# A Measurement Study of Virtual Populations in MMOGS

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## Roadmap

- Introduction
- Methodology: What we did and how
- Results: What our results show
- Conclusion: Interesting trends and where we're headed

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- Methodology: What we did and how
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# Game Recognition?

Image copyright Blizzard Inc.

# Introduction

- Research Interests
  - P2P Networking
  - Scalable MMO architectures
  - Networks and Games!



# MMOG Measurements

- Why measure MMOGs?
  - MMOGs are the largest, interactive networked application on the net
  - Measurements are essential for designing scalable architectures
  - Modern architectures have scalability issues

# State of the Art MMOG Models

- Looking at past research, prior MMOG models:
  - Assume a uniform distribution of players
  - Assume a random waypoint mobility model
  - Assume players perform actions (eat, fight, move) randomly
  - Assume session times are uniformly distributed

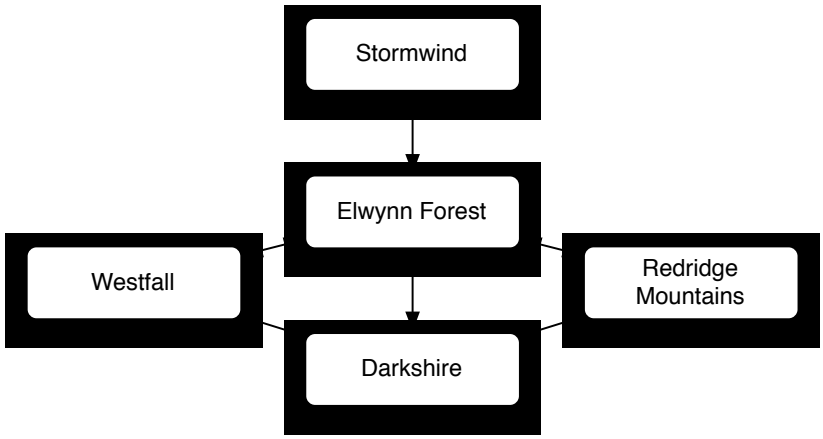


# What's been measured?

- In the past, we've seen research measuring:
  - Network patterns for FPS games [Chambers et al., '05]
  - Packet sizes, RTTs, session times and inter-packet arrival rates [Kim et al., '05]
  - Mobility models in FPS games [Tan et al., '05]
  - Session characteristics of Eve Online [Previous presentation!]

# Understanding WoW

- WoW has over 9 million subscribers
- WoW is divided by realms (one cluster per realm)
- Each realm has 4-6k players
- Each realm is divided into zones, which form a graph where edges indicate paths between zones



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# Methodology

- World of Warcraft is scriptable using LUA and the WoW scripting interface.
- We modified an AddOn called CensusPlus and wrote an AddOn called PlayerMonitor
- Using the WoW scripting interface, we could query the server about population characteristics



# Taking a Census (or who's playing?)

- WoW provides a 'who' interface:
  - Allows you to query who is currently online
  - Only returns 50 results
  - Queries can be focused by simple expressions
    - who is in a particular zone
    - who is of a particular class, level, race
    - who has a name that begins with 'a'

# Who are all the players?

- who 65-70
- who 70-70
- who c-'Warrior' 70-70
- who r-'Dwarf' c-'Warrior' 70-70
- who z-'Ironforge' r-'Dwarf' c-'Warrior' 70-70
- who n-'a' z-'Ironforge' r-'Dwarf' c-'Warrior' 70-70



# Methodology continued...

- A single measurement is not sufficient to understand who is on:
  - The population changes *while we measure!*
  - We perform two measurements, back-to-back
    - The set-difference indicates the amount of churn in the system (joins + leaves)

# Monitoring your friends

- Unfortunately, querying the whole database takes too long for some things:
  - How long a session is
  - How many zones were visited
  - How long a player remained in a given zone
- WoW lets us track 50 of our closest friends!



# The Friends List

- After a complete census, we randomly choose 50 players
  - We add them to the friends list and record their location every 10 seconds
  - WoW notifies us when they log off
  - After every census, we add new friends to our list to fill the empty spots

# Fine-grained Tracking

- The friends list allows us to track a random subset of players at a much finer level than the census
- Because players are added after they are seen in a census, we can determine their session length and zone durations more accurately



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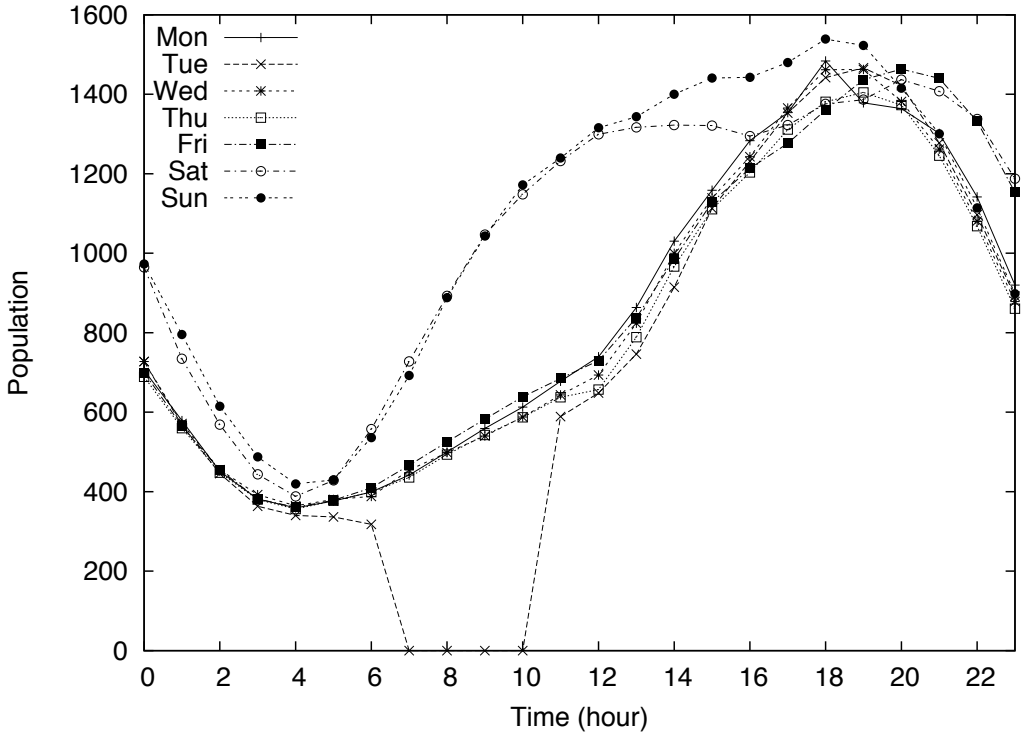
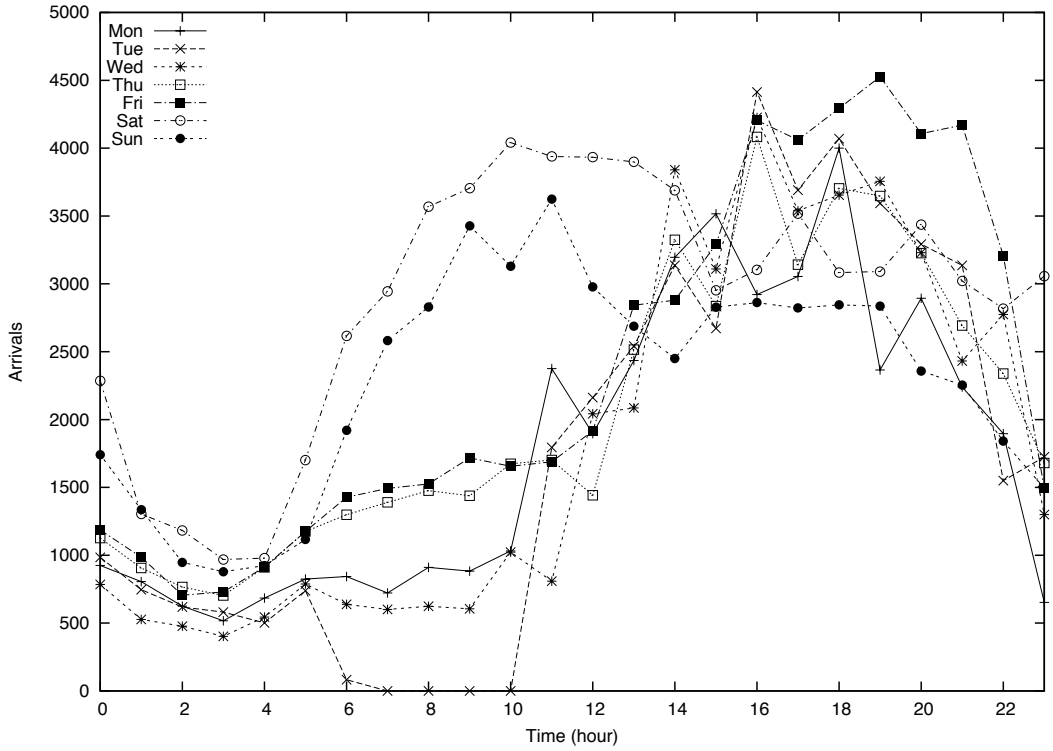
# Average Population

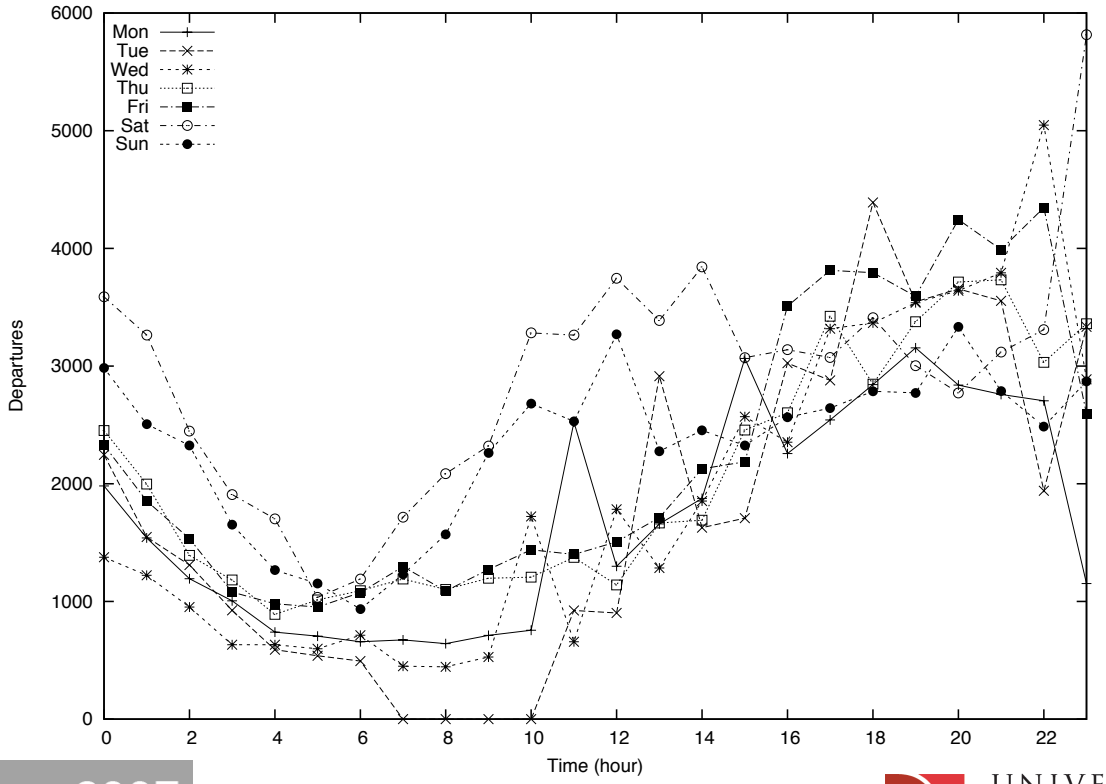





# Arrival Rate

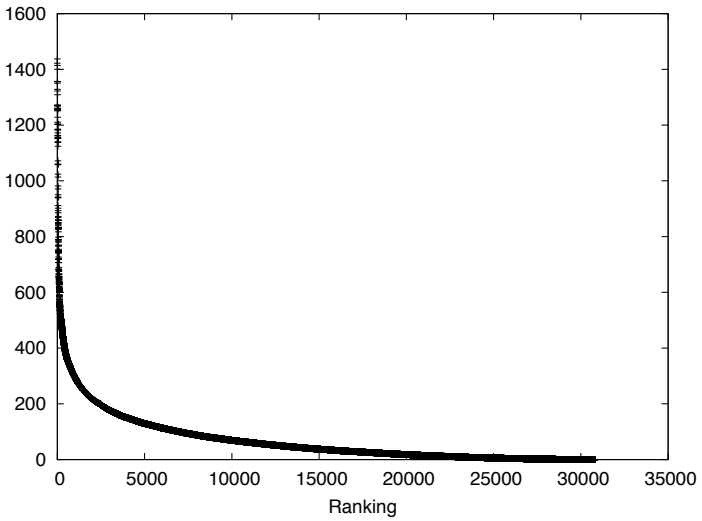


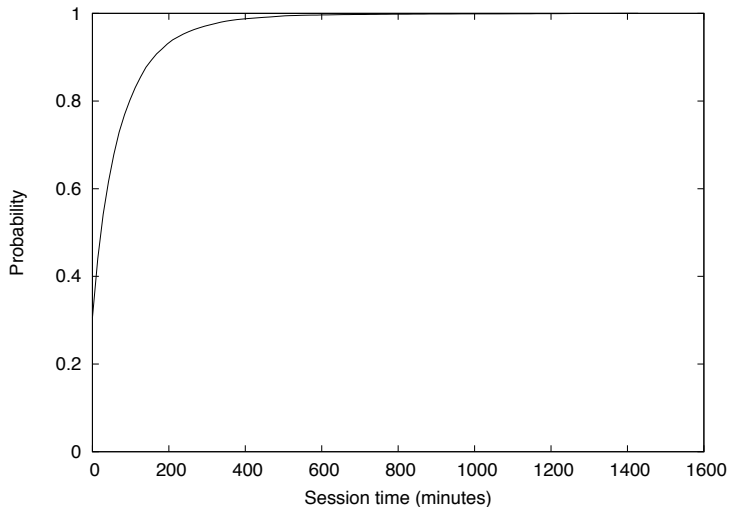
# Departure Rate



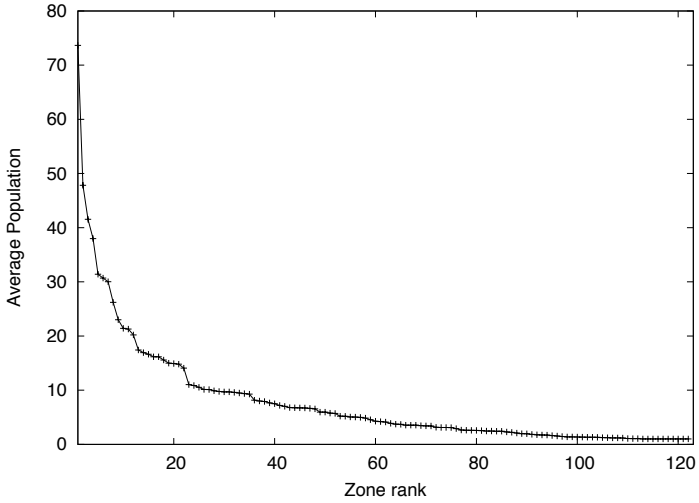


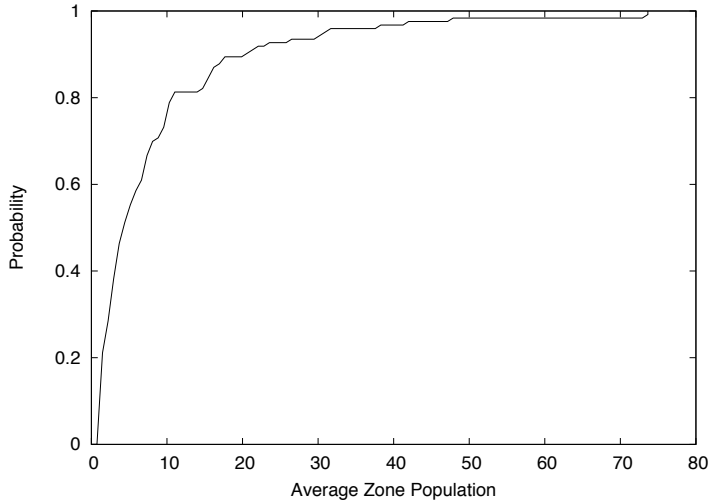

# Session Time



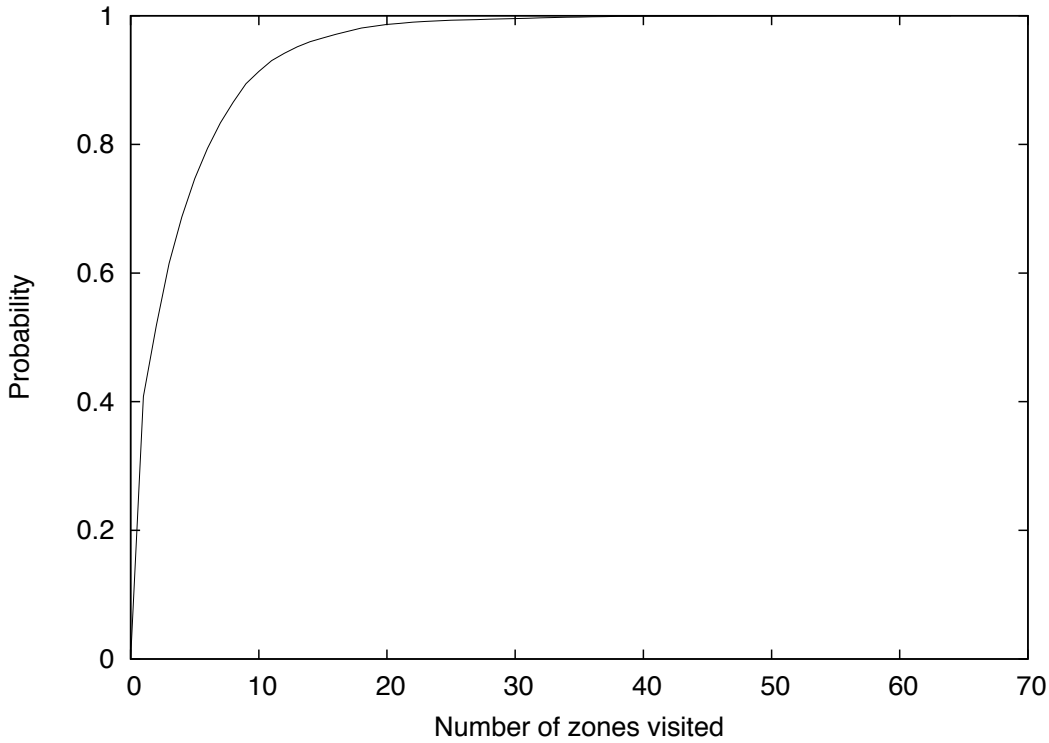
# Players Per Zone



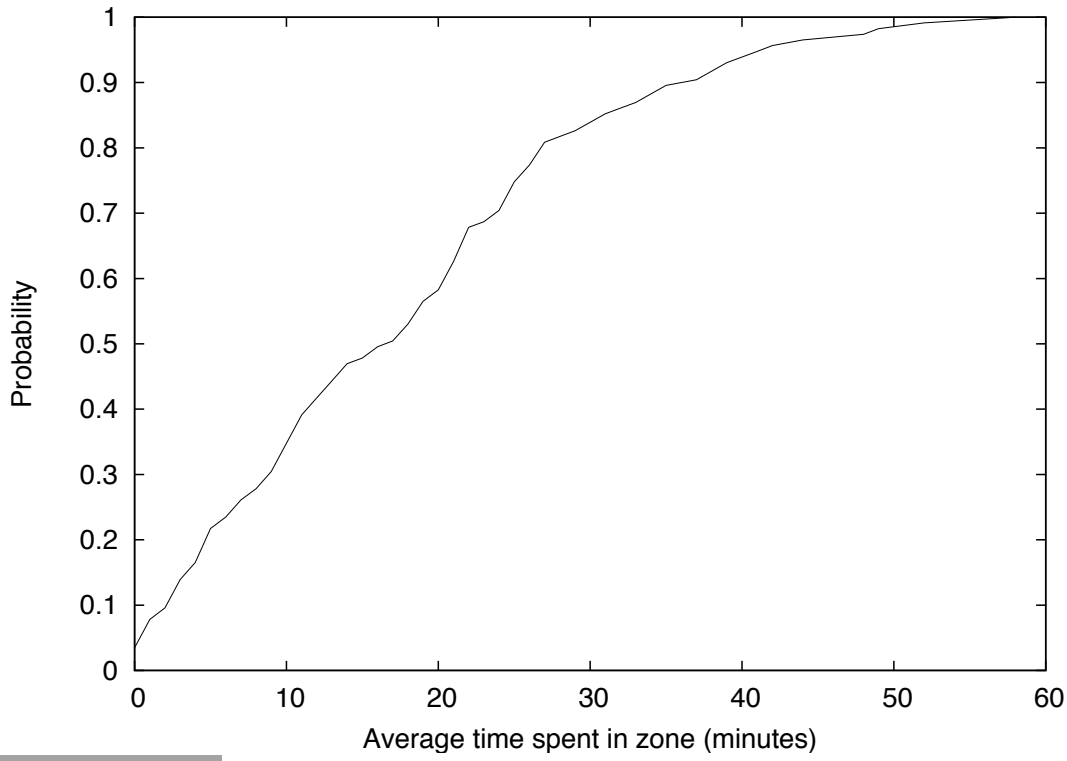






# Number of Zones Visited



# Zone Duration






# Conclusions

- Our results show that prior modeling assumptions for MMOGs similar to WoW are not correct
- General populations follow a diurnal pattern
- MMOGs must be concerned with the problem of churn
- Session times and the number of players per zone appear to follow a power-law (heavy tailed?) distribution