

BlueDot Quantum IPoE BNG

Features — Data Plane & Control Plane

The feature summary for the BlueDot Quantum IPoE BNG, and the companion to the Theory of Operations. Every capability under Data Plane, Control Plane, and Management ships and runs in this Community Edition Alpha; planned additions are gathered under Coming Next.

Document Type	BlueDot Feature Summary
Component	Quantum IPoE BNG (IPv4, Phase 1)
Edition	Community Edition — Alpha
Audience	ISP Operators, NOC & Technical Evaluators
Companion To	Quantum IPoE BNG — Theory of Operations
Source Tree	<code>ipoe/bng</code> (<code>main</code>)
Classification	BlueDot Proprietary
Date	July 2026

Every item below is implemented and running in this build. Designed-but-not-yet-shipping capabilities are listed only under Coming Next.

Data Plane Features

Forwarding & Identity

- L3-routed IPoE forwarding (/32 in FIB)
- IP-keyed sessions (framed IP)
- Anti-spoof source-IP guard
- Shared edge-router next hop
- Deny-by-default forwarding

Rate Limiting & QoS

- RFC 2698 two-rate three-colour policing
- Per-direction CIR/PIR (up + down)
- Green / yellow / red colouring
- Per-subscriber colour × direction counters
- Node-wide QoS band counters
- Zero-burst-safe policer

Filtering & Interception

- Captive walled-garden filter (DNS/HTTP/HTTPS)
- DHCP intercept & punt

Data-Plane Platform

- Userspace VPP on DPDK
- Access + core/uplink NICs (Intel E810)
- Multi-worker-correct counters
- Bulk counter RPC
- Duplicate-address protection

Control Plane Features

Subscriber Lifecycle

- Five-state session machine
- Live re-rate (no re-DHCP)
- Operator disconnect / revoke / activate
- Standard RFC 2866 terminate causes

Embedded DHCP & Addressing

- Embedded DHCPv4 server
- CIDR pools, first-free allocation
- Option 82 identity (circuit / remote-id)
- giaddr topology pool selection
- Infrastructure-IP reservation
- Retransmit-safe onboarding
- Pool-driven leases

Authentication & Service Plans

- Local AAA provider (open + gated)
- Per-line subscriber records API
- Local plan catalog (named plans)
- Default-plan guarantee (never unpoliced)
- Captive re-auth on activation

Captive Portal & Prepaid

- Walled-garden onboarding
- Portal-only DNS steering
- Prepaid expiry → captive (keeps IP)
- Activate endpoint (top-up)

Accounting

- Start / Interim / Stop orchestration
- Counter refresh before final record
- Stable Acct-Session-Id
- Restart-safe counter pre-load

Timers & Scale

- Batched interim loop ("tickler")
- Counter-derived idle detection
- Batched teardown cascade
- One-shot offer / lease timers

Persistence & Recovery

- Durable SQLite session state
- Timer rebuild from timestamps
- Three recovery modes
- Clean stale-session close
- Config & keys preserved on upgrade

Configuration & Integration

- Ownership-split config (file vs API)
- Poll-over-push integration
- Role-based API-key auth
- Audit log of mutating calls

Management, Platform & Roadmap

Management & Observability

- Versioned REST API (`/v1/bng/*`)
- OpenAPI spec + ReDoc reference
- Single-status health rollup (ok / degraded / fault)
- Accounting read path (`/bng/sessions`)
- Telemetry read path (`/bng/counters`)
- Live pool / plan / router config API
- Rotating JSON audit log

Platform & Capacities

- IPoE, IPv4
- RFC 2698 policing (per sub, per direction)
- VPP / DPDK userspace data plane
- Commodity x86 (Dell R360-class)
- Intel E810-class NICs
- Ubuntu 24.04 / kernel 6.14 / x86_64
- ~100k subs/node target; validated to 10k
- Horizontal scaling (add nodes)
- Community Edition session cap

Coming Next

- Production RADIUS client (sockets, failover, CoA)
- RADIUS accounting on the wire (gigawords, Class)
- PEN 65664 QoS vendor attributes + Filter-Id
- Prometheus `/metrics` + JSON app logs
- DSCP remarking (out-of-contract)
- IPv6 / dual-stack (DHCPv6, PD)
- Per-worker session tables (~400–500k)
- Paid license tiers

Scope & Caveats

- IPoE only (no PPPoE / 802.1X)
- L3-routed access, no per-sub VLAN / QinQ
- Policing, not shaping (no AQM)
- Pull-based telemetry (SNMP is an add-on)
- No hard data-plane volume cap
- Local AAA this build (RADIUS deferred)
- IPv4 only

Prepared from the BlueDot Quantum IPoE BNG source tree (`ipoe/bng` , `main`). Field-level request/response shapes are authoritative in the generated OpenAPI spec and the source. © 2026 BlueDot Insight LLC. BlueDot Proprietary.