



CompSci 401: Cloud Computing

Private Clouds

Prof. Ítalo Cunha

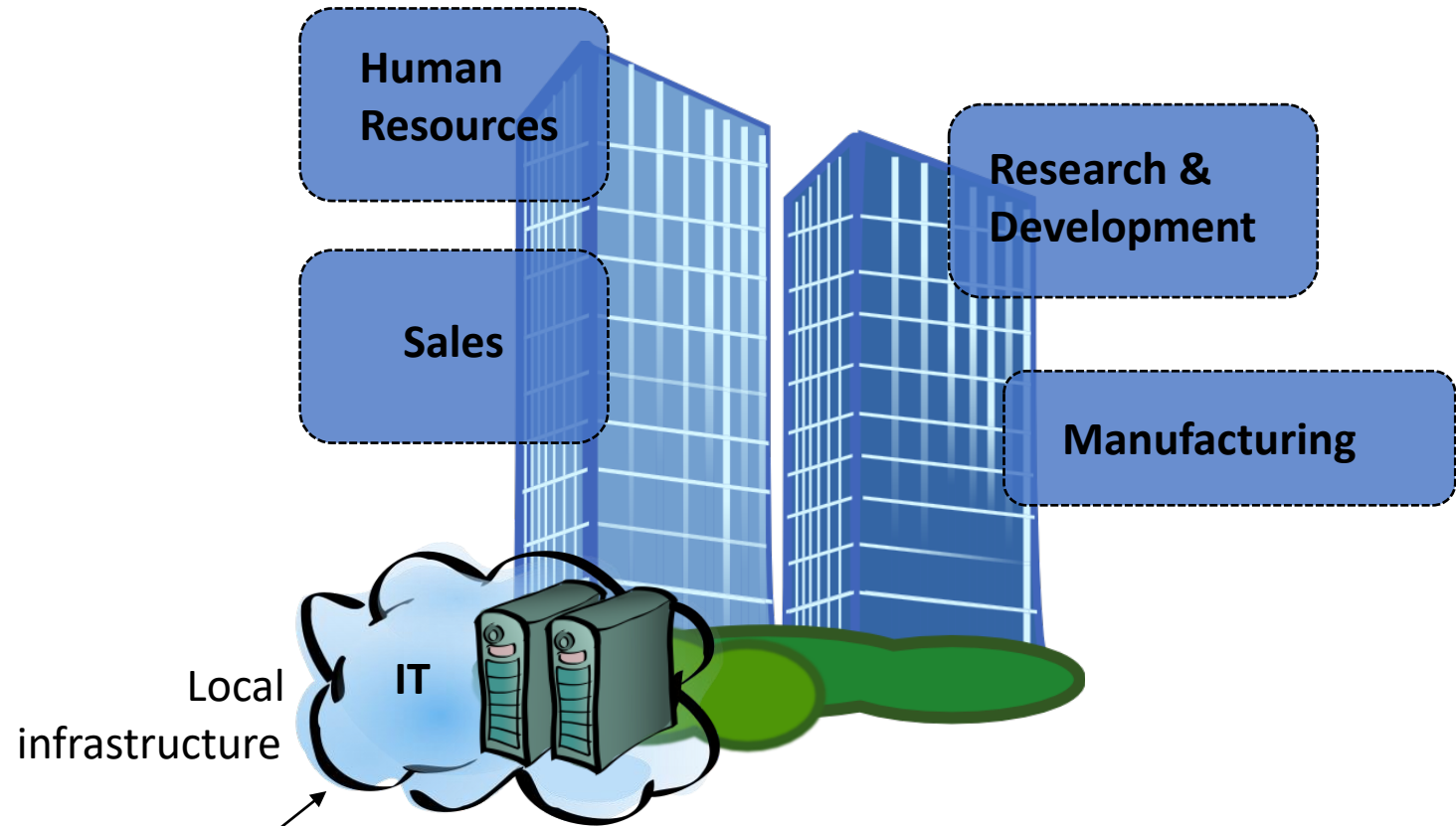


Private and public clouds



Third-party
infrastructure

Public cloud



Local
infrastructure

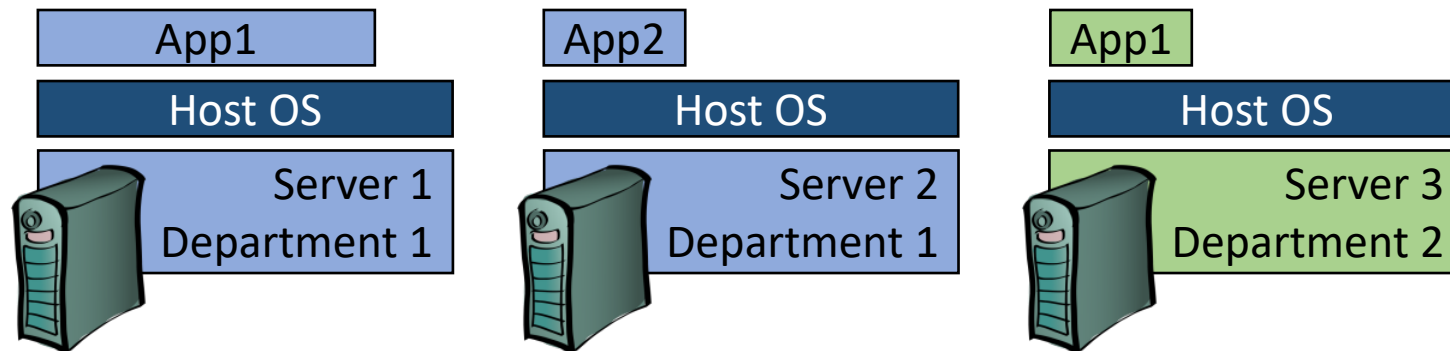
Private cloud

Private clouds

- Organizations concentrate IT equipment in a private data center
- Cloud technologies can allow further cost reductions

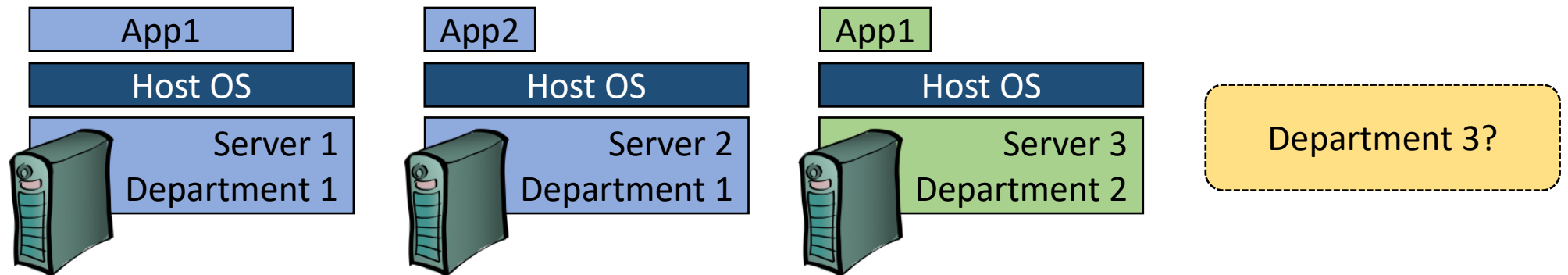
Private clouds

- Organizations concentrate IT equipment in a private data center
- Cloud technologies can allow further cost reductions



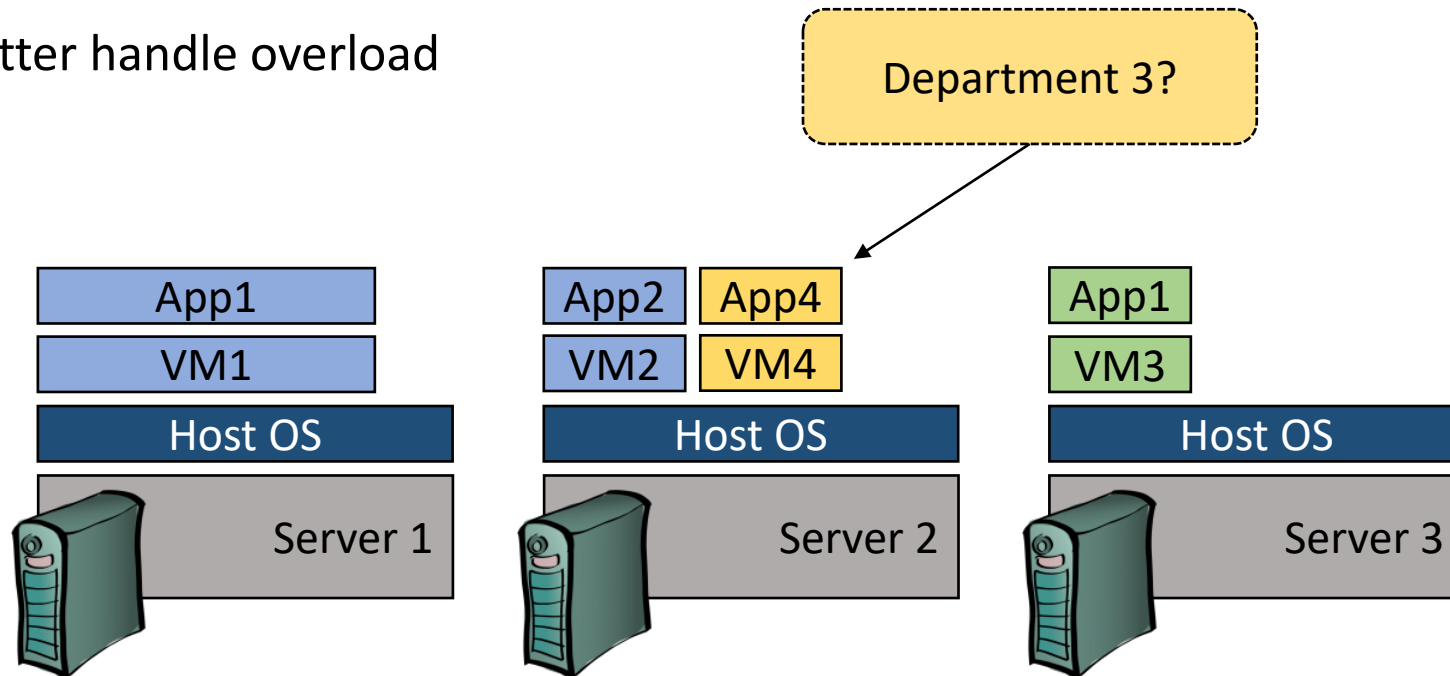
Private clouds

- Organizations concentrate IT equipment in a private data center
- Cloud technologies can allow further cost reductions



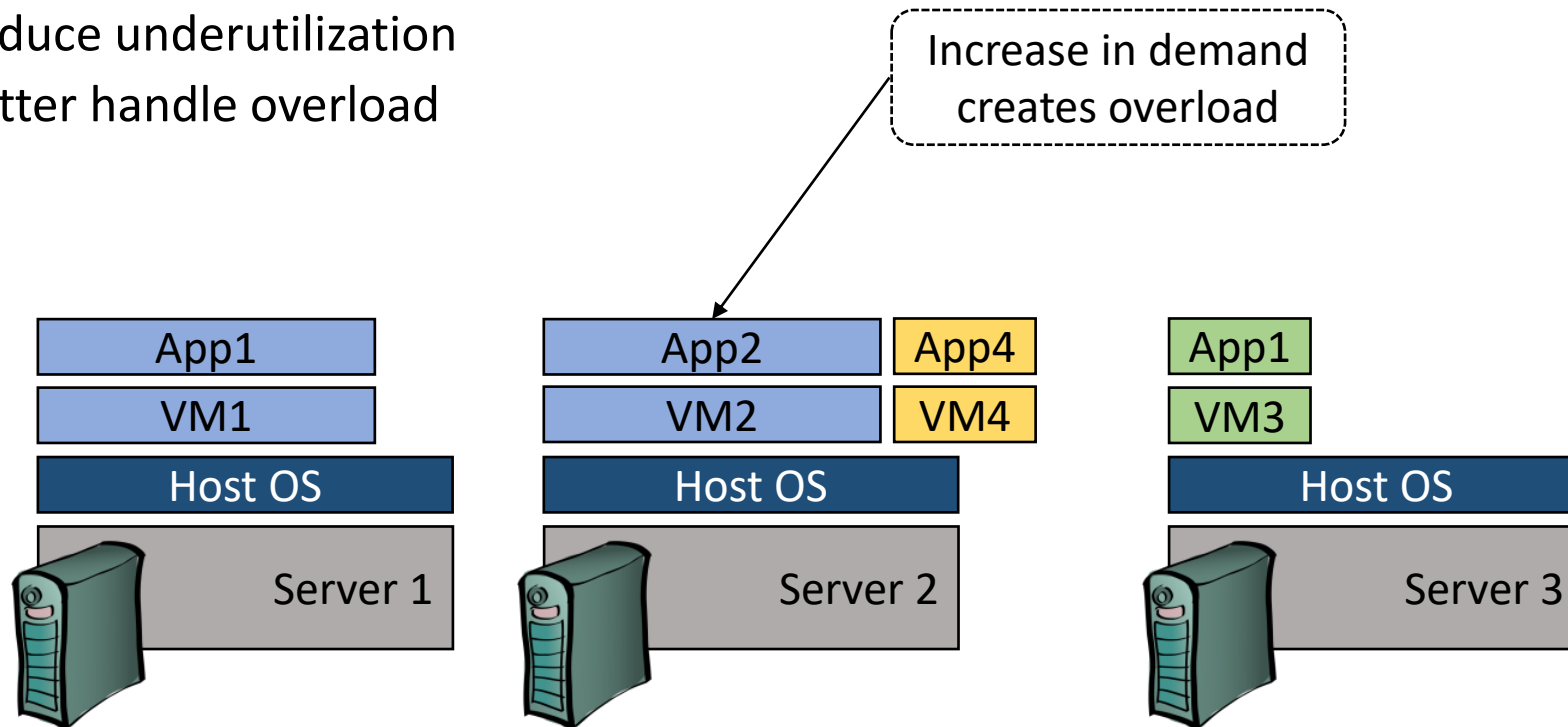
Private clouds

- Organizations concentrate IT equipment in a private data center
- Cloud technologies can allow further cost reductions
 - Virtualization and resource sharing
 - Reduce underutilization
 - Better handle overload



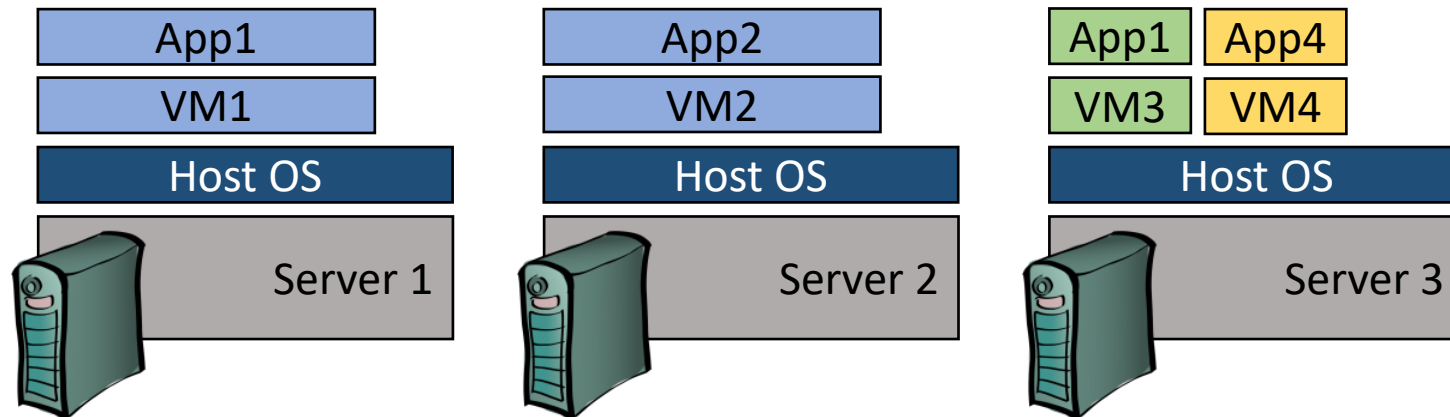
Private clouds

- Organizations concentrate IT equipment in a private data center
- Cloud technologies can allow further cost reductions
 - Virtualization and resource sharing
 - Reduce underutilization
 - Better handle overload



Private clouds

- Organizations concentrate IT equipment in a private data center
- Cloud technologies can allow further cost reductions
 - Virtualization and resource sharing
 - Reduce underutilization
 - Better handle overload



Advantages of a private cloud

- Retention of control and visibility
 - Organization controls the hardware and the network
 - Can troubleshoot problems directly
 - Adapt infrastructure to its own needs
 - Regulations may require the organization to maintain ownership of the data
 - Placement and transfers
- Reduced (network) latency for on-premises facilities
 - A private cloud is usually closer to other facilities of the organizations
 - Even better if a private cloud is located at each facility for local access
- Insurance against public cloud price fluctuations or increases
 - Operating a private cloud may be cheaper or competitive vs public clouds



CompSci 401: Cloud Computing

Public Clouds

Prof. Ítalo Cunha



Public clouds

- Major alternative to running a private cloud
- Organizations need to decide what type of service to use
 - Medium to large organizations
 - May opt for IaaS to get enough flexibility to run all in-house applications and services
 - Possibly additional services like data backup, database administration or network security
 - Startups or companies deploying specific apps
 - May opt for PaaS to reduce overhead and speed up development
 - Small organizations may subscribe to specific SaaS services
 - Web site, e-mail, office suite

Public clouds

- Definitions
 - *Public cloud*: Offers computing to customers
 - *Public cloud facility*: The infrastructure that performs the computing
 - *Public cloud provider*: A company that operates the cloud facilities

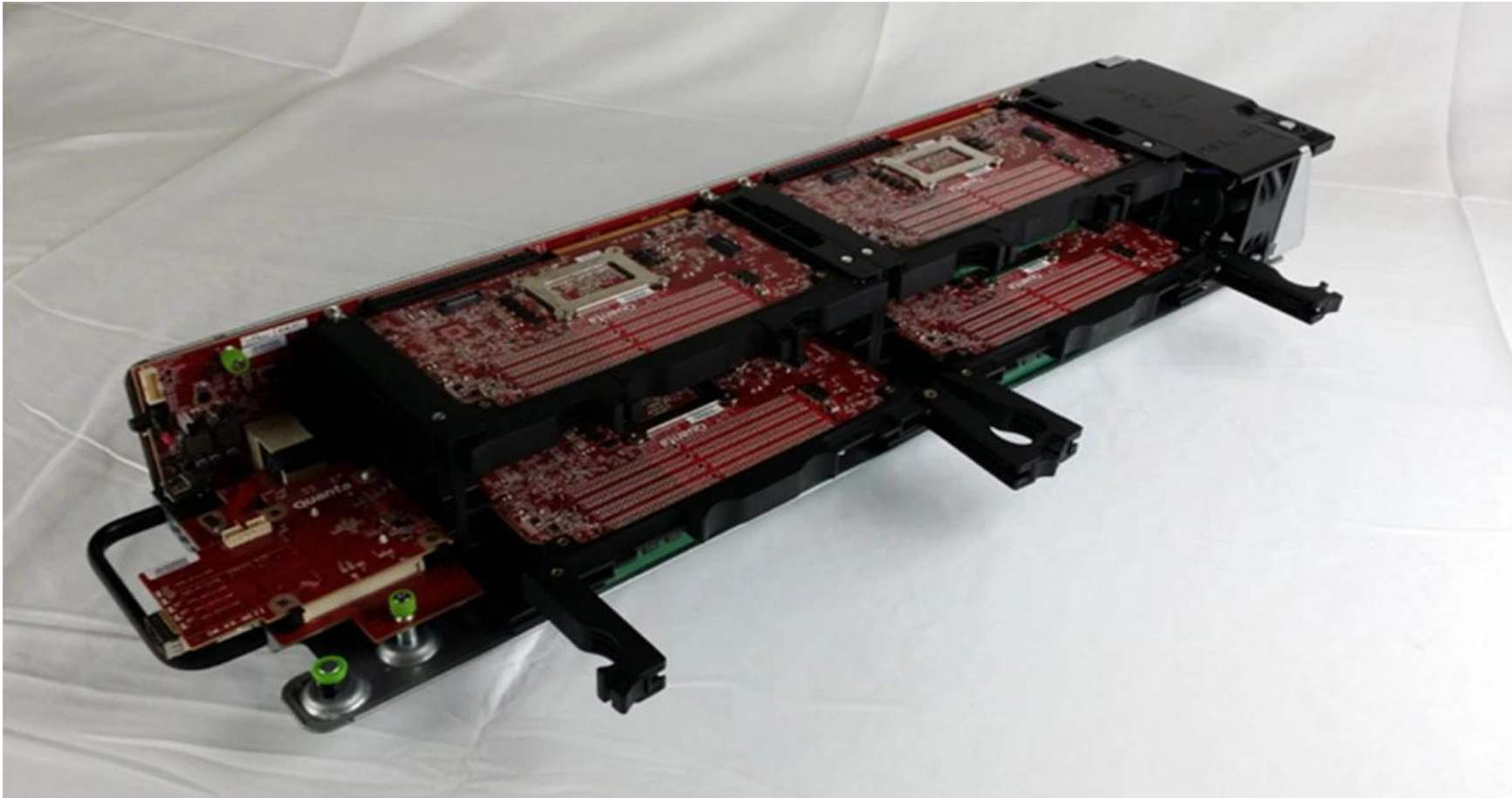
Advantages of public clouds

- Cloud providers advertise three main advantages
 - Economic – lower cost than a private cloud
 - Expertise – access to staff with expertise on many topics
 - Advanced services – offerings not available elsewhere

Economic advantage

- Cloud providers operate very large datacenters
 - Significantly larger than private clouds
 - Benefit from economies of scale
 - Can negotiate better discounts for bulk components (e.g., network cards, transceivers)
 - Can afford to develop in-house solutions or build their own components
 - Facebook designs their own [servers](#), [racks](#), and [network switches](#)
 - <https://tech.fb.com/open-compute-project/>
 - Can design new solutions to problems
 - Google designs custom cooling solutions to achieve very [high efficiency](#)

Economic advantage



Facebook server @ 2016
4x Intel Xeon
1x 50Gbps network card
Not 1U

Economic advantage



Facebook F16 Minipack
128x100Gbps switch
Buys transceivers, assembles switch
Software built in-house

Economic advantage



Google engineer in front of wall-sized air filter used. Air is used for cooling.

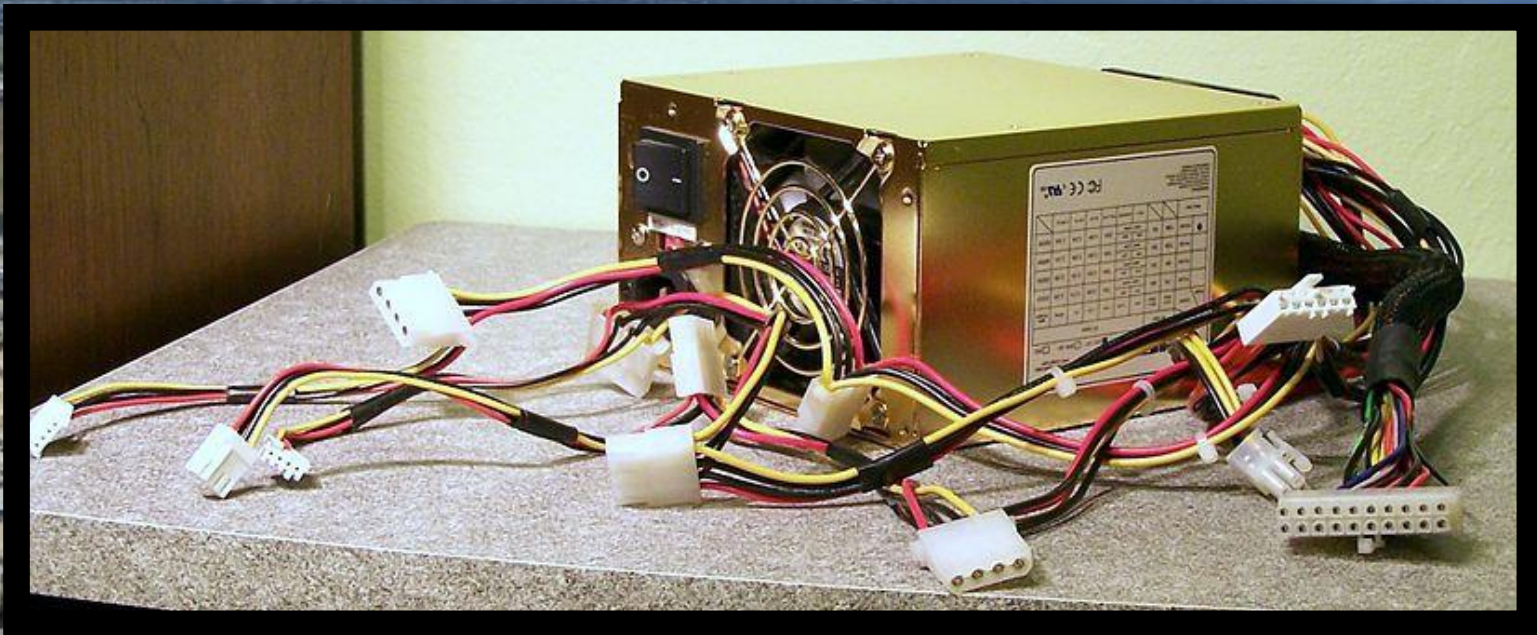
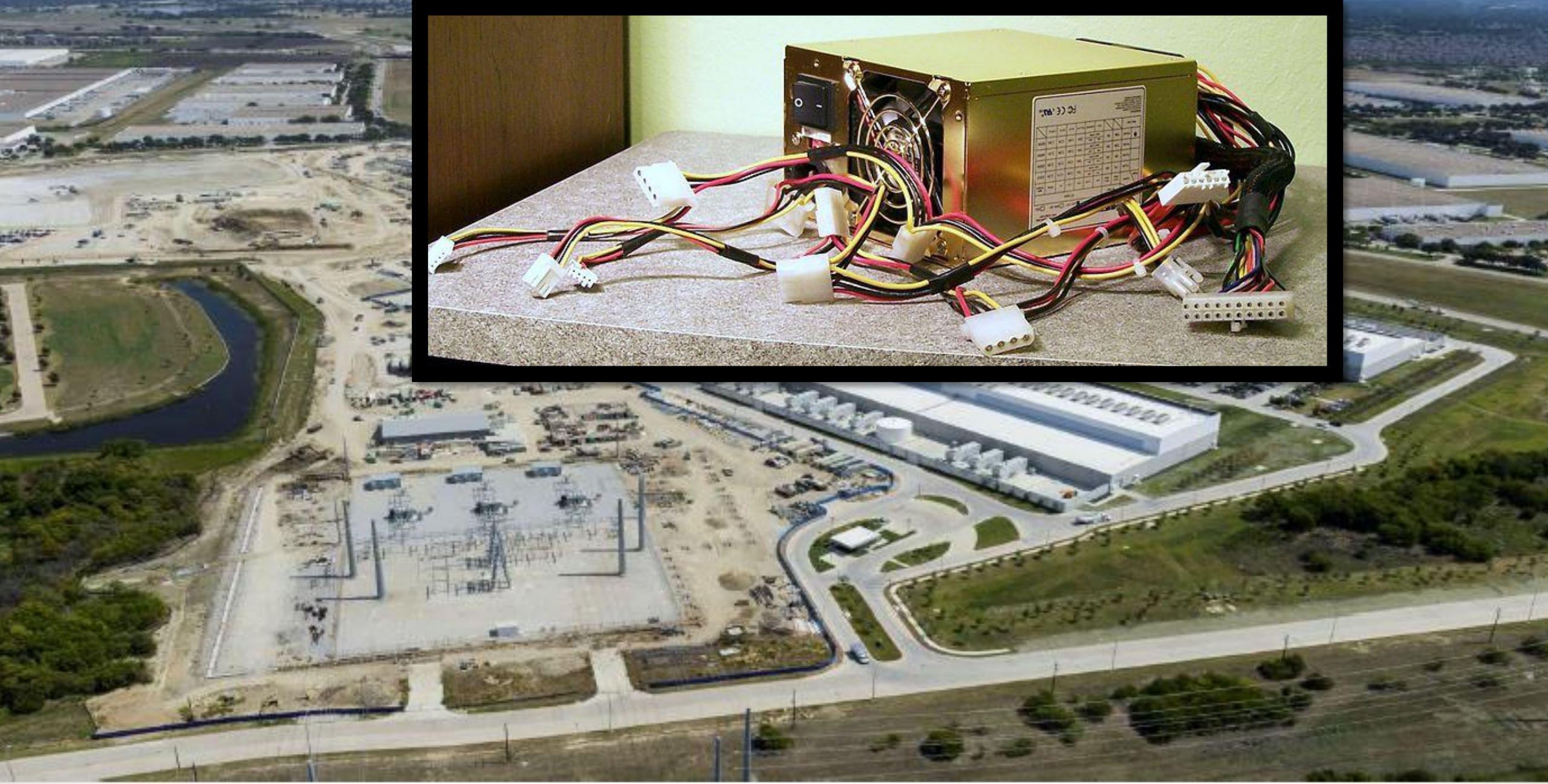
Facebook's Fort Worth data center

<https://www.facebook.com/FortWorthDataCenter>



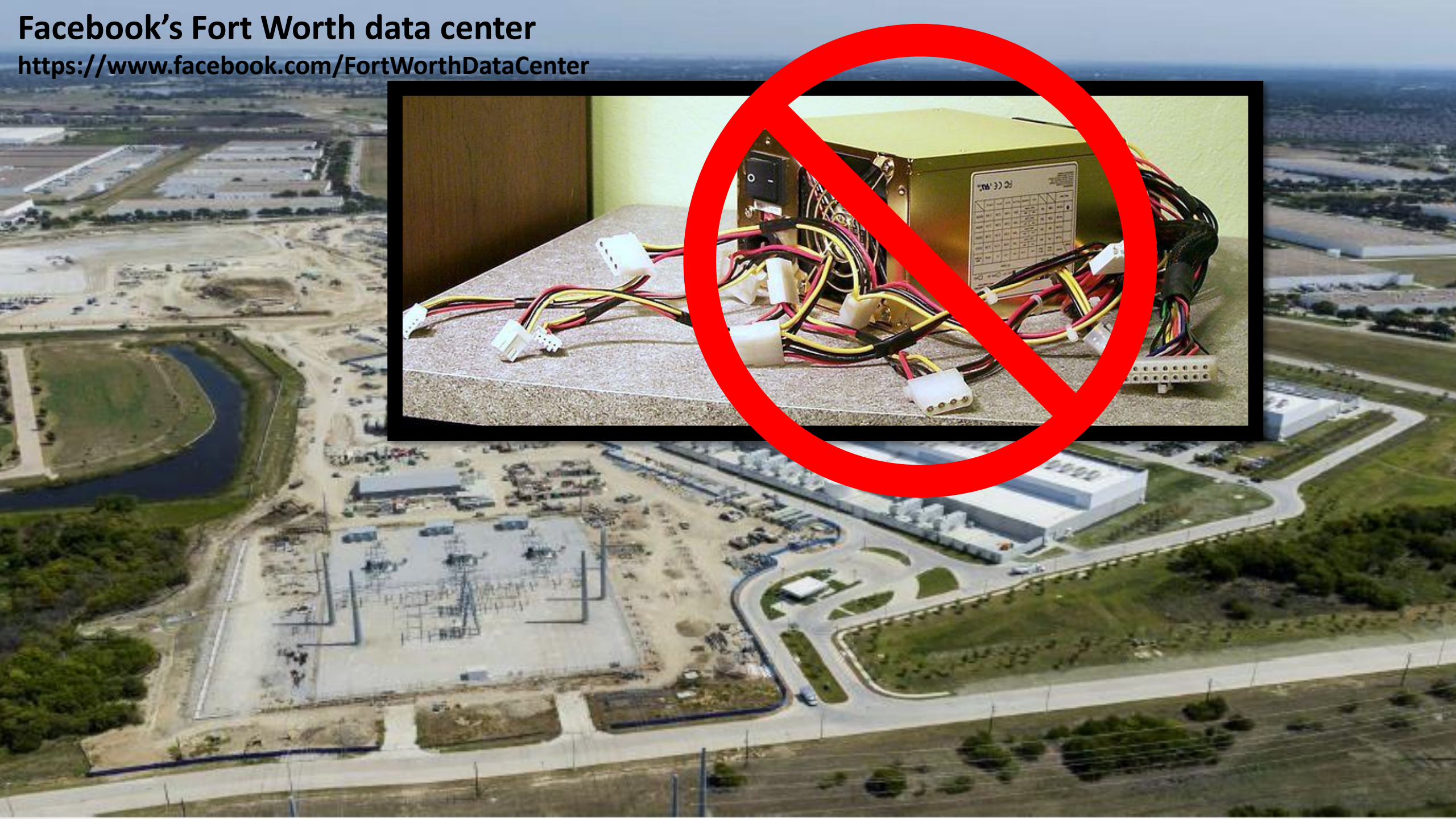
Facebook's Fort Worth data center

<https://www.facebook.com/FortWorthDataCenter>



Facebook's Fort Worth data center

<https://www.facebook.com/FortWorthDataCenter>



The expertise advantage

- Not only engineering teams to build custom solutions
- Engineers and experts on many fields, which might be too expensive for a smaller organization to maintain at similar cost
 - Operating systems
 - Artificial intelligence
 - Machine learning
 - Middleware and libraries

Advanced services advantage

- Basic cloud computing promises
 - No maintenance
 - High reliability
 - Limitless scalability
- Service offerings that may be unavailable elsewhere
 - AI-based monitoring of services and network traffic to detect anomalies
 - Automated operating system, middleware, and application updates
- Pervasive best practices
 - 24/7 staff and quick responses to incidents
 - High software and hardware security

Google incident post-mortems

- Google publishes post-mortem analysis of failures in its infrastructure
 - Describes the problem, how it was corrected, assesses impact, and discusses future prevention measures that will be implemented
 - Usually *impressive* monitoring, correction, and remediation mechanisms

Google Cloud Infrastructure Components Incident #20013

Google Cloud services are experiencing issues and we have an other update at 5:30 PDT

Incident began at **2020-12-14 04:07** and ended at **2020-12-14 06:23** (all times are **US/Pacific**).

Incident report page:

<https://status.cloud.google.com/incident/zall/20013>

Vendor lock-in

- Lock-in happens when a customer is tied to technologies available at a single cloud provider
 - Some technologies are specific to a cloud provider
 - For example, monitoring or automation frameworks
 - May not be available at other cloud providers
 - Makes it hard for a customer to move to a different provider
- Lock-in applies at all levels: IaaS, PaaS, and SaaS
- Cloud providers make it easy for customers to move in
 - Migration of on-premises computing to the cloud
 - Migration from another cloud provider



CompSci 401: Cloud Computing

Hybrid Clouds and Multi-Cloud

Prof. Ítalo Cunha



Hybrid cloud

- Public cloud for some services, private cloud for others
 - Balance depends on needs vs cost
- Combine the advantages of both
 - Control in the private cloud
 - Scalability in the public cloud

Control in the private cloud

- Some organizations must comply with regulations
 - Controlled access to data
 - For example, classified government or medical information
 - Can be enforced on the private cloud
 - Non-classified data can be pushed to the public cloud

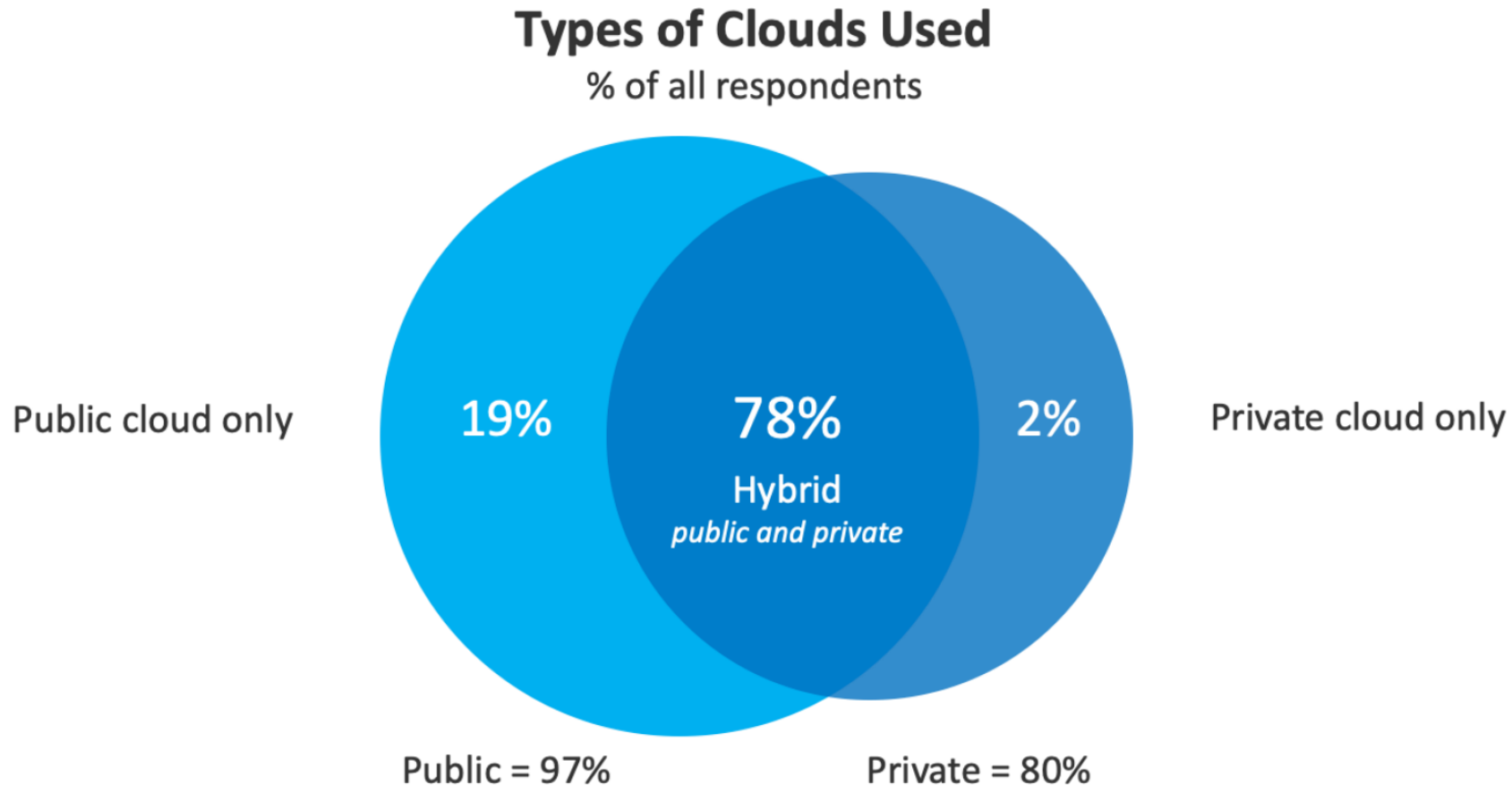
Scalability in the public cloud

- Some organizations may run most computation locally
- Resources may be insufficient during peak business season
 - Black Friday, Super Bowl
- Use public cloud to absorb temporary burst in demand
 - Public cloud must make it convenient to migrate the company's software to the cloud
 - Incurs some management overhead
 - IT team will need to learn how to manage two deployments

Multi-cloud

- Some organizations may use multiple public cloud providers
- Avoid vendor lock-in
- Two approaches
 - Map different applications to different cloud providers
 - For example, map different business units to different public clouds
 - Run all applications on all cloud providers
 - Make applications compatible with multiple clouds
- Challenges
 - Moving data takes time and incurs costs
 - Cloud offerings may differ
 - May require specialized software to make applications compatible or convert data

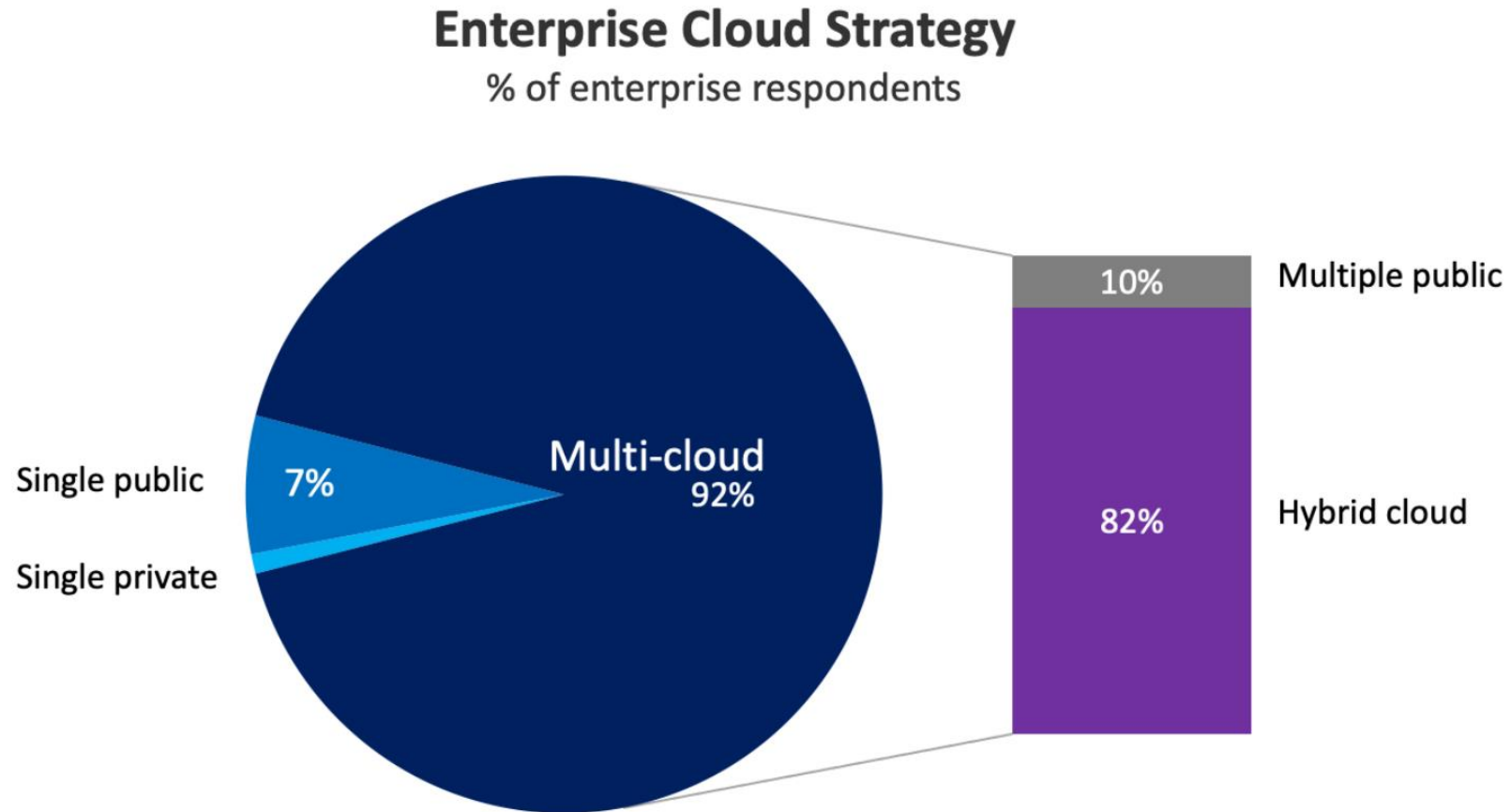
Most enterprises use at least one cloud



N=750

Source: Flexera 2021 State of the Cloud Report

Most enterprises use multiple clouds



N=750

Source: Flexera 2021 State of the Cloud Report