**CODELANDCS BLOCKCHAIN DEVELOPMENT SYLLABUS**

**WEEK 2**

**DAY 2**

**GAS AND TRANSACTION FEES**

First, let's define what gas is in Ethereum. Gas is the unit of measure for the **computational effort required to execute a transaction** or smart contract on the Ethereum network. It is used to **ensure that the network is not overwhelmed with too many computational requests,** and to incentivize miners to include transactions in blocks.

When **a user sends a transaction on the Ethereum network,** they must specify the **amount of gas** they are willing to pay for the transaction to be executed. This is called the **gas limit.** The gas limit is the maximum amount of gas that the sender is willing to pay for the transaction to be executed. If the transaction requires more gas than the gas limit, the transaction will fail and the gas that was already used will be lost.

In addition to the gas limit, users must also specify the **gas price,** which is the amount of ether they are willing to pay per unit of gas. The gas price is a measure of the value that the user places on having their transaction included in the next block. A higher gas price will incentivize miners to include the transaction in their block, but it will also increase the cost of the transaction for the sender.

**TRANSACTION FEES**

The transaction fee for a transaction on the Ethereum network is **calculated by multiplying the gas limit by the gas price**. For example, if a transaction has a gas limit of 21,000 and a gas price of 20 Gwei (a unit of ether), the transaction fee would be 0.00042 ether (21,000 x 20 Gwei). This fee is paid by the sender of the transaction to the miner who includes the transaction in a block.

The transaction fee is an important consideration for users of the Ethereum network, as it affects the cost and speed of transactions. If a user wants their transaction to be processed quickly, **they may choose to pay a higher gas price to incentivize miners** to include the transaction in their block. However, this will also increase the cost of the transaction for the user.

**Gas Limits and Contract Execution:**

Gas limits are also important for smart contract execution on the Ethereum network. Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. The code of a smart contract may require a certain amount of gas to execute, and if the gas limit is not high enough, the contract may fail to execute. This can result in the loss of funds or other adverse consequences.

Furthermore, the gas limit is an important factor in the scalability of the Ethereum network. If too many users are sending transactions with high gas limits, it can cause congestion on the network and slow down transaction processing times. This is a challenge that the Ethereum community is working to address through various scaling solutions, such as sharding and layer 2 protocols.

**ETHEREUM IMPROVEMENT PROPOSAL (EIP-1559)**

EIP-1559 is a proposal to change the way transaction fees are managed on the Ethereum blockchain. Currently, Ethereum uses a **first-price auction system for transaction fees,** where users **bid** for the amount of gas they are willing to pay to have their transaction included in the next block. This has led to high transaction fees during periods of high network congestion, making it expensive for users to send transactions and use dApps on the network.

EIP-1559 proposes a new fee structure that would replace the current auction system with a **base fee that is adjusted algorithmically based on network demand.** This base fee would be **burned**, or removed from circulation, instead of being paid to miners as a transaction fee. In addition to the base fee, **users could still include a tip** to incentivize miners to include their transaction in the next block.

**The main benefits of EIP-1559 are:**

**Predictable transaction fees:** The base fee would be adjusted algorithmically based on network demand, so users would know how much they need to pay to have their transaction included in the next block.

**Lower transaction fees:** The base fee would be burned, which could lead to a reduction in overall transaction fees, as miners would not be able to set high fees during periods of high network congestion.

**More efficient use of block space:** The base fee would be adjusted dynamically, which could lead to a more efficient use of block space and reduce the need for users to overpay for gas.

**Simplified fee structure:** The current auction system can be complex and confusing for users. EIP-1559 simplifies the fee structure by **only requiring users to specify a tip if they want to incentivize miners.**

EIP-1559 has been a topic of discussion within the Ethereum community for several years, and it has undergone multiple revisions and improvements. It was **finally implemented as part of the London hard fork in August 2021**, and early data suggests that it has been successful in reducing transaction fees and increasing the efficiency of the network.

**ETHEREUM BLOCKCHAIN STRUCTURE**

The Ethereum blockchain is made up of blocks, which are connected to each other in a **chronological order.** Each block contains a list of transactions, as well as other information, such as the **hash** of the previous block and a timestamp.

Ethereum also has a native cryptocurrency, called Ether (ETH), which is used to pay for transaction fees and to incentivize miners to secure the network. Ether is used to execute smart contracts and dApps on the Ethereum network.

**Accounts:**

Ethereum has two types of accounts: externally owned accounts (EOAs) and contract accounts. EOAs are controlled by private keys and can hold ether, while contract accounts are controlled by the code of a smart contract and can also hold ether.

**Smart Contracts:**

Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. Smart contracts are stored on the Ethereum blockchain and are executed by the **Ethereum Virtual Machine (EVM).**

The EVM is a **runtime environment** that executes smart contracts in a sandboxed environment. The EVM is responsible for executing the code of the smart contract and enforcing the rules of the contract. The EVM is also responsible for **managing the gas limit and gas price** for each transaction.

**Gas:**

Gas is the unit of measure for the computational effort required to execute a transaction or smart contract on the Ethereum network. Gas is used to ensure that the network is not overwhelmed with too many computational requests, and to incentivize miners to include transactions in blocks.

When a user sends a transaction on the Ethereum network, they must specify the amount of gas they are willing to pay for the transaction to be executed. If the transaction requires more gas than the gas limit, the transaction will fail and the gas that was already used will be lost.

**Miners:**

Miners are nodes on the Ethereum network that are responsible for processing transactions and adding new blocks to the blockchain. Miners are incentivized to secure the network by earning rewards in the form of newly minted Ether and transaction fees.

Conclusion:

In conclusion, Ethereum's structure is based on a blockchain, which is made up of blocks connected to each other in a chronological order. Ethereum has two types of accounts, EOAs and contract accounts, and executes smart contracts using the EVM. Gas is used to incentivize miners to process transactions and secure the network. Understanding Ethereum's structure is important for developers and users alike who want to build and interact with decentralized applications on the Ethereum network.