

# Power Management in Multi-Tenant Colocation Data Centers

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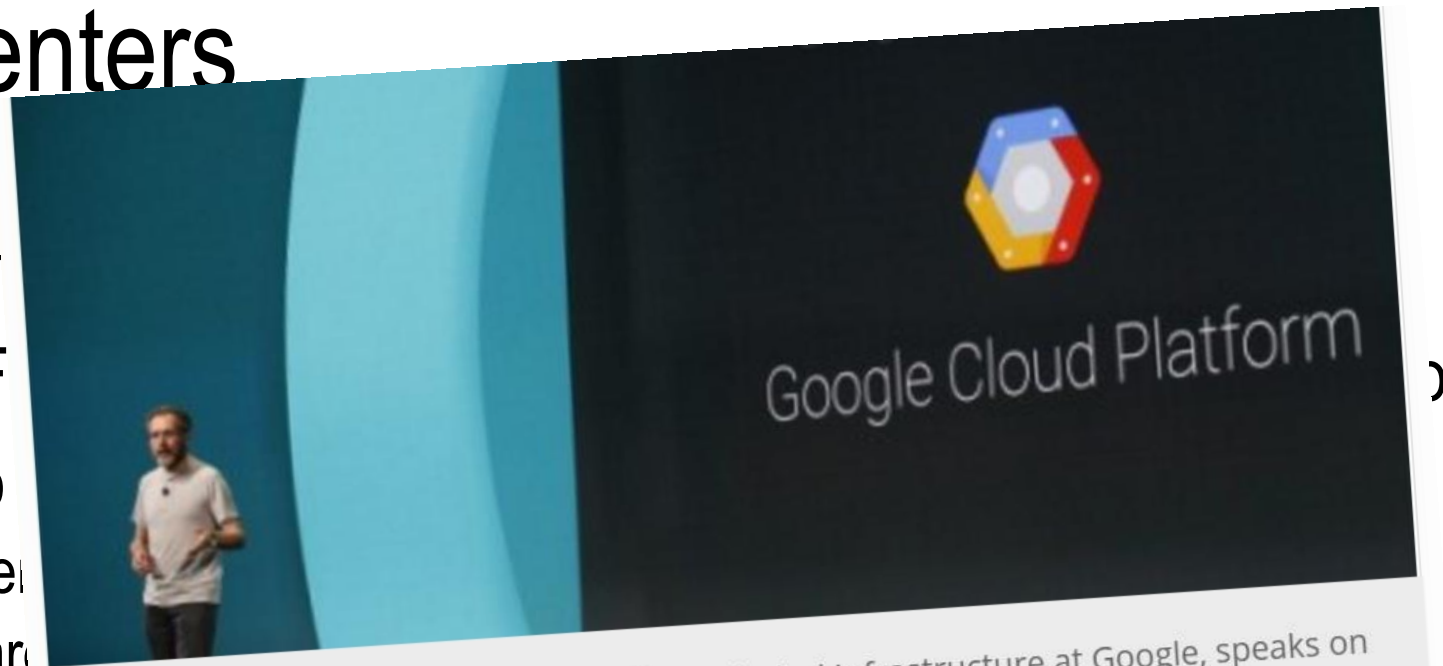
# Data centers

- Physical home of the Internet
- Google, Facebook, Apple etc., own data centers around the world
- They also use *multi-tenant* data centers
  - Complement “core” data centers
  - **Most large data centers** are “multi-tenant”, consuming 37% of all data center energy
  - Apple houses **25%** of its servers in multi-tenant data centers



# Data centers

- Physical Infrastructure
- Google, Facebook
- They also
  - Complex
  - Most largest
  - Apple has



Urs Holzle, Senior Vice President for Technical Infrastructure at Google, speaks on the Google Cloud Platform during the Google I/O Developers Conference at Moscone Center on June 25, 2014 in San Francisco, California. (Photo by Stephen Lam/Getty Images)

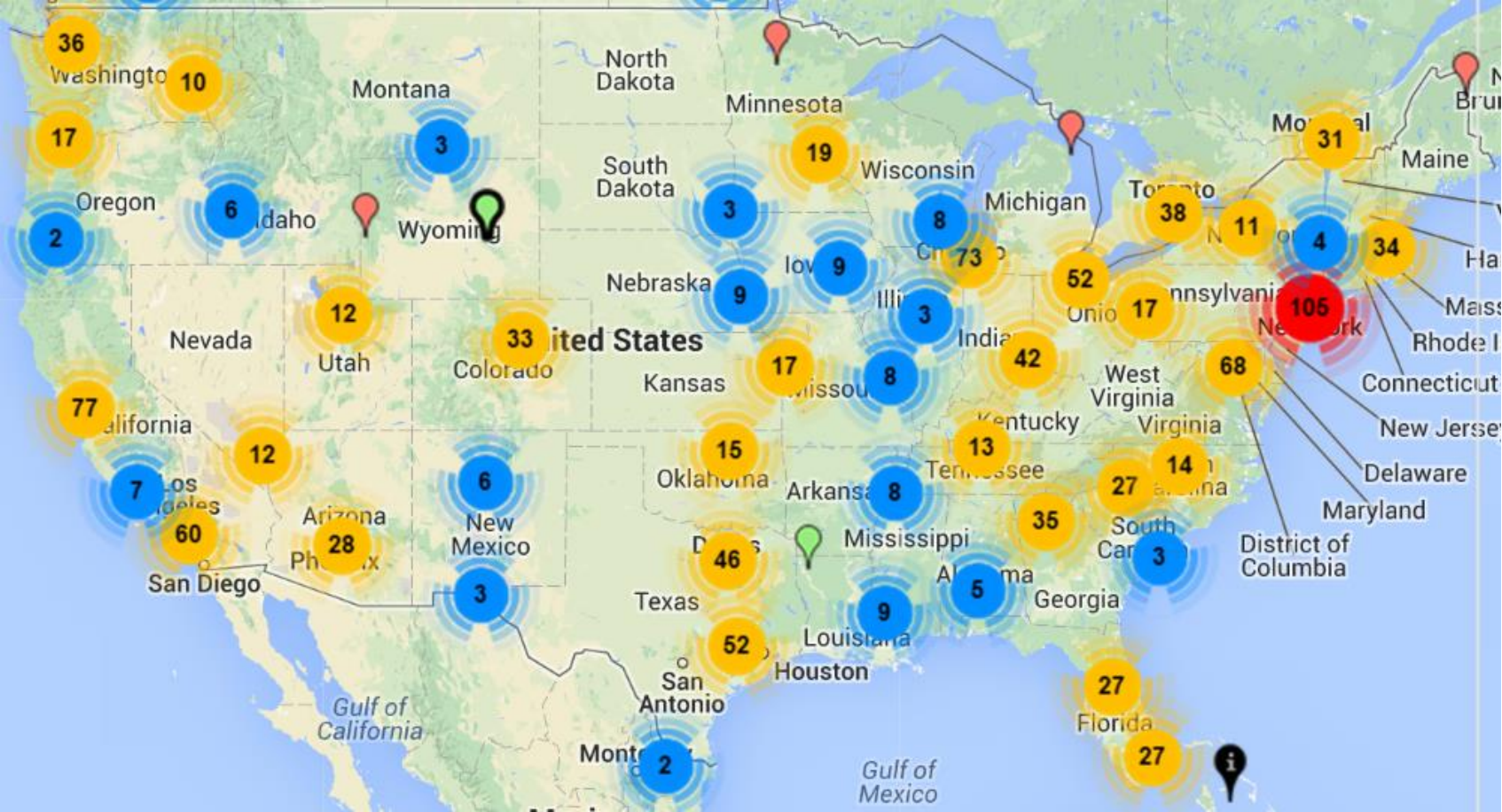
**COLOCATION, DATA CENTER STRATEGIES, GOOGLE**

Google to Build and Lease Data Centers in Big Cloud Expansion

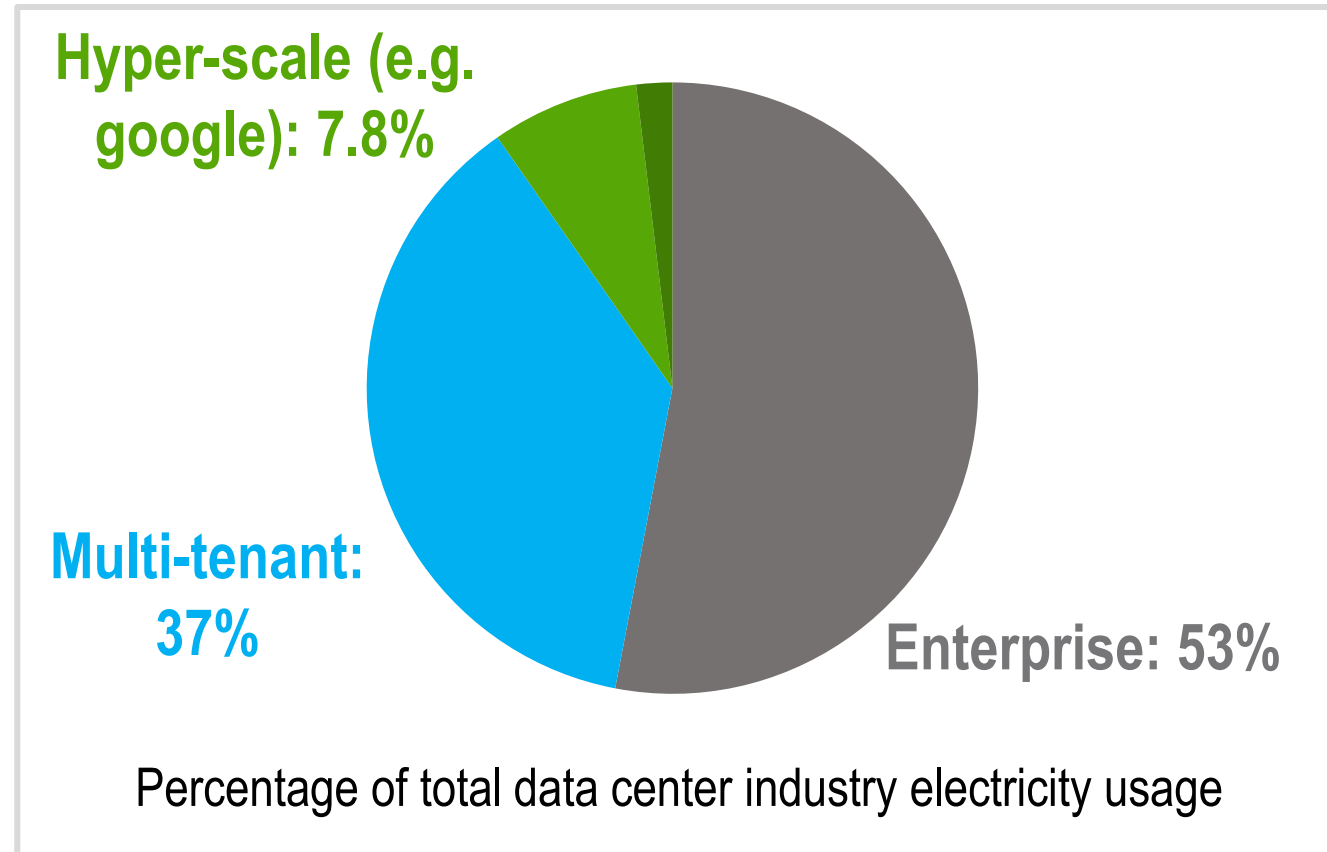
world

center energy

# An **incomplete** map of multi-tenant data centers



# Multi-tenant data centers



**U.S.\$54 billion by 2020**



# Multi-tenant data centers



A "data center" located in 818 W. 7th Street, Los Angeles, CA 90017



A data center in Santa Clara, CA

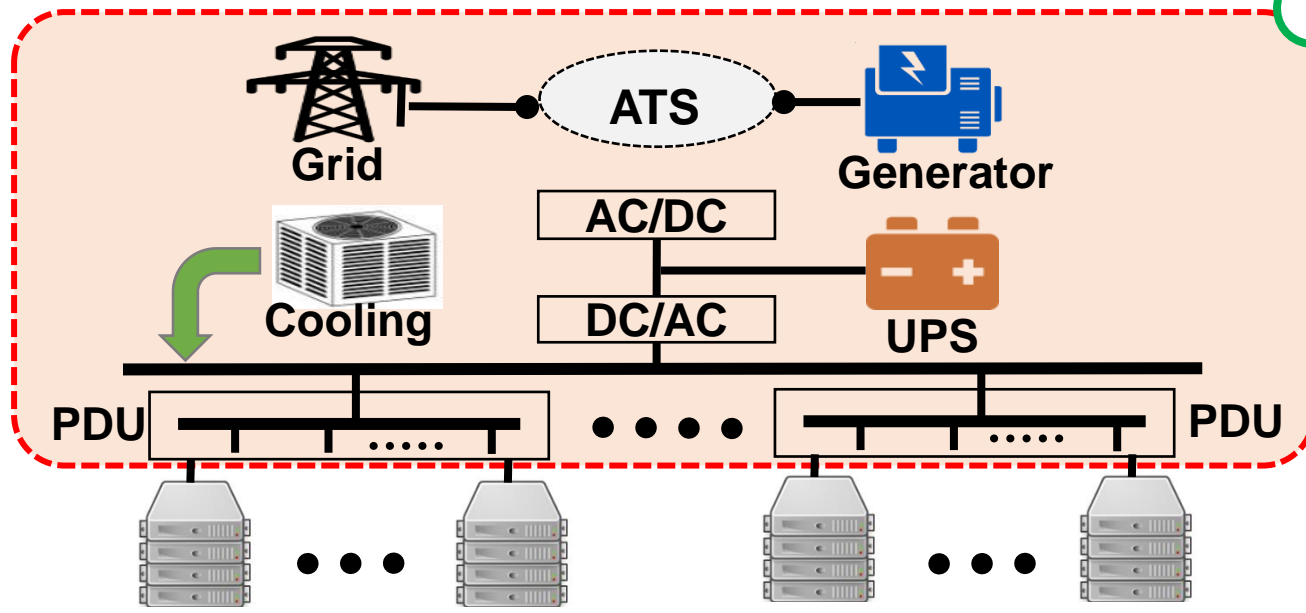
# Multi-tenant data centers





# Multi-tenant data center

Managed by the operator, and shared by all tenants.



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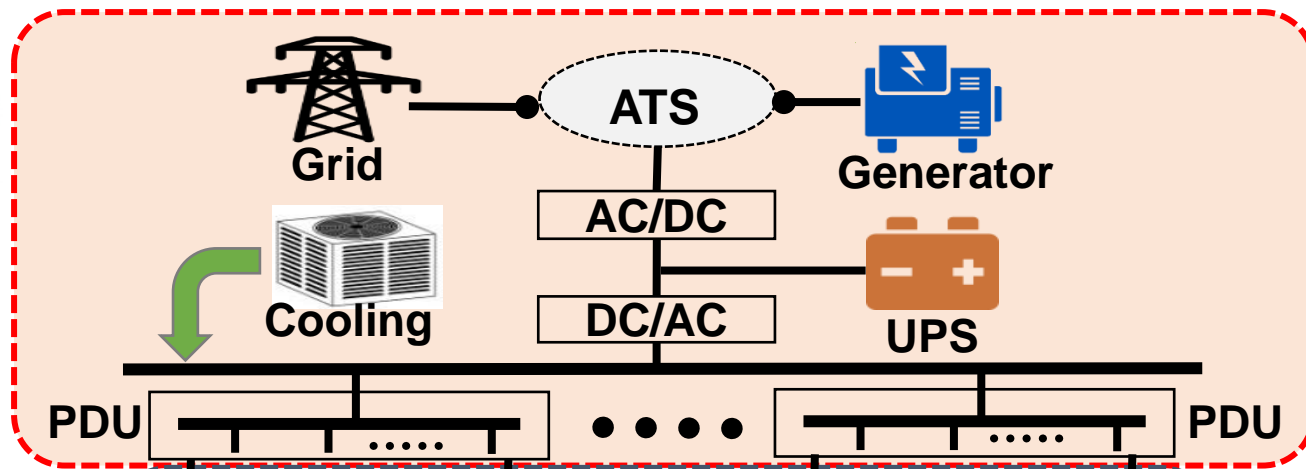




# Problems

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We have many constraints, such as rack-wise capacity infrastructure and cooling...

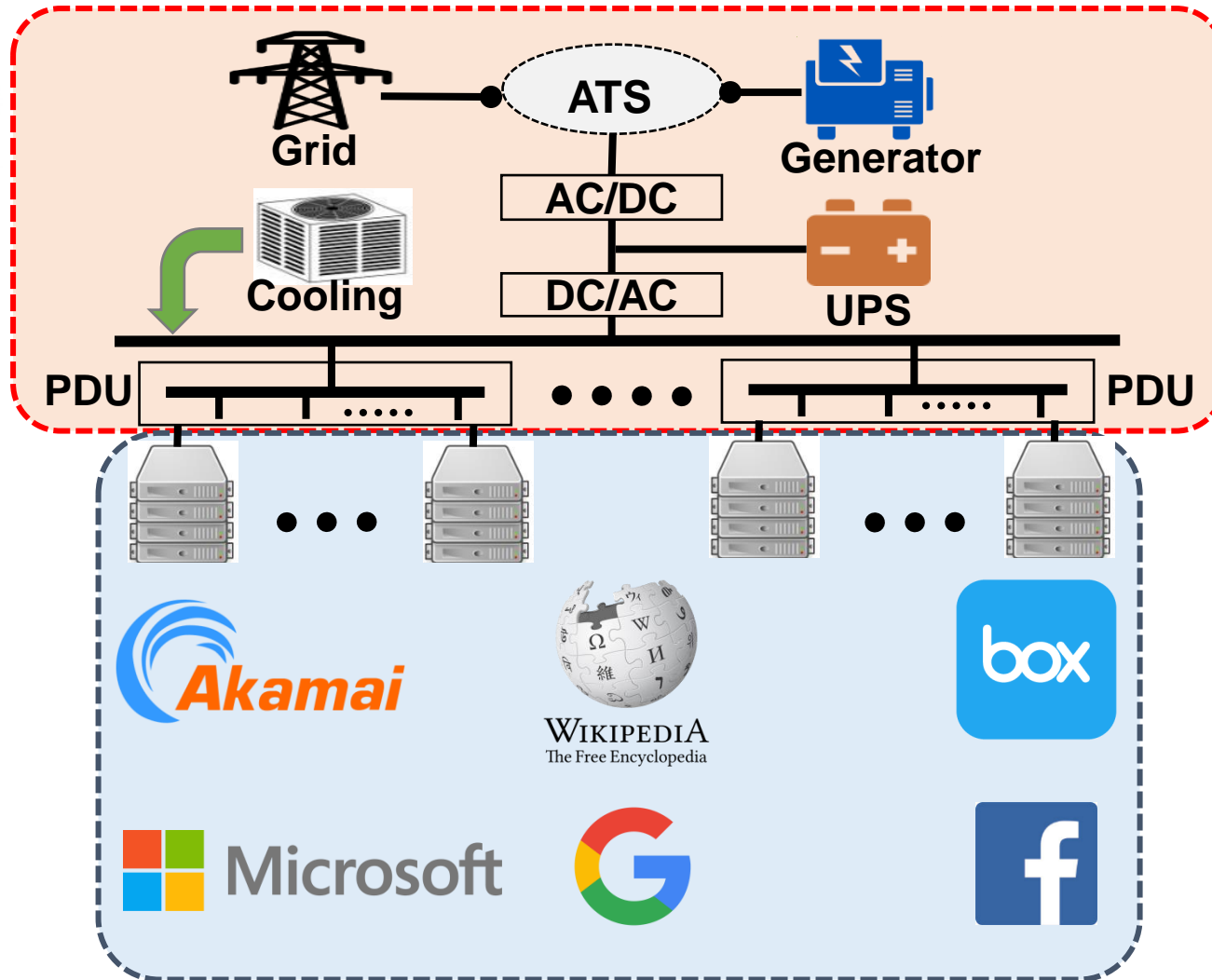


Operator has **no** control over tenants' workload or power demand at runtime

# Problems

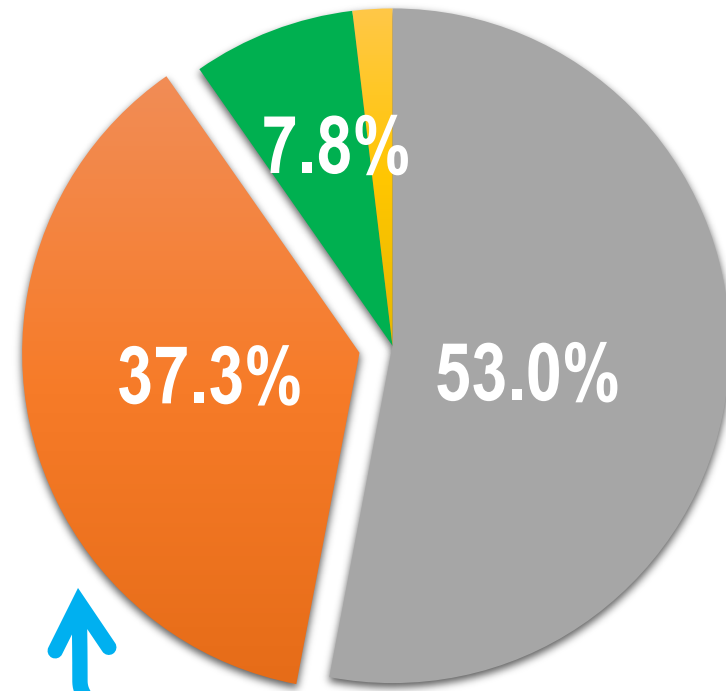
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We need  
tenant-operator  
coordination

# Where our work stands



Our focus on **multi-tenant data centers**



# Thank you!



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