

Rollback Netcode, Implmentation and Adoption

Edward Boulderstone

School of Computing Science, Newcastle University, UK

Abstract

Rollback netcode is a peer to peer networking soultion. It had potential to improve online experiences by minimizing the effects of latency over traditional delay based . However the implementation of rollback netcode in the fighting game industry has been slow and difficult. This project aims to understand understand how the industry has had difficulty implementing rollback, and find any optimizations that can be made to existing public rollback netcode understanding.

Keywords: rollback, netcode, peer to peer, fighting games, networking, industry.

1 Introduction

The goal of networking in video games is to allow people from all over the world to play with each other. However fans of fighting games have historically (Before the pandemic) gone out of their way to organise local tournaments with most major tournaments before the pandemic taking place off-line[2]. This trend started because of the when fighting games were played in arcades in the mid 1990's,[3] and continued until the start of the pandemic, in part because fighting games rely on consistent timing and a low latency environment [7], [8]. The existing networking solutions at the time simply did not provide this environment for competitive play[4]. However the spread of the corona virus in the mid 2020's fighting games found themselves having to fall back onto these "lower quality" online platforms. Games which did not have well optimized netcode found themselves on the back foot, with reduced attention [5], and games with well written netcode found their success [6].

1.1 Delay Based Netcode

The first solution to online play for fighting games was a peer to peer system known as delay based netcode. Peer to peer netcode is important for fighting games because of the aforementioned need for low latency. Because most fighting games are

¹ Email: E.Boulderstone@ncl.ac.uk

between two players [10], introducing a server will increase the ping between the two players, as the information has to travel to a separate location, before being sent to the opposing player.

Delay based netcode works by keeping two players in lockstep, meaning that each player's simulation of the game are paused whilst waiting for the input from the other player[11]. This system works well when latency is not a major factor, for example, in a turn based game, where the inputs are spread apart by seconds, a pause of half a second may go unnoticed. To address packets taking time to travel between two remote players, a number of input delay frames are added. Input delay frames delay the game state by a number of frames, and allow the local inputs to be sent ahead of time. So if the remote input arrives before the input delay frames are finished, there is no pause 1.

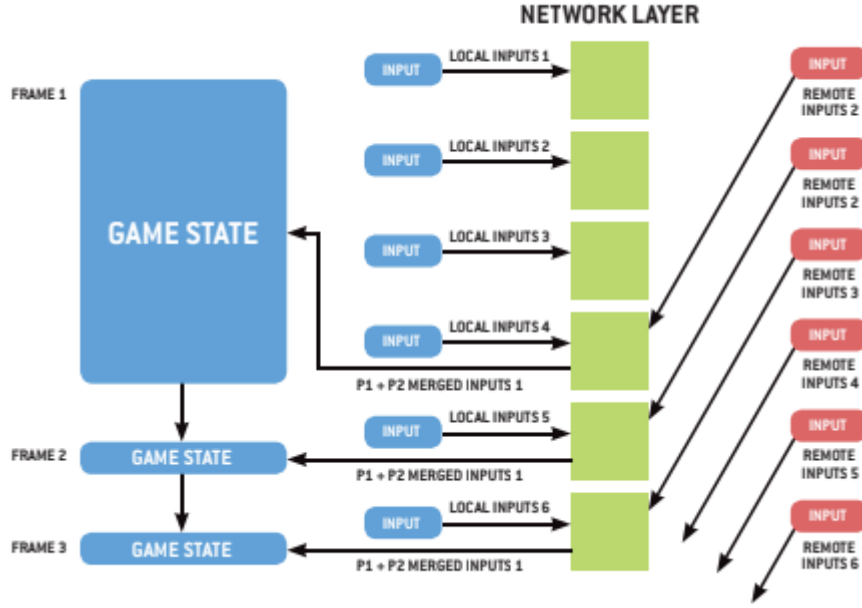


Fig. 1. Delay based netcode [1]

1.2 Rollback Netcode

Rollback netcode was developed in 2006 as a solution to the problems with delay based netcode. [9]. It works on top of existing delay based netcode by adding rollback frames, predicting the remote users inputs. When the remote user's input arrives if it matches with the predicted input, nothing happens, however if there's a discrepancy the game will "rollback", to the point of the discrepancy and re-simulate the game state back to the real time frame 2.

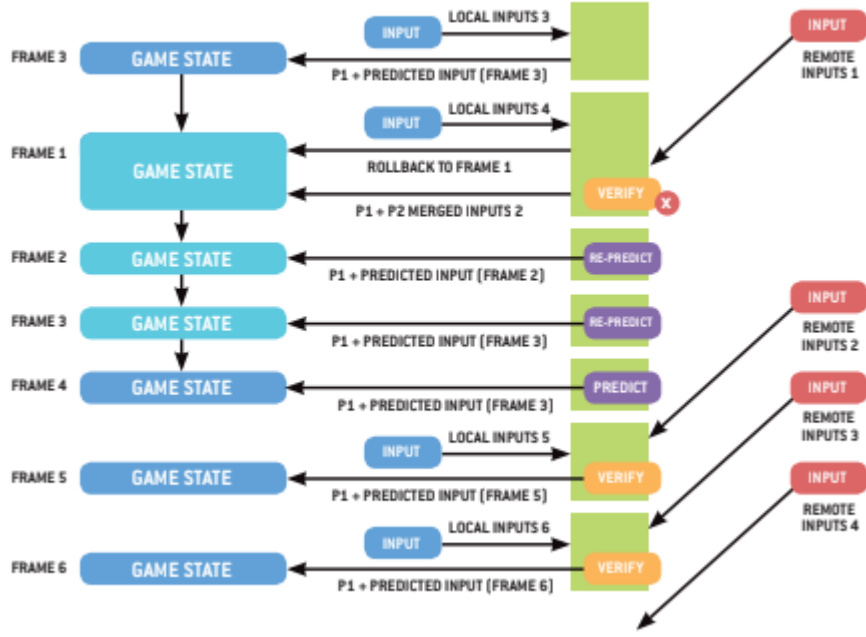


Fig. 2. Rollback netcode [1]

1.3 Difficulties in industry

In today's fighting game market, many games have rollback [13]. However there are still notable exceptions such as:

- Super Smash Bros. Ultimate[14]
- Granblue Fantasy Versus[15]
- Under Night In-Birth[16]
- Samurai Shodown[17]
- Soulcalibur VI[18]
- Dead or Alive 6[19]
- EA Sports UFC 4[20]
- Dragon Ball FighterZ[21]

Other fighting games have had difficulty in implementing rollback, such as Street fighter V and Mortal Kombat X. These difficulties with implementing and developing rollback are the basis of the motivation of this paper.

1.4 Aim

To investigate rollback netcode, its usage in industry and any shortcomings of existing public rollback netcode infrastructure

1.5 Objectives

- Understand rollback netcode and the effects on the games it's implemented in.

- Create a visualization for the differences between rollback and delay based netcode.
- Research the difficulties of implementing rollback in existing games.
- Explore optimizations for the existing public rollback structure.
- Investigate further uses of rollback netcode, in the wider video game industry.

2 What you did and how

It is highly unlikely that you will call this section by this name, it is more likely to be “Design and implementation”, “Model”, “Simulation”, “Experimental design” or such like, depending on your project. It will describe what you did and how you did it! Again, you might want to split this section into multiple sections, or introduce subsections, to separate distinct activities which you undertook, e.g. you could separate “Design” and “Implementation” into different sections.

3 Evaluation

This section might alternatively be called “Experimental results”. It describes how you assessed your project and what you found out. Where you give results in tables or graphs, remember to highlight in the text the key points that the data shows and, if possible, try to explain why you got any unexpected results.

4 Conclusions and further work

In this section you summarise what you did and discovered and (importantly) what else you would have done (or done differently) if you had the chance. It is a chance to reflect on your success.

References

- [1] https://drive.google.com/file/d/1nRa3cRBQmKj0-SEyrT_1VNokPOJWNhVI/view or https://web.archive.org/web/20220101162600/https://drive.google.com/file/d/1nRa3cRBQmKj0-SEyrT_1VNokPOJWNhVI/view Tony C., GGPO Game Developer Magazine’s article. 2012. (Visited 25/05/2022)
- [2] https://liquipedia.net/fighters/Tier.1_Tournaments or https://web.archive.org/web/20210121113554/https://liquipedia.net/fighters/Tier.1_Tournaments Liquidpedia list of major fighting game tournaments. (Visited 25/05/2022)
- [3] <https://www.usgamer.net/articles/the-oral-history-of-evo> or <https://web.archive.org/web/20220321000753/https://www.usgamer.net/articles/the-oral-history-of-evo> John L., The Oral History of EVO: The Story of the World’s Largest Fighting Game Tournament (Visited 25/05/2022)
- [4] <https://esportsinsider.com/2021/10/can-fighting-games-become-a-mainstream-esport/> or <https://web.archive.org/web/20220516060805/https://esportsinsider.com/2021/10/can-fighting-games-become-a-mainstream-esport/> Elizbar R., Can fighting games become a mainstream esport without abandoning grassroots?. (Visited 26/02/2022)
- [5] https://www.ssbwiki.com/COVID-19_pandemic_and_its_impact_on_competitive_Smash or https://web.archive.org/web/20220516020551/https://www.ssbwiki.com/COVID-19_pandemic_and_its_impact_on_competitive_Smash List of smash tournaments affected by the pandemic. (Visited 26/02/2022)
- [6] <https://techraptor.net/gaming/opinions/guilty-gear-strive-changed-fighting-games-rollback-netcode> or <https://web.archive.org/web/20210713144527/https://techraptor.net/gaming/opinions/guilty-gear-strive-changed-fighting-games-rollback-netcode> Davi B. Guilty Gear Strive Might Have Changed Fighting Games Forever. (Visited 26/02/2022)
- [7] <https://arstechnica.com/gaming/2019/10/explaining-how-fighting-games-use-delay-based-and-rollback-netcode/> or <https://web.archive.org/web/20220425211823/https://arstechnica.com/gaming/2019/10/explaining-how-fighting-games-use-delay-based-and-rollback-netcode/> Ricky P. Explaining how fighting games use delay-based and rollback netcode. (Visited 26/05/2022)

- [8] <https://www.polygon.com/2020/3/25/21192522/netcode-samurai-showdown-fighting-games-rollback-delay> or <https://web.archive.org/web/20220401231646/https://www.polygon.com/2020/3/25/21192522/netcode-samurai-showdown-fighting-games-rollback-delay> David C. Bad netcode is killing many of your favorite fighting games. (Visted 26/05/2022)
- [9] https://gamasutra.com/view/news/34050/Interview_How_A_Fighting_Game_Fan_Solved_Internet_Latency_Issues.php or https://web.archive.org/web/20220325062609/https://gamasutra.com/view/news/34050/Interview_How_A_Fighting_Game_Fan_Solved_Internet_Latency_Issues.php Kyle O. Interview: How A Fighting Game Fan Solved Internet Latency Issues. (Visted 26/05/2022)
- [10] <https://archive.org/details/nextgen-issue-015/page/n33/mode/2up> "The Next Generation 1996 Lexicon A to Z: Fighting Game". (Visited 26/05/2022)
- [11] https://www.gamasutra.com/view/feature/3094/1500_archers_on_a_288_network_.php or https://web.archive.org/web/20220506231117/https://www.gamasutra.com/view/feature/3094/1500_archers_on_a_288_network_.php Mark T. 1500 Archers on a 28.8: Network Programming in Age of Empires and Beyond. (Visted 26/05/2022)
- [12] <https://web.archive.org/web/20210228051849/https://mauve.mizuumi.net/2012/07/05/understanding-fighting-game-networking.html> Mauve M. Understanding Fighting Game Networking. (Visted 26/05/2022)
- [13] <https://attackofthefanboy.com/guides/rollback-netcode-games-list/> or <https://web.archive.org/web/20211122034207/https://attackofthefanboy.com/guides/rollback-netcode-games-list/> Andron S. Rollback Netcode Games List (March 2022). (Visted 26/05/2022)
- [14] https://en.wikipedia.org/wiki/Super_Smash_Bros._Ultimate or https://web.archive.org/web/20220519200835/https://en.wikipedia.org/wiki/Super_Smash_Bros._Ultimate Super Smash Bros. Ultimate. (Visited 26/05/2022)
- [15] https://en.wikipedia.org/wiki/Granblue_Fantasy_Versus or https://web.archive.org/web/20220512125807/https://en.wikipedia.org/wiki/Granblue_Fantasy_Versus Grandblue Fantasy Versus (Visited 26/05/2022)
- [16] https://en.wikipedia.org/wiki/Under_Night_In-Birth or https://web.archive.org/web/20220516020108/https://en.wikipedia.org/wiki/Under_Night_In-Birth Under Night In-birth (Visited 26/05/2022)
- [17] [https://en.wikipedia.org/wiki/Samurai_Shodown_\(2019_video_game\)](https://en.wikipedia.org/wiki/Samurai_Shodown_(2019_video_game)) or [https://web.archive.org/web/20220504020927/https://en.wikipedia.org/wiki/Samurai_Shodown_\(2019_video_game\)](https://web.archive.org/web/20220504020927/https://en.wikipedia.org/wiki/Samurai_Shodown_(2019_video_game)) Samurai Shodown (Visited 26/05/2022)
- [18] https://en.wikipedia.org/wiki/Soulcalibur_VI or https://web.archive.org/web/20220421074040/https://en.wikipedia.org/wiki/Soulcalibur_VI Soulcalibur VI (Visited 26/05/2022)
- [19] https://en.wikipedia.org/wiki/Dead_or_Alive.6 or https://web.archive.org/web/20220130144906/https://en.wikipedia.org/wiki/Dead_or_Alive.6 Dead or Alive 6 (Visited 26/05/2022)
- [20] https://en.wikipedia.org/wiki/EA_Sports_UFC_4 or https://web.archive.org/web/20211019192531/https://en.wikipedia.org/wiki/EA_Sports_UFC_4 EA Sports UFC 4 (Visited 26/05/2022)
- [21] https://en.wikipedia.org/wiki/Dragon_Ball_FighterZ or https://web.archive.org/web/20220424200258/https://en.wikipedia.org/wiki/Dragon_Ball_FighterZ Dragon Ball FighterZ (Visited 26/05/2022)