Boing Network — Technical Essentials

A technical companion to the plain-language BOING-NETWORK-ESSENTIALS.md. This page is for integrators, operators, and protocol readers who need accurate current facts without opening every deep spec.

Status: public **testnet** (chain **6913**) is live. **Mainnet (6914) is not live.** Tip and activation fields move — re-check live RPC before asserting a gate has crossed.

Deeper sources of truth (prefer these over copying prose from here):

Topic	Canonical doc
JSON-RPC methods, errors, probes	RPC-API-SPEC.md
Crypto, VM ISA, gas, QA rules, crates	TECHNICAL-SPECIFICATION.md
Shipped / gated / deferred timeline	FEATURES.md
Signed tx / block bincode	BOING-SIGNED-TRANSACTION-ENCODING.md
Env vars	ENVIRONMENT-VARIABLES.md
Static identity pointers	chain-metadata.json

1. Chain identity and architecture

Fact	Value
Public testnet chain id	**6913** (`0x1b01`) — *Boing Testnet*
Planned mainnet chain id	**6914** (`0x1b02`) — not live
Public RPC	`https://testnet-rpc.boing.network/`
Hosted node	Fly `boing-testnet-1` **only** (`boing-testnet-2` retired **2026-10-24**)
Bootnode	`/ip4/169.155.48.188/tcp/4001` — FLY-IO.md
Language / node	Rust `boing-node`
Hashing	**BLAKE3** (32-byte digests)
Signatures	**Ed25519** (64-byte sig; 32-byte pubkey = `AccountId`)
Consensus	**PoS + HotStuff BFT** (libp2p: TCP, Noise, gossipsub, request-response)
Execution	**Boing VM** only — custom stack ISA; not EVM / not another chain's bytecode
State	Sparse Merkle trees (account + per-contract storage); Verkle is a stated target

Addresses are **32-byte** hex (`0x` + 64 hex). Wallets and dApps must not treat chain **6913** as an EVM chain.

Signing domains (see encoding spec): transaction `BOING_TX_V2` ; priority tip `BOING_TX_PRIORITY` . Always decode with `SignedTransaction::from_bincode` / `Block::from_bincode` — zero tips and empty signature vectors are **omitted** on the wire.

2. Consensus and activation heights

Consensus is HotStuff-style BFT over a validator set. Public testnet day-to-day traffic often rides a **single hosted validator** path even though multi-validator MVP, stake-derived epochs, VRF leader election, and open registration exist in code/ops. Open validator registration activates when ops set the height (documented **400**). Equivocation reporting and related slash activation are gated (see table).

Selected activation heights on testnet 6913 (from FEATURES.md; tip was **1522** on a **2026-11-01** probe — re-verify):

Height	Feature	Notes
400	Open validator set	When ops env is set
640	`.boing` name registry	When ops env is set
1000	Height-1000 protocol rules	Crossed
1050	18-decimal native BOING	Crossed — NATIVE-DENOMINATION.md
1150	Native value on calls + opcodes `0x31` / `0x34` / `0x47` / `0xf2`	Crossed
1188	Micro fees (`execution_gas_fee_bps=100`)	Crossed
1200	Media blob Put/Announce admission	Live
1306	PHASE7 **256 MiB** blob consensus cap	Live
~1317	Phase 34 private-by-default ACL	Confirm on live `boing_getMediaBlobParams` / ACL fields
1500	Storage-tree v2 + account-tree v3 + VM hardening	**Crossed**
1600	Equivocation slash + strict JUMPI / NATIVE_TRANSFER reporting	**Gated** (tip < 1600 at last FEATURES probe)
1700	Canonical on-chain QA policy + public Unsure pool semantics	**Gated**
unset	Blake3 opcode `0x20` ; governance consensus txs 37–39; BLS committee flip	Off until env height set

Discovery: `boing_getNetworkInfo` / `boing_health` publish activation fields and `client_hints`. Do not invent heights — read the node.

3. Account and storage trees

Account leaf (global SMT) commits:

```
BLAKE3(balance_le || nonce_le || stake_le || code_hash || storage_root)
```

- `code_hash` = `BLAKE3(bytecode)` or zero; `storage_root` is the per-contract storage SMT (or zero).
- Parallel scheduling uses signed **access lists** (`read` / `write` `AccountId` s). Disjoint lists may run in the same batch; incomplete lists are unsafe.

Storage-tree v2 (testnet **H = 1500**): per-contract storage routes on **all 256 key bits** (fixes 64-bit prefix collision). See STORAGE-TREE-V2-ACTIVATION.md.

Account-tree v3 (same **H = 1500**): account routing uses full 256-bit ids. See ACCOUNT-TREE-V3-ACTIVATION.md.

Mainnet defaults remain unset until an announced height. Clients that recompute roots must switch routing when `height >=` the published activation fields.

4. VM and opcodes (highlights)

Boing VM is a deterministic stack machine (`boing-execution`). Full opcode table, gas, and well-formedness rules: TECHNICAL-SPECIFICATION.md §7–8.

Notable families:

Area	Examples
Arithmetic / bitwise	`ADD` … `MULMOD`, `LT` / `GT` / `EQ`, shifts, `AND` / `OR` / `XOR`
Context	`ADDRESS`, `CALLER`, `BLOCKHEIGHT`, `TIMESTAMP`
Memory / storage	`MLOAD` / `MSTORE`, `SLOAD` / `SSTORE`
Control	`JUMP` / `JUMPI`, `PUSH*`, `RETURN` / `STOP`
Calls / create	`CALL` (`0xf1`), `CREATE2` (`0xf5`); optional deploy init marker `0xFD`
Logs	`LOG0` – `LOG4`
Native value (from **1150**)	`BALANCE` `0x31`, `CALLVALUE` `0x34`, `SELFBALANCE` `0x47`, `NATIVE_TRANSFER` `0xf2`
Blake3 `0x20`	Memory-range hash; **gated** by `BOING_VM_BLAKE3_OPCODE_ACTIVATION_HEIGHT` (unset = never; invalid before activation)

Hardening at **1500** includes init-code QA, memory gas, stack depth **1024**. Strict JUMPI and oversized `NATIVE_TRANSFER` reporting activate at **1600**.

Bytecode size cap (QA): **32 KiB**. Contract call interpreter budget: **`GAS_PER_CONTRACT_CALL = 40_000_000`** (fee uses actual `gas_used`).

5. Native denomination and fees

- **1 BOING = 10^{18}** base units (`u128` on ledger; **decimal strings** on RPC).
- Testnet **6913**: whole-BOING below height **1050**; base units from **1050** (NATIVE-DENOMINATION.md).
- Gas price constant: **10^{12}** base units per gas (= **0.000001 BOING/gas**) before micro BPS.
- Fee market v1 (OPTIONAL-PRIORITY-FEES.md): recommended **`execution_gas_fee_bps = 100`** → ≈ **0.00021 BOING** per 21k transfer (active from **1188** on public testnet). Optional `priority_tip` for ordering; tips default to the proposer.
- Blob / Forever pin fees are **independent** of execution-gas BPS.

`boing_getNetworkInfo.native_currency` and fee policy fields are authoritative for live formatting and BPS.

6. Quality gate and public pool

Protocol QA screens **deploy** bytecode (and related metadata) before it lands on the ledger: **Allow / Reject / Unsure**.

- Preflight: `boing_qaCheck`. Structured rejection codes for wallets/UIs.
- Rule catalog and opcode whitelist: QA-GATE-RULES.md; product narrative: QUALITY-ASSURANCE-NETWORK.md.
- Live registry lists on public RPC are often empty / size-capped until policy is applied — query `boing_getQaRegistry`.
- **Canonical on-chain QA policy** and **public Unsure review pool** semantics: gated at height **1700** (`testnet-v0.1.23` / `0.1.24` era). Until that height, do not claim the public pool is live on tip.

Governance of rule lists via time-lock remains partial / roadmap — see FEATURES and BUILD-ROADMAP.

7. RPC surface (highlights)

Authoritative method list: RPC-API-SPEC.md (unit-tested against `BOING_RPC_SUPPORTED_METHODS`). JSON-RPC 2.0 over HTTP POST (default node port **8545**). Same listener: `GET /live`, `/ready`, `/openapi.json`, `/.well-known/boing-rpc`, `GET /ws` (newHeads).

Integrator-relevant groups:

Group	Examples
Health / discovery	`boing_health`, `boing_getNetworkInfo` (`client_hints`, activation heights, `developer.dex_discovery_methods`, `end_user` native DEX ids)
Chain reads	`boing_getBlockByHeight` / `ByHash` (prefer `include_code: false` for slim stubs), account/balance, receipts
Submit / simulate	`boing_submitTransaction`, `boing_simulateTransaction`, `boing_simulateContractCall`
QA	`boing_qaCheck`, registry getters
DEX discovery	`boing_listDexPools`, `boing_listDexTokens`, `boing_getDexToken`
Tokens	`boing_getTokenMetadata`, `boing_listTokens`
Media blobs	Put/announce/ACL suite incl. `boing_getBlobAccess` — see media section
Operator	Fail-closed without `BOING_OPERATOR_RPC_TOKEN` (`-32057`)

Public gateway and explorer proxies cap JSON bodies (≈ **6 MiB**) and reject truncated bodies. Browser apps need correct **CORS** (or same-origin proxy). Node listing for portals: NETWORKS-API.md (`GET /api/networks`).

8. L1 media blobs

Phases **1–33** live; Put/Announce admission from height **1200**. **PHASE7 256 MiB** consensus cap active from **1306**. Phase **34** download ACL (Grant/Revoke) is shipped; private-by-default activation around **1317** should be confirmed on live params.

- Separate **blob fee path** — not account `SSTORE`.
- Block JSON: byte fields as `0x` **hex**; large vectors stubbed when `include_code: false`.
- PutBlob **publish sessions** (`boing_requestPutBlobSession`) are **Express-side**, not node RPC.
- Download: wallet proof (publisher / ACL grantee) primary; operator / token override paths documented in HANDOFF_BLOB_DOWNLOAD_ACL.md. Explorer streams via `/api/blob/download`.
- Deferred / not wired for product claims: Phase **34.1** capability tickets; real ReservedRealV1 DAS verification; practical multi-hundred-MiB non-inline Put plane.

Full protocol: BOING-L1-MEDIA-BLOBS.md.

9. Native DEX and CP pool discovery

Boing's native constant-product AMM, factory, routers, and LP vaults are **Boing VM contracts** (selectors / CREATE2 salts in NATIVE-AMM-CALLDATA.md and related NATIVE-DEX-* docs). Capability overview: BOING-NATIVE-DEX-CAPABILITY.md.

Discovery layers (merge for pickers/labels; prefer live RPC):

1. **L1 RPC** — `boing_listDexPools` / `boing_listDexTokens` / `boing_getDexToken`; method names also under `boing_getNetworkInfo.developer.dex_discovery_methods`.
2. **`end_user`** — published canonical factory / default CP pool ids (ops freeze documented; re-read live `end_user`).
3. **Indexer / directory Worker** — HANDOFF_NATIVE_DEX_DIRECTORY_R2_AND_CHAIN.md (`workers/native-dex-indexer`, `/v1/directory/*`).
4. **Hydrated pool venue metadata** — Finance / SDK merge for UI labels.

Product orientation: Finance **Swap** targets the network default CP pool; additional factory pairs and multihop sit behind **Pools** / Smart route. Planet-scale subgraph / OBS-1 history remains deferred / partial.

SDK: **`@boing-network/boing-sdk@^0.5.38`** (npm; not unscoped `boing-sdk`). Tutorial bootstrap: `examples/native-boing-tutorial/scripts/` (operators run against live RPC; node does **not** auto-create pools on start).

10. Product surfaces (SDK / Express / Finance / Observer)

Surface	Role	Technical notes
@boing-network/boing-sdk	TypeScript client	Recommended **0.5.38**; signing, RPC helpers, blob ACL APIs; rebuild `dist/` after local SDK edits
Boing Express	Wallet	Recommended **0.1.24** (`client_hints` ; min advisory **0.1.18**); `window.boing` ; PutBlob publish sessions; v2 signing + tips
Boing Finance	Swaps / pools / tokens / NFTs	Native VM `AccountId` s in `contracts.js` / env — not EVM addresses on 6913
Boing Observer	Explorer	Public testnet RPC; same-origin `/api/rpc` ; slim blocks; QA / activation visibility
Website / faucet	Docs, join, faucet	boing.network

Integration entry: BOING-DAPP-INTEGRATION.md. Wallet product detail: BOING-EXPRESS-WALLET.md. Explorer + wallet split: BOING-OBSERVER-AND-EXPRESS.md.

11. Operations (Fly and public RPC)

Item	Detail
Hosted validator/RPC	Fly app `boing-testnet-1` — FLY-IO.md
Public hostname	Cloudflare Worker `workers/public-rpc-gateway` → Fly; **do not** point `testnet-rpc.boing.network` at a home tunnel
Chain env on public node	`BOING_CHAIN_ID=6913`, `BOING_CHAIN_NAME=Boing Testnet` — templates under `tools/boing-node-public-testnet.*`
Operator auth	Required for operator methods; **mainnet 6914** refuses start without token and refuses `--faucet-enable`
Day-2 ops	TESTNET-RPC-INFRA.md, RUNBOOK.md, PUBLIC-RPC-NODE-UPGRADE-CHECKLIST.md
WAF / edge	PUBLIC-RPC-WAF-GUIDANCE.md

Upgrading a personal laptop node does **not** change public explorer or gateway behavior.

12. Governance and deferred items

Shipped / available (with caveats): operator governance RPC (propose / vote / cooling / execute) against node-local state; stake-weighted quorum (`strict_quorum`); open validator registration when height env is set.

Gated / deferred (do not claim live on tip without checking):

- Heights **1600** / **1700** features (see §2).
- Env-gated until set: Blake3 opcode, governance consensus txs **37–39**, BLS media committee flip, mainnet tree activations.
- AdvanceExecution / Execute as consensus wire; BLS ballots — out of scope per governance activation docs.
- DHT / WebRTC / incentivized relays; light clients; bridges; mainnet launch.
- Incentivized testnet rewards program (not currently running). Framing: BOING-TOKENOMICS-AND-INCENTIVIZED-TESTNET.md; draft tables: BOING-INITIAL-TOKENOMICS.md.
- Durable planet-scale Observer (OBS-1) and full DEX subgraph history.

Plans and backlog: GOVERNANCE-CONSENSUS-TX-ACTIVATION.md, BUILD-ROADMAP.md, NEXT-STEPS-FUTURE-WORK.md, FEATURES.md “Explicitly not yet”.

Quick links

I want…	Go here
Plain-language overview	BOING-NETWORK-ESSENTIALS.md · PDF
Whitepaper	BOING-NETWORK-WHITEPAPER.md · PDF
Full RPC catalog	RPC-API-SPEC.md · PDF
VM / crypto / gas	TECHNICAL-SPECIFICATION.md
What shipped when	FEATURES.md · PDF
Tx encoding	BOING-SIGNED-TRANSACTION-ENCODING.md
Run / upgrade a node	RUNBOOK.md · FLY-IO.md
Docs map	README.md

Boing Network — Quality, enforced by the protocol.
Aligned with FEATURES / live RPC probe facts as of 2026-11-01; re-check tip and activation fields before asserting later gates.