Distributed Antenna Systems (DAS)

Application Guidelines

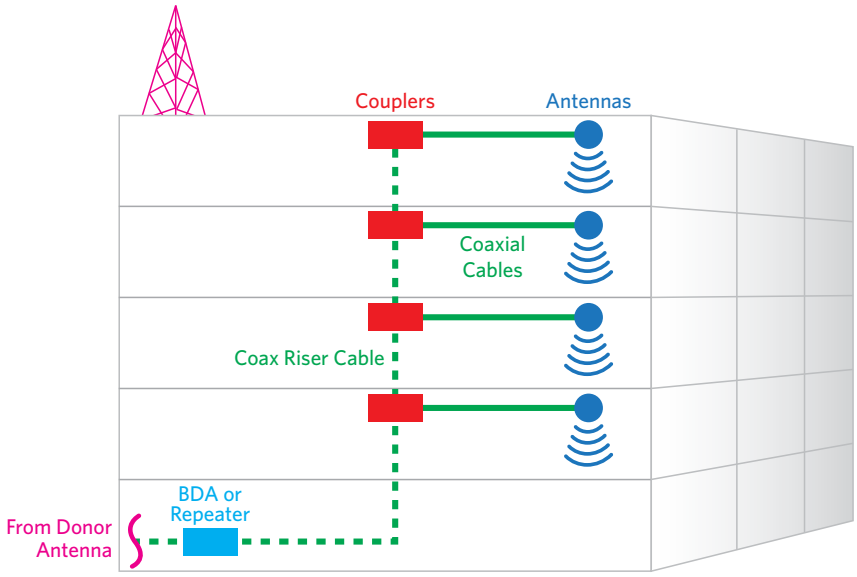
A Distributed Antenna System (DAS) is an extension of the wireless network that provides added coverage and/or capacity within a geographic area or structure. DAS is employed in structures such as commercial buildings and underground facilities that tend to inhibit external radio frequency (RF) signals, as well as high-capacity venues such as stadiums that require more bandwidth than what is provided by the standard, local wireless access points.

DAS consists of a network of spatially separated antenna nodes connected to a common source via a transport medium. The system splits the transmitted power among several antenna elements, which are separated in space, yet provide coverage over the same area as a single antenna with reduced total power and improved reliability. Antennas may also be strategically located to eliminate dead zones in areas such as elevator shafts where steel, concrete, or other barriers interfere with or block wireless service.

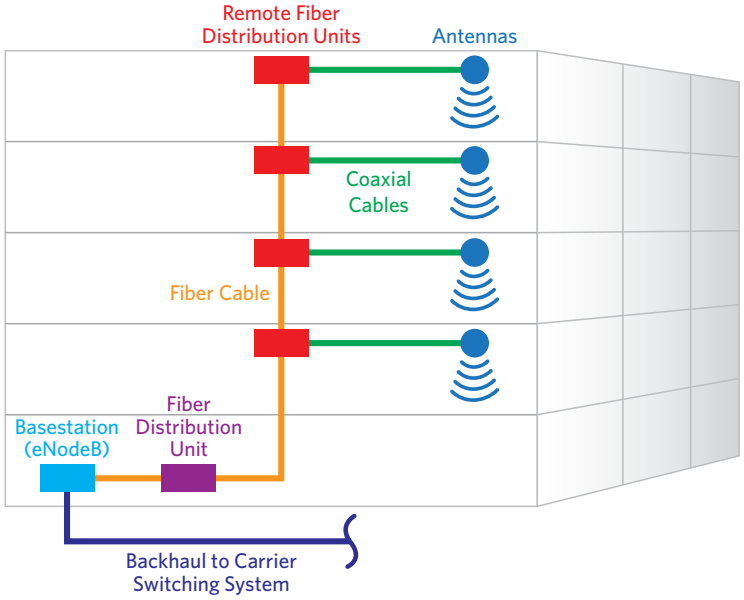
System Types

DAS is commonly divided into three broad categories: Passive, Active, and Hybrid.

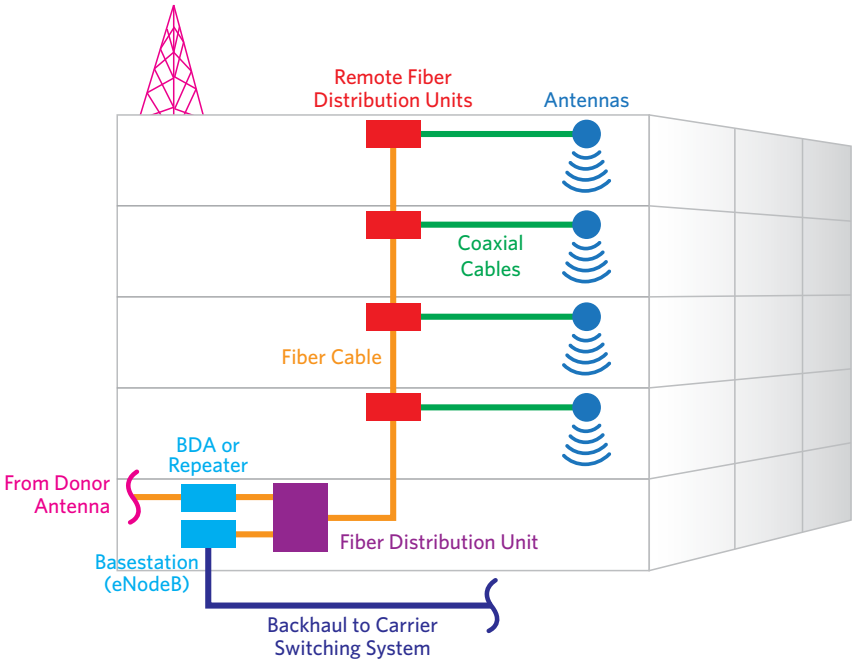
- A **Passive DAS** is a true extension of an adjacent wireless network such as a local wireless carrier. The Radio Frequency (RF) signal is typically obtained from an off-air repeater/signal booster. There is no active control of RF signals beyond the initial amplification of the donor signal. A network of 50 Ohm Coax, couplers and splitters is used to carry the RF signal to/from the distributed antennas.



- An **Active DAS** is characterized by a main hub that converts the RF signal into an optical signal, which is distributed to remotes via optical fiber. Remotes may convert the signal back to RF for distribution to antennas, or the signals may convert to intermediate frequencies for distribution over CAT 5e/6 to access points. An Active DAS is scalable and can support multiple bands or service. For example: cellular, PCS, and public safety.



- A **Hybrid DAS** is characterized by multiple Passive systems that are fed by a single Passive DAS via fiber-fed remote units (RF amplifiers). A Hybrid DAS extends the footprint of Passive DAS and is typically utilized in large footprint applications.



Ownership Models

Several system ownership models have been developed to fund, deploy, and operate DAS installations. The most common scenarios are:

- **Carrier** – Funded and operated by a wireless carrier. These are typically single carrier, but can be a consortium.
- **Neutral Host** – Funded and operated by independent 3rd parties that are DAS aggregators. Owner leases space back to multiple carriers.
- **Venue Owner** – Funded by the venue owner. Typically deployed and operated by a DAS integrator/contractor, although carrier(s)/3rd parties may partially fund. Network designs can be built for single or multiple carriers.

System Design

DAS by nature is implemented to solve coverage and/or capacity issues. Accordingly, DAS design is not as simple as picking a convenient spot for an antenna and connecting cable to the source. The use of an experienced DAS designer is highly recommended. iBwave is the modeling application used to predict RF coverage and design the DAS system.

DAS Components

Cables

For more information, visit: **superioressexcommunications.com/products/communications/wireless/in-building-cable-and-jumpers/**.

CABLES							
Part Number	Size	Ohm	Description	Dielectric	Jacket	Listing	Application
LHF-12DR	½"	50	Low Loss, High Flexible, Copper Corrugated Coax	Foam	Black, flame retardant PE	CMR	Minimum attenuation for longs runs
LHF-12DPV	½"	50	Low Loss, High Flexible, Copper Corrugated Coax	Air	White, PVDF	CMP	
HFSC-12DR	½"	50	Super Flexible, Copper Corrugated Coax	Foam	Black, flame retardant PE	CMR	Jumpers and tight spaces requiring low bend radius
HFSC-12DP	½"	50	Super Flexible, Copper Corrugated Coax	Air	White, PVDF	CMP	
HFAC-12DR	½"	50	Low Loss, High Flexible, Aluminum Corrugated Coax	Foam	Black, flame retardant PE	CMR	Cost and weight savings
HFAC-12DPV	½"	50	Low Loss, High Flexible, Aluminum Corrugated Coax	Air	White, PVDF	CMP	

Connectors

DAS cables are typically terminated with type "N" connectors which are available in straight and right-angle configurations. Connectors must be matched with cable type (HFSC, LHF, HFAC) as well as fire resistance rating (CMR or CMP). Use of improper connectors will likely result in poor performance.

For more infomation, visit: **superioressexcommunications.com/products/communications/wireless/in-building-connectors/**.

Installation Practices

DAS components are designed with installation in mind. There are certain limitations that must be respected during installation. For cable, the four most critical characteristics to remain mindful of are pulling force, bend radius, crush resistance, and temperature rating. These characteristics vary among cable types, sizes, and even manufacturers. It is critical for the designer and installer to be familiar with these criteria before the installation process begins.

INSTALLATION PRACTICES

Cable Type	Minimum Bend Radius in (mm)	Maximum Pulling Force lbs (kg)	Operating Temperature °F (°C)
HFSC-12DR	1.26 (32)	143 (65)	-22 to +167 (-30 to +75)
LHF-12DR	4.90 (125)	249 (113)	-22 to +167 (-30 to +75)
HFAC-12DR	4.90 (125)	174 (79)	-22 to +167 (-30 to +75)
HFSC-12DP	1.26 (32)	143 (65)	-4 to +167 (-20 to +75)
LHF-12DP	4.90 (125)	249 (113)	-4 to +167 (-20 to +75)
HFAC-12DP	4.90 (125)	174 (79)	-4 to +167 (-20 to +75)
CMR Jumper	1.38 (35)	n/a	-22 to +167 (-30 to +75)
CMP Jumper	1.38 (35)	n/a	-4 to +167 (-20 to +75)

Crush Resistance

Crush resistance is an important attribute, which is easily quantifiable in a test laboratory, yet difficult to predict in an installation environment. Among cable applications, RF transmission is particularly susceptible to cable damage. They best rule of thumb is to avoid actions, routes, guides, mounting devices, etc. that deform the shape of the jacket and/or outer conductor.

Cable Preparation and Termination

Cable preparation and termination are critical for optimal performance of a DAS installation. Procedures are specific to cable type. Detailed PDF instructions are available on our web site in the Technical Guidelines area: **superioressexcommunications.com/resources/technical-guidelines/**. Instructional videos are also available: **superioressexcommunications.com/resources/videos/**.

Passive Intermodulation (PIM)

Passive Intermodulation (PIM) is the noise generated by TX signals carried by the DAS interacting with non-linear characteristics of the RF path (components, connections, environment).

Installers must be familiar with PIM and the causes of PIM. PIM sources include loose RF connectors, poorly prepared RF terminations, improperly mated and misaligned parts, and metal chips or shavings inside connectors. Careful attention must be paid during the cable prep and connector termination in order to mitigate the negative effects of PIM.

New carrier defined maximum PIM is -153 dBc measured using 2x20W tone. PIM test each individual cable run as it is installed. It is easier to identify the source then waiting until the entire network is in.