PHASE 1: THE CONTRACT

Core Features (IN SCOPE)

Shorten: Long URL → Short Alias

Redirect: Short Alias → Long URL

Custom Alias (Optional)

Expiration Date (Optional)

~~Out of Scope~~

~~User Authentication~~

~~Complex Analytics Dashboards~~

~~Link Editing~~

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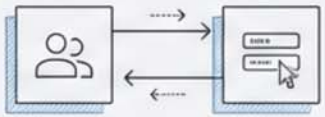
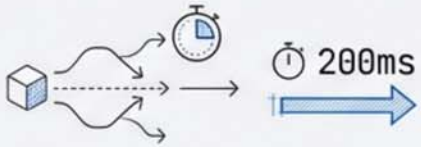
NON-FUNCTIONAL REQUIREMENTS

Scale: 100M Daily Active Users | 1 Billion URLs



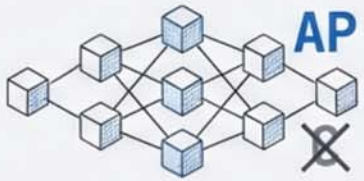
Latency: < 200ms (Redirects)



100:1

Read : Write Ratio

Availability: AP System
(High Availability > Consistency)



Read-Heavy System

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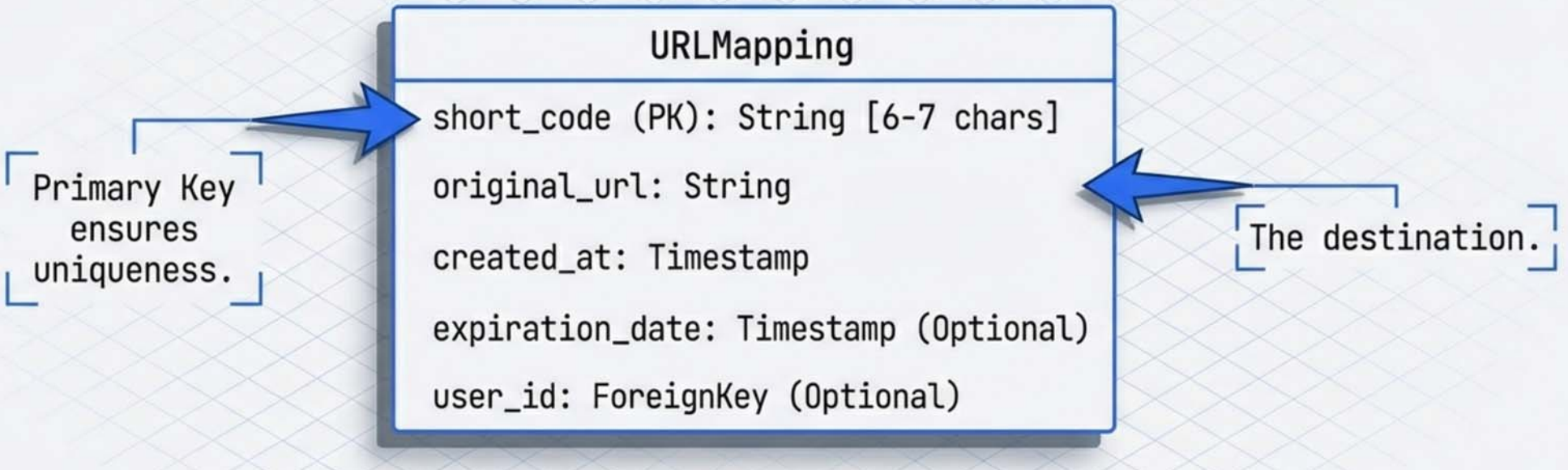
Phase 2: The Core Entities



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Phase 3: The API Contract

Create Short URL

```
POST /api/urls/shorten

Request Body:
{
  "long_url": "https://www.example.com/….,
  "alias": "custom-name" (optional)
}

Response: 200 OK
{ "short_url": "bit.ly/custom-name" }
```

Redirect User

```
GET /api/urls/{shortCode}

Response: 302 Found
Location: https://www.example.com/...
```

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Phase 4: High-Level Design (The Happy Path)

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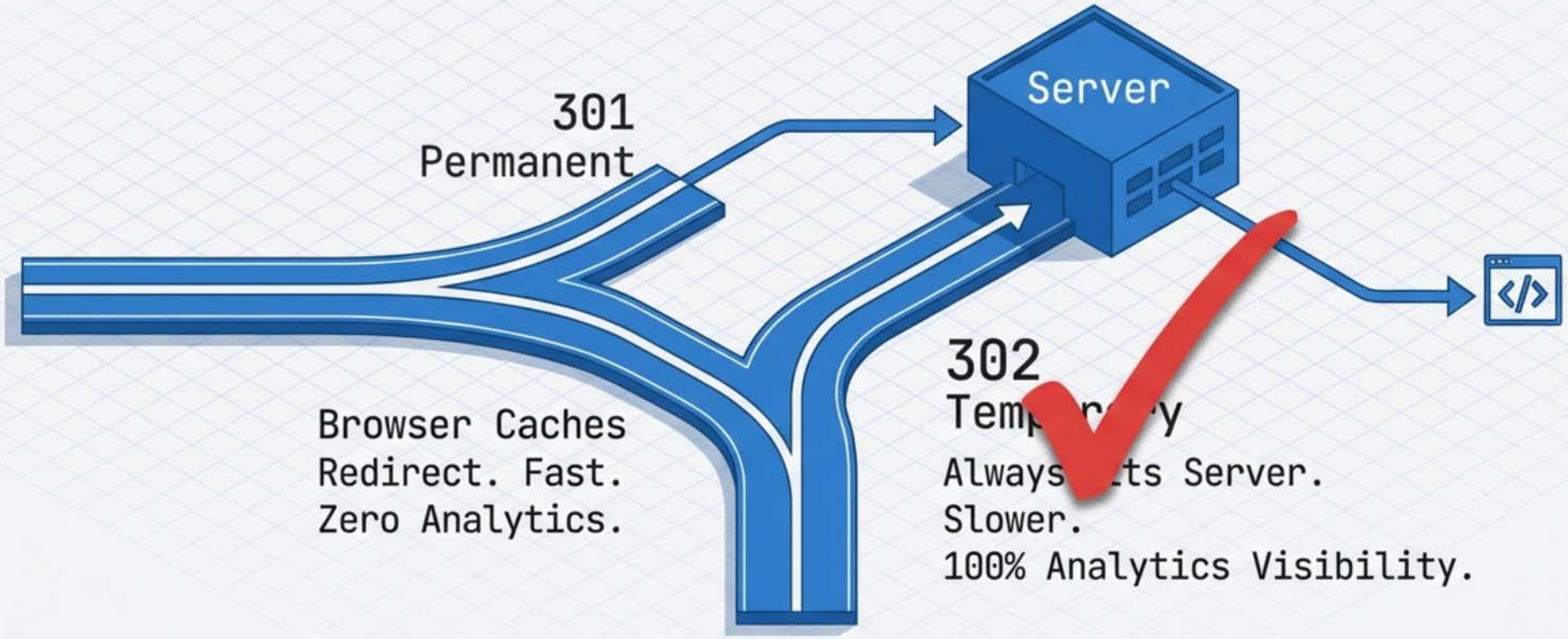
The Redirect Decision: 301 vs. 302



Business Requirement: Analytics drive revenue.

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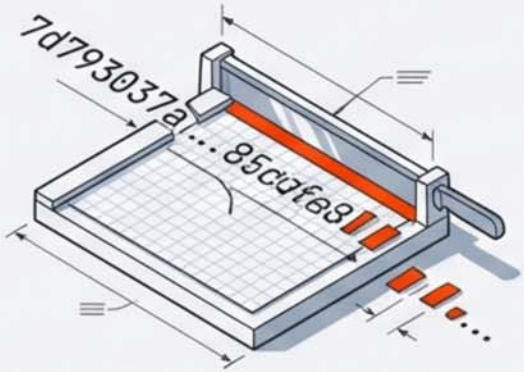
Modern Architectural Schematic

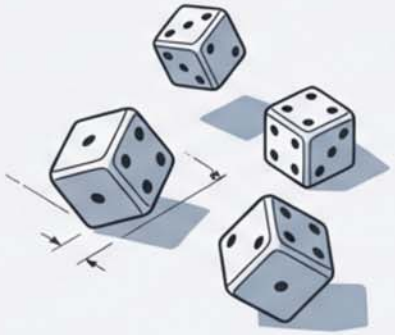
Generating the Short Code

MD5 Hashing



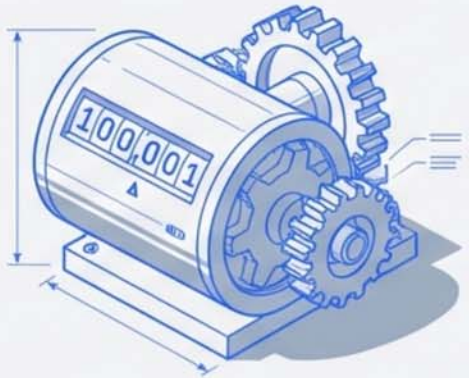
Too long.
Collisions when truncated.

Random Gen



Collision risk increases over time. **Requires "Check-Then-Write".**

The Counter



Zero Collisions.
Sequential.
Fast.

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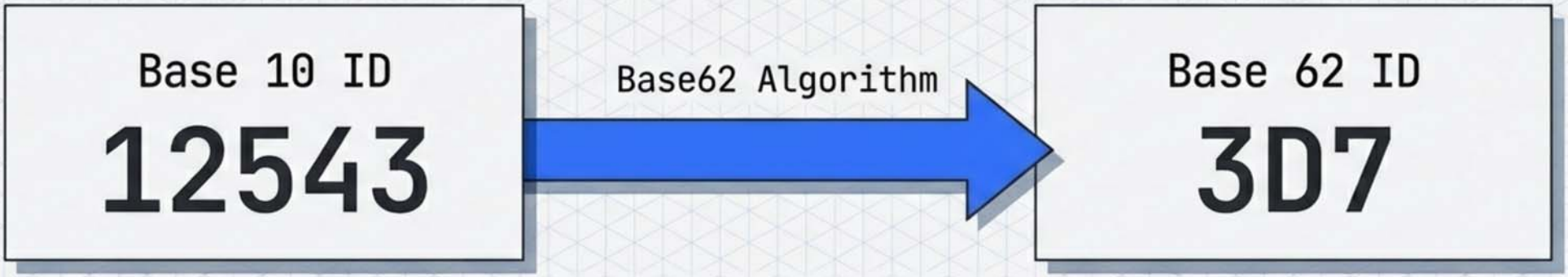
Modern Architectural Schematic

Base62 Encoding



[a-z] (26) + [A-Z] (26) + [0-9] (10) = 62 Characters

$62^6 \approx 56.8$ Billion Combinations

6 characters are enough for 56 Billion URLs.

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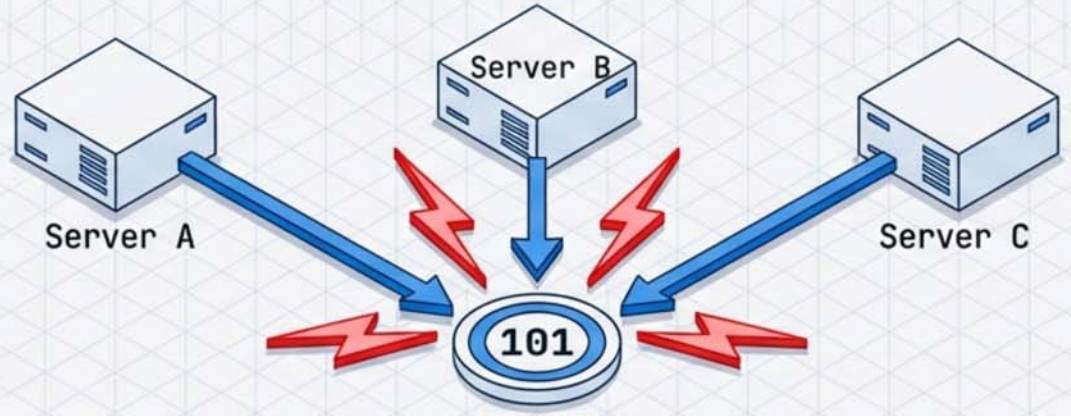
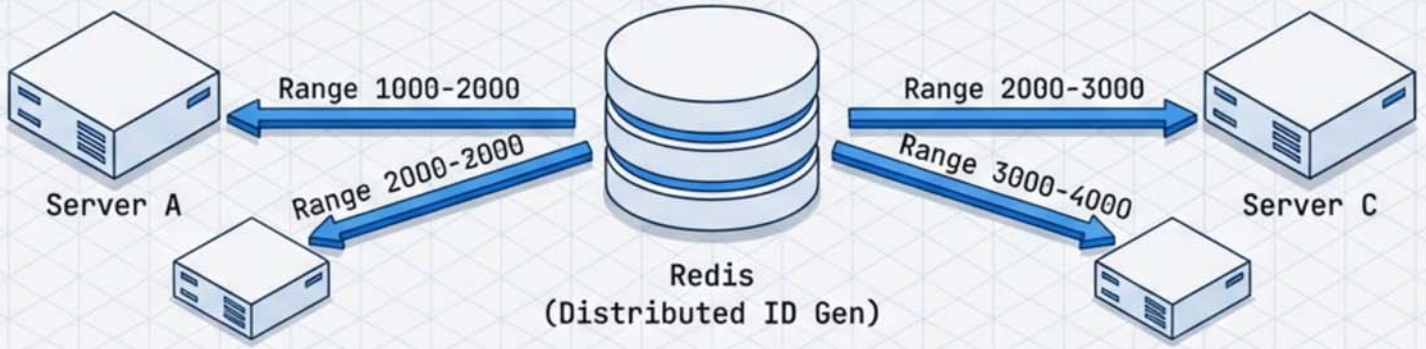
The Concurrency Problem





Atomic Increment + Range Batching = No Collisions.

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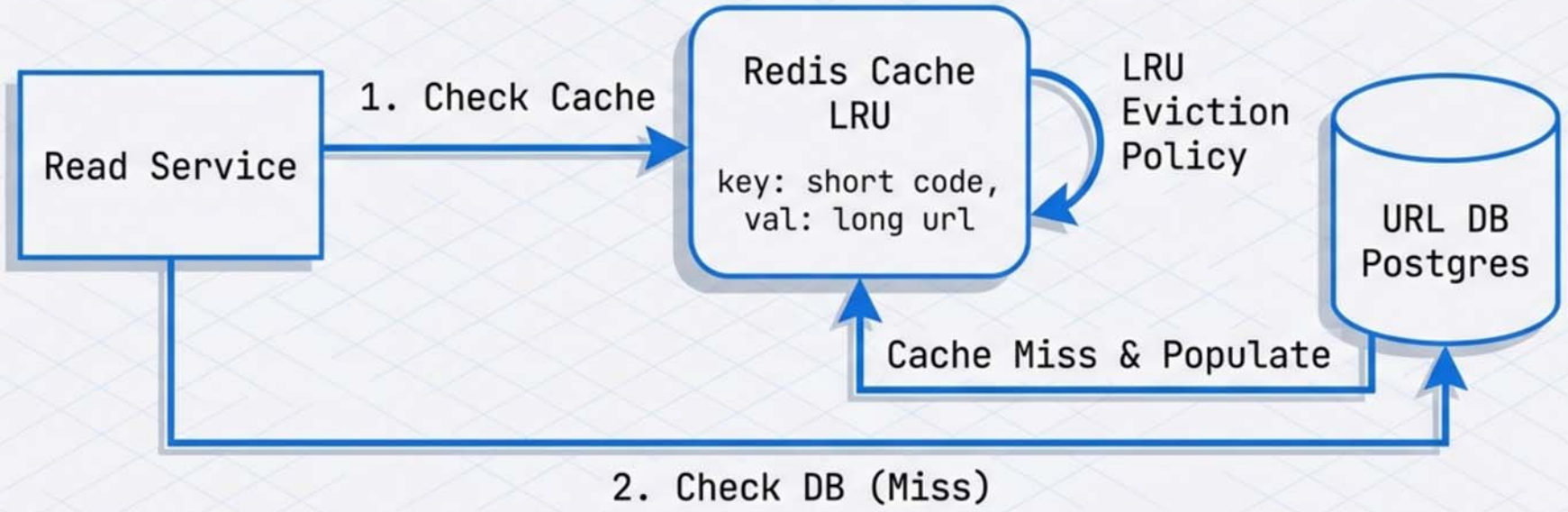
Scaling Reads: The Cache Layer



Handles 99% of Read Traffic.

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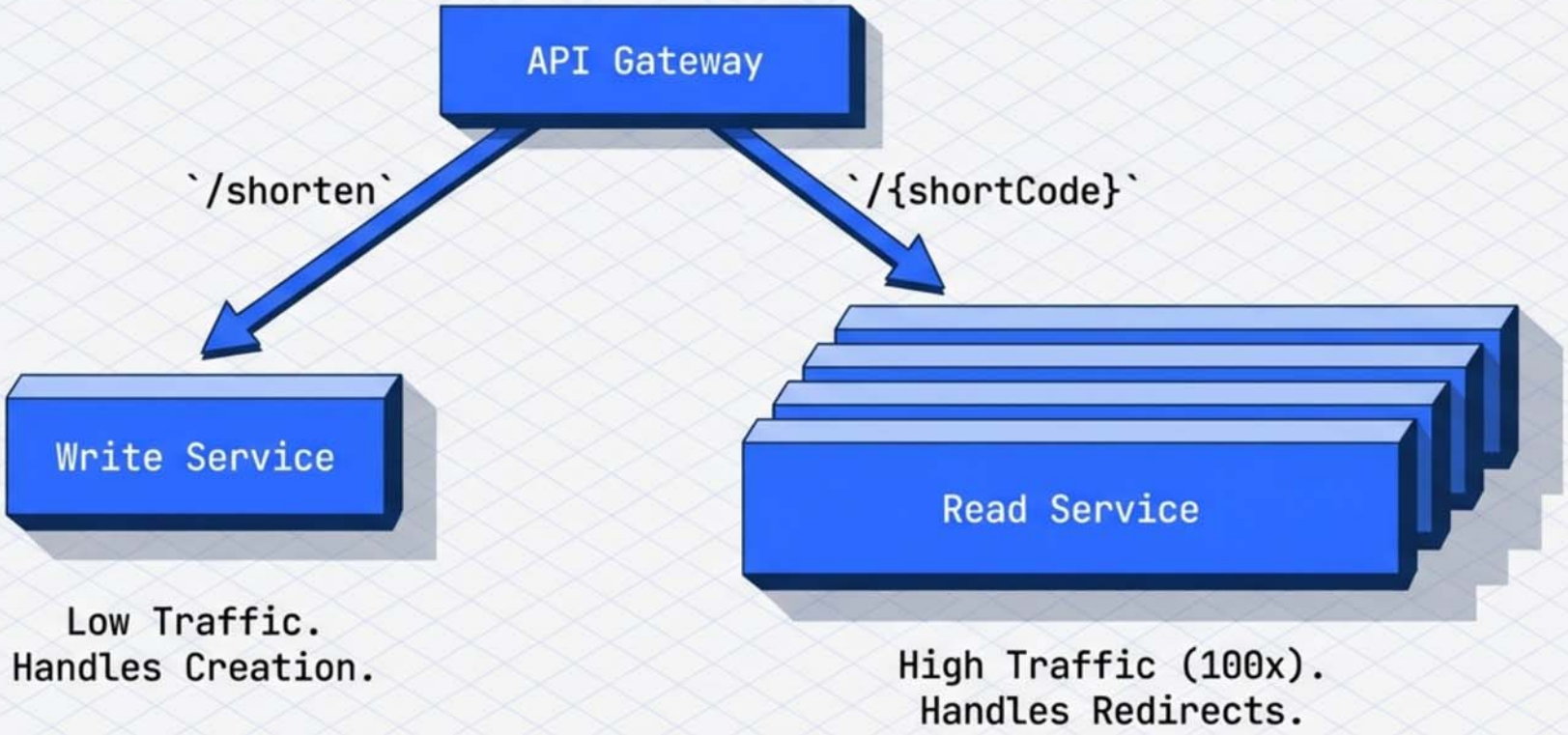
Microservices & Horizontal Scaling



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Global Scale: The CDN Layer

Reduces latency to <50ms by serving redirects from the Edge.

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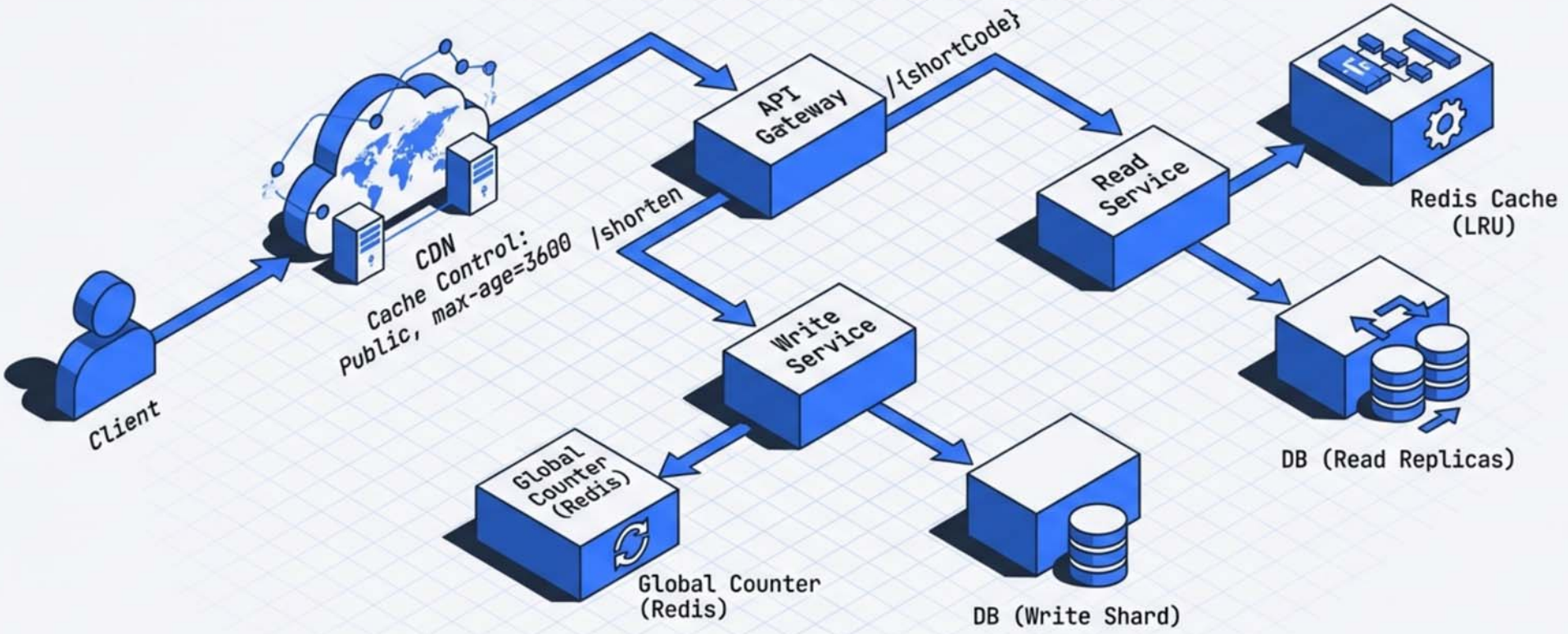
The Final Architecture



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