feel is consistent with most real time traffic. They offer a few suggestions on how to better handle the traffic and then conclude.

Overall I think this paper was quite interesting and more importantly it was well organized and presented.