

ANSI/BICSI 002-2014

Data Center Design and Implementation Best Practices

**Risk, Reliability & Availability
Selecting a Data Center Design Class**

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Discussion

Discussion points:

1. Risk analysis
2. Availability
3. Determining Data Center Class
4. Reliability
5. Efficiency and Reliability
6. BICSI Design Classifications
7. The BICSI Difference

Risk Analysis

Seven considerations:

1. Life safety – If the system failed would lives be at risk
2. Threats – Natural, man-made or technology events
3. Economic loss from loss of data
4. Economic loss from damaged equipment
5. Regulatory or contractual impact
6. Damage to the organization's reputation
7. Access to redundant off-site processing

Reliability & Availability

Reliability

- How many times will the equipment work as expected?

Availability

- How often is the equipment operational?

Reliability & Availability

Reliability

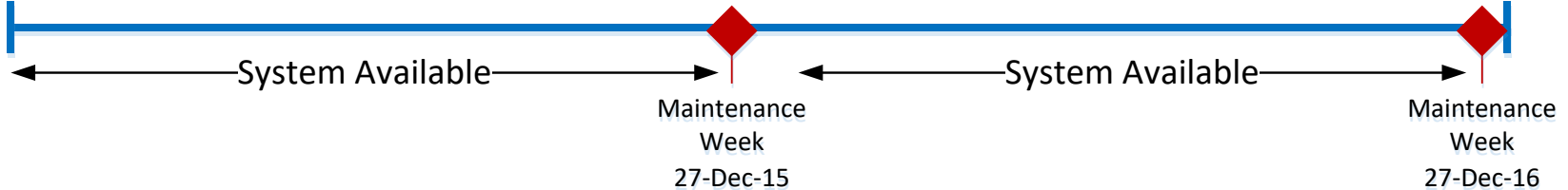
The probability that equipment or system will perform its intended function without failure over a defined time period

Mean Time Between failure

UPS Manufacturer - 2 years MTBF

1/1/2015

12/31/2016



Year end planned maintenance shutdown (5 days)

Availability

The probability that equipment or system is in condition to perform its intended function

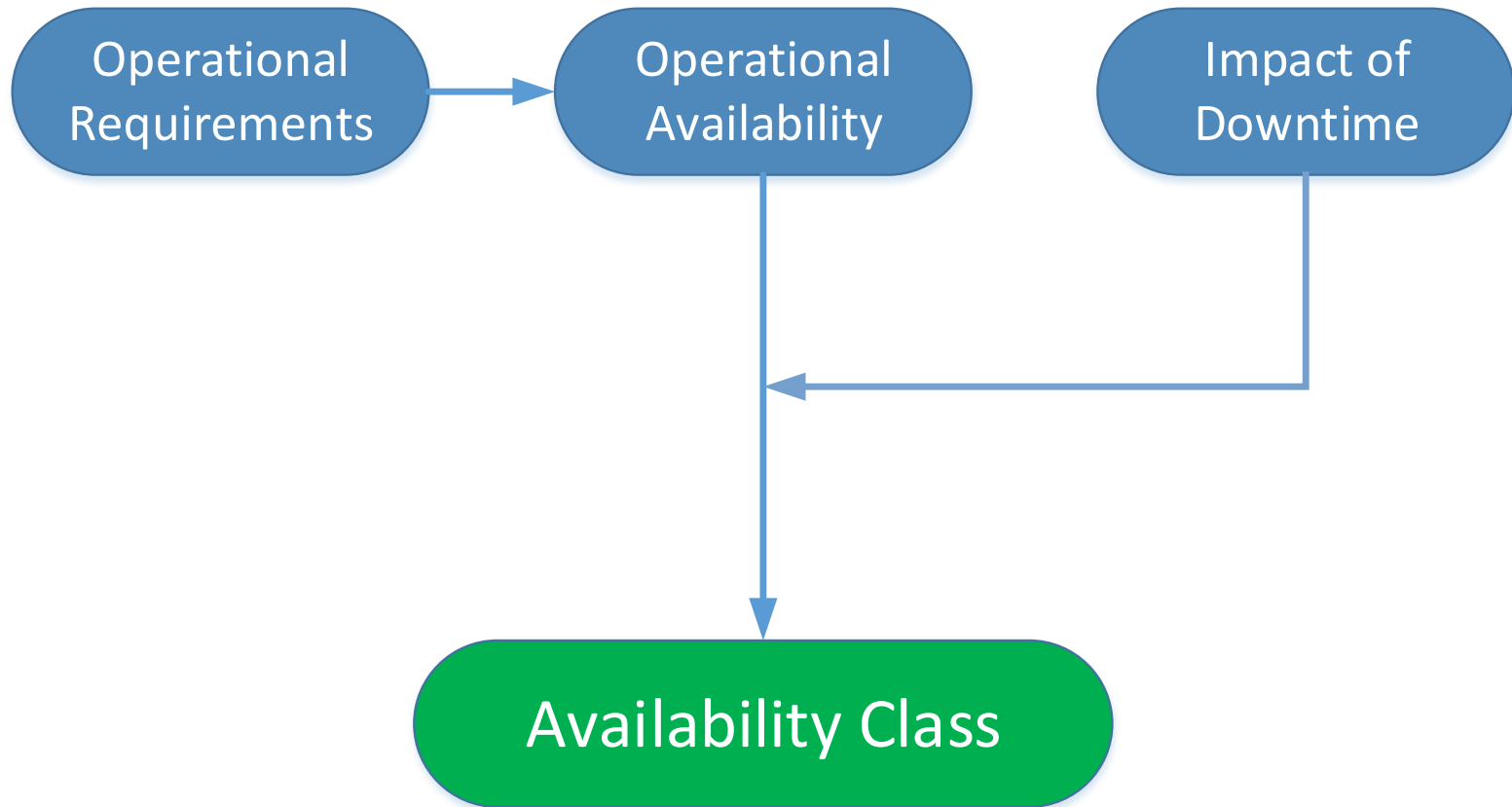
51 weeks of Availability per year

Availability


Determine the availability class for a data center

- Operational requirements
- Availability requirements
- Impact of down time
- Component and system reliability
- Impact of class on design

Defining Availability Class




Operational Requirements

Identifying Operational Requirements		
Operational Level	Annual Planned Maintenance Hours	Description
0	>400	Functions are operational less than 24 hours a day and less than 7 days a week. Scheduled maintenance is available during working hours and off hours
1	100 - 400	Functions are operational less than 24 hours a day and less than 7 days a week. Scheduled maintenance is available during working hours and off hours
2	50 - 99	Functions are operational 24 hours a day and up to 7 days a week for 50 weeks a year. Scheduled maintenance is available during working hours and off hours
 3	0 - 49	Functions are operational 24 hours a day and up to 7 days a week for 50 weeks or more. No scheduled maintenance is available during working hours
4	0	Functions are operational 24 hours a day and up to 7 days a week for 52 weeks a year. No scheduled maintenance is available

Key Factor – The amount of time planned for maintenance

Operational Availability Rating

Allowable Maximum Annual Downtime in Minutes					
Operational Level	>5000 (> 99%)	500 - 5000 (> 99% > 99.9%)	50 - 500 (> 99.9% > 99.99%)	5 - 50 (> 99.99% > 99.999%)	0.5 - 5 (> 99.999% > 99.9999%)
Level 0	0	0	1	2	2
Level 1	0	1	2	2	2
Level 2	1	2	2	2	3
Level 3	2	2	2	 3	4
Level 4	3	3	3	4	4

Operational Availability – When the IT services are expected to be available

Impact of Downtime

Classifying Downtime	
Classification	Impact of downtime
Isolated	Local in scope, single site, minor disruption or delay to non-critical objectives
Minor	Local in scope, single site, minor disruption or delay to key objectives
Major	Regional in scope, portions of the enterprise, moderate disruption or delay of key objectives
Severe	Multiregional in scope, major portions of the enterprise, significant disruption or delay of key objectives
Catastrophic	Quality of service delivery across the enterprise, significant disruption or delay of key objectives



Determining Data Center Class

<i>Impact of downtime</i>	<i>Operational Availability Rank</i>				
	0	1	2	3	4
Isolated	Class 0	Class 0	Class 1	Class 3	Class 3
Minor	Class 0	Class 1	Class 2	Class 3	Class 3
Major	Class 1	Class 2	Class 2	Class 3	Class 3
Sever	Class 1	Class 2	Class 3	Class 3	Class 4
Catastrophic	Class 1	Class 2	Class 3	Class 4	Class 4



Availability Concerns

- Component Redundancy
 - Redundancy of critical high-risk components
- System Redundancy
 - Redundancy at the system level
- Quality
 - Commercial or premium grade
- Survivability
 - Protection against external events

Reliability

“Reliability is the probability that a component or system will perform it’s intended function within stated conditions, for a specified period of time without failure”

ANSI/BICSI 002-2014 B.8.1

Reliability is calculated from published MTBF data for components and systems.

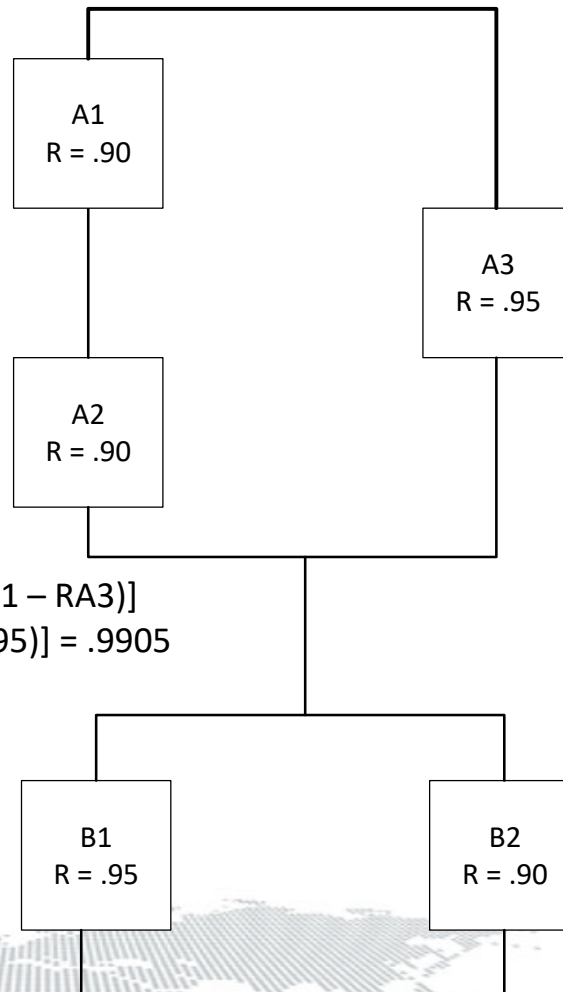
(mean time between failures)

Reliability

$$RA_{1A2} = RA_1 \times RA_2$$
$$.90 \times .90 = .81$$

$$RA = 1 - [(1 - RA_{1A2}) \times (1 - RA_3)]$$
$$1 - [1 - [(1 - .81) \times (1 - .95)]] = .9905$$

$$RB = 1 - [(1 - RB_1) \times (1 - RB_2)]$$
$$1 - [(1 - .95) \times (1 - .90)] = .995$$



$$R_{TOTAL} = RA \times RB$$
$$.9905 \times .995 = .9855475 \text{ (98.5\%)}$$

What is N

- N or Need is the resource required to serve the IT equipment
- N+1 when components (N) have at least one independent backup component (+1)

Utilization Efficiency verses Reliability

$N = 100$ kVA of UPS

N+1 redundancy can be achieved as:

1. 2 x 100 kVA modules = 200 kVA (50% efficient)
2. 3 x 50 kVA modules = 150 kVA (66% efficient)
3. 4 x 33 kVA modules = 132 kVA (75% efficient)
4. 5 x 25 kVA modules = 125 kVA (80% efficient)

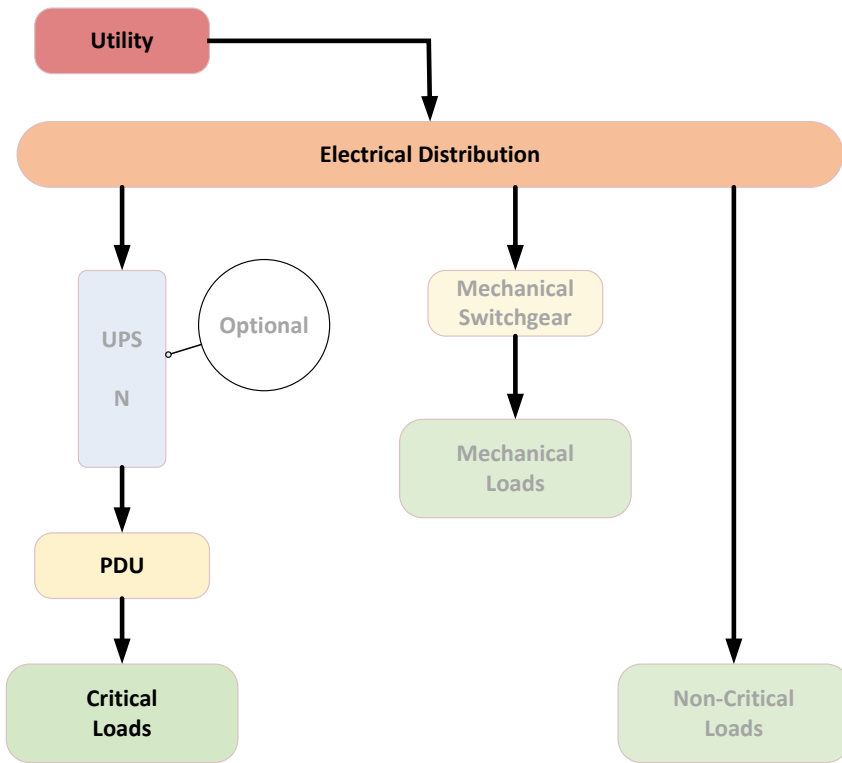
BICSI DC Design Classifications

- Class 0: Single path, and fails to meet one or more criteria of Class 1
- Class 1: Single path
- Class 2: Single path with redundant components
- Class 3: Concurrently maintainable & operable
- Class 4: Fault tolerant

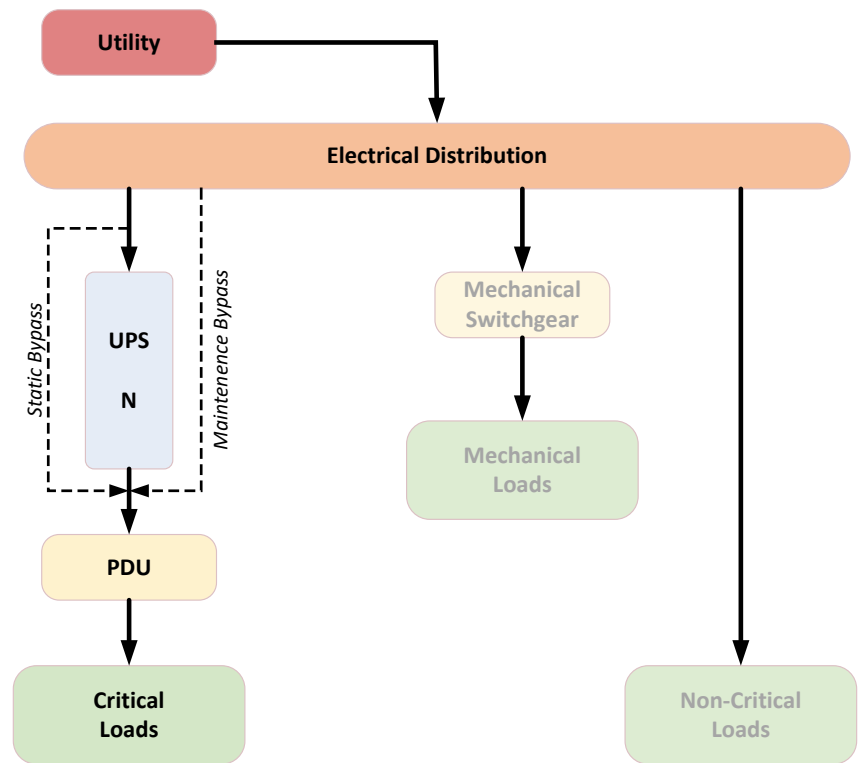
Availability Class Prefixes

- Class Fx: Facility (Electrical & Mechanical)
- Class Cx: Cable Plant
- Class Nx: Network Infrastructure
- Class Sx: Data Processing and Storage Systems
- Class Ax: Applications

Electrical Class F0 & F1

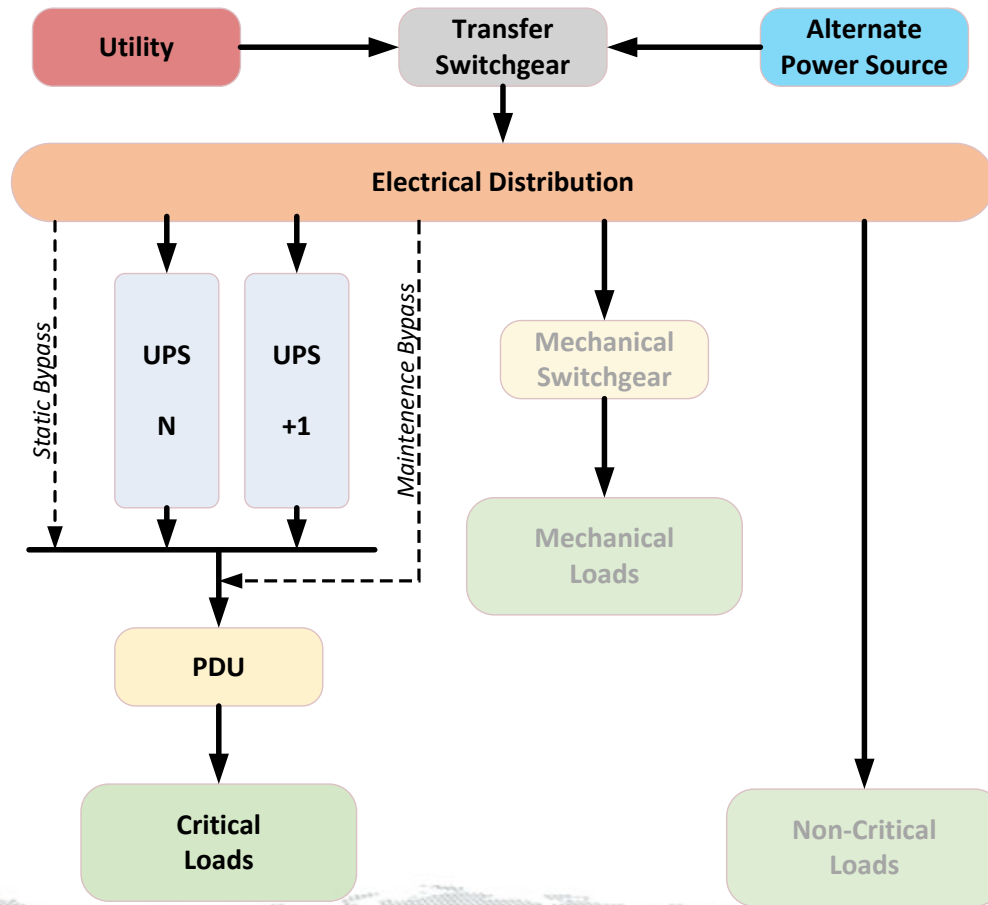


F0 – Single path, module and source



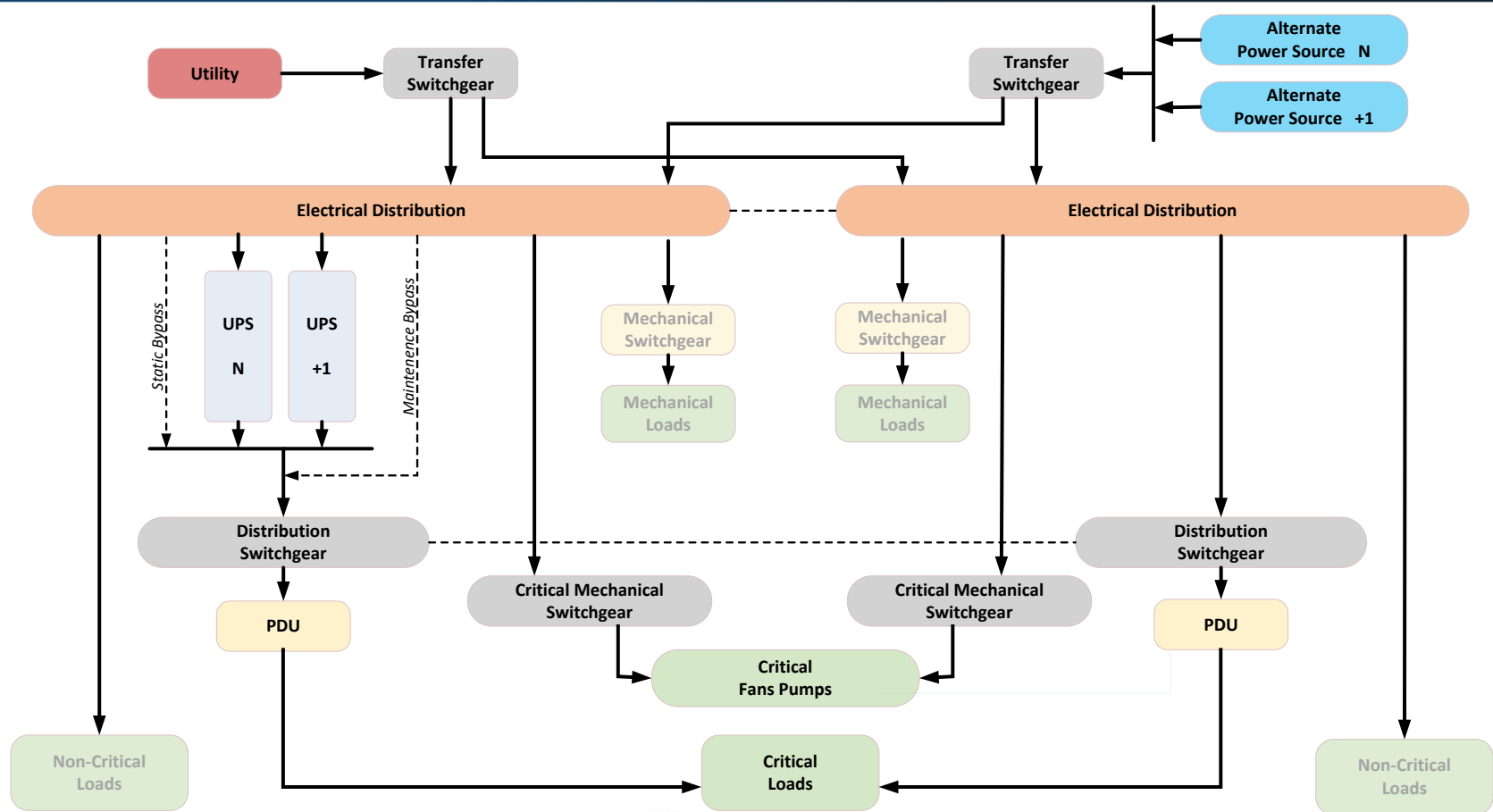
F1 – Single path, module and source

Electrical Class F2



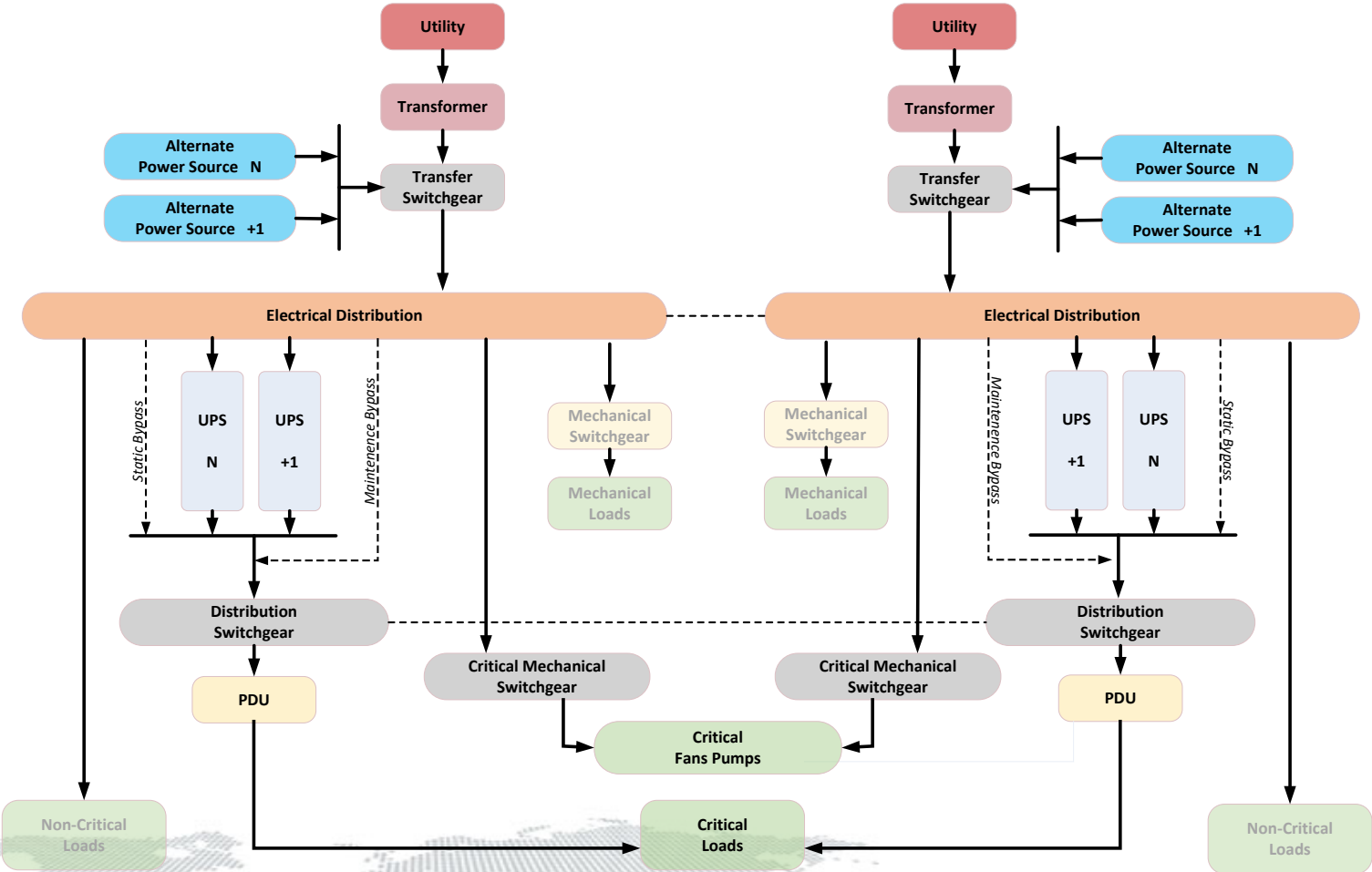
Single source, multiple module, single path

Electrical Class F3 Single Utility

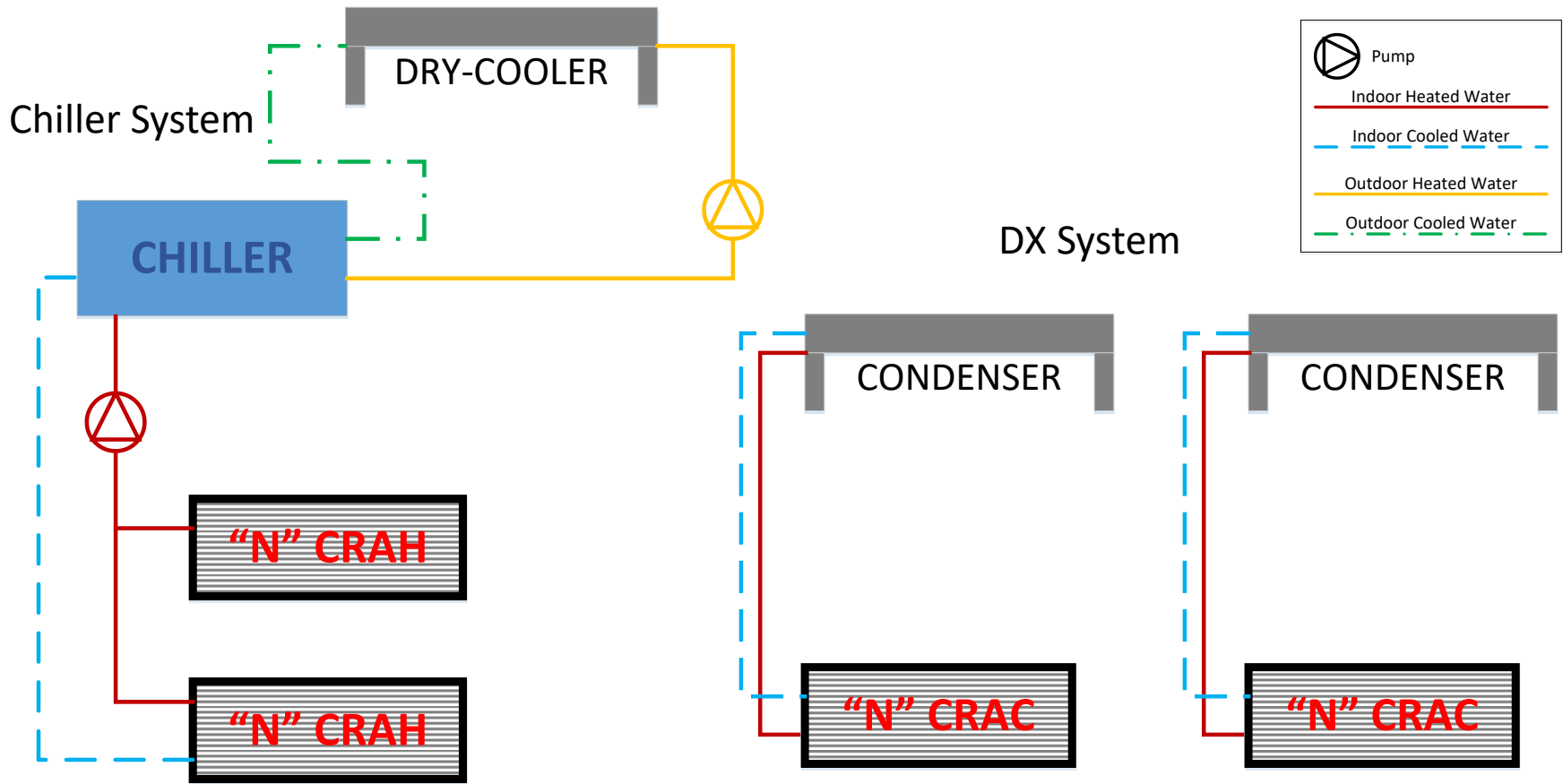


Multiple source, N rated single or multimodule system, dual or multiple path

Electrical Class F4 Two Utilities

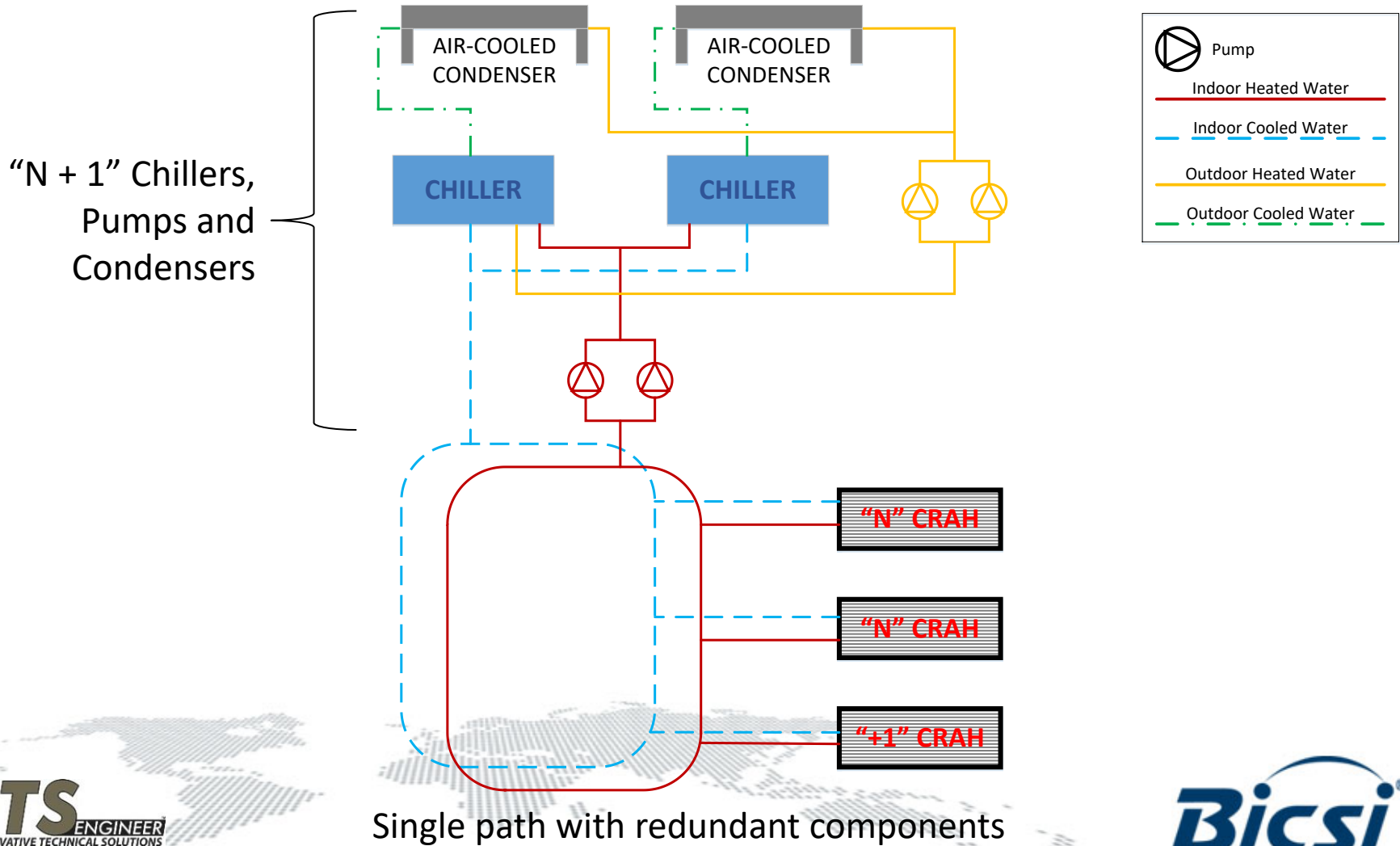


Mechanical Class F0 & F1



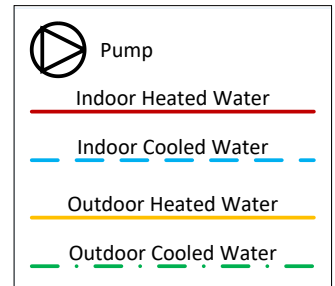
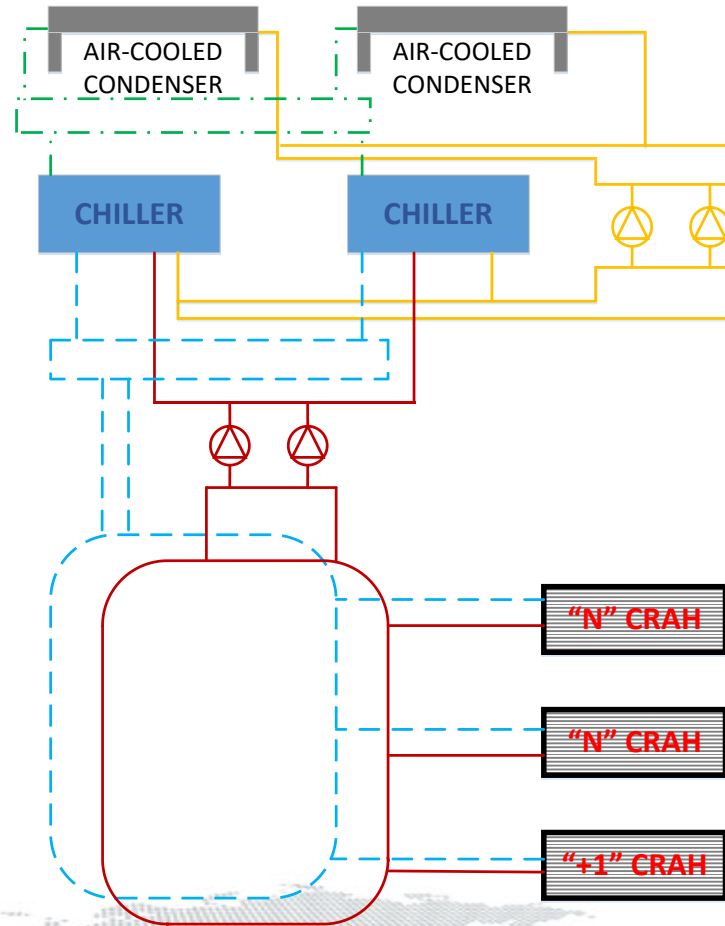
Single Path

Mechanical Class F2



Mechanical Class F3

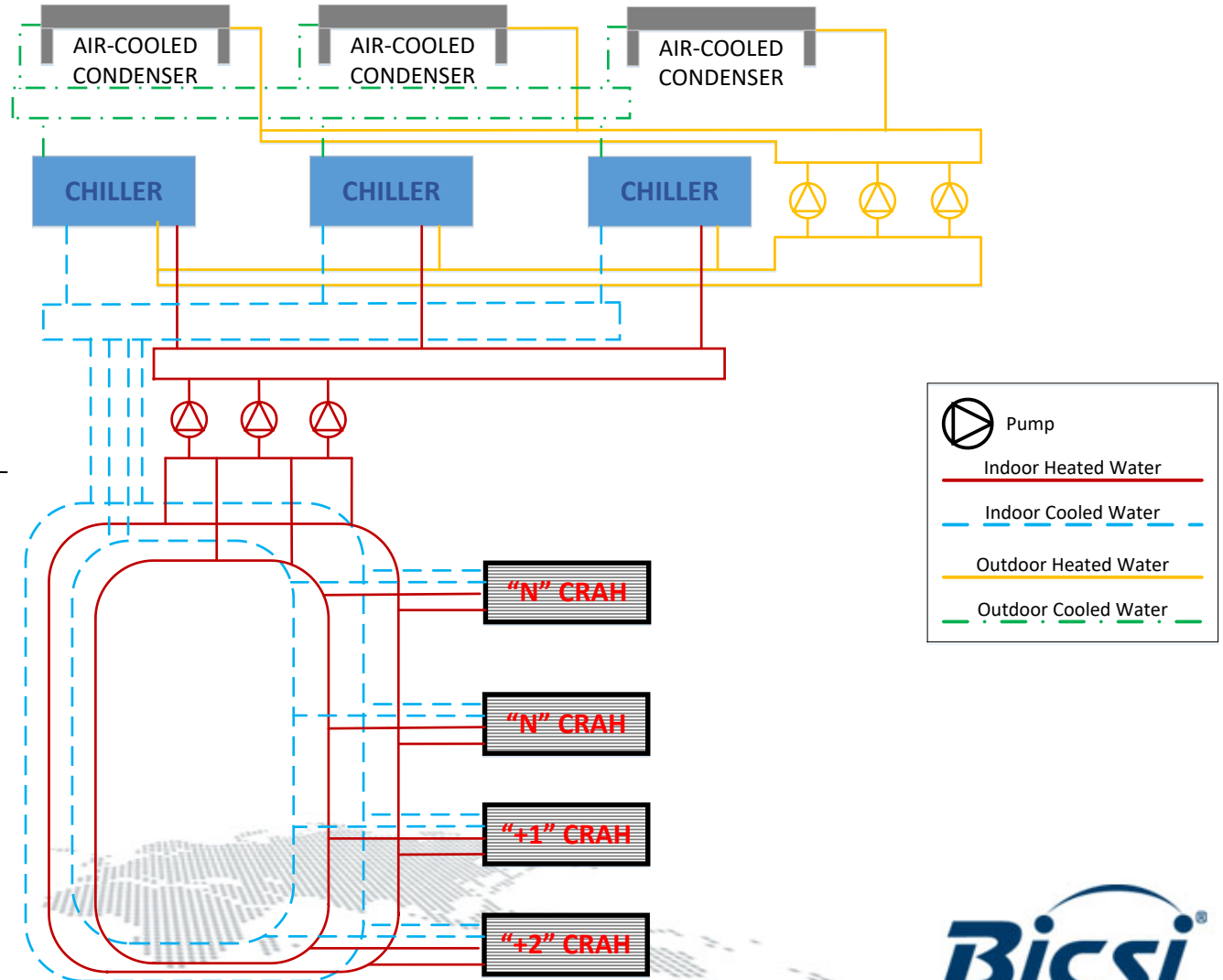
"N + 1" Chillers,
Pumps and
Condensers
Pipe loops
recommended



Concurrently maintainable and operable

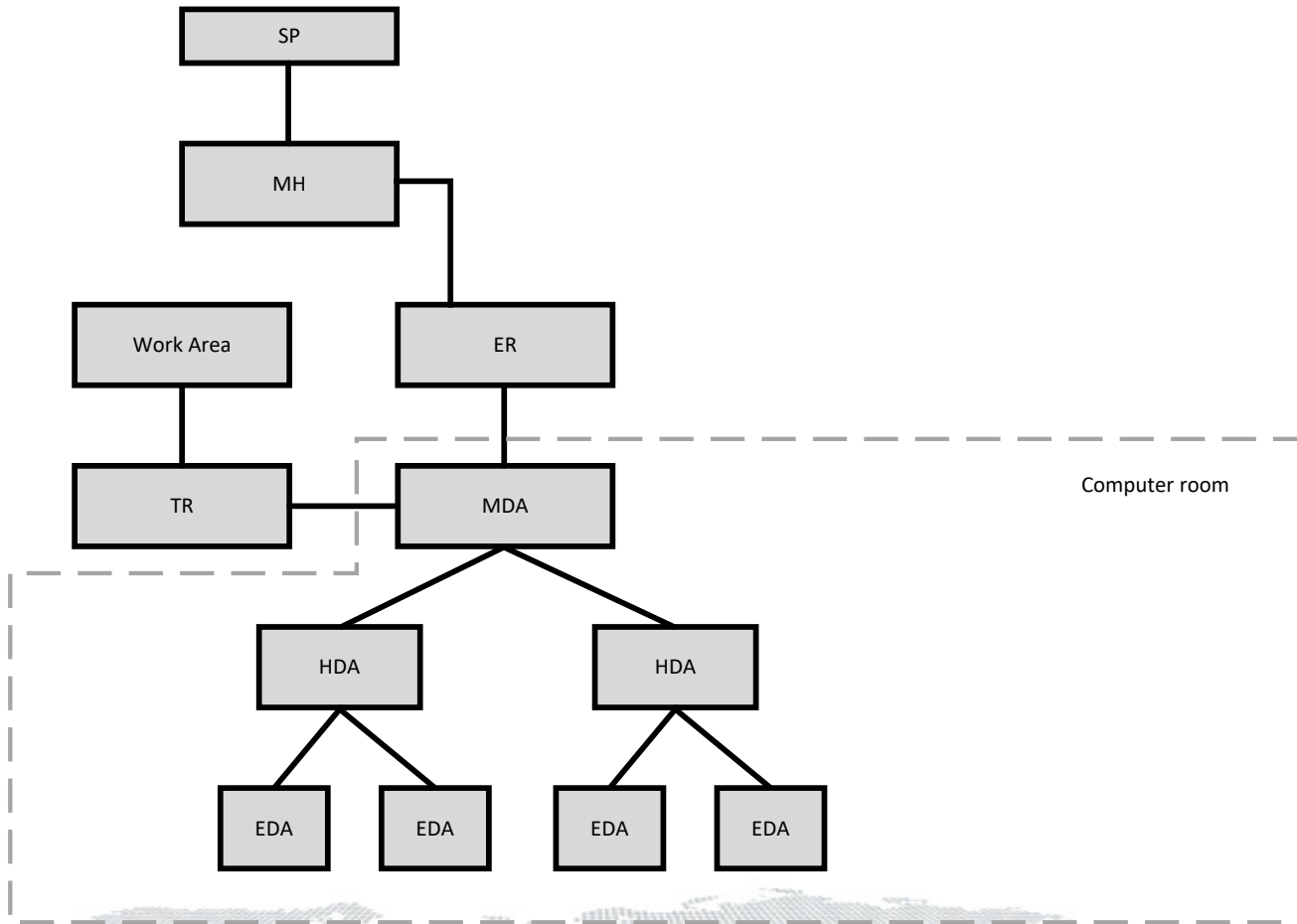
Mechanical Class F4

"N + 1" Chillers,
Pumps and
Condensers
Pipe loops
Required



Fault tolerant

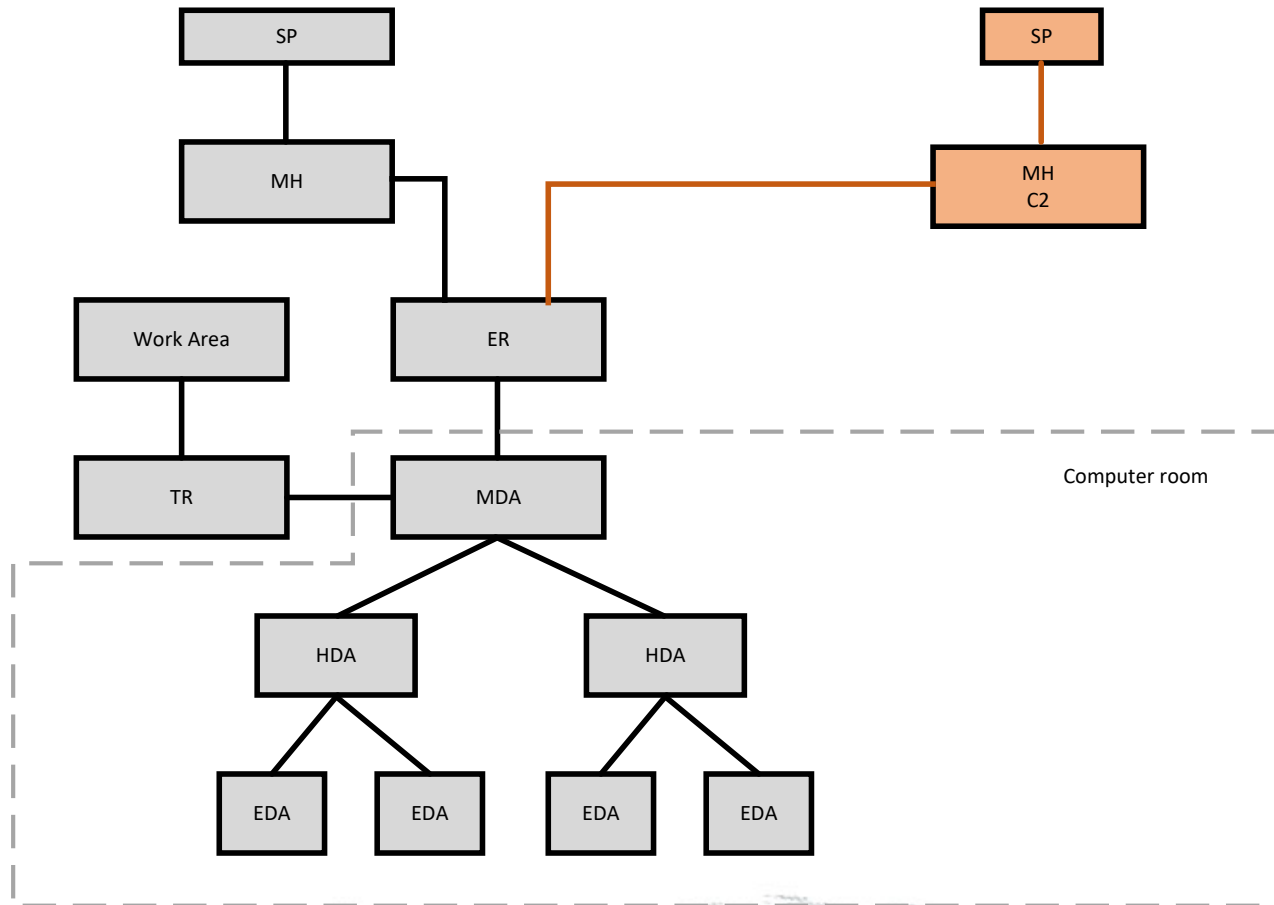
Telecommunication Class C0 & C1



SP – Service Provider
MH – Maintenance Hole
ER – Entrance Room
MDA – Main Distribution Area
HDA – Horizontal Distribution Area
EDA – Equipment Distribution Area

Single path multiple ducts from property line

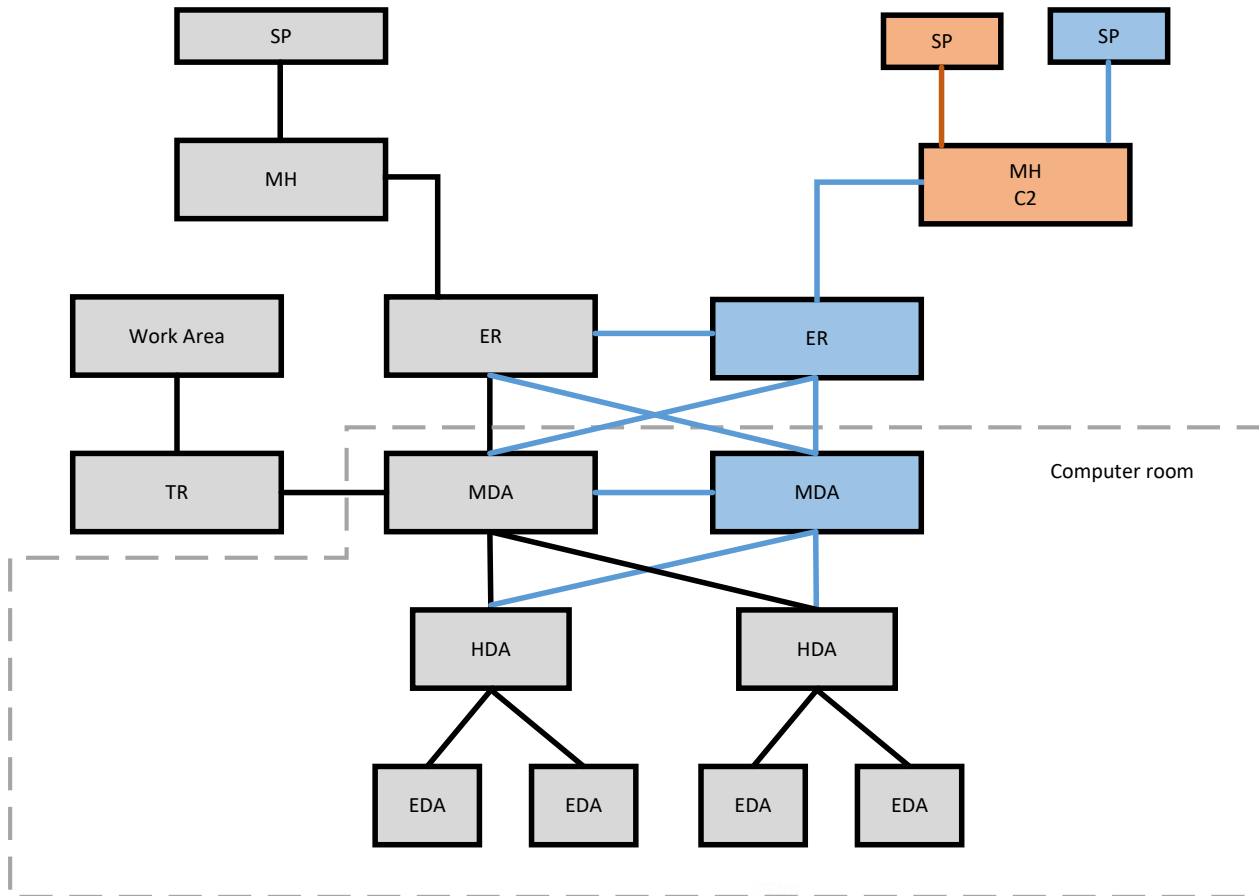
Telecommunication Class 2



SP – Service Provider
MH – Maintenance Hole
ER – Entrance Room
MDA – Main Distribution Area
HDA – Horizontal Distribution Area
EDA – Equipment Distribution Area

Redundant and diverse multipath from the property line

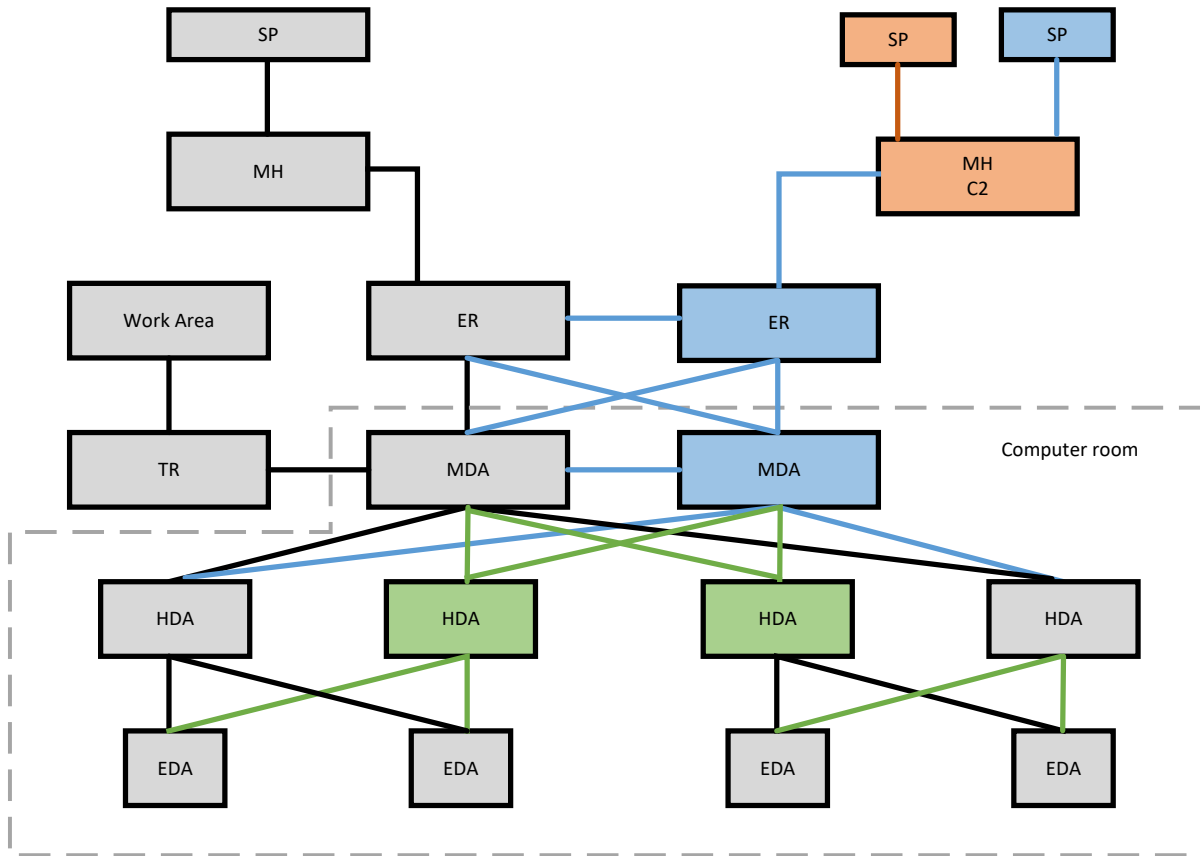
Telecommunication Class 3



SP – Service Provider
MH – Maintenance Hole
ER – Entrance Room
MDA – Main Distribution Area
HDA – Horizontal Distribution Area
EDA – Equipment Distribution Area

Redundant and diverse multipath from the property line to each HDA

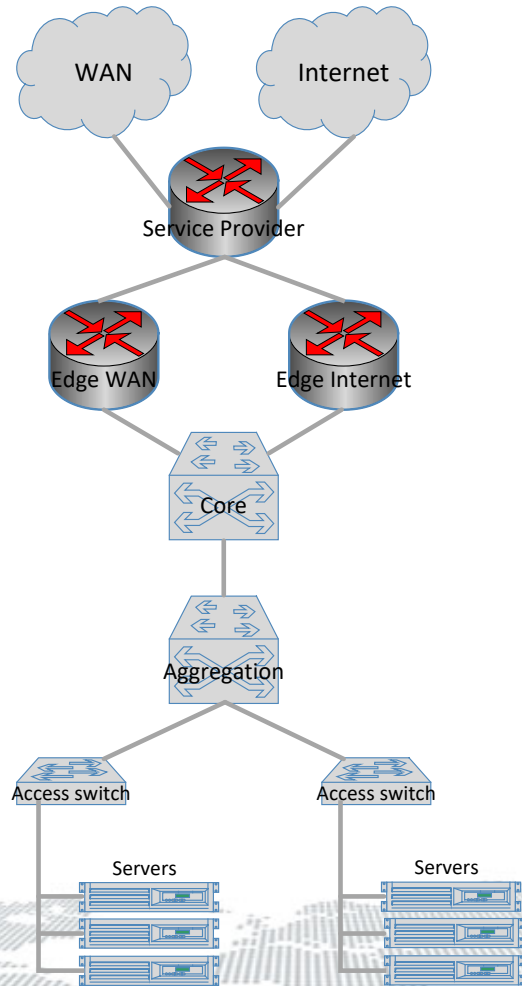
Telecommunication Class 4



SP – Service Provider
MH – Maintenance Hole
ER – Entrance Room
MDA – Main Distribution Area
HDA – Horizontal Distribution Area
EDA – Equipment Distribution Area

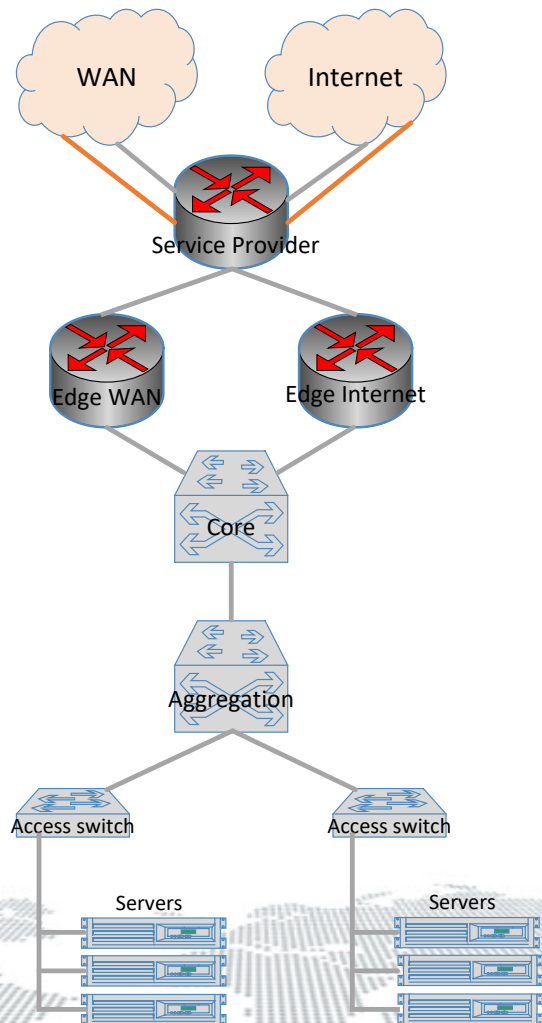
Redundant and diverse multipath from the property line to each EDA

Network Class N0 & N1



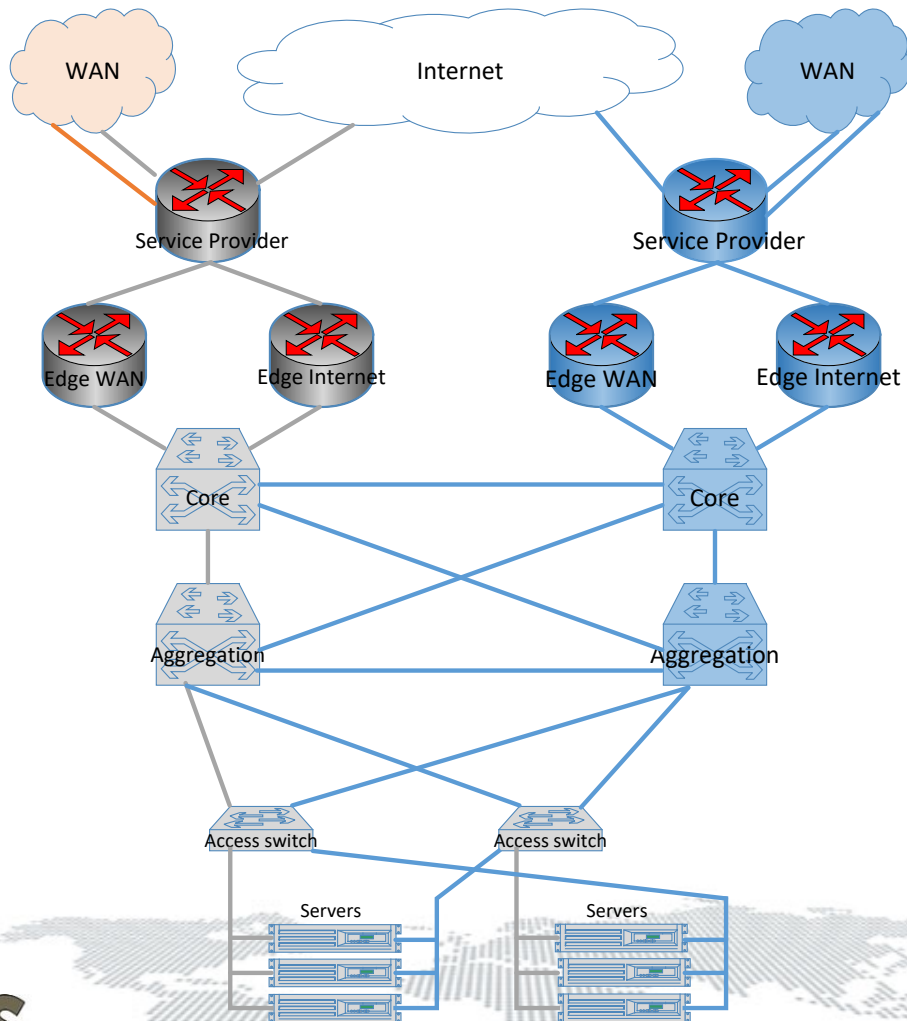
- Internet - Access from a single provider via a single link
- WAN/MAN - Single link from one service provider
- LAN/SAN - Single link connections throughout the network

Network Class N2



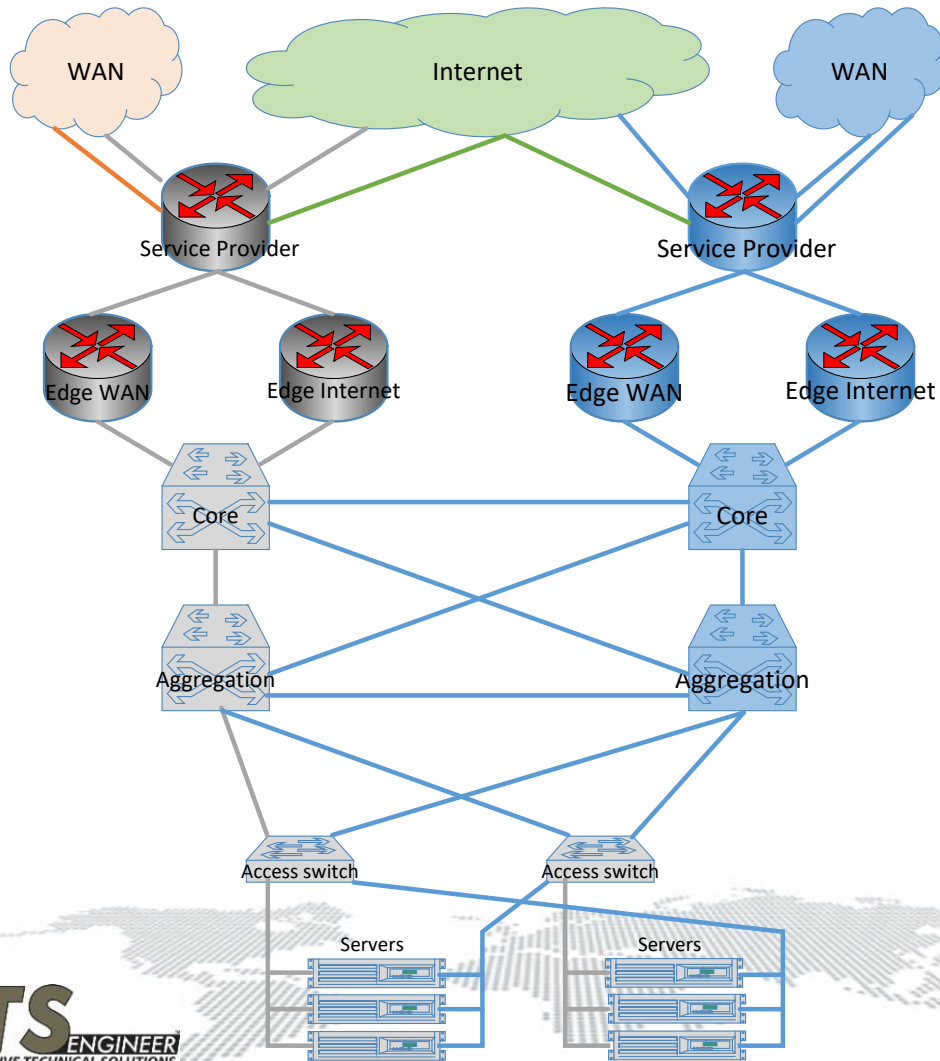
- Internet- Two service providers with a single link or one service provider with two links
- WAN/MAN – Non-redundant circuits from two service providers or redundant circuits from a single provider
- LAN/SAN - Single link connections throughout the network with redundant critical components

Network Class N3



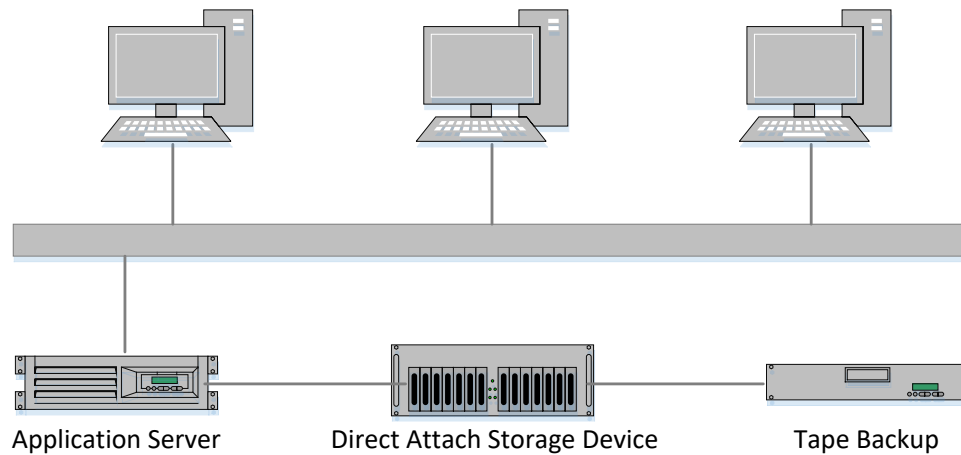
- Internet- Two service providers with a single link or one service provider with two links
- WAN/MAN – Non-redundant circuits from more than two service providers or redundant circuits from a single provider
- LAN/SAN - Redundant link and components from access switches

Network Class N4



- Internet- Two service providers with redundant links
- WAN/MAN – Multiple circuits from more than two service providers with redundant circuits.
- LAN/SAN - Redundant links, components and chassis

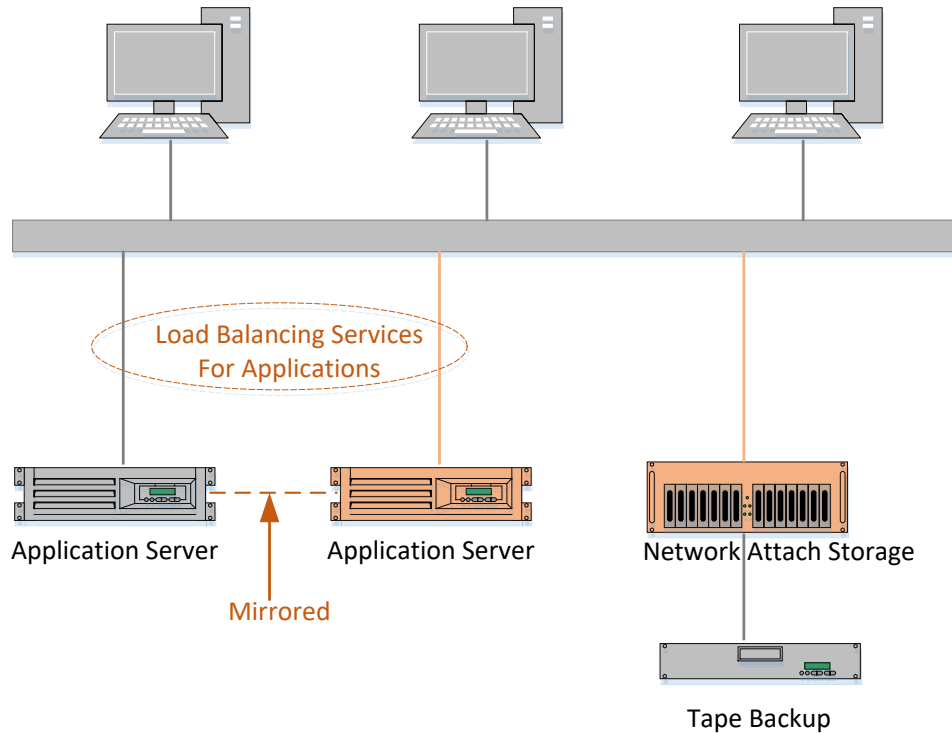
System Class S0 & S1



- Systems are implemented on specific platforms
- Hardware dependent with no seamless failover or self healing

Application specific hardware, direct attach storage

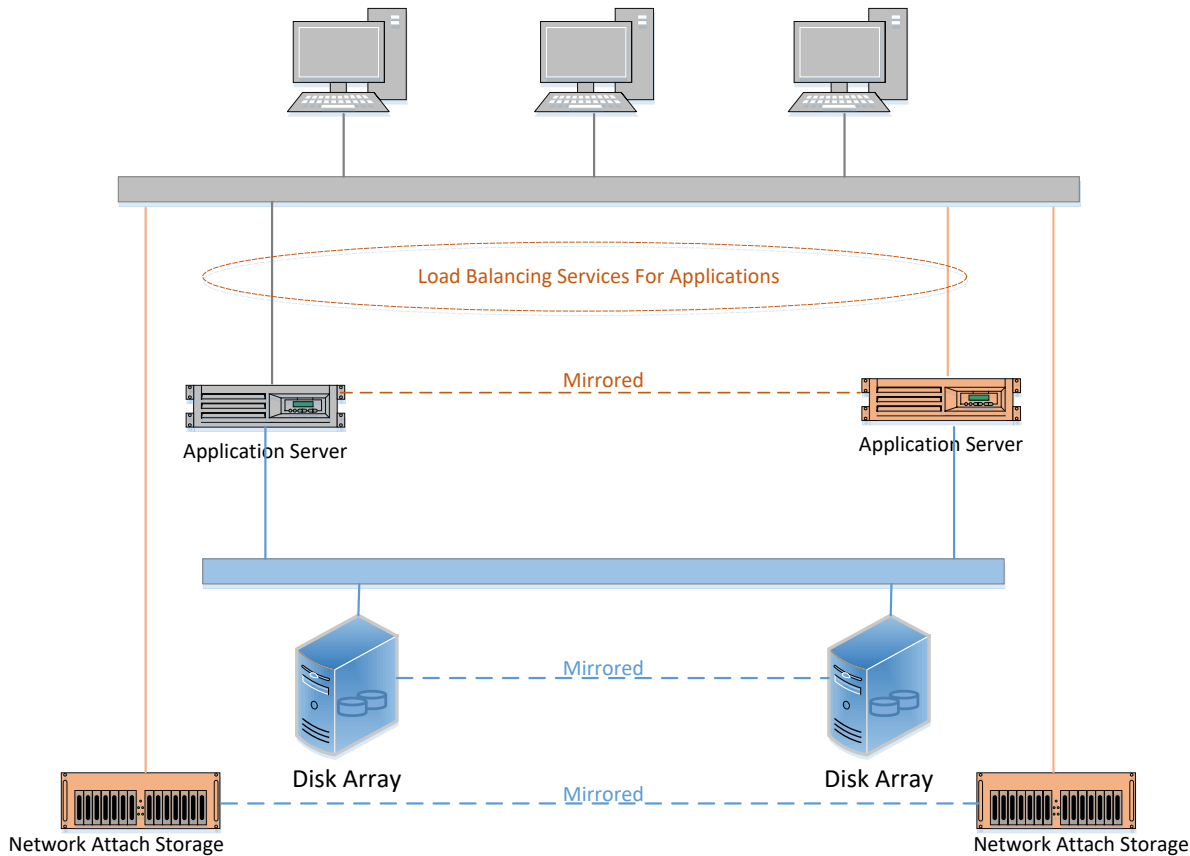
System Class S2



- Systems are implemented on specific platforms with mirrored applications
- Failure recovery through failover to redundant systems

Application specific redundant hardware with mirrored application

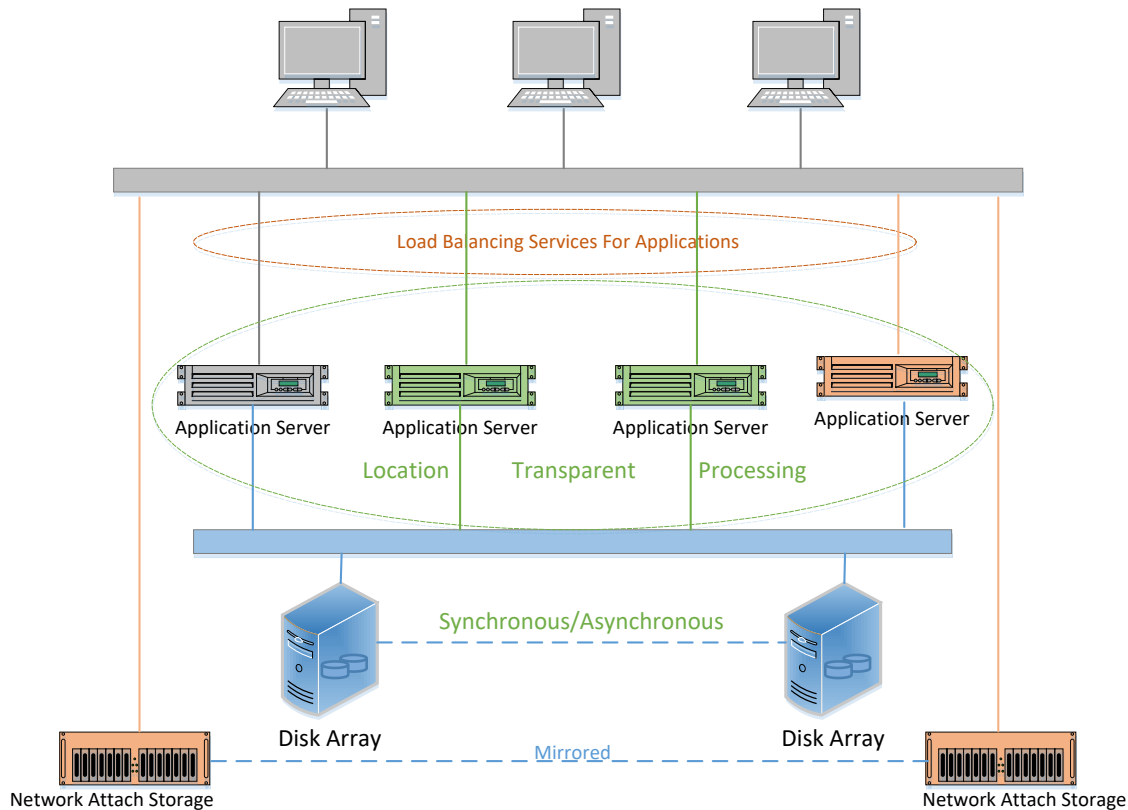
System Class S3



- Application specific hardware dependent or virtualized with mirrored applications
- Network attached storage with mirrored data on redundant systems

Hardware dependent or virtualized specific processing platforms

System Class S4



- Location transparent, virtualized systems or hardware dependent grid
- Network attached storage with mirrored data on redundant systems and automated data management

Location transparent, virtualized or grid platforms

THE BICSI DIFFERENCE

ANSI/BICSI 002-2014 Data Center Design and Implementation Best Practices covers:

- Site selection
- Space planning
- Architectural
- Structural
- Electrical Systems
- Mechanical Systems
- Fire Protection
- Security
- Management and building systems DCIM, BMS, ESS
- Telecommunications
- Information Technology
- Commissioning
- Design Process
- Reliability and availability
- Applications and Systems
- Service Outsourcing
- Multi-data center
- Testing
- Energy Efficiency

Thank You!

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