SNIA. | COMPUTE, MEMORY, CMSI | AND STORAGE

Why Cryptocurrency and Computational Storage?

SNIA BrightTalk Webcast

Live: February 15, 2022 at 10:00 am PT

Presenters:

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Eli Tiomkin (NGD Systems), Computational Storage Technical Work Group

Today's Speakers





Presenter: Jonmichael Hands Chia Network Member, SNIA Computational Storage Special Interest Group

Presenter:

Eli Tiomkin NGD Systems Member, CMSI Computational Storage Technical Work Group



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What Does SNIA Do?

 SNIA is a non-profit global organization dedicated to developing standards and education programs to advance storage and information technology.



Who is CMSI?

- Part of SNIA, the SNIA Compute, Memory, and Storage Initiative is a community of storage professionals and technical experts who support:
 - The industry drive to combine processing with memory and storage,
 - The creation of new compute architectures and software to analyze and exploit the explosion of data creation over the next decade.
- CMSI's three Special Interest Groups Computational Storage, Persistent Memory, and Solid State Drives – evangelize and educate on these technologies to the industry

www.snia.org/cmsi



- What is Cryptocurrency and Proof of Space and Time?
- What is Computational Storage?
- Why Cryptocurrency and Computational Storage?



Cryptocurrency

Proof of Space and Time



Why Storage for Cryptocurrency?



Storage is underutilized

Proof of Space and Time leverages underutilized storage to secure the network. Farming was designed to be energy efficient.



Storage is power efficient

Non-Volatile memory designed to store data power efficiently and network power scales with innovations in areal density. Currently 1/600 annual energy use of Bitcoin.



Incentivizes circular economy

Chia farming is a new use case for used storage that will help reduce e-waste and promote the secure reuse of storage.

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Farming, Not Mining!



Chia farmers store cryptographic hashes in plot files on hard drive

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Challenges come in from the network and a farmer checks plots for winning proofs

If farmer finds a winning proof, they broadcast that to the network to form a "block" on the blockchain with transactions

Farmer is rewarded Chia (XCH) Currently 2 XCH per block

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Proofs of Space and Time for the Win!





Proofs of Space

- Farmers need to prove to the network that they are storing the data.
- Need to be easily and quickly verifiable
- Needs to be resistant to attacks

Proofs of Time

- Verifiable Delay Function (VDF) that cannot be parallelized
- Easily verifiable that a real amount of time was spent with deterministic output
- Performs squaring computations within class groups of binary quadratic forms

The Fix to Proofs of Space



- Proofs of space designed with 7 tables to prevent Hellman attacks
- Need to be able to quickly retrieve proof (make farming easy)
- Plot size determined by k parameter

Plotting is Write Intensive Workload

- Phases of plotting require a lot of sort on disk & algorithmic compression
- Each K=32 plot takes 1.43TB of disk writes
 - Can be reduced by 72% with 110GB of DRAM
 - Can be eliminated with 416GB DRAM (~300GB with space tradeoff)

Chia Proof of Space Construction

Version: 1.1

Updated: July 31, 2020

Introduction

In order to create a secure blockchain consensus algorithm using disk space a Proof of Space is scheme is necessary. This document describes a practical construction of Proofs of Space based on Beyond Hellman's Time-Memory Trade-Offs with Applications to Proofs of Space [1]. We use the techniques laid out in that paper, extend it from 2 to 7 tables, and tweak it to make it efficient and secure for use in the Chia Blockchain. The document is divided into three main sections: What (mathematical definition of a proof of space), How (how to implement proof of space), and Why (motivation and explanation of the construction) sections. The Beyond Hellman paper can be read first for more mathematical background.

• Chia Proof of Space Construction Introduction • What is Proof of Space? Definitions Proof format Proof Quality String • Definition of parameters, and $\mathbf{M}, f, \mathcal{A}, \mathcal{C}$ functions: Parameters: f functions: Matching function M: A' function: A function: • Collation function C: How do we implement Proof of Space? Plotting Plotting Tables (Concepts) Tables Table Positions Compressing Entry Data Delta Format ANS Encoding of Delta Formatted Points Stub and Small Deltas Parks Checkpoint Tables Plotting Algorithm Final Disk Format Full algorithm Phase 1: Forward Propagation Phase 2: Backpropagation Phase 3: Compression Phase 4: Checkpoints



Plotting – All About Performance



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Chia Plotting – Files Are Created and Then Transferred to Hard Drive

Use compute, memory and temporary storage to create plot files

I.	Plot >	Add a Plot		🛪 ENGLISH 🗸 🌓
lode	0	Choose Plot Size		
5	2	You do not need to be synced or connected to plot. Temporary files. 600MIB (k=25, temporary space: 1.8GiB) 101.4GiB (k=32, temporary space: 229GiB) 208.8GiB (k=33, temporary space: 2104GiB) 429.8GiB (k=34, temporary space: 1041GiB) 884.1GiB (k=35, temporary space: 2175GiB) Plot Count* 1 Does your machine support parallel plotting? Plotting in parallel can save time. Otherwise, add plot(s) to the queu Add Plot to Queue Plot in Parallel Show Advanced Options	ee.	process which
	3	Select Temporary Directory		
		Select a temporary folder for plot creation. We recommend you use	a fast drive.	
		Temporary folder location *		BROWSE
		Show Advanced Options		







How Can Computational Storage Help Speed Up Plotting?

- Compression is hard new algorithms
- Lots of sort on disk acceleration
- Need to beat cost of DRAM or performance of high performance NVMe for similar price
- Opportunities to reduce disk writes
- Opportunity for doing low power plotting with onboard compute

Plotting Hardware Required

Use plotting as a service **Workstation Desktop** Server **Plotting Cloud** aws **A**akash **Or**... **High endurance NVMe** EQUINIX Inter

Create plots as fast as possible. Requires use of hardware for duration of plotting (a few months) Download plots from providers. Requires high speed internet connection



Farming – Efficient Protocol





Very lightweight process requires low CPU



Farming Hardware Required

JBOD NAS Desktop

DIY



High capacity HDD



JBODs (Just a bunch of disk) houses many hard drives Store the most data in the smallest amount of space at lowest power

Use high-capacity HDDs for best power efficiency, or cheap used drives if rack space and power are more available



TCO Chia Farming

TCO \$ per TB - Breakdown





Chia Calculator Using SNIA TCO Model!

- Use Chia Calculator to estimate earnings and input variables to look at total cost of ownership and profitability for Chia farming!
- Uses <u>SNIA TCO model</u> as base for calculations
- Very user friendly
- https://chiacalculator.com/roi

Chia Calculator

Advanced Cost and ROI Analysis

Use this advanced calculator to determine the total cost of ownership (TCO) of a Chia plotting and farming setup, and estimate the return on that investment (ROI).

The TCO model is based on this SNIA whitepaper, and special thanks to JM (aka storage jm) for supporting us build this. Make sure to watch his walkthrough video for an overview of how to use this tool.

Farming and Plotting	J Setup	Summary of Costs				
Strategy	Deployment Term	Total Cost of Ownership (TCO) over 5 Years				
How many years the farm will be kept operational, whether all	5 Years 🗸	Total	\$201.84k			
hardware will be sold at the end of deployment, and when to sell	XCH Strategy	Total per TB 5	\$31.15			
the earned XCH.	Sell Continuously 🗸	Total per TB per Month of S Deployment				
	Hardware Resale ✓ Sell hardware after 5 years		\$0.52			
Hard Drives	Drive Count Preset	Hardware Acquisition Cost	s (CapEx)	J		
The drives used in your farm. If using a combination of different	360 New 18 TB 🗸	Storage	\$144.00k			
drives, input the overall average of your entire farm.	Drive Capacity Total Capacity 18 TB 6480 TB	Server	\$23.50k			
		Total	\$167.50k			
		Total per TB \$25.85				
	0.44 % @	Total per TB per Month of Deployment	\$0.43			
	Active Power Idle Power					
	6.5 W 5.6 W 📀	Operational Costs (OpEx) over 5 Years				
	Cost Replacement Cost \$ 400 \$ 50	Storage Power Use	\$13.29k			
		Server Power Use	\$19.71k			
		Plotting Power Use	\$972.00			
	Resale Value after 5 Years	Failed Drive Replotting Power	\$18.90			



Computational Storage



Need A New Way to Look at Storage

Pain PointsPhysical SpaceAvailable PowerScaling MismatchBottleneck Shuffle

Scaling requirements are not met with existing solutions One CPU to many storage devices creates bottlenecks These bottlenecks exist, we currently just shift where they reside



Technologies that 'compose' these elements just exacerbate the bottleneck

A way to augment and support without wholesale change is needed



Using Computational Storage

Benefits

Distributed
 Processing

Faster Results

Lower Power

Smaller Footprint

Reduced data transfers

Reduced fabric provisioning

Scaling compute resources with storage provides access to results faster

Computational Storage resources 'offload' work from the overtasked CPU

Seamless architectures create new 'servers' with each storage device added



Additional CPU resources without added rack space

Why Cryptocurrency and Computational Storage?

Proof of Work (PoW)



Proof of Space and Time (PoST)

Using Storage to Plot/Farm

SSD







Auto-Plotting Cryptocurrency with Computational Storage

How does Computational Storage Support Proofs of Space?

- CSDs provide the Compute Necessary on Board
- Reducing the TCO of Chia Plotting by using CSDs at Scale
- Reduce Host activity, increase Plots more quickly
 - Faster time to Revenue, Reduced Acquisition Costs







Why Cryptocurrency and Computational Storage?

NGD



Total Cost of Ownership (TCO) Model for Storage



SSC

Auto-Plotting Cryptocurrency with Computational Storage



CMSI

Auto-Plotting Cryptocurrency with Computational Storage

How does Computational Storage Support PoST?

CSDs provide the Compute Necessary on Board





Thanks for Watching Our Webcast

- Please rate this webcast and provide us with feedback
- A link to this webcast and the PDF of the slides are posted to the SNIA Compute Memory and Storage Initiative website at <u>https://www.snia.org/forums/cmsi/knowledge/articles-</u>

presentations

- You can also find this <u>webcast</u> and many other videos and presentations on today's topics in the <u>SNIA</u> <u>Educational Library</u>
- A Q&A from this webcast will be posted to the SNIA <u>Compute, Memory, and Storage Blog</u>
- Learn more about computational storage at www.snia.org/computational





Why Cryptocurrency and Computational Storage?

🛗 February 11, 2022 💄 Marty Foltyn 🔍 Leave a comment

Our new SNIA Compute, Memory, and Storage webcast focuses on a hot topic – storage-based cryptocurrency.

Blockchains, cryptocurrency, and the internet of markets are working to transform finance, wealth, safety, digital security, and trust. Storage-based cryptocurrencies had a breakout year in 2021. Proof of Space and Time is a new blockchain consensus that uses storage capacity to secure the blockchain. Decentralized file storage will enable alternatives to hyperscale data centers for hosting files and objects. Understanding the TCO of a storage system and optimizing the utilization of the

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Where To Find Out More About Cryptocurrency & Computational Storage

- Website resources
 - www.snia.org/CMSI
- Twitter
 - <u>@sniacomputational</u>
- Blog
 - SNIAComputeMemory&Storage
- Videos
 - https://www.youtube.com/user/SNIAVideo/playlists
- Educational materials
 - https://www.snia.org/educational-library
- Joining SNIA and the Compute, Memory, and Storage Initiative
 - https://www.snia.org/member_com/join-SNIA



The ndustry leading companies of the SNIA Compute, Memory, and Storage Initiative (CMSI) support the industry drive to combine processing with memory and storage, and to create new compute architectures and software to analyze and exploit the explosion of data creation over the next decade.

CMSI Engages and Educates



- Solid State Drives Persistent Memory
 - Solid State Systems
- PM and SSD Performance
 - ✓ SSD Form Factors

CMSI Accelerates Standards

- Computational Storage Architecture Model
- Persistent Memory Programming Model
- PM Hardware Threat Model
- Solid State Storage Performance Test Specifications
- SSD Form Factor Specifications



- Persistent Memory Programming Bootcamps
- PM Remote Access for High Availability White Paper
- SSD Form Factors Explained
- Compute, Memory, and Storage Demos at live and online technology events
- Interactive Webcasts with Industry Experts
- Technology Videos on the SNIA Video YouTube Channel





Thank You for Watching!



You can always reach us at <u>askcmsi@snia.org</u> www.snia.org/cmsi

