

## CASE STUDY

### First English Lutheran Church

501 Webster Street, Kimball NE 69145

After some conversations within the Worship and Music Committee of First English Lutheran Church (FELC) an IT professional was contacted to provide a bid to upgrade the existing audio system and provide a video display system to project PowerPoint presentations of the Sunday Service. He provided a quote in February 2019 for \$6k to mount a video display on the northeast corner wall connected to a Power over Ethernet (POE) switch connected to a Gateway to transmit data from the office PC to the display at the front of the sanctuary. He also proposed to spend two hours 'cleaning up the audio' (his words).

By the summer the quote had expired and the IT person declined to renew the project. In August James Ray became involved and agreed to spearhead the process and manage the project. Taking the original quote, he contacted two other IT professionals who declined to bid on the upgrade. He then contacted an out-of-state A/V company who presented a quote for \$11k which included:

- 2 JBL High Power speakers;
- 2x600W Power Amplifier;
- HDMI extenders and 1x4 HDMI splitter;
- Display mounting hardware
- Miscellaneous hardware and labor

Not included in the quote was any mention of video displays, audio/visual or networking infrastructure.

In September, through a referral, Craig Brauer from Holy Trinity Lutheran Church in Sidney, Nebraska was brought in to discuss the expectations and requirements for an audio/visual upgrade and analyze the existing equipment. In addition to presenting the church service on video displays at the front of the sanctuary, in the 'over-flow' area and in the basement of the church, discussion included the ability to stream content out over the internet; input content from the internet from other church services; play church music; record services onto a DVD for distribution to the local nursing home and assisted living facilities; play DVD content from visiting pastors and special events; ability to input content from iPads and smartphones and the ability to monitor and control the system from hand held devices. As you can see the original concept expanded exponentially.

His findings and report included the following.

### **Sound System Upgrade Plan**

Currently FELC has eight audio input channels and two output channels. One of the output channels controls the main Peavey Speakers in a stereo configuration. These speakers are located in the front of the sanctuary. The other output channel controls the 70 volt speaker system via a separate amplifier, in a mono configuration. These 70v speakers are located everywhere: in the nave, under the balcony, in the balcony and in the basement.

### **Recommended changes.**

- 1.** Move the Peavey main speakers toward the chancel about 3-6 feet and tilted down slightly, to fix the weak sound in the first two pews. I don't think rewiring will be needed since the wires for these speakers come from the front. The wires will just have to be moved.
- 2.** Remove the speaker on the arch, pointing forward. This will reduce feedback. The 70v speaker, that was removed, can be used elsewhere.
- 3.** Purchase a powered floor monitor speaker and or an in-ear assisted listening system to provide sound to the worship leaders. A separate output channel will be needed. This will require an XLR patch cable.
- 4.** Possible removal of the two 70v fills speakers in the Nave depending results from the repositioning of Peavey speakers. These 70v speakers may also cause feedback if a presenter, with a wireless mic, walks to the back of the sanctuary. If these speakers are kept, an inline volume control maybe needed to achieve the correct balance. Again these speakers can be used elsewhere if they are removed.
- 5.** Move the speakers under the balcony to point away from the chancel area, so all the sound comes from the same direction (from the front of the sanctuary). This will require rewiring and remounting of the speakers on the 70v system. A separate output channel will be needed.
- 6.** Add an inline volume control for the speakers in the balcony and in the basement. This will require rewiring.
- 7.** Purchase a new digital sound mixer to expand the number of input and output channels. Plus reduce feedback and allow control of the mixer with a computer, tablet or smartphone. Patch cables and wiring maybe need to install the mixer.

a. Planned input channels; Drop mic, Three wired mics, Two wireless mics, Keyboard, CD player and the new SmartTV service. Total of 9 input channels needed.

b. Planned Output channels; Main Peavey Speakers, 70v Speakers, Monitor Speaker in chancel area, and the new Video presentation system. Total of 4 output channels needed.

#### **8. Optional equipment for upgrade.**

a. Wireless microphones. Your current wireless mics maybe in a bandwidth that has been sold for cellular 5G service or is used by emergency services and is restricted/illegal in 2020. Because of the buildings construction materials, you may not be experiencing interference from these services at this time.

b. CD Media player with Bluetooth. Plays CDs and streams music from smartphones, tablets and laptop computers.

c. Assisted Listening System for members that are hard of hearing. It can also be used as an in-ear monitor system for worship leaders.

d. Main Speakers and Amplifier to increase the quality of the sound. The current amplifier/mixer and speakers could be used as a PA system for events outside of the church. I have not included costs for this below.

#### **Video Presentation System Plan**

**1.** EasyWorship presentation software. EasyWorship is powerful, yet simple worship presentation software. Build your entire church service - song lyrics, scriptures, announcements, videos and sermon notes - in one place, quickly and efficiently.

**2.** Desktop Computer, with graphics hardware NVIDIA GeForce GTX or equivalent to power the EasyWorship application.

**3.** Apple iPad (2). A tablet can be used to control the EasyWorship presentation remotely with the church's WiFi network. EasyWorship supports three outputs. One for controlling the presentation (main computer display) , one for the presentation ( in your case this HDMI output can be sent to 1 or many of the 5 TVs ) and one for Foldback or Stage Display (which displays the current presentation or video, a preview of the next scheduled item, a clock and private alerts. ) Another iPad will be used to remotely control the application that controls the infrastructure –Compass Control.

**4.** Two Presentation displays and one Foldback (stage) display.

5. A 4x4 Video Matrix Switcher. This device facilitates sending any of the input sources to any or all the output displays individually or collectively. It is not a video switch for transitioning between sources to produce broadcasts. This device is for setting sources to displays before the service. The input sources will be EasyWorship presentation output, the Video Camera, SmartTV Service and DVD or BlueRay player. Output can be sent to each of the front TVs (output 1 & 2), the TV in the back (output 3), and the TVs in the basement (output 4). The Foldback or Stage Display will be directly connected to the EasyWorship computer and will not go through the Matrix Switcher.

## **Proposed Infrastructure**

In order to accomplish the stated goals, the proposed infrastructure will include:

1. Equipment from Key Digital:
  - 4x4 Video Matrix Switcher;
  - HDBaseT/HDMI Extenders;
  - HDMI Presentation Matrix Switcher;
  - Master Controller (2)
  - 2-Channel Distribution Amplifiers
  - 4-Channel Distribution Amplifiers
  - Associated cabling;
  - System Software license (Compass Control);
2. Upgrade Internet access to Viaero;
3. Netgear 16-Port Ethernet Switch;
4. Netgear 5-Port Ethernet Switch;
5. POE Injector Adapter;
6. Netgear Remote Managed Wireless Access Point;
7. Netgear 9-Port Firewall;
8. Associated cabling and couplers;
9. Isobar Surge Protectors;
10. AppleTalk TV;
11. CD/Media Player;
12. UHD Blu-Ray Player;
13. Apple iPad (2) with case;
14. Wireless Combo Mic;
15. Digital Audio Mixer;
16. 30X Optical Zoom PTZ Camera;
17. Samsung 65" The Frame QLED TV (2) for front of sanctuary;
18. Samsung 55" QLED TV (3 –one for the overflow area; one for the basement and one for the stage display)
19. EasyWorship Application software;
20. Boxcast Streaming license and video/audio embedder;

We were able to keep and reutilize the following existing equipment:

- Toshiba 19" TV (to display and monitor DVD recording and streaming output);
- Peavey XRD 680S audio amplifier;
- Bogen C-100 70volt audio amplifier;
- Dell Projector and screen;

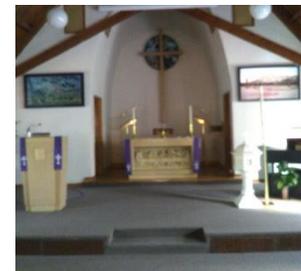
The following obsolete equipment was retired:

- Marantz PMD 201 Portable Cassette Recorder;
- Magnavox RX1335 WA 02 TV;
- Telex UR 700 UHF Wireless Mic;
- Samson UHF Synth 32 Wireless Mic;
- Nady Wireless Mic;
- Audiovox CE-255 CD/Alarm Clock recorder/player;
- AF CCD EVI-D30 12X Camera;
- Radio Shack 15-2526 RF Modulator;
- Allen Organ 903-4036-3 Transient Suppressor;

In October the replacement PC was installed and configured. Following that, the Century Link Internet access was replaced by Viaero to improve bandwidth and internet speed and reliability. In December the Key Digital infrastructure equipment was ordered and Craig set up the equipment in his office to begin programming software.

In January 2020 the electrician installed the cabling from the tech closet to the office and from the tech closet to the front of the sanctuary and up into the arch where the stage monitor will be installed; cabling was also installed up to the balcony for the WiFi Access Point and camera. The networking infrastructure was ordered and set up in Craig's office for programming and testing. The two iPads were ordered and incorporated within the remote access and control programming.

Once the displays were ordered and received, a local contractor was employed to install the two large displays at the front of the sanctuary; the stage display was installed in the arch along with the projector; the basement display was installed; the overflow display was installed; the previous display in the overflow was installed in the office for a quad view to monitor the system.



The Yamaha Digital Audio Mixer was delivered and Craig worked on programming it to communicate with the Compass Control system software.



The tech closet was modified, painted black and prepared for the Key Digital and networking infrastructure equipment. In March and April, the equipment was delivered from Craig's office to the church to be installed and tested. In the ensuing months, the equipment was tested and retested and the programming tested and modified and retested as Craig worked to simplify and automate processes. In June, the EasyWorship application was installed and tested. EasyWorship was successfully launched in June.

Over the summer a Sound and Lighting Engineer, Josh Brauer came and spent the afternoon tuning the sound system to synchronize the output of the Audio Mixer by mixing, reproducing and manipulating the equalization and electronic effects of the Audio Mixer. By controlling microphones, sound levels, and outputs, as a sound engineer he was able to combine his well-trained ears with his knowledge of acoustics to produce the best quality of sound in the sanctuary. Operating the Yamaha Audio Mixer, Josh was able to adjust the audio and music the congregation hears which is known as mixing the front-of-house sound, which is only one aspect of sound engineering. Josh worked on four distinct steps to provide commercial production of a recording including recording, editing, mixing, and mastering.

Recording of the service was successfully tested.

Over the next months the equipment was tested, modified and the programming updated and capability continually expanded to meet additional expanded requirements brought forward by the congregation. In mid-October the streaming of church services through Boxcast was commenced.

### **The Final System.**

We loosely use the term, 'Final System' which is anything but final. The project was designed to easily allow future expandability and flexible functionality. For example, the infrastructure has the capability to support future, remote IP-powered lighting control. Also, remote video conferencing can be easily incorporated and remote IT tech support capability as well as other requirements that may arise.

### **Networking**

The ISP for the church was upgraded to Viaero which provided wider bandwidth and better reliability. For security purposes, the A/V project within the church was configured behind a private Virtual Private Network utilizing a Netgear VPN Firewall. The primary hub for networking is a Netgear Smart Managed Pro Ethernet switch located in the tech closet. Ports to the Network Switch are as follows:

- Firewall switch (located in the office);
- Left front storage room;
- Right front storage room;
- Stage Display (located in the Stage Arch);
- Basement Display;
- Camera;
- Access Point;
- Overflow Display;
- 4x4 Matrix Switcher;
- 4x2 Multi-View Switcher;
- Master Controller 1;
- Master Controller 2;
- Blue-Ray Player;
- Smart TV;

The Access Point allows users operating the EasyWorship and Compass Control iPads to communicate with the associated hardware/software.

### **Audio**

The heart of the audio system is a Yamaha Professional Audio Mixer. The audio mixer takes the inputs and delivers them to various outputs, while allowing for the user to creatively mix, refine and optimize the sound quality through an intuitive digital console.

Current inputs to the audio mixer are:

- Yamaha Clavinova;
- Lectern microphone;
- Hanging microphone;
- 2-wireless microphones (each on their own input channel);
- 5-wired microphone inputs (each on their own input channel);
- HDMI audio left and HDMI audio right;
- iPad input;
- CD Stereo input;
- Potential future expandable inputs;

Current outputs from the audio mixer are:

- Peavey Amplifier/Mixer;
- Boden 70v Amplifier;
- Streaming;

- Stage Monitor 1 powered speaker;
- Stage Monitor 2 powered speaker;
- Assisted Listening device;



## **Visual**

The biggest impact of the A/V project upgrade is the extensive display system. Two large, 65” Frame displays in the front of the sanctuary make it easy to follow along with the service no matter where one is sitting.



When not in active use, the Frame Display can be set to ‘Art Mode’ to display various art images relating to seasonal themes. For special occasions the projector was mounted in the Arch and operates in conjunction with a large drop down screen located in front of the altar between the two main displays.

A 55” display mounted in the arch facing the stage enables easy viewing for the service leader and pianist to monitor the service and prompts. Another 55” display is located in the overflow area in the back of the sanctuary for people who prefer sitting in the back or when the main sanctuary is full. Another 55” display is located in the basement for special events as well as another ‘overflow’ area for viewing.



In the church office is a repurposed display that allows the operator to monitor streaming and recording viewing. Also in the church office is a large display monitor that when set up in a quad view format, allows the operator to monitor the different displays throughout the church.



The entire visual system is anchored by a top-of-the line advanced Key Digital infrastructure consisting of:

- 4x4 4K/18G HDMI Matrix Switcher;
- 4x2 HDMI VGA HDBase T Seamless Presentation Matrix Switcher and Multi-View Tiling Processor;
- (2) Master Controller with IOS Backbone;
- 4K/18G HDBase T POH Extenders;
- HDMI Distribution Amplifiers;
- Digital/Analog Audio to HDMI Embedder Inserter;
- PoE Injector;

The four inputs to the Matrix Switcher consist of:

1. EasyWorship
2. Camera
3. Apple TV
4. Blu-Ray Media Player

The four outputs of the Matrix Switcher are directed to:

1. Left Main Display
2. Right Main Display
3. Overflow Display
4. Basement Display

The Matrix Switcher enables the operator to independently or collectively direct any of the inputs to any of the output displays. It can either be manually operated or controlled by the operator with an iPad through Key Digital's Compass Control application.

The four inputs of the MultiView Video Processor are:

1. EasyWorship
2. Camera
3. Overflow Display
4. Basement Display

The two outputs are directed to:

1. Office Display
2. Streaming/Recorder Display

The MultiView Video Processor provides custom independent outputs in the following formats:

- Full screen mode
- Four equally sized quadrant mode
- Customized stacked images

This gives the operator the flexibility to create and store custom multi-view layouts, recall custom presets in 1080p (2K) Multi-view mode. The quadrant mode provides either 4K or 2K presentation options.

4K/18G HDBase T POH Extenders allow signals to be transported from HDMI to 10BaseT along CAT7 Ethernet cables from the tech closet to the different display locations and then converted back to HDMI input to the displays.

The HDMI Distribution Amplifiers provide a way to route the signals from the various inputs to multiple outputs while maintaining signal integrity.

The PTZOptics 30X SDI 1080p camera with 30X optical zoom is designed for capturing High Definition images at long distances. With support for 3G-SDI, HDMI and IP streaming, this camera is ideal for broadcasting high definition video signals for broadcast, recording or video conferencing applications.

Within the EasyWorship application, the operator can easily manipulate camera views and also have the ability to overlay the camera shot with video.

The Apple TV device gives FELC the functionality to bring in other congregation service streams, broadcast videos and commercial programs, view photos and videos from one's iPhone and iPad in addition to thousands more applications in the App Store.

While both iPads have the Compass Control and EasyWorship applications installed, for operator ease of management, one iPad is designated to run EasyWorship and the other iPad operates Compass Control.

The Blu-Ray Player provides the ability to play DVDs, both commercially produced DVDs and privately recorded DVDs from visiting speakers and can be viewed on any number of the displays.

In the same vein, the CD/Media Player allows CD content to be played through the audio system and has the capability of AM/FM Tuner functionality.

The Magnavox DVD Recorder/VCR combo unit is located in the office and provides the ability to record the services on DVD for distribution to families for instance, in wedding or funeral parties and to the nursing home facilities for elders who cannot physically attend the church service.

Our audio/video signal is digitally encoded using BoxCaster video encoder and transmitted via Ethernet through the Internet to the Boxcast end-to-end streaming platform. From there we can integrate our stream to a number of locations, to wit, our website, Facebook, YouTube etc. The Boxcast platform provides scheduling functionality and storing of our broadcasts.

## **Compass Control**

In lieu of standing at the tech closet and physically operating all the individual units of equipment, Craig integrated Key Digital's simple, plug-n-play solution for complete control and signal management of all the multiple brand subsystems from a single, hand held iPad running Compass Control Pro. The user-friendly interface provides the

operator an intuitive, easy way to navigate and control the various inputs and outputs from the audio mixer to the different display options.

The entire A/V project equipment is protected by numerous ISOBAR surge protectors distributed throughout the church.

Finally, the entire A/V system is remotely powered on and off through a NP-05B Remote PDU (Power Distribution Unit) making the start-up and shut-down of the system simple and easy to remotely operate from the iPad through the Compass Control application.

## **Conclusion**

During the course of the design, implementation and installation of the A/V upgrade project, there was a considerable consternation expressed regarding the rising expense and practicality of investing in such a 'modern' presentation system especially given the size and elderly nature of the congregation. However, that being said, as the A/V system unfolded and the people got used to the new way of following along in the worship service, visually on displays instead of printed on weekly publications, there evolved a growing not only acceptance, but appreciation and grudgingly, admittance of the value of a new way of presenting a worship service. Already, having experienced challenges not only of inclement weather but the coronavirus pandemic has led to an appreciation of being able to experience the Sunday Service live and recorded through the streaming capabilities of the new system. Overall the investment to date has been universally optimistic going forward.

As we continue to move forward working out bugs, implementing new processes, learning new creative ways of programming services, we confidently look toward the future in new and exciting ways of celebrating and sharing our worship service.

Designed, Engineered and Programmed by:

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