Selected security and privacy challenges in the Cloud

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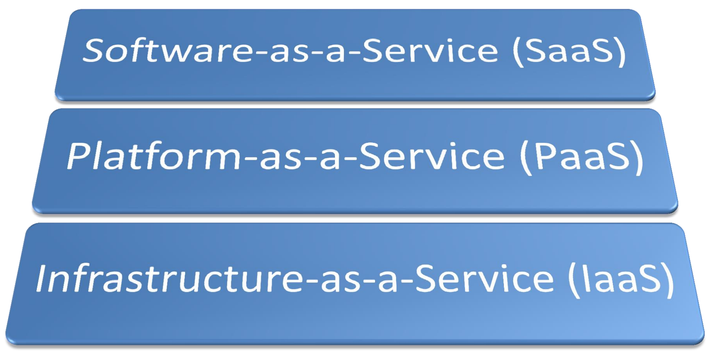

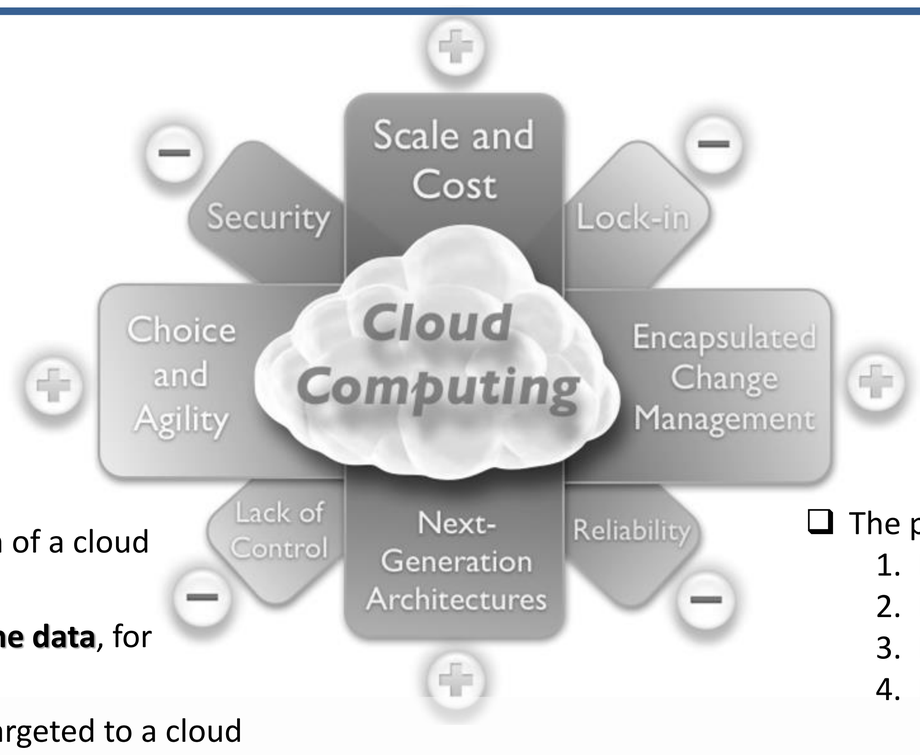

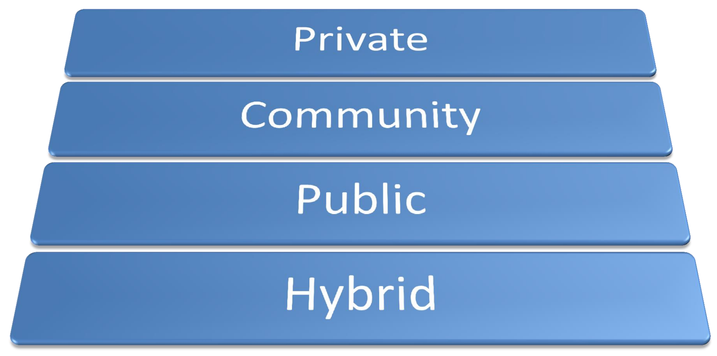

Risk-Assessment-as-a-Service

A risk assessment method can be implemented in the form of a cloud service [1], which includes:

- ❑ Dynamic and continuous collection of accurate **real-time data**, for specific deployments, tenants, and assets.
- ❑ Comprehensive **qualitative and quantitative metrics**, targeted to a cloud environment.
- ❑ A **knowledge base** (e.g. ontologies [2]) that cumulates the knowledge by public available resources and modeling tools to mitigate applicable threat.

Figure 1: *Implementing RAaaS*

Cloud migration

- ❑ The process of the ***cloud migration decision*** includes [3]:
  1. Definition of deployment profile
  2. Definition of a set of controls
  3. Evaluation of benefit and cost metrics
  4. Evaluation of the Return on Security Investment (RoSI)

Cloud security metrics

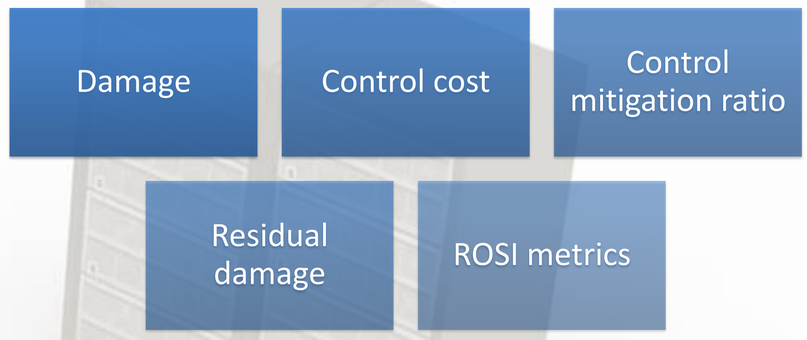

Figure 3: *ROSI assessment*

Security Threat Categorization

The available cloud security threats are categorized by [1] into ***network-related***, ***system or data-oriented***, ***organizational***. Thus, each threat is mapped to vulnerabilities examples and whether it affects the baseline security attributes, i.e. ***Confidentiality (C)***, ***Integrity (I)***, and ***Availability (A)***.

Threat	Vulnerability	C	I	A
T1. Malicious probes or scans	• Open ports • Unavailable or misconfigured IDS	✓		
T2. Cross-VM attack via side channels	• Multi-tenancy	✓	✓	✓
T3. Data leakage T4. Man-in-the-middle	•Communication encryption vulnerabilities • Weak authentication mechanism • Poor patch management	✓	✓	✓

Figure 2: *Network-related Cloud Threats*

Privacy threats and vulnerabilities

According to CSA [4], several ***top security identified threats*** refer to information disclosure, placing privacy as a top priority:

- ❑ Data Breaches/Leakage
- ❑ Account or Service Traffic Hijacking
- ❑ Insecure Interfaces and APIs
- ❑ Shared Technology Vulnerabilities
- ❑ Malicious Insiders
- ❑ Insufficient Due Diligence

Also, [5] was based on both the above mentioned threats and [6] in order to create a detailed and thorough mapping for each threat:

Vulnerability	CCM Code	Client	CSP	Infrastructure	Data	Software	Network
Undocumented data flows	-	×	×		×	×	×
Insecure or ineffective data disposal	DG-05		×		×	×	
Lack of or weak data leakage controls	DG-07		×		×	×	

Figure 4: *Data breaches or leakage threat*

A cloud provider-agnostic secure storage protocol

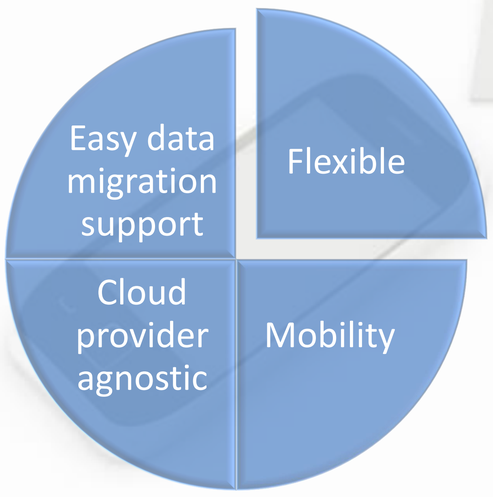

Figure 5: *Model's properties*

- ❑ A model [7] for outsourcing both static and dynamic data to third parties, while preserving their ***confidentiality*** and ***integrity***.
- ❑ Cloud-provider ***transparent-agnostic***, i.e. it can be used with ***any cloud provider***.
- ❑ Supports ***dynamic data management***, allowing users to update, delete or append new data and facilitating file sharing between users.

Procedural steps

1. The ***file is split into fixed size chunks***.
2. A ***MAC*** (Message Authentication Code) of each chunk is computed.
3. ***Each chunk is encrypted*** using a symmetric algorithm and a second randomly generated key.
4. The links between the correct order of the chunks and the random name are stored on a file called ***Index File***.
5. The ***index file is encrypted*** using the client's public key.
6. The ***encrypted chunks*** and the ***index file*** are ***uploaded on the cloud provider*** in random order.

Some early conclusions

- ❑ Existing ***cloud risk assessment*** approaches are considered premature, mainly due to the antithesis of the ***static nature of the procedure*** and the ***dynamic features of the cloud***.
- ❑ ***Cloud migration*** is a complex decision, while the tenant must fully understand the underlying ***threats, vulnerabilities and existing controls*** of such an environment.
- ❑ ***Proposed solutions*** should ensure the preservation of the security attributes, i.e. ***confidentiality***, ***integrity*** , and ***availability***.
- ❑ The ***provided controls*** in a CSP should be evaluated on a ***cost-benefit basis***, while existing research is in a still early stage.

This topic combines well with some of the security-focused publications of our Lab [8-10].

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