Indiestream Platform Architecture

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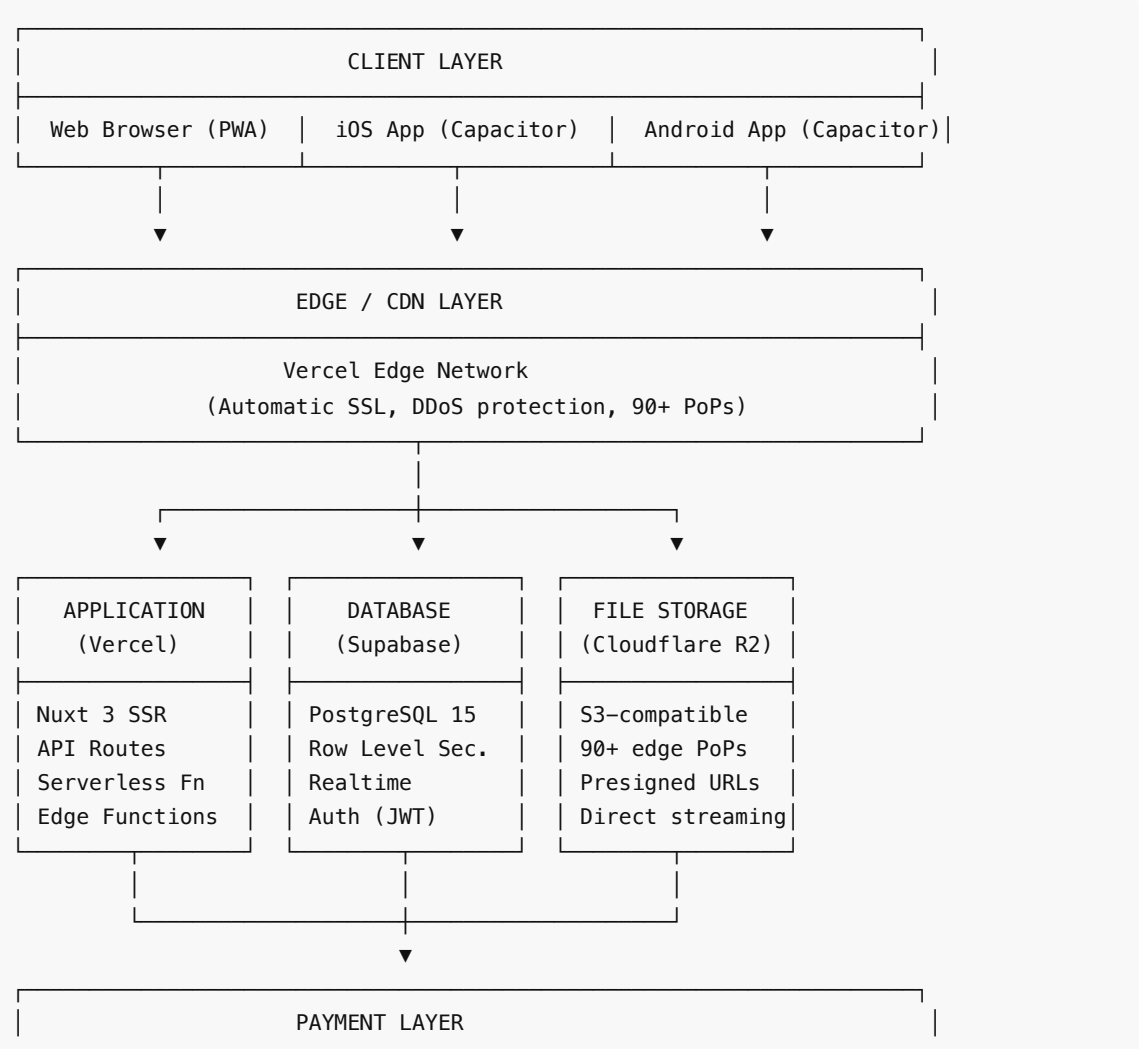
Executive Summary

Indiestream is built on a modern, serverless architecture optimized for cost efficiency and global scalability. The platform leverages best-in-class cloud services while maintaining significantly lower operational costs than traditional AWS or Google Cloud deployments.

Key Metrics:

- **Estimated monthly cost at 10,000 MAU:** ~$150-300/month
- **Estimated monthly cost at 100,000 MAU:** ~$800-1,500/month
- **Time to global deployment:** Minutes (automatic via Vercel)
- **Database scaling:** Automatic (Supabase managed PostgreSQL)

Current Architecture Overview



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│                          Stripe                              │
│   Subscriptions │ Customer Portal │ Connect (Artist Payouts) │
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Technology Stack

Layer	Technology	Purpose
Frontend	Nuxt 3 + Vue 3	Universal rendering (SSR + SPA)
UI Components	Nuxt UI + Tailwind	Consistent design system
Mobile Apps	Capacitor	Native iOS/Android wrappers
Backend	Nuxt Server Routes	API endpoints (93+ routes)
Database	Supabase (PostgreSQL)	Data, auth, realtime
File Storage	Cloudflare R2	Audio files, images
Payments	Stripe	Subscriptions, artist payouts
Deployment	Vercel	Serverless, global CDN
Email	Resend	Transactional emails

CDN & Content Delivery Analysis

Current Setup: Cloudflare R2 + Vercel Edge

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Audio Streaming Flow:

User (Sydney) ──► Vercel Edge (Sydney) ──► API Route ──► Presigned URL
                                                              │
                                                              ▼
User (Sydney) ◄──────────────────────── Cloudflare R2 Edge (Sydney)
                    Direct audio stream
```

How it works:

1. User requests a track
2. Vercel Edge (closest PoP) generates presigned R2 URL
3. User streams audio directly from Cloudflare R2's edge
4. R2 serves from nearest of 90+ global edge locations

CDN Performance Characteristics

Metric	Current (R2 + Vercel)	AWS CloudFront	Google Cloud CDN
Edge Locations	90+ (Cloudflare) + 90+ (Vercel)	450+	140+
Latency (avg)	20-50ms	15-40ms	20-50ms

Egress Cost	**$0.00** (R2 free egress)	$0.085/GB	$0.08/GB
Cache Hit Ratio	~85%	~90%	~85%

What's Working Well

Aspect	Status	Notes
Global Audio Delivery	✅ Excellent	R2 edge caching, zero egress costs
Image Delivery	✅ Excellent	Presigned URLs, proper caching headers
API Response Times	✅ Good	Vercel Edge Functions, ~50-150ms globally
SSL/TLS	✅ Automatic	Managed by Vercel
DDoS Protection	✅ Included	Cloudflare + Vercel automatic protection
HTTP/2 & HTTP/3	✅ Enabled	Modern protocols for faster loading

Potential Performance Improvements

Issue	Impact	Solution	Priority
No CDN for API responses	Medium	Implement stale-while-revalidate caching	Low
Album art not edge-cached	Low	Add Cache-Control headers to presigned URLs	Low
Large album pages	Low	Implement pagination/infinite scroll	Done ✅
No audio preloading	Low	Preload next track in queue	Future

Scaling Analysis

Current Capacity (No Changes Needed)

Metric	Current Limit	Bottleneck
Concurrent Users	~50,000	Supabase connection pooling
API Requests/sec	~10,000	Vercel serverless concurrency
Audio Streams	Unlimited	R2 has no request limits
Database Size	8GB (free) / 500GB (Pro)	Supabase plan
File Storage	Unlimited	R2 pay-per-GB stored

Scaling Triggers & Actions

User Count	Actions Required	Estimated Cost

0-10,000 MAU	None - current setup handles this	~$150-300/mo
10,000-50,000 MAU	Upgrade Supabase to Pro	~$500-800/mo
50,000-100,000 MAU	Add read replicas, connection pooling	~$800-1,500/mo
100,000-500,000 MAU	Multi-region database, dedicated compute	~$2,000-5,000/mo
500,000+ MAU	Custom infrastructure evaluation	TBD

Cost Comparison: Current vs AWS vs Google Cloud

Scenario: 50,000 Monthly Active Users

Assumptions: 100 streams/user/month, 5MB avg audio file, 500GB stored

Cost Category	Current Stack	AWS Equivalent	Google Cloud
Compute	$20 (Vercel Pro)	$150 (Lambda + API Gateway)	$120 (Cloud Run)
Database	$25 (Supabase Pro)	$100 (RDS PostgreSQL)	$80 (Cloud SQL)
File Storage	$8 (R2, 500GB)	$12 (S3)	$10 (Cloud Storage)
CDN/Egress	**$0** (R2 free egress)	**$425** (CloudFront 5TB)	**$400** (Cloud CDN)
Auth	$0 (Supabase included)	$50 (Cognito)	$0 (Firebase Auth)
Total/month	**~$53**	**~$737**	**~$610**

Why Our Stack is 10-14x Cheaper

1. **Zero Egress Fees (R2)** - This is the biggest win. Audio streaming egress at scale is extremely expensive on AWS/GCP.
2. **Serverless by Default** - No idle compute costs
3. **Managed Services** - No DevOps overhead for database, auth, etc.
4. **Vercel's Generous Limits** - Pro plan includes significant bandwidth

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Architecture Strengths

1. Cost Efficiency

- **Zero egress fees** on audio streaming (R2)
- **Serverless compute** - pay only for actual usage
- **No infrastructure management** - reduced DevOps costs

2. Global Performance

- **90+ edge locations** via Cloudflare
- **Automatic geo-routing** - users served from nearest PoP
- **Sub-100ms TTFB** for most regions

3. Developer Velocity

- **Single codebase** for web, iOS, Android

- **Type-safe** end-to-end (TypeScript)
- **Instant deployments** via Git push
- **Preview deployments** for every PR

4. Security

- **Row Level Security** - database-level access control
- **Presigned URLs** - time-limited file access
- **Managed SSL** - automatic certificate renewal
- **PCI Compliance** - Stripe handles all payment data

5. Reliability

- **99.99% uptime** SLA (Vercel Enterprise)
- **Automatic failover** - serverless functions are stateless
- **Database backups** - daily automatic backups (Supabase)

Architecture Risks & Mitigations

Risk	Severity	Mitigation
Vendor Lock-in (Vercel)	Medium	Nuxt is portable; can deploy to any Node.js host
Supabase Outage	Medium	Supabase has 99.9% SLA; can migrate to self-hosted PostgreSQL
R2 Unavailability	Low	Cloudflare's global network is highly resilient
Stripe Dependency	Low	Industry standard; alternative payment processors available
Single Region Database	Medium	Supabase Pro includes read replicas; can add as needed

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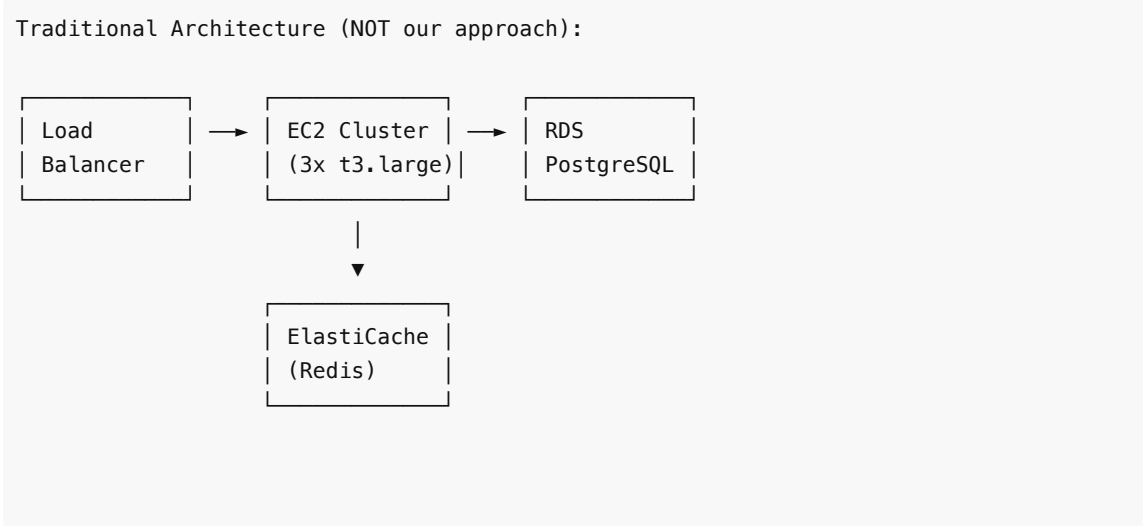
Comparison: Serverless vs Traditional Architecture

If We Built on AWS EC2/Traditional Infrastructure



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Monthly Cost at 50K MAU: ~$800-1,200 (compute alone)
+ DevOps engineer needed: ~$8,000-12,000/month
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Our Serverless Approach

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Current Architecture:

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│           Vercel (Auto-scales)          │
│  ┌─────────────────────────────────┐    │
│  │    Serverless Functions (0-∞)   │    │
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Monthly Cost at 50K MAU: ~$50-100
DevOps needed: None (fully managed)
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Future Architecture Considerations

Phase 1: Current → 100K Users (No changes needed)

- Current architecture handles this scale
- May need Supabase Pro upgrade at ~50K users

Phase 2: 100K → 500K Users

- Add Supabase read replicas for analytics queries
- Implement query caching (Redis via Upstash)
- Consider moving heavy analytics to separate service

Phase 3: 500K+ Users

- Evaluate dedicated compute for API routes
- Multi-region database deployment
- Custom CDN rules for audio content

Optional Future Enhancements

Enhancement	Benefit	Complexity
Audio Transcoding Service	Multiple quality options, bandwidth savings	Medium
Recommendation Engine	Improved discovery, retention	High
Real-time Collaboration	Live playlist editing	Low (Supabase Realtime)
Offline Sync	Better mobile experience	Medium

Feature Analysis: HiFi / Lossless Audio Streaming

Overview

This section analyzes the feasibility and cost implications of adding high-quality lossless audio streaming (FLAC/ALAC) as a premium feature, similar to Tidal HiFi, Apple Music Lossless, or Amazon Music HD.

Audio Quality Tiers Comparison

Quality Tier	Format	Bitrate	File Size (4 min track)	Use Case
Standard	MP3 320kbps	320 kbps	~10 MB	Current default
HiFi	FLAC 16-bit/44.1kHz	~1,411 kbps	~40 MB	CD quality
Hi-Res	FLAC 24-bit/96kHz	~4,608 kbps	~130 MB	Studio quality

Storage Impact Analysis

Scenario: 10,000 tracks in catalog

Quality	Avg File Size	Total Storage	R2 Storage Cost/month
MP3 320 only	10 MB	100 GB	$1.50
MP3 + FLAC HiFi	10 + 40 MB	500 GB	$7.50
MP3 + FLAC + Hi-Res	10 + 40 + 130 MB	1.8 TB	$27.00

Scenario: 100,000 tracks in catalog

Quality	Avg File Size	Total Storage	R2 Storage Cost/month
MP3 320 only	10 MB	1 TB	$15
MP3 + FLAC HiFi	10 + 40 MB	5 TB	$75
MP3 + FLAC + Hi-Res	10 + 40 + 130 MB	18 TB	$270

> ***Note:*** *R2 storage costs $0.015/GB/month. Egress remains FREE regardless of file size.*

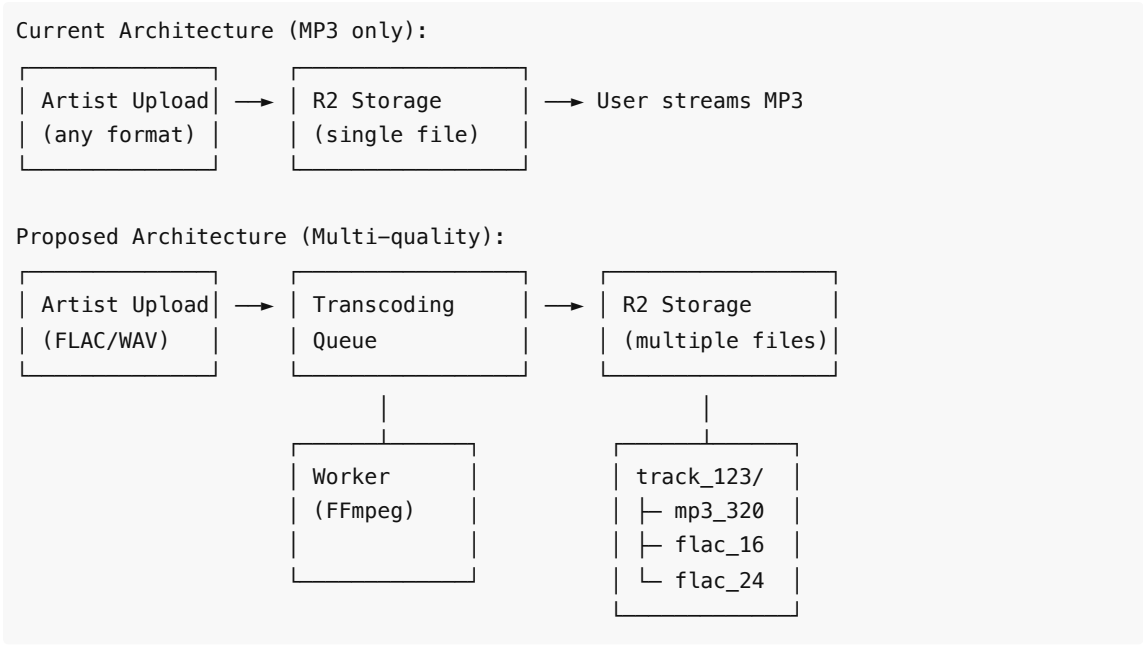
Bandwidth Impact (Still Free!)

One of Indiestream's biggest advantages is **zero egress fees** with Cloudflare R2. This means:

Quality	Data per Stream	1M streams/month	Egress Cost
MP3 320	10 MB	10 TB	**$0** (R2)
FLAC HiFi	40 MB	40 TB	**$0** (R2)
FLAC Hi-Res	130 MB	130 TB	**$0** (R2)

On AWS/GCP, this same 40TB of HiFi streaming would cost $3,400-$4,000/month in egress fees alone.

Architecture Changes Required



Implementation Components

Component	Purpose	Options	Est. Cost
Transcoding Worker	Convert uploads to multiple formats	Vercel Functions, AWS Lambda, or dedicated service	$20-100/mo
Job Queue	Manage transcoding jobs	Upstash Redis, AWS SQS	$0-20/mo
Database Changes	Track available qualities per track	Supabase (existing)	$0
UI Changes	Quality selector in player	Frontend only	$0
Additional Storage	Store multiple formats	R2	4-5x current

Cost Comparison: With vs Without HiFi

At 50,000 MAU, 100 streams/user/month, 50,000 tracks

Cost Category	Current (MP3 only)	With HiFi (FLAC)	Difference
Compute	$20	$40-70	+$20-50
Database	$25	$25	$0
Storage	$8 (500GB)	$38 (2.5TB)	+$30
CDN/Egress	$0	$0	$0
Transcoding	$0	$20-50	+$20-50
Total/month	**~$53**	**~$123-183**	**+$70-130**

HiFi on AWS/GCP (For Comparison)

Cost Category	AWS with HiFi	Google Cloud with HiFi
Storage	$58 (S3, 2.5TB)	$50 (Cloud Storage)
CDN/Egress (40TB)	**$3,400**	**$3,200**
Transcoding	$100 (MediaConvert)	$80 (Transcoder API)
Total/month	**~$3,700**	**~$3,450**

Our stack with HiFi: ~$150/mo vs AWS: ~$3,700/mo = 25x cheaper

Business Model Considerations

Potential Pricing:

- Current Listener subscription: $9.99/mo
- HiFi tier (new): $14.99-19.99/mo (+$5-10 premium)

Break-even Analysis:

- Additional infrastructure cost: ~$100/mo at scale
- HiFi premium per user: $5-10/mo
- Break-even: 10-20 HiFi subscribers

Recommendation: When to Implement

Factor	Assessment
Technical Complexity	Medium - requires transcoding pipeline
Storage Cost Impact	Moderate - 4-5x increase but still cheap
Egress Cost Impact	None - R2 free egress is the key advantage
Market Differentiation	High - audiophile market underserved
Revenue Potential	Good - $5-10 premium is industry standard

Implementation Priority Matrix

Phase	When to Implement	Rationale
Now	❌ Not recommended	Focus on core features, user acquisition
10K MAU	⚠️ Consider	Have user feedback, some paying customers
50K MAU	✅ Recommended	Revenue can fund development, clear demand signal
100K+ MAU	✅ Definitely	Competitive necessity, revenue diversification

Conclusion: HiFi Feature

Should we implement HiFi streaming now?

No, defer to later phase. Here's why:

1. **Cost is manageable** - Our R2 architecture makes HiFi viable (no egress fees)
2. **But complexity is real** - Transcoding pipeline requires significant development
3. **Focus on growth first** - Better ROI from user acquisition than premium features
4. **Easy to add later** - Architecture doesn't need to change, just add transcoding layer

When we do implement:

- Start with FLAC 16-bit/44.1kHz (CD quality) only
- Use Vercel Functions + FFmpeg for transcoding
- Offer as $14.99/mo "HiFi" tier
- Expected additional cost: ~$100-150/mo at scale
- Break-even: ~15-20 HiFi subscribers

Key Metrics to Monitor

Metric	Current	Warning Threshold	Action
API P95 Latency	~150ms	>500ms	Investigate slow queries
Database Connections	~20	>80% of limit	Upgrade plan
Serverless Invocations	~50K/day	>1M/day	Review Vercel plan
R2 Storage	~50GB	>500GB	Normal growth
Error Rate	<0.1%	>1%	Immediate investigation

Conclusion

Indiestream's architecture is **production-ready, cost-efficient, and globally scalable**. The combination of Vercel, Supabase, and Cloudflare R2 provides:

1. **10-14x lower costs** than equivalent AWS/GCP deployments
2. **Global performance** with zero egress fees
3. **Automatic scaling** with no infrastructure management
4. **Clear upgrade path** as user base grows

The platform can comfortably serve **100,000+ monthly active users** on the current architecture with minor adjustments, and has a clear scaling path beyond that.

Appendix: Service Providers

Service	Provider	Plan	Monthly Cost
Hosting/Compute	Vercel	Pro	$20
Database	Supabase	Free → Pro	$0-25
File Storage	Cloudflare R2	Pay-as-you-go	~$8 (500GB)
Payments	Stripe	Pay-as-you-go	2.9% + $0.30/txn

Email	Resend	Free tier	$0
Domain	Cloudflare	Annual	~$10/year

Current Total: ~$30-50/month (excluding Stripe transaction fees)

Document prepared by the Indiestream Technical Team