facebook

Social Hash:
an Assignment Framework for Optimizing Distributed Systems Operations on Social Networks

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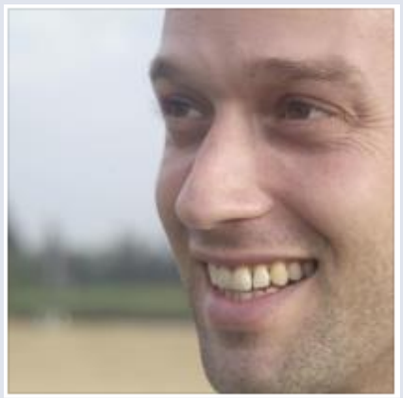
March 2016

Assignment Problem

Alon's HTTP requests

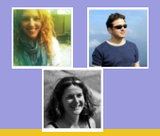


Igor's HTTP requests

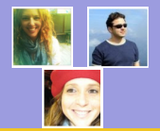
Point-of-Presence (PoP)

Front-end clusters

Cache



Cache



Cache

Assignment Problem

Alon's HTTP requests

Igor's HTTP requests

Point-of-Presence (PoP)

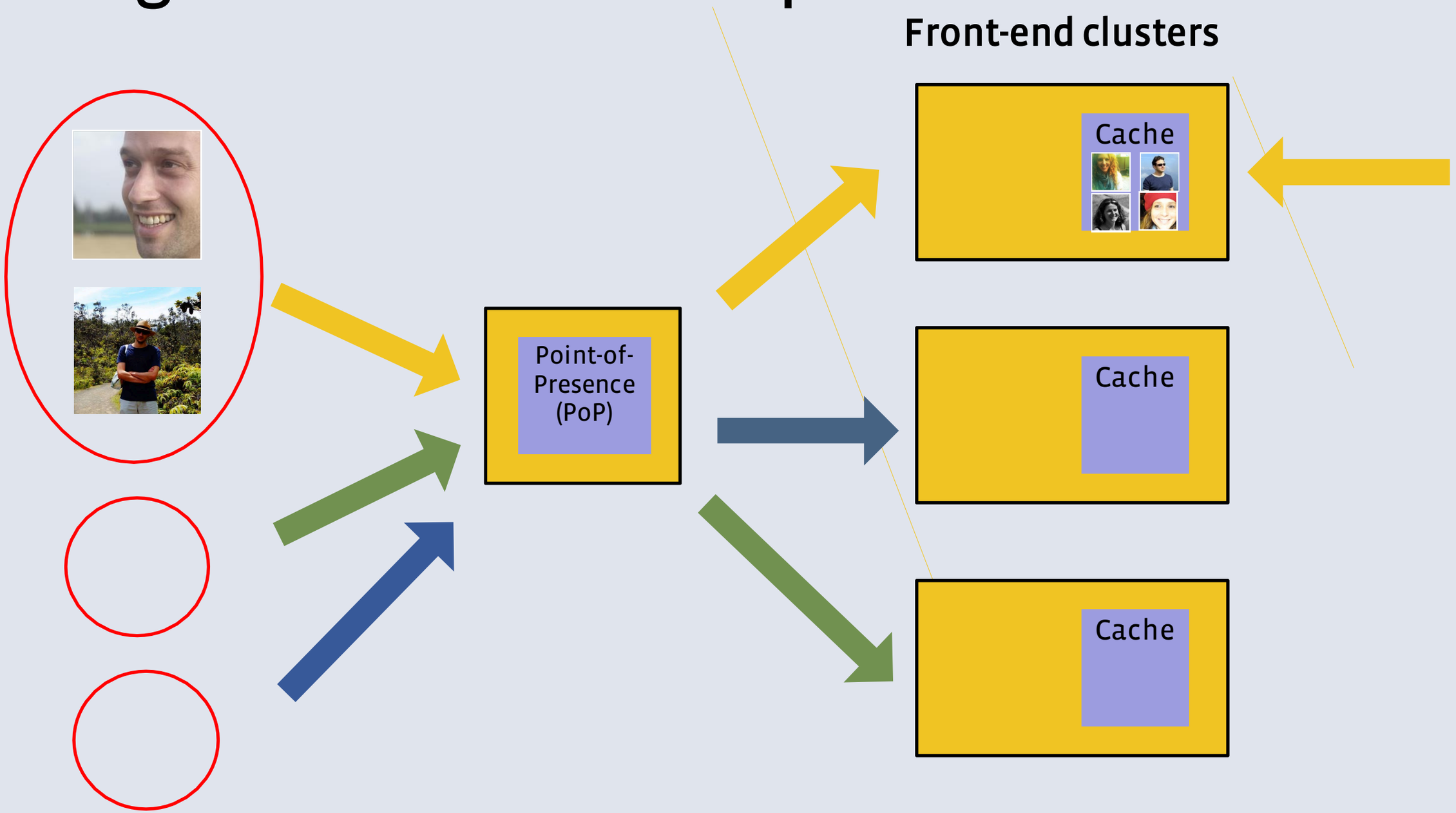
Front-end clusters

Cache

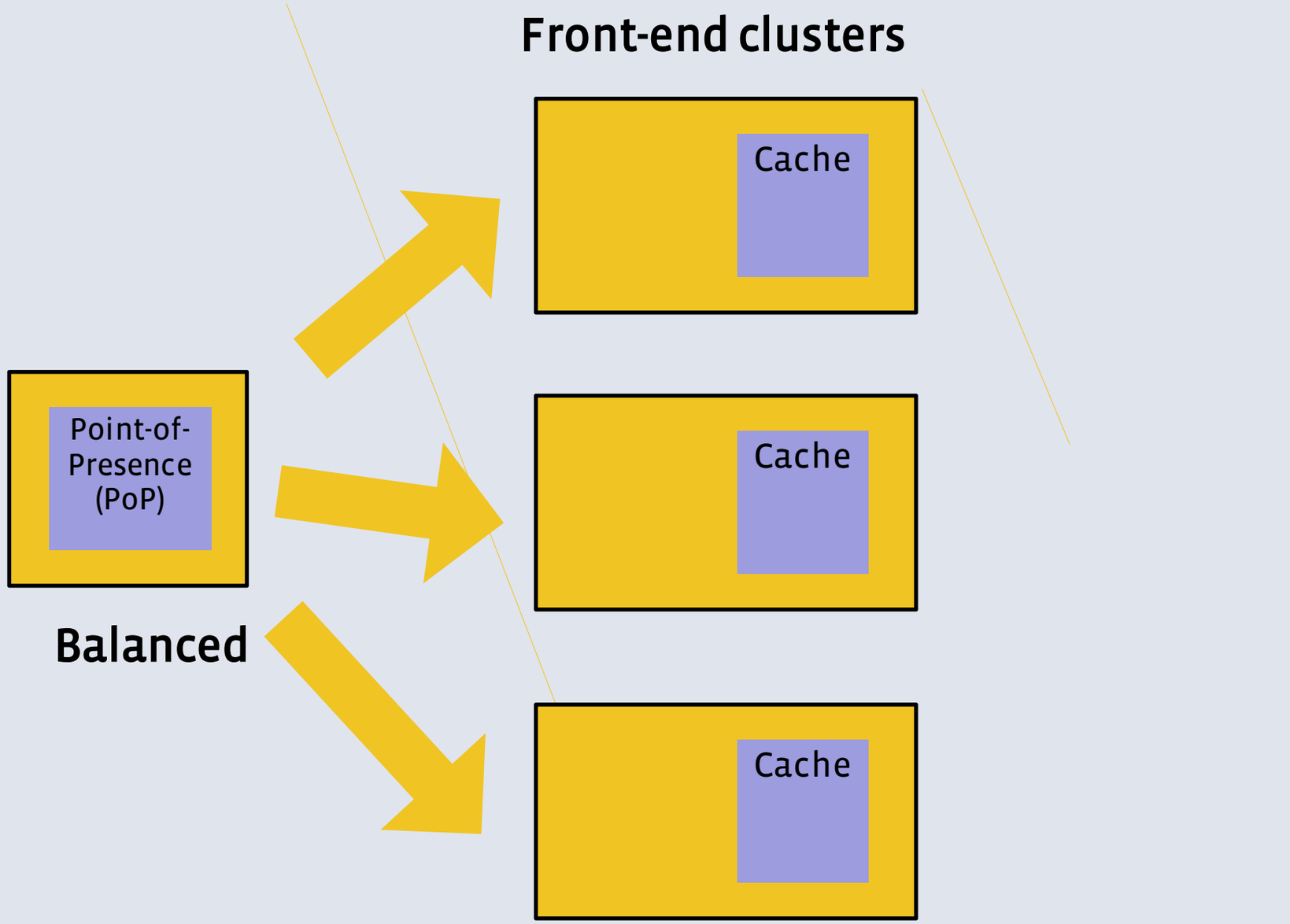
Cache

Cache

Assignment Problem Optimization



Solution Requirements



Solution Requirements

Alon's HTTP requests

Front-end clusters

Point-of-Presence (PoP)

Adaptive

Cache

Cache

Cache

Solution Requirements

Alon's HTTP requests

Point-of-Presence (PoP)

Stable

Front-end clusters

Cache

Cache

Cache

Solution Requirements

Alon's HTTP requests

Point-of-Presence (PoP)

Fast decision

Front-end clusters

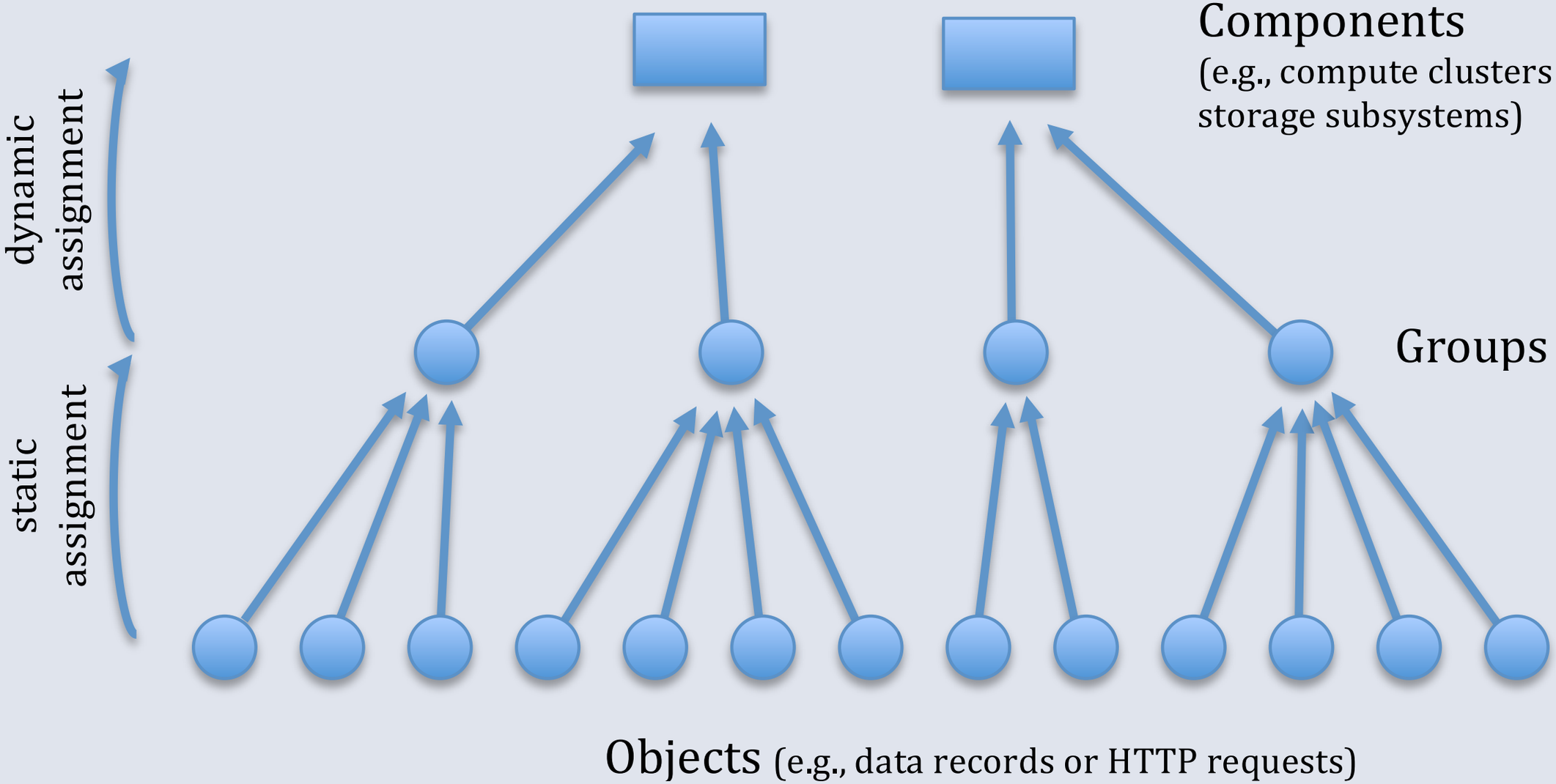
Cache

Cache

Cache

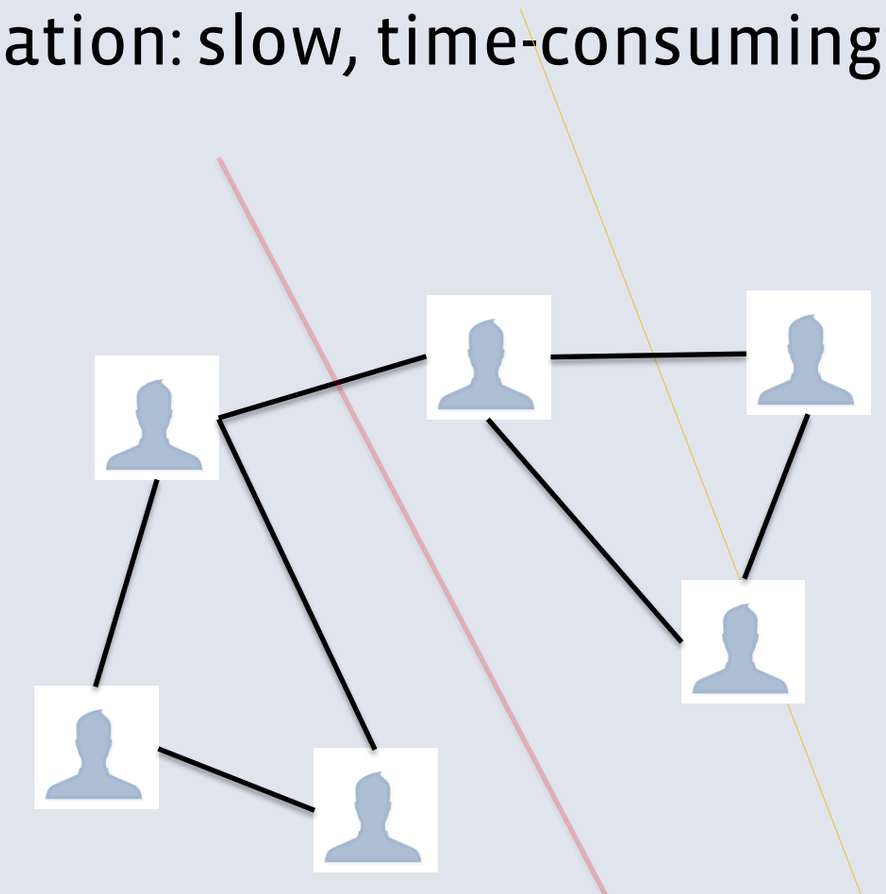
Social Hash framework

Social Hash framework



Static assignment

- Goal: assign similar objects sent to the same group
  - Data access pattern -> represent as graph -> graph partitioning
  - Large-scale optimization: slow, time-consuming

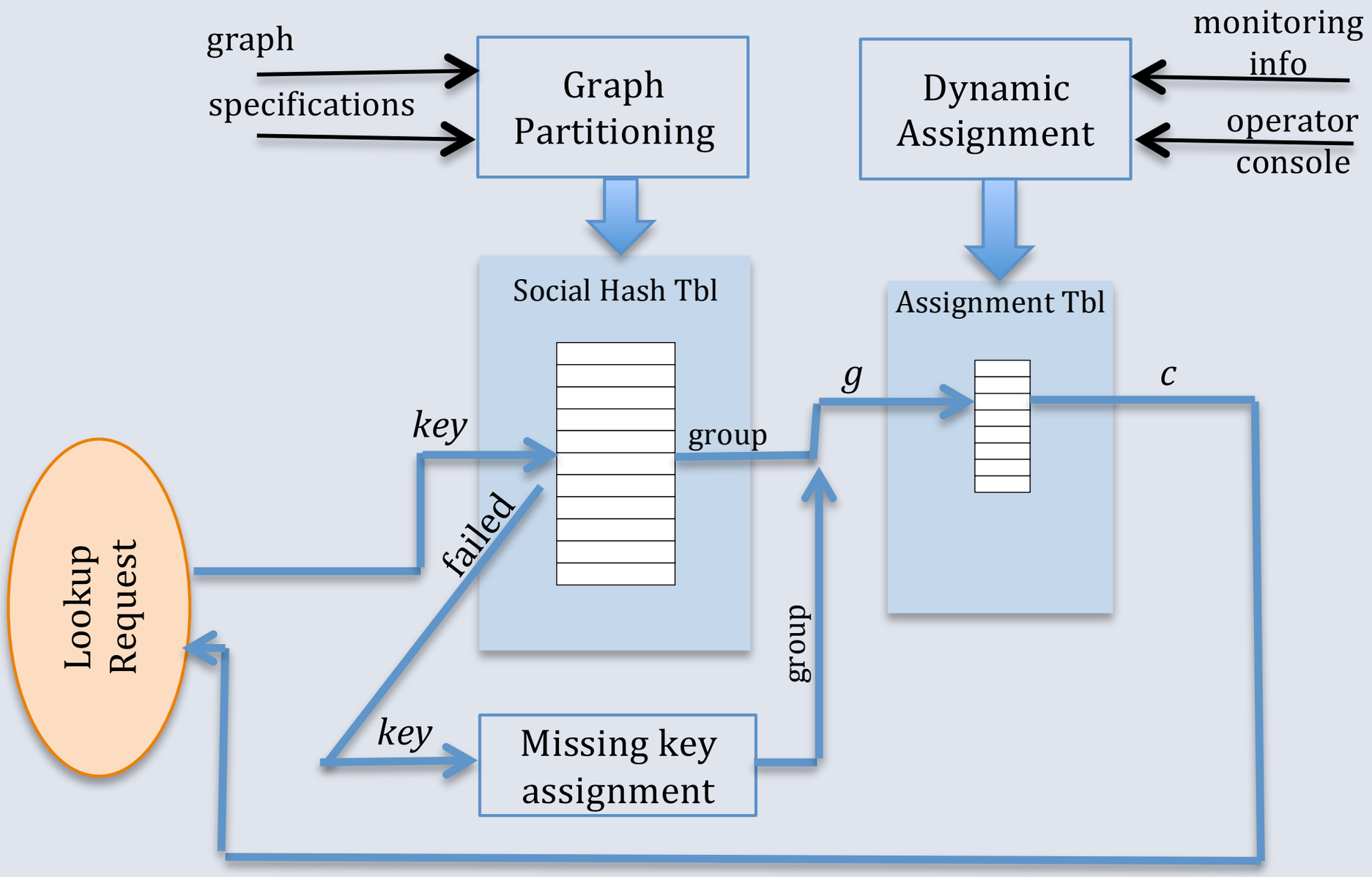


Dynamic assignment

- Goal: adapt to maintain load balance by altering group -> component
  - hardware changes
  - dynamic workload
  - addition and removal of objects

- Two-level framework separates optimization from adaptation
  - Slow optimization -> static
  - Fast adaptation -> dynamic
- Group-to-component ratio controls tradeoff

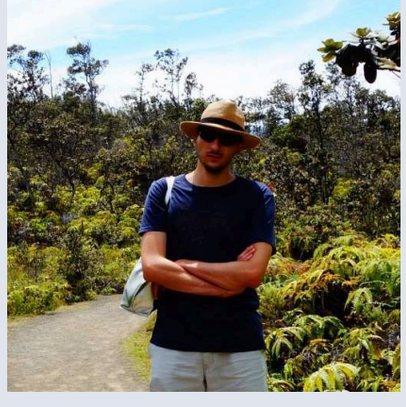
Social Hash framework

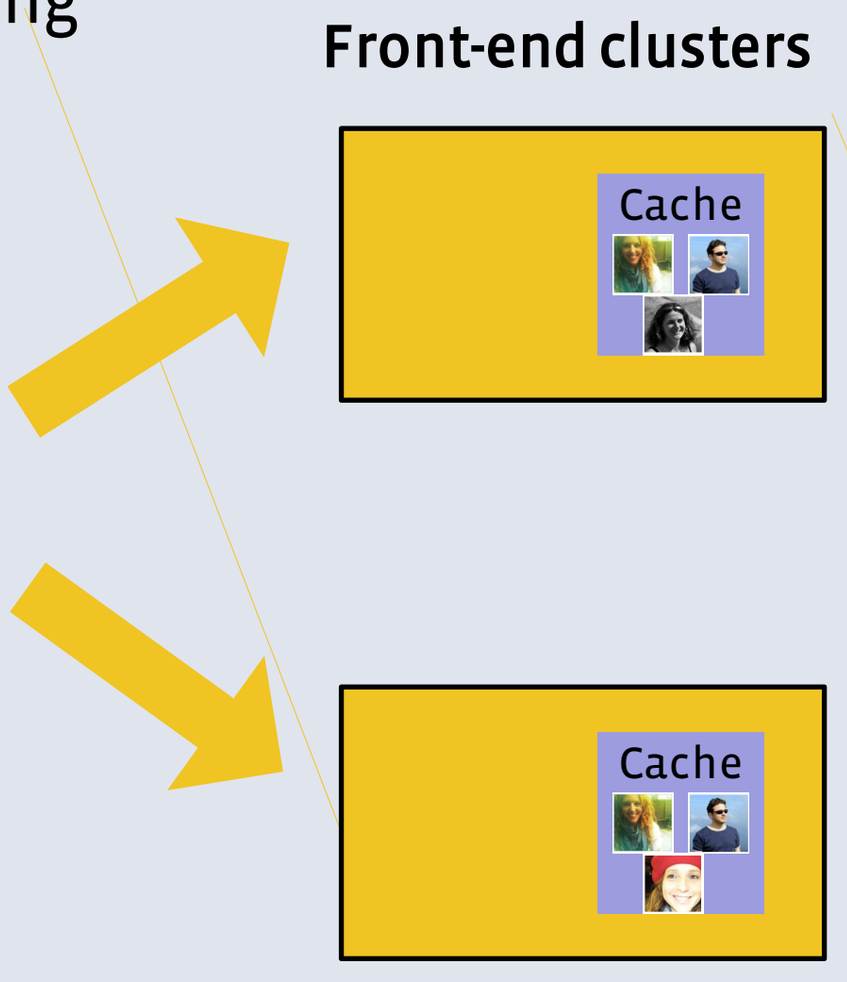


HTTP Request Routing

Social Hash for Facebook's web routing

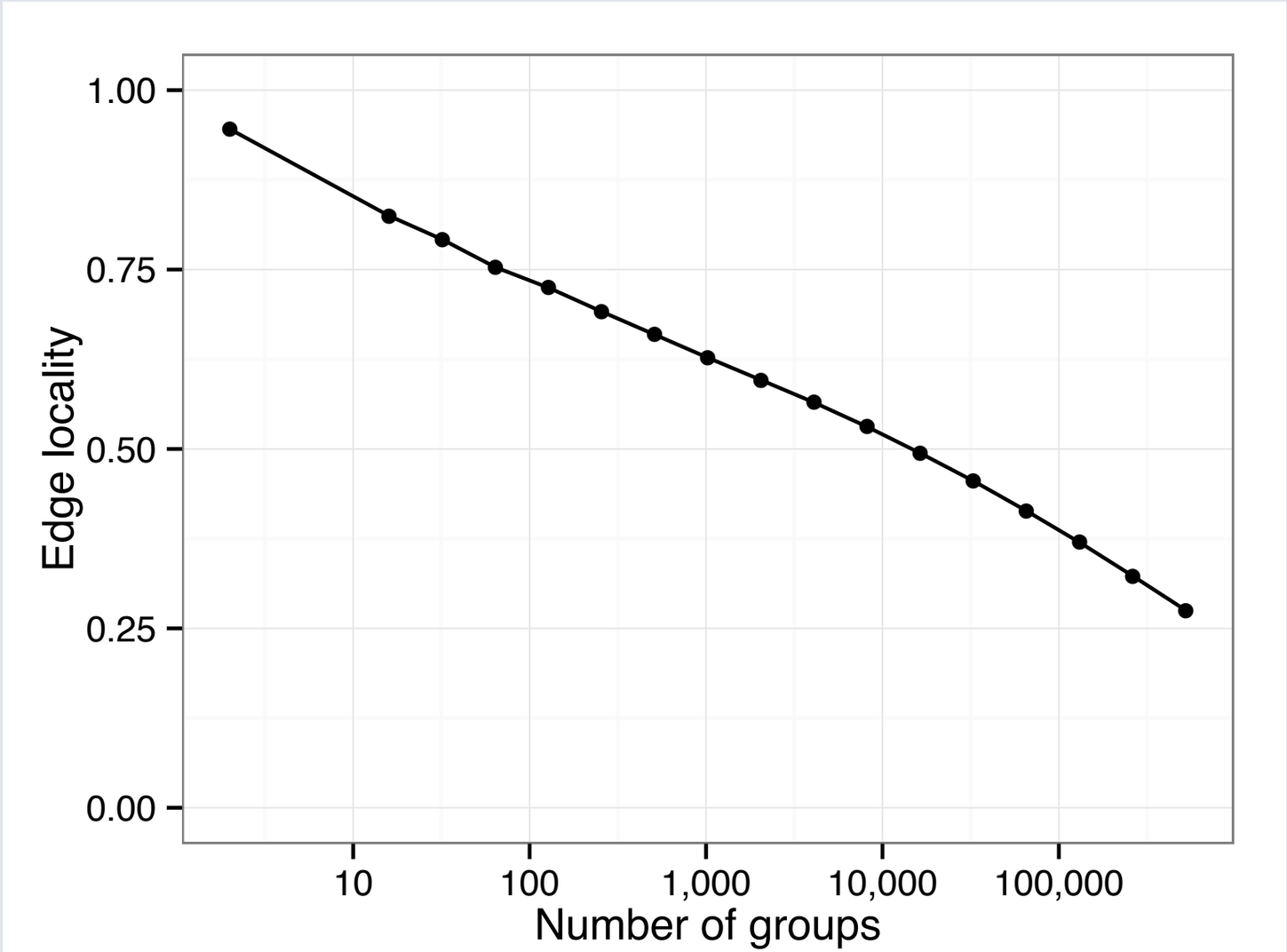
- Objects: HTTP request identified by user, Components: front-end clusters
- PoP: Dynamic assignment by hash ring





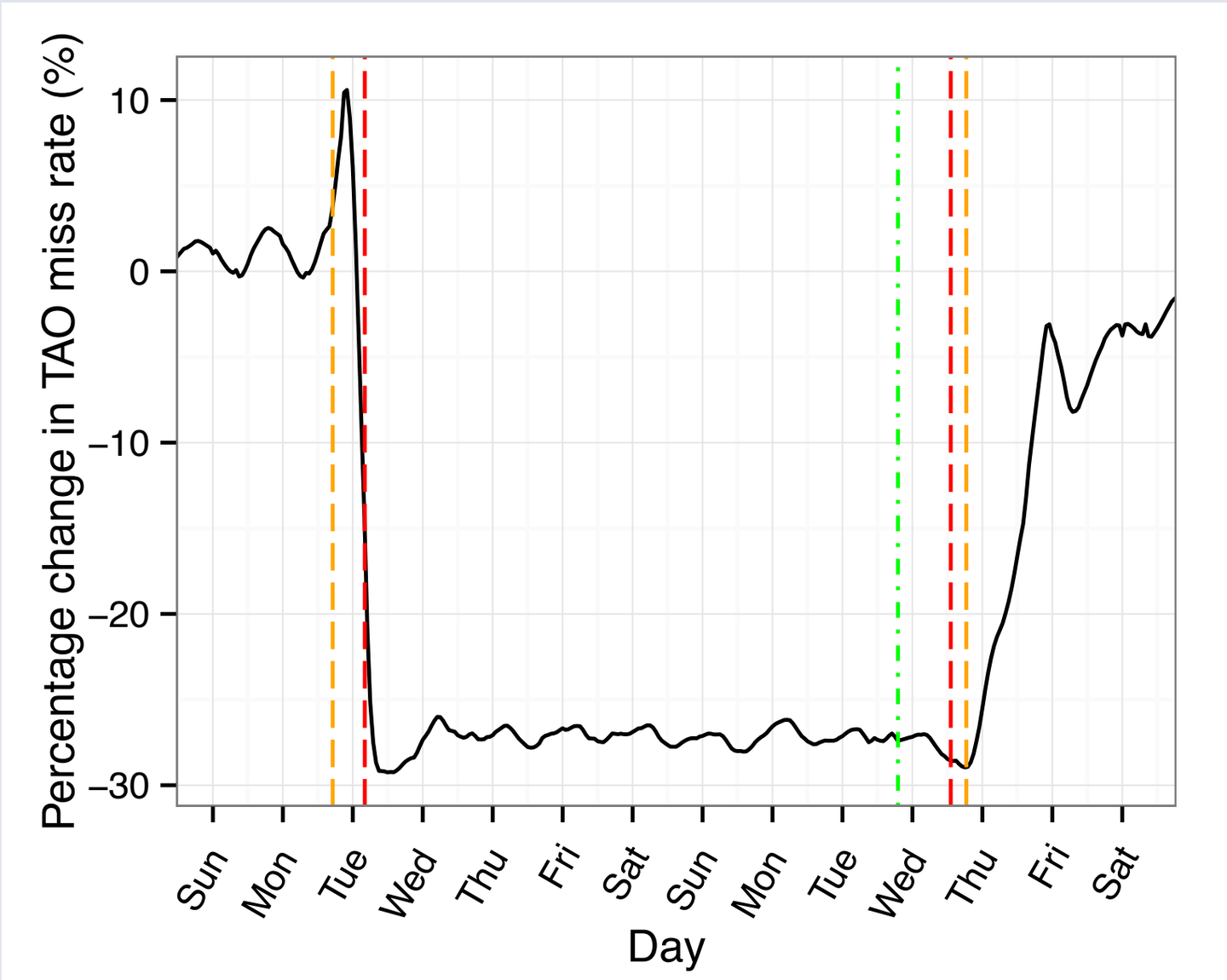
Edge locality for Facebook's web routing

- Production routing: 21k groups for 10's of front-end clusters
- Over half of friendships are within groups
- Updated on a weekly basis (~1% movement)



Live traffic experiment: TAO miss rate

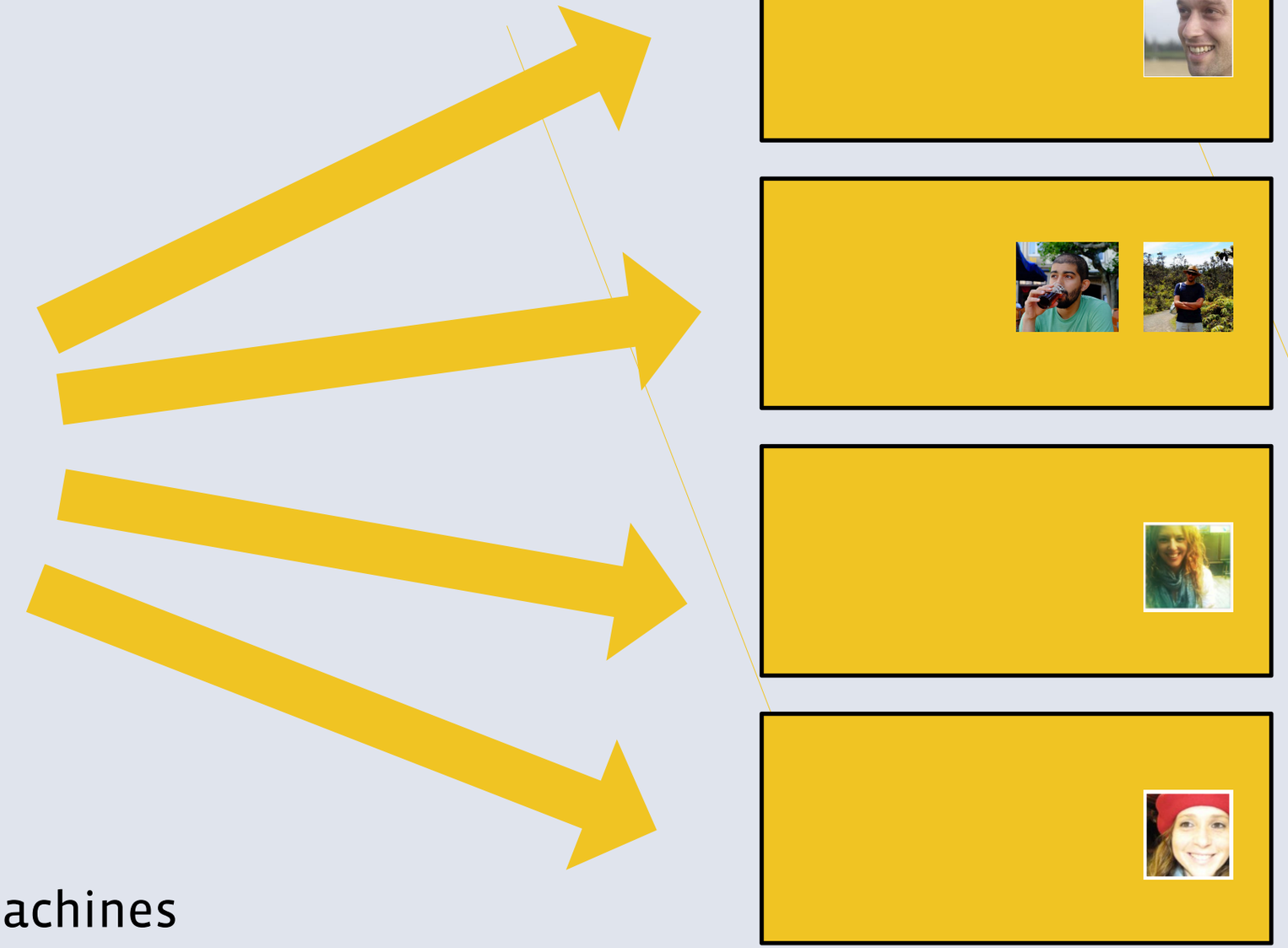
- Orange: traffic shifts
- Red: duration of test
- Green: updated Social Hash table



Storage Sharding

Assignment Problem 2: Storage sharding

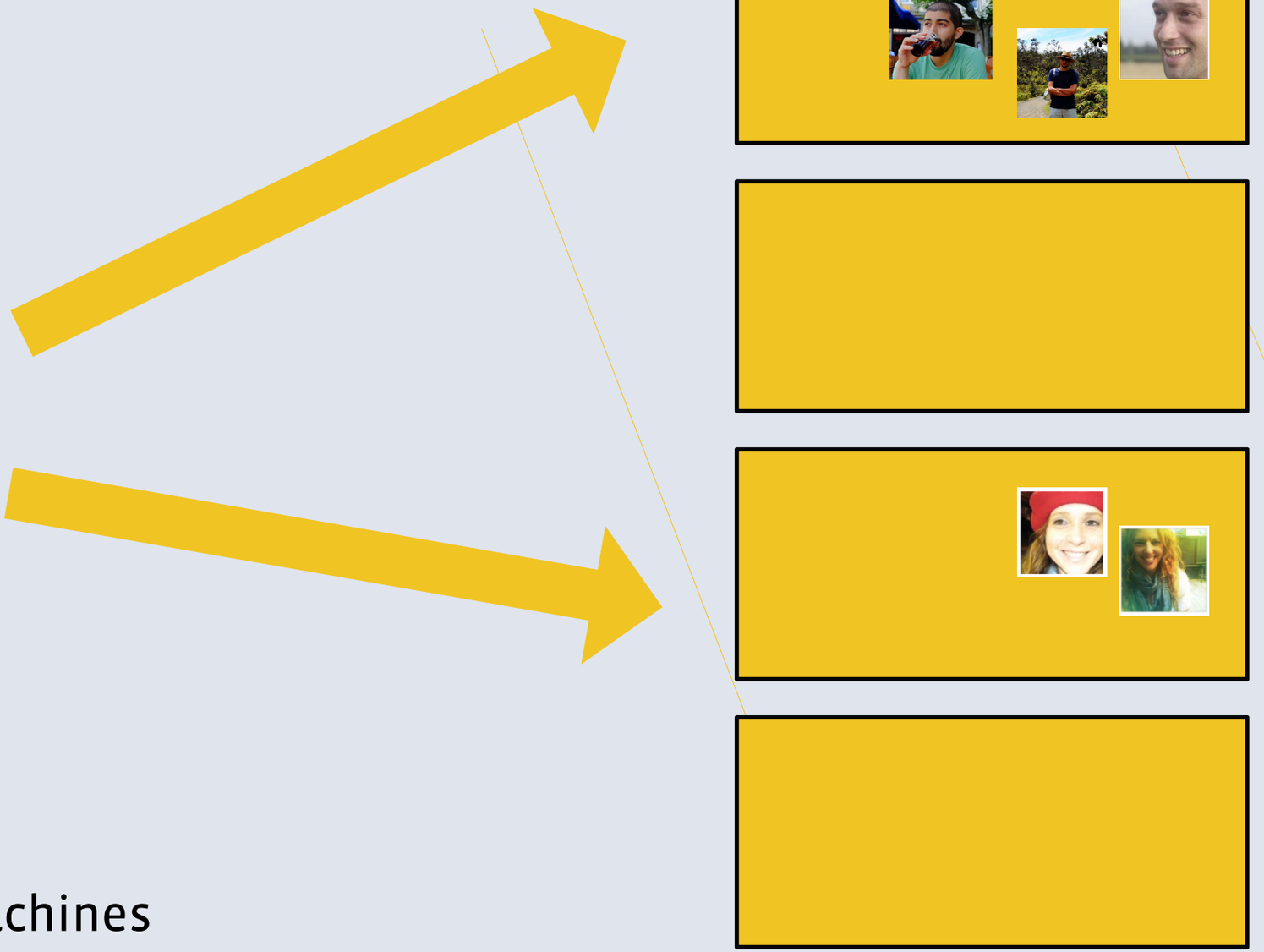
Arun's query



Objects: data records
Components: storage machines

Assignment Problem 2: Storage sharding

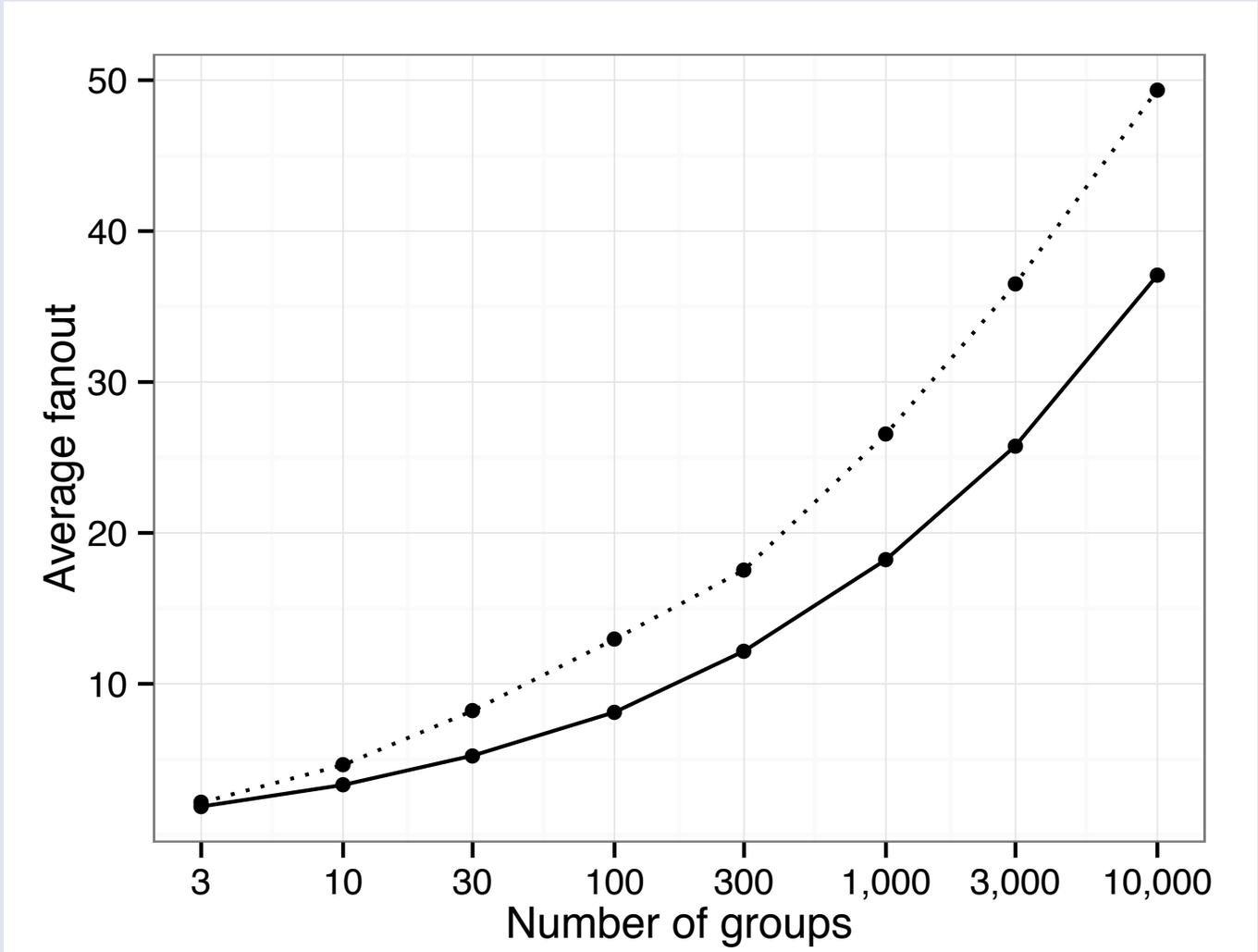
Arun's query



Objects: data records
Components: storage machines

Static assignment

- Minimize fanout through bipartite graph partitioning
- Graph contains recent queries and data records
  - edge => query accesses data record
- Dotted: edge locality optimization
- Solid: fanout optimization



Storage sharding deployment

- Graph database with thousands of storage servers
  - Group-to-component ratio of 8
  - Static assignment every few months

- Results:
  - Average latencies decreased by over 50%
  - CPU utilization decreased by over 50%

Summary

- Assignment problems are common in distributed systems design

- Proposed Social Hash framework for solving assignment problems
  - Two-level design optimizes performance with graph partitioning

- Two Facebook integrations in production for over a year
  - HTTP Request Routing: > 25% reduction in TAO miss rate
  - Storage Sharding: Latency and CPU utilization reduced by over 50%