SIAP

ACOUSTIC SYSTEMS

ACTIVE ACOUSTICS DESIGN GUIDE

THIRD-PARTY INTEGRATION

For Consultants & System Integrators

Version 1.0

E info@siapacoustics.com

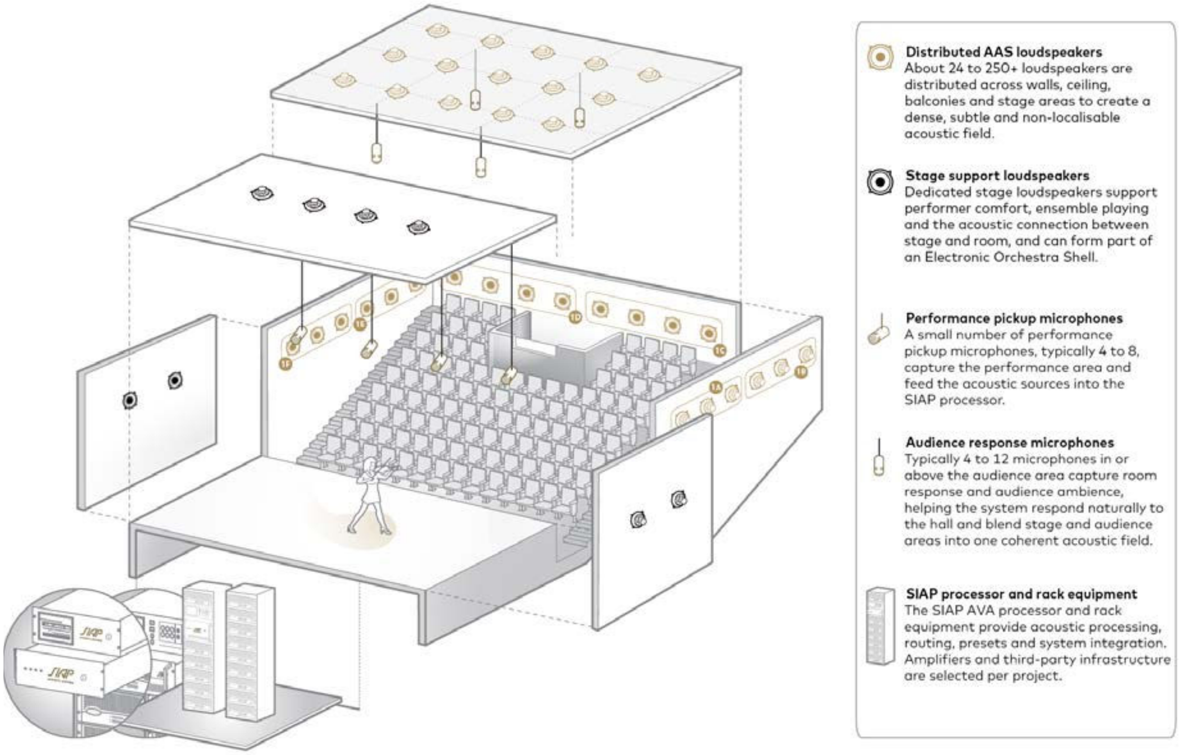
TABLE OF CONTENTS

Click the button in the footer to return to this contents page

01 EXECUTIVE SUMMARY

Active Acoustic Systems (AAS) allow venues to enhance their baseline acoustic character electronically, making one space suitable for a wide range of unamplified performances, from intimate chamber music to symphonic, choral and organ applications. Where required, an AAS can also support selected electro-acoustic, speech-related or ambience-related use cases.

This design guide explains how to approach an AAS system using the current SIAP AVA platform in combination with third-party microphones, loudspeakers, amplifiers and audio-network infrastructure. It is written for system integrators, AV consultants, acoustic consultants and technical partners who need practical guidance on the design considerations that are specific to active acoustics.



E info@siapacoustics.com

The guide is intended to reduce project uncertainty and enable consultants and system integrators to prepare a complete AAS design package. It defines the information, design choices and documentation that should be developed before SIAP performs the final AAS suitability review: room information, acoustic zones, microphone strategy, loudspeaker layout, amplifier and channel strategy, routing concept, control requirements and shared infrastructure decisions, including possible shared use of loudspeakers, amplifier channels, routing and audio-network infrastructure with FoH, Dolby Atmos or spatial audio systems where applicable.

SIAP is brand-agnostic but performance-driven. Third-party equipment can be selected to suit the project, provided it meets the acoustic, technical and operational requirements needed to create an enhanced, stable and non-localisable acoustic field.

This guide enables the consultant or system integrator to prepare the project-specific AAS design package independently. Once the design package is complete, SIAP reviews it for AAS suitability before final system configuration, acoustic tuning and commissioning.

Note: For readers unfamiliar with active acoustic terminology, key terms are defined in the glossary at the end of this document.

E info@siapacoustics.com

02 WHAT AN ACTIVE ACOUSTIC SYSTEM DOES

Core function

An Active Acoustic System creates electronically adjustable room acoustics. Using microphones, processing and distributed loudspeakers, it adds controlled acoustic energy to the room, allowing one venue to host a wide range of unamplified performances, from operetta, opera, ballet, piano, solo instruments, jazz combo, ensemble and chamber music to small orchestra, symphonic orchestra, choir, choir with orchestra and church organ.

An AAS can enhance a venue's baseline acoustic character by extending reverberation time, increasing spatial impression and improving listener envelopment. It cannot remove unwanted acoustic energy, such as excessive baseline reverberation, strong acoustic defects or high background noise. For this reason, multipurpose venues are typically designed with a controlled baseline acoustic suited to the use case with the shortest reverberation time, while AAS is used to electronically enhance or extend the acoustic character for other use cases.

Beyond reverberation time alone, an AAS can also help compensate for certain acoustic shortcomings, such as weak acoustic support, uneven acoustic distribution or areas that are acoustically isolated from the main audience field, including under-balcony seating, stalls, boxes, loges or premium seating areas.

A SIAP AAS is designed to blend with the baseline acoustic of the room, so the enhancement is not perceived as a separate loudspeaker effect. The aim is for the venue to provide an acoustic environment that is appropriate to the type of performance or use case.

Main active acoustic system concepts

CONCEPT	SHORT EXPLANATION	DESIGN BENEFITS	DESIGN CONSIDERATIONS
REGENERATIVE	Microphones capture room sound and acoustic energy is recirculated through loudspeakers, with loop gain and stability carefully controlled.	Considered to be the most 'natural' form of enhancement as it is regenerating the baseline room acoustics.	Requires careful consideration of microphone placement and loudspeaker density to avoid acoustic feedback and microphone or loudspeaker localisation.

CONCEPT	SHORT EXPLANATION	DESIGN BENEFITS	DESIGN CONSIDERATIONS
IN-LINE	Direct sound sources from microphones or line inputs are processed using convolution or algorithmic reverberation and distributed through the loudspeaker system.	As there are technical limits to regeneration, In-line uses algorithmic processing of the microphone signals to generate reverberation. Algorithmic processing offers the advantages of longer reverberation times, more control and the ability to compensate for selected acoustic shortcomings.	Requires the main pickup microphones to capture the stage area evenly and naturally. Microphones are typically directional and aimed from the audience area towards the stage, with placement and angle checked against the microphone polar pattern, stage width, source distance and required coverage. The processed sound must blend with the room without becoming a separate audible effect.
HYBRID	Combination of regenerative and in-line methods.	Combines natural regenerative enhancement with synthetic in-line processing when longer reverberation times or additional control are required. The most effective solution for multipurpose venues and rehearsal rooms, which tend to have a low baseline RT. Also an effective solution for an electronic orchestra shell.	Requires both microphone strategies to work together: main pickup microphones for even stage coverage and room microphones for stable regenerative enhancement. In a typical design, four directional main microphones may be angled towards the stage, while room microphones are positioned away from HVAC, lighting fixtures, stage machinery and other unwanted noise sources. Microphone placement, loudspeaker layout, routing, level balance and preset structure must be coordinated so both processing methods blend naturally and remain stable.

SIAP's AVA processor uses a hybrid approach. For the design team, the key requirement is to create the right physical and technical conditions: suitable microphone placement, sufficient loudspeaker density and overlap, appropriate routing, clear acoustic zones and sufficient individual channel control for level, delay, routing and tuning.

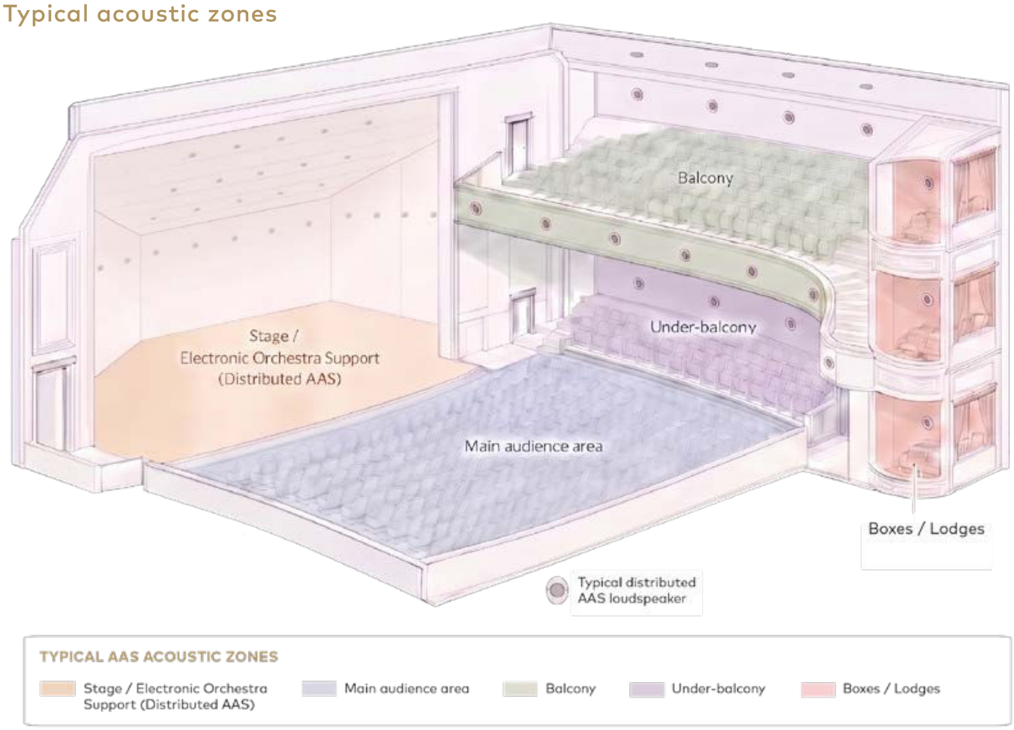
Acoustic zones

An AAS design is not only focused on adding reverberation to the audience area. The SIAP AAS divides the venue into distinct acoustic zones, creating a natural, immersive experience for both performers and audience. There are two primary acoustic zones: the main audience zone and the stage or performance zone. Together, these zones define how the AAS transfers acoustic energy in several directions: from performers to the audience, from the audience response, such as applause, back to the performers, between performers on stage, and within the audience area itself.

However, the architecture of many venues includes areas that are at the edges of, or acoustically isolated from, the main audience space. Examples are VIP boxes and under-balcony areas. These areas each have a unique acoustic character and require treatment as additional zones by the AAS. The number and type of additional zones depend on the architecture of the room geometry, seating layout, stage use, balcony structure, acoustic isolation (where the local zone seating is isolated from the acoustic field in the main seating zone) and desired acoustic presets. The AAS designer will need to identify these zones, as they will impact the processor I/O needs and hence the complexity of the system design.

Stage support or an Electronic Orchestra Shell should be considered early in the AAS design. It can improve performer comfort, ensemble playing and the connection between stage and room, but the exact stage-support approach should be defined per project.

Typical acoustic zones



E info@siapacoustics.com

TYPICAL USE CASES

AAS use cases must be discussed early because they influence microphone placement, loudspeaker density, channel count, acoustic zones, routing and control requirements.

A useful approach is to define the typical venue use cases first, and then agree which acoustic preset or operational mode is appropriate for each use case. The examples below are indicative only. Final preset names, reverberation times and functions should be agreed with the venue team.

TYPICAL USE CASE	TYPICAL AAS APPROACH	TYPICAL PRESET	INDICATIVE RT
Corporate AGM, training, product launch or presentation	Usually limited. AAS may remain off, use a short preset, or support speech-related functions where required.	Natural room / System off or Short ambience	0.9 s
Panel discussion, plenary session or TED-style talk	Mainly relevant where subtle speech support or improved room comfort is required. Voice-lift only where specifically required.	Natural room / Short ambience	0.9 s
Spoken word, drama or small theatrical performance	Can improve acoustic connection and room response without making the result sound amplified.	Short ambience or Light acoustic support,	0.9-1.2 s
Light amplified event, jazz combo or electro-acoustic performance	Useful where acoustic instruments, soloists or weak sources need subtle acoustic enhancement alongside FoH.	Light acoustic support,	1.2 s
Audition, piano, solo instrument or small ensemble	Useful for creating a more responsive room acoustic and better listener envelopment.	Piano / Small ensemble,	1.4 s
Chamber music, recital or acoustic ensemble	Strong AAS use case. Adds room response, spatial impression and acoustic connection between stage and audience.	Recital / Chamber music	1.6 s
Opera, ballet or symphonic theatre	Strong AAS use case. Can provide a larger acoustic setting and stage-audience connection, especially when combined with stage support.	Symphony orchestra	1.8 - 2.0 s
Symphony orchestra, choir or choir with orchestra	Strong AAS use case. Extends reverberation time and increases spatial impression and listener envelopment.	Symphony orchestra or Choir	2.0 - 2.4 s
Organ, church-like acoustic or spiritual event	Useful where a longer acoustic character is desired.	Choir / Church acoustics	2.5 - 4.0 s
Special artistic effect or cathedral-like acoustic	Project-specific artistic use.	Cathedral / Effect	5.0 s
Cinema, Dolby Atmos playback, fully amplified concerts or high-level playback	AAS normally off. The FoH, cinema, Dolby Atmos or playback system remains the primary programme reproduction system.	System off / Natural room	-

E info@siapacoustics.com

03 SYSTEM OVERVIEW

Core system components

A typical SIAP AAS installation consists of a SIAP AVA processor, microphones, preamplifiers or converters, amplifiers, distributed loudspeakers and one or more control interfaces. The SIAP AVA processor I/O varies from 16x16 to 128x128.

The exact AVA architecture depends on venue size, acoustic zones, required presets, channel count, third-party equipment choices and any required integration with FoH, Dolby Atmos, spatial audio, playback, show control or third-party control systems.

COMPONENT	FUNCTION IN THE AAS SYSTEM
SIAP PROCESSOR	Central processing unit for active acoustic processing, routing, presets, control and integration.
MICROPHONES	Capture the acoustic behaviour of the room and provide input for AAS processing. Main pickup microphones are typically directional. Room and optional voice-lift microphones may be added depending on application.
PREAMPLIFIERS / CONVERTERS	Provide microphone preamplification and conversion to the audio infrastructure, such as Dante, AES67, MADI or analogue audio where required.
CENTRAL ROUTING DSP / ROUTER	Used where shared infrastructure or external audio systems are part of the project. Manages signal routing between SIAP processor, FoH, Dolby Atmos, spatial audio systems, amplifiers and loudspeakers, including operational mode switching where required.
AMPLIFIERS	Drive the distributed loudspeaker system, using analogue, Dante, AES67 or other input formats depending on the project.
LOUDSPEAKERS	Create the enhanced acoustic field throughout the venue. Selection and placement are driven by density, overlap, dispersion, SPL capability and avoidance of audible localisation.
CONTROL INTERFACES	Allow users to select acoustic presets and operate the system through SIAP control panels, SIAP iPad control or third-party control systems.

Brand-agnostic integration

SIAP is designed to work with a wide range of third-party microphones, loudspeakers, amplifiers, converters and audio-network infrastructure. The system does not require a fixed loudspeaker or amplifier brand, but all selected components must meet the acoustic, technical and operational requirements of the project.

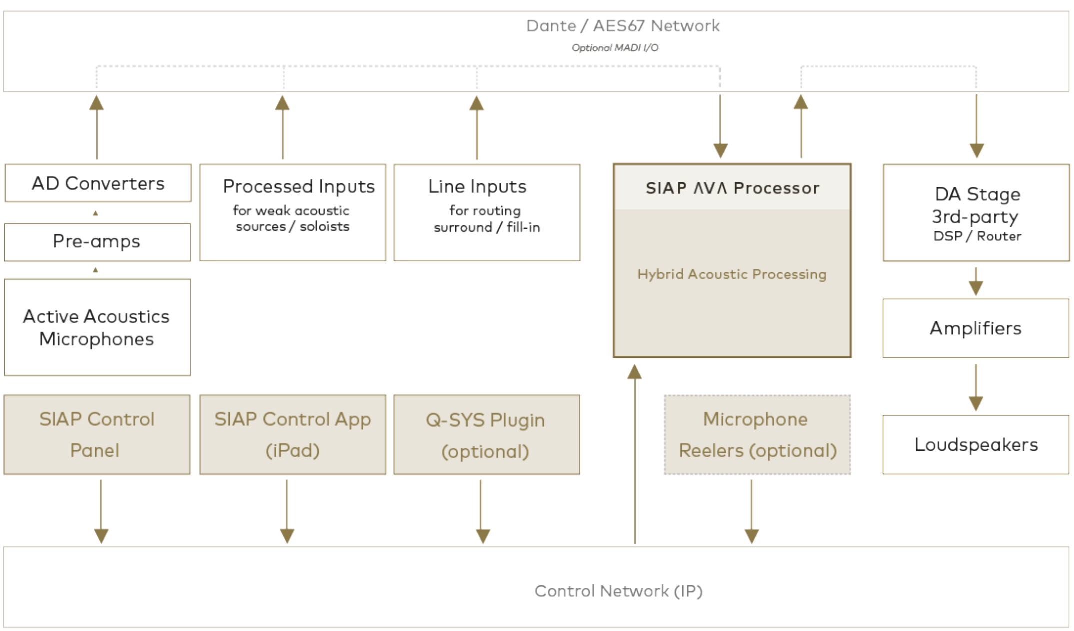
This allows consultants and system integrators to work with preferred, specified or existing equipment, while using the SIAP processor as the acoustic enhancement core. However, equipment suitable for conventional sound reinforcement is not automatically suitable for active acoustics. AAS performance depends on microphone quality, loudspeaker dispersion, loudspeaker density, signal routing, channel control, noise performance, latency and system stability.

This design guide explains the key product and performance decisions that the design consultant and system integrator should address before SIAP reviews and confirms the final system specification.

Audio integration

Audio I/O options include Dante, AES67 and MADI.

Third-party routing, amplification and loudspeaker systems are chosen by the consultant or system integrator. This design guide defines the AAS requirements, design targets and decision criteria needed to develop a suitable system concept, including channel counts, audio transport, conversion, routing, control and operational mode requirements.



Shaded items are typically supplied by SIAP. Non-shaded items represent third-party equipment or project infrastructure.

Control integration

The SIAP AAS offers several controller options: a fixed SIAP control panel, the SIAP iPad Control App, or selected third-party AV control systems that can communicate using the OSC protocol.

Typical controller locations include the main AV control room, one or more rack locations or the stage manager's position. The consultant or system integrator shall define which control locations are required.

Where third-party control system integration is required, the design package shall identify the required control platform, control locations, required user functions and the SIAP functions that need to be exposed for control.

04 DESIGN GUIDE

Design approach

Designing an AAS system starts with the acoustic and functional requirements of the venue. The goal is to define a system that can deliver the required acoustic presets for each use case.

The consultant or system integrator prepares the project-specific AAS design package using the workflow below. Once the design package is complete, it should be submitted to SIAP for AAS suitability review before it is issued to the client, included in a tender submission or used for a request for a quotation.

AAS design package checklist

DESIGN PACKAGE ITEM	WHAT SHOULD BE DOCUMENTED
PROJECT INFORMATION	Venue use cases, seating layout and capacity, room dimensions and volume, stage use and dimensions, balcony and under-balcony geometry, ceiling heights and relevant architectural constraints.
BASELINE ACOUSTICS	Baseline reverberation time of the venue, known acoustic risks (e.g., echo, resonance), zones that are acoustically isolated from the main seating zone, background noise concerns and any available measurement or simulation data.
ACOUSTIC ZONES	Main audience zone, stage zone, balcony and under-balcony zones, VIP boxes, premium seating zones and any project-specific zones where separate acoustic enhancement may be required.
MICROPHONE STRATEGY	Number of AAS microphones, microphone types, pickup patterns, positions, heights, aiming, suspension method, reeler requirements (if applicable) and cable routes.
LOUDSPEAKER LAYOUT	Loudspeaker types, quantities, positions, mounting heights, aiming, zones served, expected listener distances, coverage assumptions and localisation risk areas.
AMPLIFIER AND CHANNEL STRATEGY	One dedicated amplifier channel per AAS loudspeaker, loudspeaker-to-amplifier channel allocation, amplifier audio input type, required headroom, required AD/DA conversion and operational mode requirements for all AAS and shared-use modes, where applicable.
AUDIO TRANSPORT AND ROUTING	Dante, AES67, MADI, analogue I/O, AD/DA conversion, patching, routing diagrams, clocking, network settings and shared infrastructure requirements.
CONTROL CONCEPT	Fixed SIAP control panel(s), SIAP iPad control, third-party control integration, control locations. The fixed control panel may provide extended operation, while the SIAP iPad control is typically used for simplified daily operation.

DESIGN PACKAGE ITEM	WHAT SHOULD BE DOCUMENTED
PRESET AND USE-CASE REQUIREMENTS	Required acoustic presets, intended use cases, operating modes and any line-input, playback, voice-lift or spatial audio functions required for the project.
CONCEPT SYSTEM DESIGN DRAWINGS	PDF and/or DWG drawings showing the proposed SIAP AAS design, including microphone positions, loudspeaker positions, mounting heights, zones served, cable routes where relevant and key installation constraints.
SYSTEM BLOCK DIAGRAM	Overview diagram showing signal flow, audio transport, AD/DA conversion, preamplifiers, SIAP processor, routing/DSP, amplifiers, loudspeakers, control interfaces and any shared infrastructure with FoH, spatial audio, Dolby Atmos or playback systems.
PROJECT TIMELINE AND COMMISSIONING READINESS	Project timeline including design review, procurement, installation, installation verification, SIAP tuning, commissioning, user training and handover; equipment list, I/O and channel list, patching documentation, as-built documentation, access plan, labelling, power, network, mounting, cabling and confirmation that all microphones, loudspeakers, amplifier channels, signal paths and control connections have been installed and tested before SIAP tuning.

Where relevant, acoustic targets may also be reviewed against recognised criteria and references such as ISO 3382, ISO 23591 and NS 8178. For further background, please refer to the SIAP reference document SIAP Active Acoustics in Relation to NS 8178 and ISO 23591.

The following sections expand on the checklist above and describe the workflow, design criteria and documentation requirements for each part of the AAS design package.

Responsibilities

Clear responsibilities are essential in AAS projects. The consultant or system integrator is responsible for preparing the complete project-specific AAS design package, including third-party equipment selection, infrastructure coordination, installation documentation and integration with the venue infrastructure, unless agreed otherwise.

SIAP provides the AAS design requirements, performance criteria and workflow guidance in this document. The consultant or system integrator applies these requirements to the project-specific design package. Once the design package is complete, SIAP reviews the proposed system for AAS suitability and remains responsible for SIAP processor configuration, acoustic tuning, user training and commissioning for the agreed SIAP system.

SIAP RESPONSIBILITY	CONSULTANT/SYSTEM INTEGRATOR RESPONSIBILITY
AAS design requirements, performance criteria and workflow guidance as defined in this document.	Application of these requirements to the complete project-specific AAS design package.
Final AAS suitability review of the completed design package.	Overall system design, third-party equipment selection and infrastructure coordination.
Supply of the SIAP AVA processor, fixed SIAP control panel(s) and SIAP iPad with Control App in kiosk mode, where required.	Detailed installation drawings, cable schedules, rack layouts, power coordination, mounting details and physical installation.
SIAP processor configuration, AAS preset structure, acoustic tuning, user training and commissioning.	Coordination with architect, theatre consultant, AV consultant, acoustic consultant, contractor and venue technical team.
After sales support for SIAP-supplied hardware, configuration and AAS performance within the agreed scope.	All responsibilities for third-party equipment, installation and venue infrastructure.

Required project information and room analysis

Room analysis defines the acoustic starting point. SIAP requires reliable baseline acoustic information, including natural reverberation time, room geometry, seating layout, stage use and known acoustic constraints. An acoustic simulation or impulse response measurement is not mandatory but having it available can speed up the evaluation process. Additional acoustic investigation may be needed where there are known or suspected risks.

Consultant / SI workflow

- Collect architectural drawings: plans, sections, reflected ceiling plans and seating layout.
- Confirm room dimensions, ceiling heights, stage geometry, balcony and under-balcony areas.
- Provide a reliable indication of natural RT, preferably by measurement or acoustic model.
- Identify acoustic risks: strong reflections (e.g., a slap echo from the balcony face back to the stage), flutter echo (between 2 parallel wall surfaces), focused sound (usually caused by curved or domed surfaces), room resonances, excessive background noise (e.g., HVAC) or areas acoustically isolated from the main seating areas.
- Identify architectural, heritage, rigging, sightline, lighting, HVAC, cabling and access constraints.
- List existing or proposed loudspeaker, amplifier, DSP, network and control infrastructure.

- Include this information in the concept design package before detailed AAS layout decisions are finalised.

MINIMUM INFORMATION	PURPOSE
Drawings and room geometry	Allows the consultant or system integrator to understand room volume, distances, ceiling heights, balconies, under-balcony zones and installation constraints, and enables SIAP to undertake an AAS suitability review
Natural reverberation time	Defines the acoustic starting point and realistic extension range. AAS adds acoustic energy but cannot remove baseline reverberation.
Use cases and preset expectations	Determines required acoustic flexibility, zones, microphone strategy, loudspeaker density and control requirements.
Known acoustic risks	Identifies whether additional acoustic investigation or architectural treatment is needed before the AAS design is finalised.
Existing/proposed audio infrastructure	Determines whether equipment can be reused or shared and what additional routing, amplification or loudspeakers are required.

Define acoustic zones

The zoning strategy should be defined before final microphone and loudspeaker placement decisions are made.

Zone design workflow

- Mark the main audience and stage/performance areas, as well as any areas that may require individual acoustic enhancement, such as the under-balcony areas, VIP boxes , etc.
- Identify areas with low ceilings, short listener distance (increased localisation risk).
- Confirm the required acoustic relationships between stage and audience. Performer-to-audience enhancement is essential for most AAS applications. Audience-to-stage response and performer support are strongly recommended, typically through stage support or an Electronic Orchestra Shell. If this is not technically feasible or not included in the project budget, an AAS can still be implemented, but active stage support and the enhanced acoustic connection back to the performers will be very limited.
- Define whether these zones require additional loudspeaker density, specific loudspeaker positions, separate loudspeaker groups, dedicated amplifier channels, separate cabling routes or independent routing.
- Document the relevant area boundaries, loudspeaker groups, and routing assumptions and intended acoustic function in the AAS design package.

TYPICAL ZONE	DESIGN PURPOSE
Main audience zone	Creates the main diffuse, non-localisable enhanced acoustic field for the venue. This is normally the reference area for the primary AAS loudspeaker layout.
Stage / Electronic Orchestra Shell	Improves performer to performer ensemble synchronization, early reflections, envelopment and stage to room connection without creating a separate stage effect. Requires dedicated microphone positions and loudspeakers over the stage.
Under-balcony zones	The baseline acoustic characteristics of these zones differs from the main audience zone, so the acoustic enhancement is different. In addition, listener distance to loudspeakers is short and may require closer loudspeaker spacing, (smaller) loudspeakers with wider high-frequency dispersion, and separate routing or level control.
Stalls, VIP boxes, loges or wheelchair seating	Only where acoustically separated from the main audience area and requires additional loudspeaker support, separate cabling, routing or level adjustment.
Speech / voice-lift zone	If specified, it requires separate microphone strategy, loudspeaker zoning, routing, stability criteria and commissioning criteria.

Select and place microphones

Microphone strategy affects stability, naturalness, stage support and the ability of the SIAP processor to create a coherent acoustic response. The microphone plan should be developed together with acoustic zones, sightlines, rigging, cable routes and loudspeaker layout.

VENUE TYPE	PERFORMANCE MICS	AUDIENCE / ROOM MICS	TYPICAL TOTAL	NOTES
SMALL VENUE	2- 4	2-4	4-8	Compact rooms with limited zoning and simple geometry.
MEDIUM VENUE	4	4-8	8-12	Typical theatres, multipurpose venues and halls with a defined stage and audience area.
LARGE VENUE	4-6	8-10	12-16	Larger rooms requiring more detailed pickup, stage support or multiple acoustic zones.
VERY LARGE OR COMPLEX VENUE	Project-specific	Project-specific	16+	Typically above approximately 1,500 seats or with exceptional geometry, balconies, depth, width or zoning requirements.
ELECTRONIC ORCHESTRA SHELL	4 – 8	0	4 - 8	Preferably placed close to the performers.
VOICE-LIFT	2 - 4	0	2 - 4	Aimed at the speech pickup area.

Microphone design criteria

- Performance pickup microphones require a supercardioid pattern and are aimed towards the stage to capture acoustic sources.
- In proscenium or portal-stage venues, the performance pickup microphones are positioned close to the proscenium opening or stage-room transition. Their on-axis direction shall be aimed towards the primary acoustic source area, using the conductor position at approximately 1.30 m height above stage level as a practical reference.
- Room (audience response) microphones require a cardioid pattern and are distributed above the audience area to capture the broader room response and audience-area ambience. They shall be suspended vertically and aimed downwards.
- Microphones are suspended at approximately 6 to 7 m height, or higher where the design requires.
- Optional voice-lift microphones require shotgun or lobar pickup patterns, depending on separate voice-lift scope.
- Microphone positions must avoid sightlines, lighting conflicts, stage operations, moving scenery and rigging conflicts.
- Microphone quantities are rules of thumb. Final count depends on acoustic performance, room geometry and number of zones.

For an electronic orchestra shell or additional enhancement of early reflections, additional microphone positions closer to the musicians shall be required. Flybars/Battens or other stage rigging positions provide suitable temporary or demountable microphone locations, subject to sightlines, rigging, lighting, stage operations and repeatable positioning.

Consultant / SI workflow

- Start from the acoustic zone plan and intended use cases.
- Select preliminary performance and audience/room microphone quantities using the table above.
- Define preliminary performance microphone positions to capture useful stage-room interaction, avoiding direct on-axis loudspeaker radiation towards the microphones
- Define preliminary room microphone positions to support audience and room response, avoiding direct on-axis loudspeaker radiation towards the microphones.
- Check sightlines, lighting, rigging, stage machinery, reeler options, cable routes and maintenance access.

- Document microphone type, pickup pattern, position, height, aiming, suspension method and constraints in the design package.

NOTE: Budget moving light fixtures can often generate mechanical noise. These must not be co-located with the AAS microphones to avoid the microphones picking up the light fixture noise and adding it to the active acoustics signal paths.

Microphone reelers

Microphone reelers are a good option where AAS microphones need to be lowered into their calibrated operating position during use and retracted when the system is not in operation. The deployed microphone position is the calibrated AAS position and must be repeatable, stable and accurately defined. The retracted position is a storage position only. A microphone on a reeler must be muted or removed from AAS processing whenever it is outside its calibrated operating position. This can be achieved through the SIAP control system, the venue control system, reeler position feedback, limit switches or another agreed control method.

When microphone reelers are included, the design team should define:

- the calibrated deployed height and position for each microphone;
- the retracted storage position and visual requirements;
- cable management, strain relief and mechanical safety;
- access for maintenance and replacement, including a defined service position where microphones can be safely reached;
- control method, end stops and position repeatability;
- coordination with lighting, stage machinery, rigging, sightlines and architectural constraints.
- the method used to mute or remove microphones from AAS processing when they are outside their calibrated operating position.

Detailed mechanical design, installation and maintenance requirements for microphone reelers should be coordinated separately as part of the project documentation or a dedicated microphone reeler guide.

Select and place loudspeakers

Loudspeaker design for AAS starts with the required acoustic result: a coherent, diffuse and non-localisable acoustic field throughout the venue. The listener should perceive the enhancement as part of the room, not as sound from individual loudspeaker positions.

Flush-mounted in-wall or in-ceiling loudspeakers are preferred for AAS where the building design, mounting depth, loudspeaker aiming, coverage and service access allow it. Flush mounting can reduce cabinet and edge diffraction, improve visual integration and help the loudspeakers become less perceptible as individual sound sources. Surface-mounted loudspeakers are acceptable where they provide better aiming, coverage, service access or installation practicality, provided they meet the required AAS criteria for polar response, overlap, listener distance, SPL/headroom and avoidance of localisation.

Aesthetic requirements should be discussed early with the venue, architect or design team. The design package shall define whether loudspeakers remain visible, are concealed, or are flush-mounted, surface-mounted or otherwise architecturally integrated. Colour requirements should also be documented, including whether the complete loudspeaker, visible cabinet or grille requires a specific finish.

CRITERION	SIAP DESIGN GUIDANCE
AAS contribution	The AAS contribution is designed to add approximately 2 to 3 dB to the baseline acoustic response of the venue, depending on use case/preset.
Direct AAS SPL at listener position	The AAS loudspeaker system shall reproduce 85 dB SPL RMS nominal and 105 dB SPL peak (20dB crest factor) at the listener position, without audible non linearities (e.g., clipping, compression, limiting) or localisation. These values apply to AAS only. Shared systems shall be specified for the highest SPL requirement.
Frequency range / response	Processed operating response from 60 Hz to 15 kHz. Within the operating range, the processed response should typically remain within +/-3 dB. Low-frequency extension at 60 Hz shall not be worse than -10 dB, unless distributed subwoofer support is included.
Low-frequency strategy	Loudspeakers that do not reach 60 Hz at -10 dB require distributed subwoofer support.
Dispersion and polar response	SIAP requires coaxial or coincident loudspeaker designs that approximate point-source behaviour. Particular attention shall be paid to off-axis behaviour below and around the crossover region, typically 2 kHz to 3.5 kHz.
Coverage overlap	Loudspeaker spacing shall be based on polar response and checked at the closest listener position. As a practical design target, the -3 dB horizontal coverage edges of adjacent loudspeakers shall meet or overlap at listener height to support smooth coverage and reduce localisation. Check at 1 kHz and verify at 2 kHz and 4 kHz.
Close listener areas	Where listener-to-loudspeaker distance is 3 m or less, loudspeaker-to-loudspeaker spacing shall not exceed the listener-to-loudspeaker distance. Under-balcony areas, low ceilings and side seating therefore require closer spacing and careful localisation review.

Unlike conventional FoH coverage, AAS loudspeaker design is not only about even SPL. It also depends on sufficient loudspeaker density, smooth overlap, predictable dispersion and listener distance. Loudspeaker spacing shall be derived from the polar response and checked at the closest listener position, with the practical aim of reducing the perception of individual loudspeaker positions.

For typical theatres, side-wall loudspeakers shall be mounted at approximately 2.7 m height as a practical starting point for lateral energy distribution and localisation control. In practice, horizontal spacing often falls within approximately 2.5 m to 3.0 m, depending on polar response, listener distance, seating geometry and architectural constraints. Closer spacing is required in under-balcony areas, low ceilings or side seating where localisation risk is higher.

Ceiling loudspeakers are positioned further from listeners than wall loudspeakers, allowing wider spacing while maintaining uniform coverage. Spacing should still be checked against loudspeaker dispersion, ceiling height, required overlap and the need to avoid audible localisation.

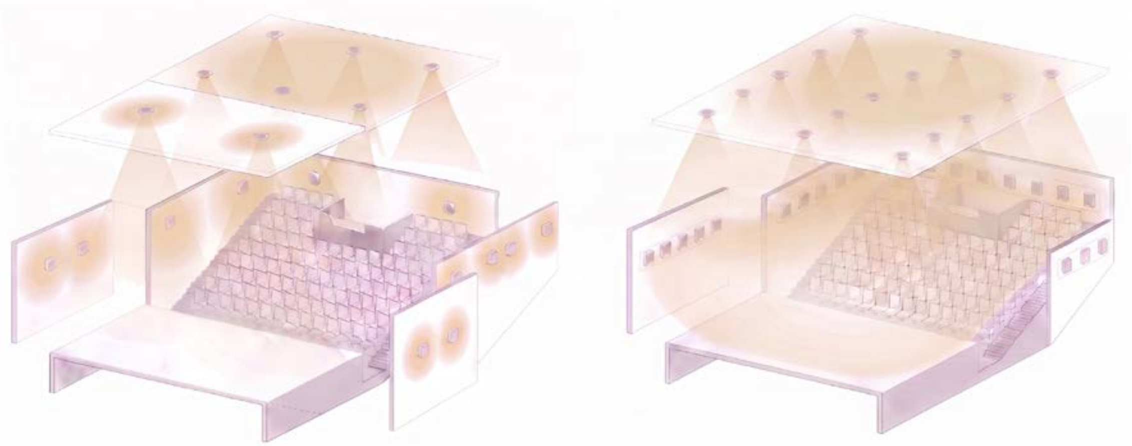
As a practical rule of thumb, the total number of side-wall loudspeakers per side should approximately match the number of ceiling loudspeakers, ensuring a balanced distribution of lateral and medial energy across the venue.

Loudspeaker design workflow

- Start from the acoustic zone plan, seating layout, listener distances and ceiling/wall geometry.
- Place side-wall loudspeakers to create sufficient lateral density and overlap at listener height, typically starting from approximately 2.7 m mounting height where the venue geometry allows.
- Place ceiling loudspeakers to maintain uniform coverage, sufficient overlap and low localisation risk, taking ceiling height and loudspeaker dispersion into account.
- Add balcony, under-balcony, rear-wall or close-listener loudspeakers.
- Check each loudspeaker candidate against polar response, off-axis behaviour, overlap, listener distance, SPL/headroom and frequency response.
- Check architectural integration: flush mounting, surface mounting, visibility, colour requirements, sightlines, heritage constraints, service access, rigging and cabling.
- Document loudspeaker type, position, height, aiming, zone, amplifier channel, expected listener distance and coverage assumptions.

Final loudspeaker placement shall be documented in the AAS design package and checked against coverage, polar response, listener distance and localisation criteria.

Loudspeaker Density and Localisation



A. Sparse loudspeaker spacing - localisation risk

B. Sufficient loudspeaker density and overlap - diffuse non-localisable acoustic field

Select amplifiers and define amplifier channel requirements

Amplifier and channel requirements determine how much individual control the AAS system has over the loudspeaker layout. If powered loudspeakers are used, amplification, input format and available headroom are part of the loudspeaker choice. If passive loudspeakers are used, the amplifier selection must provide sufficient clean headroom to meet the required SPL without limiting or audible distortion.

For the AAS design, each loudspeaker shall have its own dedicated amplifier channel. This keeps each loudspeaker individually addressable whether routing and/or tuning is handled in the SIAP processor, external DSP, amplifier DSP or another agreed part of the signal chain.

Where loudspeaker infrastructure is shared with Dolby Atmos, spatial audio, playback or other systems, the channel strategy shall define how the AAS retains individual routing and tuning across the operational modes/presets used for each use case – see section 5 below.

The channel strategy shall define

- the one-to-one allocation between AAS loudspeakers and dedicated amplifier channels;
- how SIAP processor outputs are connected to amplifier inputs;
- amplifier headroom required for AAS, Dolby Atmos, spatial audio and programme reproduction;
- how the AAS needs for routing, tuning and other configurational needs are maintained between operational modes/presets.

Specify the SIAP solution

Once the venue requirements, acoustic zones, microphone strategy, loudspeaker layout, amplifier/channel strategy and integration requirements are understood, the consultant or system integrator can prepare an initial SIAP system concept. This should define the main system quantities and I/O requirements, including AAS microphones, microphone preamp channels, loudspeakers, amplifier channels, SIAP processor inputs and outputs, audio transport format, AD/DA conversion, control interfaces and redundancy requirements.

ITEM	DESIGN CONSIDERATION / DECISION DRIVER
SIAP PROCESSOR MODEL AND I/O COUNT	Which SIAP processor model is required, and how many processor input and output channels are needed for AAS, integration and future expansion?
MICROPHONES	How many AAS microphones are required? Which microphone types and pickup patterns are used?
LOUDSPEAKERS AND AMPLIFIER CHANNELS	How many loudspeakers are required? How many amplifier channels are needed? How is one-to-one AAS channel control maintained in shared-use modes?
AUDIO TRANSPORT AND CONVERSION	Is the system based on Dante, AES67, MADI, analogue I/O or a combination? Where analogue microphone inputs or analogue amplifier feeds are used, the required AD/DA conversion must be included in the system design.
PROCESSING CONFIGURATION	Which AAS functions, zones, presets and optional modules are required?
PRESET STRUCTURE	Which acoustic presets are required for the intended use cases?
SPATIAL AUDIO OR FUNCTIONAL MODULES	Are spatial audio, voice-lift, playback, show control or other functions required? Voice-lift should be defined separately where required for the project.

For typical minimum and preferred component characteristics, refer to Appendix A - Typical Component Requirements.

Preset and routing requirements

The typical use cases, acoustic presets and indicative reverberation times should be defined early in the design process, as described in Section 02. These use cases form the basis for the SIAP preset structure, routing concept and required processor I/O.

All preset names, reverberation times/performance criteria and use cases should be agreed with the venue team. In many systems, the selected preset can also be adjusted within a limited operational range, including reverberation level.

As part of the standard SIAP acoustic preset structure, selected line inputs may follow the active room preset. For example, line inputs 1 and 2 can be processed with the same reverberation and envelopment characteristics as the selected acoustic preset, allowing weak acoustic sources to be subtly blended into the AAS system. Other line inputs may remain unprocessed and be routed as simple L/R programme inputs for show audio or playback.

Audio I/O, control and redundancy

ITEM	DESIGN CONSIDERATION / DECISION DRIVER
AUDIO TRANSPORT STRATEGY	Is the system based on Dante, AES67, MADI, analogue I/O or a combination? This affects preamps, converters, amplifier choice, patching and network infrastructure.
MICROPHONE INPUT STRATEGY	Define the microphone preamplification and conversion strategy. Microphone signals may use analogue preamps followed by separate AD conversion, or preamps with integrated AD/network audio output. The design shall define how microphone signals are transported to the SIAP processor via Dante, AES67, MADI or other agreed audio format.
LINE INPUT STRATEGY	Define line inputs for weak acoustic sources, soloists, close microphones, playback, voice-lift, FoH feeds or show-control signals.
LOUDSPEAKER OUTPUT / AMPLIFIER STRATEGY	Are amplifiers driven via Dante/AES67 or analogue outputs? Dante amplifiers can reduce analogue cabling and DA conversion. Analogue amplifiers require suitable DA conversion.
CONTROL INTERFACES	Which control interfaces are required: fixed SIAP control panel, SIAP iPad control, third-party control system or show-control integration? For wireless iPad control, the system design must include suitable Wi-Fi coverage and a strategically placed access point in the venue.
REDUNDANCY CONCEPT	Define whether system availability requires a pre-configured cold spare or a hot redundant system with automatic failover.

Where external line inputs are required for the project, the required number of inputs and outputs, input format and connection method should be defined, such as Dante/AES67, MADI, AES/EBU, analogue line inputs, XLR input panels or Dante stageboxes. Additional routing or line-input processing functions may then be defined. These functions are project-specific and should not be treated as standard AAS presets unless included in the agreed system design. Typical examples are shown below.

E info@siapacoustics.com

Example line-input / ambience functions

EXAMPLE PRESET	TYPICAL FUNCTION	TYPICAL PURPOSE
LINE-INPUT AMBIENCE	Routes selected line inputs to predefined ambient loudspeaker groups.	Adds acoustic ambience or room impression around external programme material.
THEATRE AMBIENCE	Routes theatre playback or selected FoH feeds to predefined ambient loudspeaker groups.	Supports theatre productions, show playback or special effects without replacing the FoH system.
SURROUND AMBIENCE	Routes multichannel line inputs to predefined ambient loudspeaker groups.	Supports 5.1, 7.1, 9.1 or project-specific surround feeds where these are part of the agreed system.
STEREO WASH	Routes line-inputs (L+R) to the side-walls loudspeakers.	Adds subtle reinforcement and spatial lift to the FoH mix.
SURROUND (4 CHANNEL)	Routes 4 line inputs to L/R side wall and L/R rear wall loudspeaker groups.	Supports traditional 4-channel surround playback, ambience or effects.
SURROUND (6 CHANNEL)	Routes 6 line inputs to front/rear L/R side wall and L/R rear wall loudspeaker groups.	Supports surround playback, ambience or effects using separate side-wall and rear-wall loudspeaker groups.

05 SHARED AUDIO INFRASTRUCTURE

Shared infrastructure, different design priorities

SIAP AAS can share selected loudspeakers, amplifiers, routing and audio-network infrastructure with FoH, Dolby Atmos and spatial audio systems where these systems are part of the project. Shared infrastructure can make the technical design more efficient and economical by allowing the same loudspeaker, amplifier and audio transport infrastructure to support multiple functions, provided that the layout, channel strategy, signal paths and operational modes are defined from the beginning.

Although each system has a different use case, the design priorities and infrastructure needs overlap. FoH systems electronically amplify pre-recorded and/or live performances with a design priority of high SPL/direct coverage and intelligibility. An AAS enhances the venue acoustics for live performances with a distributed, diffuse and non-localisable acoustic field as its primary design priority. Dolby Atmos is a self-contained pre-recorded/playback object-based audio system. Spatial Audio is also an object-based audio system but handles both playback and/or live show content. Dolby ATMOS and spatial audio both have a design priority for each object channel to provide even coverage of the audience areas.

Shared infrastructure shall be specified for the most demanding SPL, bandwidth and headroom requirement of the intended use cases. AAS suitability shall then be checked against loudspeaker density, polar response, overlap, listener distance, routing control, zone coverage and avoidance of localisation.

SYSTEM & APPLICATION	PRIMARY DESIGN PRIORITY	AAS INTEGRATION PRINCIPLE
FoH Application: The FoH system provides high-SPL electronic amplification of pre-recorded and/or live performances. **FoH System:** Main L-(C)-R plus sub-bass loudspeakers In fill/Front fill/Side fill loudspeakers covering private boxes, under balcony and other spaces.	High SPL Even, direct coverage of all seating areas Uniform intelligibility	Acoustic. The AAS and FoH systems generally operate mutually exclusively, with one system off when the other is on. However, the AAS can be used to acoustically enhance the performance for a lightly amplified electro-acoustic event.

SYSTEM & APPLICATION	PRIMARY DESIGN PRIORITY	AAS INTEGRATION PRINCIPLE
Dolby ATMOS application: Pre-recorded/playback system for movie theaters, based on spatial audio/object-based audio techniques. **Dolby ATMOS System:** Screen coincident L-C-R or LL-LC-C-RC-RR plus LFE loudspeakers (which occupies the performance stage, unlike the FoH system). Surround loudspeakers providing accurate rendering of audio object positioning with smooth movement.	High SPL Channel density must support smooth audio object movement. Central aiming point of all loudspeakers provides good audience coverage. See Dolby ATMOS design reference document "dolby-atmos-specifications-2024.pdf" for full details on design priorities	Electrical. Dolby ATMOS is pre-recorded content, whereas AAS is a room enhancement for live shows, so only one will be in use at any time. The Dolby ATMOS loudspeaker positioning is generally acceptable for AAS, but additional AAS loudspeakers are usually needed to avoid localisation in semi-enclosed zones such as under-balconies. The Dolby SPL requirements are usually much higher than AAS, so the Dolby loudspeaker and amplifier performance is acceptable for AAS.
Spatial Audio Application: Spatial audio rendering of pre-recorded and/or live content based on object-based audio techniques. **Spatial Audio System:** Integrated with the FoH system. Additional immersive loudspeakers providing accurate rendering of audio object positioning with smooth movement.	High SPL Channel density must support smooth audio object movement. Channel density must support accurate 3D positional rendering.	Spatial audio systems often require signal-level integration with the shared loudspeaker and amplifier infrastructure, especially where spatial audio and AAS operate at the same time. Unlike Dolby Atmos, which is often implemented as a dedicated playback system with its own layout requirements, spatial audio systems for live performance are often more closely integrated with the FoH system. A spatial audio loudspeaker layout may be suitable for shared use with AAS, but this must be checked against AAS requirements for loudspeaker density, overlap, dispersion, individual channel control, latency and avoidance of audible localisation. Because spatial audio and AAS use different processing, each system requires its own signal processing path. Where loudspeakers or amplifier channels are shared, the spatial audio and AAS signals must be combined through an agreed routing or mixing stage before the amplifier inputs.

FoH integration workflow

FoH systems remain the primary reinforcement system for amplified performances, speech, vocals, bands and show playback. The FoH and AAS are acoustically rather than electrically integrated. The FoH system provides direct programme reinforcement of mic'ed and recorded sources, while the AAS (if required for a particular show) enhances acoustic sources.

Although there is no use case for electrically integrating the AAS with the main FoH L-C-R/Sub bass loudspeakers, it is technically possible to integrate the AAS with the FoH 'fills' (front, side, underbalcony, etc). However, this can be electrically challenging (the FoH DSP and amplification are often combined) with little benefit, as the FoH fill loudspeakers are 'voiced' to different design priorities and will usually create localization.

Typical operating modes include:

- **Fully amplified performance**: FoH on, AAS off.
- **Fully acoustic performance**: FoH off, AAS on.
- **Optional**: Lightly amplified electro-acoustic performances can use the FoH for direct reinforcement of electrical instruments, while AAS supports acoustic instruments, soloists, and vocals, as well as the room acoustic and stage-audience relationships.

Consultant / SI workflow

Review the client use cases and identify if FOH and AAS acoustic integration is required. A common indicator is if there are any use cases for acoustic instruments or vocalists that are not mic'ed up for the main FoH system.

Dolby Atmos integration workflow

Dolby Atmos infrastructure provides a strong starting point for AAS integration, because many side-wall, rear-wall and ceiling loudspeaker positions, as well as the available SPL capability, can also support AAS. Dolby Atmos is a self-contained playback system, while AAS is a room enhancement system for live and acoustic use. Where both systems share loudspeakers, routing and amplification, they always operate as separate modes: a Dolby Atmos mode and an AAS mode.

Typical operating modes include:

- **Movies**: Dolby ATMOS on, AAS off.
- **Acoustic Performances**: Dolby ATMOS off, AAS on.

Consultant / SI workflow

- Start with a valid Dolby Atmos loudspeaker layout, based on applicable Dolby design guidance and project review.

- Remove the LL-LC-C-RC-RR and LFE loudspeakers from consideration.
- Transfer proposed Dolby ATMOS loudspeaker brands, models, positions and aiming data into the AAS acoustic design or simulation environment.
- Check which Dolby ATMOS side-wall, rear-wall, ceiling and sub-bass loudspeakers can also be used for AAS.
- Check side-wall, rear-wall and ceiling loudspeakers for AAS density, overlap, polar response, listener distance and zone coverage.
- Add AAS loudspeakers where the ATMOS layout does not provide sufficient support, especially for stage support, under-balcony coverage, rear-zone support, balconies, close-listening areas or acoustically isolated zones.
- Check amplifier channel strategy. Where loudspeakers are paired, grouped or processed together for Atmos or playback operation, AAS requires these loudspeakers to be unpaired/ungrouped and available as individual AAS channels. The router or amplifier preset structure should allow re-pairing for ATMOS and un-pairing for AAS.
- Define how the system switches between ATMOS, playback and AAS modes, including routing presets, automated switching, DSP presets, amplifier presets, control triggers and commissioning responsibilities.

The SPL capability required for Dolby ATMOS is higher than the SPL capability required for AAS. This means that ATMOS loudspeakers will meet the AAS SPL requirement, but they must still be checked against AAS requirements for density, overlap, dispersion, listener distance, zone coverage and avoidance of localisation.

Spatial audio integration workflow

Spatial audio creates a 3-D listening experience by positioning or moving sound objects within the available loudspeaker layout. This guide does not define a spatial audio design; it only addresses how spatial audio and AAS infrastructure can be integrated. Spatial audio design principles and layout requirements are covered in a separate SIAP spatial audio design guide.

Spatial audio loudspeaker layouts can vary widely, from compact systems to high-density object-based systems. A spatial audio layout may provide a useful starting point for shared AAS infrastructure, but it must always be checked against AAS requirements for loudspeaker density, overlap, polar response, listener distance, zone coverage, latency, individual channel control and avoidance of audible localisation.

Spatial audio and AAS may operate separately or at the same time, depending on the use case. Simultaneous operation is most relevant where AAS enhances the acoustic environment for live performers while spatial audio is used for recorded or live-rendered object-based content, effects or ambience.

E info@siapacoustics.com

Because spatial audio and AAS use different processing, each system requires its own signal processing path. Where loudspeakers or amplifier channels are shared, the spatial audio and AAS signals must be combined through an agreed routing or mixing stage before the amplifier inputs.

Typical operating modes include:

- **Fully amplified performance (all performers have microphones)**: Spatial audio on, FoH audio on, AAS off.
- **Fully acoustic performance**: Spatial audio off, FoH audio off, AAS on.
- **Acoustic performance with recorded spatial audio objects**: Spatial audio on, FoH audio on, AAS on

Consultant / SI workflow

- Remove the FoH L-C-R and Subbass loudspeakers from consideration.
- Transfer proposed spatial audio loudspeaker brands, models, positions and aiming data into the AAS acoustic design or simulation environment.
- Validate that the spatial audio loudspeakers will meet the needs of an AAS for density, overlap, polar response, listener distance and zone coverage.
- Validate that the spatial audio amplifier channel strategy will meet the needs of an AAS for channel de-localization.
- Document how routing, presets, control and commissioning are managed between the spatial audio engine and the AAS.

Routing and operational modes

The shared infrastructure design shall define:

- which loudspeakers/amplifier channels are dedicated to FoH, Dolby Atmos, spatial audio or AAS;
- which loudspeakers/amplifier channels are shared between which systems;
- how routing changes between operational modes or presets;
- whether systems operate simultaneously or only in separate modes;
- which system controls routing, rendering, amplifier channels and presets;
- sample rate, clock master, network latency settings and audio-network topology;
- redundancy concept, control responsibilities and fail-safe behaviour.

The routing concept, operational modes and shared-channel behaviour should be documented in the AAS design package using routing diagrams, channel lists and mode descriptions.

06 TUNING & COMMISSIONING

Purpose of Commissioning

Tuning and commissioning are essential to SIAP system delivery. The installation provides the physical infrastructure, but the acoustic result is created during measurement, tuning, listening and refinement. This process is carried out by SIAP engineers using system checks, acoustic measurements and critical listening.

The required commissioning time depends on venue size, system complexity, site preparedness, access conditions, number of presets and the availability of the venue team. A typical commissioning period is around five working days, but may be adjusted depending on project requirements.

Pre-commissioning package

Before SIAP tuning and commissioning starts, the consultant / SI shall provide:

- as-built drawings and final loudspeaker/microphone positions;
- complete channel list for microphones, line inputs, loudspeaker outputs, amplifiers and shared infrastructure;
- Dante/AES67/MADI/analogue patching and routing documentation;
- amplifier/DSP settings, network settings, clocking, sample rate and latency settings;
- control system description and operational mode list;
- access plan for microphones, loudspeakers, rack rooms and control locations;
- confirmation that installation, cabling, mounting, labelling, power, network infrastructure and signal paths are complete and tested.

A typical five-day commissioning period includes system verification, routing checks, microphone and loudspeaker testing, noise checks, baseline room measurements, loudspeaker balancing, zone verification, gain-structure checks, preset tuning, critical listening, live evaluation, user training, documentation and handover.

E info@siapacoustics.com

Measurement and listening

Measurements may include reverberation time, early decay time, clarity, strength, speech transmission, frequency response and time-domain plots where relevant. Standards such as ISO 3382-1 may be used as a measurement reference, depending on project requirements. Measurements are important, but they do not replace listening. Final evaluation with live musicians or representative performers is a required part of the commissioning process.

Post-installation evaluation

A follow-up evaluation shall be carried out after 6 to 9 months of operational use as part of the SIAP commissioning and optimisation process. Real-world use can reveal which presets are most valuable, whether operation should be simplified and whether small refinements would improve the venue experience.

07 FAQ / GLOSSARY

FAQ

Does SIAP require an acoustic simulation before starting an AAS design?
No. An acoustic simulation can be useful in some projects, but it is not a standard prerequisite. SIAP requires reliable baseline acoustic information, including natural reverberation time, room geometry, seating layout and known acoustic risks. If the room has known or suspected acoustic issues, additional investigation may be required.

Can AAS share infrastructure with FoH, Dolby Atmos or spatial audio systems?
Yes, but the approach depends on the use case. For lightweight electro-acoustic performances, the FoH and AAS are acoustically rather than electrically integrated. When acoustically integrated, the AAS enhances the acoustic character of the room as well as the acoustic performers. Dolby Atmos and AAS are always separate use cases. Spatial audio may be used separately or at the same time as AAS, depending on the application and system design. In all cases, shared infrastructure must still meet AAS requirements.

How many microphones does an AAS system need?
Most SIAP systems use between 8 and 16 microphones. Small venues are typically around 6 to 8, medium venues often use 8 to 12, large venues often use 12 to 16 and very large or complex venues may require more. These are rules of thumb, not fixed design rules.

Can SIAP use third-party loudspeakers and amplifiers?
Yes. SIAP is brand-agnostic, provided the selected equipment meets the acoustic, technical and operational requirements of the project. Third-party equipment must be assessed against AAS performance criteria, not only conventional sound reinforcement criteria.

Who is responsible for the installation design?
The consultant or system integrator is typically responsible for preparing the complete project-specific AAS design package, third-party equipment selection, infrastructure coordination, installation documentation and integration with the venue infrastructure. SIAP provides AAS requirements and design guidance, reviews the completed design package for AAS suitability, and remains responsible for SIAP processor configuration, acoustic tuning and commissioning within the agreed SIAP system.

Does AAS include voice-lift?
Voice-lift may be considered where subtle speech support is required, but it is not covered as a standard design function in this guide. Where voice-lift is required for the project, microphone strategy, routing, loudspeaker zoning, stability criteria and commissioning responsibilities should be defined separately.

E info@siapacoustics.com

GLOSSARY

ITEM	EXPLANATION
Active Acoustic System (AAS)	Electronic system using microphones, processing, loop control and loudspeakers to modify the perceived acoustics of a room.
SIAP processor	Central processing unit for active acoustic processing, routing, presets, control and integration. In the current product range, this role is provided by the SIAP AVA platform.
SIAP AVA platform	Current SIAP processing platform for active acoustics, virtual acoustics, voice-lift, spatial audio, signal routing, presets and system control.
Baseline acoustic	The natural acoustic behaviour of the room without active acoustic enhancement.
Enhanced acoustic field	The acoustic field created when the AAS is active and blends with the baseline acoustic of the room.
Acoustic character	Overall acoustic quality or impression of a room or preset, including reverberation time, spatial impression, clarity, support and perceived room size. In this guide, the term may refer to the baseline acoustic of the room or to the enhanced acoustic field when AAS is active.
Reverberation time (RT)	Time required for sound energy in a room to decay by 60 dB after the sound source stops. In this guide, RT values are indicative and project-specific.
Spatial impression	Perceived sense of acoustic width, space and room size experienced by listeners.
Listener envelopment	Perceived sense of being surrounded by the acoustic field, rather than hearing sound only from the stage or a small number of loudspeaker positions.
Lateral energy	Sound energy arriving from the sides of the listener. In AAS design, lateral energy contributes to spatial impression, listener envelopment and the perceived width of the acoustic field.
Medial energy	Sound energy arriving from the central and overhead loudspeaker areas of the room. In AAS design, medial energy can help balance the enhanced acoustic field, but loudspeaker placement should still be checked against coverage, overlap and localisation criteria.
Uneven acoustic distribution	Situation where different seating or stage areas experience noticeably different acoustic conditions, such as reduced reverberation, weak spatial impression, poor coverage or acoustic isolation from the main room field.
Regenerative processing	Approach where microphones capture room sound and acoustic energy is recirculated through loudspeakers, with loop gain and stability carefully controlled.
In-line processing	Approach where direct sound signals from microphones or line inputs are processed using convolution or algorithmic reverberation and distributed through the loudspeaker system.
Hybrid AAS	Combination of regenerative and in-line active acoustic methods.
Localisation	Ability to identify the direction or position of a sound source. In AAS, localisation of individual loudspeakers is generally undesirable.

ITEM	EXPLANATION
Audible localisation	Situation where an individual loudspeaker, microphone position or processed source becomes perceptible as a separate sound source.
Acoustic zone	Area of the venue requiring specific acoustic behaviour, routing or loudspeaker coverage, such as the stage, main audience area, balcony, under-balcony area, boxes or loges.
Stage support	AAS function intended to improve performer comfort, ensemble interaction and the acoustic connection between stage and room. It is not the same as stage monitoring.
Electronic Orchestra Shell	AAS stage-support function that gives performers a more supportive and enveloping acoustic environment, similar in purpose to an acoustic orchestra shell.
Voice-lift	Subtle speech support intended to improve listening comfort and intelligibility without sounding like conventional public address reinforcement. Voice-lift is not covered as a standard design function in this guide and should be defined separately where required for the project.
Line-input processing	Processing of external audio sources, such as close microphones, playback feeds or selected line inputs, through the AAS system.
Preset	Stored system setting for a specific acoustic use case or operational mode, including routing, levels, processing and control parameters.
Operational mode	Defined system state for a specific type of operation, such as AAS-only, FoH, Dolby Atmos, spatial audio, playback or shared-infrastructure operation.
Shared infrastructure	Use of selected loudspeakers, amplifier channels, routing, cabling, audio-network infrastructure or control systems by more than one audio system.
FoH	Front of House sound reinforcement system used for amplified programme sound, speech, music playback or live mixing.
Dolby Atmos	Immersive audio playback format and system concept with specific loudspeaker layout, routing and operational requirements.
Spatial audio / immersive audio	Audio approach where sounds are positioned or moved in space and rendered to the available loudspeaker layout. In this guide, spatial audio is treated separately from AAS, although infrastructure may be shared where appropriate.
Object-based audio	Audio approach where sound objects are positioned in space and rendered to the available loudspeaker layout.
OSC	Open Sound Control, a protocol that can be used for communication between SIAP and selected third-party control systems.
Dante	Digital audio networking technology used to transport multi-channel audio over an IP network.
AES67	Interoperability standard for high-performance audio-over-IP networks.
MADI	Multi-channel digital audio interface used for transporting multiple audio channels over a single connection.

E info@siapacoustics.com

Closing statement

A successful AAS design is defined by acoustic performance: a stable, natural and non-localisable acoustic field that supports the intended use of the venue. This requires the right balance between room acoustics, microphone strategy, loudspeaker coverage, system routing, control and on-site tuning.

By combining SIAP's AVA platform with carefully selected third-party components, consultants and system integrators can develop flexible venues that support electronically variable acoustics, FoH, Dolby Atmos, spatial audio and future operational requirements.

For project consultation, design review or demonstration opportunities, please contact SIAP Acoustics.

08 APPENDIX A - TYPICAL COMPONENT REQUIREMENTS

The tables below provide typical minimum and preferred characteristics for third-party components used in SIAP AAS projects. Final suitability depends on room geometry, listener distance, acoustic zones, routing, installation conditions, intended use cases and the complete system design.

Loudspeakers

REQUIREMENT	MINIMUM REQUIREMENT	PREFERRED CHARACTERISTIC	DESIGN NOTES
Type / source behaviour	Professional installation loudspeaker with predictable coverage and stable off-axis response.	Coaxial or coincident point-source design, with smooth off-axis behaviour around the crossover region.	Supports smooth overlap, reduced localisation and a natural acoustic field.
Mounting	Suitable for wall, ceiling, balcony, flush or surface-mounted installation.	Flush-mounted in-wall or in-ceiling loudspeakers where building design, mounting depth, aiming, coverage and service access allow it.	Surface-mounted loudspeakers may also be suitable where they provide better aiming, coverage or installation practicality.
Frequency range - AAS	60 Hz at not worse than -10 dB, with processed operating response up to 15 kHz or higher.	Approximately 52 Hz at -3 dB to 20 kHz, with smooth response across the operating range.	Loudspeakers that do not meet the 60 Hz requirement require distributed subwoofer support.
Frequency range - spatial / playback	Project-specific, depending on content, playback level, room size and bass management.	Full-range response preferred where possible.	Dolby Atmos projects shall follow the current applicable Dolby Atmos design requirements.
SPL capability	AAS: 85 dB SPL RMS nominal and 105 dB SPL peak at the listener position.	Spatial audio / immersive playback: 100 dB SPL continuous preferred; 105 dB SPL continuous for higher-demand playback, larger rooms or shared immersive systems.	Shared loudspeakers must meet the highest SPL and headroom requirement of all intended use cases.
Headroom / linearity	Clean output without audible strain, limiting, compression or distortion.	Additional headroom for spatial audio, Dolby Atmos, playback or programme reproduction.	AAS signals must remain linear and natural.
Dispersion / overlap	Predictable horizontal and vertical coverage.	Wide, smooth and consistent polar response, preferably with broad conical coverage of around 130° or wider.	Check overlap at closest listener position, especially at 1 kHz, 2 kHz and 4 kHz.
Crossover behaviour	No severe off-axis irregularities around the crossover region.	Smooth off-axis behaviour around 2 kHz to 3.5 kHz.	Poor crossover behaviour can increase localisation risk.

Microphones

REQUIREMENT	MINIMUM REQUIREMENT	PREFERRED CHARACTERISTIC	DESIGN NOTES
Type	Professional condenser microphone suitable for fixed installation.	High-quality small-diaphragm condenser microphone.	Low noise and predictable off-axis response are important.
Performance pickup pattern	Directional microphone.	Supercardioid.	Typically aimed towards the primary acoustic source area on stage.
Room microphone pattern	Directional microphone.	Cardioid.	Typically distributed above the audience area and aimed downwards.
Stage / upstage microphone pattern	Directional microphone.	Cardioid.	Typically used for stage support or upstage pickup and aimed towards the relevant acoustic source area.
Frequency response	Smooth response across the main acoustic operating range.	Neutral, consistent response with low coloration.	Avoid microphones with strong tonal character or poor off-axis behaviour.
Self-noise	Preferably below 20 dB(A); up to approximately 22 dB(A) may be acceptable subject to project-specific noise assessment.	Around 13 to 16 dB(A) for quiet concert halls, chamber music venues and critical acoustic applications.	Assess in relation to background noise, gain-before-feedback, processing and loudspeaker distribution.
SPL handling	Suitable for expected acoustic source levels without overload.	High SPL capability with low distortion.	Main pickup microphones may be exposed to strong stage sources.
Suspension	Stable fixed suspension or calibrated microphone reeler.	Repeatable, serviceable suspension with defined operating position.	For reelers, the deployed position is the calibrated AAS position.
Signal path	Compatible with selected preamp and audio transport strategy.	High-quality preamp with suitable AD or network-audio conversion.	Define analogue preamp + AD conversion or integrated network preamp.
Microphone cabling	Balanced microphone cable suitable for fixed installation, with effective shielding and low capacitance.	Low-noise installation cable, typically around 60 pF/m conductor-to-conductor or better.	Route away from mains power, dimmers, motors, LED drivers and other interference sources.

E info@siapacoustics.com

Amplifiers

REQUIREMENT	MINIMUM REQUIREMENT	PREFERRED CHARACTERISTIC	DESIGN NOTES
Power / headroom	Matched to the selected loudspeaker and required SPL/headroom.	Clean headroom for AAS, spatial audio, immersive playback or shared operation.	Shared systems shall be specified for the highest SPL and headroom requirement.
Channel count	Sufficient channels for the loudspeaker layout.	One amplifier channel per AAS loudspeaker.	Individual control supports routing, zoning, delay, level, tuning and future adjustment.
Noise performance	No audible amplifier noise in quiet venue conditions.	Low-noise amplifier and gain structure suitable for acoustic music and theatre use.	The system gain structure should not raise the audible noise floor.
Input format	Compatible with the project audio transport strategy.	Dante/AES67, MADI, AES/EBU or high-quality analogue input as required.	Analogue amplifier inputs require suitable DA conversion.
DSP, presets and protection	Not required for analogue amplifiers, provided required control and protection are handled elsewhere in the system design.	Integrated DSP, presets, limiting and protection may be useful for loudspeaker matching, system safety or shared-use modes.	Shared systems may require different settings for AAS, spatial audio, Dolby Atmos or playback.
Networked amplifier monitoring	Not required for analogue amplifiers.	Status monitoring, fault reporting and network supervision may be useful for networked or DSP-based amplifiers	Monitoring should support operational reliability where available.

Audio infrastructure

REQUIREMENT	MINIMUM REQUIREMENT	PREFERRED CHARACTERISTIC	DESIGN NOTES
Audio transport	Suitable for required channel count, latency, routing and integration.	Dante, AES67, MADI or other agreed professional audio transport.	Document sample rate, clock master, network topology, routing and latency settings.
Analogue conversion	Suitable AD/DA conversion where analogue I/O is used.	High-quality low-noise conversion matched to the system gain structure.	Conversion quality affects noise floor, headroom and system transparency.
Routing / mode control	Supports required AAS, FoH, spatial audio, Dolby Atmos and playback modes.	Clearly documented routing with predictable operational modes and fail-safe behaviour.	Define which system controls routing, rendering, amplifier channels and presets in each mode.
Documentation	Complete channel lists, routing diagrams, cable schedules and mode descriptions.	As-built documentation suitable for commissioning, maintenance and future expansion.	Incomplete documentation can delay tuning, commissioning and troubleshooting.

LEADING THE WORLD
IN ACOUSTIC EXCELLENCE

ACOUSTIC SYSTEMS

SIAP Acoustics BV
Runmolen 3
5404 KP Uden
The Netherlands

info@siapacoustics.com
www.siapacoustics.com