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PA solutions for Churches - part I

Church PA

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PA in Churches

Most Churches have some type of speech reinforcement. Our church tradition has virtually defined this type of PA. The framework for the conception of these installations has been a service programme dominated by:

- Speech from a lectern and/or pulpit
- Music from an organ
- Music from choirs

This means that music was marked by rhythmically smooth sounds with focus on melody and harmony. In acoustics with loads of reverb and reflections this sounds even more interesting and doesn't really need any PA at all.
Big cathedrals often have long reverberation times of seven seconds or more. In such venues, the necessity of speech-pa, which gives the audience the possibility to easily understand the preacher, was born. In this constellation PA gets its sole task of delivering the speech contributions understandably to all visitors. No more or less. Additionally the PA should not be seen or at least should be as unobtrusive as possible.
The answer to this task has been the systems with many narrow groups of de-centred and dispersed installed speakers. These systems are working with low levels out of many small speakers, which have no delay-line connected and are working simultaneously. They are developed to deliver speech in large and acoustically very difficult churches. Therefore problems occur in the following areas:

1. Delay and Reflection

Sound reinforcement with de-centred speakers is only possible at low levels, before getting too many problems. From medium levels and above, (e.g. reading simultaneous to the organ, or singing with a music group) the dispersed position of the speakers will be a major problem.
You can hear delay-effects caused by different running times, which lead to additional and artificial echoes in the room. Sound (airspeed of c.330m/s) takes around 100milliseconds (0.1s) to travel a length of 30m. So if you have 10 speakers in your church in different places, the sound out of these comes to the listener at ten different times, unless they are positioned in a circle around one listener in the centre.

Normally, each member of the congregation has one speaker close to them and they hear the sound from the other speakers as lower additional delay effects. This means, such an installation makes the often difficult acoustics of a church even more complicated by adding even more reflection type delays. A delay line for the different speaker groups would be a better solution, so speakers further away from the sound source would sound accordingly later.

2. Lower Frequency

In the frequency spectrum small speakers cut the frequencies lower than 250Hz, often 500Hz. With this effect you often solve the problem of having low frequency reflections in a big room. However, you also take in the disadvantage that the delivered sound often gives a telephone character to voices and everything sounds thin and shallow. Delivering music with such a frequency response is nearly impossible. Therefore, these speakers are not capable of delivering music at even medium level of loudness.

3. Direction & Audio Positioning

Another problem of the decentred position of speakers is the artificial effect, that sound comes from a totally unexpected direction in comparison to the optical view of the preacher, singer or musician. In the current context of entertainment culture with complex and accurate 'surround-sound', this is awkward to the ear.

The function of a church PA system has already changed and is still altering:

a. Service programming is getting more complex. Often there is contemporary music (both live and recorded) using rhythm and a big frequency spectrum with plenty of low frequency required. Also, most styles need a sound reinforcement for each instrument. Here the different instruments are balanced to each other.

b. Church environments are mostly smaller (especially in terms of cubic volume) and not as acoustically difficult as the big cathedrals. Under these conditions congregations with smaller churches start to discover the qualities of Music PA systems, which are sometimes brought along by bands. Suddenly the voice of the minister sounds warm, close and intimate for prayers. And the acoustics of the church are often dry enough, to take a centred PA position from the front without any problems.

Conclusion The PA conceived for the big cathedral is not the right system for other churches, because the acoustics are completely different.

Facing this, some ministers and church leaders start to wonder: *what if the music-PA from the band didn't look not like a Disco and was smaller and easier to handle? … the sound of it could do well enough in church…*

To this task there are new answers:

I. The traditional Speech PA systems can now be supplemented by a subwoofer, to produce a wider spread of frequency, producing a rounder, fuller sound. This adds low frequency signals and lets the voice sound more natural. But there are still the major problems of artificial delays and the inability of producing higher sound-levels. And, in addition, there is still the strange effect that sound comes out of an unexpected direction.

II. Music PA systems, meanwhile, are offering smaller speakers with unobtrusive designs but still have powerful sound capabilities.
a. Acoustic benefits, in comparison to the speech PA are:

- a wider frequency spectrum in the low frequency range
- connected to this comes a more natural sound character
- the possibility to reach medium and higher levels of sound (Solo vocalist or flute with a music group is suddenly possibly, also scripture reading with the organ or other background)
- full compatibility with all styles of music

b. Economical benefits are:

- Lower price range because of higher production-numbers of the units produced
- By using and combining different components you can get the optimum combination to fit your special church environment.
- Music PA systems have a big number of companies operating in comparison to the market for specialist Speech and Church PA systems

In practical tests you will find that a centred installation from the front gives a significantly better and more versatile sound and is the more economical solution.
Dispersed and de-centred systems can still be needed for bigger churches with very difficult acoustics, but then should be installed with an appropriate delay line. In addition, speakers should be set to deliver the full frequency spectrum equally, (including at higher levels) for a natural sound.

However, we still are left with the often-discussed optical integration of the speakers into the church environment. Here you will also find new solutions:

- Powerful and capable speakers are getting more and more compact.
- Using suitable colours you can get a harmonic visual integration in to your room.
- With a centred installation at the front you don't need to hide several speakers throughout the church, there often being only two units left and right on the front wall.
- Sometimes you can even integrate the speakers into your walls or get them designed according to your church architecture.

Acoustics

Finally, you cannot talk about PA without talking about the theme of church acoustics. Often the acoustics are just given and you cannot change them. This is a common task for sound production companies. But if there is the opportunity of changing the sound character of a room, for example at a renovation, you should take this chance, offering major improvements with small changes. What you get here, is worth gold afterwards, not only for the PA but also for the preacher, the organ and/or choirs. It is not about altering a church into a completly dry and dead acoustics. But it is about special tricks, many already used in former centuries.

The invention of the sound reflector above the pulpit is from ancient history. This small roof prevents the sound of the preacher's voice going up to the high ceiling and reflects it directly downwards to the gathered flock. With similar small measures you can improve the acoustics of your church significantly, to improve it by an amount, so that an over-reflective room is avoided and speech gets easily understood. Reflections can be avoided, deviated, damped or transferred into diffuse sound. Normally, a big difference is noticed in the sound of an empty and a full church and often the acoustics are just left in order to be alright for the 'full' version. And on most of the Sundays you are struggling with the "empty" acoustics. By having soft-chairs and a carpet, for example, you can minimise this big difference.

Some small acoustic improvements, together with a PA which is well adapted to your needs, you can create an acoustic environment in your church where people enjoy being and worshipping.

PA solutions for Churches – part II

A. Control and Correction of the Acoustics

The acoustics are the basic conditions for sound in a room. All the following measures have to adjust accordingly. Good acoustics cannot be substituted and complicated acoustics cannot be fixed by any PA. Ask these questions:

- Are your church acoustics very reflective?
- Do these reflections make listening to speech very exhausting and difficult to understand?
- Do you have to speak slowly because of this?

If so, you should experiment to see whether absorbent materials give an improvement. Typically carpets, thick curtains, damping materials for the ceiling, soft chairs will all give significant improvements. The latter ones especially minimise the difference between empty and full rooms.

B. Components of a PA

PAs have many components, which can be regarded independently. These components are:

1. Microphones
2. Mixing desk
3. Graphic Equalizer
4. Amplifier
5. Speakers
6. Induction loops for hearing aids

1. Microphones

Microphones (mics) differ in their technical setup, their polar patterns and in sound.
Generally, we advise choosing cardioid or hypercardioid polar patterns. *Never* use a mic with an omni-directional polar pattern, because you cannot avoid feedback problems.

Dynamic mics are economical, solid, have a low feedback and are very reliable.
Examples (prices are shown as a guide):
Shure SM57 and **SM58**, cardioid, for speech and instruments (SM57), vocals (SM58), price around £70, as used by the Pope and the President of the USA (enough said!)
Sennheiser MD 421 , cardioid, speech and universal £220
Beyer tg-x 58, cardioid £60
AKG d 3700, cardioid £70
Sennheiser evolution e 855, hypercardioid, £125

Condensor mics are more expensive, have a clearer response, are better for recordings and acoustic instruments, but have more feedback problems and are pop-sensitive ('P' sound)
Examples:
AKG C1000 , cardioid und hypercardioid, universal use £200
Neumann KM184, cardioid, speech and Instruments £500
Neumann KSM 105, hypercardioid, speech and vocals £370
MBC 603 ka 200, cardioid £300
Sennheiser evolution e 865, cardioid £170
Beyer opus 81, cardioid £160

All of these mics are normally long-living and need not be changed with a new PA installation if they are still in good working order.

2. Mixing Desk

Mixing desks gather the input signals and distribute them to amps and speakers. Additionally, they give the possibility to change levels and adapt the sound in the church by using equalizers. They differ greatly, especially in numbers of channels, and in their equipment specification for EQ and buses for speakers and monitors.
The mixing desk is the "eye of the needle" of the PA system, because all signals have to go through here. Therefore you should be concerned of all the possible purposes of it – because of this, don't try to save money here. And don't be afraid of big desks, they are not really more complicated than smaller ones. You can easily work with standard settings.
Normally you can calculate how many channels you need. For example: 3 x mics for altar, pulpit and other position…, 2 x radio-mics, 1 x CD stereo, 1 x acoustic guitar, 1 x keyboard (stereo?), 1 x flute, 1x solo vocal, 4-8 x choir ... you easily get to 16-24 channel for special occasions, like a children's musical etc.
Examples:
Spirit Folio F1, small handy desk with 8 or 10 mic channels and 2 stereo instruments £350-450
Allen & Heath Mix Wizard 16:4:2, 16 inputs and 4 monitor-and 2 effects buses £850
Mackie SR 24x4, 24 channels, 4 bus, 4 monitor and 2 effects £1500
Soundcraft Spirit M-Series £400-600
Yamaha GF Series £700-1100
Peavey RQ Series £140-450

3. Graphic Equalizer (EQ)

With a 15- or 31-band Graphic Equalizer you can adapt the sound very carefully to the sound character of your church. So a very bright or very dark acoustic can be subtly changed. Also certain frequencies, which may be causing problems, can be filtered. Normally, a sound technician fixes the settings on the EQ once and then it is left at these settings, unless the acoustics change.
Examples:
dbx 1215 , 2x(stereo) 15-band £350
dbx 1231 , 2x31-band, £500
Yamaha Q2031 , 2x31-band, £260
Yamaha YDG 2030, digitally programmable £550
QSC dsp 30 , digitally programmable £350

4. Amplifier

If you do not decide to have powered (active) speakers (a realistic option these days, see below), you need an Amplifier, which boosts the signals from the desk and feeds the speakers. The power of the amp should be chosen to match the church environment and the speakers you have chosen. With secure handling it is better to have too much power than too little. If the power amp cannot be placed in a different room you might be concerned about some makes, which produce considerable fan noise, which might disrupt silent or quiet church worship environments.
Examples:
QSC RMX 850/1450, 2x300/450W RMS at 4 ohms £500-650
QSC PLX 1602, 2x600W RMS at 4 ohms £1000
Yamaha P3200/4500 , 2x440/620W RMS at 4 ohms £550-660
Crown K1/K2, 2x450/800W RMS at 4 ohms £1600-1900
PSE sm 700, 2x350W at 4 ohms £350
PSE sm 900, 2x450W at 4 ohms £460
Dynacord s 900, 2x450W at 4 ohms £460
Dynacord s 1200 , 2x600W at 4 ohms £550

5. Speaker Systems

The speakers can provide the biggest difference in the sound of a PA system.
There are distinctions to be made between **two-way or three-way system with frequency crossover** providing single speakers for bass, midrange and treble or **speaker arrays** (groups) consisting of several identical speakers in one enclosure.
In sound multi-way systems have clear benefits, whilst speaker arrays can have benefits for difficult acoustic environments in terms of coverage.

Also there are **Active Systems** with built in power amps (built into the speaker enclosure) often with active crossover and each speaker having its own amp. Active systems have the benefits that they can be connected easily and that there is no power loss in long speaker cables. Expansion of your system by adding more powered speakers is easily achieved.

When considering speakers you should be concerned about an even frequency response, low distortion and a good coverage. Music capability (bass response, power handling, sound pressure level) and clarity of speech (good response of mid and high frequency with not too much bass) should normally be available. Size, colour and design should fit to the church.

Examples:
Passive speakers:
Bose 402 90Hz-16kHz, 240W, 8 Ohm, 92dB at 1W/1m £420 per unit
Bose 802 55Hz-16kHz, 480W, 8 Ohm, 92dB at 1W/1m £760 per unit
Bose MA 12 100Hz-16kHz, 300W, 8 Ohm, 92dB at 1W/1m £440 per unit
Bose MB 4 Bass-system, 40Hz-200Hz, 200W, 87dB at 1W/1m £400
Bose DigitalController 2: 4 incl. limiter + delay £430
Fohhn F H2i Hi Power, 75Hz–20kHz, 200W, 8 Ohm, 97dB at 1W/1m £600
Fohhn FB08 Basslautspr., 55Hz-150Hz, 350W, 8 Ohm, 95dB at 1W/1m £390
HK-Audio LP 112 70Hz-18kHz, 300W, 8 Ohm, 104dB at 1W/1m £780 per unit
HK-Audio LP 210 160Hz-18kHz, 400W, 8 Ohm, 110dB at 1W/1m £820 per unit
HK-Audio LP 118 Subwoofer, 40Hz-19kHz, 500W, 8 Ohm, 105dB at 1W/1m £750 per unit
JBL SF 15 , 50Hz–16kHz, 250W, 8 Ohm, 98 dB at 1W/1m £340 per unit

Active Speakers:
HK-Audio Lucas, 2x satellite, 1x subwoofer, 300W £1000
HK-Audio Elias, 2x satellites, 1x subwoofer, 300W £2100
HK-Audio Actor AT112A, 400W, as satellite or on it's own £800
HK-Audio Actor AT115 SubA, 400W, subwoofer with Satellites £760
JBL EON Power15, 50Hz-20kHz, 130W £370 per unit
JBL EON 15 G2, 39Hz-18kHz, 300W £550 per unit
JBL EVOi System, 40Hz-18kHz, 600/1300W, intelligent system with integrated auto-EQ, auto-delay and 3-way-amping, good design £1600
JBL EVOi , controller £860

6. Induction loops for hearing aids

These tools can be added to any PA system if needed. Existing Loops can easily be connected to new PA systems. However, if you have a good sounding system, with little in the way of reflected sound, people with hearing aids should rarely have any problems at all.

C. Prices of complete PA Systems:

Music-capable PA systems are often cheaper in price in comparison to their traditional equivalent, the speech PA. A good sounding system starts at around £1500 with 3-4 mics, mixing desk and a pair of powered speakers.

Here are some examples of PA systems with prices
(prices shown as a guide- source: Session PA Walldorf, Germany)

Complete Systems without mics, cables and installation:

1. Peavey system 2 x 250W
1 x Peavey XRD 800, 8-channel Powermixer with EFX
2 x Peavey HiSys 2 XT speaker
total £1120
Good for smaller churches with less reverb. Medium sound quality, therefore with some limited feedback problems, speakers are a little bulky.

2. Yamaha system 2 x 300W
1 x Yamaha MX 12/6 mixer with EFX
2 x Yamaha MS 400 powered speaker
total £1600
Good for smaller churches with less reverb. Speakers can be used on ist own. For congregations of up to 200.

3. PSE system 2 x 350W (small speakers)
1 x PSE Powerfriend 700 with EFX
2 x PSE IT 06 top speaker
1 x PSE IB 12 bass speaker
total £1700
Good for smaller churches with less reverb. The system is fully music capable with small speakers and one subwoofer. Top-Speakers can be used on its own. For congregations of up to 200.

4. HK with Mackie 2 x 600W Satellite system
1 x HK Premium System PR112/115 speaker
1 x HK VX 1200 amp
1 x Mackie MS 1402 vlz, 14-channel mixer
total £2800
Up to 300-400 people, separate components, no EFX, which would add about £150.

5. Dynacord system 2 x 500W
1 x Dynacord Powermate 1000 Powermixer with EFX
2 x Dynacord CP 12/3 top (full range)
2 x Dynacord CP 15-1 Bass-speaker
total £3260
Conceptually like PSE (3.), but with high quality capable for 300-400 people. Top-speakers can also be used on their own as single speaker-cabs.

6. JBL Installation Series, optically pleasing to the eye, fully music-capable
4 x JBL Control 28 speaker
2 x JBL SB 2 Bass-speaker
1 x QSC DSP 30
1 x QSC CX 404 amp
1 x Soundcraft Spirit M8 mixing desk
total £3890
Experienced system, sufficient for 200-300 people, can also be extended.

7. Bose/QSC system 4 x 400W
2 x Bose 402 II speaker
2 x Bose MB 4 Bass speaker
1 x Bose controller
1 x QSC CX 404 amp
1 x Soundcraft Spirit M 8
total £3900
A Bose system that's not only for installation – very flexible useage. Small speakers with high power, sufficient for 300-400 people.

8. BOSE system
1 x Mackie ms 1402 vlz
1 x QSC DSP 30
1 x Bose controller
4 x Bose MA 12
2 x Bose MB 4 bass
2 x QSC ISA 750 amp
total £3100
Suitable for long churches up to 300 seats. For a balcony you would need additional speakers, for these speaker groups have a narrow vertical coverage.

9. Special D|H Tip:
2 x JBL EVOi, 40Hz-18kHz, 600/1300 W, intelligent System with integrated auto-EQ, auto-Delay und three-way-amping, decent design.
1 x JBL EVOi controller
total £4100
Great sound, easy setup and handling, for 500-700 seats.

All examples are for simple church-rooms with not too many side-areas, corners, balconies… Cheapest solutions are not always of the best design, aesthetically pleasing designs are more expensive, of course, but this is also because the electronics within them are of a much better quality.

Conclusions

There are many capable systems for church PA. In the end you should look to your church with an experienced advisor, who can help you to find the best solution .
Contact D|H to see how we can help.

D|H offers expert independent consultation and project management for your church PA installation.

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D. D|H References- PA Systems in Churches

Great Britain:
- Newsong Community Church, Bromsgrove
  Allen & Heath GL2200, JBL EONs G2

- Tommy's Church, Nottingham
  Soundcraft Powerstation, JBL MR922 + JBL EONs

Germany:
- Evang. Kirche in Haltingen/Weil am Rhein:
  Allen & Heath Mix Wizard with HK-Audio LP 210 + LP 115

- Evang. Kirche in Badenweiler
  Spirit Mixing Desk with Fohhn speakers

- Matthäuskirche in Mannheim-Neckarau:
  Midas Venice 24 Mixing Desk with HK-Audio Actor, 4 x AT112 + 4 x AT115

- Evang. Kirche in Sulzfeld /KBZ Bretten:
  Roland Powermixer with Bose 402

- Evang. Kirche in Menzingen /KBZ Bretten
  Spirit 12:2 Mixing desk with Bose 402

- Evang. KG Diedelsheim
  JBL EONs aktiv, Behringer Mixing Desk, etc.

LINKS:

www.dhrecords.com
www.bose.de
http://pro.bose.com
www.fohhn.com
www.hkaudio.de
www.jblpro.com/installations/installs_houses_worship.html
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