Republic of the Philippines
SORSOGON STATE UNIVERSITY– BULAN CAMPUS
Information and Communication Technology Department

SYSTEM ADMINISTRATION and MAINTENANCE

Module 4 – Data Centers

Description

This course teaches skills and concepts that are essential to the administration of operating systems, networks, software, various computing support systems, and system documentation, policies, and procedures. This also includes education and support of the users of these systems.

David John S. Cayetano, MIT

Bliss, Macabog, Sorsogon City

gearlalu@gmail.com

09662175604

Module for: BSIT 4A & 4B

Module 4 (2 Weeks Duration) – Data Centers

I. Learning Activities Assignment and Assessment

These places go by different terms, and each implies something slightly different. Data centers are often stand-alone buildings built specifically for computing and network operations. Machine room or computer room evokes a smaller image, possibly a designated room in an otherwise generic office. The very smallest such places are often referred to humorously as computer closets.

Remember: *Building a data center is expensive, and doing it right is even more expensive. You should expect your company's management to balk at the cost and to ask for justification. Be prepared to justify spending the extra money up front by showing how it will save time and money in the years to come.*

At first glance, it may seem fairly easy to build a data center. You simply need a big room with tables, racks, or wire shelves in there and voil `a! In fact, the basics of building a good, reliable data center that enables SAs to work efficiently is a lot more complicated than that. To start with, you need to select good racks, you need good network wiring, you need to condition the power that you send to your equipment, you need lots of cooling, and you need to consider fire suppression. You also should plan for the room to survive natural disasters reasonably well.

Organizing the room well means thinking ahead about wiring, console service, labeling, tools, supplies, and workbenches and designating parking places for mobile resources. You also need to consider security mechanisms for the data center and how you will move equipment in and out of the room.

Location

First, you need to decide where the data center will be. If it is to be a hub for worldwide offices or for a geographic area, this will first involve picking a town and a building within that town. Once the building has been chosen, a suitable place within the building must be selected. For all these stages, you should take into consideration as part of the decision process the natural disasters that the area is subject to.

Location and Political Boundary

Sometimes, a site a few miles from another is significantly better because it is in another state or county. For example, one company leasing new data center space in the late 1990s needed many data centers for redundancy. One of the company's decisions was not to lease any space in counties that were participating in California's proposed power-deregulation plan. This often meant disqualifying one space that was just miles from another, similar space. Someone not following the regulatory politics wouldn't see the difference.

When the deregulation plan led to the famous California power problems of 2000/2001, what had previously looked like paranoia turned out to prevent significant power-related outages.

When it comes to selecting the location for the data center within the building, the SA team should have influence. Based on the requirements you build from the rest of this chapter, you should be able to discuss your space needs. You should also be able to provide the facilities department with

requirements that will help it select an appropriate location. At a basic level, you should make sure that the floor will be strong enough for the weight of the equipment.
There are, however, other factors to consider.

Progress Assessment (Location)

1. Identify and Discuss (5) five things to consider in choosing Data Center Location.
2. Identify and Discuss (5) five Keys to Success in Data Center Site Selection.

Answer the Progress Assessment question on the Learning Management System.

Access

Local laws will determine to some degree the access to your data center and, for example, may require at least two exits or a wheelchair ramp if you have a raised floor. Aside from those considerations, you also must examine how you will move racks and equipment into the room. Some pieces of equipment are wider than standard door widths, so you may want extra wide doors. If you have double doors, make sure that they don't have a post in the middle. You also may want to look at the spacing between racks for getting the equipment into place.

If you have a raised floor, you will need a ramp for wheeling in equipment. You may need to strengthen certain areas of the floor and the path to them for supporting extra heavy equipment. You also need to consider access from the delivery dock all the way to the data center. Remember that equipment is usually delivered in a box that is larger than the equipment itself. We've seen equipment unboxed at the delivery dock so that it could be wheeled into the elevator and to its final destination.

Security

Insofar as possible, your data center should have good physical security that does not impede the SAs' work. Access should be granted only to people whose duties require physical access: hardware technicians, tape-backup operators, network administrators, physical plant and safety personnel, as well as a limited number of managers. The fire safety wardens or, in some places, the emergency search teams, assigned to that area should be drawn from people who have access already.

Restricting data center access increases the reliability and availability of the equipment in there and increases the chance that wiring and rack-mounting standards will be followed. Servers, by definition, have high availability requirements and therefore should be subject to all the change management processes and procedures that the SA group abides by to meet or exceed their service-level commitments.

Remember: *Locking a data center with keys is not ideal, because keys are cumbersome to use, too easy to copy, and too difficult to trace. Instead, consider proximity badge systems, which are more convenient and automatically record accesses. Data centers with very high security requirements, such as banks or medical centers, sometimes use both keys and proximity badges, require two people to badge in together so that nobody is in the room unsupervised, or use motion detectors to make sure that the room is empty when the badge records say it should be.*

Biometric locks introduce many new concerns. Is it ethical to install a security system that can be bypassed by cutting off an authorized person's finger? If the data is sufficiently valuable, the biometric lock system may put the lives of authorized personnel in danger. Most biometric security systems also check for life by looking for a pulse or body heat from the finger. Other systems also require a PIN or do voice recognition, in addition to the biometric scan.

Power and Cooling

Power and cooling in your data center are directly related. Power makes equipment run; cooling removes the heat generated by the equipment so that it stays within operating temperature. Equipment malfunctions and can even catch on fire when it gets too hot.

You can direct the airflow in a data center in two general ways. One way is to use a raised floor as the conduit for the cold air. The airflow system pushes the cold air, creating enough pressure to force the air up holes in the raised floor. These holes are strategically placed to blow up into the equipment, carrying the heat up and away. This works because heat rises. Many people think that raised floors are to make it easier to run cables.

Remember: *Cables block airflow and shouldn't be run under a raised floor used for cooling. If your raised floor is part of your cooling architecture, overhead racks should be used to run cables and power. You will continually need to remind people that cables and other airflow-blocking devices should not be placed under the floor.*

The alternative is to have the cold air output from the ceiling and blow down onto the machines. Since hot air rises, it is less work to force cold air to flow down. With a system like this, cables can be distributed via overhead trays as before, or a raised floor can be used exclusively for cables.

Cooling Rules

Bear in mind that equipment tends to get smaller over time, so in a few years, the same amount of space will be capable of consuming more power and needing more cooling. With the popularity of high-density blade farms, all the old rules are going away.

Humidity control is another component of air conditioning.
The humidity in the data center needs to be regulated because high humidity leads to condensation and equipment failure, and low humidity causes static discharge that can damage equipment.

Data center power must be conditioned, or cleaned, to protect equipment from the spikes, brownouts, and power cuts that are a fact of life with utility power. Clean alternating-current power also means a steady sine wave and a constant number of volts.

Achieving all this requires at least one UPS that provides sufficient power at a constant voltage to the whole data center. A UPS normally supplies power from battery banks, which it is continually recharging from its in-bound power feed, when that feed is clean enough to use. Power from the UPS is then brought to distribution panels in the data center and any other locations that get protected power. A UPS with modular battery banks.

Therefore, you can design your UPS system to last either an hour or much longer. If you purchase a UPS with enough capacity to last an hour, that will cover the frequent, short outages and give you enough time to power down all the systems in the occasional multihour outage. This solution is less expensive, since the cooling system does not need to be on the UPS, because a data center can typically last an hour without cooling. From our earlier cooling and power discussion, it is clear that putting the cooling system on the UPS would double the capacity required, which would approximately double the cost of the UPS.

Remember: *Data centers that provide 24/7 service require a more sophisticated UPS system. A smaller UPS that lasts for a shorter amount of time is combined with a generator and an ATS that switches between the two. This type of UPS system will survive multi hour outages. The UPS will handle the frequent, short outages and give you enough time to power up the generator. Emergency refueling service can be prearranged to allow the building to run on generator power indefinitely.*

In addition to having the HVAC systems on generator power, it can be useful to put other building circuits onto power circuits that have generator backup. These circuits should be tolerant of small outages and spikes. Lights are good candidates, particularly in the operations and helpdesk areas. For groups such as the helpdesk, operations (for example, shipping and receiving), or a customer-service

center that needs to stay up during power outages, it can be useful to have the light and power circuits on generator backup with small deskside UPS systems.

All areas should at least have emergency lighting that comes on automatically when the power fails, even if it is not part of the building code in that region. If you have the luxury of being able to switch off utility power to the building, it can be useful to try it and see what else you would like to have on emergency power. In the absence of a full trial, mime all the things that you would do in a power outage, and note what you rely on that would not be available.

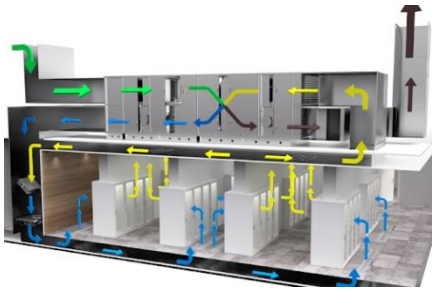
The Importance of Lighting

One site did not have emergency power brought to the lights in the generator room. This omission was discovered when a power outage occurred, and the site needed to refuel the diesel generator in the dark.

Remember: *Maximum load is more than simply what the equipment in the data center can draw. All the components of the electrical system, as well as the wiring and trip switches between them, must have the capacity to deal with your data center at maximum load and the HVAC system running at maximum capability, with the added load of the UPS charging its batteries.*

❖ Smaller Cooling Solutions Small companies often have a computer closet with a single server and a couple small pieces of network equipment. Often, the building cooling is enough for so little equipment. However, since cooling is not provided during weekends, the first 3-day weekend of summer becomes a meltdown. Alternatively, the company grows to four or five servers, and the room overheats all the time.

For larger rooms with five to ten racks of equipment, mobile cooling units can be rented at reasonable rates. Sometimes, a year of rental costs less than the installation and construction costs associated with permanent units.



Once you have the appropriate amount of conditioned power in the data center, you need to distribute it to the racks. An overhead power bus is a good way to do that, giving you the option of bringing different voltages into each rack, in case you have equipment that requires nonstandard power, as some high-end equipment does.

A **power-distribution unit** (PDU) may look like a power strip but has internal wiring that connects different sockets onto different circuits. A PDU reduces the chance of overload, whereas a simple power strip won't.

Some PDUs include remote power management, which simply means that there is a way to remotely control each individual power port. The ability to turn a particular port on or off can save a trip to the data center when a machine needs more than a basic reboot.

PDUs with Remote Power Management

PDUs with remote power management are also common at locations with no people—lights-out operation—or offices that lack on-site technical personnel, such as small sales offices. Some PDUs can be controlled from a Touch-Tone telephone. The ability to power cycle a host remotely can make a big difference in the time it takes to get an unreachable server back online.

Fire Suppression

It's a good idea to have a fire-suppression system in your data center, even if local laws do not require it. Power supplies, UPS batteries, and disks can all burn out or catch on fire. Electrical wiring can develop a fault that sparks and ignites nearby materials.

Typically, local laws not only require a fire-suppression system but also are very explicit about what systems you can and can't use. This list changes continually as dangers of new systems, particularly to those in the room when they are activated, are discovered. If you do have a choice, consider the dangers to the people working in the room, environmental hazards of the system, the damage that it might do to the equipment that is not on fire, and how well that system deals with electrical fires.

Remember: *Another thing to consider is whether to link activation of the fire suppression system with a switch for turning off power in the computer room. If you are going to dump water on all the equipment, for example, you need to cut the power to the equipment first. Such a harsh method of turning off the equipment may cause some hardware fatalities but not as many as dumping water on live equipment.*

Racks

Equipment in a data center is generally mounted in racks. At first glance, one would think that racks aren't important. They're simply sheet metal and bolts. In fact, however, they're so important as to dictate nearly every other aspect of data centers. Racks are to data centers what your spine is to your body. Your spine determines your body's shape, which affects all other aspects. Each kind of rack has a specific purpose. Some types are better for servers; other, for network equipment.

Racks organize your equipment. Being well organized means that you can fit more computers into the same-size room. The higher density is because racks stack equipment vertically. Data centers would have to be considerably larger if machines were sitting on the floor or on tables. When machines are literally stacked on top of each other, working on a lower machine is difficult without jostling the top machines.

Remember: *Racks are part of your cooling system. The airflow of the room is greatly determined by the arrangement of racks. Inside the rack itself, good airflow means that computers get cooled properly. Racks with bad internal airflow make it more difficult to cool your equipment.*

Progress Assessment (Racks)

1. **List down 5 issues to avoid server rack setup issues. Discuss your answers.**
2. **Discuss the best features to consider when selecting the appropriate rack for a datacenter.**

Answer the Progress Assessment question on the Learning Management System.