



In Row Cooling Options for High Density IT Applications

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Users wishing to deploy high density IT racks have several “In Row” Cooling solutions from which to select. In Rows come in multiple configurations adaptable to various space and aisle constraints. They can be mounted in the ceiling, over the racks, within the racks, or in the aisle. The two most common cooling media used inside the units are either refrigerant (R134a) or water; the user has a choice to use either type based on preference and comfort level. Overhead units are meant to handle sensible cooling only and hence no condensate is typically generated in the process. In fact, the internal controls monitor dew point closely and maintain refrigerant and coil temperatures above room dew point. Vertical aisle In Rows such as the RP by APC do have humidity control. Liebert makes a self contained unit that operates either on chilled water or glycol. The message is that these units come in various “flavors and colors” to satisfy the needs for your high density cooling deployment.

In this whitepaper, we will review some common In Row coolers available from vendors that have been manufacturing this type of solution for the past 5 years. We will compare and evaluate several technical and operational parameters and rank them in terms of a three-tiered favorability matrix. While this list is not inclusive of every In Row cooler type available in the market, it provides the user a starting point from which to gather intelligent information about various unit makes and models.

▲ Refrigerant Based In Row Coolers

A. Rack Overhead Liebert XDV

An XDV system is a modular cooling solution that mounts directly on the top of the racks or alternatively, suspended above the racks. Each unit connects to a main supply and return header utilizing either rigid or flexible piping with quick connect fittings. One option is to stack the XDV's and install blanking panels between the openings, although this would add complexity and cost to the install.

Rack Mounted XDV	Sensible Cooling Only		
Parameter	Description	Evaluation	
Capacity (kW)	Available in 8.8 kW and 10 kW modules.		Good
Flexibility/Scalability/Expandability	Units mount on top of Racks. Planning for additional units is relatively easy. Connects via flexible piping with quick connect fittings	Very Good	

Ease of Installation	Will need coordination with overhead IT and power cabling		Very Good	
Reliability	Dual A-B Power cords for increased uptime. Two fans on each unit add to reliability. Dependent on the reliability of the XDC unit.	Excellent		
Maintenance Effort	Minimal maintenance required: 1. Cooling fins should be kept clean 2. Circulating fans are easily accessible from the front and require no lubrication.		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring. Requires an XDC unit.			\$\$\$
Dimensions Hx Wx D	14"x 23"x 40"			

B. Row Mounted – Liebert XDH

An XDH system is a modular cooling solution that mounts in the row between racks or at the end of a row. Each unit connects to a main supply and return header utilizing either rigid or flexible piping with quick connects.

Row Mounted XDH	Sensible Cooling Only			
Parameter	Description	Evaluation		
Capacity (kW)	Available in 22 kW and 30 kW modules.	Excellent		
Flexibility/Scalability/Expandability	Units are floor mounted in between racks or at the end of a row. Will require planning day-one for location of units. Connects via flexible piping with quick connect fittings.		Very Good	
Ease of Installation	Floor mounted is easier to coordinate	Excellent		
Reliability	Dual A-B Power cords for increased uptime. Two pumped refrigerant circuits. Multiple fans for load shedding. LED sensors indicate status. Dependent on the reliability of the XDC unit.	Excellent		

Maintenance Effort	Floor mounted units are easier to access for maintenance. . Minimal maintenance required: 1. cooling fins should be kept clean 2. circulating fans are easily accessible from the front and require no lubrication		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring. Requires an XDC unit.	\$\$\$\$		
Dimensions Hx Wx D	78" x 12" x 42"			

C. Aisle Overhead – Liebert XDO

An XDO system is a modular cooling solution that mounts over the cold aisle with a Unistrut system. The unit pulls hot air from the two opposite inlets and a fan discharges the cold air down into the cold aisle. Each unit connects to a main supply and return header utilizing either rigid or flexible piping with quick connects. The user should note that the cooling value of this unit should really be analyzed as it could be disproportionally shared by two opposing racks in the cold aisle.

Aisle Overhead Mounted XDO	Sensible Cooling Only			
Parameter	Description	Evaluation		
Capacity (kW)	Available in 17.2 kW and 20 kW modules.		Very Good	
Flexibility/Scalability/Expandability	Units mount over cold aisles. Planning for additional units is relatively easy. Connects via flexible piping with quick connect fittings		Very Good	
Ease of Installation	Will need coordination with overhead IT and power cabling. Mounting above the cold aisle May require additional lighting.			Good
Reliability	Dual A-B Power cords for increased uptime. Dependent on the reliability of the XDC unit.	Excellent		
Maintenance Effort	Minimal maintenance required: 1. Cooling fins should be kept clean 2. Circulating fan is easily		Very Good	

	accessible from the bottom of the module and requires no lubrication			
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring. Requires an XDC unit.		\$\$\$\$	
Dimensions Hx Wx D	22.5" x 72" x 24"			

D. Aisle Overhead – APC OA

The OA system is a modular cooling solution that mounts over the hot aisle utilizing a Unistrut system or APC's OA mounting frame. The unit pulls air from the hot aisle via two fans and discharges the cold air vertically where it is eventually drawn back into the front of the racks. Each unit connects to a main supply and return header utilizing rigid or flexible piping with quick connects. The headers connect to the RDU cooling distribution unit capable of providing 160 kW of cooling. Again, the user is reminded that the cooling value of this unit should be analyzed as it will be removing heat from the common hot aisle. The rank was elevated to Medium as the kW is slightly higher for this unit.

Aisle Overhead Mounted OA	Sensible Cooling Only			
Parameter	Description	Evaluation		
Capacity (kW)	Up to 27 kW (5 to 14 kW/Rack densities)		Very Good	
Flexibility/Scalability/Expandability	Units mount over hot aisles. Planning for additional units is relatively easy. Connects via flexible piping with quick connect fittings		Very Good	
Ease of Installation	Will need coordination with overhead IT and power cabling. Mounting above the hot aisle may require additional lighting.			Good
Reliability	Dual A-B Power cords for increased uptime. Dependent on the reliability of the RDU unit.	Excellent		

Maintenance Effort	Minimal maintenance required: 1. Cooling fins should be kept clean 2. Circulating fan is easily accessible from the bottom of the module and requires no lubrication		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring. Requires an RDU unit.		\$\$\$\$	
Dimensions Hx Wx D	13.9" x 51.7" x 23.5			

E. Rear Door Heat Exchangers Liebert XDR

An XDR system is a fixed cooling solution that mounts directly to the rear of the IT rack. Each unit connects to a main supply and return header utilizing rigid or flexible piping with quick connects.

Door Mounted XDR	Sensible Cooling Only			
Parameter	Description	Evaluation		
Capacity (kW)	20.5 kW	Excellent		
Flexibility/Scalability/Expandability	Units are passive "fanless" heat exchangers that replace the rear door of the IT rack. Relies on server fans to provide airflow through the unit. Connects via hard and flexible piping. Once installed however, the cooling capacity is fixed and can't be scaled down.		Very Good	
Ease of Installation	Replaces IT rack rear door.			Good
Reliability	The unit is passive, no moving parts to fail other than the quick coupling which is installed on all the XD class units.	Excellent		
Maintenance Effort	No moving parts to maintain. Scheduled cleaning of the coil fins.		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring. Requires an XDC unit.			\$\$\$

Dimensions Hx Wx D	78.4" x 23.5" x 5.9" Only compatible with a 24" x 42 U Rack			
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▲ Water Based In Row Coolers

A. Rack Mounted – APC RC & RP 600 mm (24")

The RP/RC600 system is a modular cooling solution that mounts in the row between racks. Each unit ties to a main supply and return chilled water header through rigid and flexible piping.

Row Mounted RP600, RC600	Cooling w/ Option For Reheat and Humidity Control (RP Only) & Condensate Management (both units)			
Parameter	Description	Evaluation		
Capacity (kW)	Nominal 43 kW. Can go up to 70 kW.	Excellent		
Flexibility/Scalability/Expandability	Units are floor mounted in between racks. Will require planning day-one for location of units. Connects via flexible piping.		Very Good	
Ease of Installation	Floor mounted is easier to coordinate			Good
Reliability	Dual A-B Power only on RC600. Multiple fans for variable load control. LED sensors indicate status.		Very Good	
Maintenance Effort	Floor mounted is easier to maintain. Minimal maintenance required: 1. Cooling fins should be kept clean 2. Circulating fans are easily accessible and require no lubrication		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring.	\$\$\$\$\$		
Dimensions Hx Wx D	78" x 24" x 42"			

B. Row Mounted – APC RC300

An RC system is a modular cooling solution that mounts in the row between racks. Each unit ties to a main supply and return chilled water header through rigid or flexible piping.

Row Mounted RC300	Sensible Cooling w/ Option For Condensate Management			
Parameter	Description	Evaluation		
Capacity (kW)	Nominal 18.2 kW. Can go up to 30 kW.		Very Good	
Flexibility/Scalability/Expandability	Units are floor mounted in between racks. Will require planning day-one for location of units. Connects via flexible piping.		Very Good	
Ease of Installation	Floor mounted is easier to coordinate			Good
Reliability	Dual A-B Power cords for increased uptime. Multiple fans for variable load control. LED sensors indicate status.	Excellent		
Maintenance Effort	Floor mounted is easier to maintain. Minimal maintenance required: 1. Cooling fins should be kept clean 2. Circulating fans are easily accessible and require no lubrication		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring.		\$\$\$\$	
Dimensions Hx Wx D	78" x 12" x 42"			

C. Rear Door Heat Exchangers (RDHx) Coolcentric Vette

The system is a fixed cooling solution that mounts directly to the rear of the IT rack. Each unit ties to a main supply and return chilled water header through rigid and flexible piping with quick connects.

RDHx Coolcentric		Sensible Cooling Only		
Parameter	Description	Evaluation		
Capacity (kW)	16 kW up to 35kW	Excellent		
Flexibility/Scalability/Expandability	Units are passive “fanless” heat exchangers mounted on the rear door of the IT rack. Connects via hard and flexible piping. Once installed however, the cooling capacity is fixed and can’t be scaled down.		Very Good	
Ease of Installation	Door mounted.			Good
Reliability	The unit is passive, no moving parts to fail	Excellent		
Maintenance Effort	No moving parts to maintain. Scheduled cleaning of the coil fins.		Very Good	
Cost of Installation	Involves copper headers and quick connects with valves, controls and wiring. Requires a cooling distribution unit CDU.	Excellent		
Dimensions Hx Wx D	Compatible with a 42U x 24” rack but can be modified for a 30” wide rack.			

▲ Standalone In Row Coolers

A. Liebert CRV DX Standalone Cooling Unit

A Liebert CRV is a standalone unit that connects directly to an outdoor condensing unit, drycooler, or chilled water. As such, it eliminates the need for the “middle” cooling distribution unit. It has state of the art scalable cooling and control capabilities and may be specified with integral humidification and reheat.

Liebert Air Cooled CRV Unit		Full Cooling Capability using DX , Glycol, or Chilled Water		
Parameter	Description	Evaluation		
Capacity (kW)	Available in 20 kW and 35 kW Air Cooled modules	Excellent		
Flexibility/Scalability/Expandability	The units are compact and fully contained with front and rear access. Digital Scroll compressors and variable speed fans within the unit enable variable cooling capacity from 20-100%. Each unit is piped separately to a condenser/drycooler/cooling tower or chilled water source.	Excellent		
Ease of Installation	Unit sits on the floor but requires a more extensive installation.		Very Good	
Reliability	Multiple fans and Compressors with full monitoring capability.	Excellent		
Maintenance Effort	The unit is fully contained with scroll compressors and EC fans (non chilled water unit). It may also be specified with options for built in reheat, humidification, and a condensate pump. Therefore the unit will have more components to maintain.	Excellent		
Cost of Installation	This unit is piped similar to a standalone DX/Glycol/Chilled water CRAC unit.	Excellent		
Dimensions Hx Wx D	78.84" x 23.6" x 43.3"			

▲ Conclusion

There is no lack of choice when it comes to selecting an In Row cooling solution for high density applications. We have presented several products with a ranking matrix that can clarify the technical and operational impacts when selecting amongst the many brand names. While the list of products was limited to three manufacturers: Liebert, APC, and Coolcentric, additional products from Huntair, Stulz and Motiveair are being introduced and will most likely go through the same process to gain customer confidence and truly compete in the high density market.

In TSS' database of previous and ongoing projects, we have designed, installed, commissioned and maintained almost all the types mentioned in this paper. TSS can help you in your next high

density installation project from the conceptual selection process through design, construction, and facility maintenance of the completed project.

▲ About the Author

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Mr. Namek is located out of the headquarter office of TSS in Columbia, Maryland and has over 17 years of experience in both Design and Project Management of mechanical systems for mission-critical, commercial, and government projects. He is skilled in HVAC, plumbing, and fire protection design, construction management, engineering economics, *as well as* energy analysis. With over ten publications in various leading industry journals, his current areas of interest are in data center energy efficiency, the cloud computing environment, and the dynamics of change in the data center business model. Mr. Namek was awarded his B.S. Degree in Mechanical Engineering from American University of Beirut and his M.S. Degree in Engineering Management from Virginia Tech. He is a board member in the ASHRAE National Capital Chapter.