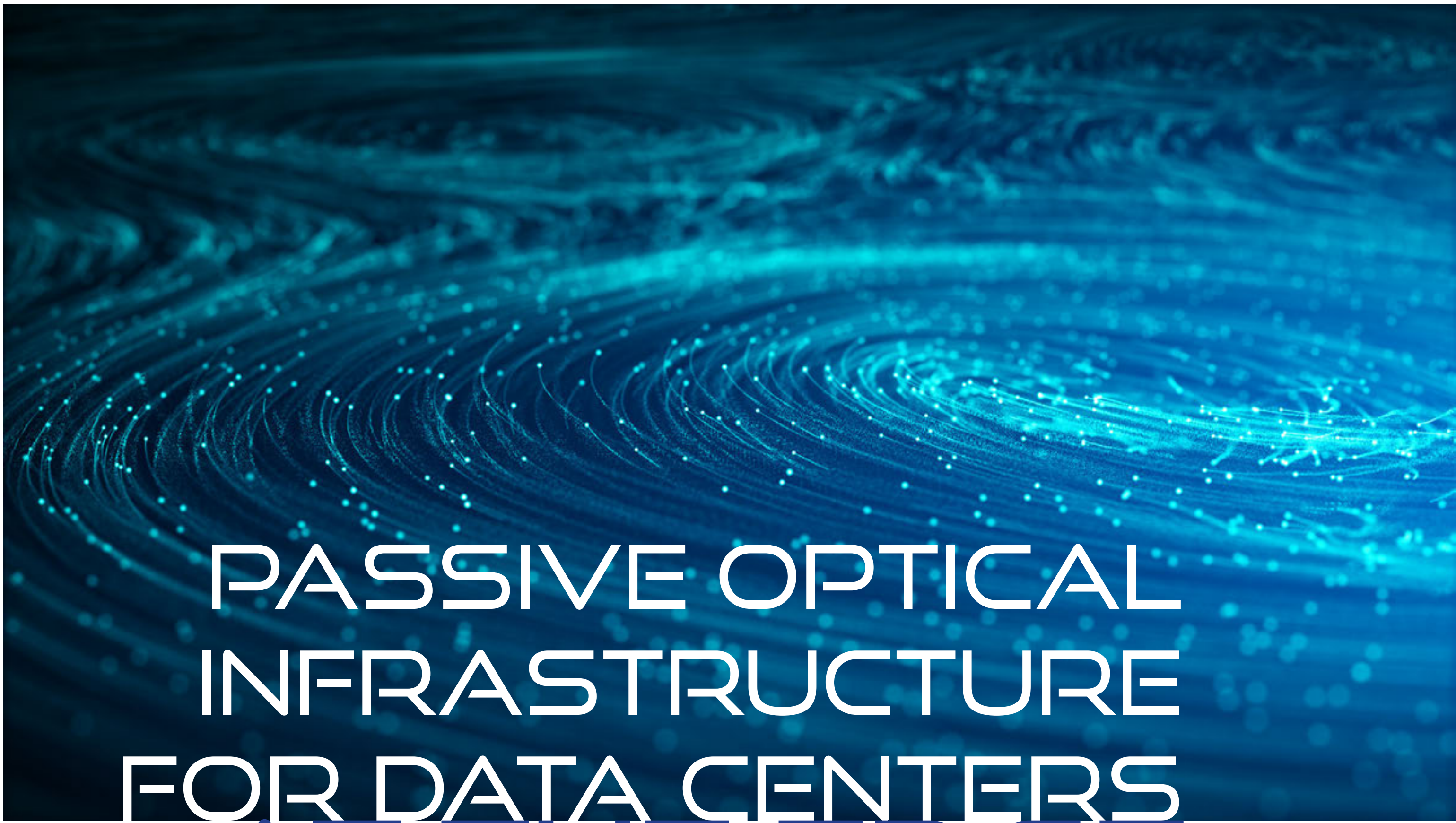

PASSIVE OPTICAL INFRASTRUCTURE FOR DATA CENTERS AT THE EDGE

by Manja Thessin, RCDD, RTPM

Although we are still in the early days for significant edge data center investments, there is increasing interest and demand for the benefits they bring. Edge computing brings processing capabilities closer to the end user device or source of data which eliminates the journey all the way back to the cloud data center and thus reducing latency, cost, and security risks. The move to edge computing is driving a massive proliferation of local data centers.

That trend is driven by the endless demand for more data capacity, which has increased 60% per year for the last 30 years.[1] That growing data consumption means that the world doesn't just need more fiber capacity; it needs fiber to go to places it never needed to go before: rooftops, neighborhood street-sides, businesses, and factories.

Fiber is a crucial connection technology for data centers. Fiber-optic communications has grown far beyond its origin in long-haul transport. Instead of spanning continents or connecting distant cities, fiber is now increasingly linking data centers and enterprises just dozens of miles apart.

There is still much confusion today about what constitutes an edge data center. Edge data centers can look quite differently depending on their location along the edge continuum – a spectrum ranging from the device or application edge near the end user all the way to the regional edge which is closest to the cloud. Each edge compute environment will differ depending on the type of use case it supports, as well as where the edge compute resource is being deployed.

Most edge deployments are occurring at the regional edge today. These are predominantly colocation data centers that host hundreds of different types of customers and achieve great economies of scale—sharing cooling, power, operations, and

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maintenance expenses. Thus far, this is where most investments are being made, led by infrastructure companies. To some degree, this is also being driven by CDN providers who are looking to distribute their networks and respond to the increased demand for data centers at a more local level.

These facilities can be as large as hyperscale data centers. The edge nodes in this environment are likely to be located within a standard data center server rack.

The passive optical infrastructure here is all about density. Ultra-high fiber count cables, such as modern flexible ribbon cables enable this density. On large campuses the number of splice points can be in the tens of thousands. The ability to mass fusion splice these massive amounts of fiber is critical to achieving a fast, easy installation. High-density splice enclosures and frames designed to handle thousands of fibers are required. Pre-terminated ultra-high count fiber cable solutions supporting data center interconnect applications are also gaining traction. These cables come fully connectorized in pre-determined lengths from the factory, thus eliminating the need for splicing in the field. Furthermore, smaller diameter cables ensure maximum pathway utilization. New air blown cable variants are a great option helping to achieve density and ease of installation.

Edge computing is beginning to drive a natural convergence between large cloud providers and telco service providers. Over the next few years telco service providers will increasingly leverage existing data centers at the edge of their mobile network. These sites are near peering points and therefore located near major cities, which could make them good candidates for edge computing. Though unlike colocation providers who have developed a business model and campus architecture meant to incorporate compute assets, these locations require a more focused solution—blending their existing infrastructure with compute power necessary to support edge computing.

Edge compute will drive an overbuild of 5G small cell networks to support latency-sensitive applications such as autonomous vehicles, augmented reality, mass IoT in smart city infrastructure, or drones, to name a few. As edge computing expands into deeper parts of the network, such as a deployment alongside small cell infrastructure, the environment will look quite different compared to that of a traditional data center. Small cells are small low-powered antennas—sometimes called nodes—that provide coverage and capacity in a similar way to a tower. They are usually attached to existing infrastructure in the public right of way like utility poles or streetlights. This would mean the edge server would likely be standalone and needs to be ruggedized since it will not be housed in a rack or enclosure. The passive optical infrastructure here will require innovation in hybrid power and fiber solutions suited for weatherized outdoor environments. These environments require solutions capable of meeting strict space constraints, as well as suited to operate in dusty, sparsely maintained, non-temperature-regulated conditions.

Some edge deployments will be housed in micro data centers. This could be edge being deployed as one or two servers, as a rack colocated in an existing on-premise data center, or as a mini data center enclosure which could be up to a single rack. In industrial edge deployments, you may have a single edge device running workloads—at an oil rig, for example. Given the harsh environments, this setup would need to be constructed to withstand extreme conditions such as high or low temperatures, corrosive humidity, extreme weather or excessive dust and dirt. Alternatively, in a retail or entertainment venue setting the requirements are totally different. There you have limited space to be able to install an enclosure for the edge node and would need equipment that can be hidden away from view as much as possible.

The passive optical infrastructure solutions here need to be flexible and support dense, high-performance compute outside of the traditional data center in a range of diverse environments.

It is highly probable that the definition and scope of edge may never reach a true conclusion. It will likely only continue to morph as new use cases emerge and technical advancements further push the realm of possibilities. Recent innovations, such as hollow-core fiber to further mitigate latency or multi-core fiber technology which enables significant increases in the number of parallel optical fiber cores without increasing cable size, show great promise to address requirements at the edge in the future.

As we move forward, understanding how passive optical infrastructure enables a hyperconnected digital fabric at the edge, will be paramount to unlocking new potential.

Sources:
1 *Nokia Bell Labs Institute | Optical research: Why we break world records | by Theodore Sizer | Mar 16 2020*

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