

BANG & OLUFSEN

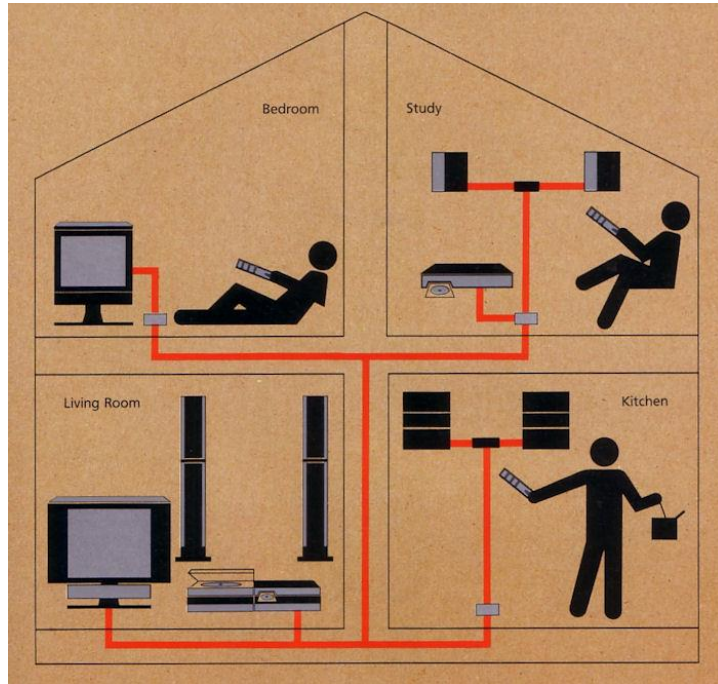


BEOLINK
MULTIROOM

White Paper
July 2015

Introduction

Since 1982, the BeoLink concept has made it possible for Bang & Olufsen products to be used in multiple rooms at once. Already then, Bang & Olufsen enabled use cases for what the mass market now 30+ years later calls 'Multiroom'.



BeoLink Concept as presented in 1985

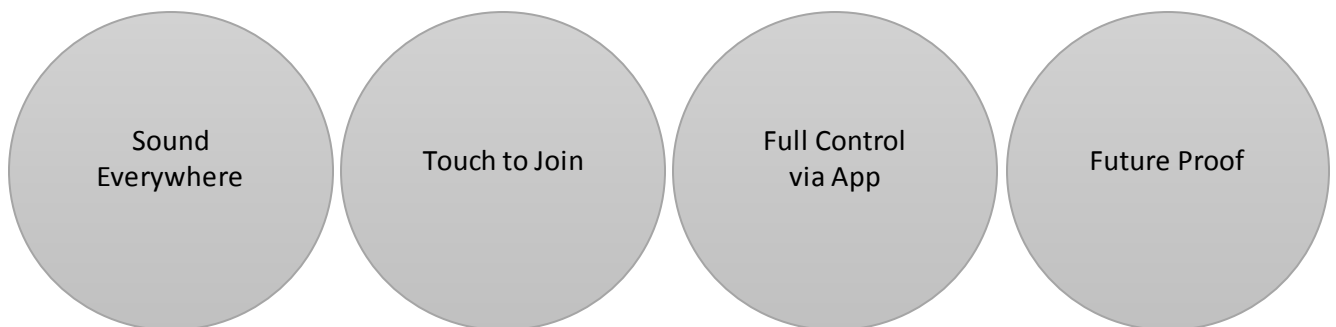
While BeoLink has been an integral part of most Bang & Olufsen products for many years for 30 years, it required a special cable to be wired around the house and to individual products. All our latest network connected products include the BeoLink Multiroom functionality integrated into them "out of the box", without the need of any extra equipment. Products communicate and work with each on top of standard home network infrastructure, providing to the customers even more value, functioning as a common and seamless system.



Some of the BeoLink Multiroom products (2015)

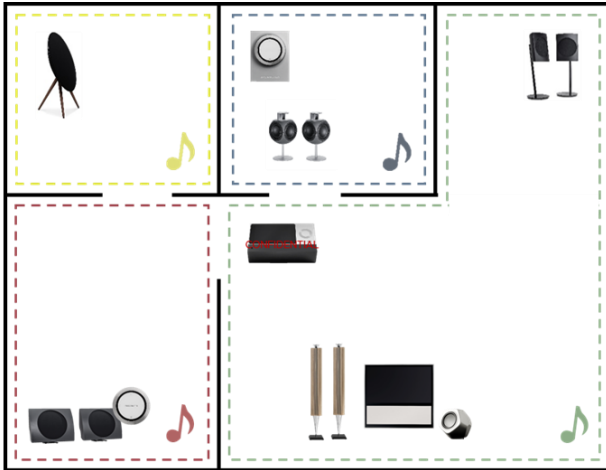
Core Concepts

The BeoLink Multiroom functionality is outlined in the following four concepts

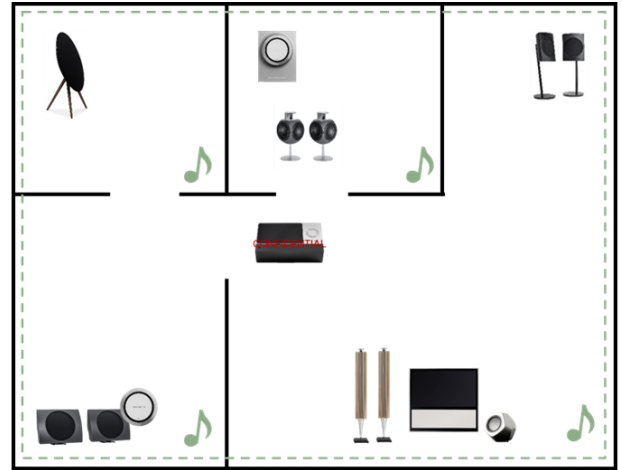


1. Sound Everywhere

With Bang & Olufsen Multiroom you can play different music in different rooms – or you can have the same music playing at the same time in different rooms. This functionality is an inherent feature of all the latest network connected Bang & Olufsen products.



Play different music in different rooms...



... or play the same music in multiple rooms at the same time

- Products are connected wirelessly via Wi-Fi, making it simple to install or move them around the home.
- The sound distribution among products is 'echoless' and thereby synchronised even if you can hear it from several rooms at the same time.
- You can have multiple different ongoing music experiences in the Multiroom setup – two rooms can play one synchronised sound source, while another three rooms can play another sound source.
- There is no need for an 'audio master' in the system; any two products (e.g. two BeoPlay A9s) can form a Multiroom session.

2. Touch to Join

With a single touch, you can expand sound from one room to several more. Simply go to a product in your home, touch it, and it will come to life. If music is already playing on your system, the second product will automatically join the ongoing music experience.

If multiple experiences are going on (e.g. if two products are already playing different music in the kitchen and the dining room), simply touch the product again to toggle between ongoing experiences or to start a new one. When starting a new experience on a product, Internet Radio (TuneIn) comes first and then you can touch again to

toggle among the music services (e.g. Deezer and Spotify), which come next in the priority list.



Tap the BeoPlay A9



Press the Music button on BeoSound Essence



View all ongoing music experiences in your home on the BeoSound Moment interface and touch the one you want to join.



Select "JOIN" on BeoRemote One if you are in front of your television, and bring the music to the television speakers.

3. Full Control via App

Pick up your smartphone or tablet to take full control of your system.

The BeoMusic App lets you start the music in any of Bang & Olufsen's newest audio products, and you can easily select the music source you want to play. Furthermore, the App provides an overview of all products available in your Multiroom setup, shows you what they are currently playing, and with a very simple command you can expand the music experience from one room to another.

A beautiful application that fully compliments the Multiroom offering.



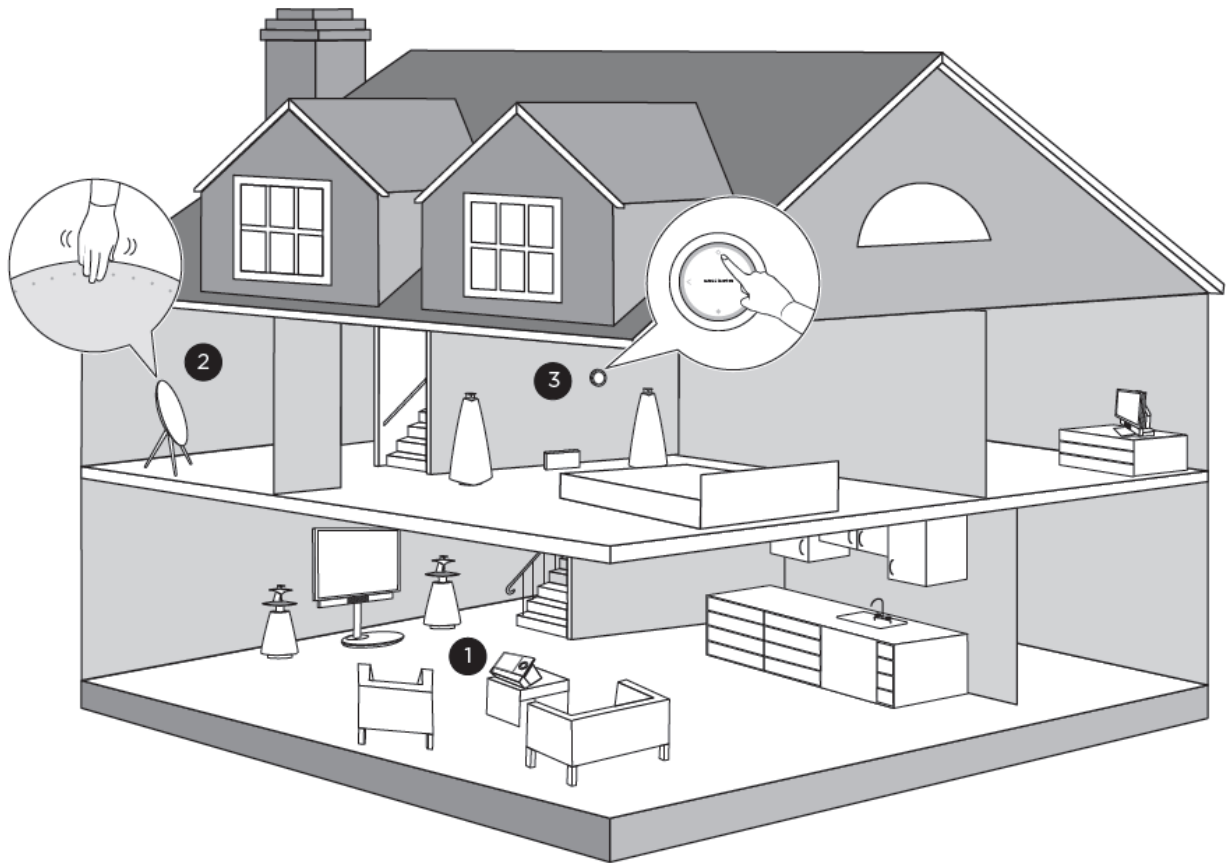
4. Future Proof

Like no other manufacturer, Bang & Olufsen offers customers a long life with their Bang & Olufsen solution.

You can start with one simple setup and add products over time and in more rooms as you like. BeoLink is a system that takes basic operation of older products into account as well as ensures that new developments can become part of the basic BeoLink experience. This can be executed in different ways, but the experience is made seamless for the customer.

In addition, your products remain up-to-date through software updates that provides you with new features and functions, so the longevity and value of a Bang & Olufsen product is significantly different from the market.

One Touch Operation in Detail



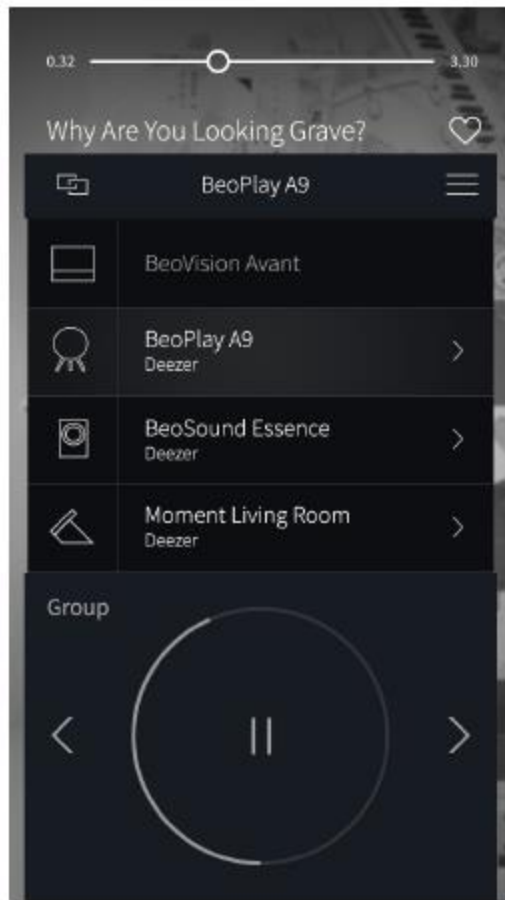
With a single touch you can join playing sources and expand the experience to all or selected products on your network.

1. In the living room, you select music to play on your music system, like BeoSound Moment. Music plays through the connected speakers.
2. Upstairs simply tap on the back of BeoPlay A9 to join the currently playing source. In this case, BeoSound Moment in the living room. If you want to start a local source, just tap again.
3. In the bedroom, press the button on BeoSound Essence Remote to hear the already playing music through the connected speakers. If you want to start a local source, press the button again.

BeoMusic App

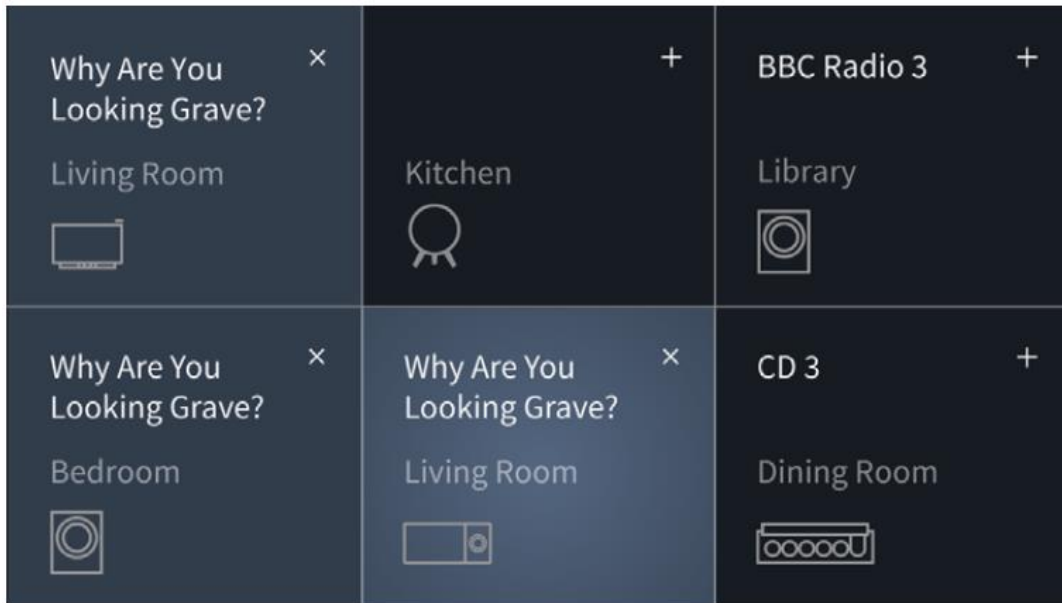
The BeoMusic App is the controller of the whole BeoLink Multiroom system. The mobile device can be oriented in the two directions: portrait view and landscape view.

On the portrait view products are shown in alphabetical order according to the name assigned by the customer.



When more products are present than can be shown in one screen, scroll vertically or horizontally according to view.

In the top of the App is shown the status of which track or channel is playing in the selected product/room and a progress bar for this. In the bottom of the App it is possibilities to control the volume of the selected product and selecting next or previous track/channel. In the background a graphics is seen that either relates to the track or the radio station. Each product is represented by a line, having an icon of the product to the left and displays the data about the product. The top line shows the product/room name and the next line shows the source.



Turning the smart phone to the horizontal mode automatically enters our signature multiroom screen, which gives an overview of all your products / system. A tile represents each product. The top line informs about the track/station (source currently playing). If the product is not playing the line is left blank. The second line shows the product/room name and below this a product icon of the product is displayed.

A selected product is changing color to light blue, and operating possibilities are marked by the “+” and “x”. Pressing the “+” button on a product/room results in expanding the source played on the selected product/room to be played in that room. The “+” changes to an “x” as well as the product/room also becomes light blue - indicating that the source is played in all rooms that are light blue simultaneously. The product/room being the leader has a circular glow.

Pressing the “x” button on a product/room unlink from the product played or terminate an ongoing session, if played in one room only. Pressing the “x” button on the product/room having the source, will let the product go to Standby although the source will still be playing in the other room.

The BeoMusic App is available on the Apple App Store (for iOS devices) and the Google Play (for Android devices). For more information, please visit: <http://www.bang-olufsen.com/beomusic>

BeoSound Moment Link tab



With its large display, the BeoSound Moment can give you a visual overview of all the ongoing experience throughout your system. Simply tap on the experience you want to listen to, and the BeoSound Moment will instantly join the same experience.

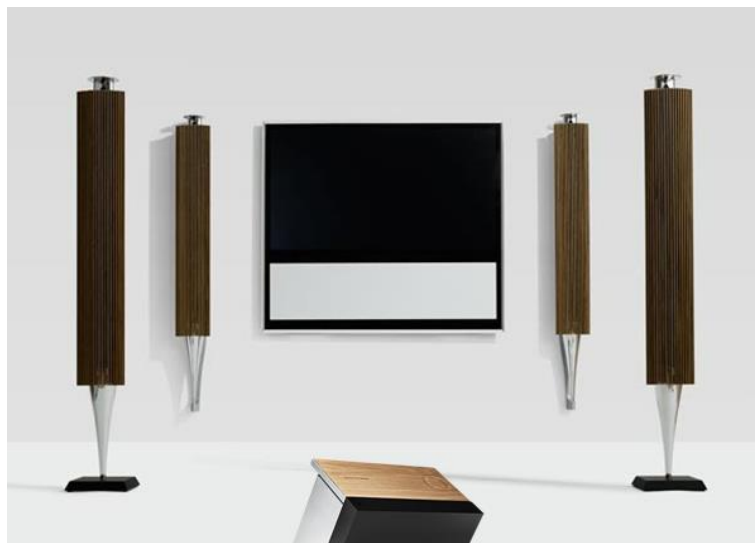
Role of the TV

While many other companies nowadays offer "multiroom" solutions, their offering is purely focused on music. At Bang & Olufsen we put a lot of focus into integrating all your Audio / Video equipment, and that of course means making also the TVs part of the holistic experience. Instead of filling up the house with products, you simply take the sound experience with you wherever you are.

1. Integrated Setup / Speaker Sharing

A TV would typically have external speakers, for a movie surround setup (e.g. in a 5.1 speaker setup).

With BeoLink Multiroom "integrated setup" (or "speaker sharing") you can share speakers between TV and music system and reduce clutter in the room.



No need to have separate speakers for the TV and the music system, and make double investment on speakers. You can simply add an audio system in your setup (e.g. BeoSound Moment) and the system will cleverly make sure that both products can utilize the same speakers

2. Playing sound from other products to TV speakers

Many people have a TV in a room (e.g. living room or kitchen), but the audio system(s) in other rooms (e.g. dining room, bedroom, etc)

While they don't see the need for an audio system in the room with the main/secondary TV (e.g. living room or kitchen), they often would like to have music there



Bang & Olufsen TVs have their own music sources (Deezer, Spotify, Internet Radio, Home Media). Via BeoLink Multiroom sound from an audio system can also be brought to the TV speakers, as if the TV was also a clever connected speaker (in a wireless, echoless manner)

As described earlier, sound from an audio system can be joined from a TV, via the BeoRemote One, or the BeoMusic App.

3. Playing sound from other products to TV speakers

There are use cases where the customer might want to distribute sound from the TV, to an audio product. Imagine the scenario that you are watching the live news on the TV, and you want to take the sound from the broadcast station to your kitchen speaker



This is also possible with the BeoLink Multiroom, allowing the TV to be a “full citizen” among the other audio products in the system.

Technologies in Context

BeoLink Multiroom is a concept that spans across multiple generations of products:



Magical enduring experiences



The Products
(mix of different generations)

The concepts & functionality of what products can deliver when used together

BeoLink

Master Control Link
(1982 – 1995)

Master Link
(1994 – 2015)

Network Link
(2012 -)

The "technology" the products use to talk to each other



The "physical" connection

The most modern products, currently on the market, utilize Bang & Olufsen's proprietary "Network Link" technology for seamless sound distribution, across products. Network Link technology is based on the IP (Internet Protocol) and operates on top of the customer's standard network infrastructure. That means that products communicate with each other wirelessly, via the home's standard WiFi network, without the need of any special infrastructure. Of course, option to wire the products, via standard Ethernet network, is also possible. The products can co-exist on the network along with other network equipment (e.g. such as computers, laptops, media servers, etc).

Example of products integrating the Network Link technology:



The previous generation of Bang & Olufsen products (starting from 1994), was also a "connected" ecosystem of products, but running on an older "analogue" technology,

which we called “Master Link”. You will recognize some iconic products in the portfolio:

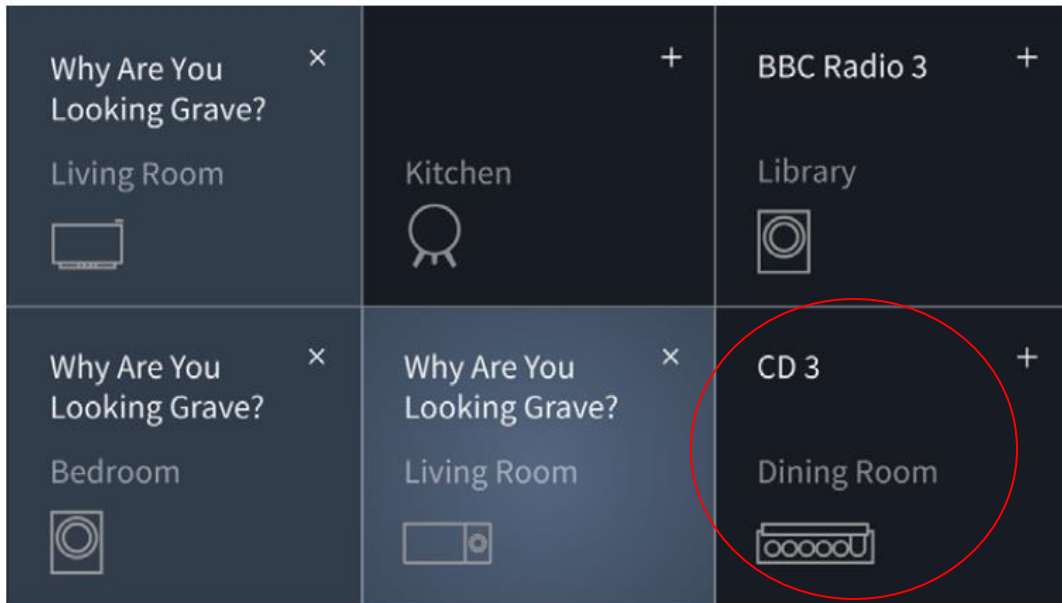


The Master Link technology allowed integration of products, and it required a special cable to be wired throughout the house, and be used as the common “bus” for physically linking the products.

However, new or old products, at Bang & Olufsen we make sure that all your products works seamlessly together. Customers, who own equipment with the Master Link technology, are also able to interconnect them to the same common system with the newest products. This allows them to share resources and experience across rooms and products, allowing customers to keep their beloved CD player, or in-wall speakers in the bathroom and match them even with the newest audio system and/or TV.

A simple scenario:

- Your beloved BeoSound 9000 6-CD player, from 1994, can still proudly stand on your living room wall.
- It can still play your favorite CDs and via the BeoMusic App be illustrated and controlled, as shown in the screenshot, for distributing sound to the other rooms in the system



- For example, wirelessly stream sound to a BeoPlay A9, from 2015, in your bedroom

How is this possible? The two generations of products are “bridged” with a product we call “BeoLink Converter”. This is essentially a “hide away box”, which seats as a “translator” between the Network Link and the Master Link world, making an on-the-fly conversion of the experiences and music streams, from one system to the other.



However, customers do not need to worry about those technical details, as certified Bang & Olufsen installers can carry out the need installations. Customers can just focus on enjoying their seamless experiences, and let the Bang & Olufsen ecosystem take care of the rest.

Sound Distribution Limitations

Sound distribution among different products is not only a matter of technology and networks. Nowadays, there are many stakeholders in this ecosystem (music labels, music streaming services, mobile ecosystems), and they control an important part of the experience.

These parties sometimes impose commercial and legal limitations on which sound content we can distribute and how. We work closely with them to give our customers

the best possible experiences within the set boundaries. In the table below, you will find an overview of the distribution of sound among different devices.

MUSIC SOURCE	DISTRIBUTION
DLNA	Can be distributed among products as long as there is no content protection (DRM) applied in the media files.
Bluetooth	No limitations
Internet radio (TuneIn)	No limitations
Deezer	No limitations
QQ Music (China)	No limitations
Line-in	No limitations
Spotify	Spotify sound can only be distributed among devices with "Spotify Connect" feature.
AirPlay	AirPlay sound cannot be distributed in a multiroom system. This is a legal limitation from Apple.

System Scalability & Sound Quality

The BeoLink Multiroom system runs on top of standard networking infrastructure (e.g. the home WiFi router), and thus it depends on this 3rd party element/component. This means the performance/scalability of your system depends on the performance of your router. We have contacted system testing with a number of different popular routers on the market. Our testing shows that with a modern home router, the system can handle the following number of BeoLink Multiroom products:

Number of simultaneously streaming devices, Wirelessly	Upto 8
Number of simultaneously streaming devices, Wired	Upto 18
Number of connected devices in the system (not – streaming)	Upto 32

The sound distribution among BeoLink Multiroom products is performed in uncompressed CD quality. The support for even higher quality audio distribution (up to 192kHz/24bit) will be added in the future versions of Network Link, via SW updates to the products.

BeoLink Multiroom vs. Immaculate Wireless Sound

The BeoLink Multiroom is a complimentary concept to the Immaculate Wireless Sound (IWS), also integrated to selected Bang & Olufsen products. The table below describes the boundaries of each system, and its advantages. Many products (such as BeoSound Avant, BeoVision 11, BeoSound Moment, etc) are supporting both systems/technologies at the same time.

BeoLink Multiroom vs Immaculate wireless sound (IWS)

Immaculate Wireless Sound, which is based on the WISA-technology operates on a proprietary radio technology, aiming at linking speakers to master products.

The technology is best for uncompressed, multi-channel, sound with focus on low latency. Delay between TV and speakers is a common problem with wireless audio solutions. WISA-technology reduces this latency down to a mere 5 ms, eliminating lip-sync issues to give you the smoothest audio/visual experience. The synchronization between speakers for the WISA technology is also one of the key differences, with less than a sample difference keeps the stereo image steady.

However, the WISA technology requires that the products (Audio/Video master and speakers) are located in the same physical space (e.g. living room), and cannot be used through-out the home (e.g. across walls) and thus in a multiroom system. The WISA technology is recommended for usage in a single room, e.g. a square room of dimensions of up to 9m x 9m.



BeoLink is based on Bang & Olufsen's NetworkLink technology, which runs on top of standard IP networks. That means, on top of existing Ethernet (wired) and WiFi (wireless) networks

Since it can work anywhere where you have Ethernet/WiFi connectivity, it can work through out the home, among different rooms

It is targeted towards sound / music distribution, where the latency is not very critical (as is in the case of video). However, the sound is still echo-free for the end customer. And quality is of course lossless.

BeoLink can work on top of the existing home infrastructure (i.e. your existing WiFi network), however since it depends of 3rd party equipment (e.g. WiFi router) quality/stability is also affected by those components



BeoLink Advanced

The currently described features of “BeoLink Multiroom” is inherently build-in Bang & Olufsen products. “BeoLink Advanced” is where you take integration to the next level and here you may require additional equipment. BeoLink Advanced offers the following elements

- Audio and Video distribution across the house or across more locations
- Control of non-Bang & Olufsen sources
- Integration of home automation (Smart home solution)
- More locations in the same system

Audio and Video distribution

With Advanced BeoLink you can get sound and video distributed to several rooms using non-Bang & Olufsen equipment, but you also have the possibility to access content from other locations e.g. the summerhouse, where you can access music from your central server at home, or maybe your film archive.

Control of non-Bang & Olufsen products

In addition to control of Bang & Olufsen Audio Video equipment, you can also add equipment from other brands to your setup and still operated it from one remote control. This includes projectors and screens of other brands.

Integration of home automation (Smart home solution)

In addition to AV equipment, you can make sophisticated installation with home automation equipment all controlled from multiple devices of your choice your Bang & Olufsen remote, a dedicated App or a switch or panel on the wall

More locations can be in the same system

You can have an installation that includes more locations – such as summerhouse, the pool house or a second home. You can access e.g. your music collection placed in your home, from your summerhouse, or you can get your installer to change, update or fault-find on your installation from a remote location.

Resources

Further information can be found at:

- BeoLink Multiroom: <http://www.bang-olufsen.com/beolink>
- BeoMusic App <http://www.bang-olufsen.com/beomusic>
- Integration of Bang & Olufsen products in larger installations: <http://www.beointegration.com/>