



Strategies For More Environmentally Friendly Networks

Abstract

Focusing on using sustainable technologies with minimal environmental impact is a strategy giving many companies a competitive edge. Consumers consider green technologies an important factor that influences their decision-making processes and fortunately for network installers and internet providers, there are a variety of methods of building and upgrading networks that are both good for the environment as well as the bottom line. Here we examine the benefits of fiber over other signal carrying technologies and provide insights on how to build the greenest fiber networks you can and reduce fiber counts.

Introduction

Traffic on the network infrastructure, in the United States and the world, is growing exponentially. In order to meet the increased subscriber demand and to support high-bandwidth emerging technologies such as the faster and denser 5G deployments, Multiple System Operators (MSOs, as they are called) are looking to enhance network capacity while holding or reducing capital expenditures (CapEx) and operating expenditures (OpEx).

This challenge is even greater now that consumers and end-users are increasingly conscious of the environmental impact products and services have. In prior years, “going green” was considered an additional expense that often relied on substantial government subsidies and incentives. However, analyzing the real costs of the more environmentally friendly solutions often reveals hidden benefits and market advantage over competitors who have made less effort to consider environmental implications.

Fiber Versus Coax Or Direct Attach Copper (DAC)

Direct Attach Copper (DAC) solutions for datacenters, along with DSL, twisted pair, and coaxial internet solutions rely on copper conductors to carry signals long, medium, and short distances. Copper interconnect technologies have been around for many decades and are a well-established mature technology. Even though there are places for conductor-based transceivers in a modern eco-network, copper always starts at a deficit because, at its core, it is not an environmentally friendly technology. The huge negative impact copper mining has on the local environment makes relying on transport beyond within the same rack somewhat undesirable. DACs are an energy efficient solution for short interconnects, but still rely on mined materials. For connections between racks, rows, or rooms, Active Optical Cables (AOCs) are a great combination of low energy consumption, flexibility, and reduced reliance on mined materials. And they cost less than paired transceivers with a fiber jumper connecting them!

Copper Mining Meets The Environment = No Bueno

Like many mining operations, copper mining leads to the destruction of the local surface environment and ecosystem as a result of digging operations and the necessities of operating heavy equipment. Of course, copper must be mined where it is found, which can be in extremely delicate ecosystems or near water sources that may travel hundreds of miles. In a 2010 news feature, Corning stated, "Industry data indicates that the mining required to provide two kilograms of copper wire (roughly the amount you'd need for a 200-foot length of Cat6 cable) translates into about 1,000 kilograms of environmental impact. The creation of that same length of fiber requires only about .06 of a kilogram of environmental impact."



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Water pollution is a serious problem with copper mining, as the byproducts and runoff from the mining process are toxic to both plant and animal life. Moreover, copper mining and copper processing release Sulfur Dioxide into the atmosphere, resulting in acid rain events that can range hundreds of miles away from the actual mining location. This causes habitat destruction and damage to farms, buildings, and drinking water supplies.

Compare that with the primary raw material of fiber optic cabling. Fiber is mostly silicon dioxide with trace amounts of other glasses and crystalline materials such as germanium tetrachloride and phosphorus oxychloride which are used to manufacture core fibers and cable claddings. The acquisition and manufacture of fiber optic cabling exhibits a fraction of the environmental impact of copper mining and copper cable manufacture. Starting off from a more sustainable point, along with greater energy efficiency over time, makes fiber topics a much more environmentally friendly choice than copper interconnect.

Fiber Tops Copper In Energy Efficiency & Operating Costs

A variety of studies and organizations have concluded that fiber optic interconnect outperforms copper interconnect technologies from an environmental perspective in many scenarios. These cases include transoceanic/submarine cable systems, in-building/inter-building networking, datacenter, and long-haul applications [1, 2, 3, 4, 5]. One of the main reasons for this is that fiber optics are more energy efficient per bit and have higher bandwidth per length than copper or coaxial solutions. The upfront benefit of this is that, for the same bandwidth and link length, fiber networks can be deployed that only use a fraction of the electronics, materials, and energy that a copper-based network would require.

Fiber-based Datacenter Rack System



Copper-based Datacenter Rack System

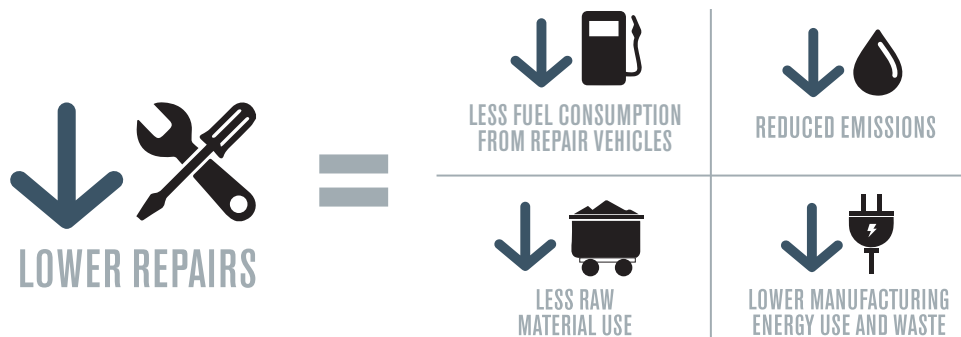


Fiber's Resilience & Reliability Is A Sustainability Win

Even beyond the direct environmental impacts of manufacturing, raw material acquisition, and operation, there are other sustainability benefits that fiber has over other networking interconnects. The main area of benefit is the reliability factor of the interconnect and networking hardware. Fiber optic interconnect tends to be far more resilient to environmental disturbances such as wind, rain, and electromagnetic interference than copper-based interconnect. For instance, a lightning strike near copper cabling can often result in damage to the cabling, the upstream, and the downstream electronics. In the case of fiber spans, which aren't electrically conductive, the cabling doesn't pick up or transfer electromagnetic interference (EMI) or other electrical disturbance, such as electromagnetic pulse (EMP), thus eliminating this failure mode.

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Combining the electromagnetic and electrical immunity with fiber optics higher environmental resilience, fiber optic installations have up to a 50 percent lower rate of repairs required when compared to copper networks. Fewer repairs result in less fuel consumption from repair vehicles, less repair vehicle emissions, less raw material use, and lower manufacturing energy use and waste [4]. Fiber optic interconnect repairs are up to 67% quicker than comparable copper or coaxial interconnect repairs. This not only leads to better customer satisfaction, but also fewer maintenance resources, and hence environmental impact.



Reducing Fiber Count

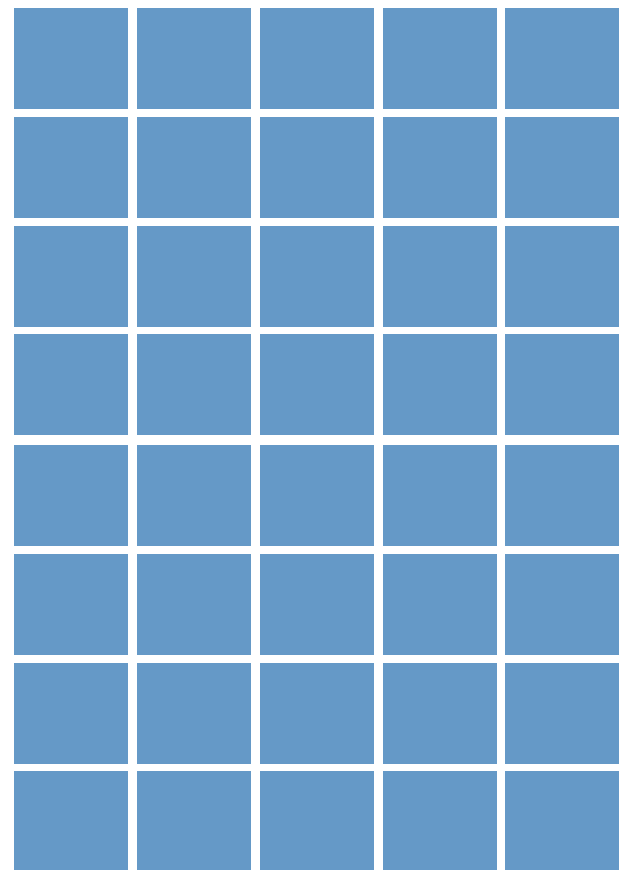
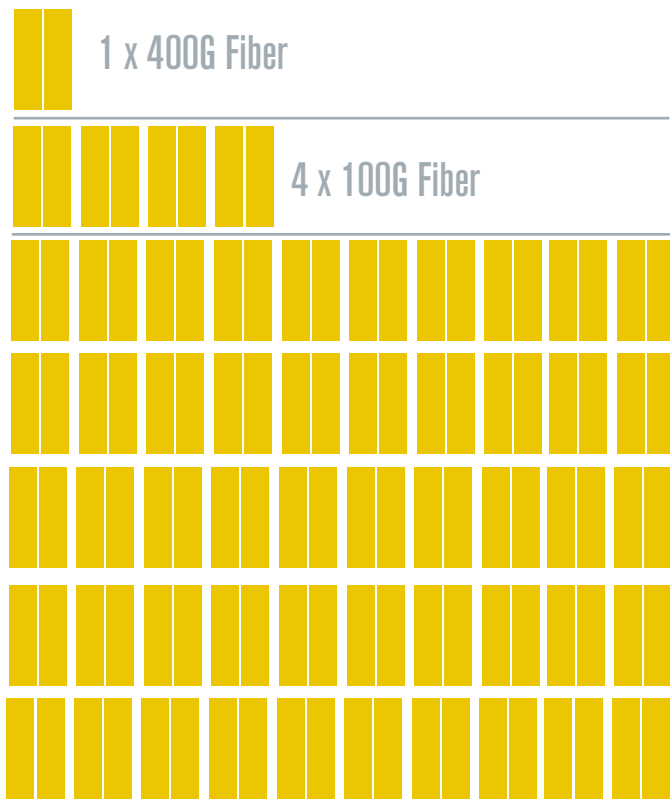
It is no surprise that reducing the number of cables in the ground and strung on poles, and the necessary installation process would also reduce the environmental impact of installing a network. In dense urban areas, a smaller fiber optic cable count would lead to much lower costs and expedite deployments. For long-distance transmission and for interconnections between urban areas and datacenters, a lower fiber cable count means less demand on the environment in the path of the network infrastructure. Because fiberoptic transmissions are not subject to interfering with each other the way that conductive technologies are, core counts for the same space are much higher due to reduced shielding requirements. This gives fiber a distinct edge.

5G networks are all about speed and densification. To support these networks, both the fronthaul and backhaul infrastructure requires substantial upgrades. This will lead to further adoption of 400G interfaces in provider networks to support the traffic demands from applications that require lower latency and higher data rates than legacy networks can provide.

Machine learning systems, commonly referred to as artificial intelligence (AI), and the Internet of Things (IOT) necessitate faster connections (lower latency), more bandwidth (higher data rates), and more connections. Higher density fiber cabling can dramatically reduce connections between racks and systems within the datacenter. Using higher throughput fiber technology also guards against early obsolescence and the cost of discarding old slower systems as waste.

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Fiber networks can be further optimized by increasing the capacity of the current fiber installations by using multiple signals traveling on individual fibers [7]. The use of passive optical filters allows for much more traffic on existing infrastructure. The best part is that CWDM and DWDM channels often can operate alongside the legacy optical traffic. In the case of PON deployments, the newer standards and revisions allow for coexisting with the earlier versions on the same fiber. That means that FTTx designs usually have a path to network upgrades without the cost and environmental impact of provisioning new fiber.



40 x 10G Fiber

40 x 10G Cat6e

Tips for Building A Greener Fiber Network

In this section, we will discuss these benefits and also provide some insights into how to leverage them for a greener network.

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Reliability Mitigates Environmental Impact

Vulnerability to environmental damage, corrosion, and wear all limit the lifespan of copper interconnect component to a fraction of what is commonly seen with fiber optic interconnects. But amongst fiber components there are also significant variations in reliability across different OEMs and third-party suppliers. Selecting the right source for your job's components is also key to staying green (and in the black) because sometimes inexpensive parts won't have the longevity and performance you need. And even high-quality parts that are pushed past their specified operating temperature ranges for operation and storage can fail in-service unexpectedly. Purchasing components multiple times over due to failures is not all that green.

A high failure rate not only burdens the operations team in charge of ensuring uptime, but also leads to higher environmental impact through the use of maintenance crews and the manufacture of replacement components. One environmental and OpEx-friendly approach is to use optical components capable of strategically exceeding industry standards and that exhibit better dependability under stress. Integra Optics' application engineers have observed 3rd party advantage while doing side-by-side comparisons with some OEM optical components. Using the highest standards in supply chain and manufacturing Integra's optical components match or outperform the OEMs [8].

Interoperability Reduces Environmental Impact

A technology we mentioned before that is growing in popularity is Dense Wavelength Division Multiplexing (DWDM). Multiple signals are combined and sent over fiber optic cores using passive filters to be split again when they reach their destination. DWDM implementations are tailored to the network demands in order to reliably get your data where you need it. Using multiple channels per fiber is an efficient use of fiber that enables MSOs to offer more advanced services and benefit subscribers by granting higher bandwidths and more responsive networks. All with less environmental impact than offering these services while employing legacy technologies.

The availability of recodable and tunable DWDM optical transceivers provide a significant benefit as well. Recodable transceivers allow technicians and installers to customize parts for multiple platforms. Each platform completely understands and accepts the part coded for it. This reduces inventory complexity by giving you one transceiver that can be coded for 80 platforms instead of stocking 80 different transceivers.

Tunable DWDM transceivers afford further customization as you no longer need to stock transceivers for individual channels. One tunable can fill the role of any of the fixed channel DWDM transceivers, so from site to site and job to job, inventory and sparing is simple and efficient. This reduces operational expenses along with the associated environmental impact and electronic waste of redundant stock.

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Integra takes this consideration to the next level with interoperable hardware and software solutions for optimum flexibility and efficiency when installing, maintaining, or upgrading fiber networks. Integra's fiber optic transceivers are designed to be readily recoded to over 80 OEM formats with the easy to use and convenient suite of Smart Coder products. The Integra Smart Coder can be used with the Integra Tuner software allowing for transceiver tuning without an internet connection for parts that utilize the MSA tuning mechanisms. This saves network installation and repair resources in remote areas or during outages.



Conclusion

The networks of the future need not only be faster, but they also need to be greener. Well planned fiber networks built on reliable components dramatically reduce environmental impact compared to using legacy copper and less modern fiber technology. Integra Optics offers extremely reliable, high performing, and flexible solutions that make building a green fiber network both environmentally and friendly to your budget.

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