LIVE STREAMING 101
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ABOUT THIS GUIDE - When searching for answers about Livestreaming your church services, the answers and advice are endless. To be honest it is overwhelming for churches that have never streamed before. When my church was thrown into live streaming due to the recent COVID-19 pandemic, I had to learn a lot in a really short time. I watched video after video, asked anyone I could for advice, spent many hours on reading articles and built spreadsheets to compare the equipment we needed with the budget we had.

None of this made me an expert in the video streaming world, but I did learn a lot. With this guide, I tried to take everything that I learned and make it easy to understand for even those most technologically challenged people. This guide is not about which camera you should buy or what hardware and software you should choose, instead this guide is about finding out what you can stream based on your internet speed and available hardware.

I have talked to several churches that rushed out to spend thousands of dollars on cameras and equipment without ever running a speed test on their internet. Imagine the disappointment of having all this new gear and your speeds not being high enough to support even a low-quality stream. Or having blazing fast internet but not realizing that your old desktop in the youth room that someone donated back in 2003 isn't powerful enough to encode an HD signal.

I hope that this information helps someone out as much as it has helped me. We are all on the same team and fighting for the same cause. If my ideas and information can help further the Kingdom somewhere besides my own church, I want to help. Also, if you have any corrections or better ideas that would benefit this guide, by all means, contact me a let me know.

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LIVE STREAMING 101
Common terms and definitions

When jumping into live streaming you can b e overwhelmed by the technical jargon you encounter. Below you will find the most common technical terms, their definition and the explanation of why they are important

BASIC STREAMING VIDEO TERMS

HD - Stands for "High Definition Television." HDTV is a high-quality video standard developed to replace older video formats often referred to as SDTV (standard definition television) HDTV uses a different aspect ratio than SDTV. While previous broadcasts used a 4:3 ratio (4 units wide for every 3 units tall), HDTV uses a ratio of 16:9. This wider aspect ratio more closely emulates how humans see the world, making the image appear more realistic.

720p, 1080p, 4k - These numbers refer to the resolution of a video. Anything 720p and above is considered to be a HD broadcast. The most common streaming resolutions for HD are 720p and 1080p. The bandwidth and equipment for 4k streaming are very demanding and therefore not very popular. Any broadcast of at least 720p will look great on the majority of devices people stream to. The total pixels for each of these are as follows; 720p = 1280 pixels wide by 720 pixels tall, 1080p = 1920 pixels wide by 1080 pixels tall. Keep these sizes in mind when creating graphics to go along with your live stream.

FPS or FRAMERATE - Stands for "Frames Per Second." This is the common measurement to show how many frames are being sent through your broadcast every second. The reason this is important is that if your frame rate is too low, your video will appear very choppy. The opposite side of that is that the higher your frame rate, the more bandwidth you need and the more processing power your computer needs. For reference, your eyes process around 12 images per second so anything above 12 FPS will show motion, but look very choppy. The amount of movement on the screen will also affect how noticeable your frame rate is. If someone is mostly static, a lower frame rate will not look choppy. If someone is in motion, a lower frame rate will look very choppy. The most common framerates are 24FPS, 30FPS, and 60FPS. 24 FPS is used by almost every movie production because it is very smooth and cinematic looking. 30 FPS and 60 FPS are the most common video camera framerates and for church streaming 30 FPS is more than sufficient. If you can stream at 60 FPS, that is great, but you shouldn't worry as long as you can stay at or above 24 FPS.

BASIC STREAMING SOFTWARE TERMS

STREAM HEALTH - This how well your stream is performing from a technical standpoint. All of the major streaming platforms will have access to some type of basic metrics to let you find any errors. If your stream is choppy, lagging behind or blurry, make note of the metrics your streaming platform is receiving. This will allow you to troubleshoot problems and isolate them to hardware issues or internet issues.

BITRATE - Is the number of bits per second. The symbol is bit/s. It generally determines the size and quality of video and audio files: the higher the bitrate, the better the quality and the larger the file size. You always want to stream in the highest bit rate possible, but keep in mind that most streaming platforms will have a maximum bitrate allowed. For example, Facebook Live will only allow a max bit rate of 4000 (4mb/s). If you can broadcast at a 4000-bit rate, then you should, but anything much higher will be wasting resources.

BANDWITH - Bandwidth describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time. For example, a gigabit Ethernet connection has a bandwidth of 1,000 Mbps (125 megabytes per second)

UPLOAD SPEED - Is the rate that data is transferred from the user's computer to the Internet.

DOWNLOAD SPEED - Is the rate at which data is transferred from the Internet to the user's computer.

SIMULACAST - This is when you stream to more than one platform at the same time. For example you may stream to YouTube, Facebook Live and your website at the same time from one device. This usually requires special software to accomplish.

BASIC STREAMING HARDWARE TERMS

ENCODER - An encoder is a device or software application that takes your content and converts it into a digital format to stream over the internet. Encoders digitize videos and send it to a online streaming platform to be live streamed to your viewers. Some encoders are stand-alone devices that take audio and video signal from a Camera or a PC, while others are software computer applications.

CPU - Central Processing Unit or "Processor" is the primary component of a computer that processes instructions. It runs the operating system and applications. If you encode your live streaming with computer software (OBS, Wirecast, vMIX et) the faster your processor the better.

GPU - Graphics Processing Unit or "Graphics Card" is a processor designed to handle graphics operations. This includes both 2D and 3D calculations, though GPUs primarily excel at rendering 3D graphics. Some computers will have integrated graphics, meaning the CPU and Motherboard will provide the video output, while others will have a dedicated separate GPU. Some live stream software options will allow the use of a dedicated GPU to help encode and take some of the load off your CPU. Some software options will run better with a high CPU and ignore the GPU for encoding.

RAM - The amount of RAM in a device determines how much memory the operating system and open applications can use. When a device has sufficient RAM, several programs can run simultaneously without any slowdown. More RAM in a computer is useful to run multiple applications at one time. If you are using your computer to only process your live stream, high RAM counts are not a necessity. 8gb-16gb should suffice.

CORE(s) - An individual "processor" within a CPU. This is mostly referred to in terms such as "Dual-Core", "Quad-Core", "Multi-Core" etc. Most all streaming software recommends a minimum of 4-core or a quad-core processor. Obviously the more cores the better. The higher your video resolution and bitrate the higher the demand for more cores to process the data.

CLOCK SPEED - is the rate at which a processor can complete a processing cycle. It is typically measured in megahertz. The faster your clock speed, the faster your processor. For example, an Intel i5 3.4Ghz processor will be faster than the same i5 at 2.3Ghz. This is not the only determination of how powerful a processor is, but the higher the number is better.

THREAD(s) - A thread is a virtual version of a CPU core. There is much debate between having more cores or more threads in a CPU. The best advice for a streaming computer is to buy the most physical cores that your budget allows.

SSD (SOLID STATE DRIVE) - is a type of mass storage device similar to a hard disk drive (HDD). It supports reading and writing data and maintains stored data in a permanent state even without power. Since SSDs have no moving parts, they don't have to "spin up" while in a sleep state and they don't need to move a drive head to different parts of the drive to access data. Therefore, SSDs can access data faster than HDDs

HDD (HARD DISK DRIVE) - The HDD is the most common storage device used to store data. Most computers made in the 1980s, 1990s, and 2000s include an internal hard disk drive. A typical consumer HDD has a rotational speed of 7200 RPM, but some high-end hard disk drives run as fast as 15,000 RPM. Laptop HDDs typically run at either 4800 or 5400 RPM. Even at the fastest rotational speed, hard drives are still limited by the "seek time" of the drive head. Therefore, SSDs, which do not have a drive head, have become a popular high-performance alternative to HDDs in recent years.

LIVE STREAMING 101
What do I need to stream?

The most basic Livestream requires three main components. A camera or video device, an internet connection and an encoder to push your signal to the internet. These sections will break down these three components and show you how they work together.

CAMERA or VIDEO DEVICE - This is what you will use to capture what you want to stream. This could be something as simple as a built-in webcam on a laptop to a $10,000 professional broadcasting camera. Most modern smartphones have high enough resolution cameras to use. They type of camera that you use can have a great impact on the quality of your stream, but it is not the only determining factor. Higher resolution and higher quality require higher computing power and faster internet speeds. No matter what route you take when deciding on the camera you want to use make sure that your internet can handle it and that your software/hardware can handle it.

ENCODER / COMPUTER - While there are different types of encoders you can use in a Livestream broadcast, this guide will focus on what the majority of people in the church streaming world use. Free software such as OBS or StreamLabs OBS, or paid Software such as Wirecast, vMix or any other computer/software combination. If you are streaming from a mobile device, your encoder can be the streaming platform app of your choice. Facebook, Instagram, YouTube, etc. Each of these apps allows you to go "live" directly from their mobile app on your phone requiring only an internet connection and compatible mobile device or tablet.

INTERNET CONNECTION - This is a vital part of your Livestream. Without a fast and stable internet connection, you will not be able to stream to your audience. This is where most people make their mistake. They fail to properly test their internet to determine if it is strong enough to handle a video broadcast. Most all Internet Service Providers (ISP) will advertise their high-speed internet in Mbps or Megabytes Per Second. This will look like "speeds up to 50mbps" or something along those lines. What they do not tell you is that is only the download speed. High download speed is great for streaming to your home or surfing the internet, but in order to send a signal out, you need a high UPLOAD speed. Very few ISP's will advertise their upload speed. In order to find an accurate number, you will need to run an internet speed test from the device you will be streaming from. The easiest way to do that is by visiting the website www.speedtest.net or download their app onto your smart device if you are streaming from a phone or tablet. After running the test you will be given three sets of numbers. PING, DOWNLOAD , and UPLOAD. Your UPLOAD speed is most important as it will determine the resolution you are able to broadcast.

DSL (digital subscriber line) internet generally offers download speeds in the 5–35 Mbps range. Upload speeds are usually in the 1–10 Mbps range.

Cable download speeds are usually in the 10–500 Mbps range, while upload speeds are 5–50 Mbps. Some providers offer more in select areas

Fiber Internet download speeds can be anywhere from 250–1,000 Mbps. Unlike cable and DSL, fiber providers usually offer "symmetrical" service, meaning the upload speeds are the same high speed.
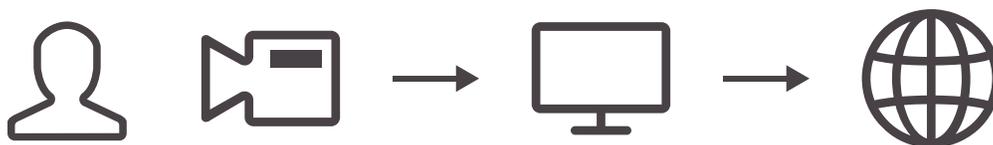
LIVE STREAMING 101
Why does is my stream quality bad?

This is the number one question that is asked when starting to live stream, but it also is the hardest to answer. There are so many factors that play a part in a quality live stream. This section will try to give an overview of each one of these and offer advice to get you started. Keep in mind that everyone has different budgets, technical knowledge, facilities, and equipment. There is not a one size fits all answer to making a stream look good. Hopefully, by the end of this guide, you will have a good idea of what you need and then you can start searching for the right equipment based on your unique situation.

DETERMINE YOUR UPLOAD SPEED - The previous section explained the need for a fast internet upload speed and this should be your first step before streaming anything. Go to www.speedtest.net or download the app to a mobile device if you are using that to stream. In order to get the most accurate results, perform a speed test on the internet connection and device you will be using to stream. Also, when at all possible please use a wired connection as it is much more stable than wifi and not as susceptible to interference or dropping a connection during your stream.

After you find out the upload speed of your connection, you can use the chart below to determine how high of a resolution your connection will support while streaming. This chart is only a suggestion to what you should be able to stream, but you should always run a stream test just to make sure your connection will support the resolution that it should. You may also want to perform a few speed tests at different times of the day to see if your speeds change. The more consistent your speed the better.

VIDEO RESOLUTION (30 FPS)	RECOMMENDED UPLOAD SPEED
SD 480p 720x480	**3** MB/s Upload Speed
HD 720p 1280x720	**6** MB/s Upload Speed
HD 1080p 1920x1080	**13** MB/s Upload Speed
UHD 4k 3840 x 2160	**50+** MB/s Upload Speed

*These are recomended speeds averaged from several different streaming platforms and streaming software services. These are not exact numbers, but should give you a general idea of what video resolution your internet service can handle while live streaming.

Also, keep in mind that you need to allow a buffer in your internet speed. If you are right on the edge of a video resolution required speed and bitrate, any fluctuations no matter how small could affect the overall stream quality.

For example, if your internet upload speed is right at 6MB/s peak, but averages around 3-5MB/s you could see quality issues when those fluctuations happen.

DETERMINE YOUR HARDWARE CAPABILITIES - Just like internet speeds, the capabilities of your hardware can have a great impact on the quality of your stream. If your internet is fast enough but your computer can not process the information quickly enough, you may see dropped frames (laggy or choppy video), audio issues or computer crashes among other various problems.

The more sources you add into your streaming software will add to the load on your processor. Even a computer that is solely dedicated to streaming will still have to compute tasks in the background in order to keep it running at a functional level. It is best to close any unnecessary applications and tasks to open up as much processing power as possible for your encoding.

Before you spend the money to buy a new computer or upgrade your current one, take a few minutes to analyze your system and determine what your weakest components are and what it would take to fix them.

FINDING YOUR HARDWARE SPECS IN WINDOWS 10

1) Open *Settings.*
2) Click on *System.*
3) Click on *About.*

FINDING YOUR HARDWARE SPECS IN WINDOWS 8

1) Click the "Start" menu and search for "System" in the search field.
2) Select the "System" option from the results.

FINDING YOUR HARDWARE SPECS IN WINDOWS 7

1) Click the "Start" menu and search for "System" in the search field.
2) Select the "System" option from the results.

FINDING YOUR HARDWARE SPECS IN WINDOWS 7

1) Find the "Computer" icon on your desktop.
2) Right-click the icon to open the context menu and select the "Properties" option.

FINDING YOUR HARDWARE SPECS IN OSx (Apple Products)

1) click the Apple icon in the top left corner of your screen.
2) From the drop-down menu, click About This Mac to open the System Information window.

Windows 10 Sample Specs

Apple Sample Specs

MORE ADVANCED SPECS IN WINDOWS

By default the specs that Windows gives you is not very detailed. In order to gain more detailed information about your system, you can download an app called CPU-ID (*www.cpuid.com*). This will give you details about your GPU, how many cores your CPU has etc.

*CPU-ID Sample Specs for CPU and GPU
in Windows 10*

IS MY COMPUTER POWERFUL ENOUGH? - After reviewing your specs on the streaming computer you will be using, you can determine if it is sufficient enough to handle the video resolution your internet is capable of handling. Below you will find a list of the most common software encoders and what their hardware recommendations are for streaming. The following information is directly from the creators of these software options. Each one of these will work great and have many different features. Choosing the right one can be hard to do. Start by seeing what hardware is required and then once you narrow down the ones you can use, then you can make a decision based on the features and cost offered.

It is easy to get caught up in CPU and GPU requirements, but don't forget that utilizing a Solid State Drive (SSD) can really boost your hardware performance. It is recommended that any computer being used for live stream encoding run off of an SSD

Please note that these are estimated specs only. The more graphics, higher video resolution, inputs and other sources you add to your stream will increase the demands of your computer power.

OPEN BROADCASTER SOFTWARE (OBS Studio)
https://obsproject.com/
https://streamlabs.com/
1) Windows, Mac, or Linux Operating System
2) AMD FX series or Intel i5 2000-series processor (dual or 4-core preferable) or higher
3) DirectX 10 capable graphics card, and
4) At least 4 GB of RAM (recommended, but not necessary)

WIRECAST
https://www.telestream.net/wirecast/
1) Windows 7 or newer, or macOS El Capitan or newer
2) Intel Core i7 CPU at 3 GHz or higher (for full High Definition 1080p streaming)
3) Integrated or discrete graphics card compatible with DirectX 10
4) at least 4 GB of RAM

VMIX
https://www.vmix.com/
1) A Windows PC running Windows 7 or newer (Windows 10 recommended)
2) A 2 GHz dual-core processor or better (Intel Core i7 at 3 GHz or higher recommended)
3) 1 GB or DDR2 or faster RAM (8 GB recommended)
4) A 7200 RPM hard drive (SSD recommended)
5) DirectX 10 compatible graphics card (Nvidia card with at least 1 GB RAM recommended)

XSPLIT
https://www.xsplit.com/
1) 2nd Generation Core i7 CPU or equivalent
2) 8BG of RAM
3) Windows 8/8.1 32 bit, 64 bit
4) GeForce or Radeon Class graphics card with DirectX 10.1 or better support
5) Dedicated Video RAM of 256 MB

CAN I STREAM TO MULTIPLE PLATFORMS WITH ONE STREAM? - The short answer is yes. The long answer is the simulcasting can be complicated to try and set up on your own. The easiest way to stream to multiple platforms with a single stream are to use a simulcasting service.

The way it works is instead of streaming to YouTube or Facebook Live, you will set your stream to point to a service that then sends your stream to your different social accounts. There are a couple of different places that do this and I would recommend that you check the reviews and requirements of each one before deciding. Keep in mind that this service will not be free and in some cases can be quite expensive.

LIVE STREAMING 101
Sources and further reading

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