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Data Centers and Alternatives

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Advancements in machine learning, data collection, and the proliferation of the Internet necessitates the provisioning of computer resources. Many of these resources are located within data centers. Data centers require tremendous amounts of natural resources and facilitate corporate monopolies. These problems can be mitigated by providing smaller amounts of data and computational power in a greater number of locations and incentivizing the provision of these resources with microtransactions.

According to Lawrence Berkeley National Laboratory (Shehabi), data centers consumed 70 billion kWh in 2014, amounting to approximately 1.8% of the United States' total energy consumption. Data centers require dedicated cooling systems and backup power generators. These cooling systems include industrial-scale air conditioning units, which are necessary for both cooling and humidity control. Based on estimates published by the Center of Expertise for Efficiency in Data Centers (Water), United States data centers consumed about 400 million gallons of water daily in 2018. This is equivalent to 552.6684 billion gallons per year. About one third of data centers do not track water consumption. Smart Water Magazine

(Services) gives a similar estimate of annual data center water consumption in the United States at 626 billion liters annually. While these figures do not represent a large percentage of total United States water consumption, they are sufficiently significant to cause problems in parts of this country whose water resources are already strained.

Data centers, by natural consequence and as implied by their name, are centralized. The tremendous natural resource requirements inherent to these centers prohibit companies without sufficient capital from investing in the construction and maintenance of such facilities. One significant usage of data center capacity is cloud computing. There are three major corporate players in the proverbial cloud computing game: Amazon, Microsoft, and Google. These companies account for 33%, 22% and 9% (Google Cloud Market Share) of total market share, respectively—totally representing 64% of the market.

Problems including but not limited to resource consumption and corporate monopolization can be mitigated by leveraging existing digital resources in a variety of locations. Two categories of such locations could be residences and small offices. These locations already provide resources necessary to facilitate the provision of computational resources, including cooling, power, and Internet connectivity. Residences and small offices are already powered and (often) air conditioned to facilitate the practicality and comfort of occupants. Similarly, almost all of these locations (within the United States) have a connection to the Internet. Considering the cost of these resources as fixed overhead, there is a low marginal cost associated with utilizing the same resources to provide services which would otherwise be provided by data centers. Contrasting a residence to a data center, the residence already bears the cost of electrical power, air conditioning, and Internet connectivity. Constantly running a small computer within a residential environment contributes little to the expenses already borne by the residence. Marginal cost is further diminished when considering that residences and small businesses may have computational and/or digital storage devices which already run constantly. These resources are often not fully utilized. For example, a business may have a server connected to a ten-terabyte drive, but it may only utilize two of these ten terabytes. Accounting for the fact that this storage is already provisioned, the marginal cost of provisioning the unused eight terabytes is reduced to zero, assuming that a ten-terabyte drive has identical resource requirements to a two-terabyte drive.

Considering the existence of data centers as proof of a market demand for digital storage, the business with the eight unused terabytes is incentivized to sell their extra storage capacity to an actor who is interested in purchasing that storage.

While the marginal cost to the business providing their unused resources is zero, the transfer of money incurs cost. For example, if the business were to provide these resources to a purchaser and facilitate the transaction using a credit card, there would be fees assessed by the credit card company. If the transfer of money could be done without the credit card company as an intermediary, a stronger incentive for the business to sell their extra resources would come in turn.

The proliferation of blockchains has resulted in the practical ability to transfer tiny amounts of monetary assets at a fraction of the cost of traditional financial institutions. If we assume that the cost of a credit card transaction is $0.30 per transaction and that the eight terabytes of storage are worth $3.00 per month, if the costumer is invoiced monthly, fully 10% of the income for the business will be spent on processing the transaction. At the time of writing, the cost of a transaction on the polygon blockchain is $3e-8. At such a rate, the customer could be invoiced every second for one month for a total monthly transaction cost of $0.08.

As our dependence on computing technology grows, so does the demand for computational resources. While these resources are currently, in large part, provided by data centers, the same resources could be provided by residences or small offices for a small fraction of the cost.

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