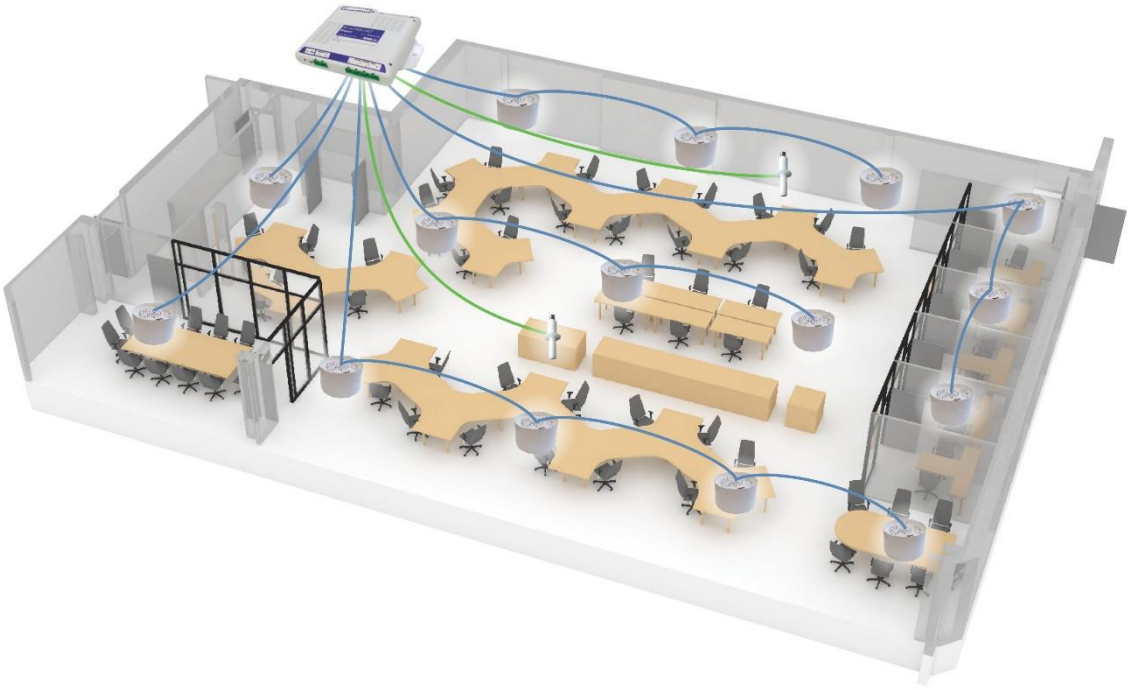
smartSMS-NET

Design Guidelines



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1. Design of the Sound Masking System

The SmartSMS-NET Sound Masking System is a zone-based system. Loudspeakers are connected in groups (1 to 6 speakers for SMS-NET ML/SL units) to a specific output channel of the controller. Each channel, or zone, is fully adjustable in frequency response and volume level, but loudspeakers within a single zone will share the same spectrum and cannot be adjusted individually except for the tap adjustment. Thus, the design of the speaker network is critical to obtain a homogeneous sound masking level and spectrum everywhere in the building. This section presents many parameters of which the importance must be understood for designing a good working system.

1.1 Acoustic Room Response

The sound produced by a sound masking loudspeaker in a room depends on the specific acoustic environment in which the loudspeaker is installed. This is called **Acoustic Room Response**. For example, a loudspeaker installed in a resonant room (ceramic floor, hard walls, etc.) will produce a louder sound level and different sound spectrum than a loudspeaker installed in an absorbent room.

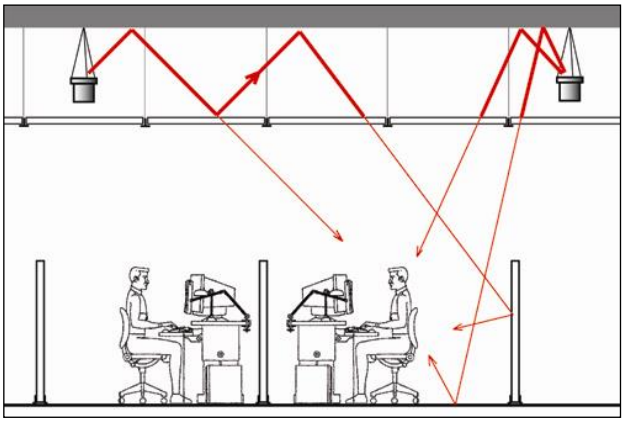

Figure 1 : Acoustic room response

The figure above shows that the sound generated by loudspeakers is reflected by the suspended ceiling, passes through the ceiling tiles, and can be reflected by the floor, walls or any surface in the room before being heard by an employee. All these elements influence the sound generated in the room.

The ***SmartSMS-NET*** can adjust each output channel automatically to the specific acoustic room response during the automatic equalization process, but the designer must ensure that every loudspeaker connected to the same zone is installed in a similar acoustic environment.

For example, in the figure below, closed offices in zone 6 are small rooms with carpeted floors and absorbent suspended ceilings, very similar in size and functions. The loudspeakers in Zone 7 are installed in a larger room with a hard floor. Loudspeakers in zones 6 and 7 should not be connected to the same channel because the acoustic room response is very different in zones 6 and 7.

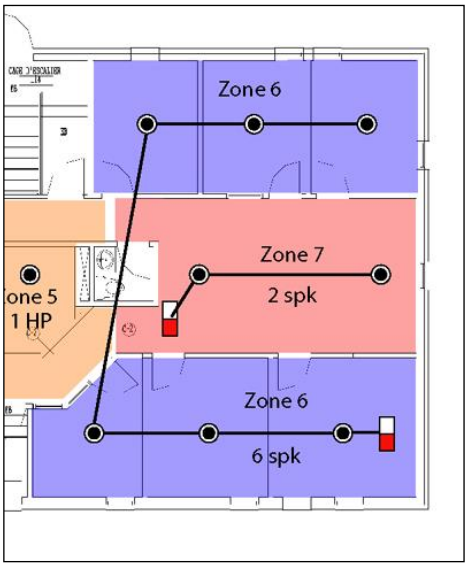

Figure 2 : Acoustic room response example

1.2 Zone Definitions

The following section presents the basic rules that must be followed when designing the loudspeaker network.

- Every loudspeaker in a zone must be of a similar brand and model to ensure similar frequency response. Also, every loudspeaker must be installed similarly (surface-mounted or in the plenum) for the same reason.
- Every loudspeaker in a zone must have a similar acoustic room response.
- Zones should also be divided by room functions. For example, a call center should not be connected to the same channel as a study room, since the sound masking level needed in each room may be very different.

1.3 Loudspeaker Surface Coverage

The masking sound produced by the speakers will be influenced by the configuration of the room (ceiling height, plenum height, ceiling tiles, absorbent materials). All these parameters will influence how sound travels within the space and will ultimately influence the area covered by each speaker. For example, if the plenum space is shallow (12 inches instead of a typical 30 inches), the sound emitted by the speaker will be more focused, thus, covering a smaller area. Speakers will then need to be installed closer to one another to provide good coverage.

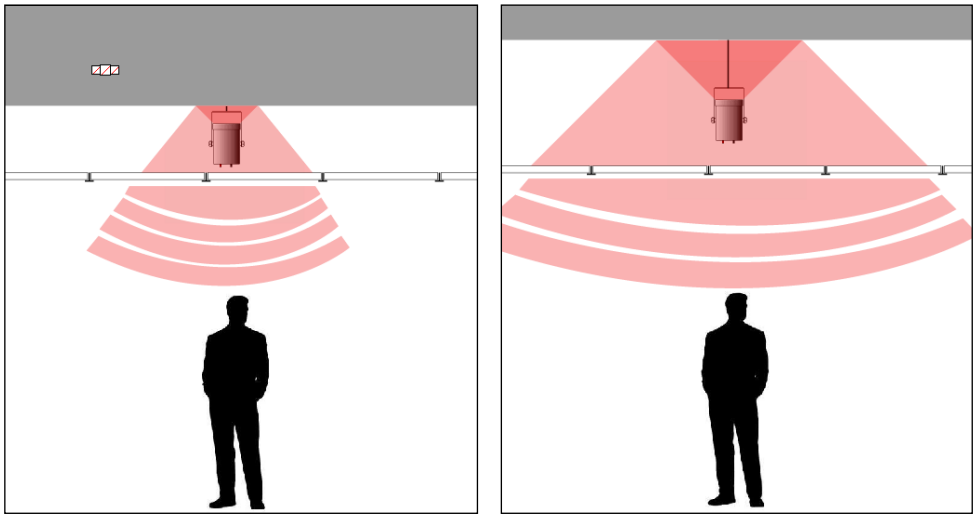

Figure 3: Influence of the plenum height on coverage

1.3.1 Plenum Installation (STR, Direct or Flat Speakers)

In the case of typical suspended ceiling tiles with speakers located in the plenum space, the distance between speakers should be:

Distance = Height of Ceiling + Height of Plenum + 3 ft.

In any case, 18 feet should be considered the maximum distance between speakers.

Condition	Ceiling Height	Plenum Height	spk distance	Coverage (sqft)
Low Ceiling/Low plenum	8	2	13	169
Normal Ceiling/Normal Plenum	9	3	15	225
High Ceiling/High Plenum	10	4	17	289

1.3.2 Open Ceiling (STR or FLAT speakers)

In the case of open ceilings or exposed-deck ceilings, speakers will need to be installed closer together because there is no ceiling tiles to help diffusion of sound.

Distance = Height of deck + 2 ft.

For example, on a 12 feet deck, speakers should be installed approximately 14 feet apart. STR Speakers should be hanged at least 1 foot below the deck. Lower is better for dispersion.

1.3.3 Surface-mounted speakers (SURF)

In the case of surface-mounted speakers, speakers will need to be installed much closer together because the exposed speakers will create stronger hot spots.

Distance = Height of Ceiling + 2 ft.

For example, on a 9 foot drywall ceiling, surface speakers should be installed 12 feet apart.

1.3.4 VibX Transducers

VibX transducers should be installed on drywall ceilings or hard surfaces. They provide excellent diffusion on drywall ceilings.

Distance = Height of Ceiling + 6 ft.

For example, on a 9 foot drywall ceiling, VibX speakers should be installed 15 feet apart. VibX are not recommended for paging or music.

1.3.5 HDN Transducers

HDN transducers can be installed on drywall ceiling or on ceiling tiles. They can be used for paging or music.

Distance (on drywall) = Height of Ceiling + 6 ft.

Distance (on tiles) = Height of Ceiling + 4 ft.

For example, on a 9 foot suspended ceiling, HDN speakers should be installed 13 feet apart.

1.3.6 Very High Plenum:

When the plenum is very high, (more than 6 feet), if you need to constrain the sound to a more or less specific location, we suggest installing Direct speakers facing down, 3 feet above the suspended ceiling. Otherwise, if the speakers are facing up, the sound will "escape" everywhere and you will lose the ability to adjust the sound level locally.

Distance = Height of speakers + 3 ft.

For example, speakers tiles at 9 feet, but with a 11 feet plenum (deck is at 20 feet). Speakers should be installed 3 feet above the tiles and spaced every 15 feet.

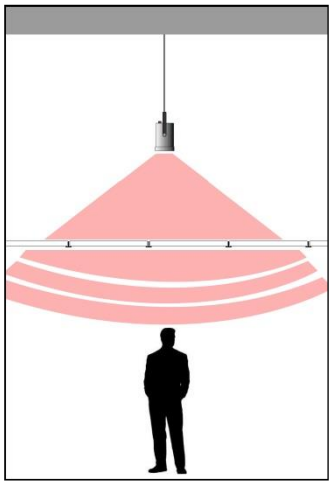

Figure 4: **Speakers facing down with very high plenum**

1.4 Sensors:

The sensors are used to measure the ambient noise level in the rooms. Sensors will cover approximately 1000 to 1400 sqft. That's 1 sensor for 4 to 6 speakers.

The goal is to install the sensors right in the middle of the open area to catch the most noise possible.

Keep the sensors 3ft away from any HVAC outlet. The air flow can create turbulence on the microphone and it will give false readings.

1.5 Example

This section provides an example of a typical design.

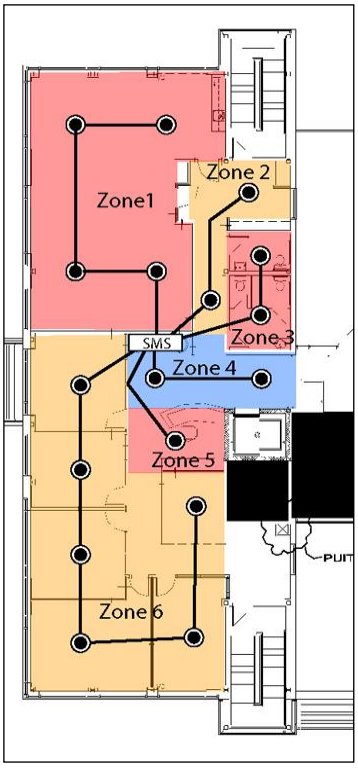

Figure 5 : **Example of a typical office plan**

Zone 1: This zone is a conference room with hard floor and suspended ceiling tiles. The room is approximately 920 sq. ft. Four loudspeakers are required; each one covers 230 sq. ft.

Zone 2: This zone is a hallway covered with sound masking to provide homogeneity of the masking sound in the entire building.

Zone 3: The bathrooms have a ceramic floor. The acoustic room response is very different from the other zones of the building.

Zone 4: This zone is a waiting room near the reception. This area is approximately 320 sq. ft.

Zone 5: This zone is above the reception desk. It is separated from zone 4 in order to reduce the sound masking level above the reception independently from zone 4.

Zone 6: This zone covers all the closed offices in that section of the building. In this case, one loudspeaker is installed above each office. The total area is 1320 sq. ft., each loudspeaker covers approximately 220 sq. ft.