this rule into other application, a metaphor of a cryptocurrency based on PoP is given:

- The money spent/received of an individual is the rating
- By spending / receiving money, the rating of an individual goes up, to a point of becoming a candidate block's writer
- The money spent/received by an individual must be productive e.g. Gross Domestic Product (GDP) factor

6.2 PoP and other consensus model

Model	Consensus Mechanism	Efficiency	Fairness
Proof-of-Work	Computational Power	Low	Medium
Proof-of-Stake	Stake	High	Low
Proof-of-Play	Use of blockchain	High	High

Table 4: Section 6.2 Summary of Proof-of-Play comparison

This consensus model is similar to the conceptual model Proof-of-Excellence. However, the player in PoP need not be excellent, the player simply has to present its act of play to mine. This avoids the issues of better players having an unfair advantage in mining.

PoP adopts some of the ideas in PoS and PoW with the disadvantages of them being eliminated. A summary of the comparison of Proof-of-Play to other models is shown in table 4 for further discussion based on their consensus mechanism.

6.2.1 PoW. The main cost of the PoW is the energy and time inefficiency(Section 2.2). Also, for a basic PoW system, nodes with better computational power (i.e. CPU performance) will hash the valid number faster to other nodes. So unfairness exists in PoW.

In PoP, the probabilistic mining function acts as a random access protocol (section 4.2). It also has an overhead of n game matches before the mining occurs. Developer can derive (equation (8)) a low expected hash rate for a PoP blockchain, making it power-efficient.

Also, the evaluation of the playing effort of a player (section 4.2) is adjusted dynamically according to the player's ability. Different skilled players have the same chance in mining a PoP block.

6.2.2 PoS. The biggest problem in PoS is the nothing-at-stake problem (section 2.2). It opens up opportunities to launch security attacks. PoW does not have the nothing-at-stake problem, since the intrinsic cost of mining on multiple chains is the decrease in the chance of mining successfully. So, In a PoW system, miners are encouraged to mine on the same chain.

Also, PoS is not fair, since the more stake a node holds, the more likely the node will mine a block. A new node joins the network will never have a hash rate higher than older nodes in the network.

In PoP, the rule is the use of the blockchain fulfills the consensus, there is no reason a community wants multiple version of game data. This is a weak assumption. To strengthen the security, similar to PoW, in-game rewards on successful mining can be implemented, such that the intrinsic cost of mining on multiple chains is the decrease in value of the player's in-game rewards (some chain do not acknowledge the player's rewards).

Also, as mentioned in Section 6.2.1, the chance of mining is designed to be more fair compare to PoW/PoS due to the dynamic adjustment of the "evaluation of the playing effort".

7 CONCLUSION

This paper introduces a consensus model P2P gaming system using blockchain as a solution to data storage issues. The consensus model aims to create a blockchain system that forms a consensus by the use of the blockchain itself, while not compromising the general properties of a blockchain. Then, the system is implemented to demonstrate the flow of the PoP, experiments have conducted to show how different parameters affect the stability of the PoP system or probabilistic mining system in general. Finally, this paper generalizes the consensus model and discuss the differences between PoP and other major consensus models.

We believe this design would bring more attention on blockchain system related to the P2P gaming system. This also acts as a design reference on blockchain in interactive system, eventually decentralize any interactive system reliably with a simple design nature like PoP: the use of a blockchain form consensus for the blockchain.

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