DATA CENTER DESIGN GUIDE

Planning to build a new data center? It may come as a surprise, but in addition to choosing a cooling method (e.g., chilled water, direct expansion, direct or indirect evaporative cooling), one of the first and most critical decisions you'll have to make, is how to distribute mechanical and electrical services to the cabinets. What you choose will affect your operational procedures and the effectiveness of the facility over its lifetime. This easy to use chart is a side-by-side comparison of the significance that each line item has for one methodology over another. An in-depth review of each line item is available upon request.

1) ***CONVENTIONAL RAISED FLOOR*** – The long-used conventional single-level raised floor approach to conceal wires and provide limited air delivery;

2) ***ON-SLAB FLOODED ROOM WITH COOLING FROM THE PERIMETER OF THE ROOM/BUILDING*** – The more recently evolved on-slab approach, flooding the room with cold air entering the space horizontally;

3) ***ON-SLAB FLOODED ROOM DESIGN WITH COOLING COMING FROM OVERHEAD*** – The on-slab approach with air entering the cold aisle from the rooftop by means of plenums and/or sometimes overhead ducts;

4) ***TIER E/A*** – Interstitial's 2-tier electro-mechanical distribution system—designed for the effective and efficient distribution of air and wiring in a data center.

To know which is best for your situation, you need to take a holistic approach as there are often trade-offs when it comes to improving airflow and distributing cable most effectively.

Below are 34 critical infrastructure features that are compared across the 4 data center designs. As is often the case, the best design seeks a balance across all those features. The 34 items were chosen as they directly impact speed, reliability, flexibility, agility, and initial as well as ongoing operating costs in a significant way.

Comparison Table of the 4 Primary Methods for Designing a Data Center

Item	Critical Infrastructure Features	✓	Conventional Single Level Raised Floor	On-Slab Flooded Room Cooling from Perimeter	On-Slab Flooded Room Cooling from Overhead	Interstitial's TIER E/A Electro-Mechanical Dist
	Mechanical					
1	Works with All Cooling Methodologies		Most, Not All	Yes	Yes	Yes
2	Typical Cabinet kW Density		≈5 kW	≈8-12 kW	≈8-12 kW	Up to and Beyond 30 kW
3	Variable Cabinet kW Density within Row		Limited	Fixed	Fixed	Variable
4	Distance from Air Supply to 1st Cabinet		8'-0"	6'0" to 10'-0"	Not Applicable	4'-0"
5	Cold Aisle Width for 10 kW Cabinet		4'-0" (with Containment)	5' to 7'-0"	6' to 8'-0"	4'-0"–Up to 24 kW Cab.
6	Containment Hot or Cold Aisle		Recommended	Required	Required	Not Required
7	Return Ceiling Plenum		Optional	Required	Not Required	Not Necessary
8	Relocation Sprinklers, Lights, Detectors		Not Required	Required with Containment	Required with Containment	Not Required
9	Overhead Mechanical Ductwork		No	No	Optional	No
10	Venturi Effect for Some Servers		Yes	Yes	Yes	No
11	Grommets for Cable Openings		Yes	Yes	Yes	No
12	Ventilation Effectiveness		Poor	Limited	Limited	Excellent
13	Dampered Airflow Control		Limited	None	Only with Overhead Duct	Yes
14	N+1 Redundancy Effectiveness		No	No	No	Yes
15	Effective Redundancy		Achievable--Costly	Achievable--Costly	Achievable--Very Costly	Included/Inherent
	Electrical/Structured Cabling					
16	Cost of Overhead Distribution		25% Premium	25% Premium	25% Premium	No Cost–Not Applicable
17	Structured Cable Distribution		Underfloor or Overhead	Overhead-Complicated	Overhead-Complicated	Underfloor--Optimal
18	Power Distribution		Underfloor or Overhead	Overhead-Complicated	Overhead-Complicated	Underfloor--Optimal
19	Grounding		Complicated--Costly	Complicated--Costly	Complicated--Costly	Simple--Low Cost
20	Floor Finish–Anti Static		Included/Inherent	Special Treatment	Special Treatment	Included/Inherent
21	Zero Signal Reference System		Very Costly	Complicated--Very Costly	Complicated--Very Costly	Included/Inherent
	Architectural					
22	Required Square Feet per Cabinet		24.9 sf	27.9 sf	31.5 sf	19.3 sf
23	Number of Cabinets in a Row		10 to 12	12 to 15	24 to 32	Up to 100
24	Complication of Design/Engineering		Average	Complicated, Risky and Costly	Complicated, Risky and Costly	Simple and Dependable
25	Flexibility/Adaptability–MAC		Moderately Complicated	Complicated and Expensive	Complicated and Expensive	Simple
26	Deployment Time		Moderate	Lengthy	Lengthy	Fast
27	Build Out Only the Space Required		Yes	Yes	Yes	Yes
28	Maintenance-Surface Cleaning		Normal	Normal	Normal	Normal
29	Underfloor Cleaning		Complicated	Not Applicable	Not Applicable	Simple and Infrequent
30	Depressed Slab/Elevated Building Core		Preferred–Eliminates Ramps	Not Applicable	Not Applicable	Preferred–Eliminates Ramps
	Structural					
31	Increased Roof Structure		Depends on Cabling Method	Yes for OH Wire Dist.	Yes, Significant (for Wire and Air)	None
32	White Space Concrete Floor Loading		≈ 300 lbs./sf	≈ 300 lbs./sf	≈ 300 lbs./sf	≈ 200 lbs./sf
33	Seismic Requirements		Special Costly Understructure	Slab and Overhead Anchoring	Slab and Overhead Anchoring	Included/Inherent
34	Load Spreading Plates for Heavy Loads		Occasionally	Not Applicable	Not Applicable	Occasionally

Interstitial Systems

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Traditional raised floor seemed like an effective way to distribute air and cable compared to other available options in the 1960's. But, especially with today's denser, hotter rooms, running electrical services and trying to accurately, consistently distribute air in the same space under a single level raised floor is doomed to failure. The other three current main options do a considerably better job today. While the Flooded Room approach is a significant improvement in air and cable distribution over traditional raised floor design, the trade-offs to make it so are considerable. Those trade-offs require further design considerations and impose substantial initial and long-term costs.

The most common alternative to raised floor designs are the two variations of the on-slab design. In both, the room is flooded with cold air, containment is used to separate the supply air from the return air, cabinets sit on the slab, and wires are run overhead. This is not a new concept. It has been used in telephone equipment rooms for decades, and more recently has been adapted for data centers.

Although this approach may have some advantages over a conventional raised floor arrangement, it still consumes too much floor space, is not easily reconfigured, and does not allow for the most efficient operation of the cooling system or the servers. Having to run all power and structured cabling overhead has a 25% cost premium. Entering aisle velocity is a chronic problem, reducing ventilation effectiveness, and negatively impacting cabinet counts, and varying cabinet kW densities. There may also be limitations to the length of cabinet runs in certain applications. Return plenums and/or ceilings and hot or cold aisle containment are necessary for the function of the mechanical system. Containment is costly and burdensome. It makes the placement of light fixtures, sprinklers and smoke detector infrastructure problematic. Any reconfiguration of cabinets has a domino effect resulting in these infrastructure elements possibly having to be reconfigured.

All this is messy in a functioning room and just isn't necessary when there's a less expensive, more flexible alternative available that allows you to install a greater number of cabinets in a given space.

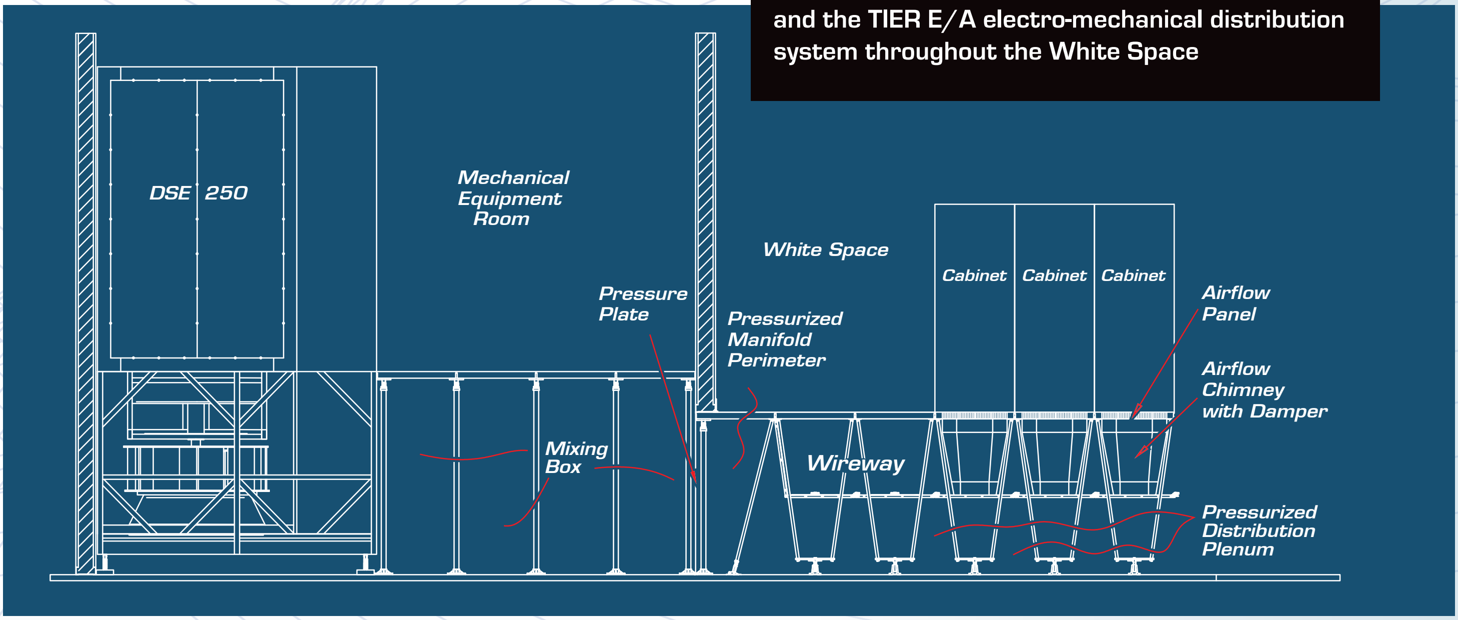
No one would seriously argue with the proposition that the more cabinets you can install in a given floor space, the more successful you are. Floor space is gold and cabinets are diamonds in today's modern data centers.

Hands down, the more modern TIER E/A™ 2-tier electro-mechanical distribution system provides for the most efficient use of data center floor space permitting the greatest cabinet densities, as compared to any other design choice available today. It provides ideal, consistent, adjustable air distribution, along with flexibility and user-friendliness for the life of the data center. TIER E/A is a system designed to sustain the constantly changing needs of the customer in the most user-friendly way—it's not just a day one system—it's a life-long building system. TIER E/A does not require expensive trade-offs, and presents no design complications. With TIER E/A you don't have to make compromises.

Because of all these features no other approach can compare to the effectiveness, efficiency, and the ROI available with TIER E/A.

Just One Example:

Section Drawing of a Mechanical Equipment Room and the TIER E/A electro-mechanical distribution system throughout the White Space



* What are not a part of this document, because they are rather rare methods for designing a complete data center are, in-row cooling, emersion cooling, liquid immersion cooling, and liquid cooling. All of which can be incorporated into any of the 4 baseline methodologies above.

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