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Site Selection Considerations for Edge Data Centers

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OVERVIEW

Data Center site selection can pose unique site selection challenges. Location criteria considerations can include both environmental and manmade outside influences, available utility services, as well as direct facility requirements. This paper will explore the specific factors that can influence site selection for Edge Data Centers (EDCs).

With the advent of both public and private cloud use, much of the data we use can be stored and processed thousands of miles from the end user. But, to meet the needs of many of today's applications, data needs to be processed very close to users and network functionality needs to be performed in real time. These needs are driving solutions to be managed at the edge of the network, in Edge Data Centers.

EDCs have some specific needs which may vary from other Data Center planning. Because the EDC is a newer type of Data Center, site selection will play a critical role in making sure that EDCs will meet industry needs while also not influencing the surrounding uses that may be adjacent to their locations.

First, it is important to understand the potential risks that may be present at any particular location being considered for an EDC as well as the potential risk introduced to the surrounding area as a result of its planned deployment. There is no such thing as the perfect site. Any location can have some element of risk involved.

The key is to weigh these risks or availabilities and decide if they are worthwhile investing in the site's development. Locational criticality, business needs, costs, and implications to reliability or systems integrity, must all be considered in order to best decide if a site is worth developing. Business drivers for system integrity, analytics of signal strength, and general needs for proximity to users factor into making a decision to pursue an EDC site.

This paper will highlight the most prevalent factors influencing good site selection practices: Environmental Risks, Manmade Risks, Utility Availability, Regulatory Influences and Onsite Planning Needs. While these factors alone do not provide an exhaustive or comprehensive set of guidelines, they are the core considerations to help formulate a strategy for developing edge data center sites.



I. ENVIRONMENTAL RISKS

Acts of nature, like severe weather, can significantly affect operational continuity in even the most hardened of facilities. EDC deployments may be physically small in size, unmanned, and/or only remotely monitored. This makes it more important to plan for and mitigate their potential exposure to the elements. EDC locations need to be prepared to operate in adverse conditions which could come from the microclimate or other potential natural hazards. Natural disasters, storms, or rare singular events can devastate entire geographic areas or small sites depending on their severity. Risks from particulates in the air, storm likelihood and normal geographic weather events can affect the availability of a site. For EDCs, mitigation planning or survivability will need to be determined early on in development.

Environmental risks can come as normally occurring events related to the local climate, as 50, 100, or 500 year events, as seasonal events, or as a combination of any or all of these types at once or in rapid succession. The effects of the earth's changing characteristics are creating more uncertainty about how often or to what degree these events can occur. Certain aspects of environmental risks are normal conditions at the specific site, for example temperature extremes. Specific features to counter these conditions must be planned up front when a site location is dependent on environmental factors.

In many cases, environmental risks of smaller sites are the most difficult factor to plan and mitigate against. At the same time, expenses to counter some environmental risks can increase site costs significantly. While some of these measures may not end up being used, without proper preparation, the impact of unpredictable environmental risks can be catastrophic.

II. MANMADE RISKS

Aside from natural occurrences, unexpected manmade risks outside the control of a site owner can also factor into site selection. Risks caused by adjacent uses, accidents, and potential acts of violence or harm should all be considered when evaluating a potential site location. Having a good understanding of some of the items listed below, the distance from these uses, as well as understanding the potential for use and population changes around a site can help better plan for potential risks. Although it may not be possible to avoid all these risks, knowing the potential for manmade risks can help increase the successful deployment of an EDC site.

- **Adjacent Uses/Facilities:** When considering a site for an EDC, the proximity to adjacent facilities and their uses can be an important factor to consider. For example, nearby hazardous conditions or manufacturing sites for hazardous products or materials could pose significant risk to the proposed site. Finding an acceptable distance from these adjacent facilities is one way to limit potential risks for the intended site. At the same time, it is helpful to anticipate how additional adjacent sites, new facilities or uses may be developed moving forward to ensure site safety and introduce unexpected risks. Even after initial site selection, these considerations should be checked periodically after the site is established to see if outside influences may change over time.
- **Adjacent Travel Corridors (Roadway, Rail, & Energy Transmission):** Adjacent transportation corridors such as major highways, railways, and airport approach/take-off corridors should be considered when looking at EDC potential locations. Although these adjacencies do not preclude EDC use, as many remote sites may benefit from their proximity to these corridors for network pathways, it should still be considered in their development due to the potential loss of access to a site due to an accident or other catastrophic event relating to these corridors.

Use/Facility Type	Considered Distance
Airport (Approach/Take-off corridors)	5 MILES
Agriculture Uses (Grain Elevators, Livestock, Fertilizer/Machinery Storage)	5 MILES
Automotive Body or Repair/Machine Shops/Gas Stations/Truck Stops	1 MILE
Chemical Plants or Storage/Foundries/Conventional Power Plants	5 MILES
Embassies/Political Groups/Large Urban Centers	3 MILES
Landfills/Waste Storage or Treatment Plants	2 MILES
Military Installations or Munitions Storage	10 MILES
Nuclear Power Plants (Active)	50 MILES
Overflow/Run-off Areas for Reservoirs or Man-made Lakes	2 MILES
Quarries/Mines/Blast Zones	3 MILES
Radio/Television Transmitters/Stations	3 MILES
Research Laboratories	3 MILES
Self-Storage Facilities	1 MILE

Table 1: Recommended Distances from EDC Sites to Adjacent Facilities

- **Vandalism and Unauthorized Access:** Restricted access to the site as well as the facility itself should be of a high consideration as part of the planned site development. With an EDC likely being unmanned and remote, any protective actions which can be afforded should be used to prevent unauthorized access at both the site perimeter as well as at the EDC itself.
- **Civil Unrest (Proximity to Civic, Military, or other Socio-strategic Location):** Part of the drive to create EDC sites is to get closer to larger numbers of users and devices. Dense urban areas are likely a rich target area for many planned deployments. However, there is a potential risk of damage to an EDC from civil unrest and considering locations further from areas which have higher potential for civil unrest such as civic or government facilities, military installations, or other socio-strategic locations may help minimize the risk.
- **Skilled Labor/EDC Support Availability:** In addition to physical and environmental conditions, the availability of skilled labor or support personnel capable of working to develop, maintain, or alter potential EDC sites is a key factor to consider in site location. A strategy to plan for the need of skilled personnel may include Artificial Intelligence (AI) or Machine Learning (ML) systems to alleviate the need for periodic site visits. However, the use of these high-tech systems may only drive up the skillsets required for troubleshooting a site if needed.

III. UTILITY AVAILABILITY

EDCs will rely on the available utilities on-site as well as off-site sources to support their operation. EDCs in remote locations, adequate utility coverage can be challenging to find. Specifically, utilities for communications, power, and water, including sanitary systems, must be taken into account based on the needs and use of the proposed sites.

- **Telecommunication Connectivity:** Communication connectivity is likely the primary need for every edge site being considered. Not only actual connection, but also quality and bandwidth will be of major concern depending on the amount of data planned to be brought to and sent from the site in consideration. Types of service available to the site, improvements required to get service to the site, and the site connectivity itself need to all be considered prior to development. The proximity of service carriers can affect the cost to develop the site.

¹Table source similar to BICSI-002 2019; Site Selection

- **Power Utility Availability** – Power needs for edge data centers are also an important aspect of site developments. It is likely that power needs are relatively low compared to more traditional data center sites. However, redundancy concerns, on-site power generation, as well as alternative power systems considerations like PV or wind systems may pose challenges on the site.
- **Water Utility Availability** – In certain instances, edge data center sites may require water-based cooling systems. In these cases, water service to the site, storage, quality, and disposal, may all play into the site development needs to support this cooling approach. This may be handled through water utility services or on-site water (such as a well or storage).

IV. REGULATORY INFLUENCES

Aside from the obvious needs to get permitting for an edge data center site, other factors regarding site, local, state, and federal regulations may hold sway on a site's development. Zoning or planning guidelines for everything from parking to vegetation to environmental permitting may be required. Labor agreements, taxation, and safety requirements may all affect a site location's ultimate viability. A firm understanding of the regulatory requirements of a specific site for a potential EDC is critical for site selection. Key categories and questions to consider include:

- **Permitted Use/Variance Requirements:** Is the site zoned for this use? Can it be changed to this use if it is not currently?
- **On-site Power Generation Permitting:** Are there regulatory requirements limiting hours of operation for on-site power generation for testing or emergency use?
- **Screening/Visual Requirements:** Are there visual requirements to hide infrastructure, utility, or other industrial uses?
- **Vegetation Requirements:** Is there regulatory requirements for vegetation at the site which may also tie into screening requirements?
- **Parking Requirements:** What parking regulations are there for the site and is there going to be overprovisioning for the intended use?
- **Taxation and Incentives:** What are the taxation elements for the site as well as any incentives based on the proposed location, use or other development aspects?
- **Future Zoning Planning and Changes:** Are there any development or planning requirements which may change in the future based on the overall district around the site?
- **Documentation in Local Language and Requirements for Use and Development:** What kind of plan requirements are in place for documentation of the site's development (language, measurement type, etc.)?
- **Labor Agreements:** Are there any pre-existing labor agreements associated with a leased site? Are there only certain available contractors who will work at the location?
- **Safety Requirements:** What are the regulatory safety requirements that may be associated with the specific site being considered? Are there specific safety requirements associated with the lease agreement?

V. ON-SITE PLANNING NEEDS

The specific planning for EDC sites requires a coordinated approach and understanding of both the elements required for the facility as well as the conditions which exist and can be

manipulated at the site. In some cases, existing conditions will need to be worked around in order to develop the site. There are three categories relating to these specific on-site planning needs. They are site logistics, site physical characteristics, and site influences.

- **Site Logistics:** Access, parking, coordination of services, meeting regulatory site requirements, and staging of construction both prior to and after completion are all concerns which must be carefully examined. As these sites are likely smaller in size and may be remote from major highways, the logistical concerns that come with setting up and operating an EDC location both in the initial phases and in the future are critical to understand when selecting a site.
- **Site Physical Characteristics:** The nature of the site itself will likely play a role in how the site is constructed. Topography, soils, and storm water drainage or retention requirements can all affect the positioning of an EDC as well as influence buildable areas for the site. Modifications may be necessary to account for things like flood plains. These all need to be examined and considered to assure proper site location and development.
- **Site Influences:** As previously noted, exterior elements surrounding a site can play into the site's layout or development. An existing structure on the site or even adjacent to the site can change orientation. Purchase or lease agreements may have restrictions in how the site can be built or even conditions requiring restoration at the end of the lease. These can all impact viability of a site location.

VI. CLOSING THOUGHTS

The site selection needs for mission critical facilities including EDCs can be complicated and involve close examination of multiple factors. Risk planning for EDCs involves coordination of network systems, planning to combat latency issues, potential concerns over both natural and manmade risks considered alongside the actual regulatory and planning needs of the site itself. Business drivers for locating a site can trump the site's specific features or concerns when trying to develop network integrity or presence in certain areas. Analytical drivers, including the reliance on Artificial Intelligence (AI) or Machine Learning (ML), as a predictor for site selection can drive interesting results that may then be challenged through physical needs or deterrents and may be at odds with those findings.

In the end, the provider whose strategy is creating a network of EDC sites will ultimately have to decide which elements are critical to the success of the network for the site locations to be functional. Support in the planning stages of the site selection process can often make challenges and risks easier to mitigate and can provide additional resources to the decision-making process. Partnering with consultants who support these types of programs on a regular basis can help ensure a strong site selection process, while industry teams focus on translating the site selection criteria that best fits their programmatic needs.

Site selection is only one of many factors of EDC development and bringing the edge system to life. The Telecommunications Industry Association's (TIA's) EDC Working Group is exploring the factors that will influence our ability to develop an EDC system capable of handling the complex needs of data processing, network agility, and data transfer. From the best planning for specific components like power and cooling systems, to reliability, availability, and serviceability needs, teams are examining systems, technologies, and approaches that best exemplify the characteristics of leading industry systems for tomorrow.

If you agree with the focus on this subject and have opinions or expertise to lend to this effort, please reach out to edcinfo@tiaonline.org for more information or to attend a regularly scheduled meeting, which are noted on TIA's website: www.tiaonline.org.

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