Higher Temperatures Without the Heat

Raising Temperatures without Sacrificing Redundancy

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Speaking

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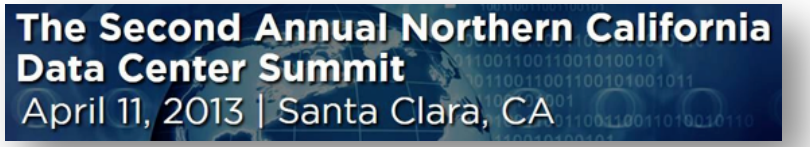
Questions

Please send questions to the host and panelists at any time by entering them in the Q&A and Chat panel.

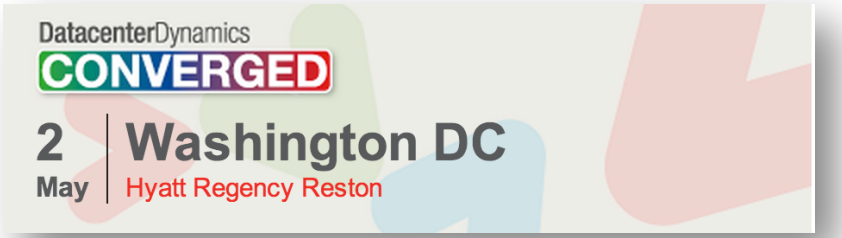
Agenda

- Review
  - What's all the buzz?
  - Review of benefits
- Potential risks
  - Hot spots
  - Reduced ride-through
  - Higher IT failure rates
- Q&A

All The Buzz



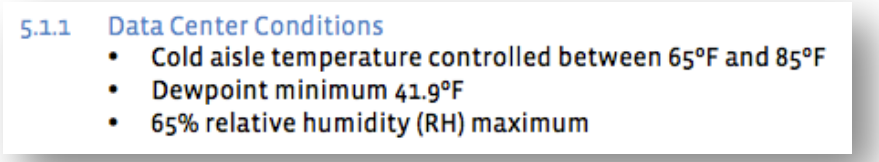
2013 NorCal CapRate Summit



2013 Data Center Dynamics - DC

2004	2008	2011
68°F - 77°F 20°C - 25°C	64.4°F – 80.6°F 18°C - 27°C	Recommended vs. Allowable

ASHRAE guidelines are widening



Facebook Open Commute

ASHRAE Standards

ASHRAE Allowable vs. Recommended

Recommended: *The recommended envelope defined the limits under which IT equipment would operate the most reliably while still achieving reasonably energy-efficient data center operation*

	Recommended
Temperature	64.4°F – 80.6°F 18°C - 27°C
Humidity	41.9°F - 59°F DP 5°C - 15°C DP

Allowable: *It is acceptable to operate outside the recommended envelope* (i.e. in the allowable envelope) *for short periods of time without affecting the overall reliability and operation of the IT equipment.*

	Allowable
Temperature	59°F - 89.6°F 15°C - 32°C
Humidity	20% - 80% RH

Benefit Review

- Reduce fan energy
  - Ramp down or turn off CRACs/CRAHs
- Increase economizer hours
  - Decrease mechanical cooling, utilize outside air
- Increase chilled water supply temperature
  - 1.5% chiller efficiency increase per °F increase
- Increase RAT set points
  - 2.7% cooling capacity increase per °F increase

Temp Increase Concerns

- Hot spots
- Reduced ride-through
- Higher IT failure rates

Hot Spots

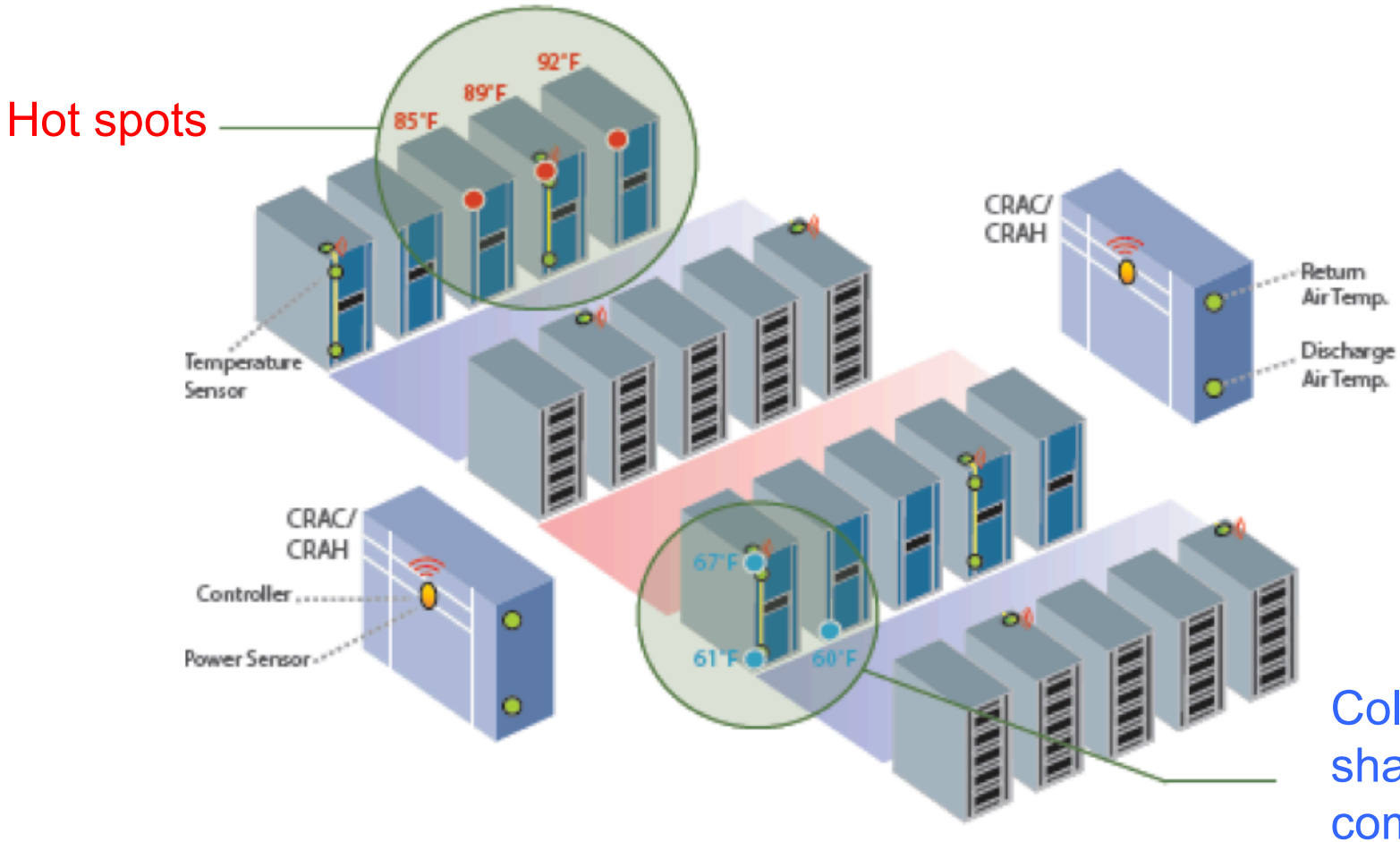
Hot Spots: Concern

- Violation of Service Level Agreements (SLAs)
- Corporate IT standards
- If it’s not broke don’t fix it
- Lack of visibility

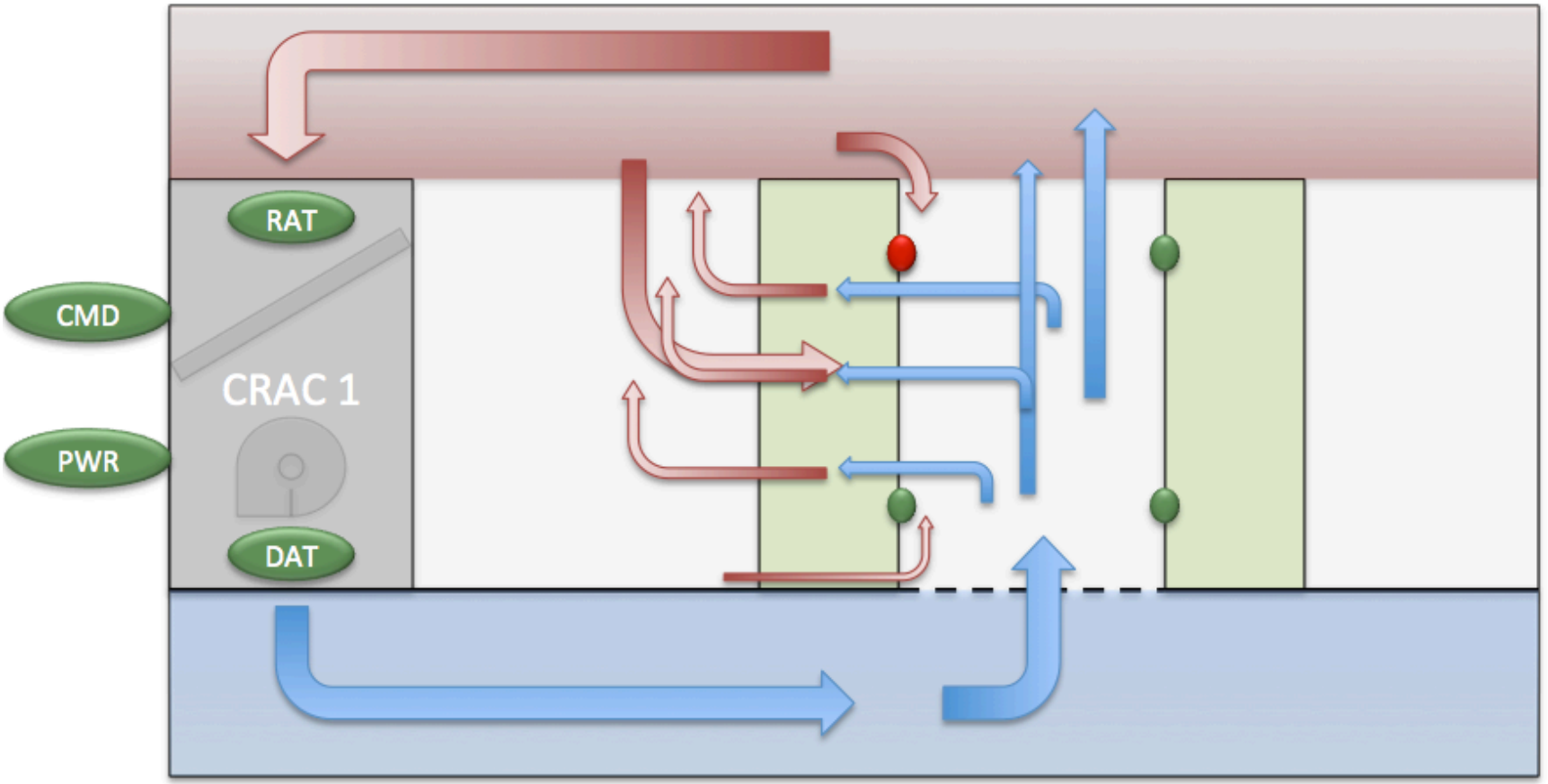
Hot Spots: Definition

- Where measured rack inlet temperatures are above ASHRAE limits/corporate standards
- Hot spots are common
- What causes hot spots?
  - Mixing
  - Excessive airflow
  - Poor air distribution
  - Equipment layout/design

Hot Spot Identification



Mixing By Excessive Airflow



Hot Spots Mitigation

- Identify hot spot locations
- Fix airflow
- Adjust mechanical cooling
- Automate and optimize
- Educate, educate, educate

Roadmap to Raise Temperatures

- Download it here:

  http://www.vigilent.com/downloads/webinars/Roadmap%20to%20Raising%20Temperatures.pdf

Ride-Through

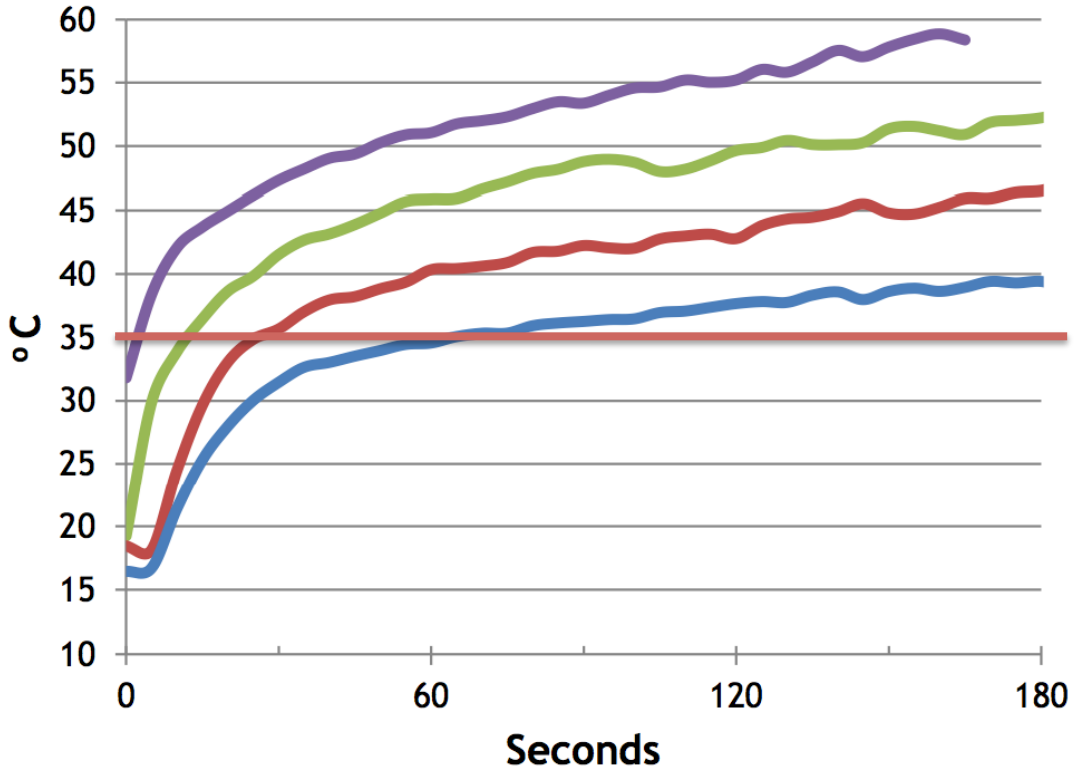
Ride-Through: Concerns

- Ride-through time goes down
- Less time to respond to cooling failures

Ride-Through: Definition

- How much time a facility has to ride through a cooling failure without reaching critical temperature.
  - Critical temperature: 95°F (35°C)
  - IT Thermal Shutdown: 120°F - 140°F (50°C - 60°C)

Total Cooling Failure

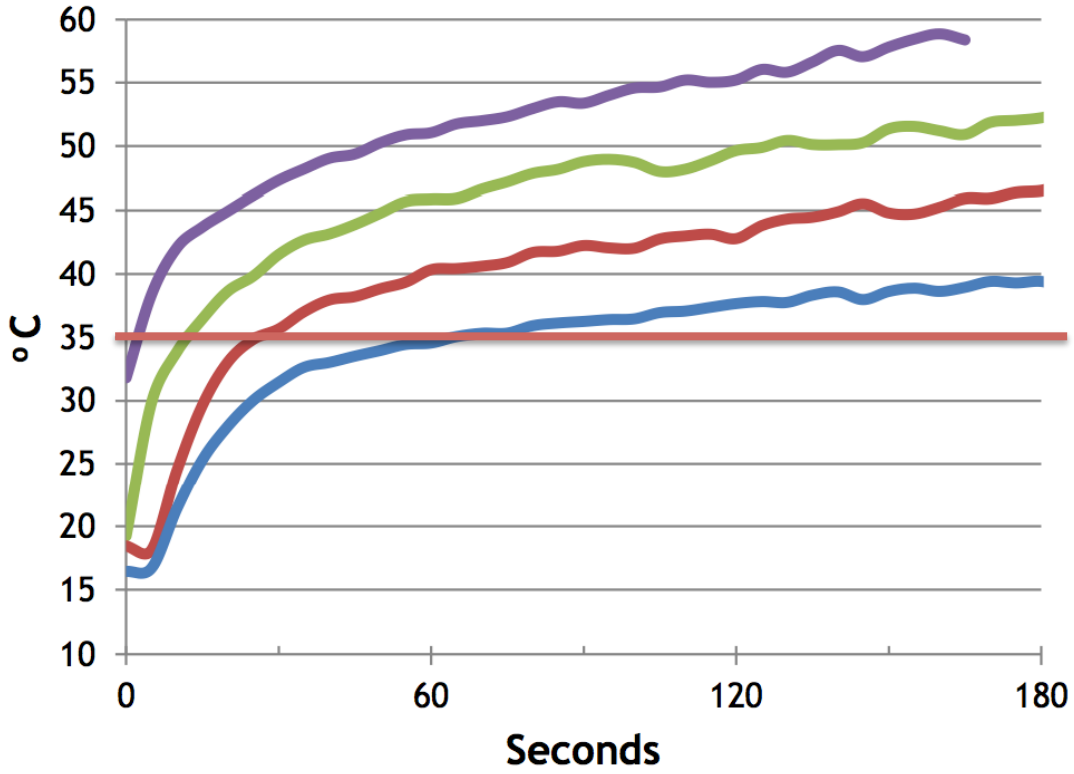


Initial Temperature Rise Rate

450W/sq ft	0.55 °C/sec
350W/sq ft	0.60 °C/sec
250W/sq ft	0.81 °C/sec
150W/sq ft	0.51 °C/sec

Source: Dell White Paper

Total Cooling Failure



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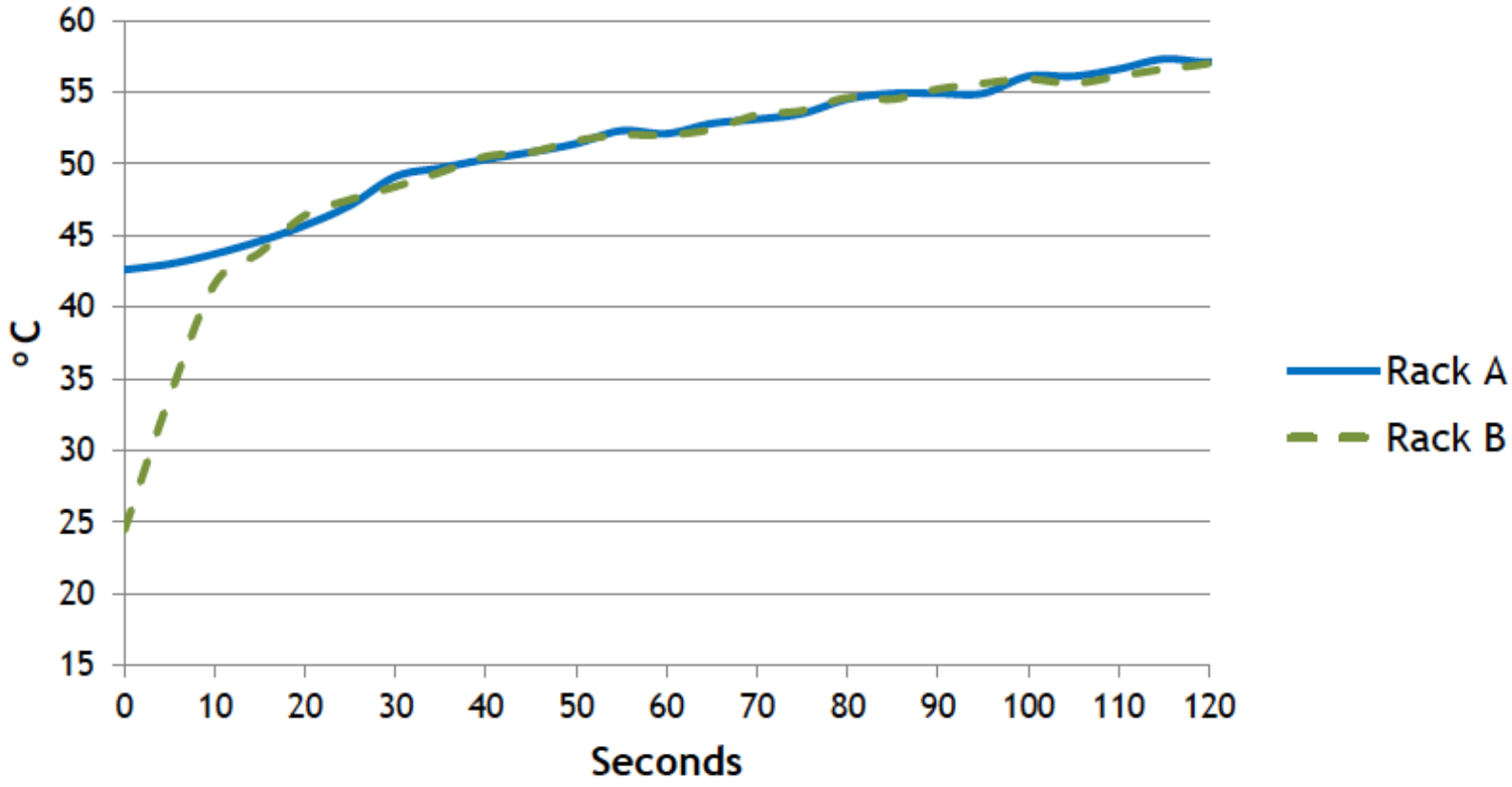
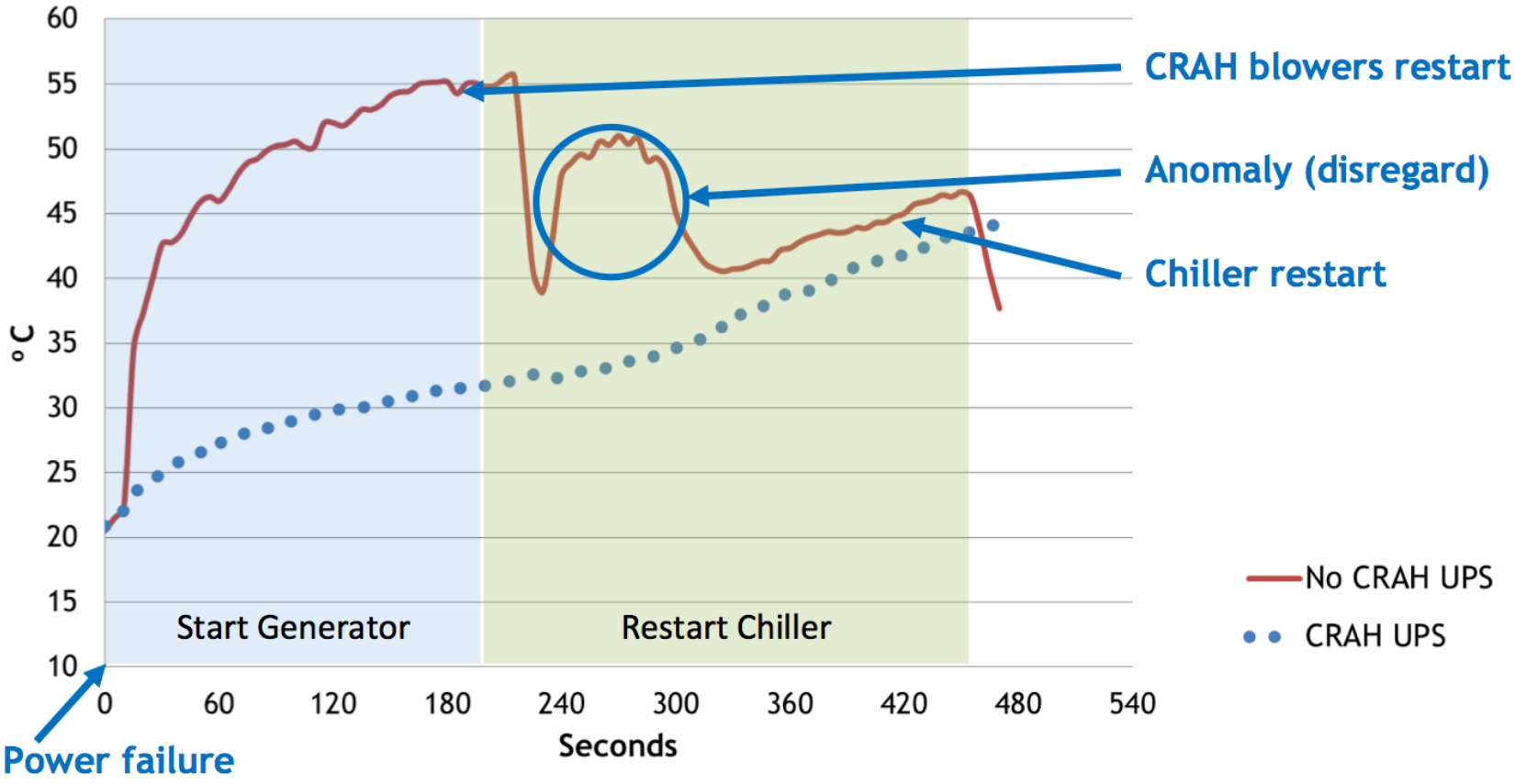
Cold spots get hot quicker

Effects of Over-Provisioning



Source: Dell White Paper

Chiller Failure vs. Fan Failure

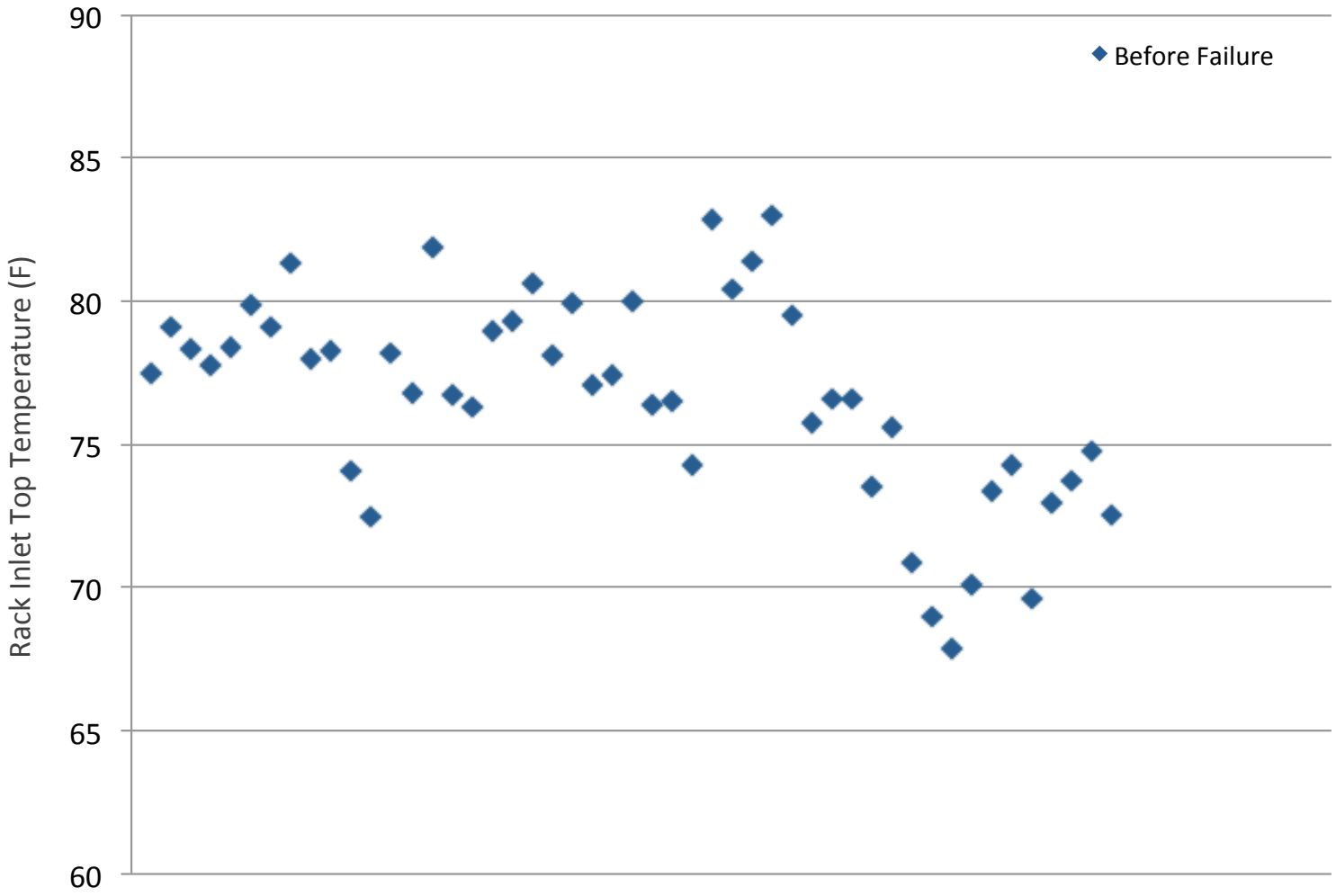


Source: Dell White Paper

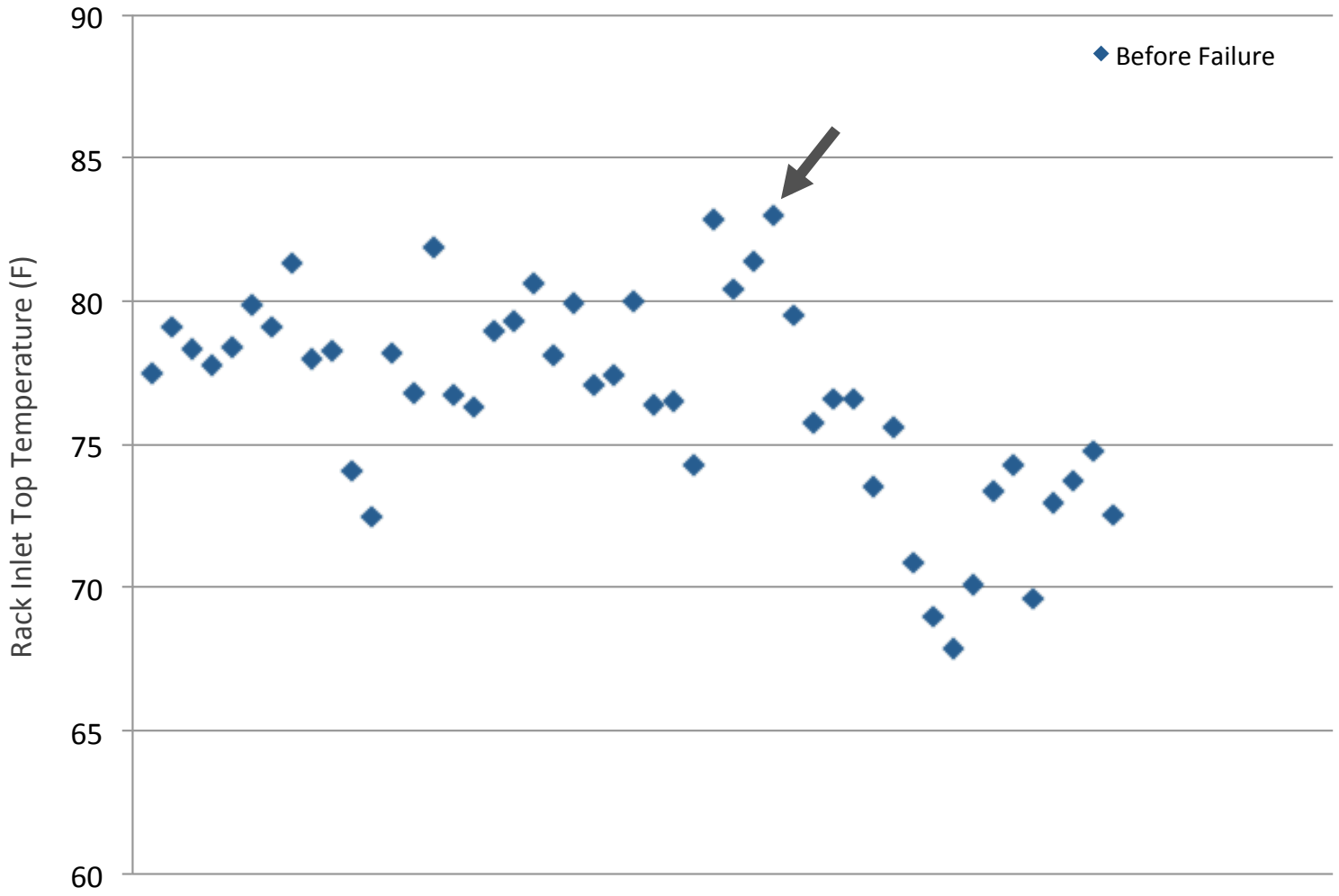
Total Failure Takeaways

- Colder temperatures rise quickly within seconds to meet warmer temperatures
- Fan failure causes temperatures to get to critical temperatures within seconds
- Chiller or DX failure, while maintaining circulation of airflow, results in a more gradual temperature increase

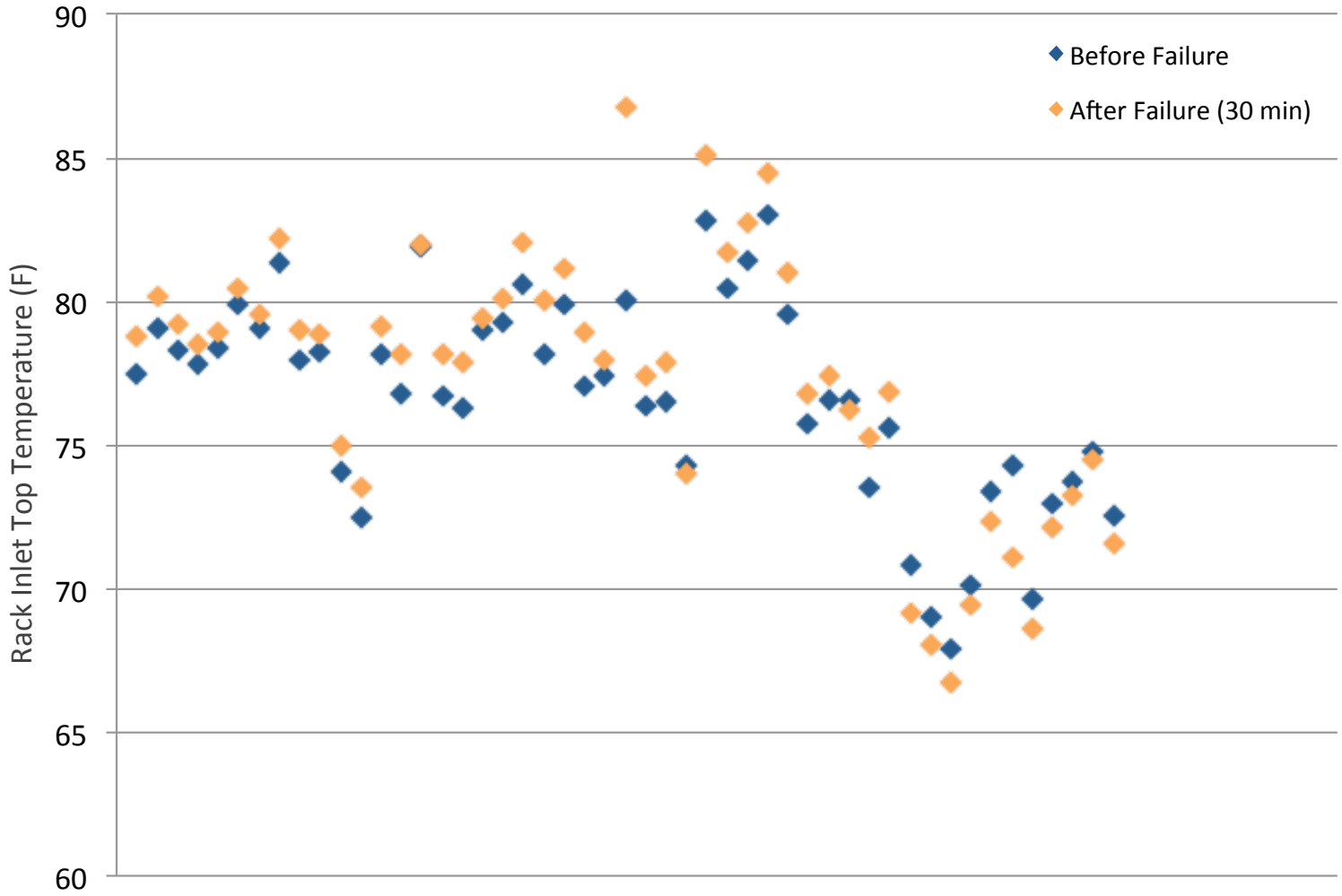
Individual CRAC Failure



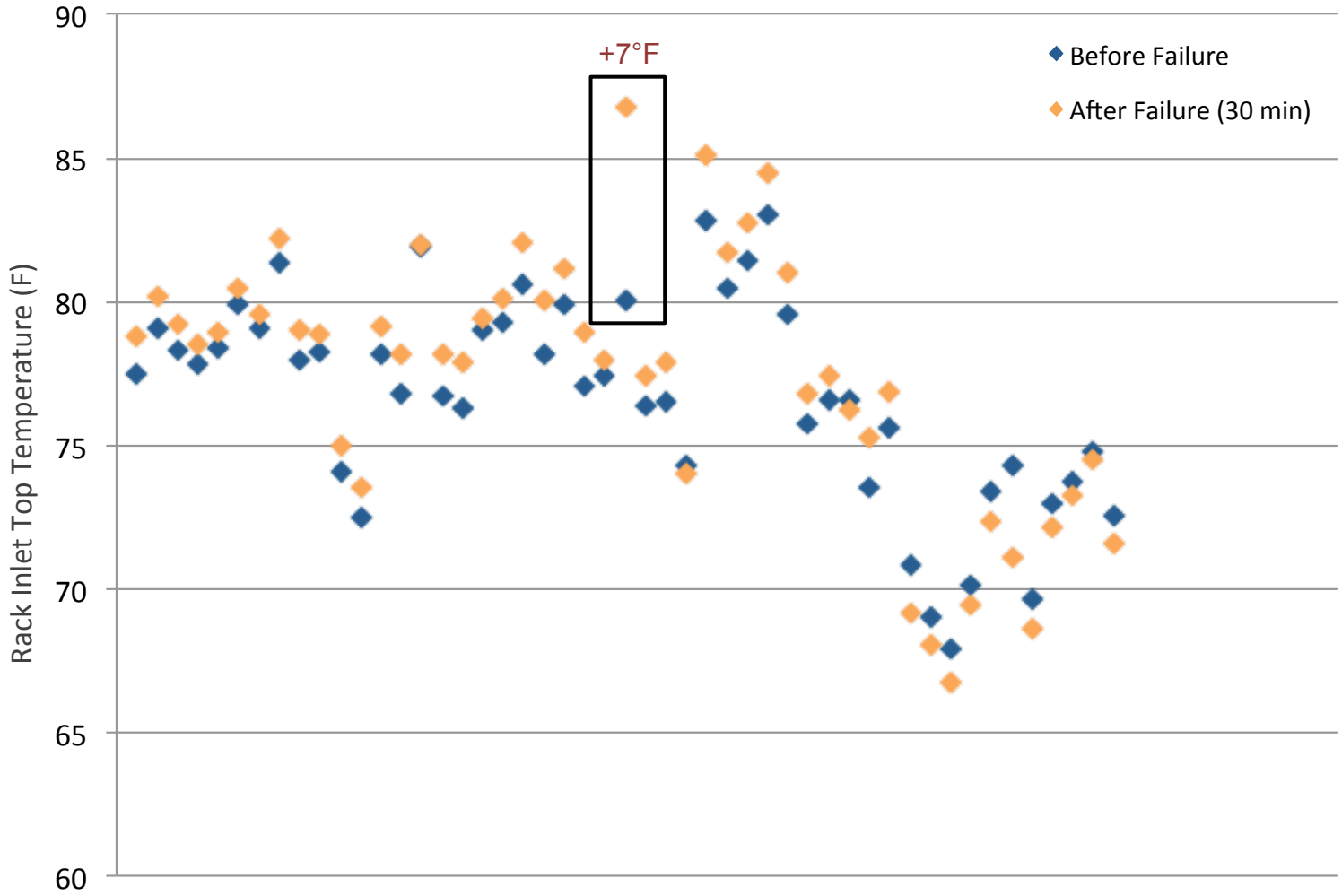
Individual CRAC Failure



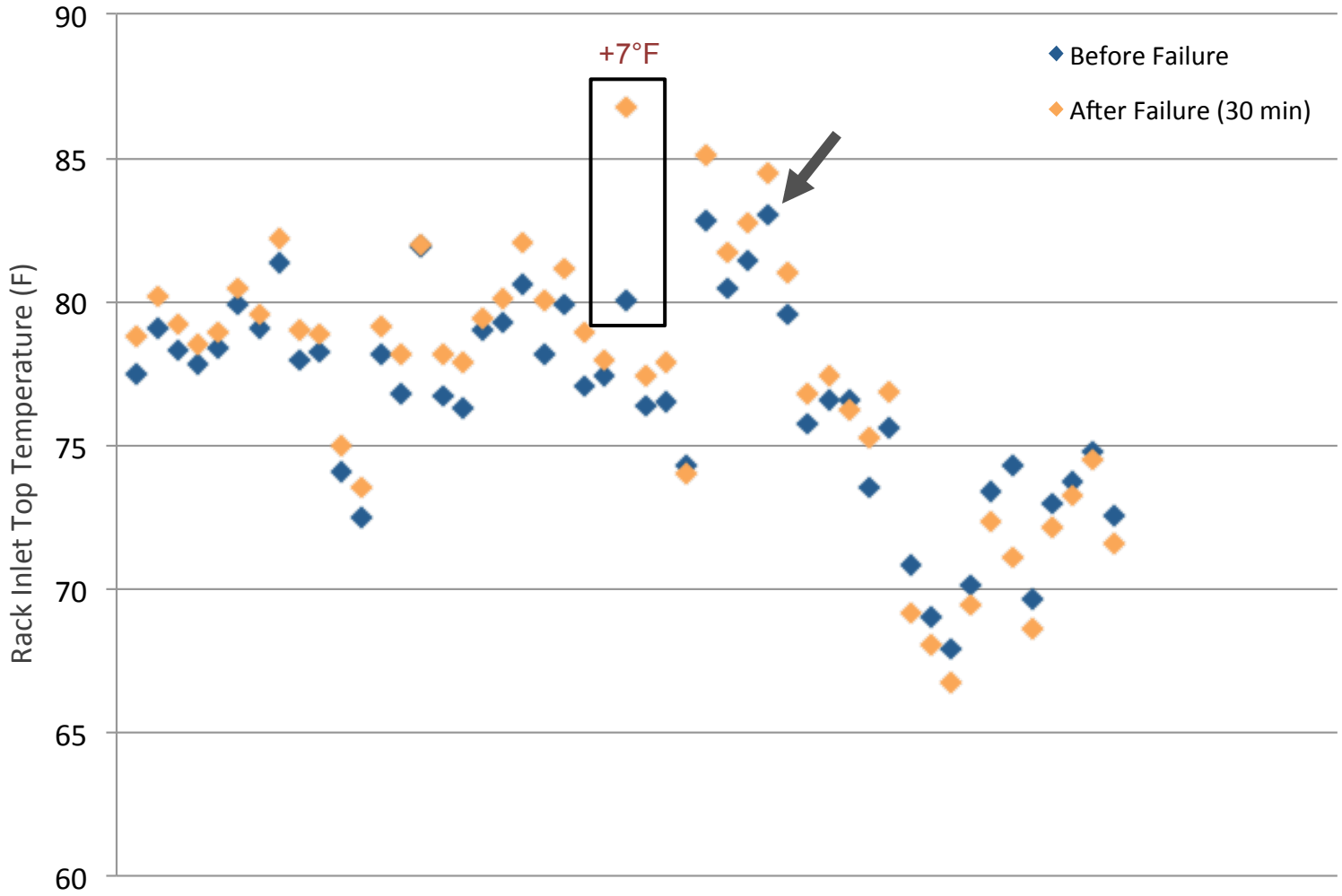
Individual CRAC Failure



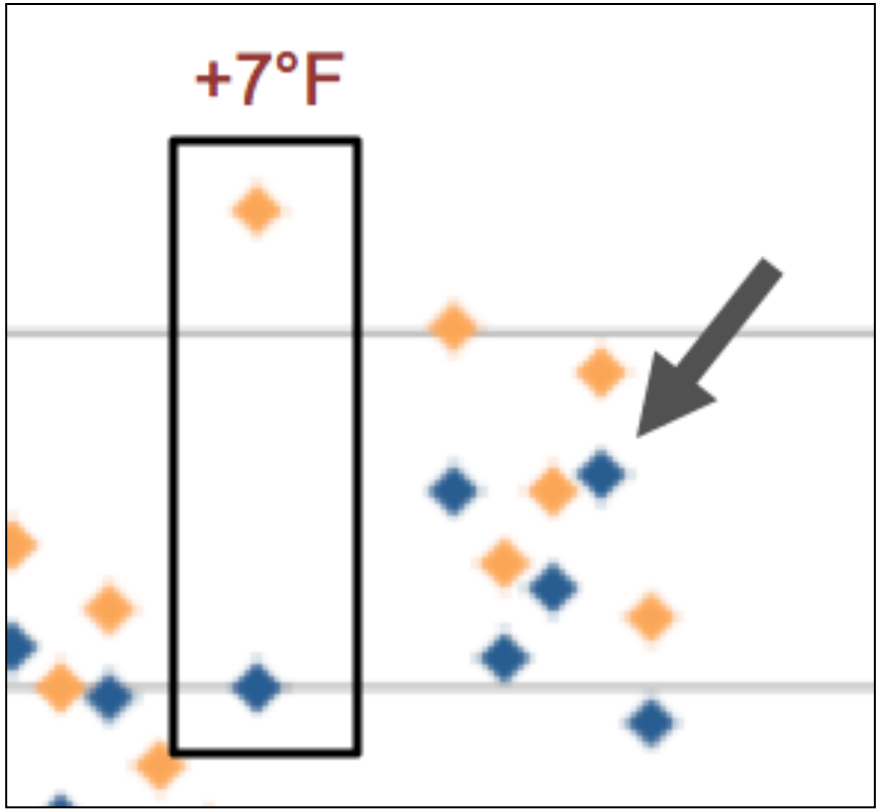
CRAC Failure Test



CRAC Failure Test



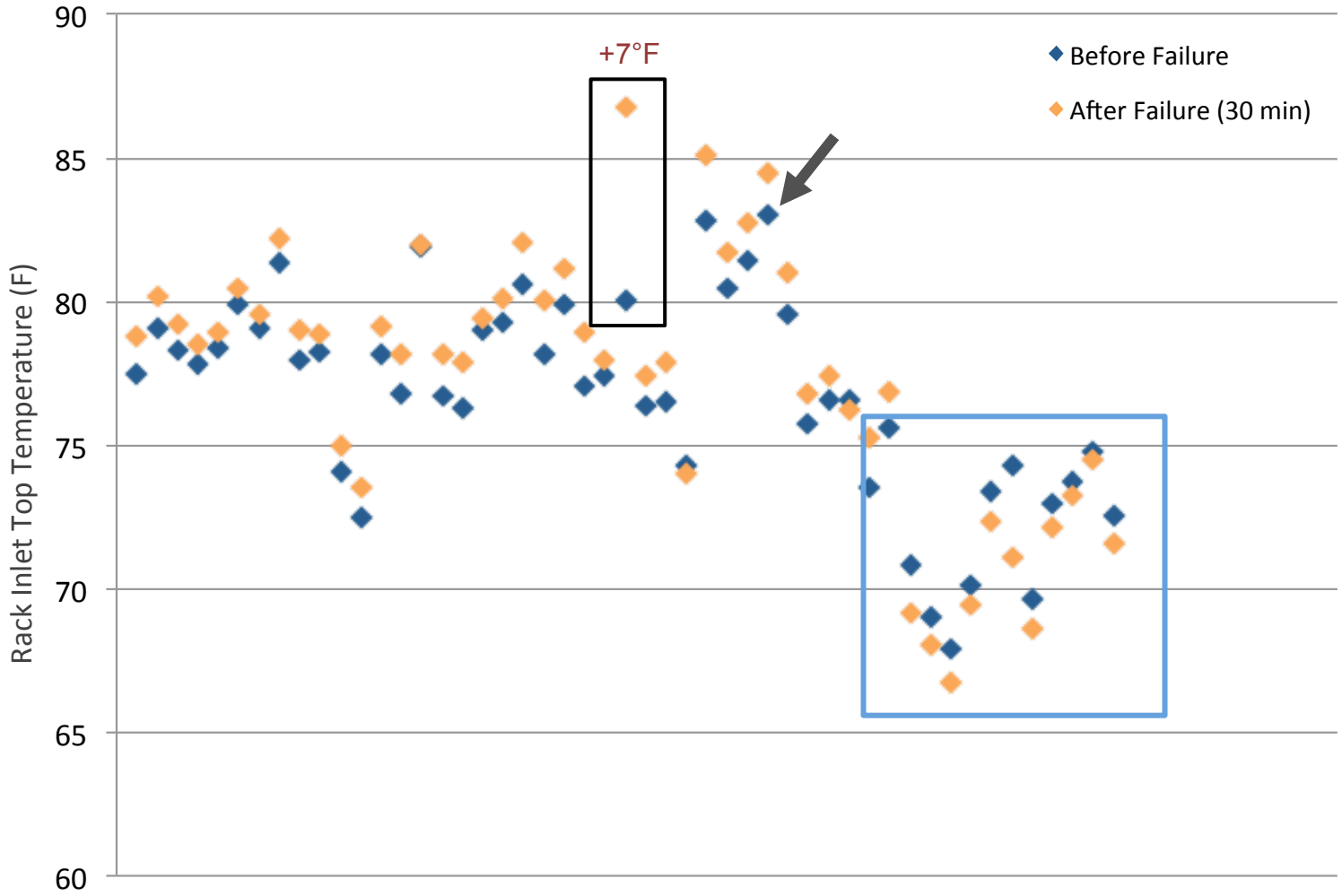
CRAC Failure Test



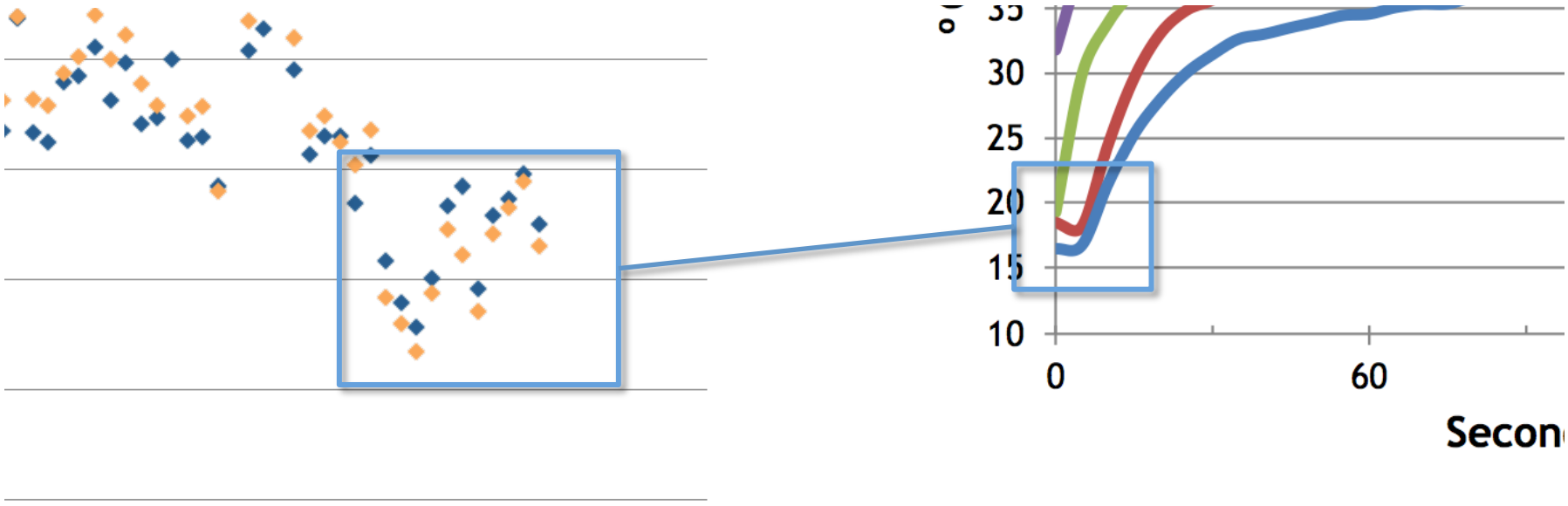
Before Failure

After Failure (30 min)

CRAC Failure Test



Temps go down!



Reducing airflow causes some temperatures to do go down

Ride-Through Takeaways

- Hot spots don't necessarily get hot the fastest
- Difference between 72°F and 80.6°F spots will only buy you seconds, not minutes
- Keeping airflow moving in the event of chiller or compressor failure can lengthen ride-through
  - Put your CRACs/CRAHs on UPS power

IT Failure Rates

IT Failure: Concerns

- IT equipment will fail more frequently at higher temperatures

X-Factor Analysis

Hardware Failure Rates at Rack Inlet Temperature

	Average	Aggressive	Conservative
Dry Bulb Temperature (C)	Average Failure Rate X-Factor	Lower Boundary of Failure Rate X-Factor	Upper Boundary of Failure Rate X-Factor
15	0.72	0.72	0.72
17.5	0.87	0.8	0.95
20	1.00	0.88	1.14
22.5	1.13	0.96	1.31
25	1.24	1.04	1.43
27.5	1.34	1.12	1.54
30	1.42	1.19	1.63
32.5	1.48	1.27	1.69
35	1.55	1.35	1.74
37.5	1.61	1.43	1.78
40	1.66	1.51	1.81
42.5	1.71	1.59	1.83
45	1.76	1.67	1.84

Source: Green Grid

Failure Analysis

- 1,000 servers operating for a year
- Baseline: 68°F (20°C)
  - 10 – 20 failures
- Typical Operation: 72.5°F (22.5°C)
  - 11 – 23 failures
- Proposed Operation: 81.5°F (30°C)
  - 14 – 28 failures

Only 0.4% – 0.8% more failures out of 1,000 servers

IT Failure Takeaways

- Tradeoff
  - Is 0.4% – 0.8% more server failures worth $100,000 energy savings?

Summary

- Hot spots
  - Identify, optimize airflow, educate
- Ride-Through
  - Cold spots get hotter faster
  - Keep air moving
- IT Failures
  - Slight increase in hardware failure, is it worth the savings?

Questions

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Thank you for attending!

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