1 Motivation

- Previous analysis of multicast user behaviour, e.g. [1], looks at MBone sessions. The limited deployment of multicast, however, means that these sessions tend to be small and single-source.
- We are interested in behaviour in large-scale, multiple-source, dynamic membership, multicast sessions for modelling multicast pricing schemes.
- Use popular unicast multiplayer games such as Half-Life [2], since from a user’s viewpoint, these are similar to their multicast equivalents.

2 Methodology

3 Number of users

We have observed strong time of day effects in the number of players. As might be expected for a leisure activity such as playing games, the peak days are the weekends. The peak time of day, however, is still in the middle of the day.

4 User duration

The distribution of the durations of a user’s session appears to be heavy-tailed, and almost follows Zipf’s law [3].

5 Inter-arrival times

The users’ inter-arrival times also vary widely, and time-of-day effects can also be observed.

6 Pricing modelling

This data collection has taken place as part of wider research into multicast pricing. We are using an expected utility model in conjunction with this usage data to simulate various multicast pricing schemes, and to examine their stability and effectiveness.

We assume the existence of network externalities; part of a user’s benefit from a multicast session is determined by the number of people in the session. Otherwise they would use a unicast transmission. We also assume that users share the cost of a multicast session. Expected utility theory [5] holds that agents choose the outcome with their highest expected utility; this means that criteria pari passu, users will choose to enter or leave a session depending on the ratio of $U$ to $P$.

Thus, we can model:

$$U - U^*(k + n^{\alpha})$$

$$P = P[n]$$

where:

- $U$ is the utility received by a participant in a session
- $n$ is the number of members in a session
- $k$ is the innate value of a session (i.e., the value to a user in the absence of other participants)
- $\alpha$ represents the diminishing marginal utility from additional members

By applying density functions to the distribution of $U/P$ thresholds to users, we can model how users will interact given membership and price changes in multiple-source sessions with dynamic membership.

7 Conclusions

- Strong time-of-day effects in membership and inter-arrival times
- Heavy-tailed distribution in users’ session durations
- High variability in users’ duration and inter-arrival times
- Data is being used for simulating the stability and effectiveness of multicast pricing schemes

References