

BLUEPRINT

Circuit Technical Blueprint

Version 2.1.0 August 2026

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1. Executive Summary

Circuit is a production-grade video streaming platform built on modern cloud-native infrastructure with native Base (Coinbase L2) blockchain integration. Released in early 2026, the platform combines live streaming, Video-on-Demand (VOD) delivery, and creator monetization with blockchain-native payment rails and token-gated content access.

Core Value Propositions

For Viewers:

- Watch-to-Earn rewards through the XP system
- Token-gated exclusive content access
- Native wallet authentication (browser wallets or social login)
- Real-time interactive features

For Creators:

- Multiple revenue streams (tips, PPV, advertising, ticket sales)
- 100% of base tip amounts (platform fee added on top)
- Token-gated content for premium experiences
- Comprehensive analytics dashboard
- Automatic stream archiving to VOD
- Subscription tiers with usage-based billing

For the Ecosystem:

- Base-first payment infrastructure
- Multi-token support (USDC, ETH)
- On-chain transaction verification
- Transparent, immutable payment records

Platform Highlights

Aspect	Description	
Platform Version	2.0.0 (Production)	
Infrastructure	Enterprise-grade, globally distributed	
Security	Comprehensive multi-layer protection	
Blockchain	Native Base (L2) integration	

2. Platform Overview

2.1 Feature Summary

Live Streaming

- Professional RTMP ingest infrastructure
- HLS delivery via global CDN
- Secure publish token authentication
- Multi-camera broadcasting with Director controls
- Automatic stream archiving
- Single-cam adaptive bitrate support; multicam ABR is capacity-gated by AMS CPU
- **Roadmap:** WebRTC ultra-low latency and broader multicam ABR after infrastructure upgrade

Video on Demand

- Direct-to-cloud upload (up to 2GB)
- Global CDN delivery

- Signed URL protection
- Automatic thumbnail generation
- View tracking with analytics

Monetization

- Pay-Per-View (PPV) with Base USDC payments
- Creator tipping (new tips use USDC; ETH retained for historical/in-flight recovery)
- Watch-to-Earn advertising
- Token-gated premium content
- Event ticketing with on-chain NFT minting
- Airtime pay-by-minute access (early access) — x402 payment channels on Base
- Creator subscription tiers with Stripe billing
- Creator payout system

Social Features

- Real-time live chat
 - Threaded comments on VOD
 - Follow system
 - Content moderation tools
 - Creator-assigned moderators
-

3. Technology Architecture

3.1 Core Technology Stack

Layer	Technology	Purpose
Frontend	Next.js 14+	React framework with App Router
UI Components	Shadcn/ui + Radix UI	Accessible component library
Styling	Tailwind CSS	Utility-first CSS
Language	TypeScript	Type-safe development
Database	PostgreSQL	Primary data store
ORM	Prisma	Type-safe database access
Caching	Redis	Rate limiting, session cache
Streaming	Ant Media Server	RTMP ingest, HLS delivery
CDN	BunnyCDN	Global content delivery
Storage	S3-Compatible	Object storage
Blockchain	Base L2 (Ethereum)	Payment verification
Billing	Stripe	Creator subscriptions
Deployment	Vercel	Serverless hosting

3.2 Application Structure

The platform follows a modular architecture with clear separation of concerns:

- **App Router** - Next.js pages and API routes
- **Components** - 174+ reusable React components
- **Libraries** - Core utilities and integrations

- **Hooks** - Custom React hooks for state management
- **Contexts** - React Context providers
- **Widget App** - Separate embedded widget application

3.3 API Architecture

The platform exposes a comprehensive REST API organized into functional domains:

Domain	Key Functions
Authentication	Wallet auth, social login
User Management	Profiles, settings, follows
Video Management	CRUD, likes, comments
Live Streaming	Create, manage, status
Payments	PPV, tips, verification
Playback Gateway	Token auth, session management
Chat & Comments	Real-time messaging
Moderation	Content moderation
Advertisements	Ad serving and tracking
Ticketing	Event creation, ticket sales, redemption
Multi-Camera	Angle management, Director controls
Billing	Stripe subscriptions, usage

4. Authentication & Identity

4.1 Wallet-First Architecture

Circuit implements a **wallet-first authentication system** where every user has an EVM wallet. This approach provides:

- **Simplicity:** Single identity model - all users have wallets
- **Web3-Native:** True wallet ownership for all users on Base
- **Web2 UX:** Social login provides familiar onboarding experience
- **Security:** Industry-standard cryptographic verification via SIWE (Sign-In with Ethereum)

How Users Connect

Circuit supports two authentication rails — both produce a fully-functional EVM wallet on Base:

Method	Description
Browser Extension (SIWE)	Direct connection via MetaMask, Coinbase Wallet, or WalletConnect — signature-based auth via Sign-In with Ethereum (EIP-4361)
Coinbase Smart Wallet (SIWE)	Passkey-based wallet, signed in with Ethereum — no extension required
CDP Embedded Wallet (Social Login)	Google OAuth or Email OTP via Coinbase Developer Platform — wallet provisioned automatically; email captured for Stripe billing compliance

All wallets are fully functional EVM wallets capable of:

- Sending and receiving ETH and ERC-20 tokens (USDC)
- Signing transactions for tips, PPV purchases, and token operations
- Holding tokens for gated content access
- Full EIP-1193 compatibility

4.2 Smart Wallet & Social Login

Circuit removes blockchain friction for mainstream users through two onboarding paths beyond traditional browser extensions.

Coinbase Smart Wallet

Smart Wallet enables users to create a passkey-based EVM wallet instantly — no extension, no seed phrase. Authentication still uses SIWE (Sign-In with Ethereum), so the underlying security model matches MetaMask and WalletConnect.

For Users:

- Zero friction onboarding — no wallet extension installation required
- Passkey-based wallet creation (biometric or device PIN)
- Fee-free transactions on Base — Circuit covers the network fee via paymaster sponsorship
- Built-in fiat on-ramp for purchasing USDC directly

For the Platform:

- Dramatically lower barrier to entry for mainstream audiences
- Full feature parity with browser extension wallet users

CDP Embedded Wallet (Social Login)

For users who want to sign in with Google or email — the lowest possible friction — Circuit integrates Coinbase Developer Platform's embedded wallet service. CDP provisions an EVM wallet automatically and authenticates via access-token validation rather than SIWE signing.

For Users:

- Sign in with Google OAuth or Email OTP — no wallet UI required
- EVM wallet provisioned automatically on Base
- Email captured by default (used for Stripe billing compliance)
- Optional fee-free payments — Circuit covers the network fee on every tip, purchase and ticket

For the Platform:

- Familiar Web2 sign-in flow for non-crypto-native users

- All payments and on-chain features remain available — wallet is real, just embedded

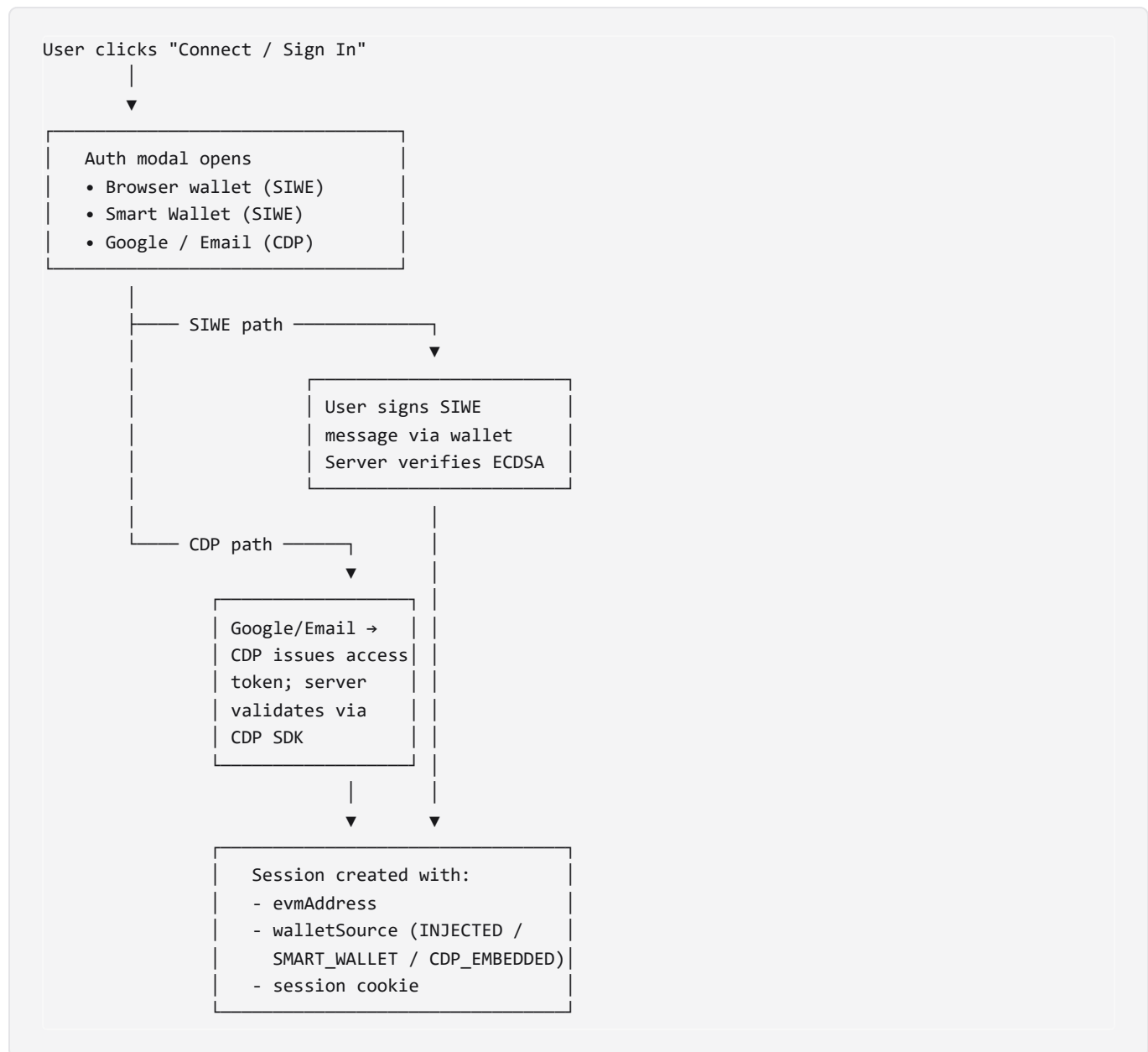
Fee-Free Payments

Network fees are the last piece of blockchain friction a mainstream viewer meets: a wallet holding only USDC cannot spend it without also holding ETH. Circuit removes that.

An embedded wallet is created as a standard account, which pays its own network fee. A viewer can opt in to having Circuit cover it instead — one confirmation in Settings, no cost to them, and from that point every tip, pay-per-view purchase and ticket is sponsored. Approval and payment also collapse from two wallet confirmations into one.

The upgrade is **permanent and user-initiated**. Circuit never performs it on a viewer's behalf, and the consent screen states plainly that it cannot be reversed. The wallet keeps the same address, the same balance and the same sign-in, and Circuit gains no ability to move funds on the holder's behalf.

Authentication Flow



Feature Parity

All wallet types have **complete feature parity**:

Feature	Browser Wallet (SIWE)	Smart Wallet (SIWE)	CDP Embedded (Social)
Watch Content	Yes	Yes	Yes
Earn XP	Yes	Yes	Yes
PPV Purchases	Yes	Yes	Yes
Send Tips	Yes	Yes	Yes
Token Gating	Yes	Yes	Yes
Token Balance Gate	Yes	Yes	Yes
Creator Subscriptions	Yes	Yes	Yes
Stripe Billing	Yes (add email in Settings)	Yes (add email in Settings)	Yes (email captured at sign-up)

Email & Stripe Billing

Users who want Stripe subscriptions can add an email address in Settings. This email is stored and used for:

- Stripe subscription billing (required for compliance)
- Usage alerts and notifications
- Account recovery communications

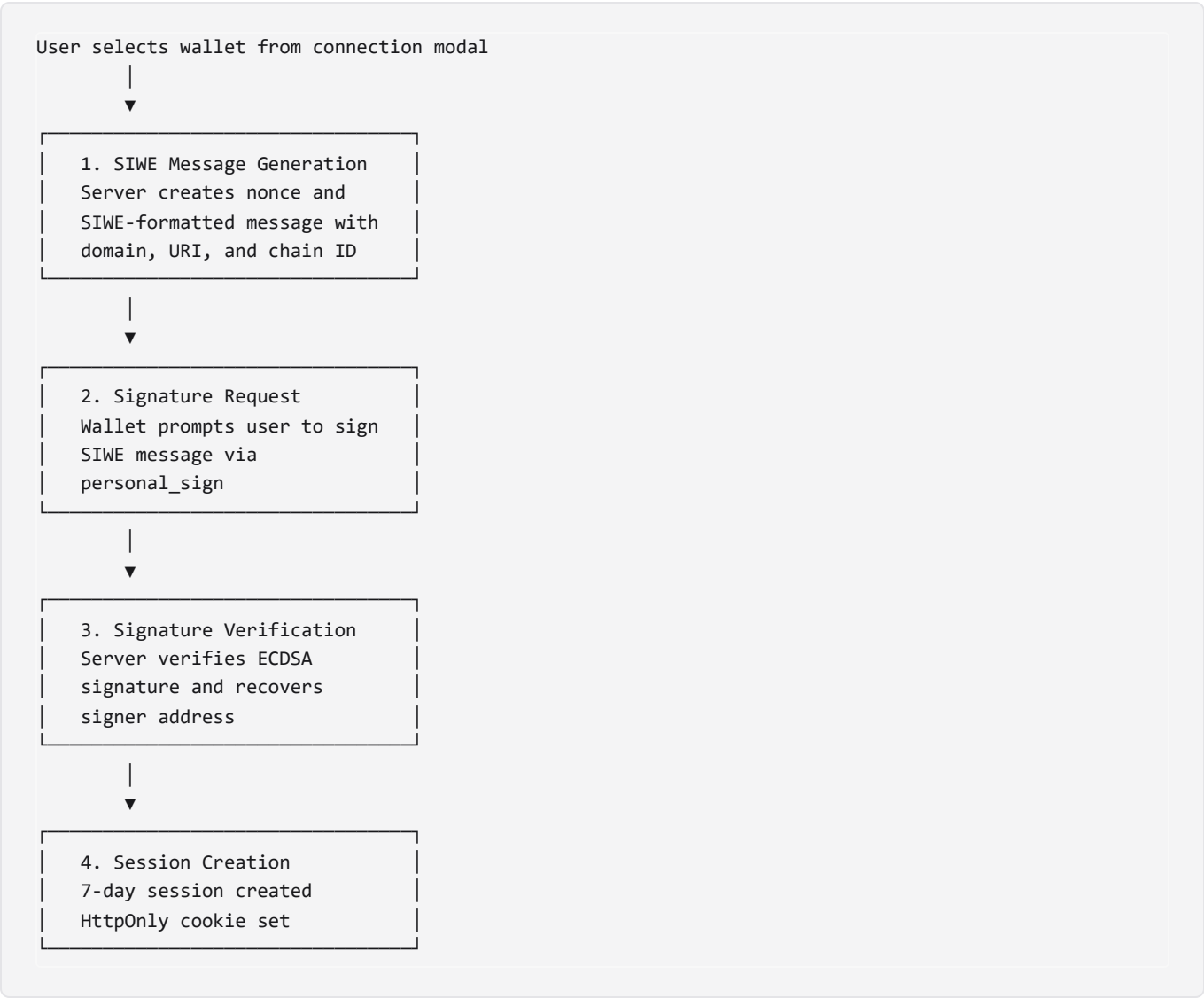
4.3 EVM Wallet Authentication (SIWE)

For users who prefer browser extension wallets, Circuit supports any EIP-1193 compliant EVM wallet.

Officially Supported Wallets

Wallet	Description	
MetaMask	Most popular EVM browser extension wallet	
Coinbase Wallet	Coinbase's self-custody wallet with smart wallet support	
WalletConnect	Protocol supporting 300+ mobile and desktop wallets	

Authentication Flow (SIWE)



Security Features

Feature	Description
SIWE Standard	EIP-4361 compliant authentication messages
Single-Use Nonces	Automatically deleted after verification
10-Minute Expiration	Short window prevents replay attacks
Address Recovery	Signature verification recovers signer address
Multi-Session Support	Up to 5 concurrent sessions per user with sliding-window renewal — sign-ins on a new device do not kill existing sessions

4.4 Session Management

Session Characteristics:

- Duration: 7 days with sliding-window renewal on activity
- Concurrent Sessions: Up to 5 active sessions per user (across devices)
- Storage: Database-backed
- Cookie Type: HttpOnly, Secure, SameSite=Lax
- Identifier: UUID session ID
- Cross-Tab Sync: BroadcastChannel keeps all browser tabs in agreement on auth state

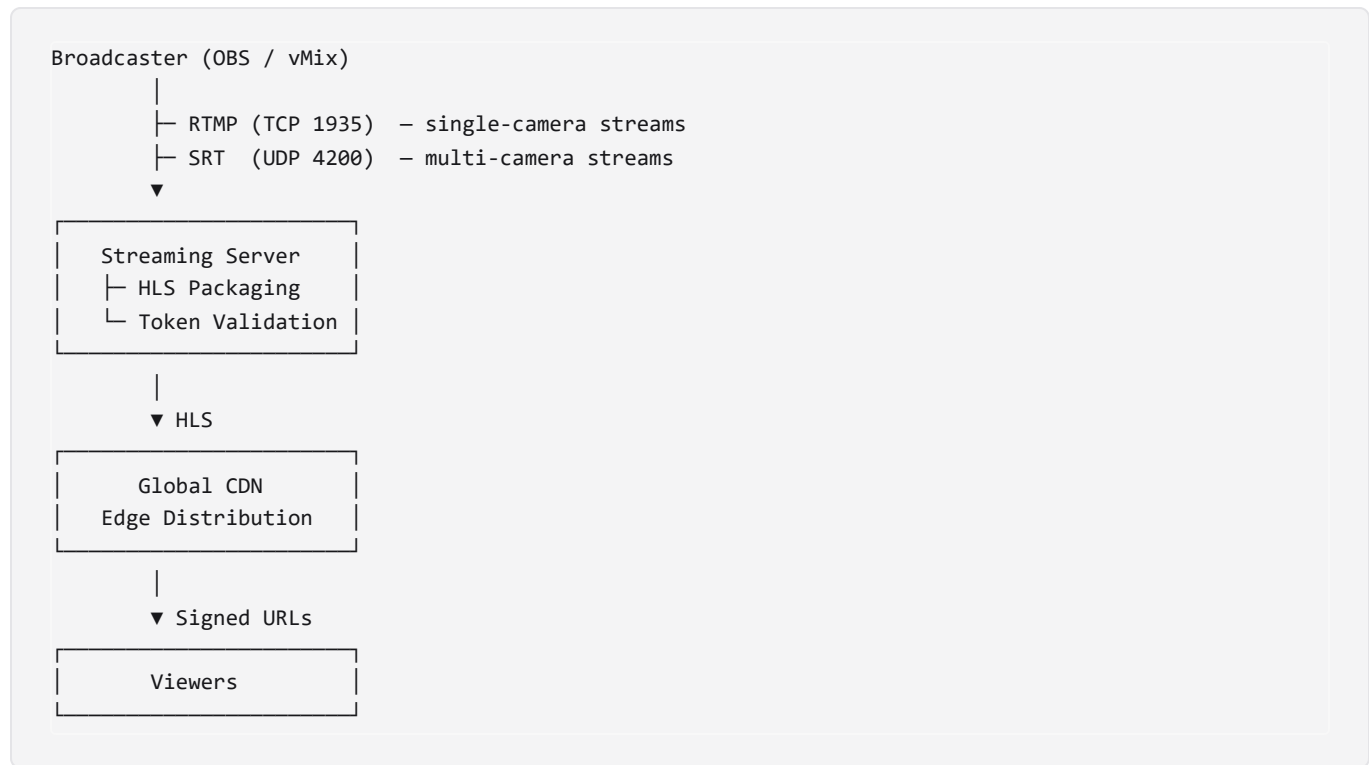
4.5 User Roles & Permissions

Role Hierarchy

Role	Level	Capabilities	
USER	0	Watch, like, comment, earn XP	
CREATOR	1	Upload content, earn tips, receive payments	
MODERATOR	2	Moderate chat, manage users, delete content	
ADMIN	3	Full platform access, user management	

5. Streaming Infrastructure

5.1 Live Streaming Architecture



Ingest Protocols: Single-camera streams use RTMP over TCP 1935. Multi-camera streams use SRT over UDP 4200 — SRT's lower latency and better packet recovery make it well-suited to synchronized angle delivery from professional encoders like vMix.

Current Delivery: HLS via BunnyCDN. Single-cam streams can use AMS ABR where enabled. Multicam is production-ready as SRT-to-HLS passthrough; multicam server-side ABR is capacity-gated because each camera adds another AMS transcode job.

Roadmap: Broader multicam adaptive bitrate delivery after dedicated AMS CPU capacity is available. WebRTC ultra-low latency delivery is also planned.

5.2 Stream Security

Security Model:

- Cryptographically random publish tokens
- Secure hashed storage (irreversible)
- Webhook validation before broadcast
- One-time token display with regeneration support

5.3 Streaming Specifications

Current Delivery:

- HLS at broadcaster output quality for passthrough streams
- Single-cam ABR support where per-broadcast AMS encoder settings are enabled
- Multicam ABR is capacity-gated on the current small AMS droplet
- Recommended broadcast settings: 1080p at 4000-6000 kbps
- MPEG-TS segment format via HLS

Vertical (9:16) Video:

- Vertical live streams and VODs are supported end-to-end: declare a vertical stream at creation (or upload a portrait file) and Circuit delivers it at native aspect with portrait-aware watch pages on desktop and near-full-bleed playback on mobile
- Paid tiers receive adaptive vertical quality (360×640 + 720×1280 ABR ladder); the Free tier delivers passthrough at broadcaster quality. Recommended broadcast settings: 1080×1920 at 3500-5000 kbps
- Stream archives inherit the source stream's orientation automatically, and browse thumbnails present portrait content with a blurred-backdrop treatment

ABR Profiles / Capacity Note:

Profile	Resolution	Bitrate	
High	720p	~3500 kbps video + 160 kbps audio	
Low	360p	~1000 kbps video + 128 kbps audio	

The current production ladder uses explicit transcoded variants and keeps source passthrough out of the ABR master. For multicam, server-side ABR still means one transcode per camera, so it should stay disabled or feature-gated until AMS has dedicated CPU headroom.

HLS Specifications:

- Optimized segment duration
- MPEG-TS segment format
- Configurable live window

5.4 Stream Archiving

Automatic conversion of live streams to VOD:

Status	Description	
<code>none</code>	Archive not enabled	
<code>recording</code>	Currently recording	
<code>processing</code>	MP4 being generated	
<code>ready</code>	Ready for publishing	
<code>published</code>	Video created	

Archive Retention by Tier

Tier	Retention Policy	
Free	30 days (auto-delete unpublished)	
Creator	Unlimited (counts against 100 GB storage)	
Creator Pro	Unlimited (counts against 300 GB storage)	
Creator Pro+	Unlimited (counts against 1 TB storage)	

Note: Published archives are never auto-deleted regardless of tier.

Entitlement Migration: Users with live stream access automatically receive archive access.

5.5 Multi-Camera Broadcasting

Circuit supports multi-camera live streams, allowing creators to broadcast multiple camera angles simultaneously with real-time switching.

Aspect	Detail
Max Cameras	Device-dependent (typically 4-8)
Switching Latency	Sub-200ms (CSS visibility swap)
Sync Method	PDT (Program Date-Time) via HLS tags
Sync Accuracy	±500ms across angles
Audio Mode	Follow active camera or primary-only
Billing	1 stream = 1 live hour (angles deduplicated)
ABR Status	Player and URL layer are ABR-ready; multicam server-side ABR requires dedicated AMS CPU capacity

How It Works



Viewer Experience

- **Single Camera Mode:** Watch one angle at a time with numbered camera buttons
- **Grid Mode:** View all cameras simultaneously in a mosaic layout
- **Camera Switching:** Click any camera button to switch instantly
- **Grid Exit:** Clicking a camera in grid mode switches to single view

Director Widget

Creators and assigned directors can control the broadcast in real-time via the Director widget:

- ATEM-style camera switching interface
- Grid/mosaic toggle for multi-view monitoring

- Camera status indicators (broadcasting, pending, offline)
- Secure postMessage bridge between widget iframe and player

Technical Details

- **Buffer Management:** Active camera gets full buffer, preloaded cameras get minimal buffer, stopped cameras load nothing
 - **PDT Synchronization:** Uses `#EXT-X-PROGRAM-DATE-TIME` HLS tags to sync angles. Nudges playback rate $\pm 3\%$ for small drift (200ms-2s), hard seeks for larger drift (>2s)
 - **Device Adaptation:** No artificial limits on modern devices. Only restricts on genuinely slow connections (2G/slow-2G via Network Information API)
 - **Billing Deduplication:** Angle streams share the parent stream's billing period. A 2-hour broadcast with 4 cameras = 2 live hours, not 8
-

6. Content Delivery Network

6.1 CDN Integration

Architecture:

- Pull zone configuration from object storage
- Global edge distribution via BunnyCDN's worldwide network
- Token authentication for protected content
- Separate zones for VOD and live streaming

Security:

- Cryptographically signed URLs
- Time-limited access tokens
- Anti-hotlinking protection

6.2 Playback Gateway

Three-layer security for content access:

Layer	Purpose	Description	
Playback Token	Request authentication	Validates user authorization	
Database Session	Business rules	Enforces concurrency limits	
CDN Signed URL	Content delivery	Secures actual media files	

Heartbeat System:

- Regular client-server communication
- Session extension on activity
- Watch time tracking for analytics

6.3 Concurrent Stream Limiting

Strategy: Newest Device Wins

When a user watches on multiple devices:

1. Detect active sessions
2. Terminate older sessions
3. Allow newest to continue
4. Notify terminated sessions gracefully

7. Monetization Systems

7.1 Base Payment Architecture

All payments are processed on Base (Coinbase L2) in USDC:

Component	Description
Payment Token	USDC — see §7.3 for ETH's historical-only status
Network	Base (Ethereum L2)
Verification	On-chain transaction confirmation
Fee Collection	Separate platform fee transfer
Network Fee	Paid by the viewer, or covered by Circuit for wallets with fee-free payments enabled (§4.2)

Benefits:

- Low network fees via L2 scaling — and zero for viewers on fee-free payments
- Near-instant transaction finality
- On-chain fee transparency
- Immutable payment proof

Wallet Cash-Out Via Coinbase Offramp

Circuit supports user-directed USDC cash-out through Coinbase Offramp where Coinbase supports the user's region and withdrawal method. The flow is non-custodial from Circuit's perspective:

1. Circuit creates a hosted Coinbase Offramp session.
2. The user completes Coinbase's sell flow.
3. Circuit helps the user sign the exact USDC transfer from their Circuit wallet to Coinbase's managed destination address.

4. Circuit verifies and records the on-chain send status.

Coinbase handles bank account or Coinbase account connection, sell execution, KYC/compliance, and fiat payout. Circuit never receives or holds the user's cash-out funds.

7.2 Deployed Smart Contracts (Base Mainnet)

All Circuit smart contracts are deployed on Base L2 (chain ID [8453](#)) and are publicly verifiable on [Basescan](#).

Contract	Address	Purpose
CircuitTicket (ERC-721)	0x34011586f119fa9B8B2a4CD40131DDC3Ee678E35	Event ticket NFT contract
CircuitPaymentSplitter (PPV v3)	0x6052Cf98afA7f4759808C79FA363C232796DF6f3	Atomic USDC PPV payment splitting
CircuitTipSplitter	0xC1f0c0Ca12a6C8bd63DE626fF5e041305b9c7A70	Atomic USDC tip splitting
CircuitTicketSale	0x86b87B851f8bD017aCE80cB6bA4c5E4970871e0d	Atomic USDC payment + ERC-721 ticket mint
CircuitAirtimeRouter	0xDbeF8bfc11Ea264F12f423681049CcF8db8c0c3A	Airtime pay-per-minute session settlement (x402)

Payment Token: USDC on Base — [0x833589fCD6eDb6E08f4c7C32D4f71b54bdA02913](#)

All contracts are written in Solidity 0.8.24, built with Hardhat + Ignition, and use OpenZeppelin v5.2+ as the security baseline. Platform fees are enforced on-chain in basis points (e.g., 1000 bps = 10%).

7.3 Supported Tokens

Token	Description	PPV	Tips	Tickets
USDC	Circle stablecoin on Base (~\$1 USD)	Yes (default)	Yes (atomic split via CircuitTipSplitter)	Yes
ETH	Native Base chain currency	No	No new issuance (historical relay recovery only — see §7.5)	No

PPV, ticket, Airtime, and new tip payments use USDC. Historical or already-issued ETH relay tips remain recoverable and verifiable but cannot be initiated.

7.4 Pay-Per-View (PPV)

Fee Structure:

- Base fee: 10% (added on top)
- Minimum fee: \$1 USDC
- Creator receives: 100% of base price
- User pays: base price + the greater of 10% or \$1

Example (\$10 USDC content):

```
Base price:    $10 USDC → Creator (via CircuitPaymentSplitter)
Platform fee:  $1 USDC → Platform (10% = $1, matches minimum)
Total paid:    $11 USDC
```

Example (\$2 USDC content — the minimum applies):

```
Base price:    $2 USDC → Creator
Platform fee:  $1 USDC → Platform (10% = $0.20, minimum applies)
Total paid:    $3 USDC
```

The minimum dominates below \$10, so the effective rate on low-priced content is higher than 10%. Creators set the price their audience sees at checkout as the total, and the breakdown is itemised there before payment.

Transaction Verification:

- 1-confirmation finality on Base (no reorgs)
- On-chain verification via viem (decodes PaymentSplit event)
- Automatic entitlement creation on confirmation

7.5 Tipping System

Two-Step Flow:

1. Payment info generation (no DB record until confirmed)
2. Record creation after wallet submission
3. On-chain verification and confirmation

Fee Structure:

- Base fee: 5% (added on top)
- Minimum fee: \$1 USDC
- Creator receives: 100% of tip amount

Example (\$20 USDC tip):

```
Tip amount:    $20 USDC → Creator (via CircuitTipSplitter)
Platform fee:   $1 USDC → Platform (5% = $1, matches minimum)
Total paid:     $21 USDC
```

Tip Settlement Models

New tips use USDC through CircuitTipSplitter. The ETH row documents the retained recovery path for tips issued before ETH initiation was disabled:

Token	Model	Settlement
USDC	Splitter — atomic on-chain via CircuitTipSplitter	Creator and platform receive their shares in the same transaction
ETH (historical/in-flight only)	Legacy relay — an already-issued tip sent ETH to a platform-controlled address	Record/verify/manual recovery retained; no new client or API initiation

Current USDC tips and retained legacy ETH records are server-verified against the exact on-chain transaction before confirmation.

7.6 Creator Subscription Tiers

Creators can subscribe to paid tiers for increased resource limits and professional features.

Tier Comparison

Tier	Monthly	Bandwidth	Storage	Live Hours
Free	\$0	25 GB	10 GB	3 hrs
Creator	\$49	500 GB	100 GB	20 hrs
Creator Pro	\$149	2 TB	300 GB	60 hrs
Creator Pro+	\$299	5 TB	1 TB	120 hrs

Overage Billing

Paid tier creators can opt-in to overage billing to exceed their limits:

Resource	Overage Rate
Bandwidth	\$0.05/GB
Storage	\$0.10/GB-month
Live Hours	\$3.00/hour

Spend Cap: Enabling overages applies a tier-scaled default monthly spend cap, which creators can raise, lower, or remove — preventing unexpected charges by default.

Usage Tracking

- Real-time usage dashboard
- Alerts at 50%, 80%, and 100% thresholds
- Daily usage aggregation from CDN logs
- Prorated billing for mid-cycle tier changes

7.7 Event Ticketing

Creators can sell tickets to scheduled events (concerts, premieres, watch parties) with on-chain NFT minting for ticket proof-of-purchase.

Aspect	Detail	
Ticket Format	ERC-721 NFT on Base (CircuitTicket contract)	
Payment Token	USDC (on-chain via CircuitTicketSale)	
Purchase Model	Atomic — USDC payment + NFT mint in one transaction	
Inventory	Per-tier with on-chain supply caps	
Fee Model	10% platform fee enforced on-chain	

Purchase Flow



ERC-721 Ticket Metadata

Each ticket NFT includes OpenSea-compatible metadata:

- Event name and description
- Tier name and tier-specific imagery
- Event date and time
- Unique ticket number
- Creator information

Fee Structure

- Platform fee: 10% (added on top of ticket price)

- Creator receives: 100% of ticket price
- Buyer pays: ticket price + 10%

Inventory Management

- Creators set per-tier supply caps
- Real-time inventory tracking
- Automatic sold-out detection
- Draft → Active → Ended event lifecycle

7.8 Airtime (Pay-Per-Minute)

Airtime is Circuit's pay-by-the-minute access model. Instead of paying a full PPV price up front, a viewer authorizes a bounded amount of USDC and is charged only for the time actually watched — ideal for sampling a live stream, joining part of an event, or paying only for the minutes consumed.

Airtime is built on **x402 payment channels** on Base. The principle is an "arcade card": the viewer loads USDC into their own channel, Circuit meters watched time, and only the watched amount is ever claimed — never more than a cap the viewer authorizes in advance. **Circuit never custodies the viewer's funds**; unspent Airtime stays in the viewer's channel and can be released back to their wallet.

Status: Early access. *CircuitAirtimeRouter is deployed on Base mainnet and Airtime has been validated on controlled creator content. It is being selectively enabled per creator and per stream as Circuit finalizes the experience — not yet broadly available.*

How It Works

Viewer loads USDC into an Airtime channel (signed ERC-3009 deposit)



Viewer authorizes a bounded spending cap Circuit can never exceed



Session starts; playback is metered minute by minute



On stop, only the watched amount is settled and split (creator + platform)



Unused Airtime stays available or is released back to the viewer's wallet

Fee Structure

- Creators set a per-minute rate in USDC
- Platform fee: 10% (added on top), enforced on-chain in basis points
- Creator receives 100% of their per-minute rate for watched time

Example (creator rate \$0.50/min, 6 minutes watched):

Watched time: 6 min × \$0.50 = \$3.00 USDC → Creator

Platform fee: \$0.30 USDC → Platform (10%)

Total charged: \$3.30 USDC (from the authorized cap)

Metering & Fairness

Rule	Behavior	
Billable playback	Only active, visible playback counts as watched time	
Not billed	Paused, buffering, or backgrounded playback is never charged	
Server-authoritative	Billing is calculated server-side and can never exceed the authorized cap	

Viewer Safeguards

Safeguard	Detail	
Authorized cap	Circuit can never claim more than the amount the viewer authorizes up front	
Non-custodial	Funds stay in the viewer's x402 channel until settlement	
Visible runway	The player shows remaining Airtime and stops automatically at the cap	
Release to wallet	Unused balance can be withdrawn back to the viewer's wallet	
Receipts	Settled sessions appear in purchase history beside PPV and tickets	

Settlement & Transparency

When a session ends, only the watched amount is settled through public Base transactions, and the creator/platform split is recorded with an itemized, verifiable receipt — so both sides can independently confirm what was charged and paid.

Scope: Airtime currently applies to **live streams**, opt-in per creator and per stream. VOD Airtime and combined "PPV-or-Airtime" access (letting viewers choose one-time purchase or pay-by-minute for the same content) are on the roadmap.

8. Token Gating

8.1 Token-Gated Content

Creators can restrict content access using token ownership or balance requirements:

Gating Types

Type	Description	Duration
Token Gating (NFT)	Any ERC-721 token from specified contract address	24-hour windows
Token Balance Gate	Minimum ERC-20 or ETH balance (not spent)	24-hour windows
Ticket Gating	Atomic USDC + ERC-721 purchase via CircuitTicketSale	Permanent (per-event)

Verification Flow

1. User requests gated content
2. System retrieves user's EVM address
3. **NFT gating:** ERC-721 `balanceOf()` checked on-chain via viem
4. **Balance gating:** ERC-20 `balanceOf()` or ETH balance checked via viem
5. **Ticket gating:** CircuitTicketSale purchase verified on-chain
6. Entitlement created (24-hour expiry for NFT/balance, permanent for tickets)
7. Access granted or denied

8.2 EVM Address Support

All users have a single EVM address (`0x...`) on Base chain. This address is used for:

- Authentication (SIWE signature)

- Token ownership verification
- Payment transactions
- NFT profile picture verification

8.3 NFT Profile Pictures

Users can set owned NFTs as profile avatars:

- Real-time ownership verification
- Automatic cache invalidation
- Fallback to default avatar

9. XP Reward System

9.1 Watch-to-Earn Mechanics

The XP system rewards users for watching content, preparing for future native token distribution.

Base Rate: 1 XP per minute watched **Daily Cap:** 240 XP (4 hours of content)

Earning Sources

Source	XP Rate	Cooldown	
Watch Time	1 XP/minute	24h per content	
Ad Completion	Variable	Per campaign	
Bonus Events	Variable	None	

9.2 Diminishing Returns

To ensure fair distribution and prevent farming:

Watch Count	Multiplier	Example (5-min video)
1st (new)	100% (1.0x)	5.0 XP
2nd (rewatch)	50% (0.5x)	2.5 XP
3rd	25% (0.25x)	1.25 XP
4th	10% (0.1x)	0.5 XP
5th+	1% (0.01x)	0.05 XP

Key Feature: Users can rewatch indefinitely at 1% XP - never reaches zero.

9.3 Level Progression

Default Formula (Square Root):

```
Level = floor(sqrt(totalXP / 100))
```

Level	XP Required
1	100 XP
5	2,500 XP
10	10,000 XP
20	40,000 XP
30	90,000 XP

9.4 Multiplier Tiers

Viewer Multipliers:

Level	Multiplier
0+	1.00x
5+	1.05x
10+	1.10x
20+	1.15x
30+	1.20x

9.5 Anti-Abuse Protections

The platform implements layered anti-abuse measures:

- **Velocity Monitoring** - Flags abnormal earning patterns for review
- **Session Integrity** - Validates continuous viewing
- **Rate Limiting** - Prevents automated abuse
- **Server-Authoritative Calculations** - All XP computed server-side
- **Daily Cap Enforcement** - Hard limits on daily earnings

9.6 Bootstrap Mode

Status: Currently active in production.

To prevent early-adopter compounding while the platform builds its initial audience, Circuit launches with **Bootstrap Mode** enabled — all viewer level-multipliers are normalized to 1.00x regardless of XP earned. Users still earn and accumulate XP at full base rate; what's deferred is the *bonus multiplier* effect from level-ups.

Configuration is database-driven (`xp_config` table) so exit can happen without a code deploy.
Default exit thresholds:

- 100 concurrent active viewers across the platform
- 100,000 watch-minutes per day
- 14 consecutive days meeting both thresholds

When all three are sustained, multipliers re-engage at the levels defined in §9.4.

10. Advertisement System

10.1 Ad Types

Type	XP Reward	Completion Requirement	
WATCH_TO_EARN	Variable	80% watch time	
DISPLAY	None	Impression delivery only	
SURVEY	Variable	Response submitted	
POLL	Variable	Option selected	

10.2 Placement Types

Placement	Use Case	Description	
PRE_ROLL	Before content	Full-screen video ad	
MID_ROLL	During content	Triggered at content midpoint	
POST_ROLL	After content	Full-screen video ad	
REWARDS_WIDGET	User-initiated	Sidebar opt-in ads	
PLAYER_OVERLAY	During playback	Non-intrusive banner	

10.3 Creator XP Attribution

- Creators receive 5% of XP actually awarded to the viewer on their content
- Creator XP is capped at 200/day; a zero-XP viewer completion produces zero creator XP
- This is XP attribution stored separately for analytics, not money or an advertiser payout
- Ads/Rewards is mandatory for every creator tier and sits outside optional-widget limits

10.4 Daily Limits

- Maximum daily XP from ads enforced
- Resets at midnight
- Server-side validation

10.5 Delivery Validation and Abuse Posture

Circuit currently has no dedicated ad-fraud detection subsystem. The obsolete implementation was removed in August 2026 because Circuit has no advertisers or external campaign spend to protect. Reward completion requires a server-issued impression and remains subject to server-side completion thresholds and daily caps. Dedicated fraud controls are rebuilt when the first real CPM/CPC counterparty creates that requirement.

10.6 Poll & Survey System

The platform supports comprehensive polling and survey functionality for audience engagement and market research.

Survey Types

Type	Use Case	Creator	
AD_CAMPAIGN	Platform-controlled campaign research	Platform admins	
CREATOR_POLL	Audience engagement	Creators	

Question Types (8 Total)

Type	Description	
SINGLE_CHOICE	Radio button selection	
MULTIPLE_CHOICE	Checkbox selection	
RATING_SCALE	Numeric scale (configurable)	
NPS	Net Promoter Score (0-10)	
STAR_RATING	1-5 star rating	
TEXT_SHORT	Single line text	
TEXT_LONG	Paragraph text	
YES_NO	Boolean selection	

Features

- XP rewards for survey completion
- Duplicate response prevention
- Live results with real-time polling
- Question randomization option
- Fraud detection (fast response + pattern checks)

11. Community Features

11.1 Real-Time Chat

Features:

- Character limits for manageable messages
- Rate limiting to prevent spam
- Slow mode (configurable interval)
- Followers-only mode
- Subscribers-only mode
- Profanity filter
- Custom banned words

Message Flow:

1. Authentication check
2. Rate limiting
3. Chat settings validation
4. Ban/timeout check
5. Message creation
6. Automatic broadcast to subscribers

11.2 Comments System

Features:

- Threaded discussions
- Generous character limits
- Rate limiting
- Soft delete with audit trail

11.3 User Badges

Badge	Criteria	
Creator	Content owner	
Admin	Platform administrator	
Moderator	Platform or content moderator	
Founder	Beta supporter (future)	

11.4 Moderation Tools

Actions:

- Message/comment deletion
- User timeout (temporary)
- User ban (permanent)
- All actions logged for accountability

Protections:

- Cannot ban platform admins
 - Cannot ban content creators on their own content
 - Audit trail for all moderation actions
-

12. Security Architecture

12.1 Security Overview

Category	Status	
Authentication	Production-ready	
Authorization	Production-ready	
Payment Security	Production-ready	
Input Validation	Production-ready	
Data Protection	Production-ready	
Infrastructure	Production-ready	

12.2 Rate Limiting

Comprehensive rate limiting protects all API endpoints:

- **Authentication endpoints** - Strict limits to prevent brute force
- **Sensitive operations** - Additional restrictions for high-risk actions
- **Payment endpoints** - Balanced limits for legitimate transactions
- **Public endpoints** - Higher limits for general access
- **Admin endpoints** - Appropriate limits for administrative functions

All rate limits use sliding window algorithms for fair enforcement.

12.3 Input Validation

- **Schema validation** - Type-safe runtime validation on all inputs

- **ORM parameterization** - Automatic SQL injection prevention
- **Whitelist validation** - Strict validation for enums and options
- **XSS prevention** - Automatic output escaping

12.4 Role-Based Access Control

Role	Level	Capabilities
USER	0	Watch, like, comment
CREATOR	1	Upload, earn, receive tips
MODERATOR	2	Moderate chat, manage users
ADMIN	3	Full platform access

12.5 Data Protection

Encryption at Rest:

- AES-256-GCM for sensitive data
- Industry-standard password hashing

GDPR Compliance:

- Right to Access: Account settings
- Right to Rectification: Profile updates
- Right to Erasure: Grace period deletion
- Data Anonymization: Complete PII removal

12.6 Security Headers

The platform implements comprehensive security headers:

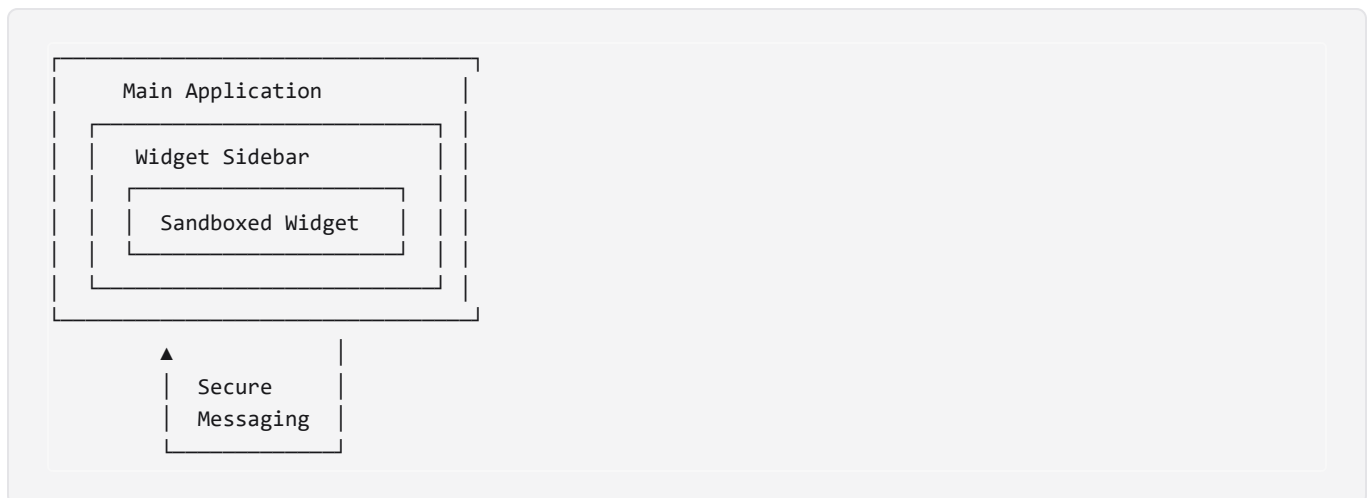
- Strict Transport Security (HSTS)

- Frame protection
- Content type enforcement
- XSS protection
- Content Security Policy
- Referrer control

13. Widget Ecosystem

13.1 Architecture

Widgets operate as a separate application embedded via sandboxed iframes:



13.2 Widget Types

Widget	Purpose	Content Type
Bio	Creator profile & links	All
Tip	USDC tips on Base	All
Embed	Custom content (Twitter, YouTube)	All
Card	Promotional poster with CTA button	All
Chat	Real-time messaging	Streams
Comments	Discussions	VOD
Rewards	Watch-to-earn ads	All
Interact	Polls & surveys	All
Director	Multi-camera switching controls	Multi-cam Streams

13.3 Security Measures

- CORS validation with origin whitelisting
- Short-lived authentication tokens
- Iframe sandboxing
- Message type validation
- Secure cross-origin communication

13.4 SDK Capabilities

The Widget SDK provides:

- Ready state signaling
- Event communication
- Message listening

- Authentication token management
- Authenticated API requests

14. Database Architecture

14.1 Schema Overview

The platform uses a comprehensive relational database schema:

Core Model Groups

Group	Purpose	
Authentication	User accounts, sessions, settings	
Content	Videos, streams, metadata	
Social	Follows, likes, comments, watchlist	
Payments	Transactions, entitlements, tips, payouts	
Chat	Messages, settings, moderation	
Ads	Campaigns, placements, tracking	
XP	Configuration, balances, transactions	
Multi-Camera	Multi-cam configs, angle streams	
Ticketing	Events, tiers, purchases, redemptions	
Billing	Usage tracking, tier management	

14.2 Key Models

User Model:

- Authentication data (EVM address, wallet source)
- Profile information
- Statistics and metrics
- Billing fields (Stripe, subscription tier)
- Preferences and settings

Video Model:

- Content metadata
- Delivery configuration
- Gating settings
- Analytics data

Stream Model:

- Stream configuration
- Status tracking
- Security settings
- Widget configuration

MultiCam Model:

- Parent stream reference
- Camera angle configuration
- Layout and switching preferences

TicketEvent Model:

- Event metadata and scheduling
- Linked stream reference
- Ticket tiers with pricing and inventory
- Purchase tracking and NFT minting status

14.3 Performance Optimization

- Strategic indexing on frequently queried fields
- Composite indexes for complex queries
- Query optimization for common access patterns

15. Performance & Scalability

15.1 Caching Strategy

Multi-Layer Caching:

Cache Type	Purpose	
Session Cache	Reduce authentication queries	
Concurrent Checks	Optimize limit enforcement	
User Profiles	Cache infrequently changing data	
Stream Metadata	Fast access to live data	
XP Tracking	Accurate reward calculations	

Performance Impact:

- Significant reduction in database queries
- Sub-10ms response times for cached data
- Graceful degradation when cache unavailable

15.2 Database Optimizations

- Connection pooling for efficient resource use
- Singleton client patterns
- Strategic indexing
- Query optimization

15.3 Client Optimizations

- Server-side rendering where beneficial
- Dynamic imports for code splitting
- Image optimization (WebP format)
- Infinite scroll with intersection observer

16. Technical Specifications

16.1 File Upload Limits

Type	Maximum Size	
Video Files	2 GB	
Thumbnails	10 MB	
Ad Creatives (Video)	100 MB	
Ad Creatives (Image)	5 MB	

16.2 Supported Video Formats

Extension	MIME Type	
.mp4	video/mp4 (recommended)	
.mov	video/quicktime	
.webm	video/webm	
.avi	video/x-msvideo	
.mkv	video/x-matroska	

16.3 Cooldown Systems

System	Duration	Scope	
Content XP (VOD)	24h	Per video/user	
Content XP (LIVE)	None	While broadcasting	
View Tracking	24h	Per video/user	
Ad Rewards	24h	Per campaign/user	

17. Glossary

Term	Definition
Airtime	Circuit's pay-by-the-minute access model — viewers authorize a bounded amount of USDC through an x402 payment channel and are charged only for watched time
Angle Stream	Individual camera feed within a multi-camera broadcast
Base	Coinbase's Ethereum Layer 2 rollout — Circuit's primary blockchain
Bootstrap Mode	Launch-phase XP setting that normalizes all viewer multipliers to 1.00x; database-configured exit thresholds
CDN	Content Delivery Network for global content distribution
CDP	Coinbase Developer Platform — social login with embedded EVM wallets
CDP Embedded Wallet	EVM wallet provisioned automatically through CDP via Google OAuth or Email OTP, authenticated by access-token validation
CircuitAirtimeRouter	Smart contract that settles Airtime pay-per-minute sessions and splits creator/platform shares on Base
CircuitPaymentSplitter	Smart contract for atomic USDC PPV payment splitting
CircuitTipSplitter	Smart contract for atomic USDC tip splitting
CircuitTicketSale	Smart contract for atomic USDC payment + ERC-721 ticket mint
Director	Real-time camera switching interface for multi-cam broadcasts
Entitlement	Access grant for gated content
ERC-3009	USDC "transfer with authorization" standard enabling a gasless, signed deposit into an Airtime channel
ERC-721	Non-fungible token standard used for ticket NFTs
ETH	Native Base chain currency, used for gas; historical tip records remain recoverable
HLS	HTTP Live Streaming protocol

Heartbeat	Periodic client-server ping for session maintenance
Multi-Cam	Multi-camera broadcast configuration with synchronized angle streams
PDT Sync	Program Date-Time synchronization for aligning multi-camera HLS streams
PPV	Pay-Per-View, one-time purchase model
Relay (Tips)	Historical ETH tip settlement model retained for already-issued record/verification/recovery; new issuance is disabled
RTMP	Real-Time Messaging Protocol — single-camera ingest over TCP 1935
SIWE	Sign-In with Ethereum (EIP-4361) authentication standard
Smart Wallet	Coinbase Smart Wallet — passkey-based EVM wallet, no extension required
SRT	Secure Reliable Transport — multi-camera ingest protocol over UDP 4200, lower latency and better packet recovery than RTMP
Ticket Event	Scheduled event with purchasable ticket tiers and atomic on-chain NFT minting
Token Gating	Access control via ERC-721 ownership or ERC-20/ETH balance verification
USDC	Circle-issued USD stablecoin on Base (6 decimals)
VOD	Video-on-Demand, pre-recorded content
x402	Payment-channel settlement standard on Base that underpins Airtime pay-by-minute billing
XP	Experience Points, platform reward currency

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