Infinity Battle: A Glance at How Blockchain Techniques Serve in a Serverless Gaming System

Feijie Wu
Department of Computing
The Hong Kong Polytechnic University
Hong Kong, China
The Chinese University of Hong Kong, Shenzhen
Shenzhen, China
harli.wu@connect.polyu.hk

Ho Yin Yuen
Henry C.B. Chan
Department of Computing
The Hong Kong Polytechnic University
Hong Kong, China
andy.aa.yuen@connect.polyu.hk
cshchan@comp.polyu.edu.hk

Victor C.M. Leung
Shenzhen University
Shenzhen, China
The University of British Columbia
Vancouver, Canada
vleung@ieee.org

Wei Cai*
The Chinese University of Hong Kong, Shenzhen
Shenzhen Institute of Artificial Intelligence and Robotics for Society
Shenzhen, China
caiwei@cuhk.edu.cn

ABSTRACT

The blockchain technology provides a data authentication and permanent storage solution to the data volatility issue in peer-to-peer games. In this work, we present the Infinity Battle, a serverless turn-based strategy game supported by a novel Proof-of-Play consensus model. Comprising three major phases: matchmaking, gaming session and global synchronization, the proposed demo game generates a blockchain through distributed storage and processing.

CCS CONCEPTS

• **Computer systems organization** → **Peer-to-peer architectures**; • **Applied computing** → *Computer games*; • **Information systems** → Distributed storage.

KEYWORDS

Blockchain, Peer-to-Peer, Game

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1 INTRODUCTION

Dominating the current gaming market, multiplayer online games usually adopt a client-server architecture, which is easy to implement but requires high maintenance costs because of the dedicated game servers [2]. Moreover, recent data loss cases alert us to the fact that a single dedicated server/cluster is vulnerable due to single points of failure, which possibly harming players' virtual assets and affecting their gaming experience [11]. To overcome these shortfalls, researchers are seeking decentralized solutions for video games. For instance, Dota 2[1], a well-known multiplayer online battle arena (MOBA), provides a serverless gaming system. However, such architecture only enables game players under the same peer-to-peer (P2P) network to share volatile gaming sessions, as its gaming data can not be authenticated and permanently stored outside the P2P network.

To overcome this issue, blockchain [3] becomes a potential solution. Proof-of-Play (PoP) [12] provides a consensus mechanism for blockchain with the aim of guaranteeing data genuineness [5, 13]. The objective of this consensus model is to combine the advantages of both Proof-of-Work [8] and Proof-of-Stake [6] in which a new transaction is created based on the game result in a P2P game (i.e., computational power for playing a game) without consuming additional or wasteful computational power. Basically, there are two phases – *Shared Turns* and *Block Writing*, ensuring the integrity of the game data and gaming quality, respectively. *Block Writing* also manages the number of valid blocks. Compared to blockchain games [4, 7, 10], a subgenre of P2P games whose entire gaming procedures interact with the blockchain itself, a P2P game coupled with PoP provides a generic solution. An apparent reason is because PoP supports real-time P2P games while blockchain games do not. Additionally, players in PoP do not need to pay high transaction fees because they are miners, while current public platforms of blockchain games disallow a player to be a miner.

Much like traditional multiplayer online games, the components of a P2P gaming system include matchmaking, gaming session and gaming data storage. Note that PoP focuses on solving the data storage issue only. In this paper, we describe our development of a game called Infinity Battle to demonstrate the operation of PoP. To the best of our knowledge, this is the first blockchain-related game

*corresponding author

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[1] https://www.opendota.com/

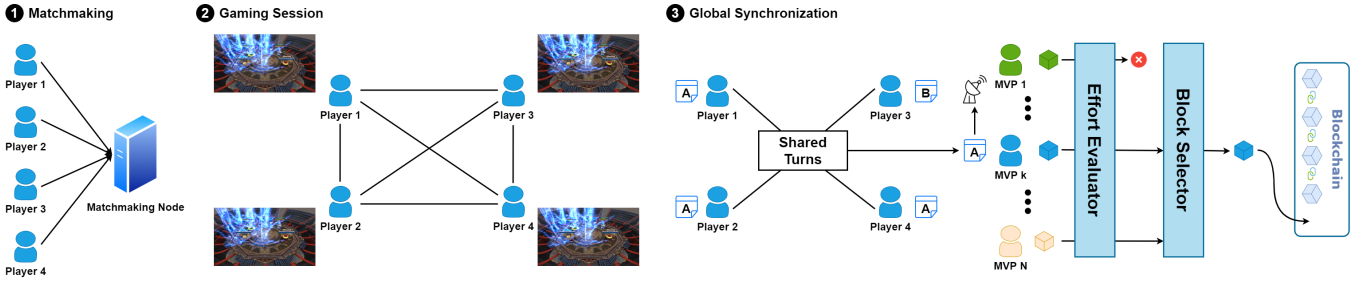

Figure 1: The procedure of Infinity Battle from matchmaking to global synchronization

demostration that achieves a real-time serverless gaming system with an anti-cheating mechanism.

2 INFINITY BATTLE

Infinity Battle is a turn-based strategy game with four players separated into two teams. Unlike a traditional gaming system, every player joins in the game with an equal role, which is an important characteristics of a P2P game. In general, a complete cycle consists of three phases: **Matchmaking** assists in arbitrarily grouping four players to form a P2P gaming network; **Gaming Session** offers a battlefield where all players follow a series of rules and fight for victory; **Global Synchronization** stores both non-gaming data and a gaming record with the help of the blockchain techniques. Figure 1 shows the general procedure of Infinity Battle. The following three subsections elaborate the figure part by part and introduce the technique behind each phase.

2.1 Matchmaking

As the first stage in all multiplayer online games, matchmaking considers numerous factors such as network latency and skill level, and it is the most complex part of a game [1]. To simplify our work on the P2P matchmaking task and preserve the feature of decentralization feature, we assume that there are a large number of matchmaking nodes all around the world, but there is no connection between any two of them. Consequently, each matchmaking node forms a group only with those players who are connecting to it. In the first section of Figure 1, there are four players simultaneously connecting to a matchmaking node, and a new match is successfully created. In general, while the matching node should evaluate players' skills in this demo paper we assume that the players' capabilities are comparable in this demo paper.

2.2 Gaming Session

Coordinating with the matchmaking node, a group of players form a pure P2P network [9]. They are divided into two teams and all of them enter the battlefield, as illustrated in the second section of Figure 1. During the gameplay, each player independently broadcasts the actions to all other nodes using the User Datagram Protocol.

Before the battle starts, each player chooses a unique character. Then, in each round, a player can play the game using one of the three predefined attack methods. Although some skills/methods are more powerful, players cannot use all skills and methods in every round. If a character dies, it will be reborn after a certain number of rounds. Furthermore, that character's teammates become stronger before the character is reborn. The game ends when all characters on one team die.

2.3 Global Synchronization

After the gameplay, relevant data will be saved to a distributed storage system based on PoP. The entire process is shown in the third section of Figure 1. As in the first period of PoP, *Shared Turns* is maintained by all players in a match, whose collection pool stores the game records. Players in this period tend to be honest on account of the incentives [12], and therefore, an overall game record can be determined based on a majority vote. The most valuable player (MVP) of the match, a winner with superior performance, broadcasts it throughout the network and prepares a candidate block containing both gaming and non-gaming records for the blockchain system. A block becomes valid if and only if it satisfies the following two conditions: (1) The MVP makes a sufficient effort in the last match, and (2) The block satisfies a specified mathematical formula. The first condition aims to encourage players to have a positive attitude toward every match, while the second is to avoid a large number of orphan forks. These two conditions correspond to Effort Evaluator and Block Selector, both of which make up the Block Writing phase. In case of the appearance of natural forks, PoP adopts probabilistic finality to determine which chain should eventually be added to the blockchain system.

3 CONCLUSION

This paper presents Infinity Battle, a P2P turn-based strategy game to demonstrate PoP. The proposed system can be fully operated in a distributed manner. Equipped with an anti-cheating mechanism and other functions, there are three main phases: matchmaking, gaming session and global synchronization. Our demo shows how a P2P game with an innovative PoP consensus model can be used to support a blockchain system.

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