Data Center Efficiency Workshop

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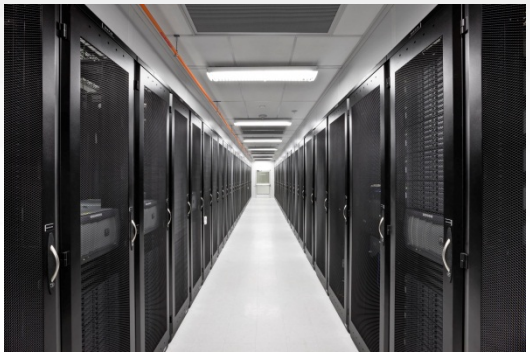
Agenda

1) NetApp Data Centers and Lab Profile
2) NetApp DC design Attributes
3) Generations of NetApp DC designs
4) IT Equipment Environmental Specifications
   - Temperature
   - Humidity
   - Particulate Contamination
5) NetApp DC/Lab Environments
6) Best Practices and what we can improve upon
7) Q & A

NetApp Data Center and Lab Profiles

- RTP GDL-2 (Global Dynamic Lab#2) – May 2014
  - Product Development (Owned and Operated)
  - 2235 52U Racks @ 9 kW/rack with an estimated annual PUE = 1.14
- HDC (Hillsboro Data Center) - Aug. 2012
  - Production Site 1 – Corporate IT (Custom Wholesale Lease)
  - 480 52U Racks @ 9.3 kW/rack with an estimated annual PUE = 1.3
- RTP GDL-1 (Global Dynamic Lab#1) – Apr 2010
  - Product Development/Corporate IT DR Site 2 (Owned and Operated)
  - 2160 52U Racks @ 12 kW/rack with annual PUE = 1.18
  - 1st EPA Energy Star Certified Data Center in the US
- SVL B2.1 Lab – Aug 2008
  - Product Development (Owned and Operated)
  - 720 52U Racks @ 8 kW/rack with annual PUE = 1.34
- SVL B11DC – Mar 2005
  - Corporate IT – former production DC –current Site 3 Tertiary storage (Owned Operated)
  - 330 47U Racks @ 2.4 kW/rack with annual PUE = 1.4

NetApp Data Center and Lab Attributes



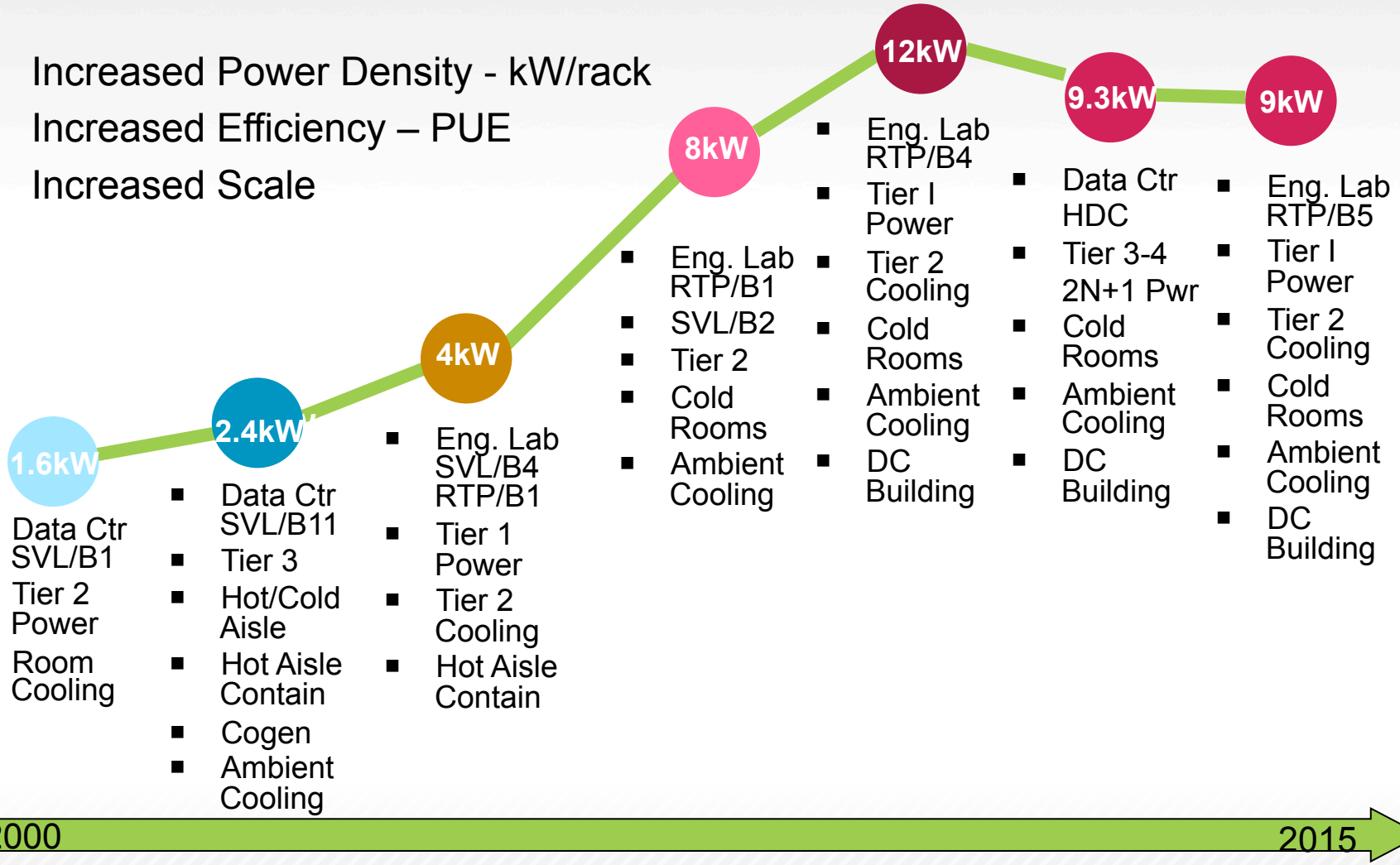
- Outside Air Economizers
- No raised floors - Overhead Duct
- High Efficiency CRAH's
- High Efficiency Chilled Water Plants
- Cold Aisle Containment
- Barometric Relief Dampers
  (Newer designs)
- Busway Electrical Distribution
- Flywheel UPS

NOTE: Wholesale Colo (non-owned)

HDC uses RTU's with OAE and Battery UPS

5 Generations of DC Design @ NetApp

- Increased Power Density - kW/rack
- Increased Efficiency – PUE
- Increased Scale



Cisco Nexus

Environment

- Operating temperature
  - 32 to 104°F (0 to 40°C)
- Humidity
  - 5 to 95% (noncondensing)
- Altitude
  - 0 to 13,123 ft (0 to 4000m)

NetApp FAS 8000 & 6200 Series

System Environmental Specifications

- Operating Temperature
  - 10° C to 40° C (50° F to 104° F)
- Relative Humidity
  - 20% to 80% relative humidity, noncondensing (28° C wet bulb temperature)
- Altitude
  - at <= 3,000 m (at <= 10,000' feet) elevation

IBM BladeCenters

HS22/HS23 Environment:

- Air temperature:
  - Blade server on: 10°C to 35°C (50°F to 95°F). Altitude: 0 m to 914.4 m (0 ft to 3000 ft)
  - Blade server on: 10°C to 32°C (50°F to 89.6°F). Altitude: 914.4 m to 2133.6 m (3000 ft to 7000 ft)
- Humidity:
  - Blade server on: 8% to 80%

NEBS Environment

- Air temperature:
  - Blade server on: 5°C to 40°C (41°F to 104°F). Altitude: -60 m to 1800 m (-197 ft to 6000 ft)
  - Blade server on: 5°C to 30°C (41°F to 86°F). Altitude: 1800 m to 4000 m (6000 ft to 13000 ft)
- Humidity: 8% to 85%

IBM – Particulate Contamination

Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document. Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the device to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If IBM determines that the levels of particulates or gases in your environment have caused damage to the device, IBM may condition provision of repair or replacement of devices or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 1. Limits for particulates and gases

Particulate	•The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2[1]. •Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. •The deliquescent relative humidity of the particulate contamination must be more than 60%[2]. •The room must be free of conductive contamination such as zinc whiskers.
Gaseous	•Copper: Class G1 as per ANSI/ISA 71.04-1985[3] •Silver: Corrosion rate of less than 300 Å in 30 days

2000

NetApp DC/Lab Environments

DC/Lab Environment to match equipment requirements in consideration of the human factor

- Air temperature:
  - ~ 74F (23.3C) SAT
  - ~ 16F ΔT
- Humidity:
  - 20% to 80% (70% stop limits in some facilities) No added humidity (ex. HDC)

NetApp DC/Lab Environments

Particulate Control

- Air Intake Prefilters
  - MERV 8-13 AHU filters
  - Particulate Monitoring with control integration (Aircuity in SVL B2)
  - Humidity:
  - 20% to 80% (70% stop limits in some facilities) No added humidity (ex. HDC)

- Gaseous Contamination
  - Purafil Corrosion Coupons
  - Purafil ONGuard 3000 active monitoring/control integration (SVL)

RTP B4 Controls - sample

- Cold Room Pressure Control
  - Each cold room controlled to 0.001”WC DP adjustable by varying the VFD
    - The VFD PID holds when the associated cold isle door is open
    - The VFD PID does not calculate when pressure is within 0.00075 of setpoint.
    - In each case this must be the output from the PID not analog output to the VFD signal.
- Occupancy
  - Current Relay on Hot aisle lights will occupy two adjacent cold rooms.
  - Occupancy will have a delay on off of 1 hour
- Supply Air Temperature
  - Each unit supply air temperature controlled by the modulating chilled water valve and economizer to maintain 65°F occupied 75°F unoccupied, adjustable.
  - Supply valve and actuator per P&ID. 10’ Pressure drop across valve.
  - Rate of temperature change is limited to 5°F per hour

RTP B4 Controls - sample

- Economizer Operation
  - Modulate dampers to maintain mixed air setpoint to setpoint
  - Economizer enabled by differential enthalpy
- Humidity control
  - Enable humidifier @ 25%, adjustable (no longer in place)
- Auxiliary Damper Control
  - Cold room Dampers
    - Provide (installed by mechanical contractor) dampers and spring return NO actuators
    - Actuator mounted on inside of damper for cold room access
  - Pressure Control
    - Each auxiliary damper modulated by it's PID when the VFD PID is equal to 100%, or all fans to that room failed, to maintain the room pressure setpoint
  - Dehumidification Control
    - Each auxiliary damper has an individual minimum damper position controlled by space humidity PID

Questions

RTP B5 GDL-2

HDC Cold Room