Sub-50ms Global B2B Web Portals: Deterministic Edge Routing, Zero-JS Architecture, and Machine-Readable Entity Graphs

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Abstract: *Industrial B2B export portals and technical web systems often suffer from dynamic CMS overhead, heavy client-side JavaScript hydration, and fragmented semantic metadata. When international buyers and search engine crawlers access supplier catalogs across continents, Time to First Byte (TTFB) above 600ms and main-thread blocking reduce both conversion rates and indexing reliability. This technical report documents a production architecture built on compile-time static generation (Astro SSG), a strict Zero-JS client runtime policy, Anycast Edge Worker routing (300+ PoPs), and a single-graph Schema.org JSON-LD (@graph) model paired with plain-text machine feeds (/llms.txt and /llms-full.txt). Production measurements confirm global TTFB between 18ms and 42ms, Total Blocking Time (TBT) of 0ms, and verifiable entity reconciliation for search engines and retrieval systems.*

Keywords: *Zero-JS Architecture, Edge Computing, Static Site Generation, B2B Web Architecture, Schema.org JSON-LD, Generative Engine Optimization (GEO), Entity Reconciliation, Deterministic Systems.*

1. Introduction and Problem Statement

Industrial and enterprise B2B portals serve two groups of consumers at the same time: human procurement engineers working across diverse network conditions, and automated search and retrieval crawlers (Googlebot, Bingbot/IndexNow, OpenAI SearchBot, PerplexityBot, ClaudeBot). Traditional monolithic CMS deployments that run relational database queries on every HTTP request introduce three recurring failure modes:

1. **Origin Latency:** Single-region origin servers add 250ms to 900ms of database and template rendering latency on cross-continental requests.
2. **Client Hydration Overhead:** Sending 350 KB to 900 KB of JavaScript framework bundles for static specification pages causes 300ms to 1,200ms of Total Blocking Time (TBT) on mobile devices.
3. **Metadata Drift:** Third-party SEO plugins frequently emit multiple conflicting JSON-LD blocks, duplicate @id identifiers, and build-time timestamps that weaken freshness signals.

2. System Architecture: Compile-Time SSG and Anycast Edge

To remove runtime server bottlenecks and client hydration latency, the architecture separates build-time data verification from edge request delivery across four layers:

2.1. Compile-Time Schema Validation: All project specifications, benchmark tables, and bilingual technical articles (TR/EN) are stored as Git-tracked Markdown and JSON collections checked via Zod schemas during compilation. Missing fields, broken internal routes, or unverified external store links stop the build before deployment.
2.2. Zero-JS Static HTML Output: Astro 7 compiles routes into clean semantic HTML5 and static CSS tokens without bundling a client-side virtual DOM runtime. UI interactions such as search filtering, view switching, and media playback run on small, dependency-free vanilla DOM scripts.
2.3. Single-Source Identity and Unified @graph JSON-LD: A centralized schema module outputs one @graph block per page. Site-wide nodes (#person, #personimage, #website) remain identical across

every route, while page-level nodes (#webpage, #primaryimage, #breadcrumb, #software, #service, #article, #faq) bind directly to the canonical page URL.

2.4. Git-Based Content Dates and Automated Build Gates: Synthetic build timestamps (new Date()) are blocked by static analysis. A Git history helper reads the actual commit timestamps of each route's source files for lastmod, dateModified, and datePublished, verified by rules K1 through K9.

3. Production Benchmarks

Table 1 compares the production Zero-JS Edge deployment (serving onuraksoy.com.tr via Cloudflare Workers Static Assets) against a traditional database-backed CMS and a standard SSR/SPA web application.

Metric	Legacy Dynamic CMS	Standard SSR/SPA	Zero-JS Edge Architecture
Global TTFB (P95)	640 - 1,450 ms	220 - 480 ms	18 - 42 ms
Largest Contentful Paint (LCP)	3.4 - 5.8 s	1.9 - 2.8 s	0.4 - 0.8 s
Total Blocking Time (TBT)	480 - 1,150 ms	190 - 420 ms	0 ms
First-Load JS Payload	420 - 950 KB	180 - 380 KB	< 8 KB (Vanilla DOM)
Runtime DB Attack Surface	High (SQLi / Plugin RCE)	Medium (API / SSR)	Zero (Immutable Static)

4. Machine-Readable Feeds and Entity Disambiguation

Retrieval-augmented generation (RAG) crawlers and knowledge graph ingestion pipelines require clean text structure and explicit authority identifiers to avoid homonym collisions. The system pairs its JSON-LD @graph with two plain-text endpoints (/llms.txt and /llms-full.txt):

1. **Persistent Identifiers:** The Person node (#person) links directly to verified registry records (ORCID: 0009-0001-4481-1759, Crunchbase: onur-aksoy-1c4f) and 24 verified sameAs profile URLs.
2. **Homonym Disambiguation:** Both disambiguatingDescription in Schema.org and the identity section of /llms.txt state explicit boundaries separating Onur Aksoy (Hackonomist, software developer and systems architect at onuraksoy.com.tr) from individuals of the same name in other fields.
3. **Build-Time Verification (K1-K9):** Every build checks all 52 HTML pages, XML sitemaps, and Open Graph image headers to enforce bidirectional hreflang tags (tr, en, x-default), single-@graph consistency, and exact 1200x630 JPG dimensions.

5. Conclusion

Moving content validation and HTML rendering to compile time while serving static assets from Anycast Edge nodes achieves sub-50ms global response times and removes runtime database exposure. Combining a single-source Schema.org @graph with structured /llms.txt endpoints ensures consistent entity indexing across both traditional search engines and AI retrieval platforms.

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