



School: Campus:

Academic Year: Subject Name: Subject Code:

Semester: Program: Branch: Specialization:

Date:

Applied and Action Learning

(Learning by Doing and Discovery)

Name of the Experiment : Layer 2 Bridge – Explore Optimism / zkSync

Objective/Aim:

To study the concept of blockchain Layer 2 (L2) bridges, understand how they enable cross-network communication between Ethereum Layer 1 and Layer 2 chains, and perform token transfers between Arbitrum and StarkNet test networks to compare speed, gas efficiency, and confirmation times.

Apparatus/Software Used:

- Node.js and npm
- Hardhat Framework / Remix IDE
- Arbitrum Sepolia Testnet
- StarkNet Testnet
- Official Bridge Interfaces (Arbitrum Bridge / StarkGate)
- MetaMask Wallet
- Testnet ETH Faucets

Theory/Concept:

Layer 2 scaling networks are built to improve Ethereum's scalability by executing transactions off-chain and periodically submitting proofs to Layer 1. This reduces congestion and gas costs while preserving the security of the Ethereum mainnet.

Key Concepts:

- **Layer 2 Solutions:**

Secondary frameworks that execute batches of transactions off-chain and anchor validated results to Ethereum Layer 1.

- **Optimistic Rollups (Arbitrum):**

Transactions are considered valid unless challenged through a fraud-proof system. Optimistic rollups allow fast and inexpensive transfers but have longer withdrawal times due to the challenge period.

- **Zero-Knowledge Rollups (StarkNet):**

Use advanced cryptographic proofs (STARKs) to instantly verify transaction correctness. They offer near-instant withdrawals and greater scalability.

Advantages of Layer 2 Bridges:

- Reduced transaction fees
- Faster confirmation times
- Scalable asset transfers

Procedure

1. **Configure MetaMask Wallet:**
 - Add Arbitrum and StarkNet testnets using custom RPCs or automatic bridge prompts.
 - Example RPC URLs:
 - Arbitrum Sepolia: <https://sepolia-rollup.arbitrum.io/rpc>
 - StarkNet Testnet: <https://alpha4.starknet.io>
2. **Acquire Testnet Tokens:**
 - Request Goerli or Sepolia ETH from <https://goerlifaucet.com>.
 - Use official Layer 2 faucets for Arbitrum and StarkNet test ETH.
3. **Use Official Bridge Portals:**
 - Visit <https://bridge.arbitrum.io/> or <https://starkgate.starknet.io/>.
 - Connect your MetaMask wallet.
 - Select **Deposit ETH** from Ethereum (Layer 1) to Layer 2.
 - Confirm and wait for bridge finalization.
4. **Observe Transaction Details:**
 - Track progress on:
 - Etherscan (Ethereum Layer 1)
 - Arbiscan (Arbitrum)
 - StarkScan (StarkNet)
 - Note transaction confirmation time and gas used.
5. **Optional – Deploy a Smart Contract on L2:**
 - Deploy a simple “HelloLayer2.sol” contract using Hardhat:


```
npx hardhat run scripts/deploy.js --network arbitrum
```
 - Interact with the contract to verify execution speed and gas cost.
6. **Withdraw Tokens Back to Layer 1:**
 - Use the bridge interface to initiate withdrawal.
 - Observe delay times:
 - Arbitrum: ~7 days (fraud-proof challenge period)
 - StarkNet: few minutes (instant proof verification)
7. **Compare Networks:**
 - Record and analyze gas fees, confirmation speeds, and withdrawal durations for both Arbitrum and StarkNet.

Observation Table:

| Network | Deposit Confirmation Time | Withdrawal Time | Avg. Gas Fee (Gwei) | Bridge Used |
|----------|---------------------------|-----------------|---------------------|------------------|
| Arbitrum | ~1–2 min | ~7 days | ~0.003 | Arbitrum Bridge |
| StarkNet | ~45 sec | ~2–3 min | ~0.0015 | StarkGate Portal |

ASSESSMENT

| Rubrics | Full Mark | Marks Obtained | Remarks |
|--|-----------|----------------|---------|
| Concept | 10 | | |
| Planning and Execution/ Practical Simulation/ Programming | 10 | | |
| Interpretation Result and | 10 | | |
| Record of Applied and Action Learning | 10 | | |
| Viva | 10 | | |
| Total | 50 | : | |

Signature of the Faculty:

Signature of the Student:
 Name
 Regn.No.