Cloud Computing

Module 17

Unmask the Invisible Hacker.




Statistics: Cloud Predictions

More than **65%** of enterprise IT organizations will commit to **hybrid cloud** technologies before 2016, vastly driving the rate and pace of change in IT organizations

By 2017, **20%** of enterprises will see enough value in **community-driven** open source standards/frameworks to adopt them strategically

By 2017, **25%** of IT organizations will formally support a "**consumer tier**" to allow workers to develop their own personal automation

By 2017, IT buyers will actively channel **20% of their IT budgets** through industry clouds to enable flexible collaboration, information sharing, and commerce

By 2016, more than **50%** of enterprise IT organizations building hybrid clouds will purchase new or updated workload-aware **cloud management** solutions

IDC FutureScape: Worldwide Cloud 2015 Predictions, *https://www.idc.com*

Statistics: Cloud Predictions (Cont'd)

- **60% of SaaS** applications will leverage new function-driven, micro-priced IaaS capabilities by 2018, adding innovation to a "commodity" service
- By 2015, 65% of the selection criteria for enterprise cloud workloads in global IT markets will be shaped by efforts to comply with **data privacy legislation**
- 75% of IaaS provider offerings will be **redesigned**, **rebranded**, or phased out in the next 12-24 months
- By 2016, there will be an **11% shift of IT budget** away from traditional in-house IT delivery, towards various versions of cloud as a new delivery model
- By 2017, **35% of new applications will use cloud-enabled** continuous delivery and DevOps lifecycles for faster rollout of new features and business innovation

IDC FutureScape: Worldwide Cloud 2015 Predictions, *https://www.idc.com*

Module Objectives

- Understanding Cloud Computing Concepts
- Understanding Cloud Computing Threats
- Understanding Cloud Computing Attacks
- Understanding Cloud Computing Security
- Cloud Computing Security Tools
- Overview of Cloud Penetration Testing



Module Flow

1. Introduction to Cloud Computing
2. Cloud Computing Threats
3. Cloud Computing Attacks
4. Cloud Security
5. Cloud Security Tools
6. Cloud Penetration Testing

Introduction to Cloud Computing

Cloud computing is an on-demand delivery of **IT capabilities** where IT infrastructure and applications are provided to **subscribers** as a metered service over a network

Characteristics of Cloud Computing

1. On-demand self service
2. Distributed storage
3. Rapid elasticity
4. Automated management
5. Broad network access
6. Resource pooling
7. Measured service
8. Virtualization technology

Types of Cloud Computing Services

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Infrastructure-as-a-Service (IaaS)

- Provides virtual machines and other abstracted hardware and operating systems which may be controlled through a service API
- E.g. Amazon EC2, Go grid, Sungrid, Windows SkyDrive, etc.

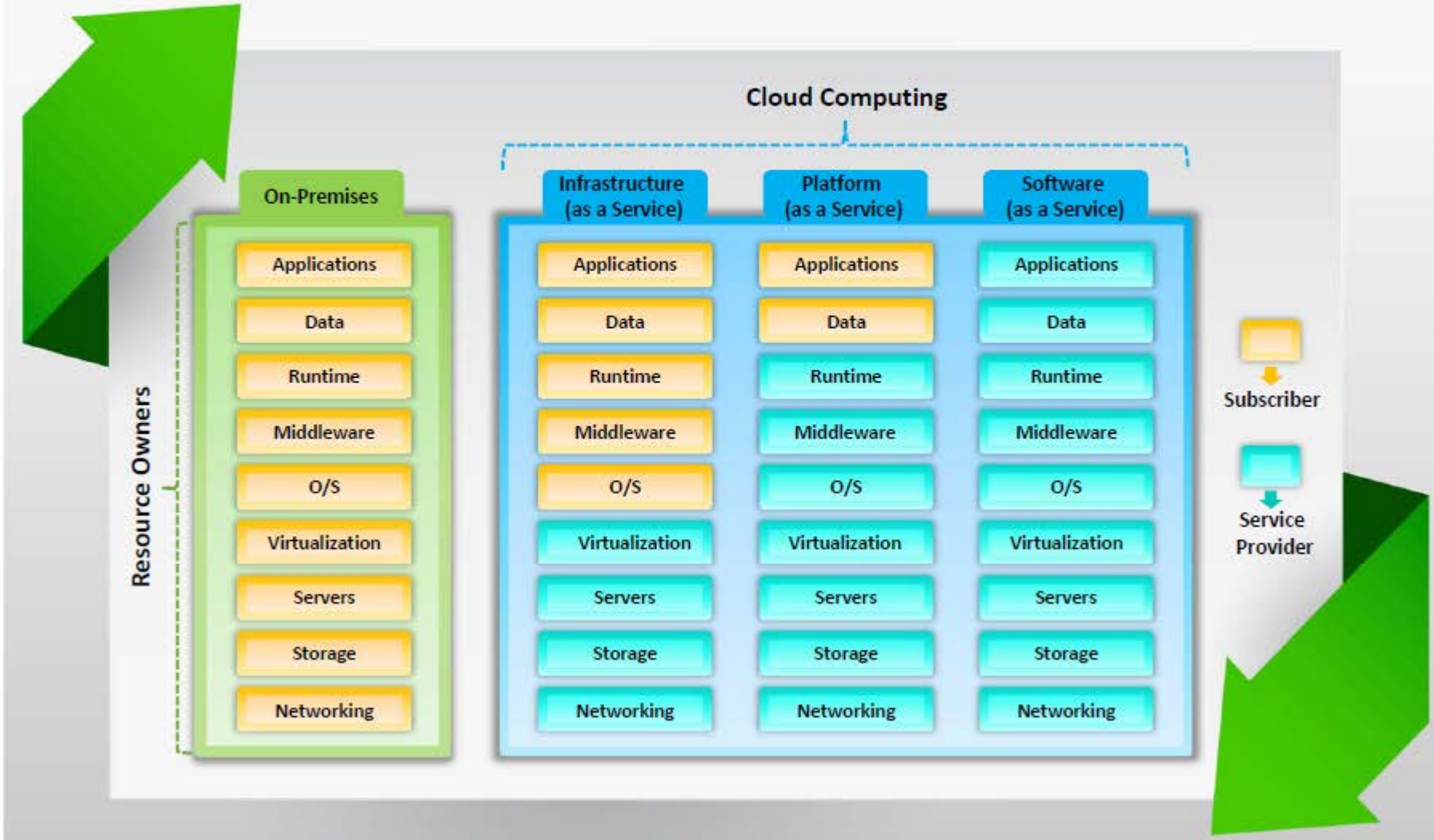
Platform-as-a-Service (PaaS)

- Offers development tools, configuration management, and deployment platforms on-demand that can be used by subscribers to develop custom applications
- E.g. Intel MashMaker, Google App Engine, Force.com, Microsoft Azure, etc.

Software-as-a-Service (SaaS)

- Offers software to subscribers on-demand over the Internet
- E.g. web-based office applications like Google Docs or Calendar, Salesforce CRM, etc.

Separation of Responsibilities in Cloud



Cloud Deployment Models

Cloud deployment model selection is based on the **enterprise requirements**

Private Cloud

Cloud infrastructure operated solely for a **single organization**

Community Cloud

Shared infrastructure between **several organizations from a specific community** with common concerns (security, compliance, jurisdiction, etc.)

Hybrid Cloud

Composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models

Public Cloud

Services are rendered over a **network that is open for public use**

NIST Cloud Computing Reference Architecture

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NIST cloud computing reference architecture defines five major factors:

Cloud Auditor

A party for making independent assessments of cloud service controls and taking an opinion thereon

Cloud Broker

An entity to manage cloud services in terms of use, performance, and delivery who also maintains relationship between cloud providers and consumers

Cloud Consumer

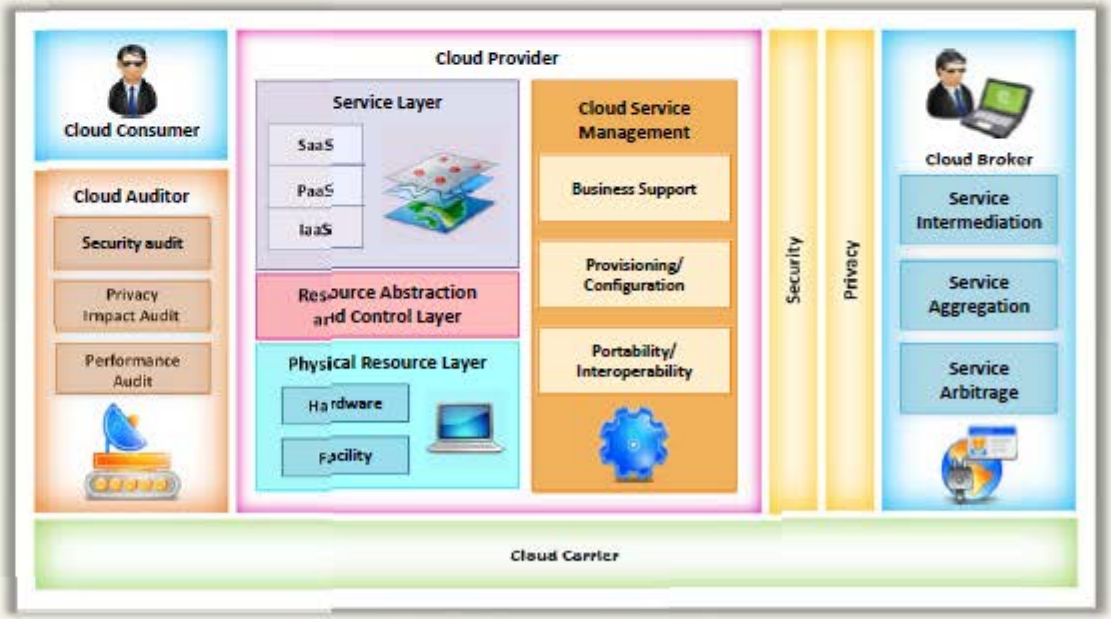
A person or organization that uses cloud computing services

Cloud Carrier

An intermediary for providing connectivity and transport services between cloud consumers and providers

Cloud Provider

A person or organization providing services to interested parties



Overview of the NIST cloud computing reference architecture

Cloud Computing Benefits

Economic

- Business agility
- Less maintenance costs
- Acquire economies of scale
- Less capital expense
- Huge storage facilities for organizations
- Environmentally friendly
- Less total cost of ownership
- Less power consumption

Operational

- Flexibility and efficiency
- Resiliency and redundancy
- Scale as needed
- Less operational problems
- Deploy applications quickly
- Back up and disaster recovery
- Automatic updates

Staffing

- Streamline processes
- Well usage of resources
- Less personnel training
- Less IT Staff
- Multiple users utilize resources on cloud
- Evolution to new model of business
- Simultaneous sharing of resources

Security

- Less investment in security controls
- Efficient, effective, and swift response to security breaches
- Standardized, open interface to managed security services (MSS)
- Effective patch management and implementation of security updates
- Better disaster recovery preparedness
- Ability to dynamically scale defensive resources on demand
- Resource aggregation offers better manageability of security systems
- Rigorous internal audit and risk assessment procedures

Understanding Virtualization

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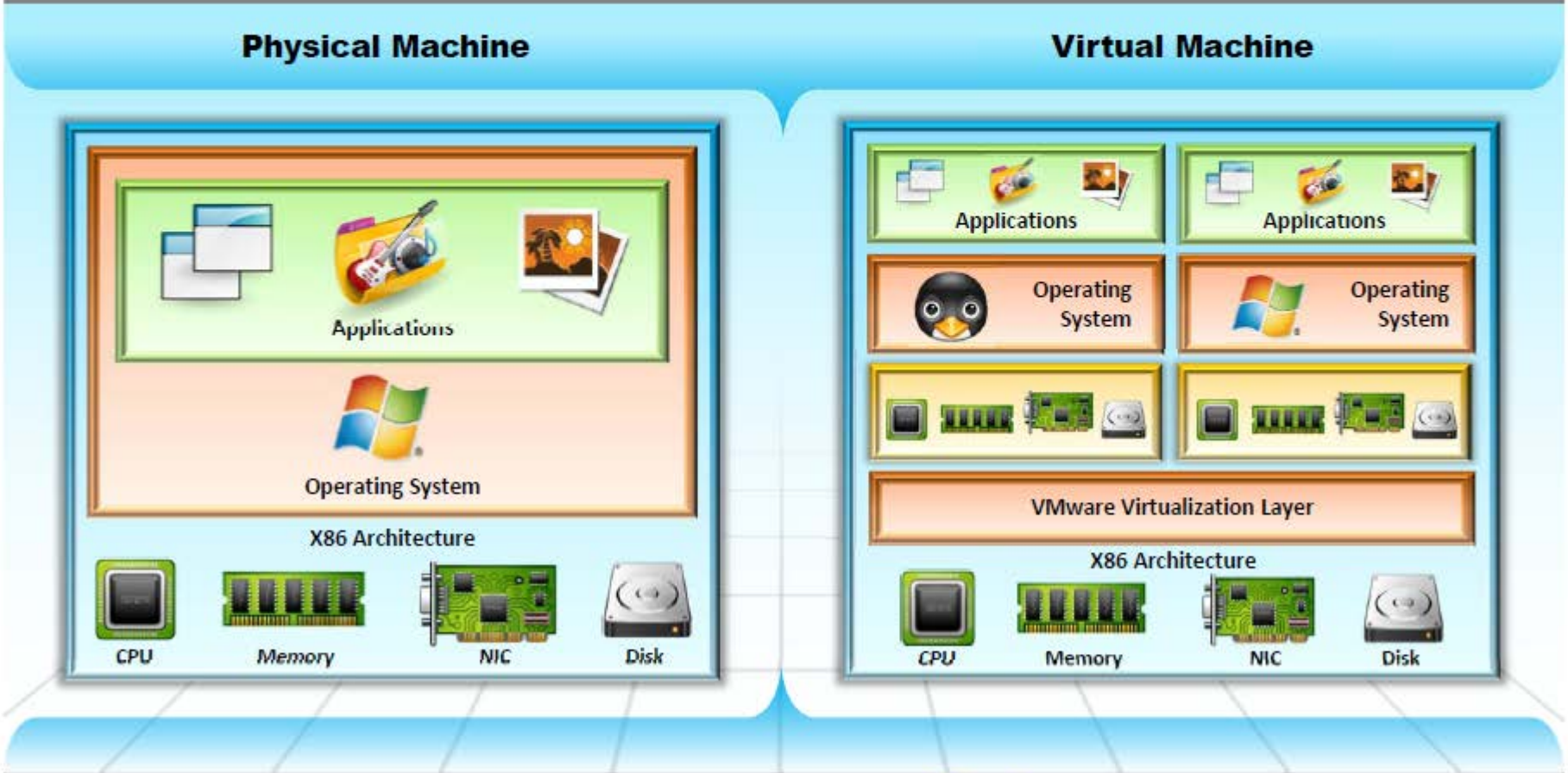
- Virtualization is the ability to **run multiple operating systems on a single physical system** and share the underlying resources such as a server, a storage device or a network



Benefits of Virtualization in Cloud

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1. Increases business continuity through efficient disaster recovery
2. Reduces cost of setting cloud infrastructure (cost on hardware, servers, etc.)
3. Improves the way organizations manage IT and deliver services
4. Improves operational efficiency
5. Reduces system administration work
6. Facilitates better backup and data protection
7. Increases service levels and enable self-service provisioning
8. Helps administrators to ensure control and compliance

Module Flow

1. Introduction to Cloud Computing
2. Cloud Computing Threats
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Cloud Computing Threats

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1. Data breach/loss
2. Abuse of cloud services
3. Insecure interfaces and APIs
4. Insufficient due diligence
5. Shared technology issues
6. Unknown risk profile
7. Inadequate infrastructure design and planning
8. Conflicts between client hardening procedures and cloud environment
9. Loss of operational and security logs
10. Malicious insiders
11. Illegal access to cloud systems
12. Privilege escalation
13. Loss of business reputation due to co-tenant activities
14. Natural disasters
15. Hardware failure
16. Supply chain failure
17. Modifying network traffic
18. Isolation failure
19. Cloud provider acquisition
20. Management interface compromise
21. Network management failure
22. Authentication attacks
23. VM-level attacks
24. Lock-in
25. Licensing risks
26. Loss of governance
27. Loss of encryption keys
28. Risks from changes of Jurisdiction
29. Undertaking malicious probes or scans
30. Theft of computer equipment
31. Cloud service termination or failure
32. Subpoena and e-discovery
33. Improper data handling and disposal
34. Loss or modification of backup data
35. Compliance risks
36. Economic Denial of Sustainability (EDOS)

Cloud Computing Threats (Cont'd)

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Data Breach/Loss

Data loss issues include:

- **Data is erased**, modified or decoupled (lost)
- **Encryption keys are lost**, misplaced or stolen
- **Illegal access to the data** in cloud due to Improper authentication, authorization, and access controls
- **Misuse of data** by CSP

Abuse of Cloud Services

Attackers **create anonymous access to cloud services** and perpetrate various attacks such as:

- **Password** and **key** cracking
- Building rainbow tables
- **CAPTCHA**-solving farms
- Launching **dynamic attack points**
- Hosting **exploits** on cloud platforms
- Hosting **malicious data**
- **Botnet** command or control
- **DDoS**

Insecure Interfaces and APIs

Insecure interfaces and APIs related risks:

- Circumvents **user defined polices**
- Is not credential leak proof
- Breach in **logging and monitoring facilities**
- Unknown API dependencies
- Reusable **passwords/tokens**
- Insufficient input-data validation

Cloud Computing Threats (Cont'd)

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Insufficient Due Diligence

Ignorance of CSP's cloud environment pose risks in **operational responsibilities** such as security, encryption, incident response, and more issues such as contractual issues, design and architectural issues, etc.

Shared Technology Issues

Most underlying components that make up the cloud infrastructure (ex: GPU, CPU caches, etc.) **does not offer strong isolation properties** in a multi-tenant environment which enables attackers to attack other machines if they are able to exploit vulnerabilities in one client's applications

Unknown Risk Profile

Client organizations are unable to get a clear picture of internal security procedures, security compliance, configuration hardening, patching, auditing and logging, etc. as they are less involved with **hardware** and **software ownership** and maintenance in the cloud

Cloud Computing Threats (Cont'd)

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Inadequate Infrastructure Design and Planning

- Shortage of computing resources and/or poor network design gives rise to unacceptable **network latency** or **inability to meet agreed service levels**

Conflicts between Client Hardening Procedures and Cloud Environment

- Certain client hardening procedures may conflict with a **cloud provider's environment**, making their implementation by the client impossible

Loss of Operational and Security Logs

- The loss of security logs poses a **risk for managing the implementation of the information security management program**
- Loss of security logs may occur in case of under-provisioning of storage

Malicious Insiders

- Disgruntled current or former employees, contractors, or other business partners who have authorized access to cloud resources can misuse their access to compromise the **information available in the cloud**

Cloud Computing Threats (Cont'd)

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Illegal Access to the Cloud

Weak authentication and authorization controls could lead to illegal access thereby compromising confidential and critical data stored in the cloud

Loss of Business Reputation due to Co-tenant Activities

Resources are shared in the cloud, thus malicious activity of one co-tenant might affect the reputation of the other, resulting in poor service delivery, data loss, etc. that bring down organization's reputation

Privilege Escalation

A mistake in the access allocation system causes a customer, third party, or employee to get more access rights than needed

Natural Disasters

Based on geographic location and climate, data centers may be exposed to natural disasters such as floods, lightening, earthquakes, etc. that can affect the cloud services

Hardware Failure

Hardware failure such as switches, servers, etc. in data centers can make the cloud data inaccessible

Cloud Computing Threats (Cont'd)

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Supply Chain Failure

- Cloud providers outsource certain tasks to third parties. Thus the security of the **cloud is directly proportional to security of each link** and the extent of dependency on third parties
- A disruption in the chain may lead to **loss of data privacy** and **integrity**, **services unavailability**, **violation of SLA**, **economic** and **reputational losses** resulting in failure to meet customer demand, and cascading failure

Modifying Network Traffic

- In cloud, the network traffic may be modified due to flaws while provisioning or de-provisioning network, or **vulnerabilities in communication encryption**
- Modification of network traffic may cause **loss**, **alteration**, or **theft of confidential data** and communications

Isolation Failure

- Due to the **isolation failure**, attackers try to **control operations** of other cloud customers **to gain illegal access** to the data

Cloud Computing Threats (Cont'd)

Cloud Provider Acquisition	Acquisition of the cloud provider may **increase the probability of tactical shift** and may effect non- binding agreements at risk. This could make it difficult to cope up with the security requirements
Management Interface Compromise	Customer management interfaces of cloud provider are accessible via Internet and facilitates **access to large number of resources**. This enhances the risk, particularly when combined with **remote access** and **web browser vulnerabilities**
Network Management Failure	Poor network management leads to **network congestion**, **misconnection**, **misconfiguration**, lack of resource isolation etc., which affects services and security
Authentication Attacks	Weak authentication mechanisms (weak passwords, re-use passwords, etc.) and inherent limitations of **one-factor authentication mechanisms** allows attacker to gain unauthorized access to cloud computing systems

Cloud Computing Threats (Cont'd)

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VM-Level Attacks

Cloud extensively use **virtualization technology**. This threat arises due to the **existence of vulnerabilities in the hypervisors**

Lock-in

Inability of the client to **migrate from one cloud service provider to another** or in-house systems due to the lack of tools, procedures or standards data formats for data, application, and service portability

Licensing Risks

The organization may **incur huge licensing fee** if the software deployed in the cloud is charged on a per instance basis

Loss of Governance

In using cloud infrastructures, **customer gives up control to the cloud service provider** regarding issues that may affect security

Loss of Encryption Keys

The loss of encryption keys required for **secure communication** or systems access provide a potential attacker with the possibility to get **unauthorized assets**

Cloud Computing Threats (Cont'd)

Risks from Changes of Jurisdiction	Change in jurisdiction of the data leads to the risk, the **data** or **information system is blocked** or **impounded** by a government or other organization
Undertaking Malicious Probes or Scans	Malicious probes or scanning allows an attacker to collect **sensitive information** that may lead to **loss of confidentiality**, **integrity**, and **availability of services and data**
Theft of Computer Equipment	Theft of equipment may occur due to **poor controls on physical parameters** such as **smart card access at the entry** etc. which may lead to loss of physical equipment and sensitive data
Cloud Service Termination or Failure	Termination of cloud service due to non-profitability or disputes might lead to **data loss** unless end-users are **legally protected**
Subpoena and E-Discovery	Customer data and services are subpoenaed or subjected to a cease and **desist request from authorities or third parties**

Cloud Computing Threats (Cont'd)

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Improper Data Handling and Disposal	01	It is difficult to ascertain data handling and disposal procedures followed by CSPs due to **limited access to cloud infrastructure**
Loss/ Modification of Backup Data	02	Attackers might exploit vulnerabilities such as **SQL injection**, insecure user behavior like **storing passwords**, **reusing passwords** etc. to gain illegal access to the data backups in the cloud
Compliance Risks	03	Organizations that seek to obtain compliance to standards and laws may be put at risk if the CSP **cannot provide evidence of their own compliance** with the necessary requirements, outsource cloud management to third parties and/or **does not permit audit** by the client
Economic Denial of Sustainability (EDOS)	04	If an attacker engages the cloud with a malicious service or executes malicious code that **consumes a lot of computational power and storage from the cloud server**, then the legitimate account holder is charged for this kind of computation until the main cause of CPU usage is detected

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Cloud Computing Attacks

1. Service Hijacking using Social Engineering Attacks
2. Session Hijacking using XSS Attack
3. Domain Name System (DNS) Attacks
4. SQL Injection Attacks
5. Wrapping Attack
6. Service Hijacking using Network Sniffing
7. Session Hijacking using Session Riding
8. Side Channel Attacks or Cross-guest VM Breaches
9. Cryptanalysis Attacks
10. DoS and DDoS Attacks

Service Hijacking using Social Engineering Attacks

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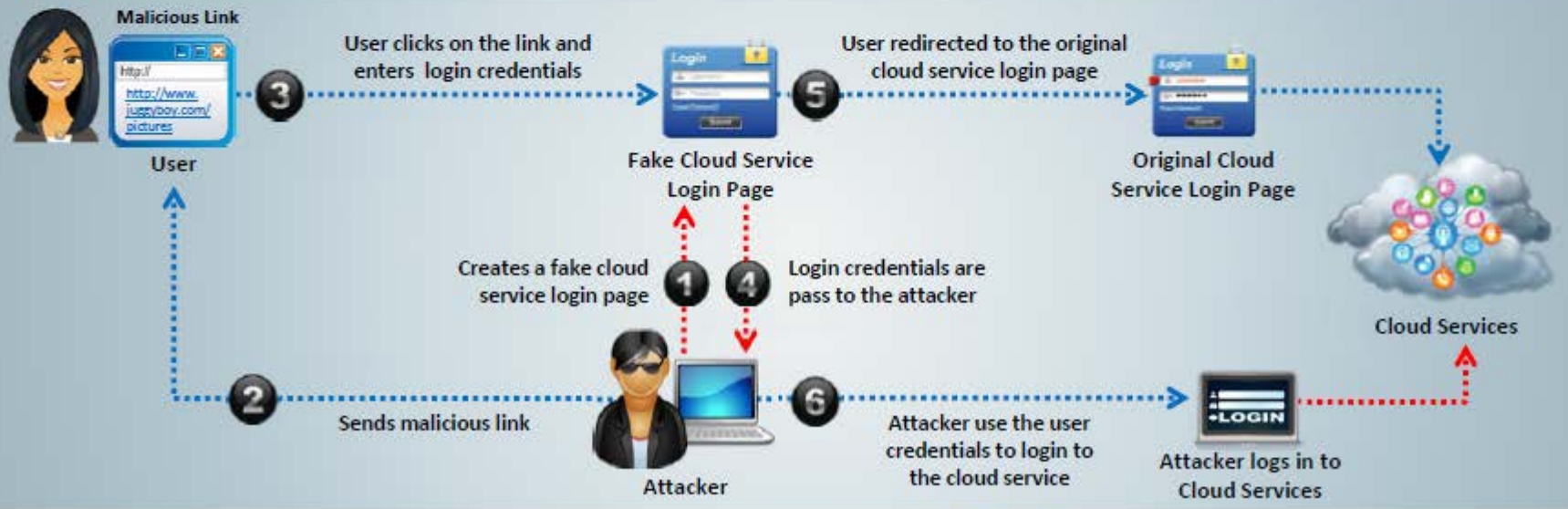
01 Social engineering is a non-technical kind of **intrusion that relies heavily on human interaction** and often involves tricking other people to break normal security procedures

02 Attacker might target the cloud service provider to **reset the password** or **IT staff accessing the cloud services to reveal passwords**

03 Other ways to obtain passwords include: **password guessing**, using **keylogging malware**, implementing **password cracking techniques**, sending **phishing mails**, etc.

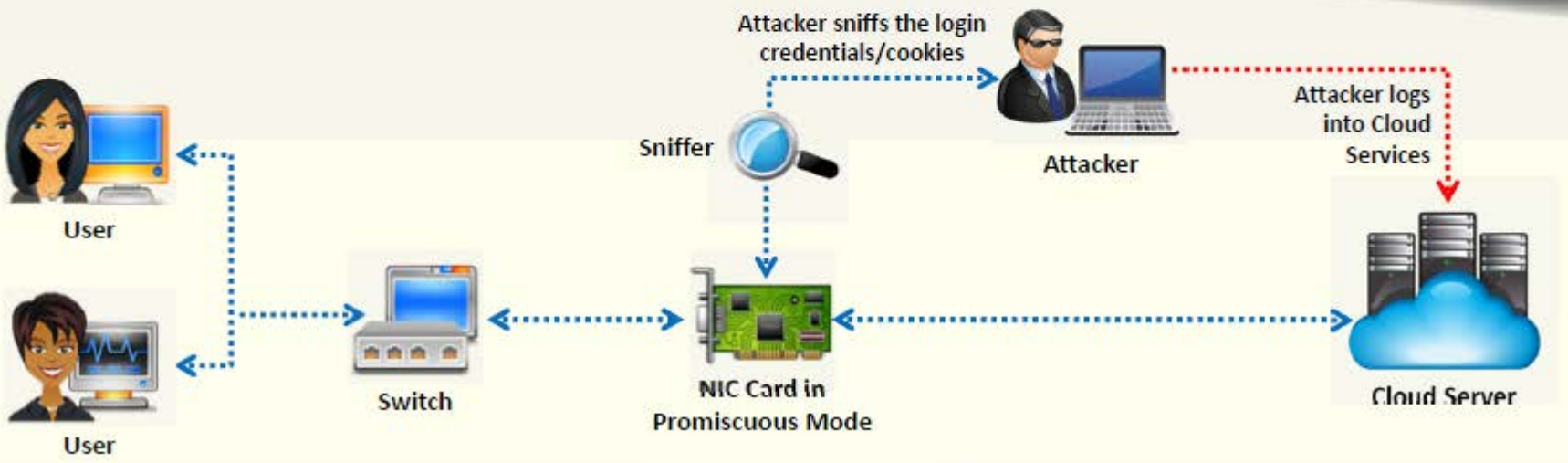
04 Social engineering attack results in **exposing customer data**, credit card data, **personal information**, **business plans**, staff data, identity theft, etc.



Service Hijacking using Network Sniffing

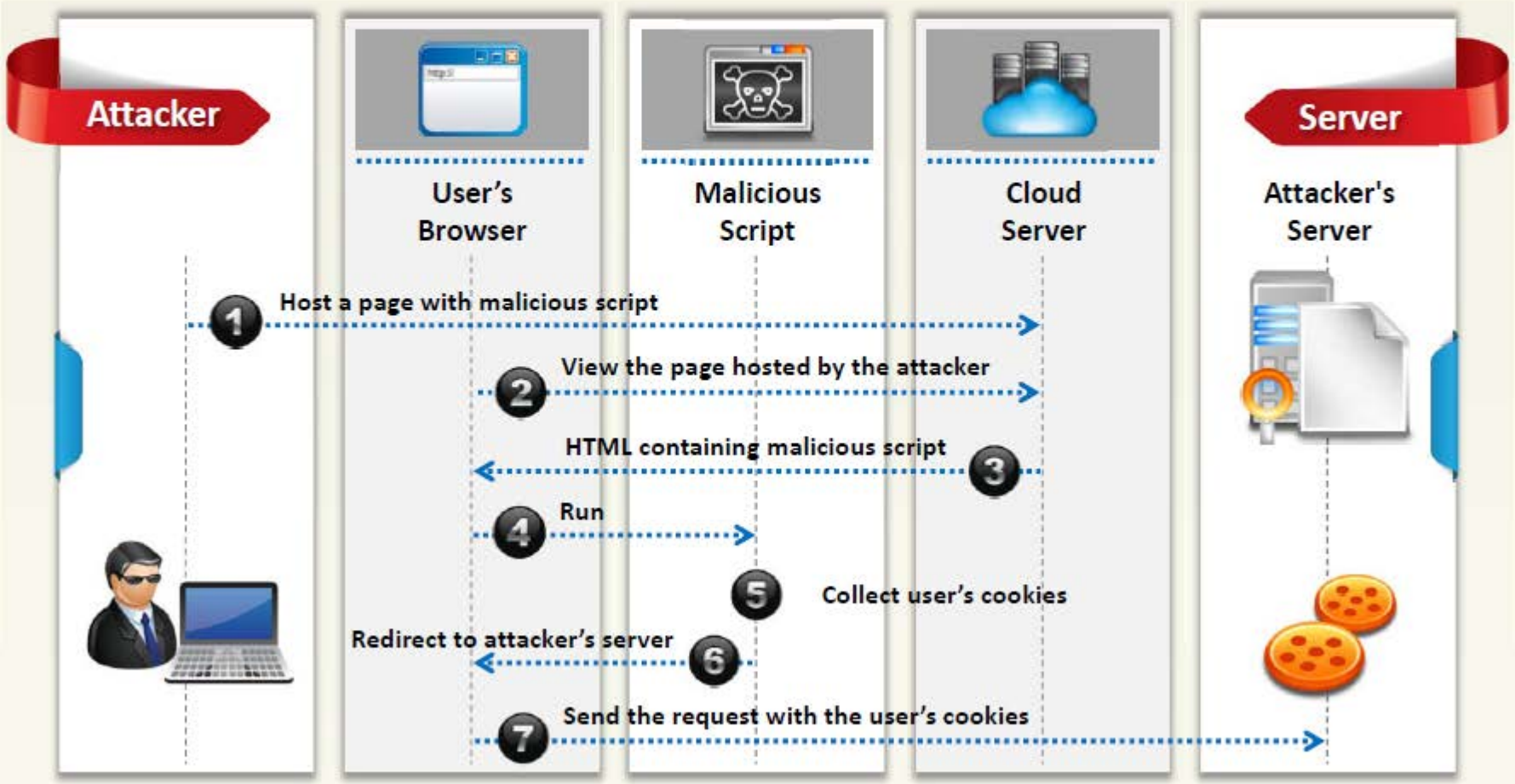
Network sniffing involves **interception and monitoring of network traffic** which is being sent between the two cloud nodes

Attacker uses packet sniffers to capture sensitive data such as **passwords**, **session cookies**, and other web service related security configuration such as the **UDDI** (Universal Description Discovery and Integrity), **SOAP** (Simple Object Access Protocol) and **WSDL** (Web Service Description Language) files



Session Hijacking using XSS Attack

Attacker implements Cross-Site Scripting (XSS) to **steal cookies that are used to authenticate users**, this involves injecting a malicious code into the website that is subsequently executed by the browser

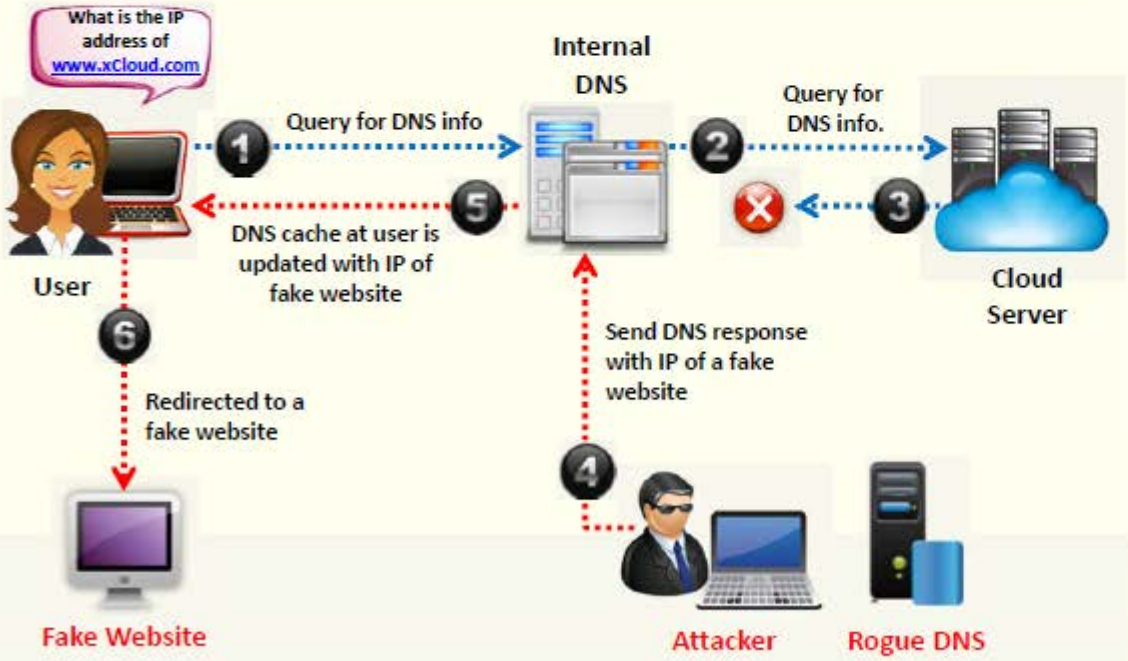


Session Hijacking using Session Riding

- Attacker exploits website by implementing **cross site request forgery** to transmit unauthorized commands
- In session riding, attacker rides an active computer session by **sending an email** or **tricking the user to visit a malicious webpage** while they are logged into the targeted site
- When the **user clicks the malicious link**, the website executes the request as the user is already authenticated
- **Commands used include**: Modify or delete user data, execute online transactions, reset passwords, etc.

Domain Name System (DNS) Attacks

Attacker performs DNS attacks to **obtain authentication credentials** from internet users



Types of DNS Attacks

DNS Poisoning

Involves **diverting users to a spoofed website** by poisoning the DNS server or the DNS cache on the user's system

Cybersquatting

Involves conducting **phishing scams by registering a domain name** that is similar to a cloud service provider

Domain Hijacking

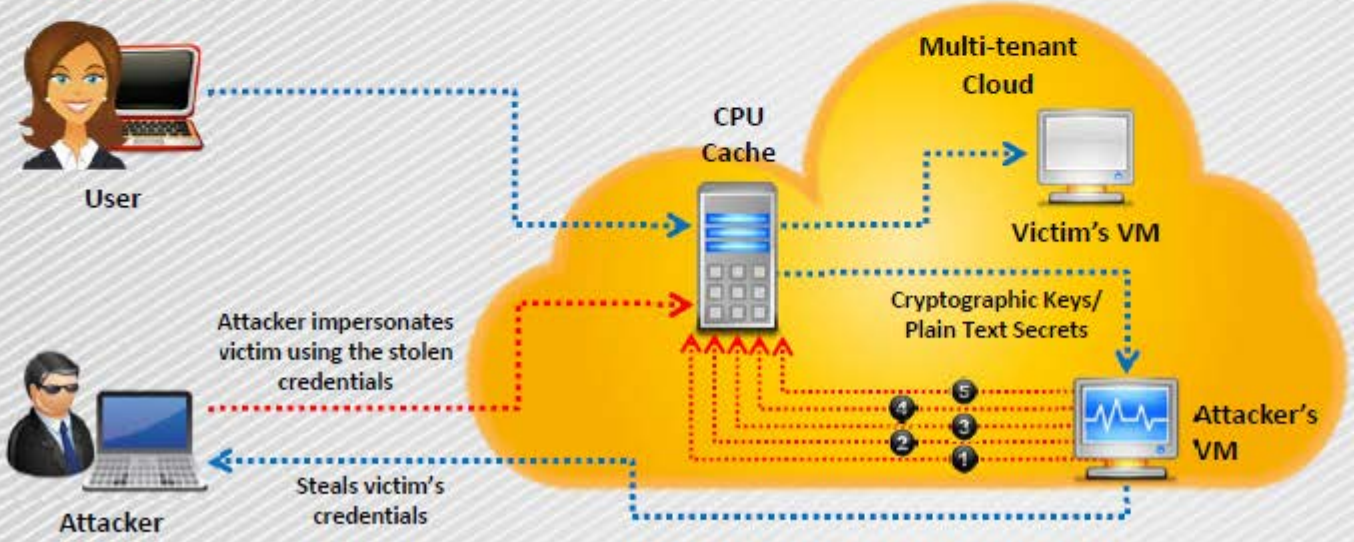
Involves **stealing** a cloud service provider's domain name

Domain Snipping

Involves **registering** an elapsed domain name

Side Channel Attacks or Cross-guest VM Breaches

- Attacker compromises the cloud by placing a **malicious virtual machine** in close proximity to a target cloud server and then launch side channel attack
- In side channel attack, attacker **runs a virtual machine on the same physical host of the victim's virtual machine** and takes advantage of shared physical resources (processor cache) to **steal data** (cryptographic key) from the victim
- Side-channel attacks can be implemented by any **co-resident user** and are mainly due to the vulnerabilities in shared technology resources



Side Channel Attack Countermeasures

1. Implement **virtual firewall in the cloud server back end of the cloud computing**, this prevents attacker from placing malicious VM
2. Implement random **encryption** and **decryption** (encrypts data using DES, 3DES, AES algorithms)
3. **Lock down OS images and application instances** in order to prevent compromising vectors that might provide access
4. Check for repeated access **attempts to local memory and access from the system to any hypervisor processes** or shared hardware cache by tuning and collecting local process monitoring data and logs for cloud systems
5. **Code the applications and OS components** in way that they access shared resources like memory cache in a consistent, predictable way. This prevents attackers from collecting sensitive information such as **timing statistics** and other behavioral attributes

SQL Injection Attacks

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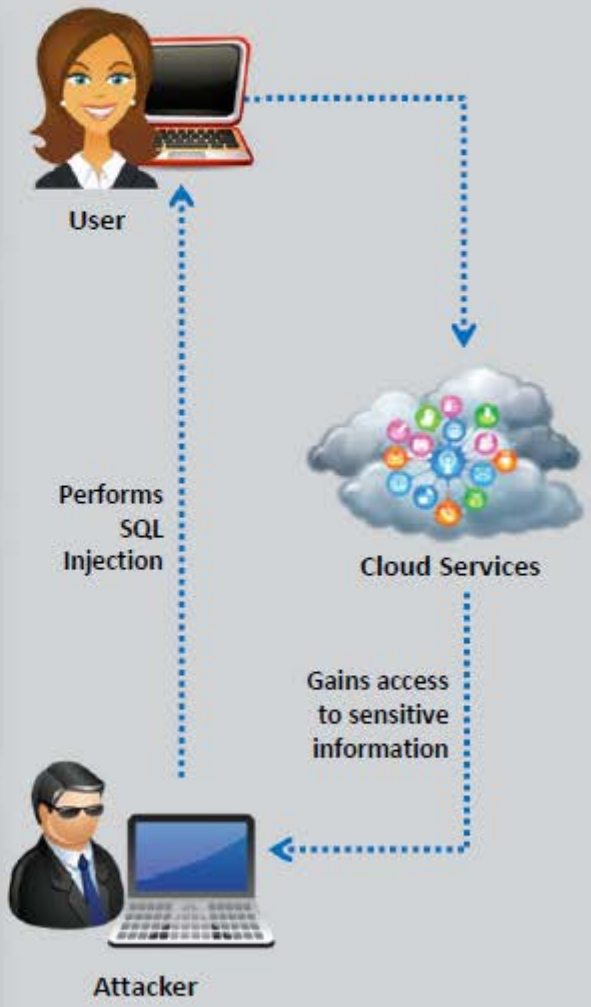
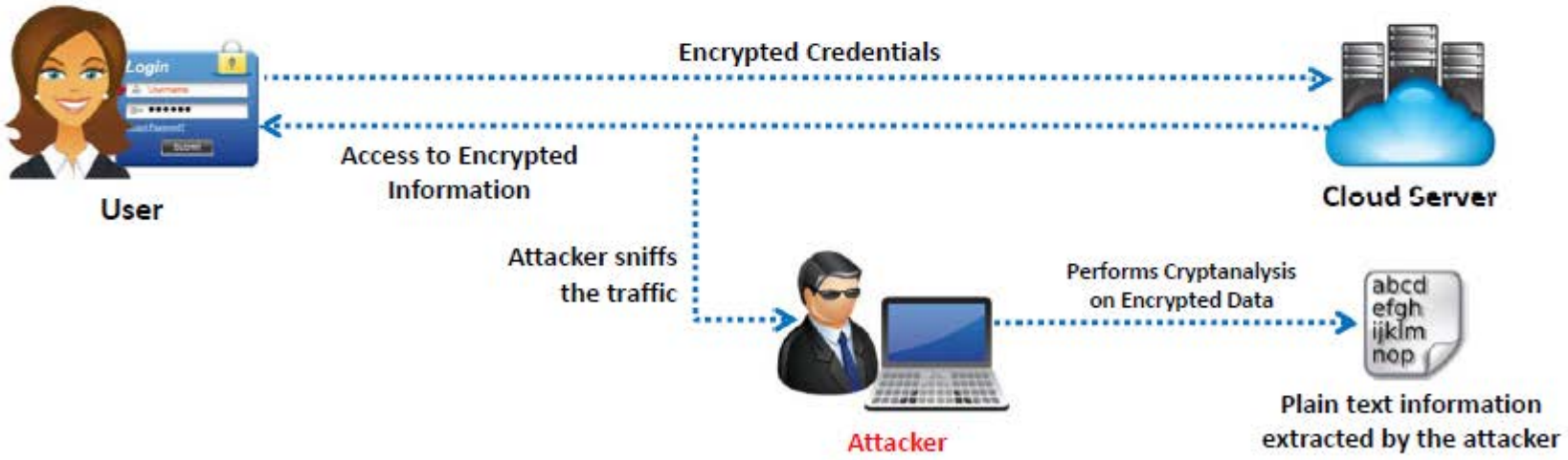
- Attackers target SQL servers running **vulnerable database applications**
- It occurs generally when application uses input to **construct dynamic SQL statements**
- In this attack, attackers **insert a malicious code** (generated using special characters) into a **standard SQL code** to gain unauthorized access to a database
- Further attackers can **manipulate the database contents**, **retrieve sensitive data**, remotely execute system commands, or even **take control of the web server** for further criminal activities



Cryptanalysis Attacks

- **Insecure** or **obsolete encryption** makes cloud services susceptible to cryptanalysis
- Data present in the cloud may be encrypted to prevent it from being read if accessed by malicious users. However **critical flaws in cryptographic algorithm** implementations (ex: weak random number generation) might turn strong encryption to weak or broken, also there exists novel methods to break the cryptography
- Partial information can also be obtained from encrypted data by monitoring **clients' query access patterns** and **analyzing accessed positions**



Cryptanalysis Attack Countermeasures

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1

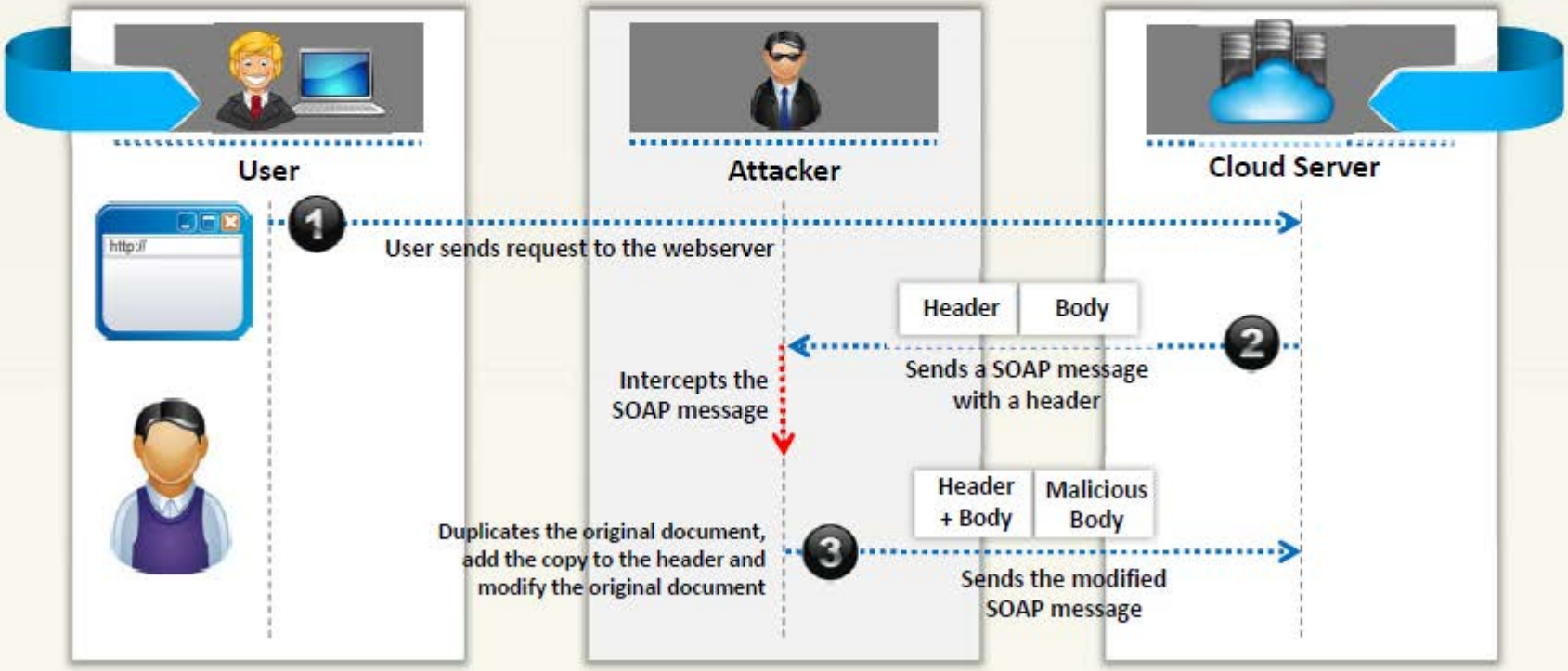
Use **Random Number Generators** that generate cryptographically strong random numbers to provide robustness to cryptographic material like Secure shell (**SSH**) keys and Domain Name System Security extensions (**DNSSEC**)

2

Do not use faulty **cryptographic algorithms**

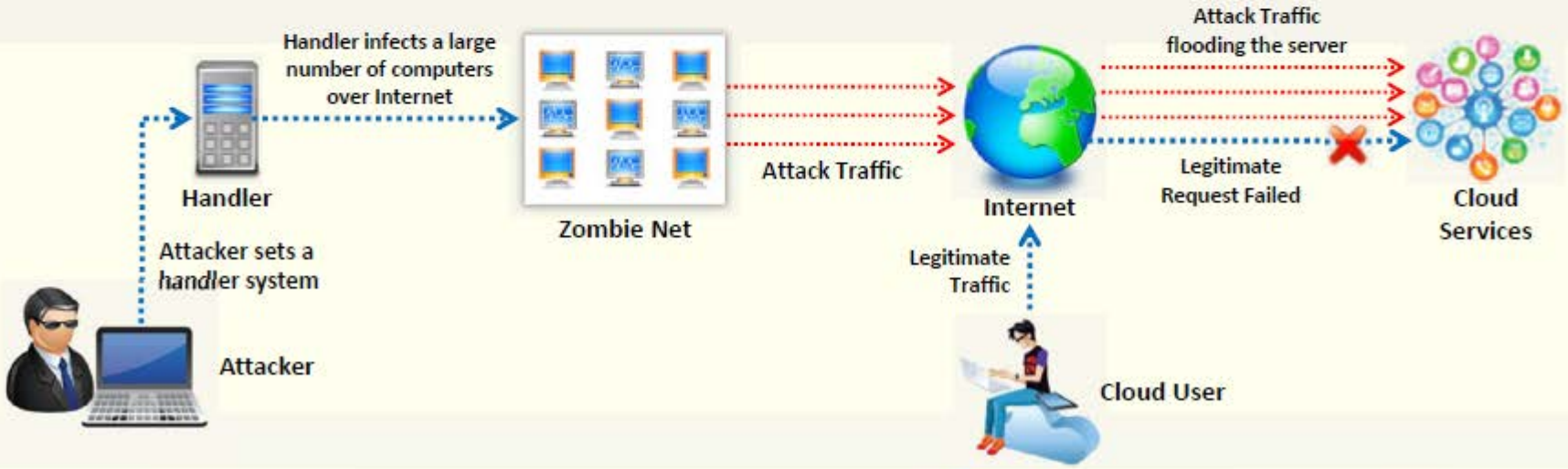
Wrapping Attack

Wrapping attack is performed during the **translation of SOAP message** in the TLS layer where **attackers duplicate the body of the message** and send it to the server as a legitimate user



Denial-of-Service (DoS) and Distributed Denial-of-Service (DDoS) Attacks

- Performing DoS attack on cloud service providers may **leave tenants without access** to their accounts
- Denial of Service (DoS) can be performed by:
  - **Flooding the server** with multiple requests to consume all the system resources available
  - **Passing malicious input** to the server that crashes an application process
  - **Entering wrong passwords** continuously so that user account is locked
- If a DoS attack is performed by using a **botnet** (a network of compromised machines) then it is referred to as Distributed Denial-of-Service (DDoS) attack



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Cloud Security Control Layers

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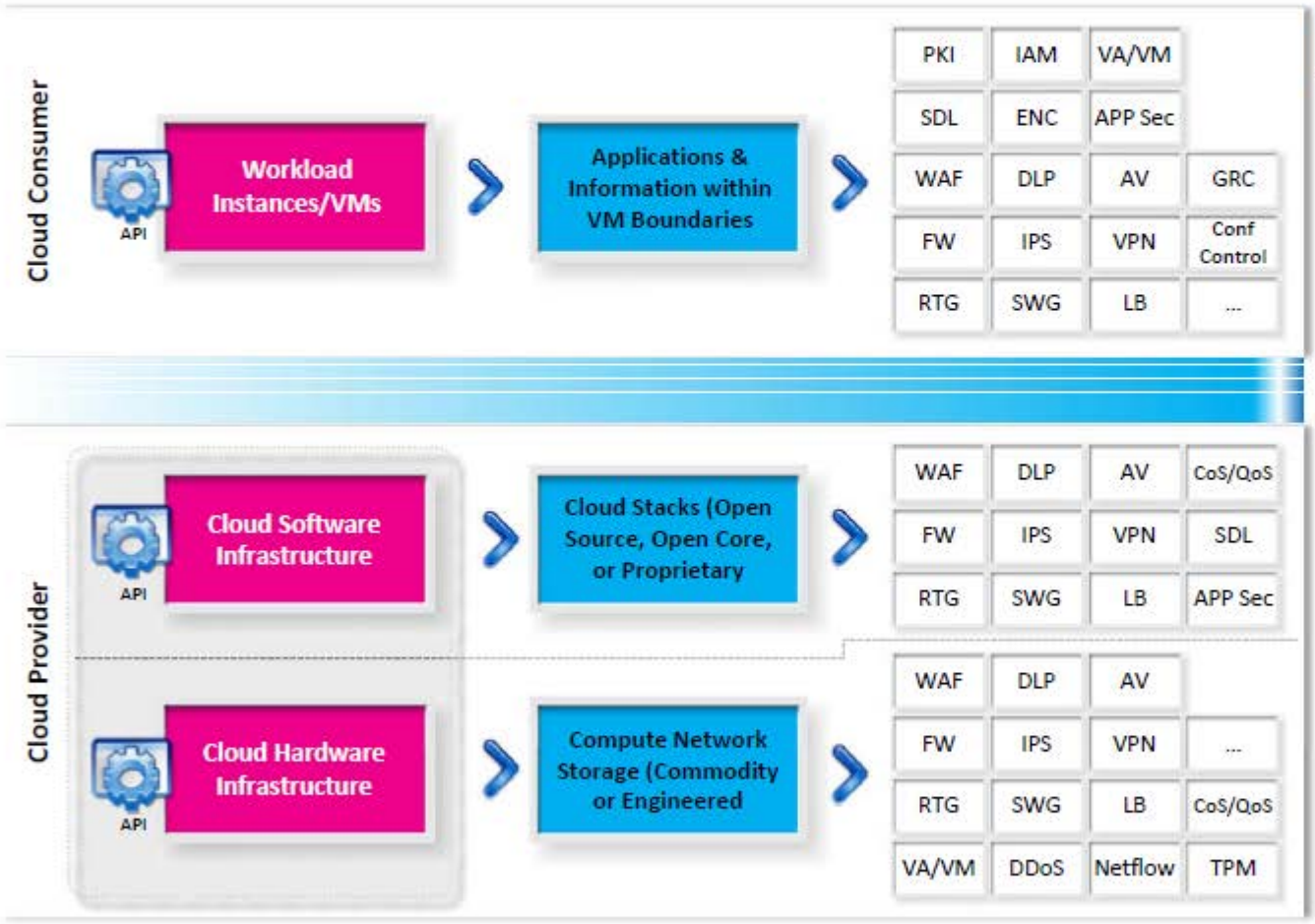
01	**Applications**	SDLC. Binary Analysis, Scanners, Web App Firewalls, Transactional Sec
02	**Information**	DLP, CMF, Database Activity, Monitoring, Encryption
03	**Management**	GRC, IAM, VA/VM, Patch Management, Configuration Management, Monitoring
04	**Network**	NIDS/NIPS, Firewalls, DPI, Anti-DDoS, QoS, DNSSEC, OAuth
05	**Trusted Computing**	Hardware & software RoT & API's
06	**Computer and Storage**	Host-based Firewalls, HIDS/HIPS, Integrity & File/Log Management, Encryption, Masking
07	**Physical**	Physical Plant Security, CCTV, Guards

Cloud Security is the Responsibility of both Cloud Provider and Consumer



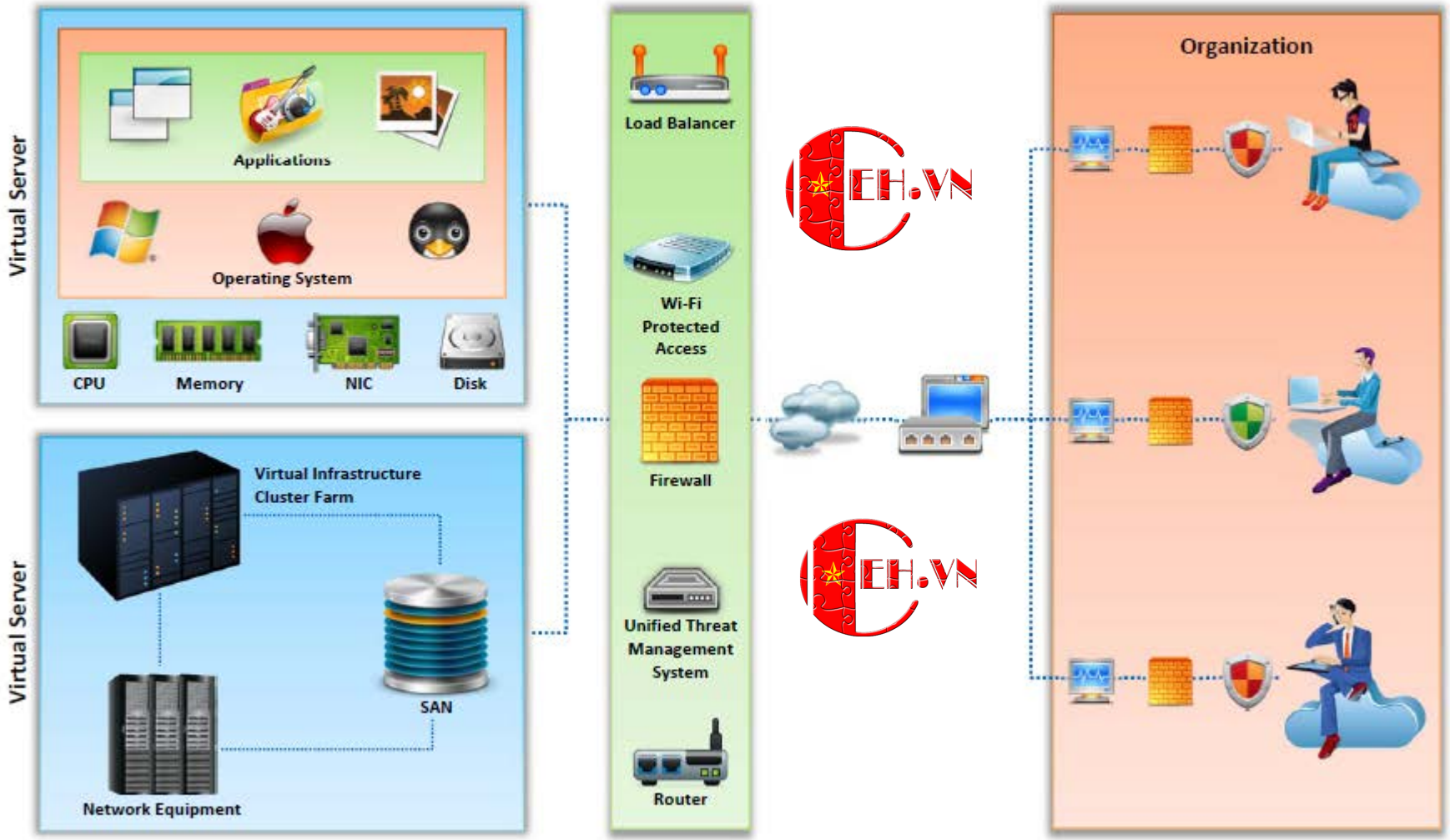
Security Controls

- PKI: Public Key Infrastructure
- SDL: Security Development Lifecycle
- WAF: Web Application Firewall
- FW: Firewall
- RTG: Real Traffic Grabber
- IAM: Identity and Access Management
- ENC: Encryption
- DLP: Data loss prevention
- IPS: Intrusion Prevention System
- SWG: Secure Web Gateway
- VA/VM: Virtual Application/Virtual Machine
- App Sec: Application security
- AV: Anti-virus
- VPN: Virtual Private Network
- LB: Load Balancer
- GRC: Governance, Risk, and Compliance
- Config Control: Configuration Control
- CoS/QoS: Class of Service/ Quality of Service
- DDoS: Distributed denial of service
- TPM: Trusted Platform Module
- Netflow: Network protocol by Cisco

Cloud Computing Security Considerations

- Cloud **computing services should be tailor made** by the vendor as per the given security requirements of the clients
- Cloud service providers should provide higher **multi tenancy** which enables optimum utilization of the cloud resources and to secure data and applications
- Cloud services should implement **disaster recovery plan** for the stored data which enables information retrieval in unexpected situations
- Continuous monitoring on the **Quality of Service** (QoS) is required to maintain the **service level agreements** between consumers and the service providers
- Data stored in the cloud services should be implemented securely to ensure **data integrity**
- Cloud computing service should be **fast**, **reliable**, and need to provide **quick response** times to the new requests
- Symmetric and **asymmetric cryptographic algorithms** must be implemented for optimum data security in cloud computing
- Operational process of the cloud based services should be **engineered**, **operated**, and **integrated** securely to the organizational security management
- **Load balancing** should be incorporated in the cloud services to facilitate networks and resources to improve the response time of the job with maximum throughput

Placement of Security Controls in the Cloud



Best Practices for Securing Cloud

- Enforce **data protection**, **backup**, and **retention** mechanisms
- Implement strong **authentication**, **authorization** and **auditing** mechanisms
- Enforce **SLAs** for patching and vulnerability remediation
- Check for **data protection** at both design and runtime
- Vendors should regularly undergo **AICPA SAS 70 Type II audits**
- Implement **strong key generation**, storage and management, and destruction practices
- Verify one's own cloud in **public domain blacklists**
- Monitor the **client's traffic** for any malicious activities
- Enforce **legal contracts** in employee behavior policy
- Prevent unauthorized server access using **security checkpoints**
- Prohibit **user credentials sharing** among users, applications, and services
- Disclose applicable **logs** and **data** to customers

Best Practices for Securing Cloud (Cont'd)

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- Analyze **cloud provider security policies** and SLAs
- Assess security of **cloud APIs** and also log customer **network traffic**
- Ensure that cloud undergoes regular **security checks and updates**
- Ensure that physical security is a **24 x 7 x 365** affair
- Enforce **security standards** in installation/ configuration
- Ensure that the memory, storage, and network access is **isolated**
- Leverage strong **two-factor authentication** techniques where possible
- Baseline **security breach notification** process
- Analyze **API dependency chain software** modules
- Enforce stringent **registration and validation process**
- Perform vulnerability and configuration **risk assessment**
- Disclose infrastructure information, **security patching**, and firewall details

Best Practices for Securing Cloud (Cont'd)

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1. Enforce stringent **cloud security compliance**, SCM (Software Configuration Management), and management practice transparency
2. Employ security devices such as IDS, IPS, firewall, etc. to guard and stop **unauthorized access** to the data stored in the cloud
3. Enforce strict **supply chain** management and conduct a comprehensive supplier assessment
4. Enforce stringent **security policies and procedures** like access control policy, information security management policy and contract policy
5. Ensure **infrastructure security** through proper management and monitoring , availability, secure VM separation and service assurance
6. Use **VPNs** to secure the clients data and ensure that data is **completely deleted** from the main servers along with its replicas when requested for data disposal
7. Ensure **Secure Sockets Layer** (SSL) is used for sensitive and confidential data transmission
8. Analyze the **security model** of cloud provider interfaces
9. Understand terms and conditions in **SLA** like **minimum level of uptime** and **penalties** in case of failure to adhere to the agreed level
10. Enforce basic information security practices namely strong **password policy**, **physical security**, device security, **encryption**, data security, network security, etc.

NIST Recommendations for Cloud Security

Assess risk posed to client's data, software and infrastructure

Select appropriate deployment model according to needs

Ensure audit procedures are in place for data protection and software isolation

Renew SLAs in case security gaps found between organization's security requirements and cloud provider's standards

Establish appropriate incident detection and reporting mechanisms

Analyze what are the security objectives of organization

Enquire about who is responsible of data privacy and security issues in cloud

Organization/Provider Cloud Security Compliance Checklist

Management	Organization	Provider
Is everyone aware of his or her cloud security responsibilities?		
Is there a mechanism for assessing the security of a cloud service?		
Does the business governance mitigate the security risks that can result from cloud-based "shadow IT"?		
Does the organization know within which jurisdictions its data can reside?		
Is there a mechanism for managing cloud-related risks?		
Does the organization understand the data architecture needed to operate with appropriate security at all levels?		
Can the organization be confident of end-to-end service continuity across several cloud service providers?		
Does the provider comply with all relevant industry standards (e.g. the UK's Data Protection Act)?		
Does the compliance function understand the specific regulatory issues pertaining to the organization's adoption of cloud services?		

Module Flow

1. Introduction to Cloud Computing
2. Cloud Computing Threats
3. Cloud Computing Attacks
4. Cloud Security
5. Cloud Security Tools
6. Cloud Penetration Testing

Core CloudInspect

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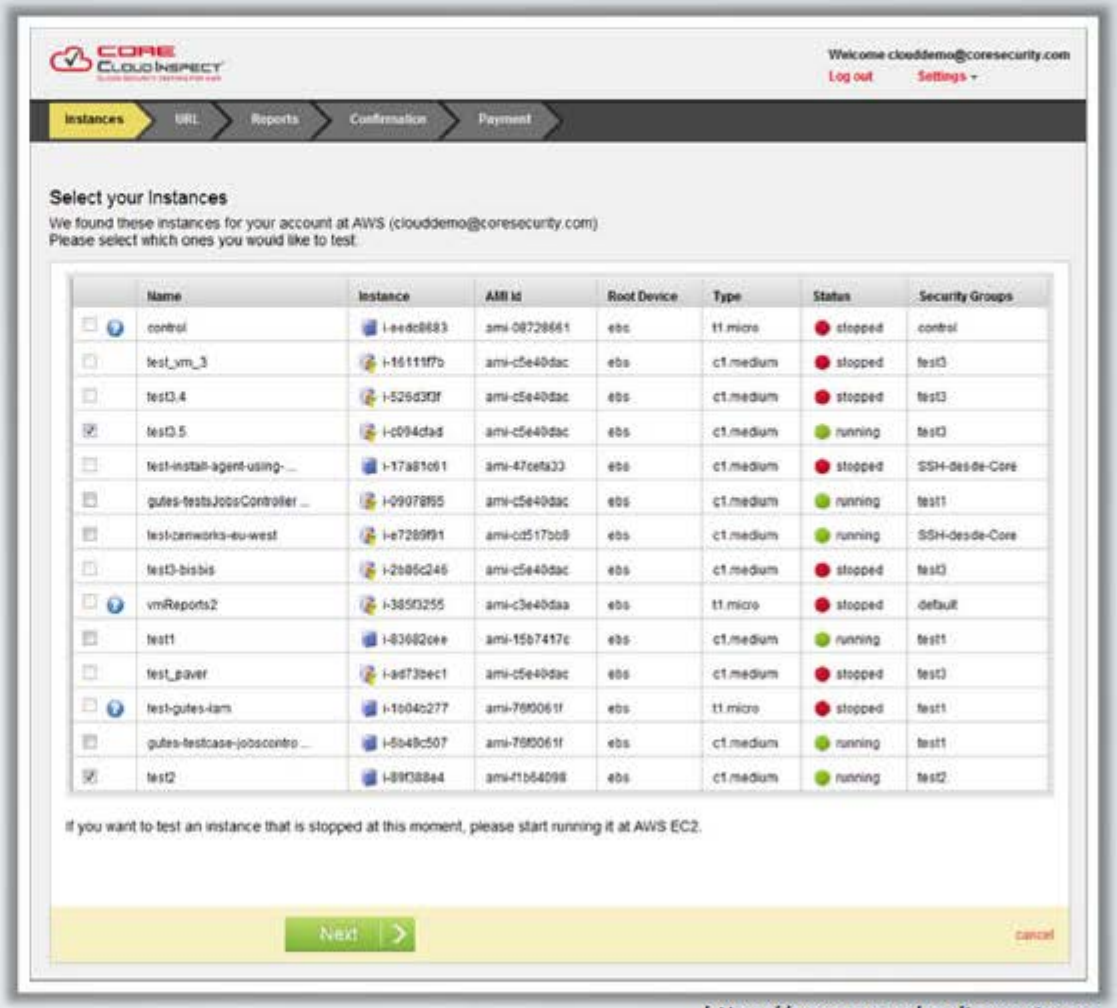
1 Proactively **verify the security of your AWS deployments** against real, current attack techniques

2 Safely **pinpoint and validate critical OS** and services vulnerabilities with no false positives

3 **Measure your susceptibility** to SQL injection, cross-site scripting, and other web application attacks

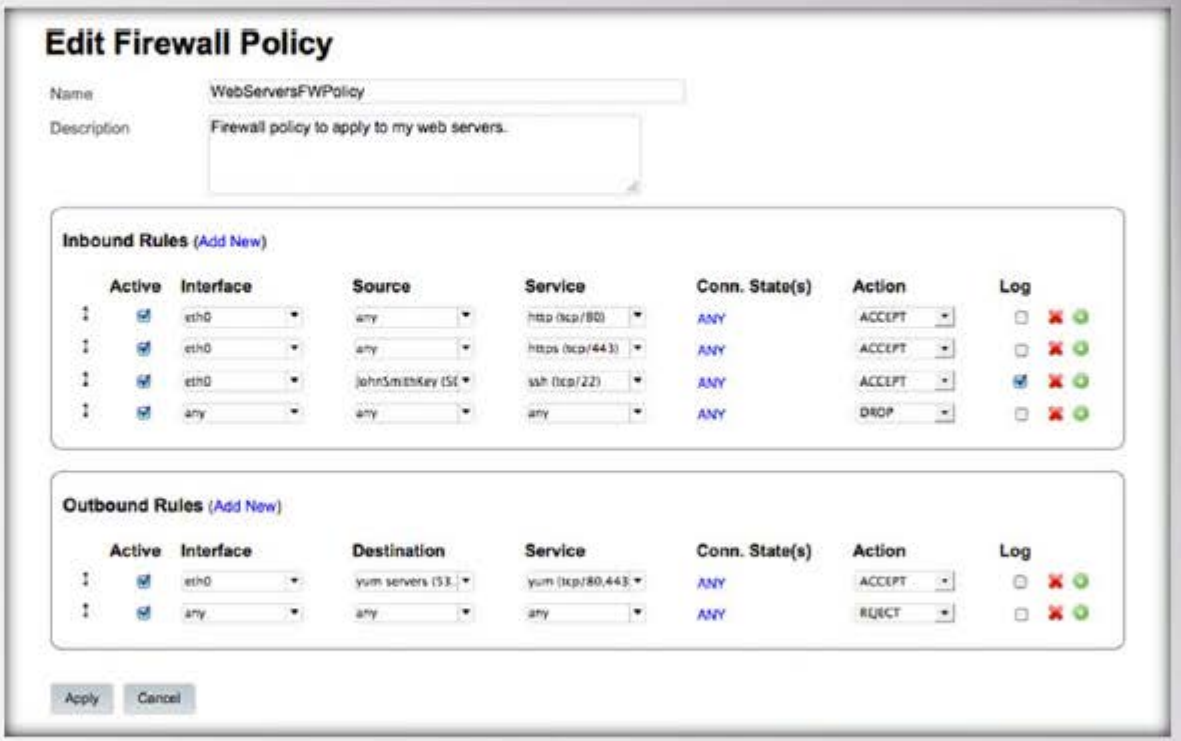
4 **Get actionable information** necessary to remediate security exposures



https://www.corecloudinspect.com

CloudPassage Halo

CloudPassage Halo is the **cloud server security platform** with all the security functions you need to safely deploy servers in public and hybrid clouds



http://www.cloudpassage.com

Cloud Security Tools

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Alert Logic
https://www.alertlogic.com

SecludIT
http://secludit.com

Dell Cloud Manager
http://www.enstratius.com

Nessus Enterprise for AWS
http://www.tenable.com

Qualys Cloud Suite
https://www.qualys.com

Trend Micro's Instant-On Cloud Security
http://www.trendmicro.com

Symantec O3
http://www.symantec.com

Cloud Application Visibility
http://www.zscaler.com

Porticor
http://www.porticor.com

Panda Cloud Office Protection
http://www.cloudantivirus.com

Module Flow

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What is Cloud Pen Testing?

Cloud pen testing is a method of actively evaluating the security of a cloud system by **simulating an attack from a malicious source**

Security posture of cloud should be monitored regularly to determine the presence of **vulnerabilities** and the **risks** they pose

Cloud security is based on the shared responsibility of both **cloud provider** and the **client**

Type of cloud as well as the type of cloud provider determines if pen testing is allowed or not

- If it is **SaaS**, pen testing is **not allowed** by providers as it might impact their infrastructure
- If it is **PaaS** or **IaaS**, pen testing is **allowed** but coordination is required

The contract and SLA made with cloud provider states if pen testing is allowed, if so **what kinds of tests** are allowed and **how frequently** can it be done

Key Considerations for Pen Testing in the Cloud

- Determine the **type of cloud**; PaaS, IaaS or SaaS
- Obtain **written consents** for performing pen testing
- Ensure every aspect of the Infrastructure (IaaS), Platform (PaaS), or Software (SaaS) are included in the **scope of testing** and **generated reports**
- Determine **what kind of testing** is permitted by Cloud Service Provider (CSP) and **how often**
- Prepare **legal** and **contractual** documents
- Perform both **internal** and **external pen testing**
- Perform pen tests on the **web apps/services** in the cloud without web application firewall (WAF) or reverse proxy
- Perform **vulnerability scans on host** available in the cloud
- Determine how to coordinate with the CSP for **scheduling** and **performing the test**

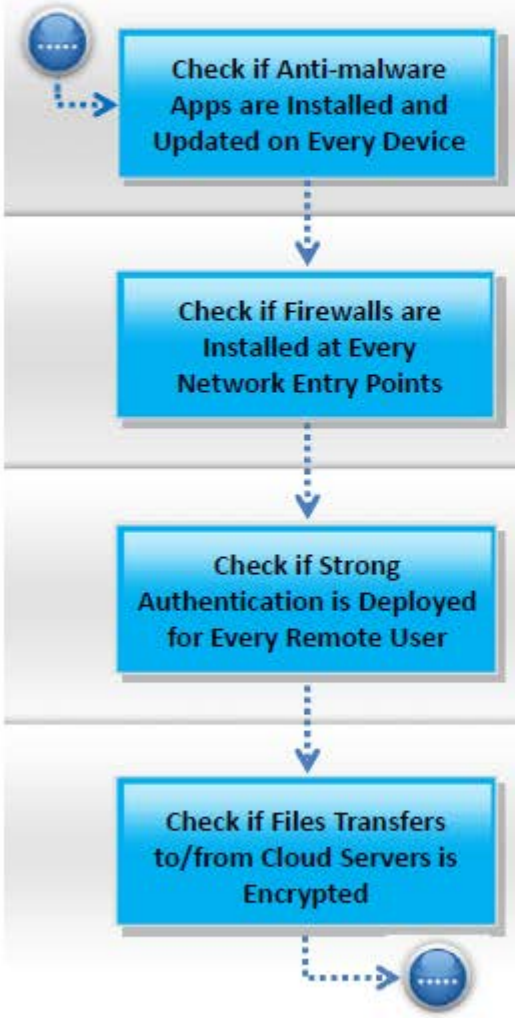
Scope of Cloud Pen Testing

1. Pen testing **web applications** includes mobile applications
2. Pen testing network or host includes **systems**, **firewalls**, **IDS**, **databases**, etc., available in cloud
3. Pen testing **web services** includes mobile back-end services

Cloud Penetration Testing

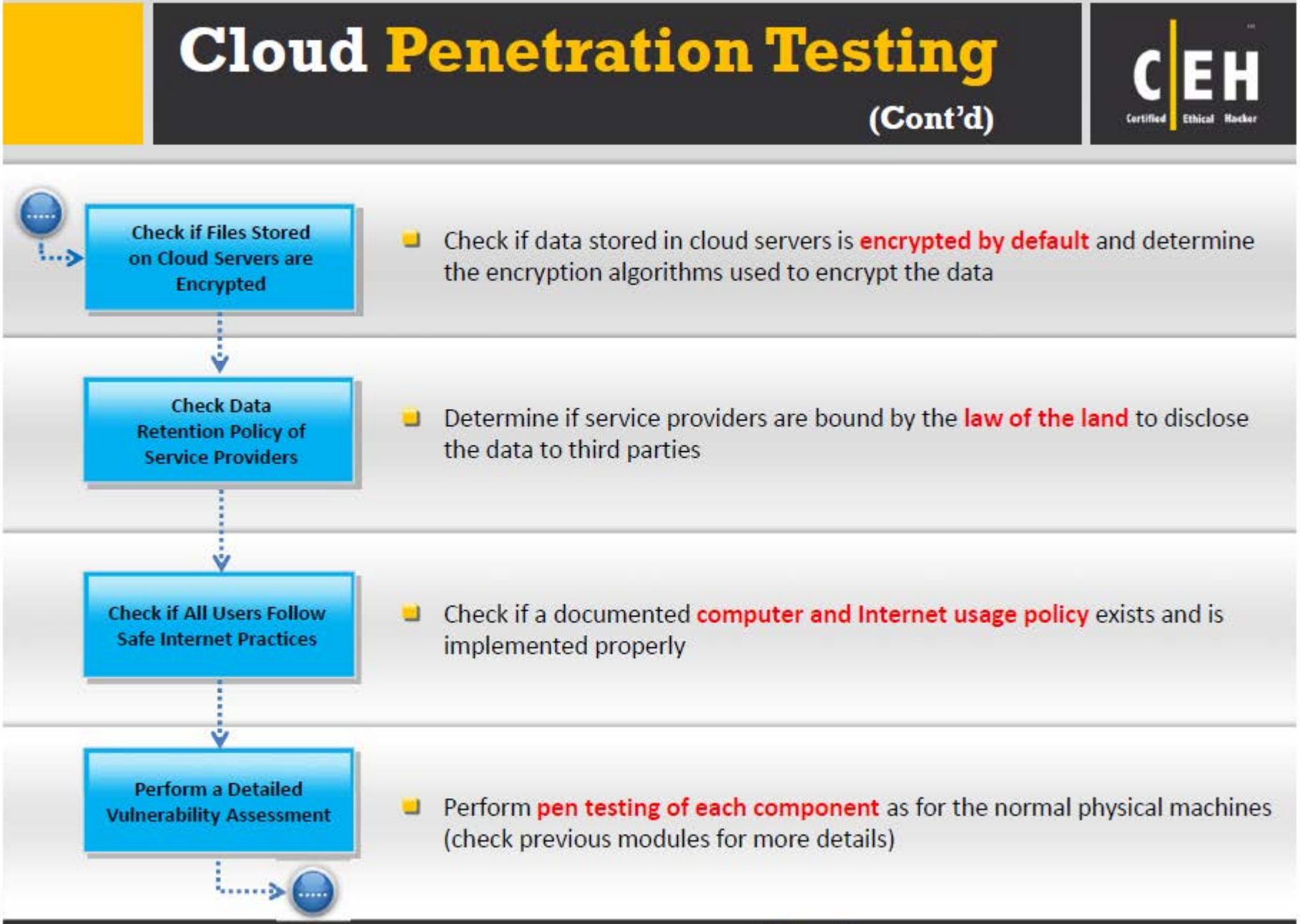
- Check the **service level agreement** (SLA) between subscriber and cloud service, and determine the provisions to switch over to other CSPs
- Check **Service Level Agreement** (SLA) document and track record of **CSP** to determine Roles and responsibilities of the CSP and subscribers in managing the cloud resources
- Check the responsibilities of the **CSP** and **subscribers** in maintaining compliance, and check if the SLA provides transparency on this issue
- Check if **activity** of one subscriber affect the other

Cloud Penetration Testing (Cont'd)



- Check if each component of the cloud infrastructure, i.e. **data center**, **access points**, **devices**, and **suppliers** is protected using appropriate security controls
- Unused **ports**, **protocols**, and services should be blocked
- **Two-factor authentication** should be used to validate those using OTP (One Time Password) for accessing the network to ensure security
- Check the cloud services for **SSL encryption** in the access URL, **security certificates** from reputed **vendors**, and security **pad locks**

Cloud Penetration Testing (Cont'd)



Cloud Penetration Testing (Cont'd)

- Check if the cloud service provider offers features for **cloning** of **virtual machines** when required
- Cloning of virtual machines helps minimize the **down time** as affected machines and **evidence** can be **analyzed offline**, facilitating investigation of a suspected security breach
- Automated cloud security testing solutions can **proactively** verify the security of **cloud deployments** against real, current attack techniques

TOOLS

1. **Core CloudInspect** (*https://www.corecloudinspect.com*)
2. **Dell Cloud Manager** (http://www.enstratus.com)
3. **Parasoft SOAtest** (http://www.parasoft.com)

Recommendations for Cloud Testing

- Find out whether the cloud provider will **accommodate** your own **security policies** or not
- **Pay attention** to the service provider's **agreement** so that the **coding policies** can be secured
- Compare the provider's **security precautions** to the present levels of security to ensure the **provider** is achieving better security levels for the user
- **Authenticate** users with a user name and password
- Ensure that the cloud computing partners suggest **risk assessment** techniques and information on how to reduce the **uncovered security** risks
- Ensure that all **credentials** such as accounts and **passwords** assigned to the **cloud provider** should be changed regularly by the organization
- Make sure that a cloud **service provider** is capable of providing their policies and procedures for any **security agreement** that an agency faces
- **Strong password** policies must be advised and employed by the **cloud pen testing** agencies

Recommendations for Cloud Testing (Cont'd)

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1. Ensure that the existing business IT **security protocols** are up-to-date and flexible enough to handle the risks involved in cloud computing
2. Make sure that you can offer IT support and use more **stringent layers** of security to prevent potential data breaches
3. Make sure that the access to **virtual environment** management interfaces is highly restricted
4. **Password encryption** is advisable
5. Protect the **information** which is uncovered during the penetration testing
6. Pay special attention to cloud **hypervisors**, the **servers** that run multiple operating systems
7. Use a **centralized authentication** or single sign on for the firms that use SaaS applications
8. Make sure that the workers are provided with the best training possible to comply with these **security parameters**

Module Summary

- Cloud computing is an on-demand delivery of IT capabilities where IT infrastructure and applications are provided to subscribers as a metered service over a network
- Cloud services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS)
- Virtualization is the ability to run multiple operating systems on a single physical system and share the underlying resources such as a server, a storage device or a network
- Attackers create anonymous access to cloud services and perpetrate various attacks such as Password and key cracking, Building rainbow tables, CAPTCHA-solving farms, Launching dynamic attack points, etc.
- Wrapping attack is performed during the translation of SOAP message in the TLS layer where attackers duplicate the body of the message and send it to the server as a legitimate user
- Cloud service providers should provide higher multi tenancy which enables optimum utilization of the cloud resources and to secure data and applications
- Cloud pen testing is a method of actively evaluating the security of a cloud system by simulating an attack from a malicious source