# PFSENSE ROUTER AND FIREWALL SOFTWARE

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Abstract:

The pfSense is a software system that combines router and firewall in one product. This is a stable operating and simple to use cybersecurity solution for implementation in computer networks. This software package is intended for wide range of users, from individual clients to small, medium or large enterprises. The pfSense is one of the world's leading router, firewall, as well as VPN solution for secure cloud networking and network edge based on an open-source software platform.

The computer networks utilizing the pfSense system, have significantly higher degree of control and better management of incoming Internet traffic, which tends to become more and more extensive over time. The set of performances is what makes it unique and exceptional while also surpassing the existing competitors in that area. This open source network security solution raises the overall cybersecurity and accompanying parameters to a significantly higher levels.

The pfSense software brings users and developers together. There is a large community which is strongly supporting it, while constantly evolving and upgrading it too. Though pfSense can be downloaded, installed and used free of charge, it is possible to make commercial support to the pfSense's developers team. There is also an enhanced version, pfSense Plus software package combined with Netgate hardware, providing capabilities such as prevention of specific attack mechanisms, proxy filtering, network services, user authentication, monitoring of either traffic or device, all at an affordable price.

Keywords:

pfSense, Router, Firewall, Computer Network, Traffic Control.

## INTRODUCTION

pfSense is a specialized software, a free network firewall distribution, based on the FreeBSD operating system with a custom kernel and option to include the third party free software packages for additional functionality [1].

It serves as a firewall and a router simultaneously, for networking computers. [1]

This software was created in 2004. as a project by two students Büchler and Ulrik, but officially have appeared in October 2006. as fork of the original m0n0wall firewall project in FreeBSD operating system distributions.

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In addition to amateur use, pfSense also provides the possibility of installing a professional version and consequently specific settings for companies and organizations. [2]

pfSense software is a free, custom, open-source FreeBSD distribution specifically aimed for use as a firewall and router. It is fully managed and adjusted through a standard web environment. In addition to being a powerful, flexible firewall and router platform, it includes a long list of related features and system packages, which allow further extensibility without adding unnecessary options and potential security vulnerabilities to the base distribution.

The pfSense software is constantly being improved, and the latest version of it is 2.6.02.

pfSense now represents the world's leading open-source firewall, router and VPN solution for secure networking at network edge and in the cloud. Already several million installations of different versions of this software are active worldwide and they protect numerous computers in homes, companies, government offices, educational institutions, directly or indirectly through Internet Service Providers (ISPs). [1]

## 2. GENERAL PFSENSE FEATURES

pfSense can be viewed as a type of operating system, software for networking devices having open source code. It is based on FreeBSD operating system. Due to the large number of initial compatibilities, the pfSense team chose this type of operating system (FreeBSD) as the base for the kernel. pfSense has excellent hardware portability. Other vendors software are no match to it. It provides highest level of cybersecurity completely free of charge. The pfSense has also open source code which means that expert users can adapt it to their needs. [2]

Other software do not have such capabilities, and even may not be tailored to suit the hardware, except for those specifically designed and made for that system (many router operating systems are dedicated software, locked to run on only one type of router and cannot be applied to another system). [2]

The complete documentation on installing and configuring the pfSense service is extensive, helpful, relevant, and open-access too. It is available for access on the official website of the creator of this product.

pfSense can be installed on a physical computer with operating system or on a virtual machine, and after appropriate settings, be put into full operation.

The community gathered around this software is very active and creative - they collaborate with other software developers. Any of the pfSense users can make their own versions and improvements of the original software code through the Github platform. If a fork suggested is popular enough, or it fixes a bug, or adds a new features, the pfSense team can add that code as a part of the official pfSense software. This often happens in practice. [2]

pfSense software includes the same features as the most expensive commercial firewall solutions. In some cases it implements additional features that are not available in commercial, closed source software. It also supports hardware that is generally considered older, or even hardware that is not of the standard x86 architecture. Certainly pfSense offers a higher quality of service for the money invested. According to what characterizes it, the adequate implementation of the mentioned software follows. [2]

Installation and further configuration of pfSense is done according to available and very comprehensive instructions. In order to install it, it is necessary to open an appropriate account. Log-in into the system requires classic authentication - the software uses a typical username and password login form.

By following defined steps for a specific software implementation procedure, an old and obsolete computer can be transformed into a high performance network device which can be used as a router, firewall, server (DHCP, DNS...), intrusion detection system, intrusion prevention. All of the above mentioned is realized in single device, on one piece of hardware, with one software solution. In addition to the ones already listed, the pfSense system contains numerous other options, which makes it an excellent solution either for home or corporate needs, if it is combined with adequate hardware. Another feature of that system, apart from the possibility of installation with minimal requirements for hardware components, is the easy upgrade and portability of the system, considering that all settings remain memorized. [3]

pfSense is Free and Open Source Software, based on the Unix-based FreeBSD operating system. The minimum hardware requirements for pfSense is a 500 MHz processor (for a throughput of 10 Mb/s - 20 Mb/s), while a throughput of 21 Mb/s - 100 Mb/s requires a 1 GHz CPU. A throughput of 101 Mb/s - 500 Mb/s requires a 2 GHz processor with PCI network cards, while above 501 Mb/s a multi-core CPU faster than 2 GHz is needed. [4]

Future-proofing is a term that means the so-called "preparation for the future", and it is considered to be one of the most important notions/ terms in the IT field. This assumes that a system is made better, more powerful and with more features than is currently needed. pfSense adapts to the above needs and scales up to serve and satisfy increasing demands. In computer networks this means a higher number of possible interconnections, equipment providing higher Internet up-link and/or down-link speed and data transfer between the local network, servers having excess capabilities and more resilient than the current application demands and similar. [2]

In case of pfSense, an important strength is its possibility to modifying the code by the user. When proprietary operating systems and/or software for network devices are considered there is always the issue of security, as well as privacy. It is very difficult to find out exactly what data some software collects, and which data (packets) are sent over the Internet. Even for advanced users, who have the ability and expert knowledge to see the sent packets, in most cases (and most of the time) that data is encrypted and cannot be read by human without appropriate decoding. That's another reason why free and open-source software (FOSS) is getting more and more popularity - because of its transparency.

pfSense software includes the same features and provides many options as the majority of expensive commercial firewall solutions. In some cases, pfSense has additional features not available in commercial closed source solutions. [1]

Netgate's pfSense software is available in the Azure and AWS marketplaces, as well as their respective cloud platforms. Many organizations and enterprises rely on pfSense software to provide reliable, full-featured firewall protection in the cloud, without hidden feature fees, arbitrary licensing fees, and user restrictions. [1]

In some cases pfSense has successfully replaced major commercial firewalls, including Check Point, Cisco PIX, Cisco ASA, Juniper, Sonicwall, Netgear, Watchguard, Astaro, etc. Listed software includes a web environment for configuration of all its components. There is no need for any knowledge of UNIX, using commands and manually editing sets of rules. [1]

Specific features that pfSense is providing include the following [5]:

- Firewall;
- Status table;
- NAT (Network Address Translation);
- Redundancy;
- VPN (IPsec, OpenVPN, PPTP);
- PPPoE server; and
- Dynamic DNS.

In wireless network configurations, it is easy to connect the WLAN access point (Access Point - AP) to the firewall, which protects / takes care of and provides connection to wireless devices (smartphones, tablets, etc.). This type of configuration with network devices and introducing pfSense system as a boundary between LAN and WAN, is presented in Figure 1. Although there are mini computers and routers for pfSense, equipped with a WLAN chip, very few of these devices can work in the access point mode. In most cases, they only support client mode, so they can connect to a WLAN. In addition, pfSense only supports a few tabs for access point mode. [6]

pfSense is a free, Open Source firewall and router, based on a FreeBSD platform, which is popular for its reliability, transparency and a clear, user-friendly interface. In addition, it is an indisputable fact that it includes numerous functionalities, which are characteristics of commercial, more expensive firewall/ router products. [7]

The pfSense Plus is more advanced software made by Netgate, the networks router and firewall for cloud. It is a robust, resilient, reliable and safe software product. It is currently the most reliable firewall on a global scale. This software has gained the respect and favour of users, and has been installed more than seven million times worldwide, having over 50 software releases since its inception in 2001. (Figure 2). The software is fully operational thanks to support of open source technology. pfSense Plus has over seven million installations protecting, businesses, homes, governments, educational institutions and service providers.

The pfSense Plus software package features a number of advanced options. Among these the most important are the following: mechanisms for preventing attacks from the network, setting up proxy traffic filtering, secure/ certain network services, authentication of users at login, monitoring of the network and its segments. [1]
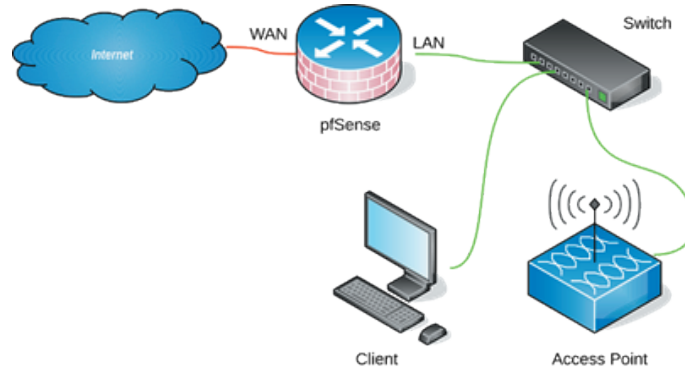
Figure 1 - Connecting Wireless Access Point on pfSense.



Figure 2 - pfSense Plus important numbers.

The software includes the same features listed as more expensive commercial firewall solutions provide. In addition pfSense includes additional features that are not available in standard vendor or proprietary source solutions. Organizations across the world rely on pfSense software to provide reliable, full-featured firewall protection in the cloud.

There are no hidden features and functions fees, no arbitrary licensing fees, and no artificial user limitations. [1]

The main properties of pfSense Plus software, from technological, business and utilization aspects, in Table 1 are presented in detail. [1]

## 3. PFSENSE SECURITY

The level of security in the pfSense system is incomparable (is much higher) to the maximum level of security provided by an ordinary router. The most significant item is the fact that the firewall is modular and receives constant updates, so that when new types of attacks appear, the system can be preemptively protected against them as potential threats.

In a professional environment, the capabilities of pfSense are almost outstanding, ranging from address blocking, remote server monitoring, making notifications about new MAC addresses, address separation and a large number of different packages that additionally secure the network.

Table 1 - Addressing Table [8].

| Open Source Technology | Proven Success | Business Assurance | Deployment Flexibility |
|---|---|---|---|
| • Trusted and preferred by many organizations<br>• 3x-5x lower total cost of ownership than traditional solutions<br>• Avoids vendor lock-in<br>• Faster response to critical security vulnerabilities | • Over seven million installs serving literally every continent<br>• Widely deployed in critical business, government and educational IT infrastructures<br>• 15+ years of continued innovation across 53 releases and counting | • 24/7 global support options<br>• Get prompt responses to critical issues from Netgate experts who consistently exceed SLA expectations<br>• Professional services and training for specialized needs | • Home, remote office, headquarters and data center premises installations<br>• Turnkey appliance and virtual machine instances<br>• Cloud ready - AWS or Azure Marketplaces |

For a network administrator, these capabilities mean a lot, because no commercial router has this level of safety and security. That is why many medium and small IT companies are now switching to the pfSense for router and/or firewall solution. Large IT enterprises often use a combination of multiple services, and even write their own services and programs designed to protect the network. The level of protection provided by pfSense is high, but there are options to open ports, rules on both sides of the network (WAN/LAN), the possibility to create virtual addresses to block access. [2]

As an extremely powerful, robust, yet easy-to-use software solution, pfSense software combines and delivers simultaneously firewall, router, and VPN functionality to users. These are intended for cybersecurity implementation and use in homes, companies (small and medium size enterprises), educational and scientific institutions (faculties, schools, institutes) and government agencies, making computer networks more resilient and safer.

With additional packages, which are often used in pfSense, a computer network quickly becomes very secure from Internet threats. However, this requires a higher level of knowledge that is not common, so the average user is recommended to keep everything at the factory settings. There always is the possibility of a configuration error, which can also create even bigger problems in a computer network.

In addition, there is an additional level of protection from a pfSense. The option to add open VPN networks directly to the router enables encryption of data sent over the Internet. fBlockerNG prevents the download of unnecessary advertising cookies or packages and traffic analytics that are often transferred by computers. Known suspicious websites can be blocked or avoided, silent ping is provided and sending of appropriate data. [2]

## 4. CONCLUSION

pfSense as a system protection management, traffic control and cybersecurity software is a good choice. Experts in the field, computer network administrators rely on it worldwide. In addition to being completely free, the code is open source and is continuously updated with the new versions. The community gathered around the pfSense software is very active and provides constant upgrade and support. It also provides unparalleled portability - compatibility with a variety of different hardware devices that might not be used in a computer networks otherwise.

When comparing the capabilities of a computer network based on and protected by pfSense, to a network of approximately the same complexity, and qualities, only based on proprietary software and hardware, there is huge difference in their investment cost. Often, most proprietary options, especially those offered by Internet service providers, are of low level quality and simply cannot be compared to the capabilities of open source software.

The features provided by open source software excel more and some of the highest quality software today have this kind of code. The number of users of open source software is increasing significantly and growing linearly with the number of active developers who are searching for a better alternative to vendor solutions. The number of users switching to the Linux operating system, as well as all possible distributions of that system, is growing more and more, following the number of active developers who strive to provide the best possible software code. Due to the UNIX subsystem, there is a high number of options available in the standard Linux operating system. Also, as OpenBSD improves, so does pfSense becomes almost perfected over time. As new hardware emerges, the scope of pfSense's functionality increases

Today, pfSense is often used for various tasks, from large and medium-sized enterprises, and also in small, home or personal computer networks. It is especially applicable in networks having a large number of wireless connected users, or a server. Since the mentioned system is very easy to configure and set up, users can be laymen or experts alike.

With increase in bandwidth demands, higher internet speeds, many obsolete routers become bottlenecks in the data flow between network segments and internet. Due to the modularity of pfSense, and the power of modern desktop processors, the pfSense system can reach packet transfer data-rate above 100 Gb/s. With several thousands of companies using pfSense software, pfSense becoming one of the world's most trusted open source network security solution.

Providing comprehensive network security and control solutions for large companies, Netgate with pfSense Plus software brings together the most advanced technology available to make network protection more effective than ever before. These products on the most reliable platforms are configured and to provide the highest levels of performance, stability and cybersecurity are designed.

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