

# **CARDANO DEVELOPMENT COURSE**

## **Module 1: Introduction to Cardano Development.**

### **1.0 Understanding the Cardano Blockchain and its Architecture.**

#### **1.1. Cardano eUTxO Model**

#### **1.2 Cardano DApp Architecture**

# 1.0 Understanding the Cardano Blockchain and its Architecture.

## 1.0.1. Brief History

Charles Hoskinson and Jeremy Wood, both former members of the Ethereum team, co-founded Cardano. In 2015, they established Input Output Hong Kong (IOHK) to develop more sustainable blockchain solutions. By adopting a peer-reviewed approach to blockchain development and introducing the Ouroboros consensus mechanism, Cardano Mainnet was launched in 2017.

## 1.0.2. Ouroboros

Ouroboros is a proof-of-stake (PoS) consensus mechanism that selects nodes to validate transactions based on the amount of ADA they have staked, rather than relying on computationally intensive work like proof-of-work (PoW) chains. This approach offers two key benefits: it significantly reduces energy consumption and encourages honest participation, as validators have a financial stake at risk if they act maliciously.

## 1.0.3. The Cardano Blockchain Architecture

Cardano is a third-generation blockchain that prioritizes scalability, security, and decentralization. The blockchain model consists of several key components and layers. Users engage with the ledger by creating transactions, which are temporarily stored in the mempool until they are added to a block. Stake pools are responsible for producing blocks and receive rewards for their participation, which they distribute to their delegators. The Cardano layered architecture consists of:

- **Cardano Settlement Layer (CSL):** This layer is responsible for handling ADA transactions and ensuring security through the Ouroboros proof-of-stake (PoS) consensus mechanism.
- **Cardano Computation Layer (CCL):** This layer supports smart contracts and DApps, allowing for programmability and automation.

- **Consensus Mechanism – Ouroboros:** Unlike Bitcoin’s proof-of-work (PoW), Ouroboros uses stake delegation and validators to achieve network consensus, making Cardano more energy-efficient.
- **Native Assets:** Cardano allows users to create and manage custom tokens directly on the blockchain without the need for smart contracts, improving efficiency.

# 1.1 Blockchain Record Keeping Models

The major Smart Contracts Blockchain networks commonly use two record-keeping models: the Extended Unspent Transaction Output (eUTXO) model, utilized by Cardano, and the Account/Balance model, adopted by Ethereum. This section explores the fundamentals of these models and highlights their differences.

## 1.1.1 Understanding Cardano eUTXO Model

Cardano's Extended Unspent Transaction Output (eUTxO) model is an advancement of Bitcoin's UTXO model, offering increased flexibility, security and scalability. Each transaction consumes outputs from previous transactions and creates new outputs for future ones. Fully synchronized nodes store all unspent transaction outputs, giving rise to the term "eUTXO" (Extended Unspent Transaction Output). A user's wallet monitors the unspent transactions linked to their addresses, with the wallet balance representing the total value of these unspent outputs.

*For example,*

1. Jon earns 20.5 ADA through staking rewards, resulting in one eUTXO of 20.5 ADA.
2. Jon sends 2 ADA to Ron. Jon's wallet uses his eUTXO of 20.5 ADA, sending 2 ADA to Ron and receiving 18.5 ADA as a new eUTXO to his address.
3. If Ron had an eUTXO of 5 ADA before step 2, his wallet now shows a balance of 7 ADA from two eUTXOs.

## 1.1.2. Understanding Account/Balance Model

The Account/Balance Model maintains the balance of each account as a global state. It checks that an account's balance is sufficient to cover the transaction amount.

*For example,*

1. Jon gains 30 ETH through mining, recorded in the system.
2. Jon sends 7 ETH to Ron, reducing his balance to 23 ETH.
3. Ron's balance increases by 7 ETH, so if he had 3 ETH initially, he now has 10 ETH.

## 1.2. Overview Of The Cardano dApp Architecture

A typical Cardano DApp consists of:

1. **Frontend:** Built using frameworks like React.js or Next.js to provide an interactive UI.
2. **Backend:** Uses middleware services like Koios, Blockfrost, or custom APIs to fetch blockchain data.
3. **Off-chain:** Off-chain scripts written in Javascript or Typescript using Lucid Evolution or MeshJs. This component handles computations, data storage, and logic execution that do not need to be processed on-chain, reducing congestion and transaction costs.
4. **Smart Contracts:** On-chain scripts written in Aiken, Plutus, or other DSLs that define & enforce business logics and transaction validations.
5. **Wallet Integration:** Uses the CIP-30 standard to interact with browser wallets such as Nami, Eternl, or Lace.