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Data Centers' Electric Power Supply

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Large-scale computer systems have been around for a while, and many people are already familiar with the term data center. In the 1940s, computers were so large that individual rooms had to be specially set aside to house them. Even the steady miniaturization of the computer did not initially change this arrangement because the functional scope increased to such an extent that the systems still required the same amount of space. Even today, with individual PCs being much more powerful than any mainframe system from those days, every large-scale operation has complex IT infrastructures with a substantial amount of hardware – and they are still housed in properly outfitted rooms. Depending on their size, these are referred to as *server rooms* or *data centers*.

Data centers are commonly run by large companies or government agencies. However, they are also increasingly used to provide a fast-growing cloud solution service for private and business applications.

Data center preferably consists of a well-constructed, sturdy building that houses servers, storage devices, cables, and a connection to the Internet. In addition, the center also has a large amount of equipment associated with supplying power and cooling, and often automatic fire extinguishing systems.

An indicator of the security level is provided by the *tier* rating as defined by the American National Standards Institute (ANSI). This proprietary rating system begins with Tier I data centers, which are basically warehouses with power, and ends

with Tier IV data centers, which offer 2N redundant power and cooling in addition to a 99.99% uptime guarantee.

A Tier 1 data centre can be seen as the least reliable tier due to the fact that capacity components are non-redundant as well as the distribution path being a single, non-redundant path and as such, if a major power outage or disaster occurs, the equipment is more likely to go offline as there are no backup systems in place to kick in if any issues do occur.

Tier 1 data centers are appropriate for:

- companies with a passive web marketing presence,
- small internet based companies with no customer support or e-commerce facilities on-site.

Tier 2 data centres are considerably more reliable than Tier 1 data centres although they can be subject to problems with uptime. To achieve Tier 2, the facility has to meet the criteria achieved with a Tier 1 data centre, as well as ensuring that all capacity components are fully redundant.

Tier 2 data centers are appropriate for:

- Internet based companies who can cope with occasional downtime and will incur no penalties for this,
- companies that do not run 24/7, allowing time for issues to be resolved,
- higher intensity data driven servers such as model imaging programs.

Tier 3 data centres are commonly seen as the most cost effective solutions for the vast majority of medium to large businesses, with availability topping 99.98%, ensuring minimal downtime. To put this figure in perspective, this means that your equipment should see a maximum of two hours of downtime on an annual basis. Tier 3 data centres have to meet all of the requirements of Tiers 1 and 2 as well as ensuring all equipment is dual-powered and has multiple uplinks. Some facilities also offer some fully fault-resistant equipment, although to achieve Tier 4, all equipment including HVAC,

servers, storage, chillers and uplinks must be fully fault-resistant. This tier is generally considered as Tier 3+ in the marketplace.

Tier 3 data centers are appropriate for:

- companies with a worldwide business presence,
- companies that require 24/7 operational hours,
- organisations that require consistent uptime due to financial penalty issues,
- e-commerce and companies running full online operations,
- call centres,
- VOIP companies,
- companies with heavy database driven websites,
- companies that require a constant web presence.

A Tier 4 data centre is generally considered the most expensive option for businesses. Tier 4 data centres adhere to all the requirement of Tiers 1, 2 and 3 as well as ensuring that all equipment is fully fault-resistant. This is achieved by creating physical copies of all essential equipment, otherwise known as N+N.

Tier 4 data centers are appropriate for:

- large, multinational companies,
- major worldwide organisations.

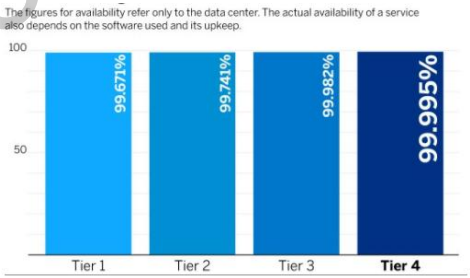

Fig.1 – Data centers' availability

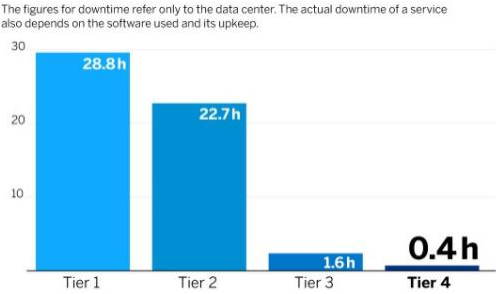

Fig.2 – Data centers' downtime

Data centers are connected to two separate grid sectors operated by the local utility company. If one sector fails, then the second one will ensure that power is still supplied. The diesel motors are configured for continuous operations and are always in a preheated state so that they can be started up quickly in the event of an incident. It only takes an outage in just one of the external grid sectors to automatically activate the generators.

Within the data center, block batteries ensure that all operating applications can run for 15 minutes. This backup system makes it possible to provide power from the time a utility company experiences a total blackout to the time that the diesel generators start up. The uninterruptible power supply (UPS) also ensures that the quality remains constant. It compensates for voltage and frequency fluctuations and thereby effectively protects sensitive computer electronic components and systems.

A redundantly designed power supply system is another feature of the data center. This enables one to perform repairs on one network, for example, without having to turn off servers, databases, or electrical equipment. Several servers or storage units have multiple, redundant power supply units,

which transform the supply voltage from two grid sectors to the operating voltage. This ensures that a failure of one or two power supply units does not cause any problems.

Data centers' erection is very expensive. However, these costs are justified. Interruption in power supply of the bank leads to a large monetary damage. According to the research in 2016, the average cost of a data center outage has steadily increased from $505,502 in 2010 to $740,357 in 2016. Maximum downtime costs increased 32 % since 2013 and 81 % since 2010. Maximum downtime costs for 2016 are $2,409,991.

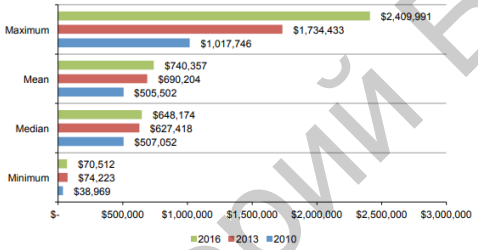

Fig.3 – Data centers' outages cost

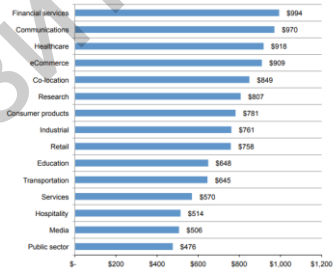

Fig.4 – Total cost of unplanned outages by industry in 2016

From these arguments it could be concluded that investment in data centers' construction leads to decreasing costs of electric power supply outages.