**Data Centers And Networking**

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**Executive Summary:**

Data centers serve as critical assets for organizations, managing large amounts of data for processing, storage, and dissemination. With the rise of cloud computing, distinctions between cloud providers' and enterprise data centers blur. Modern data center networks employ virtualization, combining physical and multi-cloud environments for scalability and efficiency. Key monitoring areas include real-time availability, bandwidth usage analysis, and network configuration management. Sustainable computing practices involve equipment upgrades, minimizing bypass airflow, and utilizing eco-friendly modes. Leading examples include Google, focusing on carbon-free energy by 2030, and Digital Realty, achieving 100% renewable energy coverage and significant progress in solar and wind power integration.

**Subject: The Role of Data Centers in Computer Networks**

A data center is a facility composed of networked computers, storage systems and computing infrastructure that organizations use to assemble, process, store and disseminate large amounts of data. A business typically relies heavily on the applications, services and data contained within a data center, making it a critical asset for everyday operations.Enterprise data centers increasingly incorporate facilities for securing and protecting [cloud computing](https://www.techtarget.com/searchcloudcomputing/definition/cloud-computing) resources and in-house, on-site resources. As enterprises turn to cloud computing, the boundaries between cloud providers' data centers and enterprise data centers become less clear-cut.

**Data Center Network:** A data center network consists of switches, routers, and other hardware components that work together to provide the connectivity and security needed to run applications and process data. As application requirements continue to change to address shifting business demands, data center networks must evolve as well. Traditional data center networks depend heavily on hardware and physical on-premises servers, which present storage, reliability, and latency issues in the face of a continuously growing volume of data. Furthermore, the only way to scale up a traditional network is to deploy larger switches and routers, which is both expensive and limited by the physical size of the data center. These larger, more complex devices also present greater risks; they are more prone to failures, and those failures have a wider impact (or “blast radius”) than do smaller devices. Modern data center networks, on the other hand, incorporate virtualization to support applications and workloads across both physical and multi cloud environments. Although modern networks still rely on physical components (routers, switches, firewalls, servers, etc.), they also depend on software components such as management and automation systems and analytics to reliably and efficiently deliver data and services among end users.

**How Modern Data Center Works**: Modern data center networks are designed to address scalability and redundancy limitations that occur when traditional data center networks need to grow and evolve. This is achieved with an architecture consisting of an IP-based underlay that interconnects physical devices and a virtual overlay consisting of a control plane and a data plane to provide connectivity between endpoints. Using a Clos or spine-and-leaf architecture for the underlay reduces latency and increases interconnectivity.

**In a data center network some of the important areas that need to be monitored on a regular basis are:**

### **i) Real-time availability**:

ManageEngine OpManager's data center networking solution provides comprehensive network health and availability monitoring to ensure peak performance round-the-clock for your datacenter network.

It provides complete visibility into all of your [network devices](https://www.manageengine.com/network-monitoring/availability-monitoring.html#deviceavail) and [associated interfaces/ ports](https://www.manageengine.com/network-monitoring/availability-monitoring.html#interface) and [WAN links using Cisco IP SLA](https://www.manageengine.com/network-monitoring/availability-monitoring.html#wan-link). It has in-built data center network monitoring tools that provide real-time dashboards and a multi-level threshold based alerting system to instantly identify and resolve network issues based on early indications before it causes a network outage.

### **ii) Bandwidth monitoring**:

In data center networking , it is also essential to analyze bandwidth usage patterns, track application growth and number of connections, and control excess bandwidth consumption. This helps identify and allocate optimal bandwidth to avoid wasting it or causing traffic congestion that hinders network performance.

Data Center networking with OpManager enables you to monitor over 230 different interface types out-of-the-box to track [interface performance](https://www.manageengine.com/network-monitoring/interface-monitoring.html) using metrics such as traffic speed, errors, discards, packet loss, etc., with advanced bandwidth and flow analysis. You can also use the in-built Netflow module to get further insights and actions on capacity planning, anomaly detection, traffic shaping using ACLs, etc.

### **iii) Network configuration management:**

Network configuration management is a process that is carried out throughout the entire life cycle of an asset in the data center network (DCN) and a simple misconfiguration due to human error can cause outage, loss of revenue and failure to meet service level agreements (SLA) might incur legal repercussions.

**How data centers can contribute to sustainable computing:**

## **1. Upgrade to New Equipment:**

## Although equipment may not be considered broken or need extensive maintenance as operation efficiency appears to be optimal, the older the equipment, the less energy efficient it may be.

While regular maintenance and repair can improve the functionality of equipment, over time, equipment becomes less reliable and more expensive to maintain. It is also important to not only replace the larger, more prominent equipment but the smaller, often forgotten equipment as well, such as capacitors and circuit breakers.

## **2. Minimize bypass airflow**

Another aspect of data centers that greatly contributes to the amount of energy used is the cooling system. [Data center cooling](https://www.sunbirddcim.com/glossary/data-center-cooling) is estimated to account for roughly half of total data center energy consumption, so it is important to optimize airflow to improve energy efficiency. Bypass airflow is the air that returns to a cooling unit without removing any heat. It results in lost cooling capacity, higher cooling costs, and an increase in hot spots. Therefore, bypass airflow decreases the energy efficiency of the cooling system and requires additional cooling to remove heat from the IT equipment.

## 3. Switch to Eco Mode

Uninterrupted power supplies (UPSs) can waste a significant amount of energy despite being able to operate on several modes that can reduce this waste. Economy (ECO) Mode is an option designed to minimize the losses associated with inefficient energy usage, and it involves incoming power passing directly through the UPS. In this mode, the servers run on utility power but are still protected in the event of a power outage.

**Some Examples of Data Centers:**

**Google:**

Google owns and operates data centers all over the world, helping to keep the internet humming 24/7. Learn how our relentless focus on innovation has made our data centers some of the most high-performing, secure, reliable, and efficient data centers in the world.

**Sustainability Measures:**

1. Google Cloud is a real leader in green energy. They became carbon neutral in 2007 and later matched all their energy use with renewable energy, a first for a major company. Their future goal is to eliminate their carbon footprint and run on 24/7 carbon-free energy in all their global data centers by 2030.
2. Google uses cool tech like cooling economizers and free cooling with low-temperature air to make their data centers more efficient. They also optimize airflow and run their IT equipment at warmer temperatures to save energy on cooling.

**Digital Realty:**

Digital reality delivers a safe and open meeting place accelerating collaboration, innovation, and growth for leading enterprises and service providers.They have the global footprint with local expertise and connectivity to the locations that matter most with over 310+ data centers across 25+ countries, and over 50+ metros.

**Sustainability Measures:**

Digital Realty, a data center company, received the 2021 EPA Energy Star Partner of the Year Sustained Excellence Award for its energy efficiency efforts. It’s the first data center worldwide to achieve 1GW of sustainable IT capacity and also has 64% renewable energy coverage, which increased by 14% in just a year.

In 2021, Digital Realty made remarkable progress by adding 118MW of solar and wind power to its energy grid. It also issued two green bonds, bringing the total value of its green bonds since 2015 to $6bn. Their US and European portfolios achieved 100% renewable energy coverage, and their French portfolio is carbon neutral.

Citations:

1. <https://www.techtarget.com/searchdatacenter/definition/data-center>
2. [https://www.juniper.net/us/en/research-topics/what-is-a-data-center-network.html#:~:text=Why%20do%20we%20need%20 data,speed%2C%20and%20larger%20storage%20space](https://www.juniper.net/us/en/research-topics/what-is-a-data-center-network.html#:~:text=Why%20do%20we%20need%20data,speed%2C%20and%20larger%20storage%20space).
3. <https://www.manageengine.com/network-monitoring/data-center-networking.html>
4. <https://www.sunbirddcim.com/blog/8-ways-ensure-green-data-center>
5. <https://www.digitalrealty.asia/>
6. <https://www.google.com/about/datacenters/>