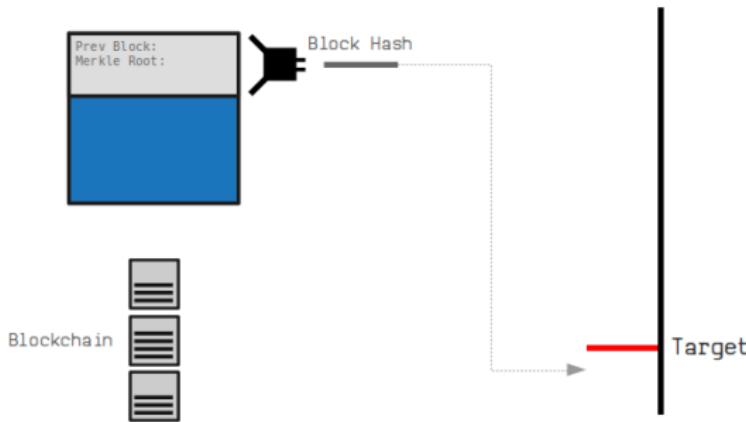


## Q4: Target adjustment

Suppose someone would start a Bitcoin clone today with the same initial mining target as Satoshi Nakamoto back in 2008, but using today's hash power. How many minutes (approximately) would it take to arrive at the current mining target?

# Target

“The number you need to get below to mine a block.”

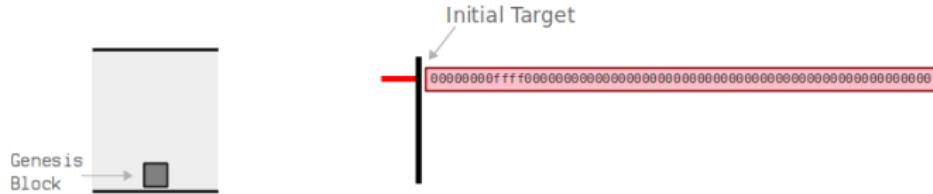


- The target is used in mining. It is a number that a block hash must be below for the block to be added on to the blockchain.
- The target adjusts every 2016 blocks (roughly two weeks) to try and ensure that blocks are mined once every 10 minutes on average. It therefore creates a consistent time between blocks and a consistent issuance of new bitcoins in to the network (via the block reward).

<https://learnmeabitcoin.com>

## How is the target calculated?

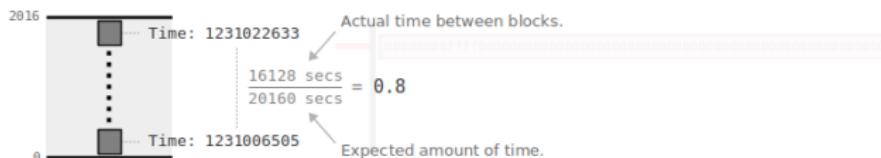
This initial (and maximum) target value is hard-coded in to the source code of every bitcoin node.<sup>1</sup> It was probably best-guess by Satoshi at what be a good starting point for a difficult-enough target that would result in a 10-minute interval between new blocks.



<https://learnmeabitcoin.com>

# How is the target calculated?

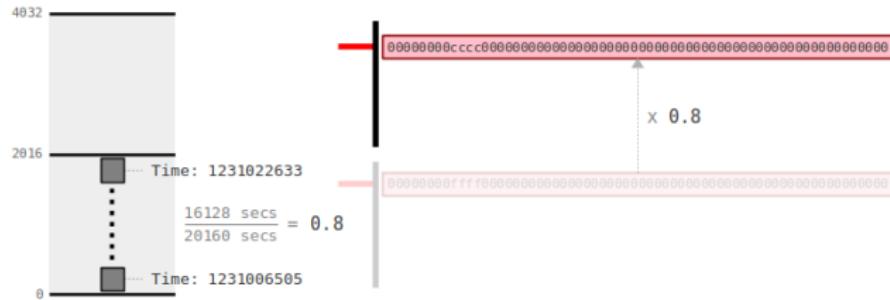
After every 2016 blocks, each node will look at the time between the last 2016 blocks and work out if they were being mined faster or slower than 10 minutes on average.



<https://learnmeabitcoin.com>

## How is the target calculated?

If blocks during this period were being mined faster than every 10 minutes, the target will adjust downwards to make it more difficult to get below the target for the next period of blocks.



<https://learnmeabitcoin.com>

## How is the target calculated?

Conversely, if blocks were being mined slower than every 10 minutes, the target will adjust upwards to make it easier to get below the target for the next period of blocks.



As a result, each node regularly recalculates the target to enforce a 10-minute interval between new blocks, even as miners join and leave the network over time.

<https://learnmeabitcoin.com>

## Q4: Target adjustment

Suppose someone would start a Bitcoin clone today with the same **initial mining target** as Satoshi Nakamoto back in 2008, but using today's hash power. How many minutes (approximately) would it take to arrive at the **current mining target**?

## Q4: Target adjustment solution

## Where is in the lecture?

## Gauging the Difficulty

#### Q4: Target adjustment solution

First block's target value difficulty\_1\_target:

## Q4: Target adjustment solution

First block's target value difficulty\_1\_target:

The current\_target at end May 2020:

oooooooooooooooooooo01297f6oooooooooooooooooooo0oooooooooooo0oooooooooooo

## Q4: Target adjustment solution

$$\frac{\text{initial mining target}}{\text{current mining target}} \cong ?$$

## Q4: Target adjustment solution

$$\frac{\text{initial mining target}}{\text{current mining target}} \simeq 2^{4*11}$$

## Q4: Target adjustment solution

Limited to the interval  $[0.25, 4]$

How many steps it takes to adjust down from the max target to current target?

## Q4: Target adjustment solution

Limited to the interval [0.25,4]

How many steps it takes to adjust down from the max target to current target?

$$2^{4*11} = 4^x \rightarrow x = ?$$

## Q4: Target adjustment solution

Limited to the interval [0.25,4]

How many steps it takes to adjust down from the max target to current target?

$$2^{4*11} = 4^x = 2^{2*x} \rightarrow$$

$$4*11 = 2*x \rightarrow x = 22$$

## Q4: Target adjustment solution

Total time (10 min): ?

## Q4: Target adjustment solution

Total time (10 min):

$$10 + \frac{10}{4} + \frac{\frac{10}{4}}{4} + \dots =$$

$$10 + \frac{10}{4} + \frac{10}{4^2} + \dots + \frac{10}{4^{22}} =$$

$$10\left(1 + \frac{1}{4} + \frac{1}{4^2} + \dots + \frac{1}{4^{22}}\right) =$$

$$10\left(\left(\frac{1}{4}\right)^0 + \left(\frac{1}{4}\right)^1 + \left(\frac{1}{4}\right)^2 + \dots + \left(\frac{1}{4}\right)^{22}\right) =$$

$$10 * \sum_{n=1}^{22} \frac{1}{4}$$

## Q4: Target adjustment solution

$$10\left((\frac{1}{4})^0 + (\frac{1}{4})^1 + (\frac{1}{4})^2 + \dots + (\frac{1}{4})^{22}\right) = \\ 10 * \sum_{n=1}^{22} \frac{1}{4} = ?$$

## Q4: Target adjustment solution

$$10\left((\frac{1}{4})^0 + (\frac{1}{4})^1 + (\frac{1}{4})^2 + \dots + (\frac{1}{4})^{22}\right) = \\ 10 * \sum_{n=1}^{22} \frac{1}{4} = ?$$

$$\sum_{i=0}^n P^i = \frac{P^{n+1} - 1}{P - 1}$$

## Q4: Target adjustment solution

$$10\left((\frac{1}{4})^0 + (\frac{1}{4})^1 + (\frac{1}{4})^2 + \dots + (\frac{1}{4})^{22}\right) =$$

$$10 * \sum_{n=1}^{22} \frac{1}{4} = 10 * \frac{(\frac{1}{4})^{23}-1}{\frac{1}{4}-1} =$$

$$10 * \frac{(\frac{1}{4})^{23}-1}{-\frac{3}{4}} =$$

$$10 * \frac{1-(\frac{1}{4})^{23}}{\frac{3}{4}} =$$

$$10 * \frac{4}{3} * (1 - (\frac{1}{4})^{23}) \cong 10 * \frac{4}{3}$$

Adjust only after 2016 block

$$\text{Total time} \cong 2016 * 10 * \frac{4}{3} = 26880 \text{ (min)}$$

## Q5: Feasibility of Mining

Calculate the economic feasibility of mining in Germany and in two countries of your choice. Start from the factors given in the slide. Identify at least one additional factor that influences the cost of mining. Create a table of the factors for each of the countries and calculate whether mining is worthwhile. Document the sources from which you obtained the cost data (as URLs if possible). Your choices should be driven entirely by economics, but one of your countries could be a variation where you restrict yourself to e.g. renewable resources.

## Q5: Feasibility of Mining

- Countries: Germany, and two others: China, France, Switzerland Japan,... (ups to you)
- Factors: **hardware, electricity**, and property rental (pool fee,...)

## Q5: Feasibility of Mining

- hardware: not so much different between countries
- electricity (property rental,...): quite different

## Q5: Feasibility of Mining

How to calculate?

- mining reward = roughly 6.25 BTC per 1 block mined and 1 BTC = 9,314.31 \$
- mining cost = hardware cost + operating cost

benefits = mining reward - mining cost

## Q5: Feasibility of Mining

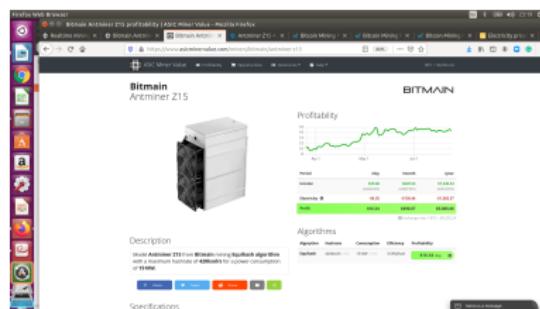
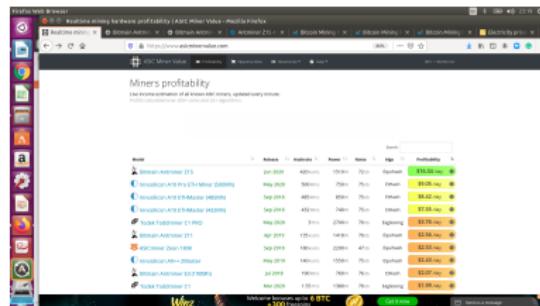
How much that I can get? and how much that I need to pay?

- Hashrate
- Power consumption

Calculate: real or estimates

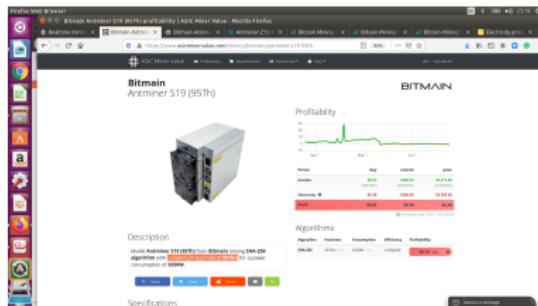
# Q5: Feasibility of Mining

- Hashrate
- Power consumption

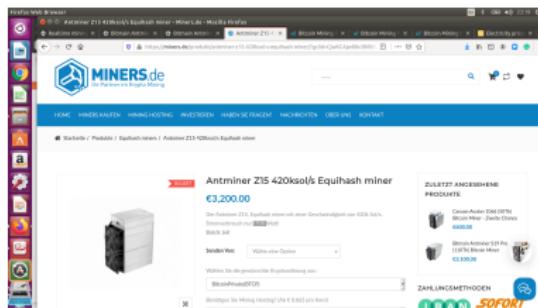


<https://www.asicminervalue.com/>

# Q5: Feasibility of Mining



Check the price

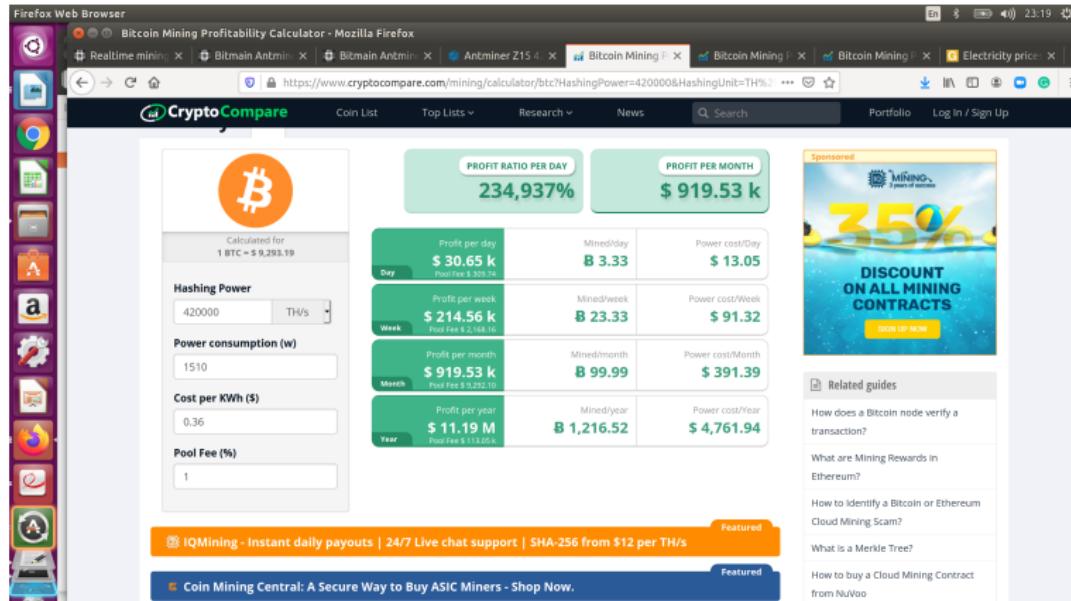


[https://miners.de/produkt/antminer-z15-420ksol-s-equihash-miner/?gclid=CjwKCAjw88v3BRBFEiwApwLeVcOs70521Nn5GpM6cwvzgnVBDHcvVPBPjIIo2n7PoGUIlEelpl7nhoCXvgQAvD\\_BwE](https://miners.de/produkt/antminer-z15-420ksol-s-equihash-miner/?gclid=CjwKCAjw88v3BRBFEiwApwLeVcOs70521Nn5GpM6cwvzgnVBDHcvVPBPjIIo2n7PoGUIlEelpl7nhoCXvgQAvD_BwE)

# Q5: Feasibility of Mining

antminer-z15

- Hashrate: 420k
- Power consumption: 1510

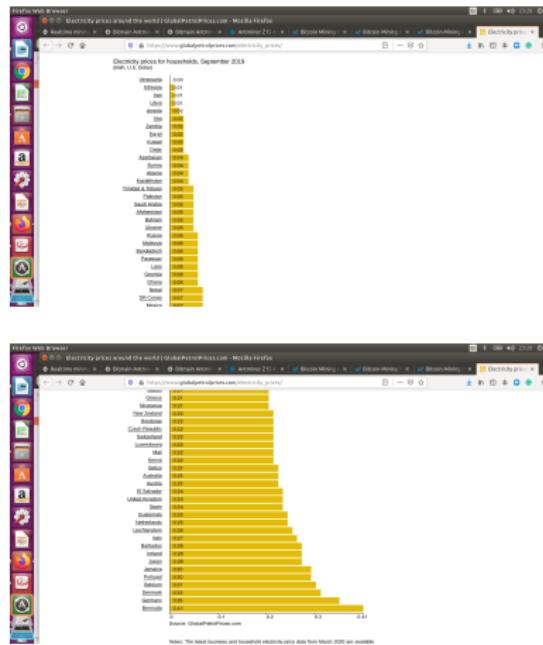


<https://www.cryptocompare.com/mining/calculator>

<https://www.buybitcoinworldwide.com/mining/calculator/>

## Q5: Feasibility of Mining

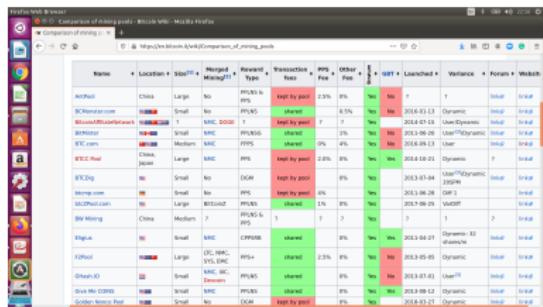
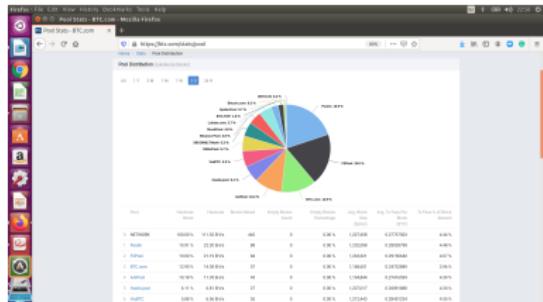
# Electricity



[https://de.globalpetrolprices.com/electricity\\_prices/](https://de.globalpetrolprices.com/electricity_prices/)

## Q5: Feasibility of Mining

## Pool fee



[https://en.bitcoin.it/wiki/Comparison\\_of\\_mining\\_pools](https://en.bitcoin.it/wiki/Comparison_of_mining_pools)  
<https://btc.com/stats/pool>

## Q5: Feasibility of Mining

<https://www.cryptocompare.com/mining/calculator>

<https://www.buybitcoinworldwide.com/mining/calculator/>

<https://www.asicminervalue.com/miners/bitmain/antminer-z15>

[https://en.bitcoin.it/wiki/Comparison\\_of\\_mining\\_pools](https://en.bitcoin.it/wiki/Comparison_of_mining_pools)

<https://btc.com/stats/pool> <https://pool.btc.com/>

<https://www.asicminervalue.com/>

<https://whattomine.com/>

[https://de.globalpetrolprices.com/electricity\\_prices/](https://de.globalpetrolprices.com/electricity_prices/)