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Longest Chain vs. Most Work: Which Takes Precedence?

Understanding "Work Done" in Blockchain

- In Proof-of-Work blockchains like Bitcoin, "work done" refers to the total computational effort (hashing power) expended to build a chain of blocks.
- Each block's "work" is based on the mining difficulty at the time it was mined: higher difficulty means more hashes (and thus more energy) were required to find a valid block[1] [2].

Longest Chain Rule vs. Most Work Rule

- **Misconception:** The "longest chain" is often thought to be the chain with the most blocks. However, the correct rule is that nodes adopt the chain with the **most cumulative work**, not necessarily the one with the most blocks[1] [3] [2].
- **Why?** Difficulty can change over time. For example, if one chain has more blocks but was mined during a period of low difficulty, it might actually represent less work than a shorter chain mined at higher difficulty.

Example Scenario

Chain	Blocks	Difficulty	Total Work (Hashes)	Adopted?
Chain A	100	Low	1,000,000	No
Chain B	95	High	2,000,000	**Yes (more work)**

- Even though Chain A is longer, Chain B is adopted because it represents more total work[1] [2].

Why Does "Most Work" Take Precedence?

- The chain with the most work is the one that required the most computational effort to build, making it the most secure and tamper-resistant.
- This prevents attackers from creating a long but low-difficulty chain to overtake the main chain, ensuring network security[1] [3].

Example: Trailing Zeroes in Proof of Work

- When mining, the goal is to find a hash of the block header (including the nonce) that is **below a target value**.
- This is usually visualized as finding a hash with a certain number of leading zeros (not trailing zeros)[4] [5].

- The more leading zeros required, the harder it is to find a valid hash, increasing the work needed.

Example

- Suppose the target for a valid hash is any hash starting with four zeros:
  - Valid hash: `0000a3f9b2c...`
  - Invalid hash: `1f3b9a7c...`
- The probability of finding a hash with more leading zeros decreases exponentially, making the mining process more difficult as the network's total hash rate increases[4] [5].

Table: Longest Chain vs. Most Work

Rule	What It Means	Which Wins?
Longest Chain	Most blocks	Not always correct
Most Work (Chainwork)	Most total computational effort (hashes)	**Always takes precedence**

Key Takeaways

- The **chain with the most cumulative work** (not necessarily the most blocks) is considered the valid chain in Bitcoin and similar blockchains[1] [3] [2].
- Mining difficulty and proof-of-work ensure that creating a valid block requires finding a hash below a certain target, often visualized as requiring a number of leading zeros in the hash[4] [5].
- This system secures the blockchain against attacks and ensures consensus across the network.

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1. https://learnmeabitcoin.com/technical/blockchain/longest-chain/
2. https://bitcoin.stackexchange.com/questions/29742/strongest-vs-longest-chain-and-orphaned-blocks
3. https://cryptoservices.github.io/blockchain/consensus/2019/05/21/bitcoin-length-weight-confusion.html
4. https://stackoverflow.com/questions/47554039/when-checking-a-bitcoin-block-why-do-you-get-a-leading-prefix-of-zeros-once-you
5. https://www.johndcook.com/blog/2025/06/20/bitcoin-proof-of-work/