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INCREASING DATA CENTER COOLING CAPACITY IN EFFECTIVE WAY BY APPLYING SPATIAL CONTRIBUTION

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Abstract: In today's fast-paced digital world, data centers are at the heart of modern businesses, processing huge amounts of information around the clock. As organizations transition from conventional on-site environments to cloud-based solutions, the focus is on enhancing system efficiency, security, and scalability. This paper explores the evolution of data centers and key challenges like virtualization, standardization, and the growing shift toward hybrid cloud models. One of the most difficult aspects of data center administration is keeping computers cool while remaining efficient. We describe a simple method for calculating the appropriate cooling capacity while taking into account the power of IT equipment, climatic conditions, and future growth requirements. In addition, we evaluate traditional and cloud data centers to assist organizations in making better IT decisions. We have applied a proposed methodology to identify total power consumption by using the total wattage of all IT equipment, including servers, storage devices, and networking equipment. By leveraging new technologies and making the most of their resources, companies can create a data management strategy that's reliable, cost-effective, and ready for the future.

Keywords: Virtualization, Hybrid cloud, Cooling Capacity, Data center, Networking.

I.INTRODUCTION

Server

A server is a big computer that has a big storage place that has been connected and has been saved in it. Small companies, industries, hospitals, and colleges have a small amount of data. Big companies like Google, Microsoft, AWS, IBM etc. They are having a huge amount of collection of data.

Example: Google, Facebook, and Microsoft have their own data centers to store the multiple and infinite storage places, and they've been managed by Google data center security.

Data Center

Data + Center = Data Center information of any kind of data, phone, websites, manufacture, multiple servers, computer. Data centers primarily serve as storage hubs for data and applications, whereas the cloud enables access to computing resources and services via the internet. Cloud computing is categorized into three main types public, private, and hybrid, each offering different levels of control, security, and scalability.

Example: The name is saved in the data center on one computer.

II.REQUIREMENT OF DATA CENTER

Full and full-size servers (1000 to 10000) have been kept in it. One computer can provide more heat; in a data center (or server room), there will be more and more amounts of heat that have been reduced to control using AC and water spray. There were numerous tiers of data and very protected zones. Data wishes to be secured; each individual's data is more significant to any small-scale enterprise than to a larger-scale industry. A minimum of 10 to 11 levels of security has been imposed. The data center has been run in most in maximum 99% uptime server & computer (365). If the data center has been slow, they also have multiple and many kinds of alternative things to work on the website, etc.

A. ADVANTAGES OF DATA CENTER

They not only have a single data center in the world. They also have a different country and a different place to store the data. If one place is down because of the server, it is also worse they also have multiple places of data centers.

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Facebook: If we published a photo or video on Facebook, how it will be published means using a cable to communicate with the user and data center (line connection). Facebook has a cable connection under the sea.
Example: Facebook has 10 to 15 data centers; if one is down, another one will help you. They have a cable to connect our request to the center.

III.DATA CENTER AND VIRTUALIZATION

The demand for IT services continues to rise while its budgets remain flat. This makes it increasingly difficult to manage growth, especially with a complex, siloed IT infrastructure. Silo data center structures create governance problems as vertical application infrastructures make centralized management and future growth nearly impossible. Fragmented maintenance and management increase the total cost of ownership because applications can't scale easily when built on silos of isolated resources. Data center standardization and consolidation through virtualization is the way to break down silos and also reduce capital expenditure, eliminate inefficiencies, and meet increasing growth demands at every level of the data center, from compute to storage to networking.

There is a need for swiftly supplied on-demand capacity that is dependable, highly available, and highly scalable in order to deliver virtualization economics across the entire data center server. virtualized enables physical servers to be partitioned into many virtualized servers. Each virtual server runs its own operating system and application server. Virtualization facilitates management, improves scalability, and reduces capital expenses by reducing the number of physical servers in the data center.

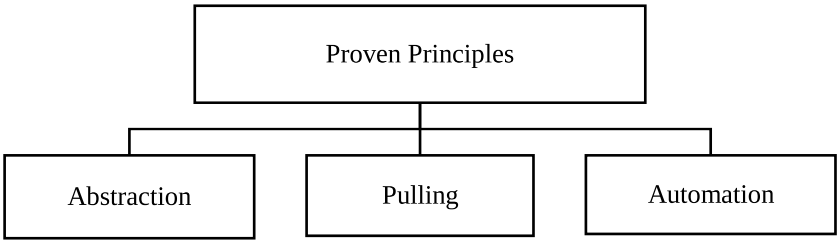

Fig.1 Proven Principles

Virtual server growth has led to an increase in storage and network demands to leap up the proven principles of abstraction, pulling, and automation can be applied to standardize the storage and network layer with software-defined storage. Physical storage is decoupled from the virtual workloads. Storage resources are then abstracted to enable pulling replication and non-demand distribution for higher availability.

The result is a storage layer much like that of a virtualized compute. It's standardized, aggregated, flexible, efficient, and scalable with software-defined networking. The logical network is decoupled from the physical network topology. This allows it to treat their physical network as a pool of transport capacity that can be consumed and repurposed on demand. The result is multiple logical networks that can be dynamically provisioned and managed, all utilizing the underlying physical network as a simple backplane. As we move into the mobile cloud era, the same tools and processes used to virtualize and consolidate your on-premises data center can be used to facilitate your move to the hybrid cloud.

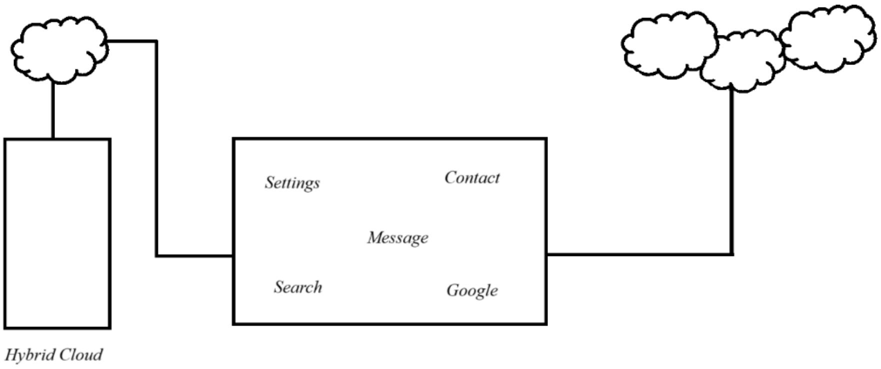

Fig.2 Hybrid Cloud

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Hybrid cloud architecture services from many heterogeneous suppliers can be managed as if they were all part of the same virtual cloud. Workloads may be moved effortlessly between your data center and hybrid cloud without the need for re-architecture. Over 250,000 clients rely on VMware for data center consolidation and standardization.

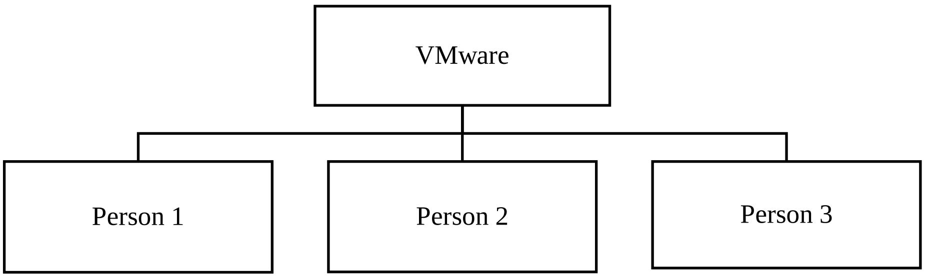

Fig.3 VMware

Michigan.gov solutions improving across business units and reducing cost on important factor for a financially strapped state budget with virtualization on investment of $1.6 million yielded **(1,600,000 USD = 135,815,194 INR**) to 5.25 million in capex (capital expenditure) (**5.25 million USD*82 INR/USD=431.7 million INR**) savings and over $850,000 in labor cost saving while the time to deploy new applications into production was reduced by approximately 35% managing future growth while reducing cost and complexity in a silo data center is no longer impossible.

Difference Between Data Center and Cloud Data Center

Features	**Data Center**	**Cloud Data Center**
Ownership	You own it! The company is responsible for the whole thing – the servers, storage, everything.	Big companies like AWS, Google, or Microsoft handle everything. You just use it.
Infrastructure	You've got all the physical servers, storage, and networking gear right there.	It's all virtualized. The cloud provider takes care of the physical infrastructure, and you get to work with it online.
Scalability	Growing your infrastructure is a bit of a hassle. You'll need to buy more hardware.	It's super easy. You can scale up (or down) instantly as your needs change.
Cost	Expect a big upfront cost for hardware, power, and maintenance.	Pay-as-you-go model. No big upfront costs, and you only pay for what you use.
Maintenance	Your in-house IT team handles everything – from updates to repairs.	The cloud provider manages all the maintenance, so your team has more time for other things.
Accessibility	You can only access it at the physical location.	You can reach it from anywhere with an internet connection. Super flexible!
Security	Security is all on you. You decide how to protect everything.	The cloud provider handles security at the infrastructure level, but you're responsible for securing your own data.
Disaster Recovery	You'll need to set up your own disaster recovery plan.	Disaster recovery is built into the cloud provider's service. They've got you covered.
Performance	Typically, really fast locally, but if you need to expand, it'll take time.	Speed depends on your internet connection, but scaling up is instant. No waiting around!
Customization	You have complete control over everything. Hardware, software – you name it.	You have complete control over everything. Hardware, software – you name it.

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Data center virtualization and consolidation help your IT team reduce capital expenditure and eliminate inefficiencies on the route to meeting increasing growth demands and delivering virtualization economics across the data center and ultimately expanding to the hybrid cloud to open the door to new services and business innovations.

IV.PROPOSED METHODOLOGY

Problem Statement
To determine the necessary cooling capacity for a data center.

V.RESULTS AND DISCUSSION

Problem solution
A fundamental estimation can be derived by summing the heat generated from three primary sources: the spatial contribution, the IT equipment's thermal output, and the presence of personnel.

Total Power Consumption
Calculate the total wattage of all IT equipment, including servers, storage devices, and networking equipment.

Additional Heat Sources
Account for heat generated by UPS systems, lighting, and even people working in the data center.

Expressed mathematically, this initial calculation is
Cooling Capacity (BTUs) = (Floor Area (ft²) × 20) + (IT Equipment Power (Watts) × 3.14) + (Number of Occupants × 400)
To convert BTU/hr to tons of cooling, divide by 12,000.

Floor Area (ft²)	IT Equipment Power (Watts)	Number of Occupants	Total Cooling Capacity (in BTU)
500	2000	5	18,280 BTUs
800	500	3	18,770 BTUs
300	1000	2	9,940 BTUs

Environmental Conditions
Maintain recommended temperature (18–27°C) and humidity (45–60%) levels for optimal equipment performance.
Redundancy
Include extra capacity for future expansion and unexpected failures.

VI.CONCLUSION OF FUTURE WORK

Scalability of Cooling Systems for Growing IT Infrastructure Designing cooling solutions that can adapt to increasing IT loads without excessive cost or infrastructure overhaul. Understanding how factors like temperature, humidity, and airflow influence cooling needs and overall system performance.

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