Reliable Stake Conference Broadcasts

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Several years I wrote a paper about Stake Conference broadcasting. This paper, written for the Church technology website, described the system implemented for the Lincoln California Stake. I have since moved to Utah and have implemented a greatly improved version in two stakes in Morgan county. This design has been greatly influenced by the collaborative work done whilst serving on the Hill Cumorah Pageant technical staff for 10 years. In short, the design has been tried and proven. The design that is describe below is the 3rd generation. This 3rd generation is possible because of ongoing improvements in available hardware and software, both in capabilities and cost. This 3rd generation approach was used when the two Morgan Utah stakes were divided into three stakes in September of 2017. During this conference, we broadcasted to ten buildings without any issue.

The purpose of this paper is to describe how to broadcast a stake conference between buildings as well as inside of buildings. It is my experience that having a quality audio and video environment will allow the members of the stake to get more out of the conference. The AV environment does not change the message that is being given by the stake leaders but rather it removes obstacles or distractions. It is similar to wearing clean versus dirty glasses. It is my hope that other stakes will benefit from the work done by myself and others over the years. If there are gaps that need to be filled in, please provide feedback and I will endeavor to update this paper.

In order to broadcast a reliable and quality stake conference, there are several elements that should be considered. These include some of the following:

- Broadcast to remote ward buildings
- Distribution within the buildings
- Reliable internet
- Sound capture
- Meeting house network (Intranet)
- High Definition Video

Many of our church buildings were built with a coax cabling system that only supports the now obsolete television standards that are many decades old. While some of this equipment and infrastructure may still work, it proves to be a distraction for many who are viewing the broadcast. Consequently, members of the stake do not get as much out of the conference as they should and indeed (be it right or wrong) some do not attend the conference because of the low quality of the broadcast.

In recent years the church updated its broadcasting system to accommodate the newer digital technologies and to improve the reliability of stake broadcasts. After significant testing (doing

video distribution at the Hill Cumorah Pageant and working through many stake broadcasts within my own Stake) the collaborative efforts of a variety of individuals have achieved a very reliable and high-quality solution. This solution does not involve the church broadcasting system due to reliability and quality issues. It is telling when a conference starts, and the members are asked to pray that the technology will work.

The solution detailed below is low cost, reliable and very scalable. Some best practices will also be supplied. Not all of the elements of system need to be implemented immediately, indeed an incremental approach is strongly suggested. In short, focus first on reliable broadcasting between buildings and then expand outwards or rather build on your success. Finally adapt to the needs or your stake and the direction of the Stake President.

Executive Summary

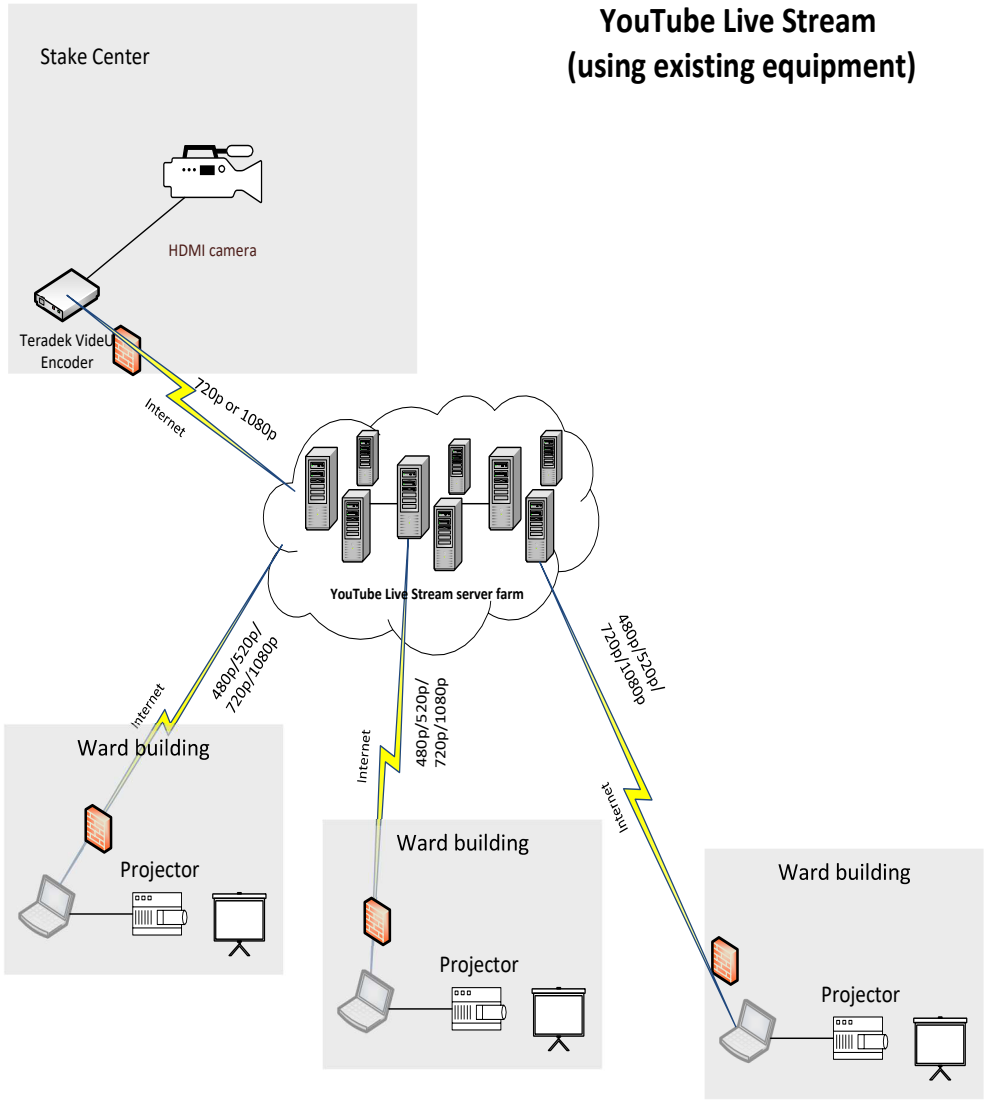
The recipe for a reliable Stake Conference broadcast is:

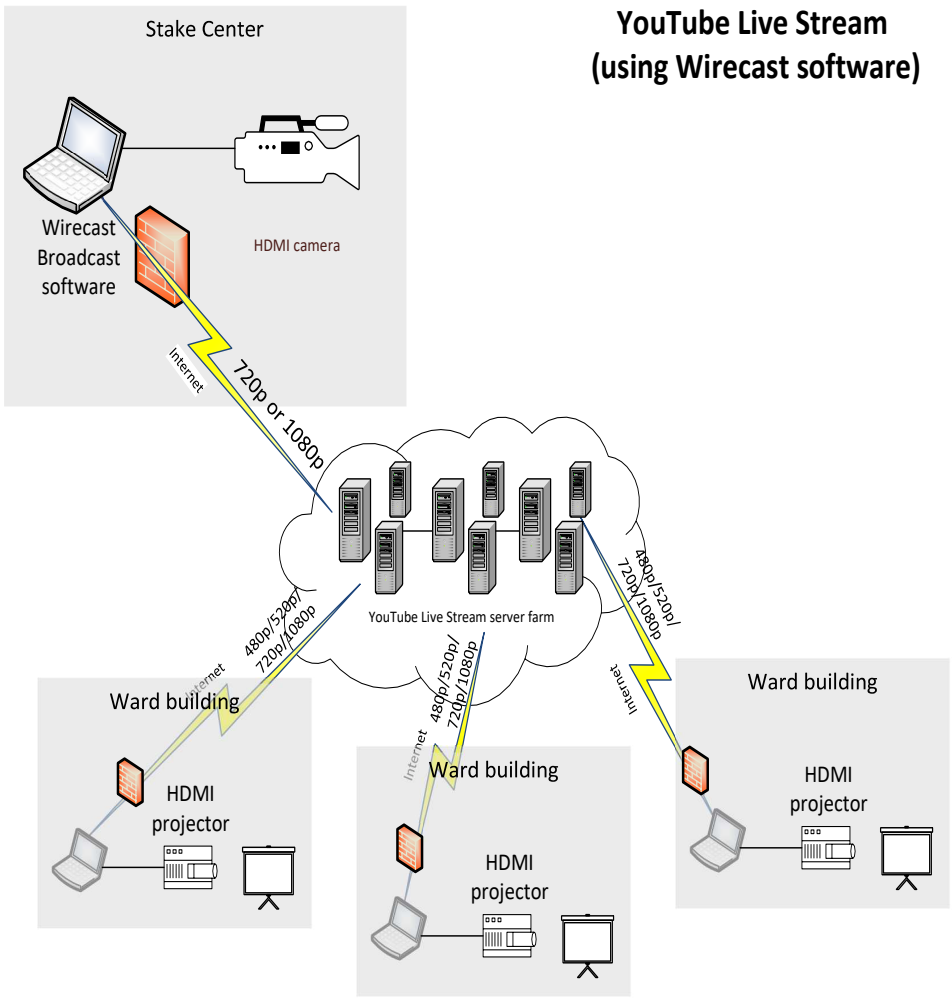
1. Broadcast between buildings using "YouTube Live Stream" not the church distribution system. Other commercial solutions exist but are outside the scope of this paper.
2. Use "Wirecast" software from Telestream (either Macintosh or Windows) to broadcast to "YouTube Live Stream" (Teradek VidiU devices are available via the Church Distribution Center, but these devices are limited compared to Wirecast)
3. Within a church building, distribute the YouTube feed with J-Tech HDbitT devices.

Cost:

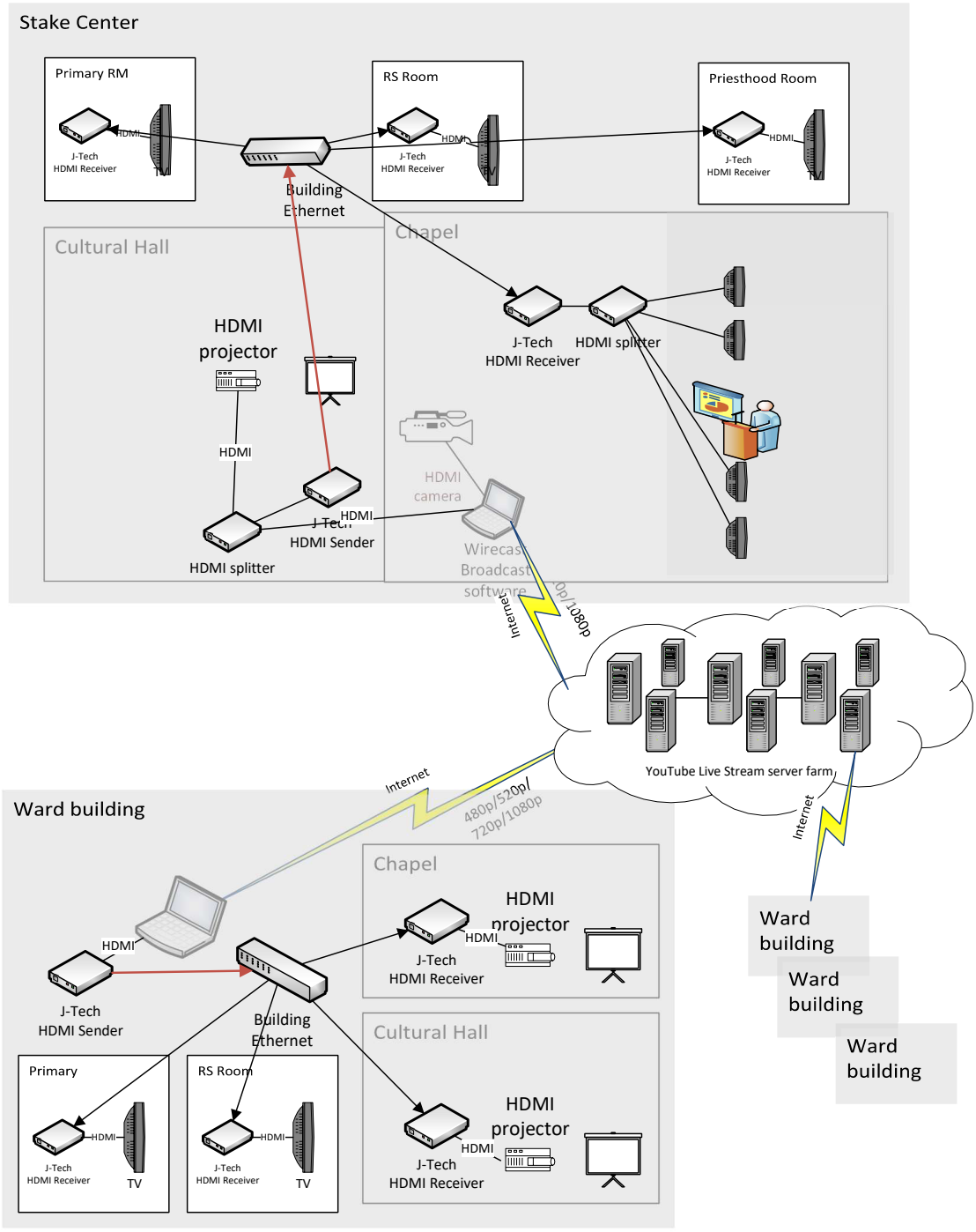
- YouTube Live Stream - $0.00
- VidiU HDMI encoder - $560 available from Church Distribution or
- Wirecast software $695 (available from Telestream) – Recommended over VidiU HDMI encoder
- Blackmagic Design UltraStudio Mini Recorder (HDMI capture) - $145
- HDMI splitter - $25
- J-Tech HDbitT - $90 for a Sender Receiver pair, plus $50 per additional receiver (~ $200 per building for a 3-receiver solution)

The following three diagrams illustrate the most basic solution up to a far more capable solution. Again, an incremental approach is highly recommended.




YouTube Live Stream
(using Wirecast software)
Stake Center
Wirecast
Broadcast
software
HDMI camera
Internet
720p or 1080p
YouTube Live Stream server farm
480p/520p/
720p/1080p
480p/520p/
720p/1080p
480p/520p/
720p/1080p
Internet
Internet
Internet
Ward building
HDMI
projector
Ward building
HDMI
projector
Ward building
HDMI
projector

YouTube Live Stream with Wirecast software and J-Tech HD-Bit-T (HDMI over Ethernet)



Broadcasting between buildings

Broadcasting between buildings requires a hardware or software solution. Around 2015, the church started providing Teridak video encoders. These $560 boxes are able to connect to the church distribution system, but they will also connect to a number of other video providers. Although other free services like Facebook can be used, we have learned from our experience that "YouTube Live Stream" seems to work best. The YouTube solution advantages include:

- Extremely reliable
- Free
- Minimum latency (1 second – 7 seconds)
- Video streams can be uploaded with one resolution (i.e. 720p or 1080p) and then viewed in multiple simulations resolutions (i.e. 480p, 520p, 720p, 1080p)
- The church uses this service for General Conference
- Broadcasts can be secured so that only intended recipients can view the stream
- YouTube viewer is available on almost any device
- Redundant video feeds can allow for a less than 1 second fail over for the receivers
- There is no real limit on the number of viewers
- Playback can be paused and even rewound

A better solution for broadcasting is a software package from Telestream called "Wirecast". Wirecast runs on both Windows and Macintosh platforms. While both are great platforms, the Macintosh platform seems a bit better for this task. The Wirecast solution use to be on the church distribution site. If Wirecast is utilized, spending the $100 dollars for the annual maintenance contract is highly recommended as it includes automatic updates (a bargain).

Some of the added benefits of the Wirecast solution are:

- Titles can be injected into the stream. It is nice to add the names of the speakers, as is done in General Conference.
- Words for hymns can be added in a camera angle.
- Multiple cameras can be used
- Complex multi-layer shots can be created
- Video and other multi-media can be accommodated (except during the main Sunday session)
- Monitoring the video feed is simpler
- Monitoring and adjusting the audio feed can be done inside the software
- Audio and Video can have a delay added to allow better syncing between the two.
- Preview and Live pictures can be seen and adjusted
- Video streams can be recorded locally
- Local HDMI feed can be supplied while streaming to Youtube, Facebook or the church distribution system.
- Simultaneous feeds can be accommodated (YouTube, Facebook, Church Distribution …)

Broadcast within the Stake Center

Most of the church buildings are equipped with a coax video distribution system. This system does not support the 720P or 1080P resolutions. A much better solution is the HD over Ethernet solution. This solution takes an HDMI source and converts it to an Ethernet multicast (Class D IP address). The ethernet output is plugged into the buildings Ethernet and then multiple receivers are plugged into the buildings network throughout the building. This in-building distribution solution is currently being used by the 3 stakes I have served in and the Hill Cumorah Pageant. The costs is $90 for a sender/receiver pair and then $50 for each additional receiver. These devices have been tested through 3 network switches without issue. In theory, the manufacture claims up to 250 of these devices can be installed on a single network. Since this is a multicast solution, adding more receivers has NO effect on the performance of the equipment.

The solution we have been using is from J-Tech. It may be purchased via Amazon.com.

- J-Tech Digital HDbitT Series ONE TO MANY CONNECTION HDMI Extender (Full HD 1080P)
- J-Tech Digital HDbitT Series ONE TO MANY CONNECTION HDMI Extender (Full HD 1080P(Receiver Only))

For a greater refinement of this solution, see the appendix. Note, the additional details found in the appendix do not have to be done, they simply refine the solution.

Appendix – Refinement and Best Practices

This appendix discusses possible refinements/ enhancements as well as some best practices. Remember to take an incremental approach and adapt to the needs of your stake and its available resources.

In Building distribution

To improve the performance of the HDbitT boxes, it is helpful to have "Smart" network switches versus "Dumb" network switches. Meeting houses typically have inexpensive and slower (100 Mbps) "Dumb" switches, some costing as little as $30 for a 24 port switch. Upgrading to a fast "Smart" 24 port switch will cost between $180 - $220 on Amazon. The following switch is recommended:

- Netgear GS724Tv4

Using a smart switch and turning on "IGMP Snooping" limits the video traffic to only those ports with HdbitT devices plugged in. An alternative is to use a 5 or 8 port switch ($30 - $60) with just the affected ports plugged in.

- Netgear GS105E-200NAS ProSafe Plus Switch, 5-Port Gigabit Ethernet
- Netgear GS108Ev3 ProSafe Plus Switch, 8-Port Gigabit Ethernet

While there are many great manufactures of network switches, the Netgear GS724, GS105E & GS108E ProSafe switches have served me well for the last 10+ years. These switches play nice together (they can be cascaded). At a minimum, ensure any switches are Gigabit capable and support "IGMP Snooping" (a standard smart switch feature). With smart switches, VLAN capabilities can also be enabled and add value.

WIFI should always be turned off for a broadcast. HdbitT devices produce a significant amount of IP traffic so Gigabit switches should be used. Most Access points (WIFI) devices cannot keep up with the associated traffic from HdbitT or similar devices. Smart switches that have "IGMP Snooping" turned on will prevent the multicast (video stream) from going over the WIFI connections.

Video streams can be isolated from the normal data network by plugging the HdbitT devices into a separate switch. This approach, however, is not as versatile as the smart switch approach. A Smart switch solution means that HDbitT receivers can be plugged into any network port in the building (RS room, Primary, Chapel, Gym, High Council, …)

Extron vs HDbitT

As new buildings are built or remodeled, they are being outfitted with a very powerful HD over Ethernet solution from Extron. This is a high-end system which allows multiple sources to be selected for viewing in the RS room and Primary room. The HDbitT solution while not as powerful is very inexpensive (a few hundred dollars per building), scalable and easy to install or repair.

Network Latency Audio & Video

HDbitT devices introduce about 300 millisecond of delay. When distributing the picture in remote rooms or buildings, this is not an issue. For remote rooms in the Stake Center, the sound should come from the HDMI connection not the building sound. The sound and picture from the HDMI connection should be in sync but if the picture comes from HDMI and the sound comes from the building audio system, then the audio and video will be out of sync.

If a projector is used in the Stake Center's gym, this projector should be connect to the camera via an HDMI cable if possible not an HDbitT device, since the video will lag by about 300 milliseconds and annoy some people.

Monitors for the stand

Placing 3 or 4 monitors on the stand in front of the 1st row will allow those on the stand to see what is being seen by the congregation. Feedback on this attribute continues to be very positive. Placing an additional monitor about 10 feet behind the pulpit allows those in middle of the choir to see themselves. Typically, there is a pocket of people in the choir who are on camera for the whole meeting (due to the camera angle) and they often do not realize how visible they are. Thus if they fall asleep during the meeting … they are seen doing so … in living color. Warning the choir members of this and placing an extra monitor helps eliminate this distraction.

Sound

The most important element of a conference broadcast is sound. Without the sound, nothing else matters. When broadcasting to other buildings, it is important to get a quality sound feed. Different buildings have different designs for their sound system. Whenever possible, capture the audio directly from the pulpit microphone. In some buildings this is a simple XLR Y cable connected before the pre-amp, in other buildings this may be a temporary or permanent XLR cable. Ensure that a 50 or 60 cycle hum is not present, if it is, inexpensive isolation devices will correct this problem.

While the church has long placed "Crab boxes" in the buildings, a simpler solution for injecting sound into the buildings audio system is the Laptop Interface. There are two versions worth considering. One has ground loop removal capabilities and one doesn't. $40 & $55 respectfully. These laptop interface boxes are also available from Amazon.com

- Rapco Horizon LTIBLOX Laptop Interface Device
- Rapco Horizon LTIGLBLOX Laptop Interface With Ground lift

Cameras

Many stakes have older low-quality cameras. High quality cameras can often be rented or borrowed. Newer SLR cameras often have full motion video capabilities. Look for HDMI outputs. If a camera does not natively output HDMI, it is not likely to produce a high-quality picture.

Technology Team Roles

Running a successful broadcast requires the efforts of a technology team. While there may be several ways of running this, consider the following role-based team. There are two types of technology callings in a stake. One is Stake Technology Specialist, which is an Assistant Stake Clerk, and the other is an Assistant Technology Specialist. The latter is not a Priesthood calling, thus it is open to the Sisters and the youth. Given that we run a conference more in line with the third diagram above, the following roles are used:

- Videographer & Backup broadcaster – A person who runs the camera(s) and backs up the person running the broadcasting equipment (computer)
- Broadcaster & Backup Videographer – Person running the overall broadcasting software and the person in charge of the overall broadcast
- Lyrics and Titles – This person provides Titles and Lyrics to the broadcasting software. Power Point is a great way to present this material. This person may also be assigned to monitor the YouTube feed and report any issues.
- Satellite building projection – Two per building. When all works well, one person is fine but when things don't go well, a second person is really helpful and removes a lot of stress.
- Coordinator – A coordinator, who resides in the Stake Center, stays in contact with the satellite buildings and the projection in the Stake Center. Group text messaging works well for communication. This is a pivotal role. This person correlates any issues with projection in the buildings and then works with the broadcaster as needed. Without this person, the broadcaster can become overwhelmed with duplicate or inaccurate information.

Having callings issued for a permanent technology team simplifies setup and take down, skills and roles are well known and well-practiced, and the team members are known in advance. This approach is also a great way to involve some of the youth in the stake as well as to tap the assistance of the sisters.

While the team described above uses 9 or 10 people over 3 buildings, a much smaller team could be used depending on the level of sophistication and the available resources. Bottom line, adapt the model to the needs of your stake.

Broadcast to remote ward buildings

Broadcasting using YouTube Live Stream is a simple and powerful way to distribute the video feed. Care needs to be taken to ensure the video stream does not go to unintended viewers. When broadcasting via YouTube Live Stream, there are three possible viewer models, they are: Public (anyone can view it), Un-Published (hidden, you have to know the exact URL to view) and Restricted. Public does not seem to fit with church policy and so it should not be used. Unpublished works fine as long as the URL is kept confidential, thus preventing unauthorized viewing. Restricted is perhaps the safest method as it requires viewers to have a YouTube account and specifically listed in the configuration as an authorized viewer.

A good practice is to not distribute the URL outside of the technology team and refer all requests for viewing to the Stake Presidency. This prevents the technology team from having to get involved in "who can view" discussions. Such decisions truly should be made by the Stake President and whomever he might delegate authority to. The use of YouTube playlists is recommended as the playlist URL can be provided in advance. Should the Stake President decide to provide the URL, a playlist URL greatly simplifies the process because the URL can be handed out a week or more in advance.

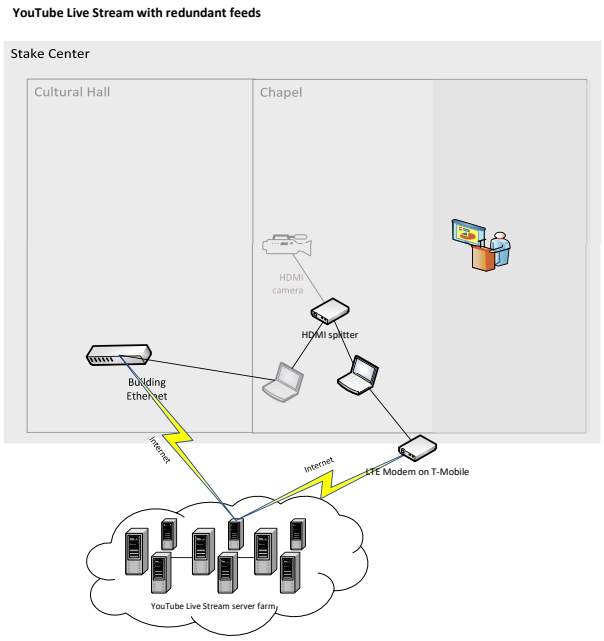
Satellite with HDbitT

Another use of the HDbitT devices is when a building needs to use the satellite. Most of the satellite receivers have an HDMI output so this can be plugged into the HDbitT sender and thus distributed throughout the building.

Redundant Streams

Reliable internet is not always possible. With YouTube, it is possible to have two different paths for the feed. When the Morgan Country Utah stakes were split in 2017 and there were 10 buildings to broadcast to, we tried to ensure we had redundant independent paths for sending and receiving. The Cameras provided the HDMI feed to two computers. Each computer was connected to a different internet provider (one was the building internet, the other was an LTE modem on T-Mobile), Both feeds went to the same URL source on YouTube. The first URL stream connected to YouTube is the one that is used for the subscribers. If the Primary feed is lost, YouTube will immediately switch to the second feed. This switch takes under 1 second.

Redundant streams is a consideration point but not a requirement. It really depends on the criticality of the broadcast and the reliability of the network. Morgan county is a small rural county that does not have a single traffic light, so many buildings receive their internet over the air. For most conferences, we only run one computer and have a second internet path ready to switch to if the primary goes down. Redundancy therefore becomes a risk based decision.



Redundant Internet

In the meeting houses (a.k.a Satellite buildings), the buildings internet is normally sufficient (assuming WIFI is turned off). That said, a simple backup is to have a smart phone or tablet on a wireless provider that can be used should the building internet go down or become unreliable.

Preshow Testing

Before moving away from the church distribution system, we observed time and time again that preshow testing would often work but as soon as the conference started, the problems would start. One could almost set a watch by the timing of it. Bottom line, just because a broadcast looks good at 9:30 AM on Sunday doesn't mean that at 10 AM (start of the meeting), that everything will be fine.

Experience teaches the value of testing the broadcasts at the same time as the conference. For several weeks leading up to a conference, a short test broadcast was done from our Stake Center at the same time as the conference (normally 10 AM). For this testing, the building WIFI was turned off.

HDbaseT vs HDbitT vs HDMI extender

The equipment used in my 1st and 2nd generation solution was an HDMI transmitter and remote dongles. The signal was sent over Cat 5e or Cat 6 cables using proprietary technology. HDbaseT and HDbitT devices are ethernet based so they will work over existing ethernet networks and will travel through existing network switches. The 1st generation systems used 2 separate ethernet cables per dongle, then single cable solutions came out. If you are using such technology, it is worth replacing this equipment with HDbitT or HDbaseT because of the improvements in reliability and distance. HDbaseT is a standard but it does not add significant value over the HDbitT devices. Over time, these devices will continue to improve in capability and the costs will continue to go down.

HDMI Short Throw Projector

Short Throw projectors have an advantage of requiring only a few feet to project a large picture. The cost is basically the same as a standard projector. In most situations, this works better.

The Epson projectors listed below also have a network interface. This can be used to remotely control the project allowing the projector to be put into A/V Mute mode. If the projector is plugged into the network, during the adult meeting (from the back of the chapel) the projector can be activated thus no one has to run up to the projector to turn it on and then wait for the picture to stabilize.

Equipment Photos

Note: All of the equipment list below can be obtained from Amazon.com

Device	Description	Cost	Photo
Black Magic Design Ultra Design Studio Mini Recorder	Used to capture an HDMI signal being sent to a computer. Note: HDMI ports on most computers are HDMI Out devices only.	$145	
J-Tech EX-120M-L HDbitT	HDMI over Ethernet	$90 Sender receiver pair $50 additional receivers	 
J-Tech JDT-Mini-1X2SP	HDMI 1x2 splitter	$17	
J-Tech JDT3DSP0104	HDMI 1x4 splitter	$25	
J-Tech JDT3DSP0108	HDMI 1x8 splitter	$43	
Netgear GS105E	Netgear Prosafe 5 port gigabit switch	$35 - $50	
Netgear GS105E-200NAS	Netgear Prosafe 8 port gigabit switch	$60	
Netgear GS724T	Netgear Prosafe 24 port gigabit switch	$180 - $200	
Rapco LTIBLOX	TRS (audio output) – XLR mic level adapter	$40	

Rapco LTIGLBLOX	TRS (audio output) – XLR mic level adapter W/ ground lift	$56	
Epson PowerLite 955WH WXGA 3LCD Projector HDMI MHL 3200 Lumens	Standard HDMI projector	$980	
Epson PowerLite 535W WXGA 3LCD Projector	Short-throw HDMI projector	$988	
Pyle PLPTS7	Projector stand	$48	