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BLOCKCHAIN · BEGINNER · LESSON 2 OF 13

Centralized, Distributed, Decentralized

Three words that sound alike but describe very different ways to run a system, and why the difference matters for your money

7 min read 6 quiz questions with answer key

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Centralized, Distributed, Decentralized

IN ONE SENTENCE

Distributed describes where a system's machines are. Decentralized describes who controls it. Blockchains try to be both, and that is what sets them apart from the systems we use every day.

Two questions that describe any system

In Lesson 1 we saw that every digital payment depends on someone keeping the record. To understand how blockchains are different, we need a simple way to describe *who* keeps a record and *how*. Two questions are enough:

- **Where does it run?** On one computer, or on many computers spread across different places?
- **Who has the final say?** One party, or many independent parties that must agree?

These questions sound similar, but they are completely separate. A system can run on thousands of machines and still be controlled by a single company. Keeping the two apart is the key to this whole lesson.

Centralized: one party in control

In a **centralized** system, one organization makes the decisions and holds the authority. Your bank's records, a national stock exchange, an online game's servers and a social media platform are all centralized. One party writes the rules, runs the system and can change it at any time.

This model is popular for good reasons:

- **Speed.** Decisions happen in one place, so the system can process huge volumes quickly.
- **Easy fixes.** A mistake can be corrected and a lost password can be reset.
- **Clear accountability.** When something breaks, you know exactly who is responsible.

The weakness is the other side of the same coin. Whoever controls the system can freeze an account, block a user or change the rules. And if that one party is hacked, shut down or simply makes a bad decision, everyone who depends on it is affected.

Distributed: many machines, often one owner

A **distributed** system spreads its work across many computers, often in many countries. A large search engine, a global card payment network and a video streaming service all run on enormous numbers of servers in data centers around the world.

Distribution is an engineering choice. It makes a service faster and keeps it online when individual machines fail. But it says nothing about control. Every one of those servers still belongs to the same company, follows the same management and can be switched off by the same decision.

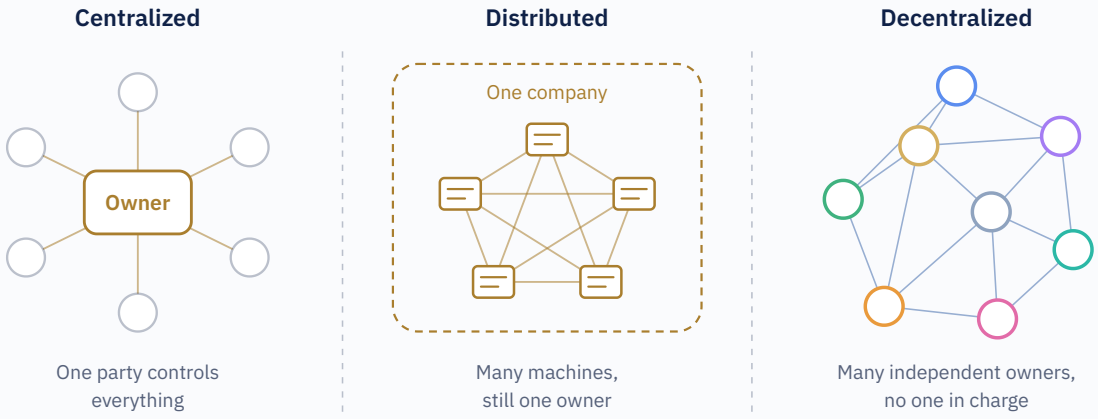


Figure 1. Distributed describes where a system runs; decentralized describes who controls it. A blockchain aims to be both.

ANALOGY: BRANCHES OF ONE BANK

A bank with five hundred branches is spread across the whole country, yet every branch follows orders from the same head office. If head office decides to close your account, all five hundred branches will refuse to serve you. Lots of locations is not the same as lots of decision makers.

Decentralized: no single party in charge

In a **decentralized** system, control is shared among many independent participants. No single person, company or government can change the rules alone, and anyone who follows the rules can usually join or leave freely.

Bitcoin is the best-known example. Anyone can download the software, run a copy of the ledger and check every rule for themselves. There is no head office, no CEO and no customer support desk. The network keeps going as long as enough independent participants keep taking part, wherever they happen to be.

A blockchain like Bitcoin is therefore both distributed and decentralized: its copies sit on many machines around the world, and those machines belong to many different people and businesses who do not need to trust each other.

A REAL EXAMPLE

In 2021, China banned Bitcoin mining, and most of the computers securing the network had to shut down or move abroad. The network's total computing power fell to roughly half by late June. Yet Bitcoin never stopped: blocks kept being produced, transactions kept settling, and within months the computing power had recovered as miners restarted in other countries. A single government closing down a big share of the network was not enough to switch it off.

Decentralization is a spectrum, not a switch

Few systems are perfectly centralized or perfectly decentralized. Most sit somewhere in between, and the word "decentralized" is often used loosely in marketing. A few questions help you see where a system really sits:

- **How many independent parties would have to agree** to change the rules or shut the system down? The higher the number, the more decentralized it is.
- **Who can join?** Can anyone take part, or does someone have to approve you first?
- **Can you leave with what is yours?** Or can someone hold your assets or data back?
- **Who controls the software and the upgrades?** A project can call itself decentralized while a small team can still change everything.

Later lessons return to these questions when we look at mining, staking, smart contracts and governance.

A NOTE ON WORDS

These terms have shifted over time. In 1964, the engineer Paul Baran drew famous diagrams of "centralized", "decentralized" and "distributed" networks, where the words described the shape of the connections. In crypto today, decentralized is about control and distributed is about location, which is how this course uses them.

The trade-offs

Decentralization is not automatically better. It buys some valuable properties by giving up others:

	Centralized	Decentralized
Speed	Fast, decisions in one place	Slower, many parties must agree
Cost per action	Low	Higher
Fixing mistakes	Easy, the operator can reverse	Hard, often impossible
Censorship resistance	Low, one party can block you	High, no single gatekeeper
Resilience	One failure can stop everything	Keeps running when parts fail
Accountability	Clear, you know who to contact	Spread out, no help desk

The rule of thumb: decentralization is worth its cost when you cannot, or do not want to, rely on a single party. When one trusted party works well, a centralized system is usually simpler, faster and cheaper.

Why this matters for traders

- **The same coin can sit in two different worlds.** Bitcoin itself runs on a decentralized network, but bitcoin held in an exchange account sits inside a centralized system. The exchange controls access, sets withdrawal limits and can pause activity. The asset is the same; the risks depend on where it is held.
- **Outages hit centralized platforms first.** During sharp market moves, exchanges have at times slowed down, halted withdrawals or gone offline. The Bitcoin network itself has kept producing blocks almost without interruption since 2009; its last serious disruption was in 2013.
- **"Decentralized" is a claim worth checking.** When a project calls itself decentralized, ask who can change the rules. A small group with that power is a point of risk, and it is often where regulators and attackers focus first.

Key terms

Centralized	A system where one party holds the authority and makes the decisions.
Distributed	A system whose work is spread across many computers or locations. It describes where a system runs, not who controls it.
Decentralized	A system where control is shared among many independent participants, so no single party can change the rules alone.

Single point of failure	One part whose failure or capture can bring down or control the whole system.
Permissionless	Open to anyone who follows the rules, with no approval needed to join.
Censorship resistance	How hard it is for any party to block someone from using a system or to remove their transactions.

Key takeaways

1. Two separate questions describe any system: where it runs, and who has the final say.
2. Centralized systems are fast and easy to fix, but one party can freeze, block or change the rules.
3. Distributed means many machines. It improves speed and uptime but does not by itself spread control.
4. Decentralized means no single party is in charge. Blockchains like Bitcoin are both distributed and decentralized.
5. Decentralization is a spectrum with real trade-offs, and it is worth its cost when relying on one party is not acceptable.

Test yourself

Circle one answer for each question. The answer key with explanations is on the next page. You can also take this quiz online at markettalks.info and see your score instantly.

1. A company runs its service on servers in 30 countries, but one management team makes every decision. What kind of system is this?

- (A) Decentralized, because it runs in many countries
- (B) Distributed but centralized
- (C) Neither distributed nor centralized
- (D) Decentralized and permissionless

2. What does "decentralized" mainly describe?

- A Where the computers are located
- B How fast the system is
- C Who controls the system and can change its rules
- D How strong its encryption is

3. What is a genuine advantage of a centralized system?

- A Fast decisions and easy fixes for mistakes
- B No one can ever freeze your account
- C No single party can ever switch it off
- D Anyone can change the rules

4. What happened to the Bitcoin network after China banned mining in 2021?

- A The network stopped for several months
- B All past transactions were reversed
- C China took control of the network
- D It kept running, and its computing power recovered as miners moved abroad

5. You hold bitcoin in an exchange account. Which model controls your access to it?

- A Decentralized, because Bitcoin is decentralized
- B Centralized, because the exchange controls the account
- C Distributed, because the exchange has many servers
- D Permissionless, because anyone can open an account

6. Which question best tests how decentralized a system really is?

- A How many servers does it run on?
- B How well known is its brand?
- C How many independent parties would have to agree to change the rules or shut it down?
- D How old is the project?

Answer key

1 B

Distributed but centralized

Many locations make it distributed, but one team holding all the authority makes it centralized. Location and control are separate questions.

2 C

Who controls the system and can change its rules

Decentralization is about control. A decentralized system shares authority among many independent participants, so no single party can change the rules alone.

3 A

Fast decisions and easy fixes for mistakes

With one party in charge, decisions are quick and mistakes can be reversed. The other options describe properties of decentralized systems, or simply are not true.

4 D

It kept running, and its computing power recovered as miners moved abroad

Computing power fell sharply, but blocks kept being produced and transactions kept settling. Within months, miners had restarted in other countries.

5 B

Centralized, because the exchange controls the account

Bitcoin's network is decentralized, but an exchange account is run by one company. The exchange decides on access, limits and withdrawals.

6 C

How many independent parties would have to agree to change the rules or shut it down?

The number of independent parties needed to change or stop a system measures how spread out control really is. Server count measures distribution, not decentralization.

SOURCES

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