Chapter 3

Understanding of Different Types of Data Centre

3.1 Introduction

Data centre technology and management are changing rapidly, with new approaches to design and operation appearing every year. This means we won't be able to cover everything happening in the world of data. A data centre is a structure that houses a large group of networked computer servers typically used by businesses, governments, and organizations for the remote storage, processing, or distribution of large amounts of data [7]. While many organizations will have computing services in the same location as their offices that support their day-to-day operations, a data centre is a structure dedicated to 24x7x365 days of large-scale data processing and handling.

In entire words there are half a million data centres, say that an organization's on-site servers and data storage can be called a data centre [1][8]. The term data centre refers to facilities that are expressly dedicated to housing computer systems and associated components, such as telecommunications and storage systems. The facility might be a private centre, which is owned or leased by one tenant only, or a shared data centre that offers what is called "colocation services," and rents space, services, and equipment to multiple tenants in the centre.

Data centres are very different from what they were just a short time ago. Data Center IT Infrastructure has moved from old-style on-premises server room physical servers to virtual networks that support applications and capacities of physical infrastructure and into a multi-cloud environment.

3.2 Characteristics of Data Centre

The key characteristics of an IT data centre and the tasks that need to perform by IT staff to run the IT data centre smoothly. Organizations or Businesses which construct IT data centres should ensure that the below key characteristics are met.

Manageability: Data centres should provide easy, flexible, and integrated management to automate and reduce manual intervention for repeatable tasks. Service level agreements with customers, including service response time and escalation paths. Overall and specific monitoring of service levels Speedy registration and resolution of support requests, trouble tickets, and alarms. Coordinated computing equipment refresh process with the roadmap for customers Standards compliance and certification now

and into the future, Modularity /Scalability/ Reliability, Environmental Control/ Sustainability, and Safety [2].

Service level agreements with customers, including service response time and escalation paths Overall and specific monitoring of service levels Speedy registration and resolution of support requests, trouble tickets, and alarms. Coordinated computing equipment refresh process with a roadmap for customers. Standards compliance and certification.

Data integrity: Data centres should have mechanisms to ensure that data is stored and retrieved exactly as it was received by implementing data integration checks like error correction codes or parity bits. Characteristics of a Data Centre [4].
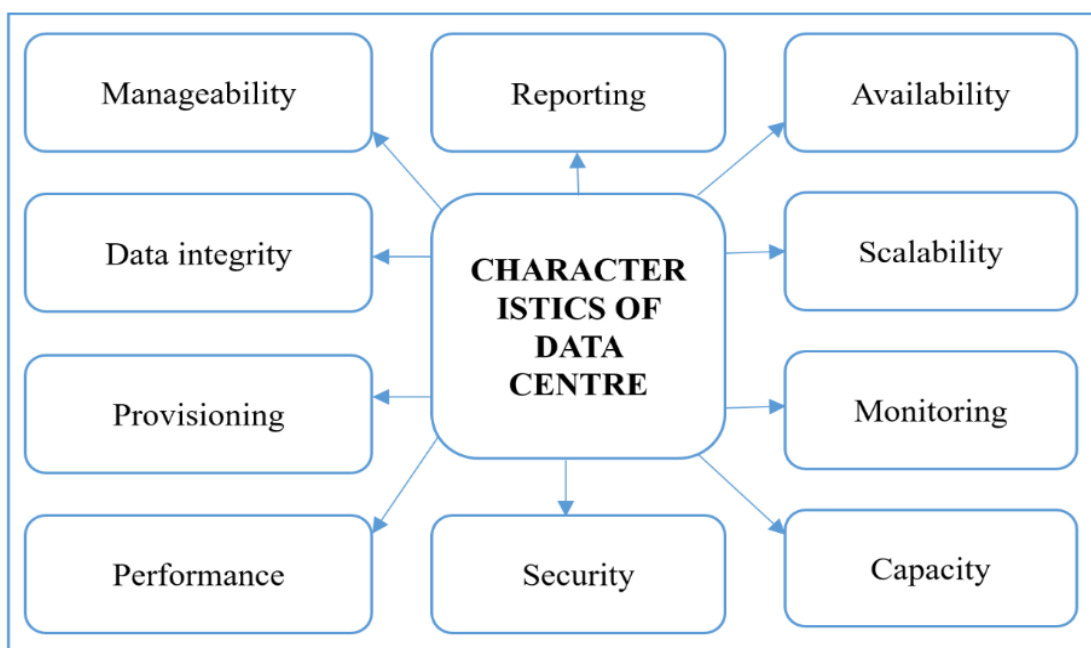

Figure 3.1: Characteristics of Data Centre

Availability: Datacentres should ensure that the data and other IT resources in the data centre should be available to the business 24/7. Unavailability of information can severely affect business operations which may lead to financial losses and a bad reputation.

Town Data Centre provides real-time and/or critical data services with the highest level of availability and redundancy, as well as the ability to rapidly failover (transfer operation to another Server) when and if required. If organizations require on-premises backup then set up a passive server premise for real-time data sync, when TDC Connection are fail that then time servers are activated [5].

If Optical Fibber Cable or Wireless Point to Point connection is failure or Maintenance or requires Cloud-based connection at that time Town Data Centre is provided to our server Online to access anywhere in time.

These data centre network topologies are called Active/Passive, and Active/Active, respectively. Should a disaster or an outage occur, disaster mode would dictate immediately moving all of the primary data centre's processing to the second data centre. If Wireless Point to Point connection is failing or Maintenance or requires a Cloud-based connection at that time TDC is provided to our server Online to access anywhere in time.

Flexibility: We propose the Town Data Centre for GLIA METODA, industries requirements are fixed and in the future, gradation is limited so flexibility is not wide but limited. It's easy to manage and flexible. The data centre to accommodate new technology, power, and cooling needs, Ease of switching to new operational, safety requirements, Modularity, electrical and mechanical design, and Manage requests for every industries requirements. Security: Strict security policies and procedures should be established to prevent unauthorized access. Control measures have to be taken to prevent the alteration of information.

Scalability: Datacentre resources (compute, storage, and network) and facilities should be scalable to meet the changing business requirements without interrupting business operations.

Capacity: Datacentre should be able to provide additional capacity and resources to efficiently store and process large and increasing amounts of data either without interrupting the availability or with minimal disruption. Performance: Datacentre components should provide optimal performance based on the required service levels. Monitoring Systems: it is a continuous process of gathering information on various elements and services running in the data centre. The reason is obvious to predict unpredictability.

Town Data Centre to deploy the same level of monitoring systems and support. The more cost-effective and secure solution to monitor critical infrastructure. Advanced surveillance technology monitors and records activity on approaching driveways, building entrances, exits, loading areas, and equipment areas. These systems also can be used to monitor and detect fire and water emergencies, providing early detection and notification before significant damage results.

Many times, facility infrastructure is equipped with advanced monitoring systems to provide additional security. Monitoring support to look for in a town data centre can include High-definition video surveillance of both the interior and exterior with archival support, live technical monitoring by expert NOC staff, and 24X7X365 support from a live expert. The more cost-effective and secure solution to monitor critical infrastructure. Advanced surveillance technology monitors and records activity on approaching driveways, building entrances, exits, loading areas, and equipment areas. These systems also can be used to monitor and detect fire and water emergencies, providing early detection and notification before significant damage results.

Reporting: A resource performance, capacity, and utilization gathered together at a point in time. Provisioning: it is a process of providing the hardware, software, and other resources required to run a data centre.

Maintenance & Services: all the network and data centre equipment active and passive are under monitoring and every three or six months maintain like clean garbage files, dust cleaning, proper shutdown and shut up, error checking, patching update, and firmware updating as possible all the logical and physical maintenance are implemented.

NOC: Many times, facility infrastructure is equipped with advanced monitoring systems to provide additional security. Monitoring support to look for in a data Centre provider can include: High-definition video surveillance of both the interior and exterior with archival support, Live technical monitoring by expert NOC staff, 24X7X365 support from a live expert

Disasters Recovery & Emergency Backup: The Town data centre located in Centre of Excellence or VAGUDAD Village Data centre site is safe from natural disasters such as hurricanes, earthquakes, tsunamis, and floods. Man-made issues such as the potential for terrorist attacks and robes are also controlled by Local Police. In a less populated area, there is a lower risk because it is less likely to happen. Any emergency backups in the data centre are managed as per the situation.

Environment Monitoring: A severe room design, therefore, includes environment monitoring. This may be at the room level and ideally within each server rack in at least 3-6 positions including the bottom, middle and top, front and rear. Computer and server rooms tend to have alarms being missed to higher-than-normal ambient temperature within the room, high humidity, or a failed UPS battery.

The environment monitoring system should be connected to the local IP network and offer instant access views of the environmental aspects being monitored, as well as email and text alarm alerts. Transparency: transparency is an ethical policy to town data centre today users can't trust for his data security but the town data centre are all things like server network data security are share to users as per his services subscription, the user requires to visit town data centre to allow as per requirement for transparency policy.

Redundancy: Town data centre at GLIA METODA has redundancy facilities from power and cooling, geographically-diverse central offices, multiple data network carrier access, and Hardware it does not require compared to the cloud data centre and also has minimal downtime.

Data accessibility and server uptime are crucial considerations for a data centre. VMWare software-based high availability solutions can provide additional protection bare level backup against hardware failures to ensure that Operating System level backup is too easy to install in VMWare software and works as its. Town Data Centre is ensuring high SLA uptime and redundancy strategies. The difference between Tier-IV 99.99% uptime and Tire-I 99.96% uptime may not sound significant, but it amounts to almost an hour of data availability each year. Town data centre at GLIA METODA his redundancy facilities his minimal downtime.

Remote Hands: This service is also known as smart hands. These are technicians of the town data centre are provide technical support for our Clients. They are mostly used to perform virtual and manual tasks that cannot be completed through remote management. Remote hands can be retailed in various units from GLIA METODA he provides troubleshooting within a time.

Data Centre Amenities: The town data centre offering These amenities typically include office or work stations, conference rooms, access to phones, computers, printers, and other office equipment. These additions would come in handy when staff would need to work out of the data centre, or if the office experienced equipment failure and needed a backup workplace solution.

Other amenities that can help a data centre provide stand out above the rest are simple features like break rooms or kitchens, storage facilities for client equipment, and secure loading docks. Facilities should be designed with more than just machines in mind. Making customers feel comfortable and productive while on-site is important.

Audit: Regular compliance audits are another key aspect of protecting customer data and equipment. With many customers facing a variety of regulatory requirements as a part of doing business, it's only natural that data centres design their infrastructure and operations with compliance in mind. A good facility

IT Asset Management: IT Asset Management (ITAM) is a system of business practices that seeks to maximize the value of IT equipment within an organization by combining financial, contractual, and inventory data to track the status of IT assets across their lifecycle.

3.3 Different Types of Data Centres

Many styles of data centres and service models are available. Their classification depends on whether they are owned by one or many organizations, how they fit into the topology of other data centres, what technologies they use for computing and storage, and even their energy efficiency [9][10]. There are four main types of data centres: The different types of data centres are based on how they are owned, technologies used, and energy efficiency. Some of the main types of data centres that organizations use are Enterprise data centre, colocation data centre, cloud data centre, micro data centre, and edge data centre there is a data centre to define the capacity on several racks, build-up areas, power capacity, and security levels. These are a common type of data centre and their capacity.

3.3.1 Traditional Data Centre

The Traditional data centre is also called Enterprise, On-premises, or server room these are built, owned, and operated by companies and are optimized for their end users. A traditional data centre is a facility housing IT equipment, such as servers and routers. Data centre hardware components and technical elements include Compute, memory, and processing power. Storage to house data. Networking to connect the components and access the internet. Most often they are housed on the corporate campus. On-premises is an environment where resources are deployed in-house or within a data centre. The Server room is dedicated to one industry or company to set up on-premises and all control is managed by the owner. The data centre is a huge server combination and provides services to more than one industry via VPN. Cloud Data centre is on the upgrade version of Data centre but it provides an online solution so anyone can use it anywhere. The hybrid Data centre is the combination of a server room and a data centre.

Figure 3.2: Traditional/Server Room/On-Premises Data Centre

3.3.2 Cloud Data Centre

The word cloud is a third-party company who is providing services on rental for servers on the internet. The main difference between the cloud vs data centre is that a data centre refers to on-Premise hardware while the cloud refers to off-premise computing. The cloud stores data in the public cloud, in this off-premises form of a data centre, data and applications are hosted by a cloud services provider such as Amazon Web Services (AWS), Microsoft (Azure), IBM Cloud, or another public cloud provider. Discover more about data centres and what the future will bring to them and your network.
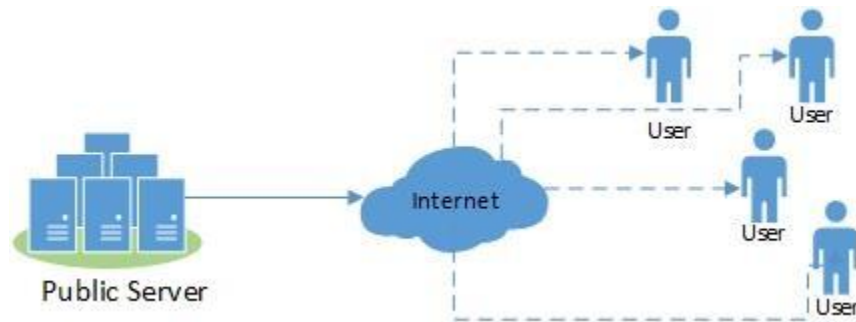

Figure 3.3: Cloud Data Centre

3.3.3 Colocation Data Centre

In colocation data centres, a company rents space within a data centre owned by others and located off company premises. The colocation data centre hosts the infrastructure: building, cooling, bandwidth, security, etc., while the company provides and manages the components, including servers, storage, and firewalls.
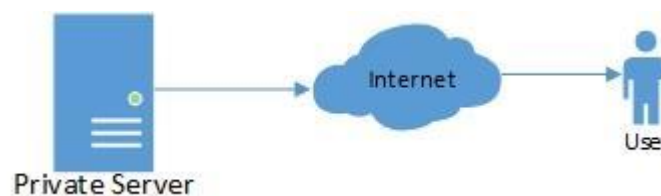

Figure 3.4: Colocation Data Centre

3.3.4 Hybrid Data Centre

A hybrid data centre helps businesses leverage new technologies and are being recognized as an ideal solution to scalability and security. A hybrid data centre means mixed computing and storage environments. Adoption of a hybrid IT infrastructure environment combines the benefits of on-premises data centres, private cloud, and/or public clouds services allowing to quickly respond to changing business needs. The real advantage of a hybrid cloud lies in the ability to gain a comfortable and flexible middle ground to ensure all workloads are treated properly and cost-effectively.

A hybrid data centre infrastructure allows businesses to easily customize workload placement based on their workloads and applications. This means that some workloads can remain on-premises, while others run in the cloud the best of both worlds.
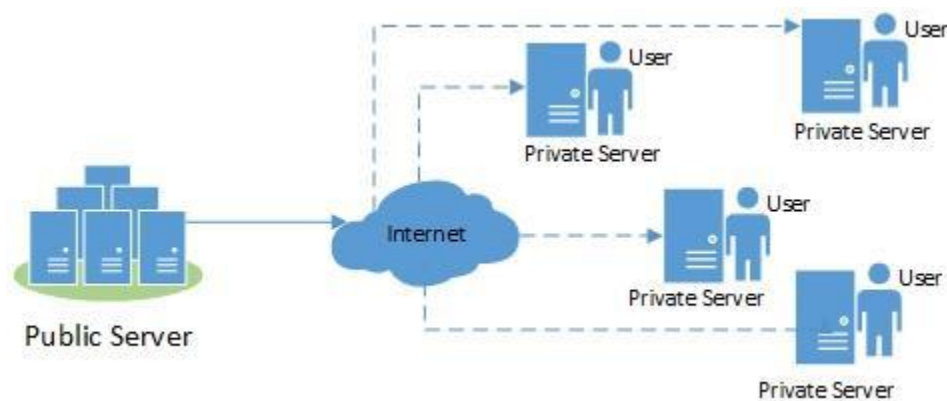

Figure 3.5: Hybrid Data Centre

3.3.5 Edge Data Centre

Edge data centres are located in tier-2 markets that don't have easy access to larger, more powerful colocation facilities. According to Cisco's estimates, about one-third of all traffic will use these data centres and IoT devices to bypass the core altogether by 2022, keeping data at the edge near end users [6].

Edge data centres may be defined differently by different data centre professionals based on their roles, industries, or priorities, and due to the relative infancy of edge data centres as an established trend. However, most definitions share the following key characteristics: Local. Edge data centres are placed near the areas they serve and are managed remotely. Small. Edge data centres have the same components as a traditional data centre but are packed into a much smaller footprint. Part of a larger deployment. An edge data centre is one of many in a complex network including a central enterprise data centre. Mission critical. Edge data centres house mission-critical data, applications, and services for edge-based processing and storage.

These data centres are managed by a third party (or a managed services provider) on behalf of a company. The company leases the equipment and infrastructure instead of buying it.
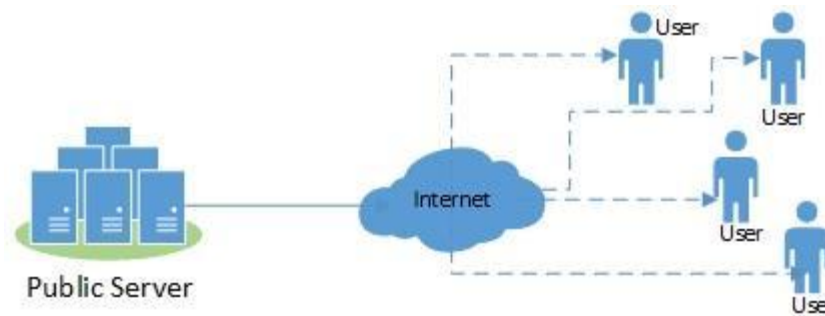

Figure 3.6: Edge Data Centre

3.3.6 Micro Data Centre

Schneider Electronic-APC Wall Mount Micro Data Centre is an innovative new way to deploy server and networking equipment at the edge. The unique low-profile design enables large-depth devices to be wall mounted in a compact and less intrusive form factor than traditional wall mount cabinets. It can ship pre-integrated with APC Smart-UPS Battery backup, netbook physical and environmental security, and Eco Structure IT, our cloud-based remote monitoring platform to stay connected at the edge Micro Data Centre C-Series 6U Wall Mount.

Increase deployment speed, reduce configuration time, reduce on-site installation time, and cloud-based centralized monitoring.

Figure 3.7: Micro Data Centre

3.4 The Standard for Data Centre Design and Infrastructure Certifications

The generally maximum accepted standard for data centre design and infrastructure there are two types of organizations providing the certification standard, one is ANSI (American National Standards Institute)/TIA-942 and the second is Uptime Institute.

3.4.1 ANSI RIA-942

ANSI (American National Standards Institute)/ TIA (Technology Innovation Agency)- 942 Certifications and ratings (Telecommunications Industry Association). It embraces standards for American National Standards Institute and Technology Innovation Agency-942, ready certification confirms compliance with four different categories of data centre rated for levels of redundancy and fault tolerance. ANSI/TIA-942 describes the following four rating levels in which data centres can be classified. Detailed specifications are given in the ANSI/TIA-942 standard [34].

Rated-1: Basic Site Infrastructure, A data centre that has single capacity components and a single, non-redundant distribution path serving the computer equipment. It has limited protection against physical events.

 Rated-2: Redundant Capability Module on Site and IT Infrastructure, A data centre that has redundant ability mechanisms and a single path non-redundant distribution path allocation of the computer equipment. It has improved protection against physical events.

 Rated-3: Concurrently Maintainable Site Infrastructure, A data centre that has redundant capacity components and multiple independent distribution paths serving the computer equipment. Typically, only one distribution path serves the computer equipment at any time. The site is concurrently maintainable which means that every capacity component, including elements that are part of the distribution path, can be removed/replaced/serviced on a planned basis without disrupting the ICT capabilities of the end user. It has protection against most physical events.

 Rated-4: Fault Tolerant Site Infrastructure, A data centre that has redundant capacity components and multiple independent distribution paths serving the computer equipment which all are active. The data centre permits synchronized maintainability and one fault anywhere in the installation without affecting downtime. It has protection against almost all physical events.

The validity of ANSI/TIA-942 Design Certification is valid for one year, extendable if a site is not operational yet. The ANSI/TIA-942 Facilities Certification is valid for 3 years. By the end of year 1 and year 2, the data centre should undergo a surveillance audit. By the end of year-3, the data centre must undergo a recertification audit to maintain valid certification. The ANSI/TIA-942 Ready Certification is valid for one year with yearly re-certification.

3.4.2 Uptime Institute

Uptime Institute created the data centre Tier classification levels over 25 years ago, and today, they remain the international standard for data centre performance Tier 1 to 4.

PARAMETERS	TIER 1	TIER 2	TIER 3	TIER 4
Uptime guarantee	99.671%	99.741%	99.982%	99.995%
Downtime per year	<28.8 hours	<22 hours	<1.6 hours	<26.3 minutes
Component redundancy	None	Partial power and cooling redundancy (partial N+1)	Full N+1	Fault-tolerant (2N or 2N+1)
Concurrently maintainable	No	No	Partially	Yes
Compartmentalization	No	No	No	Yes
Staffing	1 shift	1 shift	1+ shift	24x7x365
Typical customer	Small companies and start-ups with simple requirements	SMBs	Growing and large businesses	Government entities and large enterprises
The main reason why companies select this tier	The most affordable data centre tier	A good cost-to-performance ratio	A fine line between high performance and affordability	A fault-tolerant facility ideal for consistently high levels of traffic or processing demands

Table 3.1: Uptime Institute Tier Classification Levels

TIER I: Basic data centre site infrastructure is A Tier 1 data centre it has single-capacity components and a single, no redundant distribution path. Typically, a modest on-premises data centre solution. Tier 1 data centres offer a small solution of infrastructure redundancy and experience high levels of system downtime. They have no backup systems in place to protect against power loss or cooling system failure and tend to lack the energy efficiency standards of higher-tier facilities, which results in higher power and cooling costs [33].

99.671% minimum uptime, 28.8 hours of downtime annually, No infrastructure redundancy, and No more than 28.8 hours of downtime per annum. 99.671 % uptime ratio a year. This is the bottom aggregate of uptime that an ability categorized by the Uptime Institute certificate can produce. The zero redundancy level of a facility does

not ensure any redundancy in IT Equipment's operations. Facilities do not have any redundancy guarantees inside their power and cooling certification procedures. They typically do not have a backup cooling system or generator, so when they're down for maintenance, for instance, they're completely down.

TIER II: This data centre offers improved protection against physical events and Redundant-capacity IT Infrastructures module. It has single redundant-capacity modules and no redundant distribution path. Tier 2 data centres are usually private data solutions that integrate very basic backup domain system availability. They still tend to be inefficient in terms of power and cooling usage, due to either poor infrastructure design or an inability to manage processing workloads efficiently.

99.74% uptime Equipment a year. This is the slightest amount of uptime that this provider has in a year. 99.74% minimum uptime, 22 hours of downtime annually, Partial redundancy, and No further twenty-two hours of downtime in 365 days. There is a significant barrier between Tier one and Two concerning downtime. Redundancy is one of the main aims of the data center uptime SLA. Fractional cooling and various power redundancies do not provide tier two uptime ration. The Redundancy in all areas of procedure critical aspects of its automatic structure accepts priority. These two aspects are power and cooling distribution. Redundancy in these areas is only partial. No part of the system is fault tolerant.

TIER III: Equivalent sustainable IT Infrastructure site organization to data centre protection combined with virtually all physical proceedings, provided that terminated capacity mechanisms and numerous autonomous distribution tracks. Respectively module containers are unconcerned or swapped without troublemaking services to end operators. Considered the bare minimum standard for most enterprises, a tier 3 data centre has redundant systems in place to limit its vulnerability to equipment failure and various operational errors. They utilize uninterrupted power supply battery systems that continue to deliver power to servers while power is switched over to generator backup, helping them to maintain consistently high levels of uptime.

99.98% uptime. This is a tier 3 uptime provider that can produce. The layings-off assistance to protect this amount straight a system grieves unpredicted issues. 99.98% minimum uptime, No more than 1.6 hours of downtime annually. Redundancy N+1 fault tolerance Tier three uptime providers can experience repetitive maintenance without an interruption in processes. Unscheduled maintenance and emergency shutdown may affect problems in the system. Difficulties may affect customer-facing

service level issues and tack actions. Seventeen-two hours of fortification from the power supplier must have at least information three days before exclusive power. This power cannot connect to any hardware or critical site or IT source. This maintenance or precision is not more than two hours of downtime per year. This downtime is allowed for maintenance purposes or emergency issues.

TIER VI: Tier four is a Fault-tolerant IT infrastructure site. This data centre provides the maximum levels of enabled synchronized maintenance and one fault anywhere in the data centre installation without producing downtime. A tier four data centre incorporates true fault tolerance into its infrastructure with full N+2 redundancy. It has twice the resources and equipment necessary to maintain services even in the event of severe disruptions. Organizations that cannot afford to tolerate even a few moments of downtime generally opportunity to tier 4 data centres to meet their computing and colocation needs.

99.99% uptime per annum. This is the level with the highest guaranteed uptime. It must be maintained for a centre to maintain Tier four ranking 99.99% minimum uptime of twenty-six minutes of downtime yearly. N+2 or better redundancy provides zero single points of failure Tier four redundancies for each procedure and data protection. No single fault or error can shut down the infrastructure. Data Centre infrastructure N2+1 is two times required for operation plus a backup. Another way of saying "fully redundant" is no more than twenty-seven minutes of downtime per year. Service providers must allow for some downtime for up-gradation types of equipment operations. This yearly downtime does not affect the customer service Level Agreement. Ninety-six-hour power outage protection infrastructure must have at least ninety-six hours of self-determining power to meet the requirements at this tier. This power supply must not be connected to any other outside source and is an entirely redundant secondary power supply.

Redundancy	Description
N	N refers to the minimum number of resources (amount) required to operate an IT system. No redundancy solution is available for the system. In case of a failure until the issue is diagnosed and resolved.
N+1	the base level of resources required for the system functionality plus a single backup/ redundancy
N+2	plus two separate backups/ redundancy
2N	2N simply means that there is twice the amount of required resources/capacity available in the system.
2N+1	Twice the required resources/capacity. Plus single backup is an additional redundancy step.

| 2N+2 | Twice the required resources/capacity. Plus twice backup as an additional redundancy step. |
| 3N+2 | Three are the required resources/capacity. Plus twice backup as an additional redundancy step. |

Table 3.2: N Tier Redundancy

TIER V: is a relatively new standard in data centre requirements. Tier 5 data centres must meet the same standards as Tier 4, plus several additional ones. For example, they must be able to run forever without water, have outside air pollutant detection (and be capable of initiating a protective response), have permanently installed stored energy system monitors, securable server racks, and much more. Furthermore, Tier 5 data centres are required to run on local, renewable power projects.

3.5 Study of Indian Data Centre and his Facility

3.5.1 Ctrls Data Centre

CtrlS data centre is eighteen years old and Pioneer Group has built the largest accessible infrastructure worldwide. In India, Data centers were established October 2007. Ctrls data centre is Asia's largest Tier four centre and managed services supplier. CtrlS works five data centre facilities, together with four Tier data centres in Hyderabad, Mumbai, Noida, Bangalore, and Tier three data centre in Mumbai its b one hundred MW hyper-scale facility. The corporate acts as a trustworthy consultant to over three, 500 Indian and international multinationals. 1000000 square feet. 7 locations Bandwidth provides 2Mbps to 2Gbps depending on the requirement. Ctrls all data centre power capacity per rack 3kw to 15 KW use. Seven data centre in India and 99.99% Service level agreements for uptime. He provides firewall, five six, eight, and nine zone security, also quake-proof facility, a cloud management port, and SSL services.

3.5.2 Reliance Data Centre

Reliance Data Centre primary provider of subcontracted data centre infrastructure for managements with mission-critical IT processes. Reliance data centre provides reliable, scalable hosting, network, application, and consulting services. Reliance DC provides services similar to Co-location, Managed hosting, Storage and Data Backup, Network connectivity, Application, and managed-to-host. Reliance manages Zero downtime hosting and managed services provide essential security and speed. In India nine data centres with 650000sq.ft hosting space and Tier III+ with N+N redundancy. Reliance Data Centre Infrastructure for organizations with mission-critical IT operations. Reliance uses Synchronous Transport Module bandwidth is the SDH ITU-T Optical Fibre Cable network transmission standard bit rate of 155.52 Mbit/s. power capacity

information is not provided in the above table. Reliance gives 100% Service level agreement and Tier3+ Data centre Standards. Also provide firewall, cloud management portal, and SSL Certificates services. Reliance DC connect to government establishment, banking and financial organizations, Mass media companies, and educational institutions are connected with them [17].

3.5.3 Gujarat State Data Centre

Gujarat Informatics Limited was established as the nodal agency in 1999. The company started help to information technology grow fast and accelerate the process of E-Governance in the state. The Government has enabled Gujarat Informatics Limited to successfully implement information technology projects in the state. Gujarat State Data Centre (GSDC) Under the Indian national e-Governance Strategy of the Government of India. Gujarat State data centre facility acquaintance Centre can act as a representative and convergence purpose between open unsecured property rights and sensitive government surroundings. State knowledge Centre (SDC) has been known. Gujarat State Data Centre has been identified as a work for core and critical infrastructure [18]. The data centre components are used to need for the consolidation and hosting of applications and storage that are essential delivery of e-Governance services. GSDC has a total capacity of 7000square feet SDC in India and five data centre in Gujarat. Service level agreement 99.74% and Tier 2 standard data centre. GSDC 200+ servers and 84 Racks with 200TB Storage provides. Gujarat state data centre 49 applications and 228 websites hosted and 83184 Mailboxes. Gujarat Informatics Limited has more than fifty new storage servers deployed for service provided to SRDH-UIDAI, CTP, Food and Civil, and BISAG. Gujarat state data centre also provides a mini data centre or colocation data centre at Rajkot, Surat, Vadodara, and Mahesana city. Gujarat state data centre provides decentralized services to citizens in the state.

3.5.4 BSNL Data Centre

Bharat Sanchar Nigam Limited is sort from BSNL IDC data centre and services provided. BSNL is the leading telecom service provider in India and has seven data centre located in India Ahmedabad, Faridabad, Ghaziabad, Jaipur, Ludhiana, Mumbai, and Chennai. Who maintains the most fault-tolerant networks [19]. BSNL and NxtGen have collaborated to launch dedicated Internet data centres across India to assist you to leverage the facility of cloud computing. Power-driven by BSNL and managed by NxtGen, these facilities can feature exceptional capability for future enlargement with

optimum power, cooling, and IT infrastructure performance. BSNL provides 45Mbps Bandwidth. In a detail of the above table, BSNL has a 63440 sq. ft. Total capacity. BSNL has six data centre in India and N+1 Redundancy provide. Service level agreement 99.98% uptime. Tier3 standard follows. Firewall service and SSL certification detail not provided in the above table but Cloud management portal services provide.

3.5.5 Sify Data Centre

Sify In 1998 first Indian ISP pioneered Internet, data centre, voice, and international call centres service providers. Sify is an ICT Solutions provider and the largest integrated Services Company in India. Sify telecom data network infrastructure reaches more than 1600 cities and towns in India. Sify expanded its Data centre located in the US and its headquarters in California and Silicon Valley. Sify provides 100Mbps to 10Gbps Bandwidth. Its Total capacity of 42500square feet. Sify 1.6MW to 20MW Power Capacity of Usage. Sify has six own data centre and 39 third-party partner data centre so a total of 45 data centre. Sify provides N+1 Noida, Bengaluru, Mumbai, and Chennai N+N Redundancy. Safety Technology provides SLA 99.99% and Tier 3 standard. Firewall services detail is not provided in the above table but also provide Cloud management portal and SSL Certification [20].

3.5.6 ESDS Data Centre

ESDS is a first generation entrepreneur who Managed Data Centre Service starting in 2005 and is an Auto-Scalable Cloud Solution provider in India. It provides services in Banking & Finance, Healthcare, Education, Energy & Utilities, Agriculture, production, IT, recreation & Media, Travel, Telecom, Government, and e-commerce. ESDS has experience in Managed Cloud Solutions, Virtualization, and Disaster Recovery. ESDS has enlightened Cloud as a Software Solution to convert CAPEX into OPEX, this is eliminating expensive hardware cost and maintenance costs [22]. ESDS cloud computing platform patented from USPTO Patent 9176788 and UK Patent GB2493812. ESDS offers 10Gbps Backbone Network Bandwidth and A capacity of 100000square feet. The power capacity of ESDS Data centre is 4kw to 10kw. ESDS has eight data centre in India. In the details of the table, ESDS provides N+N redundancy and 99.99% Service Level Agreement. Tier-3 Standards follow firewall services detail not provided in the above table. Cloud Management Portal and SSL Certification services provide.

3.5.7 Tata Communications Data Centre

Tata Communications data centre uses its advanced technology solutions for skills and domain experience transversely to its international network for delivering managed solutions to multi-national corporations and communications service suppliers. Its global network contains a cultured and major submarine cable network and Tier one. Tata Communications infinite universe of connections in the cloud and under the seas [22]. IP network connectivity to 240 countries and areas across four hundred PoPs. And approximately 1 million square feet of data centre and colocation space across the globe. TATA Communication provides 2Mbps to 10Gbps Bandwidth. 3kW to 6kW rated AC Power Capacity. 44 Data centre in India [23]. TATA Provide Multiple Layers of redundancy. 99.95% of Service Level Agreement and Tier-3 standard follows. TATA Also provides Firewall services, a Cloud management Portal and SSL Certified.

3.5.8 Webwerks Data Centre

Webwerks Data Centres, located in three countries in over six geographically single data centres. The among leaders in India for the past two decades. Webwerks Data Centres are Carbon Neutral donating in the direction of Worldwide Green data centre concepts. Webwerks in Indian first data centre to hold OIX-2 and host an OIX-1 IXP Mumbai-IX. They also fulfil all data centre requirements for full Open-IX supporters. They are cloud Based by the Ministry of Electronics and Information Technology of the Government of India. Their clients in Microsoft, Google, Godrej, Canon, TATA, Netflix, Facebook, and Akamai. Webwerks provide 155-Mbps bandwidth. Webwerks Mumbai based data centre total capacity of 30000square feet and 2kw to 40kw power capacity. Webwerks five data centres in India, and N+1 Redundancy provides. In the detail of the above table, Webwerks provide 99.99% service level agreement uptime. Tier 3 and tier 4 standard follows. Webwerks provides firewall services, a Cloud management Portal, and SSL Certification.

Features	Ctrls	Reliance	GSDC	BSNL	SIFY	ESDS	TATA	Webwerks
Bandwidth	Up to 2 Gbps	STM-1	X	45Mbps	Up to 10 Gbps	10 Gbps back side	Up to 10 Gbps	155 Mbps
Total Capacity	1000000 sq. ft.	650000 sq. ft.	7000 sq. ft.	63440 sq. ft.	425000 sq. ft.	100000 sq. ft.	1000000 sq. ft.	30000 sq. ft.

Power Capacity	3 kW to 15 kW	X	X	X	1.6 MW to 20 MW	4 kW to 10 kW	3 kW Or 6 kW	2 kW to 40 KW
Number of Datacentres	7	9	5	6	45	8	44	5
Redundancy	N+N	N+N	X	N+1	N+1	N+N	Multiple Layers	N+1
SLA Uptime	99.99%	100%	99.74%	99.98%	99.98%	99.99%	99.95%	99.99%
Standards	Tier 4	Tier 3	Tier 2	Tier 3	Tier 3	Tier 3	Tier 3	Tier 3&4
Firewall Security	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cloud Management Portal	Yes	Yes	X	Yes	Yes	Yes	Yes	Yes
SSL Certificates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Migration Services	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dedicated Servers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quality ISO	ISO 9001	X	X	X	ISO 9001	ISO 9001	X	ISO 9001
Security ISO	ISO 27001	ISO 27001	ISO 27001	ISO 27001	ISO 27001	ISO 27001	ISO 27001	ISO 27001

Table 3.3: Indian Data Centre and its Facility

3.6 Cloud Computing Service Models

IaaS, PaaS, and SaaS are the three most popular types of cloud service offerings. (They are sometimes referred to as cloud service models or cloud computing service models.)

3.6.1 Infrastructure as a Service

A purveyor provides customers pay-as-you-go access to storage, networking, servers, and other data center resources in the cloud or infrastructure as a service is as per requirement data center services access to cloud-hosted physical and virtual servers, storage, and networking the backend IT infrastructure for running applications and workloads in the cloud [3][32].

IaaS customers can choose between virtual machines (VMs) hosted on shared physical hardware (the cloud service provider manages virtualization) or bare metal servers on

dedicated (unshared) physical hardware. Customers can provision, configure and operate the servers and infrastructure resources via a graphical dashboard, or programmatically through application programming interfaces (APIs).

3.6.2 Platform as a Service

A data centre services provider suggests access to a cloud-based setting in which users can construct and deliver applications. The wage earner supplies fundamental infrastructure. PaaS, or platform as a service, is on-demand access to a complete, ready-to-use, cloud-hosted platform for developing, running, maintaining, and managing applications. PaaS through a graphical user interface (GUI), where development or DevOps teams can collaborate on all their work across the entire application lifecycle including coding, integration, testing, delivery, deployment, and feedback [3][32].

3.6.3 Software as a Service

A Cloud services provider supplies software submissions concluded the internet. Users contribute to the software and access it through the web or user APIs. Software as a service is on-demand access to ready-to-use, cloud-hosted application software [32]. The vendor manages all upgrades and patches to the software, usually invisibly to customers. Typically, the vendor ensures a level of availability, performance, and security as part of a service level agreement (SLA). Customers can add more users and data storage on demand at an additional cost. Today uses or mobile phone almost certainly uses some form of SaaS. Email, social media, and cloud file storage [3].

Details	Traditional IT	IaaS	PaaS	SaaS
Application	User Manage	User Manage	User Manage	Provider Manages
Data	User Manage	User Manage	User Manage	Provider Manages
Runtime	User Manage	User Manage	Provider Manages	Provider Manages
Middleware	User Manage	User Manage	Provider Manages	Provider Manages
OS	User Manage	Provider Manages	Provider Manages	Provider Manages
Virtualization	User Manage	Provider Manages	Provider Manages	Provider Manages
Servers	User Manage	Provider Manages	Provider Manages	Provider Manages
Storage	User Manage	Provider Manages	Provider Manages	Provider Manages
Networking	User Manage	Provider Manages	Provider Manages	Provider Manages

Table 3.4: Management Responsibilities for Traditional IT, IaaS, PaaS and SaaS[32]

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