

Cooling Strategies for Ultra-High Density Racks and Blade Servers

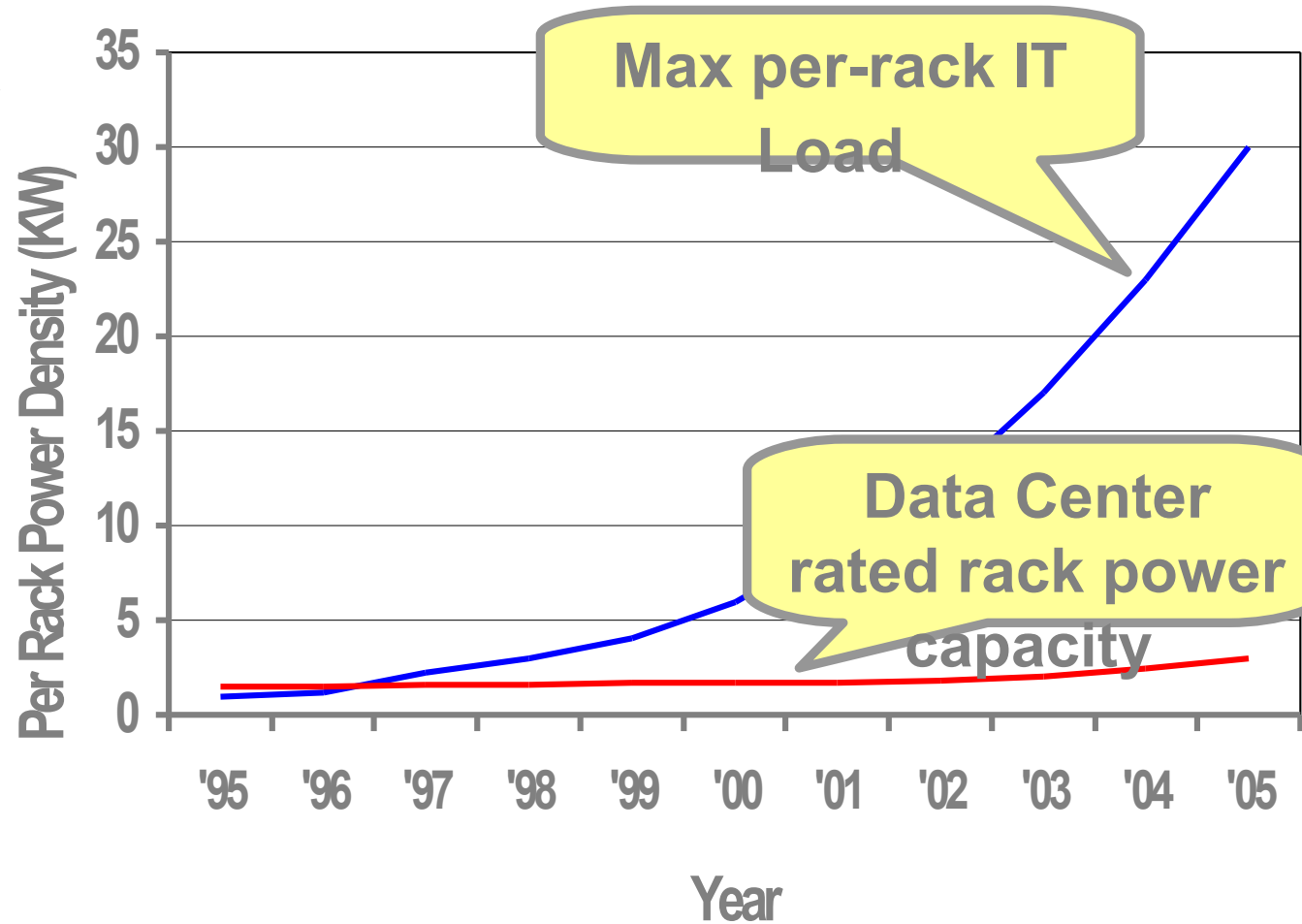


Wahid Nawabi
Director - WW Enterprise Segment
APC
E-mail: wahid.nawabi@apcc.com



Market Driver - High Density/Blade Computing

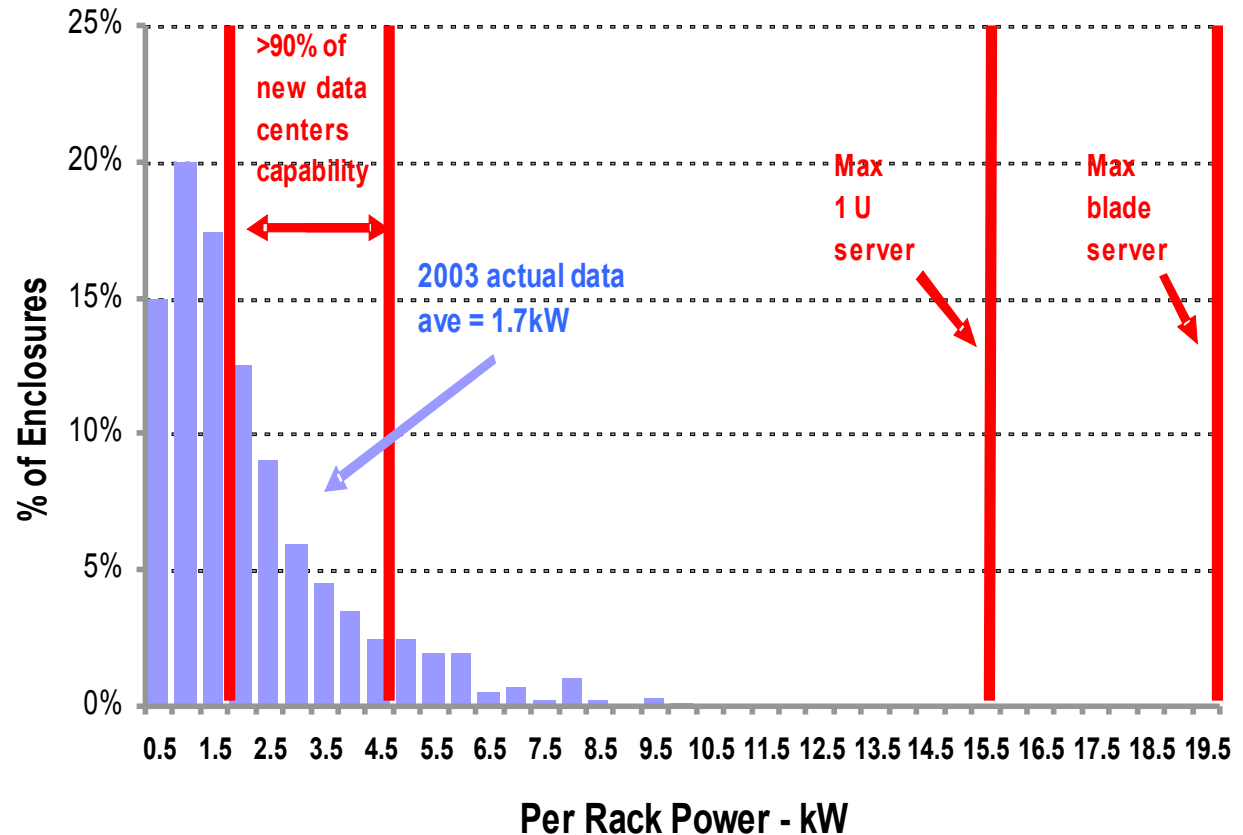
- IT Loads are Greatly Exceeding Rated Capacity
- Legacy Data centers are not designed or instrumented to provide information about localized density capability
- Users may not realize there is a problem until they attempt deployment



Blades greatly exceed the capabilities of Today's Data Centers!

Market Driver - Actual power draws in real data centers

- Blades Exceed Raised Floor Capabilities of Existing and New Data Centers
- Blade Servers Require up to 20 times Power & Cooling of Average Data Center Design Values



Blades exceed raised floor capabilities of existing and new data centers

Compaction does not mean less area or cost

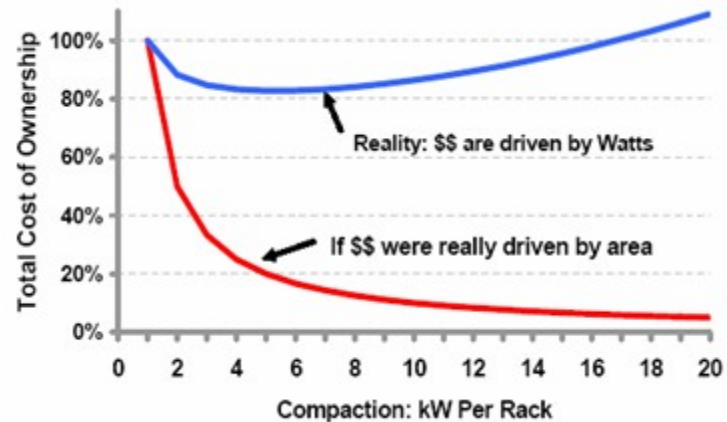
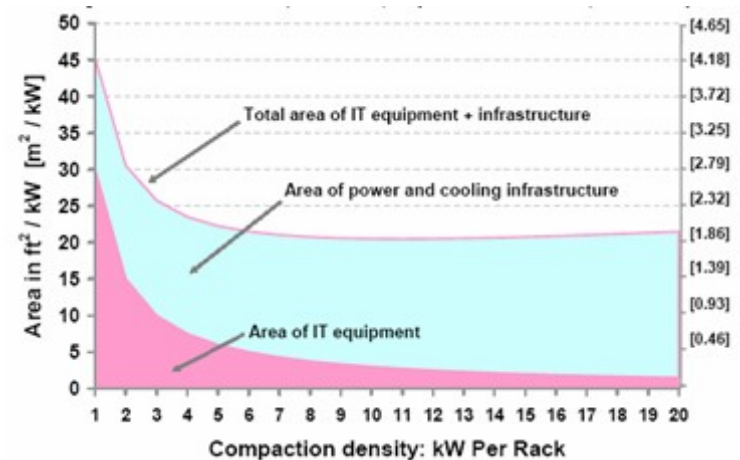


- **Increasing Power Density – Physical Space Requirements**

- Reduced IT Equipment Area... Yet May Increase Overall Area Required (For NCPI Supporting Power & Cooling Equipment)

- **Reducing Power Consumption – Operating Costs**

- TCO Savings – Driven by Power Related Costs



Key Benefits are Realized from Reducing Power Consumption versus Increasing Power Density



Cooling Capability Limitations of Data Centers

Rack

Row

Room

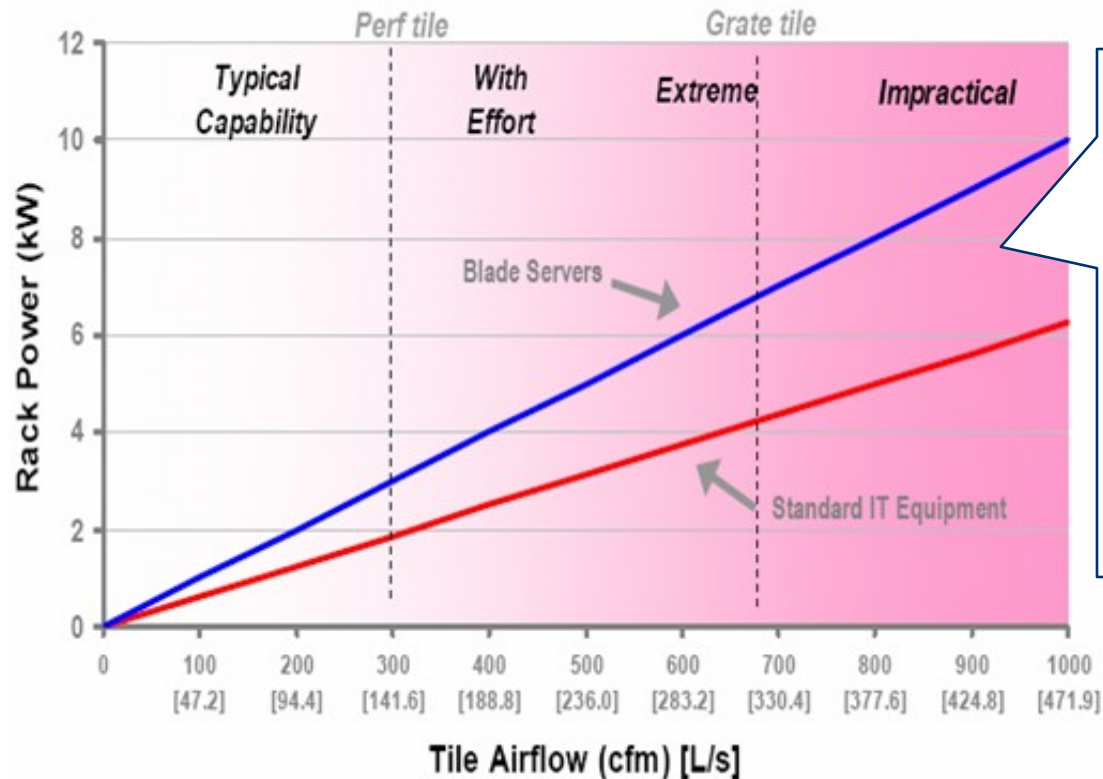
Challenges

Power Req'ts

Cooling Req'ts

- Supply Cool Air
- Remove Hot Exhaust Air
- Keep Hot Exhaust Air Away From Intake
- Redundant
- Interrupt
- Manner

■ Floor Tile Cooling - Practical Limitations



Available Rack Enclosure Cooling Capability of a Floor Tile as a Function of Per-Tile Airflow

Above 300 cfm can only be achieved with special effort:

- Careful Raised Floor Design
- Careful CRAC Placement
- Control of Under-Floor Airflow Obstacles

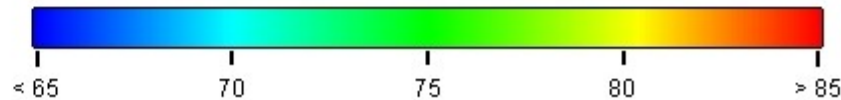
There are Practical Limits in Achieving Per-Tile Airflow Above 300cfm



Same racks, same room, slightly different cooling design



Temperature (deg F)



Totally different cooling airflow results!

Current approaches provide unpredictable performance

Cooling the data center



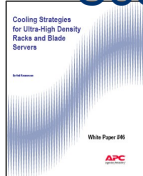
Five Strategies for deployment of High Density Racks

Rack

Row

Room

Deployment Strategy	Description	Application
Spread the Load	Split the equipment among enclosures to keep peak load down.	<ul style="list-style-type: none"> Existing data centers, when high density equipment is a small fraction of the total load.
Borrowed Cooling	Provide average cooling capability with rules to allow borrowing of underutilized capacity	<ul style="list-style-type: none"> Existing data centers, when high density equipment is a small fraction of the total load.
Supplemental Cooling	Provide average cooling capability with provision for supplemental cooling equipment.	<ul style="list-style-type: none"> New construction or renovations Mixed environment High density equipment location is not known in advance
Dedicated High Density Areas	Create a special high density row or zone within the data center.	<ul style="list-style-type: none"> New construction or renovations Density 10-25kW per rack When requirement exist to co-locate high density devices
Whole Room Cooling	Provide high density cooling capability to every rack.	<ul style="list-style-type: none"> Rare and extreme cases of large farms of high density equipment with very limited physical space



Five Strategies Cover Practical Solutions for Both New & Existing Data Centers



Five Strategies For High Density Deployment

1 Spread loads

“Free” strategy

2 “Borrowing”
rules

“Free” strategy – but must
enforce rules

Up to 2x average design density

3 Supplemental
cooling

Requires additional
equipment

Up to 10 kW / rack

4 High-density

State-of-the-art technology
10-25 kW / rack

5 Maximum
density for
whole room
zone

Extreme cost, rarely used

➔ **Best method depends on facility
constraints and business
needs/preferences**

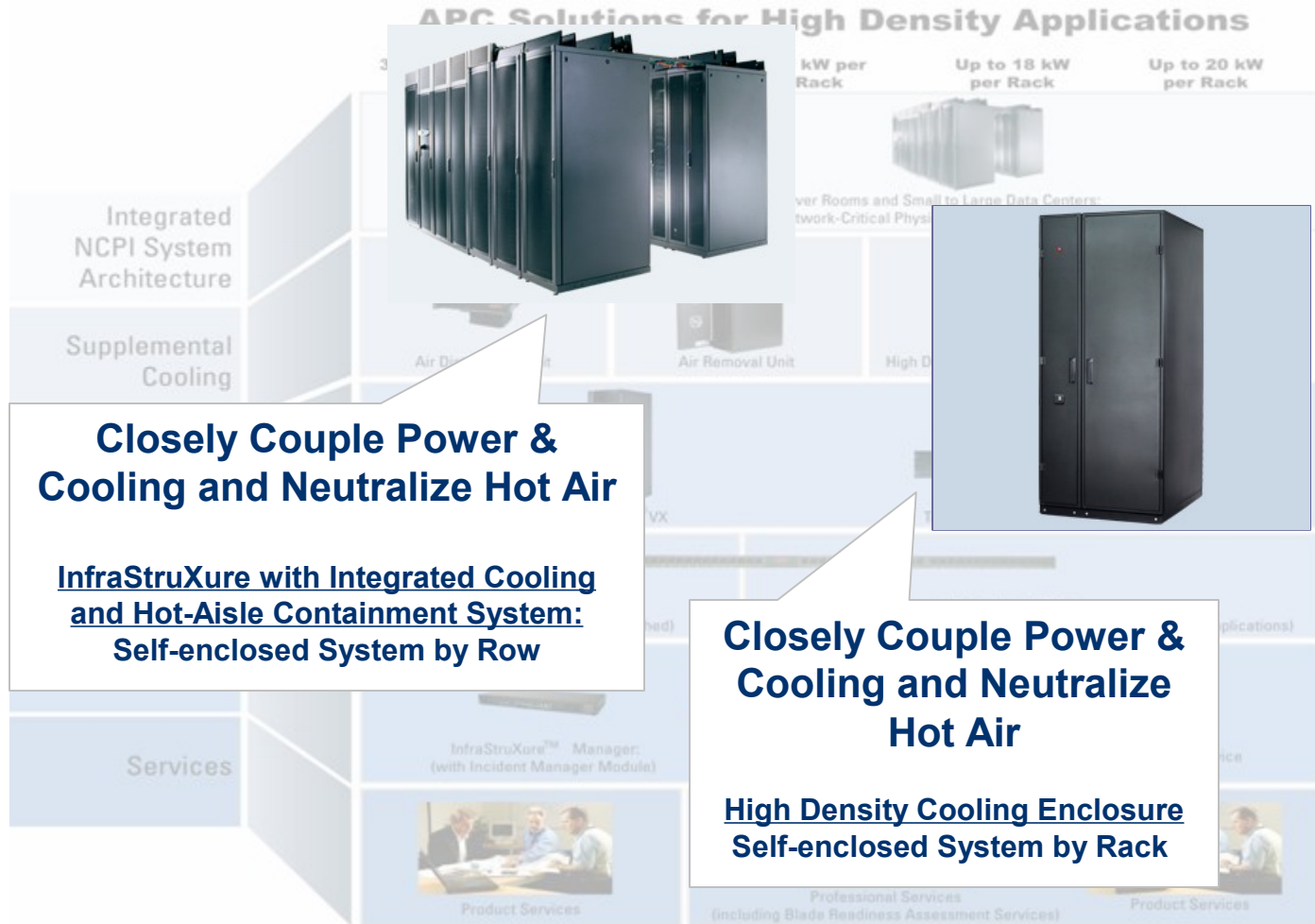
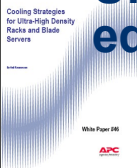
Make Cooling Predictable

Challenges

Power Req'ts

Cooling Req'ts

- Supply Cool Air
- Remove Hot Exhaust Air
- Keep Hot Exhaust Air Away From Intake
- Redundant Uninterrupted Manner



Successful High Density Deployment Needs to Address Today's & Tomorrow's Power & Cooling Challenges

InfraStruXure® Systems for High Density Applications



Range of System Configurations

Price and performance systems available for all budgetary high density needs

Rack Design

Enclosure design enables a variety of cooling options to ensure high availability at any density



Server-specific Designs

Designs are based on major OEM blade server manufacturers to minimize time required in integrating and pre-testing the systems

Air Containment

Increase cooling predictability in extreme high-density environments with rack-level solutions that neutralize the hot exhaust air at the rack or row level

In-row Cooling

Supports up to 30kW in a rack with enhanced modular, scalable solution



High Density NCPI Should be Flexible Enough to Deploy at a Rack-, Row- or Room-Level



Make Cooling Predictable – up to 20kW per Rack

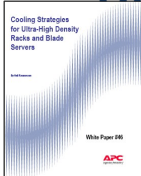
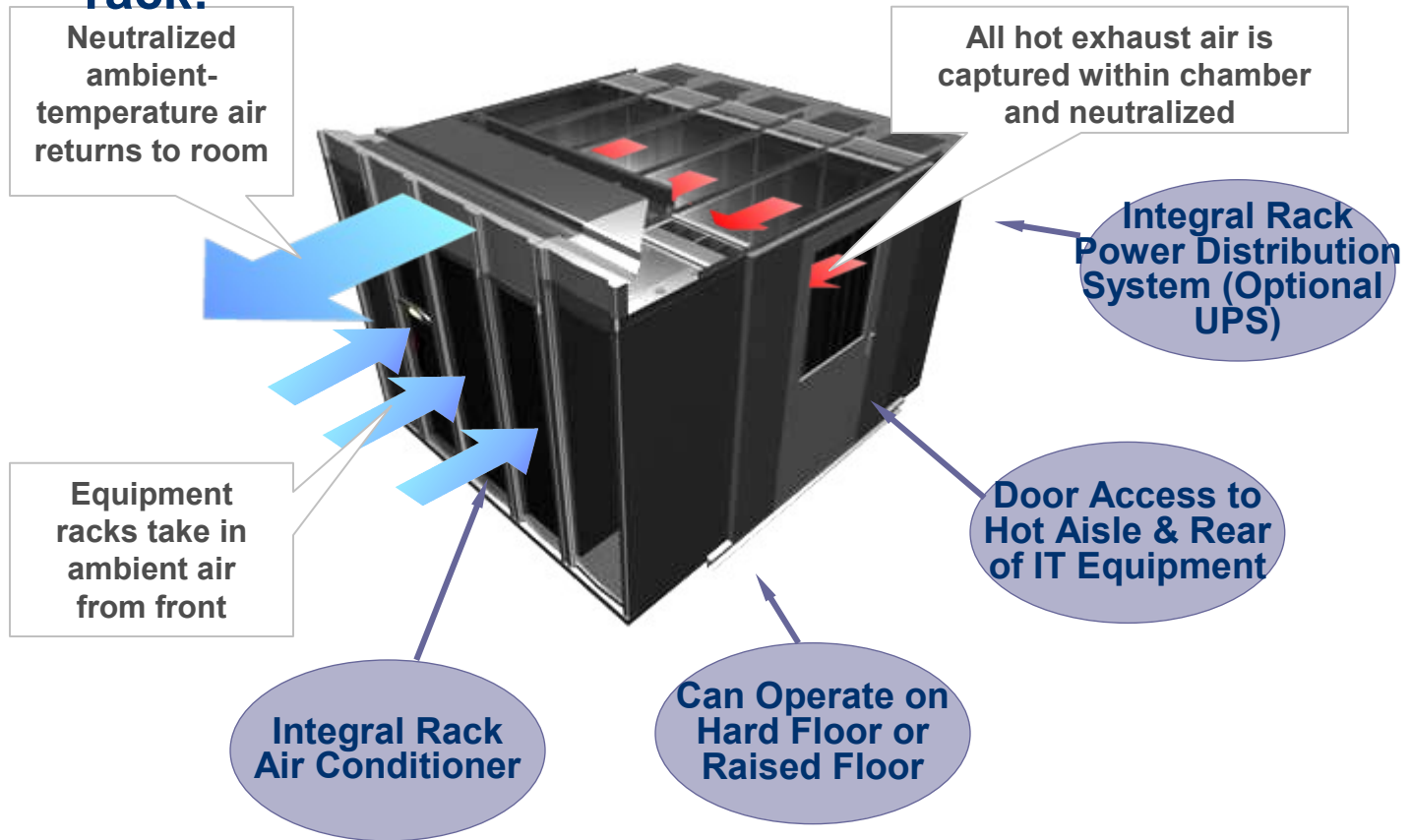
Challenges

Power Req'ts

Cooling Req'ts

- Supply Cool Air
- Remove Hot Exhaust Air
- Keep Hot Exhaust Air Away From Intake
- Redundant Uninterrupt
- Manner

InfraStruXure with Integrated Cooling & Hot Aisle Containment System – 20KW per rack!



Innovative NCPI System Provides Cooling up to 20kW per Rack



Approaches which are NOT Recommended

Rack

Row

Room

Approaches NOT Recommended

- Reducing Air Temperature
- Replacing Tile with Grates
- Installing Top of Rack Fans

Approaches which are NOT Recommended

- Reducing Air Temperature
 - Reduce capacity of air conditioners
 - Dramatically increase humidifier water consumption
 - Dramatically decrease operating efficiency of DC (and significantly increase electrical bill)
- Replacing Vented Tile with Floor Grates
 - Decrease airflow in other areas
 - Unpredictable variations to occur in airflow
- Installing Top of Rack Fans
 - Doesn't address problematic hot air at front intake
 - Fans make more heat
- Isolating Racks to Area Open on All Sides
 - Allows hot exhaust air to return to server intake



Installing
Racks

Will Not Address and Often Worsen High Density Challenges

Conclusion

- **Conventional data center designs have poor electrical efficiency, and are unable to meet density requirements**
- ***Expect to see increasing use of hard-floor environments in data centers of all sizes***
- ***Expect to see cooling more closely integrated & coupled with rows and racks, instead of rooms & areas***
- ***Expect to see modular solutions that can deploy as needed; this is the most effective way to save energy and TCO while increasing availability.***