**Solmate Project Solution**

**Since**: Wednesday, December 15, 2021

**Version**: 2

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1. **Problem**

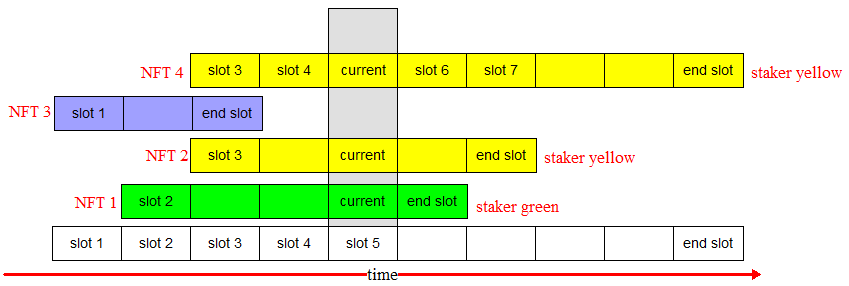
* Previously it’s found that the follow algo can exaust comput unit very soon, just few stekd NFTs can exaust it.

Loop through a slot gap

Loop through (wallet, nfts) over BtreeMap

Loop through nfts

1. **Model Deep Analysis**



As long as the reward calculation is based on $CIETY emission of per slot, the per slot caculation can’t be avoided, is a MUST, no matter:

* Whether veNFT is used or not
* Whether a outside trigger is empoyed or not

As illustrated in the above diagram, on slot 5,

Staker Yellow contributes 2 cells

Staker Green contrubutes 1 cells

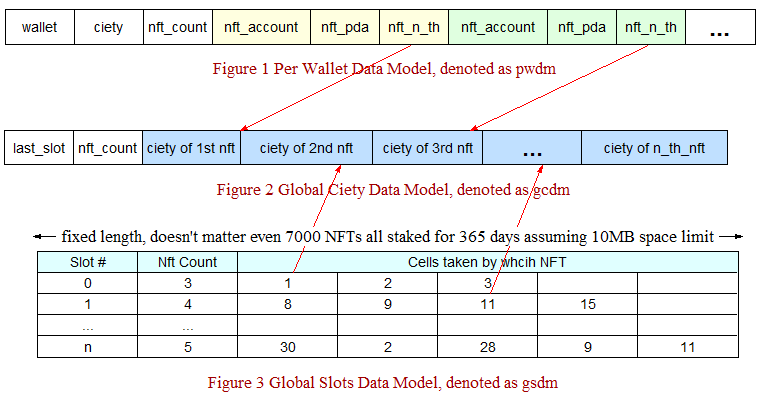
So,

Staker Yellow’s share is: 2/3

Staker Green’s share is: 1/3

Any share calculating mechanism is a variant of this.

1. **Data Architecture**
   1. **Data Model**



* 1. **Data Size Evaluation in Worst Case**
* Pwdm, wallet(32) + ciety(4) + nft\_count(2) + (nft\_account(32) + nft\_pda(32) + nft\_n\_th(2)) \* 7000 = 462038 bytes, each wallet has an account holding this
* Gcdm, last\_slot(2) + nft\_count(2) + ciety\_of\_nth\_nft(4) \* 7000 = 28004 bytes, globally only one account holding this
* Gsdm, 365 \* (slot(2) + nft\_count(2) + nft\_nth(2) \* 7000) = 5111460 bytes = 4992 kb, meaning all NFTs staked for 365 days, globally only one account holding this

1. **Idea**

We used to use to use hilgh capsulated data structure, like Vec and BtreeMap, actually it’s not absolutely necessary given a fixed data volume.

DATA STRUCTURE WITH FIXED STRUCTURE AND SIZES ARE EXTREMELY EFFICIENT, we drop any high level collection struct, like Vec and BtreeMap, instead WE DO EVERYTHING ON RAW BYTES ARRAY DIRECTLY.

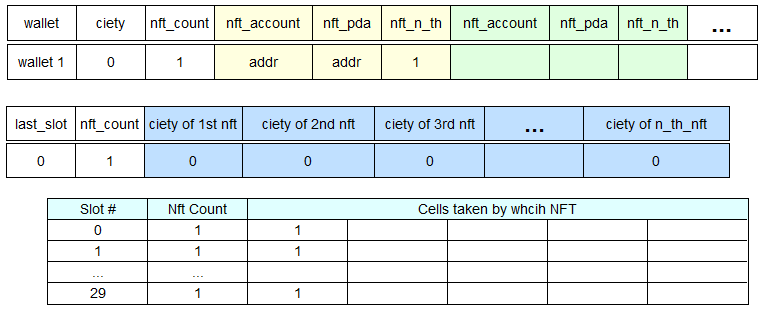
1. **Algo Per Use Case**
   1. **Stake**

Input = a wallet + multiple NFTs

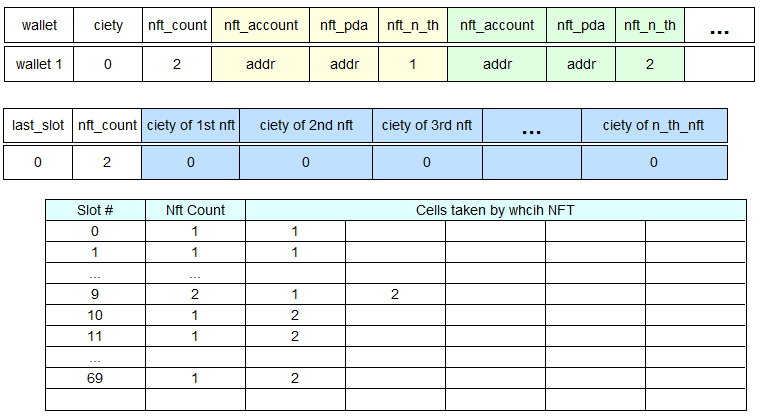
Given one time of staking, for each staked NFT:

* nft\_nth = gcdm.get(‘nft\_count’) + 1, O(1)
* gcdm.set (‘nft\_count’, nft\_nth), O(1)
* pwdm.add( (nft\_account, nft\_pda, nft\_nth) ), O(3)
* loop all slots taken by given NFT, O( number of slots \* 2), 365\*2 at most, assuming only one NFT can be staked at one time.
  + gsdm.get(slot).set(‘nft\_count’), O(1)
  + gsdm.get(slot).appendOnSlot(nft\_nth), O(1)

for example, if right after initialization there is an NFT staked which has a time length 30 days, then all data model will look like this:



If this staker staked another NFT for 60 days after 10 days, the data models will look like this:



* 1. **View Reward**

Input = a wallet

* Curr\_slot = clac\_curr\_slot(now), O(1)
* Last\_slot = gcdm.get(‘last\_slot’)
* For slot in [curr\_slot, last\_slot], worst case O((last\_slot – curr\_slot)\*7000)

For nft\_nth in [0, gsdm.nft\_count)

Shere = 1/gsdm.nft\_count

Accumulate gcdm.ciety on nft\_th

* Update gcdm.last\_slot
* Calculate total rewards of a staker, for i in [0, pwdm.nft\_count), O(pwdm.nft\_count \* 2)
  + total\_ciety = total\_ciety + gcdm.getCiety(nft\_th)
  + pwdm.set(‘ciety’, total\_ciety)

1. **Tests**
   1. **Case I**

* Right after initialization, a staker can stake 21 NFTs for 365 days.
* Only update gsdm, not include any other operations, like escrowing etc
* Remaining compute units are 3501

There MUST be a limit to how many NFTs a staker can stake at one time.

This updates 365 \* (2 + 2 + 21\*2) = 16790 bytes in 2 levels of nested loops, the time complexity is O(16790).

This big improvement conviced me it may be feasible with the idea of DO EVERYTHING ON RAW BYTES ARRAY DIRECTLY.

* 1. **Case II**

With gsdm, imagine a trigger call the calculation of reward everyday, the worst case is that the slot of calculating day has 7000 NFTs.

This will update 2 + 2 + 7000\*2 = 14004 bytes, O(14004) < O(16790), so it’s reasonable that there is no worries of exausting the limited compute units given we have this trigger even in the worst case.

But this doesn’t include updating gcdm.ciety 7000 times and update N wallets’ ciety.

But if we don’t employ a trigger, then there is a balance between slots\_gap and num\_nfts:

slots\_gap \* (2 + 2 + num\_nfts\*2) <=16790

Test I is a simulation of staking though, in case of viewing rewards, algorithmically it’s similar, just writing byets becomes reading bytes, so it’s reasonable in this way to estimate the situation of the case of viewing rewarding.

**In the following estimating resutls based on the above inequality:**

* **slots\_gap means how often rewards are viewed by stakers.**
* **num\_nfts means an average number of NFTs staked on the slots of a gap**
* **All possible balanced combination are (NOTE: within a gap, on each its slot, it all has num\_nfts NFTs):**

slots\_gap= 1 num\_nfts= 7000

slots\_gap= 2 num\_nfts= 4196

slots\_gap= 3 num\_nfts= 2797

slots\_gap= 4 num\_nfts= 2097

slots\_gap= 5 num\_nfts= 1678

slots\_gap= 6 num\_nfts= 1398

slots\_gap= 7 num\_nfts= 1198

slots\_gap= 8 num\_nfts= 1048

slots\_gap= 9 num\_nfts= 931

slots\_gap= 10 num\_nfts= 838

slots\_gap= 11 num\_nfts= 762

slots\_gap= 12 num\_nfts= 698

slots\_gap= 13 num\_nfts= 644

slots\_gap= 14 num\_nfts= 598

slots\_gap= 15 num\_nfts= 558

slots\_gap= 16 num\_nfts= 523

slots\_gap= 17 num\_nfts= 492

slots\_gap= 18 num\_nfts= 465

slots\_gap= 19 num\_nfts= 440

slots\_gap= 20 num\_nfts= 418

slots\_gap= 21 num\_nfts= 398

slots\_gap= 22 num\_nfts= 380

slots\_gap= 23 num\_nfts= 364

slots\_gap= 24 num\_nfts= 348

slots\_gap= 25 num\_nfts= 334

slots\_gap= 26 num\_nfts= 321

slots\_gap= 27 num\_nfts= 309

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slots\_gap= 35 num\_nfts= 238

slots\_gap= 36 num\_nfts= 232

slots\_gap= 37 num\_nfts= 225

slots\_gap= 38 num\_nfts= 219

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1. **Analysis & Conclusion**

* Basically it’s safe to have trigger, But this doesn’t include updating gcdm.ciety 7000 times and update N wallets’ ciety.
* Don’t call other functions, due to taking stake frame is not free.
* If we have a trigger, we have to let host\_wallet own accounts of all stakers about staking info, host\_wallet is the only payer for calcualiting rewards.
* Once a compute unit overflow occurs, no one can see his rewards and unstakes.
* Solution B: modify contracts and wirte a special client to calculate rewards by stages from last slot down to current slot.

**Test with 3rd party BitSet, 1d x 7000 NFT**

D:\mike\ap\_gitlab\analytics-app>solana logs 9MJzW1oEzvjHnmdLdoGRGr1i4hu82g7eEEnxvmifcDZD

Streaming transaction logs mentioning 9MJzW1oEzvjHnmdLdoGRGr1i4hu82g7eEEnxvmifcDZD. Confirmed commitment

Transaction executed in slot 101644660:

Signature: 4dW26siYnNa1kbNnGLiirZjiYdttQ4qA1qjoRkbX3dqnnbcs4qdqTFuEKHaUgtvRuR74riZkqEKMZiVTCeBB7gTW

Status: Ok

Log Messages:

Program 11111111111111111111111111111111 invoke [1]

Program 11111111111111111111111111111111 success

Program 8q4kHVxZ1LycQ5ty88zN6sa6KYDk8q8eB68xzwaAhMcX invoke [1]

Program consumption: 199230 units remaining

Program consumption: 71365 units remaining

Program log: staked\_slots===1

Program log: staked\_nfts===7000

Program log: aaaaaaaaaaaaaaaaaaaaa

Program consumption: 70268 units remaining

Program log: bbbbbbbbbbbbbbbbbbbbb

Program consumption: 70219 units remaining

Program 8q4kHVxZ1LycQ5ty88zN6sa6KYDk8q8eB68xzwaAhMcX consumed 129945 of 200000 compute units

Program 8q4kHVxZ1LycQ5ty88zN6sa6KYDk8q8eB68xzwaAhMcX success

Disconnected: receiving on a closed channel

**Directly Manipualte Bits, 1d x 7000 NFT**

D:\mike\ap\_gitlab\analytics-app>solana logs 9MJzW1oEzvjHnmdLdoGRGr1i4hu82g7eEEnxvmifcDZD

Streaming transaction logs mentioning 9MJzW1oEzvjHnmdLdoGRGr1i4hu82g7eEEnxvmifcDZD. Confirmed commitment

Transaction executed in slot 101728824:

Signature: 5mpU9eGpwHmhT31pu8uPmY74QPwk2oxjCKAbmpjwhXD7fQU7bU56XCtXtP7fPsKFWpqTDpUutzC7DT5iQr9A2W7g

Status: Ok

Log Messages:

Program 8q4kHVxZ1LycQ5ty88zN6sa6KYDk8q8eB68xzwaAhMcX invoke [1]

Program consumption: 199226 units remaining

Program log: staked\_slots===1

Program log: staked\_nfts===7000

Program log: aaaaaaaaaaaaaaaaaaaaa

Program consumption: 198188 units remaining

Program log: bbbbbbbbbbbbbbbbbbbbb

Program consumption: 198139 units remaining

Program 8q4kHVxZ1LycQ5ty88zN6sa6KYDk8q8eB68xzwaAhMcX consumed 2019 of 200000 compute units

Program 8q4kHVxZ1LycQ5ty88zN6sa6KYDk8q8eB68xzwaAhMcX success

Disconnected: receiving on a closed channel