PRISONER'S DILEMMA

WHITE PAPER

The Play to Earn revolution has brought about a new paradigm in gaming. While this space has seen a lot of projects over the past couple of years, in our opinion, few, if any, live up to the standards of “a great game”.

Most of the attempts so far in the blockchain gaming space have been, as it’s safe to expect from the primite years of such a dynamic market, low-effort attempts at stapling the word “blockchain” on top of games. A hypothesis easy to demonstrate by the lack of any truly blockchain based game. As far as we know, to this date, there is none.

We believe that the reason for this is a cultural outlook on reality from within the blockchain space. Crypto people see blockchain as a tool that enables infinite outward possibilities, of abundance and freedom.

We took a look at blockchain gaming from a different perspective. The aspect of blockchains that we believe truly bring value to potential gaming use cases comes from the exact opposite mentality — its capacity to create stringent realities within game scenarios.

Loss aversion can truly feel like loss aversion. Games can be global and uncontrollable, all while being force-ably transparent. For the game proposal that you are about to read, these aspects are critical.

One of the most discussed and studied game theory models in existence is The Prisoner’s Dilemma. Chances are you have heard of it. It describes a game theory model that shows why two rational individuals might not cooperate, even if for the clear rational benefit of both of them.

Two members of a criminal organization are arrested and imprisoned. Each prisoner is in solitary confinement with no means of communicating with the other.

The prosecutors lack sufficient evidence to convict the pair on the principal charge, but they have enough to convict both on a lesser charge.

Simultaneously, the prosecutors offer each prisoner a bargain. Each prisoner is given the opportunity either to betray the other by testifying that the other committed the crime, or to cooperate with the other by remaining silent.

Games fundamentally require randomness, entropy, in order to be fun. On a blockchain, you cannot as much as throw a dice without the outcome being known by at least one party that can participate in the game, rendering it useless.

What you can do, however, is use a blockchain's capacity for anonymity, scarcity, imposed unescapable scenarios (unescapable smart contracts) and transparency to create very life-like games around deeper, more complex, innately human mechanisms, such as the ones behind the original Prisoner's Dilemma.

If A and B each betray the other, each of them serves two years in prison.

If A betrays B but B remains silent, A will be set free and B will serve three years in prison.

If A remains silent but B betrays A, A will serve three years in prison and B will be set free.

If A and B both remain silent, both of them will serve only one year in prison (on the lesser charge)

THE ORIGINAL PREMISE

“I believe in two things, discipline and the Bible. Here, you’ll receive both. Put your trust in the Lord. Your ass belongs to me. Welcome to Shawshank.”

Warden Norton,
The Shawshank Redemption

At the beginning a game, all prisoners have the same sentence and the same amount of money.

The goal of each prisoner is to escape from jail as quickly as possible, with as much money as possible. When a prisoner escapes, he takes with him his entire remaining balance plus a bonus from each of the remaining captives.

Each day spent in jail costs the prisoner **rent,** which will be subtracted from their balance.

Failure to pay rent as a prisoner means losing the game.

While the goal of the prisoners is clear — to escape from jail as fast and as rich as possible, there are multiple ways to escape jail, each varying in risk. Players choose their strategies depending on the game dynamics, their individual risk appetite and their level of trust in their peers.

Serve your sentence

Low risk. Low reward.

Costs: rent
Reward: none
Risks: Remain among the last to leave jail, drastically reducing the escape prize (which can be zero)

On the surface of it, a perfectly adequate strategy might be simply trying to stay in your corner. After all, this is what most people do in jail.

If a prisoner believes that his fellow prisoners will fail in their higher risk attempts and run out of money or have their sentence increased, they might actually make it out of jail among the first.

Prisoner's dilemma

Low risk. Low reward.

Costs: Prisoner's dilemma fee (low)
Rewards: Slight sentence decrease.
Risks: Lose money. Slight sentence increase.

Prisoners can join Prisoner Dilemmas. Each Prisoner's Dilemma is composed of two prisoners and one guard.

In a Prisoner's Dilemma, guards interrogate prisoners, trying to turn them against each other.

Each individual prisoner can choose to co-operate with the other prisoner or defect. If both prisoners cooperate, there is a very slight decrease in sentence for both. If both prisoners defect, there is a moderate increase in sentence for both. The guard takes both the Prisoner's Dilemma fees.

If only one prisoner defects while the other cooperates, the defector gets a high sentence reduction while the prisoner who cooperated gets a high increase in sentence. The guard splits the money from the cooperator with the defector.

Because the costs and risks of playing Prisoner's Dilemma are relatively low, prisoners are encouraged to play multiple times.

Parole

Moderate risk. High reward.

Costs: application fee + parole budget (prisoners can choose to apply for parole with more than the minimum parole budget)
Rewards: Chance to escape from jail.
Risks: Guards deny parole. Money lost.
Risk level reflected in parole acceptance rate (percentage of parole acceptance during the current game)

A prisoner can apply for parole after 1/3 of their sentence with a minimum amount of rents (calculated at the beginning of each game). Prisoners can put aside as much money as they want for their parole application. Increasing the amount theoretically increases the chances of parole acceptance. (Keep an eye on the parole acceptance rate when applying for parole).

When a prisoner chooses to apply for parole, a committee of guards has one day to vote upon whether they grant parole or not. If guards do not gather to vote within one day, the prisoner's money is returned to him and all guards are fined a total of the amount of the missed parole.

If the committee grants parole, the prisoner is released from jail, the guards that voted get a percentage of the parole budget and the rest is distributed among all the guards.

If the committee denies parole, the prisoner's sentence remains unchanged, the prisoner loses the parole budget, which gets distributed to the guards according to the formula defined within the game.

To guide the thinking of the prisoner, the in-game parole acceptance rate is visible to everyone.

A prisoner can apply for parole as many times as they want, assuming they have the funds.

Bribe

High risk. High reward.

Cost: Bribe fee
Reward: Instantly escape from jail
Risk: Get caught. Lose money. Increase sentence.

Prisoners can initiate a bribe. When a prisoner is investigated by a guard, the guard decides whether to accept the bribe or not.

If the guard accepts the bribe, the prisoner loses the bribe money and is released from jail. The guard gets the entire bribe amount.

If the guard does not accept the bribe, the prisoner loses the bribe and gets his sentence moderately increased. The guard keeps a small part of the bribe while the rest is distributed to all of the guards.

Prisoners can try to find guards outside of the game and pre-communicate their bribe attempt in order to try to increase their chances.

Beware: Bribes do not expire and guards can investigate each other as well, so there's a chance that you get caught if the guard you are trying to bribe gets caught before he manages to release you.

A prisoner can initiate as many bribes as they want, assuming they have the funds.

Very high risk. High reward.

Costs: Escape fee
Reward: Escape from jail if not caught during the attempt.
Risks: Getting caught before escaping. Lose escape money. Significantly increases sentence.

The dream of any prisoner: planning an escape. Just as in real life, this is a very high risk and high reward strategy. Prisoners can plan an individual escape or they can group together, sharing the costs.

In an escape, timing is critical. Since an escape takes a few days, you should try to plan your escape when guards are busy (or better, inactive).

If the prisoner doesn't get investigated by the day of their escape, the plan is successful, the prisoner is free!

If the prisoner gets investigated while planning an escape, they lose all the escape money which goes to the guard that investigated them and their sentence is severely increased.

Moderate risk, moderate reward.

Costs: escape fee
Rewards: financial gain
Risks: moderate sentence increase

Money management is a crucial aspect for the game: all actions cost money and if the prisoner becomes broke, he loses the game. Thankfully, there's a way to increase one's balance with only moderate risk: faking an escape.

On the surface, a fake escape attempt is indistinguishable from a real one. Guards only find out if the escape attempt was real or fake through investigating or on the day of the escape, when it's too late.

If a prisoner is investigated while they are engaged in a fake escape, the guard that investigates loses money, which goes to the prisoner. The prisoner's sentence is increased moderately.

If a prisoner doesn't get investigated before the day of the fake escape, the guards are collectively fined and the money goes to the prisoner. There is no sentence increase in this case.

At the beginning of each round, all guards have the same amount of money, proportional to the number of players. In addition to their initial balance, guards have a "pocket money" balance. All activities that earn (or lose) money increase (or decrease) the "pocket money" balance.

The goal of a guard is to maximise their pocket money before the game ends. The initial balance gets discarded at the end of the game.

At the beginning a game, all prisoners have the same sentence and the same amount of money.

The goal of each prisoner is to escape from jail as quickly as possible, with as much money as possible. When a prisoner escapes, he takes with him his entire remaining balance plus a bonus from each of the remaining captives.

Each day spent in jail costs the prisoner **rent,** which will be subtracted from their balance.

Catch escapees in the act

Medium risk. Medium reward.

Cost: Investigation fee.
Reward: The prisoner's escape fee (if the prisoner was trying to escape).
Risk: If prisoner was faking an escape, lose money.

If a prisoner shows signs of suspicious activity, any guard can choose to investigate them. Investigating prisoners costs money and comes with moderate risk. The guard must pay a fee for every activity they want to investigate.

If it turns out that the prisoner was trying to escape from jail, the guard who investigated them takes the prisoner's escape fee and the investigation fee gets refunded. In turn, the prisoner gets an increased sentence.

If the prisoner was only faking an escape, the guard must pay a fine for being wrong and the fine goes to the prisoner.

To promote transparency and discourage corruption, any information resulting from prisoner investigations becomes public for everyone else to see. Discovering an escape attempt is often a very useful hint into that prisoner's intentions, and because prisoners can have simultaneous escape plans, it might be a good idea to look into any other activities that prisoner might have engaged in. There is no time to lose: since investigation results are public, other guards will want to do the same and reap the rewards.

Parole

Cost: Parole voting fee.
Reward: 10% of the parole amount divided among guards who voted.
Risk: Parole reputation.

When a prisoner applies for parole, guards can vote to either approve or deny the request. In both cases, the parole money is split among guards (10% among the guards who voted and 90% among all guards). If the majority votes to deny parole at the end of the parole day, the prisoner stays in jail. If they grant parole, the prisoner is set free.

Because guards lose money every time a prisoner gets released from jail and because the income from parole applications is the same regardless of the outcome, there is a signifiant incentive to deny parole, especially when the amount of money involved is low.

However, there is a risk to this strategy, namely the parole acceptance rate. Parole requests are one of the main sources of income for guards. Money gained from parole requests can be allocated towards investigating more prisoners and participating in Prisoner Dilemmas. If the parole acceptance rate drops too much, prisoners might become less willing to apply for parole and this very important source of revenue might disappear.

Besides managing parole reputation, there are multiple strategies that guards might employ when deciding when to grant parole. Denying paroles with low amounts will encourage prisoners to allocate more money towards parole (and thus less money towards other activities). On the other hand, because parole acceptance rate is expressed as a percentage, denying just a few of the highest paid parole requests would yield significant revenue while not decreasing the acceptance rate too much.

Whatever strategy the guards might choose to employ, it's important to keep it secret from prisoners so as to not allow them to take advantage of it. Beware corrupt guards!

Accepting bribes

High risk. Medium reward.
Cost: Investigation fee.
Reward: The guard keeps the entire bribe amount.
Risk: If the investigated prisoner is innocent, lose the investigation fee. Significant fine when getting caught taking a bribe.

When investigating a prisoner, a guard might find a bribe waiting for them. If the guard is corrupt, they might decide to accept the bribe and set the prisoner free.

There is significant risk involved in taking bribes. Guards can be investigated by their peers — if caught, the bribe gets confiscated and the guard must pay a significant fine. Getting caught multiple times is likely to result in the guard going bankrupt.

There is a statute of limitations that applies to taking bribes. If more than one day passes since the taking of the bribe, the guard can no longer be fined. Nevertheless, guards must carefully protect their reputation, as a bad reputation is likely to result in increased scrutiny.

Stealing bribes

Low risk. Low reward.

Cost: Investigation fee.
Reward: The guard keeps 10% of the bribe amount. The rest is distributed to all guards.
Risk: If the investigated prisoner is innocent, lose the investigation fee.

Upon investigating a prisoner and finding a bribe, an honest guard will turn the prisoner in and claim the reward, which consists of 10% of the bribe amount. The other 90% gets distributed equally among all guards. The prisoner gets punished with an increased sentence.

Catch corrupt guards

Low risk. Low reward.

Costs: Prisoner's dilemma fee (low)
Rewards: Receive money if prisoners turn on each other.
Risks: Lose the Prisoner's Dilemma fee.

Guards can join Prisoner Dilemmas, where they are matched with two prisoners. In the Prisoner's Dilemma, guards have soft power. While they cannot make any decisions themselves, their role is to convince prisoners to turn on each other. One effective way to do so is to sow distrust between the two parties.

If the guard succeeds, they achieve two beneficial goals: a monetary reward and the fact that at least one of the prisoners gets a slight sentence increase.

If only one of the prisoners defects, the guard receives a fee refund, plus an amount equal to half of one Prisoner's Dilemma fee (taken from the prisoner who lost).

If both prisoners defect, the guard receives a fee refund, plus the two fees that the defecting prisoners paid.

If both the prisoners cooperate, the guard loses their Prisoner's Dilemma fee.

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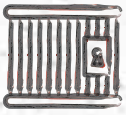
Pre-registration

The game starts with a pre-registration phase, when players sign up to play the game and invite their friends. Once a game is over, pre-registration starts for the next game. The pre-registration phase lasts one hour, or until the threshold for minimum number of players has been reached. All players are notified 30 minutes before the start of the game.

Because the initial balance of all players is based on the total number of players, there is an incentive to invite as many players as possible.

Start of the game

When the game starts, players are assigned to one of the two camps: Prisoners and Guards. The game assigns an initial balance to each player, based on the total number of players in the game. Based on the initial balance, the game determines the price of rent for prisoners, the value of fines for guards, as well as the cost of each game activity.

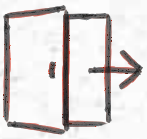


Midgame

The game is divided in days. At the beginning of each day, players are notified regarding how many prisoners escaped, how many were released, how many were caught with bribes or trying to escape and finally, how many remain still in jail.

Prisoners and guards can adopt a variety of strategies based on their risk tolerance. All other things being equal, the game rewards players who are active.

If a prisoner gets out, they are out of the game and they get to keep their token balance. If a prisoner or guard goes broke, they are eliminated from the game.



Endgame

The game ends when there are no more prisoners, either because they went broke, or escaped, or bribed their way out of jail, or because they were released through parole or by serving their sentence. When the last prisoner is out of jail, the guards that remain get to leave with their pocket money.

If all guards are eliminated while there are still prisoners serving their sentence, the game ends and the prisoners get to keep their balances.