

LTE/4G wireless backhaul with no strings attached

by Ira Palti, President and CEO, Ceragon Networks Ltd.

The growth of mobile networks depends significantly upon the backhaul structure that relays the traffic between the local radio base stations and the core network. As data traffic grows, the need for backhaul grows, requiring more base stations and faster links. Most backhaul relies upon either fibre or microwave links - each with its own advantages and disadvantages. Microwave is easier, less expensive and faster to deploy in many situations, but there are situations where fibre is a better long-term investment.



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As mobile technology evolves, the demand for advanced services grows apace, straining existing cellular networks.

As the need for mobile network data capacity grows, so does the need for additional backhaul to connect mobile radio base stations to the core network. Deciding on which mobile backhaul technology to deploy is a complicated task. The two major mobile backhaul contenders are fibre and microwave. Which, then, is better for mobile networks, and when, where and why?

The basic rule of thumb is - if you can 'hit fibre' within 200 meters (~600feet) and if there are no regulatory issues that prohibit you from connecting to that fibre - then fibre should be your preferred alternative. In almost all other scenarios, high-capacity microwave is simply much more cost-efficient.

Capacity, deployment and endurance

Next generation mobile access networks, such as HSPA/HSPA+, LTE and WiMAX,

generate huge amounts of data traffic. A perfect world with endless funds would have given operators the opportunity to deploy fibre optic cables anywhere and everywhere they desired throughout the entire backhaul network. Unfortunately, funds are not always easily available and digging trenches in city streets or over hilly terrain is a costly challenge. Luckily, high-capacity LTE/4G-ready microwave solutions fit the bill in terms of capacity, long-term cost-effectiveness and system agility.

When considering whether and when to use a fibre or microwave backhaul infrastructure, there are several items to take into account:

- cost-effectiveness;
- terrain;
- regulations;
- distance;
- deployment Time;
- reuse options;
- climate; and
- network requirements at any given point.

Cost estimates for each of the two backhaul alternatives, as shown below in Tables 1 and 2, show that fibre optic trenching costs are highly influenced by population density (i.e. rural, metropolitan and urban), terrain and regulation. These costs include the needed infrastructure, renovation construction works and right-of-way per meter of trench and fibre.

Fiber Optic Lines		
Ethernet Switch or TDM multiplexer		\$2,500
Trenching Costs [\$ per meter] Including infrastructures renovation construction works and right-of-way	Rural	\$30
	Metropolitan	\$90
	Urban	\$130
Fiber Costs [\$ per meter] Including fiber, connectors, fusions and tests		\$7

Table-1: Trenching fibre optic costs. Source - Wireline operator

In comparison to fibre optic trenching, the costs of setting up a microwave backhaul link, according to industry average, are shown below in Table 2. The figures include equipment and installation costs, antenna, license fees and annual maintenance costs.

Wireless Point-to-Point Microwave Link Costs	
Equipment (including equipment cost)	\$14,000
Installation costs (antenna, cabling)	\$20,000
Maintenance costs (including license fee)	\$40,000
Fixed wire element of the cellular line (cost for wireless backhaul)	\$10,000
Total Full Microwave Link (including maintenance)	\$84,000
Total Full Microwave Link (including license fee)	\$94,000
Total Fixed Element (Long Haul) Microwave Link (including maintenance)	\$94,000

Table 2: Wireless point-to-point microwave link costs

Terrain and regulations

The regulations of laying fibre optics and deploying microwave backhuls vary from place to place.

As illustrated in Table 1, fibre costs and trenching costs are expensive when considering population density. Physical trenching takes time and involves clearing a variety of regulatory issues such as right-of-ways, post-deployment renovation works and physical access to the trenching path.

Microwave does not need trenches for system deployment, there is no cable maintenance and physical access to the base stations is usually relatively easy. Microwave only needs spectrum and line-of-sight between the two end-points. Microwave is suitable for any terrain, be it hilly or plateau, and works over both long and short distances.

The business case for microwave rests on its ease of deployment and greater range, performance and agility. Low operating expense makes microwave more cost-effective in the long run and offsets the initial capital expenditure.

Distance and deployment

In greenfield¹ base-station deployment scenarios - when new towers need to be erected for point-to-point microwave, fibre optics are more cost-effective over short distances. However, in urban environments, tower set-up is typically not required as antennas can be mounted on rooftops and existing towers. In this case, the microwave option becomes far more attractive even at a very short distance.

In rural environments microwave becomes more cost-effective at around 1.6 Km

(~1mile) when tower set-up costs are involved - although even here, when new towers are not required, microwave is more attractive almost from the start.

At distances above 2.5Km (~1.7 miles) self-owned fibre becomes so expensive, that even a protected trunk solution becomes more cost effective.

Figure 1 illustrates the comparison of the various mobile backhaul scenarios versus the increasing distance from the cell-site to the aggregation site.

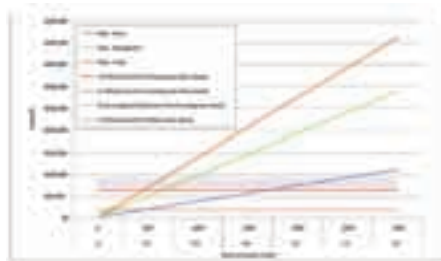


Figure 1: Microwave and fibre backhaul solutions vs. Distance

Since there are no right-of-ways questions to deal with and little infrastructure to deploy, microwave links can be set-up in a matter of hours, whereas fibre can take months because of seeking to seek approval and gain digging licenses, meet regional regulations and implement post-cable deployment renovation works.

Reuse options and climate

Getting the best out of technology and ensuring its durability and reliability are important factors to take into account when choosing a technology.

Reusing microwave equipment is simply a matter of disassembling and relocating it. This can be done in a matter of hours with no regulatory fees or approvals needed.

The weather is not something we can control, but Adaptive Coding and Modulation (ACM) and proper advance link planning can easily reduce the impact of climate upon microwave backhaul. Fibre cables, buried underground, are normally not affected by the climate, but they are subject to floods and manmade power-cuts (digs, neighbouring infrastructure maintenance, etc.)

Network requirements

At the end of the day, there's no one-size-fits-all backhaul technology. Network

lateral thinking, namely, getting the most out of the backhaul solution that best suits specific demands in each segment, can save operators significant time and expenses.

Reaching this golden equilibrium requires deep network know-how and experience in planning and installing complex backhaul networks. Some vendors of wireless backhaul equipment offer systems as part of a 'solutions combo'. However, LTE/4G microwave backhaul network specialists, with teams of seasoned professionals trained in designing and optimizing microwave 'clouds', can offer true cost-optimized deployment solutions. Establishing the right mix between wireless and wireline, high and low capacity, while providing the right management umbrella, allows operators to maximize their network resources while reducing both capital and operating expenditures.

The end game for mobile operators is to have a healthy mix of fibre and microwave in their backhaul network. Deciding on which technology to choose and when to choose it, will depend on a variety of issues including: economics, geography, regulation and more.

Though fibre-based networks can easily support the rapid growth in bandwidth demands, at distances greater than a few hundred meters, fibre is costly and takes longer to deploy than microwave. In most cases, return-on-investment (ROI) for fibre installations are long term, making it hard for operators to achieve lower costs per bit and earn profits in the foreseeable future.

Wireless microwave backhaul solutions, on the other hand, are capable of delivering high bandwidth, carrier-grade Ethernet and TDM services. Microwave is suitable for all capacities up to several Gbps over a single link and may be scaled up to multiple Gbps using aggregated (so called N+1/N+N) link techniques. Unlike fibre, wireless solutions can be set up quickly and are much more cost-effective on a per-bit basis from day one.

Wireless microwave solutions offer a versatile backhaul option for both short and long-haul deployments. At distances over several hundred meters, Microwave offers a much better cost-per-bit ratio than fibre, without compromising on availability or reliability. ●

¹ A greenfield project is one which lacks any constraints imposed by prior networks.