



SESSION 15

# What's a DApp?

## Learning Objectives

- Discuss DApps
- Explain decentralization of DApps
- Describe how to decentralize DApps using IPFS

## Introduction

Decentralized applications (DApps, pronounced as Dee-Apps) are the applications that are executed on a decentralized P2P network governed by all the members rather than by a single central authority. They are used for storing data and processing transactions on multiple nodes rather than on a single controlling authority.

DApps offer various benefits to its users. They eliminate the need for third-party intermediaries. They are deployed on top of a blockchain that uses different cryptographic techniques to process and secure transactions.

DApps integrate various smart contracts for establishing a connection to the blockchain, hence the smart contract code forms a small part of the DApps. Bitcoin and Ethereum are DApps, as they are decentralized and open source. In DApps, decentralization can also be achieved with the help of IPFS (InterPlanetary File System).

In this session, you will learn about DApps in detail along with their different categories and benefits. You will also be familiarized with the difference between smart contracts and DApps. Towards the end of the session, you will also learn about how to decentralize DApps with the help of IPFS.

## Definition of a DApp

 [LO - Discuss DApps]



Decentralized applications (DApp) are the applications that are executed on a peer-to-peer network of computers rather than on a single computer. DApps do not have a centralized authority for decision making. BitTorrent, Popcorn Time are the DApps that execute on a P2P network.

DApps are different from the distributed applications mostly in terms of ownership. The distributed application can be executed on numerous computers, but all the computers are owned by a single authority. Some of the examples of distributed applications are Amazon, Facebook etc. The DApps, on the other hand, are executed on a decentralized P2P network that is not controlled by a single authority. DApps are governed by smart contracts, which are programs comprising pre-defined rules. These rules allow DApps to run without any central authority.



Ethereum has enabled developers to execute DApps on top of its platform. The developers can write the smart contract codes on Ethereum that serve as the blueprint for the DApp.

The characteristics that make an application truly DApp are:

- The application's source code must be open source.
- The application's data and records of the operations must be stored on a public and decentralized blockchain to avoid a single point of failure.
- The application must use cryptographic tokens such as Bitcoin that are required to get access to the application.

The first known DApp is Bitcoin. This DApp tries to resolve the issue of centralization. The bitcoin DApp offers users the authority to perform the transactions without a third-party intermediary or a single entity via a self-sustainable public ledger. Some of the significant use cases of DApps are:

### **Management and transfer of money**

DApps can be used to perform the smooth transaction of money across the globe. They can make the transfer of money fast by removing the third-party intermediary with the help of blockchains and its own crypto tokens. The security is enforced in DApps through blockchain's consensus mechanism, as it is impossible to make alterations without getting the majority vote.

### **Management of business process**

Integration of DApps into an organization's processes can help in streamlining them without human intervention. The solution to critical issues and improvement in the efficiency of processes can be achieved with the help of smart contracts.

For instance, RFID chips can be inserted by logistics companies into their shipments. These can be scanned at the destination ports where the payment can be made automatically via smart contract between buyer and seller.

### **DAO (Decentralized Autonomous Organization)**

DAO is an organization where the important decisions are made by executing the codes included in the smart contracts. It provides a framework to develop faceless organizations eliminating the need for CEOs or any other leadership positions.

A DAO enforces hard-coded rules, which helps in taking the actions and decisions within an organization. Once deployed, a DAO cannot be stopped. It can be executed across the globe, as it is programmed via smart contracts codes deployed on the blockchain.

The concept of DAO is radical in the sense that it is in complete contrast to the working mechanism of modern-day organizations. A true DAO provides every investor a chance to take part in the decision-making process as no hierarchy model is followed. DAOs are completely transparent because every transaction is recorded in the blockchain and can be reviewed by anyone at any point of time. A certain amount of money (cryptocurrency) needs to be spent if you, as an investor, want to put forth a proposal and vote for it. This makes sure that investors think seriously and evaluate their decisions, thereby leading to less wastage of time in thinking about impractical solutions.

## DApp Classification

The DApps can be classified broadly into three types based on the type of blockchain model used by them, as illustrated in Figure 1:

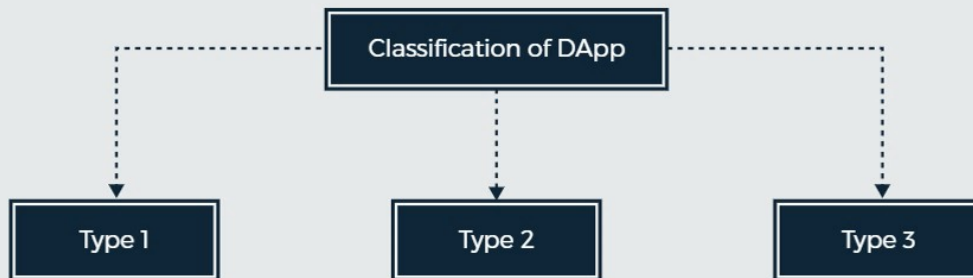


Figure 1: Classification of DApps Based on the type of Blockchain Model

### ■ Type 1

These DApps have their own blockchains. Type 1 DApps are similar to operating systems such as Windows, macOS and Linux. Bitcoin and Ethereum are examples of Type 1 DApps.

Other examples of Type 1 DApps include Factom and Siacoin.

### ■ Type 2

These DApps use the blockchain of Type 1 DApps. They are protocols that issue tokens necessary for their execution. Type 2 DApps are more similar to “general purpose software programs” such as word processor. Golem and Storj are examples of Type 2 DApps. Both these DApps work on Ethereum’s blockchain. Omni protocol is also an example of Type 2 DApp.

### ■ Type 3

These DApps use the blockchain of Type 2 DApps. They use the protocol of Type 2 DApps and issue and require tokens. The SAFE Network that uses Omni protocol is an example of a Type 3 DApp.

DApps can also be classified into three types based on the Ethereum white paper, as displayed in Figure 2:

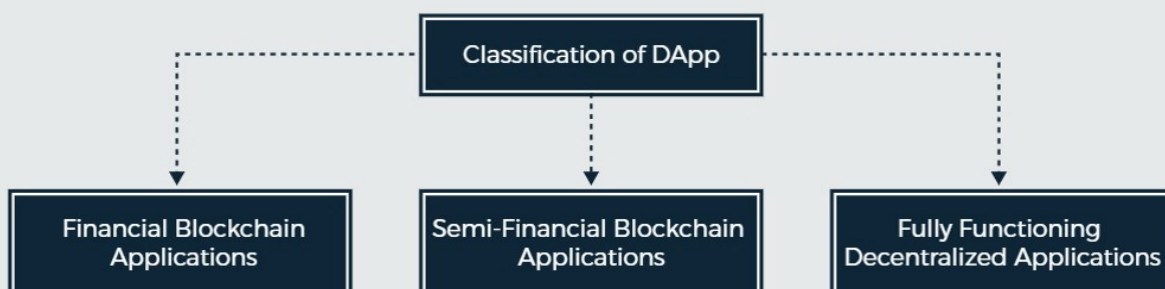


Figure 2: Classification of DApps Based on Ethereum Whitepaper



### ■ **Financial Blockchain Applications**

These type of DApps help the users in managing their finances and savings. The users of the network have the power and authority to control the DApps. A distributed and decentralized system of monetization is provided by the Bitcoin network to the users.

### ■ **Semi-Financial Blockchain Applications**

These DApps use both finances and information that is saved at the outside realm of the blockchain. The insurance applications providing a refund for flight delay are examples of semi-financial blockchain applications. An ICO (Initial Coin Offering) is another example, which is an effective way to raise funds similar to an IPO wherein cryptocurrency is involved instead of fiat money.

### ■ **Fully Functioning Decentralized Applications**

These DApps make use of both decentralized and distributed systems. They do not involve financial aspect at any level. Online voting and decentralized governance are some of the examples of fully functioning decentralized applications.

Dubai is aiming to become the world's first blockchain-powered government. By the year 2020, the city administration has resolved to manage all visa applications, bill payments, renewal of licenses and other similar administrative jobs using blockchain. This model of governance is going to be replicated in other sectors as well in a phased manner.

With the advancement in blockchain technology, you must have a clear understanding between smart contracts and DApps.

## **I Difference between DApps and Smart Contracts**

Smart contracts allow DApps to establish a connection to the blockchain. Smart contracts are the agreement between the parties, eliminating the need for a third-party intermediary. DApps are the decentralized applications that do not have the central control of an authority.

DApps typically use HTML (Hypertext Markup Language), CSS (Cascading Style Sheet) and JavaScript to render the page. For displaying the details, DApps make use of a smart contract for establishing a connection to the blockchain.

The backend code of the DApps execute on the decentralized P2P network and the smart contract only forms a small part of DApps. For creating a DApp on a smart contract system, you need to integrate several smart contracts and rely on 3rd party systems for the front-end.

DApps frontend code can be coded in any programming language, such as JAVA, HTML, CSS. The frontend code of the DApps can be hosted on decentralized storage such as IPFS (Interplanetary File System) and SWARM.

Figure 3 displays the DApp that uses a blockchain with smart contracts:

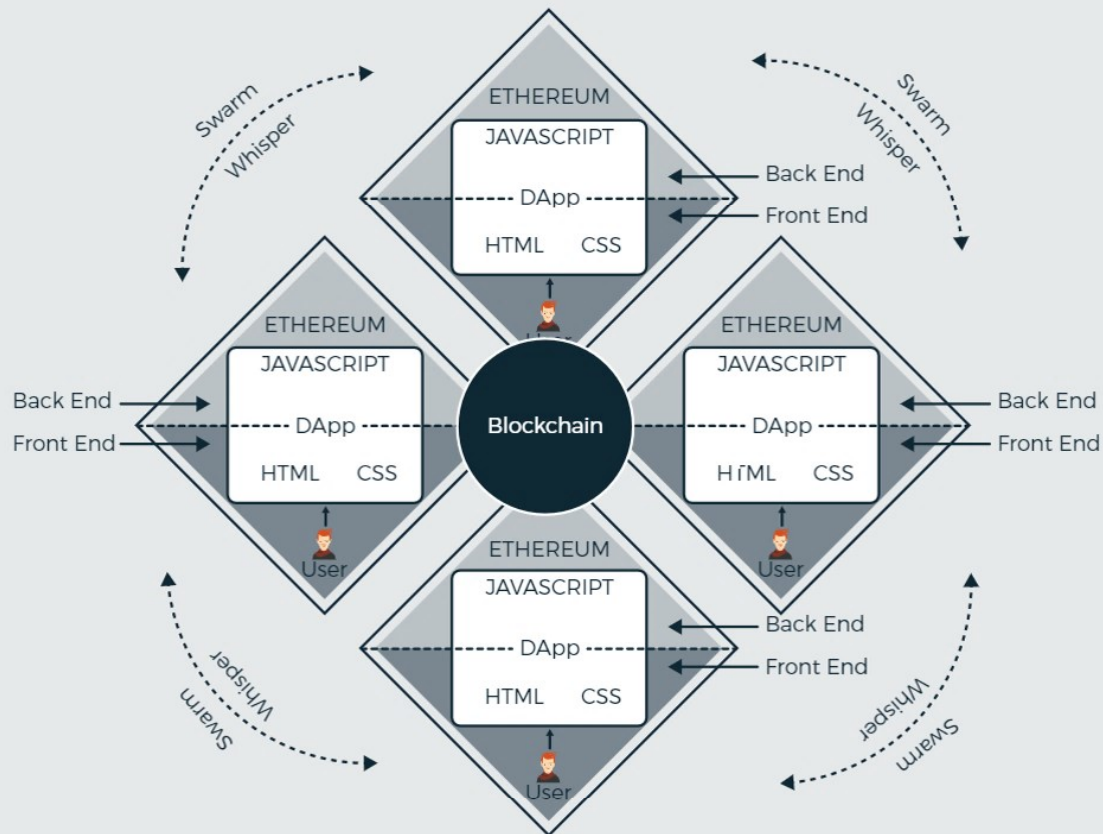


Figure 3: DApps with Smart Contracts

## Benefits of DApps

There are various benefits that are offered by DApps. The advantages of the DApps are listed as follows:

### ■ Fault Tolerant

There is no single point of failure in DApps as the data is saved on multiple nodes in a P2P decentralized network.

### ■ Prevention of Internet Censorship

Internet censorship is prevented by DApps because of the absence of a central controlling authority. It is impossible to manipulate the data saved on a DApp for personal benefit. DApps are not dependent on a single IP address because of their decentralized nature.


### ■ Increased Trust

The DApps are more reliable and trustworthy because of the absence of a single controlling authority. The data saved on a DApp is immutable, which cannot be altered.





## | Is a DApp “Truly” Decentralized?

 [LO - Explain decentralization of DApps]

The DApps are considered as purpose specific decentralized systems. Ethereum is a decentralized network because of the following factors:

- Any anonymous user can join the Ethereum network
- P2P nodes are present
- The decentralized applications that provide specific services to the users, execute on top of the Ethereum network.

There are numerous decentralized applications that use the blockchain but still do not require tokens. If the application is maintained by a small entity or a single entity, it can lead to centralization. Lesser the number of controlling entities, more decentralized would be the application. Hence, you can say that many applications that are executing on top of the blockchain are not truly decentralized.

For instance, in IPFS, it is possible to have a decentralized application without implementing blockchain and without using tokens for offering incentives.



## | Decentralizing DApps using IPFS

 [LO - Describe how to decentralize DApps using IPFS]

IPFS, which stands for InterPlanetary File System, was developed by Juan Benet in the year 2014. It is a distributed file system that aims to replace HTTP (HyperText Markup Protocol). IPFS is developed as open-source software and lacks a single point of failure; hence the nodes in a network do not require trust building among them. IPFS offers an infrastructure that uses content addressing with the help of cryptographic hash. This ensures the authenticity of the content regardless of its saved location in a network.

IPFS is a distributed file system that can be connected through a browser. IPFS takes the files and serves them in a distributed manner. When you try to access your files, they are not saved on a central server, rather they are saved on multiple nodes, thus enabling the decentralization feature.

For creating DApps using IPFS, you first have to install IPFS. Once the IPFS is installed, create the peers that will share the content. After creating the peers, create and execute an IPFS node. Keep the IPFS node running and create a directory for the files comprising CSS, HTML or JavaScript files that are going to be served on an IPFS node. The last step is to publish the created directory to IPFS, and a URL appears, which allows you to access distributed files through a web browser.

# SUMMARY

- Decentralized applications (DApps) are the applications that are executed on a peer-to-peer network of computers rather than on a single computer.
- Based on the type of blockchain model used by DApps, they can be categorized into Type 1, Type 2 and Type 3.
- DApps are "blockchain-enabled" web application. The smart contracts help in establishing a connection with the blockchain.
- DApps are the decentralized applications that do not have a central controlling authority.
- Benefits of DApps are fault tolerance, prevention of Internet censorship and increased trust.
- The DApps are deemed truly decentralized, if they are open source, decentralized and include token incentivization and consensus algorithm.
- IPFS, which stands for InterPlanetary File System, was developed by Juan Benet in the year 2014. It is a distributed file system that aims to replace HTTP.