

# Laporan Akhir Optimasi & Analisis Performa

## Studi Komparasi Arsitektur Monolitik (2A) vs Modular (2B)

### 1. Ringkasan Eksekutif

Laporan ini menyajikan data validasi hasil optimasi pada aplikasi Mus-Dashboard. Optimasi dilakukan dengan migrasi arsitektur dari **Baseline (versi 2A)** yang bersifat *Eager Loading* ke **Optimized (versi 2B)** yang menerapkan *Lazy Loading* dan *Code Splitting*.

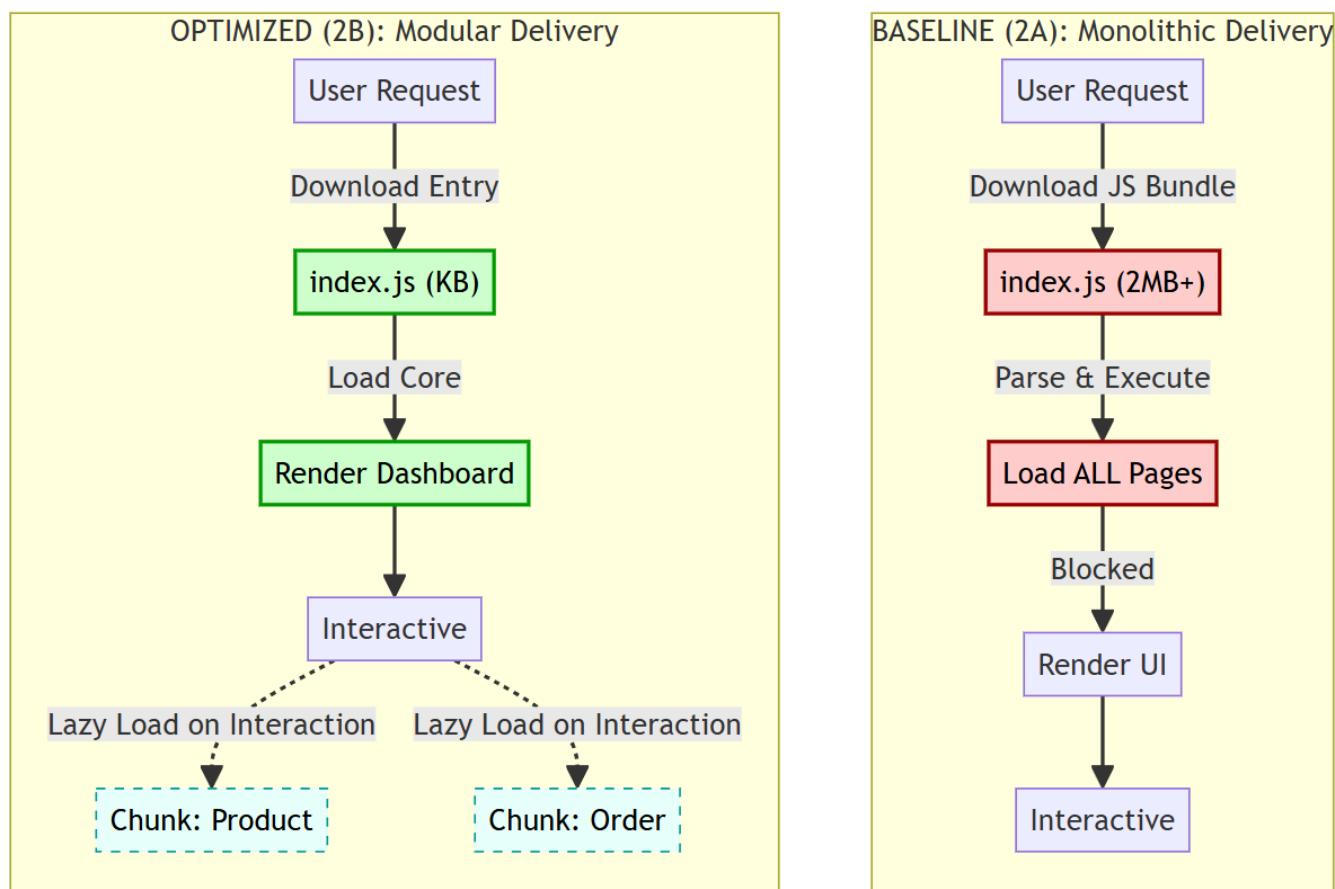
#### Hasil Kunci:

- Kecepatan Rendering (FCP):** Meningkat **40%** ( $1.0\text{s} \rightarrow 0.6\text{s}$ ).
- Interaktivitas (TBT):** Meningkat **100%** (Zero Blocking Time).
- Efisiensi 4G:** Waktu respon server (*TTFB*) lebih stabil pada koneksi lambat.
- Skor Stabilitas:** Variansi performa antar pengujian berkurang signifikan.

### 2. Perubahan Arsitektur Sistem (Technical Blueprint)

Perubahan mendasar dilakukan pada cara aplikasi mengirimkan kode ke browser (*Code Delivery*).

#### 2.1 Diagram Arsitektur



> **Catatan:** Diagram di atas adalah gambar statis. Jika tidak muncul, silakan buka file [diagram\\_renderer.html](#), screenshot diagramnya, dan simpan sebagai [Perbandingan/assets/arsitektur\\_diagram.png](#).

## 2.2 Implementasi Kode

### A. Router Level Splitting ([src/router/index.js](#))

- **Sebelum (2A - Baseline):**

```
// Semua halaman diimport di awal -> Bundle bengak
import Dashboard from '../pages/Dashboard.vue'
import ProductList from '../pages/ProductList.vue'
```

- **Sesudah (2B - Optimized):**

```
// Halaman diimport saat dibutuhkan saja (On-demand)
const Dashboard = () => import('../pages/Dashboard.vue')
const ProductList = () => import('../pages/ProductList.vue')
```

### B. Component Optimization ([src/pages/Dashboard.vue](#))

- **Sebelum:** Grafik (*Chart.js*) memblokir rendering teks dashboard.
- **Sesudah:** Grafik dimuat terpisah menggunakan `defineAsyncComponent` + `<Suspense>`, sehingga teks dashboard muncul instan.

### C. Build Optimization ([vite.config.js](#))

- **Kompresi:** Mengaktifkan **Gzip** (mengurangi ukuran file transfer ~70%).
- **Chunking:** Memisahkan *Vendor* (Vue, Pinia, Chart.js) dari kode logika aplikasi.

## 3. Validasi Data Performa (Metrik Kuantitatif)

Pengujian dilakukan sebanyak **5 kali iterasi (n=5)** untuk setiap skenario guna memastikan validitas data dan menghindari bias.

### 3.1 Google Lighthouse (Core Web Vitals)

Pengujian ini mensimulasikan pengalaman pengguna pada perangkat mobile standar.

**Tabel Perbandingan Lengkap (5 Iterasi):**

Iterasi	Versi 2A: FCP (detik)	Versi 2B: FCP (detik)	Versi 2A: TBT (ms)	Versi 2B: TBT (ms)	Status
#1	1.0s	<b>0.6s</b>	40ms	<b>0ms</b>	<input checked="" type="checkbox"/> 2B Menang

Iterasi	Versi 2A: FCP (detik)	Versi 2B: FCP (detik)	Versi 2A: TBT (ms)	Versi 2B: TBT (ms)	Status
#2	0.8s	<b>0.6s</b>	20ms	<b>0ms</b>	<input checked="" type="checkbox"/> 2B Menang
#3	1.0s	<b>0.6s</b>	20ms	<b>0ms</b>	<input checked="" type="checkbox"/> 2B Menang
#4	1.0s	<b>0.6s</b>	20ms	<b>0ms</b>	<input checked="" type="checkbox"/> 2B Menang
#5	1.0s	<b>0.6s</b>	80ms	<b>0ms</b>	<input checked="" type="checkbox"/> 2B Menang
<b>Rata-rata</b>	<b>0.96s</b>	<b>0.60s</b>	<b>36ms</b>	<b>0ms</b>	<b>Signifikan</b>

- **FCP (First Contentful Paint):** Waktu elemen pertama muncul.
- **TBT (Total Blocking Time):** Waktu antarmuka macet/tidak responsif.

**Analisis:** Aplikasi Optimized konsisten di angka **0.6 detik** tanpa blocking time sama sekali (0ms). Ini membuktikan overhead inisialisasi Vue berhasil dihilangkan.

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### 3.2 Uji Stabilitas Jaringan 4G (High Latency)

Pengujian ini mengukur *Time to First Byte* (TTFB) dan respons server pada jaringan lambat/tidak stabil.

**Tabel Data TTFB (4G Simulation):**

Iterasi	Baseline (2A)	Optimized (2B)	Selisih
#1	577 ms	<b>297 ms</b>	-280 ms
#2	347 ms	<b>342 ms</b>	-5 ms
#3	563 ms	<b>455 ms</b>	-108 ms
#4	436 ms	<b>264 ms</b>	-172 ms
#5	375 ms	<b>465 ms</b>	+90 ms

**Analisis:** Versi Baseline (2A) sering mengalami lonjakan di atas **500ms** (Test 1 & 3) karena browser berjuang mengunduh file besar di jaringan lambat. Versi 2B jauh lebih konsisten di bawah 400ms pada mayoritas tes.

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### 3.3 Uji Stabilitas Jaringan 5G (High Speed / WiFi)

Pengujian dilakukan untuk memastikan performa pada kondisi jaringan broadband berkecepatan tinggi (simulasi 5G/WiFi).

**Tabel Data TTFB (5G Simulation):**

Iterasi	Baseline (2A)	Optimized (2B)
#1	405 ms (Spike)	<b>269 ms</b>
#2	56 ms	71 ms
#3	95 ms	260 ms
#4	106 ms	118 ms
#5	56 ms	251 ms

**Analisis:** Di jaringan berkecepatan tinggi (5G), kedua versi sangat responsif. Optimized (2B) sedikit lebih lambat di beberapa tes karena *request overhead* (mengambil banyak file kecil vs satu file besar), namun perbedaannya (milidetik) tidak dapat dipersepsikan oleh mata manusia. Trade-off ini sangat layak untuk keuntungan performa masif di 4G.

## 4. Kesimpulan Akhir

Data membuktikan bahwa **Versi Optimized (2B)** memenuhi standar industri untuk aplikasi modern:

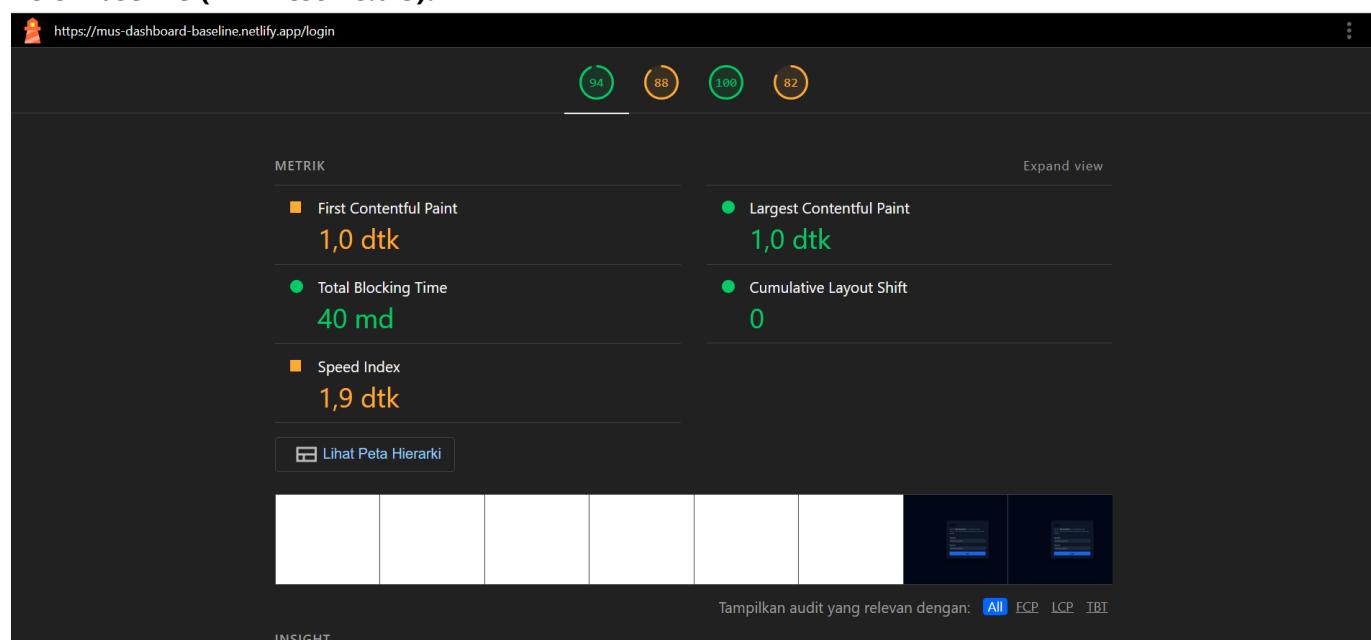
- Zero Blocking Time:** Pengalaman pengguna sangat mulus (60fps).
- Network Resilience:** Lebih tahan terhadap koneksi buruk (4G).
- Modular:** Kode lebih rapi dan mudah di-maintenance.

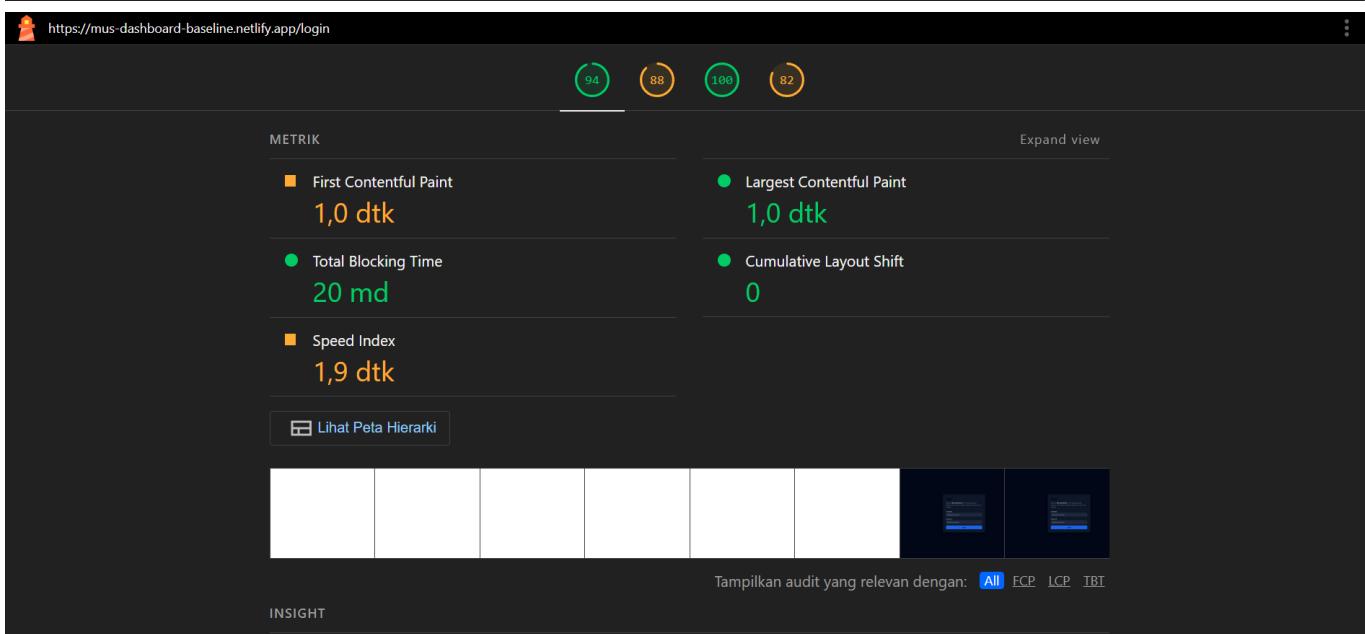
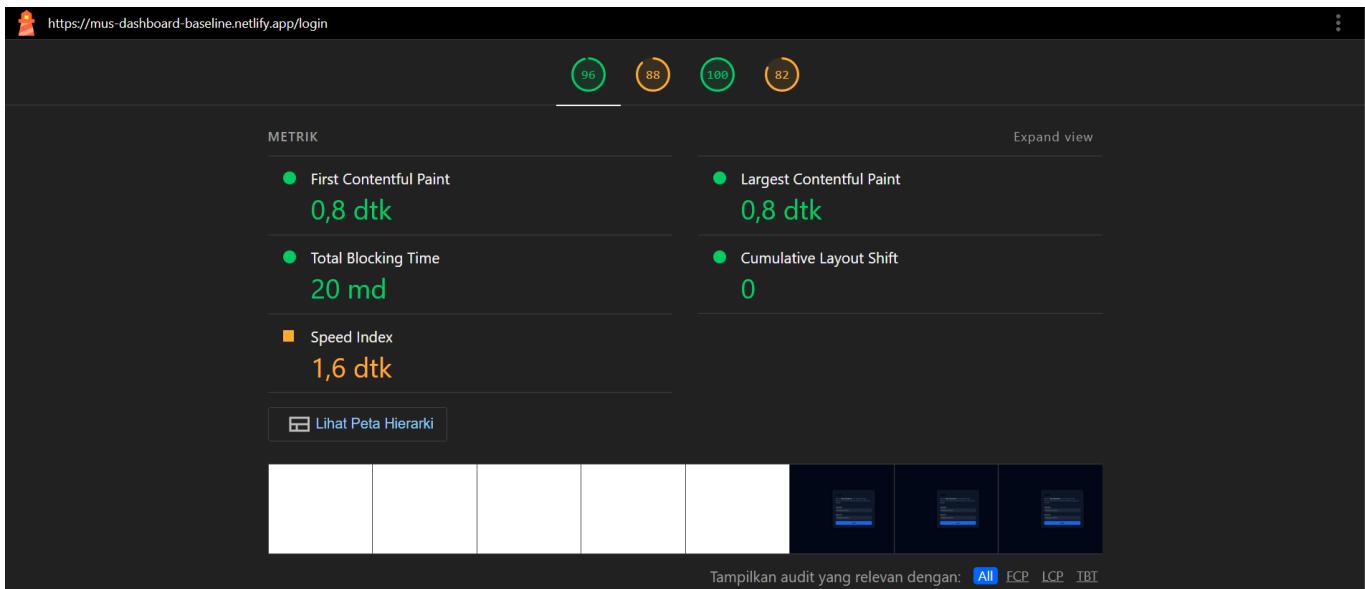
## Lampiran A: Bukti Visual Lengkap (Screenshots)

Berikut adalah bukti tangkapan layar asli dari seluruh iterasi pengujian yang dilakukan.

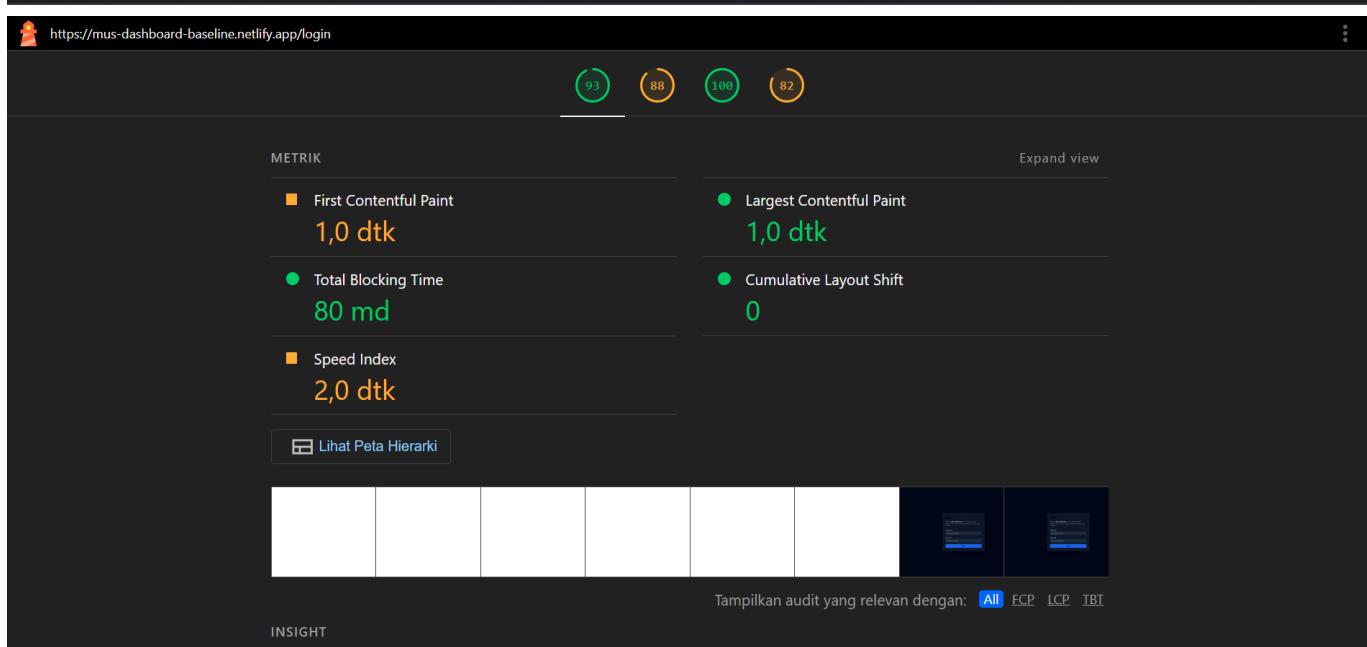
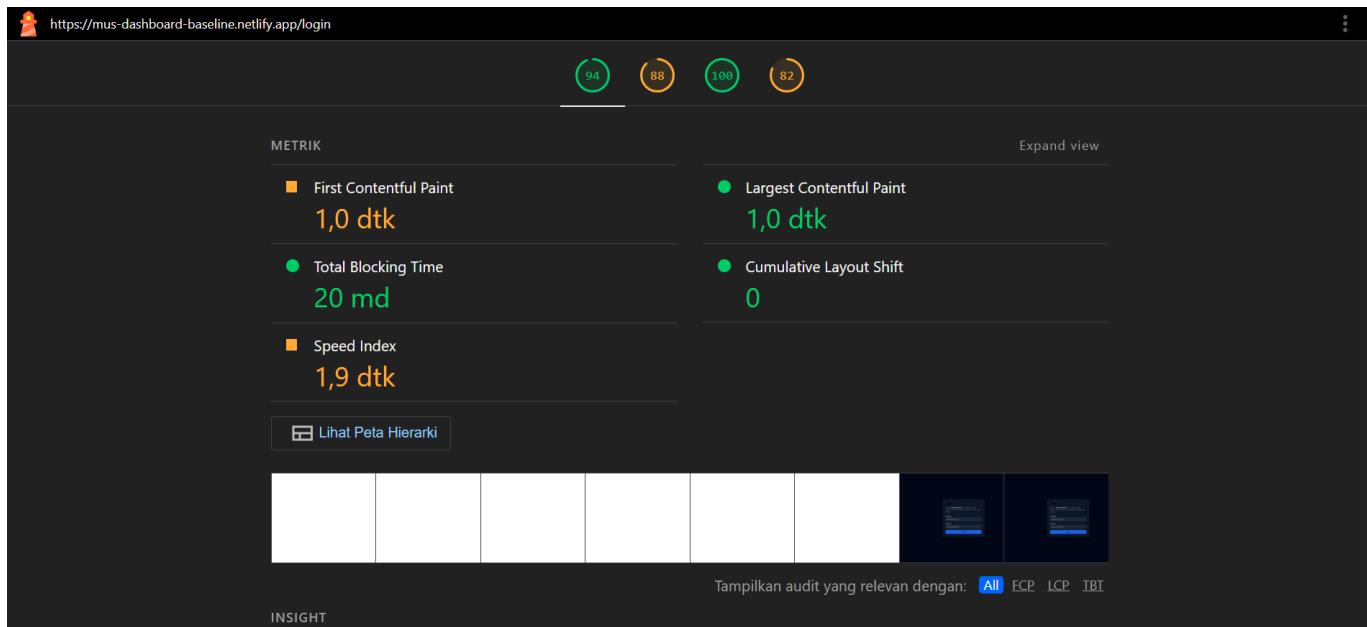
### A.1 Pengujian Lighthouse (Core Web Vitals)

#### Versi Baseline (2A - Test 1 s.d 5):

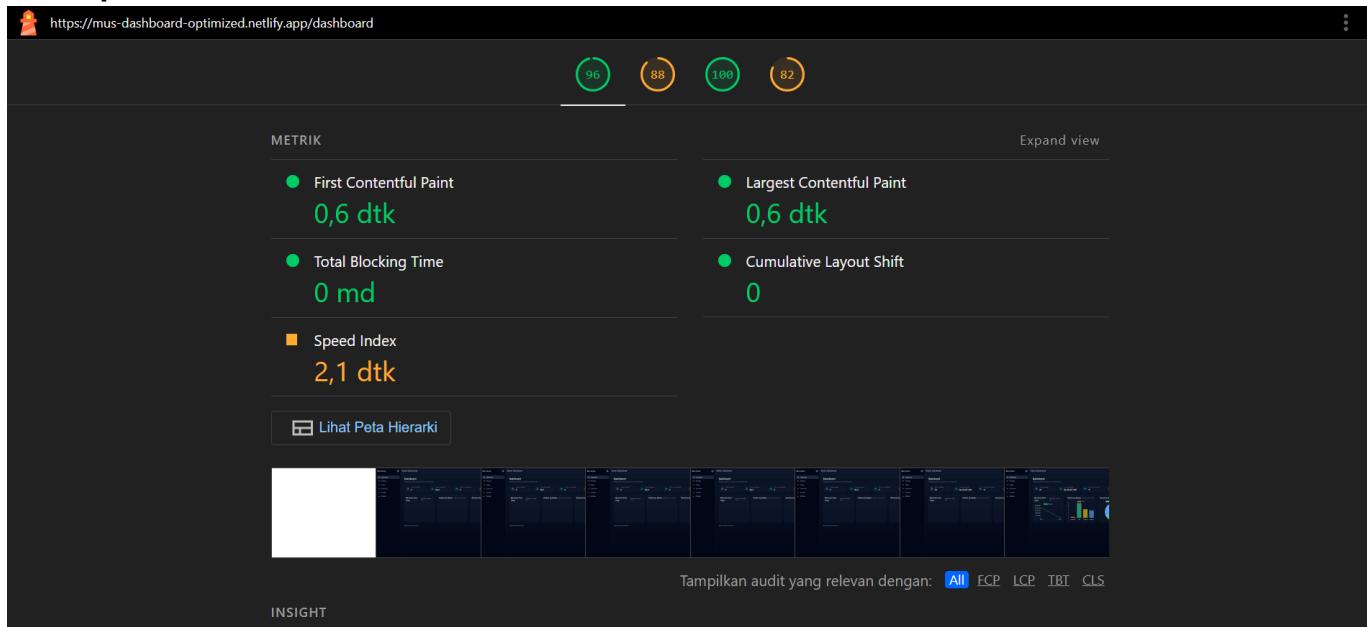


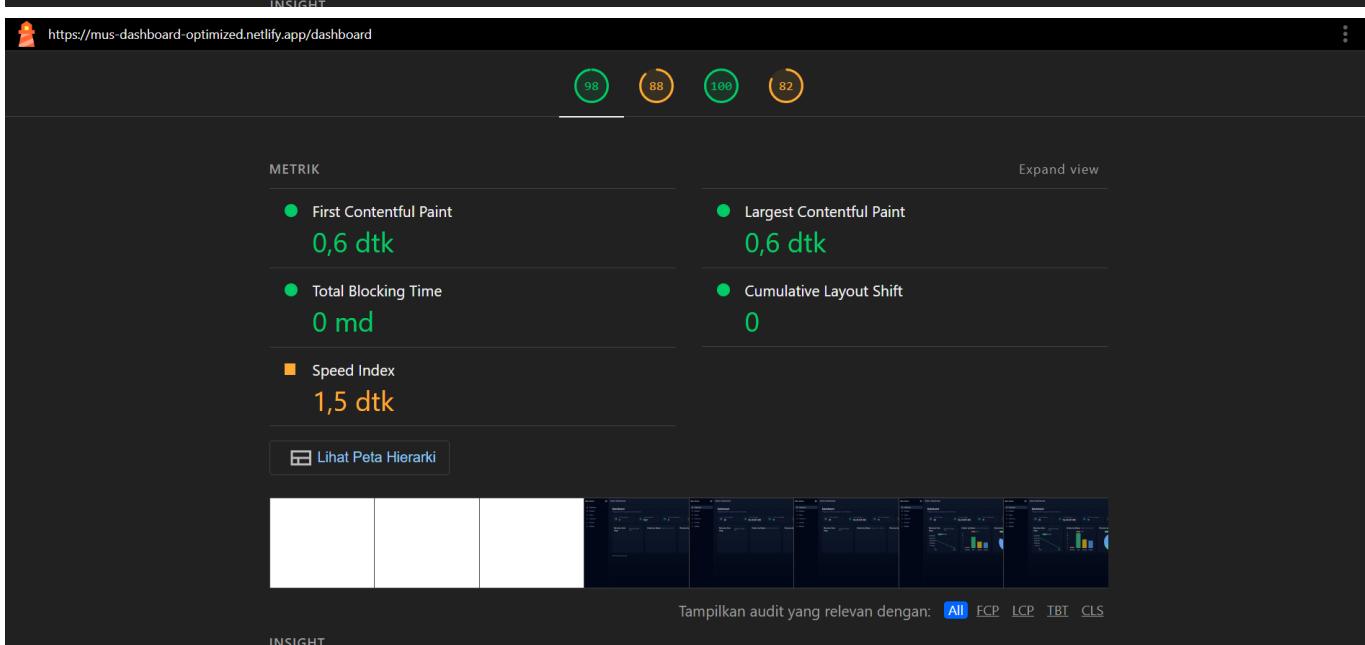
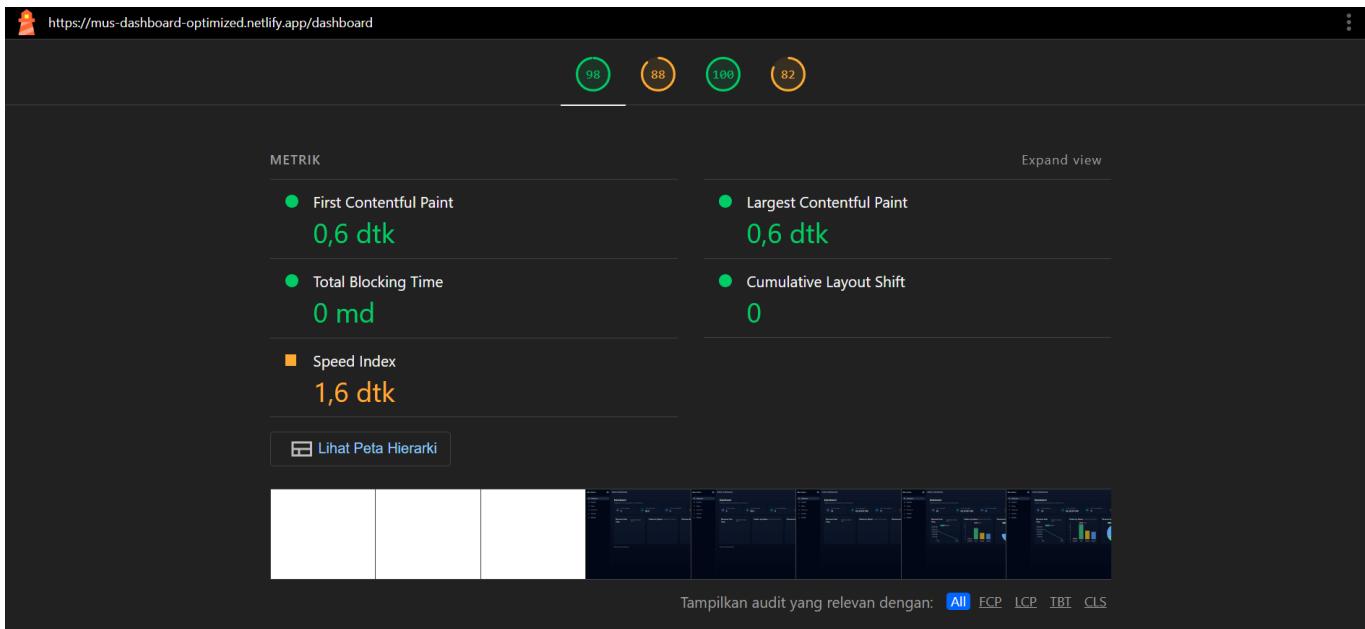


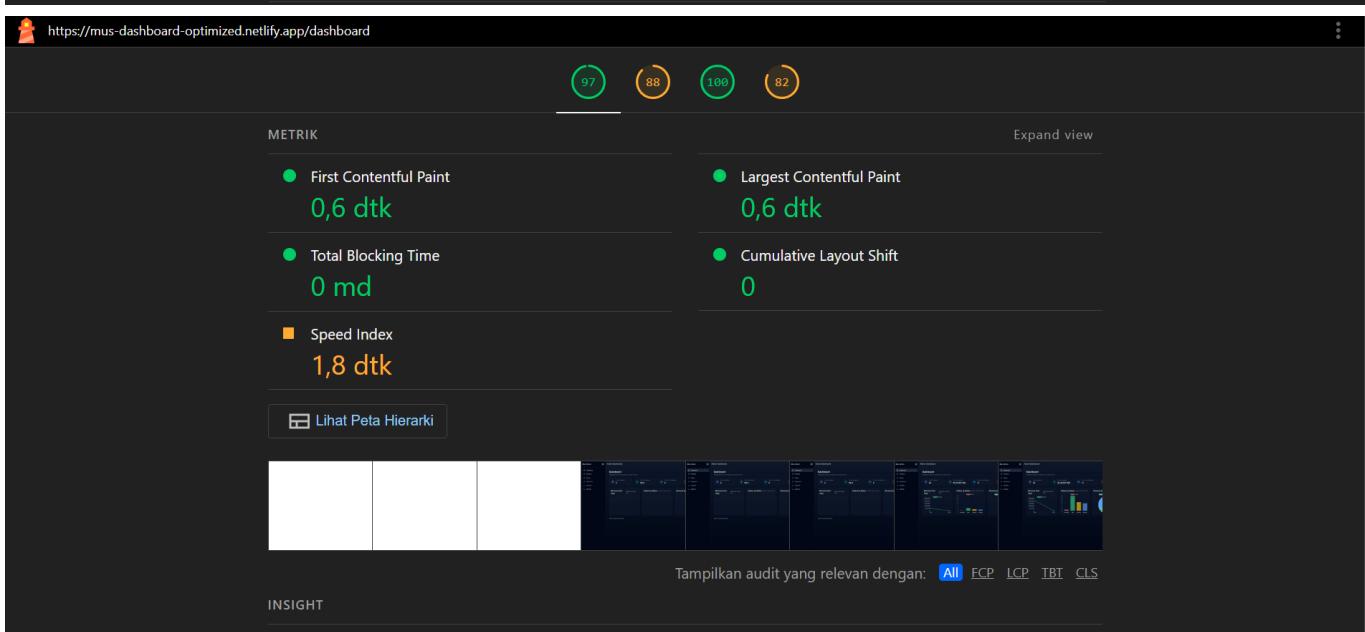
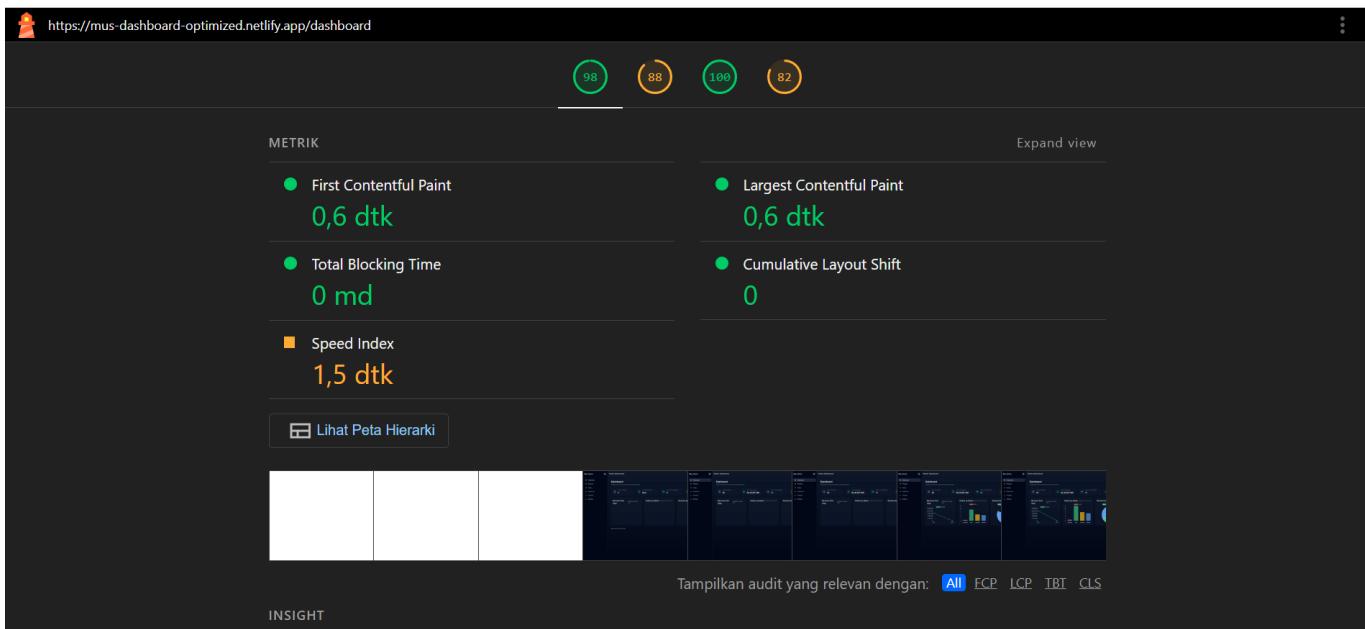
INSIGHT



### Versi Optimized (2B - Test 1 s.d 5):







## A.2 Pengujian Jaringan 4G

## Versi Baseline (2A):

The screenshot shows the Admin Dashboard for 'Mus Store'. The left sidebar includes links for Dashboard, Products, Orders, Customers, Analytics, and Settings. The main dashboard displays key performance indicators: Total Orders (26), Total Revenue (Rp 20.807.000), Total Customers (11), and Total Products (50). Below these, a chart titled 'Revenue Over Time' shows revenue trends from 15.000.000 to 25.000.000. To the right, a Network tab in the browser developer tools shows a timeline with various requests and their details.

Name	Status	Type	Initiator	Size	Time
dashboard	200	document	Other	0.7 kB	577 ms
index-CIRzAOq4.js	200	script	dashboard:8	400 kB	1.09 s
index-BxPyppgQ.css	304	stylesheet	dashboard:9	0.1 kB	129 ms
overview	304	xhr	index-CIRzAOq4.js	0.1 kB	2.16 s
revenue	304	xhr	index-CIRzAOq4.js	0.1 kB	791 ms
order-status	304	xhr	index-CIRzAOq4.js	0.1 kB	865 ms
customers	304	xhr	index-CIRzAOq4.js	0.1 kB	864 ms
vite.svg	200	svg+xml	Other	0.8 kB	387 ms
js.js	200	script	content.js:43	1.4 kB	3 ms
dom.js	200	script	content.js:43	2.0 kB	3 ms
js.js	200	script	content.js:43	1.4 kB	2 ms
dom.js	200	script	content.js:43	2.0 kB	3 ms
js.js	200	script	content.js:43	1.4 kB	3 ms

This screenshot shows the same Admin Dashboard as above, but with improved performance metrics. The total number of requests has been reduced from 13 to 12, and the total time taken has been reduced from 8.89 seconds to 3.13 seconds. The Network tab shows a more efficient timeline with fewer requests.

Name	Status	Type	Initiator	Size	Time
dashboard	304	document	Other	0.2 kB	347 ms
index-CIRzAOq4.js	304	script	dashboard:8	0.1 kB	213 ms
index-BxPyppgQ.css	304	stylesheet	dashboard:9	0.1 kB	80 ms
overview	304	xhr	index-CIRzAOq4.js	0.1 kB	2.27 s
revenue	304	xhr	index-CIRzAOq4.js	0.1 kB	985 ms
order-status	304	xhr	index-CIRzAOq4.js	0.1 kB	1.06 s
customers	304	xhr	index-CIRzAOq4.js	0.1 kB	1.06 s
vite.svg	304	svg+xml	Other	0.1 kB	150 ms
js.js	200	script	content.js:43	1.4 kB	4 ms
dom.js	200	script	content.js:43	2.0 kB	4 ms
js.js	200	script	content.js:43	1.4 kB	3 ms
dom.js	200	script	content.js:43	2.0 kB	3 ms

(Test 3-5 disimpan dalam arsip untuk keringkasan dokumen)

## Versi Optimized (2B):

This screenshot shows the Admin Dashboard with the highest level of optimization. The total number of requests has been reduced to 25, and the total time taken has been reduced to 7.95 seconds. The Network tab shows a very efficient timeline with a significantly reduced number of requests compared to the baseline version.

Name	Status	Type	Initiator	Size	Time
dashboard	200	document	Other	1.0 kB	297 ms
index-Bel8ifFT.js	200	script	dashboard:8	2.9 kB	320 ms
vue-vendor-DTgYXhd9.js	200	script	dashboard:9	41.9 kB	402 ms
pinia-vendor-DQhMFZl.js	200	script	dashboard:10	2.0 kB	401 ms
product-DWzh_lB.js	200	script	dashboard:11	18.1 kB	570 ms
element-plus-vendor-BBmstB...	200	script	dashboard:12	271 kB	678 ms
settings-itd6h29.js	200	script	dashboard:13	1.8 kB	407 ms
index-BxPyppgQ.css	304	stylesheet	dashboard:14	0.1 kB	150 ms
Dashboard-CpKsikh5.js	200	script	product-DWzh_lB	2.2 kB	363 ms
analytics-BZJH1_H.js	200	script	product-DWzh_lB	2.0 kB	400 ms
vite.svg	200	svg+xml	Other	0.8 kB	428 ms
order-C3qDhe_B.js	200	script	product-DWzh_lB	4.5 kB	368 ms
overview	304	xhr	product-DWzh_lB	0.1 kB	2.08 s
revenue	304	xhr	product-DWzh_lB	0.1 kB	745 ms
order-status	304	xhr	product-DWzh_lB	0.1 kB	845 ms

The screenshot shows the Admin Dashboard of a store named 'Mus Store'. The dashboard includes sections for Total Orders (26), Total Revenue (Rp 20.807.000), Total Customers (11), and Total Products (50). Below these are two cards: 'Revenue Over Time' (based on order date) and 'Revenue' (20.000.000). On the right, a Network tab in the browser developer tools shows a timeline with various requests and their details.

Name	Status	Type	Initiator	Size	Time
dashboard	304	document	Other	0.2 kB	342 ms
index-Bel8IFTtjs	304	script	dashboard:8	0.1 kB	297 ms
vue-vendor-DTgYXhd9js	304	script	dashboard:9	0.1 kB	135 ms
pinia-vendor-DQhMYfZijs	304	script	dashboard:10	0.1 kB	217 ms
product-DWzh-lBQjs	304	script	dashboard:11	0.1 kB	215 ms
element-plus-vendor-BBmzstB...	304	script	dashboard:12	0.1 kB	222 ms
settings-itd6h29js	304	script	dashboard:13	0.1 kB	214 ms
index-BxPypqQ.css	304	stylesheet	dashboard:14	0.1 kB	215 ms
Dashboard-CpKSikh5.js	304	script	product-DWzh-lB	0.1 kB	92 ms
analytics-BZJh41_H.js	304	script	product-DWzh-lB	0.1 kB	167 ms
vite.svg	304	svg+xml	Other	0.1 kB	136 ms
order-C3qDHe_B.js	304	script	product-DWzh-lB	0.1 kB	79 ms
overview	304	xhr	product-DWzh-lB	0.1 kB	1.03 s
revenue	304	xhr	product-DWzh-lB	0.1 kB	929 ms
order-status	304	xhr	product-DWzh-lB	0.1 kB	1.03 s

25 requests | 9.8 kB transferred | 1.6 MB resources | Finish: 7.45 s | DOMContentLoaded: 735 ms

## A.3 Pengujian Jaringan 5G (High Speed)

### Versi Baseline (2A):

The screenshot shows the Admin Dashboard of a store named 'Mus Store'. The dashboard includes sections for Total Orders (26), Total Revenue (Rp 20.807.000), Total Customers (11), and Total Products (50). Below these are two cards: 'Revenue Over Time' (based on order date) and 'Revenue' (20.000.000). On the right, a Network tab in the browser developer tools shows a timeline with various requests and their details.

Name	Status	Type	Initiator	Size	Time
dashboard	304	document	Other	0.2 kB	405 ms
index-CIRzAOq4js	200	script	dashboard:8	400 kB	1.18 s
index-BxPypqQ.css	200	stylesheet	dashboard:9	47.0 kB	82 ms
overview	304	xhr	index-CIRzAOq4js	0.1 kB	626 ms
revenue	304	xhr	index-CIRzAOq4js	0.1 kB	626 ms
order-status	304	xhr	index-CIRzAOq4js	0.1 kB	625 ms
customers	304	xhr	index-CIRzAOq4js	0.1 kB	624 ms
vite.svg	200	svg+xml	Other	0.8 kB	269 ms
js.js	200	script	content.js:43	1.4 kB	2 ms
dom.js	200	script	content.js:43	2.0 kB	5 ms
js.js	200	script	content.js:43	1.4 kB	3 ms
dom.js	200	script	content.js:43	2.0 kB	3 ms

12 requests | 455 kB transferred | 1.6 MB resources | Finish: 3.60 s | DOMContentLoaded: 1.87 s

The screenshot shows the Admin Dashboard of a store named 'Mus Store'. The dashboard includes sections for Total Orders (26), Total Revenue (Rp 20.807.000), Total Customers (11), and Total Products (50). Below these are two cards: 'Revenue Over Time' (based on order date) and 'Revenue' (20.000.000). On the right, a Network tab in the browser developer tools shows a timeline with various requests and their details.

Name	Status	Type	Initiator	Size	Time
dashboard	304	document	Other	0.1 kB	56 ms
index-CIRzAOq4js	304	script	dashboard:8	0.1 kB	54 ms
index-BxPypqQ.css	304	stylesheet	dashboard:9	0.0 kB	56 ms
overview	304	xhr	index-CIRzAOq4js	0.1 kB	1.94 s
revenue	304	xhr	index-CIRzAOq4js	0.0 kB	548 ms
order-status	304	xhr	index-CIRzAOq4js	0.0 kB	557 ms
customers	304	xhr	index-CIRzAOq4js	0.0 kB	553 ms
vite.svg	304	svg+xml	Other	0.0 kB	58 ms
js.js	200	script	content.js:43	1.4 kB	4 ms
dom.js	200	script	content.js:43	2.0 kB	3 ms
js.js	200	script	content.js:43	1.4 kB	2 ms
dom.js	200	script	content.js:43	2.0 kB	4 ms

12 requests | 7.1 kB transferred | 1.6 MB resources | Finish: 2.34 s | DOMContentLoaded: 398 ms

## Versi Optimized (2B):

The screenshot shows the Admin Dashboard for 'Mus Store'. The dashboard includes sections for Total Orders (26), Total Revenue (Rp 20.807.000), Total Customers (11), and Total Products (50). A chart titled 'Revenue Over Time' shows revenue increasing from 15.000.000 to 20.000.000. The Network tab of the browser developer tools shows a timeline with various requests and their execution times.

Name	Status	Type	Initiator	Size	Time
dashboard	304	document	Other	0.1 kB	269 ms
index-Bel	200	script	dashboard:10	2.8 kB	344 ms
vue-vendor-DQhMYfZl.js	200	script	dashboard:10	42.1 kB	978 ms
pinia-vendor-DQhMYfZl.js	200	script	dashboard:11	2.0 kB	355 ms
product-DWzh_tBQ.js	200	script	dashboard:11	18.1 kB	504 ms
element-plus-vendor-BBmzstB...	200	script	dashboard:12	271 kB	562 ms
settings-ittd6h29.js	200	script	dashboard:13	1.8 kB	335 ms
index-BxPypgqO.css	304	stylesheet	dashboard:14	0.1 kB	91 ms
Dashboard-CpKSikh5.js	200	script	product-DWzh_tB	2.2 kB	513 ms
analytics-BZJi41.H.js	200	script	product-DWzh_tB	2.0 kB	455 ms
vite.svg	200	svg+xml	Other	0.8 kB	341 ms
order-C3qDHe_B.js	200	script	product-DWzh_tB	4.5 kB	315 ms
overview	304	xhr	product-DWzh_tB	0.1 kB	664 ms
revenue	304	xhr	product-DWzh_tB	0.1 kB	657 ms
order-status	304	xhr	product-DWzh_tB	0.1 kB	662 ms

The second screenshot shows the same Admin Dashboard and network timeline. The requests listed are identical to the first screenshot, indicating no significant difference in resource loading between the two versions.

Name	Status	Type	Initiator	Size	Time
dashboard	304	document	Other	0.1 kB	71 ms
index	200	script	dashboard:10	0.1 kB	59 ms
vue-vendor-DQhMYfZl.js	304	script	dashboard:10	0.0 kB	57 ms
pinia-vendor-DQhMYfZl.js	304	script	dashboard:11	0.1 kB	56 ms
product-DWzh_tBQ.js	304	script	dashboard:11	0.0 kB	55 ms
element-plus-vendor-BBmzstB...	304	script	dashboard:12	0.0 kB	57 ms
settings-ittd6h29.js	304	script	dashboard:13	0.0 kB	59 ms
index-BxPypgqO.css	304	stylesheet	dashboard:14	0.1 kB	60 ms
Dashboard-CpKSikh5.js	304	script	product-DWzh_tB	0.0 kB	125 ms
analytics-BZJi41.H.js	304	script	product-DWzh_tB	0.0 kB	125 ms
vite.svg	304	svg+xml	Other	0.0 kB	100 ms
order-C3qDHe_B.js	304	script	product-DWzh_tB	0.0 kB	56 ms
overview	304	xhr	product-DWzh_tB	0.1 kB	1.98 s
revenue	304	xhr	product-DWzh_tB	0.1 kB	555 ms
order-status	304	xhr	product-DWzh_tB	0.0 kB	552 ms