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Blockchain (BlCh)

Holochain

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Introduction to Holochain

- What is Holochain?
  - Distributed computing framework
  - Peer-to-peer applications without central servers
  - Agent-centric architecture where user owns their data and agency
  - Cryptographic data integrity without global consensus
  - Efficiency through local validation and shared responsibility
- Key principle: "Think Local, Act Global" - act autonomously while contributing to the collective
  - Built for human-centric applications and collaboration

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Holochain vs. Blockchain

- Traditional Blockchain
  - Requires global consensus for every transaction
  - Single shared ledger as source of truth
  - High energy consumption due to mining/validation
  - Native tokens required for network operation
  - Limited scalability due to consensus overhead

- Holochain
  - Local validation with cryptographic integrity
  - Individual source chains + shared DHT
  - Energy efficient - runs on basic devices
  - No native tokens required for operation - HOT?
  - Naturally scalable through agent-centric design
  - Optional value systems per application

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Core Architecture

- Source Chains:
  - Individual append-only ledger per agent
  - Cryptographically signed entries and actions
  - Immutable history of all agent activities
  - Private and public data management
  - Local validation of all entries
- Distributed Hash Table (DHT):
  - Shared data space across the network
  - Content-addressable storage system
  - Peer-to-peer data discovery
  - Redundant data storage via neighborhoods
  - Metadata and links for data relationships
- Validation Architecture:
  - Two-step validation process:
    - Local validation via source chain
    - DHT validation by network peers
  - DNA-defined validation rules
  - Automatic detection of invalid data
  - Collective network immunity system

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Technical Implementation Details

- DNA (Application Logic):
  - Entry Types & Validation Rules
  - Integrity Zomes
    - Data schemas
    - Validation functions
  - Coordinator Zomes
  - Business logic
  - API functions
  - Data operations
- Conductor
  - Core Runtime Environment
    - Cell Management
      - DNA + Agent ID combinations
      - State management
      - Source chain operations
    - Networking
      - DHT operations
      - Peer discovery
      - P2P communications
  - API Layer
    - Admin API
    - App Interface API
    - WebAssembly Interface
    - RPC Interface

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Data Integrity & Validation Architecture

- Agent-Centric Security:
  - Individual source chains with cryptographic control
  - Private/public key infrastructure for data ownership
  - Digital signatures ensure authorship authenticity
  - Local data sovereignty with selective sharing
  - Multi-Layer Validation System:
    - 1) Source Chain Validation
      - Entry format verification
      - Hash chain integrity
      - Chronological consistency
      - Signature verification
    - 2) DHT Validation
      - Distributed validation by authorities
      - Redundant data storage
      - Warrant system for invalid data
      - Network immune system
    - 3) Application Rules
      - DNA-defined validation rules
      - Custom business logic
      - Data format specifications
      - Relationship constraints

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Holochain Use Cases & Application Patterns

[sources 1, 2, 3]

- Distributed Data Management:
  - Document management systems
  - Version control applications
  - Collaborative content creation
- Communication & Social:
  - Peer-to-peer messaging
  - Social networks
  - Team collaboration tools
- Supply Chain & Business:
  - Supply chain tracking
  - Asset management
  - Asset management
  - Audit trails
  - Certification systems
- Identity & Access:
  - Decentralized identity systems
  - Access management
  - Credential verification
  - Reputation systems
- Custom Value Systems:
  - Community currencies
  - Resource sharing networks
  - Mutual credit systems

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Development & Implementation

- Rust-based development
- WebAssembly compilation
- HDK (Holochain Development Kit)
- Testing frameworks
- Community resources

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