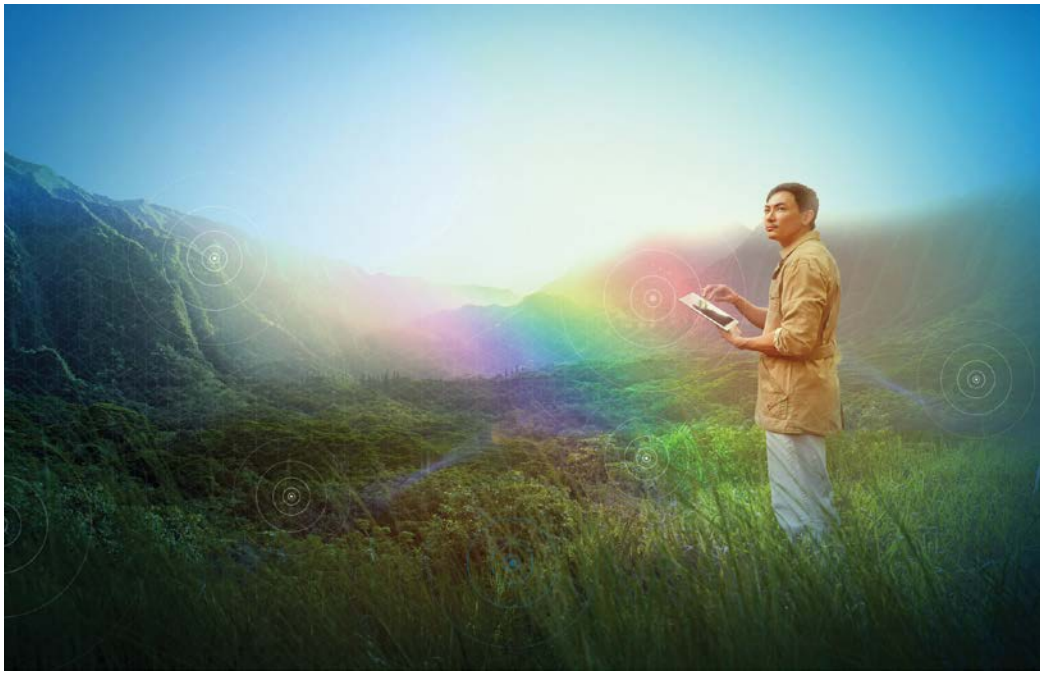
Prevention, adoption, migration: the three pillars of better spectrum efficiency

Optimizing spectrum efficiency is a big priority for wireless operators because it's so difficult and expensive to purchase more. Fortunately, there are a number of ways an operator can squeeze more performance, more capacity and more revenue from the spectrum already available. Together, these measures can be combined to help operators create a holistic, integrated strategy that is greater than the sum of its parts. They are:

1. **PREVENTION**
   of interference that can compromise network efficiency
2. **ADOPTION**
   of emerging network densification practices and small cell technologies
3. **MIGRATION**
   to new architectures and standards, such as carrier aggregation and band-width-multiplying MIMO

CommScope's decades of innovation and experience in each of these approaches means we can bring powerful solutions to bear in support of a more spectrally-efficient network.



1. Prevention: mitigating interference

It's everywhere and it's expensive. Internal and external interference can sap performance and force increased power use, particularly for LTE networks and their heightened vulnerability to interference. It's critical to mitigate any interference sources at a site, particularly PIM. Here are some good ways to do it, and the solutions that can make it easier to accomplish.

- **Interference analysis.** Examine the transmit and receive frequencies in use at the site for any that create interference or PIM.
- **Equipment selection.** Purchase 100 percent PIM-tested equipment and avoid combining parts from multiple or low-quality manufacturers. Also consider CommScope's interference mitigation filters (IMFs), which screen out interference at the antenna—suppressing unwanted frequencies while allowing the desired signals to freely pass through.
- **RF planning.** Some level of cell boundary overlap interference is necessary for LTE, but needs to be minimized as much as possible. Advanced site features like remote electrical tilt (RET), sector sculpting and low-side lobe microwave antenna patterns can greatly reduce adjacent or co-sited sector interference.

2. Adoption: densifying infrastructure

Operators can also magnify spectrum efficiency through network densification—a set of practices and architectures designed to divide and conquer the big problem of limited spectrum in a specific geographic area.

- **Small cell and DAS.** Adding more cells is one way to increase spectral efficiency. Small cell solutions like CommScope's Metro Cell and distributed antenna systems (DAS) like the ION®-U and ION-E solutions can be deployed in densely-populated urban areas, including indoor spaces the macro network can't reliably penetrate.
- **Sector splitting.** The practice of increasing capacity by splitting a sector into multiple cells with multibeam antennas allows a site to carry more traffic without interference. CommScope's six-sector solution is a highly efficient turnkey example of multibeam technology. CommScope even offers a solution that provides up to 18 beams from a single antenna.
- **4.3-10 connector ecosystem.** Spectrum efficiency demands more antennas, requiring more low-PIM connections in a limited space. CommScope's complete line of 4.3-10 equipped solutions allows more connection stability in tight spaces, plus forward-compatibility with soon-to-be-released spectrum. The consistent dynamic PIM performance of the 4.3-10 series interface offers enhanced network performance with less reliance on installation torque.

3. Migration: multiplying efficiency by multiplying antennas

Multiple-input, multiple-output (MIMO) antenna technology, in its traditional 2x2 deployment, can theoretically double cell capacity by doubling antennas and using parallel signals to add a second "lane" to the user link on the same spectrum. The wireless industry is going beyond this, migrating to 4x2 and 4x4 MIMO, which stands to potentially double again the amount of traffic an operator can move within given spectrum. And it won't end there—experts foresee virtually unlimited scale MIMO using hundreds or even thousands of antennas over a wide area. But, in the meantime, here's what you can do to take advantage today.

- **Multiport antennas.** Multiple inputs/outputs allow a single antenna to integrate multiple antennas simultaneously within the same package, allowing one antenna to perform the work of two or more.
- **Multiband combiners.** Antennas can be shared by combining multiple radios into a single RF path at the antenna feeder, multiplying equipment utilization.
- **Beam forming.** To better cover changing, dynamic network demand, beam forming allows a MIMO configuration to adapt to changing conditions and focus in areas of increased demand while reducing interference elsewhere.
- **Carrier aggregation.** Due to the fragmented nature of spectrum allocation, it's possible for a wireless operator to combine several separate LTE carriers to increase peak user data rates and overall capacity.

Spectrum efficiency is more than good science—it's good business

The bottom line for operators is that every bit and byte is money in the bank, but limited access to spectrum can put serious constraints on earning that revenue. Widening the pipe you already have is the only practical way to address this challenge, through prevention, adoption and migration. More spectrum will come on the market eventually, but business lives in the world of today—and, with CommScope on your side, you have the tools and talent you need to make business-critical efficiency moves right now.

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