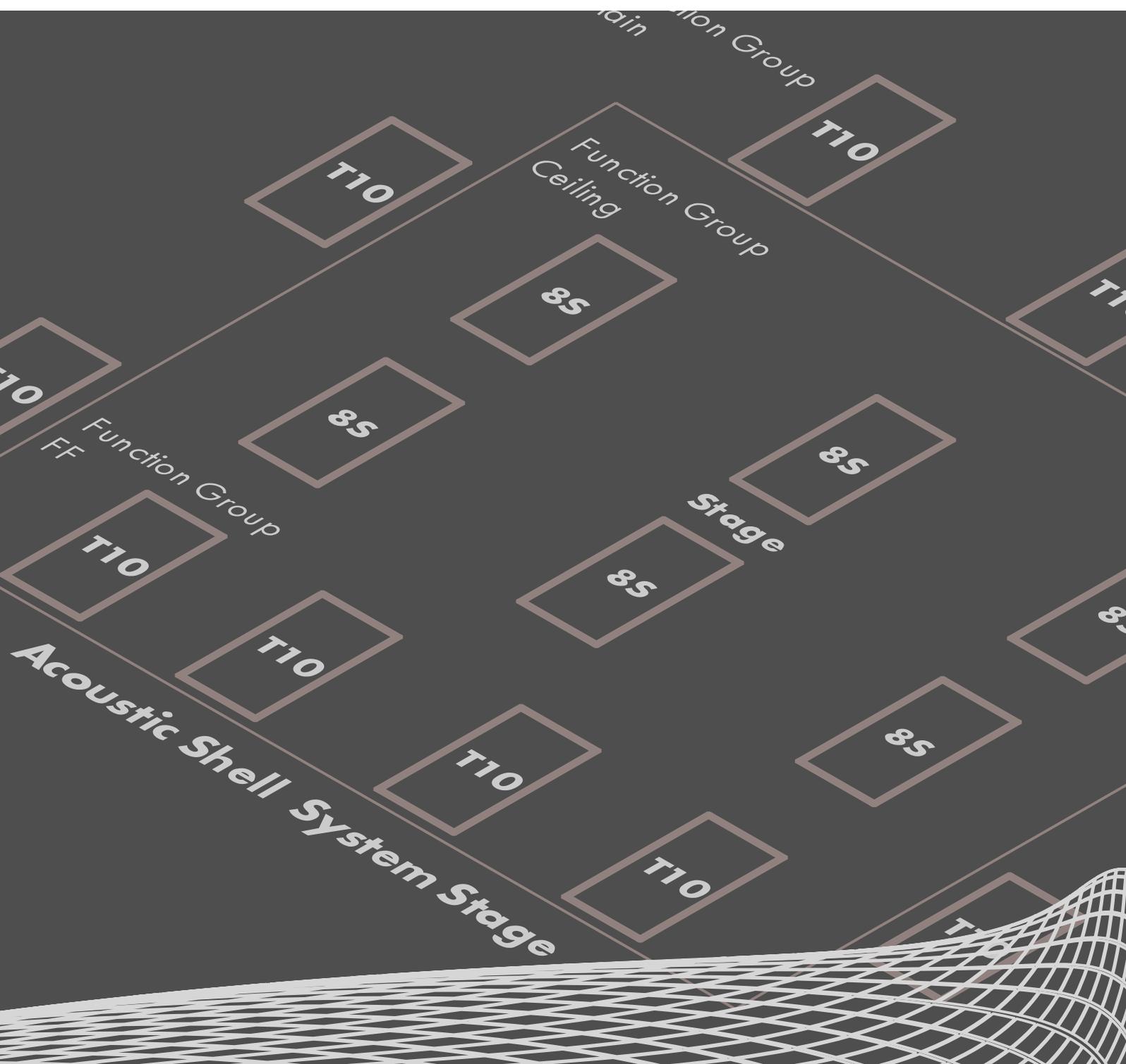


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TI 502
Acoustic shell
Stage acoustics using
En-Space
1.1 en



General information

TI 502 Acoustic shell
Stage acoustics using En-Space

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d&b audiotechnik GmbH & Co. KG
Eugen-Adolff-Str. 134, D-71522 Backnang, Germany
T +49-7191-9669-0, F +49-7191-95 00 00
docadmin@dbaudio.com, www.dbaudio.com

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1.1 Introduction

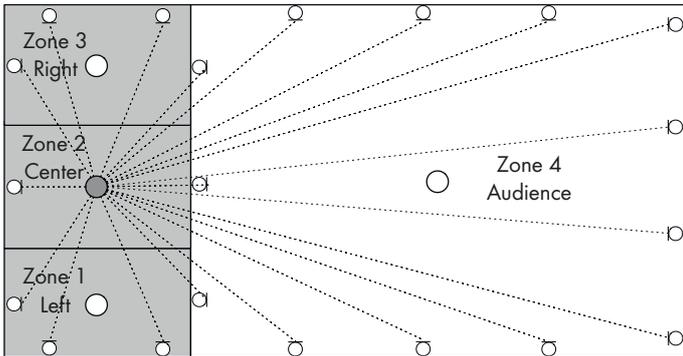
The acoustic properties of a concert hall are essential for all kinds of acoustic and orchestral music. The musical instruments require a certain amount and balance of early reflections and reverberance to amplify their performance ensuring a good experience for the audience as well as for the musicians.

Even the acoustics on stage need to fulfill certain criteria regarding level, early and late reverb to ensure a good audibility for all musicians as a prerequisite for a concerted performance.

If this not provided by the venue, as for example on open-air stages, multipurpose venues of all sizes or in dry spaces, a Soundscape system with En-Space can create the desired acoustic environment for the musicians on stage - an "acoustic shell".

1.2 DS100 Signal Engine with En-Space

The En-Space module in the DS100 is a 3D room emulation tool which comes with a set of HQ concert venues of various characteristics and sizes. Using the technology of boundary plane emulation, each room is sampled and reproduced with the highest accuracy and spatial resolution. For each room, the En-Space library provides reverb responses for 64 loudspeaker positions classified in different function groups. Each position with individual boundary responses for objects on stage and objects in front of the stage. For the Main system, there are individual responses for 4 zones in order to most accurately reproduce early reflections.



1.3 Loudspeaker setup and function groups

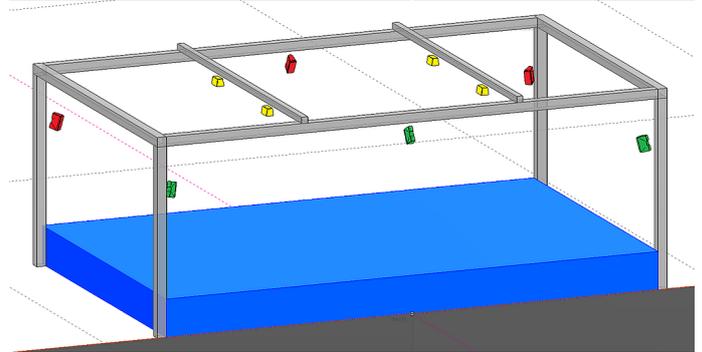
The loudspeakers should act as an acoustic shell and surround the orchestra on all sides as well as above in order to provide a homogeneous sound field. Distances to the musicians and microphones should be as consistent as possible to provide a uniform level for all orchestra members as well as to avoid feedback loops.

The function groups with the matching boundary responses for this application are Main, Frontfill, Surround and Ceiling.

As the Main function group provides specific responses for the three zones on stage, it should perform the main coverage work from the rear and the sides. To close the circle at the stage front, the Frontfill or Surround function group types may be used, the latter providing a more diffuse characteristic with less early reflections.

The Ceiling function group represents reflections from above the stage but also acts as a fill ensuring a smooth level distribution across the whole stage area.

To ensure a natural sound field with a high degree of decorrelation of the sources, all relevant locations on stage should be covered by multiple function groups. Make sure that in ArrayCalc the stage and its zones are represented by an "Early reflections" plane.



**Loudspeaker placement above the stage:
Main (red), Ceiling (yellow) and Frontfills (green)**

In the above example, speakers with higher vertical directivity (T10) are used on the edges while overhead mounted speakers provide wider dispersion (8S).

1.4 Input configuration

Please make sure that no En-Scene inputs are used to feed the acoustic shell. This would cause a direct sound component on the shell speakers. If En-Scene is used on the same DS100 to operate the audience sound system, disable the send to the function groups used for the shell for those inputs in R1 on the «Devices» ⇒ «DS100» ⇒ «Sound object routing» tab. The Ceiling function group is the only one that does not participate in En-Scene reproduction.

We strongly recommend using separate DS100 processors for En-Scene reproduction for the audience and the acoustic shell as this provides full freedom regarding function groups and En-Space room configuration.

1.5 Microphone placement

Close miking all instruments will offer maximum flexibility as this will achieve the highest reverb gain and will also provide individual channels for En-Scene operation.

When only the acoustic shell should be fed, overhead microphones provide a very good result. We recommend using at least three positions to achieve a good separation of the zones on stage. Overhead microphones require relatively little effort, however, individual instruments cannot be adjusted and the maximum reverb level may be limited.

1.6 Mixing in zones

The instruments on stage should be mixed into three zone sends depending on their position on stage: Left - Center - Right. If ambient microphones above the audience are used, a fourth send can be added.

1.6.1 Zone mixing at matrix inputs

On the «Devices» ⇒ «Matrix inputs» ⇒ «En-Space» tab, each matrix input provides a control for the En-Space reverb level of the channel. It is supplemented by four additional controls for the sends to the zones Left, Center, Right and Audience.

1.6.2 Zone mixing at the mixing console

The mix to zones can be performed more conveniently at the mixing console using for example four AUX sends for each zone routed to four DS100 inputs in Matrix configuration, each feeding one zone.

In R1 on the «Devices» ⇒ «Matrix input» ⇒ «En-Space» tab, set the Level fader for the respective Zone to 0 dB.

1.6.3 Zone mixing by En-Scene

For all matrix inputs configured for En-Scene operation, the zone mixing is performed automatically according to the position of the object.

On the «Devices» ⇒ «Matrix inputs» ⇒ «En-Space» tab, only set the overall reverb level for the channel, the four zone levels will be controlled by En-Scene.

Note: Please make sure En-Scene inputs are muted at the «Sound object routing» matrix for the function groups used for the acoustic shell.

2.1 Ravenna Festival 2019 - Pala de André

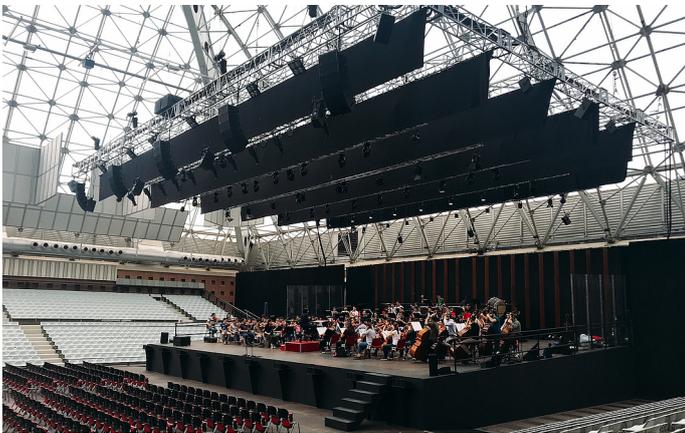
Pala de André is a large multipurpose venue mainly used for sports events and concerts. With its 3500 seats, the venue is well suited to host the main concerts of the Ravenna Festival. It has a partially transparent, approx. 20 m high pyramidal roof made out of tarpaulin.



The roof is not very soundproof therefore noise floor inside the building is relatively high. A main road passes next to the building. The reverberation time is approximately 2.4 seconds (T30, 160 Hz – 4 kHz), unoccupied.

Due to the building's symmetrical shape, there are strong sound reflections inside the venue. Diffusion elements and absorbers suspended from the ceiling have been installed to mitigate this problem. The orchestra's stage, which was especially built for the Ravenna Festival, is a temporary construction. In the past, a wooden acoustic reflector was installed above the orchestra to provide early reflections for the musicians on stage. However, due to weight reasons, the reflector option was dropped and the steep roof causes the sound to be reflected away from the orchestra.

Therefore En-Space was used as an "acoustic shell" to produce electroacoustic reverberation for the musicians on stage. In addition to the En-Scene/En-Space system for the audience, the instrument microphones were fed to a second DS100, which provided the signals for the loudspeaker shell around and above the musicians. Since the orchestra setup on stage is static, a manual matrix configuration was used to distribute the input signals to the En-Space zones. For this reason, the orchestra was divided into three groups.

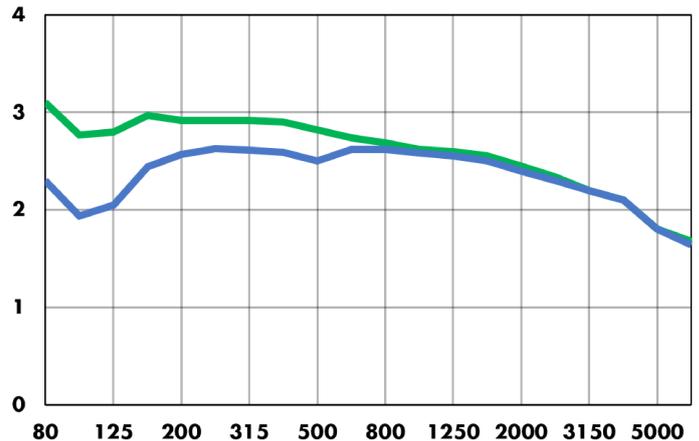


Stage with rig carrying main system and acoustic shell

The loudspeaker system design was realized using seven main speakers (T10, Main function group type), nine ceiling speakers (E8, Ceiling function group type) and four 360° speakers (Y10P, Surround function group type). With this setup, it was possible to provide all musicians with sound evenly without making individual speakers very loud. The main system was installed in a u-shape around the stage, in analogy to the IR measurement positions in the original En-Space venues. The main speakers in the shell design were responsible for the lateral envelopment of the musicians while the 360° speakers mounted on the front truss were used to increase the impression of space. The ceiling speakers helped to fill up the wide stage (approximately 20 meters) with reverberation.



Y10P loudspeakers of the acoustic shell and Y8/Y12 main system on the front truss



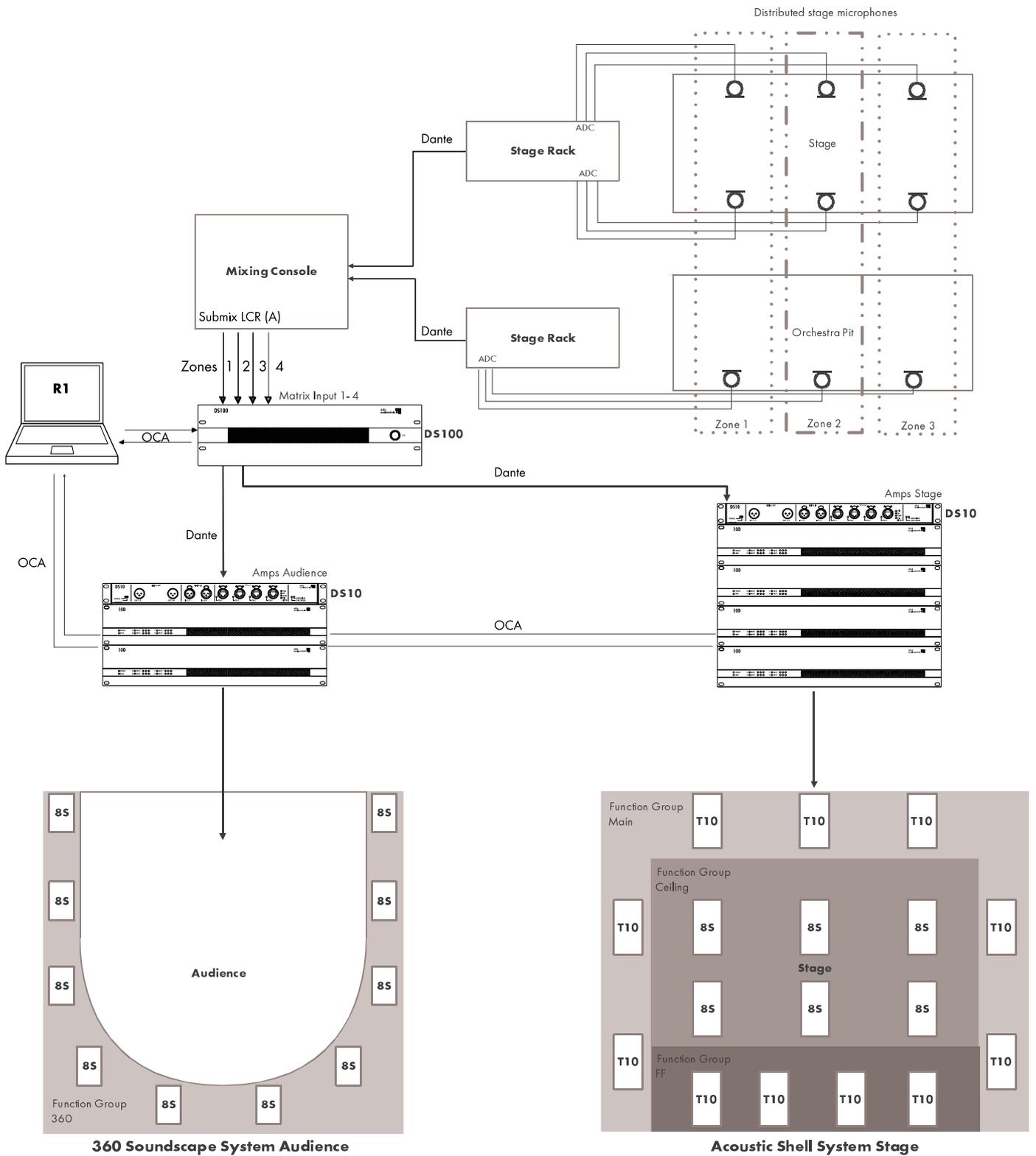
Reverberation time T30 (s) on stage with (green) and without (blue) acoustic shell

The system was controlled from FoH via R1 fed directly from the main mixing console. Both DS100 engines used the "Modern medium 2" room (Bing Concert Hall) in its original size (Predelay factor 1). The tuning effort was minimal and the system provided sufficient gain before feedback (approx. 10 dB).

As a result, applying the acoustic shell system at Pala de André both musicians and conductor perceived and enjoyed a significantly improved acoustic environment.

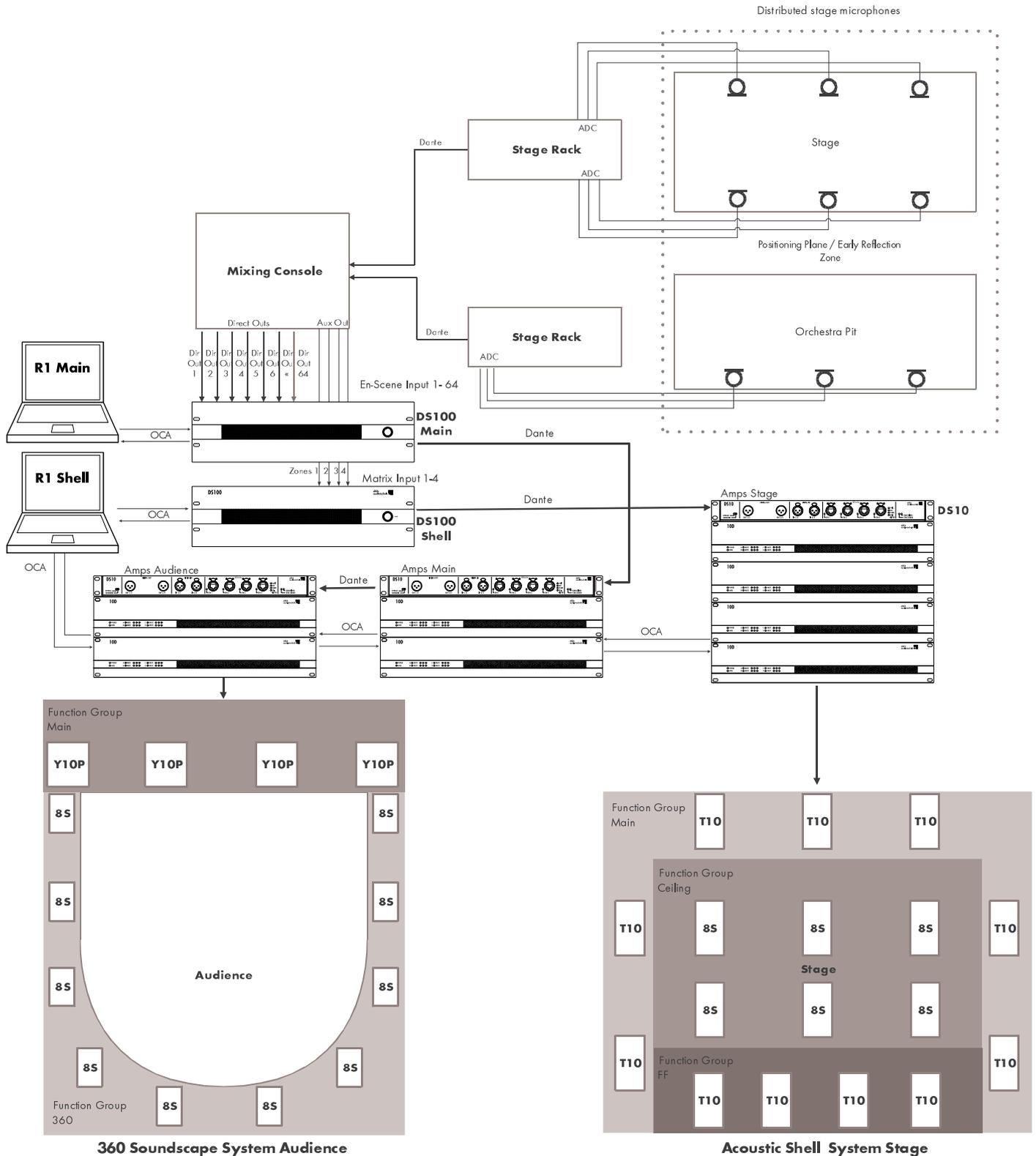
2.2 Example design En-Space only

This schematic shows a design that provides En-Space room emulation for the audience and the stage from a single DS100.



2.3 Example design Acoustic shell plus En-Scene

This schematic shows a design that provides En-Scene plus En-Space room emulation for the audience and the acoustic shell for the stage using separate DS100 engines.



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