LayerZero - The Journey of a Cross-Chain Message (V2)

Universal Postal Service of Blockchains

How a LayerZero message travels: send → verify → commit → deliver

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Overview

- Short presentation of LayerZero's cross-chain message journey
- Structured like slides with accompanying speaker notes

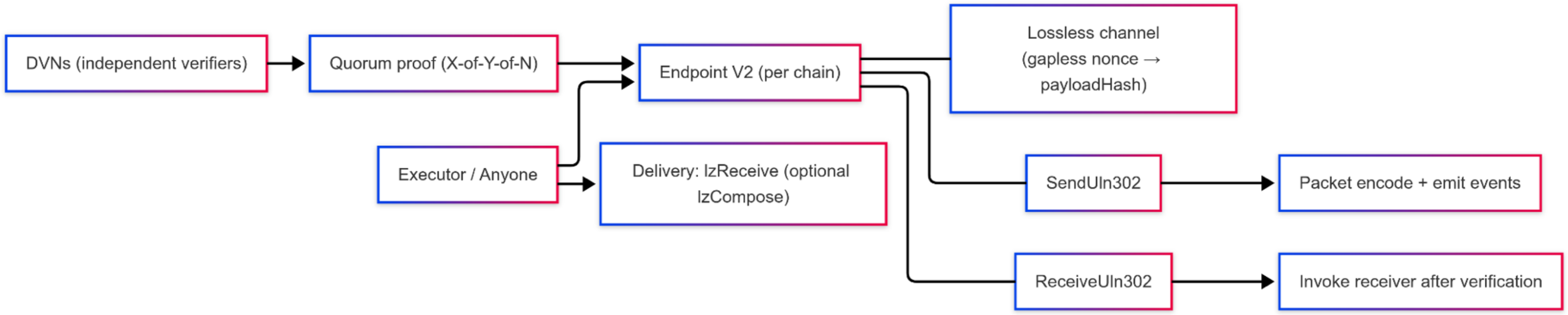
Learning Intentions & Success Criteria

- Learning Intentions
  - Understand LayerZero V2's secure cross-chain flow
  - Trace send → verify → commit → deliver
  - Know roles: Endpoint, Libraries, DVNs, Executors, OApp
- Success Criteria
  - Narrate the journey like a parcel abroad
  - Explain who does what and why it's permissionless
  - Choose sane options and DVN quorums

LayerZero — A Universal Postal Service for Blockchains

- Chains = countries (VM, consensus, gas)
- Endpoint V2 = post office (per chain)
- DVNs = independent inspectors (off-chain)
- Quorum proof = customs stamp bundle (on-chain)
- Executor/anyone = courier (last-mile delivery)

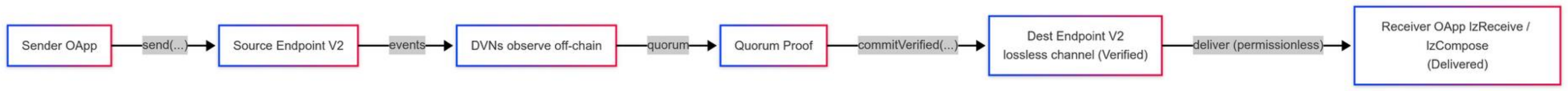
The Cast (LayerZero V2 Components)


DVNs (independent verifiers)
Quorum proof (X-of-Y-of-N)
Endpoint V2 (per chain)
Executor / Anyone
Delivery: lzReceive (optional lzCompose)
Lossless channel (gapless nonce → payloadHash)
SendUln302
Packet encode + emit events
ReceiveUln302
Invoke receiver after verification

Components (at a glance)

- Endpoint V2 (immutable)
  - Lossless channel: gapless nonces + payloadHash; audit-friendly
- Message Libraries (SendUln302 / ReceiveUln302)
  - Standardize packets; route options to off-chain executors
- Message Send Library
  - Encode outbound packet; quote fees from options; emit events for DVNs/executors
- Message Receive Library
  - Decode inbound packet; enforce DVN quorum; commit verified nonce→payloadHash
- DVNs
  - Independent verifiers; you choose quorum (X-of-Y-of-N)
- Executor / Anyone
  - Funds gas; triggers delivery to your app
- Your OApp
  - Knows endpoint + trusted peers (EIDs); implements _lzReceive(...)

The Message Journey (Source → Destination)



Step 1 — Prepare & Post (Source)

- Sender OApp calls Endpoint.send(MessagingParams)
- Endpoint stamps GUID + increments pathway nonce
- Send library encodes packet; emits events (DVNs/executors watch)
- GUID = global tracking, Nonce = per-pathway ordering

Step 2 — Customs Inspection (DVNs, off-chain)

- DVNs independently observe the source chain
- Each attests the payloadHash
- When quorum is met, a quorum proof exists

Step 3 — Customs Check-in (Destination)

- Anyone submits the quorum proof to Endpoint to `commitVerified`
- Receive library enforces DVN config and thresholds
- Endpoint records verified nonce → payloadHash in lossless channel
- Status: Verified (eligible for delivery)

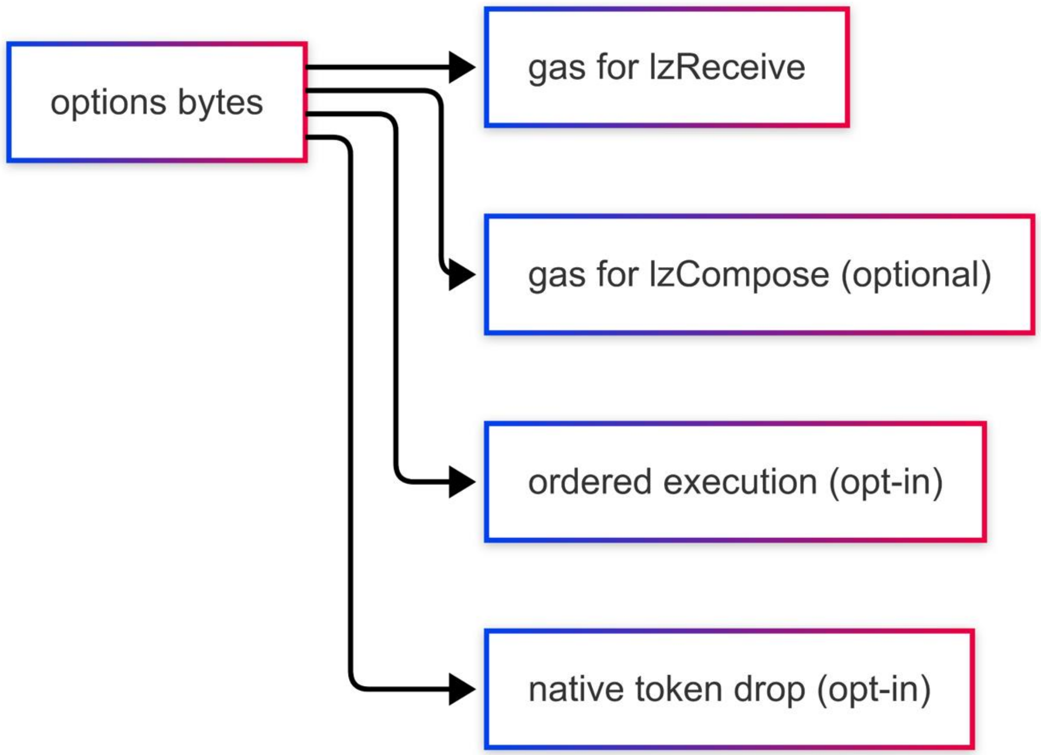
Step 4 — Last-Mile Delivery (Destination)

- Anyone funds gas/value to deliver
- Endpoint invokes receiver’s `lzReceive(...)` → your `_lzReceive(...)`
- If options included follow-ups, Endpoint later calls `lzCompose(...)`
- Status: Delivered (app logic executed)

Step 5 — Ordering

- Default (lazy): failed n doesn’t block n+1 once both are verified
- Strict FIFO (opt-in): ordered execution in options holds n+1 until n executes

Options = Your Handling Instructions


options bytes
gas for lzReceive
gas for lzCompose (optional)
ordered execution (opt-in)
native token drop (opt-in)

Properties (why the LayerZero network works)

- Exactly-once per pathway
  - Gapless nonces + payloadHash in lossless channel; clean audit trail
- Censorship-resistant
  - DVN quorum + permissionless commitVerified and delivery
- Operationally resilient
  - Executors are replaceable; anyone can retry with more gas/options
- Simple control surface
  - `options` tunes gas, ordering, native drops, compose

Receiver Gatekeeping (who can ring the doorbell?)

```
function lzReceive(
  Origin calldata _origin,
  bytes32 _guid,
  bytes calldata _message,
  address _executor,
  bytes calldata _extraData
) public payable {
  if (address(endpoint) != msg.sender) revert
OnlyEndpoint(msg.sender);
  if (_getPeerOrRevert(_origin.srcEid) != _origin.sender) revert
OnlyPeer(_origin.srcEid, _origin.sender);
  _lzReceive(_origin, _guid, _message, _executor, _extraData);
}
```

Quick FAQ

- Is there a relayer?
  - In V2 it’s split: DVNs verify; Executors (or anyone) deliver.
- Who contacts DVNs?
  - No one—DVNs watch; a third party submits the quorum proof on the destination chain.
- Why permissionless delivery?
  - Removes last-mile chokepoints; anyone can retry.
- When to enable strict ordering?
  - When business logic needs FIFO; default lazy aids liveness.

References

- LayerZero Docs — https://docs.layerzero.network/v2
- Sample Examples — https://github.com/LayerZero-Labs/devtools/tree/main/examples

Thank you

- https://layerzero.network/