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Endpoint Security Best Practices in AWS

Compiled from works completed by
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with an introduction by **John Pescatore**

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Analyst Program

Table of Contents

"The most successful security programs are the ones that can tailor security architectures, processes and controls to match business demands—while prioritizing resources to address the threats most likely to impact critical business functions and services."

A little understood fact: The internet is actually quite secure! The endpoints are the problem. The PCs and servers that are connected to the internet are running highly vulnerable software, configured by system administrators and users who make mistakes, and constantly under attack by vandals, criminals and spies. The internet is just a bunch of wires connecting everything together. Businesses have often spent the majority of their security budgets either segmenting those vulnerability endpoints away from attackers or installing numerous security agents to protect vulnerable endpoints that can't be isolated.

Endpoint security strategies have matured over the years, moving from basic signature-based antiviral agents to bloated collections of disparate security agents to more cohesive endpoint detection and response (EDR) and endpoint protection platform (EPP) solutions. While such strategies have allowed many organizations to keep up with rapidly evolving threats, major leaps forward in security have been impeded by the basic processing and storage limitations of individual PCs and servers, as well as the costs and complexity of scaling across tens of thousands of devices.

The movement to Infrastructure-as-a-Service (IaaS) cloud computing has provided an opportunity to overcome those barriers. The essentially limitless storage and processing capacity of IaaS enables endpoint software to use advanced machine learning algorithms in addition to expanded signature bases. IaaS also supports increased long-term storage and high-speed retrieval of indicators of attack, indicators of compromise and other critical forms of threat data. While the essential security problems haven't really changed, cloud computing can reduce the cost of applying resources to quickly identify and neutralize threats.

One thing that cloud computing has not changed: There is no such thing as a one-size-fits-all approach to security. The most successful security programs are the ones that can tailor security architectures, processes and controls to match business demands—while prioritizing resources to address the threats most likely to impact critical business functions and services. Just as IT has had to tailor a mix of local data centers, SaaS, IaaS and hybrid-based computing to match business needs, security strategies need to do the same.

To take advantage of cloud-based recourses to improve endpoint security, the security program must evaluate business, technical and operational considerations in addition to the overall threat environment. The papers that follow describe best practices and techniques for securing endpoints in Amazon Web Services (AWS):

- ***How to Build an Endpoint Security Strategy in AWS***, written by Thomas J. Banasik, details the levels of endpoint security controls that make up an effective and efficient approach to securing critical business services. He also summarizes the key areas of applying these controls to applications running on IaaS or hybrid services.
- In ***JumpStart Guide for Endpoint Security in AWS***, David Hazar provides a streamlined methodology for architecting, selecting and deploying an effective and efficient set of endpoint security controls across AWS-based systems.

The capabilities of IaaS have enabled businesses and development organizations to move faster to market with applications and services. Security organizations also need to take advantage of the strengths of cloud computing to move at the same speed as their attackers and make advances in raising the bar against increasingly sophisticated attacks.

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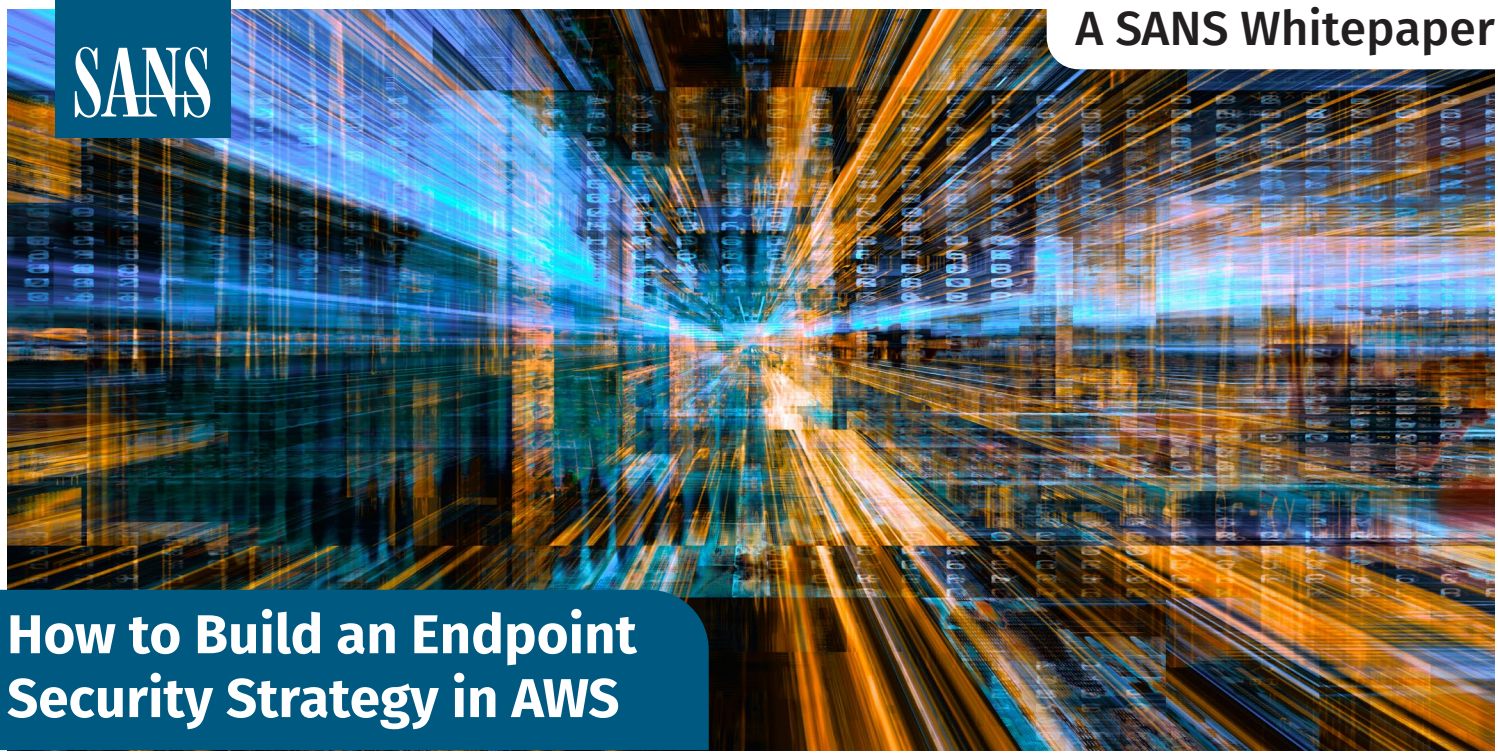

How to Build an Endpoint Security Strategy in AWS

Written by **Thomas J. Banasik**

June 2019

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AWS Marketplace

Webcast

You can access the associated webcast at:
https://pages.awscloud.com/endpoint-security.html

Introduction

The nature of today's business is driving organizations away from traditional on-premises data centers and into distributed cloud computing environments, and with this move comes the challenge of securing endpoints in a cloud-dominated world.

Not long ago, endpoint security involved little more than signature-based antivirus, but endpoint security capabilities have evolved. Now we have endpoint detection and response (EDR), machine learning (ML), user and entity behavior analytics (UEBA) and data loss prevention (DLP) integrated suites. These cloud-based endpoint security technologies are adapting to industry trends, providing cost-effective, readily deployable and fully integrated solutions to protect assets in the cloud—all managed from a single comprehensive view.

In this paper, we evaluate endpoint security requirements in Amazon Web Services (AWS). We delve into identifying threats, protecting assets, responding to events and recovering from incidents in a distributed cloud environment. This strategy develops a defense-in-depth architecture aligned with organizational business drivers in the cloud. Endpoint security solutions in the cloud provide greater flexibility to manage physical, hybrid and cloud security models while providing enhanced visibility in centralized monitoring services.

Moving Endpoint Security Solutions to the Cloud

The business case for moving to the cloud arises from the economies of scale for computing resources and storage, as physical layers of computing are abstracted to a managed partner. As endpoints are transferred, provisioned or migrated from a physical asset into a cloud model, ensuring their security is critical. A successful endpoint security strategy that addresses the various challenges of cloud migration, such as scale, speed and complexity, can yield better cost savings, visibility, agility and scalability.

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Endpoint security solutions in AWS are the hallmark of successful cloud migrations. Amazon Elastic Compute Cloud (EC2) instances provide nearly limitless efficiency gains while encompassing data protection and unparalleled visibility through cloud-native security services including Amazon GuardDuty and AWS Security Hub.[1] AWS also leverages industry-leading partners to streamline tools, ensuring that an organization's defense doesn't blink. These groundbreaking integrations allow security operations teams to identify the indicators of attack (IoAs) and indicators of compromise (IoCs) to act proactively—instead of reactively, after a breach.

[1] This paper mentions product names to provide real-life examples of how visibility tools can be used. The use of these examples is not an endorsement of any product.

Importance to the InfoSec Community

Why is an endpoint security solution so critical? With GDPR and its significant penalties for non-compliance, the expectations for data protection have changed. For example, the European Union (EU) holds data controllers and processors responsible not only for personally identifiable information (PII), but also for timely notifications when a breach occurs:

> In the case of a personal data breach, the controller shall without undue delay and, where feasible, not later than 72 hours after having become aware of it, notify the personal data breach to the supervisory authority. … Infringements of the following provisions shall, in accordance with paragraph 2, be subject to administrative fines up to 20 000 000 EUR, or in the case of an undertaking, up to 4% of the total worldwide annual turnover of the preceding financial year, whichever is higher.[2]

With GDPR and its significant penalties for non-compliance, the expectations for data protection have changed.

Of course, data is stored, processed and accessed via the endpoints that are commonly the user's interface to sensitive data, including PII. Information security starts at the endpoint to build a defense-in-depth architecture capable of securing people, processes and technology. Elevated compliance directives make the endpoint attack vector even more critical in global business operations.

Traditional vs. Cloud-Based Endpoints

What's the difference between traditional and cloud-based endpoints? Endpoints are remote computing devices designed as a human interface to translate data access to and from the network. Traditional endpoints include laptops, desktops, servers, workstations, mobile devices and the IoT. The cloud environment transfers management of the lower layers of the OSI model—physical, data link and network—to a managed service provider that controls system resources and storage while providing the organization with greater control, agility and security over data.

Defining cloud endpoints is challenging because of hybrid architectures that combine physical, virtual and cloud-based assets. The key to identifying cloud endpoints resides in the service-oriented architecture (SOA) used for providing resources as a service in such models as infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS) and software-as-a-service (SaaS). Cloud-based endpoints include provider-hosted servers, databases, instances, services and applications. Cloud-based endpoint security strategies are designed to secure data at rest, in transit and in use. These technologies include capabilities such as antivirus (AV), a host-based intrusion prevention system (HIPS), application blacklisting, machine learning (ML) and UEBA.

Cloud-based endpoint security strategies are designed to secure data at rest, in transit and in use.

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R0679&from=EN

Securing endpoints in hybrid and cloud-based hosting models is very different from doing so in a traditional on-premises data center. With SOA, cloud providers assume shared responsibility for providing resources to customers that are leveraging the cloud's economies of scale. Under that model, the customer is at risk of losing visibility into those cloud resources. Naturally, organizations objected to this, because they require visibility into all of their assets, regardless of where they reside.

Best practice recommends leveraging cloud-based SaaS solutions to enhance visibility regardless of where the endpoint lives.

The traditional data center model leveraged host-based AV and firewalls to secure endpoint data within a defined trust perimeter. The cloud abstracts the concept of on-premises data centers into a decentralized model with a de-perimeterized structure. User endpoints communicate with the cloud network via physical network connections, VPNs, mobile devices and internet-facing web portals. Endpoint communication with management services is critical to enable rapid response for security incidents. While hybrid on-premises security management services integrate with the cloud, best practice recommends leveraging cloud-based SaaS solutions to enhance visibility regardless of where the endpoint lives.

Use Case: Cloud Endpoint Migration and Integration in AWS

Moving assets to the cloud requires an evaluation of security requirements. This evaluation begins with choosing an endpoint security solutions provider that can provide support in physical, hybrid and cloud-based computing models. After selecting a provider, the organization must review its security requirements to determine which security features, such as ML, HIPS, application blacklisting and UEBA, are required. The organization must establish centralized visibility into assets and then synchronize threat intelligence with the host, as outlined in Figure 1.

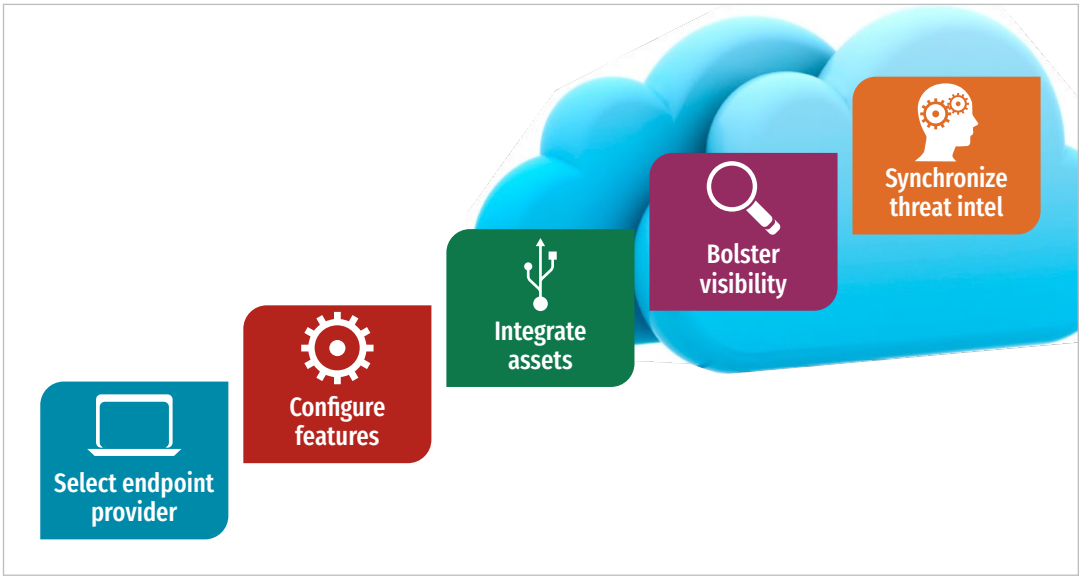

Figure 1. Five Steps of Security Endpoint Migration

The five steps shown in Figure 1 involve these activities:

1. **Select your endpoint security provider** based on business requirements for protection, migration, time, visibility, consistency, complexity, speed and scalability.

2. **Configure endpoint security capabilities to foster integration, and evaluate features** including EDR, signature/heuristic-based AV, firewall, HIPS, application blacklisting, DLP, ML and UEBA. Key activities include:
   - Evaluating endpoint agent visibility for log sources
   - Assessing integration requirements with SIEM
   - Testing AV alerting for false positive rates
   - Testing HIPS for automation capabilities
   - Evaluating UEBA for ease of implementation
   - Determining cost savings of ML capabilities

3. **Identify assets via cloud-based security managers, and deploy endpoint security agents** to physical, virtual and cloud-based assets such as Amazon EC2 instances.

4. **Bolster visibility in a comprehensive view service** such as Amazon CloudWatch event monitoring, where analysts can easily view endpoint activity.

5. **Synchronize threat intelligence** with Amazon GuardDuty agentless monitoring and conduct security monitoring in cloud-based SIEM services such as AWS Security Hub.

Endpoint Detection and Response

EDR agents are a central element of migrating to AWS. Legacy endpoint security products are limited to either blocking or allowing an activity. EDR products add the ability to record endpoint activity and store it for future searches. Capturing IoCs is an ideal feature for integrating EDR agents with threat intelligence services, such as Amazon GuardDuty, which provide continuous threat monitoring and agentless detection for malicious behavior. See Figure 2.

EDR agents also enhance cloud-based security operations by integrating system monitoring capabilities and leveraging system monitor logging and OS equivalents to provide detailed information about processes, connections and file changes. Tracing parent-to-child process relationships is key to determining the root cause of a cyber incident. A traditional security agent might report an endpoint infection, whereas an EDR security agent confirms the threat is blocked and, as shown in Figure 3, identifies the spawning process traced to a recent phishing attack.

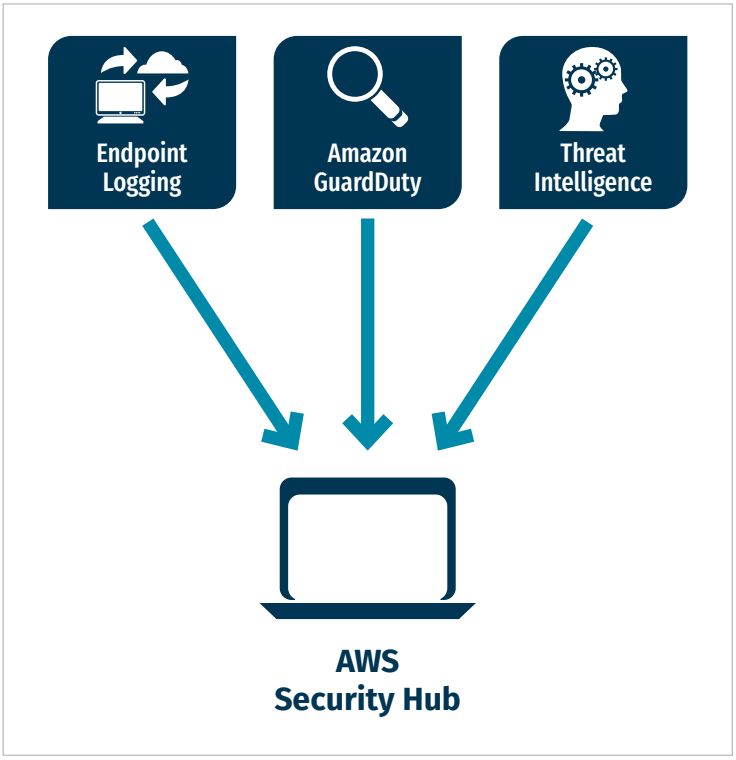

Figure 2. Amazon GuardDuty

Signature- vs. Heuristic-Based Antivirus

Endpoint security agents require a robust base of malware file signatures to stop attackers from leveraging known malicious files. Signature detections serve as a baseline of security but are not an assurance of safeguarding data, because an attacker can modify the malware source code in minutes, resulting in a new signature capable of beating signature-based AV. Heuristic- and behavior-based endpoints integrate ML to identify new malware based on behavior instead of signatures.

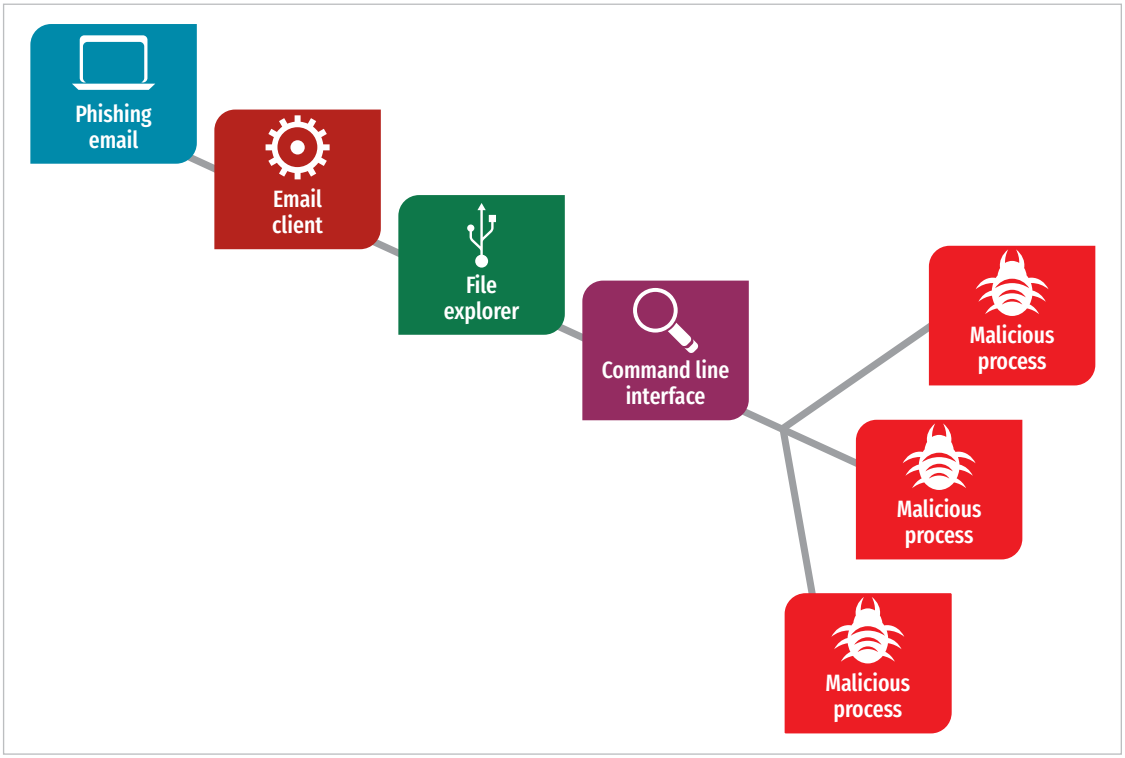

Figure 3. EDR intercepts the attack cycle before malware spreads.

Application Blacklisting

Endpoint security solutions in the cloud require application control through both whitelisting and blacklisting. AWS Systems Manager and AWS Config provide the capability to record inventory data to enable scenarios such as tracking newly installed or removed software applications, assessing security risk and troubleshooting.[3] Endpoint security solutions often include these types of application controls to prevent the use of hacking tools and malicious software. This is often a challenging process because of frequent software updates that change file-based signatures.

User and Entity Behavior Analytics

UEBA is the human equivalent of ML for systems. UEBA leverages the baseline of a user's activity to determine the expected pattern for that user. When a user deviates from the established baseline, or when a user's pattern suddenly aligns with known malicious patterns, UEBA-capable agents trigger alerting and synchronize this data into threat intelligence services such as AWS Security Hub.

[3] "Preventing blacklisted applications with AWS Systems Manager and AWS Config," April 26, 2018, https://aws.amazon.com/blogs/mt/preventing-blacklisted-applications-with-aws-systems-manager-and-aws-config

Data Loss Prevention

Security teams utilize DLP cybersecurity technology to monitor and alert on data content. This technology supports organizational compliance and data protection requirements for intellectual property, PII and confidential data. DLP technology is a unique solution for PII breach monitoring because of its content inspection capabilities. Cloud-based endpoint security agents with DLP capabilities can alert on the transfer of sensitive data, such as PII or proprietary source code, and alert cyber responders through a centralized monitoring service.

Endpoint Security Solutions in AWS Marketplace

AWS cloud-based endpoint security solutions offer seamless integration. Security solutions currently available in AWS Marketplace offer direct integration with more than 800 security applications from more than 36 leading endpoint vendors. This level of partnership allows organizations to select and integrate the most appropriate endpoint security partner based on business needs and capability requirements. Seamless integration fosters the deployment of endpoint agents across physical, virtual and cloud-based Amazon EC2 instances for total endpoint coverage in the environment.

Amazon GuardDuty allows organizations to take endpoint security further in the cloud through a threat detection service that continuously monitors for malicious activity and unusual behavior to protect AWS accounts and workloads. Amazon CloudWatch provides log visibility to view events and security incidents in greater detail. These capabilities aggregate into a comprehensive view with the AWS Security Hub. Gone are the days of traditional signature-based AV. Today, well-prepared organizations rely on the power of cloud-based endpoint security solutions.

Summary

The flexibility, elasticity and economy of cloud computing are driving organizations to move from traditional to cloud-centric computing models. Cloud migration requires evaluation of business requirements for protection, migration, time, visibility, consistency, complexity, speed and scalability. Cloud-based endpoint security solutions have moved from simple AV to integrated suites capable of securing assets in any environment with advanced capabilities such as application control, ML and UEBA. Synchronization with AWS services such as Amazon CloudWatch for log visibility, Amazon GuardDuty for threat intelligence and AWS Security Hub for synchronization provides a comprehensive view for responders to combat the threat while upholding organizational security objectives in a distributed cloud environment.

About the Author

Thomas Banasik is a SANS analyst and senior security operations center manager for Veritas Technologies, LLC. He has consulted with numerous organizations in cybersecurity across the government, military and commercial sectors. An incident response expert, Thomas has extensive experience in security operations, threat intelligence, insider threat, and threat vulnerability management. He previously worked as a senior security operations center manager for the U.S. Government Accountability Office and is a retired U.S. Army cyber and military intelligence officer. Thomas holds the GCIH, GCWN, GCIA, GSEC, and CISSP-ISSEP, ISSAP, ISSMP certifications and is currently pursuing a second graduate degree in information systems security engineering from the SANS Technology Institute.

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JumpStart Guide for Endpoint Security in AWS

Written by **David Hazar**

June 2019

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You can access the associated webcast at:
https://pages.awscloud.com/JumpStart-Guidance-for-Endpoint-Security-in-AWS.html

Introduction

Endpoint security options and products are continuing to mature. Enterprises and other organizations are moving away from point solutions—antivirus (AV) or anti-malware, host-based intrusion detection systems (HIDSs), file integrity monitoring (FIM) and application whitelisting—toward more robust endpoint protection platforms (EPPs). And many of those EPPs include new, advanced endpoint detection and response (EDR) capabilities. This move is similar to other efforts to consolidate the functionality of multiple security capabilities into a single solution or platform to make it easier for organizations to implement and maintain these technologies.

Just as these firewalls bring the capabilities of many different security appliances into a single solution, EPPs bring the capabilities of many endpoint security agents into a single agent, or at least a single management platform.

Gartner describes EPPs as "a solution deployed on endpoint devices to prevent file-based malware attacks, detect malicious activity and provide the investigation and remediation capabilities needed to respond to dynamic security incidents and alerts." A wide range of products and solutions falls into this category, in part because there is no strict definition of required capabilities for them to be considered EPPs. That's why you will find many traditional point solutions from recognizable vendors included in this category, albeit bundled together with some new solutions or with the addition of some new capabilities. You will also find more recent entrants into the endpoint security market that may have new, innovative approaches to endpoint security but may also lack maturity in more traditional detection and response capabilities.

Just as next-generation firewalls bring the capabilities of many different security appliances into a single solution, EPPs bring the capabilities of many endpoint security agents into a single agent.

Selecting and implementing endpoint security in hybrid architectures can be a time-consuming and confusing process. In this paper, we present what customers should consider when evaluating endpoint security technology in the cloud. We discuss a high-level strategy for evaluating these solutions and then discuss implementation options that organizations need to consider when planning to implement these technologies in Amazon Web Services (AWS). We also review why businesses may choose to implement endpoint security in the cloud along with the various needs and capabilities associated with different endpoint security solutions. Lastly, we discuss some of the considerations that should be part of the evaluation process for endpoint security in general, but then take a closer look at the considerations specific to implementing endpoint security in AWS.

Not all companies may choose or be able to implement endpoint security for all of their cloud workloads. Because much of the technology associated with endpoint security is installed and runs as an agent, infrastructure-as-a-service (IaaS) cloud workloads are the most obvious candidates. In AWS, endpoint security solutions typically work with

EC2 Instances or virtual machines (VMs) created on VMware Cloud on AWS. While these technologies could technically also be leveraged within containerized environments, such a situation is less typical and other container security technologies may be better suited in this type of environment. This paper focuses on implementation via instances or VMs, but most of the considerations still apply to a containerized environment.

Some cloud service types, such as platform-as-a-service (PaaS), function-as-a-service (FaaS) and software-as-a-service (SaaS), are not supported by many endpoint security technologies. However, the considerations outlined in this paper can help customers determine what protections vendors provide for these service types. There is also a case to be made for leveraging the cloud shared-responsibility model to reduce an organization's security burden if the risk for those workloads does not merit the increased visibility or if an organization feels it cannot provide better protection than the cloud vendor even with the increased visibility. In these situations, leveraging PaaS, FaaS and SaaS cloud services can help.

Understanding Your Needs

In order to evaluate endpoint security, organizations need to have a solid understanding of what capabilities are must-haves versus nice-to-haves to provide the level of protection and visibility they desire. They must also consider how the endpoint security program will be implemented, operated and maintained. Organizations should avoid purchasing technology if there is not sufficient support, funding, resourcing and processes in place to successfully implement, operate and maintain the technology for years.

After the organization determines and ranks capabilities, it needs to look at existing endpoint security technology, people and processes to understand what is currently in place and whether it is well suited for the cloud. Then, it should investigate alternative technologies, including any cloud-optimized solutions, and catalog the resources and skills that will be required, along with the policies, standards and processes that may need to be updated. This investigation will not be a one-time exercise; these points will be revisited many times throughout the evaluation process before making a choice.

Implementation Options in AWS

When the cloud was new, the only real option was to leverage technology similar to what an organization was already using on premises, if not the same technology. If you already have a successful and functional on-premises program, this can be an attractive option, but it is not the only option. Review the different options you have available, including cloud-optimized, managed services and licensing options. Then, once you have a rough idea of how you would like to implement endpoint security in AWS, it is time to start building a business case.

Cloud-Optimized

Organizations may want to look at cloud-optimized solutions for endpoint security in the cloud. Even though performance is a concern in on-premises environments, it is an even larger concern in the cloud. Traditional endpoint security technology is typically not performance-friendly. In on-premises environments, the costs for this overhead are not always as easy to see or calculate because there is usually excess capacity that can be used to compensate for the overhead. In the cloud, however, with on-demand pricing and the detailed metrics, the cost of this overhead is much easier to understand. Many cloud-optimized endpoint security tools focus on creating lightweight agents that offload the processing of data and events to other resources or even to a separate, vendor-maintained cloud environment.

Organizations should avoid purchasing technology if there is not sufficient support, funding, resourcing and processes in place to successfully implement, operate and maintain the technology for years.

Managed Services

Another option for implementing endpoint security in the cloud is to leverage a managed service provider that has experience implementing and maintaining these solutions in the cloud. Using such a provider can be a promising option for many organizations but is especially attractive for organizations that have limited cloud experience or that do not already have endpoint security capabilities. Another advantage of managed service providers is that they typically provide skilled resources and bring with them proven processes and existing cloud vendor contacts and relationships to accelerate implementation and add value quickly. They may also supplement the endpoint security technology with human-assisted analysis, custom development or configuration, and even incident response capabilities. These managed service providers can even extend AWS Marketplace solutions directly to customers through Consulting Partner Private Offers and assist with evaluating licensing options.[1]

Licensing Options

When considering how to implement endpoint security in the cloud, also consider how to license any chosen technology. If you are planning on using existing on-premises endpoint security capabilities, your organization may already have favorable licensing and it may make sense to follow a bring-your-own-license (BYOL) model. Maybe endpoint security is new to your organization, or maybe you want to evaluate a technology without implementing it more broadly. Perhaps you determine you need a different technology for the cloud or your organization favors on-demand pricing or operational cost structures. If any of those scenarios apply to you, you'll be relieved to learn that many of the products are available with on-demand pricing from AWS Marketplace. (AWS Marketplace can still be leveraged for many of these technologies following the BYOL approach as well).

Needs and Capabilities

Cloud architecture differs from what we are used to in our on-premises environments. In the cloud, almost everything is software-defined—and we do not have complete visibility into our resources and surrounding infrastructure. Also, because commissioning and decommissioning resources are so easy to do and costs are typically accrued based on the amount of time the resource is running, cloud resources tend to have much shorter lifecycles. The capabilities surrounding forensics in the cloud are also much less mature than for on-premises environments, and leveraging endpoint security can provide valuable threat intelligence for an organization's cloud ecosystem that it may not be getting from its PaaS, FaaS and SaaS workloads.

Next, we look at some of the solutions or capabilities that may exist within endpoint protection platforms and then move on to the topics organizations should consider when preparing to implement endpoint security in the cloud.

Needs and Capabilities

Note the overlap between the solutions listed below. For example, EDR solutions may provide many of the same capabilities as AV/anti-malware or HIDS solutions. Some AV solutions may also include behavior monitoring, and both HIDS and EDR solutions will most likely perform FIM. This overlap in capabilities will be one of the considerations for organizations that choose to utilize more than one solution.

Endpoint Detection and Response

The need: Identifying and protecting against unknown threats

Capabilities

- Detecting security incidents
  - Behavior monitoring
  - Analytics
  - Sandboxing
- Containing the incident at the endpoint
- Investigating security incidents
- Providing remediation guidance

Antivirus/Anti-malware

The need: Identifying and protecting against known threats

Capabilities

- Detecting viruses and malware
  - Signature analysis
  - Behavior monitoring
- Blocking and quarantining the virus or malware
- Alerting users and administrators of infection

Host-based Intrusion Detection

The need: Identifying indicators of compromise

Capabilities

- Detecting suspect behavior
  - Behavior monitoring
  - Traffic analysis
  - FIM
- Alerting users and administrators of suspect behavior

File Integrity Monitoring

The need: Identifying changes to critical or sensitive files

Capabilities

- Collecting and storing signature data for policy-defined files
- Offering interval-based or real-time signature validation
- Alerting users or administrators when tracked files are modified

Application Whitelisting

The need: Only allowing approved or authorized, signed software to execute

Capabilities

- Authorizing software or software signing certificates via policy
- Applying policies to resources
- Blocking or alerting when unauthorized software executes

General Cloud Endpoint Security Considerations

Regardless of the endpoint security technology or cloud vendor selected, some general business, technical and operational considerations are associated with implementing endpoint security in the cloud. The following sections highlight many of these considerations.

Business Considerations

	Consideration	Details
	Policies and standards	Traditional endpoint security requirements in policies and standards may not be achievable in the cloud, may not function as intended or may not be cost-effective. Organizations will need to evaluate cloud capabilities to determine what changes need to be made to ensure that compliance with policies and standards is achievable.
	Governance model	Every organization has a unique governance model. Some organizations have very centralized governance over endpoint security, whereas others may follow a more decentralized approach. Organizations will need to decide whether to centralize or decentralize governance over cloud endpoint security. Then, they must determine whether existing governance models used for traditional endpoint security can be extended to the cloud or whether a cloud-specific model is required. Consider that cloud workloads can easily span the globe and that data residency and visibility restrictions may apply in certain regions.
	Reporting and metrics	Providing the right metrics, key performance indicators (KPIs) and key risk indicators (KRIs) to the right stakeholders may require changes that account for cloud architecture. Organizations will need to define reporting requirements specific to cloud workloads and evaluate products against these requirements
	Funding and support	Funding and support for cloud endpoint security may not currently be available. Organizations may not understand the shared responsibility model as it pertains to cloud usage and may assume that endpoint security is provided by the cloud vendor. Organizations will need to understand the requirements and determine the appropriate funding and support model. What is required may differ based on the implementation model the organization chooses (for instance, traditional vs. cloud, BYOL vs. on-demand).
	Risk classification	Not all workloads share the same risk profile. It is important that organizations consider the risk associated with different cloud workloads to enable them to implement controls based on risk. If cost is not a consideration or if the risks are similar for all workloads, then a single approach to endpoint security may be appropriate. If risks vary greatly among workloads or costs are high, however, an organization will need to understand the various risk profiles to determine where to focus or require endpoint security or what to require for each profile.

Technical Considerations

	Consideration	Details
	Endpoint security capabilities	As organizations update policies and standards to address cloud workloads, they should also identify the technologies they need to comply with these new requirements. Some organizations may choose to be prescriptive about the technologies they use, whereas others may define the required capabilities and allow individual cloud operations teams to select their own technologies as long as they can validate compliance with requirements.
	Supported technology	Some technologies may not be supported for all cloud services or for all platforms running on cloud services. Organizations will need to decide whether they will allow the use of services and platforms that do not support endpoint security requirements, and if so, under what conditions. These decisions should be documented and maintained so they may be consistently applied throughout the organization.
	Agent-based technologies	No matter how lightweight, agent-based technologies decrease performance (most cloud endpoint security technologies are agent-based). In the cloud, they increase costs. Organizations may have a restriction on the number of agents that can be installed on each cloud resource. Organizations need to determine how many non-endpoint security agents are already in place to decide whether they need to consider an increase in their limits. They may also have a specific overhead allowance for agents, which needs to be evaluated during any proof of concept. Performance should be assessed before purchase, before upgrades, when configurations change and at regular intervals. Metrics should include overhead and performance monitoring.
	Active vs. interval-based or asynchronous detection and response	Technologies that provide active detection and response may require more overhead than technologies that scan at given intervals, during off-peak hours or asynchronously via out-of-band analysis engines. Organizations need to decide whether active detection and response are required or acceptable based on their cloud architecture. In particular, the longevity of cloud resources may affect this decision. Short-lived cloud resources may require more active defenses.
	Secure communication	Endpoint security solutions all typically communicate with external components or services. The external services could provide product updates or configuration data. They may also be involved in the analysis of data from the target system. Organizations need to ensure that external communication is authenticated and secured.

Operational Considerations

	Consideration	Details
	Operational responsibility and model	Operation of cloud resources is substantially different from traditional infrastructure operations. This difference may help determine who is responsible for implementing and configuring endpoint security capabilities. Organizations need to decide how best to implement and configure endpoint security technology and determine which group(s) should be responsible for this task. They also need to determine whether operations should be centralized or decentralized.
	Monitoring and response	While implementation and configuration of endpoint security capabilities may be assigned to an existing cloud operations team, monitoring may be the responsibility of others. Response could be the responsibility of either team. Organizations need to determine who will be responsible for monitoring and responding to endpoint security events. They will also need to evaluate what orchestration and automation of technology, people and processes can be leveraged or integrated into the final solution.
	Processes and procedures	Organizations may have very specific processes and procedures for dealing with endpoint security events related to their traditional on-premises infrastructure. It is likely, however, that these processes and procedures will be different in the cloud. Organizations need to create new operational processes and procedures for endpoint security in the cloud, considering any changes they have made to policies and standards related to cloud or endpoint security in the cloud.

AWS Implementation Considerations

The general considerations discussed so far can help organizations lay the groundwork as well as secure funding and support for cloud endpoint detection. Now let's take a more detailed look at some specific considerations an organization will need to evaluate before implementing these solutions in AWS.

Endpoint Detection and Response

The advantage of EDR solutions is that they focus on adding capabilities that allow them to identify unknown threats. If your organization's threat profile includes targeted attacks or advanced threat actors, consider endpoint protection platforms that excel in EDR. You may also consider EDR for high-risk workloads or for performance reasons, because many of these solutions offload processing to other resources. False positive rates may be higher for EDR than some other types of tools.

	Consideration	Details
	Cloud context support	Due to the dynamic nature of the cloud, a resource that existed a few hours ago may not exist now. Because many EDR technologies perform analysis of data or binaries external to the resource itself, there is a chance that when analysis is completed the resource may no longer exist. **Evaluate:** • The additional cloud context (specifically, tags or image IDs) that is captured, retained and used by EDR technology to allow correlation of findings and behavior with resources and the images and image versions used to create those resources • The special concerns associated with studying resources that have potentially replaced the original resource from which data was gathered
	Performance and efficiency	Many EDR platforms claim to have lightweight agents that offload analysis and processing tasks to other systems. Customers should analyze the impact and performance on production workloads. Due to the offload architecture, these technologies typically send data and binaries to separate systems or to the vendor's cloud infrastructure to perform analysis. Depending on the cloud regions in use, the transfer of data and binaries to external resources could affect both the performance and the cost of the technology. In addition, depending on the architecture, analyzing the same data and binaries from multiple systems may add additional processing time and reduce efficiency. **Evaluate:** • The architecture of the tools under consideration • Performance (CPU, memory, storage and bandwidth utilization) when used with production workloads • The amount of data and binaries that will be transferred and to what location(s) the data is being transferred • Potential impacts on cost and performance due to bandwidth • Performance impact of latency between all cloud regions in use and any identified external resources • Efficiency of coordination between agent and analysis engine(s) and efficiency of threat data distribution • Support for data compression

Endpoint Detection and Response (continued)

	Consideration	Details
	Deployment	EDR platforms may require the implementation of multiple components, and these components may need to be installed in multiple zones or regions to support distributed cloud environments. They also require the implementation of agents on the supported endpoints. **Evaluate:** • The architecture of the tools under consideration • The installation and configuration procedures for each component and agent • The availability of managed or SaaS components or preconfigured appliances from AWS Marketplace • Effectiveness and responsiveness of support • Any vendor requirements for the use of professional services for installation or configuration • Integration with other AWS technologies for deployment or validation of agent deployment (AWS Systems Manager, AWS Config, Amazon CloudWatch)[2]
	Configuration and maintenance	In order to improve the quality of detection and response, EDR technologies may require extensive configuration and maintenance. Customization of detection rules and response scripts may be available depending on product. In addition, EDR components and agents will need to be upgraded and may also require updates to datasets used for analysis. **Evaluate:** • The architecture of the tools under consideration • The upgrade procedures • The procedures for updating any datasets leveraged by analysis engines or agents • Reporting, metrics or alerting available for any out-of-date components, agents or data • Communication protocols and paths to understand required firewall and ACL changes along with any VPC peering or cross-account access • Any vendor requirements for the use of professional services for upgrades or updates • Accessibility to detection rules, scripts and other configuration details (open or proprietary) • Whether the platform allows customers to build or create their own rules • Level of effort to perform customizations to rules, scripts or configurations or to create new rules • Integrations with other AWS technologies (such as AWS Config, AWS Lambda) or configuration management tools (Puppet, Chef, Ansible, SaltStack, CFEngine) to perform updates or upgrades or apply configurations • Secure configuration guides and best practices
	Detection	Because EDR technologies support detecting both known and unknown threats, organizations should evaluate their effectiveness as part of the selection process. **Evaluate:** • Detection rate of any well-known or unknown malware samples, if your organization practices malware analysis and has appropriate analysis environments • Detection methods employed • Available benchmarks or comparisons by third-party evaluators • Product reviews and customer forums • Customer references • Whether detection is real-time, interval-based, asynchronous or configurable for each detection mechanism supported • Whether detection includes detection of non-file-based malware (such as memory resident malware)

[2] This paper mentions product names to provide real-life examples of how visibility tools can be used. The use of these examples is not an endorsement of any product.

Endpoint Detection and Response (continued)

	Consideration	Details
	Integration	Many EDR platforms also integrate with other business and security platforms. Understand what integrations are supported out-of-the-box and the level of effort required to build custom integrations. **Evaluate:** • Supported plugins and integrations with business and security platforms in use by the organization (such as AWS, ticketing, SIEM, incident response, threat intelligence) and the capabilities of these plugins and integrations • API support (such as API-first, REST API available, programmatic API available) • Whether the platform allows the customer to build custom plugins or integrations • Level of effort required and technology (languages, frameworks, and the like) supported when building custom plugins or integrations
	Reporting, metrics and alerting	EDR platforms have response capabilities, but not all rules trigger a response. Accessing and viewing what these platforms detect and the actions they take is critical to the security of the organization's endpoints. Taking that action can also aid in the identification of rules or configurations that require modification and can also assist in troubleshooting production incidents that may be caused by the EDR platform (false positive detection and response). **Evaluate:** • Support for centralized logging technologies and communication protocols, including integration with any existing or proposed SIEM technology • Out-of-the-box reports and dashboards against current program requirements • Ability and level of effort required to create custom measures and metrics • Alerting mechanisms and ability to create or modify alerts • Supported reporting and alerting formats and delivery mechanisms • Integration with AWS reporting and alerting tools (such as AWS Security Hub, Amazon CloudWatch Events, Amazon Simple Notification Service [SNS]) • Support for data aggregation across regions • Supported data export formats
	Response capabilities	Another distinguishing factor when evaluating EDR technologies is what response capabilities are available in the platform. Understand not only what response abilities exist for both human-assisted and automated response but also what expertise is required to set up, configure and maintain these capabilities. **Evaluate:** • Out-of-the-box response capabilities and features • Technologies and languages supported for automated response • Organization's ability to support automation through identified technologies and languages • Auditing and tracking of response actions • Integration with AWS response capabilities and APIs

EDR platforms are becoming more popular as organizations strive to protect themselves against emerging threats and want to acquire more active response capabilities. We have also seen, however, that companies utilizing these technologies are still susceptible to security breaches. Implementing an EDR platform requires more than just the licensing and implementation of the technology components. It requires active monitoring, response, reconfiguration and maintenance. Make sure your organization is aware of the true costs of ownership: training requirements, resource requirements, integration requirements and the costs to update policy, standards, processes and procedures. Also, make sure to thoroughly evaluate reporting, monitoring and alerting capabilities, because these are the most likely to require customization or integration work.

Antivirus/Anti-malware

The advantage of AV solutions is that they are typically mature products that excel at identifying known viruses and malware using signature-based and other techniques. Although attackers can easily evade these detections, positive identification from these tools indicates a real threat, and false positive rates are low when organizations use signature-based detection. Consider mature AV products if EDR technologies are prohibitively expensive, incapable of detecting known threats, difficult to tune or drags on performance. You still need to complete a performance analysis for AV capabilities because the resource requirements will vary based on architecture and supported detection mechanisms.

	Consideration	Details
	Cloud context support	If investigation of AV detections is delayed, the resource(s) affected may no longer exist in your cloud environment. Also, if a virus or worm is spreading throughout your environment, understanding more about the cloud asset can help speed response to the threat. **Evaluate:** • The additional cloud context (such as tags or image IDs) that is captured and retained by AV technology to allow correlation of detections with resources and the images and image versions used to create those resources • The special concerns associated with studying resources that have potentially replaced the original resource from which data was gathered
	Performance and efficiency	Traditional AV agents are not known for being lightweight and are much more likely to store and process data on the cloud resource itself. Consider how this will affect instance sizing and storage requirements. **Evaluate:** • The architecture of the tools under consideration • Performance (CPU, memory, storage and bandwidth utilization) when used with production workloads • Amount of data sent and received from management console(s) • Amount of data stored on disk (such as signature database, logs, quarantine) • Support for data compression
	Deployment	AV software requires agents and may also report data back to a management console. Update servers may also be used to distribute updates to the software and signature database. **Evaluate:** • The architecture of the tools under consideration • The installation and configuration procedures for agents and any management infrastructure • The availability of managed or SaaS components or preconfigured appliances from AWS Marketplace • Effectiveness and responsiveness of support • Any vendor requirements for the use of professional services for installation or configuration • Integration with other AWS technologies (such as AWS Systems Manager, AWS Config, Amazon CloudWatch) for deployment or validation of agent deployment

Antivirus/Anti-malware (continued)

	Consideration	Details
	Configuration and maintenance	Traditional AV products are not as configurable as EDR platforms, but it is still important to understand and review configurations on a regular basis. Reviews should be required on changes to the default configuration. **Evaluate:** • The architecture of the tools under consideration and the upgrade/update procedures • The procedures for updating signatures • Communication protocols and paths to understand required firewall and ACL changes along with any VPC peering or cross-account access • Reporting, metrics or alerting available for any out-of-date agents or signatures • Any vendor requirements for the use of professional services for upgrades or updates (not common) • Ability to customize scan intervals or manage exclusions • Whether the platform allows customers to add their own signatures • Availability and content of secure configuration guides and best practices
	Detection	Traditional AV technologies focus primarily on known threats. It is important for organizations to evaluate their effectiveness as part of the selection process. **Evaluate**: • Detection methods of any known malware samples available, if your organization practices malware analysis and has appropriate analysis environments • Available benchmarks or comparisons by third-party evaluators • Product reviews and customer forums • Customer references • Whether detection is real-time, interval-based, asynchronous or configurable for each detection mechanism supported • Whether detection includes detection of non-file-based malware (memory resident malware, for example)
	Integration	Traditional AV platforms have historically operated independently of other technologies and systems with the exception perhaps of log aggregation technologies, but it is still important to understand what integrations are supported out-of-the-box and the level of effort required to build any custom integrations. **Evaluate:** • Supported plugins and integrations with business and security platforms in use by the organization (such as AWS, ticketing, SIEM, incident response, threat intelligence) and the capabilities of these plugins and integrations • API support (API-first, REST API available, programmatic API available, to name a few) • Whether the platform allows the customer to build custom plugins or integrations • Level of effort required and technology (such as languages or frameworks) supported when building custom plugins or integrations

Antivirus/Anti-malware (continued)

	Consideration	Details
	Reporting, metrics and alerting	AV software will detect and attempt to neutralize a high percentage of well-known threats in your environment. Nevertheless, implement adequate reporting, metrics and alerting to respond quickly when you see new threats in your environment, because the extent of the automated response may be limited to killing processes and quarantining malware. Enhance the effectiveness of the technology by supporting defined standards and goals. **Evaluate:** • Out-of-the-box reports and dashboards against current program requirements • Ability and level of effort required to create custom measures and metrics • Alerting mechanisms and ability to create or modify alerts • Supported reporting and alerting formats and delivery mechanisms • Integration with AWS reporting and alerting tools (such as AWS Security Hub, Amazon CloudWatch Events, Amazon SNS) • Support for data aggregation across regions • Supported data export formats

There are many mature options when evaluating AV solutions. However, not all of these vendors have focused on optimizing their technology for the cloud. Take this into consideration when evaluating your current on-premises AV technology against other options for implementation in cloud environments. Performance and reporting may be the biggest considerations when implementing AV in the cloud.

Host-based Intrusion Detection

HIDS capabilities will be included with EDR solutions and bundled with other EPPs even if they may not advertise themselves as EDR solutions. Consider an EPP or product that focuses on HIDS if 1) EDR is prohibitively expensive or negatively affects performance, and 2) you want to detect indicators of compromise (IoCs). You will still need performance analysis for HIDS capabilities, because the resource requirements will vary based on the detection mechanisms supported and your architecture. HIDS may also offer more visibility into network traffic, depending on product capabilities.

	Consideration	Details
	Cloud context support	If investigation of HIDS detections is delayed, the resource(s) affected may no longer exist in your cloud environment. Understanding more about the cloud asset can help speed response to the threat. **Evaluate:** • The additional cloud context (tags or image IDs) that is captured and retained by HIDS technology to allow correlation of detections with resources and the images and image versions used to create those resources • The special concerns associated with studying resources that have potentially replaced the original resource from which data was gathered
	Performance and efficiency	Because of the move to EDR, traditional HIDS agents may not be optimized for cloud. Consider how this will affect instance sizing and storage requirements. **Evaluate:** • The architecture of the tools under consideration • Performance (CPU, memory, storage and bandwidth utilization) when used with production workloads • Amount of data sent and received from management console(s) • Amount of data stored on disk (logs) • Support for data compression

Host-based Intrusion Detection (continued)

	Consideration	Details
	Deployment	HIDS software requires agents to identify indicators of compromise and may also report data back to a management console. **Evaluate:** • The architecture of the tools under consideration • The installation and initial configuration procedures for agents and any management infrastructure • The availability of managed or SaaS components or preconfigured appliances from AWS Marketplace • Effectiveness and responsiveness of support • Any vendor requirements for the use of professional services for installation or configuration • Integration with other AWS technologies (such as AWS Systems Manager, AWS Config, Amazon CloudWatch) for deployment or validation of agent deployment
	Configuration and maintenance	HIDS agents and corresponding policies or rules will need to be tuned to eliminate false positives and may require custom rules or policies to monitor specific configurations or logs. They will also require regular maintenance and updates/upgrades. **Evaluate:** • The architecture of the tools under consideration • The upgrade procedures • The procedures for updating any datasets leveraged by agents • Reporting, metrics or alerting available for any out-of-date agents or policies • Communication protocols and paths to understand required firewall and ACL changes along with any VPC peering or cross-account access • Any vendor requirements for the use of professional services for upgrades or updates • Accessibility to detection rules, scripts and other configuration details (open or proprietary) • Whether the platform allows customer to build or create their own rules • Level of effort to perform customizations to rules, scripts or configurations or create new rules • Integrations with other AWS technologies (such as AWS Config and AWS Lambda) or configuration management tools (Puppet, Chef, Ansible, SaltStack, CFEngine) to perform updates or upgrades or apply configurations • Secure configuration guides and best practices
	Detection	HIDS technologies require the implementation of agents on the supported endpoints. They may also require the provisioning and deployment of management consoles and centralized update servers or appliances. **Evaluate:** • Detection methods employed • Data and services included for monitoring and detection • Available benchmarks or comparisons by third-party evaluators • Product reviews and customer forums • Customer references
	Integration	HIDS software may support integration with other reporting and alerting capabilities. **Evaluate:** • Supported plugins and integrations with business and security platforms in use by the organization (such as AWS, ticketing, SIEM, incident response, threat intelligence) and the capabilities of these plugins and integrations • API support (such as API-first, REST API available, programmatic API available) • Whether the platform allows the customer to build custom plugins or integrations • Level of effort required and technology (languages and frameworks) supported when building custom plugins or integrations

Host-based Intrusion Detection (continued)

	Consideration	Details
	Reporting, metrics and alerting	HIDS technologies focus on detection. For that reason, reporting, alerting, monitoring and response procedures are crucial. **Evaluate:** • Out-of-the-box reports and dashboards against current program requirements • Ability and level of effort required to create custom measures and metrics • Alerting mechanisms and ability to create or modify alerts • Supported reporting and alerting formats and delivery mechanisms • Integration with AWS reporting and alerting tools (such as AWS Security Hub, Amazon CloudWatch Events, Amazon SNS) • Resources and processes to support monitoring of reports and response to alerts • Support for data aggregation across regions • Supported data export formats

HIDS can provide insight into what is happening on your endpoints when more advanced endpoint detection and response is not available. However, if cloud endpoints have short lifecycles, HIDS may not provide as much value unless enough cloud context is available to determine which detections or events are relevant to similar cloud endpoints or the cloud endpoint that replaced the endpoint on which the initial event occurred.

File Integrity Monitoring

FIM may be included in many of the other EPP solutions, but you may consider it as a point solution if integrity is significantly more important than confidentiality and availability, and if the capabilities of the solutions included in your EPP do not meet your needs. FIM may become less important as organizations move toward more immutable workloads, where most sensitive files reside on read-only portions of the file system and more consistently leverage PaaS for back-end storage technologies (such as Amazon RDS, Amazon S3).

	Consideration	Details
	Reporting, metrics and alerting	File integrity monitoring typically affects performance much less than other endpoint security technologies because it is focused only on the integrity of files. Performance should still be evaluated before using these technologies in the cloud, especially when other security agents are also installed. **Evaluate:** • The architecture of the tools under consideration • Performance (including CPU, memory, storage and bandwidth utilization) when used with production workloads • Amount of data sent and received from management console(s) • Amount of data (such as file hash/signature database, logs) stored on disk • Support for data compression

File Integrity Monitoring (continued)

	Consideration	Details
	Deployment	FIM software requires agents to identify changes to monitored files and may also report data back to a management console. **Evaluate:** • The architecture of the tools under consideration • The installation and initial configuration procedures for agents and any management infrastructure • The availability of managed or SaaS components or preconfigured appliances from AWS Marketplace • Effectiveness and responsiveness of support • Any vendor requirements for the use of professional services for installation or configuration • Integration with other AWS technologies (such as AWS Systems Manager, AWS Config, Amazon CloudWatch) for deployment or validation of agent deployment
	Configuration and maintenance	Configuration and maintenance of FIM software may be less cumbersome than the other solutions we have discussed, but all solutions require some degree of configuration and maintenance. **Evaluate:** • The architecture of the tools under consideration • The upgrade procedures • Reporting, metrics or alerting available for any out-of-date agents • Communication protocols and paths to understand required firewall and ACL changes, along with any VPC peering or cross-account access • Any vendor requirements for the use of professional services for upgrades or updates • Level of effort to configure policy that determines which files to monitor • Integrations with other AWS technologies (such as AWS Config and AWS Lambda) or configuration management tools (Puppet, Chef, Ansible, SaltStack, CFEngine) to perform updates or upgrades or apply configurations • Secure configuration guides and best practices
	Integration	FIM software may support integration with other reporting and alerting capabilities. **Evaluate:** • Supported plugins and integrations with business and security platforms in use by the organization (such as AWS, ticketing, SIEM, incident response, threat intelligence) and the capabilities of these plugins and integrations • API support (including API-first, REST API available, programmatic API available) • Whether the platform allows the customer to build custom plugins or integrations • Level of effort required and technology (languages and frameworks) supported when building custom plugins or integrations
	Reporting, metrics and alerting	If a monitored file is changed, human intervention is typically required to determine the cause and whether it was an approved change. Adequate reporting and alerts are needed to facilitate this process. **Evaluate:** • Out-of-the-box reports and dashboards against current program requirements • Ability and level of effort required to create custom measures and metrics • Alerting mechanisms and ability to create or modify alerts • Supported reporting and alerting formats and delivery mechanisms • Integration with AWS reporting and alerting tools (such as AWS Security Hub, Amazon CloudWatch Events, Amazon SNS) • Resources and processes to support monitoring of reports and response to alerts • Support for data aggregation across regions • Supported data export formats

FIM is one of the easier technologies to implement for most organizations. Depending on the configuration, however, the number of files being monitored and the amount of change in the organization, the number of resources required to follow up on alerts can be excessive. Continuous tuning and integration with change management can help reduce to a manageable level the number of alerts requiring human interaction.

Application Whitelisting

Application whitelisting protects endpoints by either ensuring that only known software is allowed to execute or notifying administrators when unapproved software is executed on endpoints. This protection may be accomplished by validating hashes or signatures associated with the software or by validating software-signing certificates against the policies defined by the organization and assigned to each endpoint. Application whitelisting makes the exploitation and installation phases of the attack kill chain much more difficult. Consider application whitelisting if your environment has a high degree of homogeneity or if your organization's deployment processes are mature and would support automating the development and maintenance of the whitelist policies. Caution: Application whitelisting technologies may not prevent attacks against known vulnerabilities in whitelisted applications, so be sure to follow good vulnerability management practices.

	Consideration	Details
	Performance and efficiency	Application whitelisting solutions generally do not affect performance as much as other endpoint security solutions—as long as they are configured correctly. If they are misconfigured and block legitimate applications or services, the performance impact is significant. Changes to rules and to cloud resources should be thoroughly tested before deployment. **Evaluate:** • The architecture of the tools under consideration • Performance (CPU, memory, storage and bandwidth utilization) when used with production workloads • Amount of data sent and received from management console(s) • Support for data compression
	Deployment	Application whitelisting solutions typically require agents and a management console to update and distribute configurations and receive alerts from agents. **Evaluate:** • The architecture of the tools under consideration • The installation and configuration procedures for agents and management infrastructure • The availability of managed or SaaS components or preconfigured appliances from AWS Marketplace • Effectiveness and responsiveness of support • Any vendor requirements for the use of professional services for installation or configuration • Integration with other AWS technologies (such as AWS Systems Manager, AWS Config, Amazon CloudWatch) for deployment or validation of agent deployment

Application Whitelisting (continued)

	Consideration	Details
	Configuration and maintenance	Configuration and maintenance of whitelisting policies is critical to the successful use of application whitelisting. In enterprise environments, standardization and automation can help reduce this burden. Automated testing can validate changes to the whitelist or cloud resources before release into production environments. **Evaluate:** • The architecture of the tools under consideration • The upgrade procedures • The procedures for updating whitelists • Reporting, metrics or alerting available for any out-of-date agents or policies • Communication protocols and paths to understand required firewall and ACL changes along with any VPC peering or cross-account access • Any vendor requirements for the use of professional services for upgrades or updates • Level of effort to create and maintain whitelists and any assistance provided by technology • Integrations with other AWS technologies (such as AWS Config or AWS Lambda) or configuration management tools (Puppet, Chef, Ansible, SaltStack, CFEngine) to perform updates and upgrades or to apply configurations • Secure configuration guides and best practices
	Reporting, metrics and alerting	In order to respond quickly to outages caused by whitelists and aid in the identification of attempted exploits and unauthorized installations, evaluate the reporting and alerting features available. **Evaluate:** • Support for centralized logging technologies and communication protocols including integration with any existing or proposed SIEM technology • Out-of-the-box reports and dashboards against current program requirements • Ability and level of effort required to create custom measures and metrics • Alerting mechanisms and ability to create or modify alerts • Supported reporting and alerting formats and delivery mechanisms • Integration with AWS reporting and alerting tools (such as AWS Security Hub, Amazon CloudWatch Events, Amazon SNS) • Support for data aggregation across regions • Supported data export formats

Application whitelisting is a mature, layered security control that can be leveraged to reduce the impact of vulnerabilities in cloud environments and make exploitation of cloud resources more difficult. Because standardization is more common in the cloud, application whitelisting may be more achievable and easier to maintain. Heavy use of automation and DevOps principles can also help ease the burden of ongoing configuration and maintenance.

Making the Choice

To summarize, the key considerations for implementing endpoint security in AWS are:

- Cloud context
- Efficiency
- Ease of use
- Reporting
- Ease of integration
- Effectiveness

Have a Plan

By defining and understanding their cloud architecture, risk profile, business requirements and available resources along with understanding any gaps, organizations will be in a good position to determine which considerations outlined above are most important to them. Based on those considerations, organizations should develop a proof-of-concept test plan and evaluation matrix. The test plan and matrix should include a ranking of importance for each consideration, and where possible, acceptance thresholds. When the test plan is complete, the organization should identify two or more representative cloud environments in which to conduct the test. They should identify any additional technology they may need to aid in the evaluation of certain considerations. For example, evaluating the performance and efficiency of agents will most likely require additional setup and configuration, and, depending on the platform, performance monitoring tools may be required.

Consider Partners

As organizations build out their cloud and cloud security strategy and plan, they may want to consider working with partners to accelerate their efforts or fill any gaps in knowledge or resources that are identified. All consulting partners may extend AWS Marketplace third-party solutions directly to customers through Consulting Partner Private Offers (CPPO). Not every organization will be able to find resources with deep cloud experience and even experienced cloud technologists may only have experience in specific industries or with specific cloud vendors.

Test and Evaluate

With the plan and any additional requirements in place, the technology should be installed in the test environment, configured and monitored to gather enough data to evaluate each consideration. Every step of the process should be measured. Organizations, if possible, should avoid allowing vendors to install and configure the technology for the proof of concept unless they will be installing and managing the solution after purchase as well. At a minimum, technical resources should be available to observe these processes.

After the proof-of-concept test, organizations should evaluate the results against the test plan and acceptance thresholds. Use the collected and documented results to compare functionality, cost and other factors to determine the best solution(s) to employ.

Conclusion

Endpoint security for IaaS cloud workloads is an important part of an organization's cloud security strategy. Not only does it provide additional protections for these workloads, but it also provides additional visibility into cloud resources and the actual threats that exist in an organization's cloud environments. While many organizations are still concerned about the performance impacts and associated costs, cloud endpoint security vendors have matured, and cloud-optimized solutions are more accessible.

Fortunately, many of these solutions are offered on-demand, which makes evaluating these products and services much easier than it was in the past. To get started, you may want to review what products are available in AWS Marketplace or through a SaaS model to jump-start your evaluation process.

About the Author

David Hazar is a SANS analyst, instructor and co-author of SANS MGT516: Managing Security Vulnerabilities: Enterprise and Cloud. He also is an instructor for SANS SEC540: Cloud Security and DevOps Automation. With close to 20 years of broad, deep technical experience gained from a variety of hands-on roles serving the financial, healthcare and technology industries, his current areas of focus include vulnerability management, application security, cloud security and secure DevOps. He holds the CISSP, GWAPT, GWEB, GMOB, GCIA, GCIH, GCUX, GCWN, GSSP-.NET and GSTRT certifications.

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RETURN TO THE TABLE OF CONTENTS

Next Steps

By applying the guidelines in the preceding whitepapers, you have been able to:

- Increase accuracy and visibility into your cloud-based endpoints and ensure they are configured and patched to reduce risk against known threats
- Integrate security endpoint solutions into cloud workloads to prevent many and detect most attacks before they can affect your systems
- Reduce the time it takes to detect and categorize a potential incident, as well the time to mitigate risk and restore full operations

But securing cloud-based applications is further proof that Heraclitus's quote from more than 2,000 years ago is still valid: "The only constant is change."

Developers will come up with new applications and algorithms; business managers will come up with new ways to reach customers, increase revenue and reduce costs. And attackers will continue to find new forms of weaknesses—or take advantage of previously successful hacks that they might still be able to use.

Once you've secured the endpoints, the key next steps are all about speed:

- **How quickly can you detect and analyze the potential risk of a new executable?** Application security that can be baked into the DevOps or CI/CD pipeline is much more effective than reactively scanning applications on production workloads.
- **How rapidly can you analyze a new threat, determine your exposure, and mitigate and/or protect critical business applications?** Integrating threat intelligence with accurate asset inventory data is the starting point. Adding advanced tools for threat analysis, emergency response patching and surgical threat shielding are key areas of evolution.
- **Are you prepared to move to the next level?** Strong authentication and persistent data encryption are two areas of security that have the highest potential to thwart attacks. The movement to cloud-based applications and DevOps techniques is increasing the adoption of these practices. Security teams need to proactively test potential solutions and have business-ready architectures and working solutions in place in advance.

The capabilities of IaaS have enabled businesses and development organizations to move to market with applications and services faster. Security organizations also need to take advantage of the strengths of cloud computing to move at the same speed as their attackers and make advances in raising the bar against increasingly sophisticated threats.

RETURN TO THE TABLE OF CONTENTS