# Website Performance Optimization Checklist

## Comprehensive Guide to Core Web Vitals & Speed Optimization (2026 Edition)

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## Introduction & Core Metrics {#introduction}

### What Are Core Web Vitals?

Core Web Vitals are critical metrics developed by Google that measure real-world user experience on web pages. As of 2026, these metrics have become even more important with AI-powered search ranking algorithms that prioritize genuine user experience signals.

**The Three Core Metrics:**

o Largest Contentful Paint (LCP): Loading performance - how quickly main content appears
o Cumulative Layout Shift (CLS): Visual stability - unexpected layout changes during loading
o Interaction to Next Paint (INP): Responsiveness - time between user interaction and visual response

Google incorporated Core Web Vitals into its ranking algorithm in 2021, and by 2026, they remain essential for both SEO and user experience. New AI-based ranking systems now use performance signals more heavily than ever.

## Why Performance Matters in 2026

o User Retention: Pages with poor performance lose 53% of visitors if they take longer than 3 seconds to load
o Search Rankings: Core Web Vitals are now confirmed ranking factors; 2026 algorithms weight them heavily
o Conversion Rates: Every 100ms improvement in load time can increase conversions by up to 1%
o AI Search Compatibility: New AI search engines prioritize performance as a credibility signal
o Mobile-First Everything: Over 85% of searches are mobile; performance is non-negotiable

## Performance in 2026: What's Changed

**New Developments Since 2024:**

o AI-powered performance prediction (anticipate user needs)
o Real User Monitoring (RUM) now required by search engines
o Edge computing becoming standard (not optional)
o Streaming responses for dynamic content
o AI-assisted optimization tools
o Performance budgets are now industry standard

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# Largest Contentful Paint (LCP) {#largest-contentful-paint}

## What Is LCP?

Largest Contentful Paint measures the time it takes for the largest visible element on the page to render. This could be an image, video, text block, or other DOM element.

**2026 Target**
: < 2.5 seconds (Good), 2.5-4.0 seconds (Needs Improvement), > 4.0 seconds (Poor)

## LCP Implementation Checklist

### 1. Image Optimization Strategy (2026 Standards)

**Modern Image Formats (2026 Best Practice)**

o AVIF Format: Default format for 2026 (30-40% smaller than JPEG)
o WebP Format: Fallback for older browsers (25-35% smaller than JPEG)
o JPEG/PNG: Only as final fallback for legacy browser support

```
<!-- 2026 Image Format Priority -->
<picture>
  <source srcset="image.avif" type="image/avif">
  <source srcset="image.webp" type="image/webp">
  <img src="image.jpg" alt="Description" loading="lazy">
</picture>
```

**Compression Standards (2026)**

o AVIF quality 75-80 (excellent quality, tiny file size)
o WebP quality 80 (good quality, small file size)
o JPEG quality 85 (acceptable, fallback only)
o Target: < 50KB for above-the-fold images

**Responsive Images (2026 Best Practice)**

```
<img
  srcset="image-small.avif 480w,
          image-medium.avif 768w,
          image-large.avif 1200w"
  sizes="(max-width: 480px) 100vw,
         (max-width: 768px) 80vw,
         1200px"
  src="image.avif"
  alt="Descriptive alt text"
  loading="lazy"
>
```

## 2. Server Response Time Optimization

**2026 Standards for Time to First Byte (TTFB)**

o Target TTFB: Under 200ms (excellent)
o Acceptable: 200-600ms (good)
o Needs work: > 600ms (poor)

**Database Query Optimization**

o Implement query caching with Redis/Memcached
o Use database indexes for frequently queried columns
o Analyze slow queries (log queries > 100ms)
o Implement connection pooling

**Edge Computing (2026 Standard)**

o Use edge functions for dynamic content
o Cache database queries at edge
o Pre-compute at build time when possible
o Stream responses for large data

## 3. Critical CSS & JavaScript Management

Eliminate Render-Blocking Resources (2026 Approach)

```
<!-- Critical CSS inlined in head -->
<style>
  /* Only critical CSS for above-the-fold content */
  /* Max 14KB recommended */
</style>

<!-- Defer non-critical CSS -->
<link rel="stylesheet" href="non-critical.css" media="print"
      onload="this.media='all'; this.onload=null;">

<!-- Preload critical resources -->
<link rel="preload" as="font" href="critical-font.woff2" type="font/woff2"
crossorigin>
```

**JavaScript Optimization (2026 Standards)**

o Use code splitting by route
o Defer all non-critical scripts
o Implement dynamic imports for features
o Remove unused JavaScript (tree-shake)
o Target total JS: < 200KB for core app

## 4. Font Loading Strategy (2026)

**Font Display Strategy**

```
@font-face {
  font-family: 'SystemFont';
  src: url('font.woff2') format('woff2');
  font-display: swap; /* Show fallback immediately */
  size-adjust: 100%; /* Match fallback dimensions */
}

/* System font stack (2026 approach) */
body {
  font-family: -apple-system, BlinkMacSystemFont, 'Segoe UI', Roboto, sans-serif;
}
```

**Font Optimization**

o Use variable fonts (one file instead of many)
o Self-host fonts (avoid Google Fonts latency)
o Preload only critical fonts
o Use WOFF2 format exclusively (drop WOFF)
o Subset fonts to Latin characters only (for English sites)

## 5. Content Delivery & Caching (2026)

**Edge Caching Strategy**

```
Cache-Control: public, max-age=31536000 # Static assets: 1 year
Cache-Control: public, max-age=86400   # Images: 1 day
Cache-Control: public, max-age=3600    # HTML: 1 hour
Cache-Control: no-cache                # APIs: always validate
```

**CDN Selection (2026)**

o Cloudflare (global, free tier available)
o Vercel Edge Network (built-in if using Vercel)
o AWS CloudFront (enterprise)
o Fastly (advanced customization)

Cache-First Strategy

o Static assets cached forever (with hash busting)
o HTML cached 1 hour (or on-demand purge)
o API responses cached based on freshness requirements

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# Cumulative Layout Shift (CLS) {#cumulative-layout-shift}

## What Is CLS?

Cumulative Layout Shift measures visual instability - unexpected layout changes that frustrate users. Google shows CLS is a key ranking factor and improves conversion rates significantly.

**2026 Target**
: < 0.1 (Good), 0.1-0.25 (Needs Improvement), > 0.25 (Poor)

## CLS Implementation Checklist

### 1. Image & Video Size Constraints

**Always Specify Dimensions (2026 Standard)**

```
<!-- Method 1: Explicit width/height attributes -->
<img src="image.jpg" width="800" height="600" alt="Description">

<!-- Method 2: CSS aspect-ratio (2026 preferred) -->
<img
  src="image.jpg"
  alt="Description"
  style="aspect-ratio: 4/3; width: 100%; height: auto;"
>

<!-- Method 3: Container query for responsive sizing -->
<style>
  @supports (aspect-ratio: 1) {
    img {
      aspect-ratio: 4/3;
      width: 100%;
      height: auto;
    }
  }
</style>
```

## 2. Dynamic Content Management

### Prevent Layout Shift from Dynamic Content

```
// Reserve space BEFORE content loads
const createPlaceholder = (width, height) => {
  const div = document.createElement('div');
  div.style.aspectRatio = `${width}/${height}`;
  div.style.width = '100%';
  div.style.backgroundColor = '#f0f0f0';
  return div;
};

// Insert placeholder first
container.appendChild(createPlaceholder(16, 9));

// Load actual content
const iframe = createIframe('video-url');
iframe.onload = () => {
  container.replaceChild(iframe, container.firstChild);
};
```

## 3. Web Font Optimization

### Prevent Font Swap Flashing (2026 Approach)

```
@font-face {
  font-family: 'CustomFont';
  src: url('font.woff2') format('woff2');
  font-display: swap;
  /* Ensure fallback font metrics match web font */
  ascent-override: 110%;
  descent-override: 27%;
  line-gap-override: 0%;
}
```

## 4. Animation Performance

### Use GPU-Accelerated Animations

```
/* Good: Uses transform (GPU-accelerated) */
.element {
  transform: translateX(10px);
  transition: transform 0.3s ease;
  will-change: transform;
}

/* Bad: Causes layout recalculation */
.element {
  left: 10px;
  transition: left 0.3s ease;
}

/* Excellent: Hardware acceleration on mobile */
.element {
  transform: translateZ(0);
  transform: translateX(10px);
}
```

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# Interaction to Next Paint (INP) {#interaction-to-next-paint}

## What Is INP?

Interaction to Next Paint measures the time between a user interaction (click, tap, keyboard input) and the next visual response. This replaced First Input Delay (FID) and is now a core metric in 2026.

**2026 Target**
: < 200ms (Good), 200-500ms (Needs Improvement), > 500ms (Poor)

## INP Implementation Checklist

## 1. JavaScript Execution Optimization

### Break Up Long Tasks (2026 Best Practice)

```
// 2026 approach: Use yielding to browser
async function processBigDataset(data) {
  // Yield every 10ms to allow browser to process user input
  for (let i = 0; i < data.length; i += 100) {
    const batch = data.slice(i, i + 100);

    // Heavy processing
    processBatch(batch);

    // Yield to browser
    await new Promise(resolve => setTimeout(resolve, 0));
  }
}

// Or use scheduler API (2026 standard)
scheduler.yield().then(() => {
  // Process next batch after browser can handle input
});
```

### Modern Event Handler Pattern (2026)

```
// Debounce with immediate visual feedback
function debounceWithFeedback(func, delay) {
  let timeoutId;
  let isProcessing = false;

  return function(...args) {
    // Immediate visual feedback
    showLoadingState();

    clearTimeout(timeoutId);
    timeoutId = setTimeout(() => {
      isProcessing = true;
      func(...args);
      isProcessing = false;
      hideLoadingState();
    }, delay);
  };
}

const handleSearch = debounceWithFeedback((query) => {
  // Perform search
}, 300);

searchInput.addEventListener('input', (e) => {
  handleSearch(e.target.value);
});
```

## 2. DOM Manipulation Optimization

### Batch DOM Updates (2026 Approach)

```
// Use DocumentFragment for multiple insertions
const fragment = document.createDocumentFragment();
items.forEach(item => {
  const el = createItemElement(item);
  fragment.appendChild(el);
});
container.appendChild(fragment); // One reflow

// Or use innerHTML for bulk updates
let html = '';
items.forEach(item => {
  html += `<div>${item.name}</div>`;
});
container.innerHTML = html;
```

## 3. Virtual Scrolling for Lists

**Render Only Visible Items (2026 Standard)**

```
// For large lists, render only visible items
class VirtualScroller {
  constructor(container, items, itemHeight) {
    this.container = container;
    this.items = items;
    this.itemHeight = itemHeight;
    this.visibleItems = [];

    container.addEventListener('scroll', () => this.render());
    this.render();
  }

  render() {
    const scrollTop = this.container.scrollTop;
    const startIdx = Math.floor(scrollTop / this.itemHeight);
    const endIdx = startIdx + Math.ceil(this.container.clientHeight /
this.itemHeight);

    // Only render visible range
    this.renderItems(startIdx, endIdx);
  }
}
```

## 4. Third-Party Script Management

### Delay Non-Critical Scripts (2026 Standard)

```
<!-- Critical scripts only -->
<script src="analytics-core.js"></script>

<!-- Defer non-essential scripts -->
<script defer src="ads.js"></script>

<!-- Load after interaction -->
<script>
  document.addEventListener('click', () => {
    const script = document.createElement('script');
    script.src = 'non-critical-third-party.js';
    document.head.appendChild(script);
  }, { once: true });
</script>

<!-- Or use web worker for heavy computation -->
<script>
  if (typeof Worker !== 'undefined') {
    const worker = new Worker('heavy-processing.js');
    worker.onmessage = (e) => {
      updateUI(e.data);
    };
  }
</script>
```

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# Implementation Strategy {#implementation-strategy}

## 2026 Quick Wins (Weeks 1-2)

**Highest Impact, Lowest Effort:**

1. Image Optimization (40-50% improvement)

o Convert to AVIF format
o Implement responsive images with srcset

o Add lazy loading

1. Font Loading (10-15% improvement)

o Use system font stack
o Implement font-display: swap
o Preload critical fonts only

1. Cache Headers (20-30% improvement)

o Set proper Cache-Control headers
o Implement CDN (Cloudflare free tier)

## 2026 Core Improvements (Weeks 3-6)

1. Code Splitting & Bundling

o Split by route
o Remove unused code
o Implement dynamic imports

1. Database Optimization

o Index frequently queried columns
o Cache database results
o Query optimization

1. Third-Party Audit

o Identify high-impact third parties
o Lazy load non-essential services
o Replace with lighter alternatives

## 2026 Advanced Optimization (Week 7+)

1. Edge Computing

o Deploy functions to edge
o Cache at edge
o Pre-compute static content

1. Performance Monitoring

o Setup Real User Monitoring (RUM)
o Automated performance budgets
o Continuous monitoring

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## Monitoring & Testing {#monitoring-testing}

### Recommended 2026 Tools

| Tool | Purpose | Cost |
|---|---|---|
| Google PageSpeed Insights | Initial audits | Free |
| WebPageTest | Detailed analysis | Free/Paid |
| Lighthouse CI | CI/CD integration | Free |
| Vercel Analytics | Real user data | Free (with Vercel) |
| Sentry | Error tracking | Free/Paid |
| PostHog | Analytics | Free/Paid |

### Testing Workflow (2026)

**Before Release:**

o [ ] Lighthouse audit (target: 90+ on all metrics)
o [ ] WebPageTest with 4G throttling
o [ ] Test on real mid-range Android device
o [ ] Test on real iPhone
o [ ] Verify CLS with different network conditions
o [ ] Run performance budget checks

**Post-Release:**

o [ ] Monitor Core Web Vitals daily
o [ ] Setup alerts for metric degradation
o [ ] Track trends over time
o [ ] A/B test improvements
o [ ] Measure business impact

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## Performance Benchmarks {#benchmarks}

### 2026 Performance Goals

| Metric | Target | Industry Average |
|---|---|---|
| LCP | < 2.5s | 3.5-4.0s |
| CLS | < 0.1 | 0.12-0.15 |
| INP | < 200ms | 250-400ms |
| TTFB | < 200ms | 400-600ms |

| | | |
|---|---|---|
| FCP | < 1.8s | 2.5-3.5s |

### Expected Results from Optimization

- 7% higher conversion rates (average across industries)
- 11% lower bounce rates
- 24% faster perceived load time
- 2-3 position improvement in search rankings

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## Maintenance & Best Practices (2026)

### Weekly

- [ ] Review performance metrics
- [ ] Check for regressions
- [ ] Monitor error logs

### Monthly

- [ ] Update performance audit
- [ ] Review new optimizations
- [ ] Check competitor performance
- [ ] Analyze user feedback

### Quarterly

- [ ] Run full audit
- [ ] Update dependencies

- [ ] Review bundle size trends
- [ ] Plan next optimization phase

### Annually

- [ ] Comprehensive performance review
- [ ] Update guidelines for new year
- [ ] Plan major optimizations
- [ ] Benchmark against industry standards

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## Conclusion

Website performance in 2026 is non-negotiable. The combination of:

- AI-powered search algorithms prioritizing performance
- User expectations for instant loading
- Mobile-first browsing dominance
- Real User Monitoring becoming mandatory

...means performance optimization is a core part of modern web development.

Start with quick wins, measure everything, and iterate continuously.

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*Last Updated: December 2025*

*Updated for 2026 standards, practices, and tools*

*Review regularly as performance recommendations continue to evolve*