Cluster's Information

Machine Name	Easley	HPC Class Cluster	Hopper
Model/Type	Xeon 6438Y+ 2 GHz (4 Turbo)	Intel Xeon E5-2670 2.6 GHz (3.3)	Intel Xeon Gold 6226R 2.9 GHz (3.9)
Linux Operating System	Rocky Linux 9.5	Rocky Linux 9.4	Rocky Linux 8.10
Interconnect	ConnectX-7 @ 200 Gb/sec	InfiniBand QDR	ConnectX-4 @ 100 Gb/sec
Nodes	63	16	70
Cores/Node	64	16	32
Total Cores	4032	256	2100
RAM/Core	4-32 GB	4 GB	3-48 GB
Local disk/node	Diskless/1 TB (Tmp)	1 TB	Diskless/448 GB(Temp)
Local Scratch Space (TB)	40	6.3	1.2Pb

Storage Information

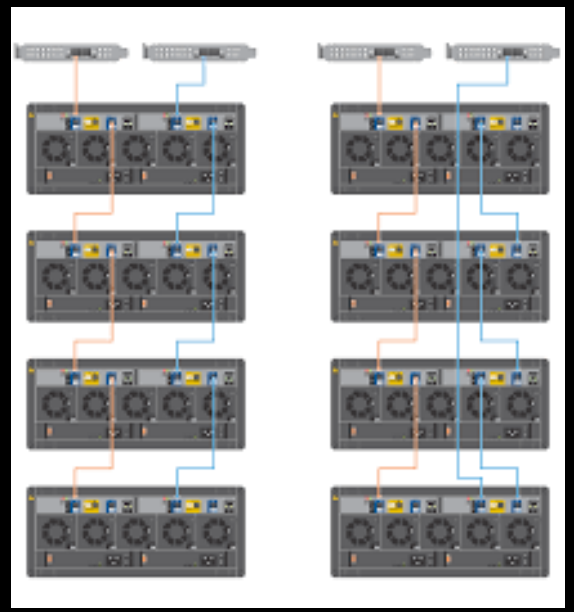
NetApp (Home and Project Dirs)	
Raw Capacity:	2PB
Connectivity	10Gb Network Ethernet

CARC System Wide Scratch	
Raw Capacity:	2PB (1.2 usable) (Hopper)
Connectivity	Infiniband 200/100Gb

Local Scratch	
Raw Capacity:	75TB (Xena, Wheeler)
Connectivity	Infiniband 56Gb/40Gb

CARC Wide Storage - BeeGFS Parallel File System

Dell ME484 Storage Shelf



UPS: Power Consumption (Hopper and Easley)

Liebert	Mitsubishi
Rated: 130Kva (kilovolt amperes, current)	Rated:150Kva
Capacity: 104Kw (power in kilowatts) Rating x 0.8	Capacity:120Kw (the draw is 120Kwh per hour)
Total Usable Power:	224Kw (154Kw Currently in use)

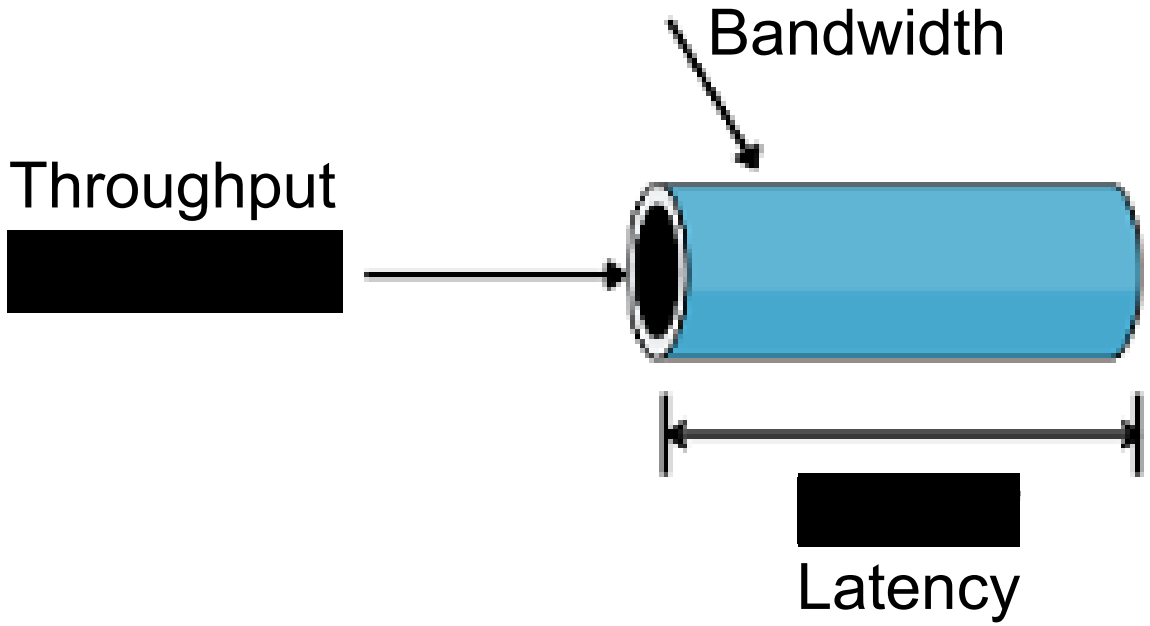
- Examples of power consumption per cluster

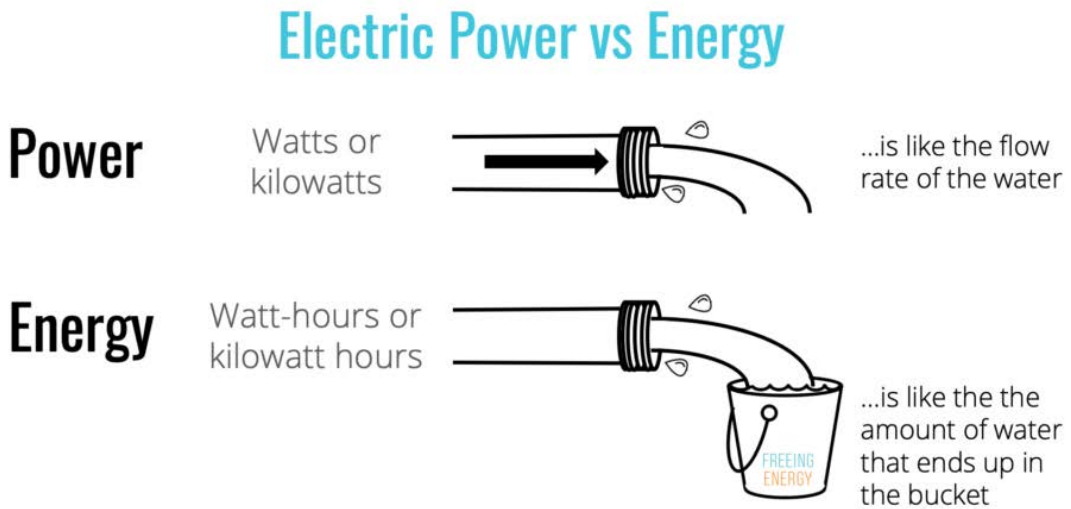
Hopper	$1.8M
84 Kw Total	14 Kw per rack (6x)

2100 cores
70 nodes

Easley	$1.5M
90 Kw Total	36 Kw per rack (2.5x)

4032 cores
305 nodes





Power (kW) refers to the rate at which energy is consumed or produced. Similarly, throughput refers to the rate at which data is successfully transmitted over a network. Both represent “how much is being done per unit of time” — energy in the case of power and data in the case of throughput.

Bandwidth is more like capacity — the maximum amount of data that can theoretically be transmitted, but not necessarily how much is actually being used.

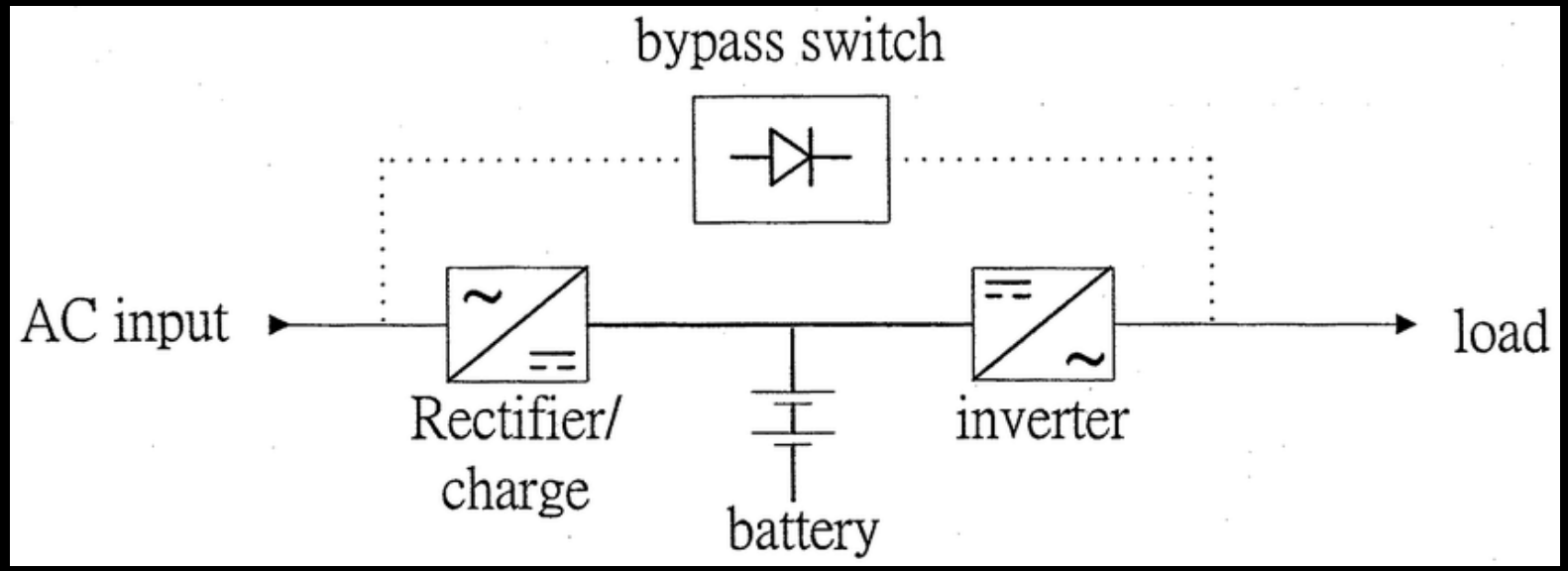
It’s more analogous to energy (kWh) or the total potential capacity of a system over time.

So, power (kW) is analogous to network throughput, as they both describe the actual rate of work (energy/data) being transmitted or consumed over time.

A source of confusion is the kW is a rate even though there is no explicit time unit. That is because watts are joules per second, so the time is built into kW.

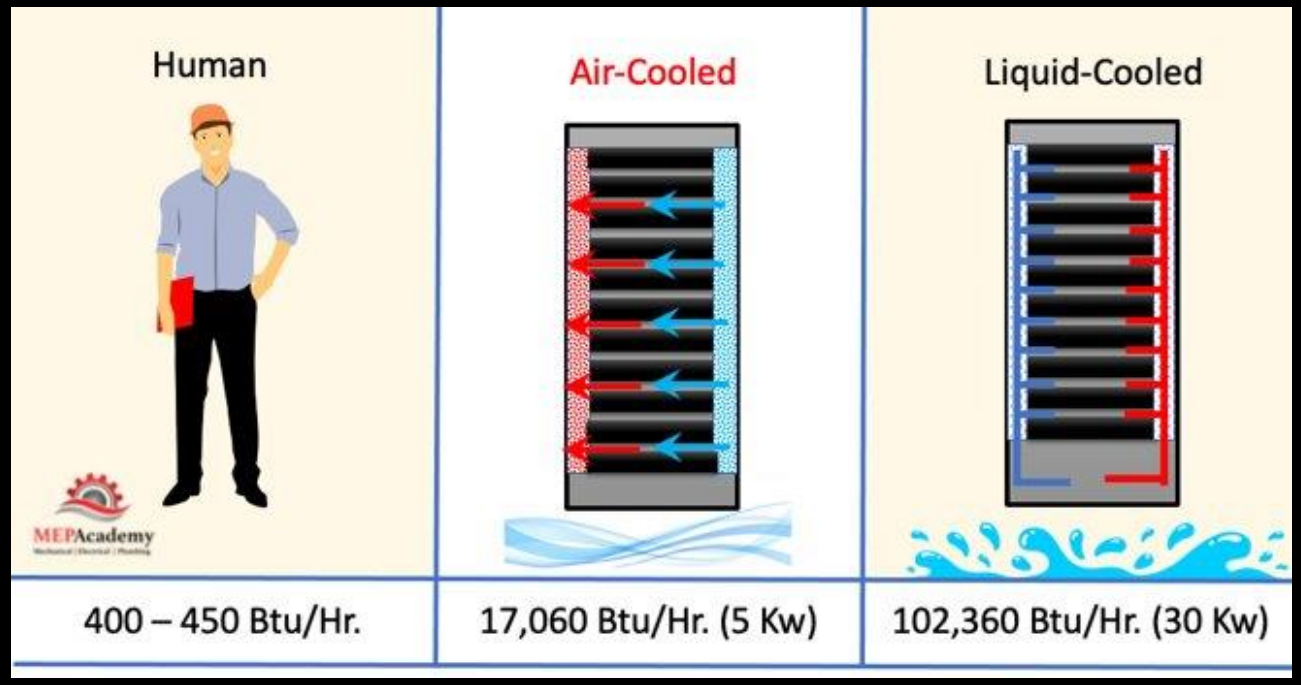
- Power (kW) ↔ Throughput: The rate at which something happens.
- Energy (kWh) ↔ Bandwidth: The capacity or potential over time.
- Draw (kVA) ↔ Latency: Inefficiencies or delays in the system.

- How an Uninterrupted Power Supply or UPS works?



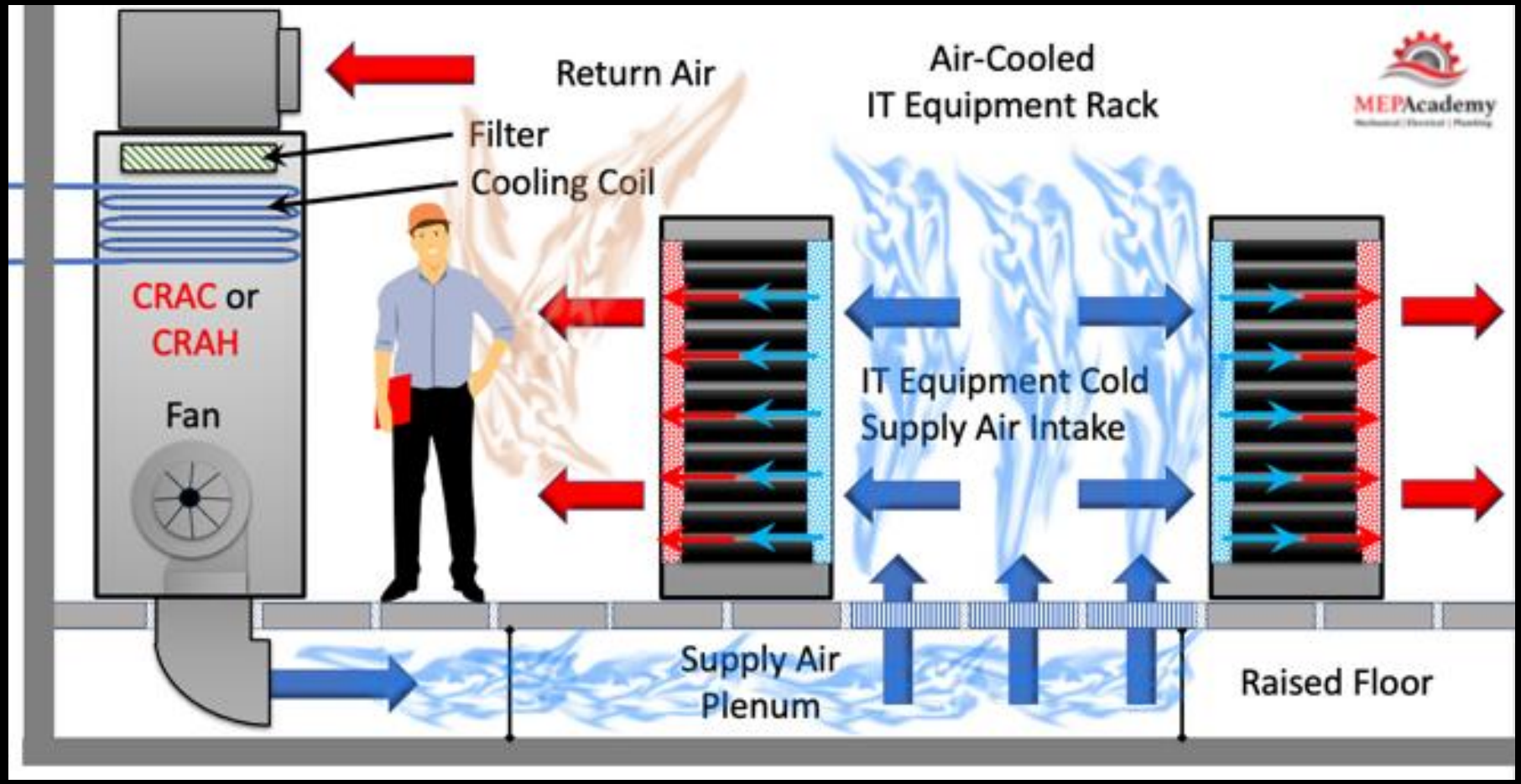
- **AC Input:** Utility Power (PNM)
- **Rectifier/Charge:** Device that optimize power (clean power) and downgrade to 12volts
- **Battery:** Source of energy connected in parallel (12 volts x 36 batteries = 432Amp hours)
- **Inverter:** converts power from DC to AC (From 12volts DC to 208volts AC)
- **Load:** Energy use to power computers
- **Bypass Switch:** Insolate electrical power incase malfunction UPS.

HVAC System



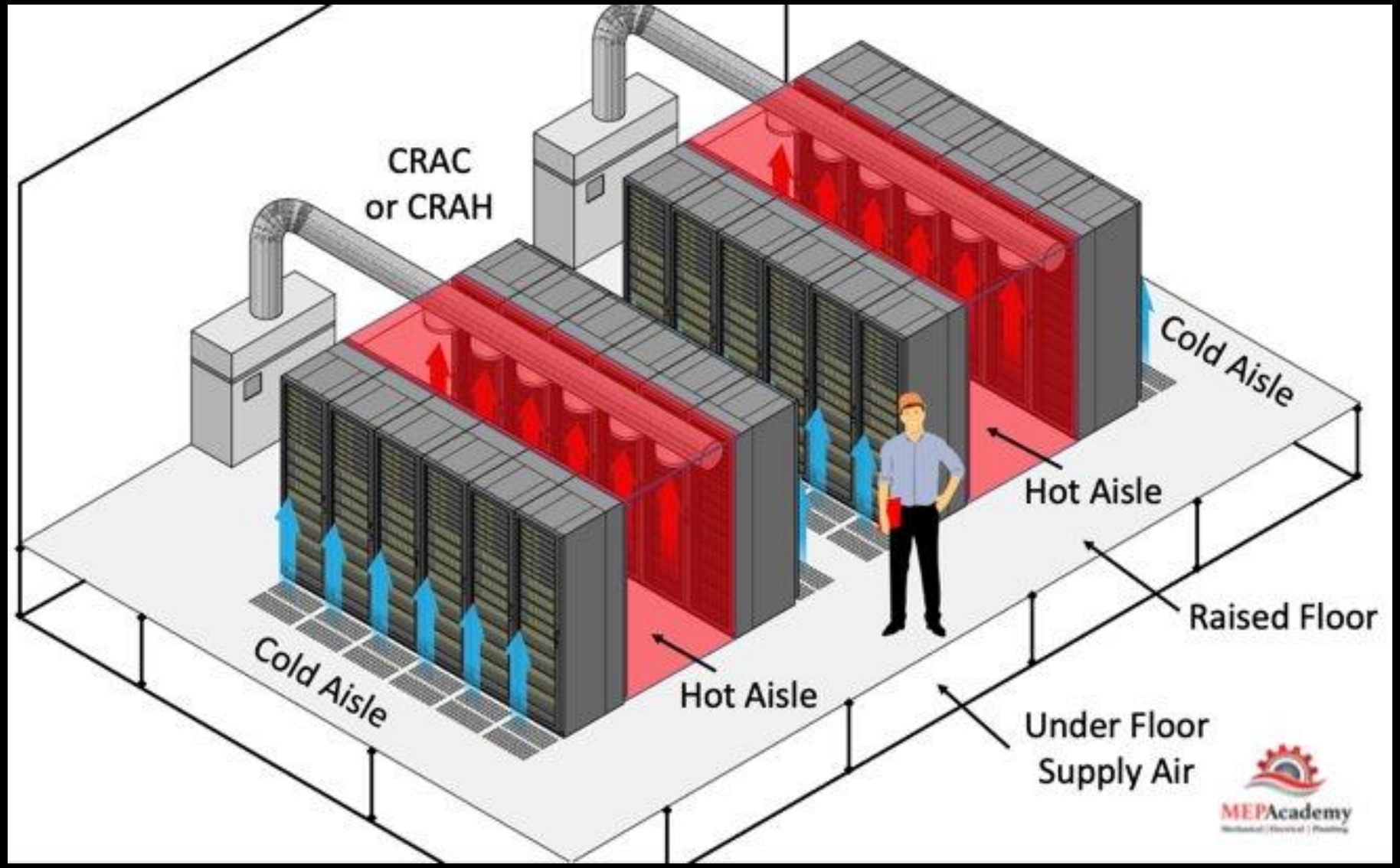
- The average person sitting gives off 400 to 450 Btu/hour, while one rack of IT Equipment can give off between 17,060 Btu/hour (5 kw) to 102,360 Btu/hour (30 kw). Data centers are energy intensive, and are growing more so.

MMR: Raised Floors – Supply Air



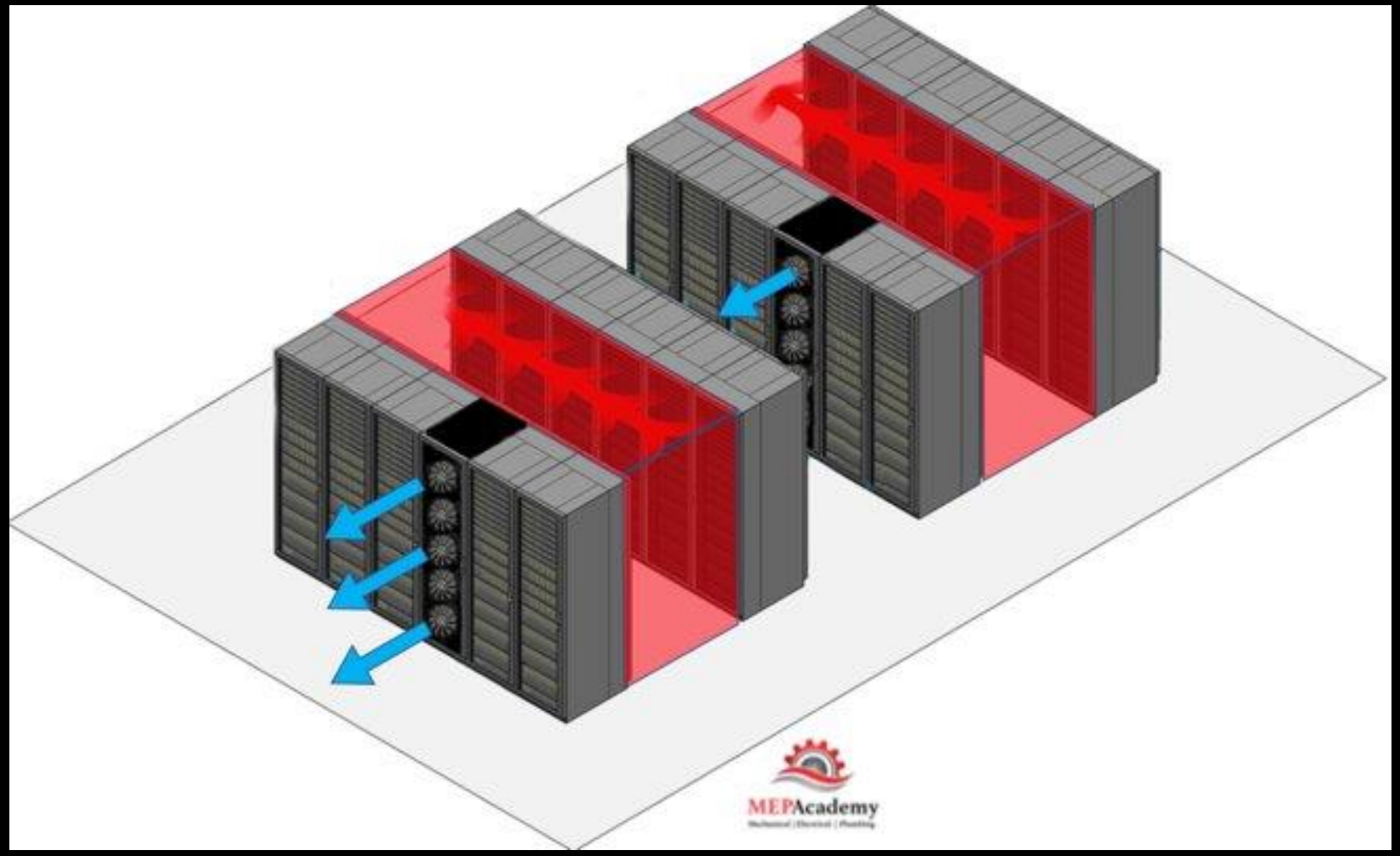
The MMR has 3 CRAC (Computer Room Air Condition) units that support the entire computer room - 1800sq feet , with a total of 90 tons of cooling. (a "ton of cooling" is a notional unit from BTUs)

CARC Main Machine Room: Hot Aisle

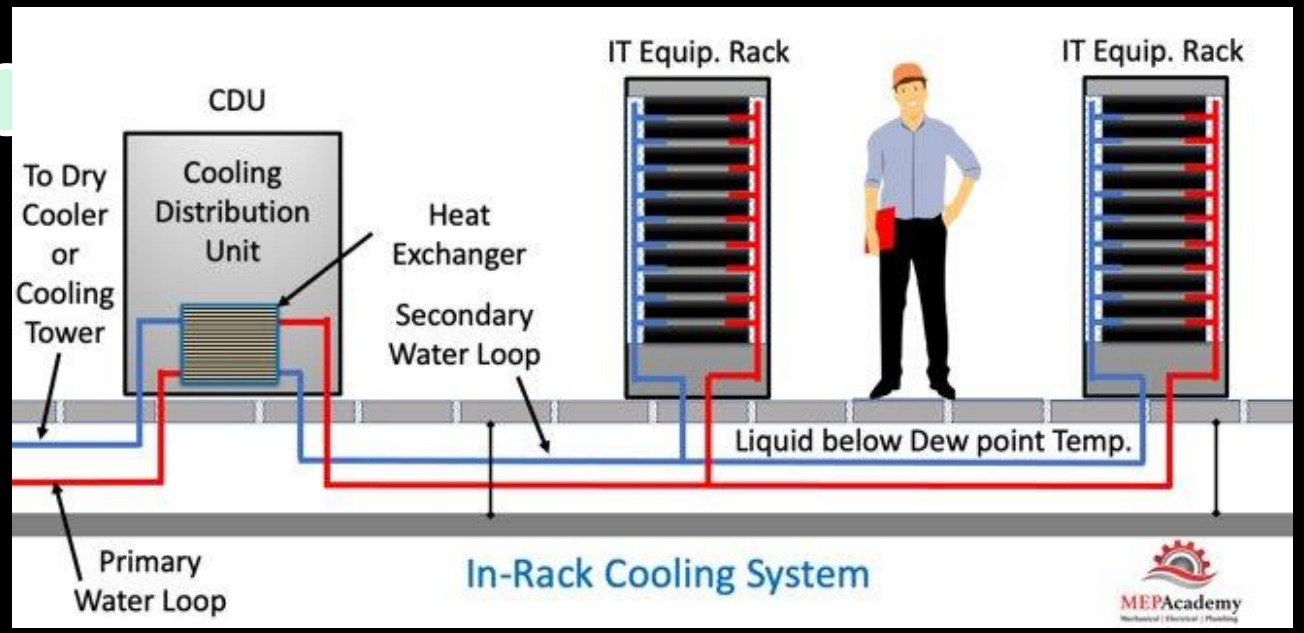


In-Row Cooling Units

In-row cooling units sit between the IT equipment racks and take the hot air from the hot aisle, and cool that air before blowing it into the cold aisle where it gets sucked into the IT equipment racks to cool down the equipment.



Liquid Colling System



The heat exchanger in the CDU keeps the two water systems separated so they never mix, allowing the liquid circulating in the racks to be unaffected by the water circulated outdoors. Water from the tower is circulated to the primary side of the heat exchanger in the CDU where it absorbs the heat from the secondary water circulating through the racks.