Distributed Antenna Systems (DAS) Cable Choices

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Distributed antenna systems (DAS) are used in a wide variety of public areas to bring wireless service to areas with poor coverage. Some of these areas include: buildings, node installations in towns, underground tunnels, etc. Typically, a large single antenna radiating at high power would provide coverage, but in DAS installations they are replaced with a series of low power antennas to cover the same area as they are safer and more robust. The most expensive and time consuming stage of the DAS process is the installation, routing the coaxial cables around the antennas can be labor intensive. Having the right coaxial cables for the assembly makes the installation a much less strenuous a task. Necessary key features include, but are not limited to: high flexibility, stability in highly dynamic environments, low loss, plenum rated, and good passive intermodulation (PIM) performance.

Plenum Rated
DAS have to leverage cables that are properly fireproofed, as the cables are typically routed through "plenum spaces". A plenum space is an area of a building that allows for forced air circulation, for example, an air conditioning system above a dropped ceiling in an office building will normally have its own airflow at a higher atmospheric pressure. This separate air flow can provide more oxygen to a flame, thus allowing a pathway for fire to travel faster through a building. Plenum rated cables leverage fireproof plastic jackets, such as teflon, to reduce smoke regularity to weaken the toxicity levels of the smoke. This has little to do with the electrical performance of a coaxial cable but is necessary in heating, ventilation, and air-condition (HVAC) environments.

Performance in Dynamic Environments
The cable stability of DAS coaxial cables in dynamic environments can also affect the electrical performance. There are a few standard characteristics that determine the quality of the cable including the flexibility, minimum bend radius, temperature test, vibration tests, etc. The minimum bend radius is a measurement of the level of bending that can be performed on a coaxial cable without kinking the center conductor, causing deformities in the dielectric, and degrading the electrical performance of the cable. DAS installations often require cables to bend and fit into tight mechanical spaces and it is important to be able to route the cables while maintaining low loss. In highly dynamic environments with a range of temperatures or high vibration, the materials used in the cable and the build will yield an acceptable cable performance for a particular DAS installation.

Passive Intermodulation (PIM) Performance
Passive intermodulation distortion is a common complication in DAS, as PIM occurs wherever there are nonlinearities in the passive components of an installation. These nonlinearities are a product of the undesired mixing of two or more signals in a passive component. This generates spurious signals that can cause a drop in signal integrity for the overall system. PIM in DAS can lead to poor communication in phone calls, dropped calls, and a decrease in data rates.

Common PIM sources include the intersection of different metals, coaxial connectors, dirty connections, loose or tight connections, ferromagnetic metals, and vibration in the environment. A junction of dissimilar metals can cause galvanic corrosion--a corrosion caused by self-induced

currents due to the electrical potential between the metals--this nonlinearity in the signal flow creates PIM. Connectors that are torqued too tight, or even too loose, can have an effect on PIM performance that will have an undesired effect in the signal chain. Ferromagnetic metals such as iron or nickel may stay magnetized when a signal runs through these materials, this is know as magnetic hysteresis and is often a source of PIM. Even vibrations in the environment of a DAS installation, such as rain or wind, will cause PIM in the antenna and cables.

To mitigate the effects of PIM it is important to eliminate the common causes of PIM, this naturally boils down to leveraging only coaxial cables with excellent PIM performance. Pushing two dissimilar metals with higher pressure will create a more uniform mating surface between the metals, thus allowing for a better signal flow. Avoiding ferromagnetic materials in cabling will avoid any magnetic hysteresis. An overall well-engineered cable with the right choice of materials and proper build can make a large difference in the PIM performance of the coax.