
# Matchmaking Is Hard

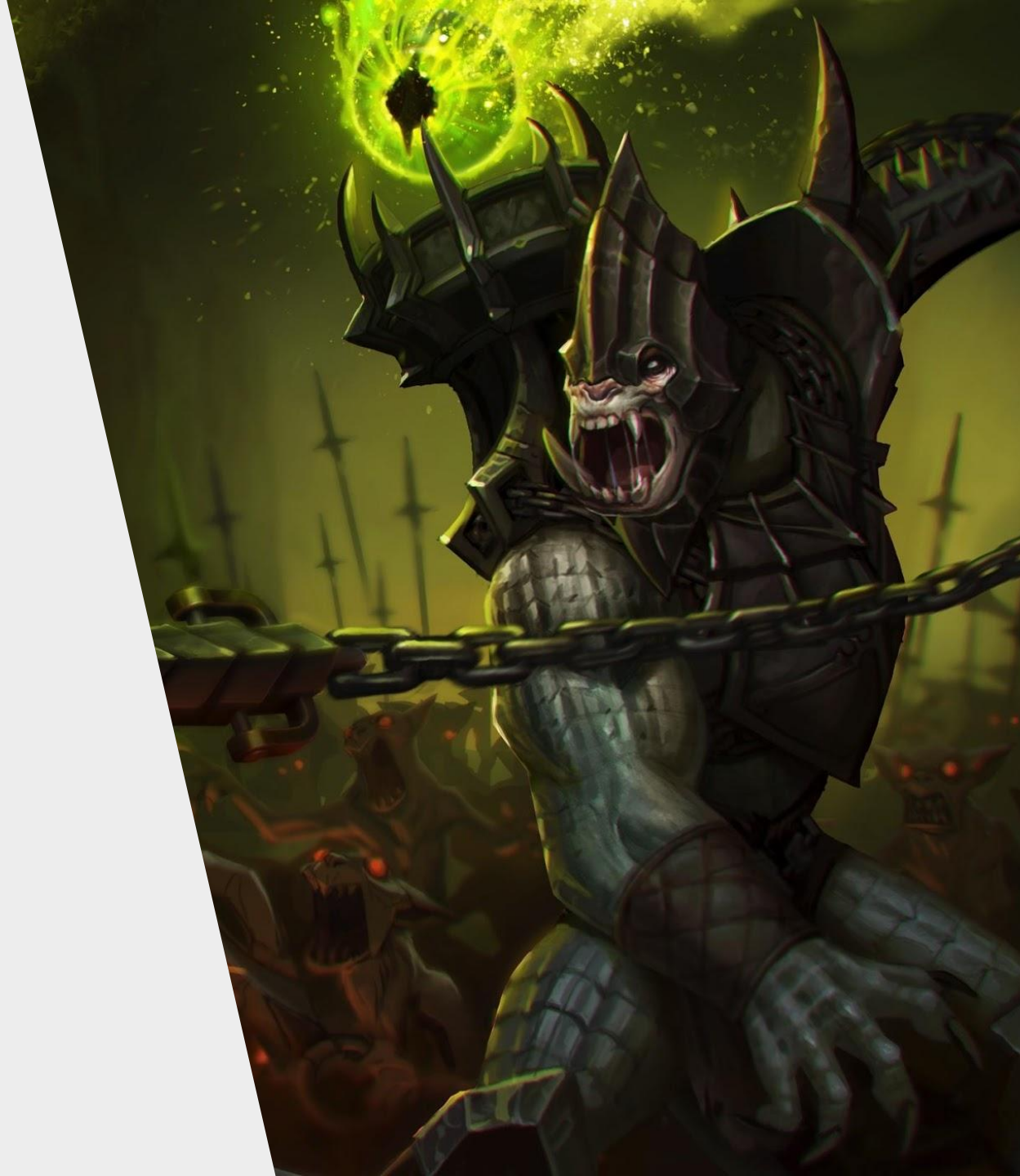
Andy Nguyen, Platform Engineer

# Vainglory is a *multiplayer online battle arena game*

## .... aka *action real-time strategy* game

## .... aka *destroy-the-other-base* game

- Control a single character
- Invade an opposing team's base with the help of computer-controlled units via multiple lanes
- Win by destroying the opposing team's main structure



# Update 3.0

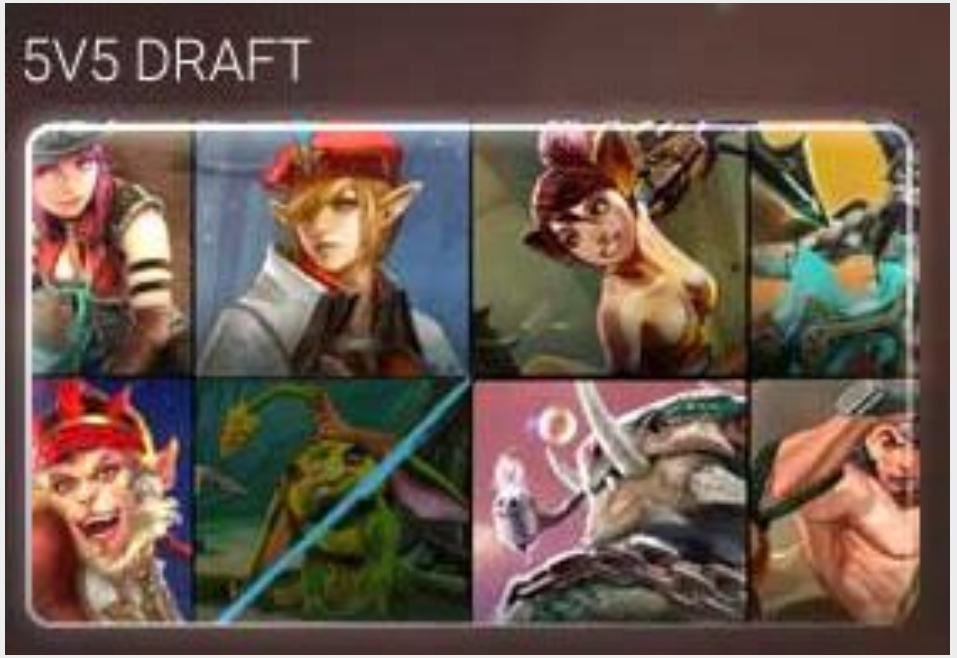
## 5v5 Map

# Matchmaker Pre-3.0

- Had only been able to support 3v3
  - Algorithm was specifically optimized for two teams of 3
- Could barely handle the level of scaling
  - $O(n^3)$ comparisons to find all eligible matches given a snapshot of the pool
  - High latency during peak times
  - Anticipated higher popularity with 5v5

## Update 3.1

## 5v5 Ranked + Draft




# 5v5 Matchmaker

- MvN matchmaking
  - 5v5, 2v2v2, battle royale, etc.
- Supports at least 5k players in queue
  - Vast improvement over 3v3 game modes (~400 players)
  - Improved resource utilization

# One day...

Match maker worst now more than ever?

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Is anyone else noticing extreme unfairness in teams in ranked matches?

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Screenshot Wtf was the **matchmaker** in this game?

5v5 **matchmaker** is... odd

Is the matchmaking improver even working?

Screenshot Is **matchmaking** broke?

/> waah waah matchmaking is so imbalanced give me fair matches

/> waah waah matchmaking takes so long put me in a game

# Breaking It Down

- Players are put into unfair games
  - They have access to exact skill rating and detailed match histories
  - High team spread and match spread are blatantly visible
- Players are waiting too long to get into a match
  - This is understandable, given that people are playing while on-the-go

# CONTEXT

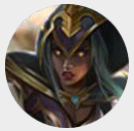
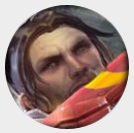
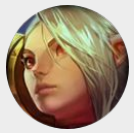
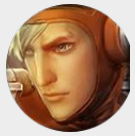
# Skill Rating != MMR

- Skill rating is a raw score (or vector) that represents how well a player (or group) plays the game
- Matchmaking Rating (MMR) is a score (or vector) derived by taking a skill rating and applying heuristics
  - Ex: based on recent win streaks
  - Ex: first 10 matches for new accounts
    (this is to measure uncertainty, something that the Elo system doesn't support)
  - Ex: based on party size / party win rate

# Visual Skill Tier (VST)

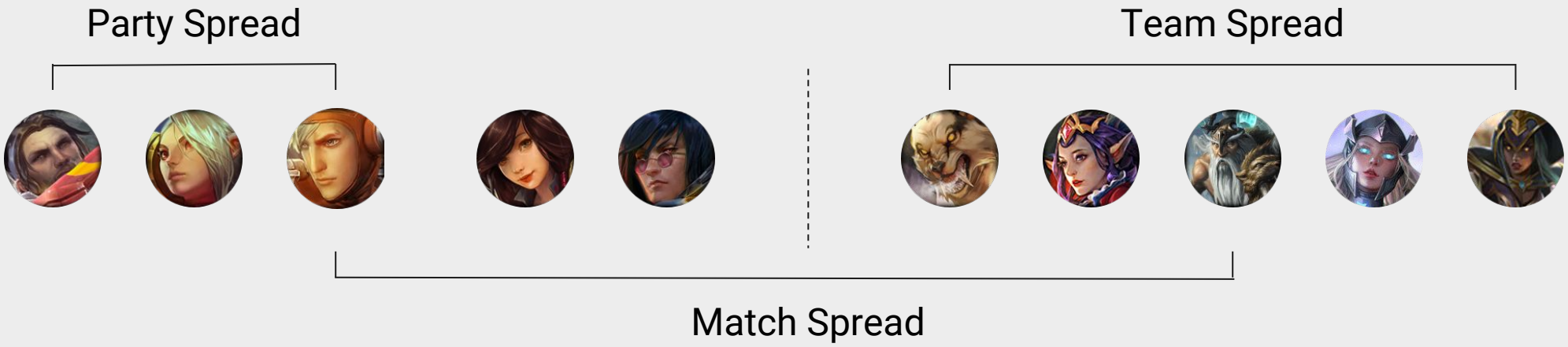
- Serves as a progression system to encourage ranked play
- Seeded from “true” skill rating and is constantly adjusted based on progression rules
  - Season reset
  - Decay / decay flooring

# Matchables 

- A group of players entering the matchmaker together
  - Solo queuer: 
  - Parties:   

# Spread


- Difference between the highest and lowest measurement in the group
  - Measurements: Elo, MMR, VST
  - Groupings: Party, Team, Match



# Greediness

- Rate of change in spread tolerance when grouping matchables
- Normally is treated as a function of how long a matchable has already been in the matchmaker

# Goals

- “Fairer” matches
  - Low team + match MMR spread, win percentage close to 50%
- Lower queue times
- Lower latency in games

# EXPERIMENTS

# Iteration Process

## Observation

What do we want to improve?

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When / where do we make the change?

## Analysis

Were we right? More importantly, what changed?

# Chaos Queue: Observations

- The first few PvP matches for new players is critical for early retention
- New players are experiencing >3 min. queue times

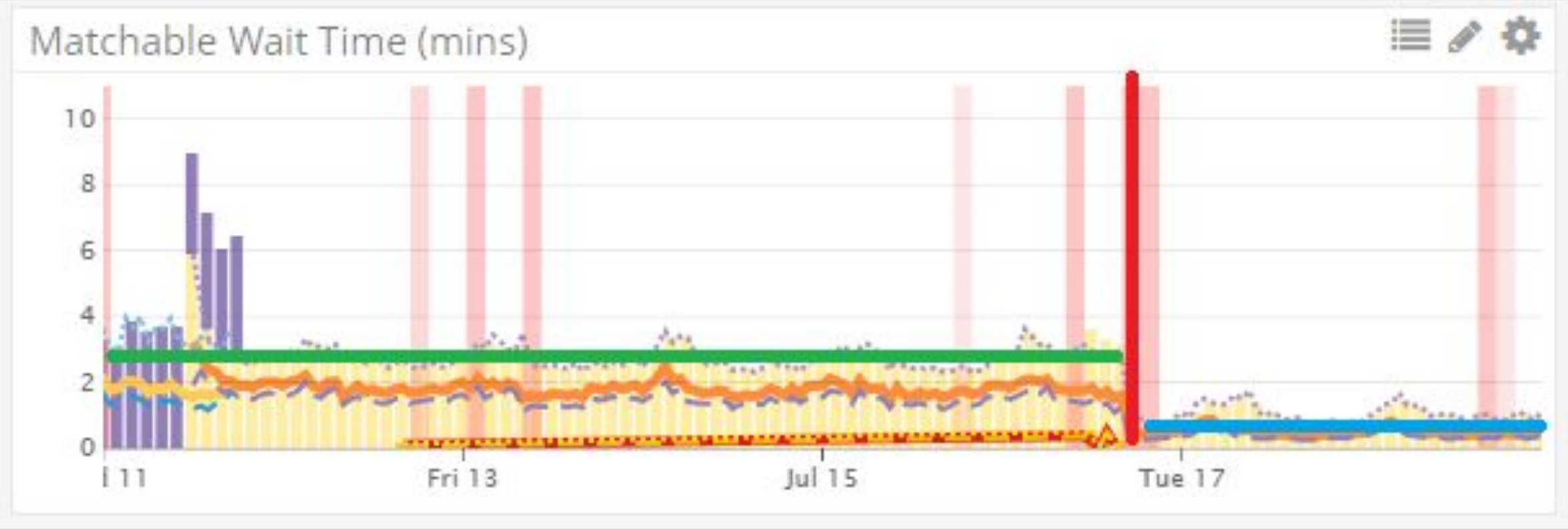
# Chaos Queue: Hypothesis

- *New players* are much more affected by getting into matches quickly than playing a perfectly fair match
  - We can relent on spread if we keep win percentages stable

# Chaos Queue: Experiment

- Action: Increase greediness sooner
  - Reduced queue times
  - Increased spreads (team + match)
  - **Increased retention**
- Duration: 1 week, in North + South America

# Chaos Queue: Analysis



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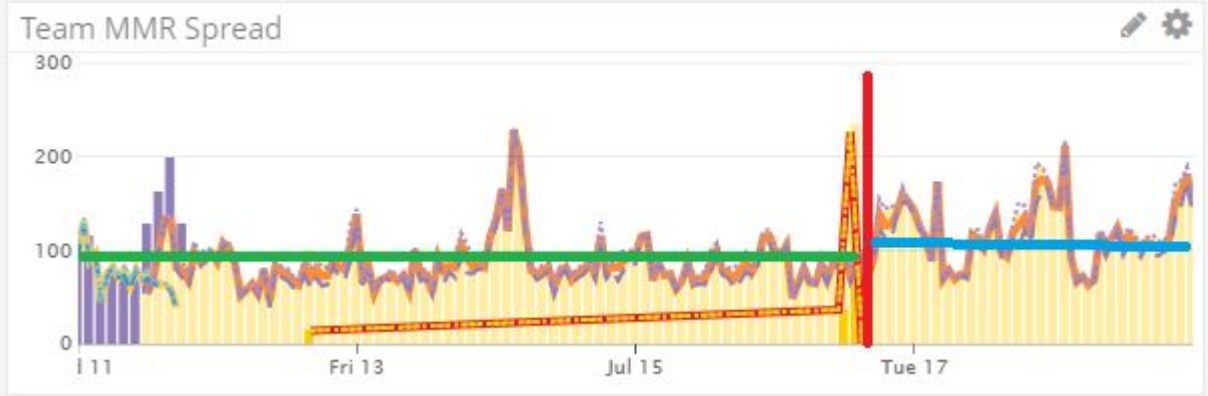


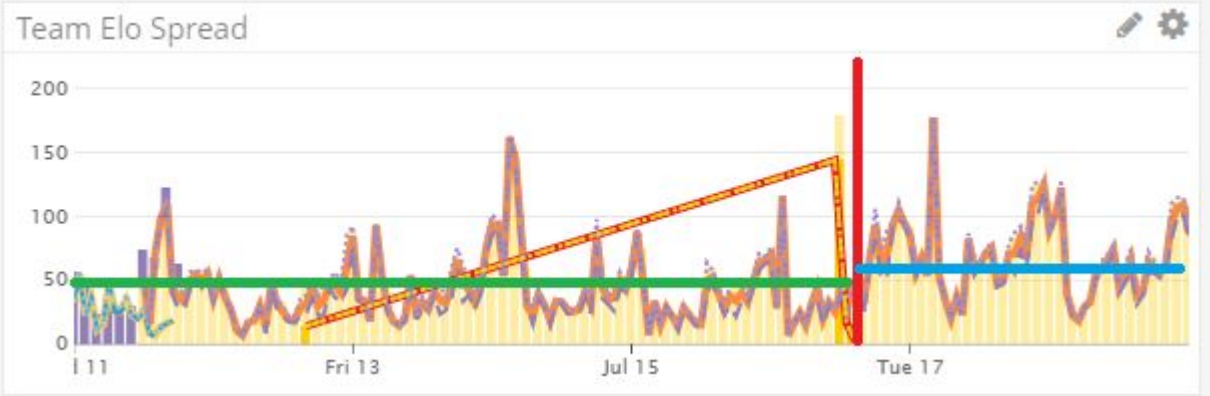

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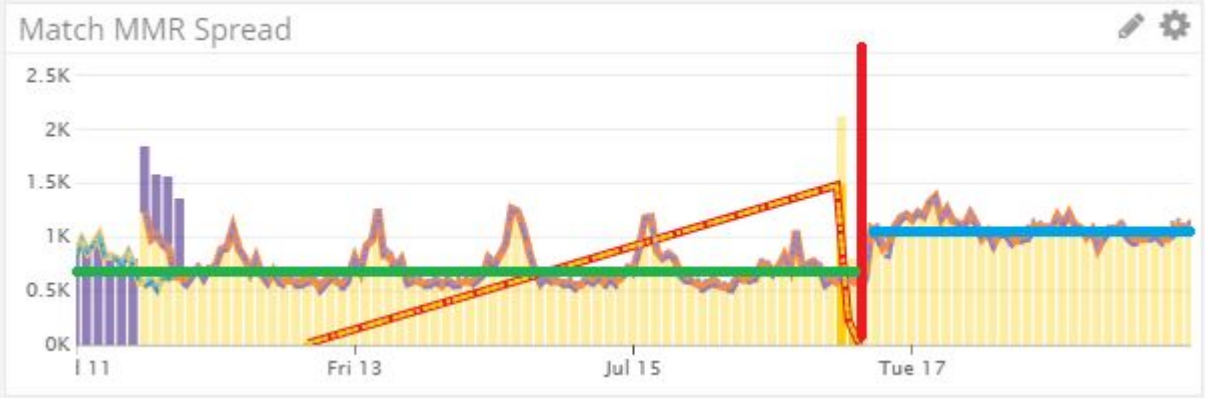


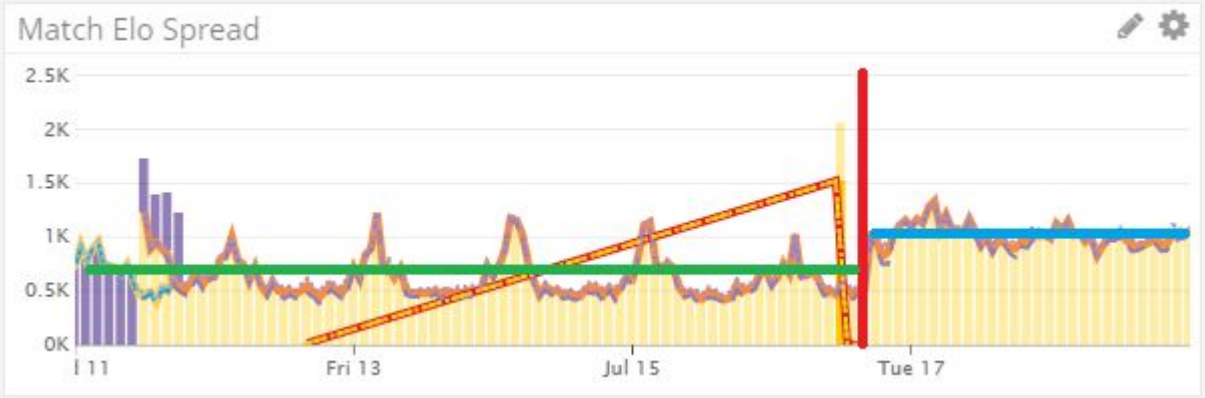

# Chaos Queue: Analysis

- Reduced queue times
- Team spread marginally increased
- Match spread almost doubled
- Marginal increase in retention

# DISCOVERIES

# Liquidity

- Is a fixed supply - you can’t just create players
  - Splitting the pool has grave effects on match spread
- Normal distribution of skill rating almost never represents skill rating distribution of liquidity

# Final Words

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- Low-latency games (<100 ms)
- To wait a maximum of 3-4 minutes
- To find players that fit above rules at 3:00 AM

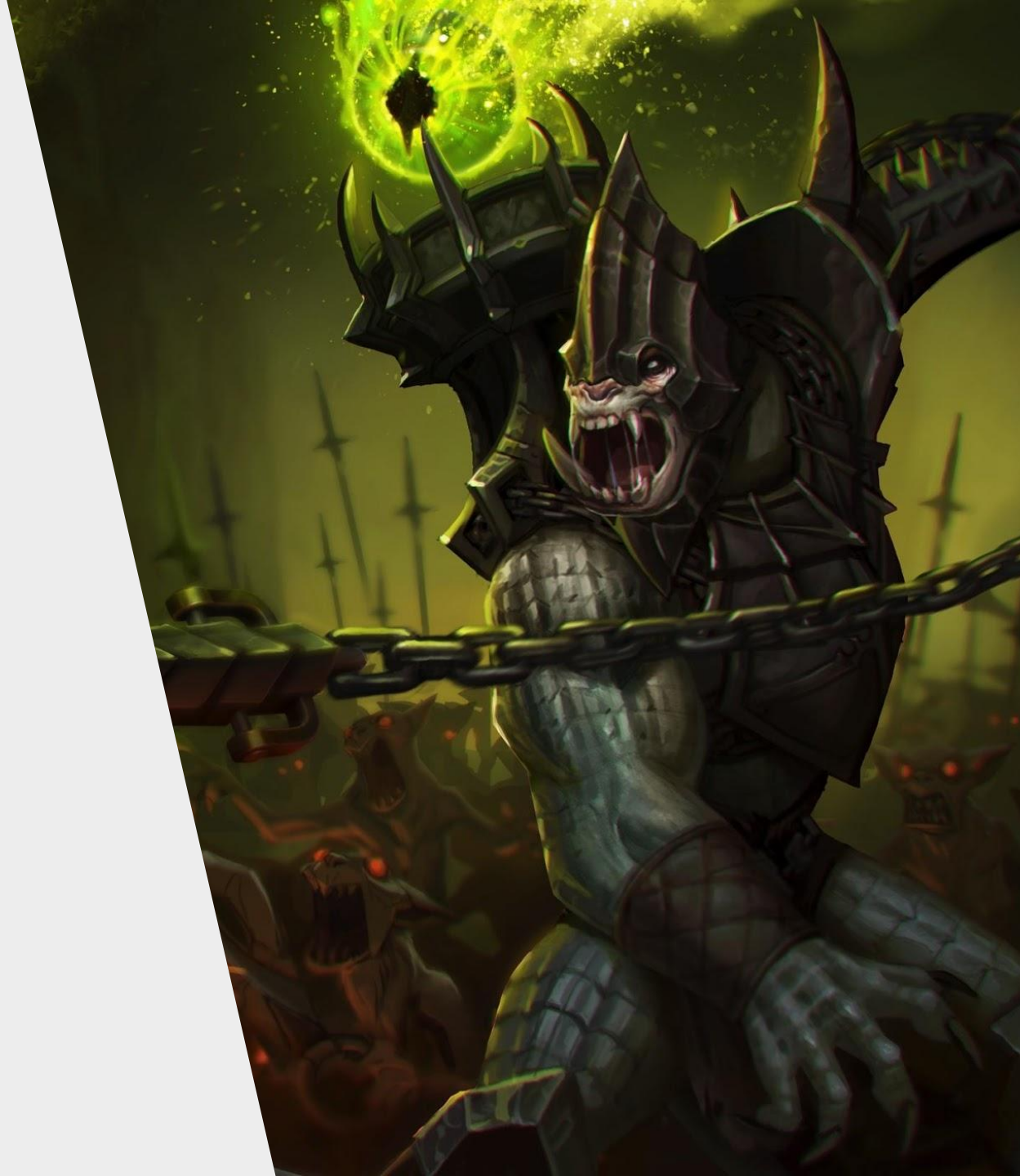
# Matchmaking Is Hard.

**Andy Nguyen**
@_ahuy_

The perfect match doesn't exi-

| LOSS BLUE TEAM | ITEMS | STATS | RANK | RANK | STATS | ITEMS | RED TEAM WIN |
|---|---|---|---|---|---|---|---|
| Octopi 3 / 14 / 6 0.64 KDA | | 28 14,407 25 k 7 k 40 k | 1337 | 1337 | 43 16,452 50 k 14 k 49 k | | Octopi 13 / 10 / 12 2.50 KDA |
| Octopi 13 / 7 / 8 3.00 KDA | | 124 20,176 68 k 9 k 39 k | 1337 | 1337 | 92 16,064 49 k 12 k 45 k | | Octopi 5 / 8 / 13 2.25 KDA |
| Octopi 14 / 11 / 6 1.82 KDA | | 100 18,974 66 k 11 k 39 k | 1337 | 1337 | 176 21,859 75 k 28 k 47 k | | Octopi 14 / 9 / 6 2.22 KDA |
| Octopi 10 / 7 / 11 3.00 KDA | | 78 18,072 54 k 33 k 67 k | 1337 | 1337 | 124 17,381 38 k 9 k 33 k | | Octopi 8 / 12 / 8 1.33 KDA |
| Octopi 2 / 7 / 4 0.86 KDA | | 22 14,121 12 k 25 k 55 k | 1337 | 1337 | 27 15,819 28 k 75 k 52 k | | Octopi 6 / 3 / 19 8.33 KDA MVP |
| DAMAGE DONE<br>HEALING DONE<br>DAMAGE TAKEN | | 85.75 k<br>9 2 | 42 KILLS | 46 KILLS | 87.58 k<br>6 4 | | |

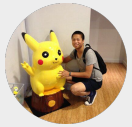
# Thank you for listening!



## Special Thanks

Sean Austin

Jon McEvoy



Michael Louie

Yuhan Chen

# Questions?

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