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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 Experiement : Layer 2 Bridge – Explore Optimism/zkSync

Objective/Aim:

To understand and demonstrate Layer-2 blockchain bridging by transferring assets between Ethereum Mainnet and Layer-2 solutions such as Optimism or zkSync, exploring how bridges improve scalability, transaction speed, and reduce gas costs.

Apparatus/Software Used:

- VS Code – for coding and configuration
- Hardhat / Remix IDE – for compiling and deploying contracts
- MetaMask – wallet to connect to different networks
- RPC URLs (for BSC Testnet / Polygon Testnet)
- Node.js & npm – for package management
- Infura / Alchemy / Ankr – RPC providers

Theory:

Layer 2 Concept:

Layer 2 (L2) solutions are built **on top of Ethereum** to scale the network by handling transactions off-chain and periodically submitting proofs to Layer 1 (Ethereum).

They maintain **security via Ethereum** but achieve **speed and low cost** through optimized execution models.

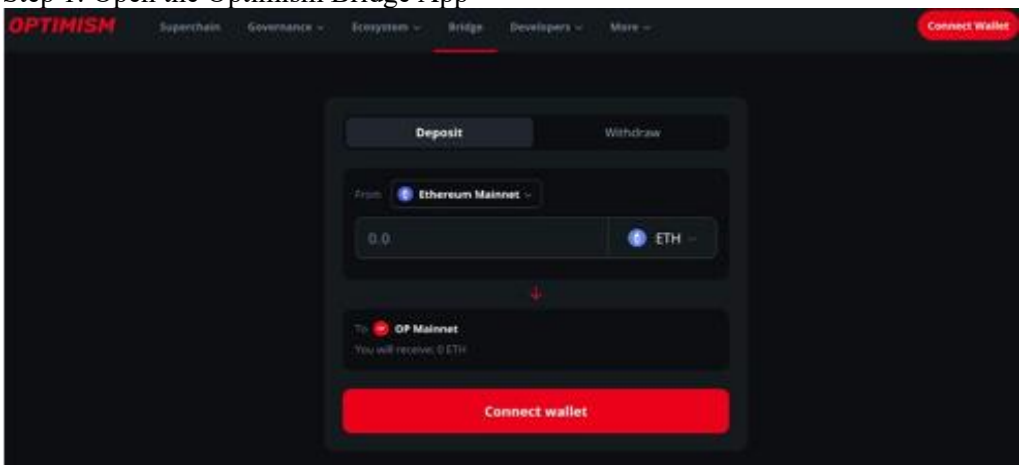
Layer Type	Examples	Mechanism	Advantage
Optimistic Rollup	Optimism, Arbitrum	Assume transactions are valid unless challenged	Low cost, high throughput
Zero-Knowledge Rollup	zkSync, StarkNet	Use cryptographic proofs (SNARKs)	Fast finality, strong security

Procedure:

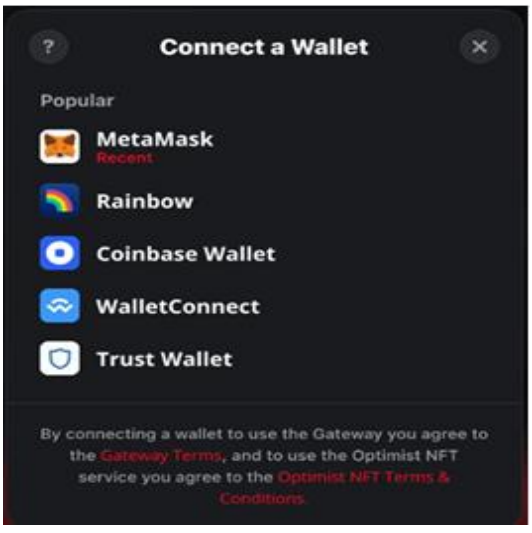
1. Start the experiment.
2. Open MetaMask wallet and ensure you are connected to the Ethereum Sepolia Testnet.
3. Add Layer-2 networks manually in MetaMask:
4. Optimism Testnet (RPC: https://sepolia.optimism.io)
5. zkSync Era Testnet (RPC: https://sepolia.era.zksync.dev)
6. Obtain test ETH from Sepolia faucet for gas and bridging.
7. Open the official bridge website:
8. For Optimism → https://app.optimism.io/bridge
9. For zkSync → https://portal.zksync.io/
10. Connect MetaMask to the bridge portal.
11. Select source network (Ethereum) and destination network (L2).
12. Enter amount of ETH or tokens to bridge and click Deposit / Bridge.
13. Confirm transaction in MetaMask and wait for bridge completion.
14. After bridging, switch network in MetaMask to the target L2 (Optimism or zkSync).
15. Deploy a simple Solidity contract (e.g., message storage) on Layer 2 using Remix or Hardhat.
16. Interact with the contract by reading and updating its state variables.
17. Note gas fee and confirmation time for each transaction.
18. Optionally, initiate withdrawal from Layer 2 back to Layer 1 using the same bridge.
19. Observe the time delay and fees for withdrawal completion.
20. Record all observations (deployment cost, transaction time, network behavior).
21. Stop the experiment.

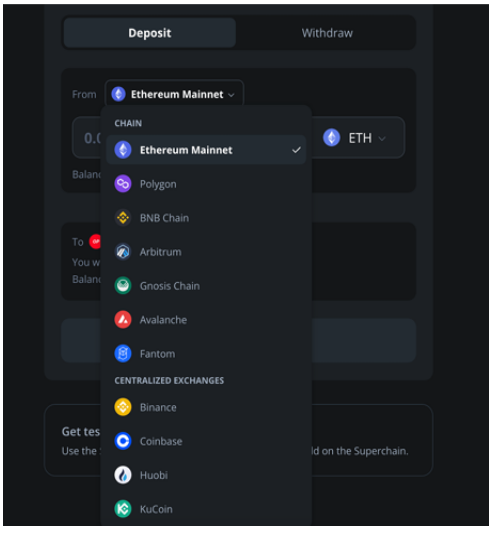
How To Bridge to Optimism Using Optimism Bridge:

Step 1: Open the Optimism Bridge App



Step 2: Connect Your Wallet and Select the Network





Observation:

1. Successful bridging of test ETH from Ethereum Sepolia → Optimism / zkSync.
2. Bridge fees and confirmation times were lower than Ethereum mainnet.
3. Deployed the same Solidity contract on both L1 and L2 using the same EVM code.
4. Gas used on L2 was ~10–20x lower than L1 deployment.
5. Transactions confirmed in seconds on L2.
6. Verified contract deployment on Optimism Explorer / zkSync Explorer.
7. Interoperability between layers was achieved via the official bridge portals.
8. Withdrawals took longer on Optimism due to fraud proof period.

ASSESSMENT

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

Signature of the Student:

Name :

Signature of the Faculty:

Regn. No. :

**As applicable according to the experiment.*
Two sheets per experiment (10-20) to be used.