

Space Optimisation

Revision 3.3, July 1, 2019

To achieve the full potential of Space Optimisation you should:

- 1. accurately measure your room dimensions, including all room features, and correctly identify the construction material of each surface, and enter these into the Space Optimisation user interface;**
- 2. correctly identify the ideal locations for your speakers, even if you are then required to relocate them to more practical locations, and enter these into the Space Optimisation user interface;**
- 3. accurately measure the environmental conditions of your room, and enter these into the Space Optimisation user interface.**

If you correctly follow these steps, Space Optimisation should provide an optimisation that will not need any further adjustment. This user guide should therefore be required for reference only.

Space Optimisation is a toolset available to all Linn DS/DSM system owners which uses highly sophisticated acoustic modelling to build up a complete picture of how your speakers, their placement, and the unique characteristics of your room interact to affect the sound you hear. Space Optimisation takes account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports, and of the characteristics of your room, such as room dimensions, construction materials, and features like doors and windows, to accurately model these interactions. It then precisely identifies frequencies that are artificially distorted by your environment, and reduces their energy and decay time, to reveal the music that would otherwise be hidden. It also applies a delay to each speaker to ensure the content from each speaker reaches your ears at the same time.

Given any and all external inputs to a Linn DS/DSM system, Space Optimisation is applied to all analogue outputs. However, note that DSD audio will not be optimised, as this would require a conversion to PCM, and that the SPDIF/TOSLINK, HDMI, and headphone outputs will not output optimised audio, as these outputs pass the unprocessed audio feed.

Significant changes have been made to the application of Space Optimisation through your Linn account. If you have a Linn DS/DSM system optimised through Linn Konfig guidance on importing and applying these optimisations through your Linn account, along with clarification of the general changes, is presented in §1.

The procedure for basic setup of Space Optimisation on Linn DS/DSM systems is then presented in §2.

Finally, the procedure for advanced setup of Space Optimisation on Linn DS/DSM systems is presented in §3.

Note that the application of Space Optimisation⁺ to Linn Exakt systems and Linn Exakt/analogue surround systems is currently unsupported through your Linn account; this must still be applied through Linn Konfig.

Contents

1	Significant changes	5
1.1	The Linn account	5
1.1.1	Adding your music system to your Linn account	6
1.2	Optimisation algorithm updates	9
1.2.1	Support for non-rectangular rooms	9
1.2.2	Optimisation based on psychoacoustic research	9
1.2.3	Optimisation calculation time	10
1.3	Importing a previous optimisation	10
2	Basic setup	13
2.1	Installing your speakers using Tune Dem	13
2.1.1	Installing your speakers	13
2.1.2	Installing your additional subwoofers	13
2.2	Adding your speakers to your music system	14
2.2.1	Adding your speakers	14
2.2.2	Adding your additional subwoofers	16
2.3	Optimising your music system	18
2.3.1	Entering your room information	19
2.3.2	Entering your speaker and listening locations	27
2.3.3	Calculating the optimisation	30
2.3.4	Applying the optimisation	32
2.3.5	Resuming an incomplete optimisation	33
2.4	Re-optimising your music system	34
2.4.1	Adding an optimisation	34
2.4.2	Adjusting an optimisation	35
2.5	Optimisation history	36
2.6	Rooms	37

3	Advanced setup	39
3.1	Environmental	39
3.2	Absorption	40
3.2.1	Approximating Floor and Ceiling Features	41
3.3	Optimisation preference	42
3.4	Simplifying room dimensions	43
3.4.1	Rooms with a partial-height recess or protrusion on a wall	43
3.4.2	Rooms with a free-standing wall	44
3.4.3	Rooms with a sloped or pitched ceiling	44
3.4.4	Rooms with a stepped floor	46
3.5	Virtual Tune Dem	47
3.6	Account Sharing	47
3.6.1	Sharing your music system	47
3.6.2	Sharing your room	49
3.6.3	Sharing your optimisation	51

1 Significant changes

In this section the most significant changes to the application of Space Optimisation are detailed.

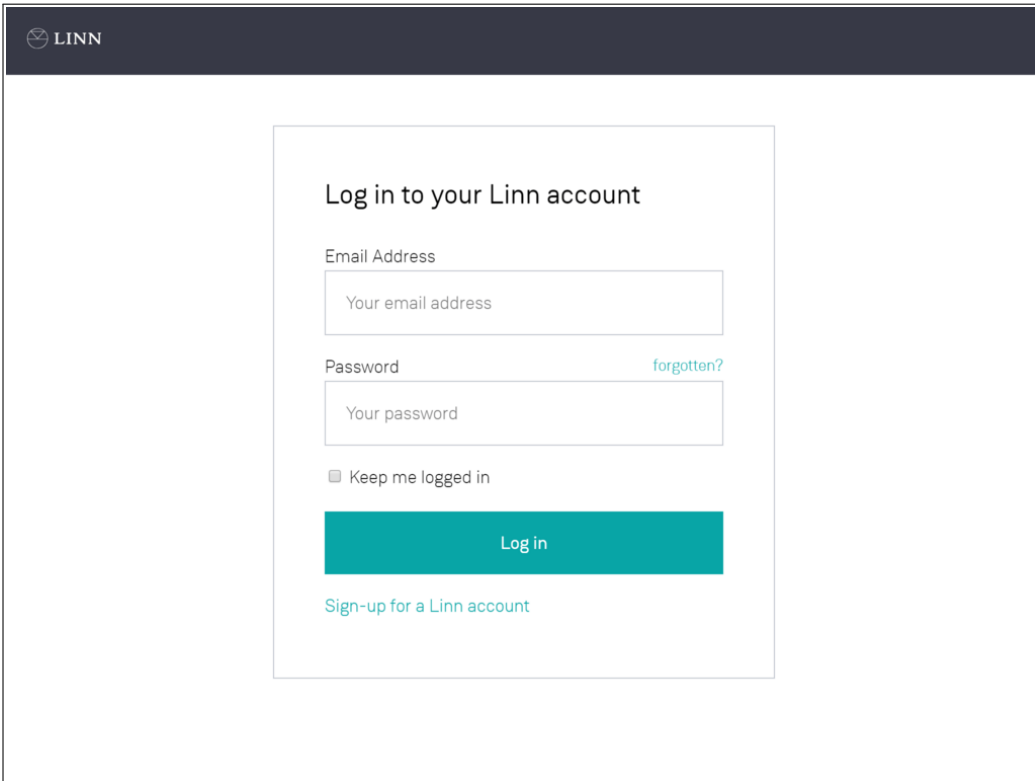
In order to utilise Space Optimisation you must create a Linn account, and your music system must then be added to your Linn account; this procedure is detailed in §1.1.

The optimisation algorithm has been updated to deliver an improved optimisation; these updates are detailed in §1.2.

Guidance on importing and applying previous optimisations from Linn Konfig through your Linn account are detailed in §1.3.

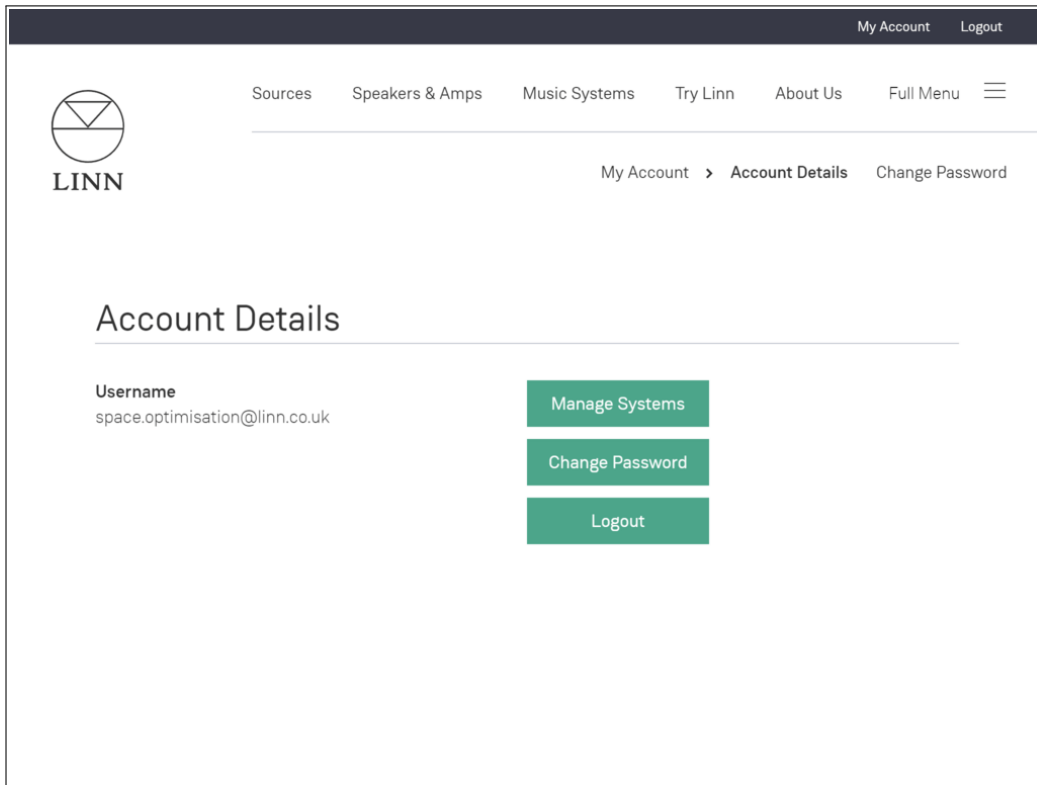
1.1 The Linn account

Navigate to the [Linn account](#) webpage, as shown below, in your browser of choice. If you have already created a Linn account, enter your credentials and click on the **Log in** button; otherwise, click on the **Sign-up for a Linn account** link and follow the instructions to create a Linn account.



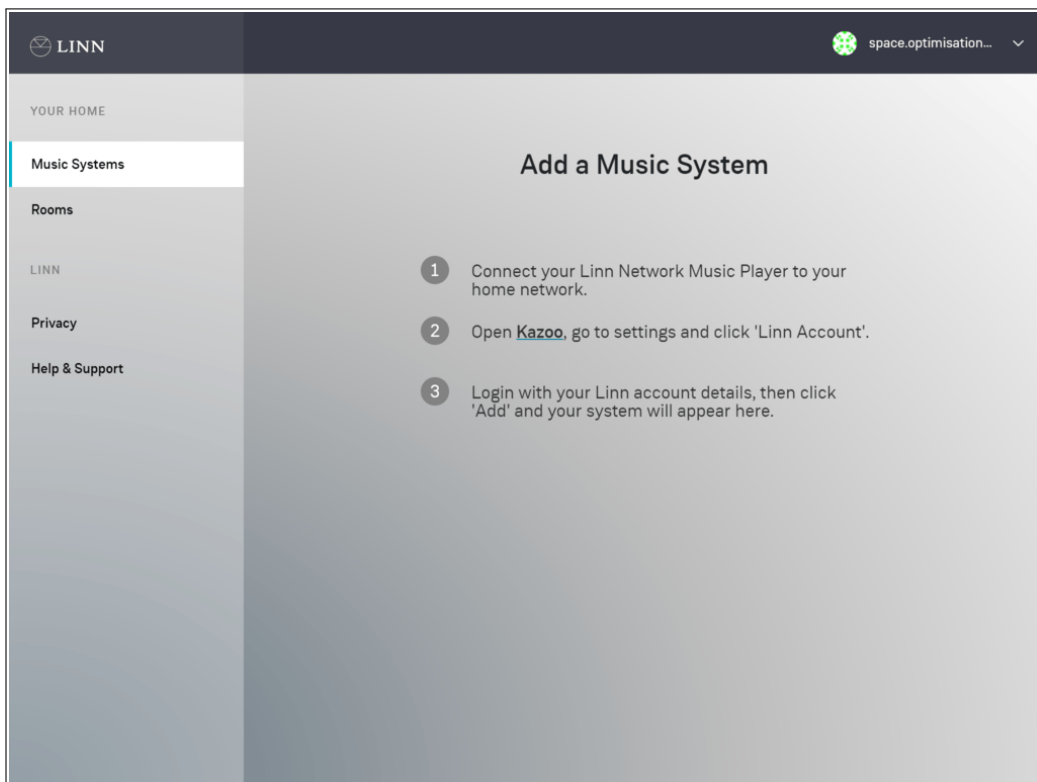
The screenshot shows the Linn account login page. At the top left, there is a dark header with the Linn logo and the word "LINN". The main content area is white and contains a central login form. The form is titled "Log in to your Linn account". It has two input fields: "Email Address" with the placeholder text "Your email address" and "Password" with the placeholder text "Your password". To the right of the password field is a link that says "forgotten?". Below the password field is a checkbox labeled "Keep me logged in". At the bottom of the form is a teal "Log in" button. Below the button is a link that says "Sign-up for a Linn account".

Within your Linn account, as shown below, you can edit your account details or manage your music systems; your Linn account is accessible from any device, allowing you to manage your music systems from your PC, laptop, tablet or phone.

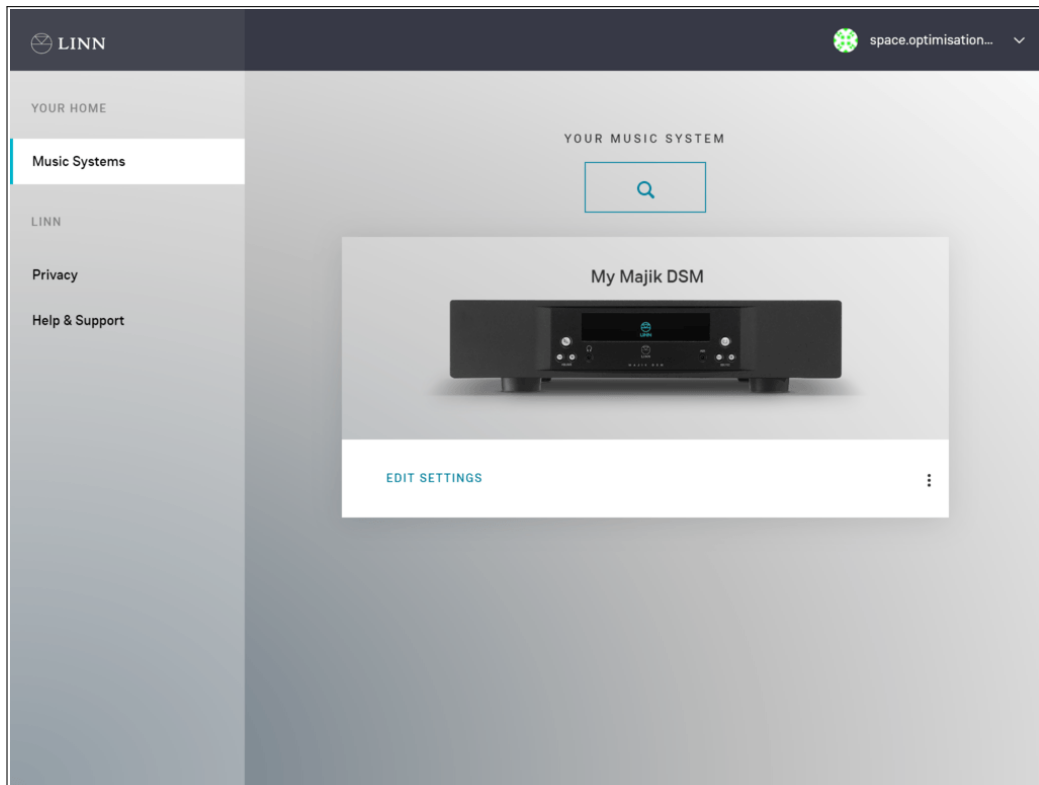


1.1.1 Adding your music system to your Linn account

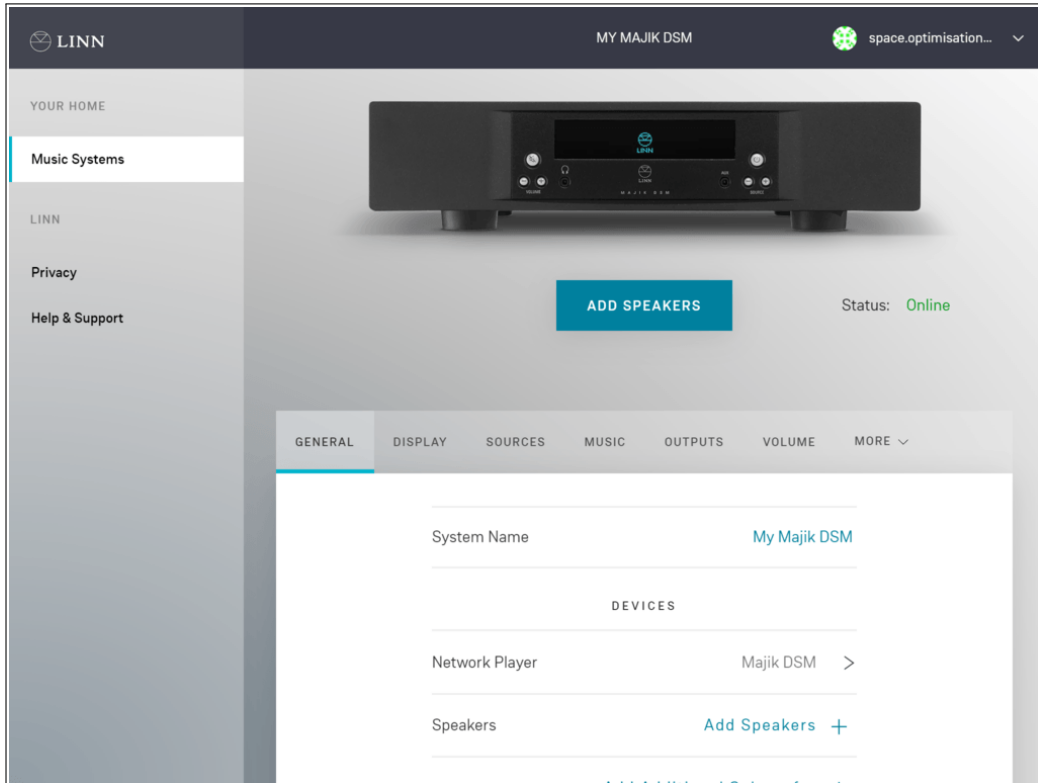
Click on the **Manage Systems** button; you will be taken to the **Music Systems** page. If no music systems have previously been added to your Linn account you will see instructions for adding a music system, as shown below; follow these instructions to add your music system to your Linn account.



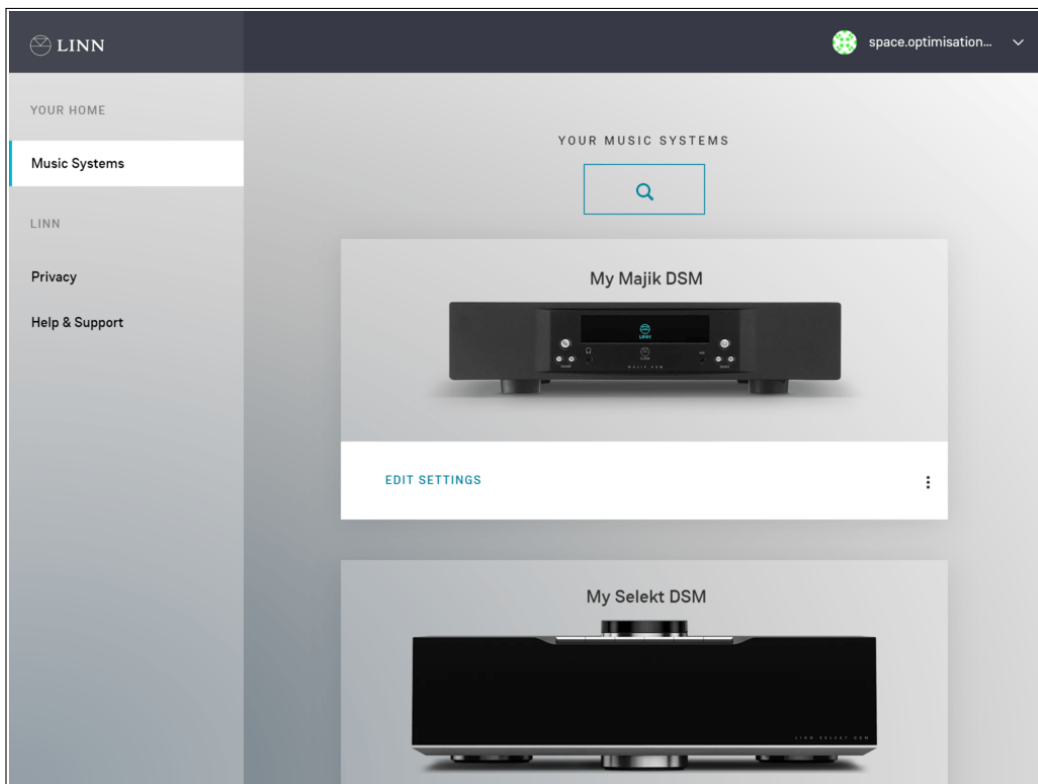
Once your music system has been added to your Linn account it will appear on the **Music Systems** page, as shown below.



Click on the **Edit Settings** link under your music system; you will be taken to the settings page for your music system, as shown below. You can configure all of your music system's settings here. In particular, you can rename your music system at any time by clicking on the system name under the **General** tab; note that music systems and rooms are now considered as separate entities within your Linn account, therefore when renaming your music system you may wish to avoid names such as 'Living Room' or 'Kitchen', instead opting for names such as 'My Majik DSM' or 'My Akurate DSM'.



You may also add multiple music systems to your Linn account; each music system will then be listed on the **Music Systems** page, as shown below. Note that you can also remove a music system from your Linn account at any time by clicking on the **:** drop-down menu under the music system and clicking on **Remove**, or through [Linn Kazoo](#).



1.2 Optimisation algorithm updates

In this section the most significant updates to the Space Optimisation algorithm are detailed.

The optimisation algorithm has been updated to support non-rectangular rooms; this update is detailed in §1.2.1.

The optimisation algorithm has also been updated based on psychoacoustic research; this update is detailed in §1.2.2.

Finally, the updates to the optimisation algorithm have resulted in a longer calculation time; this issue is detailed in §1.2.3.

1.2.1 Support for non-rectangular rooms

In earlier versions of Space Optimisation, previously available through Linn Konfig, all rooms were assumed to be rectangular. This assumption allowed for the use of analytical acoustic modelling of the interactions between your speakers and room; while sufficiently valid for minimally non-rectangular rooms, this assumption was invalid for general non-rectangular rooms. To account for this sometimes invalid assumption users were given the ability to adjust individual room modes and add custom filters in order to arrive at a valid optimisation.

In the new version of Space Optimisation, available through your Linn account, non-rectangular rooms may now be modelled. This new capability is allowed for by the use of highly sophisticated acoustic modelling of the interactions between your speakers and room; validity is thus assured for all rooms. Due to this assured validity the ability to adjust individual room modes and add custom filters has been removed; any adjustments will now be dictated by either refinements of the model inputs or user preference, and may be made through the advanced settings, as outlined in §3.

Note that rooms with partial-height recesses or protrusions on walls, rooms with free-standing walls, and rooms with non-flat floors or ceilings are currently unsupported, and so a room simplification procedure must be adopted, as outlined in §3.4.

1.2.2 Optimisation based on psychoacoustic research

Psychoacoustic research has shown that listeners have a preference not only to a flat frequency response, but also to a uniform decay time. A non-flat frequency response may be associated with the perception of 'one note bass', where a particular bass note masks other notes around it, leading to a monochromatic bass line. A non-uniform decay time may be associated with the perception of 'boominess', where a particular bass note rings out for longer than other notes around it, leading to a booming bass line.

In earlier versions of Space Optimisation, previously available through Linn Konfig, the optimisation precisely identified frequencies that were artificially distorted by the environment, and reduced their energy to give a flat frequency response.

In the new version of Space Optimisation, available through your Linn account, the optimisation can also identify how these artificial distortions change over time, and reduce their decay times to give a uniform

decay time. Furthermore, the optimisation has been updated to give a better balance of low- and mid-frequency energy. The user is also able to adjust the optimisation according to their preference, as outlined in §3.3.

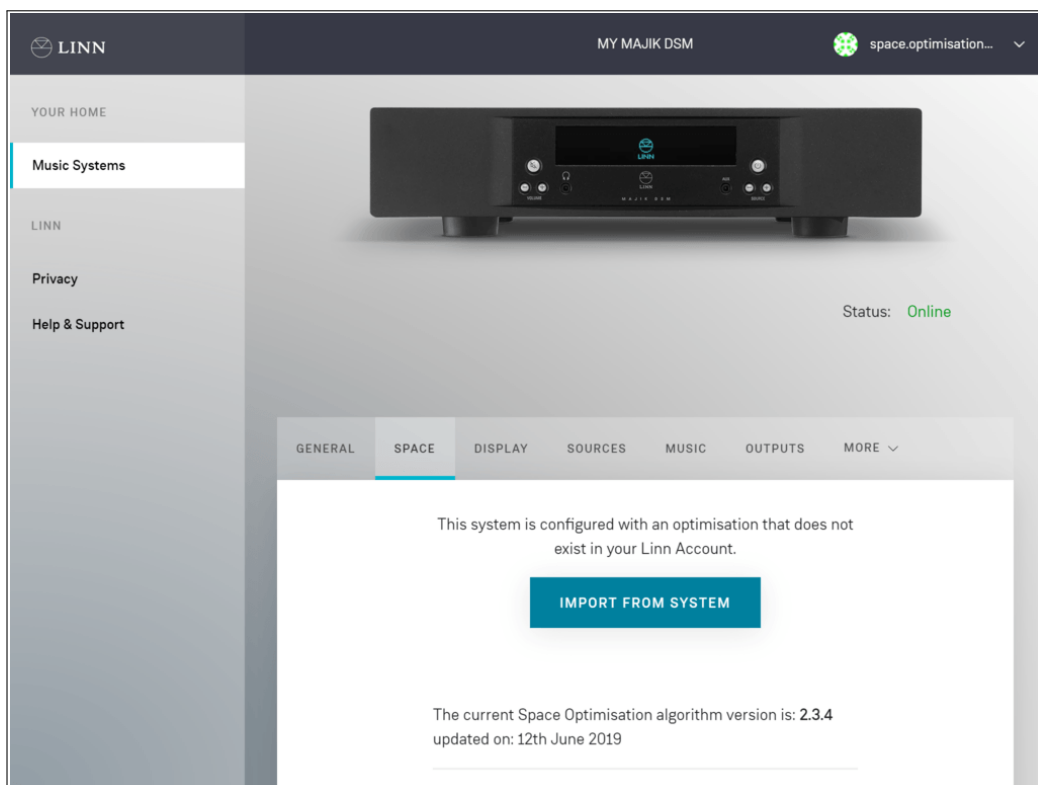
1.2.3 Optimisation calculation time

Although every effort has been made to ensure short calculation times, including the use of dedicated GPGPU cloud-computing, the use of highly sophisticated acoustic modelling in the new version of Space Optimisation, available through your Linn account, means optimisations will take longer to calculate than earlier versions of Space Optimisation, previously available through Linn Konfig. This calculation time will depend on your room and speakers, with large rooms containing multiple speakers taking longer to calculate than small rooms containing few speakers; optimisation calculations may take anywhere between four and twenty minutes, with a typical optimisation calculation taking around five minutes.

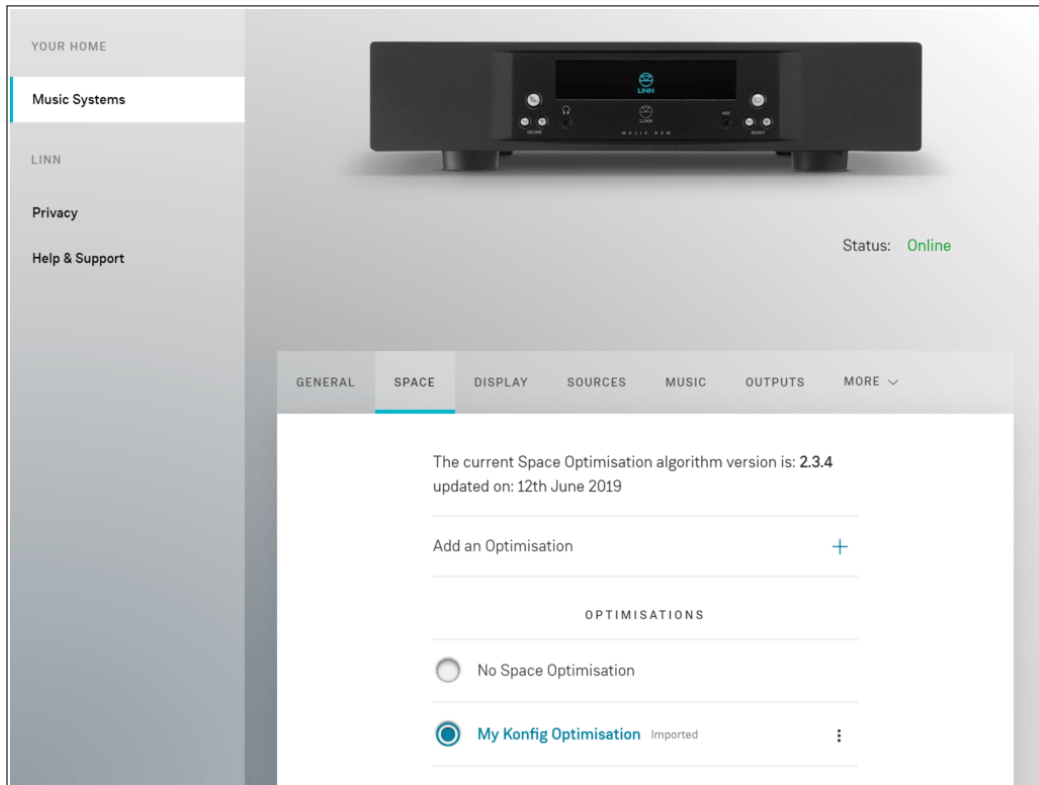
However, the benefits of the new version of Space Optimisation over earlier versions, as outlined in §1.2.1 and §1.2.2, massively outweigh this increase in calculation time.

1.3 Importing a previous optimisation

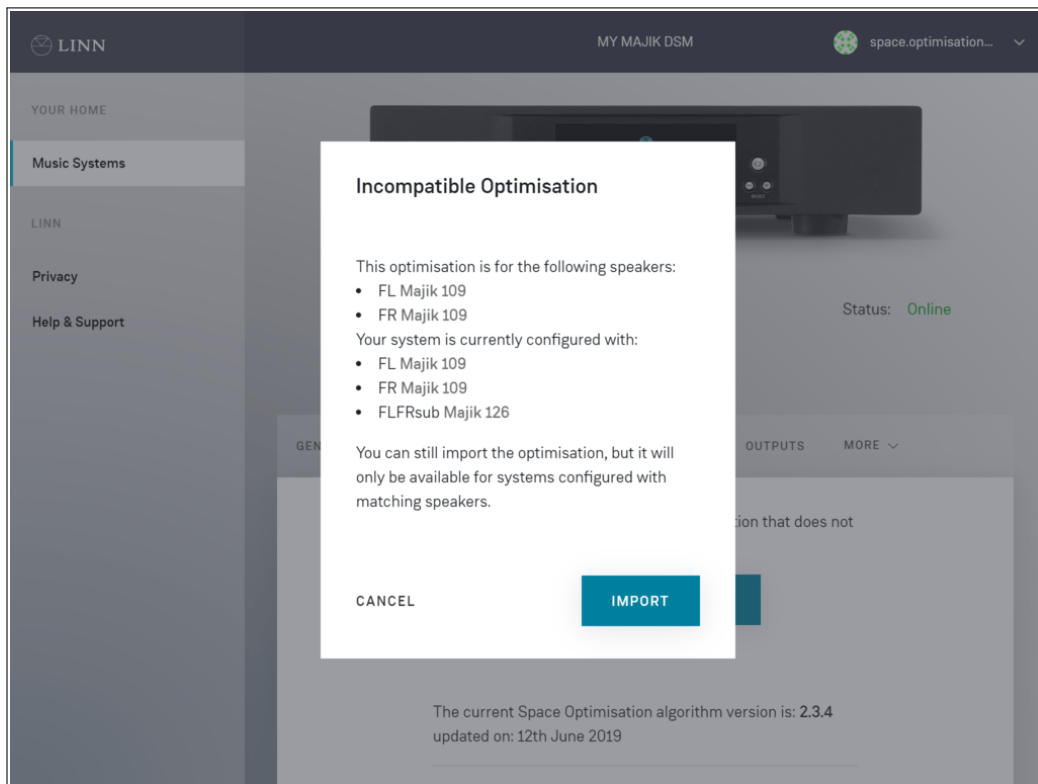
In the case that your Linn DS/DSM system has already been optimised, through either Linn Konfig or a different Linn account, a **Space** tab will be visible on the **Music Systems** page for that system, as shown below.



Click on the **Import from System** button to extract the optimisation from your Linn DS/DSM system. The optimisation will be added to a list of optimisations below the **Optimisations** heading; this optimisation will be flagged as being imported, as shown below. Note that this optimisation contains only the resultant data of the optimisation, and not the optimisation inputs such as room information or speaker and listening locations.



Note that if the music system and speakers for the optimisation you wish to import does not match that specified in your Linn account, a dialog warning you of this incompatibility will appear, as shown below. Clicking on the **Import** button will import the optimisation; however, the optimisation will not show in the list of optimisations below the **Optimisations** heading, as this list shows only the optimisations which are compatible with your music system and speakers.



Should you wish to import further Linn Konfig optimisations, you may apply these through Linn Konfig whilst logged in to your Linn account, then follow the procedure outlined above to extract them from your Linn DS/DSM system and add them to the list of optimisations. However, it is recommended that you redefine any previous optimisations through your Linn account, in order to take advantage of the improvements in the new version of Space Optimisation over earlier versions.

2 Basic setup

Before commencing optimisation please ensure that your music system has been added to your Linn account, as outlined in §1.1.1.

2.1 Installing your speakers using Tune Dem

2.1.1 Installing your speakers

When installing your speakers you should first decide along which axis of the room the speakers should be installed; for example, in a rectangular room the speakers will usually sound best along the short axis of the room. The **Tune Dem** method should then be used to find the ideal locations for your speakers; these are the locations where it is easiest to follow the tune. Correct identification of the ideal locations for your speakers is essential if you wish to achieve the full potential of both your music system and Space Optimisation; Space Optimisation is able to recreate the sound of your speakers in their ideal locations, even if you have been forced to move them to a more practical location due to domestic constraints, to give you the best of both worlds.

If you are unsure of how to find the ideal locations for your speakers please contact your expert Linn retailer.

2.1.2 Installing your additional subwoofers

Additional subwoofers may be connected to your Linn DS/DSM via the analogue outputs; note that the term additional subwoofer here refers to a subwoofer connected to an analogue output to which speakers are also connected. When installing your additional subwoofers you should aim to locate them close to your speakers; for example, in a 2.1 system the additional subwoofer will usually sound best equidistant between the speakers, and in a 2.2 system the additional subwoofers will usually sound best close to the speakers. Again, the **Tune Dem** method should be used to find the ideal locations for your additional subwoofers. Correct identification of the ideal locations for your additional subwoofers is essential if you wish to achieve the full potential of both your music system and Space Optimisation.

Additionally, when installing your additional subwoofers you should bung any ports on your speakers, and then aim to match the roll off setting on your additional subwoofer's internal DSP unit to the roll on of your speakers; depending on the method of filtering applied by your additional subwoofer's internal DSP unit you may also require a phase inversion to get the best sound.

Finally, note that you should aim to locate your additional subwoofers such that your speakers and additional subwoofers are equidistant from the listening location; as your speakers and additional subwoofers share an analogue output, Space Optimisation is unable to apply separate delays to the speakers and additional subwoofers to ensure the content from the speakers and additional subwoofers reaches your ears at the same time.

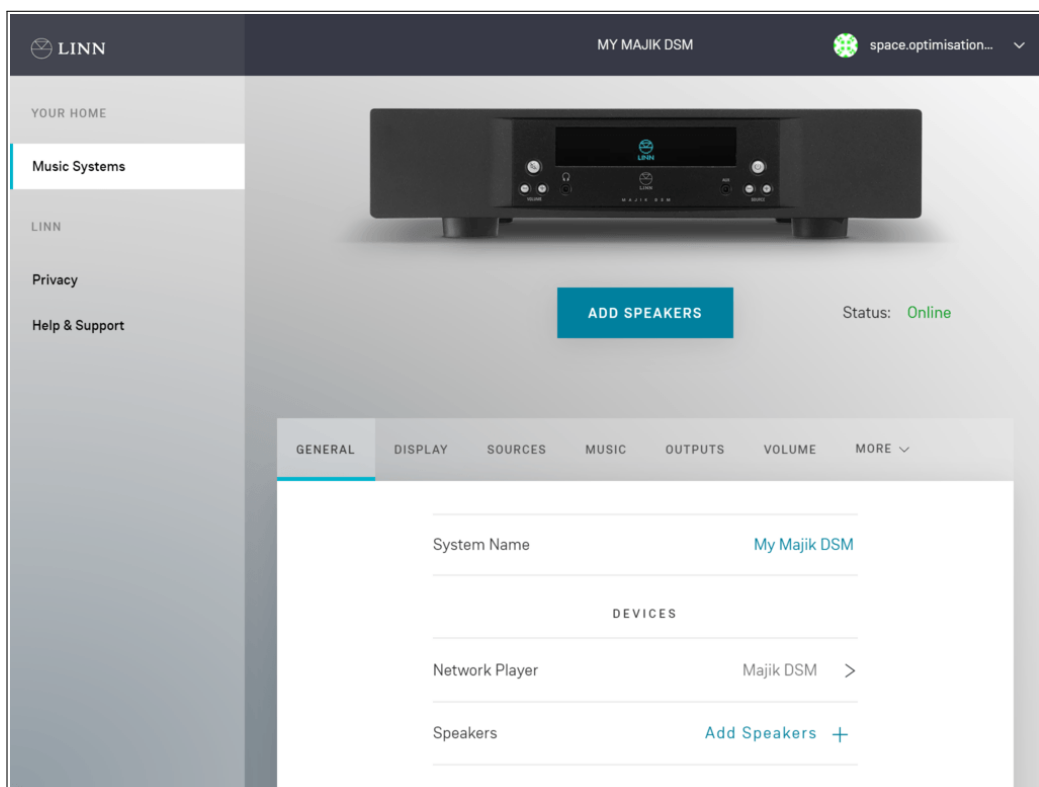
If you are unsure of how to find the ideal locations for your additional subwoofers please contact your expert Linn retailer.

2.2 Adding your speakers to your music system

Space Optimisation takes account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports. You must therefore inform your Linn account of the speakers being used with your music system before Space Optimisation can be applied.

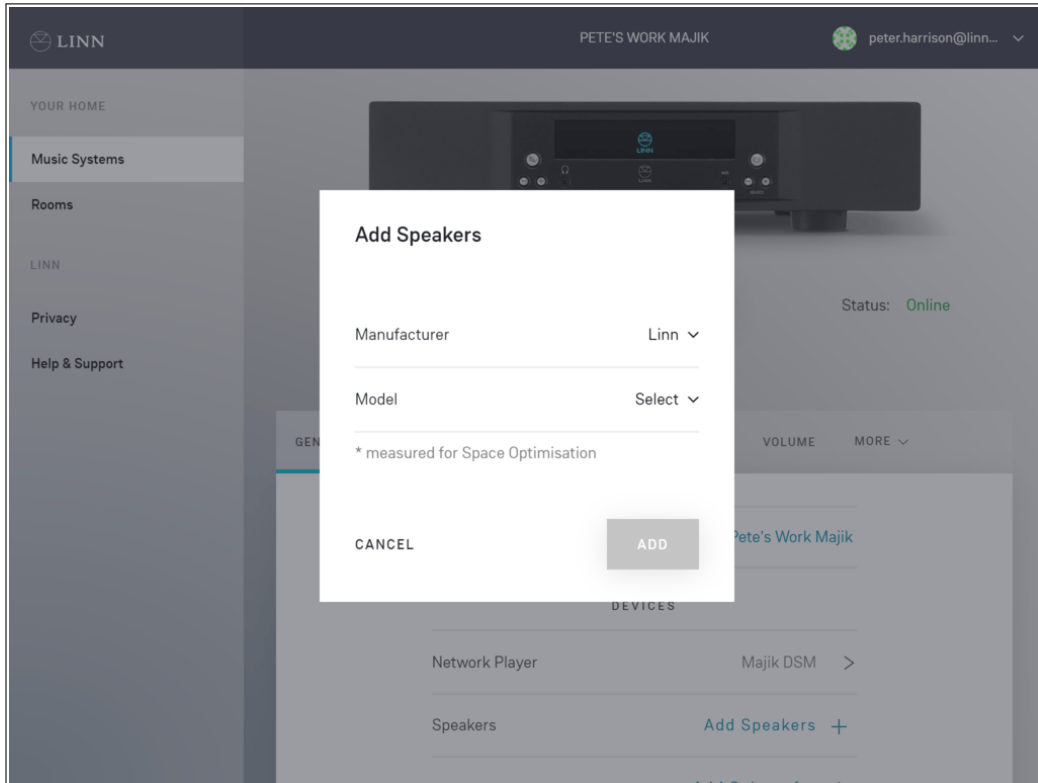
2.2.1 Adding your speakers

Navigate to the **General** tab on the **Music Systems** page for the system you wish to optimise. If no speakers have previously been added to your music system you will see an **Add Speakers** button below the graphic of your music system, and a similar link under the **General** tab, as shown below.

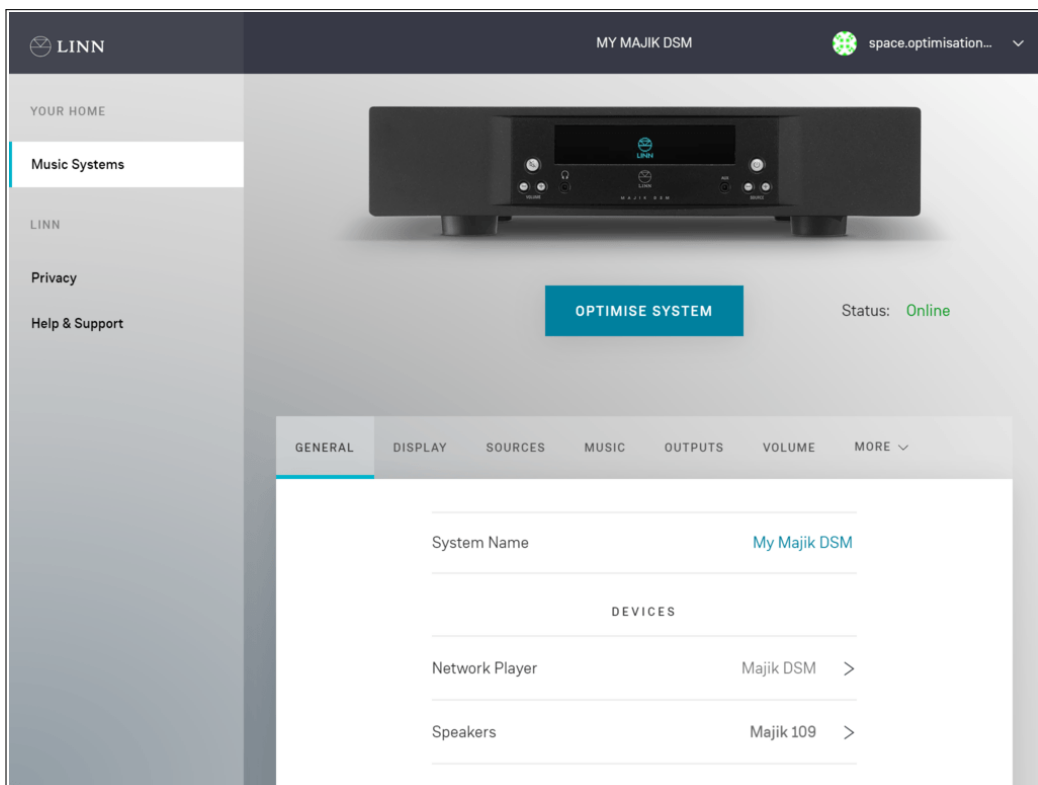


Click on either the **Add Speakers** button or link; a dialog prompting you to provide the manufacturer and model of your speakers will appear, as shown below. Select the manufacturer and model of your speakers using the drop-down menus, then click on the **Add** button; if your speakers' manufacturer or model does not appear in the drop-down menu, select **Other**. If your speakers have been measured for Space Optimisation an asterisk will appear next to your speakers' model; this means that Space Optimisation can take account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports. Otherwise, your speakers will be modelled as point sources; this means that you can still benefit from the room and placement optimisation functionality of Space Optimisation.

If you wish to have your speakers measured for Space Optimisation please contact your expert Linn retailer.

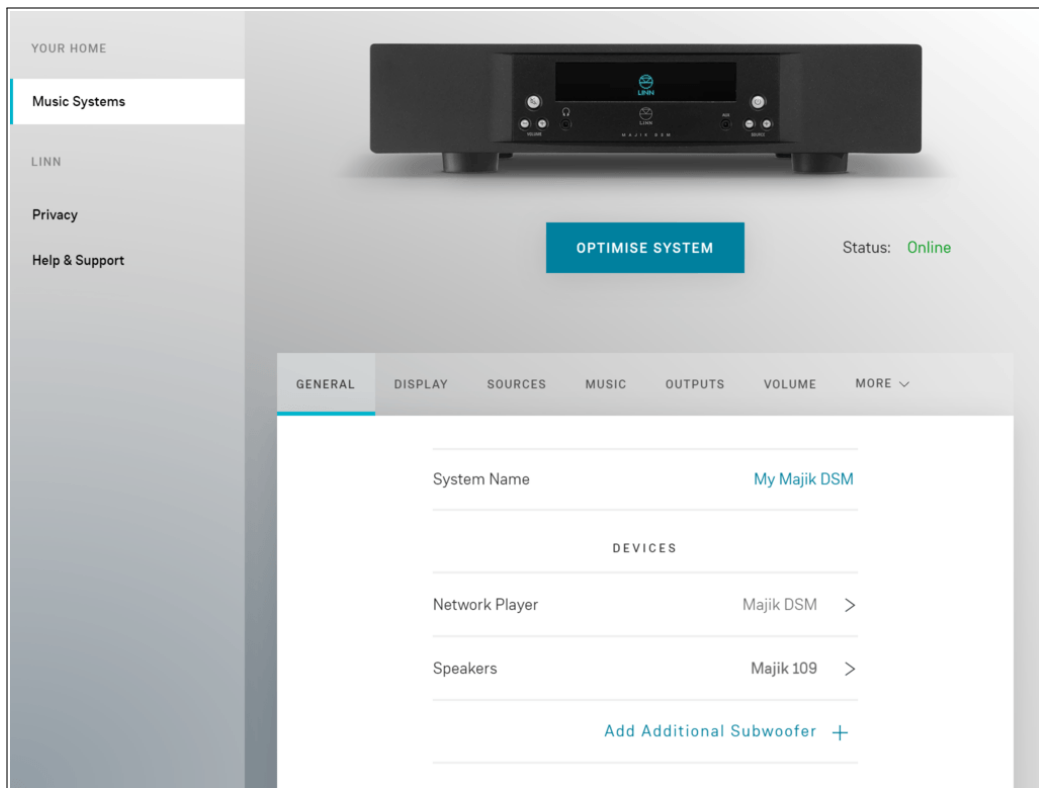


Once your speakers have been added to your music system they will appear under the **General** tab, as shown below; note that you can remove your speakers at any time by clicking on the speakers' name under the **General** tab and clicking on the **Remove Speakers** button.

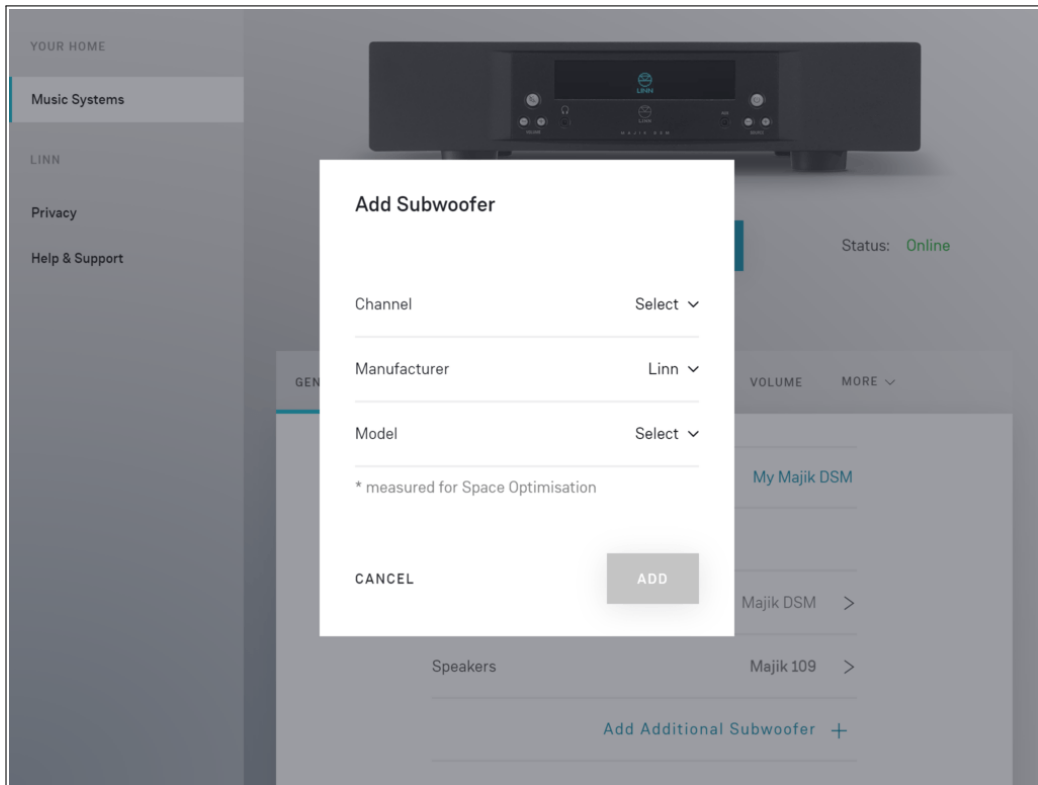


2.2.2 Adding your additional subwoofers

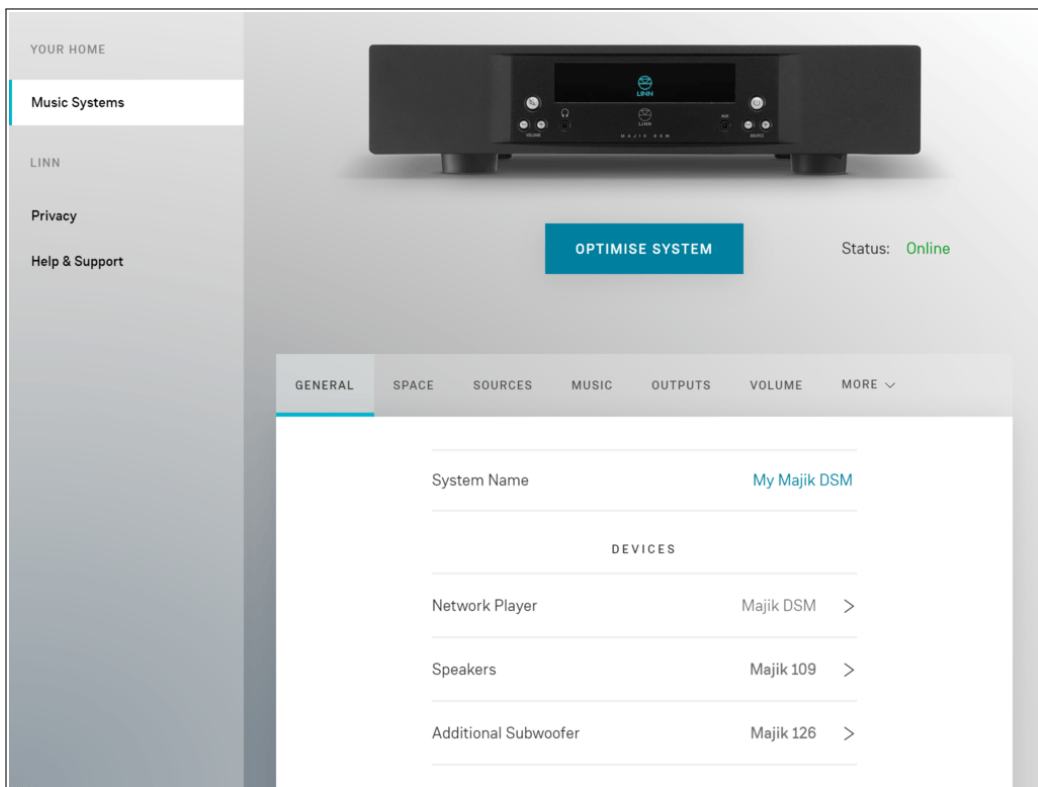
You will also see an **Add Additional Subwoofer** link under the **General** tab, as shown below.



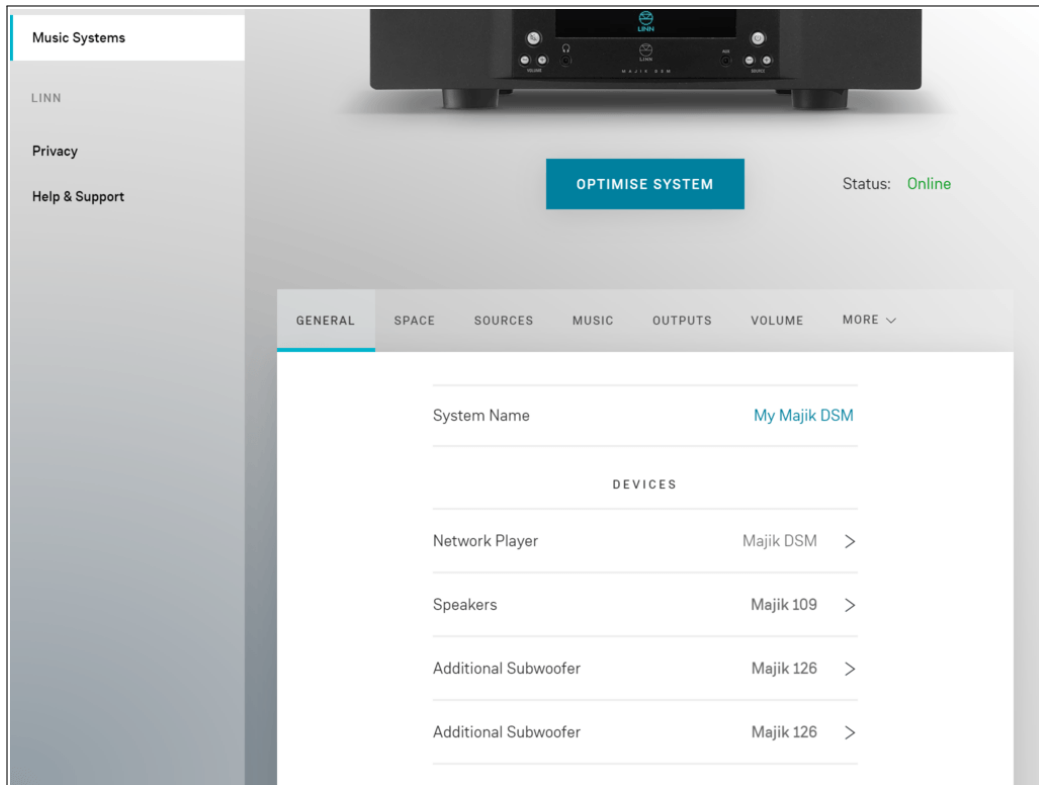
Click on the **Add Additional Subwoofer** link; a dialog prompting you to provide the channel, manufacturer and model of your additional subwoofer will appear, as shown below. Select the channel, manufacturer and model of your additional subwoofer using the drop-down menus, then click on the **Add** button; if your additional subwoofer's manufacturer or model does not appear in the drop-down menu, select **Other**.



Once your additional subwoofer has been added to your music system it will appear under the **General** tab, as shown below.

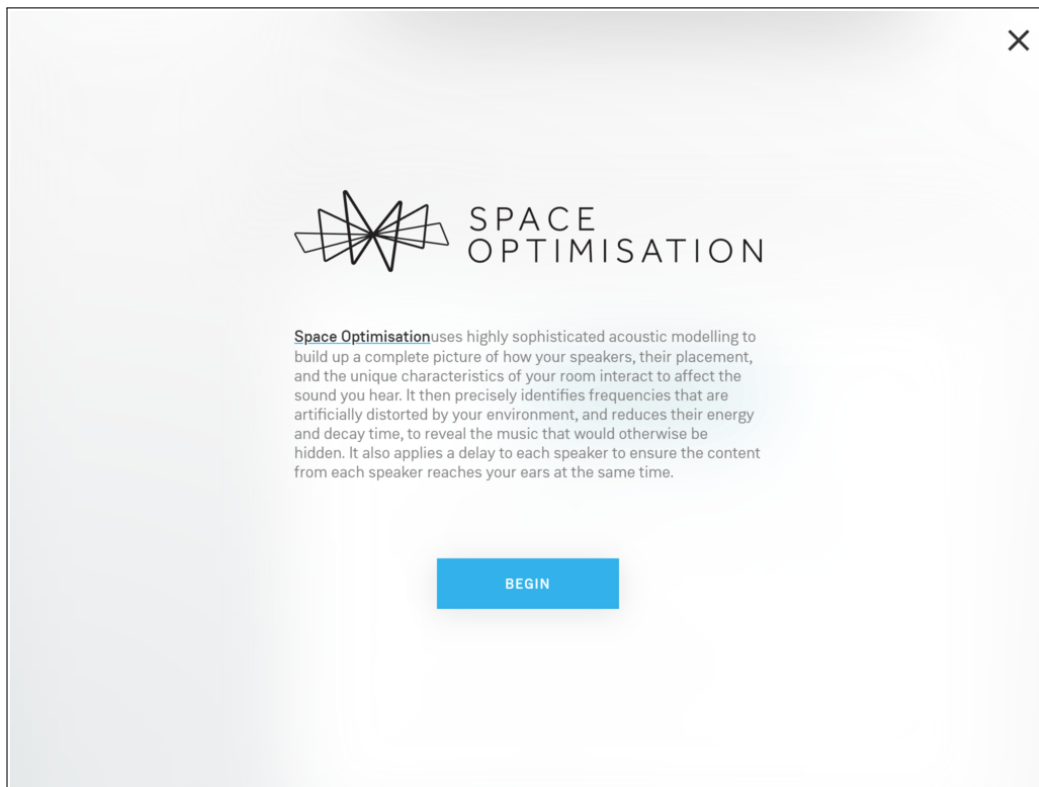


You may also add multiple additional subwoofers to your music system; each additional subwoofer will then be listed under the **General** tab, as shown below; note that you can change the assigned channel of an additional subwoofer at any time by clicking on the additional subwoofer's name under the **General** tab and reassigning the channel using the **Channel** drop-down menu, or remove it by clicking on the **Remove Additional Subwoofer** button.



2.3 Optimising your music system

If your music system is not currently optimised you will see an **Optimise System** button below the graphic of your music system, as shown above. Click on the **Optimise System** button; a dialog with a brief explanation of Space Optimisation will appear, as shown below.



2.3.1 Entering your room information

Space Optimisation takes account of the characteristics of your room, such as room dimensions, construction materials, and features like doors and windows. You must therefore inform your Linn account of your room information. Your Linn account then stores your room information separately from your music system; this makes it quick and easy to upgrade your music system, or move your music system to a new room.

Room name

Click on the **Begin** button; a dialog prompting you to provide a name for your room will appear, as shown below.

✕

Room Name

Choose a meaningful name for the room where this music system is located, for example **Main Room** or **Kitchen**

Name Main Room

NEXT

Enter an appropriate name for your room, such as 'Living Room' or 'Kitchen', and click on the **Next** button; the Space Optimisation user interface will appear, as shown below. The Space Optimisation user interface has three key steps; **Room Dimensions**, **Room Features**, and **Speaker Locations**.

SPACE OPTIMISATION

MAIN ROOM
✕

ROOM STEPS

Room Dimensions

- Floor Plan
- Height

Room Features

SPEAKER STEPS

Speaker Locations

OPTIONAL STEPS

Environmental

Absorption

Optimisation Preference

5 m

5 m

0.1m

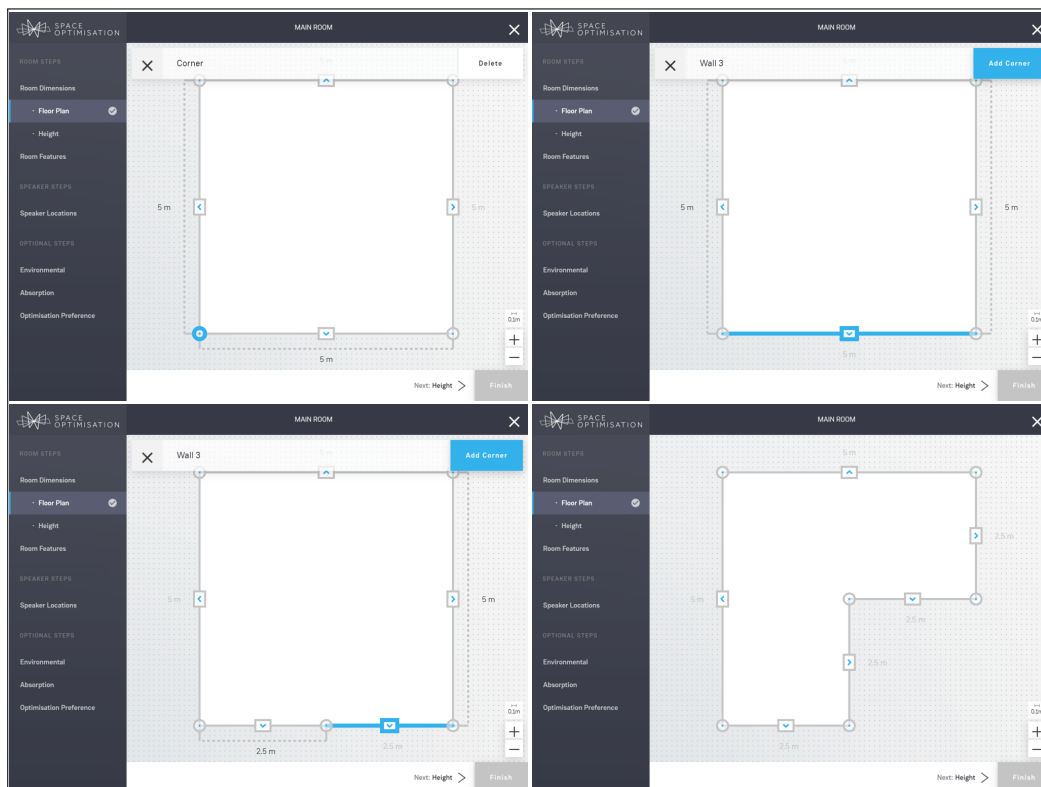
+
-

Next: Height >
Finish

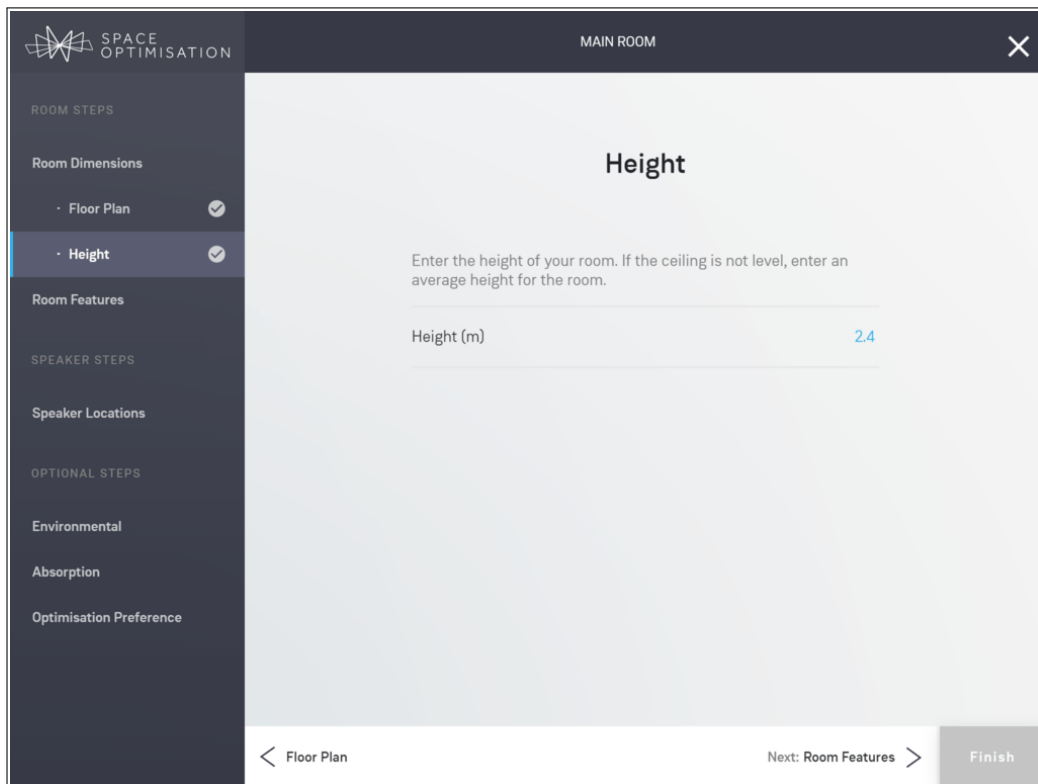
Room dimensions

In order for Space Optimisation to give you an accurate optimisation you must ensure that you have carefully measured your room; for open plan rooms, all rooms open to the main listening room should be measured. Note that small geometrical features with dimensions less than around 10 cm, such as skirting boards, architraves and window sills, and any hard furnishings, such as cupboards or wardrobes, should be ignored. All measurements are given in metres.

The **Room Dimensions** step is split into the **Floor Plan** and **Height** steps. In the **Floor Plan** step you can define your floor plan using three simple mechanisms, as shown below: you may select any corner with a click, drag it to any desired location, move it in 1 cm increments using the arrow keys on your keyboard, or delete it by clicking on the **Delete** button in the contextual control bar at the top; similarly, you may select any wall with a click and drag it to any desired location, or move it in 1 cm increments using the arrow keys on your keyboard; and finally, you may add corners to a selected wall by clicking on the **Add Corner** button in the contextual control bar at the top. These mechanisms give you complete control over the floor plan. Note that you can also zoom in and out using the $+/-$ zoom buttons in the bottom right-hand corner, or using the scroll wheel on your mouse; the grid size is clearly stated above these buttons. When dragging corners and walls they will snap to the current grid size; adjacent walls will also prefer to snap to a 90 degree angle. Note that rooms with partial-height recesses or protrusions on walls and rooms with free-standing walls are currently unsupported, and so a room simplification procedure must be adopted, as outlined in §3.4.



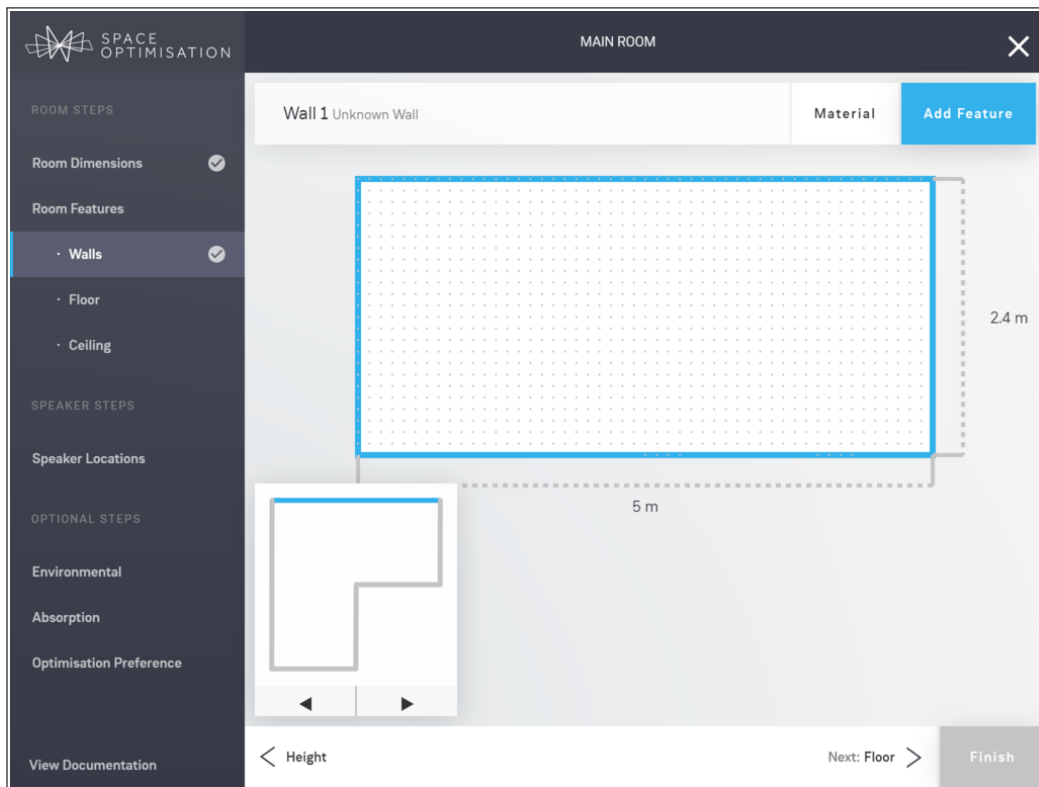
Once your floor plan has been defined click on the **Next: Height >** link in the bottom navigation pane to enter the **Height** step, as shown below. Note that rooms with non-flat floors or ceilings are currently unsupported, and so a room simplification procedure must be adopted, as outlined in §3.4. Enter the height of your room and click on the **Next: Room Features >** link in the bottom navigation pane.



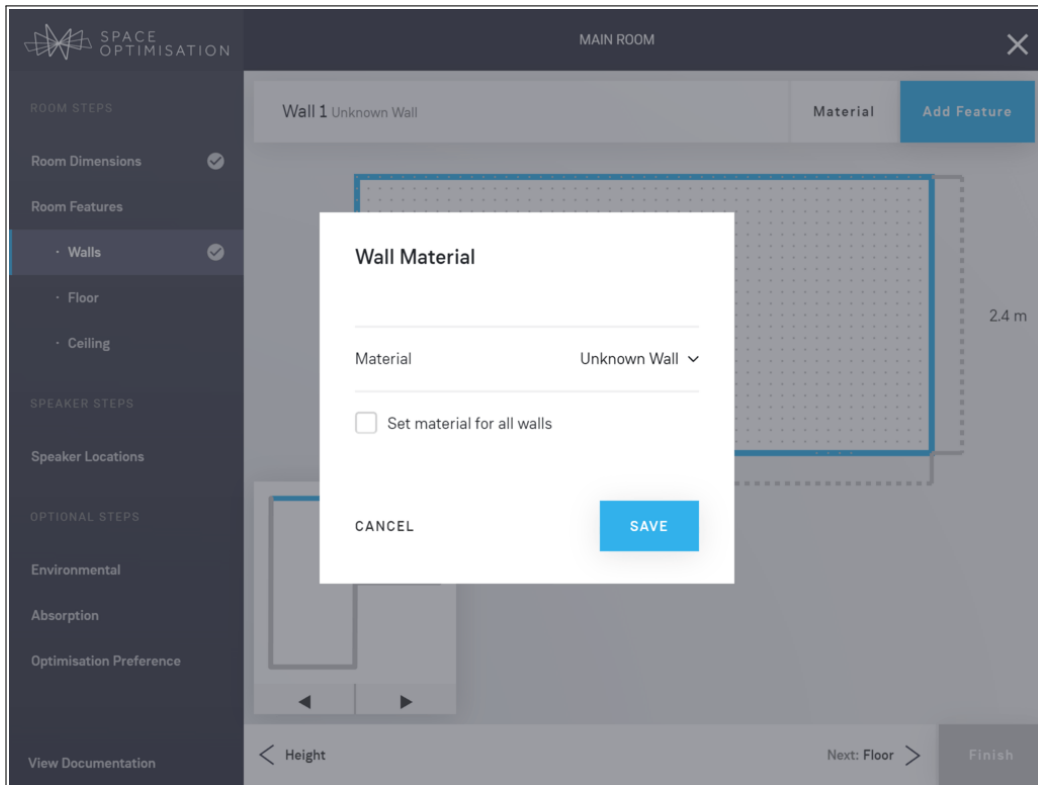
Room features

In the **Room Features** step you can define the construction materials of your room's surfaces and the features like doors and windows on each surface. You now have the ability to correctly place the features on each surface; the new version of Space Optimisation correctly considers the effects of the placement of features on the interaction between your room and your speakers. Note that any soft furnishings, such as carpets and curtains, and any decorations, such as paintings and mirrors, should be ignored.

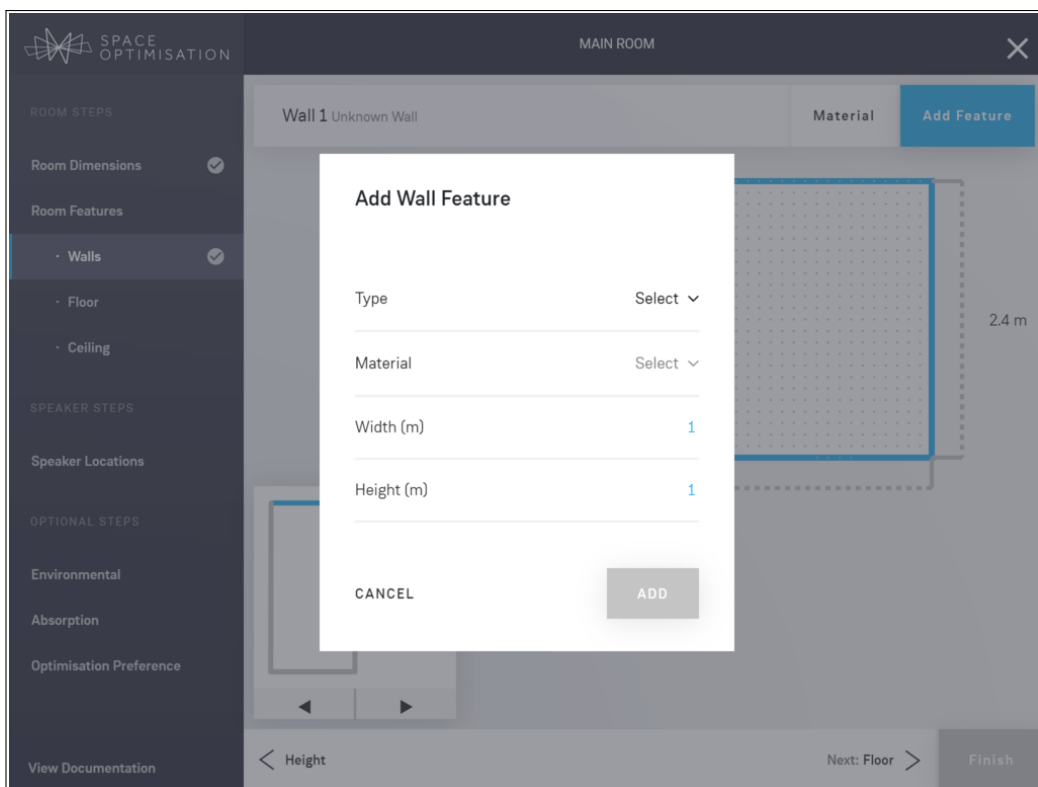
The **Room Features** step is split into the **Walls**, **Floor** and **Ceiling** steps. In the **Walls** step, as shown below, you can move between walls by either clicking on the desired wall in the mini-map in the bottom left-hand corner, or by clicking on the ◀/▶ buttons below the mini-map.



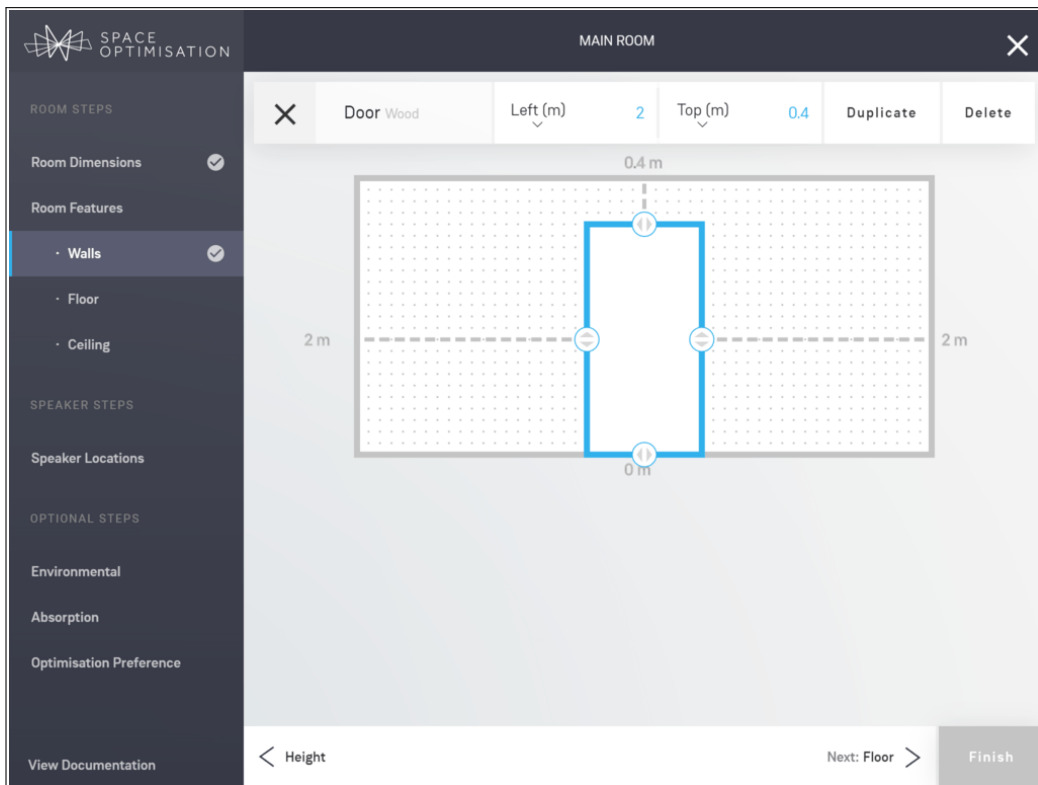
Once the desired wall is selected, you can select the construction material by clicking on the **Material** button in the contextual control bar at the top; a dialog prompting you to provide the material will appear, as shown below. Select the appropriate material using the drop-down menu: **Concrete** describes any solid or heavy construction, including brick, blockwork or stone; **Drywall** describes any mid-weight construction, including plaster on brick; **Partition** describes any flexible or lightweight construction, including wooden studwork or plasterboard walls; and **Unknown** provides an averaged absorption coefficient which should be used when the construction material is unknown. Once the desired material is selected, click on the **Save** button; note that if all of your walls are constructed from the same material, you may select the **Set material for all walls** check box to set the material for all walls.



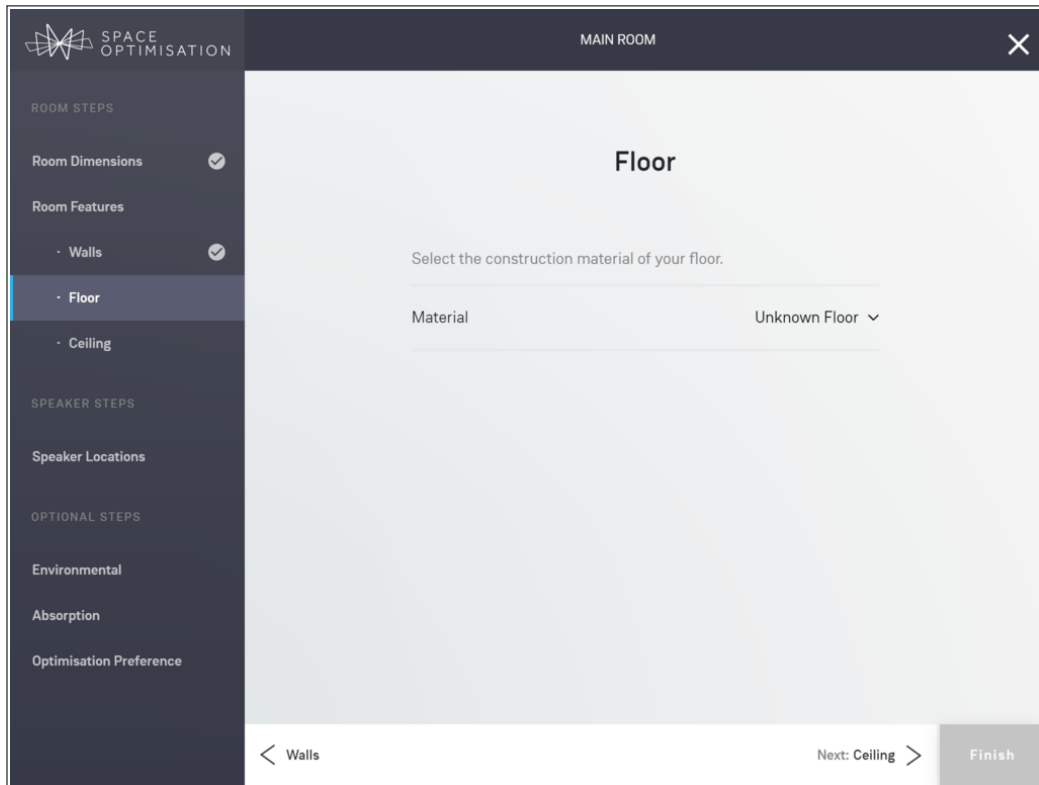
You can add features to the selected wall by clicking on the **Add Feature** button in the contextual control bar at the top; a dialog prompting you to provide the feature type, material and dimensions will appear, as shown below. Select the feature type and material using the drop-down menus, enter the feature dimensions, and click on the **Add** button.



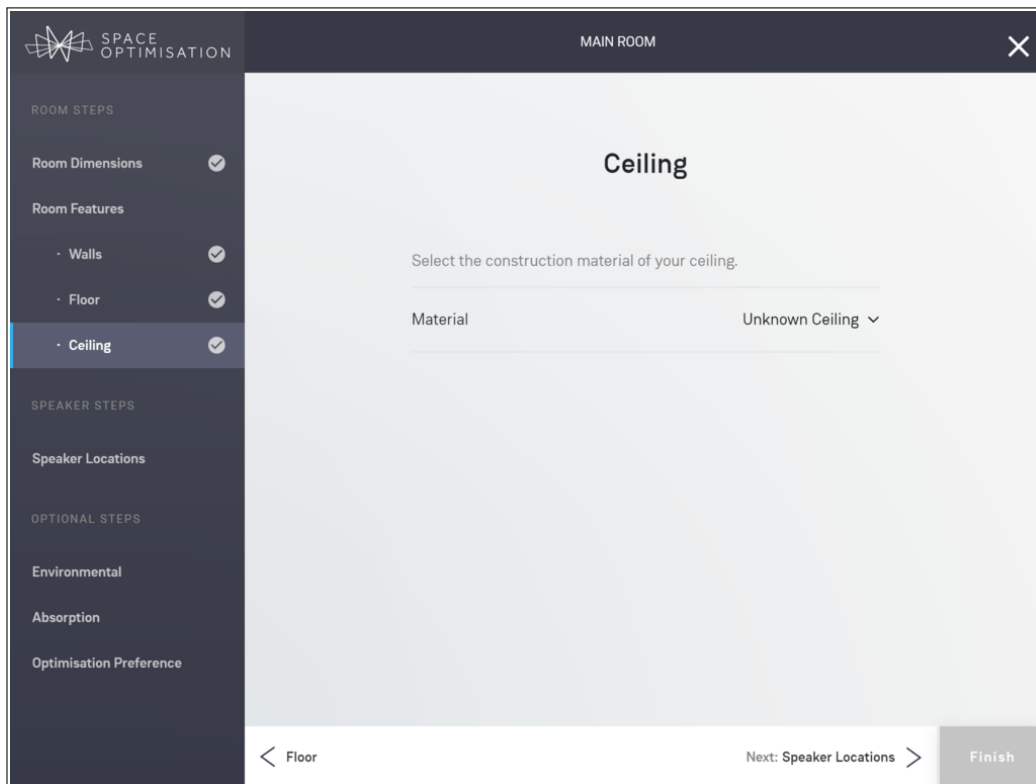
Once a feature has been added to the wall, as shown below, you can select it with a click and drag it to any desired location, move it in 1 cm increments using the arrow keys on your keyboard, or enter the measurements in the contextual control bar at the top, switching between the **Left (m)** and **Right (m)** measurements, and similarly between the **Top (m)** and **Bottom (m)** measurements, by clicking on the ∇ button below the appropriate measurement; you may also change where on the feature you wish to measure to by clicking on and dragging the \odot/\ominus icons. Deselecting the feature by clicking anywhere on the wall, you can add multiple features, and even inset features into one another, allowing you to add complex features such as doors with inset windows. Note that you can duplicate a feature at any time by selecting it with a click and clicking on the **Duplicate** button in the contextual control bar at the top, or delete it by clicking on the **Delete** button in the contextual control bar at the top.



Once the construction material and features have been defined for all of your walls click on the **Next: Floor** $\>$ link in the bottom navigation pane to enter the **Floor** step, as shown below. Select the construction material using the drop-down menu: **Concrete** describes any solid or heavy construction, including concrete or stone; **Suspended Floor** describes any suspended construction, including suspended floorboards; **Unknown Floor** provides an averaged absorption coefficient which should be used when the construction material is unknown. Note that floor features are currently unsupported, and so an approximation procedure must be adopted, as outlined in §3.2.1.



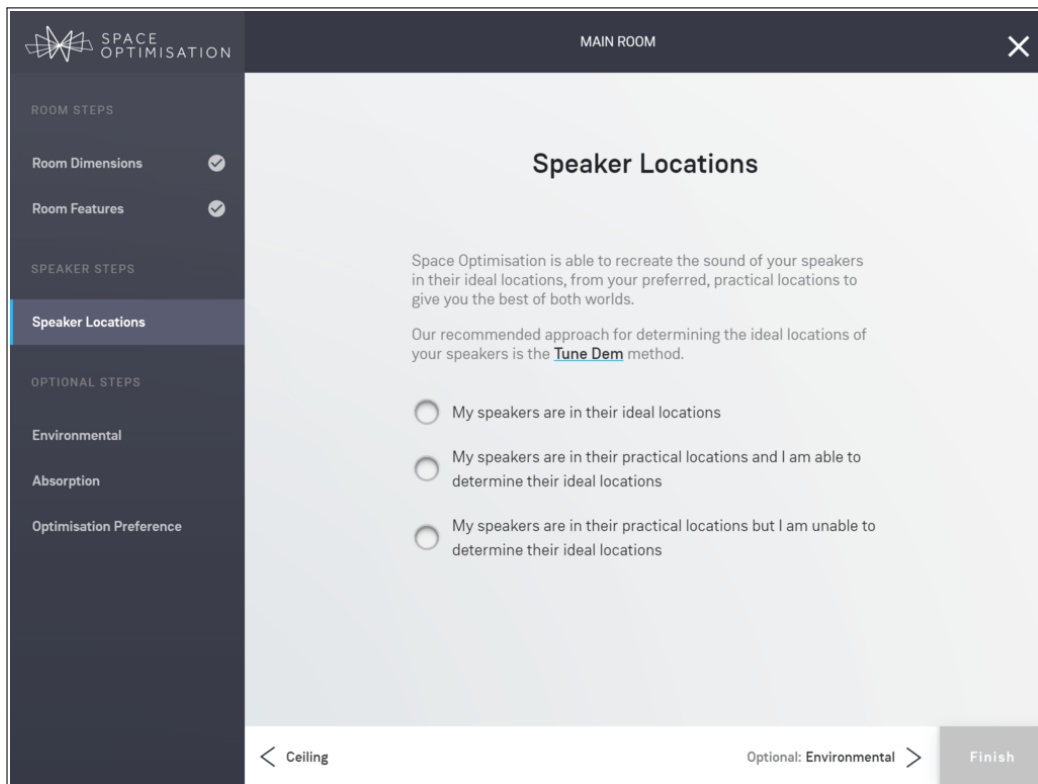
Once the construction material has been defined for your floor click on the **Next: Ceiling >** link in the bottom navigation pane to enter the **Ceiling** step, as shown below. Select the construction material using the drop-down menu: **Concrete** describes any solid or heavy construction, including concrete or stone; **Suspended Ceiling** describes any suspended construction, including suspended plasterboard or ceiling panels; **Unknown Floor** provides an averaged absorption coefficient which should be used when the construction material is unknown. Note that ceiling features are currently unsupported, and so an approximation procedure must be adopted, as outlined in §3.2.1.



2.3.2 Entering your speaker and listening locations

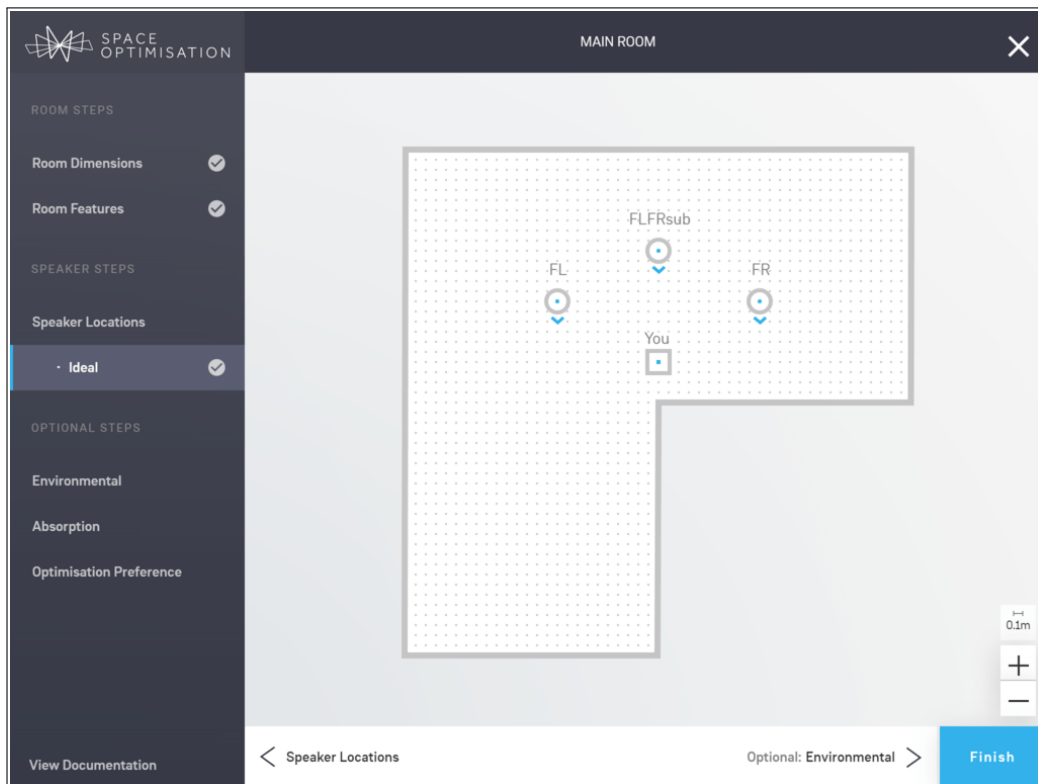
Space Optimisation takes account of the characteristics of your speakers, such as the position of each drive unit and the response of bass reflex ports. You must therefore inform your Linn account of your speakers' locations, as well as your listening location.

Click on the **Next: Speaker Locations** > link in the bottom navigation pane to enter the **Speaker Locations** step; you will be prompted to select the speaker location scenario that best matches your situation, as shown below. The **Speaker Locations** step is then split into one or two steps, **Practical** and/or **Ideal**, depending on your speaker location scenario. It is recommended that you determine the ideal locations for your speakers using the [Tune Dem](#) method to achieve the full potential of both your music system and Space Optimisation; however, sometimes you may need to make a compromise and move your speakers to more practical locations, or you may not have the ability to determine the ideal locations.

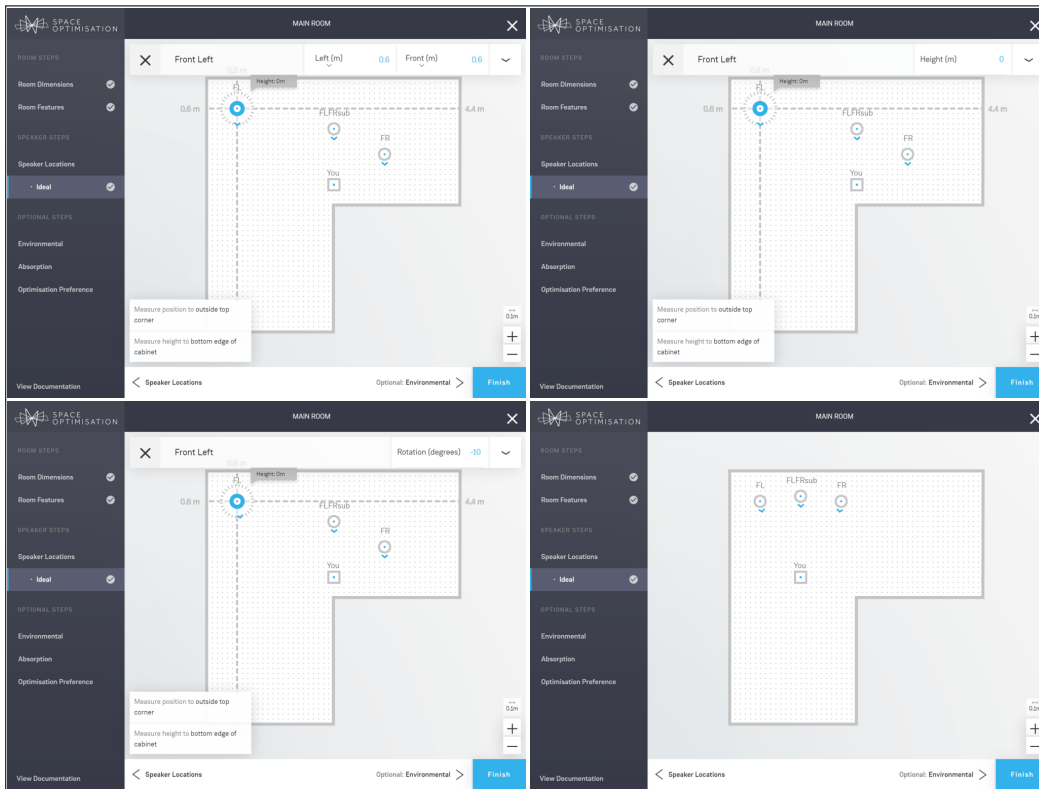


Ideal locations only

If you have determined the ideal locations for your speakers, and they can remain in these ideal locations, select the **My speakers are in their ideal locations** radio button and click on the **Next: Ideal >** link in the bottom navigation pane to enter the **Ideal** step. Your speakers will automatically appear, labelled according to their assigned channel, with the suffix **sub** for additional subwoofers, alongside your listening location, labelled as **You**, as shown below.



You can select any speaker with a click; when a speaker is selected, helpful hints will appear in the bottom left-hand corner with guidance as to where measurements should be made to on the speaker. Once a speaker has been selected you can define its location and orientation using three simple mechanisms, as shown below: you may drag the speaker to any desired location, move it in 1 cm increments using the arrow keys on your keyboard, or enter the measurements in the contextual control bar at the top, switching between the **Left (m)** and **Right (m)** measurements, and similarly between the **Front (m)** and **Back (m)** measurements, by clicking on the \vee button below the appropriate measurement; you may enter the speaker's **Height (m)** measurement by clicking on the far-right \vee drop-down menu in the contextual control bar at the top, selecting **Height**, and entering the measurement; and finally, you may enter the speaker's **Rotation (degrees)** measurement by clicking on the far-right \vee drop-down menu in the contextual control bar at the top, selecting **Rotation**, and entering the measurement. These mechanisms give you complete control over the speaker's location and orientation. Similarly, you can select the listening location with a click, and define its location with the same mechanisms as those for the speaker locations; this listening location should be measured to the average location of the centre of your head during normal listening. Note that if your room has any angled walls, you may view the measurement to any angled wall by clicking on the \sphericalangle icon in the contextual control bar at the top. For additional subwoofers, you may also enter the additional subwoofer's **Roll off frequency (Hz)** by clicking on the far-right \vee drop-down menu in the contextual control bar at the top, selecting **Roll Off**, and enabling roll off and entering the setting.



Practical and ideal locations

If you have determined the ideal locations for your speakers, but have been forced to move them to more practical locations, select the **My speakers are in their practical locations and I am able to determine their ideal locations** radio button and click on the **Next: Practical** > link in the bottom navigation pane to enter the **Practical** step. Define your speakers' practical locations as outlined above.

Once your speakers' practical locations have been defined, click on the **Next: Ideal** > link in the bottom navigation pane to enter the **Ideal** step. Define your speakers' ideal locations as outlined above.

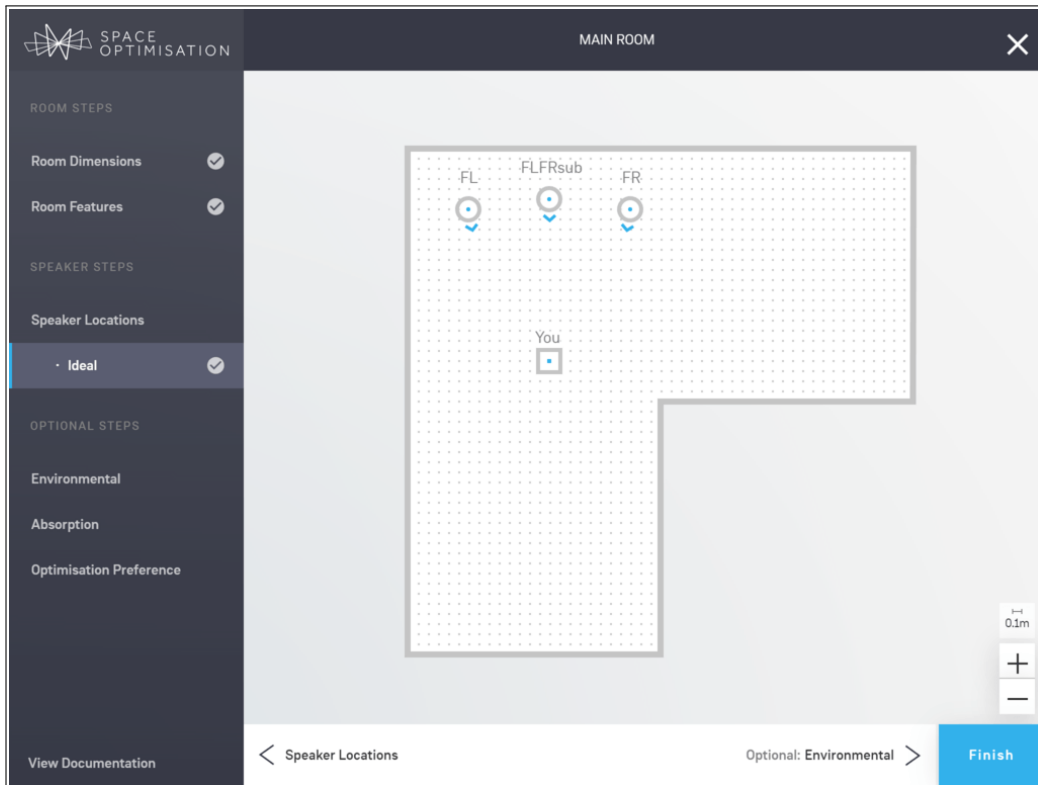
Practical locations only

If you are unable to determine the ideal locations for your speakers select the **My speakers are in their practical locations and I am unable to determine their ideal locations** radio button and click on the **Next: Practical** > link in the bottom navigation pane to enter the **Practical** step. Define your speakers' practical locations as outlined above.

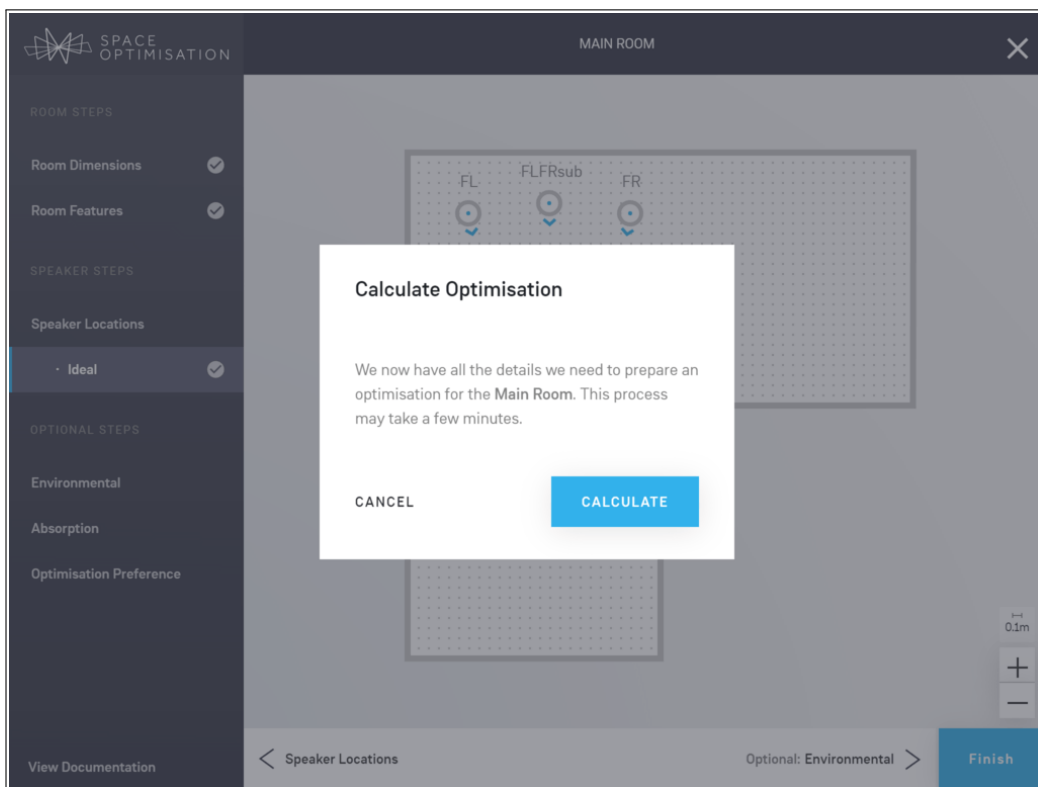
If you are unable to determine the ideal locations for your speakers, you may be able to achieve the full potential of both your music system and Space Optimisation by using the Virtual Tune Dem method outlined in §3.5.

2.3.3 Calculating the optimisation

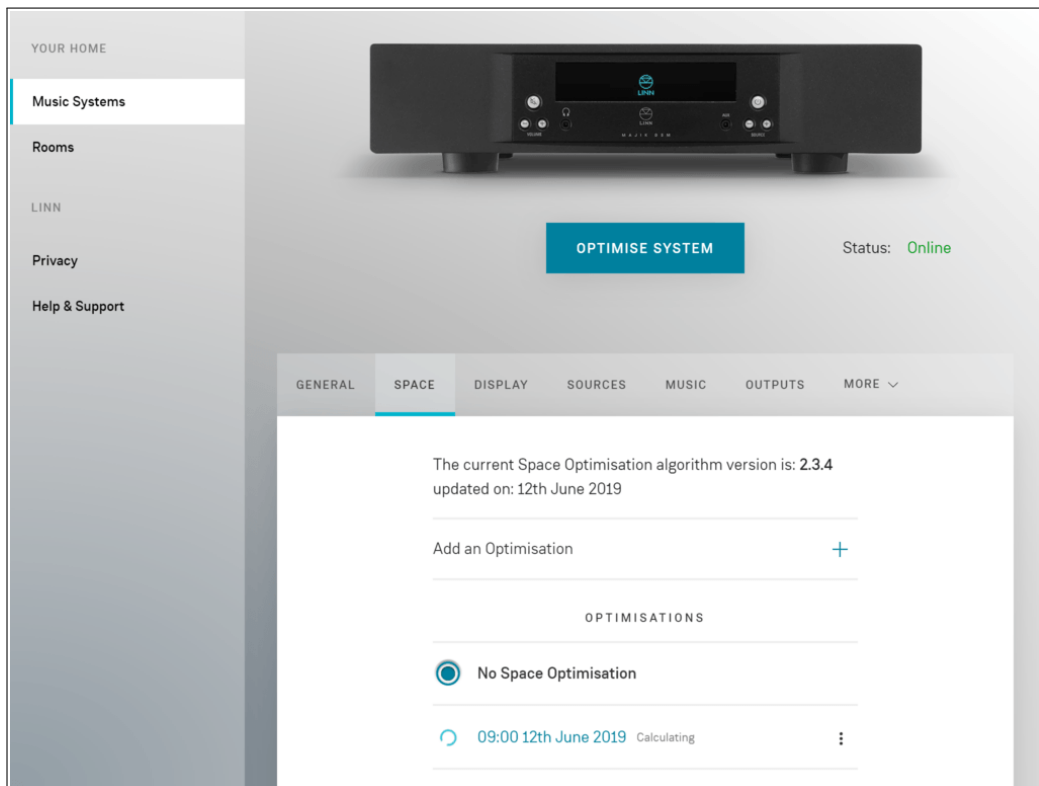
Once your room dimensions, room features, and speaker locations have been defined, the **Finish** button in the bottom navigation pane will turn blue, as shown below.



Click on the **Finish** button; a confirmation dialog will appear, as shown below. Click on the **Calculate** button to calculate your optimisation; this process may take a few minutes, as outlined in §1.2.3.

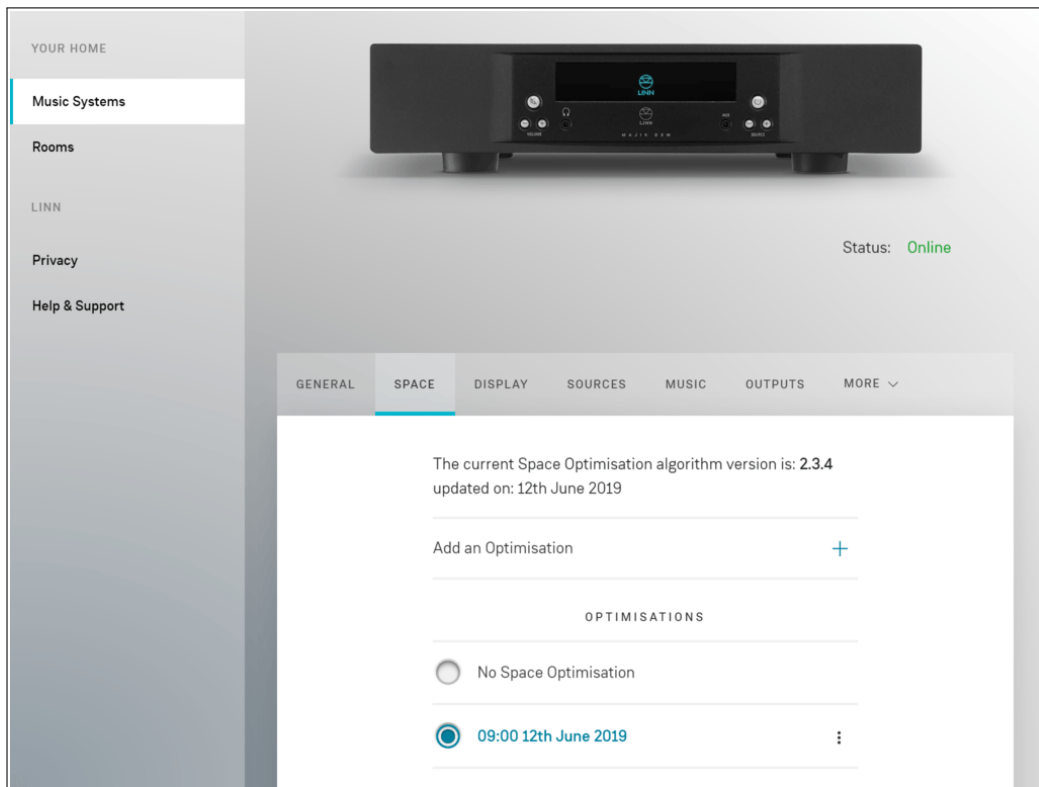


Whilst your optimisation is calculating you will be taken to the **Space** tab on the **Music Systems** page for your system, where your optimisation will be added to a list of optimisations below the **Optimisations** heading; it will be named with a time stamp, and flagged as **Calculating**, as shown below, until cloud-computing resources can be assigned and the calculation is completed.



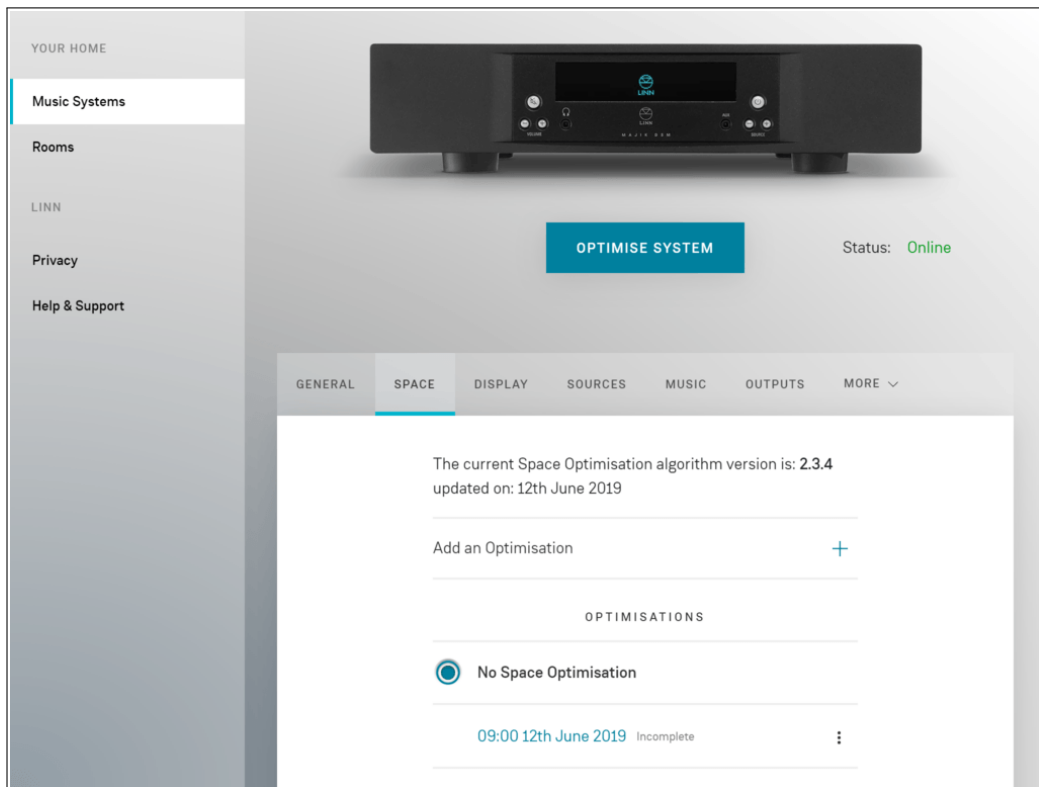
2.3.4 Applying the optimisation

Once calculated, the optimisation may be applied to your music system by clicking on the radio button next to its name, as shown below.



2.3.5 Resuming an incomplete optimisation

Note that you can exit the optimisation procedure at any time by clicking on the \times button in the top right-hand corner of the Space Optimisation user interface. The optimisation will be added to a list of optimisations below the **Optimisations** heading under the **Space** tab on the **Music Systems** page for your system; this optimisation will be flagged as being incomplete, as shown below. You may resume an incomplete optimisation at any time by clicking on the ⋮ drop-down menu to the right of its name and clicking on **Resume**; the process of defining the optimisation now proceeds as outlined above.

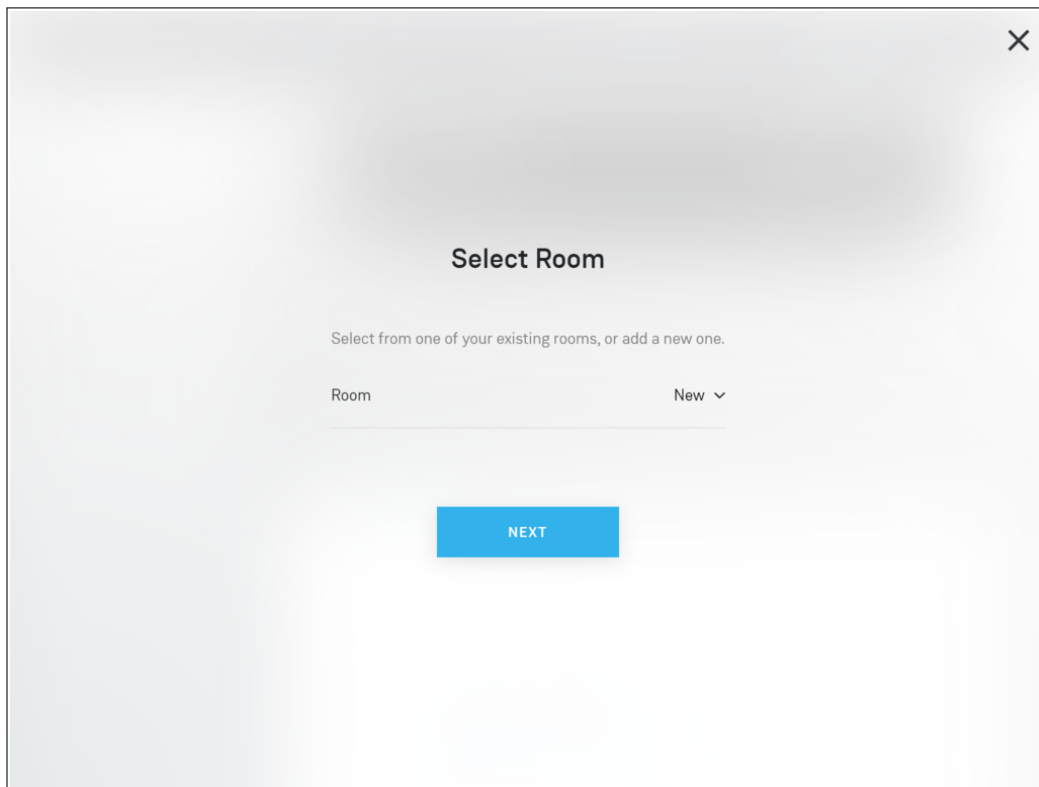


2.4 Re-optimising your music system

2.4.1 Adding an optimisation

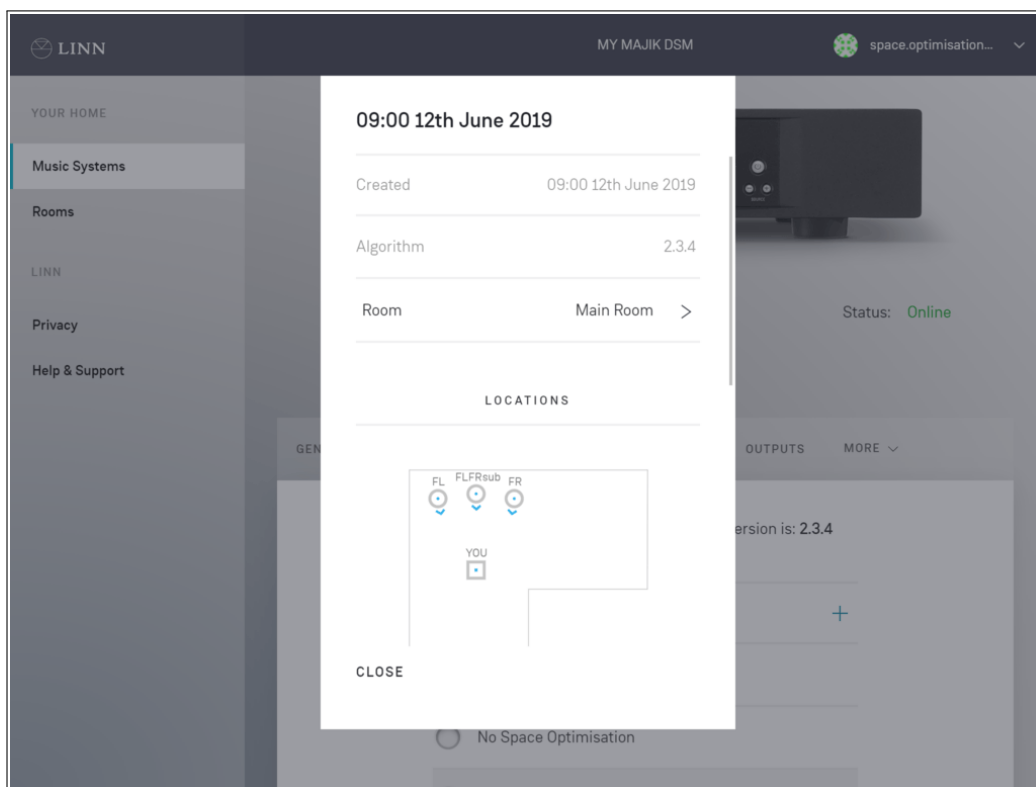
Once you have optimised your music system through your Linn account the **Optimise System** button below the graphic of your music system will disappear; you can now add further optimisations by clicking on the **Add an Optimisation** link under the **Space** tab on the **Music Systems** page for that system.


Click on the **Add an Optimisation** link; the dialog with a brief explanation of Space Optimisation will appear. Click on the **Begin** button; a dialog prompting you to choose the room you wish to create an optimisation for, or whether you wish to define a new room, will appear, as shown below. Choose a room to optimise for, or select **New** and enter an appropriate name for your room, and click on the **Next** button; the process of defining the optimisation now proceeds as outlined in §2.3.



2.4.2 Adjusting an optimisation

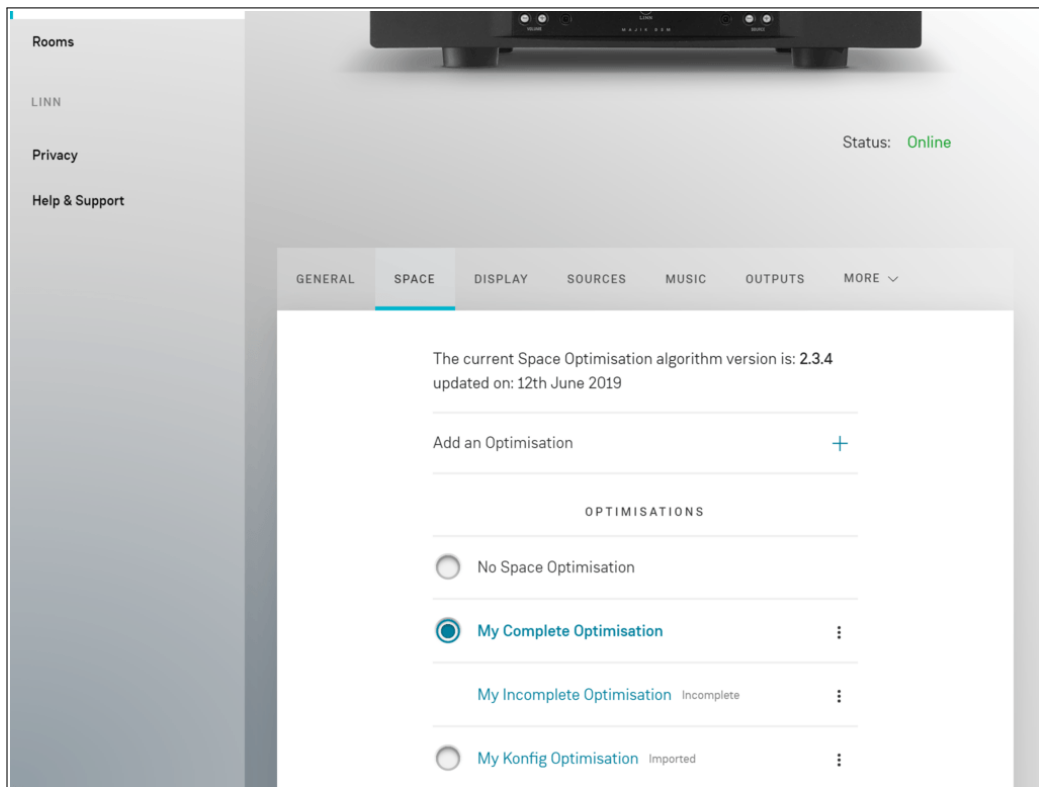
You may view the details of any complete optimisation created through your Linn account by clicking on the **:** drop-down menu to the right of its name and clicking on **Details**. A dialog with the details of the optimisation will appear, as shown below; within this dialog will be a graphic of your room and speaker setup, with further links to more detailed information on speaker and listening locations.



Should the details of an optimisation not match what you desire, the optimisation may be adjusted by clicking on the  drop-down menu to the right of its name and clicking on **Adjust**. The process of defining the optimisation now proceeds as outlined in §2.3; however, note that all information will already be defined as per the original optimisation, allowing you to make only the necessary adjustments. Note that this process will create a new optimisation with the adjustments, and will not affect the settings of the original optimisation.

2.5 Optimisation history

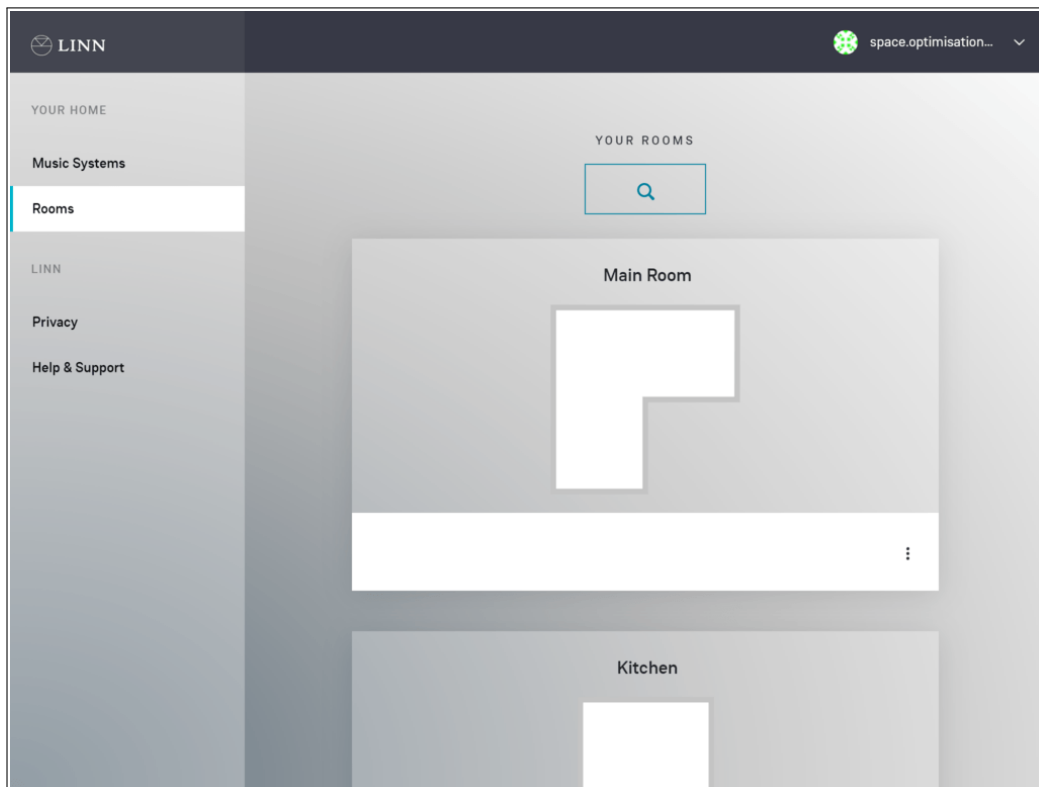
All optimisations created through your Linn account, both complete and incomplete, which are compatible with your music system and speakers, as well as any optimisations created through Linn Konfig which have been imported to your Linn account as outlined in §1.3, will appear below the **Optimisations** heading under the **Space** tab on the **Music Systems** page for that system, as shown below. Any complete optimisation, or **No Space Optimisation**, may be applied to your music system by clicking on the radio button next to its name.



You can rename any optimisation by clicking on its name, resume any incomplete optimisation as outlined in §2.3.5, adjust any complete optimisation created through your Linn account as outlined in §2.4.2, or delete any optimisation by clicking on the ⋮ drop-down menu to the right of its name and clicking on **Delete**.

2.6 Rooms

Your Linn account stores your room information separately from your music system; this makes it quick and easy to upgrade your music system, or move your music system to a new room, as outlined in §2.4.1. You can view all of your rooms on the **Rooms** page, as shown below.



Note that a room may be deleted at any time by clicking on the **⋮** drop-down menu under the room and clicking on **Delete**; deleting a room will not affect any completed optimisations, but you will no longer be able to adjust any optimisations made using that room. It is therefore advised that rooms be deleted only when you no longer have access to that room, for example if you move house.

3 Advanced setup

Space Optimisation produces a very accurate model of the interaction between your room and speakers through the use of highly sophisticated acoustic modelling; however, there exist cases where some adjustment of the optimisation inputs is required.

If the environmental conditions of your room are different to the standard environmental conditions the optimisation may incorrectly predict the frequencies that are artificially distorted; the methodology for entering your room's environmental conditions is outlined in §3.1.

If the construction materials of your room do not closely match the options provided the optimisation may incorrectly predict the amount of correction required at the artificially distorted frequencies; the methodology for adjusting the absorption of your room's construction materials is outlined in §3.2.

The optimisation has been designed to give a good balance of low- and mid-frequency energy. However, your personal preference may differ to the default balance; the methodology for adjusting the low- and mid-frequency energy balance is outlined in §3.3.

If your room has partial-height recesses or protrusions on walls, free-standing walls, or non-flat floors or ceilings the optimisation may incorrectly predict the frequencies that are artificially distorted; the methodology for simplifying your room's dimensions is outlined in §3.4.

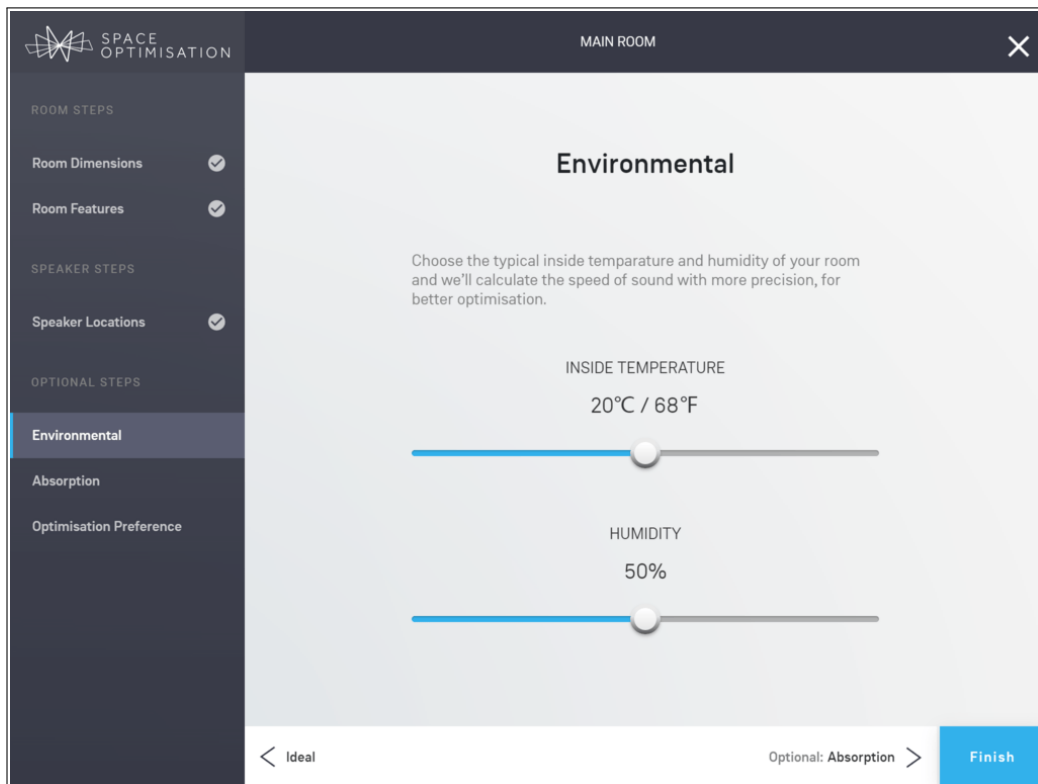
If you are unable to determine the ideal locations for your speakers, you may be able to achieve the full potential of both your music system and Space Optimisation by using the Virtual Tune Dem method; this method is outlined in §3.5.

Finally, you may share music systems, rooms and optimisations with other Linn accounts; the procedure for this is outlined in §3.6.

3.1 Environmental

If the environmental conditions of your room are different to the standard environmental conditions the speed of sound used in the optimisation will be incorrect, and so the frequencies that are artificially distorted may be incorrectly predicted; the environmental conditions must therefore be entered to give the correct speed of sound.

Whilst creating an optimisation, click on the **Environmental** link in the left-hand navigation pane to enter the **Environmental** step, as shown below.

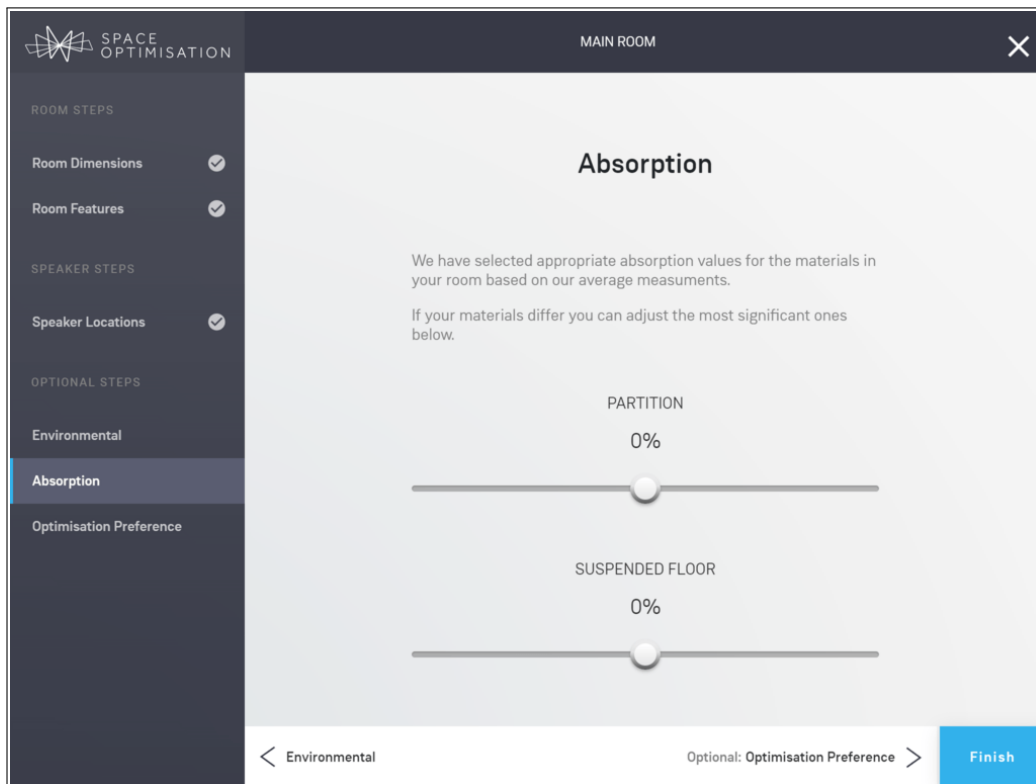


Using a thermometer and hygrometer measure the temperature and humidity in your room, and enter the values using the sliders: increasing the temperature or humidity will increase the speed of sound, therefore increasing the frequencies that are artificially distorted; decreasing the temperature or humidity will decrease the speed of sound, therefore decreasing the frequencies that are artificially distorted. Once the temperature and humidity values have been set, click on the blue **Finish** button in the bottom navigation pane to recalculate the optimisation.

3.2 Absorption

If the construction materials of your room do not closely match the options provided their absorption characteristics will be incorrect, and so the optimisation may incorrectly predict the amount of correction required at the artificially distorted frequencies; the absorption characteristics of the construction materials must therefore be adjusted to give the correct behaviour.

Whilst creating an optimisation, click on the **Absorption** link in the left-hand navigation pane to enter the **Absorption** step, as shown below. The construction materials of your room will be listed, in order of decreasing absorption area.



If a particular construction material does not closely match the options provided its absorption characteristics can be adjusted here using the sliders: decreasing the absorption will result in an optimisation that takes deeper, sharper cuts at the artificially distorted frequencies; increasing the absorption will result in an optimisation that takes shallower, broader cuts at the artificially distorted frequencies. Note that adjusting the absorption of construction materials at the top of the list will have more effect than those at the bottom of the list. Once the absorption characteristics of any offending construction materials values have been adjusted, click on the blue **Finish** button in the bottom navigation pane to recalculate the optimisation.

You should adopt a Tune Dem method for varying the absorption characteristics: increase the absorption of the first offending construction material in the list by a large amount and recalculate the optimisation; then decrease the absorption of the first offending construction material in the list by a large amount and recalculate the optimisation. Then perform an A/B demonstration to compare the two adjusted optimisations and note down any characteristics that you like from each adjusted optimisation. You should then adjust the absorption of the first offending construction material to an appropriate average value depending on your preference from the two previous adjusted optimisations and recalculate the optimisation; this process should be repeated iteratively until the absorption characteristics of the first offending construction material closely match those of your room surfaces. You should then apply this process for each offending construction material.

3.2.1 Approximating Floor and Ceiling Features

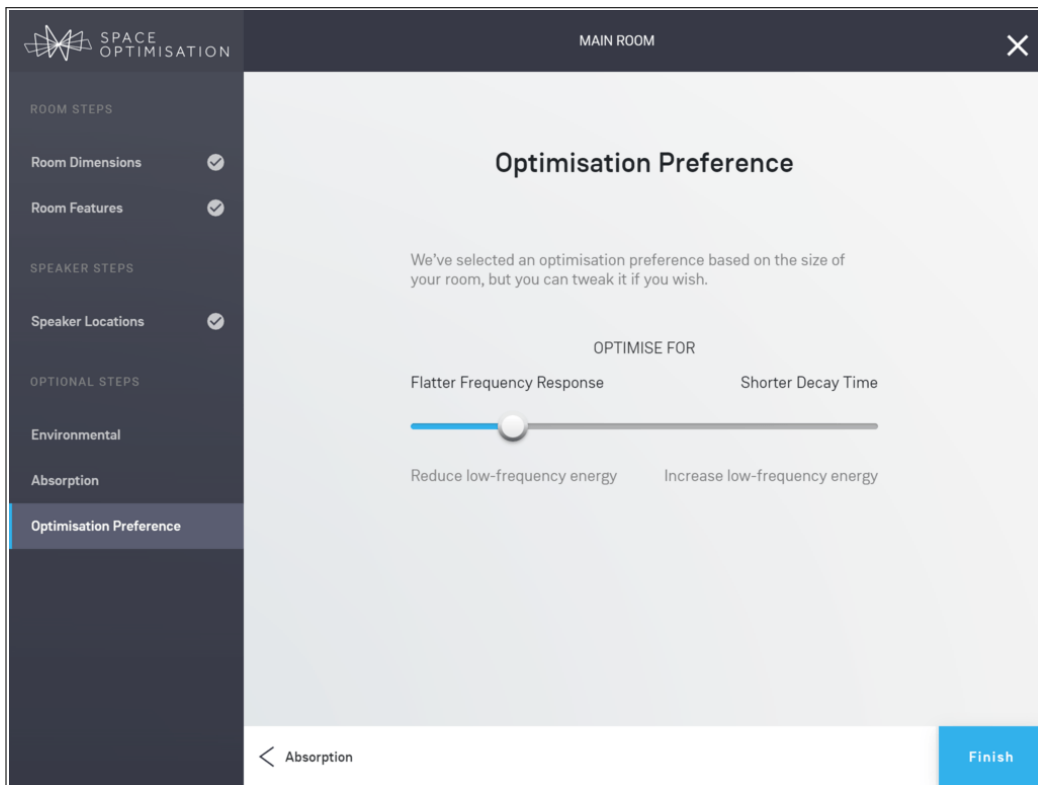
Note that floor and ceiling features are currently unsupported, and so an approximation procedure must be adopted; note that this approximation procedure takes a similar approach to that which was implicitly made in previous versions of Space Optimisation, available through Linn Konfig, where the effects of features were averaged across a surface.

The presence of floor or ceiling features, such as trapdoors or skylights, will tend to increase the average absorption of the floor or ceiling; therefore the absorption of the floor or ceiling construction material should be increased in the **Absorption** step. Note that the amount of increase required will depend on the fraction of total area taken up by such features, with large features having more effect than small features.

3.3 Optimisation preference

The optimisation has been designed to give a good balance of low- and mid-frequency energy. However, your personal preference may differ to the default balance; the optimisation can therefore be adjusted to match your preference.

Whilst creating an optimisation, click on the **Optimisation Preference** link in the left-hand navigation pane to enter the **Optimisation Preference** step, as shown below.



If the optimisation does not suit your preference, the optimisation preference can be adjusted here: moving the slider toward **Flatter Frequency Response** will result in an optimisation that takes deeper cuts and applies less decay control at the artificially distorted frequencies; moving the slider toward **Shorter Decay Time** will result in an optimisation that takes shallower cuts and applies more decay control at the artificially distorted frequencies. Once the optimisation preference has been adjusted, click on the blue **Finish** button in the bottom navigation pane to recalculate the optimisation.

You should adopt a Tune Dem method for varying the optimisation preference, similar to that outlined at the end of §3.2.

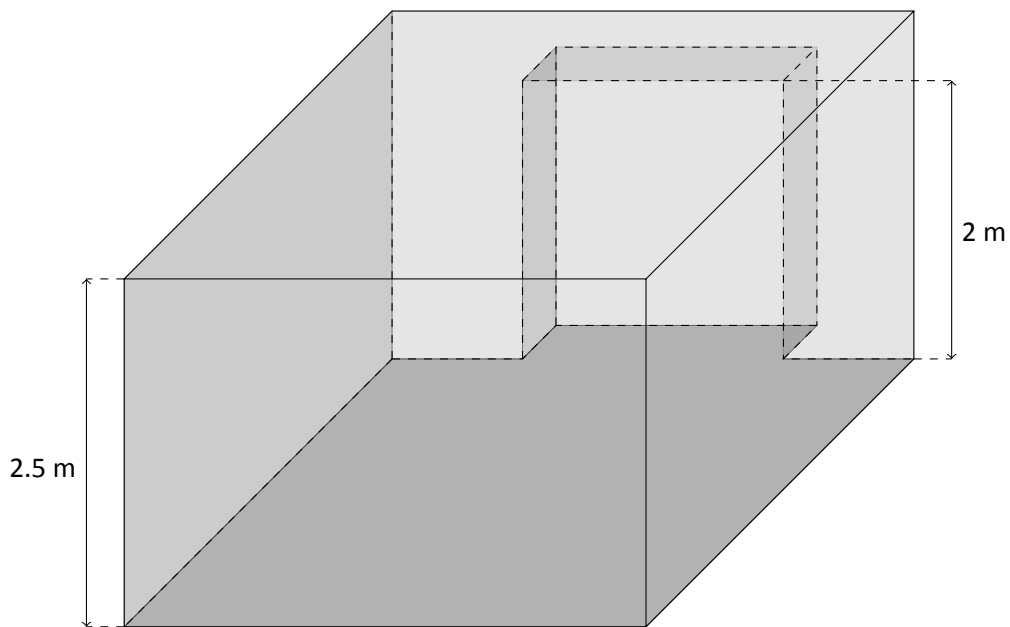
3.4 Simplifying room dimensions

Rooms with partial-height recesses or protrusions on walls, rooms with free-standing walls, and rooms with non-flat floors or ceilings are currently unsupported; if your room has any of these geometrical features you must decide on optimal averaged room dimensions.

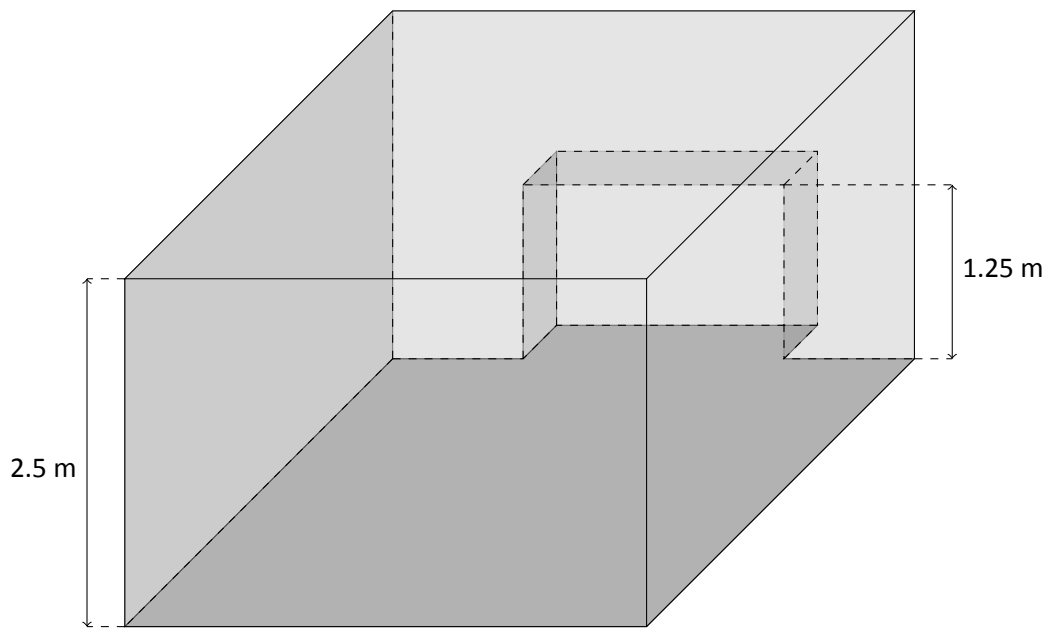
3.4.1 Rooms with a partial-height recess or protrusion on a wall

Where walls have partial-height recesses or protrusions it is recommended to take an average room dimension measurement; depending on the height of each recess or protrusion this average room dimension measurement will lie somewhere between the minimum and maximum depth of the recess or protrusion.

Consider a wall with a large recess of height greater than 50% of the room height, as shown below; the recess should here be incorporated into the floor plan, with a depth given by the maximum recess depth.

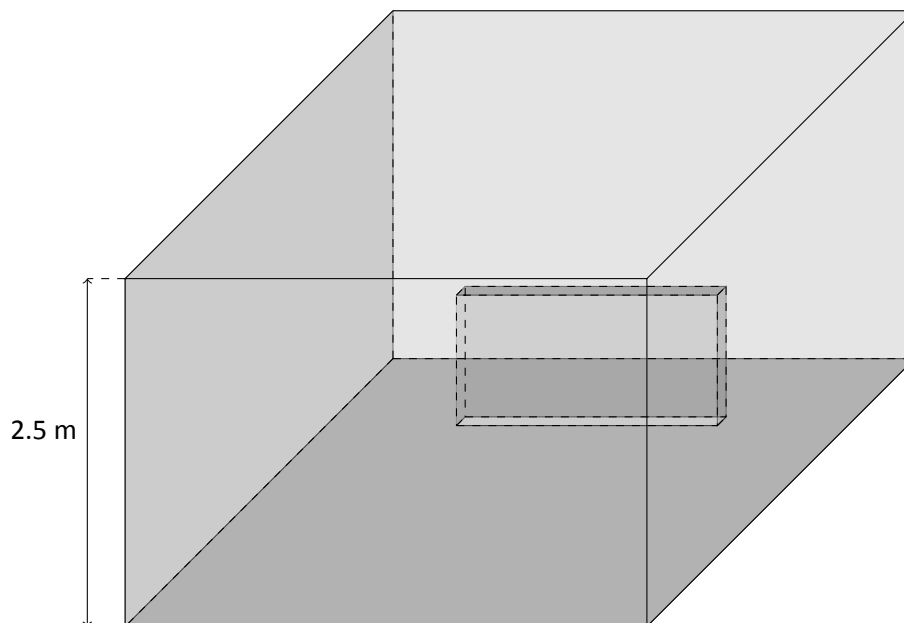


Consider a wall with a large recess of height equal to 50% of the room height, as shown below; the recess should here be incorporated into the floor plan, with a depth given by the half of the maximum recess depth.



3.4.2 Rooms with a free-standing wall

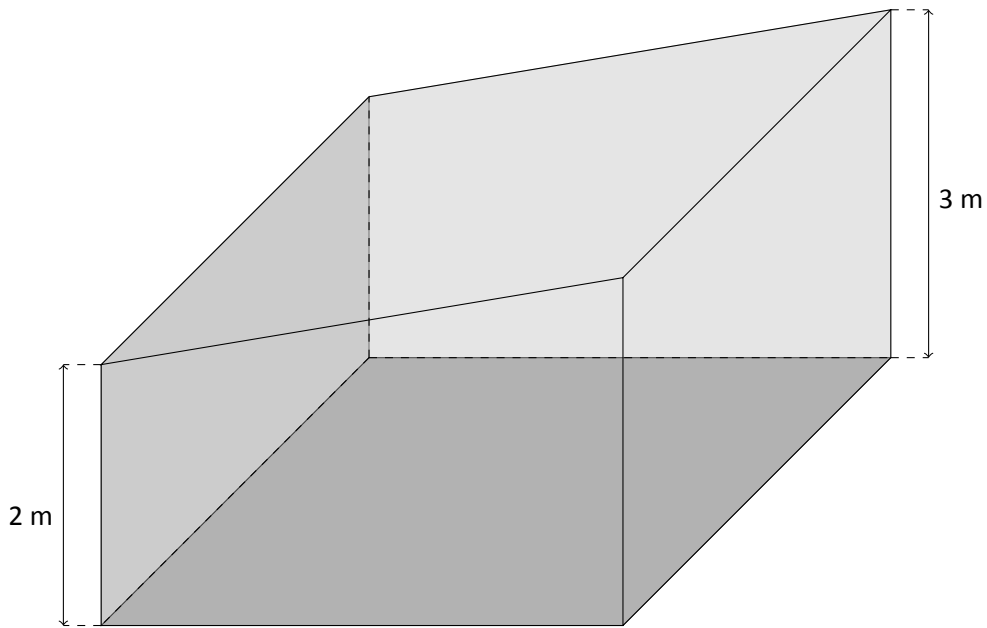
Where rooms contain free-standing walls, as shown below, it is recommended to ignore these; at low frequencies such free-standing walls are usually almost acoustically transparent.



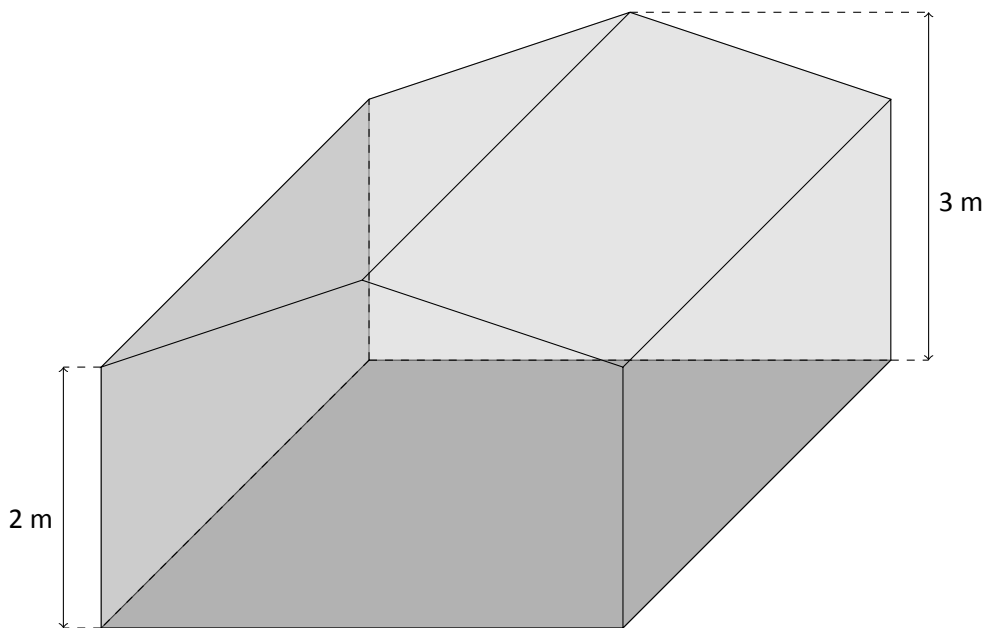
3.4.3 Rooms with a sloped or pitched ceiling

Where ceilings are sloped or pitched it is recommended to take an average height measurement: for a sloped ceiling this average height measurement will be halfway between the minimum and maximum height of the ceiling; for a pitched ceiling this average height measurement will be the minimum height plus a third of the difference between the minimum and maximum height of the ceiling.

Consider a sloped ceiling, as shown below; the average height measurement here would be 2.5 m.



Consider a pitched ceiling, as shown below; the average height measurement here would be 2.33 m.

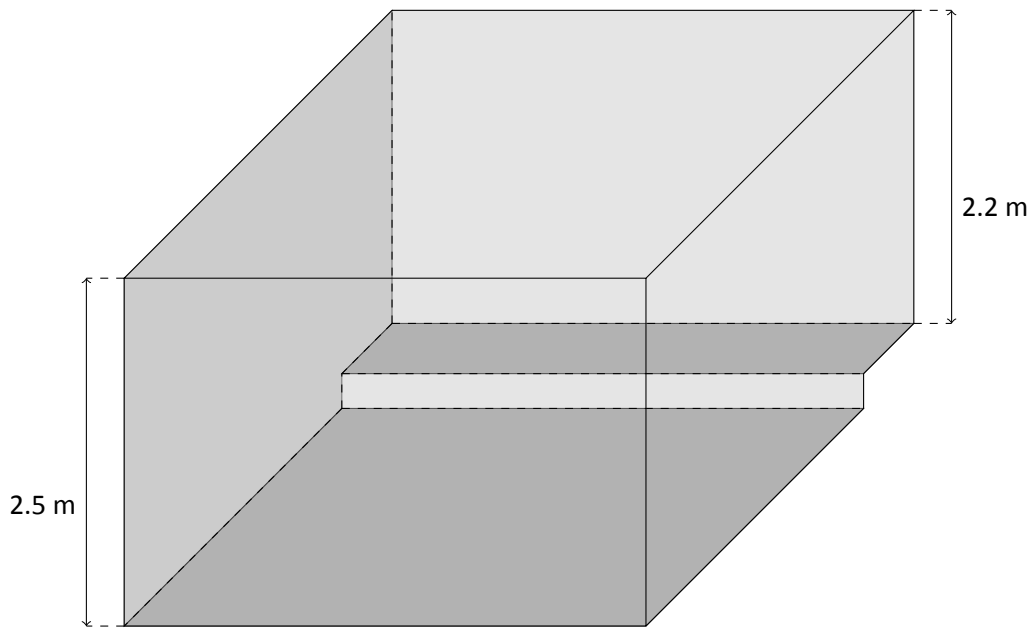


The effect of such non-flat ceilings is to reduce the strength of any modal behaviour between the floor and ceiling, and to cause a smearing of any associated artificially distorted frequencies; due to its flat ceiling assumption the optimisation may incorrectly predict the amount of correction required at these artificially distorted frequencies. This issue can be remedied by increasing the absorption of the ceiling construction material, as outlined in §3.2, resulting in shallower, broader cuts at the associated artificially distorted frequencies.

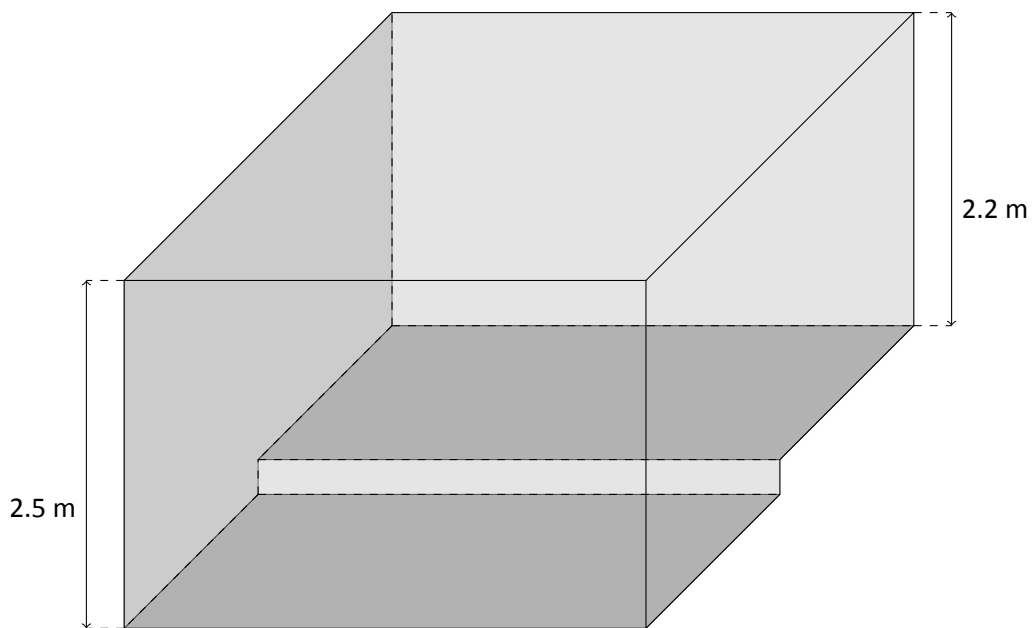
3.4.4 Rooms with a stepped floor

Where floors are stepped it is recommended to take an average height measurement; depending on the surface area of each floor section this average height measurement will lie somewhere between the minimum and maximum height.

Consider a stepped floor with a small raised section which covers less than 50% of the surface area, as shown below; the raised section can be ignored here, so that the average height measurement would be 2.5 m.



Consider a stepped floor with two equal-area sections, as shown below; the average height measurement here would be the standard average height, 2.35 m.



The effect of such non-flat floors is to reduce the strength of any modal behaviour between the floor and ceiling, and to cause a smearing of any associated artificially distorted frequencies; due to its flat floor assumption the optimisation may incorrectly predict the amount of correction required at these artificially distorted frequencies. This issue can be remedied by increasing the absorption of the floor construction material, as outlined in §3.2, resulting in shallower, broader cuts at the associated artificially distorted frequencies.

3.5 Virtual Tune Dem

If you are unable to determine the ideal locations for your speakers for physical reasons you may be able to achieve the full potential of both your music system and Space Optimisation by using the Virtual Tune Dem method.

To perform a Virtual Tune Dem, whilst creating an optimisation click on the **Speaker Locations** link in the left-hand navigation pane to enter the **Speaker Locations** step.


Now, instead of selecting the **My speakers are in their practical locations and I am unable to determine their ideal locations** radio button, select the **My speakers are in their practical locations and I am able to determine their ideal locations** radio button, and click on the **Next: Practical >** link in the bottom navigation pane to enter the **Practical** step.

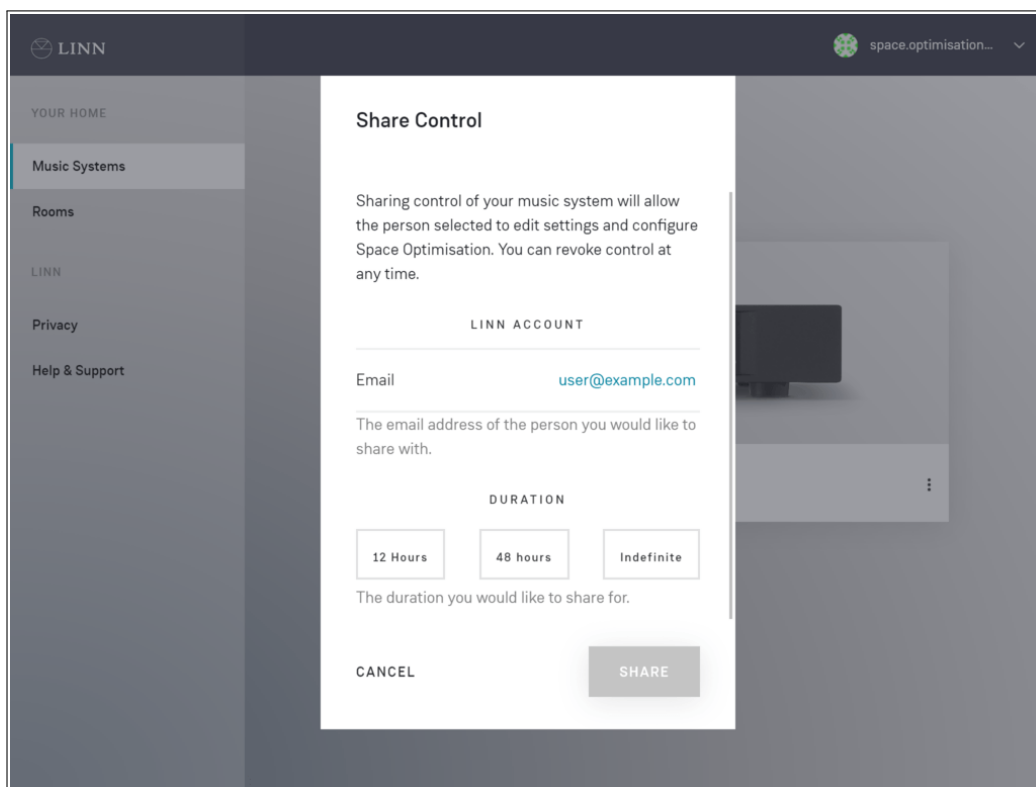
Define your speakers' practical locations as outlined in §2.3.2, then click on the **Next: Ideal >** link in the bottom navigation pane to enter the **Ideal** step. You can now adjust the ideal speaker locations to reflect any changes you would make if you were physically moving your speakers; once you have chosen an ideal location, click on the blue **Finish** button in the bottom navigation pane to calculate the optimisation. You should repeat this process using a Tune Dem method to establish the virtual ideal speaker locations.

3.6 Account Sharing

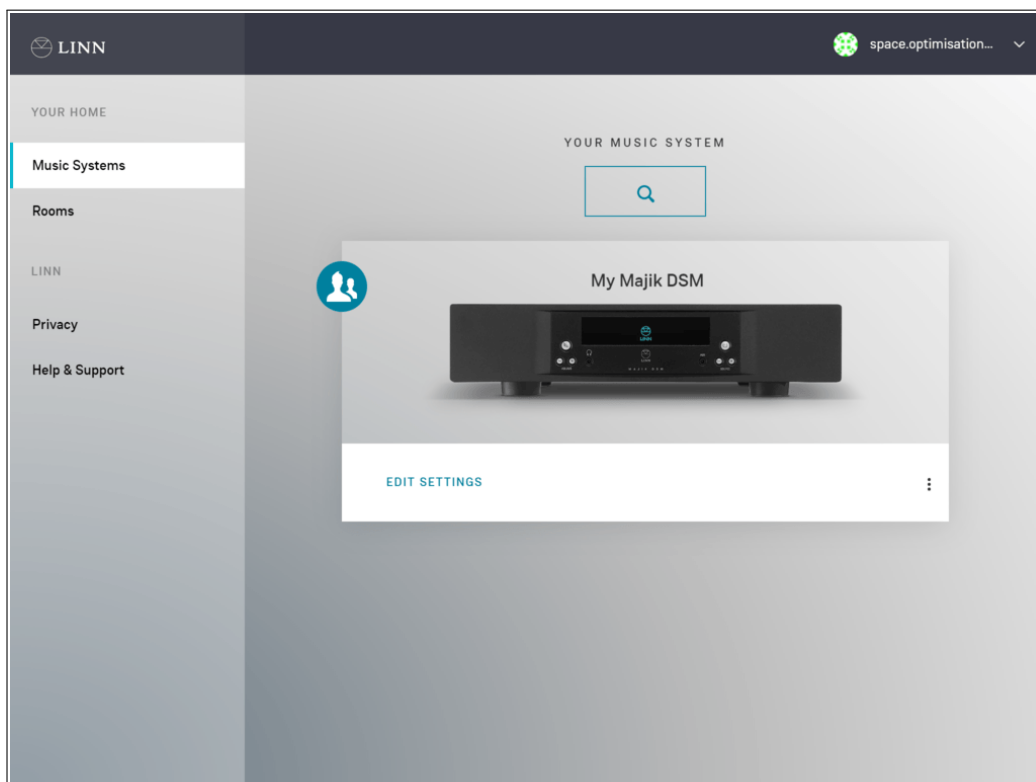
Sometimes it may be useful to share music systems, rooms and optimisations between Linn accounts; this may be of particular use to Linn retailers and their customers. The following sections outline the procedures for such sharing.

3.6.1 Sharing your music system

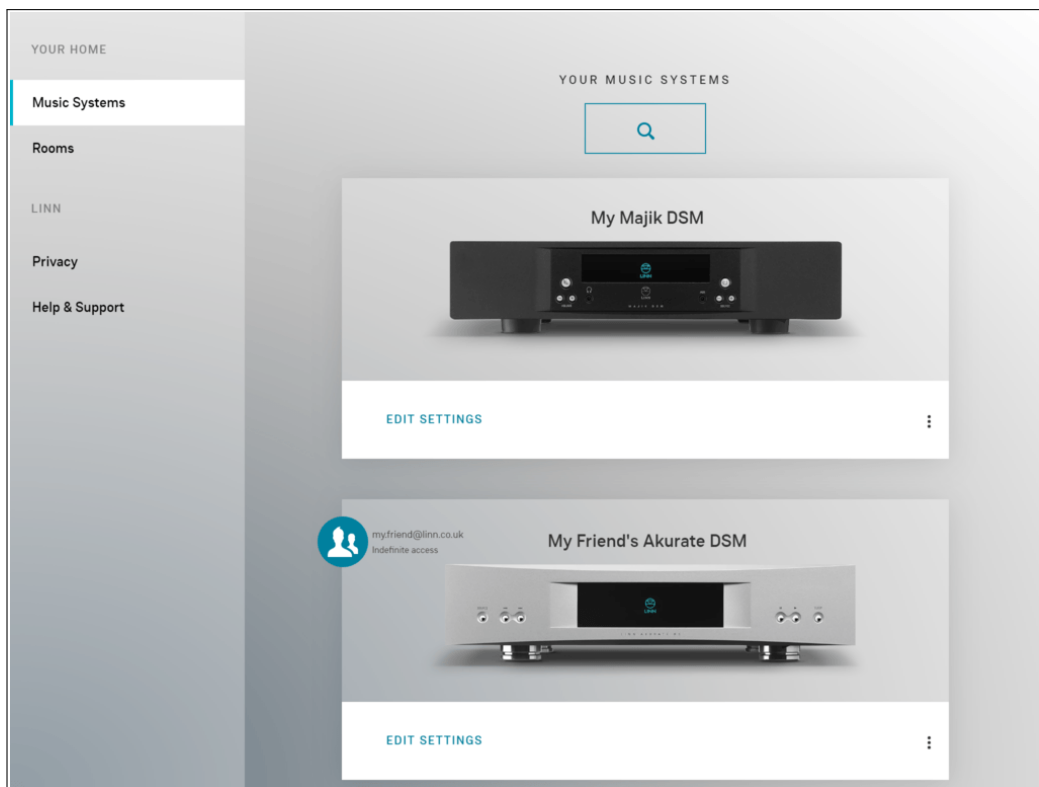
You may now share your music system with a third-party Linn account; this gives the third-party access to your music system, enabling them to configure all of your music system's settings, including Space Optimisation. To share a music system with a third-party Linn account, navigate to the **Music Systems** page, click on the  drop-down menu under the music system you wish to share, and click on **Share Control**; a dialog prompting you to provide the email address linked to the third-party Linn account and to specify the duration of the shared control will appear, as shown below. Enter the email address linked to the third-party Linn account, specify the duration of the shared control, and click on the **Share** button; note that the user interface does not check that the email address provided is linked with a Linn account, for security reasons.



Once your music system has been shared, a sharing icon will appear next to your music system to notify you that it is currently being shared with a third-party, as shown below. You may share a music system with multiple third-party Linn accounts using the procedure outlined above, and revoke shared control at any time by clicking on the **⋮** drop-down menu under the music system, clicking on **Manage Access**, and clicking on **Revoke** next to the email address linked to the third-party Linn account.

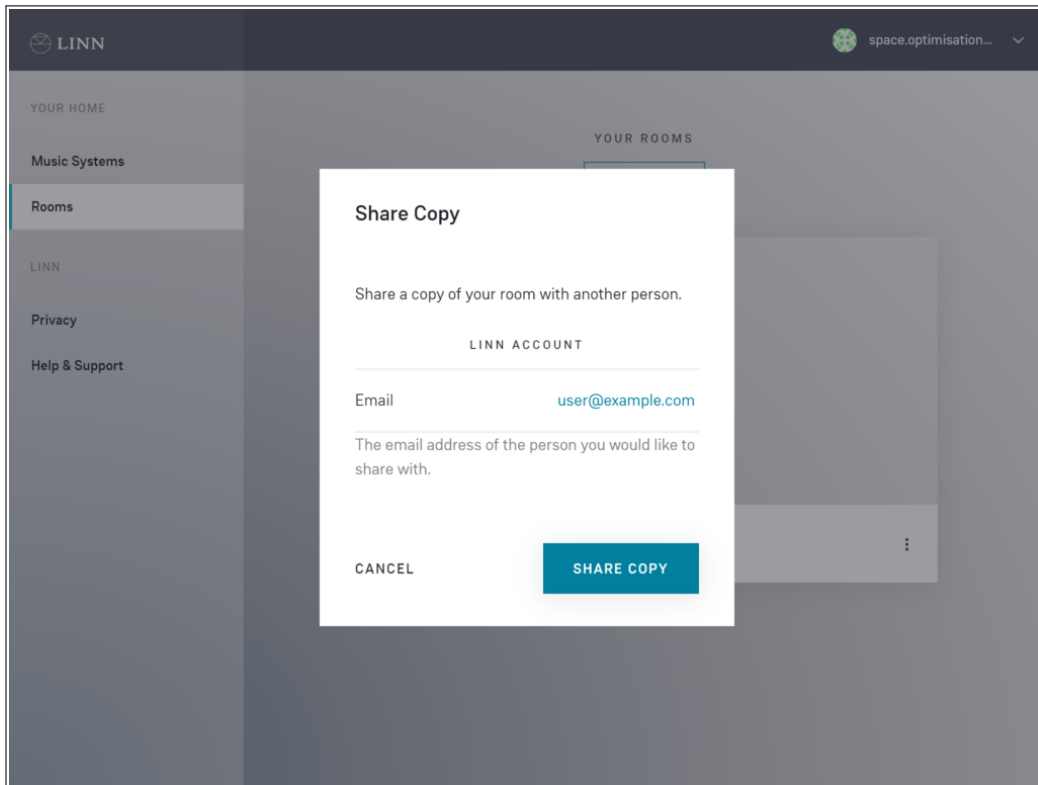


Once your music system has been shared, the third-party will receive an email from **sharedDeviceNotifier@linn.co.uk**, notifying them that you have shared your music system with them; note that this email will contain the email address linked to your Linn account. Your music system will then be listed on the **Music Systems** page of the third-party Linn account, with a sharing icon, the email address linked to your Linn account, and the duration of the shared control, as shown below. The third-party may then configure all of your music system's settings, including Space Optimisation; however, note that any rooms or optimisations created by the third-party will remain in their Linn account, and will not appear in your Linn account. The third-party may end their shared control at any time by clicking on the **:** drop-down menu under the music system and clicking on **End Access**. Note that the third-party cannot share the music system with other third-party Linn accounts.

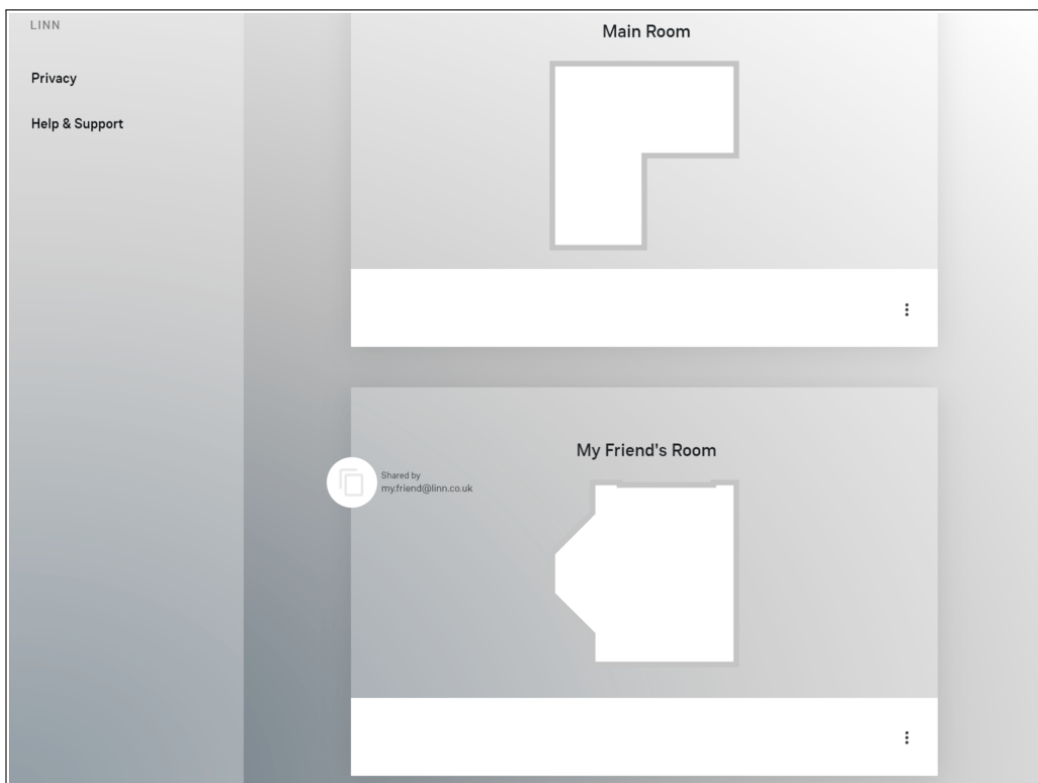


3.6.2 Sharing your room

You may now share your room with a third-party Linn account; this gives the third-party a copy of the room. To share a room with a third-party Linn account, navigate to the **Rooms** page, click on the **:** drop-down menu under the room you wish to share, and click on **Share Copy**; a dialog prompting you to provide the email address linked to the third-party Linn account will appear, as shown below. Enter the email address linked to the third-party Linn account and click on the **Share Copy** button.

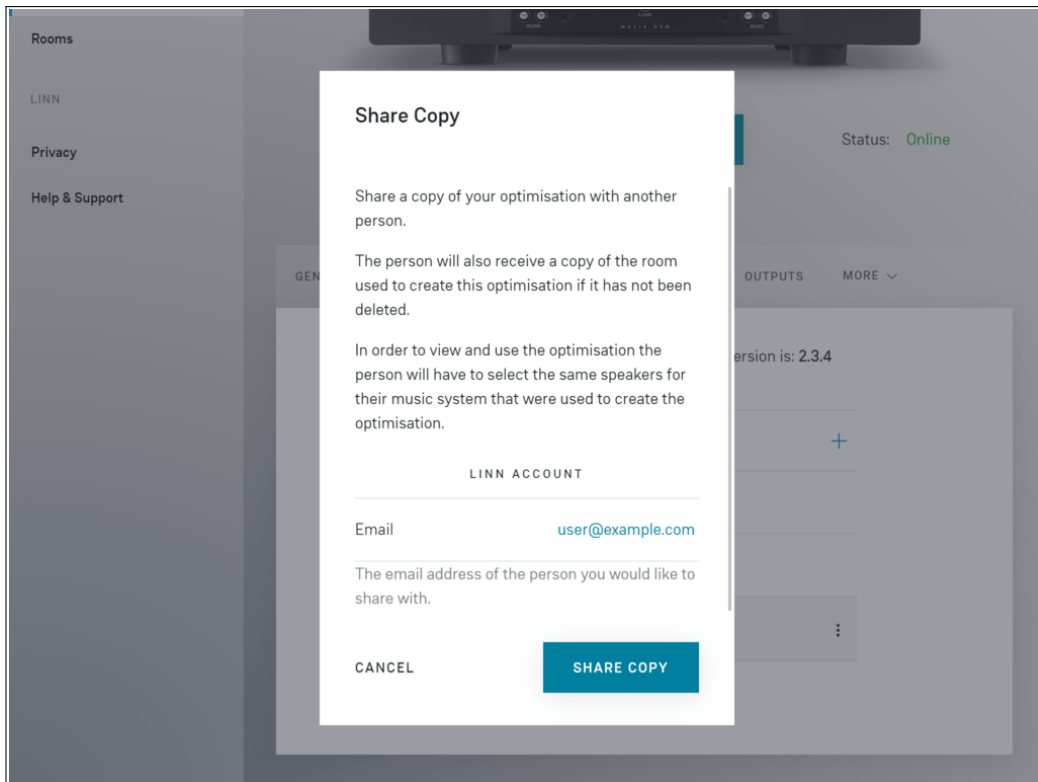


Once your room has been shared, the third-party will receive an email from **sharedRoomNotifier@linn.co.uk**, notifying them that you have shared your room with them. Your room will then be listed on the **Rooms** page of the third-party Linn account, with a copy icon and the email address linked to your Linn account, as shown below. The third-party may then use your room for Space Optimisation; note that any changes made by the third-party will only affect the room in their Linn account, and will not affect the room in your Linn account. Note that the third-party may also share the room with other third-party Linn accounts.



3.6.3 Sharing your optimisation

You may now share your optimisation with a third-party Linn account; this gives the third-party a copy of the optimisation, along with a copy of the room used to create the optimisation provided it has not been deleted. To share an optimisation with a third-party Linn account, navigate to the **Space** tab on the settings page for your music system, click on the **⋮** drop-down menu next to the optimisation you wish to share, and click on **Share Copy**; a dialog prompting you to provide the email address linked to the third-party Linn account will appear, as shown below. Enter the email address linked to the third-party Linn account and click on the **Share Copy** button.



Once your optimisation has been shared, the third-party will receive an email from **sharedOptimisationNotifier@linn.co.uk**, notifying them that you have shared your optimisation with them. Your optimisation will then be listed under the **Optimisations** heading in the **Space** tab on the setting page of any music system of the third-party Linn account, provided that the optimisation is compatible with their music system and speakers, and will be flagged as being shared, as shown below. The third-party may then apply your optimisation to their music system; note that any changes made by the third-party will only affect the optimisation in their Linn account, and will not affect the optimisation in your Linn account. Note that the third-party may also share the optimisation with other third-party Linn accounts.

