



Interested in learning  
more about security?

## SANS Institute InfoSec Reading Room

This paper is from the SANS Institute Reading Room site. Reposting is not permitted without express written permission.

### Intrusion Detection - Systems for Today and Tomorrow

In today's booming e-commerce economy age, virtually every business, including the 'brick and mortal', is connected to compete for market share in the cyberspace. Enterprise's networked systems are inevitably exposed to the increasing threats from external hackers as well as from internal. The consequences can be loss or modification of critical business data, disruption of services (availability), compromise of proprietary business plans or processes (confidentiality and integrity). To counter these threats, Informati...

Copyright SANS Institute  
Author Retains Full Rights

AD

DEEPARMOR®

## **Intrusion Detection - Systems for today and tomorrow**

Ho, Swee Yenn (George)

Version 1.2e

### **Introduction**

In today's booming e-commerce economy age, virtually every business, including the 'brick and mortal', is connected to compete for market share in the cyberspace. Enterprise's networked systems are inevitably exposed to the increasing threats from external hackers as well as from internal. The consequences can be loss or modification of critical business data, disruption of services (**availability**), compromise of proprietary business plans or processes (**confidentiality** and **integrity**).

To counter these threats, Information Security organization today deploy many methods, tools and technology to defend the legitimacy of the systems. Methods like implementing policies and procedure, user awareness, deploying firewall and authentication systems, control systems access and forming computer incident handling teams. These approach aims to prevent, protect, detect, contain, eradicate, recover and serve as a lesson learnt.

This paper will examine the intrusion detection systems, one of the relative new technologies in information security. It aims to explore, in high level, the intrusion detection systems available today, as well as new developments in the technology.

### **Intrusion Detection Systems (IDS)**

At its core, IDS for computer network systems resemble burglar alarm systems to a physical building, it is capable of detecting and alerting the systems administrator on potential intrusion, providing guidance against any potential loss of integrity and confidentiality to the enterprise's valuable intellectual assets.

Firewalls and authentication are effective in protecting and preventing unauthorized access to the systems but lacks capabilities to monitor the network traffic where majority of attacks are taking place. These attacks could be initiated by disgruntled employees and others who have legitimate network access and use that privilege to do harm.

Firewall and authentication systems are vital, but they work at the point of entry to the network, if an attack able to breached the firewall, he can roam freely through the whole network. To keep a constant eye on network traffic and to know anything out of ordinary is happening, network security should be supplemented with Intrusion Detection Systems (IDS).

There are two ways intrusion detection works. IDS is Host based, Network-based or the hybrids of the two. Each type of intrusion detection systems has its own merits and legitimate shortcoming. Regardless of the type of systems deployed, it should include the following key features:

1. Robust
2. Flexibility and Scalability
3. Ease of use

### **Robust**

IDS is expected to run continually in the background without human intervention, it should be fault tolerant, meaning that in the event of a crash or failure the product won't have to be rebuilt or reconfigured. It should remain impervious to attacks!

### **Flexibility and Scalability**

IDS should be configurable and is flexible in response to changes on the network environment, it should also be able of coping with the growth of the network traffic while maintaining fairly high accuracy in performance (scalable).

### **Ease of use**

IDS is to be managed without consuming too much of bandwidth or high overhead from the organization. However, balance should be sought between ease of use and system effectiveness. In a real situation, it requires considerable resources to manage and operate the devices.

### **Host based Intrusion detection systems (HIDS)**

Host based IDS typically reside in the hosts they are monitored, the system agent will records important system file attributes, including hashes of the files. The agent will periodically scans log files for anomalous activity and notifies the system administrator if they have detected suspicious pattern of systems access on the hosts. Another host-based approach monitors all packets as they enter and exit the host, just like a personal firewall.

Host based IDS is popular in that it can tell you if an attack actually happened and if it is significant enough to warrant action. For example the IDS can detect changes in system files and knows if someone tries to install potentially malicious software such as back doors. Back doors are highly specialized programs that let hackers remotely control a server and either steal information from or modify it in a harmful way.

Also, the host is the best location to respond to any attacks. It can also get a fine granularity of information, such as who is accessing what files and when the users log in and out of servers. It is appropriate for protecting an individual computer systems and the information it contains. However it doesn't provide data on the network as a whole. Also the security systems take on considerable processing resource of the host (CPU, RAM and storage).

## **Network based Intrusion detection systems (NIDS)**

As its name suggests, Network based IDS monitor and analyze network traffics on a designated segment. Network based IDS can be categorized as knowledge or behavior based.

For knowledge based NIDS, the systems searches for known ‘attack signatures ‘ that indicates the packets represent an intrusion. Signatures could be based on actual packet contents, and are checked by comparing the bits against known patterns of attacks, for example, attempts to modify systems files. Other known network attacks are protocol based where attackers seek weaknesses of a poorly administered web, file or other servers in a network. These port attack signatures will monitor and identify attempts to connect to network ports associated with service that are often vulnerable. Another protocol signature the systems monitors is the abnormal or illogical TCP/IP packet headers, which is identified as denial-of-service pattern of attacks.

Behavior based NIDS identify attacks by monitoring systems or network traffic patterns and flagging any activity that looks suspicious. The systems capture and analyze packets to define patterns of usage on the network. Once the IDS have constructed statistics or the traffic patterns, it will audit network traffic and analyzing them for any abnormality of the traffic pattern, which is deviated from the normal statistic.

Network based IDS provides real time monitoring and thus provides faster turn around time in detecting and responding to potential attacks. Also it is a system of probes that can be deployed at different points of the network which are deemed critical and is prone for attack so that it can capture those attacks packets at early stage, for example, these monitors can be located at a gateway or firewall between a corporate intranet and the outside internet (known as router based monitoring) or inside the intranet and between the dedicated server farm segment with other sub-segments (known as network based monitoring).

Network based intrusion detection has its faults, for knowledge based network intrusion detection systems, the systems are reliable and generate few false positives, but their strength relies upon the quality, comprehensiveness, and timeliness of the attack signature housed in the IDS’s search engine. Poorly defined signature can cause false positives, good packets are labeled as bad packets and transmission could be interrupted. Behavior based network intrusion detection systems often trigger false alarms – false positives.

In addition, this type of intrusion detection is unable to stop encrypted packets of system attack from ‘inside’ the intranet. If the attacker is logged in to the computer being attacked, no information of the attack would travel the network, and the attack would go unrecognized.

## **Hybrids IDS**

To overcome the limitations of purely host- or network- based IDS, and to combine the strength of both systems, vendors are creating hybrid systems that allow user to mix and match Host based and network based system, as well as signature based and statistical-anomaly based strategies.

## **No size fits all**

The IDSEs available today are far from perfect, they fall short in either of these three key areas: Robustness, flexibility, scalability and ease of use. According to the latest survey by Information Security (August, 2001 [www.infosecuritymag.com](http://www.infosecuritymag.com)) where more than 300 info security professionals were asked about their experience with IDS products, the response showed most users expect something more from their IDS:

### **Importance of IDS to the security infrastructure**

Almost two-thirds of respondents said their IDS is "very important" to their security infrastructure, while another 35 percent said it is "somewhat important." [3]

### **Confident on IDS to protect the systems**

Nearly one-fifth of respondents said they were either "not at all confident" or "not very confident" that their IDS is protecting their mission-critical systems from cyber attack. [3]

### **Most desire improvement on the IDS**

Almost half of the respondents in the poll said they'd like to receive more intelligent attack analysis--specifically, the ability to separate serious attacks from nuisance attacks. Another 23 percent of respondents said they'd like to reduce the number of false positives without sacrificing effectiveness. [3]

## **New Directions**

The IDS technologies are still evolving. While some IDS software vendors continue to refine their products' scanning engine beef up their signature databases and expand their data-collection and analysis capabilities. Other vendors are taking new approaches to solving oft-cited problems. [3]

There are many new developments and new directions in the intrusion detection, three of which are briefly described:

### **Meta-IDS**

"Meta-IDS" technologies allows single security console to accept from and communicate with all deployed devices that are from different vendors. This will ease the burden of tracking, reviewing and analyzing data from handful of IDSEs on a busy network. This will be possible with the effort of The intrusion Detection Exchange Format working group (IDWG) of the IETF which is currently working on standards that will unify the IDS framework of protocols and data formats so the IDSEs speak to each other, as well as to security console.

## **IDS appliances**

While the traditional IDS are mainly software based, it lack the “scalability”, especially when network architectures get more complex, as traffic speeds increase and attacks are more frequent and sophisticated, the common complaints are inefficiency and false positives to this software based IDS.

IDS appliances offers the convenience of pre configured security application in a ‘black box’ that are tailor made to plug ‘n’ play in networks of all shapes and sizes. IDS appliances also promise increased processing power (accuracy, speed) and more robust remote management capabilities that are generally lacking in the software based IDS.

## **IDS-In-Depth**

This type of IDS appliance utilize application-layer technologies to filter potential attack traffic to downstream IDSes that it works in tandem with on dedicated network segments. It captures flows of traffic, performs preliminary attack detection and filtering, and distributes a copy of the traffic to a downstream third-party IDS, which can be fine-tuned to analyze the traffic for specific attacks. The tradeoff is that the device performs only initial attack filtering, leaving the real analysis for the downstream IDS.

As the IDS are intended to sit between the Internet and the firewall to protect the network, it also provides DOS/DDOS attack mitigation and Firewall load balancing. Besides these functionalities, the IDS are also equipped with Securewatch data collection software for intrusion analysis and attack forensics.

## **Conclusion**

Attackers are constantly dreaming up news ways to infiltrate the enterprise’s network, and although firewalls and other security systems are vital, they can’t see everything. So, instead of locking the doors and hoping for the best, organization can add ever-vigilant eyes and ears to their network security with intrusion detection.

Organization cannot alone solve information security problem by adding technology and ignoring the fact that they are not monitoring for security incidents. Effective information protection is attained through a combined effort of policy, process and technology that provides protection, detection, and recovery measures.

It is important for an organization to have a clear procedures and intrusion response policies for dealing with intrusion. We want to keep intruders out, but we also want to discover and locate them when they succeed.

## References:

1. Anita Karve, "Can Intrusion Detection Keep an Eye on Your Network's Security?" Network Magazine 04/01/99 (1999) URL: <http://www.networkmagazine.com/article/NMG20000508S0022> (20 Aug, 2001)
2. Robert, Winkler. "Intrusion Detection Systems" SANS Institute, December 9, 2000 (2000) URL: <http://www.sans.org/infosecFAQ/intrusion/systems.htm> (10 Aug, 2001)
3. Andrew L. Briney, "New Directions In Intrusion Detection" Information Security August 2001 (2001): 48 – 60 URL: <http://www.infosecuritymag.com/articles/august01/cover.shtml> (20 Aug 2001)
4. Andrew L. Briney, "Zen and the Art of Intrusion Detection" ComputerWorld, Mar/12/2001 (2001) URL: [http://www.computerworld.com/cwi/story/0,1199,NAV47\\_STO58458,00.html](http://www.computerworld.com/cwi/story/0,1199,NAV47_STO58458,00.html)
5. Pete Loshin, "Intrusion Detection" ComputerWorld, Apr/16/2001 (2001) URL: [http://www.computerworld.com/cwi/story/0,1199,NAV47\\_STO59611,00.html](http://www.computerworld.com/cwi/story/0,1199,NAV47_STO59611,00.html)

© SANS Institute 2001, Author retains full rights.



# Upcoming SANS Training

[Click Here for a full list of all Upcoming SANS Events by Location](#)

SANS Seattle 2017	Seattle, WAUS	Oct 30, 2017 - Nov 04, 2017	Live Event
SANS Gulf Region 2017	Dubai, AE	Nov 04, 2017 - Nov 16, 2017	Live Event
SANS Amsterdam 2017	Amsterdam, NL	Nov 06, 2017 - Nov 11, 2017	Live Event
SANS Milan November 2017	Milan, IT	Nov 06, 2017 - Nov 11, 2017	Live Event
SANS Miami 2017	Miami, FLUS	Nov 06, 2017 - Nov 11, 2017	Live Event
SANS Paris November 2017	Paris, FR	Nov 13, 2017 - Nov 18, 2017	Live Event
Pen Test Hackfest Summit & Training 2017	Bethesda, MDUS	Nov 13, 2017 - Nov 20, 2017	Live Event
SANS Sydney 2017	Sydney, AU	Nov 13, 2017 - Nov 25, 2017	Live Event
GridEx IV 2017	Online,	Nov 15, 2017 - Nov 16, 2017	Live Event
SANS San Francisco Winter 2017	San Francisco, CAUS	Nov 27, 2017 - Dec 02, 2017	Live Event
SANS London November 2017	London, GB	Nov 27, 2017 - Dec 02, 2017	Live Event
SIEM & Tactical Analytics Summit & Training	Scottsdale, AZUS	Nov 28, 2017 - Dec 05, 2017	Live Event
SANS Khobar 2017	Khobar, SA	Dec 02, 2017 - Dec 07, 2017	Live Event
SANS Austin Winter 2017	Austin, TXUS	Dec 04, 2017 - Dec 09, 2017	Live Event
SANS Munich December 2017	Munich, DE	Dec 04, 2017 - Dec 09, 2017	Live Event
European Security Awareness Summit & Training 2017	London, GB	Dec 04, 2017 - Dec 07, 2017	Live Event
SANS Bangalore 2017	Bangalore, IN	Dec 11, 2017 - Dec 16, 2017	Live Event
SANS Frankfurt 2017	Frankfurt, DE	Dec 11, 2017 - Dec 16, 2017	Live Event
SANS Cyber Defense Initiative 2017	Washington, DCUS	Dec 12, 2017 - Dec 19, 2017	Live Event
SANS Security East 2018	New Orleans, LAUS	Jan 08, 2018 - Jan 13, 2018	Live Event
SANS SEC460: Enterprise Threat Beta	San Diego, CAUS	Jan 08, 2018 - Jan 13, 2018	Live Event
SANS Amsterdam January 2018	Amsterdam, NL	Jan 15, 2018 - Jan 20, 2018	Live Event
Northern VA Winter - Reston 2018	Reston, VAUS	Jan 15, 2018 - Jan 20, 2018	Live Event
SEC599: Defeat Advanced Adversaries	San Francisco, CAUS	Jan 15, 2018 - Jan 20, 2018	Live Event
SANS San Diego 2017	OnlineCAUS	Oct 30, 2017 - Nov 04, 2017	Live Event
SANS OnDemand	Books & MP3s OnlyUS	Anytime	Self Paced