Data Center Facilities for Smart Buildings
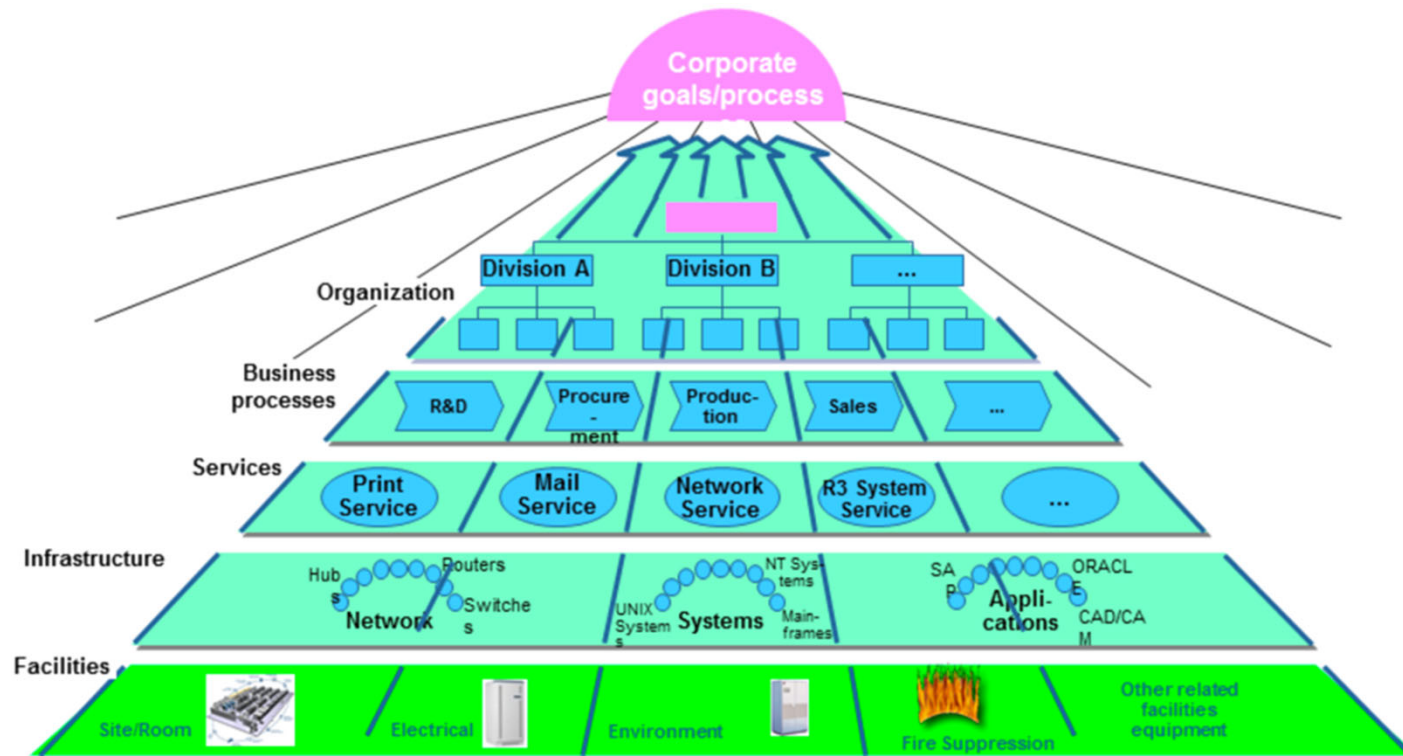
"How modern data centers support smart infrastructure"

"Building Towards Sustainable Growth"

Presented By : Phyo Thet Zin

Data Center Design & Solution

Data Center : The Foundation of every organization

- Having high-performance ICT (Information and Communication Technology) resources on hand is essential for business processes to achieve corporate goals.

Types of Data Center

❖**Enterprise Data Center**

    ❖**Owned and operated by a single organization for internal use**

❖**Colocation Data Center**

    ❖**Facilities where multiple organizations rent space and resources**

❖**Cloud Data Centers**

    ❖**Hosted by cloud service providers like AWS, Google Cloud, and Microsoft Azure**

❖**Edge Data Centers**

    ❖**Smaller facilities located close to users for low-latency processing**

Data Center Standards

Data Center are classified (Tier 1 to Tier 4) based on uptime and redundancy

Optimizing power usage through renewable energy, efficient cooling, and power management (PUE – Power Usage Effectiveness)

❖Physical Security – Surveillance, biometric access, and controlled entry

❖Physical Security – Surveillance, biometric access, and controlled entry

❖Disaster Recovery – Backup strategies, failover systems, and redundancy

Data Center Standards

❖**Rated-1 Data Center; Basic**

　　❖Single path for power and cooling without redundancy

　　❖Many single points of failure

❖**Rated-2 Data Center; Redundant Components**

　　❖Single path for power and cooling with component redundancy i.e. **N+1**

❖**Rated-3 Data Center; Concurrently Maintainable**

　　❖Multiple path for power and cooling of which one is active allowing maintenance or testing on one path without causing interruption to the critical load
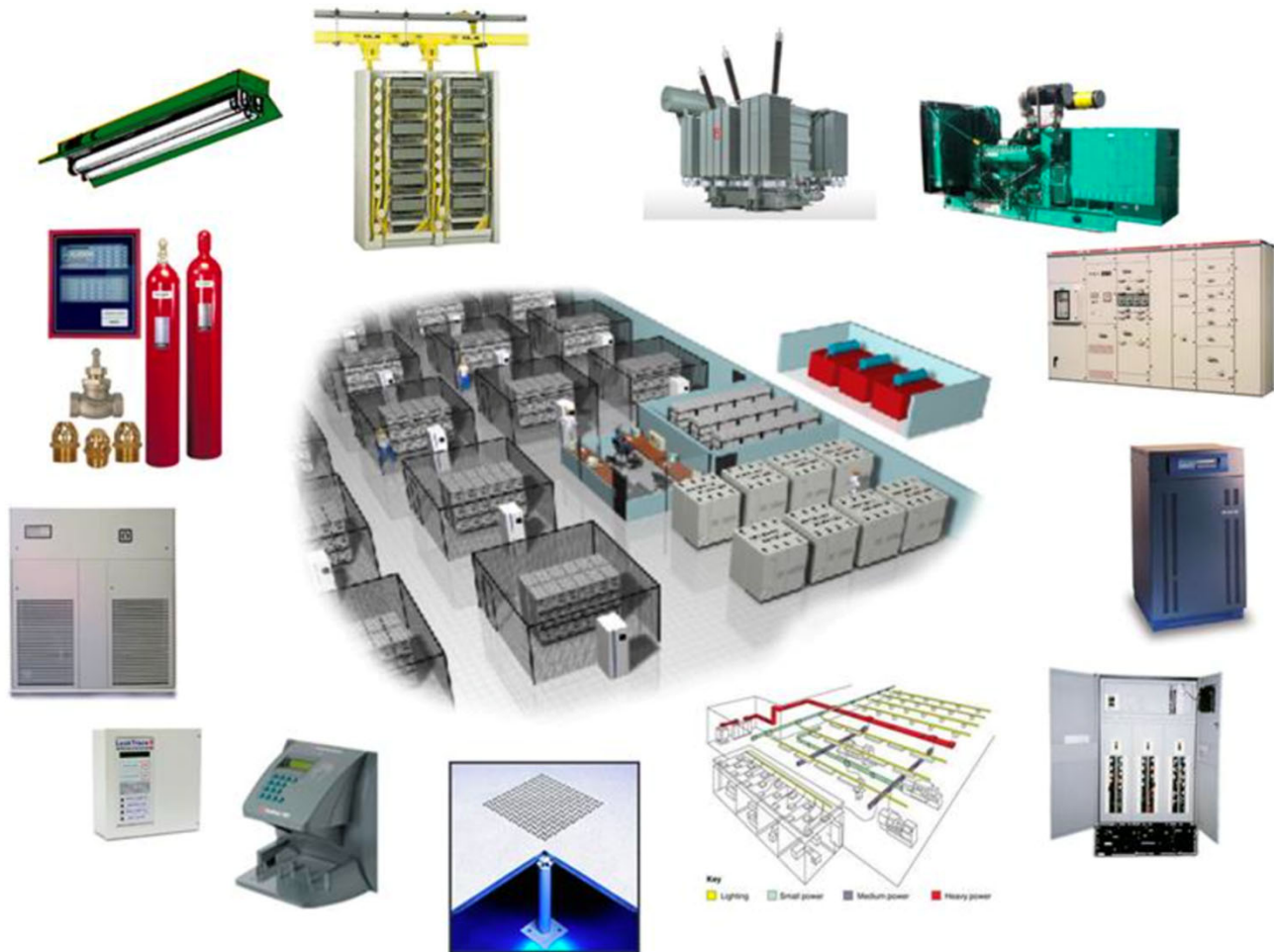
❖**Rated-4 Data Center; Fault Tolerant**

　　❖Multiple active paths for power and cooling with redundancy in each path.
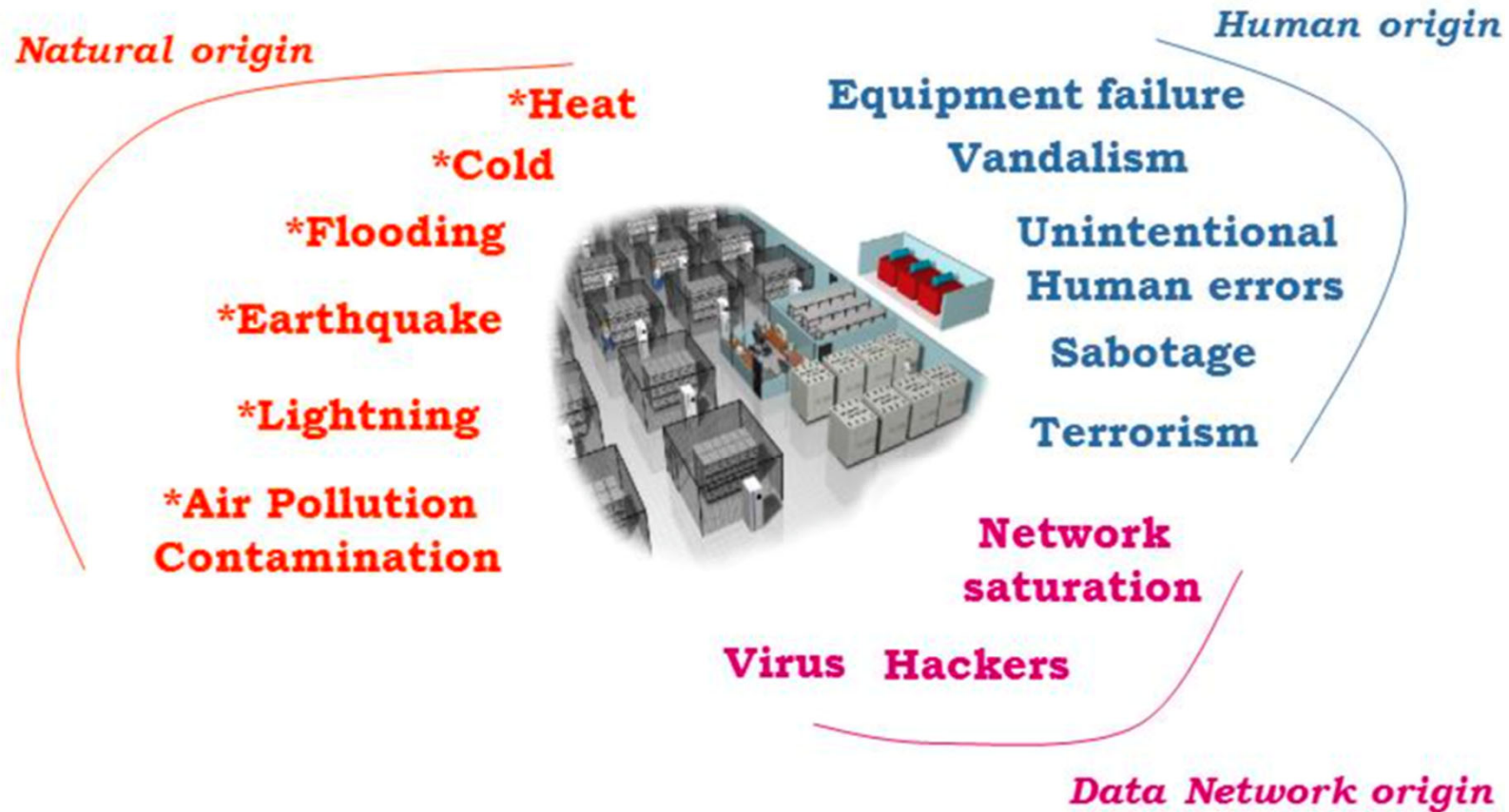
　　❖Allows for one fault.

Data Center Standards

	TIER I	TIER II	TIER III	TIER IV
Number of delivery paths	Only 1	Only 1	1 active 1 passive	2 active
Redundant components	N	N+1	N+1	2 (N+1) or S+S
Support space to raised floor ratio	20%	30%	80-90%	100%
Initial watts/ft^2	20-30	40-50	40-60	50-80
Ultimate watts/ft^2	20-30	40-50	100-150	150+
Raised floor height	12"	18"	30-36"	30-36"
Floor loading pounds/ft^2	85	100	150	150+
Utility voltage	208, 480	208, 480	12-15kV	12-15kV
Months to implement	3	3 to 6	15 to 20	15 to 20
Year first deployed	1965	1970	1985	1995
Construction $/ft^2 raised floor*	$450	$600	$900	$1,100+
Annual IT downtime due to site	28.8 hrs	22.0 hrs	1.6 hrs	0.4 hrs
Site availability	99.671%	99.749%	99.982%	99.995%

The Complexity of Data Center

Data Center : Risk Factors

Natural origin

*Heat
*Cold
*Flooding
*Earthquake
*Lightning
*Air Pollution Contamination

Human origin

Equipment failure
Vandalism
Unintentional Human errors
Sabotage
Terrorism

Network saturation

Virus Hackers

Data Network origin

*Unexpected Catastrophic events, normally impossible to predict.

Predominant causes of Data Center Failures

❖Human Error

❖Power Quality Issue

❖Electro Magnetic Fields (EMF)

❖Environmental Conditions

Predominant causes of Data Center Failures

❖**Human Error**

    ❖No or poorly executed processes and work instructions

    ❖Unauthorized access

    ❖Accidents

    ❖Unnoticed Alarm

❖**Power Quality Issue**

    ❖Poor Voltage/ Current/ Frequency regulation

    ❖High level of Common and Normal mode noise

    ❖High ground resistance

    ❖Harmonics

Predominant causes of Data Center Failures

❖**Electro Magnetic Fields (EMF)**
  ❖High radiation levels from power cables/ UPS/ Transformers/ PDU/ Lighting etc.

❖**Environmental Conditions**
  ❖Temperature/ Humidity
  ❖Wrong cooling principles
  ❖High levels of contamination

Data Center; Location, Building and Construction

❖**Site selection is difficult**
- ❖Technical requirements evaluation
- ❖Decision making process/ Business evaluation

❖**Technical evaluation**
- ❖Often done by engineers
- ❖Want the best to meet design criteria

❖**Business evaluation**
- ❖Done by senior management
- ❖Return On Investment (ROI)/ cost
- ❖Prestige
- ❖Location

Data Center; Location, Building and Construction

❖**Potential natural hazards**
- ❖Lightning
- ❖Flooding
- ❖Typhoon
- ❖Forest Fires
- ❖Seismic activity (Earthquake)

❖**Potential man-made hazards**
- ❖Flight Path
- ❖Tunnels, Lake,
- ❖Train/ Airport, RF Tower
- ❖Power distribution network
- ❖Industrial pollution, Etc.
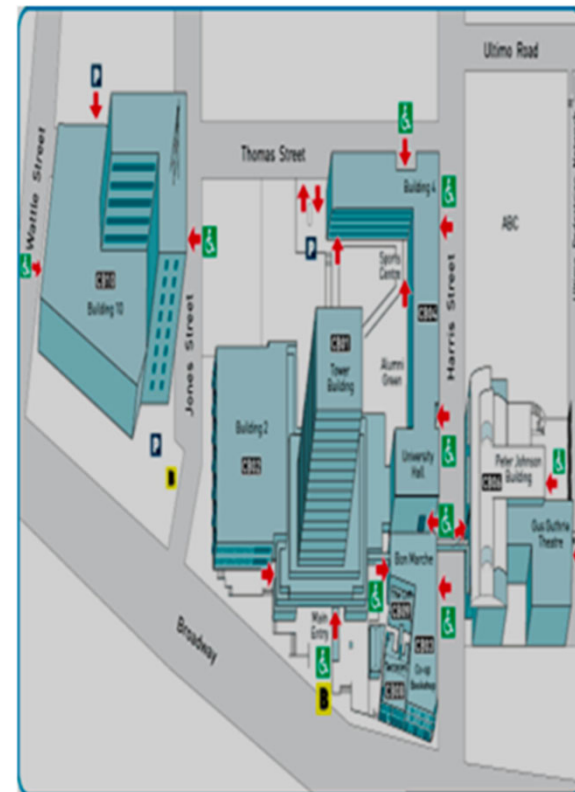
Data Center; Location, Building and Construction
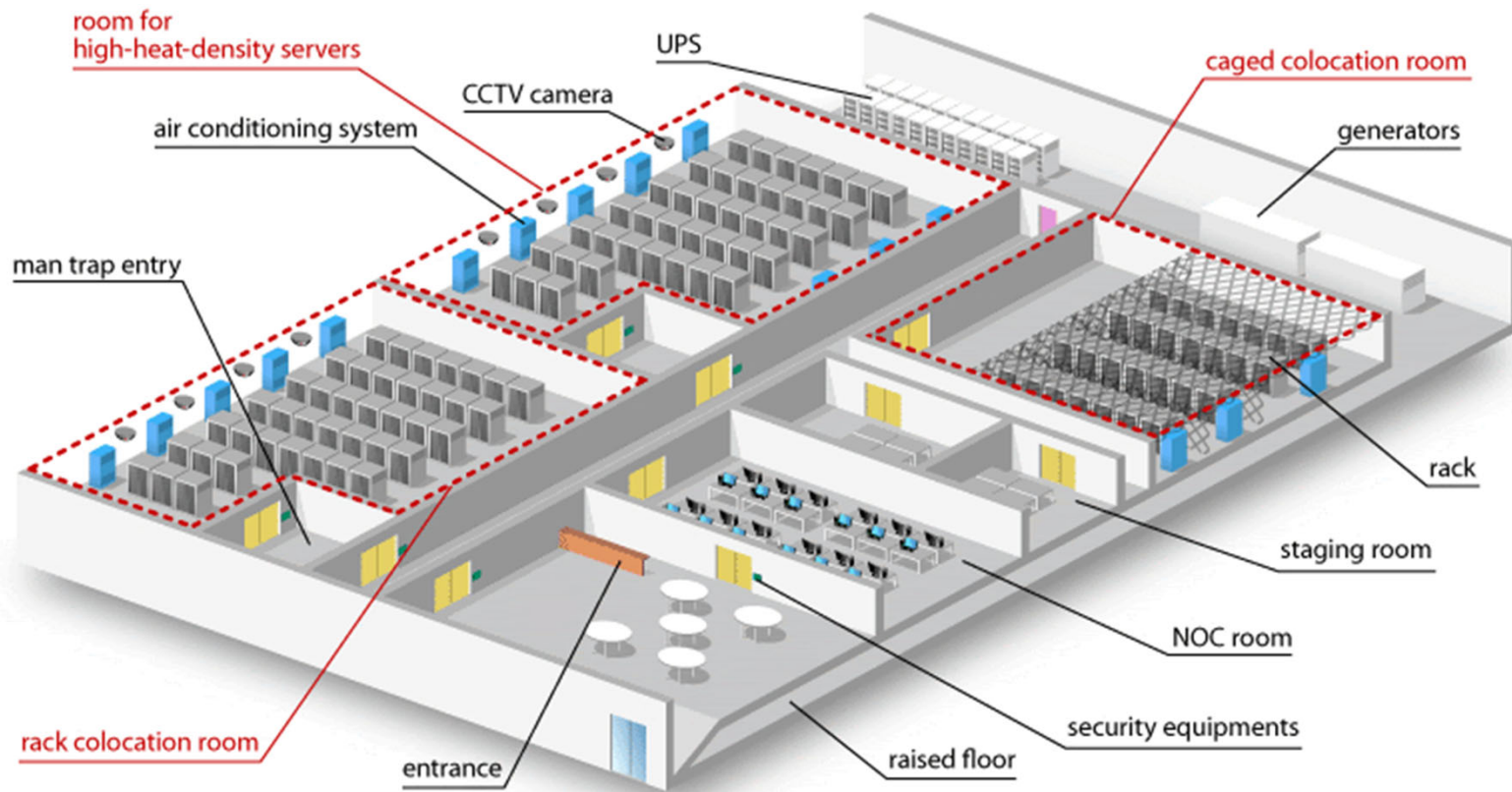
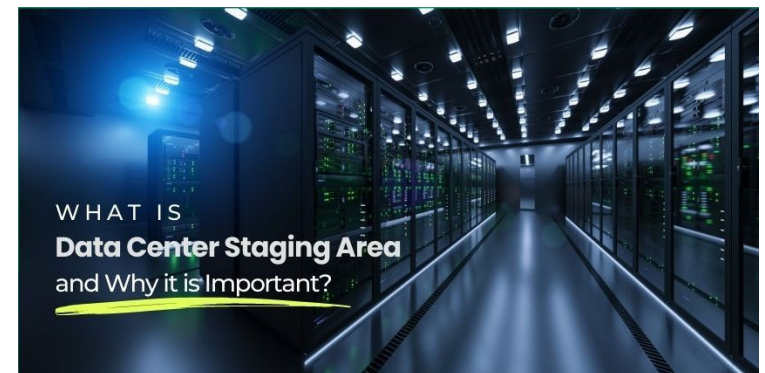# Data Center; Location, Building and Construction

Holding area

- Purpose
  - Aimed at providing an area where goods can be received, unpacked, physically inspected, and prepared for movement into the staging area

- Requirements
  - Easy access for external supply (i.e. loading bay and route to staging area)
  - Spacious
  - Proper garbage disposal
  - Secure
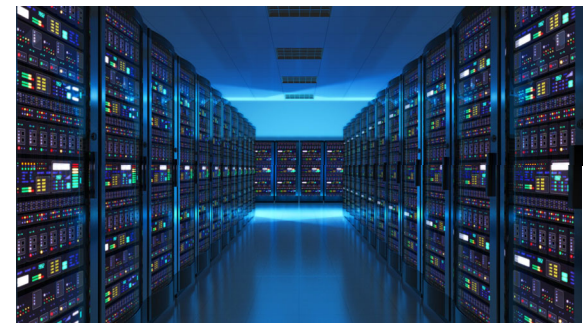
Data Center; Location, Building and Construction

Staging area

- Purpose
  - Provides an area where equipment can be acclimated, inspected, configured (H/W & S/W) and safely tested to ensure deployment readiness

- Requirements
  - Separate and secure space
  - Separate network if possible/needed
  - Separate PDU (Power Distribution Unit)
  - Environmentally controlled and monitored
  - Fire protection and other safety measures

WHAT IS
Data Center Staging Area
and Why it is Important?

Data Center; Location, Building and Construction

Computer/Server room

- Purpose
  - Provides a safe production environment where equipment can be expected to run on a 24x7 basis with minimal risk of interruption

- Requirements
  - Separate and highly secure space
  - Protection and control of power quality
  - Environmentally controlled and monitored
  - Low EMF (Electro Magnetic Field) radiation levels
  - Fire protection and other safety measures

Data Center; Location, Building and Construction

Media storage area

- Purpose
  - Provides a safe, secure and conditioned environment where media (documentation, tapes, cd-rom's etc.) can be stored in a controlled manner

- Requirements
  - Separate and secure space
  - Environmental controlled and monitored
  - Fire protection and other safety measures
    - Preferably highly sensitive smoke detection systems
    - Shelter/Bunker

Data Center; Location, Building and Construction

UPS room

- Purpose
  - Provides a safe, secure and conditioned environment where Power Protection and Conditioning systems can operate on a 24x7 basis

- Requirements
  - Separate and secure space
  - Environmental controlled and monitored
  - Fire protection and other safety measures

- Note: in some cases a small rating UPS could be located within the computer room

Data Center; Location, Building and Construction

Battery room

- Purpose
  - Provides a safe, secure and conditioned environment where batteries can be stored

- Requirements
  - Separate and secure space
    - Ideally separated from UPS room
  - Environmental controlled and monitored
  - Fire protection and other safety measures
  - Vented; if needed/required

Data Center; Location, Building and Construction

Service corridor

- Purpose
  - Provides a secure area where supporting facilities can be serviced and monitored on a 24 x 7 basis without disturbing the data centre

- Requirements
  - Separate and secure space
  - Environmental controlled and monitored
  - Fire protection and other safety measures
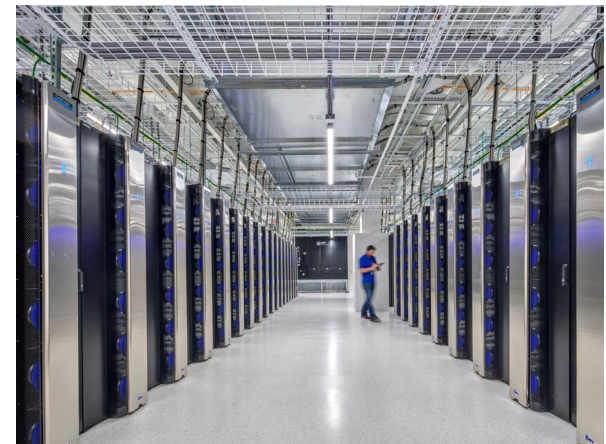
Data Center; Location, Building and Construction

Standby generator set room/area

- Purpose
  - Provides a safe and secure area where the standby generator set can be located to allow for safe operation with minimal disturbance

- Requirements
  - Separate and secure area
  - Fire protection and other safety measures
  - Fuel tanks could be located underground or above ground
    - Regulations apply and need to be reviewed before making a decision on which type to use

Data Center; Location, Building and Construction

Meet-Me / Entrance room

- Purpose
  - Provides a safe production environment where the carrier handover point equipment can be expected to run on a 24x7 basis with minimal risk of interruption
  - Note: sometimes located within the data centre

- Requirements
  - Separate and secure space
  - Protection and control of power quality
  - Environmental controlled and monitored
 - Fire protection and other safety measures
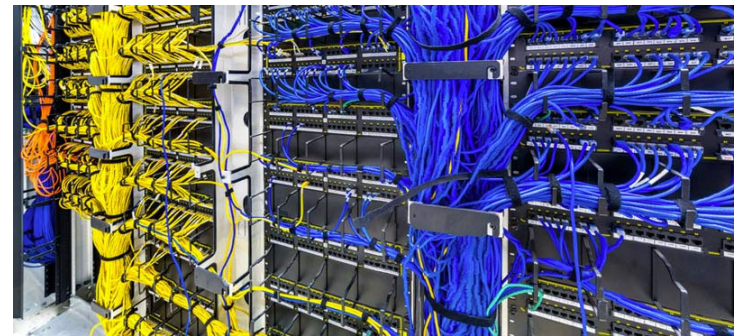
Data Center; Location, Building and Construction

Security room

- Purpose
  - Provides a secure area where security functions can be undertaken on a 24 x 7 basis

- Requirements
  - Separate and secure space
  - Protection and control of power quality
  - Fire protection and other safety measures

Data Center; Location, Building and Construction

NOC (Network Operations Control)/Command centre

- Purpose
  - Provides a secure area where the ICT infrastructure and supporting facilities can be monitored and controlled on a 24 x 7 basis
  - Note: sometimes combined with Security room

- Requirements
  - Separate and secure space
  - Protection and control of power quality
  - Environmental controlled and monitored
  - Fire protection and other safety measures

Data Center – Raised Floor System

Cold-Aisle Containment (CAC)
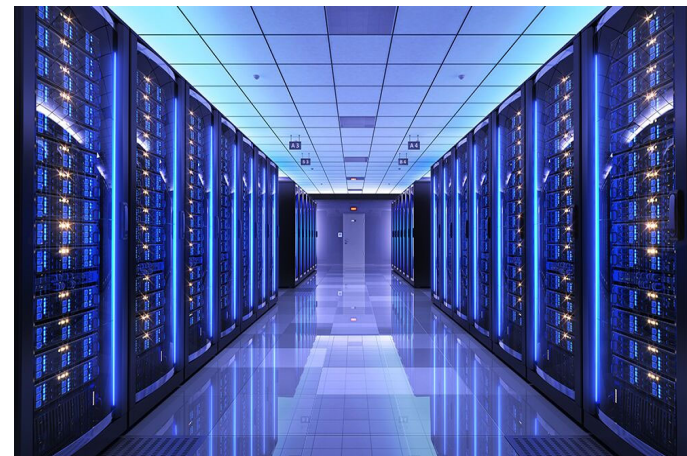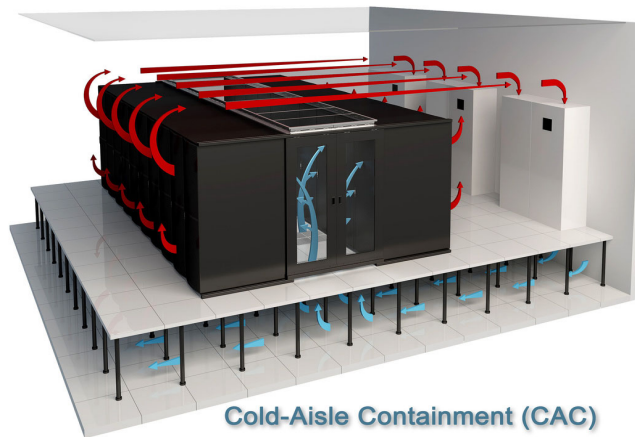
Data Center – Raised Floor System

- Two types of floors
    - Die formed welded steel construction
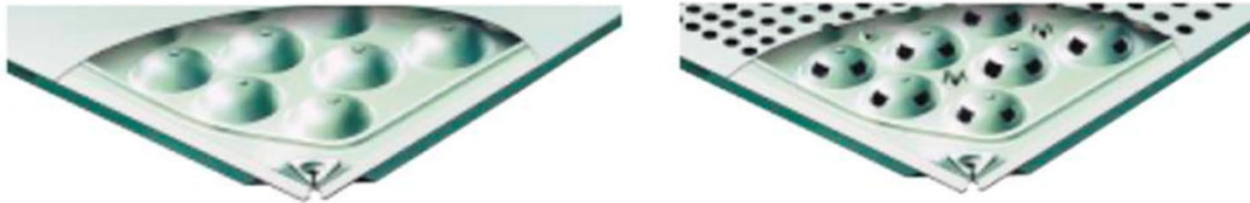
    - Die formed welded steel shell with cement-filled core

Data Center – Raised Floor System

- Raised floor needs to be connected to the ground wire

- Signal Reference Grid (SRG)

  – Provide an equipotential plane for the equipment contained within computer/server rooms.

  – Provides a low-impedance path for high-frequency noise currents to dissipate before they cause breakdown of equipment
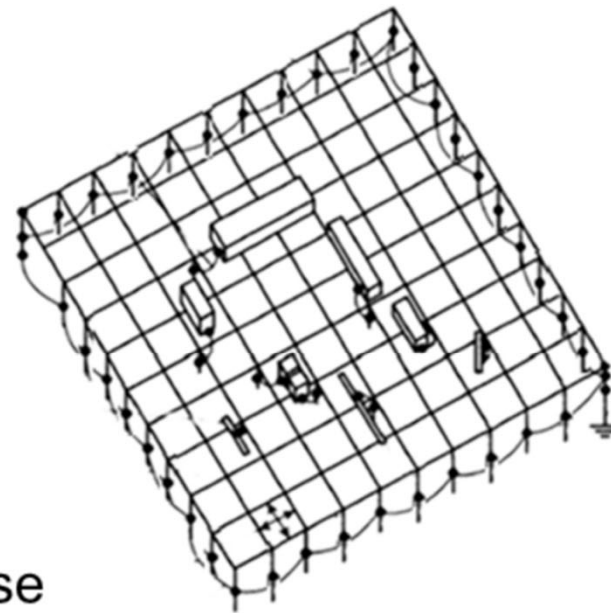
# Data Center – Raised Floor System

- All racks must be individually bonded to the SRG.
  - Serial bonding is not allowed
- Ideally created via braided copper wire or flat copper strip connected to every other pedestal or surrounding frame (IEEE-1100)
- Acceptable via grounded raised floor frames
  - Hanging or bolted frame must be free of corrosion
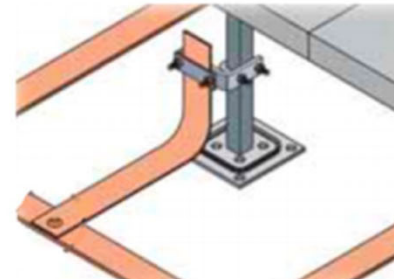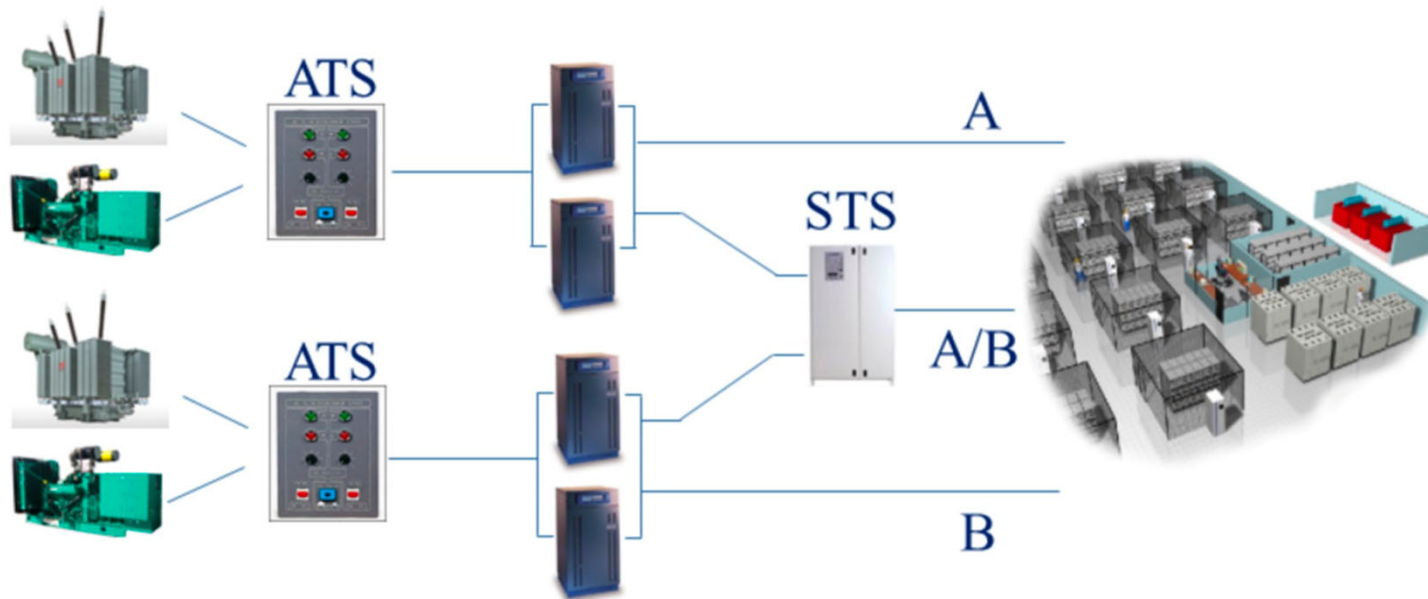
Data Center – Power Source
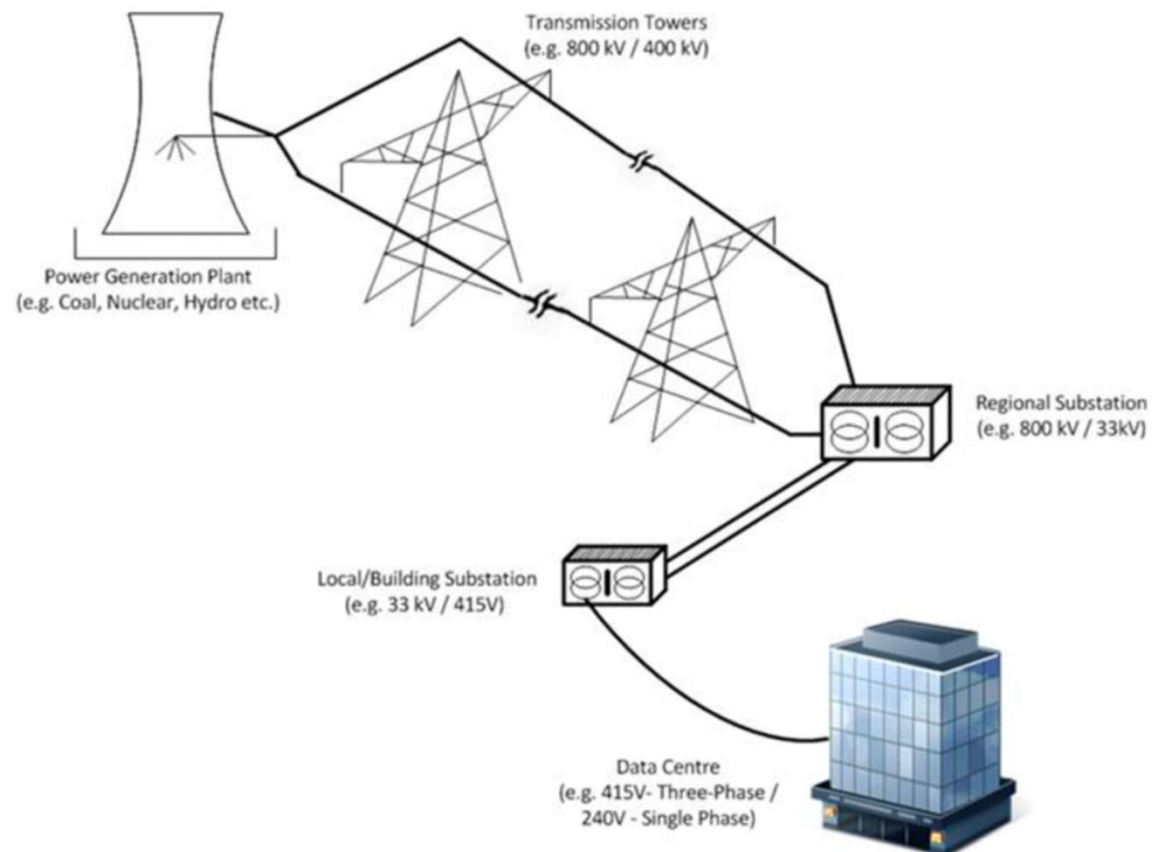
Data Center Redundant Supply
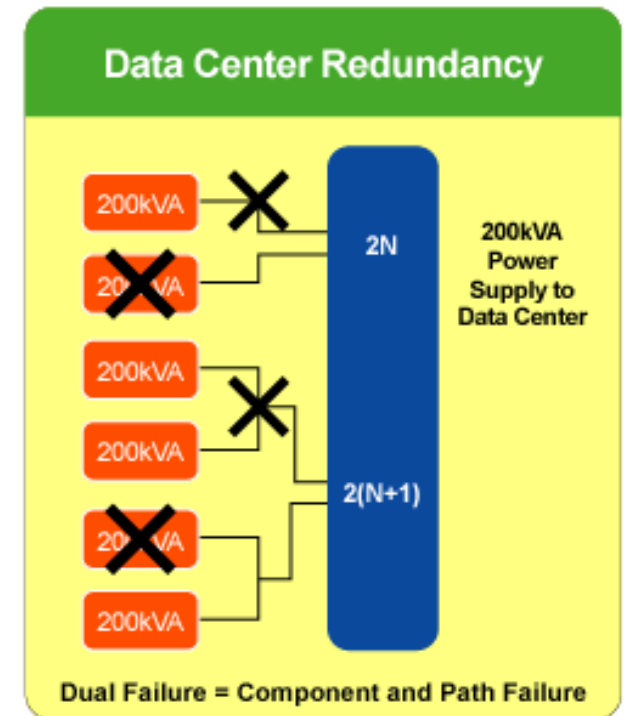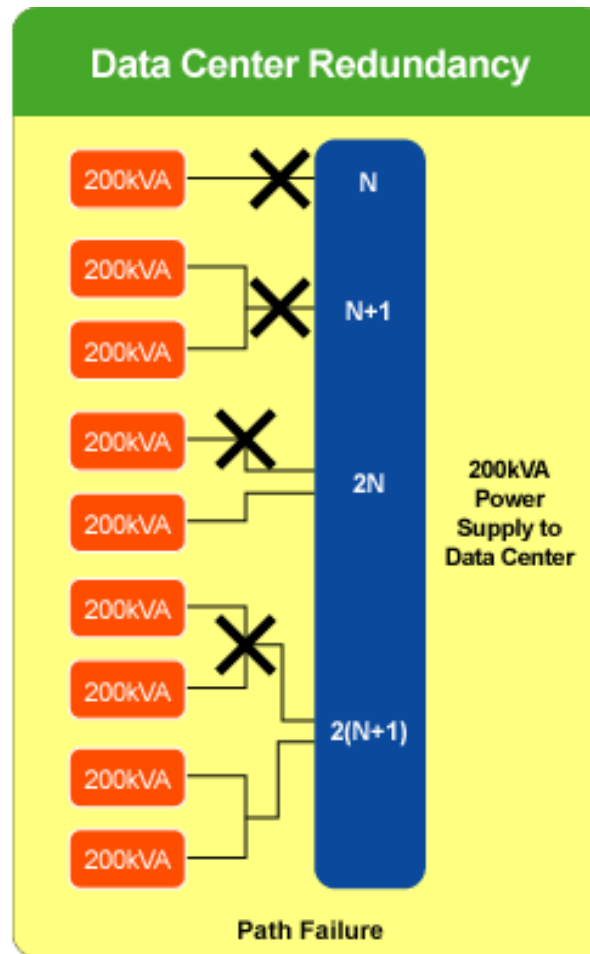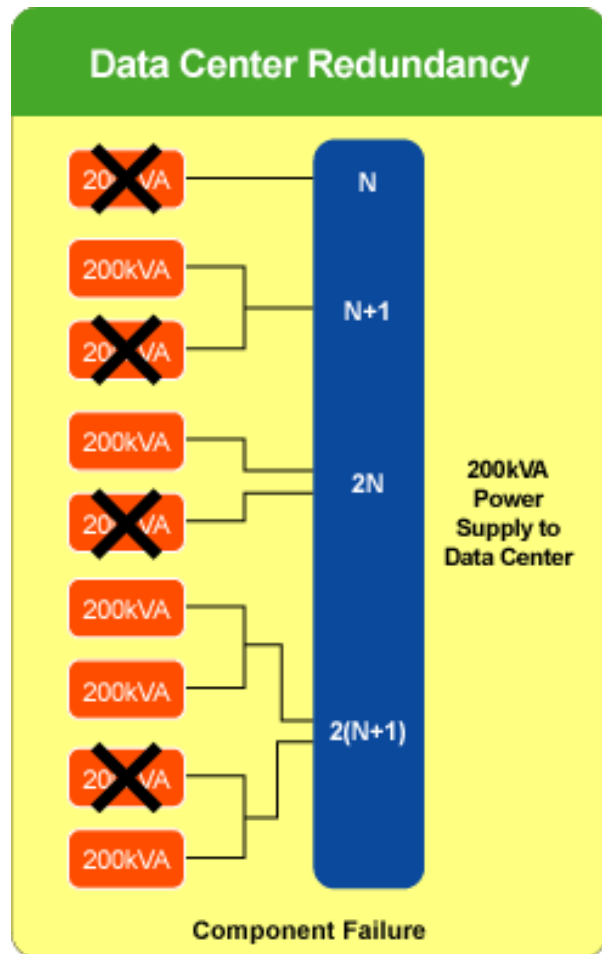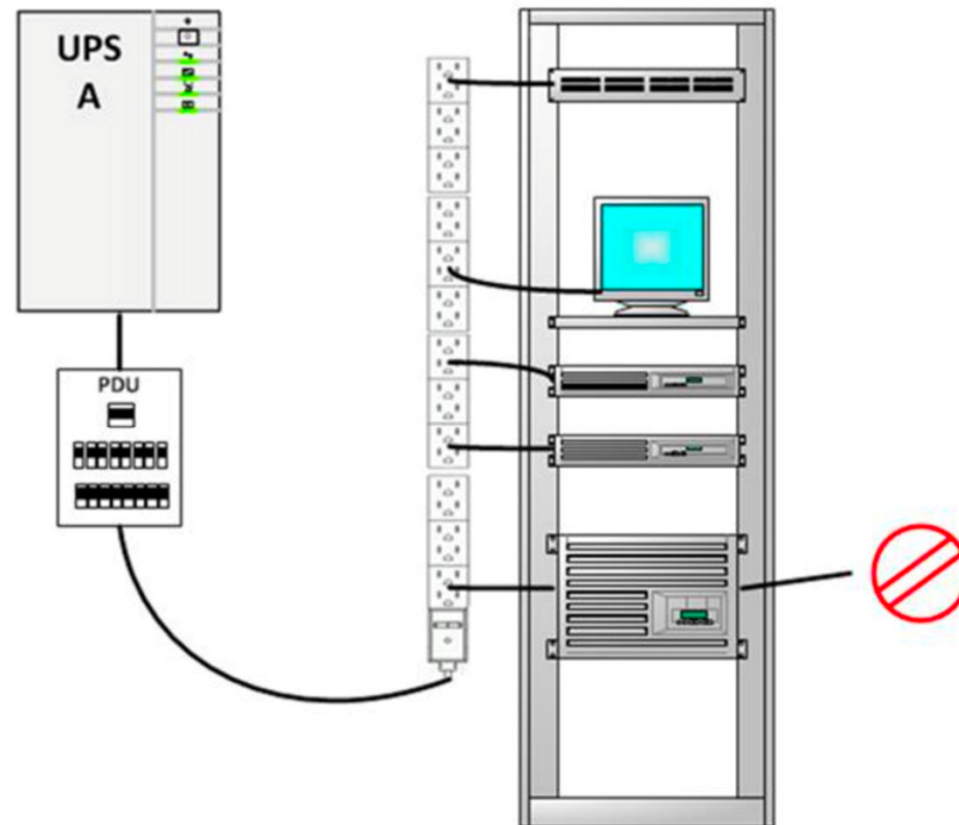
Data Center – Power Redundancy Source

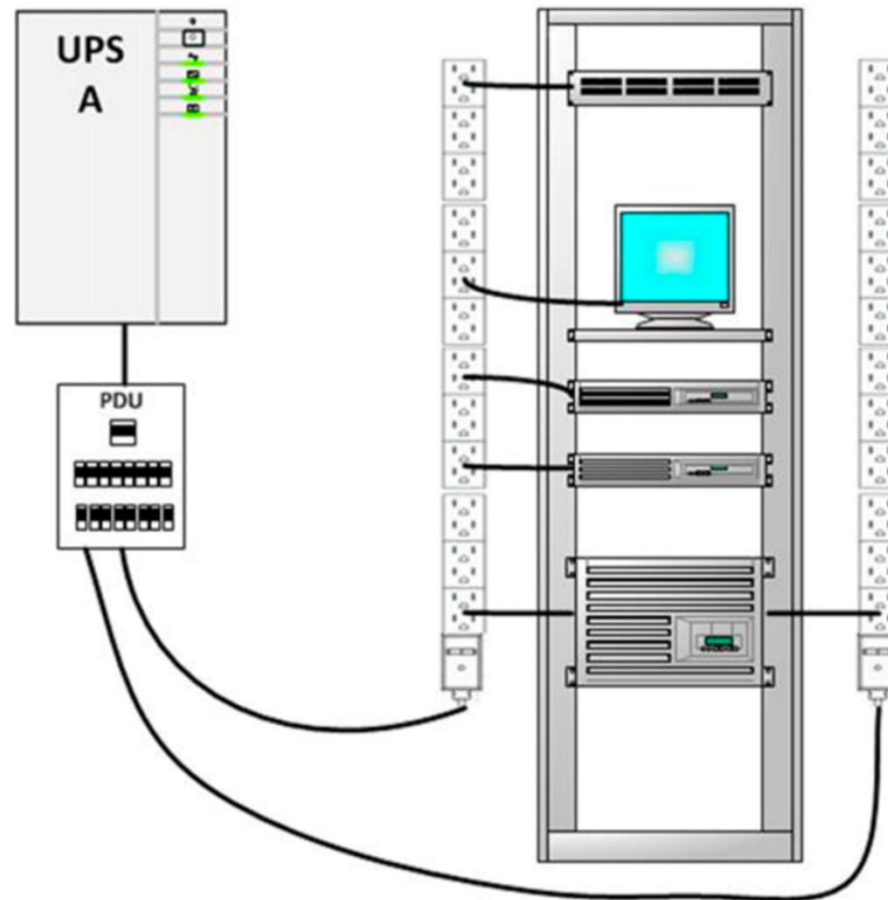# Data Center – Power Redundancy Source

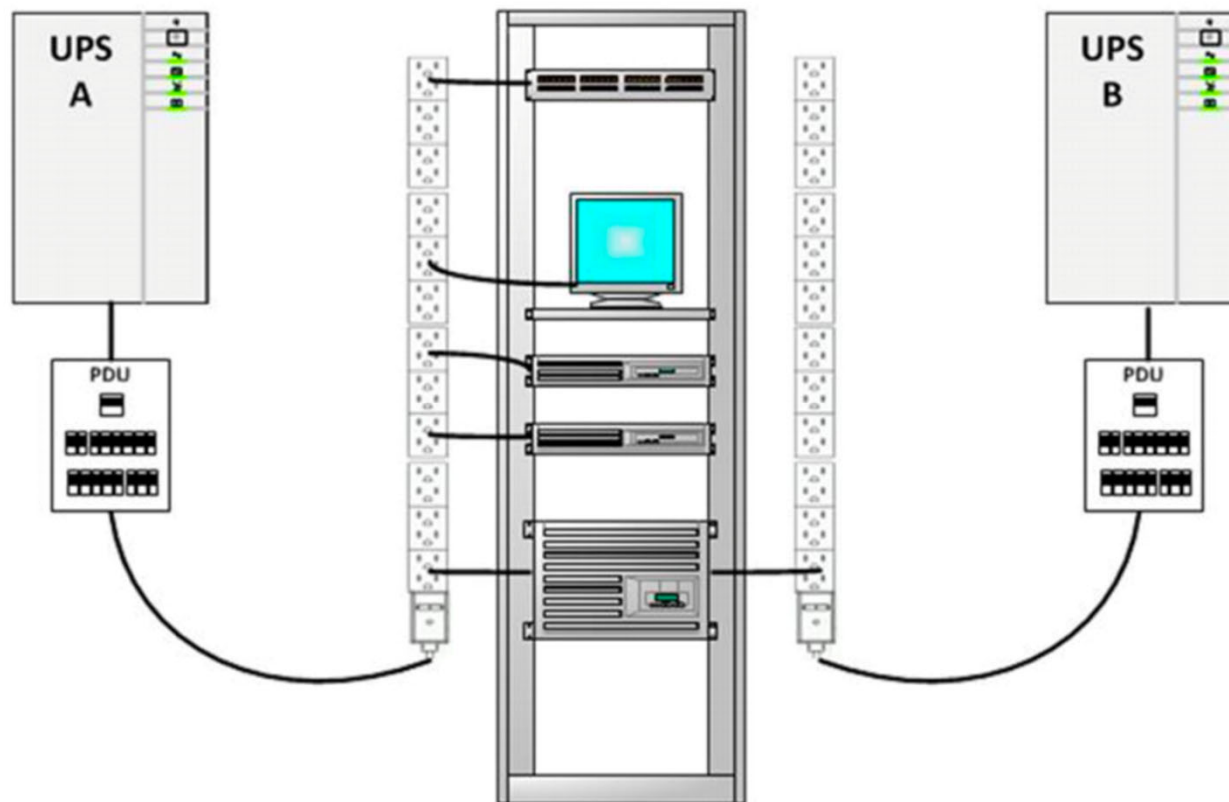# Data Center – Power Redundancy Source

Data Center – Power Redundancy Source – Low availability
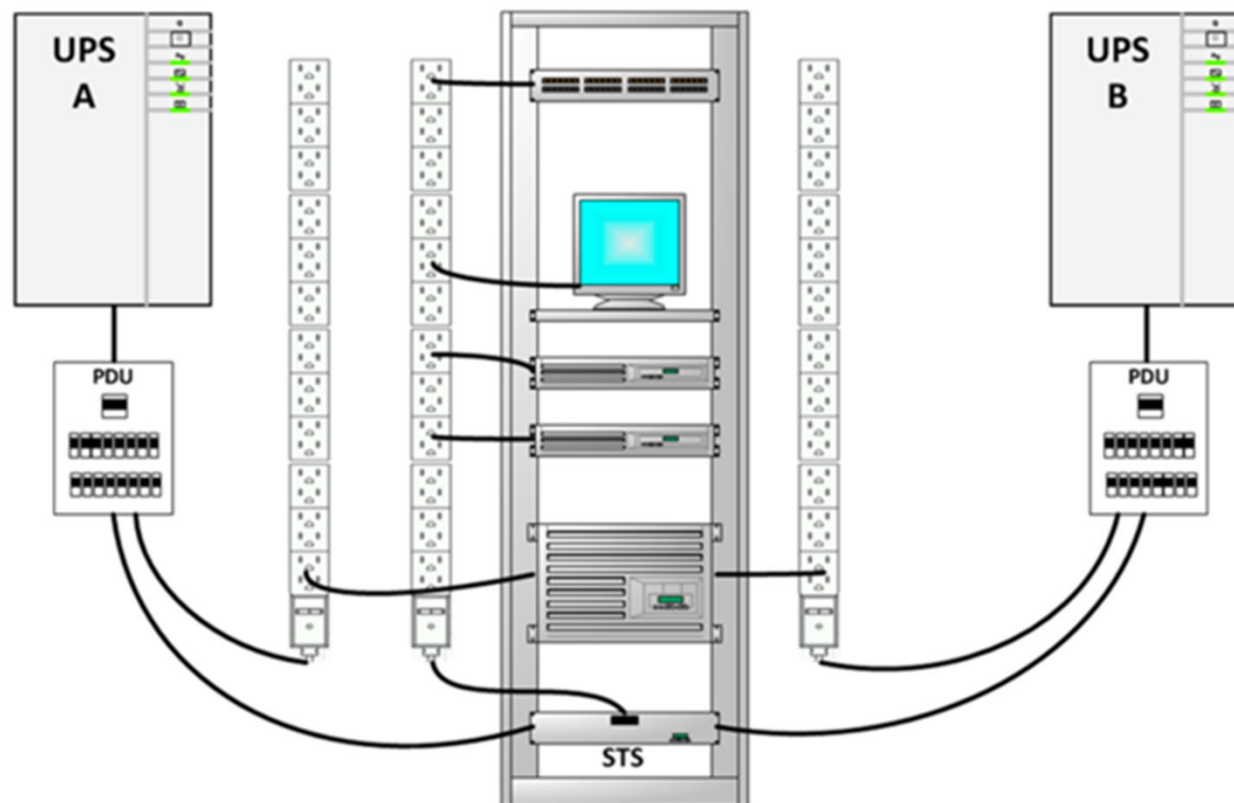
Data Center – Power Redundancy Source – Slightly availability

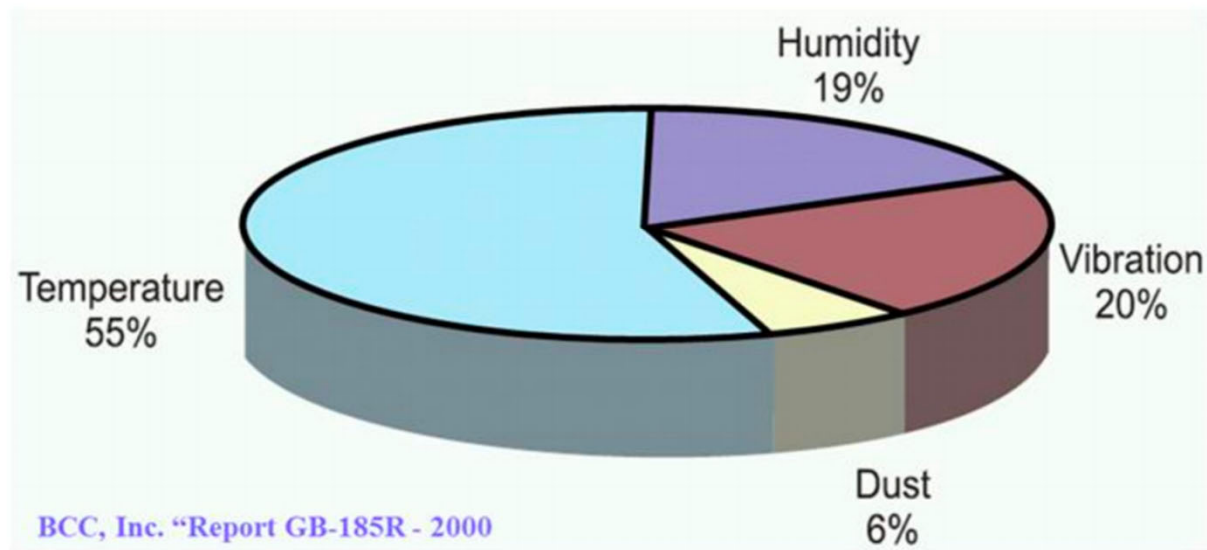# Data Center – Power Redundancy Source –Improved availability

Data Center – Power Redundancy Source –Improved availability

Data Center – Cooling System

Cooling is very important for data centres and their availability

Humidity
19%

Temperature
55%

Vibration
20%

Dust
6%

BCC, Inc. "Report GB-185R - 2000

Sources for Electronic Component Failure

Data Center – Cooling System

Comfort Air Con

- Low sensible heat load capabilities
- Simple thermostat, temperature control
- No humidification and/or de-humidification sections
- Not aimed at 24x7 operations
- Filter sections often not adequate for data centre environments
- Often no proper interface for monitoring and control
  - Fire suppression

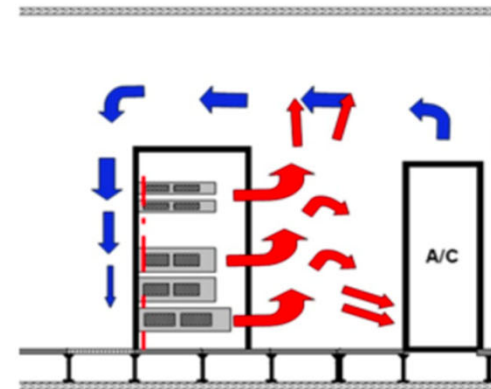# Data Center – Cooling System

Precision air conditioners

– High sensible heat load capabilities

– Narrow thresholds for temperature and humidity control

– Contains humidification and de-humidification sections

– Proper filter sections

– Aimed at 24x7 operations and therefore more reliable and robust

– Proper interface for monitoring and control

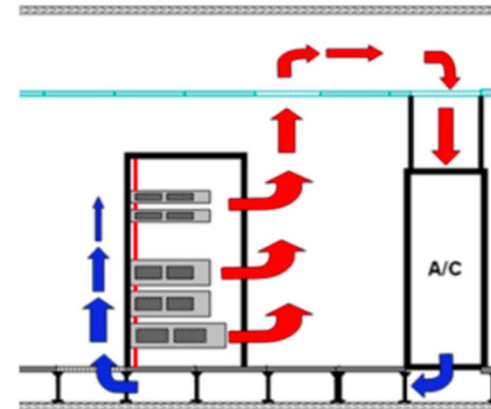# Data Center – Cooling System

Top Flow

- – Can be installed with or without raised floor
- – Limited airflow guidance (need to use ducting)

Down Flow

- – Can 'only' be used with raised floor
- – Allows for air flow guidance through raised floor

Data Center – Cooling System

Raised floor design is based on the principle of an under-floor cold air distribution path, whereby the hot air is flowing back to the air-conditioner unit either via the room or via a dedicated duct or suspended ceiling void.
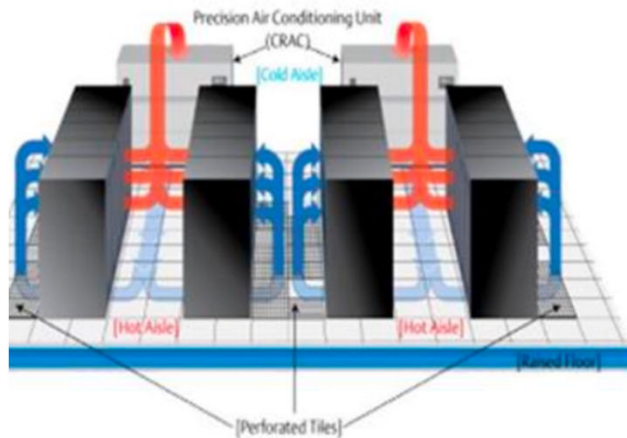
Data Center – Fire Suppression System

Novec - 1230

- Cost effective installation and maintenance
- Very effective for fire suppression
- Clear gas
- Environmentally safe
- Gas Containers should be reasonably close to data centre
- Containers can be refilled on site

Data Center – Fire Suppression System

EPO (Emergency Power Off)
Auto unlock doors
– Doors should use swing-out principle (code permitted)

Escape routes should be clear and within distance required by law (Automatic) shutdown of Air-conditioners
– country dependent, check regulation

Integration with existing building fire panel

Gas manual release and Gas abort buttons

Check your local fire-codes

Data Center – Security System

Perimeter protection and detection
- Fencing / Walls
- Moat
- Security Guards
- CCTV

CCTV
- Recording on hard disk
- Motion detection cameras
- Night vision camera
- Event/face recognition

Cameras and recorder must be on UPS

Recorder to be located in a secure area
- Avoid placement inside the computer room

Copy of hard disk should be stored off site or in another remote area of the building

Evaluate history requirements and regulations

Data Center – Security System

Doors can be secured in various ways
- Key lock
  - Proper key management procedures
- Electronic locks
  - Card reader
  - Security code
  - Biometrics (fingerprint, iris scan etc.)

Avoid tailgating at doors
- Use revolving doors
- Enforce strict policies
- Sign in/out logs

Review door access logs and security violations on a weekly basis and take action

Data Center – Security System

Ensure only persons allowed enter the computer room and other restricted areas

Supervise visitors where possible or use CCTV

Use 'cages' where possible
- No impact on cooling/fire suppression systems

Secure and lock all:
- Racks
- CRAC
- PDU's
- Etc.

Proper key management
Enforce policies

Data Center – Monitoring System

Remote monitoring can be achieved through the existing TCP/IP based network by using SNMP or other protocols

Connection to remote sites