DIGITAL REALTY
Data Center Solutions

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OEDA Conference 2011, "Is Your Community Ready for a Data Center?"

Glossary of Data Center Terms

2N - A redundancy model that ensures that every component has a backup such that the data center has no single point of failure.

A - Amp, a unit of electrical current.
AC - Alternating Current, the designation given to power that is delivered in the form of a sinusoidal wave form. AC won out over DC as the preferred method of delivering and using power in the industrial age due to the ease of voltage transformation using static devices (transformers).
ACAE - Air Conditioning Airflow Efficiency, the amount of heat removed per standard cubic foot of airflow per minute.
AHU - Air Handling Unit.
Air Mixing - The unintended mixing of cold and hot air.
Airside Economizer - A device consisting of fans, ducting and a control which utilizes outside air directly to cool the data center when environmental conditions allow. Air is typically filtered, brought into existing distribution system and then exhausted back to the atmosphere.
Aisle - The open space between rows of racks. Best-practice dictates racks should be arranged with consistent orientation of front and back to create 'cold'and 'hot'aisles.
AMS - Asset Management System.
ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers is an international technical society organized to advance the arts and sciences of air management.

BACnet - A data communication protocol for building automation and control networks.
BAS - Building Automation System.
Blanking Panel - A device mounted in unused U spaces in a rack that restricts recirculation airflow, also called blanking or filler plates.
BMS - Building Management System, synonymous with BAS, AMS and other computer-based tools used to manage data center assets.
Branch Circuit Monitoring (BCM) - A monitoring system used to record and monitor an individual electrical circuit. Typical parameters which are monitored include amperage, voltage, power factor, apparent power (volt amps), real power (watts) and energy usage (watt-hours). The branch circuit is typically defined to be a the circuit fed by a single breaker or 3 phase set of breakers in a multi-breaker panel.
BTU - British Thermal Unit, a unit of energy. 1kWh = 3412btu. Cooling equipment capacity is commonly specified in btu/hr.
Bypass Airflow - Conditioned air that does not reach computer equipment. With fixed speed fans (common in DX equipment), some bypass air is inevitable and without containment, some bypass air is prudent. Unintended bypass air can occur by escaping through cable cut-outs, holes under cabinets, misplaced perforated tiles or holes in the computer room perimeter walls.

C - Degrees Celsius.
C/H - Cooling/Heating.
Cabinet - Device for holding IT equipment, also called a rack.
CAC - Cold Aisle Containment system that directs cooled air from air conditioning equipment to the inlet side of racks in a highly efficient manner.
CADE - Corporate Average Data Center Efficiency.
CapEx - Capital Expense, the cost of purchasing capital equipment.
Carbon Footprint - A measurement of the volume of Carbon Dioxide generated by business operations, units are commonly metric tons.
CFD - Computational Fluid Dynamics, a numerical analysis technique commonly used in the analysis of airflow in data centers.

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CFM - Cubic Feet per Minute, a unit of flow rate, commonly used to specify airflow.
Chiller - A unit consisting of a compressor, a condensing section and an expansion section. The condensing and expansion sections nearly always have water or glycol as the heat transfer agent to the rest of the system; primary water/glycol on the condensing side and secondary water on the expansion side.
Close-Coupled Cooling - Cooling technology that is installed adjacent to server racks, minimizing the path that air must flow from the cooling unit through the IT equipment and back to the cooling unit.
Coefficient of Effectiveness (CoE) - Uptime Institute metric based on the Nash-Sutcliffe model efficiency coefficient.
Cold Aisle - An aisle where rack fronts face into the aisle. Chilled airflow is directed into this aisle so that it can then enter the fronts of the racks in a highly efficient manner.
Cold Spot - An area where ambient air temperature is below desired levels. Typically caused by ineffective airflow management necessitating a temperature set point lower than that which would be required with proper airflow management.
Containment - Using either long curtains or rigid plastic to maintain a physical barrier between a hot and cold aisle. Keeping warm exhaust air away from the intake of the server racks is a crucial part of making any data center more efficient.
COP - Coefficient of Performance; Used to rate the effectiveness of heat pumps or cooling units. It is the ratio of the load on a cooling unit and the energy that it uses.
CR - Computer Room.
Cooling Tower - A device which cools water via the direct evaporation of some of the water. Water is pumped into the top of the cooling tower and allowed to run down over the fill, typically pads or strips into a sump at the bottom of the cooling tower. Air is drawn in from the sides over the fill by fans in the top of the tower, evaporating some of the water which cools the remaining water. The temperature of the water in the sump is controlled by varying the speed of the fans. The water in the sump is then used to cool the condensing section of a chiller or to cool the secondary loop directly via a heat exchanger (see water side economizer).
CRAC - Computer room air conditioner (pronounced crack) which uses refrigerant and a compressor. Cooling of the air in the data center is accomplished by airflow over the evaporation coils where the refrigerant is being "directly expanded" (see DX).
CRAH - Computer Room Air Handler (pronounced craw) which uses chilled water passing through a heat exchanger to cool air flowing over the heat exchanger.
Critical Load - Computer equipment whose uptime is critical, typically supported by a UPS.
CSI - Cold Supply Infiltration index, quantifies the amount of hot air mixing with cold inlet air prior to entering the rack.
CUE - Carbon Usage Effectiveness, a metric defined by the Green Grid, which is a measure of data center sustainability in terms of data center specific carbon emissions. CUE is calculated by dividing the "total CO_2 emissions caused by total data center energy" by the "energy consumption of the IT computing equipment". An alternative way to calculate CUE is by multiplying the data center's annual PUE by the Carbon Emissions Factor for the region as determined by the EPA. The units of CUE are kilograms of carbon dioxide per kilowatt-hour.
Current Transformer (CT) - A device used to transform electrical current from one level to another with a specific ratio. For example, a 5000:5 current transformer transforms current on the primary side to current on the secondary side with a ratio of 1000:1. CTs are typically used to transform large currents to much smaller currents so that standard metering equipment can be used on a variety of circuits by measuring the secondary current rather than the large primary current.
Cutout - An open area in a raised floor that allows airflow or cable feeds.
CW - Chilled Water.

DC - Data center.
DC - Direct Current, a non-time varying method of delivering power. While slightly more efficient then AC if utilized between the DC portion of the UPS and the power supplies in IT equipment, it has not won wide acceptance in modern data centers.

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DCiE - Data Center infrastructure Efficiency, a metric developed by the Green Grid, data center infrastructure efficiency is an efficiency measure that is calculated by dividing the IT equipment power consumption by the power consumption of the entire data center. This measure is the inverse of PUE.
Dead Band - A control technique which prevents oscillation or unnecessary cycling of a controlled variable. In data center cooling, it typically applies to the action of the CRAC or CRAH relative to the set point. A certain amount of dead band around the set point prevents unnecessary cycling of the compressor or chilled water valve.
Delta T - The difference in temperature across a device. Examples include the temperature difference between the inlet and outlet of piece of IT equipment or between the inlet and outlet of a cooling unit (CRAC or CRAH). Delta T, airflow and thermal dissipation are related: thermal dissipation = airflow x delta T x specific heat of air.
Dewpoint - The temperature at which air reaches water vapor saturation. Dewpoint is constant for a specific amount of water in a specific amount of air while relative humidity varies with temperature. The latest ASHRAE spec for data center environmental conditions includes an upper limit for humidity based on dewpoint.
D/H - Dehumidifying/Humidifying.
Dry-Bulb Temperature - The temperature of the air measured using a dry-bulb thermometer such that evaporative cooling has no effect. Typically taken in conjunction with a wet-bulb reading which does include the evaporative cooling effect in order to determine relative humidity.
Dry Cooler - A liquid-to-air heat exchanger that is a radiator over which air is blown via fans. Typically used as the heat rejection device for water or glycol cooled condensers, may also be used as the heat rejection device for liquid cooled coils in an AHU under proper environmental conditions.
DX - An abbreviation for direct expansion. This refers to the use of refrigerant directly expanded into evaporation coils in the supply air stream of an air conditioning unit.

Economization - A way of utilizing the local environment around the data center to aid in cooling of the IT load by natural means rather than use more energy. There are two common types of economization, Airside Economization and Waterside Economization; sometimes referred to as LINK. Economization is a great benefit to those who can take advantage of it due to the large energy saving opportunity.
EFC - Equivalent Full Cabinets, the number of full cabinets that would exist if all the equipment in the data center were concentrated in full cabinets.
ESD - Electrostatic Discharge, more commonly ‘static discharge'.

F - Degrees Fahrenheit.
Ft^2 - Square feet, a unit of area.

GPM - Gallons Per Minute, a unit of flow rate.

HAC - Hot Aisle Containment, system that directs heated air from the outlet side of racks to air conditioning equipment return ducts in a highly efficient manner.
Harmonic Distortion - Distortion in the line voltage waveform. Any cyclical waveform can be described as the sum of sine waves of various magnitudes which are integer multiples of the root frequency (60 Hz, 120 Hz, 180 Hz, etc.). Harmonics are often the result of the non-linear loading of the power distribution system due to the nature of solid state power supplies. Harmonics are detrimental to the efficiency and capacity of power delivery equipment and rotating equipment due to increased eddy current losses and non-fundamental frequency torques.
Heat Exchanger - A device used to transfer heat energy from one medium to another. Common uses of heat exchangers are water to air heat exchangers in air handling units, plate and frame heat exchangers in economizers, etc.
HDG - Hot Dipped Galvanized.
Hot Aisle - An aisle where rack backs face into the aisle. Heated exhaust air from the equipment in the racks enters this aisle and is then directed to the CRAC return vents.

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HPDC - High-Performance Data Center, a data center with above average kW loading, typically greater than 10kW/rack.
Hot Spot - An area, typically related to a rack or set of racks, where ambient air temperature is above acceptable levels. Typically caused by poor airflow management (insufficient cool air supply or an excess of recirculation).
Hp - Horsepower.
Hr - Hour.
HVAC - Heating, Ventilation and Air Conditioning system, the set of components used to condition interior air including heating and cooling equipment as well as ducting and related airflow devices.

In-Row Cooling - Cooling technology installed between racks in a row that draws warm air from the hot aisle and delivers cool air to the cold aisle, minimizing the path of the air (see close coupled cooling).
Inlet Air - The air entering the referenced equipment. For air conditioning equipment this is the heated air returning to be cooled, also called return air. For racks and servers this is the cooled air entering the equipment.
IP - Internet Protocol, a communications technology using the internet for communications.
IR - Infrared spectrum used by thermal imaging technologies.

JVM - Java Virtual Machine, Java interpreter. Software that converts the Java intermediate language into executable machine language.

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kBTU - Kilo British Thermal Unit, one thousand BTU (see BTU).
kCFM - Kilo-Cubic Feet per Minute, one thousand CFM (see CFM).
kV - Kilovolt, one thousand volts, (see V).
kW - Kilowatts, one thousand watts (see W).
kWh - Killowatt-Hour, one thousand watt hours (see Wh). kWh is a common unit of electrical energy.
kVA - Kilovolt Amperes = voltage x current (amperage) (see VA).
KVM - Keyboard, Video, Mouse, an interface technology that enables users to access multiple servers remotely from one or more KVM sites. More obscurely, can also mean Kernel-base Virtual Machine: a version of the Java Virtual Machine for small devices with limited memory.

Latent Cooling - The process of condensing water out of air, then evaporating the water later. Energy is given up by the water during condensation. If the water is then later evaporated (such as from a drip tray), the amount of energy used to evaporate the water is the same as the amount of energy given up by the water vapor to the cooling equipment when it was condensed. Cooling is occurring later in time, hence the name "latent cooling". In a system where condensed water is pumped or drained away, the cooling that may occur from evaporation does not cool the environment where the condensation took place so the cooling capacity spent condensing the water vapor is wasted energy.
Latent Cooling Capacity - Cooling capacity related to wet bulb temperature and objects that produce condensation.
Line Noise - Distortions superimposed on the power waveform that may cause electromagnetic interference.
Liquid Cooling - A general term used to refer to cooling technology that uses a liquid evacuate heat. In data centers, the two prevalent forms of heat evacuation are liquid (chilled water) and refrigerant (DX).
Load - The demand placed on a system, typically used to describe the electrical demand on the electrical supply system or the cooling demand on the cooling system. Units are power such as kW, BTU/hr, Tons, etc.

MAH - Makeup Air Handler, an air handler that conditions and delivers outside air into an occupied space.
Make-Up Air - The conditioned air delivered by a MAU or MAH.
MAU - Makeup Air Unit, synonymous with MAH.
Maximum Temperature Rate of Change - An ASHRAE standard established to ensure stable air temperatures. The standard is 9 degrees F per hour.
MERV - Minimum Efficiency Reporting Value, ASHRAE 52.2, for air filtration measured in particulate size.

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N+1 - Need plus one, a redundancy concept where capacity is configured to include used capacity plus one additional device to enable continued operations with the failure of one system in the configuration.
NEBS - Network Equipment-Building System design guidelines applied to telecommunications equipment.
No. - Number.
Nominal Cooling Capacity - The total cooling capacity of air conditioning equipment, includes both latent cooling and sensible cooling capacities.

OpEx - Operating Expense, the ongoing expenses related to operating the data center.
Overcooling - A situation where air is cooled below optimum levels. Typically used in reference to rack inlet temperatures.

PDU - Power Distribution Unit, this typically refers to one of two pieces of equipment in the power delivery chain. One is the combination transformer/breaker panel that is often used between a UPS supplying voltage higher than that used by the IT equipment and the cabinets. The other is the smaller "power strip" like device that is used inside the rack to distribute power to the IT equipment.
PF - Power Factor represents the portion of the apparent power that is real power. The source of power factor is non-resistive components (inductors and capacitors) in the load on an AC power system. These components draw current that is 90 degrees out of phase with the voltage across them resulting in zero real power being delivered. While the power delivery system must carry this current (as well as all the current which does result in real power being delivered), it does no useful work. Power companies often charge a penalty for loads which have a power factor that is significantly far away from 1.0 since the size of the equipment that must be in place is dependent upon the total current delivered, but normal billing is based on real power delivered.
Pole - A row of power receptacles with power supplied from a PDU.
Pole Position - A power receptacle on a pole.
Potential Transformer (PT) - A device used to transform electrical potential (voltage) from one level to another with a specific ratio. For example, a 480:120 potential transformer transforms voltage on the primary side to voltage on the secondary side with a ratio of 4:1. CTs are typically used to transform large voltages to much smaller voltages so that standard metering equipment can be used on a variety of circuits by measuring the secondary voltage rather than the large primary voltage.
Pressure Differential - The difference in pressure between two locations in the data center. Air flows from higher pressure areas to lower pressure areas. Often times, the pressure differential between the under-floor plenum and the above-floor space is controlled by varying the speed of the fans supplying air to the under-floor plenum. This allows the addition of vented floor tiles to occur without affecting the air delivered to existing vented floor tiles so that additional IT load may be placed on the floor without disturbing the tuning of the existing floor.
PH - Phase, a term that describes the relationship between multiple time-varying waveforms which have a constant frequency but differ in their position relative to time. It is also used to refer to the number of sinusoidal voltages that make up the power delivery to a device. Most common are three-phase and single-phase. Single-phase consists of 2 conductors between which a sinusoidal voltage is present. Three-phase is a set of 3 or 4 conductors. In the case of 3 conductors, a sinusoidal voltage of a constant magnitude and frequency but differing relationship with respect to time exists between any 2 conductors. In a 4 wire system, the same voltage as in the 3 wire case exists between any of the three "hot" conductors and in addition, between any of the three "hot" conductors and fourth neutral conductor there exists a voltage that is smaller by a factor of the square root of three than the voltage between any of the "hot" conductors. An example of this is a 208/120 three-phase system. 208 volts exists between any of the three "hot" conductors and 120 volts exists between any of the "hot" conductors and the neutral conductor.
Plate and Frame - A type of heat exchanger commonly used in water-to-water systems. It is a series of plates held in a frame through which exists 2 paths for water which are adjacent but separate. Plate and frame heat exchanges are simple to size via the addition of additional components and maintenance is straight-forward via disassembly.
Plenum - A receiving chamber for air used to direct air flow.

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Primary Loop - Refers to the water loop which cools the condenser side of a chiller. This loop is cooled by dry coolers or cooling towers.
PU - Packaged Unit, an air handler that is a complete device shipped ready for use rather than a custom device that is assembled on-site from components.
PUE - Power Usage Effectiveness, a metric defined by the Green Grid, which is a measure of data center efficiency calculated by dividing the total data center energy consumption by the energy consumption of the IT computing equipment. This measure is the inverse of DCiE.

Rack - Device for holding IT equipment, also called a cabinet.
RAH - Recirculation Air Handler, a device that circulates air but does not cool the air.
Raised Floor - Metal flooring on stanchions that creates a plenum for airflow and cabling, synonymous with RMF.
Recirculation - Air which exits IT equipment and then re-enters either the same IT equipment or another piece of IT equipment without being cooled. Typically caused by poor control of airflow due to missing blanking panels, gaps in rows, insufficient air supply, etc.
Return Air - The heated air returning to air conditioning equipment.
RFI - Radio Frequency Interference.
Rh - Relative Humidity.
RMF - Raised Metal Floor, an alternate term for the more commonly used term ‘raised floor'.
ROI - Return on Investment, a measure of the money that an entity earns as a percentage of the total value of its assets that are invested.
RPM - Revolutions per Minute, a unit of angular velocity.
RPP - Remote Power Panel.
RTU - Rooftop Unit, an air handler designed for outdoor use mounted on a rooftop.

S+S - System plus system.
SCFM - Standard Cubic Feet per Minute, the volumetric flow rate of a gas corrected to standardized conditions of temperature, pressure and relative humidity.
Secondary Loop - Refers to the water which is used to cool the heat exchangers in AHUs and is cooled via the expansion unit in a chiller.
Sensible Cooling - The action of lowering the dry bulb temperature of air without condensation taking place.
Set Point - In a control system, this is the value against which the variable that is being controlled is compared. Temperature and humidity set points are common in the cooling system for a data center.
Short Cycling - Chilled airflow returning to cooling units without passing through IT equipment, also referred to as bypass.
STS - Static Transfer Switch, a solid state device which transfers the feed of power from one source to another source such as from the incoming utility to a generator.
Sub-Floor - The open area underneath a raised computer floor, also called a sub-floor plenum.
Supply Air - The cooled airflow emitted from air conditioning equipment.

TCE - Triton Coefficient of Effectiveness, a data center efficiency metric developed by the Uptime Institute synonymous with UCE. (see also CoE)
Thermistor - A type of resistor with resistance varying according to its temperature.

U - A unit of space in a rack, equal to 1.75". The vertical dimension of racks and IT equipment is often specified in "Us" such as 42U.
UCE - Upsite Coefficient of Effectiveness, a data center efficiency metric developed by the Uptime Institute synonymous with UCE. (see also CoE)

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UPS - Uninterruptible Power Supply, a device placed in series with the supply of power from the utility which contains energy storage such that the supply of power from the UPS is continuous even when the utility supply is removed. While battery-based energy storage is the most common, flywheel-based energy storage is gaining in popularity due to the reduced maintenance cost.

V - Volt, a unit of electrical potential.
VA - Volt-Amp, a unit of apparent power. In AC circuits, the magnitude of the voltage across a circuit times the current through the circuit is the apparent power. Including a representation of the angle between the two waveforms in the form of power factor (see PF) yields the real power.
VFD - Variable Frequency Drive, a device which supplies AC power of varying frequency, typically used to control the speed of induction motors. In the data center, it is common to vary the speed of fans, pumps, and chillers.

W - Watt, a unit of power, commonly used in electrical discussion, watts are the product of potential (volts, see V) and current (amps, see A). If the current and voltage are AC, the relationship between watts, volts and amps includes power factor (see PF), watts = volts x amps x PF.
Waterside Economizer - A system which uses a source other than a chiller to cool the secondary loop water used by the AHUs. This typically consists of either a dry cooler or cooling tower, piping, valves and in the case of a cooling tower, it also includes a heat exchanger since the secondary loop water is treated completely differently than the primary loop water and is typically much "better" water.
Wet-Bulb Temperature - The temperature of the air measured using a wet-bulb thermometer, that is, the temperature to which a wet surface can be cooled by evaporation. This temperature is affected by both the dry bulb temperature and the dew point of the air. Dryer air has a lower wet bulb temperature. This is a design constraint when utilizing cooling towers or evaporative pads in the cooling process.
Wg - Inches of water column, a unit of pressure based on the height of a column of water supported by the pressure differential between the top and bottom of the column. 1 inch wg = .036 psi.
Work Cell - The area of a rack and the related area immediately in front of and behind the rack. Standard racks are 2 feet wide and 4 feet deep. Standard aisles are 4 feet wide, so half of that space is workspace for a given rack. This results in a standard work cell of 16 square feet. Actual work cell size varies with data center design.
WPSF - Watts per Square Foot, a unit of power density. In a data center this is a bulk term that refers to the total load in a particular space divided by the total area of that space. This is a design parameter for total capacity of the cooling and power systems and is used in conjunction with point load (the amount of load in a small space such as a rack).
WUE - Water Usage Effectiveness, a sustainability metric defined by The Green Grid, which is a measure of the water used on-site for data center operations including humidification and on-site evaporation for cooling or energy production. WUE is calculated by dividing “annual water usage” by the “energy consumption of the IT computing equipment”. The units of WUE are liters/kilowatt-hour (L/kWh).