Note

Establishing Data Centres in Developing Countries

By Emmeline Perreve

Summary

The digital divide between under-connected and hyper-digitalized economies continues to widen. Many developing countries lack the capacities and infrastructure to harness digital data and technologies, at the risk of exacerbating existing inequalities. For instance, Africa and Latin America together account for less than 5 per cent of the world's colocation data centres. As a growing number of developing countries aspires to catch up and establish data centres locally, this note reviews some of the main needs, good practices and successful experiences in doing so.

Introduction

A data centre is a facility that houses different types of servers such as website servers, database servers, e-mail servers, cloud servers. They must be managed and operated by data centre specialists. Physically speaking, it is a network of computing and storage resources with routers, switches, storage systems, servers, firewalls and application-delivery controllers. It has to connect servers, data centre services, storage, and external connectivity to end-user locations.

In summary, a good data centre: (i) has a good security; (ii) is performant and powerful; (iii) has a good, adaptable and flexible architecture and design; (iv) is well connected to the outside networks; (iv) is energy-efficient and as much green as possible. To achieve those goals, the government needs to be involved to provide a favourable framework for data centres to develop at their best. This will be developed later in that note.

There are several ways of conceiving a data centre. The first step is hence to establish a bill of specifications and to identify the special requirements of that data centre. To understand that will help choosing the best solutions while establishing the business plan. As developing a data centre is part of a global development strategy that should have a long-term impact, policies and decisions should be taken with awareness of long term development objectives and plans.

Data-centre ownership and management: different solutions

A data centre is not always owned by its user. It can be[1] :

- Owned by the enterprise itself: It is then adapted to the special needs of the end users and is often housed on the campus

- Owned by a third party (managed services provider): the company leases the infrastructure instead of buying it

- A colocation: a company rents space within a DATA centre owned by others. 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.

- A cloud data-centre: is off-premises. The data is hosted by a cloud services provider.

Main characteristics of a Good Data Centre

It is essential to have good and performant infrastructures that will avoid for the data centre to have any technical problems. This includes security and the materials used during the design of the data centre.

A good security to avoid misfunctioning and improper intrusion

The aim is to protect both performance and integrity of the data centre.

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[1] https://www.cisco.com/c/en/us/solutions/data-center-virtualization/what-is-a-data-center.html

● *Technical security*

Data centres can be hierarchised depending on their reliability and resilience level. A distributed architecture is the best solution to resist breakdowns. The site infrastructure should be fault-tolerant thanks to a redundant system (see below). A significant infrastructure is needed to support the centre's hardware and software: subsystems, uninterruptible power supplies (UPS), ventilation, cooling systems (water cooling or air-based cooling system[2]), fire suppression, backup generators, automatic failover and load balancing, and connections to external networks. This is essential to make the data centre work. As risk of fire is very high in a data centre, it must also have fire protection system - the chemical system is increasingly chosen by data centre designers as it is more ecological.[3]

● *Surveillance and management*

In order to avoid problems linked to power failure, temperature, humidity, equipment failure or water, all of those items should be kept under surveillance. Some software programs of surveillance and management allow informatic administrators to monitor the equipment, measure its performance, detect the mistakes and implement corrective actions without being physically in the data centre[4]. All actions should be transparent, traceable and auditable. Also, to automatize this surveillance reduces the costs and the time employees spend on the maintenance.

● *Establish a disaster recovery protocol*

It is important to plan what must be done in case of fire or flooding and how to recover as fast as possible every data and the general functioning of the infrastructure. One possible solution is to have several sites: in case of damage of one of them, not all data is damaged.

● *Avoid improper intrusion on secret data*

Access doors and corridors should be large and let big informatic equipment move along. Security cameras may be appropriate to avoid any improper entry in the centre.

The increase in data consumption leads to a need in stronger security standards: for example, create a strong perimeter on the cloud to safeguard the data. "With data localization, companies can store critical data within the national boundaries, and this requires better infrastructure like smarter and modern data centres to process, store and manage copious amounts of data of various kinds."[5]

"The most important challenge is to secure the data of any organization into the data-centre with no security breaches and data losses. This challenge has been overcome by the in-flight optical encryption that results in increased protection of the data while transmission from one data centre to another. "[6]

A good architecture and design: good materials, adaptability and flexibility

Once the area of the data centre is secured, the architecture of a data centre must pay attention to electrical and mechanical infrastructure, and to both the composition and disposition of the informatic equipment. A robust infrastructure is vital, even if it is not enough to ensure a good performance.

[2] https://www.researchandmarkets.com/reports/4986843/data-center-market-in-india-industry-outlook?utm_source=dynamic&utm_medium=GNOM&utm_code=swlrwx&utm_campaign=1352846+-+India+Data+Center+Market+Outlook+and+Forecast+2020-2025+-+Migration+to+Cloud-Based+Business+Operations%2c+Increased+Investments+from+Colocation+Providers&utm_exec=joca220gnomd

[3] https://www.lebigdata.fr/definition-data-center-centre-donnees
[4] https://www.lebigdata.fr/definition-data-center-centre-donnees
[5] https://www.expresscomputer.in/news/major-datacenter-challenges-of-cios-security-software-complexity-compute-and-budget/44658/
[6] https://www.i2k2.com/blog/challenges-for-indian-data-centers/

There are several levels of security and performance but the most efficient and secure one is the "tier IV"[7] ("fault-tolerant site infrastructure" : it has redundant-capacity components and multiple independent distribution paths that enable concurrent maintainability and one fault anywhere in the installation without causing much downtime) - 25 minutes downtime, 99,995% availability, 2 independent utility paths, fully redundant 2N+1, able to sustain 96 hours power outage ; though, it is also the most expensive and represents a multi-million dollars business.

Racks and cabinets can be used as basic building blocks – they can support massive objects (in depth and space). The cable management must be able to support the current cable density while letting enough space for growth. One should prefer some cables with small outer diameter.

To choose the right cabling solution, it is important to have flexible and scalable cabinets and racks that can support higher weight. The chosen manufacturer should be well aware of the current trends and the new developing technical requirements. [8]

> ❗ **Important**
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> The space, the infrastructure and every material must be flexible and adaptable to any newer equipment that may arrive, and be able to support shifting business demands and requirements. Attention should be paid to the scalability of the infrastructure.

Need of global good and powerful infrastructures

⏵ *Localisation*

A good stability especially in meteorological terms is needed, just as an easy access to roads and airports, energetical availability, telecommunication. The interconnection among the data centres must be as strong as possible in order to have the lowest latency. Though, when the data centres are set up apart, it is possible to minimize the hardware induced latency and replace it with fibre optics to reduce the transmission impairment issues.[9]

⏵ *Connectivity and storage*

It is essential that the data centre is well connected and able to communicate across the multiple sites: as it must respond to a demand of hyper connectivity due to the modern activities, the cable linking the data centre to the rest of the world must be strong, support big exchanges of data (both in and out). Though, those infrastructures must not be overly used but should be available. A good storage system is also needed.

⏵ *Capacity constraints*

"The data sets that enters and leaves the data centres are often very large ranging from 100's of GBs and TBs. This affects the efficiency of the data centers. So to improve this issue the data centre providers must enable the transmission rates between 40G to 100G and higher over almost any distance. This will dramatically improve the capacity limitation of Data Centres."[10]

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[7] https://www.cisco.com/c/en/us/solutions/data-center-virtualization/what-is-a-data-center.html
[8] https://www.colocationamerica.com/blog/data-center-design-best-practices

[9] https://www.i2k2.com/blog/challenges-for-indian-data-centers/
[10] https://www.i2k2.com/blog/challenges-for-indian-data-centers/

▶ *Power*

The processing power must be high with and improved computing efficiency. The electricity provider must be able to supply the data centre with the upcoming increasing need in electricity on the long term.

As the data centre consumes a lot of energy, it produces warmth that needs to be cooled.

▶ *Modular design solution*

All the devices and data centre elements work in collaboration with each other, which optimizes the setting up and organization time. As mentioned above, the global network must support adjustments, changes to the network arrangement and technology upgrade without causing major infrastructural disruptions.

Energy-efficiency and environmental concerns

▶ *Some energy tips*

A data centre requires a lot of energy. As far as it is possible, any loss should be avoided. For example, the created warmth can be reused in the town. The issue of energy is recognized as to be a big challenge. In India[11], the growth of energy consumption is a major challenge that the data centre industry has to face. It seeks energy efficiency.

The used energy can be related to the energy production in the country. For example, in Iceland they use geothermal alimentation[12] which is a clean energy. The proper utilisation of natural resources provides with benefits: they often propose solutions that can be easily translated into flexible space designs and have reduced environmental impacts. It is also often cost effective, energy efficient, and has a high performance.[13] The use of materials with low emission, catalytic converter and alternative energetic technologies is increasingly popular.[14]

▶ *Maximise global efficiency*

The informatic equipment should be used in the most productive and efficient way: it allows to have lower costs and a low energy consumption. For this, every resource and space should be used at its maximum.

Qualified and trained staff to implement and take care

A data centre requires well trained staff to configure the servers, adapt computational load, guarantee an interrupted functioning. The manufacturer must also offer credible resources, competence in project coordination throughout the entire design and planning phases, and the ability to create better opportunities for extended location support.

If the country wants to invest for the long term and really want to be strong in data centres concerns, it might be a useful investment to create a centre for education and training that can provide certification of professionals, as well as a training curriculum.

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[11] https://www.researchgate.net/publication/272747867_Opportu nities_and_Challenges_for_Indian_Data_Center_Energy_Effici ency_Findings_from_Focus_Groups/link/54ed61f10cf27bfbfd772 4c9d/download
[12] https://www.unenvironment.org/news-and-stories/story/iceland-world-leader-clean-energy-supports-africas-push-geothermal-power
[13] https://www.colocationamerica.com/blog/data-center-design-best-practices
[14] https://www.lebigdata.fr/definition-data-center-centre-donnees

Experience of data centres in India: some challenges, opportunities and lessons[15]

IT and Infrastructure

Design and operation should be separated, just as the IT and the facilities personnel. It's better to choose a modular design that can integrate changes and infrastructure consolidation.

It is also important to define the environmental and physical limits of server operation: for example, there are some requested temperatures for the infrastructure to be working.

Maximization of data centre utilization with the right sizing is also important. Finally, it is also important to make a carbon footprint reporting and to encourage cool and clean locations, and make available natural gas. State government may use this as economic stimuli.

Expertise and Awareness

In India, data centres identified several needs such as a need for a better benchmarking[16]. They also need to identify further possibilities of development, for example with market analysis and opportunity assessment that are needed both by industry and government policy makers. The main issue is a lack of awareness and the need of more technical expertise. The undertaking of some case studies would provide industry the confidence to adopt new best practices and emerging technologies.

It might be wise to create an information and awareness framework, for instance in conducting some workshops or industry forums to exchange information and discuss experience with other countries.

Regulation and policies

The government has a crucial role to play in the establishment of a legal framework favourable to the development of data centres.

Concerning the fiscal frame, developing a supportive policy such as tax incentive might be welcome[17] as it would both encourage efficiency and clean supplies and be a monetary relief for the centres.

Some policies and regulations about energy standards would also help establish good practices. The government must provide specific guidance and create some regulations on energy standards, establish some mandatory efficiency codes and ask for some reporting requirements.

An institutional framework to stimulate change might as well be opportune such as establishing competition between companies so that they always try their best to be competitive.

Cost estimation

It is a big challenge for every data-centre to achieve bandwidth growth with minimal cost. A high-speed networking can help reduce the transport and power consumption costs.

[15]https://www.researchgate.net/publication/272747867_Opportunities_and_Challenges_for_Indian_Data_Center_Energy_Efficiency_Findings_from_Focus_Groups/link/54ed61f10cf27fbfd7724c9d/download
[16]https://www.researchgate.net/publication/272747867_Opportunities_and_Challenges_for_Indian_Data_Center_Energy_Effici

ency_Findings_from_Focus_Groups/link/54ed61f10cf27fbfd7724c9d/download
[17] https://www.livemint.com/news/india/govt-s-nudge-may-help-india-become-a-global-data-centre-11580664564132.html

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