

Cloudy Skies:

9 MYTHS

about online media storage + delivery

by Michael de Nigris

Content is king. Your most discriminating customers have increasing demands for their audio and video content, including how and where they want to enjoy it. As an integrator, how do you keep up with the ever-changing digital media landscape so you can continue to meet their expectations?

Cloudy Skies demystifies the “cloud” in context with networked A/V installations. Learn about online storage, streaming services, the technical aspects of digital media, and the best way to consume it.

There’s no time like the present to get on board with cloud-based media so you can design a sophisticated A/V system that satisfies the eyes and ears of your best clients.

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Converge with a higher standard.

Introduction

Audio and video source equipment used to be so much simpler, and it wasn't too long ago, either. Integrators could source a CD player for music, maybe with a high-end DAC and a separate amplifier for the audiophile. For video, there have always been ample choices in players to satisfy everyone from the casual viewer to the highly discriminating videophile. Plug them in, power them up, and you were done with content delivery. The customer simply popped in a disc from the local music or video store.

Today's content marketplace is awash with dozens of different technologies and almost countless service providers. Just about every piece of A/V equipment today has an Ethernet jack—a conduit for a myriad of different types of content and various formats, all with a huge range of quality, and it's always changing. From the time you source the equipment to the time you install and test it, the landscape of online content will have likely changed.

It's not sufficient to simply ensure that the gear you're sourcing for your projects has an internet connection and a collection of online service logos on the faceplate—it's how it manages those capabilities that really counts. What services does it provide, and how do those services fit the listening and viewing habits of your customer? How does the equipment interact, if at all, with the collection of portable music players, cell phones and tablet devices that your customer undoubtedly owns?

In order to truly meet your client's requirements and deliver an A/V system that fits their lifestyle, you have to understand the cloud and embrace this evolving technology, its various service providers, and how they all address different media needs and habits.

M Y T H 1

The "cloud" is a buzz word for the internet.

The "cloud" is certainly tossed about with reckless abandon, and it's frequently substituted for the "internet" in marketing materials. When properly used, however, the cloud has its own meaning.


In the 90s, the term "cloud," as it relates to data communications technology, was coined by corporate and university IT engineers who began to depict offsite data accessed over the internet as an amorphous blob on network diagrams.

When we talk about the cloud, it means that the data is not stored on a hard drive, physical disc or even on another local computer or server. Instead, data is stored on a server in a faraway data center or, more likely, on many servers in many data centers. Similarly, applications that run in the cloud process their logic on remote servers and send the results to your screen, over the internet.

The "internet," on the other hand, is properly thought of as the world-wide network of computers, wires, switches, routers, satellites and fiber optics that allow you to connect to the cloud and access your content. The term "internet" reflects the fact that you really don't know where the data is. It's just out there somewhere, on the internet, in the cloud.



"Cloud"



**internet?
hype?**



WIIFM?

M Y T H 2

Online storage costs too much.

Today, online storage costs more than local storage. However, the laws of scaled economies would suggest it's likely to change in the near future as more people leverage online storage. In the meantime, having your content in the cloud provides several benefits over local storage that may be worth the additional cost for many of your clients. Here are the ABCs:

Access. Cloud-based storage means global access. Most online storage providers have a variety of browser-based, mobile and tablet applications that allow you to access and play your content wherever you go. Amazon Cloud Drive is a great example of this. Their Cloud Player software can run on PCs and Macs, on Android-based devices and in most browsers. You can also access your content using an iPhone or iPad. Often, the very thing you want to listen to is not where you are because you didn't have the time or foresight to synchronize all of your devices. Once you've experienced the convenience of having your entire media collection follow you wherever you go, it's hard to live without it.

Backup. If your content is replicated in the cloud, it provides a secure, offsite backup. This is significantly better than a local backup on an external drive or NAS device because it's isolated from any physical disaster (flood, fire or lightning) that might affect the local equipment.

Convenience. Some equipment can actually use cloud services to synchronize content among several physical locations. This is a real convenience for customers with vacation homes, boats and businesses when they want access to their library wherever they go. One successful CEDIA dealer shared an extreme example. Before leaving town for the weekend, a customer would pull the hard drives from his RAID cabinet and carry them onto his private jet so he could watch his movies at his vacation home.

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M Y T H 3

It's safer to keep your data on the ground.

This issue is raised frequently by integration pros and customers alike. It is sometimes a valid concern, depending on the service, how the cloud is utilized and what you're actually paying for.

If you download an album or movie, then it makes sense to want a local copy, particularly if you're concerned about the longevity of the service provider. You probably don't need to worry about Apple or Amazon suddenly folding up anytime soon, but some of the smaller, niche players probably need to demonstrate a longer track record before you should trust them with the sole storage of a large digital media collection that you've paid for.

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Before Walmart purchased VUDU.com, an online movie service that allowed you to purchase movies stored exclusively on their servers in the cloud, some dealers and customers were rightfully wary of purchasing content and entrusting this young startup with their movie collections. If VUDU were to disappear, so would your collection.

Other providers charge you a fee for accessing their libraries. You don't purchase individual albums or tracks; rather, you have access to the service's entire collection in exchange for a monthly or annual fee. Rhapsody, PANDORA® internet radio, Last.fm, Spotify and Netflix are examples of this type of service. Protecting your collection is less of a concern with these providers because you're paying a fee for the service, not buying individual works.

MYTH 4

Cloud storage = cloud streaming.

Cloud streaming does not equal cloud storage. There's a significant difference between these two types of services, and each leverages different aspects of cloud-based technology to deliver or store content for their customers.

Cloud storage services provide your customers with a quantity of real, allocated disk space on their servers. Typically, they also provide software-based utilities for moving and copying content between your cloud and your local computer storage. Amazon Cloud Drive, MP3Tunes, mSpot, and Google Music are some examples of this type of service.

Cloud streaming providers, on the other hand, utilize their own cloud-based storage to warehouse their media collection and provide customers with streaming access to that content. Since customers don't have any allocated space on these types of services, they can't upload their own content. Pandora, Rhapsody, MOG, Last.fm and SiriusXM fit this category.

Cloud streaming/storage hybrid. Some services simulate this experience by scanning your local library and creating a matched online library, so it's almost the same as streaming your own music collection. One important note is that you're not really streaming your files. If you have high-bitrate content, the service provider still matches files in their database, encoded at their standard bitrate, which can be lower than your original files (see Myth #7).

MYTH 5

You own that album.

We've all seen the legal notices, FBI warnings and fine print on music packaging and movies. When you buy a CD or download an album, you actually purchase a limited license to play back its content for personal use. As consumers, we generally know where to draw the line, even since the rise and fall of peer-to-peer file sharing. Today, now that we have a variety of cloud storage and streaming options, that line has gotten fuzzy. Whose data is it, anyway?



For several years, the big three online behemoths—Apple, Amazon and Google—have been attempting to negotiate deals with the record labels to be able to provide online lockers where customers could store their own content. However, the record labels consider this to be streaming, and they want to be paid royalties each time the track is played rather than only once when the customer purchases the content.

Amazon Cloud Drive. Recently, despite protests from the music industry, Amazon launched its cloud offering using a duo of services: Amazon Cloud Drive for media storage and Amazon Cloud Player for remote, web-based playback. Amazon’s position is that since customers have their own discrete storage space and upload content that they own, it’s really no different from a personal hard drive; therefore, Amazon should not have to pay streaming royalties to the music labels. The argument has held so far. As of the publication of this paper, the record companies haven’t filed suit, which is possibly due to the fact that Amazon is one of the largest retailers of their content.

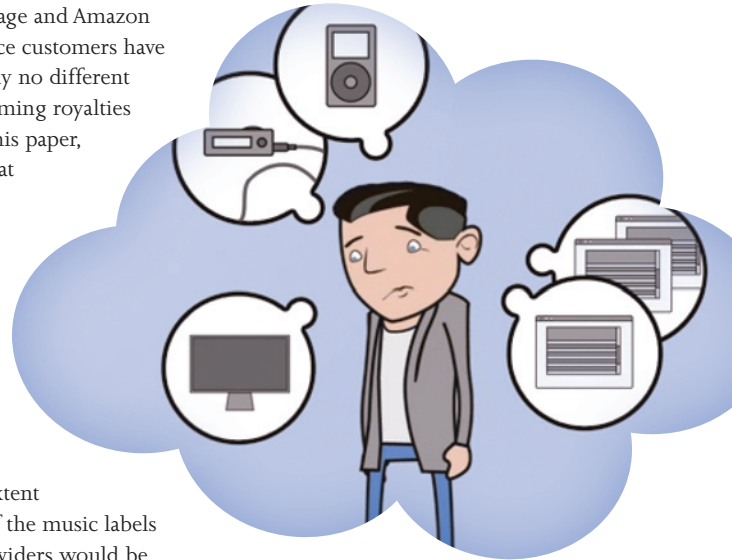
MP3Tunes employed the same argument to provide online music lockers even before Amazon did, but they did not fare as well, and litigation with the record companies is still pending.

Amazon’s approach is not the most efficient use of cloud storage because the same file can be replicated thousands of times across users’ accounts. This, in part, drives up the prices of these types of services, which can cost anywhere from \$20 per year for a small library up to as much as \$1,000 for a terabyte of content. Amazon mitigates this to some extent by not charging for the storage of media purchased from its online store. If the music labels were to back away from their current position, it’s possible that service providers would be able to store one copy of each track and virtually link them to multiple user accounts. Then real economies of scale could come into play and greatly reduce the cost for everyone.

Google Music. Google recently took a similar approach to Amazon and launched Google Music. It works generally the same way as Amazon’s service. One key difference is that the storage component of Amazon’s offering, Amazon Cloud Drive, can be used to store video content, photos, documents and other file types; whereas, Google Music can only store music files.

iCloud. Apple’s iCloud takes a different approach altogether. They’ve cleverly found a way to realize the economy of shared storage without getting involved in the whole streaming vs. purchasing debate. iCloud is not a true cloud storage solution, as it currently works for only music and movies. In fact, it might rightfully be called iDownload. Customers don’t upload or stream their own content using Apple’s servers the way Amazon and Google’s services work. Instead, iCloud provides a way for a user’s various computers and devices to automatically download music from the iTunes store that was purchased or ripped on another device. For an additional fee, they also offer a “matching” feature to facilitate the replication of content acquired elsewhere. Naturally, iCloud is limited to iDevices (iPad, iPhone and iPod Touch), as far as mobile access goes.

While iCloud provides a way to synchronize your library through the cloud, there’s a significant difference with this approach, and it’s mostly relevant to those customers who prefer their digital content uncompressed and/or at higher bitrates. Because you’re not actually uploading your own content, when you synchronize your library with other computers or devices, you won’t get the high-bitrate content from your source library. Instead, the content will be Apple’s copy of the same track, which usually means a compressed file at 256 kbps.



Video: autonomic-controls.com/cartoon

M Y T H  6

Streaming services all do the same thing.

The other major category of cloud-based media services is online streaming, and there are many different models. Each service yields its own set of advantages, offering listeners varying degrees of customization and unique experiences for new music discovery and social interaction.

Broadcast streaming radio. The most basic type of streaming service uses the internet as an alternative means of transmission to satellite or over-the-air broadcasts. **SiriusXM Internet Radio** is one such example. Interestingly, SiriusXM internet broadcasts are streamed at a bitrate of 128 kbps on average, double that of their satellite transmission which is broadcast at 64 kbps. Accordingly, devices capable of receiving SiriusXM broadcasts over the internet will provide higher quality sound, provided the device is capable of the higher bitrate.

Another example of broadcast streaming is **TuneIn Radio** (formerly RadioTime). Many traditional radio broadcasters mirror their programs through an internet stream. TuneIn provides a database of more than 40,000 of the world's radio stations, all searchable by genre, program name or locale. A special feature called "Local Stations" uses your geographic location to provide a list of AM/FM radio stations in your area. Internet streams of AM and FM broadcasts are prolific enough that a streaming media device that supports TuneIn Radio can eliminate the need for an over-the-air AM/FM tuner. The interference-free digital signal is usually superior to the over-the-air broadcast, too. Some stations are not available on TuneIn Radio due to licensing reasons, so a customer's preferred station lineup should be reviewed before employing this strategy.

Custom internet streaming. More sophisticated streaming services like **PANDORA® internet radio** allow you to build custom radio stations that play music according to your particular taste in music, which you can start by naming artists that you like. By rating songs that the service presents in real time, you can fine-tune each station you create and also discover new music. With this model, you can influence the content but not specify it. Pandora is wonderful when you want to simply play music that's both familiar and similar in style, allowing room for flexibility and discovery.

Virtual streaming libraries. Other services like **Rhapsody** and **Spotify** provide more of a virtualized library in the cloud. You can select specific albums, artists and tracks that you want to hear, as well as create your own playlists. Your selections and playlists can be accessed by computer, mobile devices and certain home audio components that have partnered with these service providers. Rhapsody and Spotify are great when you know exactly what you want to hear and you have the time and motivation to construct a collection of music and playlists.

Services like **Last.fm** and **MOG** combine the benefits of custom radio and virtual library streaming, allowing you to construct your own library online, but also offering the ability to let the service suggest music for you based on your listening habits and/or listener-provided keywords and track ratings.

Increasingly, each service is creeping into the social media sphere in unique ways. This presents a whole new level of consumer desire to not only enjoy their media independently, but also check out others' recommendations and share their own unique tastes, anonymously or openly with their friends. In the near future, more high-end A/V devices that stay ahead of the curve will integrate social media features alongside streaming services.



M Y T H 7

Bitrate doesn't affect sound quality.

The most common measure of quality for streaming content is the bitrate. This is commonly expressed as the quantity of data over one second, such as **kbps** (kilobits per second) or **Mbps** (megabits per second). The more data that is transferred during one second of playback, the better the content will sound or appear, but it will only be as good as the device will allow.

You're playing to discerning ears. Most of us in the custom installation business work with clients of discriminating tastes, and hopefully you're specifying amplification and loudspeaker equipment with sufficient audio fidelity that provides an audible difference between a 128 kbps and a 320 kbps audio file. In the CEDIA universe, the minimum acceptable bitrate is generally considered to be 128 kbps for background music played over small, in-wall speakers. 192 kbps is better for larger sound systems, and 320 kbps is best for audiophile-quality equipment.

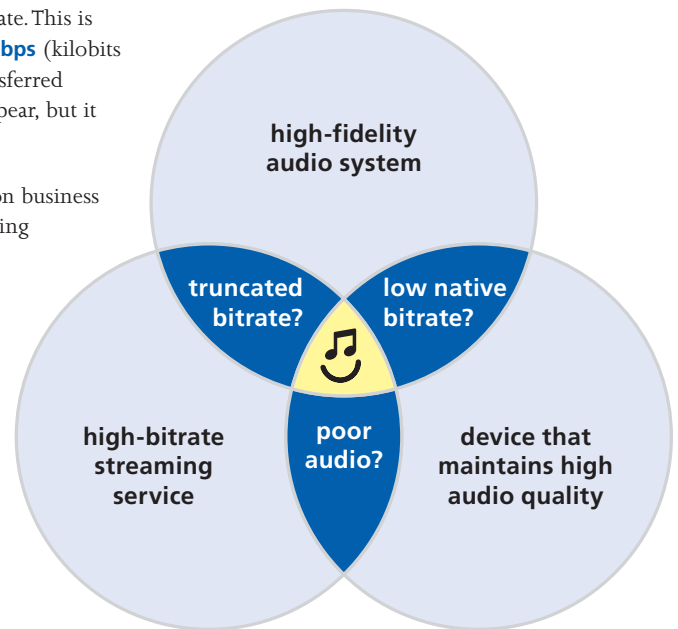
So, who provides discerning bitrates? For free services, Pandora, Grooveshark and Last.fm stream their content at 128 kbps. SiriusXM states on their website that they employ a variable-bitrate (VBR) algorithm that attempts to optimize the data stream based on your connection speed and the complexity of the content, but technical observation has shown that the broadcasts seem to be consistently 128 kbps. Pandora offers a paid upgrade option, called Pandora One, delivering content at 192 kbps. For high-bitrate content, MOG and Spotify support 320 kbps audio, which is attractive to our high-performance minded clientele. Both are fee-based services that require a subscription.

Many service providers don't publish their bitrates at all. You can generally assume that if a provider isn't declaring otherwise, they are probably providing content at 96–128 kbps.

Make sure your device is discerning, too. Some of the popular, consumer-oriented, desktop streaming products support services that natively provide a very high bitrate, but the device compresses the content for ease of synchronized distribution around the home. While you may be tuned into a service like MOG or Spotify, which both stream music at 320 kbps, the device may be compressing the audio down to the lowest common denominator—an unacceptable 64 kbps (or worse), to ensure that it can deliver the content around the home over the network.

A common mistake is to use line-level outputs on these inexpensive devices to create a multi-room network. Some installers believe that since they're connecting to a better amp and speakers than what's on the device, they must be preserving the high-quality audio. In reality, the device may be compressing the content down to an unacceptable level before it reaches the line-level outputs. These devices are a great shortcut for a quick and cheap multi-room setup without having to run cable throughout a home, but there's no free lunch—you ultimately get what you pay for.

When selecting equipment to play back streaming services, it is important to know which services the device supports, what bitrate is offered by those services and if the device renders the content at the maximum bitrate served by the provider.



M Y T H  8

Size doesn't matter.

Ok, so you've specified high-quality equipment that will deliver the highest bitrate content at full fidelity to your amplification and video equipment. Great! But there's one more important factor to consider: can your internet connection and local network handle all that data? This is where A/V installers must become (or subcontract) IT geeks in order to deliver maximum value to their clients.

How big is your pipe? While bitrate is a measurement of how much data exists in the content over time, bandwidth is the measurement of a network's capacity to move data over time. Most networks today run at 100 Mbps. In other words, they have the ability to move 100 megabits of data around the network each second. Most residential broadband internet connections deliver between 5 and 25 Mbps, most of the time, so this is almost always the bottleneck. This does vary throughout the day, however, based on local broadband demand, so it pays to profile your customer's internet connection over several days to determine their average throughput. There are many tools available on the internet that will measure and log your connection speed over time. A quick Google search will reveal many popular options.

Practically speaking, you'll find that audio rarely presents a problem since it's unusual to find audio content that exceeds 320 kbps. A kilobyte is 1/1000 of a megabyte, so there's almost always plenty of headroom to easily send high-quality music flying all around the house. Video is in a different stratosphere, which is why it's wise to install gigabit networks (1000 Mbps) into new installations.

It's best to stick with wired connections for video applications. Even if your math says your WAP can keep up with one or two streams of HD content, at best it will sap the bandwidth for everyone else on the access point while streaming video, and at worst video dropouts, hiccups, and freezes will reflect poorly on your installation and frustrate your customer.



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M Y T H  9

You can't stream high-quality video.

There are ways, and the technology is improving. When it comes to the digital delivery of content, music will always lead the way. CDs came before DVDs. Music downloads preceded movie downloads. Streaming—same story. This is simply due to the fact that it takes a lot less storage space, bandwidth and horsepower to store, deliver and render audio than video content.

As technology inevitably becomes faster and cheaper, video downloading and streaming is becoming a realistic option for a growing number of consumers. For this reason, if you want to know what video content delivery is going to look like in five years, you need only look at music delivery today. The CD is all but dead—and soon too will be DVDs and eventually even Blu-ray discs. Why bother with optical media once we reach the point where a 1080p, HD program with full-range surround sound can be reliably streamed into the home instantly, and on-demand?

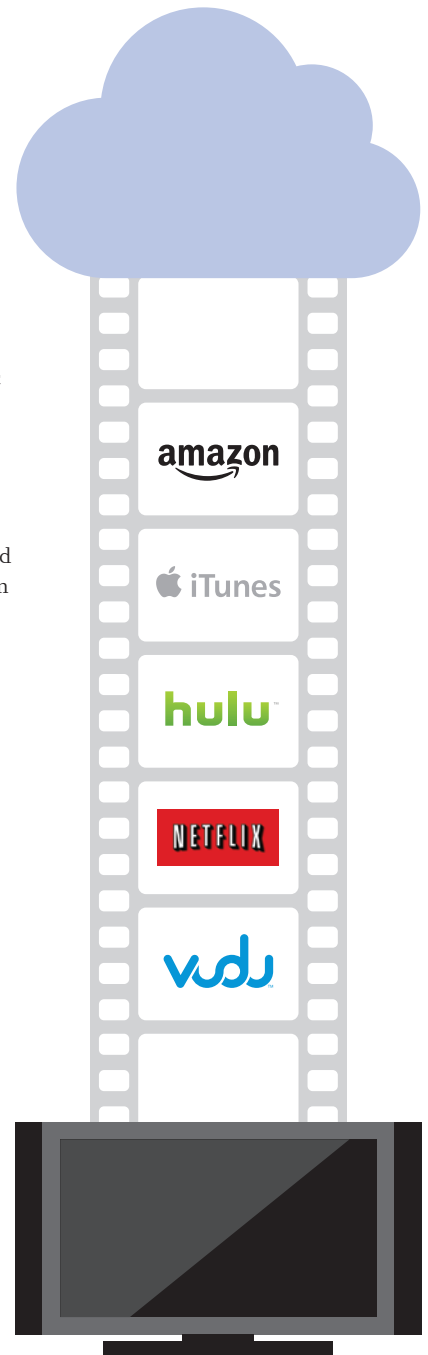
Some of the most popular online providers of streaming movie and video content are Apple (iTunes), Netflix, Amazon and VUDU. Each of them have a slightly different model of delivery, and most of them are not quite up to the highest standards of audio and video quality that the custom electronics industry is accustomed to, but it's getting better all the time.

Netflix utilizes a variable delivery method that throttles the resolution of the content based on the viewer's internet connection speed. This results in content delivery between 1.5 Mbps ("DVD quality") to 3 Mbps ("Better than DVD quality"). Currently, only the PS3 game console is able to stream Netflix at 1080p resolution with full 7.1 audio, but only if your internet connection can consistently deliver 3.0 Mbps.

The next rung up the quality ladder is 720p HD content, supported by both Amazon and Apple. The best performer seems to be VUDU, which uses a proprietary compression algorithm called HDX that supports 1080p, 24 frames per second (FPS), with full Dolby® Digital Plus 5.1 surround sound.

Aside from the supported studios and the number of titles available, it pays to understand the different delivery technologies used by each of the providers so that you can optimize your customer's environment to minimize frustrations with quality. There are generally three distinct techniques utilized to deliver video content on-demand over the internet: **streaming**, **download-and-play** and **progressive download**.

Streaming can be thought of like a broadcast. The flow of data begins once you request the content from the provider, and it continues throughout the duration of playback in real time. This technique is used by Netflix and Amazon (although, with Amazon, you also have the option to download and play). The primary advantages of this method are that it minimizes the requirements for local storage on the playback device, and playback begins very quickly—usually after just a few seconds to buffer some of the data to the device's memory.



The disadvantage of streaming is that if there's an intermittent internet interruption or sudden bandwidth constraint on your network, the viewer will experience freezing, pixelation or a complete loss of the signal—much like what happens when a digital satellite signal is interrupted by rain or snow. The quality of the image can suffer because the bitrate of the content must be set to something slightly less than the bandwidth of the typical viewer. Netflix utilizes a network analysis algorithm that dynamically sets the bitrate of the content based on the bandwidth of the viewer. This approach attempts to minimize outright interruptions, but the result is that you have no control over the quality of the content, and it might vary throughout the viewing session.

Download-and-play works exactly as you would expect. The content is downloaded completely to the host device before playback begins. The advantage of this method is that quality can be strictly controlled. Since all of the content is on the local device before playback begins, the viewer's internet connection and networking equipment will play no role in the quality of the video output, as those factors will only affect the time required to download the content. Obviously, the big disadvantage is that the viewer must wait for the entire program to be downloaded before they can watch it. Depending on the quality of the video and the customer's bandwidth, this could take hours. This method is utilized by Amazon when purchasing content.

Progressive download is a technique that mitigates the disadvantages of the two methods discussed previously, while preserving their advantages. With this method, the file is downloaded to local storage, but playback begins as soon as enough data has been received (a buffer) to ensure that the download progress will stay ahead of playback. The amount of data that must be downloaded before you can begin viewing is variable, as it is calculated by the device in real time by monitoring the data transfer rate during the first part of the download. A straightforward, mathematical formula is used to determine when the device can begin playback while ensuring the playback will trail behind the download for the duration of the program.

With most modern broadband internet connections, playback usually begins within seconds or a few minutes instead of hours (as is the case with download-and-play). Additionally, since playback does not begin until enough data has been stored on the device's internal storage, the quality of the program can be carefully controlled. While it is still possible to experience an interruption in playback, should the internet connection fail or slow down significantly, it's generally a very rare occurrence with reliable internet service. Because of the initial delay, this method is ideal for feature movie presentations, but it's not well suited to channel surfing or rapidly browsing content.

Rumor has it that progressive download as a method of delivery was developed by Apple for George Lucas, who famously said of Star Wars, "There are 24 frames per second in this movie, and none of them are optional." Indeed, this is the current method of video delivery on the Apple TV set-top box.



Conclusion

While there are many A/V companies doing whatever they can to hitch their wagon to the “Cloud,” understanding the real benefits of cloud-based media will help you evaluate product offerings and determine if they leverage the advantages of the cloud to useful effect, or if it’s just marketing.

The paradigm shift from local content consumption to cloud-based content and services is a significant change, and therein lies the opportunity. Remember the shift from LP to CD? CD to Digital? CRT to Plasma? All of these shifts in technology drove waves of new equipment sales and installations. These major shifts don’t come around as often as we’d like, so get started early and capture your share of new business.

Understand the major categories of cloud services and products discussed in this paper, and select a suite of components and services that cover all the bases. Try them, get familiar with their operating characteristics, and be ready for your clients when they ask about cloud services, because they will. Nothing inspires confidence in your recommendations like having the answer prepared in advance.

Once you’ve evaluated your options and settled on a suite of products that will help your clients realize substantial benefits, you can then turn your attention to engineering your network designs to be as robust as possible. Remember, **content is king**. If the network is the weakest link, your customer’s experience will suffer, so over-engineer your networks.

About the Author

Michael de Nigris is CEO and Co-Founder of Autonomic Controls, Inc. Founded in 2006, the company introduced the world’s first cloud-based media servers, making audio and video consumption more reliable, easy and fulfilling. Exclusively engineered for custom installation, Autonomic products have become an industry standard for converging content for multi-room distribution from the most popular sources, such as iTunes, Windows Media, PANDORA® internet radio, TuneIn Radio and SiriusXM Internet Radio.