- Cloud Computing Background
- Cloud Models
- Why do you still hesitate to use cloud computing?
- Causes of Problems Associated with Cloud Computing

Cloud Computing Vs On-prem

Definitions

Cloud Computing

- A computing model where IT resources (servers, storage, networking, applications) are delivered over the internet by a third-party provider on a pay-as-you-go basis.

On-Premises

- A traditional computing model where all IT infrastructure is physically located, owned, and managed within the organization's facilities.

Cloud Computing Vs On-prem

Cloud Computing

Pros

- Low upfront cost (pay-as-you-go)
- High scalability and elasticity
- Fast deployment and time to market
- Built-in availability and disaster recovery
- Reduced operational overhead

Cons

- Less control over infrastructure
- Dependency on internet connectivity
- Ongoing operational costs
- Shared responsibility for security
- Potential data residency concerns

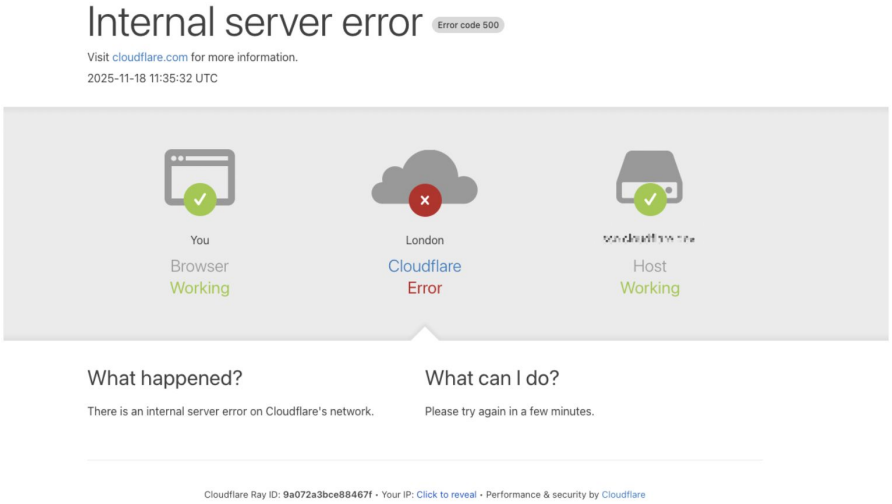
On-Premises

Pros

- Full control over systems and data
- High customization and flexibility
- Easier to enforce strict compliance
- No dependency on internet access
- Predictable long-term costs

Cons

- High upfront capital investment
- Limited scalability
- Longer deployment times
- Requires in-house maintenance and expertise
- Disaster recovery is costly and complex



The issue was not caused, directly or indirectly, by a cyber attack or malicious activity of any kind. Instead, it was triggered by a change to one of our database systems' permissions which caused the database to output multiple entries into a "feature file" used by our Bot Management system. That feature file, in turn, doubled in size. The larger-than-expected feature file was then propagated to all the machines that make up our network.

https://blog.cloudflare.com/18-november-2025-outage/

Amazon reveals cause of AWS outage that took everything from banks to smart beds offline

AWS explains in a lengthy post how a bug in automation software brought down thousands of sites and applications

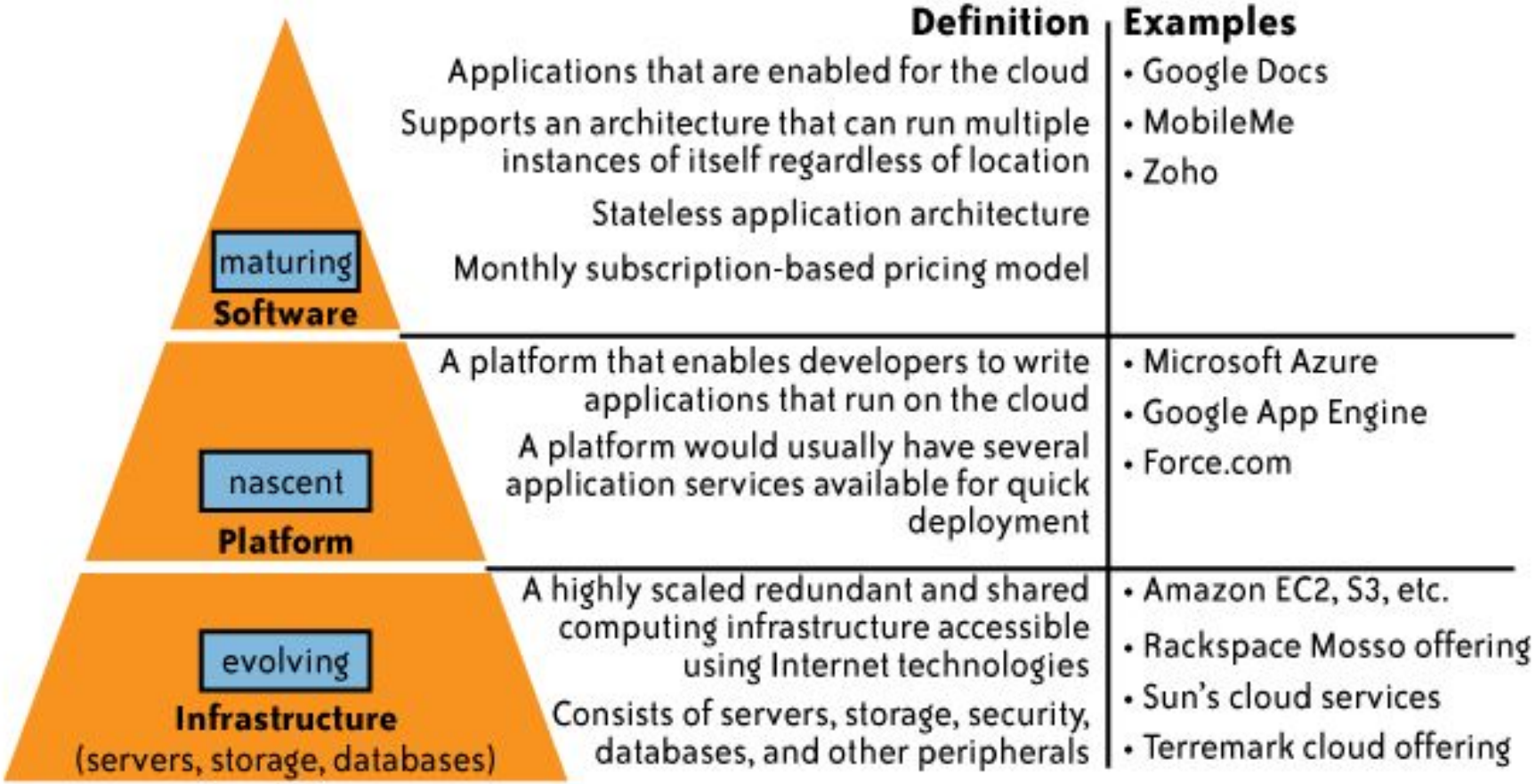
Record-breaking DDoS attack agair Microsoft Azure mitigated

The attack was linked to the Aisuru botnet, which targets compromised home and cameras.

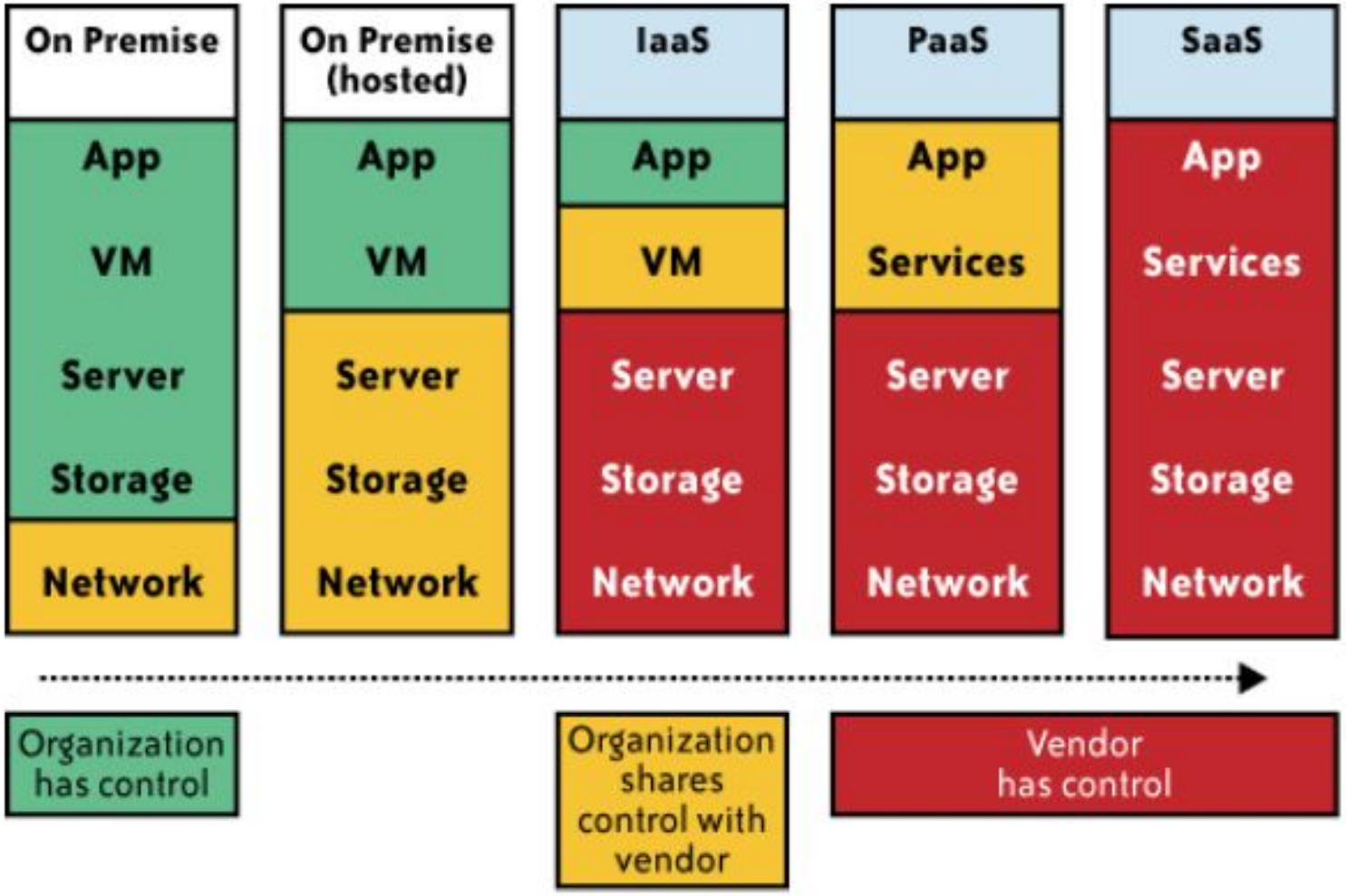
Cloud Models

- Delivery Models
  - SaaS
  - PaaS
  - IaaS
- Deployment Models
  - Private cloud
  - Community cloud
  - Public cloud
  - Hybrid cloud

Delivery Models



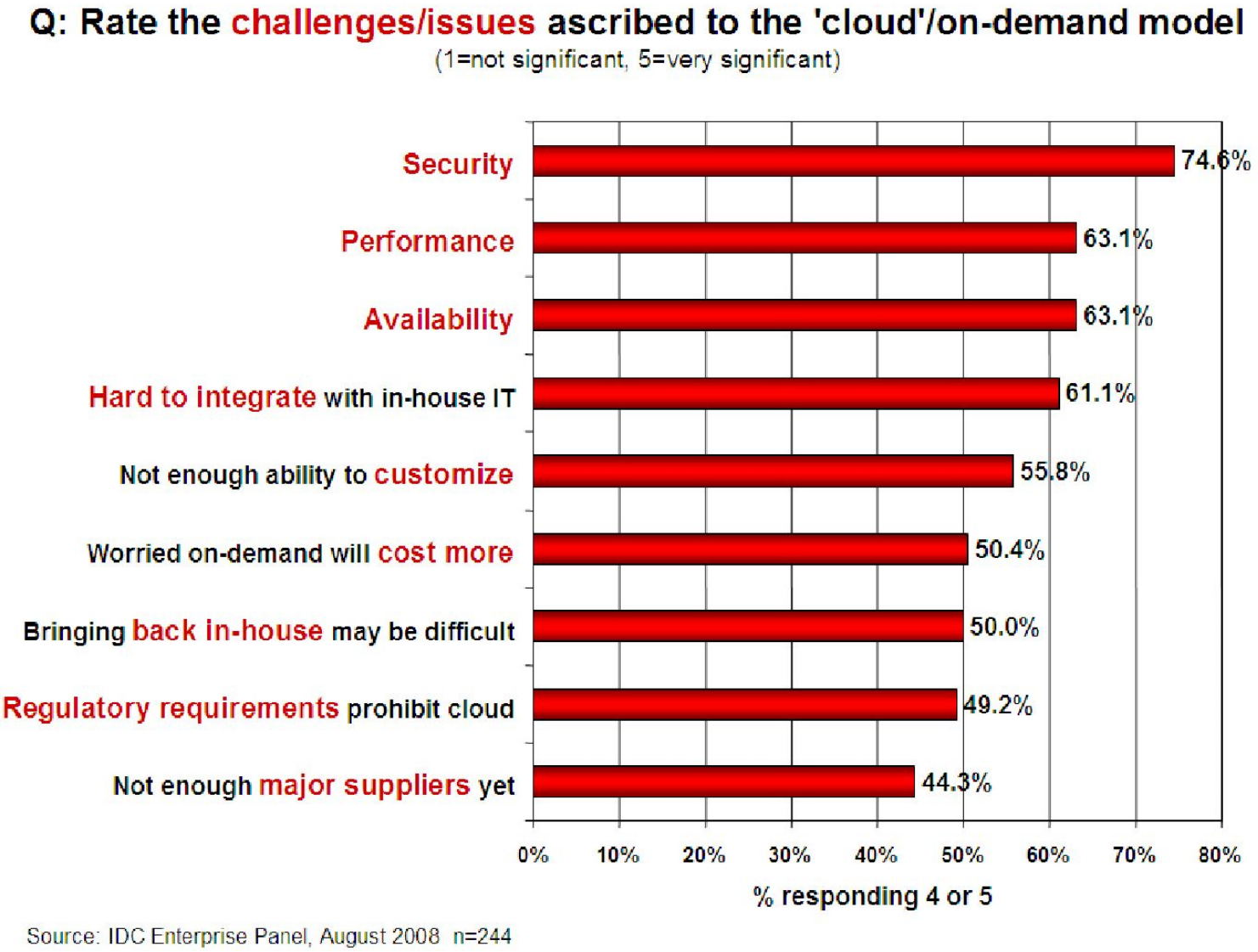
Impact of cloud computing on the governance structure of IT organizations



If cloud computing is so great, why isn't everyone doing it?

- The cloud acts as a big black box, nothing inside the cloud is visible to the clients
- Clients have no idea or control over what happens inside a cloud
- Even if the cloud provider is honest, it can have malicious system admins who can tamper with the VMs and violate confidentiality and integrity
- Clouds are still subject to traditional data confidentiality, integrity, availability, and privacy issues, plus some additional attacks

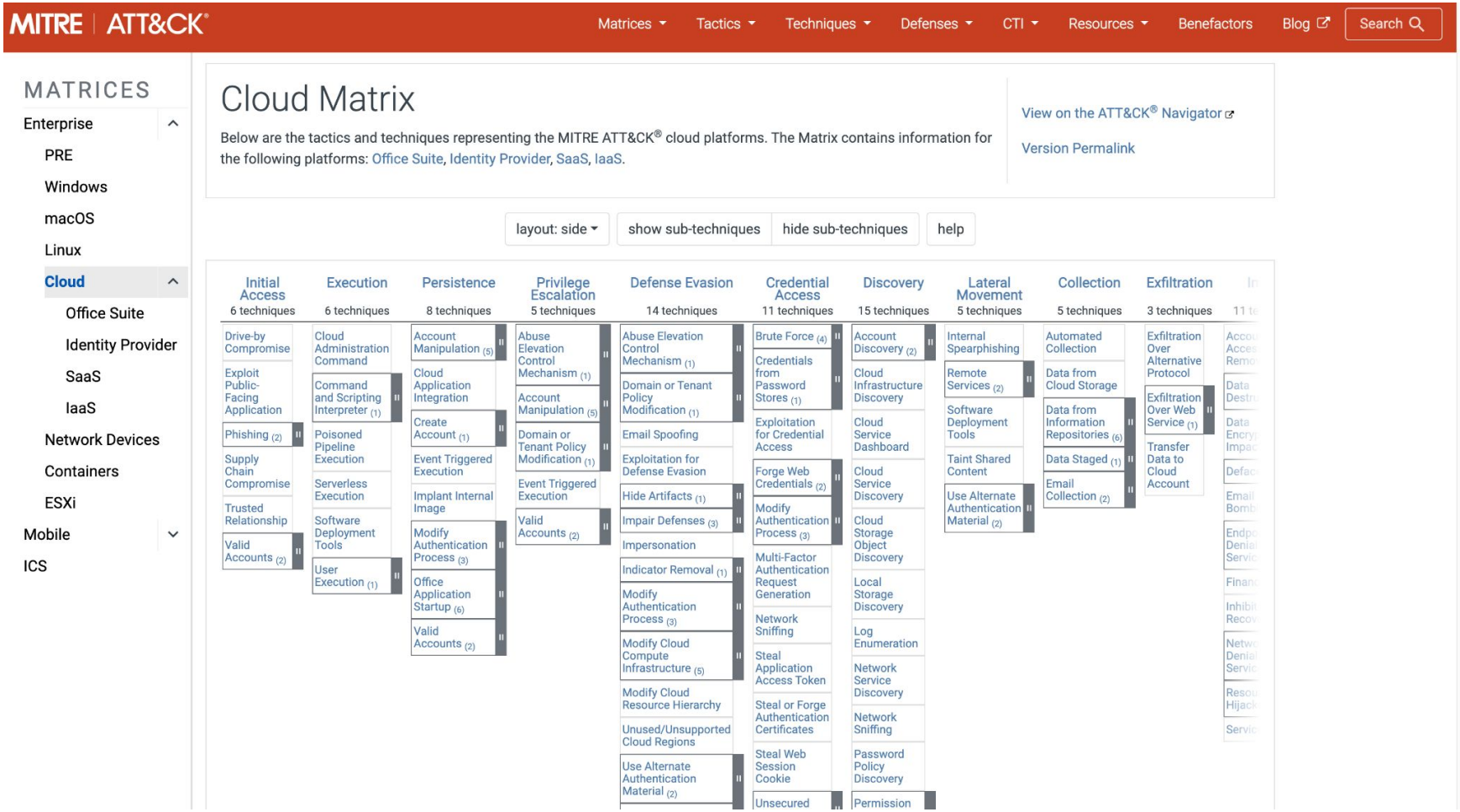
Companies are still afraid to use clouds



Source: IDC Enterprise Panel, August 2008 n=244

https://attack.mitre.org/matrices/enterprise/cloud/

mitre cloud



Causes of Problems Associated with Cloud Computing

- Most security problems stem from:
  - Loss of control
  - Lack of trust (mechanisms)
  - Multi-tenancy
- These problems exist mainly in 3rd party management models
  - Self-managed clouds still have security issues, but not related to above

Loss of Control in the Cloud

- Consumer's loss of control
  - Data, applications, resources are located with provider
  - User identity management is handled by the cloud
  - User access control rules, security policies and enforcement are managed by the cloud provider
  - Consumer relies on provider to ensure
    - Data security and privacy
    - Resource availability
    - Monitoring and repairing of services/resources

Lack of Trust in the Cloud

- A brief deviation from the talk
  - (But still related)
  - Trusting a third party requires taking risks
- Defining trust and risk
  - Opposite sides of the same coin (J. Camp)
  - People only trust when it pays (Economist's view)
  - Need for trust arises only in risky situations
- Defunct third party management schemes
  - Hard to balance trust and risk
  - e.g. Key Escrow (Clipper chip)
  - Is the cloud headed toward the same path?

Multi-tenancy Issues in the Cloud

- Conflict between tenants' opposing goals
  - Tenants share a pool of resources and have opposing goals
- How does multi-tenancy deal with conflict of interest?
  - Can tenants get along together and 'play nicely' ?
  - If they can't, can we isolate them?
- How to provide separation between tenants?

- Cloud Computing brings new threats
  - Multiple independent users share the same physical infrastructure
  - Thus an attacker can legitimately be in the same physical machine as the target

Taxonomy of Fear

- Confidentiality
  - Fear of loss of control over data
    - Will the sensitive data stored on a cloud remain confidential?
    - Will cloud compromises leak confidential client data
  - Will the cloud provider itself be honest and won't peek into the data?
- Integrity
  - How do I know that the cloud provider is doing the computations correctly?
  - How do I ensure that the cloud provider really stored my data without tampering with it?

Taxonomy of Fear (cont.)

- Availability
  - Will critical systems go down at the client, if the provider is attacked in a Denial of Service attack?
  - What happens if cloud provider goes out of business?
  - Would cloud scale well-enough?
  - Often-voiced concern
    - Although cloud providers argue their downtime compares well with cloud user's own data centers

Taxonomy of Fear (cont.)

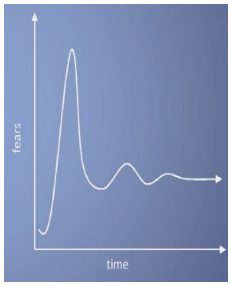
- Privacy issues raised via massive data mining
  - Cloud now stores data from a lot of clients, and can run data mining algorithms to get large amounts of information on clients
- Increased attack surface
  - Entity outside the organization now stores and computes data, and so
  - Attackers can now target the communication link between cloud provider and client
  - Cloud provider employees can be phished

Taxonomy of Fear (cont.)

- Auditability and forensics (out of control of data)
  - Difficult to audit data held outside organization in a cloud
  - Forensics also made difficult since now clients don't maintain data locally
- Legal quagmire and transitive trust issues
  - Who is responsible for complying with regulations?
    - e.g., SOX, HIPAA, GLBA ?
  - If cloud provider subcontracts to third party clouds, will the data still be secure?

Taxonomy of Fear (cont.)

Cloud Computing is **a security nightmare** and it can't be handled in traditional ways.
John Chambers
CISCO CEO



- Security is one of the most difficult task to implement in cloud computing.
  - Different forms of attacks in the application side and in the hardware components
- Attacks with catastrophic effects only needs one security flaw

class exercise

Read https://cloudsecurityalliance.org/blog/2025/05/07/unpacking-the-2024-snowflake-data-breach#

1. What was the attacker's primary goal after gaining access to Snowflake customer accounts?
2. Which MITRE ATT&CK Cloud tactic best describes the use of stolen Snowflake credentials to login successfully?
3. Which MITRE Cloud technique explains how the attacker accessed data without exploiting a software vulnerability?
4. Which cloud-focused ATT&CK tactic covers the large-scale extraction of sensitive data from Snowflake environments?
5. Which MITRE Cloud tactic applies to advertising stolen Snowflake data for sale and extorting victims?
6. What are the mitigation the blog mentions?

class exercise

1. **Attacker's primary goal:** Financial gain via data exfiltration and extortion.

2. **MITRE Cloud tactic for stolen credential login:** Initial Access – **Valid Accounts (T1078.004)**

3. **MITRE Cloud technique for accessing data without exploiting a vulnerability:** Initial Access – **Valid Accounts (T1078.004)**

4. **MITRE Cloud tactic for large-scale data extraction:** Collection – **Data from Cloud Storage (T1530)**

5. **MITRE Cloud tactic for selling/extorting data:** Exfiltration – **Exfiltration Over Web Service (T1567.002)**

6. **Mitigations mentioned in the blog:**

- **Preventive:** MFA, least privilege, conditional access, anti-malware, DLP, secure design

- **Detective:** Security monitoring, baseline deviation detection, audit log monitoring, incident management

- **Corrective:** Breach notification, supply chain assessments, vulnerability/patch management