



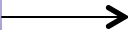
Unfair Data Centers for Fun and Profit

Akshitha Sankaranarayanan, Thomas F. Wenisch

University of Michigan



On-Line Data Intensive (OLDI) Services: SLO



Web search

Google

thomas wensch

thomas wensch
thomas wensch unicorn
thomas wensch umich

The image shows a Google search interface for the name 'thomas wensch'. Below the search bar, there are three suggested search terms: 'thomas wensch', 'thomas wensch unicorn', and 'thomas wensch umich'. Below these suggestions is a grid of six image search results. The first row contains three images: a man wearing a party hat, a man in a pink shirt with his arms outstretched, and a close-up of a man with glasses. The second row contains three images: a yellow Pikachu plushie, a purple unicorn with a rainbow mane, and a profile view of a man smiling.

Online retail & ads



Thomas Wensch Be sure you turn your volume up when you watch this.



Must meet stringent Service Level Objectives (SLOs)

SLO Impacts Quality of Experience



End-user

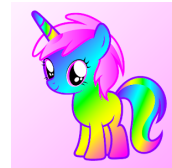


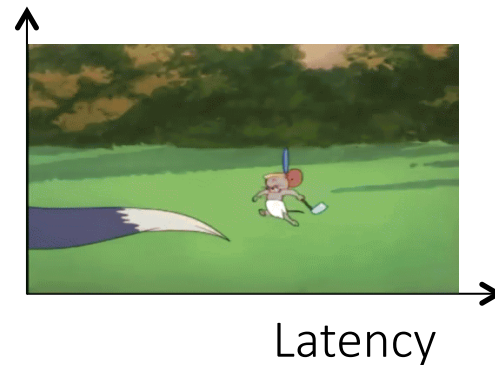
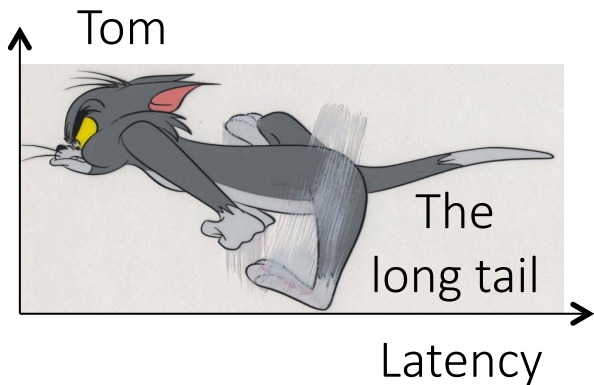
Image search



User abandonment

OLDI operators seek an SLO $\leq \sim 300$ ms

Tail Latency



- SLOs are impacted by the 99th+% (tail) latency
- Negatively affects user experience

Goal: Minimize OLDI tail latency without hurting cost efficiency

Quality of Experience is Subjective

- Do all end-users have the same stringent SLO requirement?



Impatient user -> stringent SLO



Patient user -> flexible SLO?

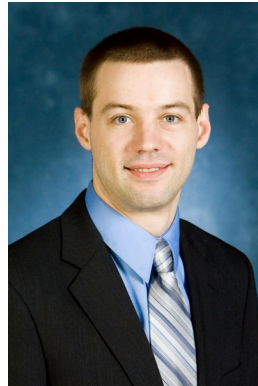
Can we make SLOs user specific?

SLOs Based on End-User Tolerance

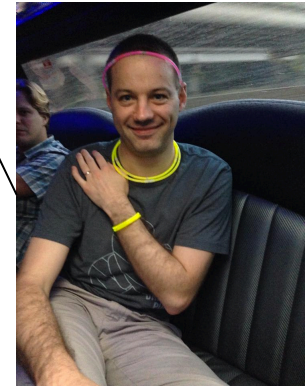
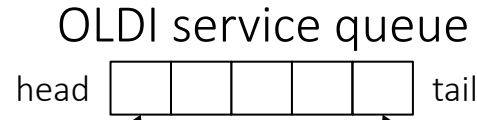
- Prioritizing OLDI requests based on user tolerance threshold



Have our cake & eat it too?



User @work



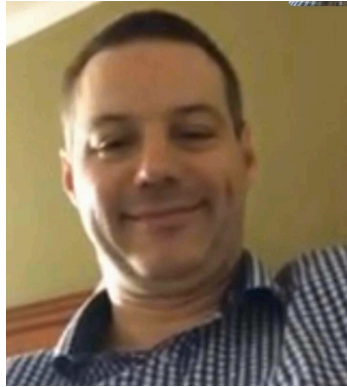
User @play

Setting user-specific SLOs can reduce SLO violations

Are User-Specific SLOs Ethical?



Some data centers set SLOs based on geography



Thomas Wenisch
February 17 · 🌐
DTW -> DCA
👍 Daniel Ángel Jiménez and 1 other

Thomas Wenisch
March 22 at 10:15 PM · 🌐
DTW -> MSN
👍 Jayneel Gandhi and 4 others

Thomas Wenisch
January 8 · 🌐
SJC -> LAX -> DTW
👍 Amlan Nayak and 6 others

Thomas Wenisch
December 31, 2018 · 🌐
PVD -> DTW
👍 1

Democrat



Republican



User traits used to set SLOs may be unethical

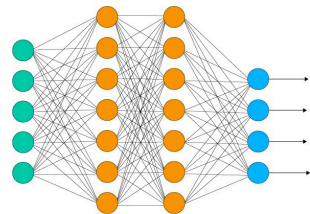
Modern data centers must determine ethically-acceptable user traits to set user-specific SLOs

Unfair Data Center Scheduler

Create data set mapping user profiles to abandonment rates



Use data set to train an ML model



Predicts user-specific tolerance scores

Offline phase

User request

Extract user features

Geographic location

Political orientation

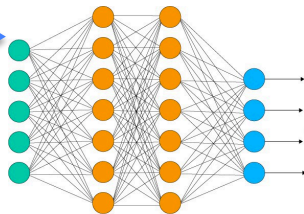
Race



Age

Nature of employment

Sex



Predict user-specific SLO

Tolerance score

SLO

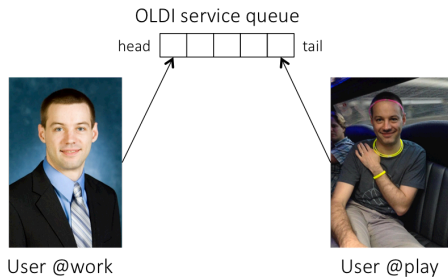
At run-time

Conclusion

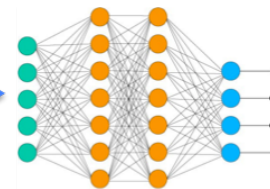
- Modern data centers enforce stringent OLDI SLOs for QoE



QoE might be subjective



User-specific SLOs reduce violations & improve cost



User-specific tolerance can be determined using ML & integrated with the scheduler



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Akshitha Sriraman
University of Michigan

