Nodes

A **node** (`merod`) is the core runtime that orchestrates synchronization, event handling, and blob distribution across a distributed network of peers. It wraps the DAG with WASM execution, networking, and lifecycle management.

What Nodes Do

Core Responsibilities:

1. **Delta Management**: Apply deltas to WASM state in correct causal order
2. **Network Coordination**: Gossipsub broadcasts + P2P sync streams
3. **Event Execution**: Trigger event handlers on receiving nodes
4. **Blob Distribution**: Content-addressed file sharing
5. **Resource Management**: Memory limits, cleanup, garbage collection

Node Types

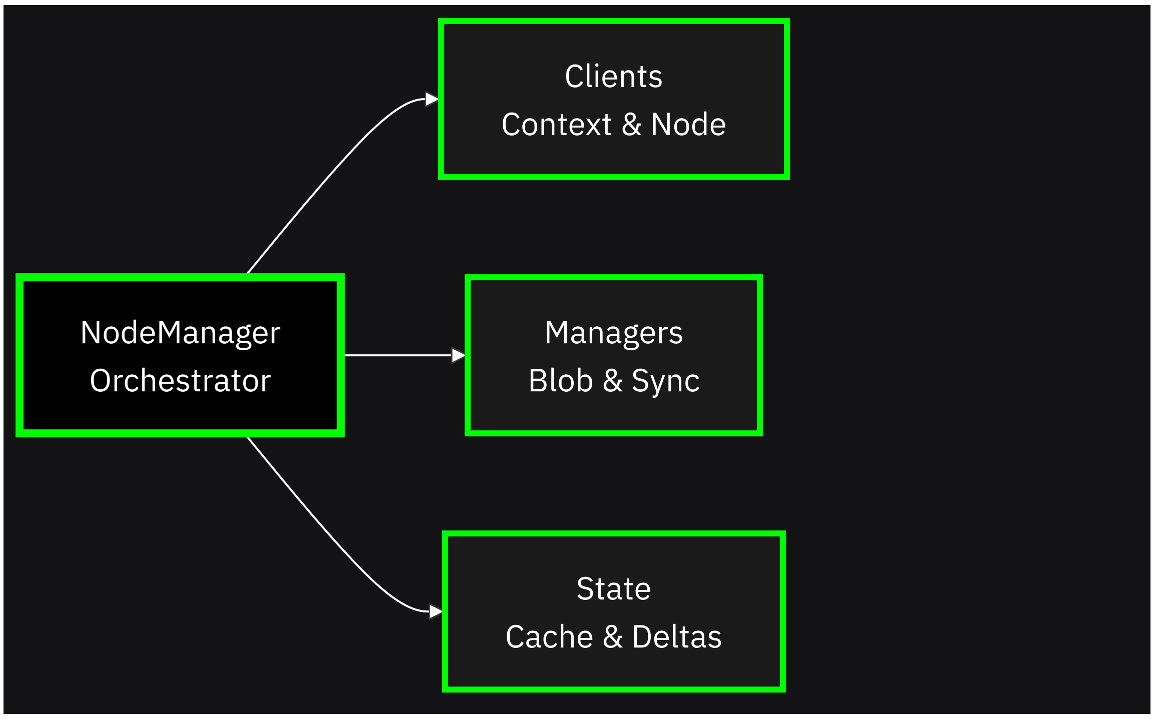
Coordinator Node

- First node in a network
- Handles initial context creation and bootstrap
- Can serve as entry point for new peers

Peer Node

- Joins existing network
- Connects to coordinator or other peers
- Participates in P2P mesh

Node Architecture



Components

- **NodeManager**: Orchestrates sync, events, lifecycle, periodic timers
- **NodeClients**: ContextClient (WASM execution), NodeClient (P2P operations)
- **NodeManagers**: BlobManager (content storage), SyncManager (periodic sync)
- **NodeState**: Blob cache, delta stores per context

See `core/crates/node/README.md` for detailed architecture.

Synchronization

Nodes use dual-path sync:

- **Gossipsub** (~100-200ms) - Fast real-time broadcast
- **Periodic P2P** (every 10-30s) - Catch-up and recovery

See Architecture Overview for sync flow diagrams.

Event Handling

When deltas are applied:

1. Author node skips handlers (local UI already updated)
2. Peer nodes execute handlers automatically

3. Events propagate via DAG causal ordering

Blob Distribution

Content-addressed blob storage:

- Blobs stored by hash (blob ID)
- LRU cache with eviction (5 min or 100 blobs / 500 MB)
- P2P distribution via streams
- Periodic garbage collection

See `core/crates/node/README.md` for blob management details.

Admin Surfaces

JSON-RPC (port 2528):

- `/jsonrpc` - RPC calls

WebSocket (`/ws`):

- Real-time subscriptions (deltas, events, state changes)
- JSON-RPC over WebSocket

SSE (`/sse`):

- Alternative to WebSocket for event streaming
- Browser-friendly real-time updates

Admin API (`/admin-api/`):

- Node administration, context management, identity operations
- JWT token authentication

See `core/crates/server/README.md` for API details.

Monitoring & Debugging

Key metrics and logs:

- **DAG stats**: Pending deltas, applied deltas, DAG heads per context
- **Network stats**: Peer count, Gossipsub mesh health, P2P stream activity

- **Performance**: Delta application latency, sync duration, memory usage
- **Events**: Event handler execution, errors, warnings

See Monitor & Debug for detailed guidance.

Configuration

Nodes can be configured via:

- **Command-line flags**: `--swarm-addrs`, `--config`
- **Configuration file**: TOML file with network, storage, runtime settings
- **Environment variables**: Override specific settings

Deep Dives

For detailed node documentation:

- **Node Architecture**: `core/crates/node/readme/architecture.md` - Complete system design
- **Sync Configuration**: `core/crates/node/readme/sync-configuration.md` - Tuning parameters
- **Event Handling**: `core/crates/node/readme/event-handling.md` - Event flow and handlers
- **Troubleshooting**: `core/crates/node/readme/troubleshooting.md` - Common issues

Related Topics

- Run a Local Network - Getting started with nodes
- Architecture Overview - How nodes fit into the system
- Contexts - Application instances managed by nodes