



In-Building Wireless Solutions

Passive Distributed Antenna Systems



INDOOR

KATHREIN

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Who we are and what we stand for

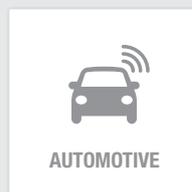
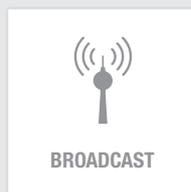
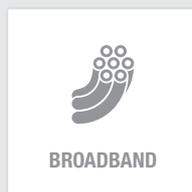
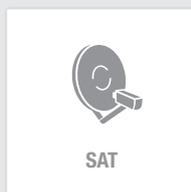
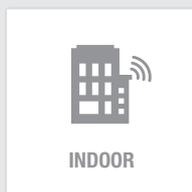
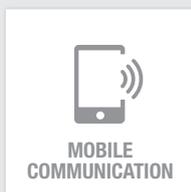
Kathrein is a leading international specialist for reliable, high-quality communication technologies.

We are an innovation and technology leader in today's connected world. Our ability to provide solutions and systems enables people all over the world to communicate, access information and use media, whether at home, at the office or on the road. We cover a broad spectrum:

from outdoor and indoor mobile communication solutions, to satellite reception, broadband and broadcast technology, to transmission and reception systems in vehicles.

As a hidden champion and family-owned enterprise, we have been working on the technologies of tomorrow since 1919. We take pride in our dedicated employees and our passion for customers and quality.

Our Solutions



Find out more about us at www.kathrein.com

A woman with dark hair tied back, wearing a blue denim jacket over a white and black striped shirt, is smiling and looking at her smartphone. She is standing in a modern, brightly lit indoor space, possibly a shopping mall or office lobby, with blurred background elements like columns and lights. A red square with a white arrow pointing right is in the top left corner of the image area.

Passive Distributed Antenna Systems

With increasing data traffic and the need for mobile access any time and anywhere, additional availability of mobile networks in indoor environments is indispensable. The network coverage supplied by macro sites is not sufficient to overcome the high penetration losses due to the used façade material of most buildings resulting in poor indoor coverage. To overcome this, distributed antenna systems (DAS) are numerously installed in typical indoor venues like shopping malls, hotels, transportation, hospitals etc.

Today, everyone is talking about active DAS, allowing flexible capacity adaption and easy network modification. Depending on the size of the venue and the specific application, it is still often a more cost effective solution to use a passive DAS. Although passive DAS are relatively unflexible to retroactive changes in the system setup, the clear advantages are the simple design, low material costs, low maintenance efforts, high reliability and easy coverage deployment. Hence in venues without significant change in requirements over time the use of a passive DAS may often be reasonable.

According to an ABI research study from January 2016, the size of the in-building wireless market is predicted to more than double in revenue by 2020. These numbers reflect the importance of in-building systems in the future and show the indispensability of indoor DAS installations.

With more than 3 million sold indoor products and more than 20 years of experience in passive indoor systems, Kathrein is a trustable partner for future investments in the indoor sector. Not only do we supply high quality products for DAS but we also provide complete installation and planning services.

Functional Layers of a Passive DAS

In a passive DAS, all components which are used for the distribution of the source signals throughout the indoor location are passive devices. A passive indoor system consists of 4 main levels:

1. Signal source

The signal supply for the indoor system can be fed into the building in different ways:

- a. Donor antenna + repeater
- b. Standard base station (BTS)
- c. Baseband unit (BBU) plus Remote Radio Head (RRH)

2. Combiner (Point of Interface, POI)

The different source signals and different frequencies are interconnected to a common interface

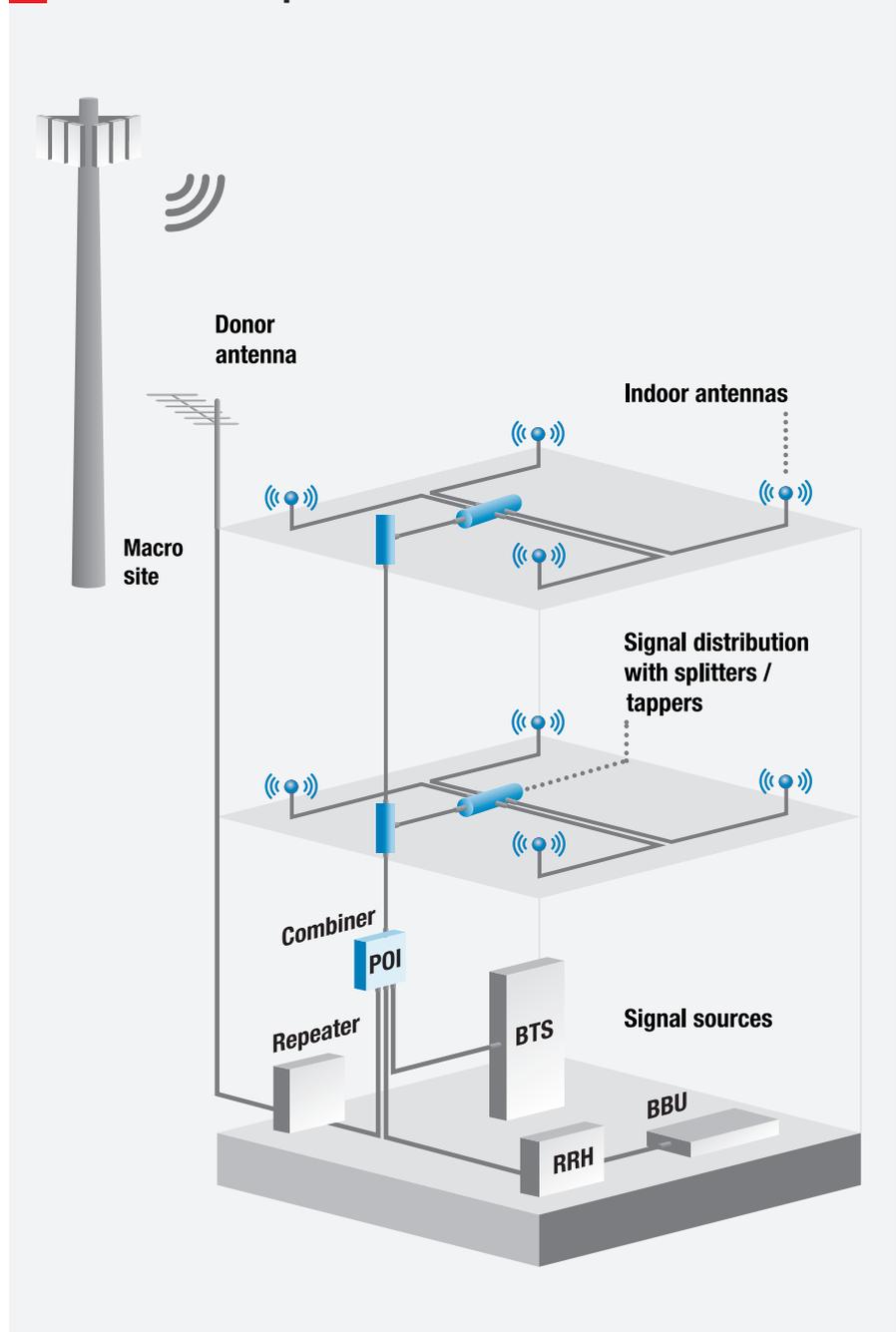
3. Signal distribution

Electrical accessories like splitters and tappers are used to achieve the correct signal level on the different antennas

4. Indoor antennas

Multi-band antennas are used for the distribution of the signal in the building

> Structure of a passive DAS



Combiner (POI)

Frequently, passive DAS are multi-operator, multi-band applications. In order to connect multiple operators/bands to one common mobile network, the use of combiner systems is essential.

Standard multi-band combiners offer the possibility to interconnect different bands to one single multi-band application. With a huge range of more than 100 products, Kathrein offers the highest variety to choose the required band combination:

- Dual-/Triple-/Quad-Band
- 50 MHz – 2700 MHz

For combinations in the same frequency range, same-band or hybrid combiners can be used.

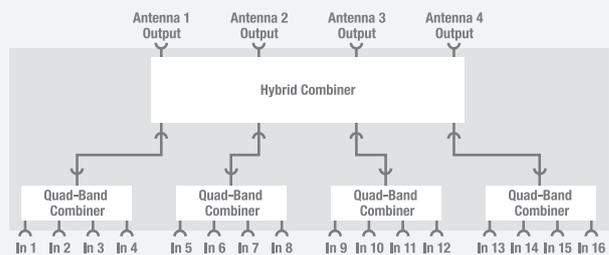
Besides standard combiner products, Kathrein's hybrid combiner systems offer the possibility to interconnect multiple operators to one single indoor system. These hybrid combiner systems merge multi-operator, multi-band inputs to a fixed number of outputs (e.g. 4). The different solutions can flexibly be adapted to different frequency needs.

- Different coupling ratios with e.g. 8, 12 or 16 inputs and 4 outputs
- Up to 4 operators / 4 different frequencies

In addition, Kathrein provides customised combiner solutions in 19" cabinets for dedicated network scenarios. The systems can be adapted to different frequency ranges and system requirements.



16:4 Hybrid combiner system



Block diagram of a 16:4 hybrid combiner system

Signal Distribution

In order to distribute the sum of signals to the different floors/ spots, the correct split of the signals is essential. The signals may need to be split up equally or unequally to achieve the correct signal level at the antenna.

Splitters provide the possibility to equally split up the input signal:

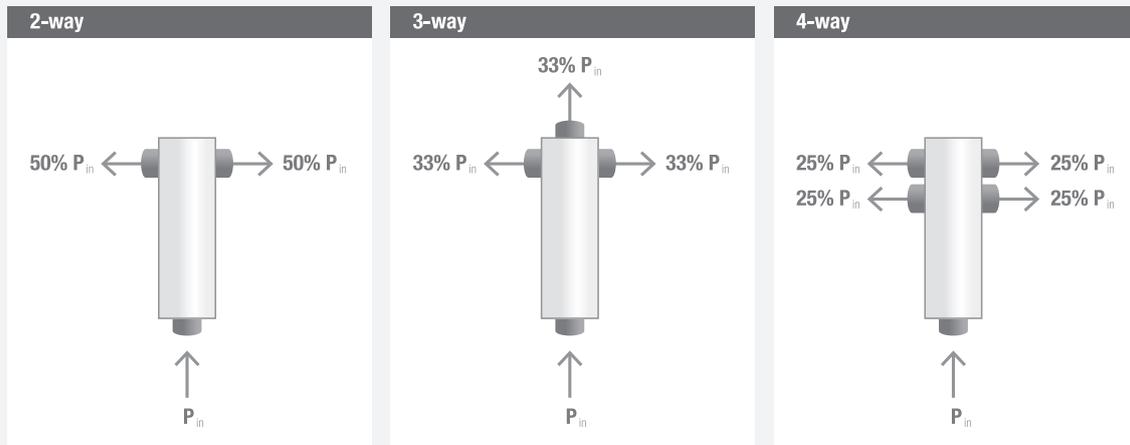
- 2, 3 or 4 output ports
- 380-3800 MHz

Tappers can split up the input signal with unequal distribution at the output ports:

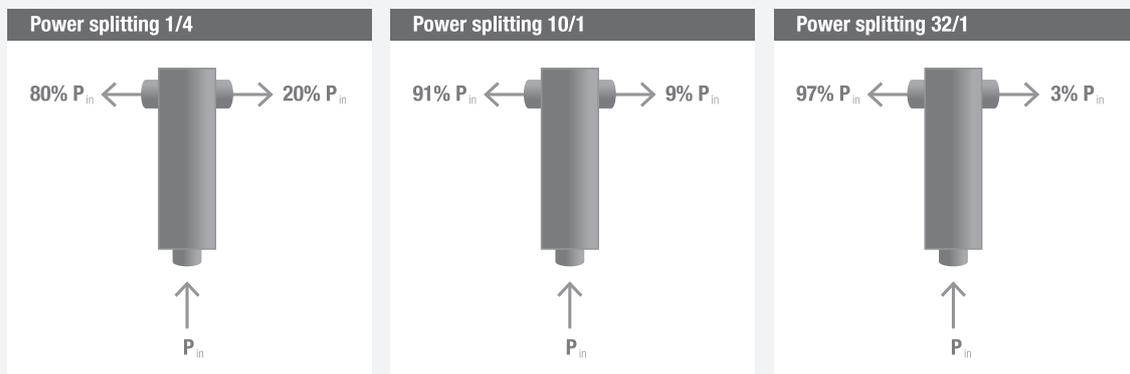
- 2 output ports
- Different splitting ratios
- Adjustable versions available
- 380-5920 MHz

> Example of different power distributions for splitters and tappers

Splitters



Tappers



The choice of the correct device depends on the architecture of the building and the needed signal distribution. An example of the RF power split with Kathrein electrical accessories is given on page 8.

Indoor Antennas



In indoor applications, the antennas are the only elements in the whole systems which are in most cases visible. Thus, it is essential that the visual impact is kept to a minimum. The unobtrusive broadband design of Kathrein indoor antennas makes them highly versatile for a wide range of applications:

- Frequency ranges of 370 – 470 MHz/694 – 6000 MHz
- Ceiling or wall mounting
- Omnidirectional or directional
- MIMO capability

The choice of antennas is normally performed depending on the coverage and installation requirements for the building. Clear trends can be observed towards complete integration of

the antennas into intermediate floors and suspended ceilings as well as towards partial integration of the antennas, e.g. in the ceiling. One example of a partially integrated Kathrein indoor antenna is shown in the picture above.

If the system shall support MIMO, it is recommendable to use special MIMO antennas with 2 polarisations instead of using 2 single antennas which would need to be separated in space and provoke a higher visual impact. During the planning phase, it is important to include potentially needed MIMO setups beforehand in order to provide the correct cabling – for MIMO, double cabling may be needed.

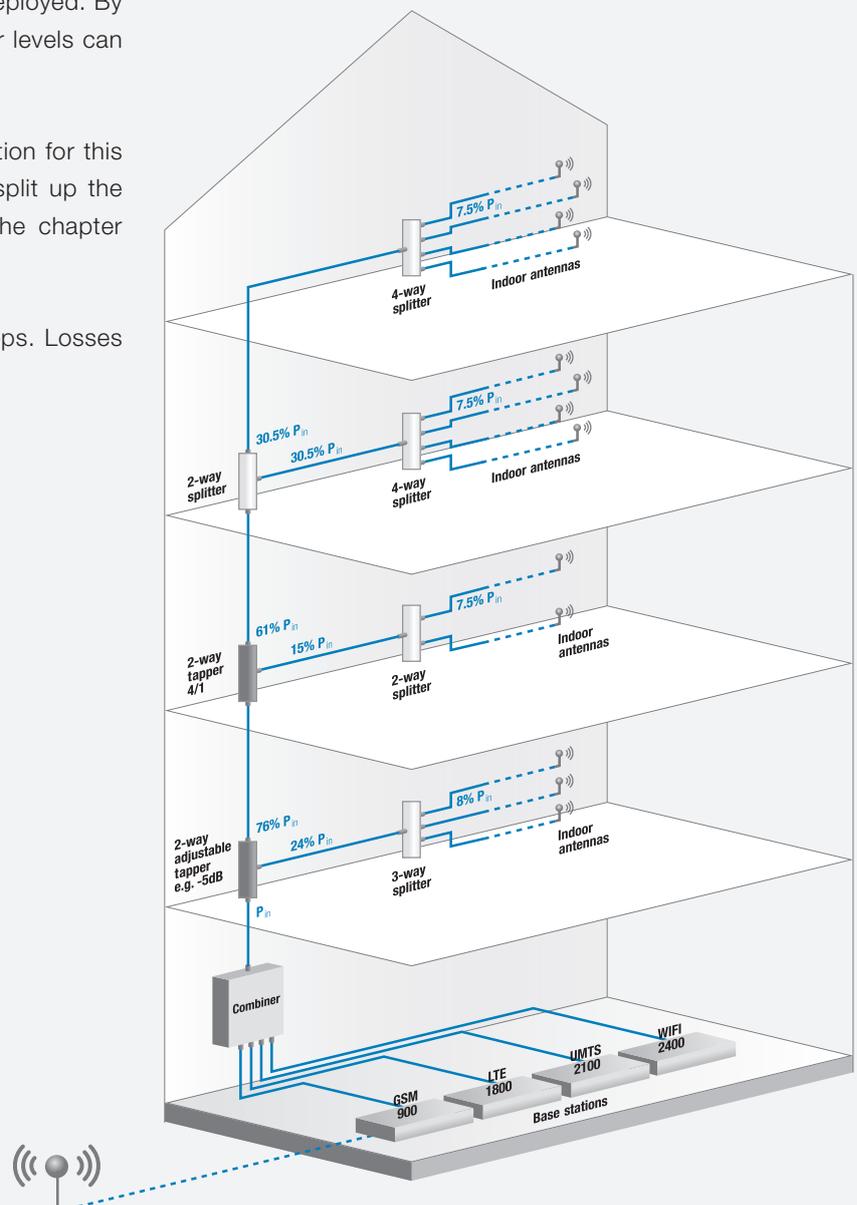
Signal Distribution in a Passive DAS

> Calculation example

In order to achieve a similar RF power distribution on each floor of a 4-storied building, different splitter and taper versions can be deployed. By choosing different devices, the power levels can be adapted accordingly.

The below picture shows the calculation for this scenario. The splitters and tappers split up the power with the ratios indicated in the chapter “Signal Distribution”.

The values are rounded to 0.5 % steps. Losses are not included in the calculation.



Kathrein Services for Passive DAS

Kathrein offers a variety of support services during the complete lifecycle of passive DAS projects. The broad experience of a long-experienced innovation and technology leader and the dedication of a motivated and committed team are uniquely combined within Kathrein services. Our highly experienced team in the Kathrein headquarters in Rosenheim and the service hub in Bucarest together with our local sales partners are the basis for our support unit.

Top quality is a synonym for Kathrein products and this quality also guides our implementation of Kathrein services. We help to realise passive DAS projects with the benefit and reliability for which Kathrein is known in the market.

We focus on our customers' needs – our support is available for single tasks as well as complete projects. We perform the service works so that our customers can concentrate on their main tasks.

The following services are provided:

Planning services

Support during the initial setup and all further upgrades like additions of technologies, network operators and technologies. We offer the whole range of planning from the scratch and initial walk tests up to the detailed CAD plans.

Implementation services

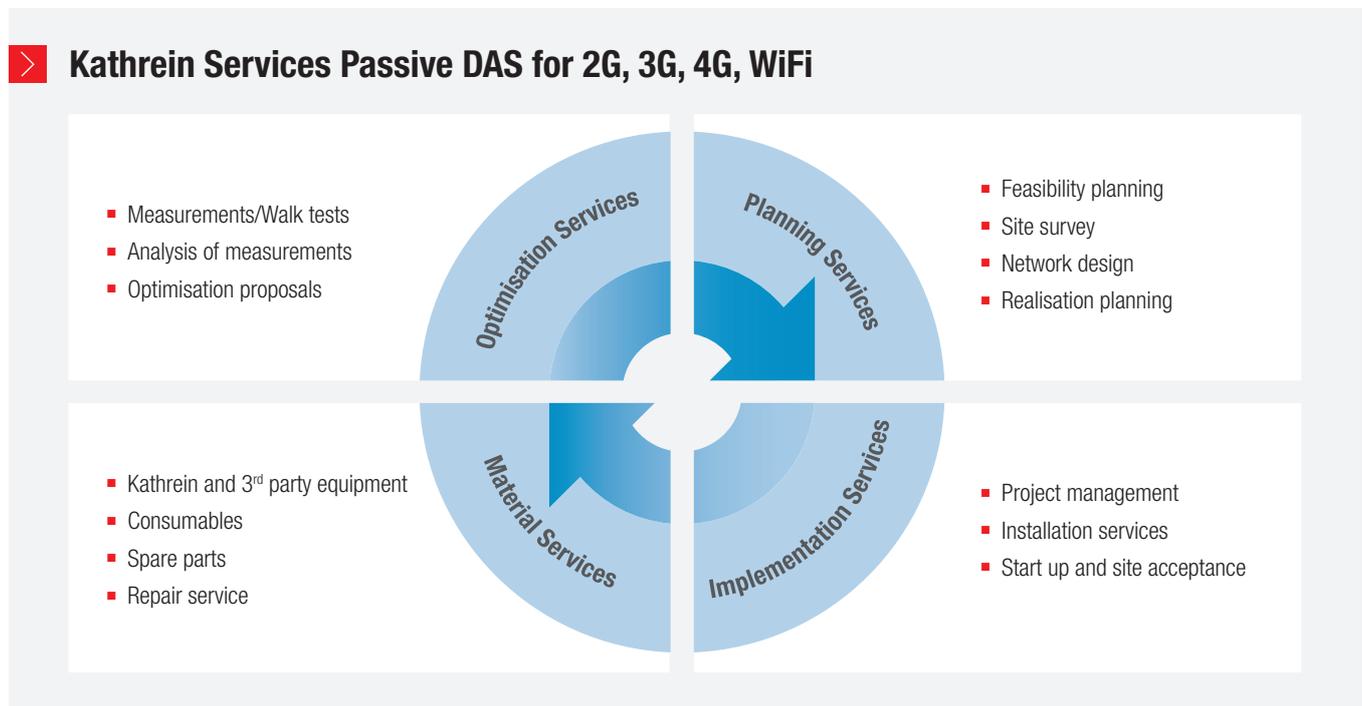
Local customer care for each implementation step. We have a qualified team of local Kathrein branches and partners who support over the whole project lifecycle. An experienced project management team takes care that everything is in place on time.

Material services

Delivery of all material turn-key and on time. We make all the logistics and maintain the spare part chain.

Optimisation services

Providing the quality which mobile users expect. We perform and analyse site surveys and walk test and present optimisation proposals which are in compliance with the planning objectives. In case of troubles in the field, we send our local team on-site to evaluate the system performance and suggest next steps.



Examples of Successfully Installed Passive DAS



Passenger ferry



Donor antenna on the ferry's deck



Kathrein indoor antenna on the passenger deck

> **Indoor Coverage on Passenger Ships in Greece**

Greece has over 1,400 islands, 227 of which are inhabited. Millions of passengers use passenger ships for their transportation around the islands. Travel time may vary from 30 minutes to 12 hours. Therefore, mobile operators wish to provide mobile signal coverage within the ships. Initiated by the mobile operators Cosmote, Vodafone Greece and WIND, Greece's passenger ferries have been equipped with passive DAS. Kathrein's sales partner MorteK has been selected for this job due to their expertise in DAS installation, their special knowledge about installations in ships and the superior quality of Kathrein indoor products. MorteK has already successfully installed passive DAS in more than 100 passenger ferries throughout Greece. The radio coverage within the ships is provided by installing a dual band repeater, donor antennas and the relevant DAS. Depending on the needed coverage scenarios, the planning is individually performed for each deck splitting up the power levels with splitters or tappers accordingly. The average quantities of the mobile communication equipment per ferry are:

- 1 donor antenna
- 15 service antennas
- 10 splitters
- 10 tappers

With these sophisticated project solutions, mobile coverage is provided on the complete ships. The whole system is made available by one supplier only which eases the installation complexity and minimises the administration efforts.

Indoor DAS in Greece

Country	Greece
Facility	Passenger ships
Operator	Cosmote, Vodafone Greece, WIND
Year of Installation	Since 2010
Kathrein Sales Partner	MorteK

> Indoor DAS for the Romanian Operator RCS & RDS

Romanian operator RCS & RDS knows that mobile access in indoor environment is a crucial topic. In Kathrein's Romanian subsidiary, Romkatel, they found a trusted and reliable partner to build up indoor DAS (Distributed Antenna System) in a variety of buildings, from the design phase, over full material delivery, up to the implementation services. During the last year, Romkatel professionally and successfully implemented more than 70 passive DAS in shopping malls, supermarkets and office buildings on behalf of RCS & RDS. In total, 700 Kathrein indoor antennas, 300 splitters and 350 tappers were installed for the RCS & RDS single-operator projects. Typical antennas in these installations were e.g. bidirectional antennas, wall-mounted directional antennas and ceiling mounted omni-antennas. The reliability of Kathrein indoor products, the 100% availability and know-how of the Romkatel design and implementation team were key factors for RCS & RDS in their supplier selection process. With Romkatel as a partner and its complex portfolio of materials and services, including iBwave design, successful turnkey projects are a guarantee.

Indoor DAS in Romania	
Country	Romania
Facility	Shopping malls, super markets, office buildings
Operator	RCS & RDS
Year of Installation	2015 – present
Kathrein Sales Partner	Romkatel



Shopping mall equipped with Kathrein antennas

> Indoor Passive DAS in Mauritius

When Mauritius Telecom was searching for a supplier to provide reliable mobile network coverage in public buildings, they chose Kathrein's African sales partner Kathrein Africa Ltd. as their supplier. The key for this choice was Kathrein Africa's professionalism and long-term experience in RF. During 2015, Kathrein Africa successfully completed passive DAS for Mauritius Telecom in the following buildings:

1. Nexteracom Office Building 1 – 14 floors, 103 antennas, 14 tappers, 55 splitters
2. Nexteracom Office Building 2 – 13 floors, 86 antennas, 13 tappers, 51 splitters
3. Nexteracom Office Building 3 – 8 floors, 57 antennas, 6 tappers, 30 splitters
4. Citadelle Shopping Mall – 22 floors, 134 antennas, 17 tappers, 66 splitters

With these projects, the requirement of mobile connectivity was fulfilled in the buildings. As a complete solution supplier, Kathrein Africa Ltd. guided this project from planning to installation towards its success.

Indoor DAS in Mauritius	
Country	Mauritius
Facility	Office buildings, shopping mall
Operator	Mauritius Telecom
Year of Installation	2015
Kathrein Sales Partner	Kathrein Africa Ltd.



Lobby of Nexteracom office building with Kathrein antennas

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