

Dark Forest: Lessons from 3 years of on-chain gaming

gubsheep, 0xPARC

> df





I'm gubsheep

- Worked with the Ethereum Foundation since 2018 on education, community, and applied ZK R&D.
- Created Dark Forest and spent 2019-2021 building it with Ivan Chub, Alan Luo, Brice Huang, Robert Cunningham, ...
- Currently working on applied ZK R&D and other applied crypto experiments at 0xPARC.

> df



Today's Talk

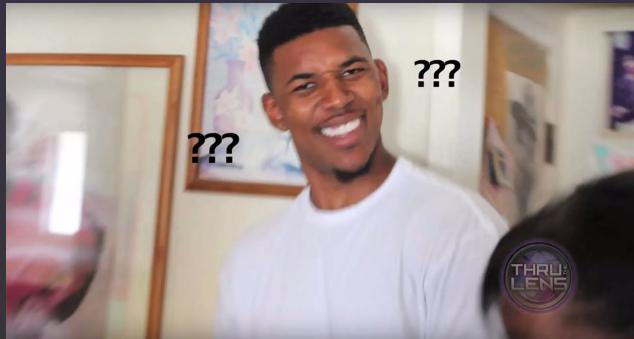
What can projects like **Dark Forest** teach us about innovation in crypto broadly?

Today's Talk

Dark Forest is a **decentralized MMORTS** game
built with **zkSNARKs** on **Ethereum**.

Today's Talk

Dark Forest is a **decentralized MMORTS** game
built with **zkSNARKs** on **Ethereum**.



@algoriddims

5506256 pts 1.0M 2.7M 51 -



Plugin Library

heatmap + x



(-173880, 15318)

TEMP: 21° (DEEP SPACE)

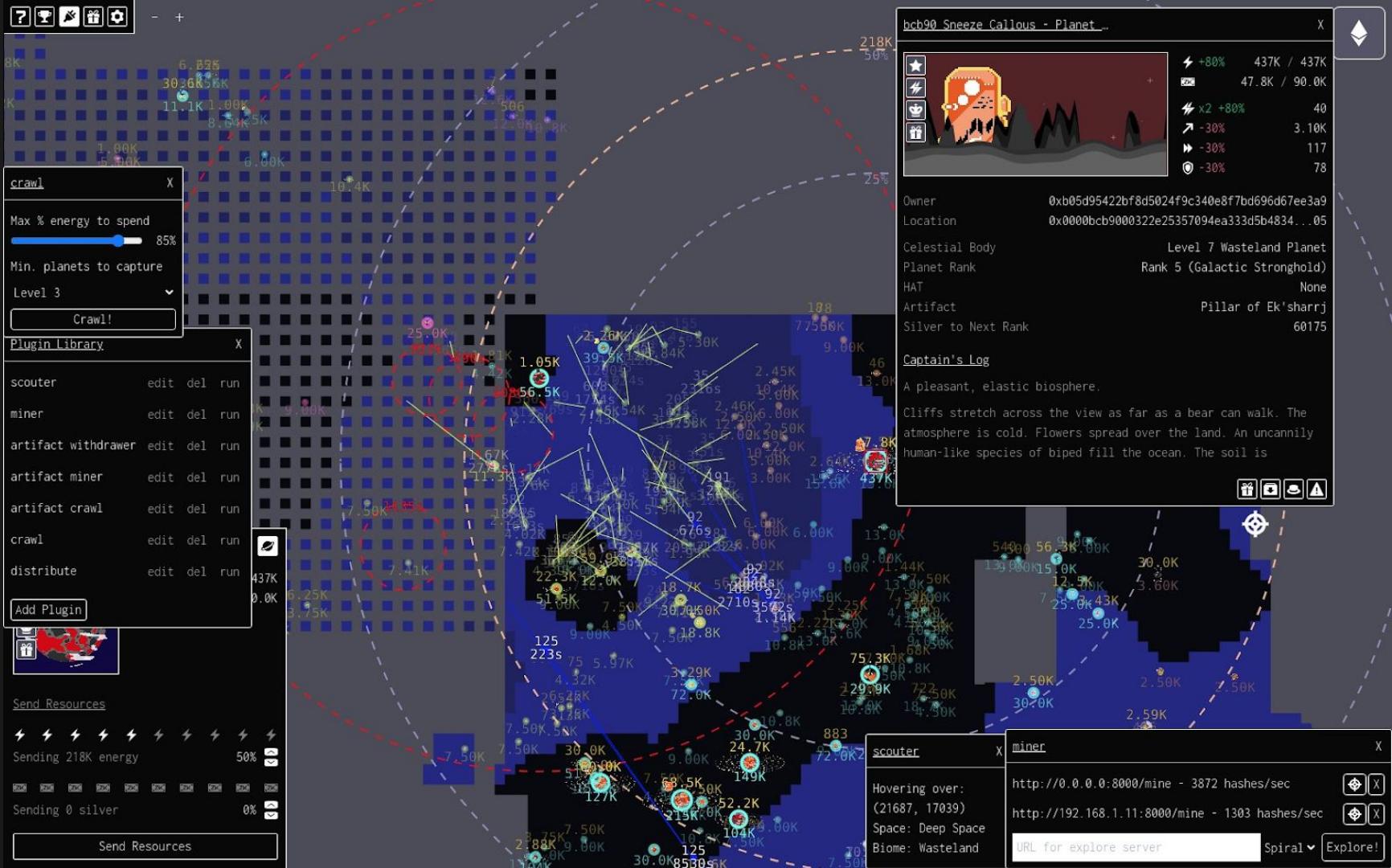
303 #/s @ (-187504, 21184)

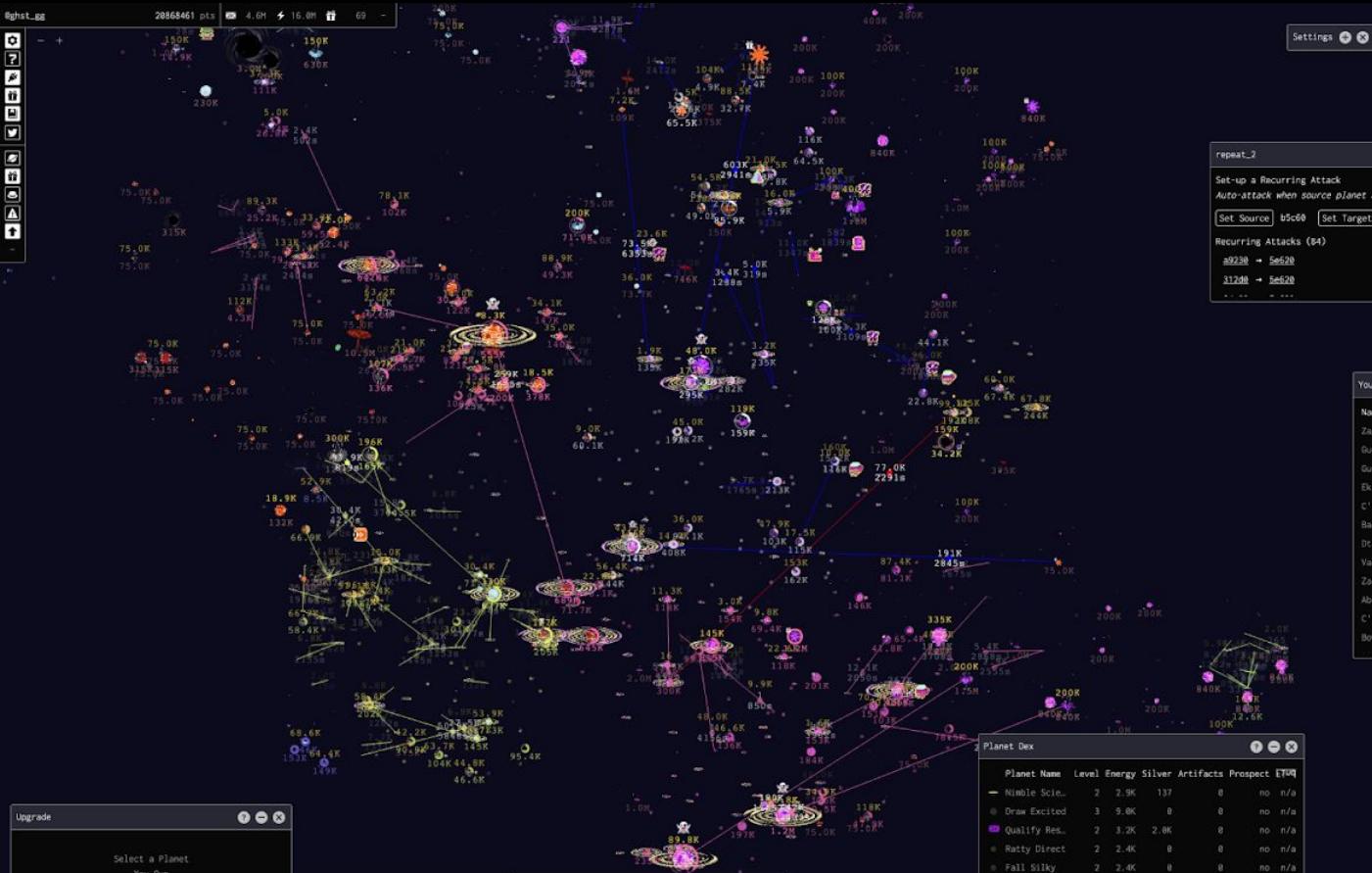
Move

1 core



[TX CONFIRM] PLANET_TRANSFER transaction (0x [xec4b](#)) confirmed.
[TX SUBMIT] PLANET_TRANSFER transaction (0x [db8c9](#)) submitted to blockchain.
[TX CONFIRM] PLANET_TRANSFER transaction (0x [xd8c9](#)) confirmed.
[TX SUBMIT] PLANET_TRANSFER transaction (0x [a6fb](#)) submitted to blockchain.
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[TX SUBMIT] PLANET_TRANSFER transaction (0x [07b0](#)) submitted to blockchain.
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[TX SUBMIT] PLANET_TRANSFER transaction (0x [bf5f7](#)) submitted to blockchain.
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[TX SUBMIT] PLANET_TRANSFER transaction (0x [a5bc](#)) submitted to blockchain.
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[TX SUBMIT] PLANET_TRANSFER transaction (0x [2c91](#)) submitted to blockchain.
[TX CONFIRM] PLANET_TRANSFER transaction (0x [x2c91](#)) confirmed.
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[TX CONFIRM] PLANET_TRANSFER transaction (0x [xd9e1](#)) confirmed.
[TX SUBMIT] PLANET_TRANSFER transaction (0x [d9ec](#)) submitted to blockchain.
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[TX SUBMIT] PLANET_TRANSFER transaction (0x [ba4d](#)) submitted to blockchain.
[TX CONFIRM] PLANET_TRANSFER transaction (0x [xba4d](#)) confirmed.
[TX SUBMIT] PLANET_TRANSFER transaction (0x [07a4](#)) submitted to blockchain.





Facts		Type	Value
	Location	Type	Value
j	Iron Cut	Monolith	Legendary
j	Bell Write	Monolith	Legendary
j	Wide-eyed X.	Colossus	Legendary
ad	Inventory	Black Domain	Epic
ad	Inventory	Black Domain	Epic
ad	Inventory	Spaceship	Epic
ad	Inventory	Pyramid	Epic
ad	Inventory	Colossus	Epic
e	Cub Scary	Black Domain	Epic
e	Organization	Phosid Cannon	Epic
e	Spotty Nerve	Colossus	Epic
e	Lip Try	Pyramid	Epic

In Library	
ng Started	edit del run
ke Artifacts	edit del run
age	edit del run
ce Explorer	edit del run
exp	edit del run
_2	edit del run
date	edit del run
er	edit del run
silver	edit del run
planet	edit del run
...	

imed.
[CORE]:
1

Today's Talk

Dark Forest is a **decentralized MMORTS** game
built with **zkSNARKs** on **Ethereum**.

Dark Forest started
as a pie-in-the-sky experiment

“Let’s build a ZK game where every WASD
move triggers a transaction and a zkSNARK
proof on-chain”

A lot has happened since!

- 10k+ players from around the world have participated in Dark Forest rounds, running entirely on-chain
- Trillions of gas used on Ropsten / xDAI / Gnosis Chain
- Rich developer ecosystem: plugins, alternate clients, GPU miners, player corporations, data marketplaces, chain analysis tools, and more
- Epic on-chain dramas featuring deception, betrayal, universe-wide alliances, ...

A lot has happened since!



willchang.eth | WLD Show Podcast
@wiilichang

Move over Star Wars.

What happened this past round of Dark Forest has to be the most epic space saga of all time.

Bitter Rivals. A Dream of Glory. Betrayal. Redemption.

Here's the story 

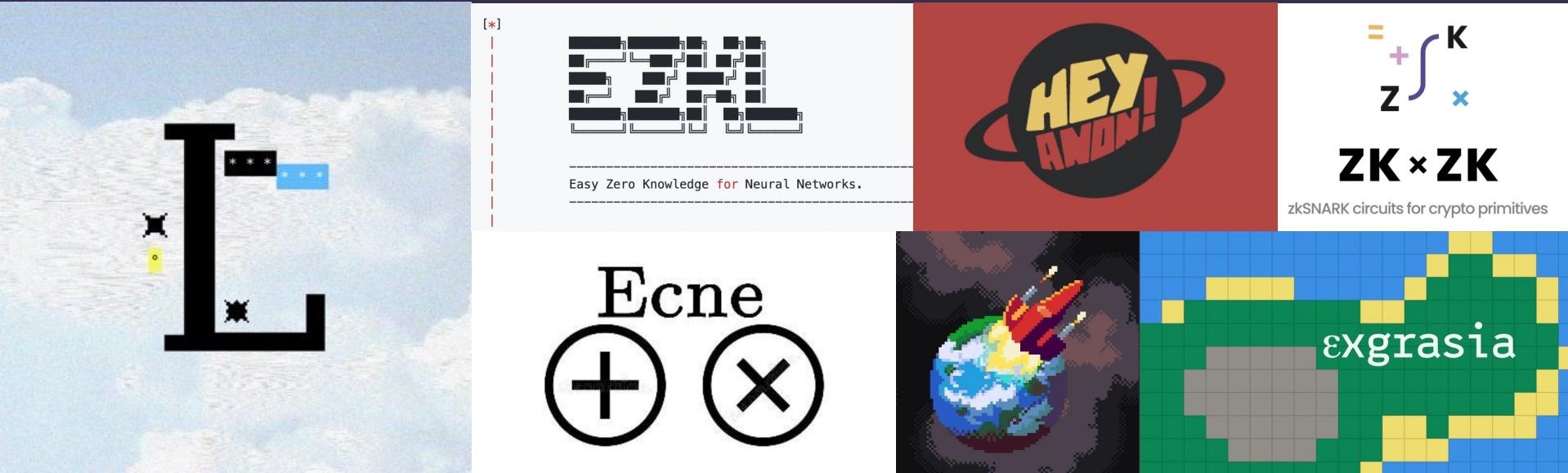


dfdao and ordenGG have agreed to a diplomatic draw in Dark Forest v0.6.5



A lot has happened since!

Today: a thriving ecosystem of “next-generation” application R&D, in the broader 0xPARC community



QUESTION 1

Why build games
on the **blockchain**?

REASON: Permissionless Interoperability

Dark Forest is an Ethereum **smart contract**, which anyone (player, bot, or smart contract) can interact with programmatically.

Client-side plugins



v0.6.0

Scoring Planets

Utilities

Planet	Level	Score
1. Society Eggnog	9	0
2. Beautify Sedate	5	681
3. Apply Place	3	851
4. Cleave Rate	3	1270
5. Marble Far	3	1506
6. Actor Beseach	4	1711
7. Enhancing Hydrant	3	1737
8. Glitter Protective	3	1855
9. Annoyed Berserk	3	1871
10. Establie Kill	3	2036
11. Trust Leather	3	2090
12. Resolve Blush	3	2106
13. Miss Lick	3	2169
14. Ill-fated Vacation	3	2169
15. Lean Spring	3	2211
16. Drive Testy	3	2270
17. Distracted Prod	3	2402
18. Grade Nine	3	2471
19. Peace Giant	3	2568
20. Present Pusheen	3	2658

See the top scoring planets within your vision

v0.6.0

Tiny Leaderboard

Utilities

		Time
66.	0x6d5adb	31005461
67.	future6655	30891410
68.	arn_e	30171048
69.	0x76a959	30103572
70.	James0461876	30013270
71.	0x9029cc	29910425
72.	yh_chen	29808758
73.	0x8295e6	28234957
74.	Bulmenisaurus	27469536
75.	0xe5f3a7	27188682
76.	dm4	27011078

Shows a tiny leaderboard with timer

v0.6.0

Remote Snarker

Productivity

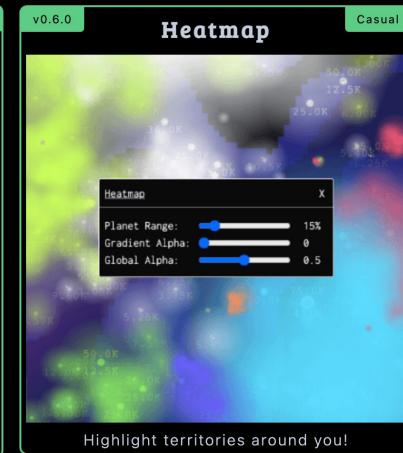
Remote Snarker

https://snarker.onrender.com/move | busy: 0.00 | 5.00s/snark | 17 Snarks Calc'd

URL for remote snarker

Add

Speed up snark computation using servers.



Third-party client implementations

 gakonst/dark-forest

 Watch ▾

Code

Issues 1

Pull requests 1

Actions

Projects

Wiki

Security

Insights

master ▾

3 branches

0 tags

Go to file

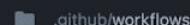
Add file ▾

Code ▾



gakonst Merge pull request #13 from mattssse/misc ...

 f441ea5 12 days ago  117 commits



.github/workflows

ci: do not double run tests

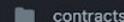
14 days ago



abis

fix: update abis

17 days ago



contracts

feat: add smart contract account scaffolding

2 months ago



crates

rustfmt

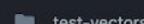
12 days ago



scripts

feat: add abis and codegen for bindings

2 months ago



test-vectors

fix: off by one error in threshold calc + more tests cases

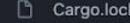
2 months ago



.gitignore

feat: add abis and codegen for bindings

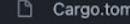
2 months ago



Cargo.lock

chore: update deps

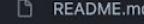
14 days ago



Cargo.toml

simplify members

12 days ago



README.md

docs: add readme for cli

14 days ago



README.md

dark-forest.rs

About

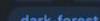
[WIP] Rust implementation of the Dark Forest game client



rust

cryptography

ethereum



Readme

Releases

No releases published

Packages

No packages published

Contributors 3



gakonst Georgios Konstantopoulos



kobigurk Kobi Gurkan



mattssse Matthias Seitz

Automations and bots



nick.eth @nicksdjohnson · Aug 16

...

Weekend project: A [@darkforest_eth](#) AI.

So far it attacks planets, distributes silver, upgrades planets, and prospects and finds artefacts.

Still on the todo list is distributing energy. Figuring out how to allocate and use artefacts will be tricky though.

Rose Sleepy (L4R0)	Sending 27000 silver to Oatmeal Breathe (L5R0)
Six Hiss (L4R0)	Sending 14250 silver to Oatmeal Breathe (L5R0)
Fog Resell (L4R0)	Sending 25471 silver to Onerous Jaded (L5R2)
Jail Amuck (L4R0)	5% to prospect
Changeable Ludicrous (L4R0)	Capturing Redo Convince (L5R0) with 28125
Measly Depend (L4R0)	12% to attack Redo Convince (L5R0)
Daffy Sneeze (L4R0)	10% energy to send silver to Fold Rapid (L3R0)
Otter Button (L4R0)	30% energy to send silver to Fold Rapid (L3R0)
Harbor Country (L4R1)	89% to attack Redo Convince (L5R0)
Bridge Convince (L4R0)	34% to attack Redo Convince (L5R0)
Lose Jail (L4R0)	Capturing Rhythm Snap (L4R0) with 34771
Childhood Partake (L4R2)	91% to attack Rhythm Snap (L4R0)

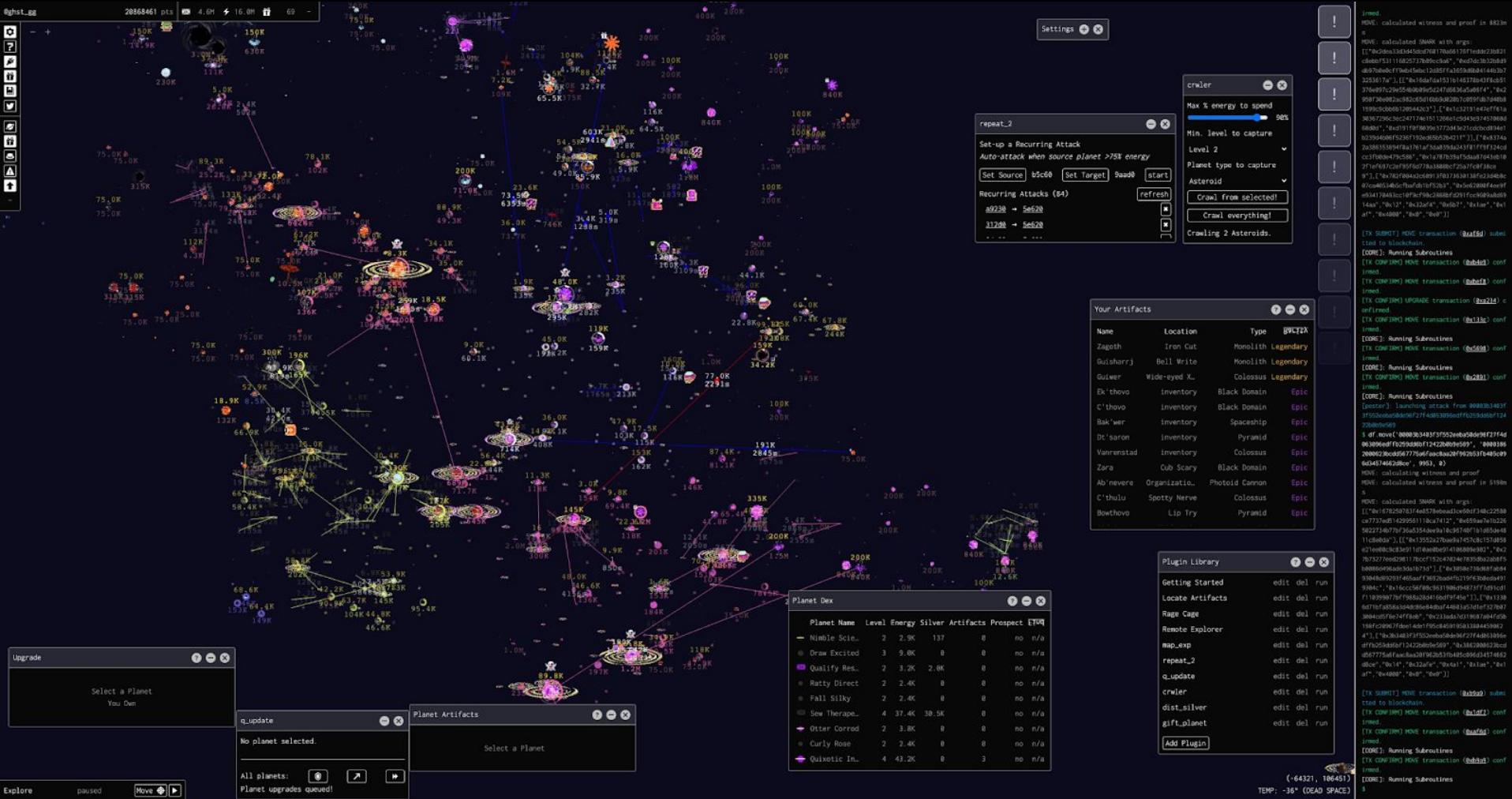
9

12

85



Tip



New core gameplay features

Project Sophon

[Twitter](#) [GitHub](#)

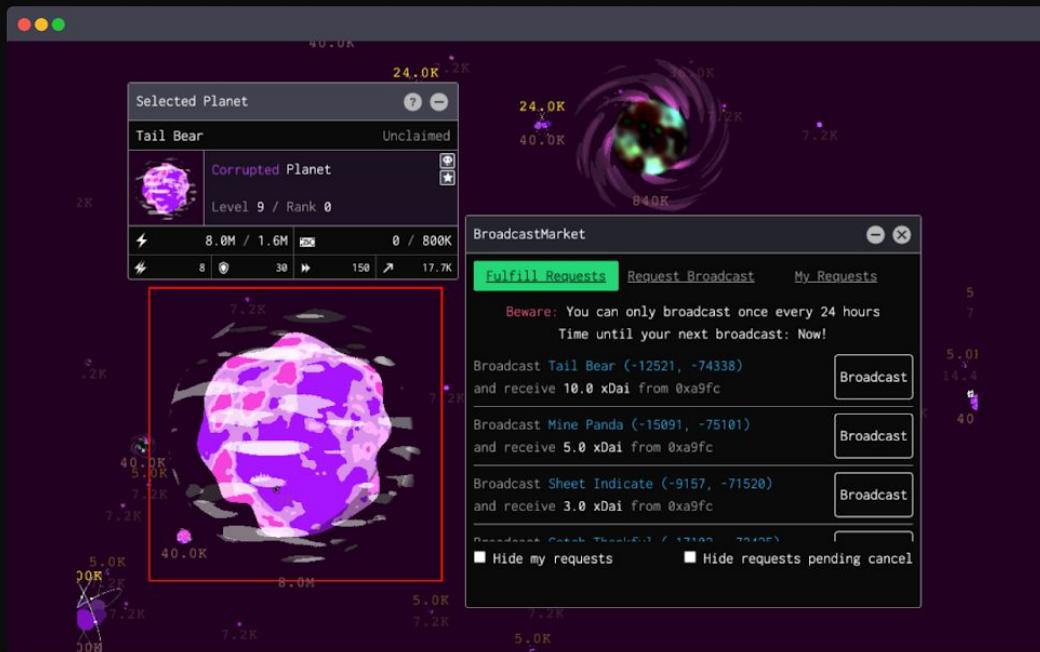
Broadcast Market

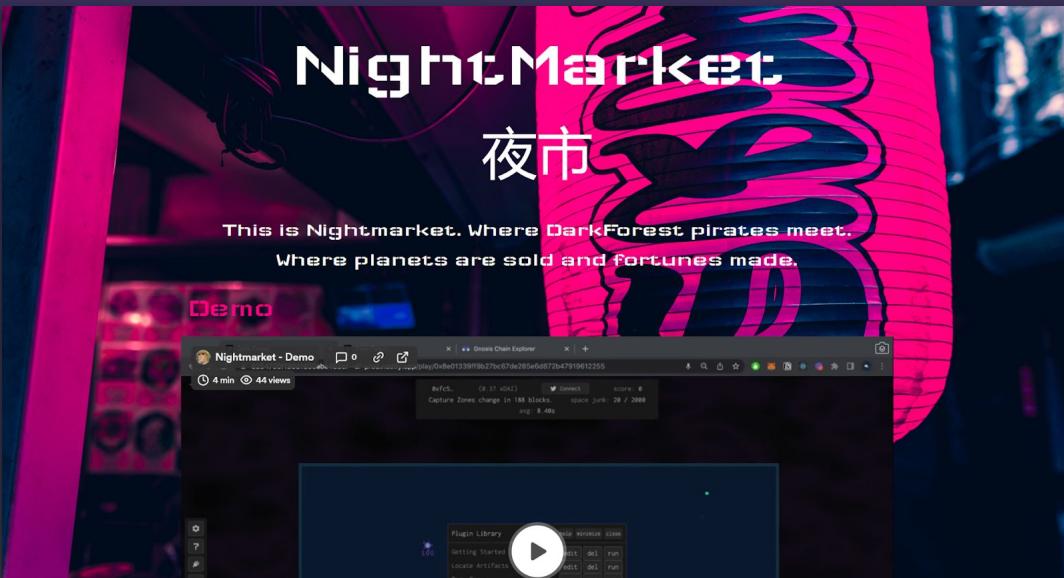
Forget refilling across the xDai Bridge. Play to Earn with Sophon.

Each player only gets one Planet Broadcast per day—don't waste it, you could be getting paid to play!

Just create a new plugin containing:

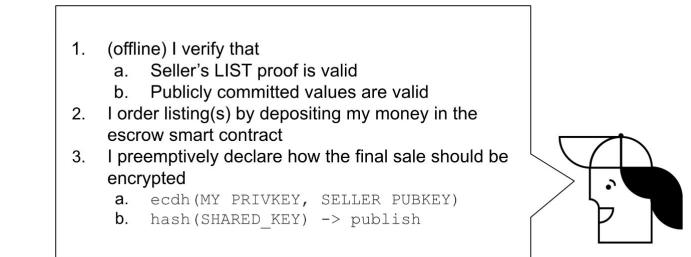
```
1 export { default } from "https://play2earn.projectsophon
```





	Constraint	Publicly Verifiable Value
Seller	hash(PLANET_X/Y, PLANETHASH_KEY)	A valid planet hash
	perlin(PLANET_X/Y, BIOMEBASE_KEY)	The correct biomebase
	poseidon_encode_check(CIPHERTEXT, PLANET_ADDR, KEY)	Valid ciphertext using KEY
	hash(KEY)	KEY won't change later
	SELLER_ADDR * SELLER_ADDR	Watermark proof to Seller

1. (offline) I verify that
 - a. Seller's LIST proof is valid
 - b. Publicly committed values are valid
2. I order listing(s) by depositing my money in the escrow smart contract
3. I preemptively declare how the final sale should be encrypted
 - a. ecch(MY PRIVKEY, SELLER PUBKEY)
 - b. hash(SHARED_KEY) -> publish



	Constraint	Publicly Verifiable
Seller	poseidon_encode_check(SALE_CIPHER, KEY, SHARED_KEY)	The KEY being sold is correctly encrypted with SHARED_KEY
	hash(SHARED_KEY)	Seller uses Buyer's expected SHARED_KEY
	hash(KEY)	The correct KEY is being sold
Buyer	1. Smart contract verifies & execs the sale proof 2. Buyer decrypts KEY with SHARED_KEY offline 3. Buyer decrypts CIPHERTEXT with KEY offline	

Marketplace							minimize	close
Listing				Inventory				
Name	Type	Stat %	Value	Stat %	Value	TPM %	Order	Action
Wormhole	Structure	+0%	+0%	+0%	+0%	+0%	500.0xDai	Buy
Photoid Cannon	Structure	+0%	+0%	-50%	+0%	+0%	500.0xDai	Buy
Planetary Shield	Structure	+0%	+0%	+100%	-80%	-80%	500.0xDai	Buy
Planetary Shield	Structure	+0%	+0%	+100%	-80%	-80%	500.0xDai	Buy
Pyramid	Structure	+0%	+0%	+10%	+20%	+0%	500.0xDai	Buy
Planetary Shield	Structure	+0%	+0%	+200%	-80%	-80%	600.0xDai	Buy
Black Domain	Structure	+0%	+0%	+0%	+0%	+0%	666.0xDai	Buy
Planetary Shield	Structure	+0%	+0%	+350%	-80%	-80%	666.0xDai	Buy
Black Domain	Structure	+0%	+0%	+0%	+0%	+0%	780.0xDai	Buy
Pyramid	Structure	+0%	+0%	+45%	+0%	+0%	800.0xDai	Buy



The Astral Colossus - Inventory

The Astral Colossus

[minimize](#) [close](#)

0. The Astral Colossus	(Rank 34: 76528735)	76528735
1. @TheVelorum	(Rank 189: 505491)	17700133
2. @davidryan59	(Rank 100: 5275290)	13898245
3. @scotato	(Rank 228: 260000)	7979795
4. @tofu4956	(Rank 91: 8120164)	3747725
5. @jojazzas	(Rank 117: 2958284)	3477702
6. @orden_gg	(Rank 1: 777777777)	3461902
7. @MJ659600	(Rank 70: 30316438)	3347518
8. @xJunshen	(Rank 68: 34673145)	3165856
9. 0xcF0cc...	(Rank 221: 281000)	3081000
10. @CryptoPriest6	(Rank 61: 48465292)	2822434
11. 0x2616B...	(Rank 10: 154472935)	2734149
12. @thelegendoftin1	(Rank 184: 592176)	2073140
13. @vjotav	(Rank 72: 26777836)	1650000

[Contribute](#) [Leaderboard](#) [Help](#)

Plugin Library

help minimize close

Claim Game Mode

edit del run

Artifact Shards

edit del run

Oil and Uranium R...

edit del run

Sattelites

edit del run

Add Plugin

What does permissionless interoperability mean?

Permissionless interoperability means that players can build the game experience, not just core developers.

It means that other games can hook into your game to share assets, identity systems, mechanics, and more. No “support team” or “BD team” needed.

Marketplaces, player corporations, nested games inside games, new resources and mechanics, automations, alternate clients, interoperable assets and stats, shared reputation systems, and more...

QUESTION 1

Why build games
on the **blockchain**?

QUESTION 2

Why build **games**
on the blockchain?

QUESTION 2

Why build anything which
we don't have a obvious
practical use case for
on the blockchain?

REASON 1

Games are a technically demanding
yet low-stakes environment.

They allow us to rapidly push infrastructure
forwards without putting massive amounts of
financial value at risk.

Deleted Account

My main thing was making sure you all knew df v.05 was going to...

We have pretty big improvements on Nethermind nodes which we profiled with their team on DF after the end of the game.

Will scale up infrastructure before the launch. If you have an idea how can we make a smoke test before the play test I am very interested in it

Diamonds in Projects

- Smart Contracts as Apps - EIP-2535 Diamonds and the feasibility of a DAO Operating System
- Dark Forest & the Diamond Standard - Dark Forest project moves to and discusses diamonds.
- The Diamond Standard: A new paradigm for upgradeability - DerivaDEX on diamonds.
- We like the (EIP-2535) Diamonds - Premia Finance talks about their use of diamonds.
- Why Gotchivault is upgrading to the Diamond standard - How to upgrade an existing proxy contract to EIP2535 Diamonds.
- Handling multiple tokens, with a modern solidity architecture via Diamonds & ERC1155
- Smart contract packages — upgradeability for normal people

core: subtract deposit gas from pool, so other txs do not use the same gas #35

Closed

protolambda wants to merge 1 commit into [tx-pool-fix](#) from [deposit-gas-pool-fix](#)

(Gnosis, Erigon, Lattice) Fast EVM chain for Dark Forest and on-chain games

project, is working on better programming models and better infrastructure. We are investing heavily in a protocol and infra lab. The protocol lab would work on better programming models (we currently have an EVM [ECS](#) system) and better clients (~ software), while the infra lab would work on better execution layers (~ hardware). Having both labs to work freely with the rest of the ecosystem (Gnosis, Erigon, OP, etc) will allow us to build products faster. Having them in-house with us makes it easier for them to "build what they want" given we have products in production today that require much better infrastructure.

[ethereum-optimism / reference-optimistic-geth](#) Public archive

[Code](#) [Issues](#) [Pull requests](#) [Actions](#) [Projects](#) [Security](#) [Insights](#)

core/types: deposits do not tip, avoid basefee subtraction #37

Closed

protolambda wants to merge 1 commit into [optimism-prototype](#) from [effective-gas-tip-cap](#)

[Code](#) [Pull requests](#) [Actions](#) [Projects](#) [Wiki](#)

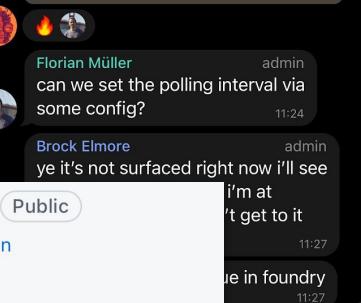
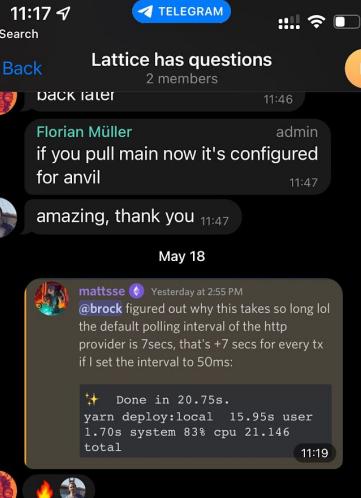
speed up UC 100x :))

[Browse files](#)

gameboy

nalinbhardwaj committed on Aug 26

1 parent: [cc2c666](#) commit: [3cb287dec873f57cbf](#)

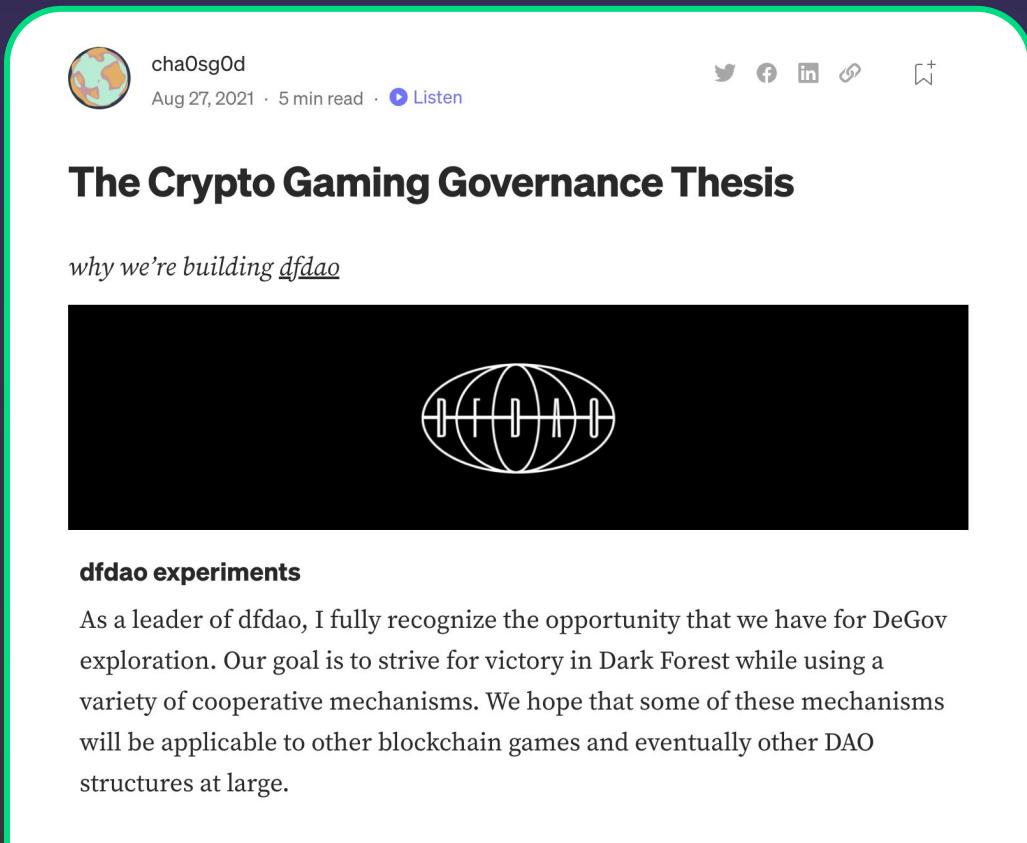


REASON 2

Games are a leading social indicator
in technology.

How players interact with new affordances in games gives us insight into how users will interact with digital systems of the future.

REASON 2



cha0sg0d
Aug 27, 2021 · 5 min read · [Listen](#)

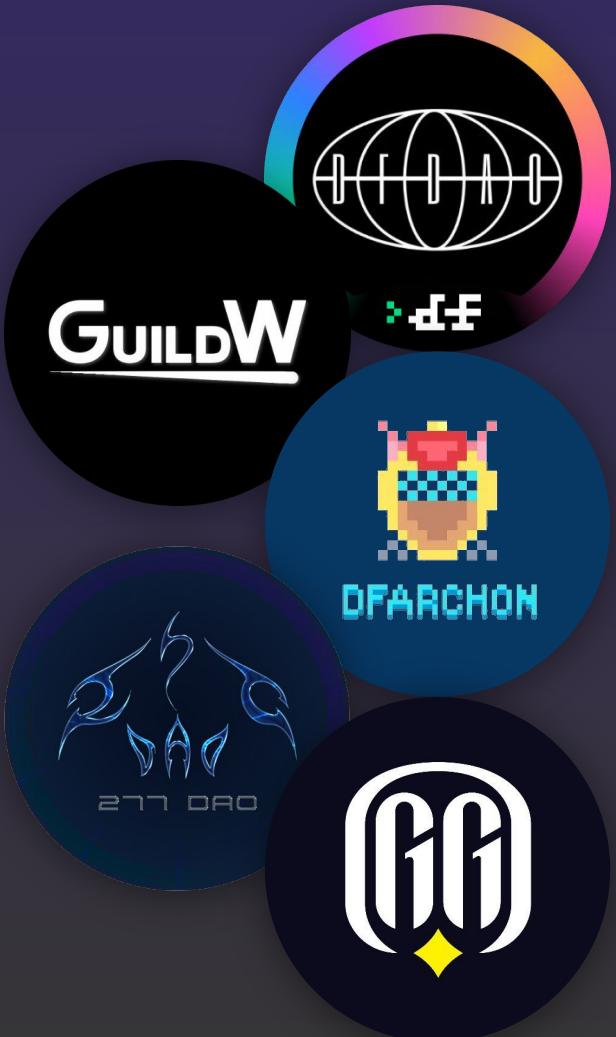
The Crypto Gaming Governance Thesis

why we're building [dfdao](#)



dfdao experiments

As a leader of dfdao, I fully recognize the opportunity that we have for DeGov exploration. Our goal is to strive for victory in Dark Forest while using a variety of cooperative mechanisms. We hope that some of these mechanisms will be applicable to other blockchain games and eventually other DAO structures at large.



REASON 3

Games are inherently playful.

A thriving indie game community can help “bridge the gap” between technologists and creatives, artists, writers, and thinkers – introducing greater intellectual diversity to the ecosystem.

REASON 3



Lars "Totally Texas" Doucet
@larsiusrprime

...

Okay, the day has finally come.

I am forced to grudgingly admit that I have found a blockchain game that legitimately does something with Blockchain that is genuinely new, innovative, and that you can't do with a centralized service.

That game is Dark Forest.

4:14 PM · Jun 15, 2022 · TweetDeck



What does it mean to build for
the future?

Fuck around and find out

“The Alto aimed to be not a machine of its time, but of the future... The governing principle of [Xerox] PARC was that the place existed to give their employer that ten-year head start on the future. They even contrived a shorthand phrase to explain the concept. The Alto, they said, was a time machine.”

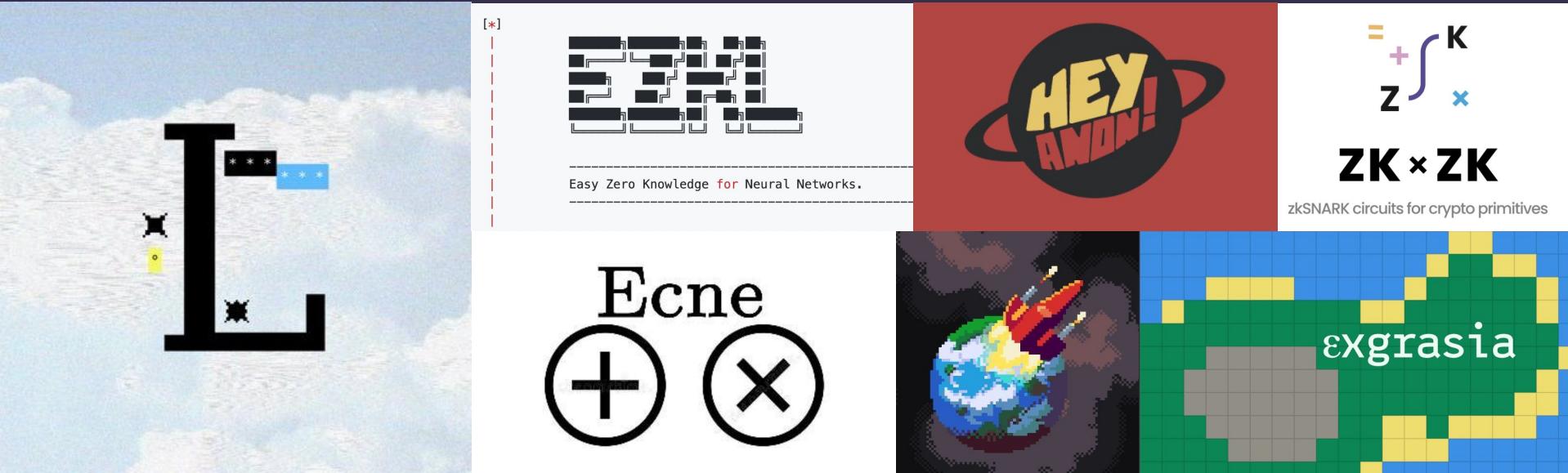
-Dealers of Lightning by Michael Hiltzik

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Today: a thriving ecosystem of “next-generation” application R&D, in the broader 0xPARC community



Systems vs tools



GAMES SHOP ...



Lena Oxiton
Online

ALL GAMES



WAR
ZONE



BATTLE
NET



Shop World of Warcraft

Forums

Patch Notes



NEW EXPANSION

Brave the Beyond in Shadowlands - Buy Now

Journey beyond the veil, discover five otherworldly realms of wonder and horror, gain incredible powers — and save Azeroth from all-consuming darkness.

Shop now



NEWS

Slay monstrosities in Torghast's twisting corridors



NEWS

Jump Into This Week's PvP Brawl:
Arathi Blizzard



NEWS

Level anew with the new Threads of
Fate game mode

GAME VERSION

World of Warcraft

PLAY



Version: 9.0.2.37142

LATEST NEWS



ACROSS BATTLE.NET



CALL OF DUTY: BLACK OPS COLD ...
Save up to 33% on Call of Duty:
Black Ops Cold War until

CHATS & GROUPS

Playing World of Warcraft - 2

Magni Bronzebeard ★
Torghast - Frostmane



Arthas Menethil ★
Torghast - Frostmane



Favorites - 4/5

Magni Bronzebeard ★
Torghast - Frostmane



Arthas Menethil ★
Torghast - Frostmane



Jim Raynor ★
Away



Tychus Findlay ★
Adventure Mode



Friends - 10/32

Hana Song
In Menus



John Price
In Menus



Soap MacTavish
In Menus



Sarah Kerrigan
Away



Tal Rasha
Busy



Arcturus Mengsk
Away



Deckard Cain
Adventure Mode



Facebook

facebook.com

Search Facebook

Josephine Williams

Watch

Events

Friends

Memories

Add to Story

Tom Russo

Betty Chen

Dennis Han

Cynthia Lopez

What's on your mind, Josephine?

Photo/Vid eo

Tag Friends

Feeling/Activity

Fiona Ozeri

5 hrs · 4 people

Best fireworks show I've ever seen!

Save the Pomeroy Theatre

Weekend Trips

Jasper's Market

Red Table Talk Group

Best Hidden Hiking Trails

Eric Jones

Cynthia Lopez

Betty Chen

Tina Lim

Molly Carter

Josephine Williams
See Your Profile

Settings & Privacy

Help & Support

Dark Mode

Switch to Classic Facebook

Send Feedback

Log Out

Privacy · Terms · Advertising · Ad Choices · Cookies · More · Facebook © 2019

Client-side plugins



v0.6.0

Scoring Planets

Utilities

Planet	Level	Score
1. Society Eggnog	9	0
2. Beautify Sedate	5	681
3. Apply Place	3	851
4. Cleave Rate	3	1270
5. Marble Far	3	1506
6. Actor Beseach	4	1711
7. Enhancing Hydrant	3	1737
8. Glitter Protective	3	1855
9. Annoyed Berserk	3	1871
10. Establie Kill	3	2036
11. Trust Leather	3	2090
12. Resolve Blush	3	2106
13. Miss Lick	3	2169
14. Ill-fated Vacation	3	2169
15. Lean Spring	3	2211
16. Drive Testy	3	2278
17. Distracted Prod	3	2402
18. Grade Nine	3	2471
19. Peace Giant	3	2568
20. Present Pusheen	3	2658

See the top scoring planets within your vision

v0.6.0

Tiny Leaderboard

Utilities

		Time
66.	0x6d5adb	31005461
67.	future6655	30891410
68.	arn_e	30171048
69.	0x76a959	30103572
70.	James0461876	30013270
71.	0x9029cc	29910425
72.	yh_chen	29808758
73.	0x8295e6	28234957
74.	Bulmenisaurus	27469536
75.	0xe5f3a7	27188682
76.	dm4	27011078

Shows a tiny leaderboard with timer

v0.6.0

Remote Snarker

Productivity

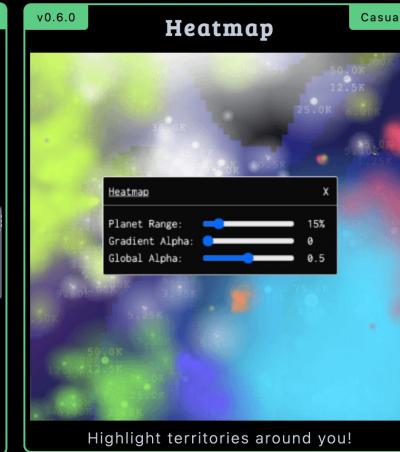
Remote Snarker

https://snarker.onrender.com/move | busy: 0.00 | 5.00s/snark | 17 Snarks Calc'd

URL for remote snarker

Add

Speed up snark computation using servers.



@projectsophon/df-plugin-dev-server

An ESBuild server for Dark Forest plugin development.

Installation

You can install the command globally using:

```
npm i -g @projectsophon/df-plugin-dev-server
```

Usage

Once installed, you should have access to the command:

```
df-plugin-dev-server
```

You can see the supported flags by running:

```
df-plugin-dev-server
```

```
Start a Dark Forest plugin development server.
```

```
Options:
```

--help	Show help	[boolean]
--version	Show version number	[boolean]
--dir	The directory to load [deprecated: use --glob instead]	[string]

Light Forest - Custom Dark Forest Arena Rounds

Light Forest is the simplest way to create a custom branded [Dark Forest Arena](#) round for your own community. It creates a website and game client for you automatically so you can focus on building your perfect game.

Requirements

- Install `node >= 14` (Consider using [nvm](#))
- Install [Yarn](#)

Install

Click the link below to create a new repo from the Light Forest template.

<https://github.com/dfdao/lightforest/generate>

Or, if you have the [GitHub CLI](#):

```
gh repo create <new-repo-name> --template="dfdao/lightforest"
```

Clone that new repo to your local machine.

Setting up a round

1. Visit arena.dfdao.xyz/arena and create a map. Once the map is created, you will get a unique hash of the map's configuration. Copy this value and save it for later.



Velorum

Jun 3 · 3 min read · ⚡ Member-only · [Listen](#)



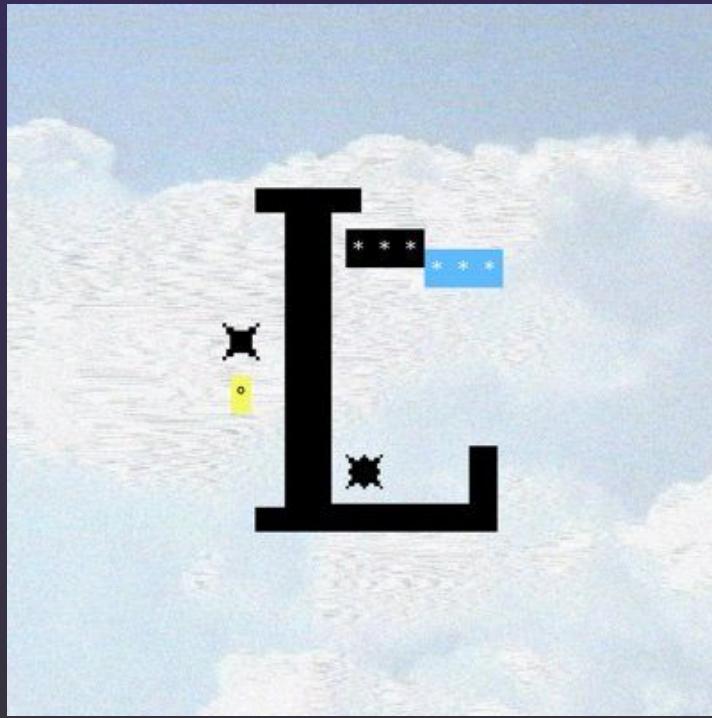
+



🏎️ Dark Forest Arena: Grand Prix 🎁

One month ago, we launched a public play test for [Dark Forest Arena](#), a short, action-packed version of [Dark Forest](#).

Systems vs tools



Playing the infinite game

“There are at least two kinds of games:
finite and infinite”

“A finite game is played for the purpose of winning, an infinite game for the purpose of continuing the play.”

“To play Dark Forest is to build on Dark Forest.”

-DFDAO



An Evening in the Dark Forest - Tuesday 4:30PM - 8PM

Autonomous Worlds Arcade - Wednesday 4PM - 7PM

Applied ZK SLS - Thursday 10AM - 6PM

Autonomous Worlds SLS - Friday 10AM - 3:30PM

ZK Community Hub - Continuous, Tuesday through Friday

tinyurl.com/0xparc-devcon