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In-Match and Out-Match Game Console Network Ping Comparison Analysis on a First-Person Arena Shooter (Case Study: East Jakarta, Indonesia)

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ABSTRACT

As offline and online game technologies evolve, gaming technology and devices constantly change. Games can be played on PCs or various console machines, including portable and non-portable devices. XDefiant is a free-to-play, first-person arena shooter in which players compete in fast-paced online matches. This research aimed to compare the ping values between in-match and out-match when playing an online first-person shooter game on a console machine. The study utilized a quantitative method using primary data and a descriptive approach, with data collected from June to July 2024. The game capture latency stage involved taking 30 screenshots in 10 in-match scenarios and 30 screenshots during out-match scenarios. Network pings were analyzed during both in-match and out-match. The mean ping during the in-match was significantly higher than during the out-match, with an average difference of approximately 12.77 ms. The standard deviation for the in-match was also higher than that for the out-match. An interesting finding was that the maximum ping during out-match was higher than during in-match, though the difference was only 1 ms. The ping trend increased during the in-match, while it decreased for better performance during the out-match. Despite the varying trends in both in-match and out-match, players reported excellent game performance during the research period.
Keywords: *analysis, first-person shooter, game, latency, online.*

INTISARI

Teknologi dan perangkat gim terus berkembang, begitu pula teknologi gim luring dan daring. Gim dapat dimainkan di komputer pribadi atau berbagai mesin konsol, termasuk perangkat portabel dan non-portabel. XDefiant adalah arena tembak-menembak orang pertama yang gratis dimainkan di mana para pemain bersaing untuk menjadi yang terbaik dalam pertandingan daring yang bergerak cepat. Penelitian ini bertujuan untuk mengetahui perbedaan nilai ping antara dalam-pertandingan dan luar-pertandingan saat memainkan gim penembak-orang-pertama daring di mesin konsol. Penelitian ini menggunakan metode kuantitatif dengan data primer dan pendekatan deskriptif. Pengambilan data dilakukan pada bulan Juni hingga Juli 2024. Tahap perekaman latensi gim dilakukan dengan mengambil 30 tangkapan layar pada 10 dalam-pertandingan dan 30 pada luar-pertandingan. Ping jaringan dianalisis selama pertandingan-dalam dan luar-pertandingan. Rata-rata ping di dalam-pertandingan lebih signifikan daripada di luar-pertandingan. Perbedaan rata-rata sekitar 12,77 ms. Standar deviasi untuk dalam-pertandingan juga lebih signifikan dibandingkan dengan simpangan baku untuk luar-pertandingan. Anomalinya ada pada ping maksimal, dimana luar-pertandingan memiliki ping lebih besar dibandingkan dalam-pertandingan, dengan selisih hanya 1 ms. Tren linier ping meningkat selama dalam-pertandingan. Namun, tren linier ping menurun untuk performa yang lebih baik di luar-pertandingan. Meskipun tren dalam-pertandingan dan luar-pertandingan mengalami kenaikan dan penurunan, para pemain menemukan bahwa kinerja gim sangat baik selama periode penelitian.
Kata kunci: analisis, daring, latensi, penembak-orang-pertama, permainan.

INTRODUCTION

Gaming technology and devices are constantly evolving (Budinugroho & Islam, 2023), as are offline and online game technologies. Games can be played on a PCs or various console machines, including portable and non-portable devices.

Online multiplayer games have become increasingly popular today, attracting a worldwide audience and creating virtual communities that transcend national borders (Soorya et al., 2024). In 2020, online gaming generated $178 billion. Many shooter, action-adventure, role-playing, and sports

games have massive player bases around the globe. Most online games need only a small amount of bandwidth, but they are highly affected by latency (Madanapalli et al., 2022).

The arena shooter game is designed to be played as a shooter in an enclosed arena. As is common with arena shooters, players are split into two teams and compete to earn the highest score before a timer expires (Baqapuri et al., 2021). Recently, there has been a growing number of online game titles in this genre.

XDefiant is a free-to-play, first-person arena shooter in which players compete to be the best in fast-paced online matches (Ubisoft EU/UK, 2024). Ubisoft released it on 21 May 2024, and it is playable on PC, PlayStation 5, Xbox Series X|S, and Amazon Luna. The following Figure 1 shows a screenshot of the gameplay.

Figure 1. Gameplay Screenshot

Internet connection is essential for online, single-platform, and multi-platform network games. In addition to bandwidth, other aspects need to be considered to play the games online smoothly, such as latency, packet loss, and choke. Better subscribed Internet access with higher bandwidth, smaller latency, zero packet loss, and zero choke would be ideal for playing an online game, primarily a first-person shooter.

The term latency indicates the duration it takes for information to move from one location to another. It may also be referred to as ping during a speed test. Esports players, as well as competitive gamers in general, require minimal network latency to increase their likelihood of winning. Typically, the shorter the network latency, the less time there is between a player's action and the desired result (Liu et al., 2021).

Bandwidth and latency impact everything related to online communication. Connections with high speed and low latency provide the fastest speeds and quickest response times. On the other hand, if the connection has low speed and high latency, it causes slow downloads, choppy streams, and delayed responses (Parrish, 2023). Physical distance to the server, connection speed, networking equipment connected to the internet, the number of devices sharing the connection, and traffic loads from nearby customers on the network can impact actual speed (AT&T Business, 2024).

The internet service provider and the type of connection mainly influence ping performance. Several factors affecting ping are beyond the user's influence, such as the distance between servers (AT&T Business, 2024). This research aimed to find ping value differences between in-match and out-match while playing an online first-person shooter game on a console machine. Similar research has been conducted (Rahim et al., 2024; Wandy & Bhakti, 2021) with differences in ping to analyze the game performance and genre.

RESEARCH METHODOLOGY

This research used a quantitative method with primary data and a descriptive approach. The game console was set up to connect the network directly to the modem from the Internet Service Provider (ISP) using a Cat 6 UTP cable. During the research period in June and July 2024, the version of XDefiant used was 1.03.017 and the gamers had levels ranging from 26 to 45.

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Figure 2 shows how the research flows, starting from the initial discussions to data analysis:

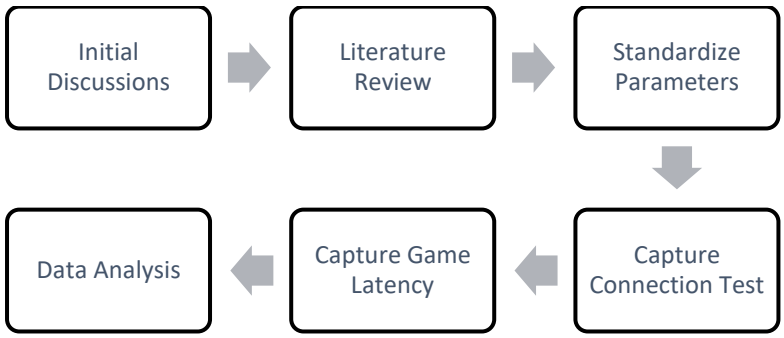
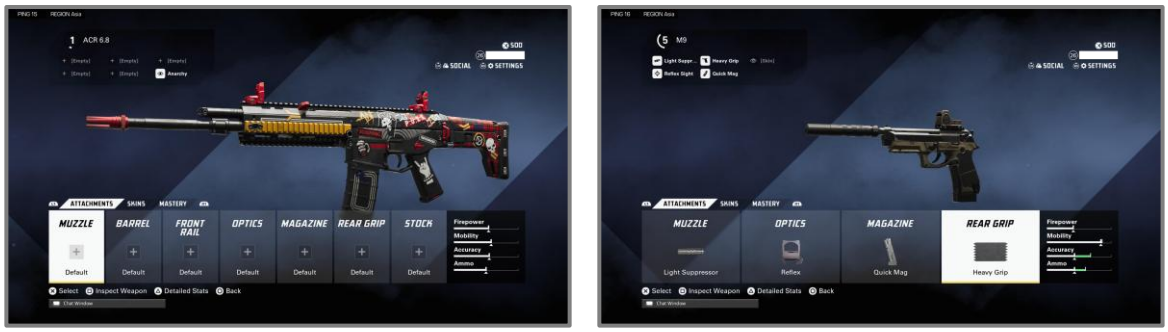


Figure 2. Research Flow

The initial discussion began in June after the game was released and downloaded on the Sony PlayStation 5 console. The game provided ping information and automatically selected regions on the top-left screen both during and outside of matches. This research paper analyzed the differences in ping inside and outside of matches, which has never been performed previously in similar research activities.

The literature review was also conducted to support the research activity. Literature was taken from journal articles to websites over the last ten years. Certain parameters must be standardized during the research period to ensure consistency in the in-match gameplay and minimize differences, making the captured game latency data more suitable for this research.

The weapons used by the gamers for data acquisition remained consistent throughout the research period: ACR 6.8 as the primary weapon and M9 as the side weapon:



(a) (b)

Figure 3. Weapon Used during the Research (a) Primary Gun (b) Secondary Gun

These weapons were consistently used in the in-match period, ensuring uniformity in the data capture process. Figure 4 shows the same character used during the in-match:

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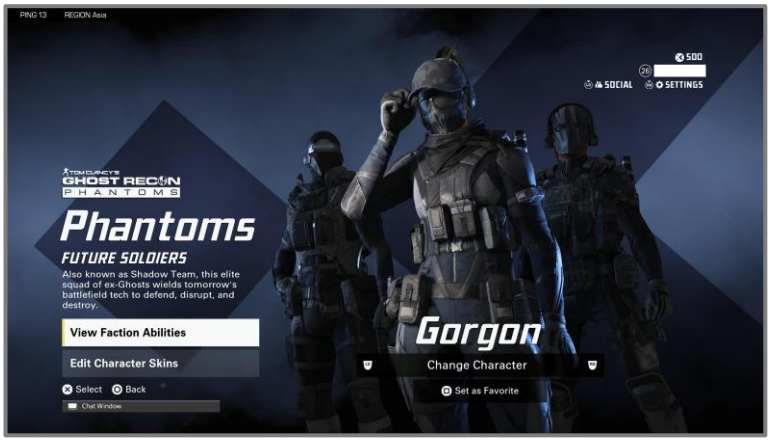

Figure 4. Character Used during the Research

As shown in Figure 4, the character was used multiple times across the 30 matches. Using the same character in matches could standardize the data capture process.

The next step in this research was to capture a connection test to measure the Internet speed performance before the in-match and out-match latency performance. Figure 5 shows an example result of a console test Internet connection in a screenshot:

Figure 5. Console Test Internet Connection Screenshot

This step used the connection test measurement feature provided in the game console, and some screenshots were taken. The game capture latency stage also involved capturing 30 screenshots from 10 inside matches and an additional 30 screenshots from outside of matches. The ping result on the left-top of the screen is shown in Figure 6:

Figure 6. Ping and Region on the Game Screen

After all the data captured from June to July 2024 was gathered, it was analyzed using a spreadsheet with a statistical approach. The mean and the standard deviation were then used to analyze the captured data to see the network connection and latency from a statistical perspective. The following generic formula was used to find the mean from console connection test data:

$$\bar{x} = \frac{\sum_1^n x_i}{n}$$

Later in the following sections, population standard deviation was used to support the analysis. The following generic formula was used to find the population standard deviation from the console connection test data:

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

Both formulas were then used for ping analysis. The results and analysis of these were discussed in the following section.

RESULTS AND DISCUSSIONS

The network speed tests from the console machine were analysed. All of the console connection tests resulted in NAT type 2. After conducting the test five times, the results are shown in the following Table 1:

Table 1. Console Connection Test Results

#	Download (Mbps)	Upload (Mbps)
1	47.8	13.0
2	46.8	9.5
3	51.1	11.5
4	50.4	16.9
5	49.9	11.1
Average	**49.2 ± 1.63**	**12.4 ± 2.51**

The test results showed that the average download was 49.2 Mbps, with a standard deviation of 1.63 Mbps, which was insignificant. The upload average was 12.4 Mbps, around a quarter from the download, with a standard deviation of 2.51 Mbps. This standard deviation was found to be more significant compared with the download. From here, it was also found that the connection between the download and the upload was asynchronous. According to the gamers in this research, running the game with this Internet speed was no issue.

Then, the network pings were analyzed during the in-match and out-match. Table 2 shows the in-match and out-match ping based on minimum, mean with the standard deviation, and the maximum value of ping captured during the research process.

Table 2. In-Match and Out-Match Ping

	Min Ping (ms)	Mean Ping (ms)	Max Ping (ms)
In-Match	16	29.67 ± 6.10	35
Out-Match	13	16.90 ± 4.97	36

Table 2 shows that the in-match mean ping was more significant than the out-matches. The average difference was around 12.77 ms. The standard deviation for the in-match was also more significant than that for the out-matches. The anomaly was in the maximum ping, where the out-match had a bigger ping than the in-match, despite the difference being only 1 ms.

The raw data, as seen in Table 2, were then broken down for further analysis to understand the ping differences better. Figure 7 displays the ping gap between in-match and out-match based on data captured from 30 instances.

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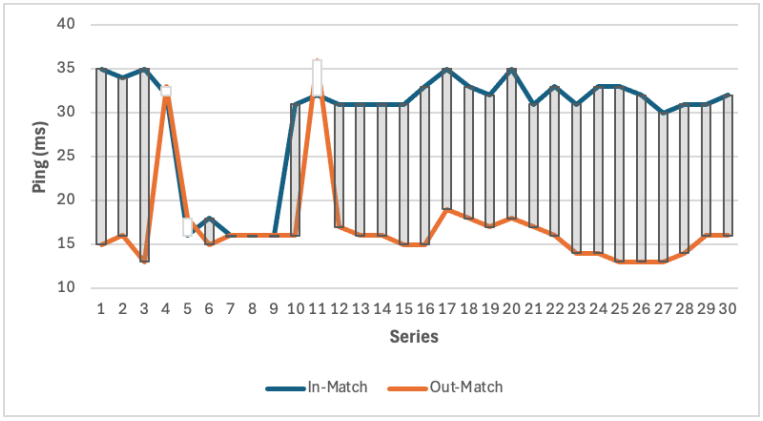
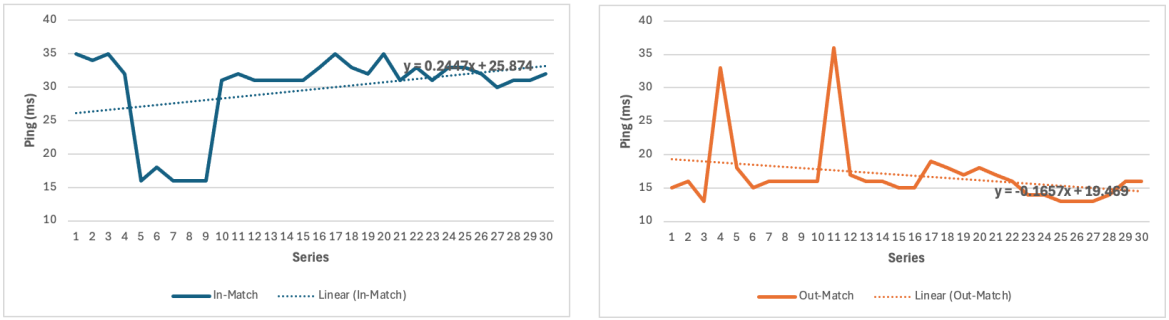


Figure 7. Ping Gap

Figure 7 illustrates a significant ping gap between in-match and out-match scenarios. Although a few instances showed the opposite condition, with the ping gap being equal for both, gamers did not perceive these differences as impactful when they played the game.

The raw data was also analyzed to see the ping trends. Figure 8 shows both in-match and out-match data separately to see more specific linear trends.



(a) (b)

Figure 8. Ping Result Analysis (a) In-Match (b) Out-Match

Figure 8 (a) depicts that the ping linear trend increased for the in-match. However, Figure 8 (b) indicates that the ping linear trend decreased for better performance in the out-match. The game performance remained excellent, even though the trends for both in-match and out-match showed instances where it increased and decreased.

CONCLUSION

The mean ping in the in-match was more significant than that in the out-match. The average difference was around 12.77 ms. The standard deviation for the in-match was also more significant than that for the out-matches. In the maximum ping, the out-match has a ping bigger by 1ms than the in-match, which is an anomaly. The ping linear trend increased for the in-match; however, it decreased for better performance in the out-match. Although the trends for both in-match and out-match differed, the players found that the game performance was excellent throughout the research period.

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