A Polyglot & GDPR-Compliant Approach For Caching Personalized Content
Presentation is loading
Of **3.5 hours** you spend online each day...

...**20 minutes** are wasted waiting for pages to load.

In your life, you will waste **one whole year**.
You Heard The Stories

Amazon: 100 ms slower → -1% Conversion Rate
Zalando: 100 ms faster → +0.7% Revenue Per Session
Walmart: 100 ms faster → +1% Revenue

---

Greg Linden, Make Data Useful. Stanford Data Mining Class CS345A, 2006
# Delay Psychology: Rules of Thumb

<table>
<thead>
<tr>
<th>Delay</th>
<th>User Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 100 ms</td>
<td>Instant</td>
</tr>
<tr>
<td>100 – 300 ms</td>
<td>Small perceptible delay</td>
</tr>
<tr>
<td>300 – 1000 ms</td>
<td>Machine is working</td>
</tr>
<tr>
<td>1+ s</td>
<td>Mental context switch</td>
</tr>
<tr>
<td>10+ s</td>
<td>Task is abandoned</td>
</tr>
</tbody>
</table>

Stay under 1000 ms to keep users’ attention

---


# Delay Psychology: Rules of Thumb

<table>
<thead>
<tr>
<th>Delay</th>
<th>User Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 100 ms</td>
<td>Instant</td>
</tr>
<tr>
<td>100 – 300 ms</td>
<td>Small perceptible delay</td>
</tr>
<tr>
<td>300 – 1000 ms</td>
<td>Machine is working</td>
</tr>
<tr>
<td>1+ s</td>
<td>Mental context switched</td>
</tr>
<tr>
<td>10+ s</td>
<td>Task is abandoned</td>
</tr>
</tbody>
</table>

Page Speed = Money

Stay under 1000 ms to keep users’ attention

---

I. Grigorik, High performance browser networking, O’Reilly Media, 2013

Jakob Nielsen, Usability Engineering, Morgan Kaufmann, 1994
Global Pandemic: More Traffic, Reduced Speed

United Kingdom
- Traffic: ↑ 78.6%
- Download Speed: ↓ 30.3%

Difference calculated between February 27th and March 31st.

Italy
- Traffic: ↑ 109.3%
- Download Speed: ↓ 35.4%

Difference calculated between February 30th and March 31st.

Spain
- Traffic: ↑ 39.4%
- Download Speed: ↓ 8%

Difference calculated between March 1st and March 31st.

France
- Traffic: ↑ 38.4%
- Download Speed: ↓ 13.9%

Difference calculated between February 26th and March 31st.

3 Things Make Your Website Slow

1. Backend Processing
2. Network Delays
3. Client
We Are Baqend

We bring performance research to practice.

40+ man-years of web performance research

Novel technology for caching dynamic data

Speed Kit – SaaS for e-commerce speed
Speed Kit Makes Websites Fast

Website

Fast Requests

Speed Kit Cloud

Real-Time Sync

Origin Server

Tracking & Ad Services
2 Challenges:
1. Detect content updates
2. Keep caches coherent
Challenge I: Detect Content Updates

Can be triggered via periodic CRON job or REST API

Revalidation Job

{ "contentTypes": ["html"] }
Challenge II: How We Solved Cache Coherence
Challenge II: How We Solved Cache Coherence
Challenge II: How We Solved Cache Coherence

Without Cache Sketch: Stale Cached Data
Challenge II: How We Solved Cache Coherence

Validate Freshness

Expiration Cache (Browser Cache)

Invalidation Cache (CDN)

refresh Cache Sketch every $\Delta = 30$ sec.

Add to Server Cache Sketch

01011

03041
Challenge II: How We Solved Cache Coherence

Δ-Atomicity: Cache Sketch refresh interval determines max. staleness

Validate Freshness

Expiration Cache (Browser Cache)

Invalidation Cache (CDN)

Add to Server Cache Sketch

refresh Cache Sketch every Δ = 30 sec.

01011

03041
HTML Caching With Dynamic Blocks

Speed Kit’s **Dynamic Blocks** for recommendations, carts, wishlists, A/B tests, etc.:

1. Blocks *defined* by selector.

2. Speed Kit loads a fast anonymous & the personalized view in **parallel**.

3. Dynamic blocks are **replaced**.
USP: Accelerating Personalization

Browser (blocks marked by selector)

Replace Dynamic Blocks

Fast & Anonymous

Speed Kit Cloud

Slow & Personalized

Origin Server
GDPR Compliance By Default

No external processing of sensitive user information.

Privacy by default
No cookies leaked & only public data cached

Full Control
Decision what to handle made in client (whitelist)
Key Technology: Service Workers

- Programmable **Network Proxy**, running as a **Background** Process, without **DOM** Access.
- Capabilities:
  - Intercept & rewrite **HTTP requests**
  - **Cache** data (**CacheStorage**)
  - **Store** data (**IndexDB**)
  - Respond **offline** or in slow network
  - Sync data & handle push
Automatic Image Optimization

Device

Optimizer (on the edge)

- WebP 640x320px 100 KB
- JPG 1280x640px 500 KB

- Images transoded to WebP
- Rescaled to match Screen Size
- JPG and PNG Recompression
Reliable Opt-in

>90% browser support.

In older browsers (and upon errors): fallback to original site.
Integrated Real-User Monitoring

Browser → Cloud Backend

- Time-to-First-Byte
- First (Contentful) Paint
- DOM Timer
- First Input Delay

Session Length
- Time on Site
- First User Interaction
- Bounce Rate

Cart Size
- Transactions
- Conversion Rate
- Revenue

Page Views & Sessions
- Browser Distribution
- JavaScript Errors
- Caching Insights

Performance
User Engagement
Business KPIs
QA Metadata

Timing API
Service Worker
Unhandled Errors
Split Testing For Web Performance

Speed Kit Users vs. Normal Users

- Speed Kit enabled
- **Measurable uplift:**
  - Performance
  - User engagement
  - Business success
- Speed Kit disabled (no acceleration)
Before Speed Kit

After Speed Kit

1.5x faster
Overall Performance for Baur.de

**First Contentful Paint Histogram**

*Histogram of first contentful paint on PDV pages compared between the two A/B test split groups*
Before
Speed Kit

After
Speed Kit

2.5x faster
Decathlon: Uplift According to Google

Before Speed Kit
- Fast <1s: 37%
- Average 1-2.5s: 52%
- Slow >2.5s: 11%

After Speed Kit
- Fast <1s: 73%
- Average 1-2.5s: 21%
- Slow >2.5s: 6%

*Time until First Contentful Paint according to Google’s Chrome User Experience Report (CrUX)*
Stylefile: Business Uplift

User-Based Conversion Rate: +1.9%

Average Order Value: +3.8%
Speed Kit Optimizes End-To-End

1. Offloaded Servers
   Shop Backend (unmodified infrastructure)

2. Low Latency
   Speed Kit (in user browser)

3. Fast Customer Experience
Thanks! **Questions?**

Details & newsletter on [speedstudy.info](http://speedstudy.info)

Wolfram Wingerath  wolle@baqend.com