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1-Click Gamer Network Optimization Tool

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Abstract: In the fast-paced internet world that we live in today, internet technologies and tools that enable us to connect online are rapidly changing and improving. To adapt to the changing environment, many game developers are changing their business models to adjust to this online environment by developing games that are centred around online gaming. As such, the internet demands of consumers such as gamers are increasing because of the need for quality internet connection for optimal gameplay. There are too many factors that can affect online gameplay. Moreover, not all gamers are equipped with the network knowledge and skills to diagnose and troubleshoot any internet issues that may arise during their gameplay session. The main contribution of this research was to gather insights from Malaysian broadband internet consumers, mainly from gamers and general users regarding their opinions of their ISP service experience in gaming, general use and service quality. A 1-click solution is presented as a smart autonomous network monitoring tool that can autonomously monitor, diagnose, and troubleshoot network problems with minimal input from the user. This research was conducted using a mixed-mode research methodology where the participants were asked to fill up a questionnaire regarding the user experience of their Internet Service Provider (ISP), and their perception of the 1 click-automated networking tool for their personal use. It is shown that there is a market demand for a 1 click-automated networking tool as gamers and general users both agree that such a tool would be beneficial to them by improving the internet quality of a network.

Keywords: Gaming; network optimization; troubleshooting & management

1. Introduction

In today's modern gaming ecosystem, many games require a stable internet connection to run optimally and ensure smooth gameplay. The further away the gamers are located from the physical data centre, the higher the latency and ping time the gamer will experience. For example, a gamer in Malaysia playing on an American server will experience significantly higher latency in comparison to a gamer in America playing on an American server. Despite relying on the internet to connect people globally, gamers are often incentivised by online game companies to play in their local region because of better ping response times. Unfortunately, for games that are unavailable in their local region, gamers are forced to play in another region and accept the latency penalty. Most gamers are aware of the connectivity issues caused by internet quality and geographical location, and the most common misconception of online gaming is that they need to have an extremely fast internet connection to play online when an average internet speed (10 – 50Mbps) is good enough. However, some major ISPs in Malaysia claim that the ideal internet speed for gaming is 300Mbps to 1Gbps, which could potentially indicate poor bandwidth management, poor network routing and ISP throttling for their lower-level internet plans . Additionally, a gamer's online gaming experience will vary based on the activity of the network-connected devices such as IoTs and smartphones that

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are consuming the gamer's home internet bandwidth. Therefore, the barrier to entry for online gaming is needlessly high and disincentivises users to try gaming due to the high internet prices.

In recent years, the gaming industry has been slowly changing and adapting to a newer business model that is called the “live service model” which is a purely online gaming model where gamers will have to log into a game online to play . This model is introduced because of the wide availability of internet access which allows games to be easily accessed and downloaded anywhere in the world. A good example is Epic Games’ Fortnite, where the developers changed their business model to Free to Play and added a battle royale game mode to Fortnite due to the rise of popularity of battle royale games such as PUBG. Fortnite’s overwhelming success in the battle royale genre resulted in more than $5 billion in annual profits for Epic Games because the developers made the game free for everyone to play.

The free-to-play model has made gaming more accessible for everyone and has positively impacted the gaming market in Malaysia. One of the main factors contributing to the boom in mobile gaming is that smartphones are getting more powerful and affordable to everyone, which draws many people to try mobile gaming. As can be seen in Figure 1, a survey made in 2021 confirmed that the top 4 gaming devices used by gamers for gaming are Smartphones, PC, tablets, and consoles. Out of the 4 devices, smartphones were the most used device for gaming, leading by a wide margin of 97% and it should also be noted that over 70% of gamers are playing online games . Online gaming in Malaysia is more popular than ever and because of this, the internet requirements for gamers are rapidly increasing. To capitalize on that, ISPs should take advantage of the current market opportunities and benefit from providing smart internet and networking solutions that can improve the gaming experience of their users. Studies have shown that smart solutions have proven to be able to monitor, diagnose and troubleshoot user networking and internet problems [1] [8] [9] [10]. These implementations may also have a positive effect on ISPs, where smart systems can automatically diagnose and troubleshoot user problems, leading to operational efficiency and decreased overheads for technical support staff. While also increasing company brand awareness and financial earnings.

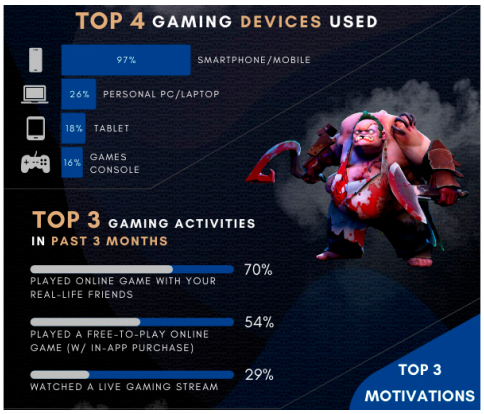

Figure 1. Top Gaming Devices & Activities [7].

One of the main causes of annoyance for online gamers is network delay, sometimes known as "lag". A typical shooting game only needs a few hundred kilobits per second (kbps) of bandwidth; therefore, a faster internet connection does not directly affect the gaming experience on its own. Contrarily, a 100 millisecond (ms) increase in latency can substantially affect gaming performance [11], since the gamer’s motions in the game are slower and their spells take longer to activate. To combat the latency issue, a new industry called "game acceleration" has emerged, encompassing anything from gaming (Content Delivery Networks (CDNs) to gaming Virtual Private Networks (VPNs) like WTFast and ExitLag. A client/server solution called the WTFast Gamers Private Network (GPN R) was created to enhance network performance for online games that use centralised game servers. A GPN R improves connections between the client's computer and the gaming network by lowering network latency, spikes, and jitter [12]. Since the reliability of the game's connection is a

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typical worry among gamers who play online, the much-increased connection consistency of WTFast's GPN R service is one of its primary features. This is achieved by controlling the data path from the client to the game server. The authors in [12] used data from tens of thousands of GPN R and non-GPN R (normal internet) connections to build a statistical model of spike predictability, frequency, and severity. The goal was to identify the types of conditions and improvements that may be identified utilising a GPN R. The researchers presented a statistically solid assessment of the effectiveness of WTFast's GPN R service, along with a comparison of latency, spikes, and jitter across GPN R vs. non-GPN R lines.

The main advantage of a 1-click automated tool is to make network optimization more accessible for consumers. Based on the study [13] general consumers have found it hard to understand the technical jargon used in networking which made self-diagnosing network problems unnecessarily hard. Therefore, this automated system can help in monitoring, diagnosing, and maintaining the user network with minimal input from the users. However, there has been limited solution and articles on such 1-click tools in the current market.

1.1. Problem Statement

It is due to the accessibility that more people are gaming and trying out various games. But not all gamers will have the same gaming experience as gaming experience depends on several factors such as PC specifications, internet quality, router quality, ISP, internet plan, router configurations, household total concurrent bandwidth usage, and more. Because of this, the gaming experience will vary from person to person according to their situation. Diagnosing and troubleshooting internet issues may prove to be troublesome and time-consuming due to the myriad of potential factors influencing the gaming experience, and internet quality. This may prove to be daunting for gamers that are not knowledgeable about network troubleshooting and may resort to asking for technical support from other parties which may take days to resolve an issue. As for knowledgeable users, self-troubleshooting can be very time-consuming as it will take time to investigate each aspect relating to the network to find the problem and some users may not have extra time for diagnosing issues.

Additionally, given the inconsistent implementation of residential internet networks, together with the lack of knowledge and tools, internet users are required to handle a more complicated challenge of network management. This issue is then magnified by the sudden surge of IoT devices in the technology market currently, such as smart wearables, smart TVs, light bulbs and more taking up internet bandwidth [14]. Managing the bandwidth of so many devices will pose a major challenge to unknowledgeable users and in turn, will negatively impact the quality of their home internet and gaming performance. Hence, user self-network diagnosing, monitoring, and troubleshooting is a very time-consuming and intimidating task for new and experienced users alike. Consequently, this led to the main problem of automating these tasks without the need for complicated technical knowledge or usage of multiple silo systems. Furthermore, there was insufficient literature on the availability of 1-click automated tools available for end-user to assist the user. Therefore, the proposed system aims to assist users in detecting and fixing the issues autonomously and if required, informing the users when intervention is required.

The mixed mode methodology will be utilized to conduct this research as it is determined that this methodology will give the best outcome for the research [15]. The appropriate sample population has been decided and the survey distribution method will be a digital survey will be used to distribute to the population. Data analysis and data collection tools were determined.

1.2. Research Objectives

The proposed system is designed to accomplish the following research goals through research investigation:

RO1: To gain insight into the relationship between internet speed, game latency and price to offer a smoother gaming experience.

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RO2: To compare the evaluation results of different network optimization theories with others to offer a smoother gaming experience.
RO3: To identify the ways to optimize networks for better gaming latency and smoother gaming experience.

1.3. Research Hypotheses

RH1: More expensive internet plans do not necessarily contribute to a smoother gaming experience.
RH2: Optimizing the home network has a positive contribution to a smoother gaming experience.
RH3: The proper utilization of network optimization tools to optimize users' networks will allow ISPs to improve their brand recognition while offering a smoother gaming experience.

1.4. Value Creation

This research proposes a 1-click automated network optimization tool specialized for gaming which functions as an automated gaming network prioritization and routing (VPN tunnelling), automated network diagnostic, monitoring and troubleshooting tool (internet quality, network settings and configuration), can autonomously monitor and report network quality, generate user-readable network statistics to gauge network performance and able to autonomously enforce bandwidth limitation for other applications and priority for gaming applications. Finally, self-diagnosing network issues can also reduce the overhead and support costs of ISPs and offer more competitively priced internet plans and a more efficient support team. ISPs will also receive fewer complaints regarding network issues leading to fewer bad user reviews which can increase their brand recognition.

2. Literature Review

Ever since the popularity of the live service model, many developers including industry giants such as Square Enix, Electronic Arts and Blizzard Activision have begun adopting it into their games as this live service model has proven to attract more gamers and profit in comparison to the traditional buy to play model [16]. There is no denying that the future of gaming is moving towards online gaming, in 2020 itself, 74% of the total global gaming revenue comes from in-game purchases such as cosmetics, weapons, etc, the free-to-play market is the most dominant model for PC and mobile gaming and will be expected to grow in the future [17]. This live service free-to-play model has also been slowly influencing the Massively Multiplayer Online (MMO) genre with notable games such as World of Warcraft, Final Fantasy XIV and Guildwars 2 making their base game free to play. By making the base game free to play, the game will be more accessible to new players keen to try the game for free and in hopes that they will buy the expansions soon.

The example of Lost Ark, however, is a completely free-to-play MMORPG where all the expansions are completely free for everyone to play. The way they monetize the game is through in-game transactions such as selling skins, pets, player boosts, mounts and more, this is completely optional and up to the gamer to decide if they want to make purchases. Based on Figure 3, 74% of all game revenue in 2020 comes from in-game purchases [17]. The requirements to play an MMORPG game vary from game to game and the type of intensity required. The more fast-paced (intense) the game, the more network requirements are needed to run the game, meaning that the gamer will need to have a lower latency between the servers to effectively play the game smoothly. Even though the game requires a reasonable amount of reaction and latency time to play well, the gameplay is often slower-paced than that of a first-person shooter. As a result, compared to FPS, the user criteria for low-latency gameplay in MMOs are more lenient. Final Fantasy XIV (FF XIV) and World of Warcraft are two examples of MMORPGs (WoW). The typical latency requirement for MMO players is between 50 and 200 ms [18] [19].

As the bandwidth requirements for families become larger, and the internet becomes more of a commodity and accessible to many income groups, there will be a huge need for user self-diagnostic and troubleshooting tools. Providing self-diagnostic tools for users will help them to fix the problem faster and will also save resources and costs for the ISP as they will not need to hire more on-site and

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off-site customer support 24/7. Based on the literature, ISPs are using a manual tool that measures the network quality of a user based on various metrics such as packet loss test, jitter test, delay test, and bandwidth test [9] [20] while there were silent on the availability of automated 1-click network optimization tool currently.

Based on Literature [8], the authors are implementing an automated network troubleshooting solution that focuses on wired and wireless network fault and configuration management which finds and repairs network abnormalities. As home networks now contain an ever-growing number of smart gadgets, making it increasingly difficult to handle their issues. The issue is further exacerbated by the absence of tools and consumer education for automatically diagnosing and repairing issues. Hence the need to innovate automated troubleshooting solutions for the public. While preparing the study, many papers involving network troubleshooting specialised for gaming were studied. Studies have been found on a gaming-centric network optimization software called WTFast which works by rerouting the network connection to a network that offers the best connection between the computer and the selected game server. Based on the lowest latency and greatest stability, WTFast selects the most optimal route. Based on the Literature [12], WTFast achieves this by using Machine Learning technology to automatically find the best connection and routing path from the source to the game server. This has greatly improved the game efficiency with the need for the gamer to technically understand or know which path should be taken.

Network monitoring is crucial for an excellent quality internet connection. As [21] stated, quality network monitoring directly reflects the performance of the network. This is why users will need to make sure that everything is operating properly and learn how to monitor their network. With network monitoring tools, users can see which devices and application is eating up their bandwidth which can cause poor network performance. Chapter 2.2.6.1 will focus more on the ISP side which monitors the internet performance. Chapter 2.2.6.2 will focus more on the user hardware which monitors the hardware side such as bandwidth monitoring and quality of service (QoS) aspects. Based on Literature by [21], the authors review a few network monitoring tools that autonomously monitor a network and can generate network performance metrics for the administrators to study and analyse. There are 3 types of monitoring:

Active - The foundation of active measurement techniques is the idea that by adding traffic to a network, one may learn more about its characteristics. This method may be applied to large-scale networks, end-to-end, or per link, to gather accurate data and evaluate the quality of observed network segments. However, active monitoring is considered invasive to a network. Passive – The idea of passive monitoring is based on gathering and analysing traffic data to estimate network characteristics and monitor network performance and behaviour. Passive measurement is considered non-intrusive to a network. Hybrid – The concept of hybrid measurement is the combined use of active and passive theories combined. Where active probes are distributed to a network and its' traffic is passively monitored. Then the measurer will track the probes' path and inform their end-to-end delays [21].

Based on the Literature [10], the authors have introduced their interpretation of an enhanced bandwidth control platform for effective monitoring of resource utilization. In recent years, the bandwidth requirements for an organization have drastically increased and studies have found that bandwidth usage is usually not associated with the main function of the organization [10]. A large chunk of that bandwidth is used by social media sites such as Twitter, Instagram and other sites which are unrelated to the function of most organizations. Resulting in an increased budget to increase organizational bandwidth. The system monitors a given network's bandwidth and resource utilization to improve the quality of service (QoS) to users.

Based on the survey results shown in Table 1, several gaps are yet to be filled in the field of network optimization. While all the tools listed in the literature have been proven to serve their purpose, in the end, there is still lacking a feature-complete (all-in-one) tool for network optimization that a general consumer can use. An example of a feature-complete tool is a network optimization tool that can provide smart network allocation, while autonomously diagnosing, troubleshooting, and monitoring the network with a click of a button.

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Table 1. Literature Comparison Table.

Purpose	Summary
LaggingMeter- Tool to measure the network quality of a device	Strengths: Can measure a device's internet quality. Weaknesses: No tool to diagnose network problems. Must rely on user knowledge for self-diagnosing. Cannot passively record network quality.
Measuring internet speed- Using Speedtest.net to measure the network quality of a device	Strengths: Can measure a device's internet quality. Weaknesses: No tool to diagnose network problems. Must rely on user knowledge for self-diagnosing. Cannot passively record network quality.
HomeNetRescue- Automated network troubleshooting that detects anomalies in a wireless network, network configuration & settings	Strengths: Can automatically diagnose and fix network anomalies. Shown to increase network throughput by 131%, reducing wireless transmission delay by 46% and jitter by 24%.
Network Monitoring- Automated active/passive network monitoring to autonomously monitor network quality and generate user-readable network statistics to gauge network performance.	Strengths: Can monitor a network continuously via active/passive/hybrid methods. Can generate network statistics for more in-depth user analysis. Weaknesses: No tool to diagnose network problems. Must rely on user knowledge for self-diagnosing.
Bandwidth Monitoring and Control Platform- the system monitors a given network's bandwidth and resource utilization to improve the quality of service (QoS) to users.	Strengths: Can continuously monitor the local area network (LAN) and overall bandwidth consumption. Able to manually impose bandwidth limitations on certain devices to improve the quality of service (QoS) of other users. Weaknesses: Cannot automatically and dynamically impose QoS as required.
WTFast Gamer's Private Network- WTFast GPN works by optimally re-rerouting a user's network that offers the best connection between the user and the game server. WTFast will automatically select the best route to the game server to reduce latency.	Strengths: Focused on game connectivity and routing (Game priority). Find the best connection (VPN routing) automatically. Weaknesses: Do not have any network diagnostic tools. Cannot record network quality. Only focuses on getting the best connectivity to the game.

Firstly, the knowledge requirements to troubleshoot a network for general consumers are quite high as there is too much technical jargon being used in the networking field that could prove incomprehensible to them. Based on the study of [13] on the study of "the role of language choice in home network troubleshooting" suggests that both technical and informal words were troublesome for the participants. The design of technical assistance scripts and training materials, as well as the design of troubleshooting tools and systems, should be redesigned to be more user-friendly towards non-tech-savvy consumers.

Secondly, ISPs have failed to consider the benefits they would receive if they could make network troubleshooting more accessible to consumers and raise more awareness about basic

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networking. Having more customers self-diagnose and fix their network would lead to fewer complaints and reduce the resource allocation to the customer support department. Which in turn will reduce the strain on the on-site technical support engineers and reduce the customer wait time for a technical support team to arrive on-site to troubleshoot more serious issues as summarized in Table 2

Table 2. Proposed Technology.

Automated Network Optimization for Gaming
Automated gaming network prioritization and routing (VPN tunnelling)
Automated network diagnostic, and troubleshooting tool (internet quality, network settings and configuration)
Autonomously monitor and report network quality
Generate user-readable network statistics to gauge network performance.
Bandwidth limitation for other applications and priority for gaming applications.

In the current research, researchers are focusing on Network Troubleshooting [9] [20] [8], while some are focusing on Automated Network Monitoring and alerting [21] [10]. In the proposed work, the focus will be on Automated Network Optimization for gaming. While the WTFast automated gaming network optimization [12] can automatically reduce gaming latency by smart VPN tunnelling, it still requires the customer's network performance to be good. WTFast is not able to solve any local networking issues caused by other devices in the local network such as a family member consuming most of the bandwidth by downloading a large file.

This research will propose a 1-click automated network optimization tool specialized for gaming which functions as an automated gaming network prioritization and routing (VPN tunnelling), automated network diagnostic, monitoring and troubleshooting tool (internet quality, network settings and configuration), can autonomously monitor and report network quality, generate user-readable network statistics to gauge network performance and able to autonomously enforce bandwidth limitation for other applications and priority for gaming applications. The main advantage of a 1-click automated tool is to make network optimization more accessible for consumers based on the study of [13] general consumers have found it hard to understand the technical jargon used in networking which made self-diagnosing network problems unnecessarily hard. Therefore, this automated system can help in monitoring, diagnosing, and maintaining the user network with minimal input from the users. Finally, self-diagnosing network issues can also reduce the overhead and support costs of ISPs and offer more competitively priced internet plans and a more efficient support team. ISPs will also receive fewer complaints regarding network issues leading to fewer bad user reviews which can increase their brand recognition.

3. Methodology

A mixed mode (quantitative + qualitative) research methodology has been selected as will give the best outcome for the research as the mixed mode methodology will help in providing a clearer perspective of user perception through analyzing the results of the contradictions and similarities of both qualitative and quantitative data [22] [23] [24]. This methodology can encourage several pathways of study that enhance the data and allow questions to be answered more thoroughly, also allowing the participants to voice their opinion and share their experiences [25]. Digital survey forms are used to conduct the mixed-mode research which includes a combination of open-ended and close-ended questions. This mixed mode methodology will help in conducting a systematic investigation of the impact of network optimization for excellent quality internet, by collecting data of all types of internet users by using online questionnaires. The period for final data collection was a cross-sectional short-term study, which took around 1 week.

It is determined that the sample respondents should be all types of internet users such as general users and gamers. While the sampling frame will be centred around all broadband users in Malaysia such as Maxis, Time, Unifi etc. Also, it is determined that the sampling size for the total number of

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participating respondents should be around 50 people. Additionally, non-probability sampling will be used for the survey where respondents will voluntarily decide to participate in the survey also known as convenience sampling. Google Forms will be used for data collection as it is more convenient and accessible for respondents, which will increase the chances of participation. As for data analysis, interval data will be used as a unit of measurement to summarize the data with many types of descriptive statistics such as mode, median, and mean; range, standard deviation; and frequency. To collect and analyse the data, Microsoft Excel is used to tabulate and eventually visualize the data into meaningful graphs and charts. Google Forms will be the data collection tool that is used for this research because it is more accessible as participants would not need to have an e-mail account to participate. Participants are surveyed via digital surveys, also known as online questionnaires, which are research techniques used in a virtual setting. These surveys fall under the category of online research methods (ORM). Many of these ORMs have roots in previous research procedures that have been modernised and re-envisioned to function in a digital world that is always changing and on the go. Online surveys have gained popularity as a means of information gathering due to the growing use of the Internet. While the practice of internet research is still developing and is still relatively new, digital surveys for market research now have new opportunities and levels of complexity because of the rise of social media.

The survey questions are distributed to social media and discussion forums such as Facebook and Reddit to collect data. As this survey is designed so that general internet users and gamers alike can participate, the questions are made to be simple and understandable by everyone. Because it is a mixed-mode research, the questionnaire length will be around 5-10 minutes instead of the usual 3-5minutes in quantitative research. With mixed mode, the questionnaire is constructed in a way where open-ended and close-ended questions are both integrated into the survey. The respondents will be given a set of predetermined questions with a small section that, based on their answers will lead to a separate set of questions. This method to conduct data collection is very efficient for collecting data in a short amount of time. The use easy of understanding language is used to ensure that the non-technical respondents will be able to understand the questions to reduce misunderstandings which will lead to higher-quality data. The survey consists of about 25-27 questions depending on the participant's response. It will be divided into 4 sections which are Demographics, User Detailed, User Knowledge, and user perception of a 1-click automated network tool which will be discussed in the next section below. The questionnaire is segregated into 4 sections because it is designed to gradually ease the respondent into the questionnaire and not make it too cluttered and long that it might negatively impact the respondent and the quality of survey responses [22]. To prepare the data for analysis, duplicate and incomplete data will be removed. In addition, the digital survey tool, Google Forms has a built-in feature to prevent data duplication and ensure that the participants are submitting data that is complete.

Detailed analysis will be conducted using SmartPLS software and the data will be processed using an equation modelling algorithm called partial least squares equation modelling (PLS-SEM). This statistical modelling technique is an emerging tool that has been utilized by many researchers across various disciplines [26]. In the case of this research, PLS-SEM will be expected to draw conclusions from open-ended responses and determine reliability and validity. The data collection has been split into 3 parts to test and improve the survey before distributing it to a larger population. The first part is Preliminary Data, where the survey form has been sent to 5 people to gauge their feedback, such as better wording for survey questions. The second part will be Pilot Data, where the improved survey form will be sent to 10 other people, before proceeding to the third part which is Final Data where the finalized survey form is sent and distributed to social media and forum sites. The reliability measurement determines if the acquired data is dependable and capable of producing good and accurate findings as shown in Figure 2. The data stability and consistency will be tested as part of the reliability measurement. This metric will assist us in determining if the data obtained is accurate and trustworthy. Cronbach's Alpha Coefficient Range states that 0.9 > is Excellent, 0.8 to 0.9 is Very Good, 0.7 to 0.8 is Good, 0.6 to 0.7 is Moderate, and 0.6 is Poor [23] [27].

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Alpha Coefficient Range	Strength of Association
< 0.6	Poor
0.6 to < 0.7	Moderate
0.7 to < 0.8	Good
0.8 to < 0.9	Very Good
0.9 >	Excellent

Figure 2. Strength of Association Determination.

Content validity ensures that the survey questions can cover all aspects of the criteria that are being measured and ensures that it contains all important items while excluding redundant and unnecessary items [24]. The subjective views of experts and non-experts are what constitutes content validity. Hence, the proper identification of the population and sample are determined, which are general internet consumers and gamers. Concurrent validity refers to the operationalization's capacity to distinguish between groups that it should, in theory, be able to distinguish between [24]. In short, it is a measurement that measures how well a new test equates against a proven test. Hence, the mixed-mode survey will be conducted using Google Forms for digital surveys. Construct validity guarantees that theories are converted into concrete measurements and that survey questions are accurate to the subject at hand. Domain experts in the IT field such as Network Engineers, Security Engineers, IT Support, and more were involved in the survey to ensure construct validity. The research has also determined the threats to internal validity which has the potential to skew the results of the survey. Therefore, it is important to identify and consider them.

It is ensured that the possible threats are addressed by diversifying the sample size and ensuring that the survey is relevant to both population types. The survey is designed to be inclusive in a way that the structure of questions will be understood by anyone who has used the internet before. Privacy and ethics were also considered when designing the research where on the form, it is stated that their confidentiality would be respected and that, going forward, all references to them will refer to them as "Participant 1,2,3." The design methodology is a step-by-step developmental process that starts with research methods and procedures which serve as a model for all scientific studies [28]. It is also considered a research methodology path that researchers follow to conduct their research [29]. The research approach is considered a considerable step in the research design process as it will establish the relevancy of the information that is studied from various sources [29]. From that, a research design has been adopted based on what the author has composed as shown in Figure 3.

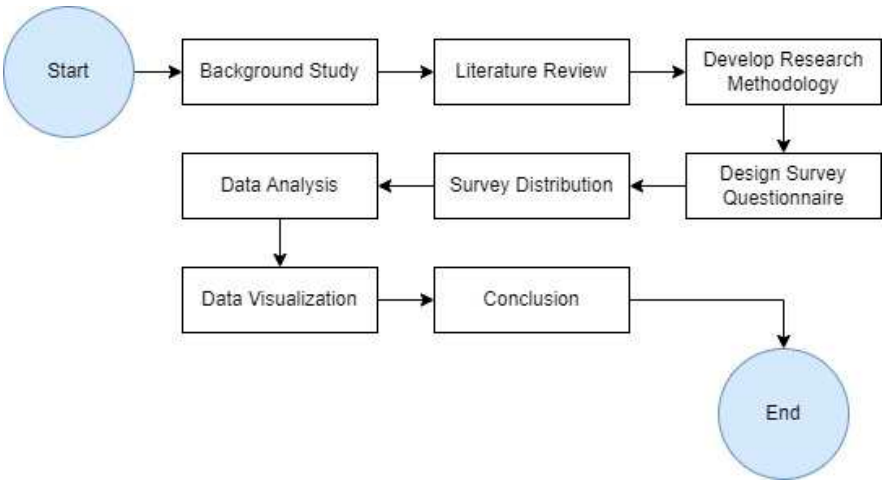

Figure 3. Phases in research methodology.

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4. Findings and Discussions

In this section, the paper will introduce the narrative of the findings and provide further analysis of the findings. This background information will present some insights about the current environment that leads to the paper's contributions.

62.5% of Unifi subscribers are gamers, while 37.5% are general users.

55.2% of other ISP subscribers are general users, while 44.8% are gamers.

Figure 4 shows that Unifi is more popular because they are the pioneer in the field, being the first ISP company in Malaysia to deploy fibre internet to consumers back in 2010 [30]. Additionally, gamers may prefer more consistent internet quality over better internet speed as shown in Figure 5.

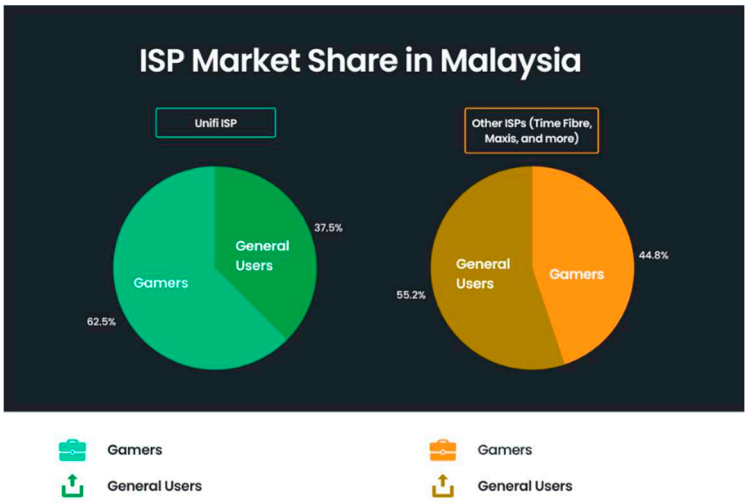

Figure 4. ISP Market Share in Malaysia.

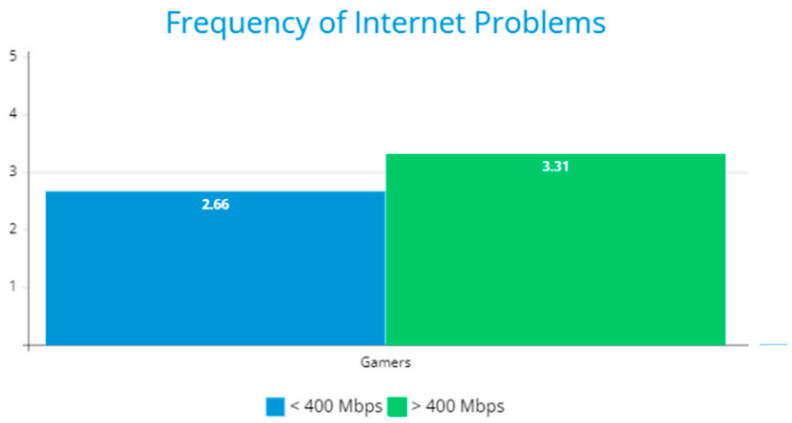

Figure 5. Frequency of Internet Problems.

Gamers and general users have around the same average internet speed of 271 and 264 Mbps, respectively. This result is in line with Unifi's online recommender system, and Maxis' minimum recommended internet plan for gaming which is 300Mbps [2] [3] as shown in Figure 6.

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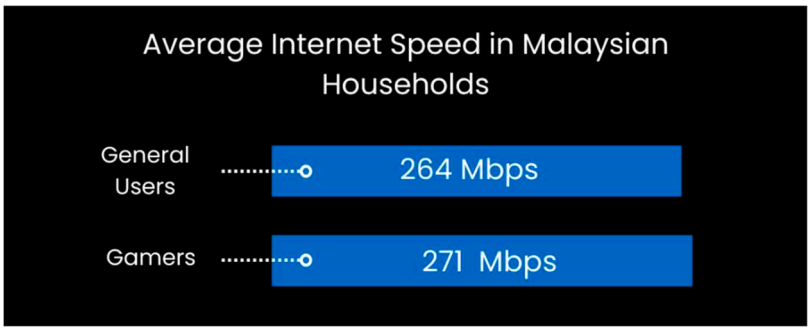

Figure 6. Average Internet Speed in Malaysian Households.

Gamers and normal users both have similar average internet speeds as shown in Figure 7. Therefore, more expensive internet plans do not necessarily contribute to a smoother gaming experience. As even according to the survey, gamers with 400Mbps above internet plans experience similar levels of internet issues during gaming. Gamers on average have about 9 devices at home while general users have 6 as shown in Figure 7. However, smartphones remain the most popular device for gamers as there are a lot of popular mobile games available in the market for free right now [31]. General users, only mostly use smartphones, laptops, and IPTVs. General users normally use these devices to consume online content such as browsing social media and watching online videos and movies. With more devices consuming bandwidth, troubleshooting an internet issue will become increasingly more difficult and time consuming, thus the tool can identify and fix issues more effectively.

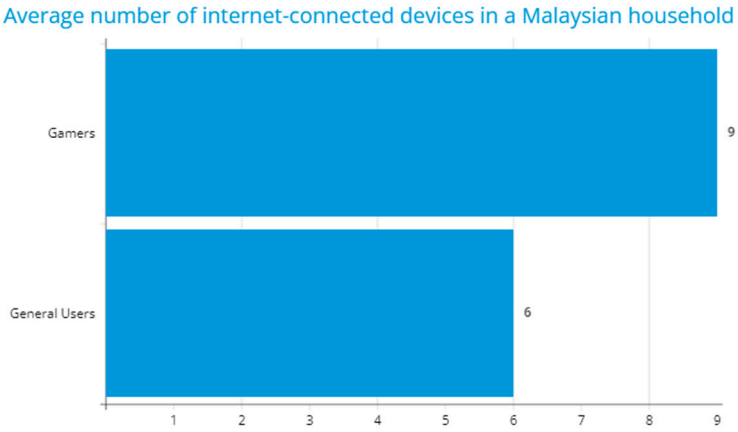

Figure 7. Average number of Devices in a Malaysian household.

Gamers encounter internet issues more often and tend to troubleshoot their home networks more often as shown in Figure 8. On average, gamers spend 28 minutes more troubleshooting their network problems as compared to general users. Additionally, their networking troubleshooting success rate is also lower as compared to general users as shown in Figure 9. After all, gamers require a stable internet connection to play online games smoothly [21], but general users can still browse the web and watch videos with unstable internet. By automatically identifying and resolving network faults, the programme has the potential to significantly decrease the amount of time typically required to solve an internet issue while simultaneously improving the success rate of troubleshooting.

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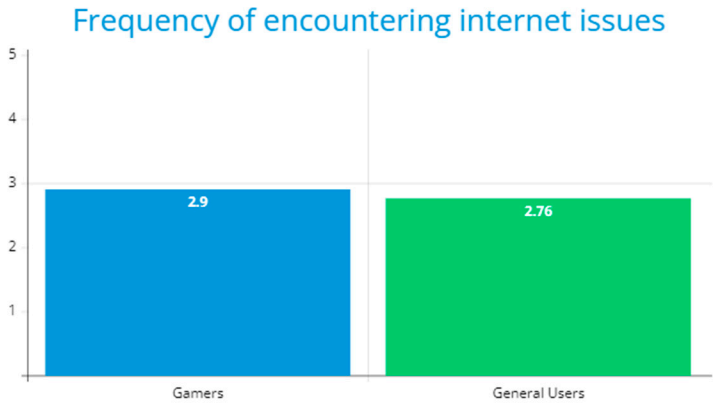

Figure 8. Frequency of encountering internet issues.

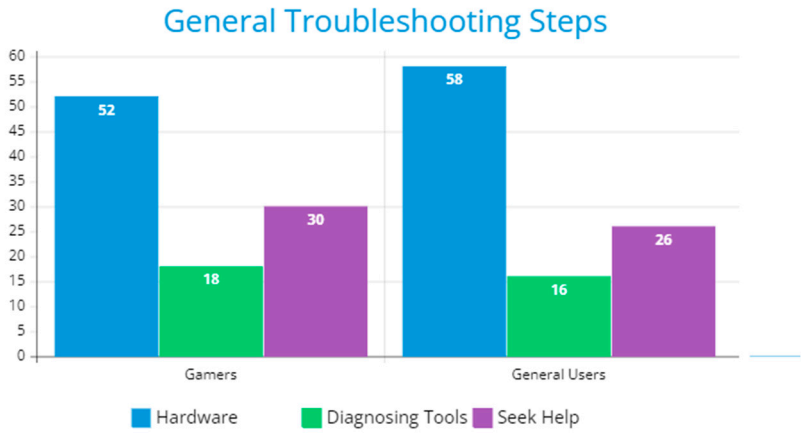

Figure 9. General self-troubleshooting steps.

Gamers and general users have about the same level of technological and digital literacy, this is in line with a study done about technological literacy amongst millennials and older generations [32]. Both populations have similar troubleshooting methodologies. About 50% will look at the hardware, about 30% will choose to seek help (Google, family, friends) and about 20% will resort to using diagnostic tools (windows diagnostic). Trying to diagnose internet problems will take a long time as shown in Figure 9, and there are no predefined steps that a user can take for them to solve the issue systematically. To solve that, the tool is equipped with a diagnosing feature that can automatically diagnose an internet issue and try to solve them automatically, if it is unable to do so, then it will let the users know what the issue is and what are the steps that the users can take to try to fix the issue themselves.

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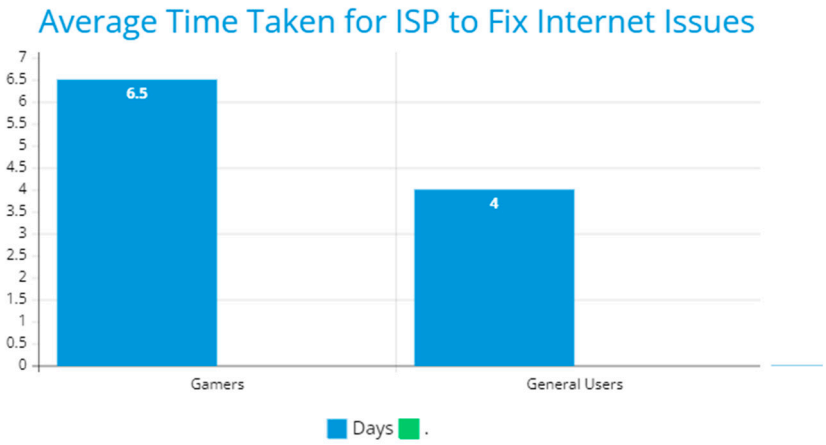

Figure 9. Average time for ISP to resolve an issue.

About 30% of gamers and general users choose to contact support when they have internet issues. It takes 6.5 days on average to solve a gamer's issue while only took 4 days on average to solve a non-gamers issue. This could be because a gamer's network requirements are higher than compared of general users. After all, gamers require a stable internet connection to play online games smoothly [21], but general users can still browse the web and watch videos with unstable internet.

100% of gamers have positive sentiments about the proposed tool, while 96% of general users have positive sentiments as shown in Figure 10. Mainly because it is easy, convenient, and time-saving. Also, some prefer having this tool as they have negative experiences when relying on ISPs to resolve their issue. Proper utilization of network optimization tools to optimize users' networks will allow ISPs to improve their brand recognition while offering a smoother gaming experience. It can be said that internet consumers want a tool that can automatically monitor and manage their networks as they do not want to waste precious time trying to troubleshoot an issue or wait for an ISP to resolve an issue for them. Gamers and normal users both overwhelmingly agree that the smart tool will be useful for general home network management. It can be said that the users want a "set-and-forget" tool that can help them to fix network issues without the need to worry about it and will save them time to do something more meaningful instead of wasting time troubleshooting an issue.

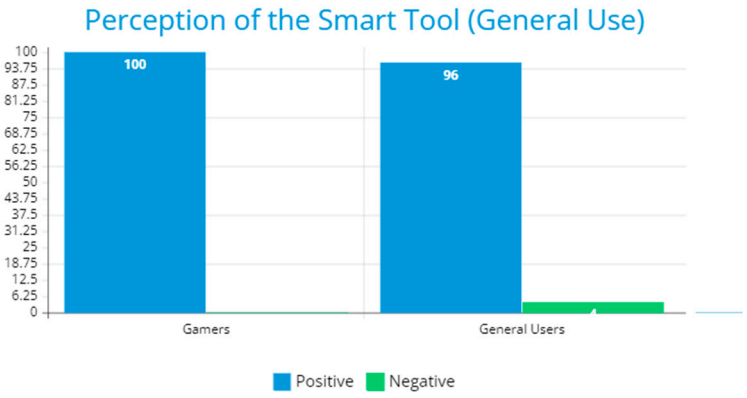

Figure 10. User perception of the smart tool (general use).

86% of gamers have positive sentiments about the tool for gaming as it can potentially improve the gaming experience and efficiently manage their network as shown in Figure 11. However, 14% of gamers have negative sentiments as they already have their solutions and do not experience network issues while gaming. 44% of the non-gamers also have positive sentiments about the tool for gaming mainly because of the smart QOS capabilities which can give everyone a better internet experience. While 66% remained neutral as they are not gamers.

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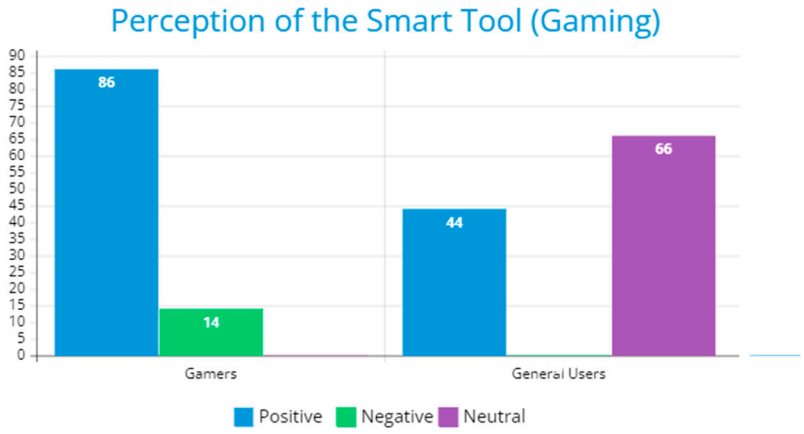

Figure 11. User perception of the smart tool (Gaming).

Proper utilization of network optimization tools to optimize users' networks will allow ISPs to improve their brand recognition while offering a smoother gaming experience. Based on Table 47, the majority of gamers overwhelmingly agree that the smart tool will be useful for network optimization to improve gaming performance.

Over 90% of both populations agree that they will be less likely to contact ISP support if the smart tool can solve their internet issues as shown in Figure 12. 90.6% positive sentiments as they do not need to wait in a queue for a call, and less human interaction. While 9.4% have negative sentiments as they think the tool is untrustworthy or they have no use for the tool. It can be said that ISPs can gain more brand recognition by developing innovative tools that are useful to consumers. Gamers and normal users both agree that they will be more likely to recommend an ISP that has the tool. Gamers and general users have about the same internet speeds of 270 Mbps lower than the ISP's recommendation of 300Mbps minimum for gaming. It can be said that higher internet speeds do not necessarily contribute to a smoother gaming experience as even gamers with 400Mbps speeds often experience the same level of internet issues as well. Gamers have more internet-connected devices as compared to general users, as many devices are capable of gaming, such as mobile phones, laptops, desktops, consoles and more. Because of that, gamers have more devices connected to the network and that would mean more devices consuming the bandwidth. Hence, the more devices a consumer has, the larger their bandwidth requirements, which means higher internet plans.

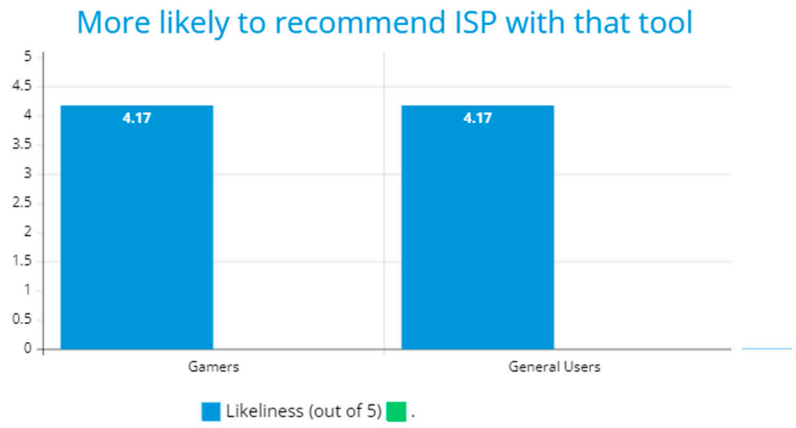

Figure 12. Likeliness to recommend an ISP.

Gamers and general users have similar network troubleshooting skill levels as most of them troubleshoot their problems themselves with comparable results. Both parties share similar

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troubleshooting steps by diagnosing their hardware first, some will seek help, and some will use specialised tools to try to solve their problems. Gamers encounter internet issues more often and tend to take a longer time to troubleshoot their network problems. On average, ISPs took a longer time to resolve a gamer's network issue as compared to general users. It takes 6.5 days on average for gamers and 4 days on average for general users. Gamers have positive sentiments about the smart tool for general home network management and improving gaming latency. And they are likely to recommend an ISP that provides the smart tool.

The average internet speed of gamers is about 270Mbps, which is as expected as Unifi and Maxis market their 300Mbps plan as a gaming product but 100mbps for work-from-home and online learning purposes. This shows that gamers do not need extremely fast internet speed to be able to game as the average internet plan for gamers is about 270Mbps. However, internet quality still depends on the number of household users and the number of internet-connected devices in the household as those will also consume bandwidth which will affect the gameplay experience. Gamers want a tool that can improve their gaming experience that is easy to use, and hassle-free. As not all gamers are knowledgeable enough to manage their network. Based on the survey, gamers spend more time troubleshooting their network compared to normal users. Gamers also want a tool that can solve their issues without consulting with people as they prefer minimal human interaction based on the survey as explaining their issue is very troublesome, annoying, and time-consuming.

5. Conclusion

The main objective of this research was to gather insights from Malaysian broadband internet consumers such as gamers and general users regarding their opinions of their ISP technology deliverable in providing the most optimized bandwidth performance. Three hypotheses were tested based on the contribution to the gaming experience. Analysis and studies had been conducted and 3 out of 3 hypotheses were confirmed. Based on the results from the survey, there is a positive impression of the 1-click bandwidth optimization tool amongst all respondents. It can be concluded that there is a market demand for the automation tool as both gamers and general users agree that they would use the tool as it would be beneficial for them.

As this research started by exploring systematic literature reviews and the theoretical contribution, future activities will include more experiments to understand the practical contribution. The data is currently collected in Malaysia, and this limits the possibilities of other geographical-centred considerations in terms of gamer preference or service provider specification. While this research has provided meaningful contributions, future research should explore bandwidth acceleration to gain greater speed performance for real-time multiplayer gaming. Furthermore, the proposed solution is focused on network optimization while there is still further contribution from the data transmission perspective.

This research will be useful for the ISP industry, especially for autonomous QoS traffic management for gaming. The diagnosing feature of this tool also has the potential to change the way how ISPs provide value-added technical support to customers. Next, the smart diagnosing feature may also be able to autonomously fix customer network issues which will reduce the number of customer service calls to the support centre and less hassle for customers. This research has proven that there is a market demand for such a tool and the advancement of smart autonomous tools in this field will be highly desirable to all parties, customers and ISP companies included. This can drive the ISP support operation costs down and in turn, will improve internet quality and may lower the prices of internet plans for consumers. In the future, we will examine the deep learning techniques [33] [34] [35] for the gamer private network as it could be beneficial in improving home network management, internet optimization (wired and wireless), troubleshooting and data analytics. With the use of unsupervised learning and pattern recognition, deep learning has the potential to further optimize and automate home networks by studying the user's internet usage and activity.

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