



Quaestor

Query Web Caching for DBaaS Providers

Felix Gessert, Michael Schaarschmidt, **Wolfram Wingerath**, **Erik Witt**, Eiko Zoneki, Norbert Ritter

Who we are



Research Project since 2010



Backend-as-a-Service **Startup** since 2014

Introduction

Main Part

Conclusion



Motivation and
High-Level Overview



Challenges and Main
Contributions

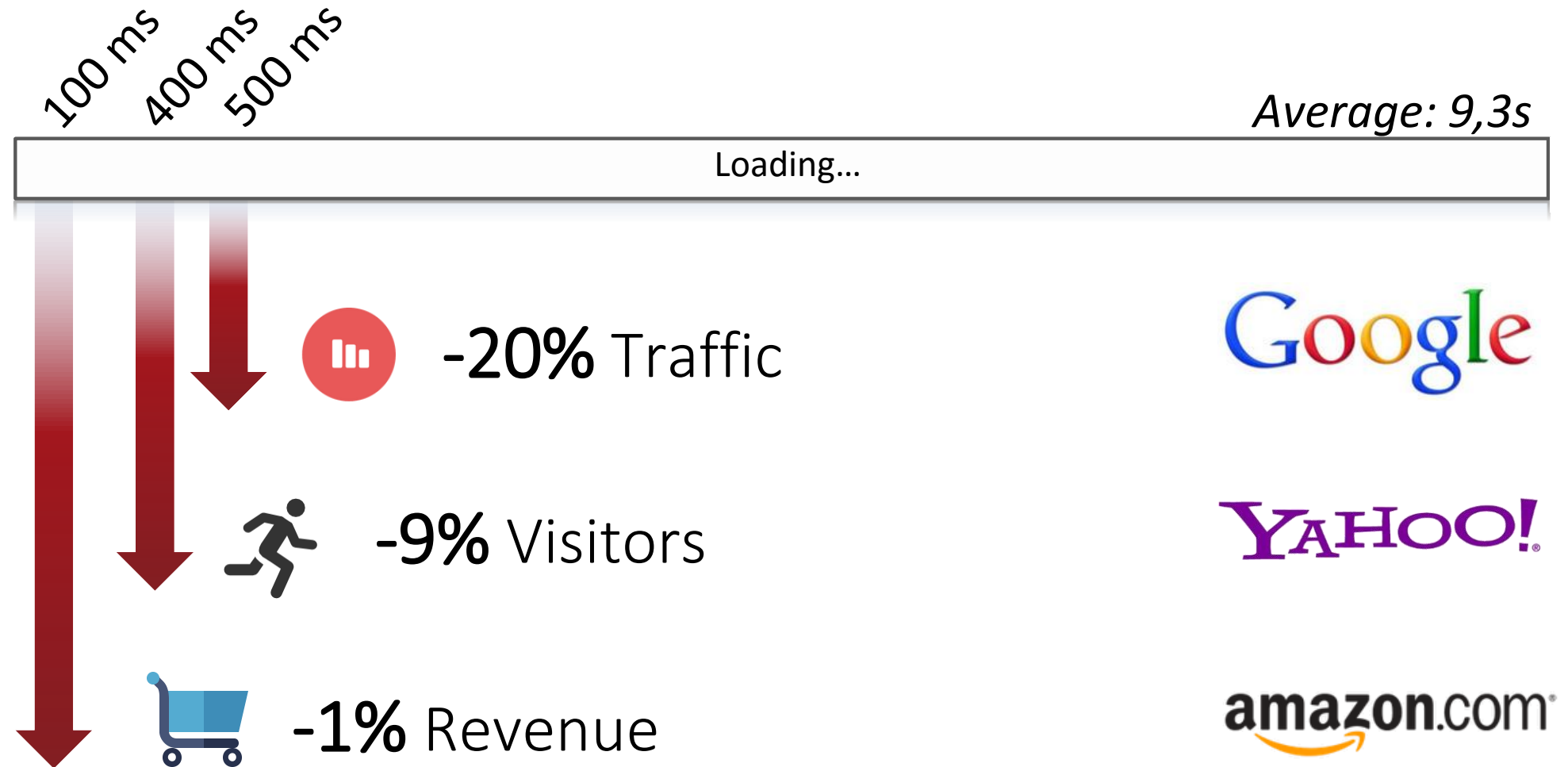


Industry Application



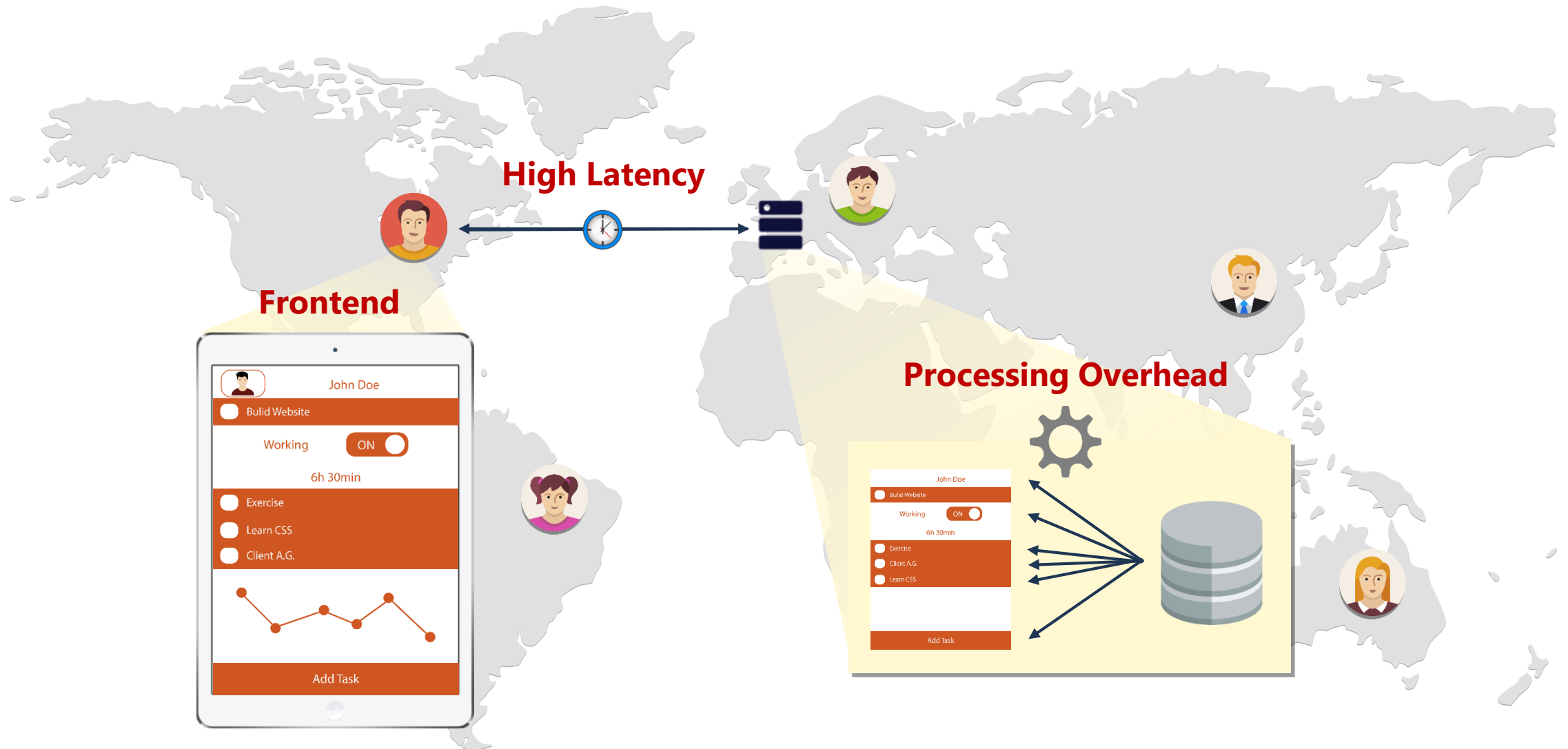
Presentation
is loading

The Latency Problem



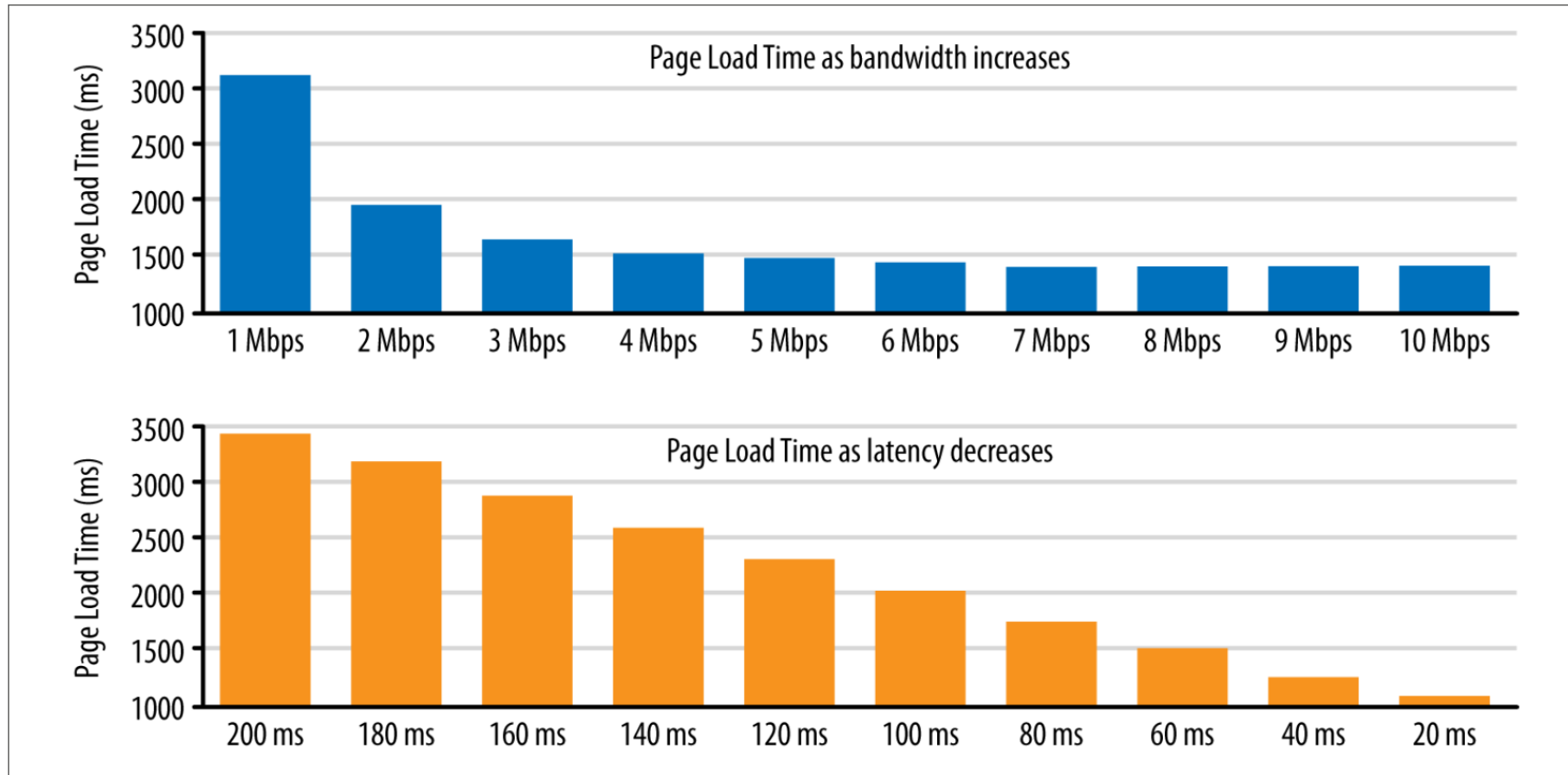
State of the Art

Three Bottlenecks: Frontend, Latency and Processing



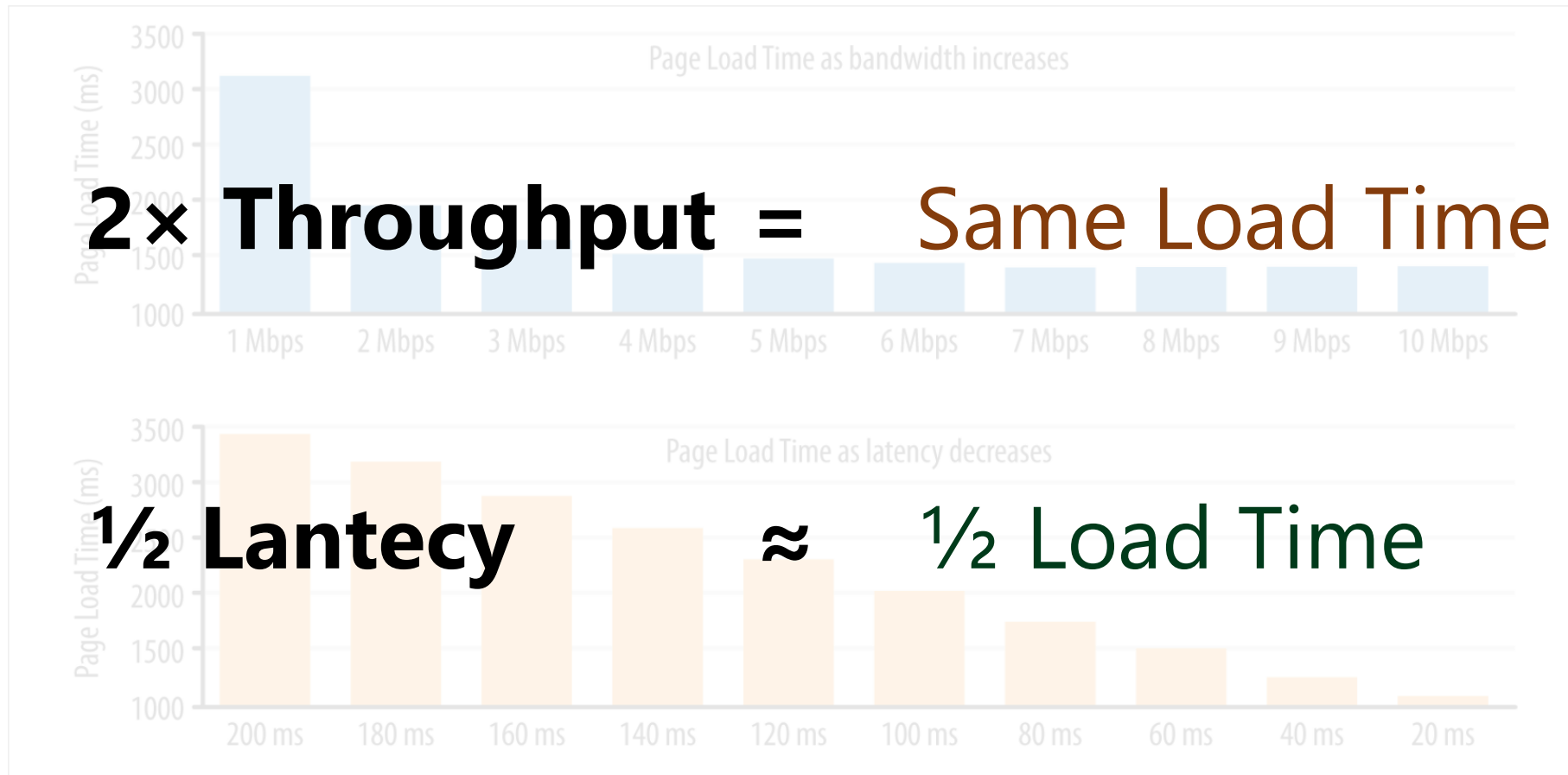
Netzwerk

Throughput vs. Latency



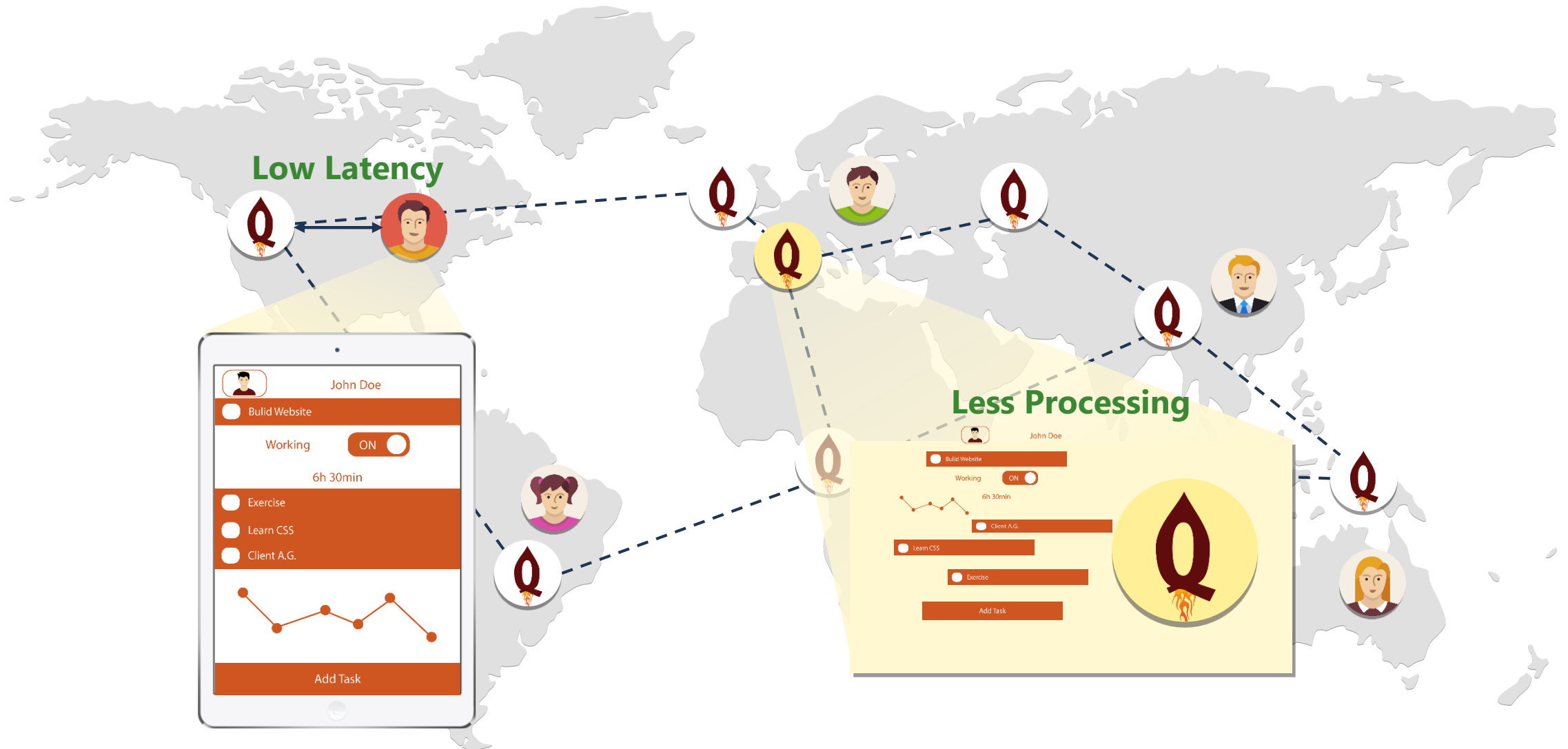
Netzwerk

Bandbreite vs. Latenz



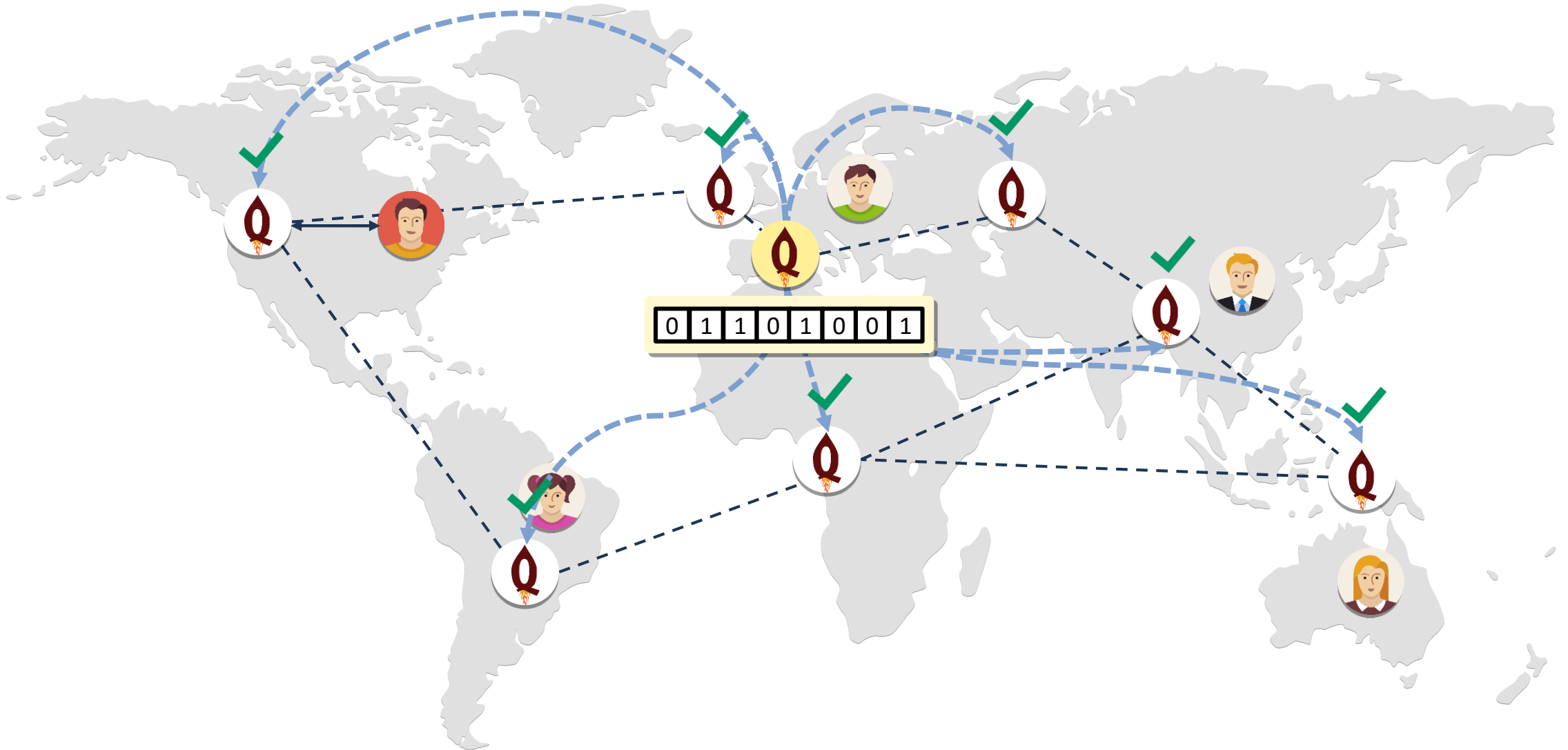
Solution: Global Caching

Fresh Data From Distributed Web Caches



New Caching Algorithms

Solve Consistency Problem



Typical Speedup: 15x

Impact of Global Baqend Caching

TRY THIS

benchmark.baqend.com

Baqend
Azu
Par
Fireba
Kinv
Apiom

Politik



11. November 2014 12:42 Uhr
Deutsche Rentenversicherung

Renten könnten 2015 um zwei Prozent steigen

Die Deutsche Rentenversicherung geht von einem Anstieg über der Inflationsrate aus. Abschlagsfreie Rente ab 63 Jahren stößt auf großes Interesse.



11. November 2014 10:05 Uhr
Europäischer Gerichtshof

Deutschland darf EU-Ausländern Hartz IV verweigern

Der Europäische Gerichtshof hat entschieden: Deutschland kann arbeitslose Zuwanderer aus der EU von Sozialleistungen ausschließen. Das Urteil könnte ein Signal sein.



11. November 2014 06:48 Uhr
APEC-GIPFELTREFFEN

Obama besänftigt China

Die USA wollen China nicht klein halten, sagt Präsident Obama vor dem Treffen mit Chinas Staatschef Xi. Der plädiert für mehr wirtschaftliche Verflechtung.



10. November 2014 19:17 Uhr
ISRAEL

Keiner will von Intifada sprechen

Messerattacken auf Israelis, Krawalle auf dem Tempelberg, Schirmmützen im Gassengewirr

Wirtschaft



11. November 2014 07:15 Uhr
HONORARBERATUNG

Guter Rat zur Geldanlage ist selten

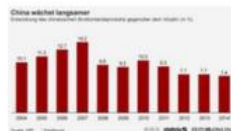
Honorarberatung ist in Deutschland endlich gesetzlich geregelt. Doch gibt es kaum Honorarberater. Und gut qualifizierte noch viel weniger.



10. November 2014 21:32 Uhr
CHINA

Der berühmteste Wohltäter Chinas – nach eigenen Angaben

Der chinesische Unternehmer Chen Guangbiao wurde ausgerechnet mit Bauschutt sehr reich. Jetzt baut er Wände aus Geldbündeln und zertrümmert öffentlich Luxusautos.



10. November 2014 19:29 Uhr
KONJUNKTUR

China steckt in der Wachstumsfalle

Jahrelang hat China die Welt mit hohen, oft zweistelligen Wachstumsraten beeindruckt. Doch diese Zeiten sind vorbei, wie unsere Grafik des Tages zeigt.



10. November 2014 13:45 Uhr
WÄHRUNG

Russlands Zentralbank lässt Rubel frei handeln

Kultur



11. November 2014 10:14 Uhr
NICOLAUS HARNONCOURT

Mozarts Triptychon

Nikolaus Harnoncourt ist der Detektiv unter den Dirigenten. Jetzt legt er Indizien vor, wie drei von Mozarts Sinfonien zu einem nie gehörten Oratorium verschmelzen.



11. November 2014 06:39 Uhr
HANS MAGNUS ENZENSBERGER

Der Unerschütterliche

Hans Magnus Enzensberger wird 85. Ein Besuch bei dem herrlich eigenwilligen Intellektuellen. Mit Tumult hat er gerade ein erstaunlich persönliches Buch veröffentlicht.



10. November 2014 um 18:25 Uhr
DDR-DESIGN

Sandmännchen und Stasi-Mikrofone

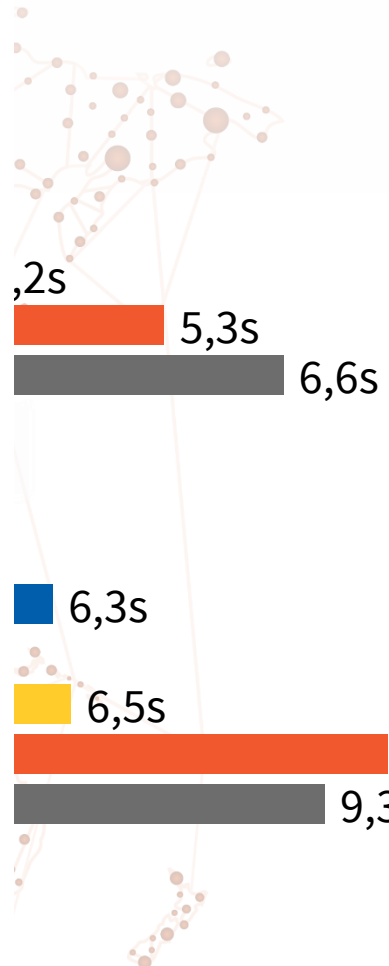
Das größte Museum für DDR-Design steht ausgerechnet in Los Angeles. Ein Buch über das Wende Museum zeigt, welche Schätze und Abgründe es dort zu entdecken gibt.



10. November 2014 um 15:25 Uhr
AZEALIA BANKS

Klare Ansage aus Harlem

Erst galt Azealia Banks als großes Raptalent, dann als streitsüchtig und selbstverliebt. Ihr seit Jahren erwartetes Debüt zeigt jetzt, wie gut das eine zum anderen passt.



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Motivation and
High-Level Overview



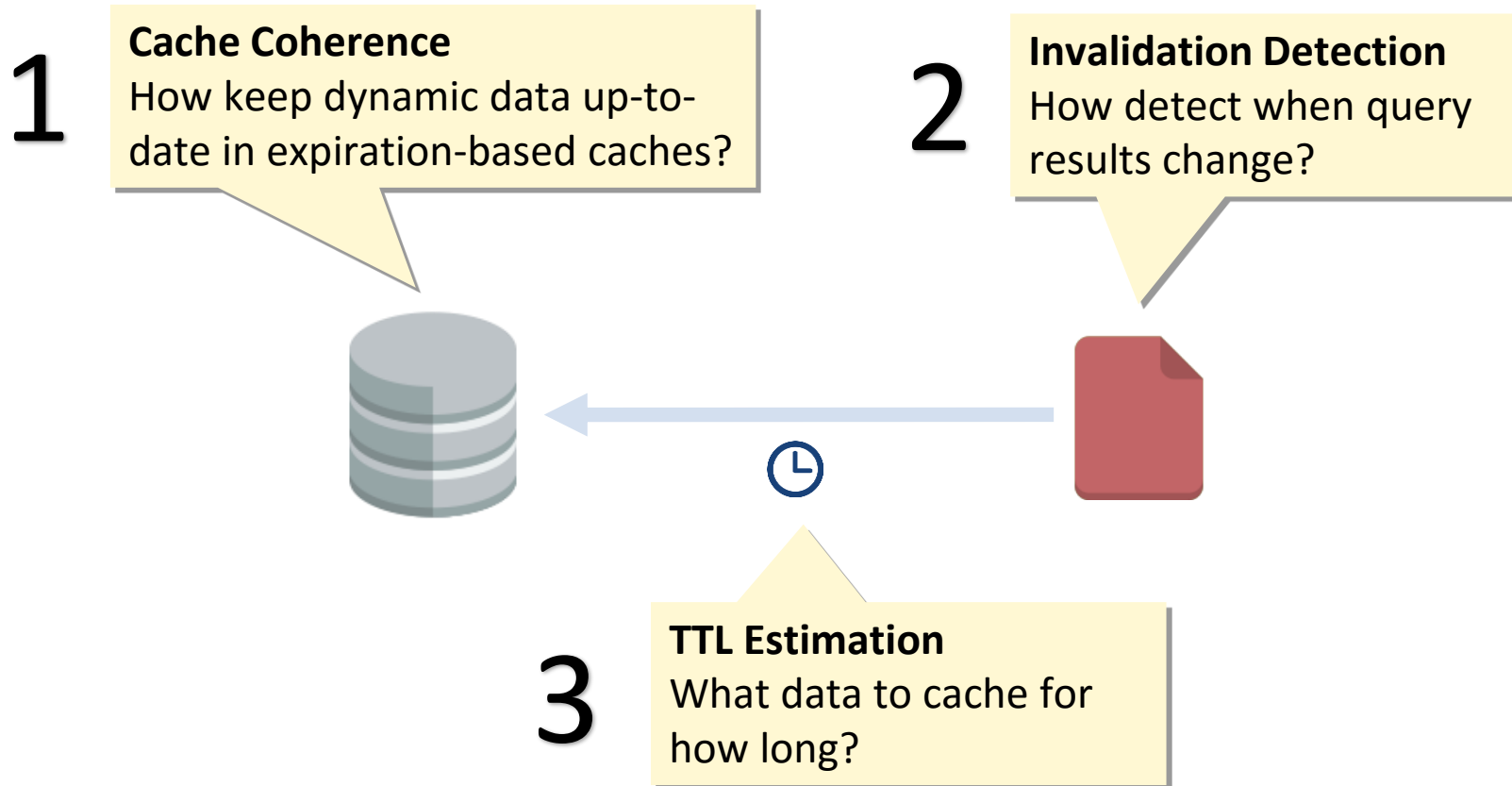
Challenges and Main
Contributions



Industry Application

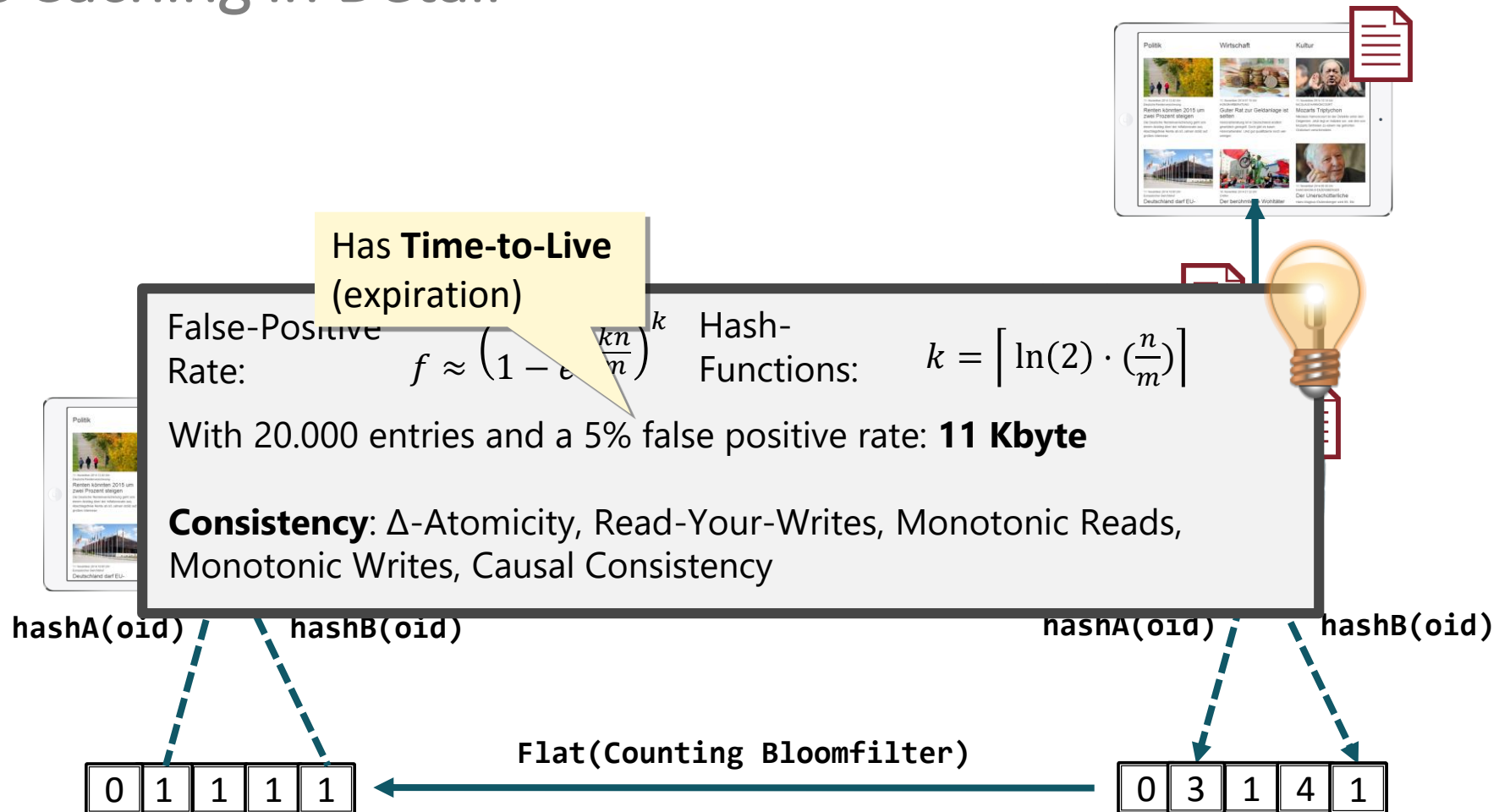
Challenges

How to achieve globally low latency



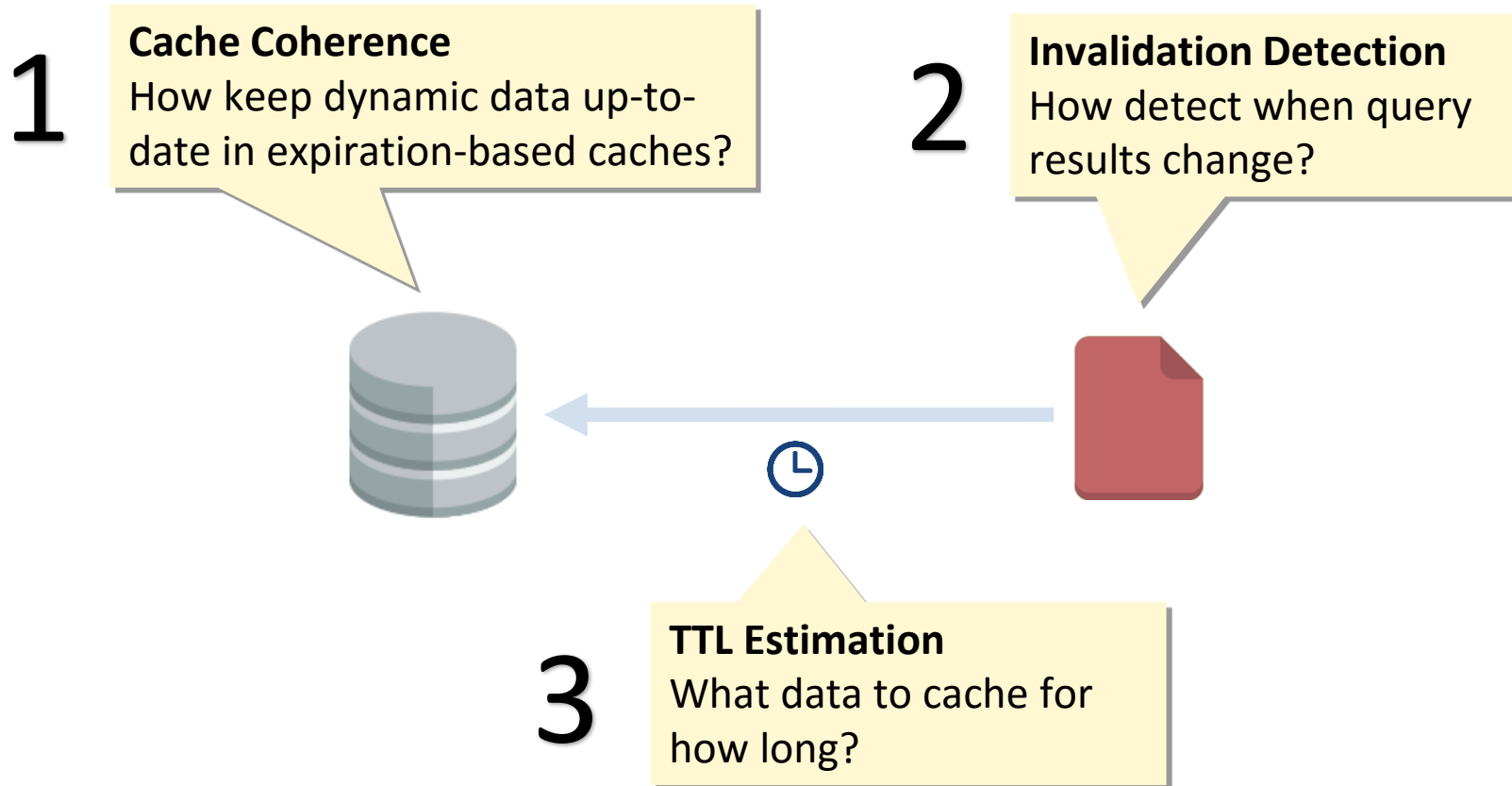
Cache Coherence

Dynamic Caching in Detail



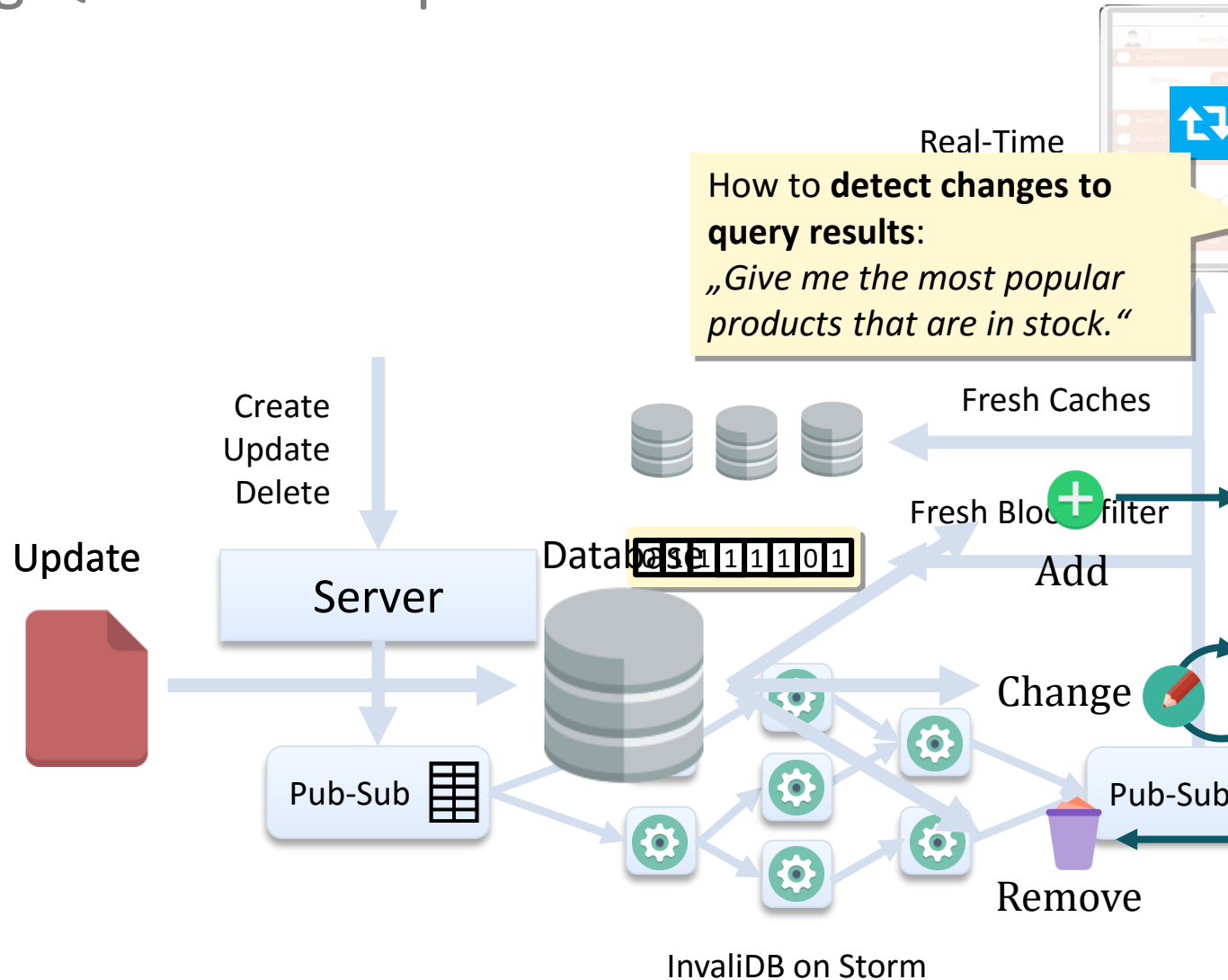
Challenges

How to achieve globally low latency



Invalidation Detection

Matching Queries and Updates



DEAL OF THE DAY

\$10.25 - \$179.99

Ends in 16:45:48

Up to 50% Off Handbags

★★★★★ 21

See details



DEAL OF THE DAY

\$97.99

List: ~~\$149.95~~ (35% off)

Ends in 16:45:48

Save on Hitachi Gas Powered Leaf Blower

Ships from and sold by Amazon.com.

★★★★★ 1961

Add to Cart



\$15.63 - \$16.79

9% Claimed

Ends in 4:40:49

BESTEK surge protector

Sold by BESTEK, and Fulfilled by Amazon.

★★★★★ 162

Choose options



\$18.66

Price: ~~\$39.99~~ (53% off)

18% Claimed

Ends in 3:05:49

AUKEY Table Lamp, Touch Sensor Bedside Lamp + Dimmable War...

Sold by Aukey Direct and Fulfilled by Amazon.

★★★★★ 669

Add to Cart

InvaliDB

Filter Queries: Distributed Query Matching

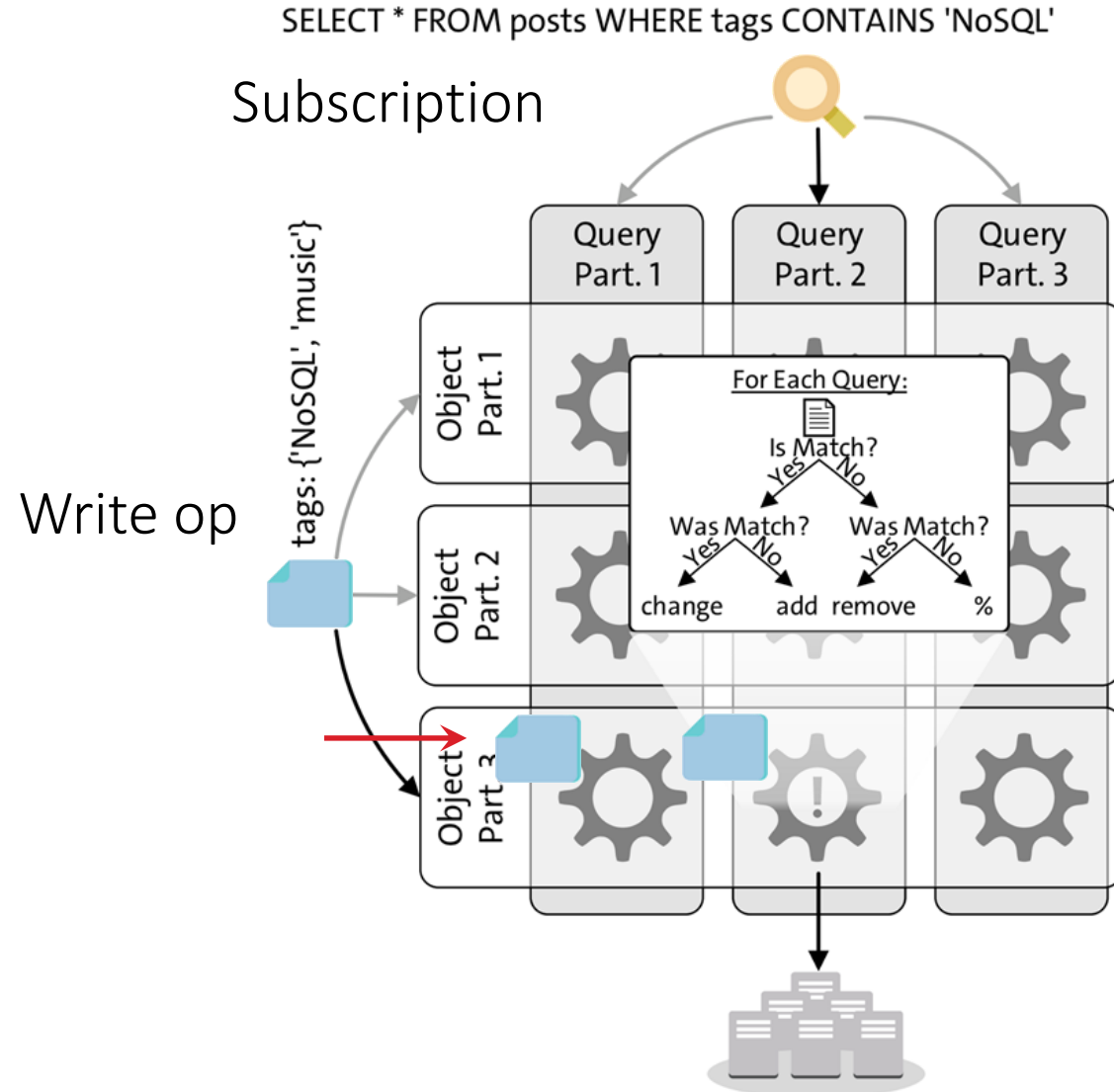
Two-dimensional partitioning:

- *by Query*
- *by Object*

→ scales with queries and writes

Implementation:

- Apache Storm & Java
- MongoDB query language
- Pluggable engine





Filter word, e.g. "http", "Java", "Baqend"



Real-Time

Static

Last result update at 15:51:21 (less than a second ago)

1. Conju.re (conju_re, 3840 followers) tweeted:
https://twitter.com/conju_re/status/859767327570702336

Congress Saved the Science Budget—And That's the Problem <https://t.co/UdrjNidakc>
<https://t.co/xlNjpEpKZG>

2. ねぼすけゆーだい (Yuuu__key, 229 followers) tweeted:
https://twitter.com/Yuuu__key/status/859767323384623104

けいきさんと PENGUIN RESEARCHのけいたくん がリプのやり取りしてる...

3. Whitney Shackley (bschneids11, 5 followers) tweeted:
<https://twitter.com/bschneids11/status/859767319534469122>

holy..... waiting for it so long 🍷 © <https://t.co/UdXcHJb7X3>

4. Lisa Schmid (LisaMSchmid, 67 followers) tweeted on #teamscs, and #scs...
<https://twitter.com/LisaMSchmid/status/859767317311500290>

Congrats to Matthew Kent, winner of the 26th #TeamSCSCoding Challenge.
<https://t.co/vx1o0WgJrZ> #SCSChallenge

5. Brian Martin Larson (Brian_Larson, 40 followers) tweeted on #teamscs, a...
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https://twitter.com/Brian_Larson/status/859767317303001089

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Programming Real-Time Queries

JavaScript API

```
var query = DB.Tweet.find()  
  .matches('text', /my filter/)  
  .descending('createdAt')  
  .offset(20)  
  .limit(10);
```

Static Query

```
query.resultList(result => ...);
```

Google

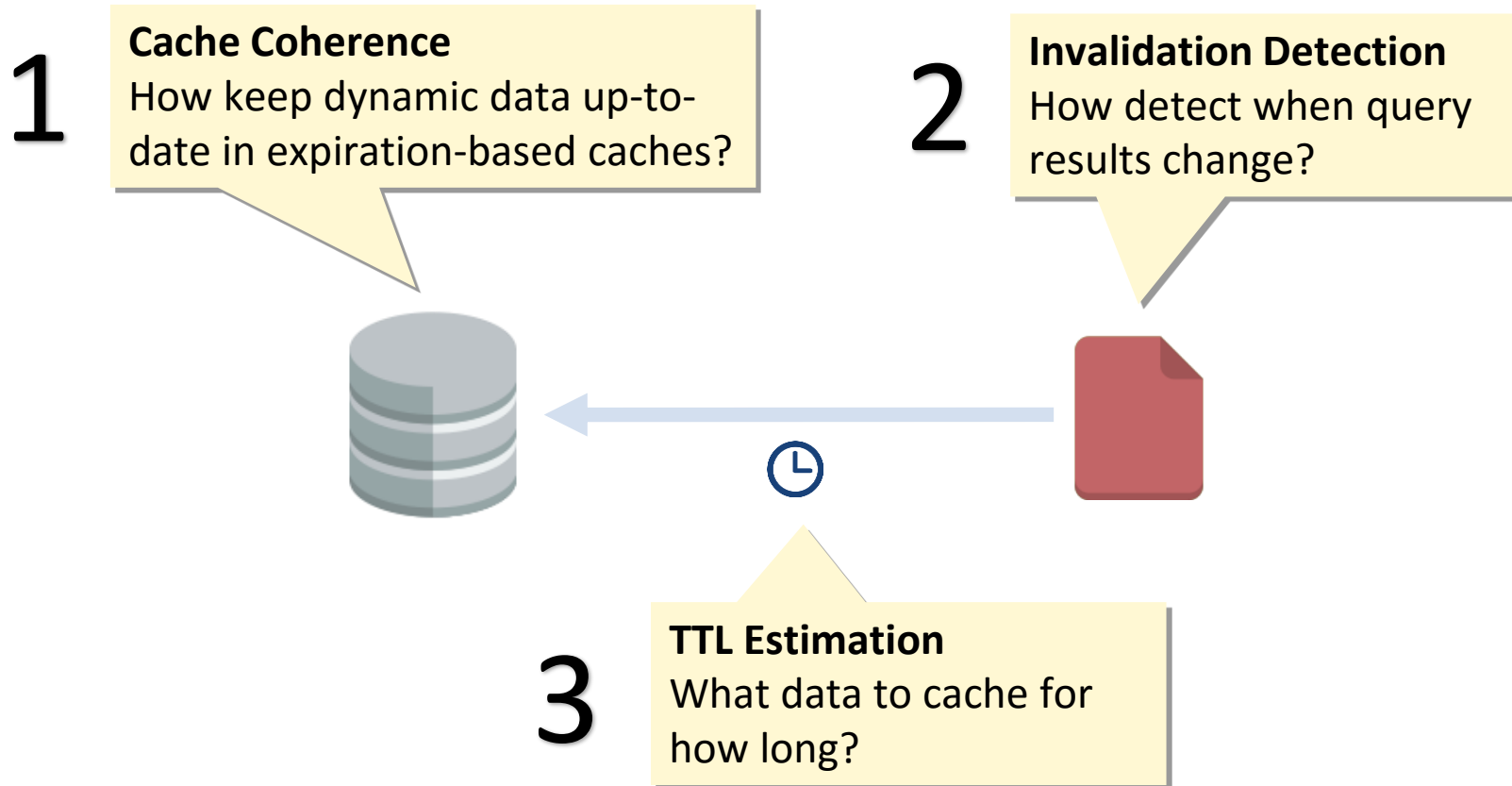
Real-Time Query

```
query.resultStream(result => ...);
```

Twoogle

Challenges

How to achieve globally low latency



Learning Representations

Determining optimal query result representation

- ▶ **Setting:** query results can either be represented as references (id-list) or full results (object-lists)

Id-Lists
 $[id_1, id_2, id_3]$
Less Invalidations

Object-Lists
 $[\{id: 1, val: 'a'\}, \{id: 2, val: 'b'\}, \{id: 3, val: 'c'\}]$
Less Round-Trips

- ▶ **Approach:** Cost-based decision model that weighs expected round-trips vs expected invalidations
- ▶ **Ongoing Research:** Reinforcement learning of decisions

TTL Estimation

Determining the best TTL and cacheability

- ▶ **Problem:** if $TTL \gg$ time to next write, then it is contained in Cache Sketch unnecessarily long
- ▶ **TTL Estimator:** finds „best“ TTL and decides cacheability
- ▶ Trade-Offs:

Verfahren: Zeit bis zum nächsten Write $E[T_w]$ schätzen
(Alex Protocol, EWMA, Deep Reinforcement Learning)



Gute TTLs \rightarrow optimaler Bloomfilter



- fewer invalidations
- stale reads

- higher cache-hit rates

$TTL < TTL_{min} \rightarrow$ *write-heavy* Daten nicht cachen

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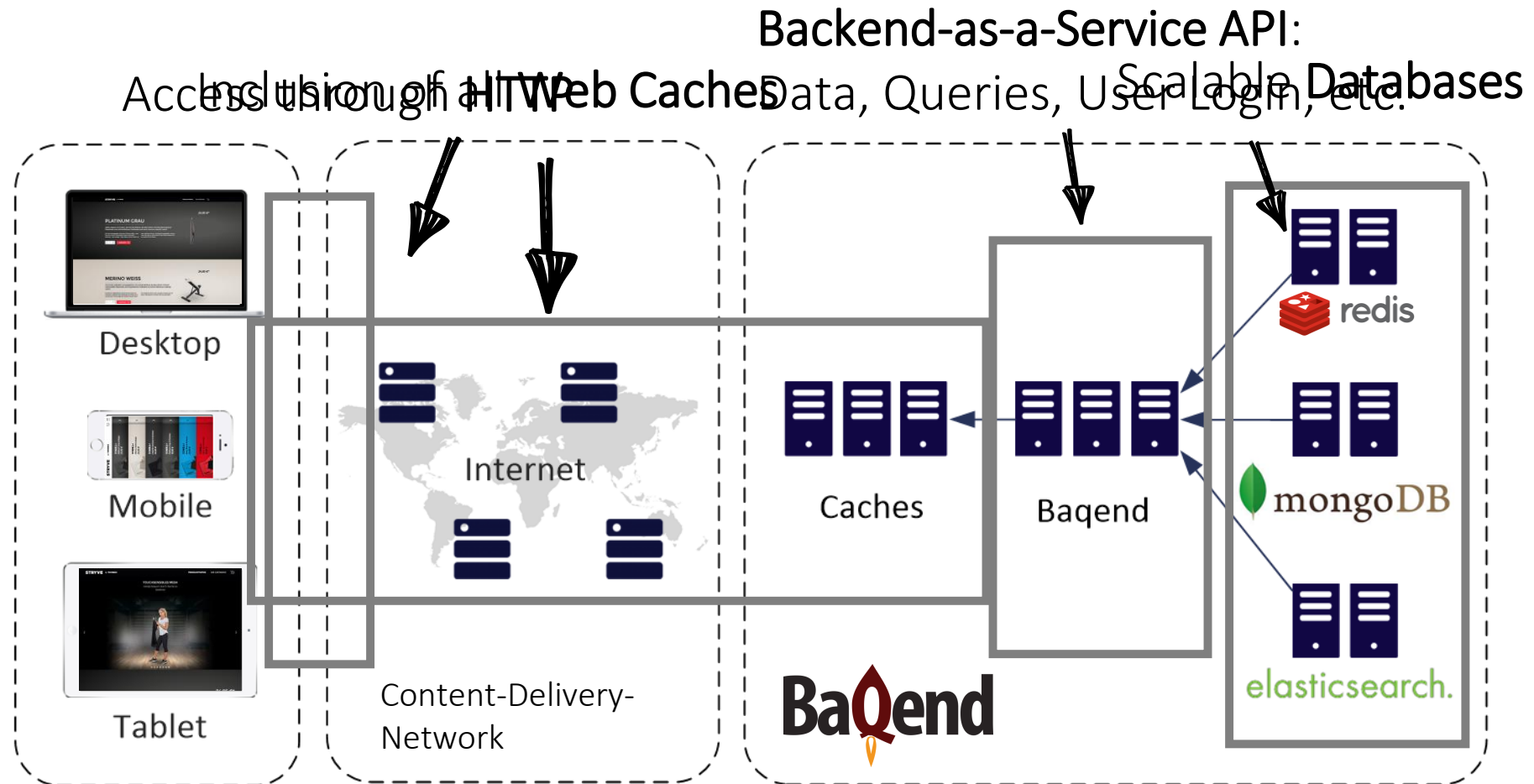
Challenges and Main
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Industry Application

Backend Architecture

Baqend Cloud



Backend Architecture

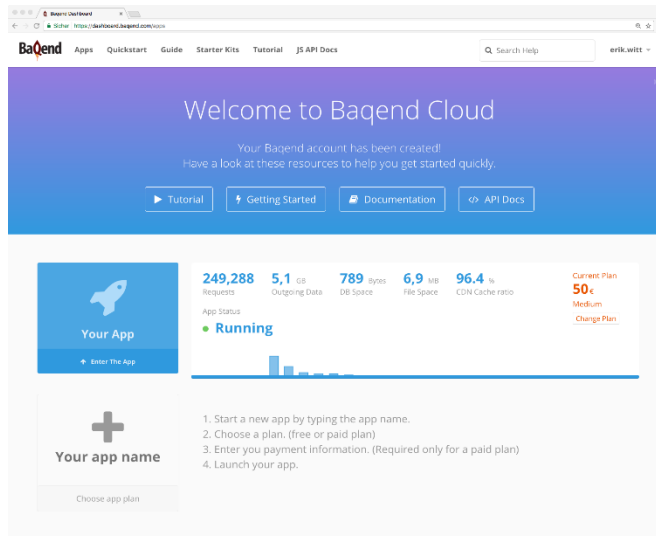
Baqend Cloud

Baqend



Development On Baqend

Dashboard



Create schema, configure, browse data, etc.

CLI

```
hannes@bq1:~$ baqend --help

Usage: baqend [command] [options] <args...>

Commands:

  login [options]           Logs you in and lo
  register                  Registers an accou
  open [app]                Opens the url to y
  dashboard                 Opens the url to t
  deploy [options] [app]    Deploys your baqen
  logout [options]          Removes your store
  typings [options] <app>  Generates addition
  start [name] [dir]        clones the starter

Type in one of the above commands followed by

Options:
```

Develop, deploy and test frontend und backend code

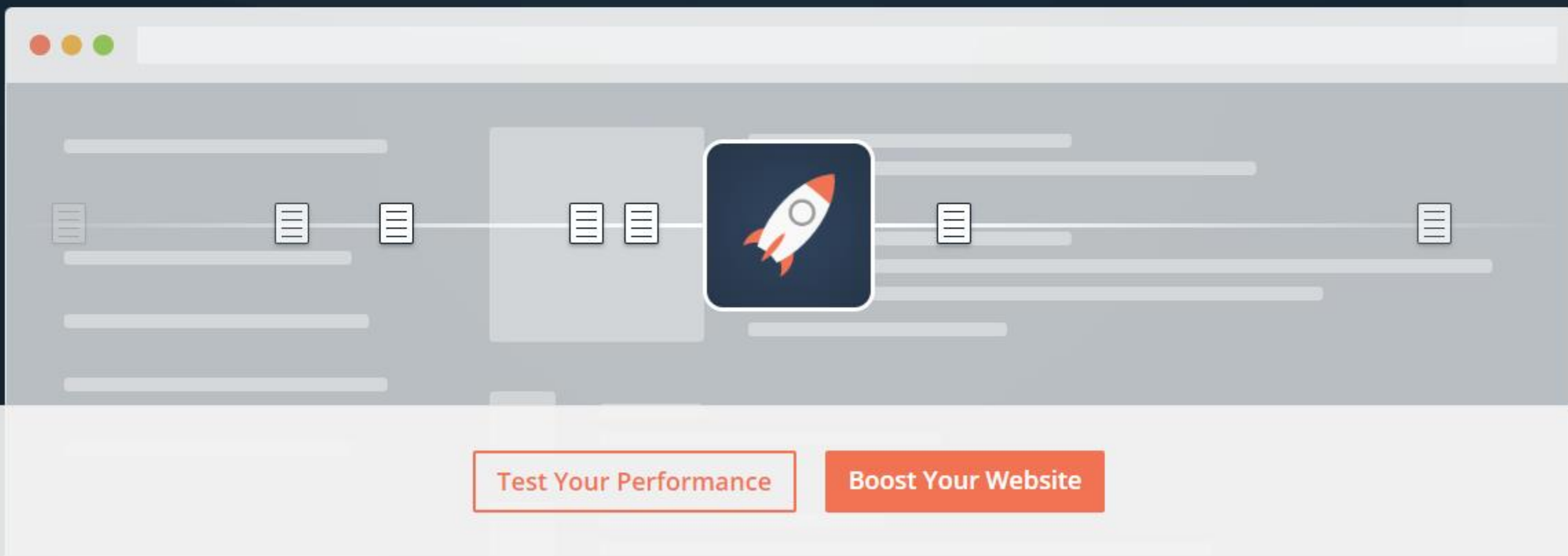
REST & SDK

```
script.js
1 function leaveMessage(name, message) {
2   //Create new message object
3   var msg = new DB.Message();
4   //Set the properties
5   msg.name = name;
6   msg.message = message;
7   msg.date = new Date();
8   //Insert it to the database
9   msg.insert().then(showMessages);
10 }
11
12 function showMessages() {
13   DB.Message.find()
14     .descending("date")
15     .limit(30)
16     .resultList()
```

Website logic: load site, get data, login, etc.

Speed Kit Makes Websites Load Faster.

A code snippet that boosts web performance on your current technology stack.



Baqend Speed Kit

Applying Our Caching to Existing Websites

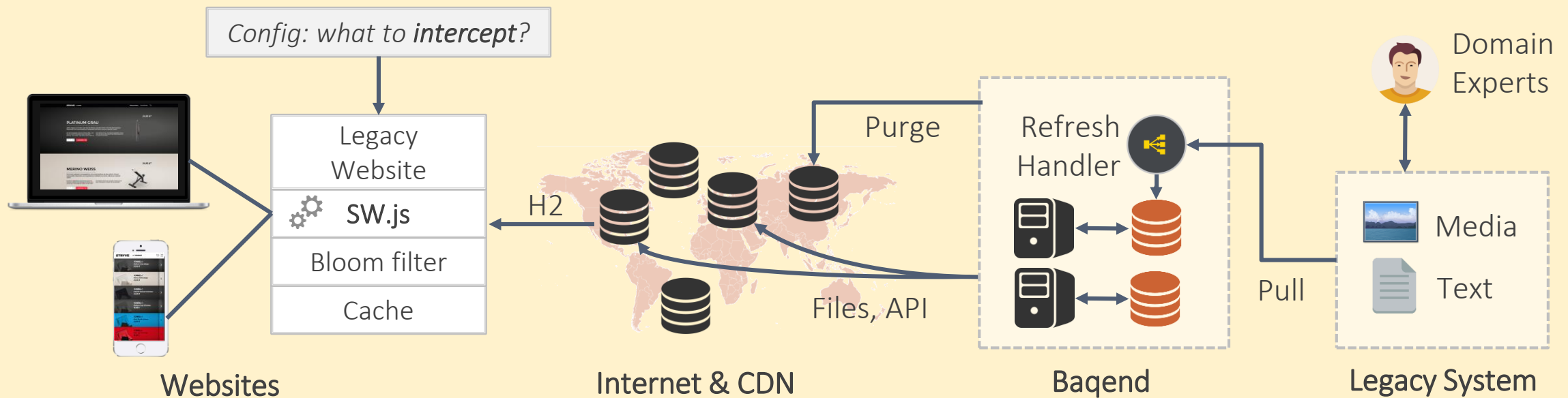
- **Redirects** requests to Baqend for faster delivery by including a **snippet**
- Also available as a **WordPress-Plugin**
- Will be released in **August 2017**



Speed Kit

Supercharge your website by adding three lines of code.

Boost your website



VLDB Performance with Speedkit 😊



>10x
Faster Loads



Automatic
Scaling



Faster
Development



BaQend

For a web without
loading times.

Contact us:

info@baqend.com

www.baqend.com

[@Baqendcom](https://twitter.com/Baqendcom)