

K-BOW
BRIDGE THE GAP



Micro C-RAN Capacity Solution

Indoor Mobile Broadband



INDOOR

KATHREIN

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Who we are and what we stand for

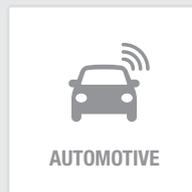
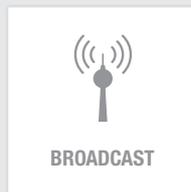
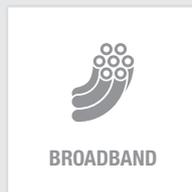
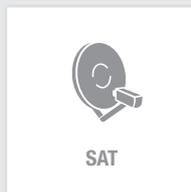
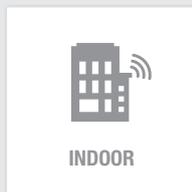
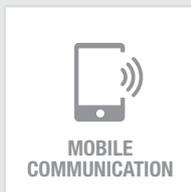
Kathrein is a leading international specialist for reliable, high-quality communication technologies.

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



K-BOW

BRIDGE THE GAP



Kathrein Micro C-RAN and Indoor Mobile Broadband Solution



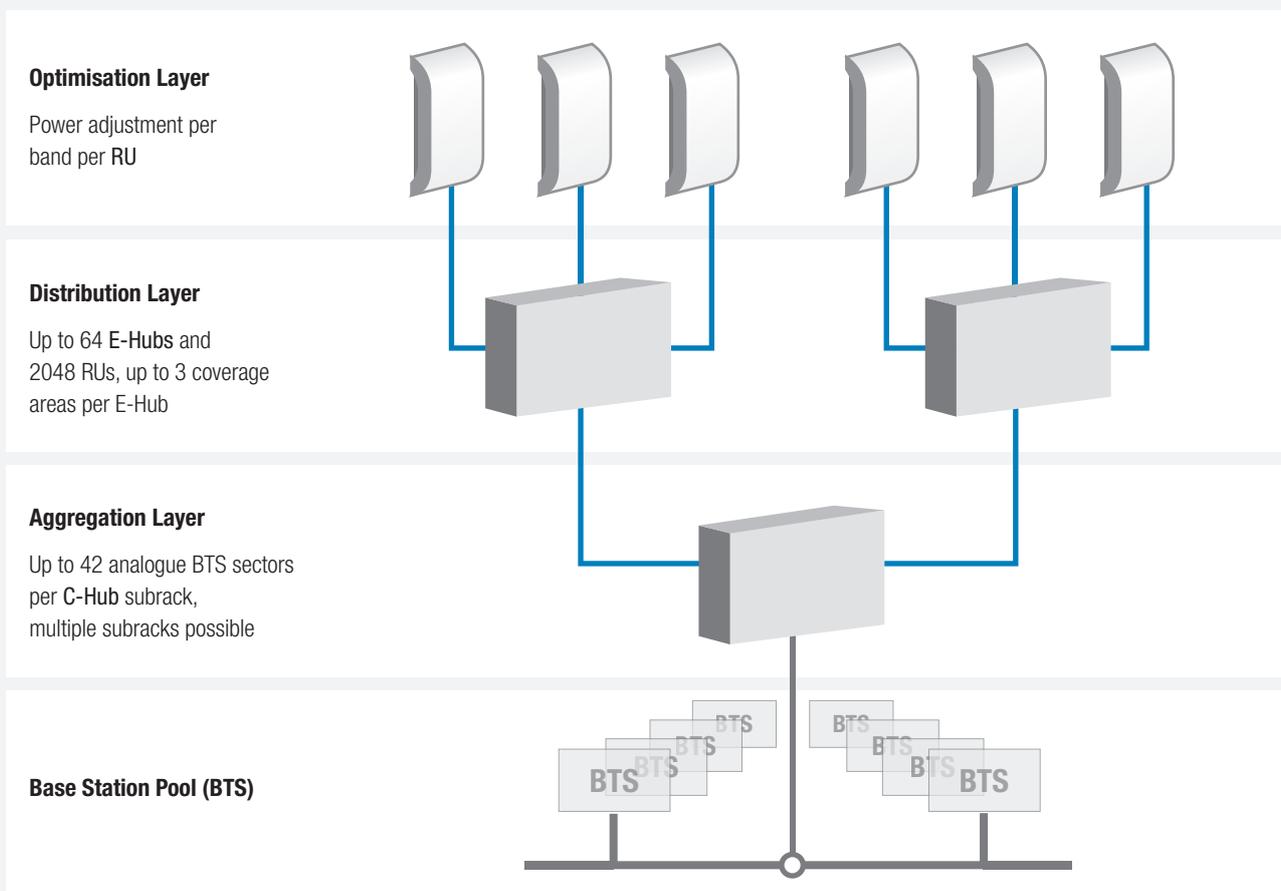
Honoured by the IF Industrial Design Award 2015 and the German Design Award 2016

With K-BOW, Kathrein enters a new dimension in in-house mobile broadband. By combining the synergies and experience available from the areas of highly efficient antennas, RF signal processing and power amplification technology, Kathrein is providing a future-proof solution for the challenges of today and tomorrow.

- K-BOW is a Micro C-RAN system which makes use of a centralised base station pool. It transforms an indoor mobile communication environment into a flexible multi-operator, multi-band and multi-standard network.
- K-BOW provides flexible signal distribution and routing over all supported frequency bands and technologies, thereby enabling an optimal capacity distribution within the very dense traffic areas of the network.
- K-BOW deployments are future-proof. The Kathrein system is technology independent and includes MIMO capability from day one. LTE-A features are transparently supported. The system is expandable in live operation. No additional cabling is required.
- K-BOW is designed with a minimum requirement on installation efforts. Install, connect, commission: no lengthy configuration and calibration – one time visit.

K-BOW Functional Layers

> **The K-BOW System Consists of the Following Nodes, Which Can Be Placed in a Physically Separated Way:**



The layers of the K-BOW solution:

Aggregation (Central Hub), distribution (Expansion Hub) and sectorisation on RU level

— Optical connection
— Coax connection



C-HUB



E-HUB



Connect RU

Compact RU

Aggregation Layer

The Central Hub (C-Hub)

At the C-Hub, MNO base stations are connected to the K-BOW via standardised analogue interfaces. The band selective front end modules support three input ports per band and are available for multiple frequency bands. This variety of units provides the flexibility for operators to equip the C-Hub just with the bands to be used in the K-BOW system. Since the full spectrum of each band is supported, the C-Hub is ready to connect multiple operators as well as MIMO-capable Base Transceiver Stations (BTS). The C-Hub transforms the signals into a digital data stream. On the digital domain, the K-BOW system can access, condition and route every single sub-band within the K-BOW system. Via configuration, the desired signal mix is aggregated and forwarded in the system.

Distribution Layer

The Expansion Hub (E-Hub)

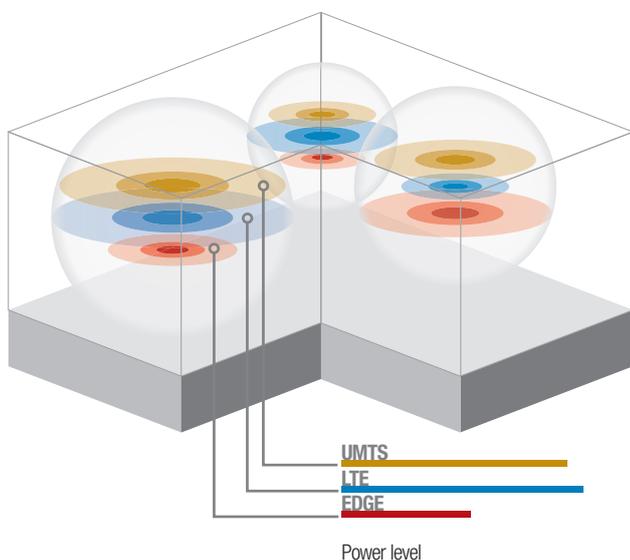
The digital signal covering a mobile bandwidth of 240 MHz spectrum per 10 Gbps optical link is forwarded to the E-Hub. The digital link allows distances of up to 20 km. Depending on the routing flexibility in a system, between 8 and 64 E-Hubs can be connected to the C-Hub layer. At the E-Hub, the signals are converted to analogue signals and then allocated to up to three sectors. This allocation can be changed remotely via the node manager or standardised SNMP integration to a legacy MNO OSS system.

Optimisation Layer

The Remote Unit (RU)

Each RU is equipped with band selective transceivers and LTE MIMO transceivers. The K-BOW RUs also provide transparent IP connectivity with a throughput of up to 700 Mbps, which can be used for a sensor network, a small cell or WiFi access points. The K-BOW RUs are available as wall-mounted versions with integrated broadband antennas and also as a hidden ceiling-mounted version with an external antenna. Since each band is controlled separately, the output power per band can be adjusted according to the respective situation. This provides entirely new options for operators to optimise indoor signals by individually controlling the output power per band per RU and not within a DAS tree of connected antennas. The output power of the low-power RU is up to 22 dBm per band, which is sufficient to support multi-operator scenarios with typical power requirements.

Optimisation of Indoor Mobile Broadband

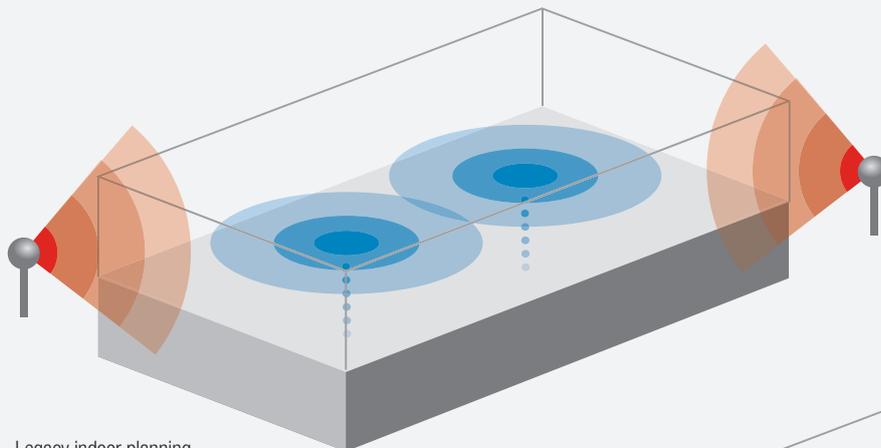


Having the right signal at the right place is critical to customer satisfaction. Today signal coverage and a good broadband experience all around the office are both essential. Ensuring this service requires a very high level of flexibility in optimisation. One of the main parameters in indoor optimisation is the adjustment of the power level. In particular, an indoor environment has totally different coverage and signal propagations across all frequencies. For instance, having an optimal 900 MHz signal on one RU does not automatically mean an optimal signal with the same power at 2.1 GHz or 2.6 GHz. Optimising the signals requires an adjustment per band and even per operator. With K-BOW, you can adjust the power level on every RU of every band and operator individually. This enables you to reach the best radio conditions for a high modulation rate in order to achieve the best possible broadband experience.

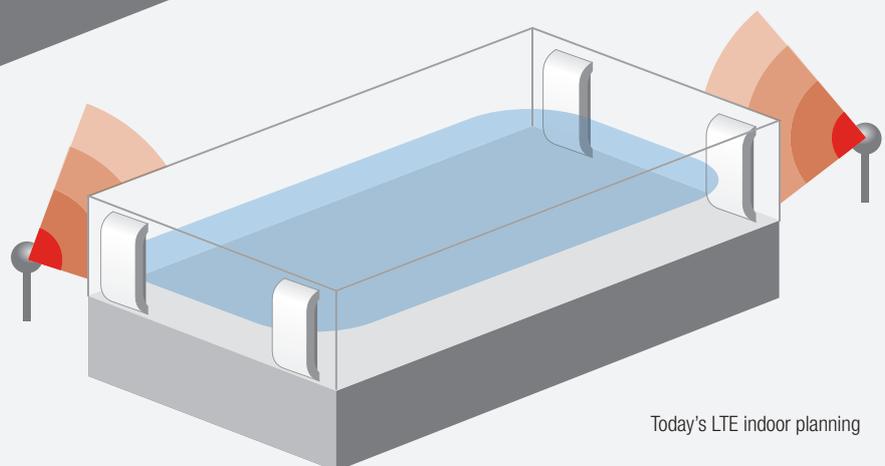
> Indoor Design Change for Dominant LTE Networks Conditions

The most important aspect in indoor planning today is the role of the dominant signal when planning indoor coverage. In 2G and 3G it was possible to force the user equipment to the indoor cell by controlling the parameters. In LTE, with the use of the same frequencies both inside and outside the building, it is necessary to get the dominant

indoor signal to all parts of the building. This changes the rules of designing an indoor solution. To get a homogeneous cell solution inside the building, it is necessary to distribute the signal indoors from the same direction as if the macro network were covering the building from the outside.



Legacy indoor planning



Today's LTE indoor planning

Flexible Routing



Scenario Management

Public venues, exhibitions and other high traffic areas are subject to very dynamic capacity demand scenarios. With conventional solutions, the complete capacity for a whole venue is normally scaled for a higher traffic requirement than actually needed. This is because conventional systems are neither dynamic nor flexible with respect to smart traffic management. One of the advantages of K-BOW is the ability to manage different scenarios and thereby route the capacity to where it is needed. For instance, crowded locations with high traffic requirements can be served with all available carriers, technologies and frequency bands subject to deployment of a predefined scenario.

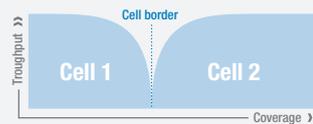
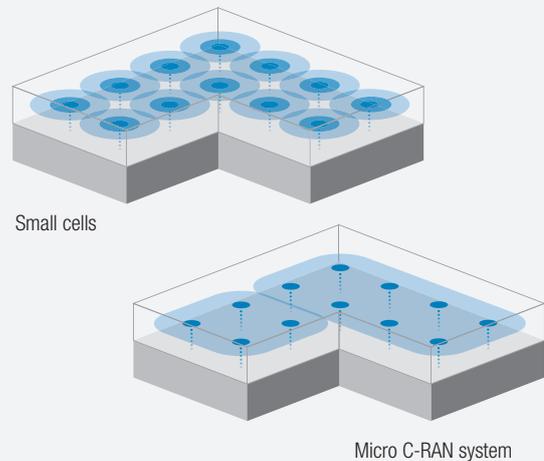
Optimised Cell Structure

Another advantage of K-BOW is the possibility to adapt the number of cells depending on indoor traffic requirements. This special architecture feature eliminates potential border interferences, thereby making it possible to achieve up to 10 times higher data throughput at the cell edge. This optimised cell structure reduces the indoor handovers to a minimum, hence increases network quality and performance and customer experience. This is especially the case for VoLTE, where low latency is needed and where every handover is detrimental to system performance.

> Small Cells Versus Micro C-RAN System

Stand-alone small cells are mainly deployed in residential facilities and small businesses. Having small cells in a building is a very fast way to roll out capacity for a single operator. Each small cell has its own dedicated capacity, handover and coverage area.

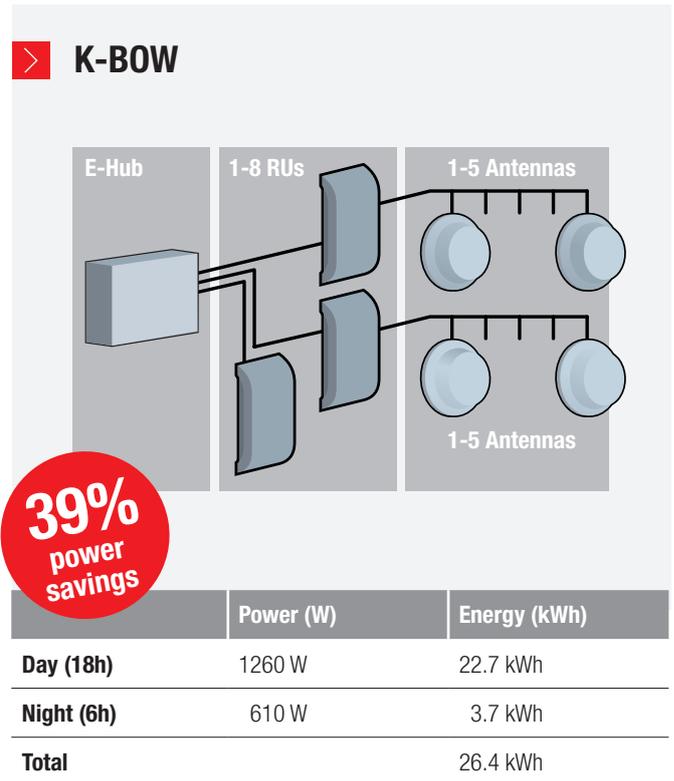
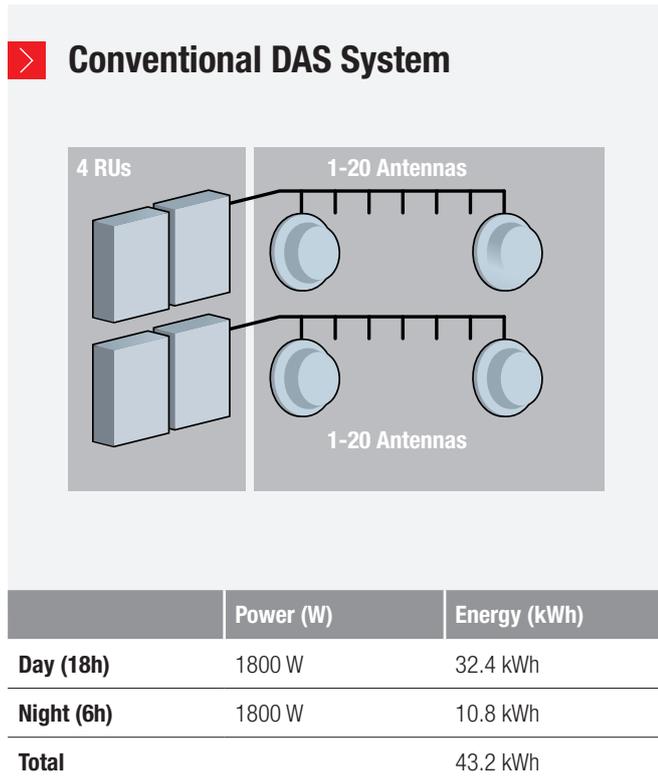
Small cells are characterised by limited user capacity. Due to price competition, the chipsets of these small cells have limitations in features (LTE-A features).



Cell border situation

The biggest limitation in an LTE coverage area is at the cell edge, as typically the data speed performance of broadband services decreases dramatically due to interference and other reasons.

Power Saving



Green DAS Solution

Energy saving in in-building DAS systems is becoming more and more important. Depending on traffic requirements, K-BOW can turn certain bands into sleep mode, while ensuring that a minimum required coverage level is maintained. For instance, during certain times of the day a venue may require full capacity with all available carriers. During off-peak times, a scenario with a single carrier is sufficient to ensure service. This power saving mechanism allows the operator to maintain full

customer satisfaction at a maximum service level with a minimum energy consumption. This can be implemented by deploying a pre-planned and pre-configured scenario which can be activated remotely as needed. Compared to a legacy DAS system, K-BOW can save up to 39% of energy on demand. Conventional DAS systems also need to respect total power considerations and undergo lengthy recalibration when adapting to such changes.

Optimising Your Total Cost of Ownership (TCO)



K-BOW gives you short response times to end customers. If your corporate customer wants to move from one floor to another or needs a service upgrade for more mobile broadband capacity in its executive floors, K-BOW MNOs can:

- Remotely run independent single or multi-operator strategy based on a single platform which is compatible with OEM base station solutions

- Remotely change the capacity by sectorisation in a defined area in realtime

- Remotely optimise the coverage and capacity within a building or campus

- Remotely provide macro layer end-user experience by using the system integrated LTE MIMO

- Remotely activate adjacent services (small cells, sensor networks or WiFi access points) by using transparent IP channels available at the RU with up to 700 Mbps

- Eliminate costly system leveling activities of installation teams with automatic calibration

- Avoid the need to access premises in order to add new carriers or introduce MIMO. This is managed remotely from the network operations centre

Network sharing is one of the key ways to share investment and hence reduce capital expenditure. Kathrein K-BOW supports multi-operator connectivity and offers the opportunity to target dedicated MNO signals at dedicated sectors in specific areas within a building or area.

In traditional systems, a signal cocktail of all connected bands and carriers is transmitted over a distributed antenna arm. With Kathrein's unique K-BOW power saving options, selected bands and carriers can be switched on and off per small cell sector.

The fast development of telecom standards and features to improve spectral efficiency and network capacity is a challenge for most traditional systems. K-BOW is designed to capture all of today's legacy system requirements such as 2 x 2 MIMO and is prepared for 3GPP release 11 and 12 features to further enhance the end-user experience. Examples of these features include Carrier Aggregation, CoMP, etc. K-BOW is built on a highly flexible platform to further develop the K-BOW solution as per industry and MNO needs.

Since all the K-BOW functionalities are managed remotely by a node manager, capacity allocation can be delivered on-demand. K-BOW becomes the SON enabler for indoor and campus deployments, thereby saving expensive network resources and reducing the number of field support personnel needed to manage a continuously changing environment.

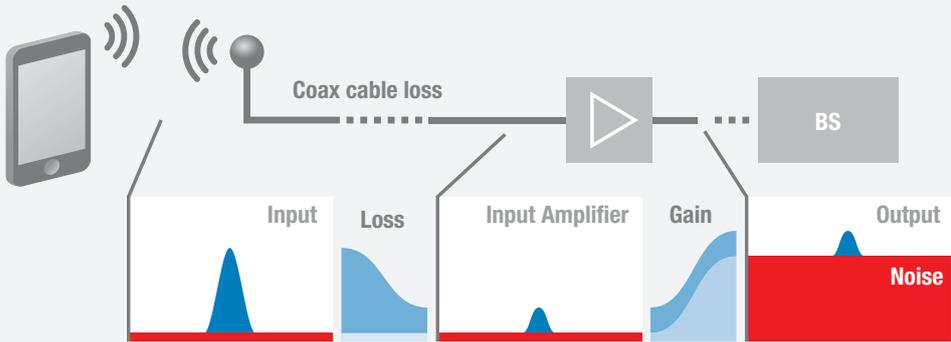
These future-proof features ensure the best total cost of ownership for the entire product life cycle.

> High Signal to Noise Ratio (SNR) for High Data Rates

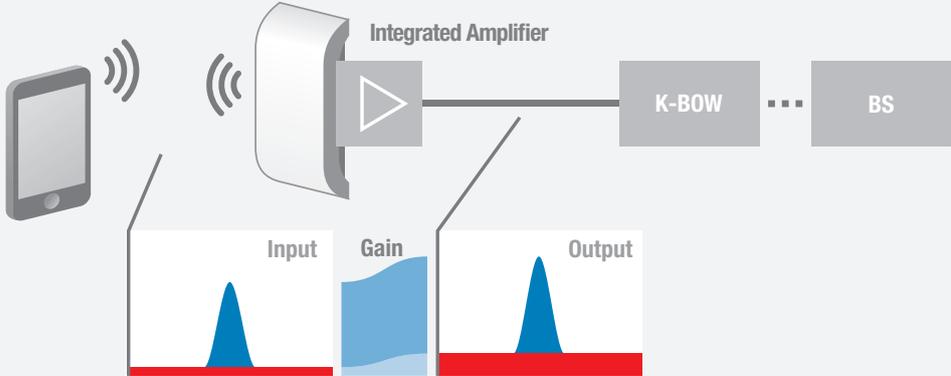
Long coax cabling between RU amplifier and antenna will not only attenuate the signal, but it will also degrade it with respect to the noise level. K-BOW brings the amplifier directly to the antenna and supports the best possible signal

to noise ratio. Selected amplifiers and high-quality components in the whole signal chain from the base station output to the antenna ensure a high SNR and enable the system to meet the demand on high data rates in the building.

Traditional DAS system



K-BOW with high SNR



Design Matters in In-House Solutions



Passive K-BOW
directional antenna

Within office buildings, restaurants, shopping malls or public venues, the design of equipment plays a vital role. Entering these areas with an in-building solution requires a harmonic design which fits into the environment, or at best, the system should not be visible at all.

Besides the attractive shape and timeless design, a special focus was put on ensuring that the active remote units are cooled passively, hence do not require active cooling.

With the Compact Remote Unit and the passive K-BOW antenna family, Kathrein has reached a new level in the design of neutral antenna and in-building components.

The outstanding design was honoured by the IF Industrial Design Award 2015 and the German Design Award 2016.

With our new Omni Antenna series for ceiling mounting, you have the possibility to choose between different types of cover plates, depending upon the type of suspension used for the ceiling. We developed three different types to cover all possible use-cases. The antenna module is always identical, but there are different cover plates.

Solution 1



With a suspended ceiling made of polystyrene, rock wool or plastic, there is no need to have a visible cover. You can use our calibration ring to fix the antenna above the suspended ceiling.

Solution 2



With a suspended ceiling made of wood, plasterboard or similar materials, you will require our small cover plate for a hole with a diameter of 250 mm.

Solution 3



With a suspended ceiling made of metal, stainless steel or aluminium, you will require our large cover plate for a hole with a diameter of 385 mm.

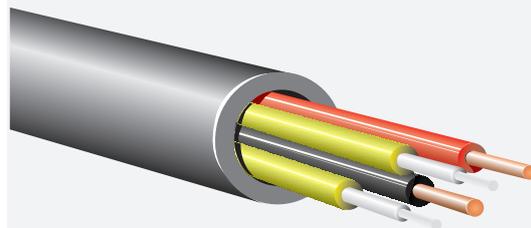
> Cabling of a DAS System

K-BOW is a next generation future-proof system. With the pure fibre infrastructure between C-Hub, E-Hub and RU, Kathrein is providing a system which reduces costly additional cable installation when an extension to future technologies and adjusted traffic requirements is needed. Typically, building infrastructures make use of universal cabling, connecting radio, WiFi, IP and sensing networks.

K-BOW is based on a fibre cabling concept which supports distances between the E-Hub and designated RUs of up to 3 km. Between C-Hub and E-Hub, we support up to 20 km in distance.

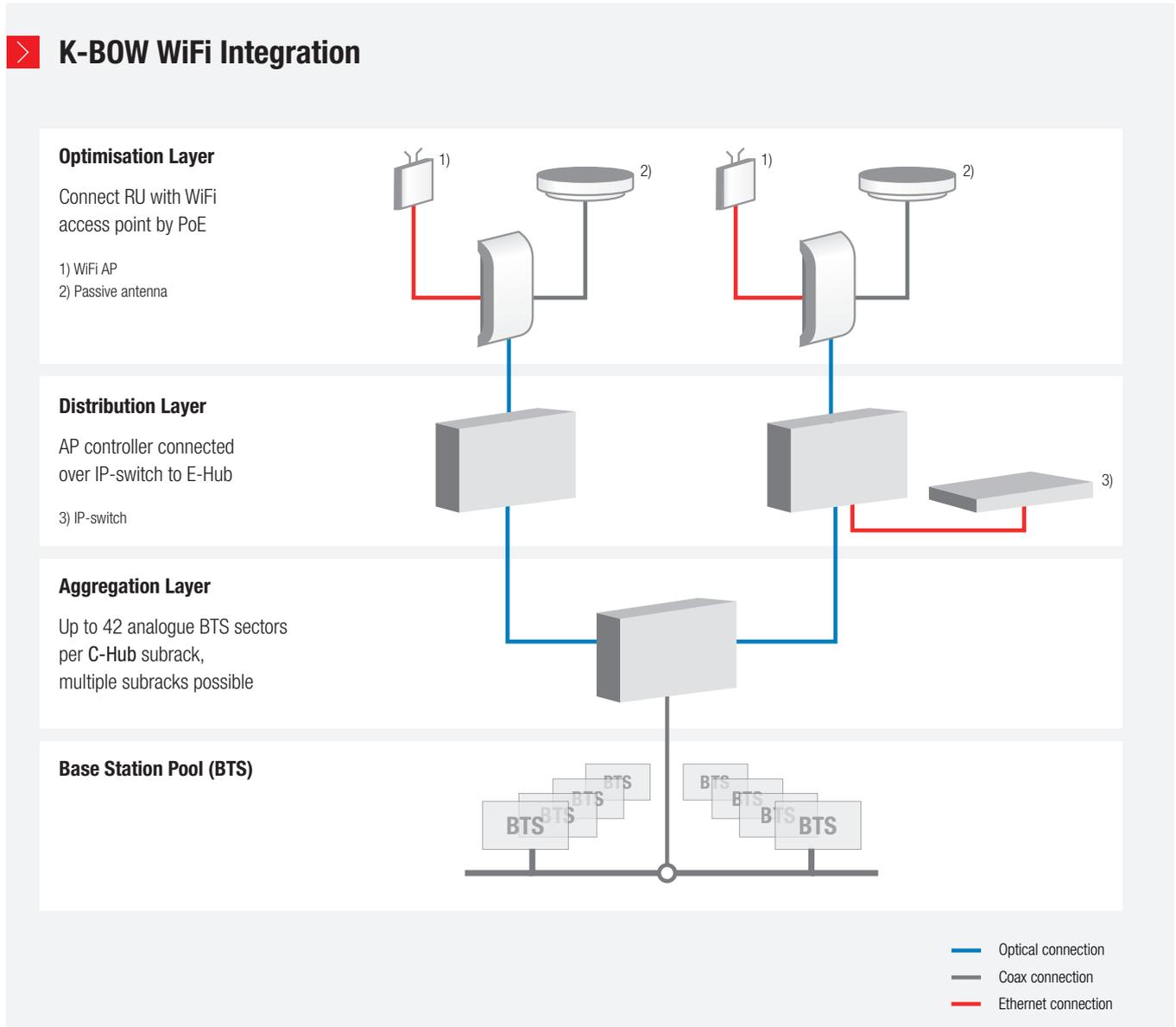
This enables best-in-class applications for campus or Micro C-RAN solutions in a dense urban high traffic scenario.

By installing hybrid fibre cable (HFC), you have the advantage of a thin flexible cable combined with the option to reduce investments by a future-proof broadband connection.



Profile of a hybrid fibre cable

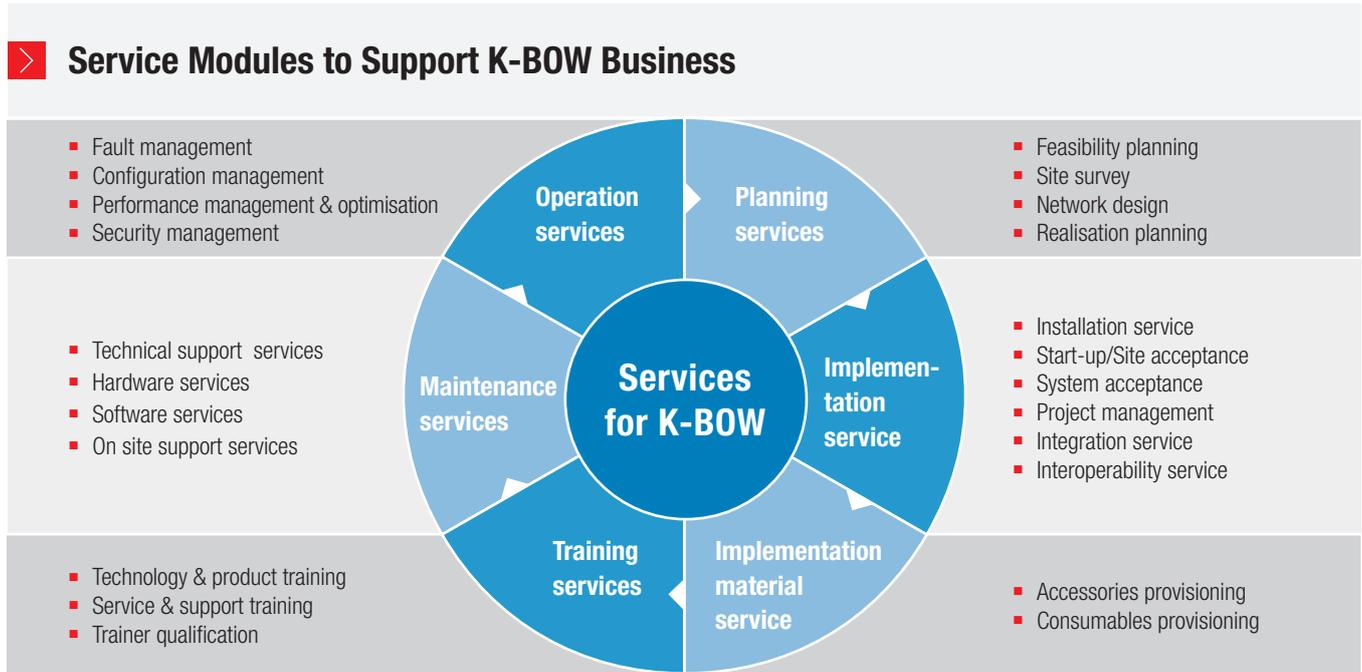
WiFi and Cellular: A Converged Network in Buildings



With K-BOW, you can realise a mobile cellular coverage and WiFi coverage by using only one cabling infrastructure. From a radio signal perspective, the best place for a WiFi and cellular coverage antenna is on the ceiling. Using our Connect RU with the transparent Ethernet channel, an easy

extension with a WiFi access point powered by PoE can be made. For building owners this solution saves one dedicated installation, for network operators it is an ideal approach for offloading data traffic through a WiFi network. The combined solution is the optimal basis for LTE-U technologies.

K-BOW Services



With the introduction of Kathrein's new K-BOW system, Kathrein has developed a full service portfolio to secure the system availability in a 24/7 mode for our customers.

The service portfolio is modular and covers all phases of the service life cycle. With our certified service provider network, we can offer these services all over the world

Planning services

The planning services cover the entire planning chain from high level feasibility planning to detailed realisation planning.

Implementation service

The high standard of implementation services is ensured by a qualified selection and certification process for the service providers and the system start-up/integration teams.

Implementation material services

The K-BOW services provide all parts and tools required to set-up and to operate K-BOW over the whole service life cycle.

Training service

The training and certification programme for service providers and employees is based on a blended learning concept with a focus on fast know-how and skill transfer into the organisations.

Maintenance services

We ensure the lifecycle performance of a K-BOW system by provisioning various maintenance and ad-hoc services on a modular basis covering customer demands.

Operation services

We provide a managed K-BOW service in various service level agreements: fault and configuration management, performance management & optimisation and security management.

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