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Hyperscale Datacenter Architecture

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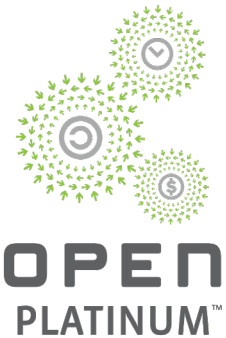
Hyperscale Datacenter Architecture Trends

Varun Sakalkar
Principal Engineer, Google



Contents

- Key drivers
- Solution approaches
- Call to action

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Hyperscale Datacenter Architecture

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5 drivers

- Faster capacity delivery
- Global deployment footprints
- Diversified IT product portfolio
- Sustainability
- Security

Solutions

Modular systems

Manage energy demand & supply fluctuations

Secure systems

Mission: Modular, Secure systems that can track to energy demand & supply fluctuations globally

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Faster Capacity Delivery

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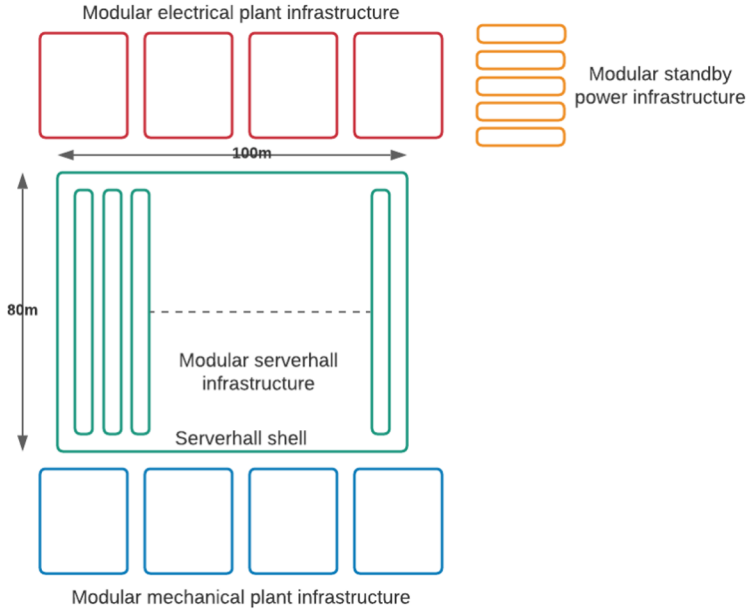
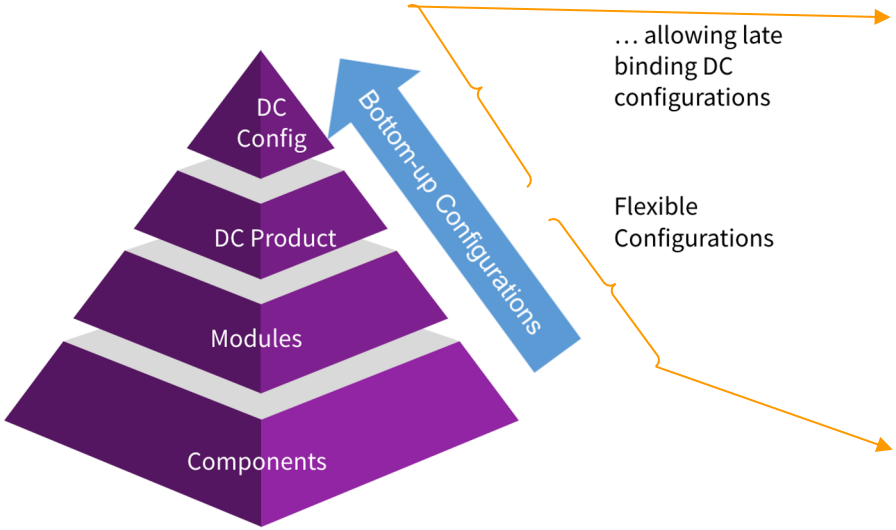
"Reduce time to first and/or incremental MW"

(a) Modular design and permitting
(b) Incremental capacity deployment
(c) Pre-manufactured & inventoried infrastructure components



Modular designs - Flexibility, configurability & extensibility



Data center configuration as a function of

- Controlled interface specification
- Standard kit of parts and local variations

Flexibility in product portfolio

- Design and engineer products to allow for customizations or deployment variances
- Understand variance drivers to inform product strategy

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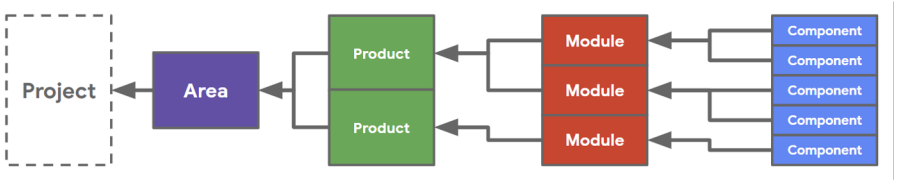

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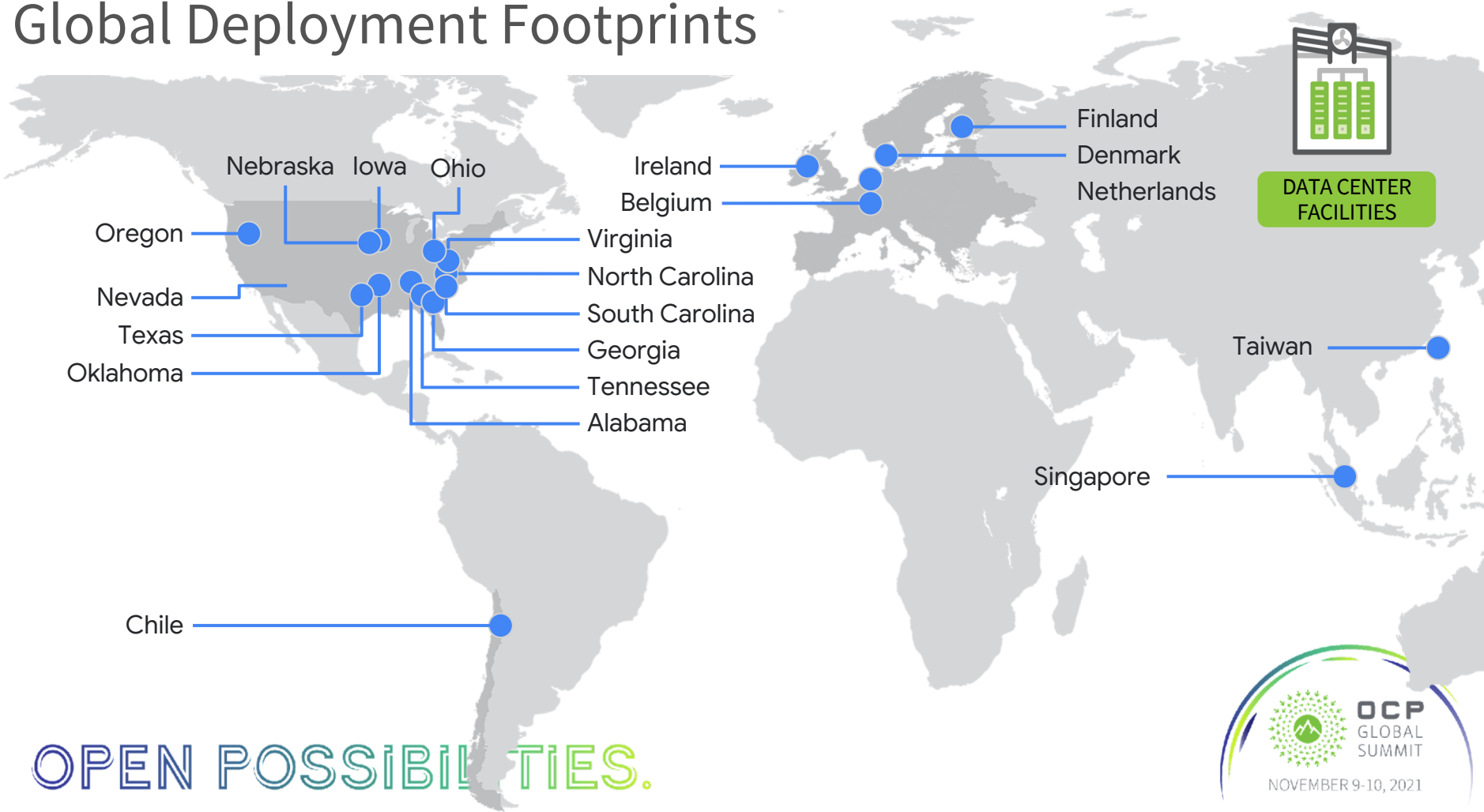
Global Deployment Footprints



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Global Deployment Footprints

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"Design once, deploy everywhere"

(a) Minimal customizations for site-specific requirements
(b) Regional (global, if possible) inventory pools
(c) Suppliers with global reach

Diversified IT product portfolio

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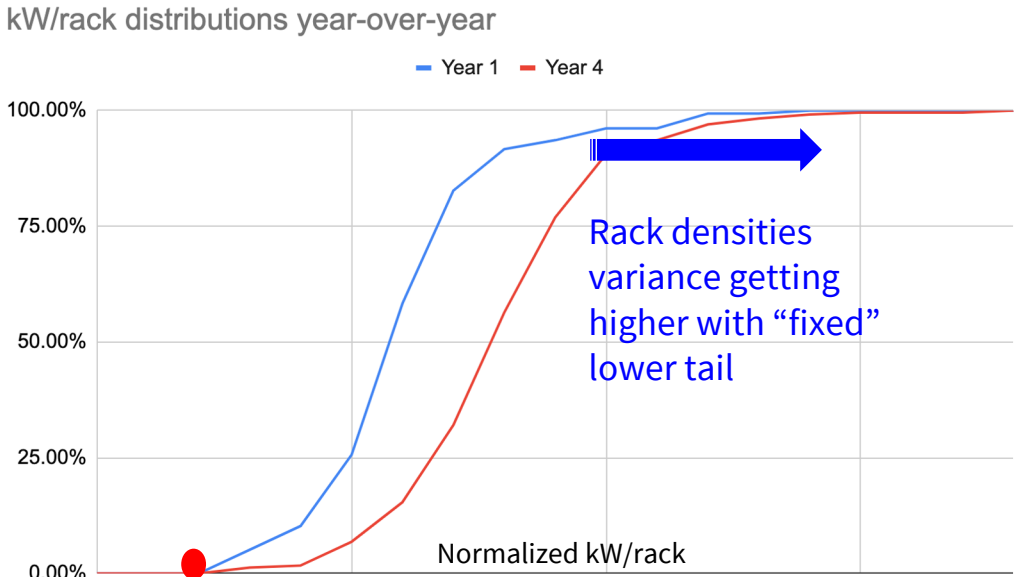
"Payload-agnostic datacenters"

(a) Increasing power densities: x86, ARM and ML
(b) Support industry trends: liquid & immersion cooling



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Power density variance and deployment efficiency

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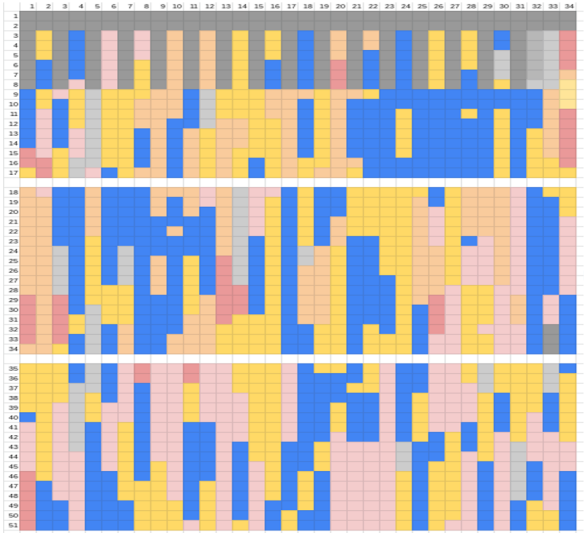
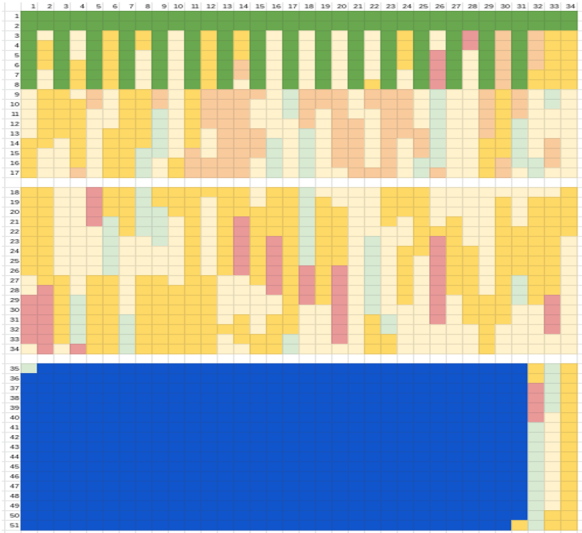
- Leverage deployment tools to enable cost optimized rack density deployment, while expanding physical deployment constraints
  - Enable high density air cooled rack deployment
  - Provision for flexible DC fit out





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Sustainability

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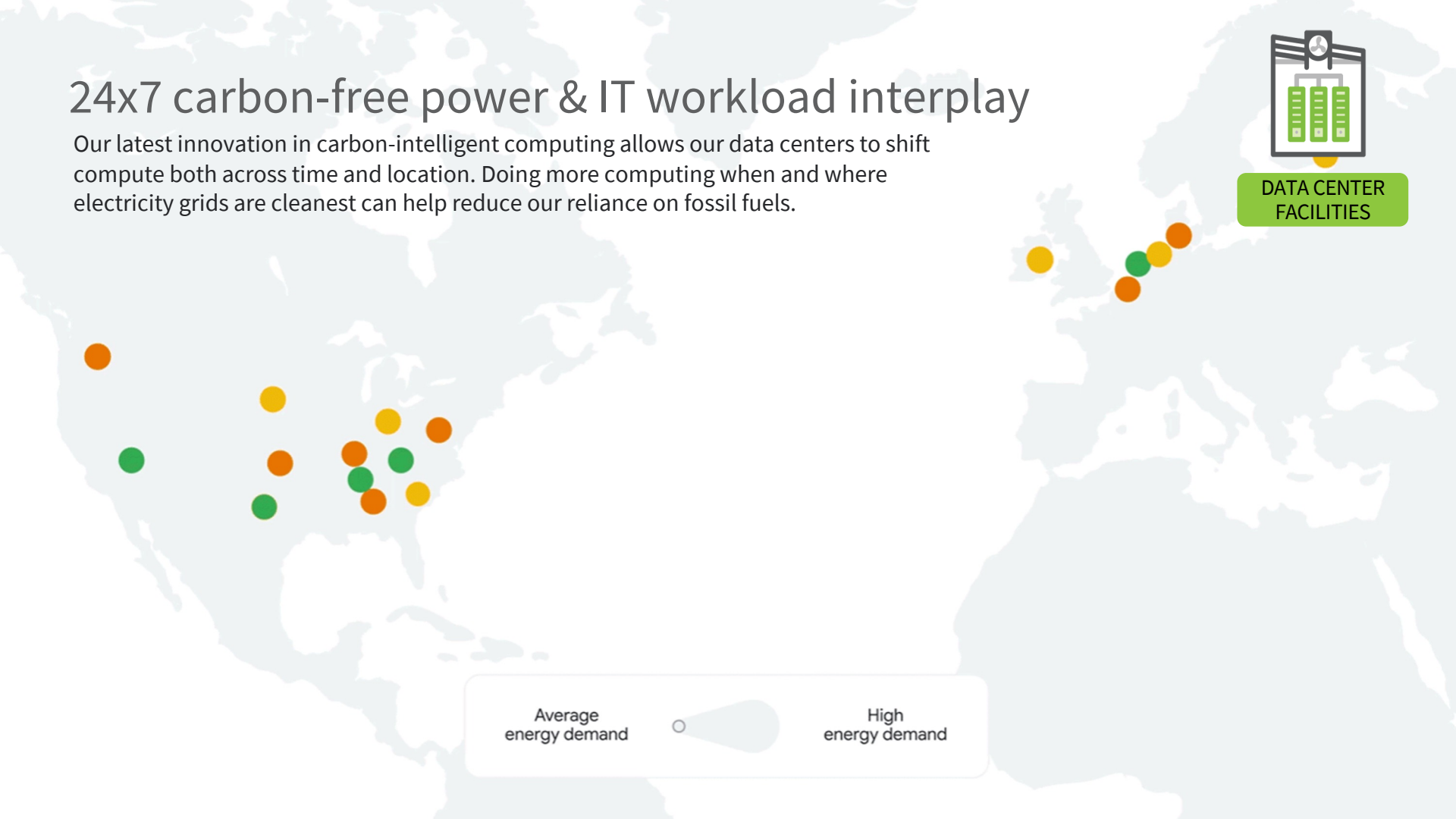
"Zero-carbon and zero-water operations"

(a) 24x7 carbon-free power & IT workload interplay*
(b) Availability of water
(c) Zero-carbon backup power

*"We now do more computing where there's cleaner energy", Google Blog, May 2021

24x7 carbon-free power & IT workload interplay

Our latest innovation in carbon-intelligent computing allows our data centers to shift compute both across time and location. Doing more computing when and where electricity grids are cleanest can help reduce our reliance on fossil fuels.



Shifting compute across locations

By shifting compute across location as well as time, we're able to further reduce the carbon intensity of our applications around the clock and around the globe.

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Cleaner backup power to enable 24/7 CFE

First-ever

battery backup system for generator replacement at a hyperscale data center

Flexible capacity

provided to grid, paving the way toward a clean energy future

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Security

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"OT hardware and software on par with IT workloads"

Key Steps:

(a) Rigorous approach to securing OT equipment
(b) Standardize data payloads for faster integration

Design Principles:

1. Increase complexity for a successful compromise (prevent & detect) and,
2. Reduce blast radius of a compromise (identify, prevent, detect, respond & recover).

Call to Action

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- Commonalize infrastructure: Greater pan-industry collaboration on standards and interfaces
  - Eg., Distribution voltages, process water supply & return temperatures etc
- Hyperscale partners and suppliers: Modular & manufactured product mindset
- Co-design between IT hardware design and datacenter workstreams
- Articulate a common set of objectives for 24x7 and reduced-water technologies
- Agree on requirements for next-gen open protocol for infrastructure devices, addressing security, semantic richness, broad applicability

Thank you!