

## Media Technique and Sound Systems in Churches

Ernst-Joachim Voelker<sup>1</sup>, Wolfgang Teuber<sup>1</sup>

<sup>1</sup> *Institute für Akustik und Bauphysik, Oberursel und Zweihausen, Germany*  
*info@iab-oberursel, info@iab-zweihausen*  
*www.iab-oberursel.de*  
 V00410

### 1. Introduction

Today, media technique means the knowledge, application and use of visible and audible information for improved communication. Sounds and pictures are being presented via computers and worldwide digital connections. Listeners, users, and spectators are informed immediately and can select their program for recording or fast switching between programs. Radio and TV stations invite the listeners to use the internet to get additional insights and replies. This throws a spotlight on future developments. Suddenly, art and technology grow together as in the ZKM in Karlsruhe, the Center of Art and Media Technology /1/ which was opened in 1997 /2/. For many multimedia installations similar questions rose up whether sound and TV transmission is possible e.g. via internet /3/4/. The intention is to send information, opinions, questions, to say thank you or ask for answers. No wonder, that the priests in churches want to reach their community at home, on vacation or in hospitals. Unfortunately, nowadays sound systems serve mainly visitors. TV is for surveillance or for following the liturgy /5/. There is almost no possibility to use the internet for TV or radio transmission. Instead, the church should be "On Air" around the clock e.g. with information, reports and films. This is a multimedia task both for young and older people who both are fascinated by new technologies.

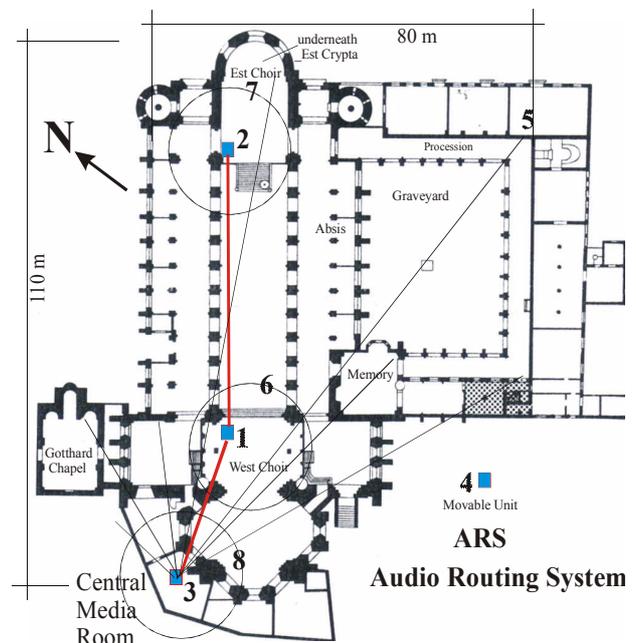
### 2 Many religious events

The Cathedral St. Martin of Mainz has for many years been using a sound and TV system for different services during the day, on weekends and for special events. The requirements are well known /6/7/. Most important is the intelligibility of speech and the good acoustics for organ, choir, orchestra and musical groups. Cameras are necessary to pursue the service, e.g. for the sexton, the priest or the organist. Sometimes processions take place. The singing congregation follows the priest through the church, along the arcades, to the graveyard. The organ, far away in the church, continues to play and should be audible during the procession. Loudspeakers are mounted to allow the transmission. Microphones can be switched on to amplify the speech of the priest during the funeral when around 1000 people are outside on and around the church graveyard. Another procession is that of Fronleichnam (Corpus Christi), when a congregation of 3000 people leaves the church and follows the way through the city and around the church. Music from the church is transmitted to the loudspeakers which are mounted along the way. The music originates from a brass band, the organ and the "Schola", consisting of 6 singers on spot 7 in Fig. 1. More than 12 microphones are required. For the church itself the conventional total sound

system works out. The altar 1 has 5 microphones, 2 for the ambows (rostrum), 2 to 5 for the Schola and choir on spot 8, 1 microphone for the Cardinal behind 8. 6 microphones are installed at the Choretas (balconies) south and north for choir and orchestra. The conductors only see each other on TV monitors. Other cameras provide pictures from Schola and choir when performing in the east or west choir (chor). They are around 100 m apart from each other. On many occasions the church is fully occupied. Then people are additionally sitting in the East Crypta (200 seats), in the Memory (60 seats) or in the Gotthard Kapelle (60 seats). It has always been intended to provide them with video monitors to pursue the service. The same applies for the side ships of the church, from where the altars east or west cannot be seen, e.g. at Christmas, Eastern or for the ordination to the priesthood when there are more than 5000 visitors in the church, 600 of whom are on both sides in the side ships. Two video screens are planned to help, one on each side.

### 3 New designs

The old sound and video system has to be totally replaced. This applies for the wiring as well. The church with its East Choir 7 and West Choir 1, adjacent rooms and outside areas



**Fig. 1 Cathedral of Mainz St. Martin, Ground Plan**

Center of catholic church since Bonifacius and Willigis 1000,  
 Volume  $V = 73000\text{m}^3$ , Seats 2500, occupied 5000,  
 Reverberation Time unocc. 8 s, occ. 6 s. Maximal height 36 m

must be totally involved in the different activities. An Audio Routing System has been introduced /8/ which works with all inputs and outputs in different constellations. The ARS allows inputs from microphones as well as outputs to the amplifiers and loudspeakers. Nevertheless, mixing consoles are desired for spots 1 and 2. Nr. 3 is located in the Central Media Room CMR. One ARS station is transportable and can be used at any of around 30 outlets throughout the church. In combination with a small digital mixing console connected to microphones or a CD player the spot in question will become a mixing area. The routing takes place with a PC from the same spots, of course with necessary priorities. 40 microphones and 90 loudspeakers can be matched together with 6 mixing consoles, 3 of them smaller.

#### 4 Video Transmission

At the time being, 8 cameras are used for the organist, the sexton or security, some are privately installed. The organist can play on 6 organs where he needs information on the service, where the procession stands or when the Bishop and priests enter the church. 24 cameras are required, 2 additional movable ones with remote control, mounted high on two columns of the church on both sides. For recor-

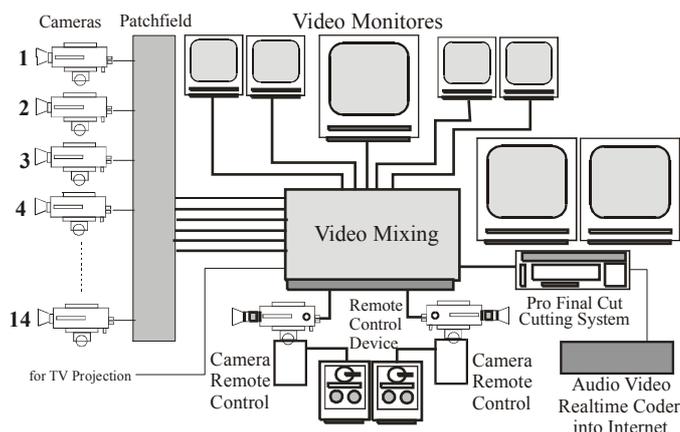


Fig. 2 Video System for Info, Recording and Program

ding the video signals of the cameras are synchronized. The video mixing desk offers many possibilities to receive or to send the pictures, e.g. to the Eastcrypta, the Memory or the Gotthard Chapel, including the projection screens for the ships on both sides. The remote controlled cameras allow zooming and smooth movements.

#### 5 Speech intelligibility

The sound system has to follow the different activities, e.g. at the east or west side, with the Schola or an orchestra playing in the East Choir. Due to their opposite directions loudspeakers should only acoustically supply the near field. Consequence: Sound from above. When turning from west to east with remaining positions of the loudspeakers additional delays are not helpful. They would produce audible echos. Instead, the intention is to mask echos by using many reflections in between, as successfully designed in the Landau Festival Hall /9/. When the sound on every listening place is limited almost to the direct sound arriving

from the next loudspeaker in around 4m distance, then the  $STI=0,47$  which is fairly good /10/11/, in 8m  $STI=0,38$ , without the sound system only  $STI=0,30$ , derived from 28 churches with and without sound system  $STI= 0,44/0,41$ ,  $RT60=3,5s$  /12/.

#### 6 Up to date Information

Information should be spread out fast. Recordings for dictation set and DV, digital storage and short post production are necessities. Journalists can use the press distribution sets which are available on 20 locations for sound and video supply. The access to internet takes place via a real time coder. Emergency calls follow the public requirements /10/.

#### 7 Concerts

With its  $RT60$  of around 6 s the huge church with 37000m<sup>3</sup> sounds brilliant with a value of 0,77, average for concert halls is 0,82, according to Beranek /13/. The acoustical warmth measures 1,0, average 1,08. No wonder that concerts sound good and are very famous. For recordings many microphones can be connected with the mixing desk 1 in Figure 1 to be routed to the digital recorder via ARS. For rehearsals, especially with organ, a monitoring system is required to hear the announcements of both the conductor and the organist. This system works in addition to the intercom which connects 18 spots.

#### References

- /1/ Klotz, H.: Zentrum für Kunst und Medientechnologie, G. Braun, Karlsruhe (1992)
- /2/ Völker, E.J.: Digital and Analog Audio Transmission for a Studio and Theater Complex - Planning, Installation and Measurements, 104th AES Convention in Amsterdam (1998) preprint 4666
- /3/ Teuber, W., Voelker, E.J.: 2-Bus Conference System for the European Central Bank ECB in Frankfurt, 112th AES Convention München (2002) preprint 5601
- /4/ Voelker, E.J., Teuber, W.: Multimediale Audio- und Videotechnik für die Eingangshalle Roter Platz der Helmut-Schmidt-Universität der Bundeswehr in Hamburg, Vortrag in der Universität am 2004-04-05 (2004)
- /5/ Voelker, E.J.: Akustik, Schallabsorption and Lautsprecheranlage in Kirchen, Fortschritte der Akustik, DAGA in Dresden (1994)
- /6/ Voelker, E.J., Teuber, W.: Some acoustical aspects for sound system design in churches, 96th AES Convention in Amsterdam (1994) Preprint 3866
- /7/ Voelker, E.J.: Akustik, Schallabsorption und Lautsprecheranlagen in Kirchen, Fortschritte der Akustik, DAGA 1994 in Dresden (1994) Tagungsband
- /8/ Voelker, E.J.: Studio production techniques for a new Art Center in Karlsruhe-integrated computerised techniques for recording, post production and sound reproduction, 94th AES Convention in Berlin (1993)preprint
- /9/ Voelker, E.J., Teuber, W.: Roomacoustical Conditions for the Landau Festival Hall, Germany, Fortschritte der Akustik, FNA,DAGA Meeting in Straßbourg, Tagungsband(2004)
- /10/ DIN EN 60489:2002, Elektroakustische Notfallwarnsysteme, Beuth Verlag, Berlin (2002)
- /11/ DIN EN 60268-16:2004, Elektroakustische Geräte, Teil 16: Objektive Bewertung der Sprachverständlichkeit durch Sprachübertragungsindex, Beuth Verlag Bewrlin (2004)
- /12/ EMPA Studie, Schweiz (2002)
- /13/ Beranek, L.: Concert and Opera Halls -How they sound, Acoustical Society of America (1986)