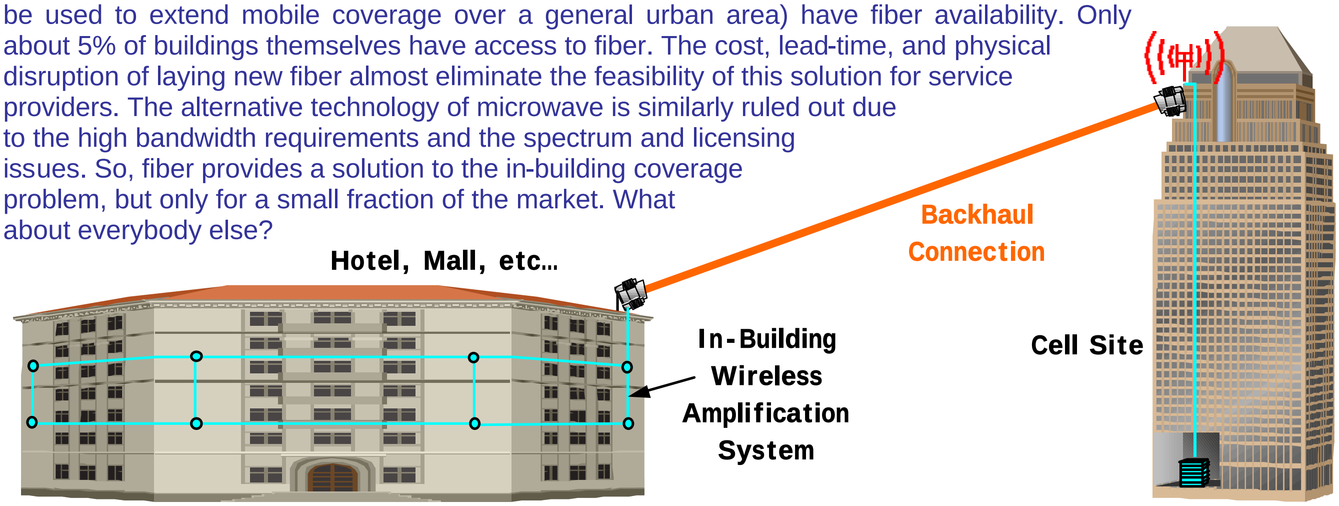
Application Note – In-Building Cell Site Extension

Wireless cellular service is no longer a luxury but a requirement for a steadily growing number of people. Malls, hotels, and other public structures want and need to offer service, and yet it is precisely these places that have the worst coverage. Wouldn't it be nice if mobile service let you be more…well… mobile?

Getting Coverage Where You Need It

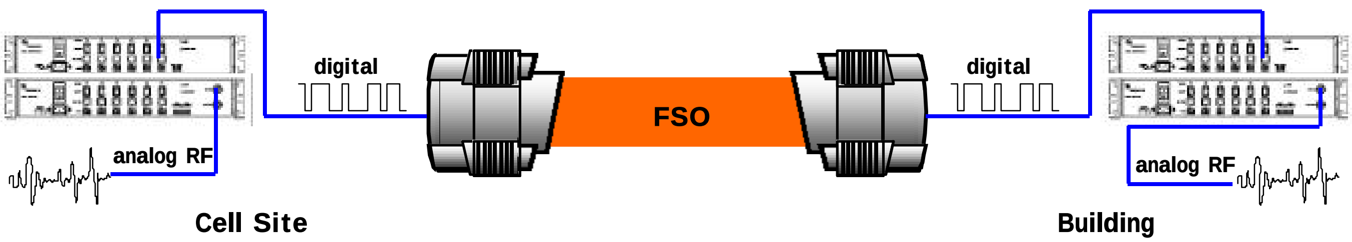
The growing demand for mobile wireless service is driving service providers to expand networks at an unprecedented pace. However, as urban areas become more densely populated, it is becoming increasingly difficult for network coverage to reach every user. There are many areas such as tunnels, indoor stadiums, and elevators where coverage is of poor quality or does not exist at all. It is precisely these areas that hold the largest number of potential subscribers, making it crucial not only to extend coverage but capacity as well. Simply adding cell sites to an existing network is neither practical nor economical. Each new cell site requires a significant amount of time and money to set up. Real estate and zoning laws make it difficult, and sometimes impossible, to put a cell site in the desired location.

A specific and important subset of this problem involves the extension of mobile service to specific buildings. Certain structures, for example malls, warehouses, or underground parking structures, may desire complete wireless coverage. In this case, a backhaul connection is made between the cell site and that building. This in turn is connected to an in-building amplification/repeater system that distributes wireless coverage throughout the building. Until recently, the only technologically feasible choice for this backhaul connection was optical fiber. Only fiber could handle the high bandwidth required to supply the building with sufficient coverage and Quality of Service (QoS). The problem is that the current fiber infrastructure does reach much further into urban areas than the mobile network itself. It is estimated that only 25% of the desired remote antenna locations (which may be used to extend mobile coverage over a general urban area) have fiber availability. Only about 5% of buildings themselves have access to fiber. The cost, lead-time, and physical disruption of laying new fiber almost eliminate the feasibility of this solution for service providers. The alternative technology of microwave is similarly ruled out due to the high bandwidth requirements and the spectrum and licensing issues. So, fiber provides a solution to the in-building coverage problem, but only for a small fraction of the market. What about everybody else?



FSO ➔ Coverage ➔ Revenue: Making the Connection

Free-space optics (FSO) offers a new, robust, and economical solution to the cell-site extension problem. FSO is capable of the same capacity and performance as optical fiber – including 1.5 Gbps and more of throughput in each direction simultaneously. It accomplishes this without all the disruption involved in laying fiber. Municipal and zoning approvals are not required, and neither are the associated waiting periods. This translates into much more than added convenience: capital expenditures can be reduced by as much as 80% compared to the creation of a new cell site. Also, because FSO operates in an unlicensed part of the spectrum, the lack of licensing fees reduces operating expenditures. Even more savings are realized by virtue of the fact that an FSO link can be deployed in a matter of hours, as opposed to months. This gives the service provider the flexibility to respond instantaneously to changing real estate and market demands.



The SONAbeam/Digivance Combination

The phenomenal benefits of FSO for this application are made possible by the digital RF technology developed by ADC. ADC's Digivance™ converts 25 MHz of RF spectrum into a 1.482 Gbps digital bitstream, allowing it to be transported over a free-space optical link. One Digivance™ at the cell site digitizes the RF signal. The digital signal is then carried over the FSO link to the building, where a second Digivance™ converts the signal back into analog RF. At this point, the in-building amplification system can take the analog signal and distribute wireless connectivity throughout the building.

Because of the all-digital transport, and because the RF and optical transmissions are completely decoupled, there is no signal degradation due to optical attenuation, and the signal can be re-amplified at the building without any increase in noise. Consequently, unlike typical analog RF repeater systems, the dynamic range and signal quality are virtually unaffected by the distance between the cell site and the building. Higher-power amplifiers can be used without increasing noise, resulting in higher capacity in the building.

The SONAbeam™ 1250-M and 1250-S are ideally suited for this application. Both are capable of operating at full-duplex bandwidths up to 1.5 Gbps, and the SONAbeam's exceptionally high link margin allows for longer link ranges and higher availability than any other FSO system on the market. fSONA's commitment to carrier-class quality and performance ensure that no trade-offs or compromises need be made for the sake of added coverage.

fSONA's SONAbeam™ and ADC's Digivance™: two winning technologies that complement each other perfectly. Together, they offer the only truly economically feasible solution for in-building cell site extension.

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