

Partitioned Epoch Reward Distribution

<https://github.com/solana-foundation/solana-improvement-documents/pull/15>

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Background

- long block time at epoch boundary because of paying out rewards (i.e. 550K active stake accounts)

update_rewards_with_thread_pool_us								
			num_nodes	mean	25%	median	75%	90%
epoch	parent_slot	slot						
400	172799999	172800004	1856	6.0446	4.7005	5.5542	6.9978	8.2098
		172800008	1849	5.9215	4.6368	5.5042	6.7184	8.0151
		172800012	1820	6.4132	4.9909	5.9759	7.3126	8.7821
		172800016	1817	6.1725	4.8232	5.7501	7.1026	8.4538
		172800020	1860	22.5487	14.1648	19.3020	25.9193	37.9001
		172800024	1825	5.7729	4.6952	5.4360	6.5741	7.4773
		172800028	1816	5.7738	4.6650	5.4328	6.5811	7.4315
		172800032	1814	5.7824	4.6077	5.4334	6.5606	7.6282
		172800036	1816	5.7568	4.6698	5.4193	6.4865	7.4628

New Approach

- Spread out reward distribution over multiple blocks
- Two phases
 - Reward Calculation Phase
 - Reward Distribution Phase

Rewards Calculation

- Compute all the rewards to be distributed
- Last for $N = 1000$ block height
- Use a background service to do the calculation

Rewards Distribution

- Distribute the rewards over M blocks
- Each block distribute $64 * 64$ rewards (4K total)
- Reward distribution happens before TXN processing

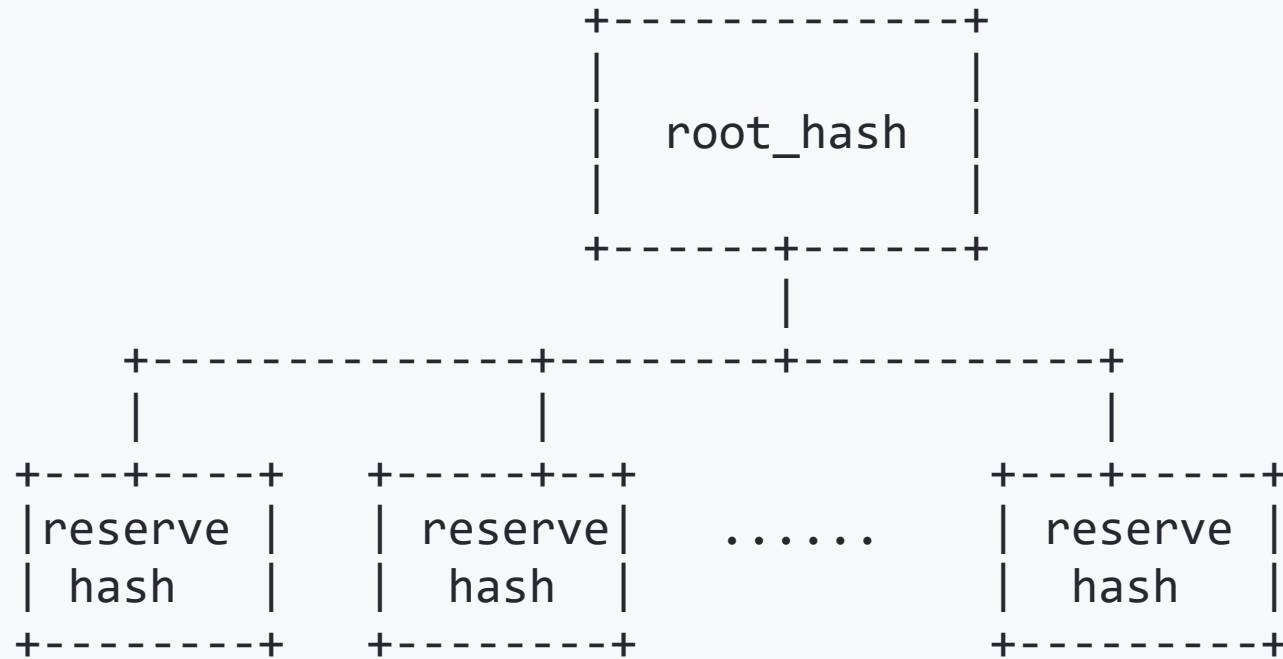
EpochRewardHistory Sysvar Account

- maintains a history of epoch rewards (i.e. 512)

```
struct RewardHistoryEntry {  
    total_reward_in_lamport: u64,           // total rewards for this epoch  
    distributed_reward_in_lamport: u64,     // already distributed reward amount  
    root_hash: Option<Hash>,               // hash computed from all EpochRewardReserves  
}  
  
type EpochReward = (Epoch, RewardHistoryEntry);  
  
struct RewardHistory {  
    rewards: [EpochReward; 512],  
}
```


Reward Hash

```
root_hash = Hash(EpochRewardReserve[..].reserve_hash)
```



Impact

- Restrict stake account access during reward period
 - i.e. withdraw, merge, split stakes need to wait
 - new transaction error: LockedRewardAccountsDuringEpochReward.
- Snapshot and cluster restart during reward period
 - new field in snapshot
 - `reward_calculation_result: Option<RewardCalculationResult>`
 - cluster restart load `reward_calculation_result`
 - resume reward distribution

Q&A

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