Cryptocurrency Mining: Managing Compute-Intensive Transactions in the Data Center

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THE IMMERSION COOLING AUTHORITY®

Cryptocurrency Mining: Managing Compute-Intensive Transactions in the Data Center

Digital assets inside the blockchain ecosystem, such as cryptocurrency mining, are compute -intensive. To be profitable, they require 24/7/365 high-density operations, and this strains operations and power use in the data centers that host the activity. As the demand for digital asset management grows, how can their data center partners efficiently enable mining in their facilities without compromising service to other clients?

Fortunately, there are options for data centers to manage intensive compute loads without the high cost. This white paper will review the challenges facing data center owners, operators, and managers who host cryptocurrency mining, and examine the benefits of single-phase liquid immersion cooling in providing fast, reliable service with lowered costs.

Current State of Cryptocurrency Mining

Digital asset management (DAM) includes compute-intensive transactions using blockchain. Bitcoin is the first widely adopted cryptocurrency, and first proof of work digital currency. While it serves a relatively small market (with 120 billion digital transactions annually compared to 710 billion in the entire world financial market), the mining of Bitcoin alone consumes 1% of the world's energy[3]. That's almost as much as all global data centers put together.

Cryptocurrencies By the Numbers[1]

Cryptocurrencies in Circulation: 7,500+

Market Cap: $2.21 trillion

Daily Trading Volume: $120 Billion

Price of Bitcoin: $29,126.12

Energy use is a significant element of concern with the rise in cryptocurrency mining; and the sector is facing some potential regulatory hurdles and calls for safeguards, to ensure that mining operations adhere to environmental sustainability standards. Energy use is also a key factor in why hosting digital asset mining can be complicated for data centers.

Powering Cryptocurrency

Over 2,100 kWh electricity for every trade, deposit into Bitcoin ATM, or payment for goods with crypto token.[2]

[1] https://fortunly.com/statistics/cryptocurrency-statistics & https://www.coinbase.com/price/bitcoin
[2] https://digiconomist.net/bitcoin-energy-consumption/
[3] https://digiconomist.net/bitcoin-may-consume-as-much-energy-as-all-data-centers-globally

Processing Cryptocurrency

Cryptocurrency mining is all about processing — using computational power to generate a profit. In the early days, miners used CPUs and GPUs for processing. As the sector matured, so has the hardware. In 2011, miners started using field programmable gate arrays (FPGA), which used less power than GPUs and needed massive cooling fans, and had to be modified for cryptocurrency mining. Today, miners use application specific integrated circuit (ASIC) processors, designed for the sole function of mining cryptocurrency. This new hardware enables solving for one specific algorithm and uses power more efficiently.

Hashrate is a key metric for miners. Speed is required to make digital asset mining profitable. To make a digital asset mining a successful investment, miners have to be harvesting more cryptocurrency than they are paying for electricity. The trend of increasing prices for cryptocurrency drives more orders, and the need for more mining hardware. High speed is also a security tool — a higher hashrate requires more physical processors, which makes it harder for bad actors to disrupt the operations.

Hashrate: Measure of speed of compute power: hashes per second (h/s)

Typical hashing rate of a Bitcoin ASIC: **30-110 terahash per second (TH/s)**

Source: MinerDaily [4]

All this processing requires a tremendous amount of energy — cryptocurrency mining is the ultimate in high-density computing. **A single transaction uses as much electrical energy as nearly 1.5 million Visa transactions.**

Mining of cryptocurrency also creates a significant carbon footprint. **Bitcoin, with over 40% of the cryptocurrency market, on its own produces about 22.5 million metric tons of CO_2 emissions each year.**[5]

Energy Used For Cyptocurrency Mining in 2020: 100 TWh

Source: International Energy Agency [6]

CRYPTO CLIMATE ACCORD

Net-zero emissions from electricity for crypto-related operations by 2030, with more than 250 signatories[7]

[4] https://minerdaily.com/2020/bitcoin-miners-need-these-essential-conversions/
[5] https://fortunly.com/statistics/cryptocurrency-statistics/#gref
[6] https://www.iea.org/reports/data-centres-and-data-transmission-networks
[7] https://cryptoclimate.org

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Data Centers and Cryptocurrency

Blockchain transactions like cryptocurrency mining are compute-intensive. They require specialized, high-performance hardware that can solve the computational algorithms at a high-speed, with accuracy and efficiency. The demand for this kind of hardware only continues to grow. And these transactions strain data center resources, both space and power, that can be used for other clients.

Miners need data centers that can handle this kind of hardware and the intensive processing requirements. Data centers that support cryptocurrency mining are as dense as possible, and are usually in range of 1-5 megawatt facilities[8]. In addition to energy use and sustainability concerns, any data center hosting cryptocurrency mining activities faces two main challenges: cooling the processors and high costs.

Cooling Requirements

Cryptocurrency mining runs at maximum capacity 24/7/365. The demands this puts on a data center are different than that of hyperscale cloud or enterprise data centers. The latter users require uptime and reliability — a data center going offline can result in lost revenue and risk loss of reputation and clients — yet do not run at peak capacity at all times. While downtime does result in lost money for the currency miners, N+1 redundancy is not as important.

Because the intense processing requires incredible power all day every day, cryptocurrency mining generates massive heat, and that makes density and cooling more important considerations for data centers housing these activities.

Costs

Standard data center build costs and cooling technology can make profitable mining impossible. Currency volatility necessitates fast, reliable deployment and massive numbers of servers. Adding racks to an existing site or building out a new cryptocurrency mining focused data center is expensive. And the power to cool this massive infrastructure is also a major cost, and a significant consideration for data centers as they must effectively allocate power and resources to all of their clients.
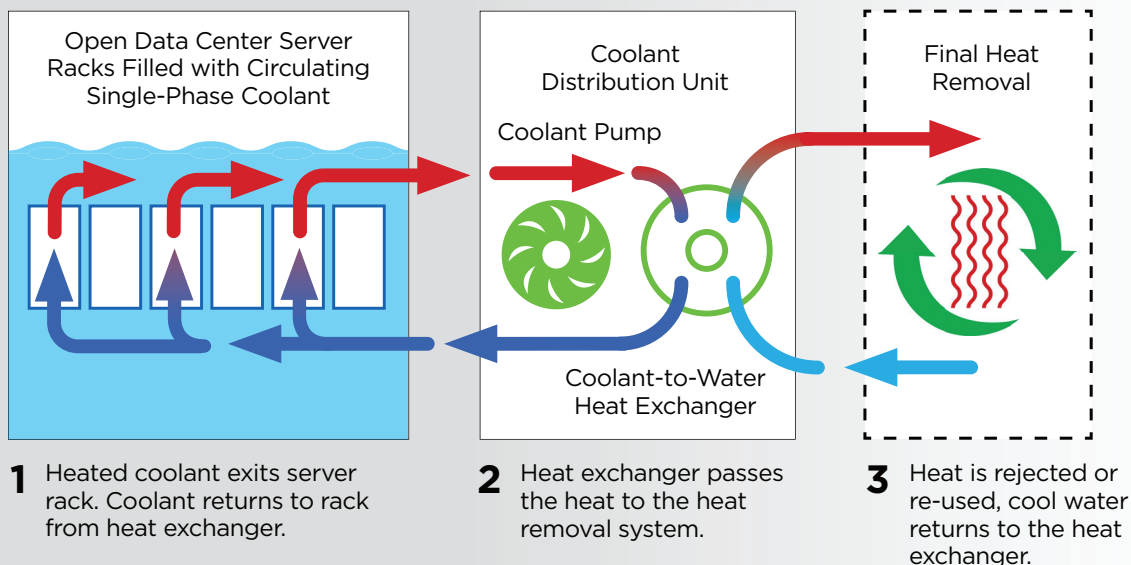
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[8] https://lifelinedatacenters.com/data-center/impact-bitcoin-mining-data-centers/

Solution: Liquid Immersion Cooling

As more data centers accommodate digital asset management operations, like cryptocurrency mining, it will affect how the facilities are planned and built. To overcome the challenges of the massive cooling requirements and energy use, and high costs, data centers hosting crypto mining need the most advanced cooling system available — and they are turning to single-phase liquid immersion cooling as the solution.

Here's How It Works:

Liquid immersion cooling moderates compute temperatures by completely immersing all heat-generating server components in a circulating, non-conductive liquid coolant. It offers the highest level of efficiency plus virtually unlimited capacity.

Open Data Center Server Racks Filled with Circulating Single-Phase Coolant

Coolant Distribution Unit

Coolant Pump

Final Heat Removal

Coolant-to-Water Heat Exchanger

1 Heated coolant exits server rack. Coolant returns to rack from heat exchanger.

2 Heat exchanger passes the heat to the heat removal system.

3 Heat is rejected or re-used, cool water returns to the heat exchanger.

Benefits

When data centers hosting cryptocurrency mining clients adopt liquid immersion cooling, they realize the following benefits:

- **Ease of deployment** — The volatility of cryptocurrency requires fast, reliable deployment. Liquid immersion cooling is an all-in-one solution — cooling and servers together mean minimal site preparation.

- **Lower costs** — Standard data center build costs can make cryptocurrency mining unprofitable. Deploying a single-phase liquid immersion cooling solution can reduce build out costs by as much as 50%, and lower cooling energy costs by as much as 95%.

  Eliminate operating and maintenance costs of complex components such as chillers, air handlers and humidity control systems which are no longer needed. Only three moving parts — redundant coolant pumps and the facility's water pumps — means improved reliability and reduced maintenance needs.

- **Energy efficiency** — Single-phase immersion cooling can deliver an pPUE of 1.03 or less — significantly less than free-air cooling.

- **Space efficiency** — Liquid cooling means no need for raised floors, chillers, or computer room air conditioning units (CRAC).

Cooling Digital Asset Mining Resources with GRC

GRC is the world's immersion cooling authority, providing containerized and rack-based single-phase immersion cooling solutions to data centers since 2009. As the leaders in the data center cooling market, GRC's solutions have helped some of the largest cloud, HPC, and telecom organizations build extremely efficient, cost effective, and resilient data centers across the globe.

GRC's HashRaQ MAX immersion cooling systems can cool up to 288 kW per coolant distribution unit (CDU)[9], allowing customers to pack in miners at far greater densities. GRC cryptocurrency cooling solutions provide the following advantages to data centers:

- Allows DAM servers, like ASICs, to operate without fans.
- Supports the extreme power density of cryptocurrency mining operations.
- Cuts cooling energy costs by up to 95%, drawing less total power to cool servers than the fans removed.
- Simplifies data center architecture.
- Minimizes capital expenses, by reducing build out costs by as much as 50%.
- Protects valuable IT assets
  - o Fewer vibration induced failures.
  - o Coolant protects severs against airborne contaminants and corrosion.
- Future proofs your operations
  - o Reliably cools over 288 kW/CDU, so you never run out of cooling capacity, even when a new generation of hardware pushes power and cooling needs.

Data center owners and operators can place our HashRaQ MAX® systems wherever the power is least expensive, without nearly as much concern for the building being a typical data center space. Whether it is a new build or adding cryptocurrency mining capabilities to an existing facility, GRC's liquid immersion cooling solutions enable you to create an ultraefficient data center with minimal site preparation, and make data asset mining more profitable.

[9] Utilizing a drycooler

HashRaQ^MAX — Built for the Sustainability of Your Business

Designed exclusively for crypto mining, the HashRaQ MAX is a next-gen immersion cooling system that can tackle extreme heat loads. Plus, it offers exceptional value. You'll experience excellent density and performance with minimal infrastructure costs, along with lower supplemental expenses such as electrical, plumbing, networking, and shipping.
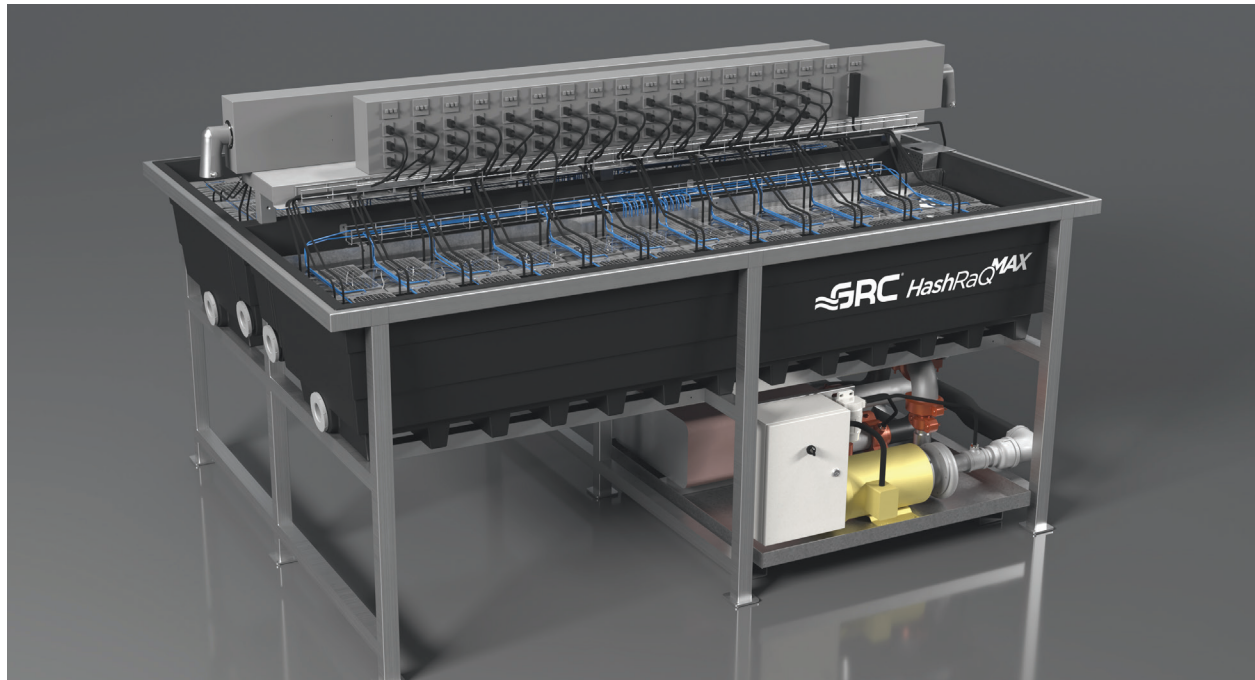
HashRaQ MAX Features and Benefits at a Glance

- Powerful, yet affordable
- Reduces miner and cooling power use[10]
- Minimal cooling system power requirements— pPUE of <1.02[11]
- Cools up to 288 kW per CDU utilizing a dry cooler
- Supports overclocking of over 6 kW/miner
- Optimized for maximum number of miners — capable of 48 Bitmain S19 miners per system
- Remote monitoring provides real-time access to system operating parameters and alerts
- Space-saving footprint with minimal infrastructure requirements

- Performs well in harsh environments
- Accepts warm or chilled facility water
- Racks made with 100% post-industrial, recycled plastics
- Engineered for a long service life
- Recyclable at end of life
- Includes tested and validated, long-lasting dielectric ElectroSafe® coolant with 1200X the cooling capacity of air
- Includes PDUs
- Immersed miners are protected against outside elements and increase reliability

[10] Accomplished through removal of fans.
[11] General specification with 288 kW load.

Call: +512.692.8003
Email: ContactUs@grcooling.com
Visit: grcooling.com