CSCI 5409 Adv Topics in Cloud Computing – ~~Summer~~, 2023 *Fall*
Week 8 – Lecture 1 (Oct 27, 2023)

Cloud Deployment Models

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Housekeeping and Feedback

- Start recording

Objectives

- Understand and differentiate between cloud deployment models

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Section 1. Cloud Deployment Models

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Cloud Deployment Models

1. Overview
2. Cloud Deployment Models

Overview

- "A **cloud deployment model** represents a specific type of cloud environment, primarily distinguished by ownership, size and access."[1]
- A **cloud deployment model** is a specific configuration of environment parameters such as the accessibility and proprietorship of the deployment infrastructure and storage size. This means that deployment types vary depending on who controls the infrastructure and where it's located
- The cloud delivery model defines **how** you will deliver your software, the cloud deployment model defines **where** you will deliver your software from
- Six major types of cloud deployment models:
  - Public cloud
  - Private cloud
  - Virtual private cloud
 - Community cloud
  - Hybrid cloud
  - Multi-cloud

[1]: Cloud Computing (T. Erl, Z. Mahmoud, R. Puttini), pg. 73

Cloud Deployment Models — Public Cloud (1/2)

- "A **public cloud** is a publicly accessible cloud environment owned by a third-party cloud provider."[1]

- This is the usual deployment model that we're mainly here for: AWS, Azure, Google Cloud, others (IBM, Oracle, Alibaba, etc.)

  GCP

- Pros
  - Low cost
  - No hardware investment
  - No infrastructure management

- Cons
  - Multitenancy - security and privacy concerns
  - Organizations must trust cloud provider to deliver on their service level agreements (SLAs)

[1]: Cloud Computing (T. Erl, Z. Mahmoud, R. Puttini), pg. 73
[2]: https://phoenixnap.com/blog/cloud-deployment-models

Picture from: https://phoenixnap.com/blog/cloud-deployment-models
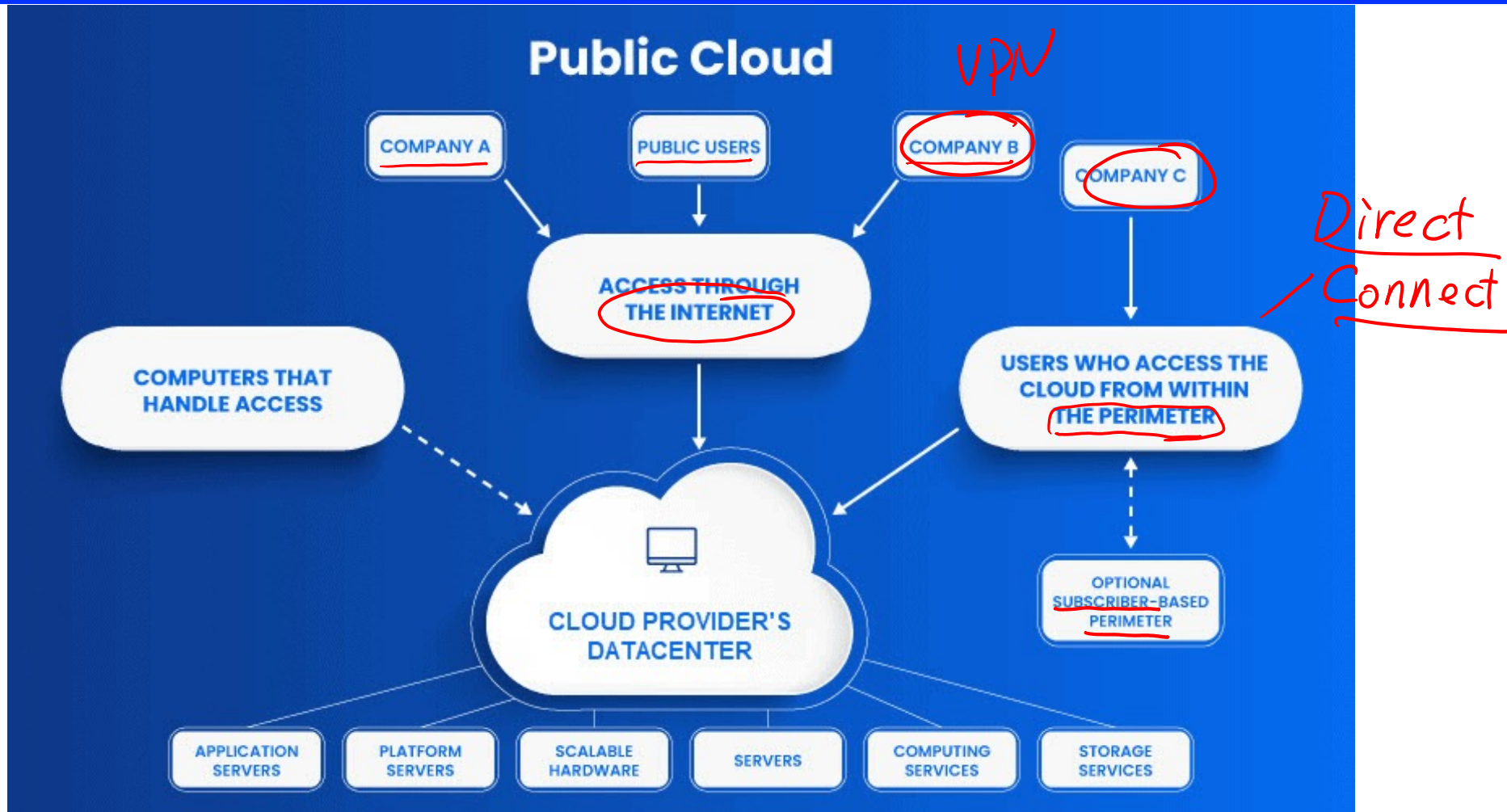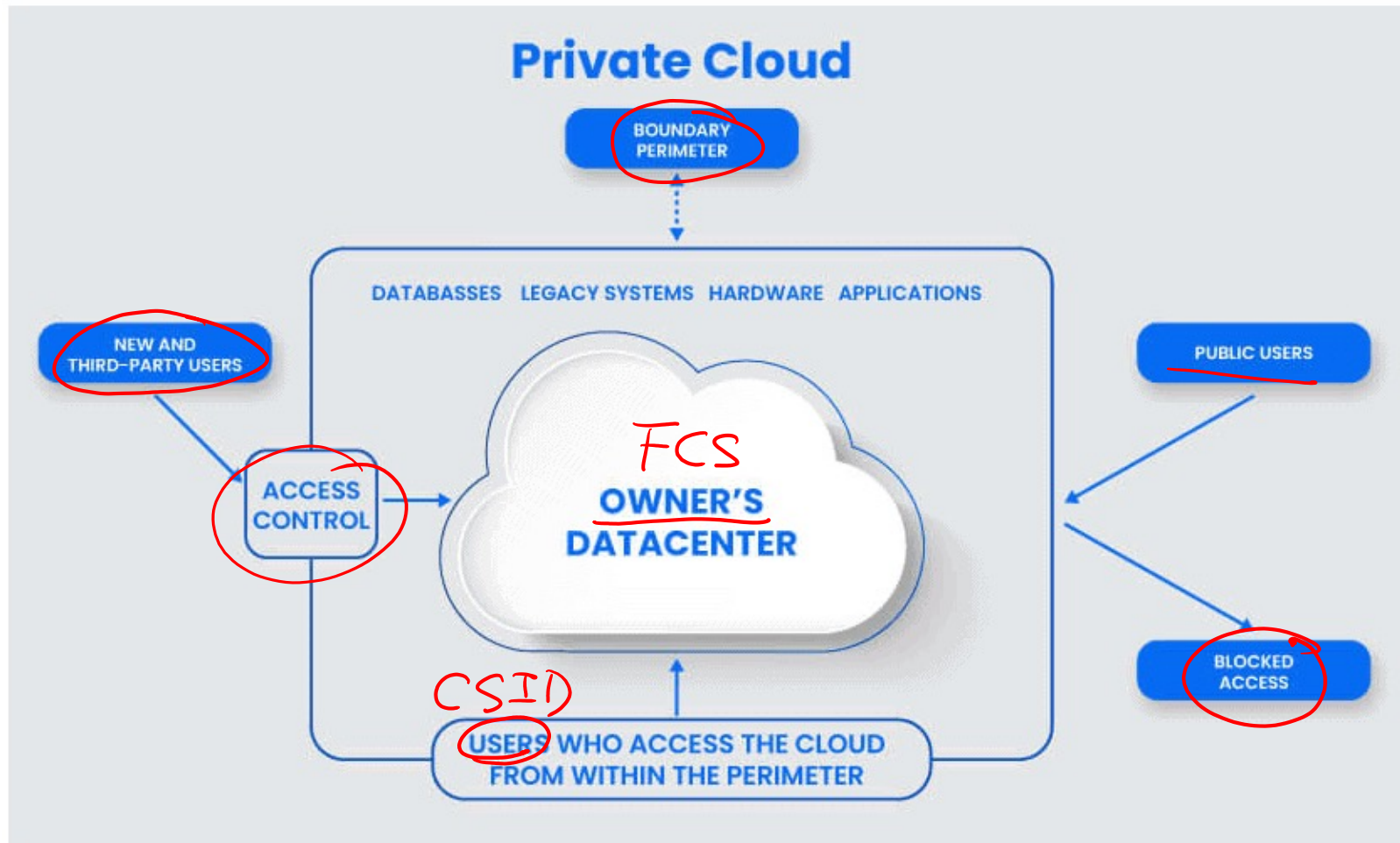
Cloud Deployment Models — Private Cloud (1/2)

- "A **private cloud** is owned by a single organization. Private clouds enable an organization to use cloud computing technology as a means of centralizing access to IT resources by different parts, locations, or departments of the organization."[1]

- Pros [2]
  - Customization
  - Data privacy
  - Security
  - Full control
  - Legacy systems

- Cons [2]
  - High cost
  - Fixed scalability
  - High maintenance

- Example: **openstack.**

The Faculty of Computer Science maintains IT infrastructure on racks in the 3rd floor server room, this infrastructure runs openstack to provide the faculty with a private cloud!

[1]: Cloud Computing (T. Erl, Z. Mahmoud, R. Puttini), pg. 75
[2]: https://phoenixnap.com/blog/cloud-deployment-models

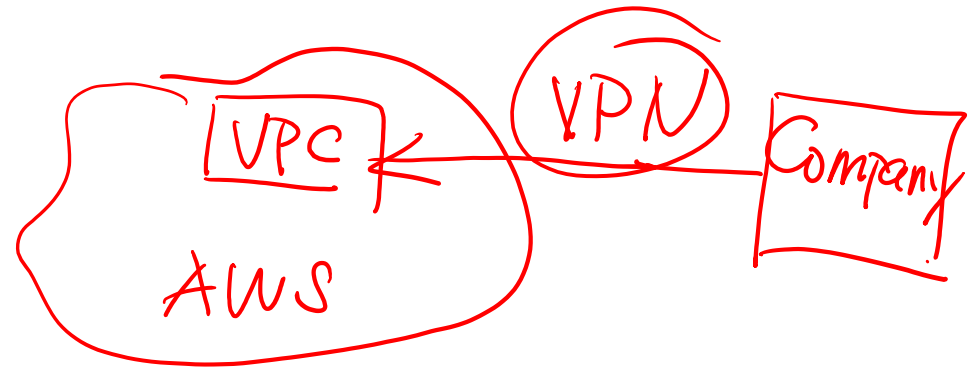Picture from: https://phoenixnap.com/blog/cloud-deployment-models

VPC — Networking

- A **virtual private cloud** is a segment of a public cloud using a secure connection (e.g. VPN)[1]

- Pros [1]
  - Cheaper than private clouds
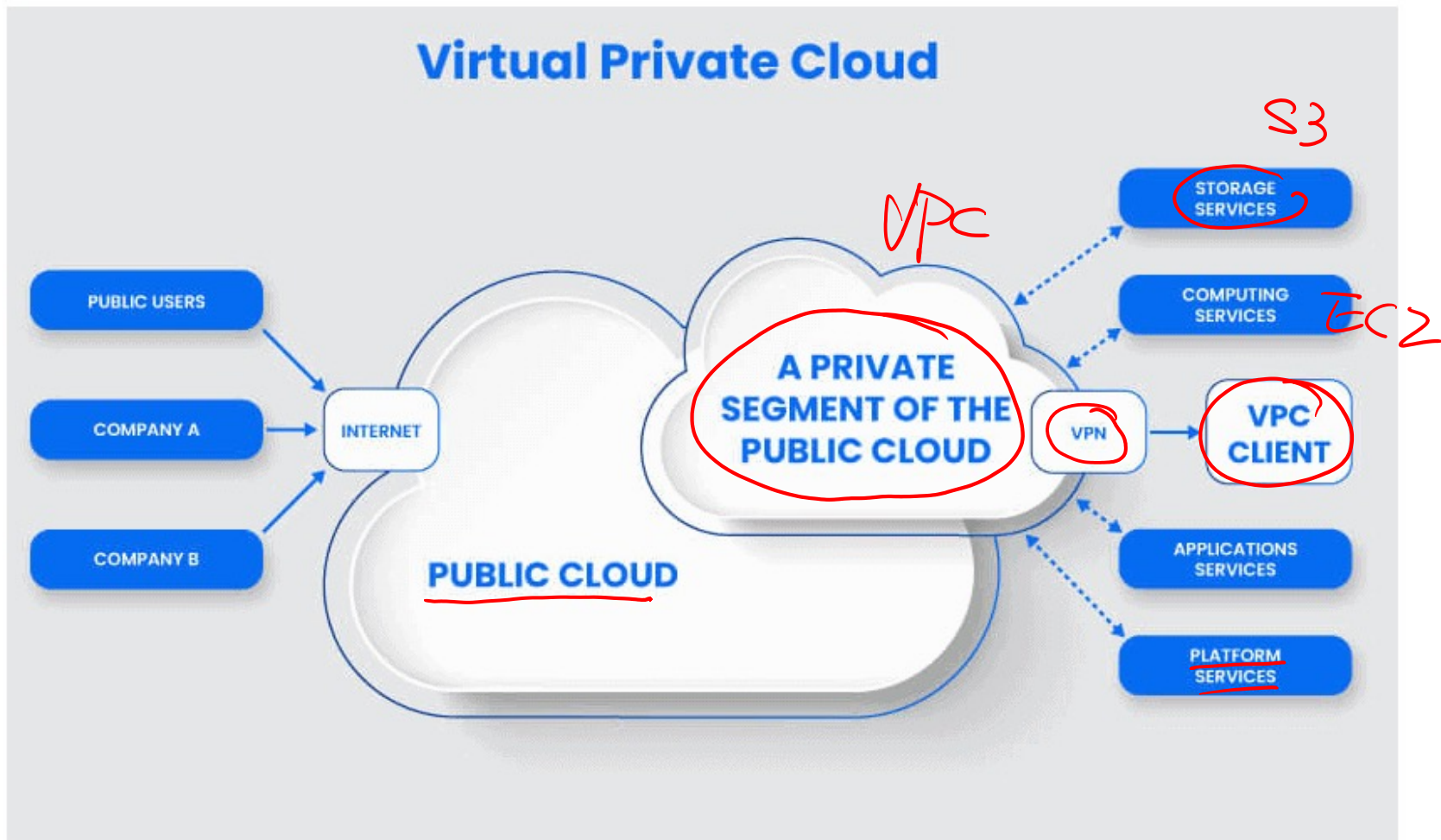 - More well-rounded than a public cloud
  - Maintenance and performance

- Cons [1]
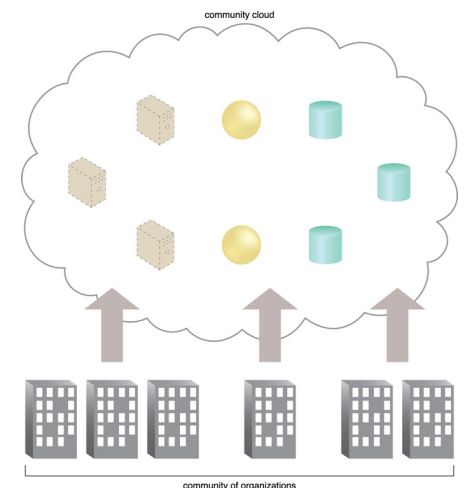 - It is not a private cloud
  - Typical public cloud problems

AWS *VPC* ← *VPN* *Company*

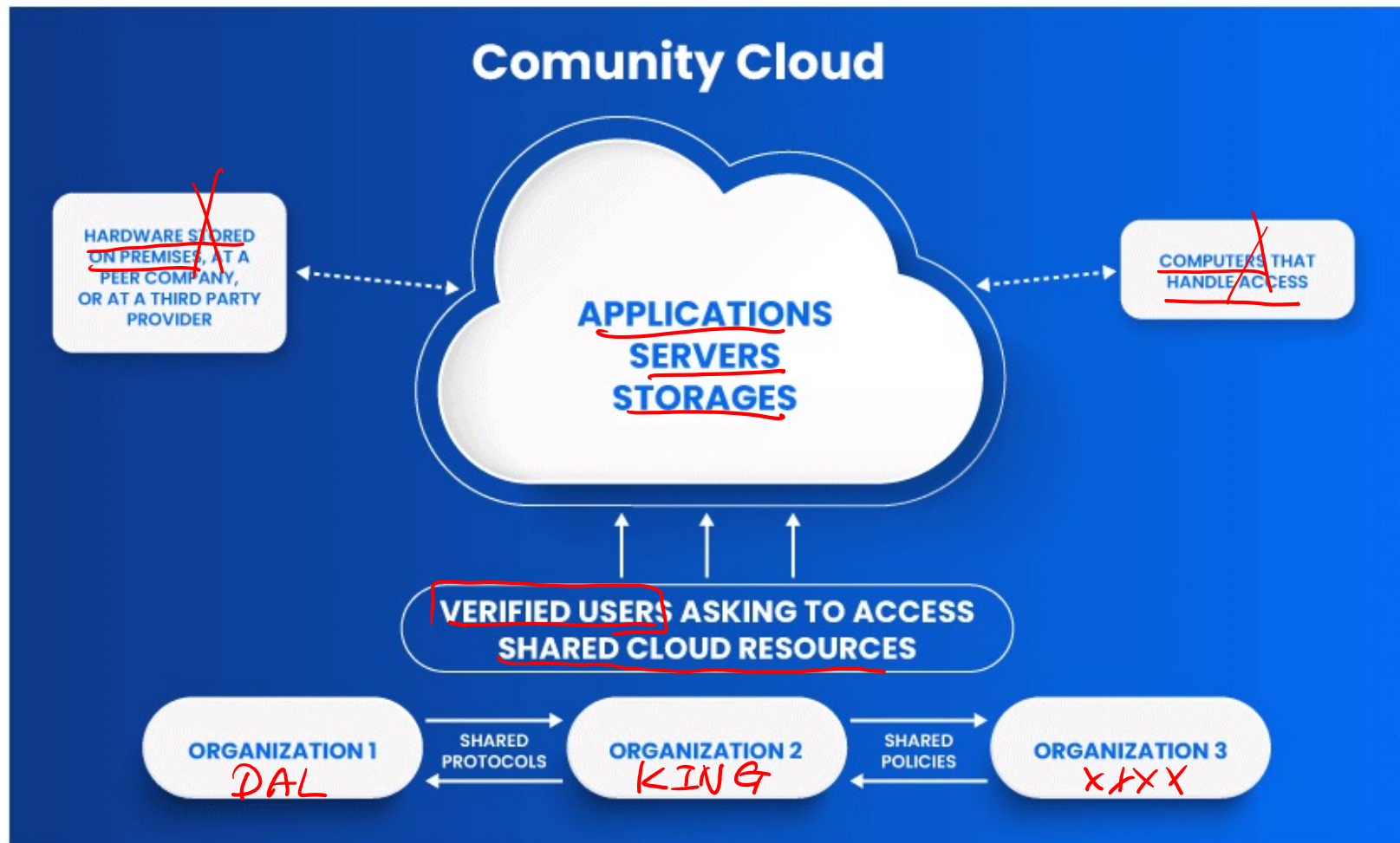[1]:https://phoenixnap.com/blog/cloud-deployment-models

[1]:https://phoenixnap.com/blog/cloud-deployment-models

- "A **community cloud** is similar to a public cloud, except that its access is limited to a specific community of cloud consumers. The community cloud may be jointly owned by the community members or by a 3rd party cloud provider that provisions a public cloud with limited access."[1]

- Usually this means a data center that rents rack space to small companies, data center looks after power/internet availability, community member looks after their own servers/storage

- Pros:
  - Organizations can choose the level of hardware control they want to relinquish
  - Some cost savings over private cloud (general day to day maintenance no longer requires staff)

- Cons:
  - Multitenancy (physically co-located hardware, communal access to the data center)
  - Organizations don't really get the best of public or private cloud

[1]: Cloud Computing (T. Erl, Z. Mahmoud, R. Puttini), pg. 74

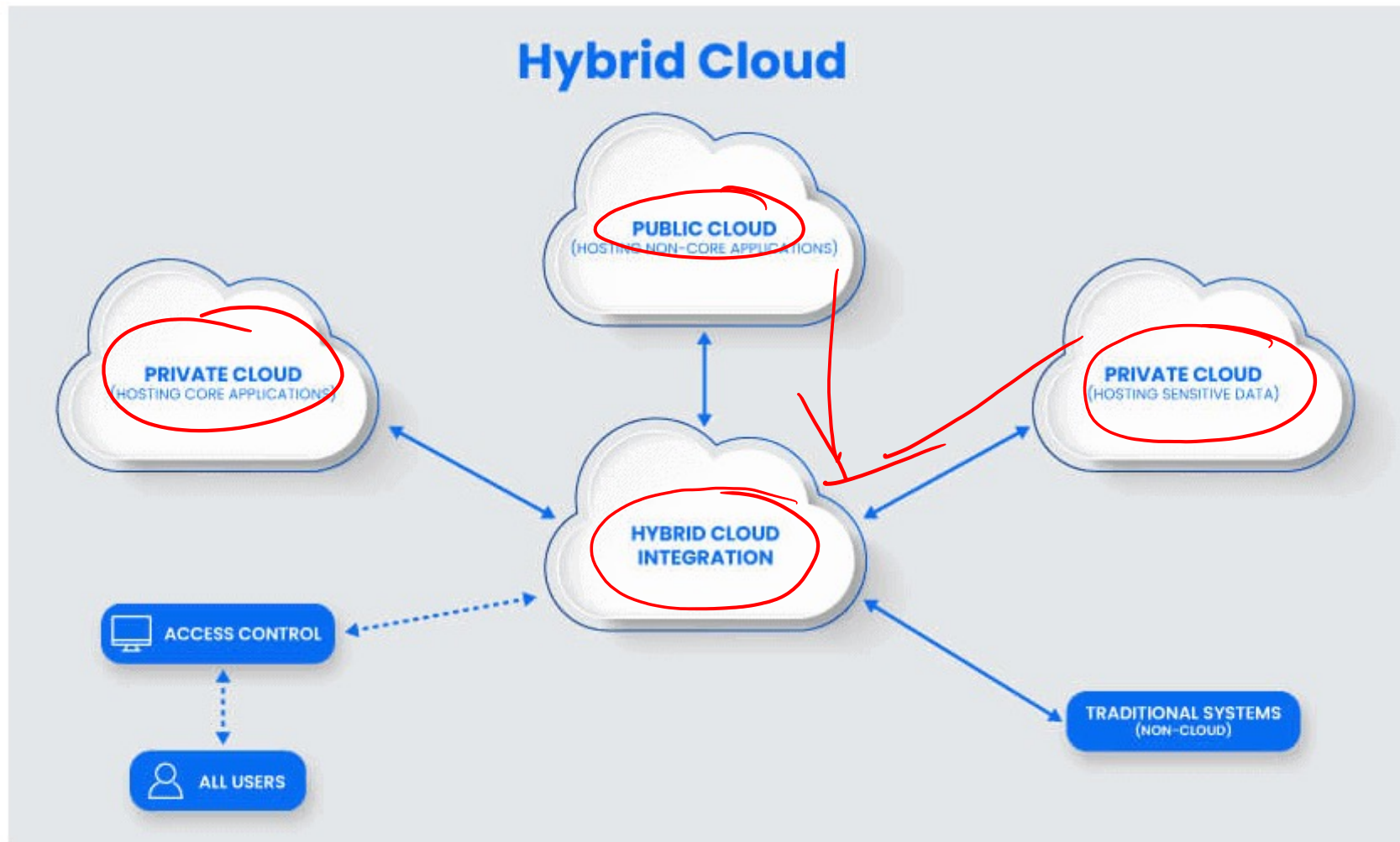Picture from: https://phoenixnap.com/blog/cloud-deployment-models

Cloud Deployment Models — Hybrid Cloud (1/2)

- "A **hybrid cloud** is a cloud environment comprised of two or more different cloud deployment models."[1]

- A cloud consumer chooses to deploy cloud services processing sensitive data to a private cloud, and other, less sensitive cloud services to a public cloud.[1]
  - Another example is that a portion of a company's data cannot legally be stored on a public cloud[2]

- This model is often used for cloud bursting [2]
  - Cloud bursting allows an organization to run applications on-premises but "burst" into the public cloud in times of heavy load

- Pros:
  - Enjoy the benefits of each deployment model (public and private)
  - Anything in the public cloud can be given high availability
  - Anything in the private cloud is safe in your trust boundary

- Cons:
  - Additional architectural overhead / complexity
  - Higher potential for mistakes that breach the trust boundary
  - Equipment / personnel costs to maintain the private cloud while also needing experts in the public cloud

[1]: Cloud Computing (T. Erl, Z. Mahmoud, R. Puttini), pg. 77
[2]: https://phoenixnap.com/blog/cloud-deployment-models

Picture from: https://phoenixnap.com/blog/cloud-deployment-models

Cloud Deployment Models — Multi-Cloud (1/2)

- **Multi-cloud** is the use of multiple public cloud providers (and maybe even private) to realize ultra-high availability
  - If you can design your system using standards supported by all cloud providers (e.g. Docker), you can deploy a mirror copy of your infrastructure to multiple cloud providers, and have it sitting there turned off until you need it
- Pros:
  - Highest possible level of availability, when one cloud goes down simply turn on your other provider, this can even be automated
  - Immediate benefit of any advance in technology from any provider
  - Achieving multi-cloud indicates high quality architectural design of organization's software
- Cons:
  - Additional cost to hold data needed by your software/trickle costs
  - Difficult to achieve: Cloud providers purposefully blocking standardization to prevent loss of customers

- According to Statista, as many as 90% of large enterprises were using a multi-cloud approach in 2021 and the figure is expected to rise to 93% by 2023.

Image: https://analyticsindiamag.com/top-multi-cloud-tools-anthos-aws-azure/

Cloud Deployment Models — Model Comparison

Lab2Market

Model	Cost	Security	Difficulty	Availability
Public Cloud	$ Organization can find the cheapest provider	Low, data leaves the trust boundary, multitenancy, 3rd party in control of hardware	Low	High
Private Cloud	$$$ Organization must purchase equipment and employ staff to maintain it	Highest, nothing leaves the trust boundary	Medium	Low, you lose geographical diversification, even if you spread at great cost you can't compete with the big players
Hybrid Cloud	$$$ Potentially less equipment to buy, but gains offset by increased difficulty	Slightly less than private, risk introduced by complexity of implementation	High	Medium, your private cloud becomes your weak point of failure
Community Cloud	$$ Cheaper than private, more than public	Medium, data still technically leaves trust boundary, yet multitenancy reduced	Low	Medium, data center is probably more reliable than your premises, but not geographically diverse
Multi-Cloud	$$ Overhead for "cold" systems idle waiting to be activated	Super lowest, multitenancy vastly increased, more difficult to audit/monitor, any flaw in any cloud provider puts you at risk	High	Highest possible, this is why you're doing this!

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