

# NDI<sup>®</sup>

Introduction to NDI<sup>®</sup>



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# 1 Preface – Introducing NDI® 3.7

## The Next Evolution of NDI

From the very beginning, NewTek's mission could be distilled to one imperative – 'Give storytellers a voice through video'. We are convinced that computers, software and networks comprise the keystones of the next generation of video tools. And not for high-end markets only, but for anyone who wants to produce a show or stream their team, class, or congregation – and have fun while doing it.

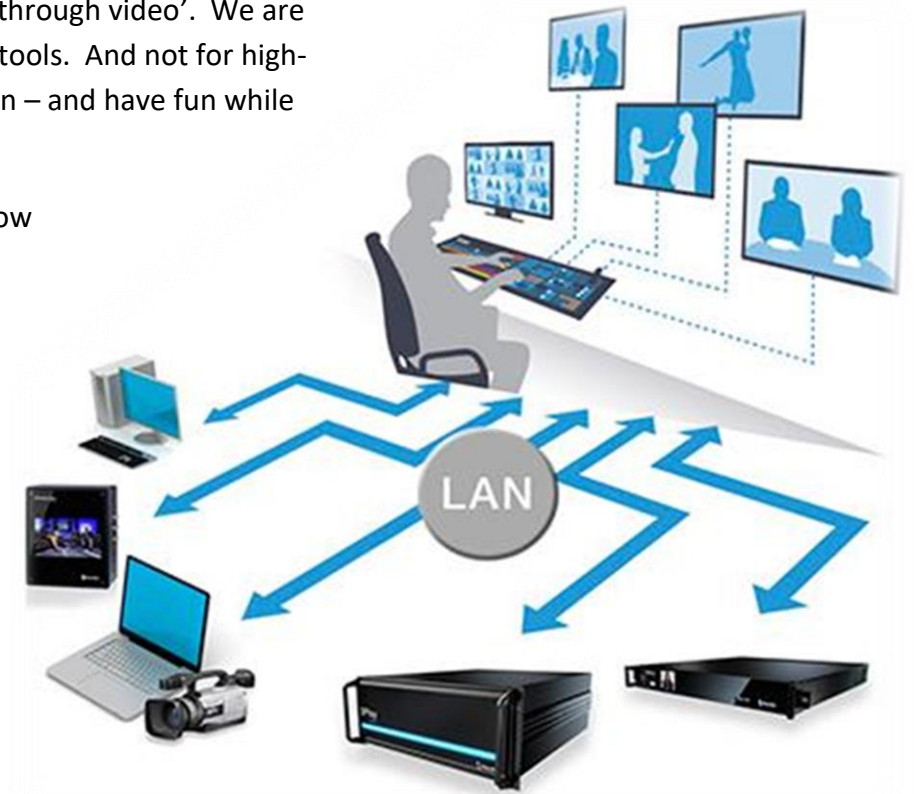
*Video revolutions start in basements and garages* wherever creative programmers have great ideas (we know because we started there, too!) We want them to succeed. When they win, we all win. NDI® is where our commitment to this vision becomes reality.

We *could* have kept NDI to ourselves. Instead, we made it both incredibly easy to implement and *free* to sell. Thus we were gratified but not surprised to see hundreds of great new products appear as if overnight that using NDI's outstanding a/v interchange features and other features.

And we give away, completely free of charge, a richly powerful suite of NDI Tools – to enable developers and end-users alike to immediately multiply the benefits of their use of NDI.

*We're very proud of NDI. It's what results when a video software company designs an IP protocol.* NDI checks all the important boxes for production, but doesn't paint you into a corner. For example, NDI-SMPTE2110 interop is fully functional. Likewise, we anticipate that upcoming protocols in various stages of development by hardware-focused companies will be equally complementary to and compatible with NDI.

*We want to sincerely thank the community for making NDI the world's most successful IP standard for video production.* Without thousands of companies who joined hands with us, more than ten million people would still be chained to HDMI and SDI. While this latest build is dubbed version 3.7 (full integer updates occur at IBC on NDI's anniversary), it is extremely feature packed and delivers massive benefits for NDI developers and customers alike.



## NDI Scan Converter



The new version of NDI Scan Converter provides vastly improved image quality and much, much more. The GPU is now used for screen capture, and handles the lion's share of color conversion, processing and transmission. Capture all of your system's desktops in real-time, at full 60Hz or even games at 120Hz or above and with almost no CPU usage.

Note: This version of Scan Converter relies on the latest DirectX 11 API, thus requires Windows 8 or better.

Choose an audio source for your screen capture. Now you can play a computer game or Power Point presentation with sound (with no impact on frame-rate) and supply it as an NDI source. Scan Converter now fully supports

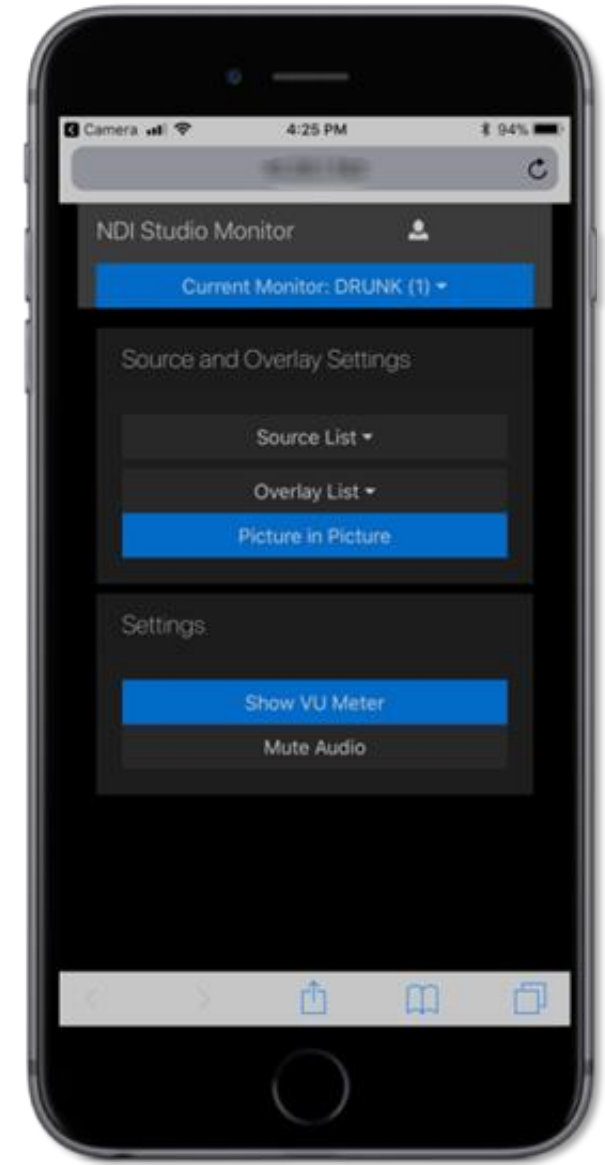
webcams, too.

Stream games with audio, and overlay a webcam on the stream while supplying voice-over. Send PowerPoint to Hangouts, Zoom Media, Skype, or GotoMeeting (see NDI Virtual Input), and use your webcam to talk to them. Too, NDI Scan Converter now provides 'region of interest' support, so you can capture video directly from a YouTube page.

## NDI Studio Monitor

It would be hard to overstate the importance of this 'little giant'. Signage is an extensive and important video field, and Studio Monitor now has it covered. The set for virtually every show now includes multiple video screens; lobbies, building façades and billboards display giant screens, and so on. Supplying these sources over analog cabling was always impractical, SDI hardware costs are prohibitive, and HDMI's distance limitations prevents it from serving as a reliable alternative. IP is, of course, the perfect solution – ubiquitous, reliable, and inexpensive.

Need to update the display on a remote screen? NDI Studio Monitor now provides an integrated web server; just scan a QR code on the display to turn your mobile device into a (password-protected) remote control. What's more, multiple instances of Studio Monitor running on the same machine can be independently controlled. Even when you have lots of different computers



running Studio Monitor, they all ‘see’ each other over P2P, giving you complete control from any point on your network!

An equally radical and valuable addition to Studio Monitor lets you overlay titles and graphics (even full motion video) on the display. Assign a unique overlay to appear over video in your lobby and apply something different for your showroom. Or use the Overlay feature to provide picture in picture output.

Too, each Studio Monitor instance can now choose which sound device to use for playback, and which video monitor its output should appear on (or which *monitors* it should span). You can even set Studio Monitor to launch on computer startup so that multiple instances, all correctly configured, launch automatically. Buy a NUC or two to easily and inexpensively create multiple, remotely controllable, 4K outputs.

Better support for joysticks and keyboard shortcuts for PTZ control round out this phenomenal upgrade.

## NDI Virtual Input

Assign NDI video sources as inputs to anything that supports webcams (including GotoMeeting, Skype, Hangouts, Zoom Media, and much more!) NDI Virtual Input fully supports 1080p60 or even 4K at full frame-rate, and even allows you to modify audio levels for different application requirements.

## VLC Media Player



This new version of our VLC plugin now supports both VLC 3.0 and VLC 2.x. Virtual PTZ control is also built-in, allowing you to pan and zoom around in VLC output displayed in Studio Monitor or a TriCaster as though you were controlling a real PTZ camera. Video format support is improved, as are time-stamps and more.

## Adobe CC drivers

The new driver supports the latest version of Adobe CC, at the same time as delivering higher quality, floating point color support, and more.

## NDI HX Drivers

The NDI|HX drivers are now integrated into NDI tools to make things quicker and more convenient. The drivers feature many optimizations, bug-fixes and improved support for complex network setups. In addition, hardware acceleration support has been upgraded.

## Changes to the SDK

We’ve made it the entire SDK easier to use. Functions are easier to understand, but fully backwards compatible. The new SDK Getting Started Guide will accelerate the learning process for those who are new to the NDI ecosystem.

## Changes to the Protocol

Really, NDI itself has been completely transformed ‘under the hood’, including truly massive optimizations to the underlying protocol to support UDP data transfer, with Forwards Error Correction (for both Unicast and Multicast).

What is more, NDI now automatically detects NICs, and all the possible paths between a source and a destination, in order to spread the bandwidth out across all the possible paths.

This delivers much better performance in almost every case, even on high latency networks. What is more, very sophisticated internal congestion control reduces packet loss, and helps everything run on real-world networks which often employ ‘less than ideal’ routers or switches.

## More reliable discovery

Numerous discovery and connection edge cases are handled better, to provide increased reliability when network topologies change, across multiple NICs (or networks) and much more. In other enhancements, NDI discovery on the local machine is improved as also are NDI sources on virtual networks.

## NDI Hardware

NewTek will soon be launching a reference FPGA project running on a Xilinx reference board that we will let people play with for free; if you make a commercial project, we’ll even work with you to help make it successful.

## And more ...

Traditionally, using RGB video was 80% slower than YCbCr. We’ve added AVX2 optimizations to bring this down to just 20% (assuming you have enough memory bandwidth on your system to keep up). We also now support 4:2:0 video color spaces on input, and we even include FFMPEG for Windows with NDI support for your convenience, eliminating the hassle of working out how to compile it yourself.

## You Want it When?

Release is scheduled for right after NAB (when we’ve woken up from the fun. See you at the show!)

# NDI®



## 2 Why NDI®?

*Every few decades, the video production industry goes through a revolution that forever changes the way we work, and what we can achieve. It is thrilling to know that one is happening right now (and you can be part of it).*

For example, the industry abandoned analog cameras, video and transmission in favor of digital systems over a decade ago, paving the way for vastly more efficient non-linear workflows. Similarly, the explosion of the Internet and widespread adoption of high speed networking set the stage for the next revolution. We confidently predict that twenty years hence it will be clear that this shift was far more important than matters like resolution, frame-rate, and the like.

Today, virtually every computer system in the world is potentially connected to every other one. Literally billions of devices have high quality screens, fast processors and cameras. In this environment, it is inevitable that efficient, economical, non-linear video transfer in IP space will ultimately supersede linear connection methods (such as SDI, HDMI, etc.) and systems.

NewTek NDI® (Network Device Interface) makes it easy to share high-quality video over a local Ethernet network. *However, the NDI vision is vastly more exciting and important than any mere 'cable upgrade'.*

Consider how the Internet is much more than an improved way to move data from point A to point B. At home, the office, and everywhere in between, you, and your associates use many different devices – tablets, smart phones, laptops, workstations, and more. You might work independently, or perhaps you share files while communicating by video chat with someone in the next office, or on another continent.

The 'net' enabled countless innovators to truly change how the world works, lives and plays in fundamental ways, by creating tools and workflows that use data in ways that no-one had ever

### THINK OF NDI AS YOUR OWN 'VIDEO INTERNET'.

Like a webpage, each NDI source is instantly available to many viewers and devices. Wherever your network extends – throughout your office, broadcast studio, hospital, campus (etc.) – NDI is ready for immediate display, capture, replay, production, and more.

NDI operates bi-directionally over a local area network, and supports many ultra-low latency, ultra-high quality video streams on shared connections. It is resolution and frame-rate independent, supports 4K (and beyond) along with 16 channels (and more) of floating-point audio. Alpha channel, command channels, tally data, bi-directional metadata, and things like access rights and grouping are natively supported.

NDI's superb performance over standard 1Gbit/s networks makes it possible to transition facilities to an incredibly versatile IP video production pipeline without negating existing investments in SDI infrastructure, or costly new high-speed network installations (though 10Gbit and beyond can provide even more simultaneous channels of video).

We expect you to find all of this hard to believe. That's why we want you to try NDI out for yourself.





imagined. *NDI constitutes a similar quantum leap for video production.*

From the outset of personal computing, NewTek foresaw that video production would inevitably leverage the exponential progress of general computing.

Our vision also embraces the commensurate advances in general purpose networking and the Internet. Production systems using IP to integrate data, video, and audio are transforming live video production yet again – in ways that would have seemed miraculous just a few years ago.

*NewTek's mission is to give storytellers a voice through video, using innovation and technology to fundamentally change the way video is created and used.* NewTek NDI springs from these core values. We are providing it to the world for free to make it easy to connect video products over IP, in turn greatly expanding creative options for video producers – providing them with greater power, increased efficiency, and economy.

### 3 How Do I Start Using NDI®?

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The NDI® concept is simple:

You supply a video source, and send it to your network as NDI. At that point, anyone else on that network can see it and work with it (unless you deliberately restrict access) just as if it was a locally connected to their system.

In this brave new world of IP video, you do not need to think about capture cards, SDI, HDMI, etc. (although you can use these methods to connect to legacy sources, as we will discuss a bit later). You might also enjoy freedom from dependency on distribution amps, video matrix routers, and the like.

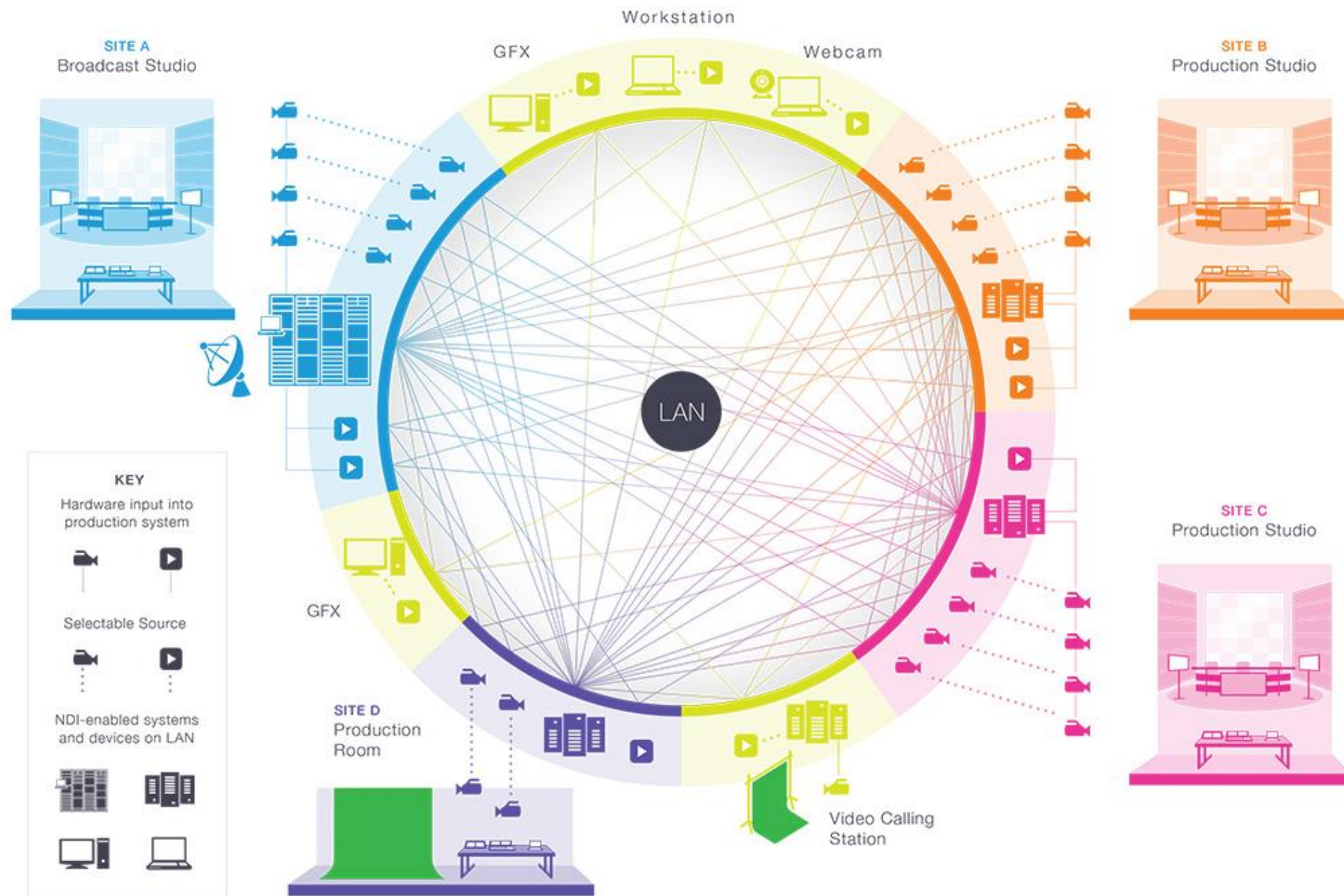
Let's begin our adventure by creating an NDI source.

For more than 40 years, the need to physically connect cameras, graphics systems, video switchers and routers has dictated studio design, architecture and workflows. ***This is no longer true.***

- Production operations, including video mixing, can be performed wherever it is convenient (and quiet), rather than being shoe-horned into the actual production space.

So – you might producing a video in your office; someone in the next office can also view it, and so can still others down the corridor, elsewhere on your campus, or on the other side of the world – all at once.

- Your graphics systems need no longer be in your control room (with bi-directional communication they can be controlled from somewhere else as well).
- Naturally, the reverse is also true. If someone takes your source and inserts it into their program, you can connect to their NDI output and see the result.
- You can even use other NDI channels to video chat to collaborate on the production.

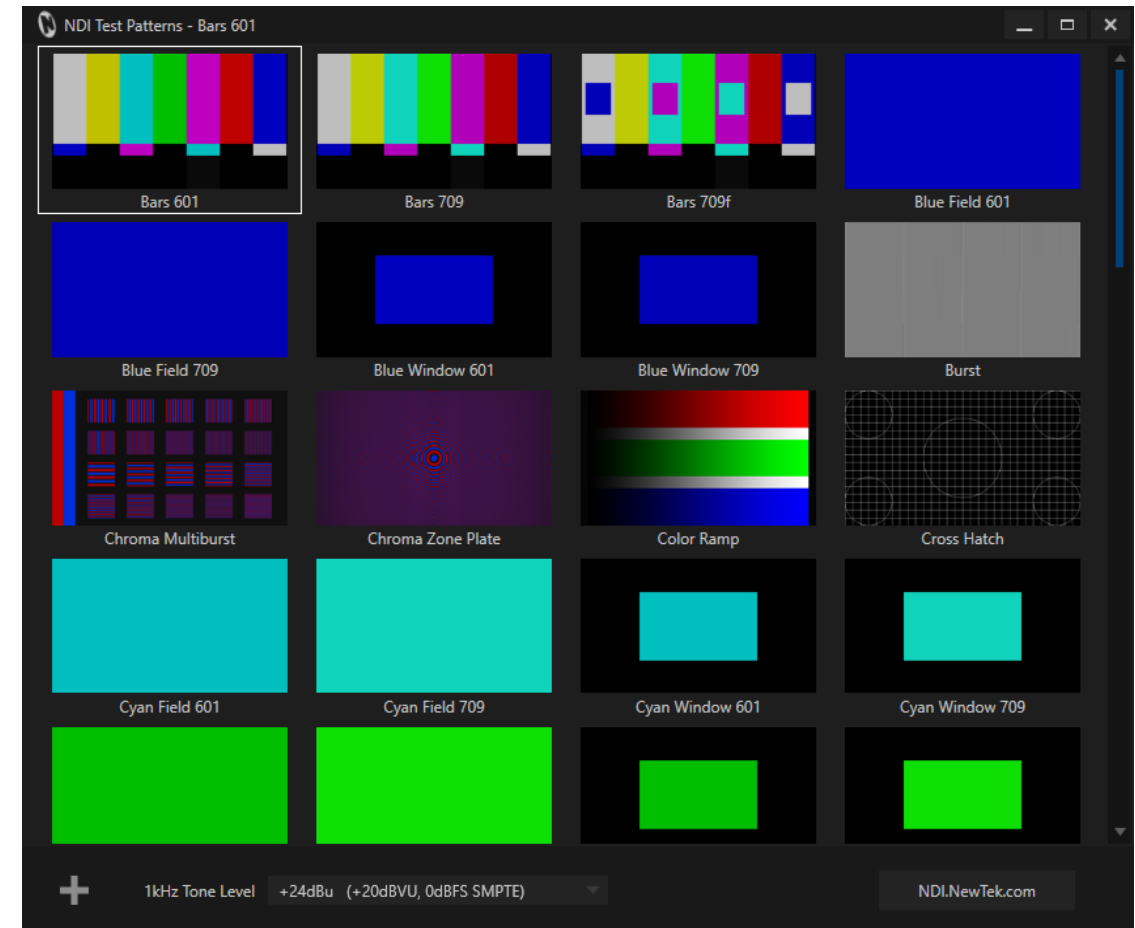


## 4 Sending Video Over NDI®

Our first exercise will generate an NDI® test pattern and 1 kHz audio signal.

- Download and install the NewTek NDI Tools from <https://www.newtek.com/ndi/>.
- Launch *NewTek > NDI Test Patterns* (Fig. 1) from the Windows® *Start menu*.

*Congratulations - you're already making NDI video and audio visible on your network!* Of course you can't see it without a suitable video monitor, though, so let's add one.



## 5 Viewing NDI®

We now have an NDI® video source – the test pattern you configured in the previous section – and since your computer almost certainly has an IP connection already, it is already visible to any other system on that network.

The next step is to open a video monitor that can see it.

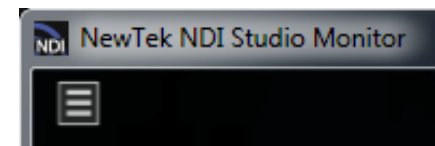
*Since we're dealing with an NDI source, client systems do not require a special, add-on hardware card with SDI or HDMI connectors.* Nor must you run any heavy cabling, or add an external video monitor to view your NDI source.)

Launch *NewTek > Studio Monitor* from the Windows® Start menu.

- Right-click and select the “*Test Pattern*” source from the menu (the first part of the source menu entry is your computer’s name on the network).

*NewTek NDI Studio Monitor* is now showing the content from the NDI channel output by the *NDI Test Patterns* generator. (Double click the image to toggle full screen display.)

*Note: This document details NDI Studio Monitor for Microsoft Windows. For OS X users, NewTek provides a similar application, called NDI Video Monitor. The feature set and interface of the latter differs somewhat from NDI Studio Monitor. In particular, it presents controls and settings in the application menu at the top of the desktop.*



Video Source & Settings Menu



Full-Screen Toggle

To satisfy yourself that this high-quality, low latency video source is really available network-wide, install *Studio Monitor* on a second networked system, too. Then display the same NDI source on that second system.

You are already broadcasting NDI video across your local Ethernet network, and each NDI-enabled application and system has real-time access to it.

In many ways your NDI-enabled network is operating like a powerful video matrix router connecting everything to everything, with NDI maintaining complete visibility, identification, bandwidth management, and so on.

Even if there are hundreds of NDI channels available, and lots of machines viewing them, they are all managed correctly, automatically.

*NDI is so efficient that a single machine can receive and send an amazing number of video and audio sources. Bandwidth consumption is limited to those sources that are actually being used.*

Compare this with the traditional production pipeline world based around capture cards, distribution amps and routers; A computer system able to support scores of SDI sources is, for all practical purposes, a pipedream – but not so with NDI. For many purposes, an existing gigabit network may supply all the bandwidth you need.

*STUDIO MONITOR HAS AN INCREDIBLE NUMBER OF OTHER FEATURES. THESE ARE FULLY DESCRIBED AFTER THIS INTRODUCTORY TOUR IN SECTION 13, UNDER THE HEADING STUDIO MONITOR IN DEPTH.*

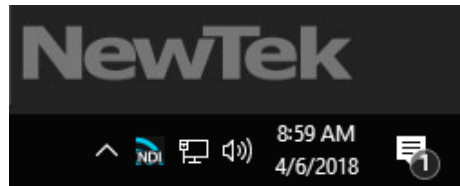




## 6 Sending Video via NDI®

While test signals are handy, let's now consider creating an NDI® source with moving video in it. To demonstrate, we'll use the Scan Converter included with NDI Tools to capture video playing in a desktop application in real time, making it visible on the network.

- Open your web browser, and navigate to your favorite streaming video site, and choose a video to play
- Alternatively, you could launch a video player (e.g., VLC from Videolan), load a video clip and start playback.
- Launch Scan Converter from the Windows® Start menu (a small NDI notification icon is added to the Windows Taskbar).

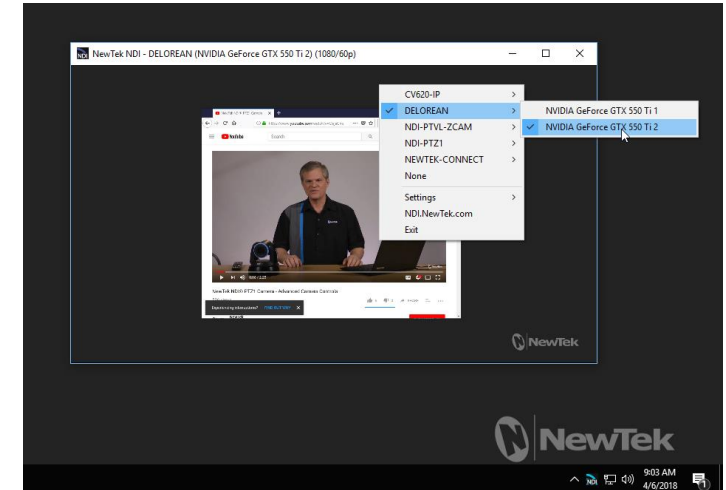


Scan Converter System Tray icon

*Believe it or not, that's all there is to it!* Your system desktop(s), including any video playing on it, is already being sent to the network as one or more high quality NDI video streams. To confirm this, use the *NDI Studio Monitor* application (installed earlier and launched in the previous section) to confirm that the Desktop and the video player window are available.

- Simply use Studio Monitors to select the correct graphics card entry from your local host system to do so.
- To finish up, try playing your video in full-screen mode!

[SCAN CONVERTER'S MANY OTHER FEATURES ARE FULLY DESCRIBED AFTER THIS INTRODUCTORY TOUR IN SECTION 13, UNDER THE HEADING SCAN CONVERTER IN DEPTH.](#)



Studio Monitor showing Windows Desktop capture

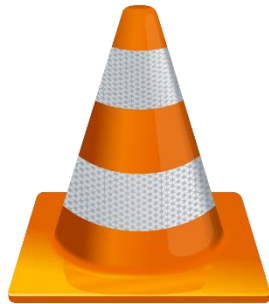




# VLC and NDI®

Do you have *VLC media player* for Windows® installed? If not, download and install the latest version from the link below:

<http://www.videolan.org/vlc/download-windows.html>

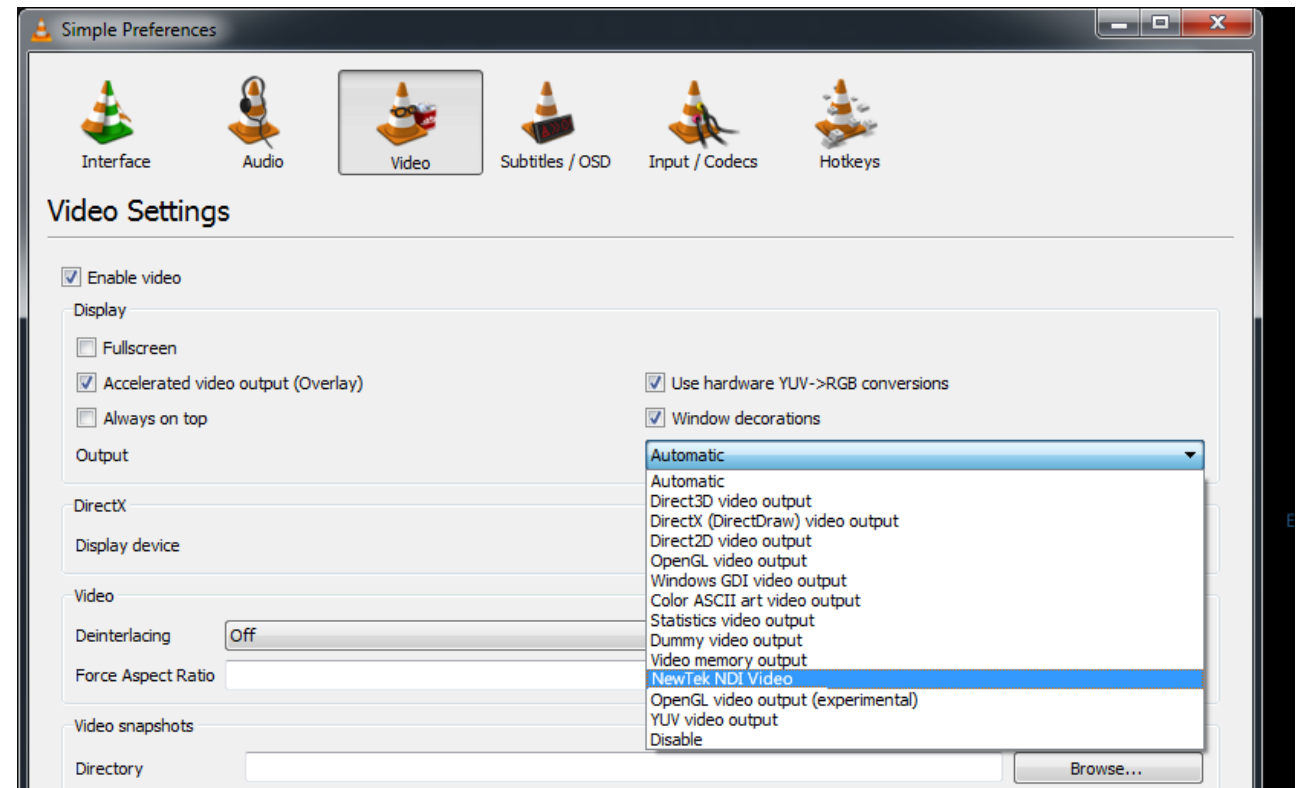


*VLC media player* is a powerful and popular open source utility, with capabilities extending well beyond what we can discuss here. Given its name, you will not be shocked to discover it is also a media player. Conveniently, too, it supports almost every known media file, is highly customizable, and can easily be controlled externally.

Let's use it to create an NDI® channel on your network. You previously installed the *NewTek NDI VLC Plugin* as part of the *NewTek NDI Tools Pack*. Let's continue from there as follows:

- Launch *VLC media player*, and use the *Tools* menu to open the *Preferences* panel.
- Click the Video icon in *Preferences*, and select *NewTek NDI Video* from the *Output* menu.

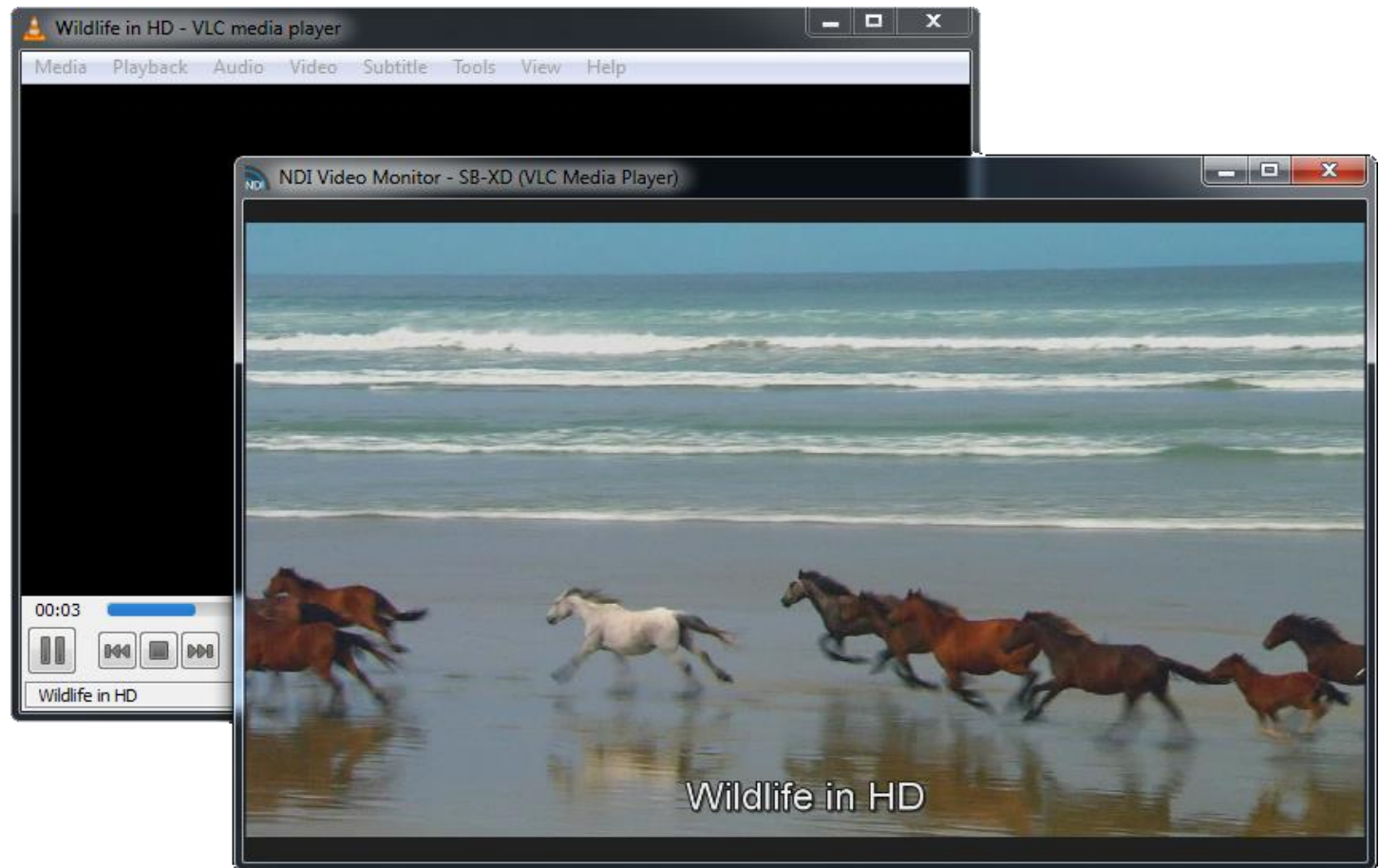
This tells *VLC media player* to direct its video output to the *NewTek NDI VLC Plugin*.



- Click the *Audio* icon at the top of *Preferences*, and repeat the steps above to select *NewTek NDI Audio as VLC media player's* audio output.
- Exit and re-start *VLC media player*.
- Choose *Open File* in the *Media* menu of *VLC media player* to select a video clip to play.
- Finally, choose your new NDI channel as the source for *NDI Studio Monitor*.

*NewTek NDI Studio Monitor* now shows the NDI output from *VLC media player*.

Audio and video played within *VLC media player* is being encoded in real-time by the NDI plugin. It is then sent to the local *NewTek NDI Studio Monitor* window, and is also supplied to your network, and any systems connected to it.



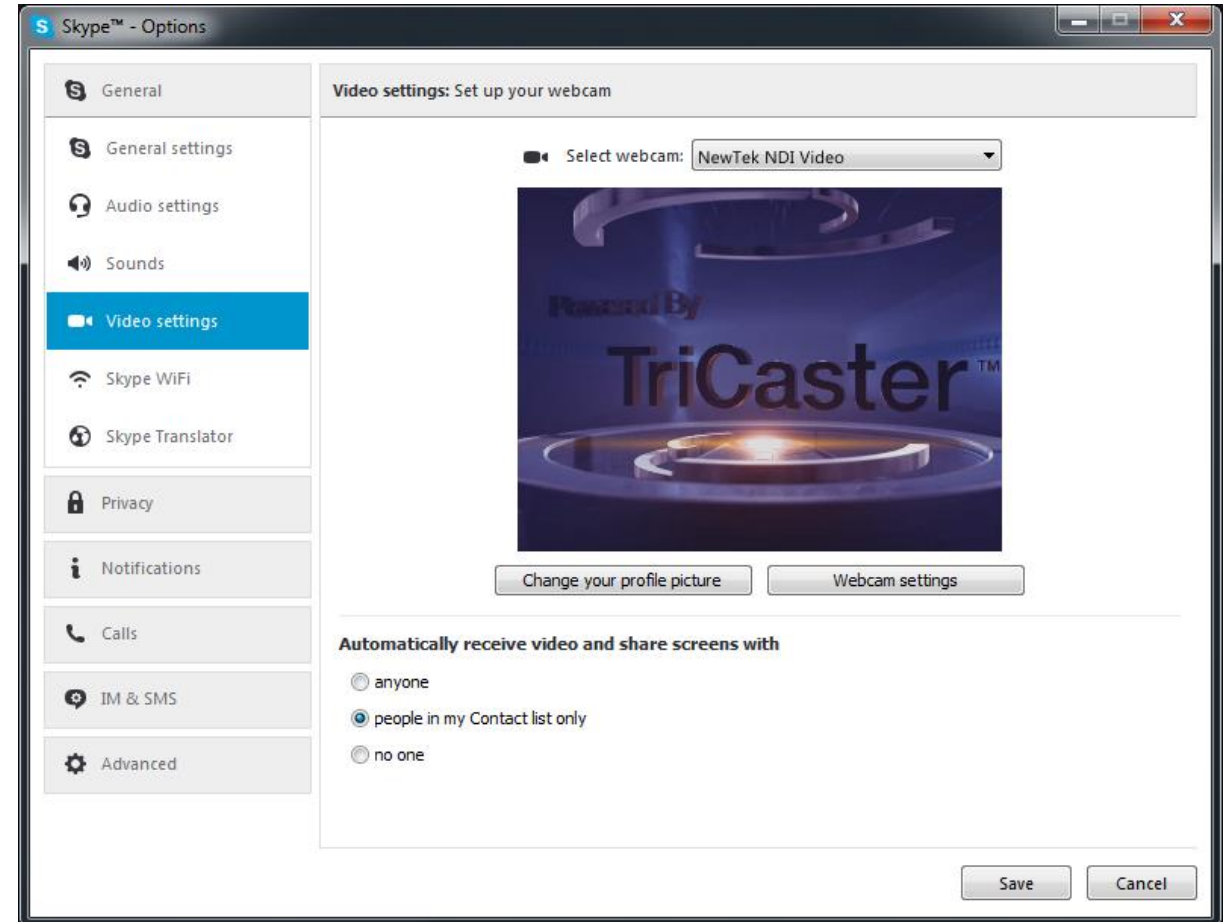
## 7 Send NDI® Video to Skype

More than 300 million people use Skype. *Wouldn't it be wonderful to supply a truly high quality video source to your Skype connections?* You could, for instance, do a company meeting using a group Skype video conference, and present pristine quality video to them.

Assuming you already have Skype installed, proceed as follows:

- Launch NDI Tool's Virtual Camera application from the Windows® Start menu.
- Right-click the NDI® icon that it adds to the Windows® *Task Tray*, and select one of the NDI sources you have previously added to your network, and which are now listed in the popup menu.
- Launch Skype, and select *Options* from its *Tools* menu.
- Click *Video settings* in the column at left. Use the *Select webcam* menu to choose *NewTek Video Source* (you can do the same thing in the *Audio settings* pane if you wish the remote Skype viewer to hear audio from the NDI source).

Skype is now ready to send your high quality NDI source out to contacts in the usual manner. (Naturally, the watermark visible in the *NewTek NDI Transmit Trial Version* is absent in the full version of this tool).



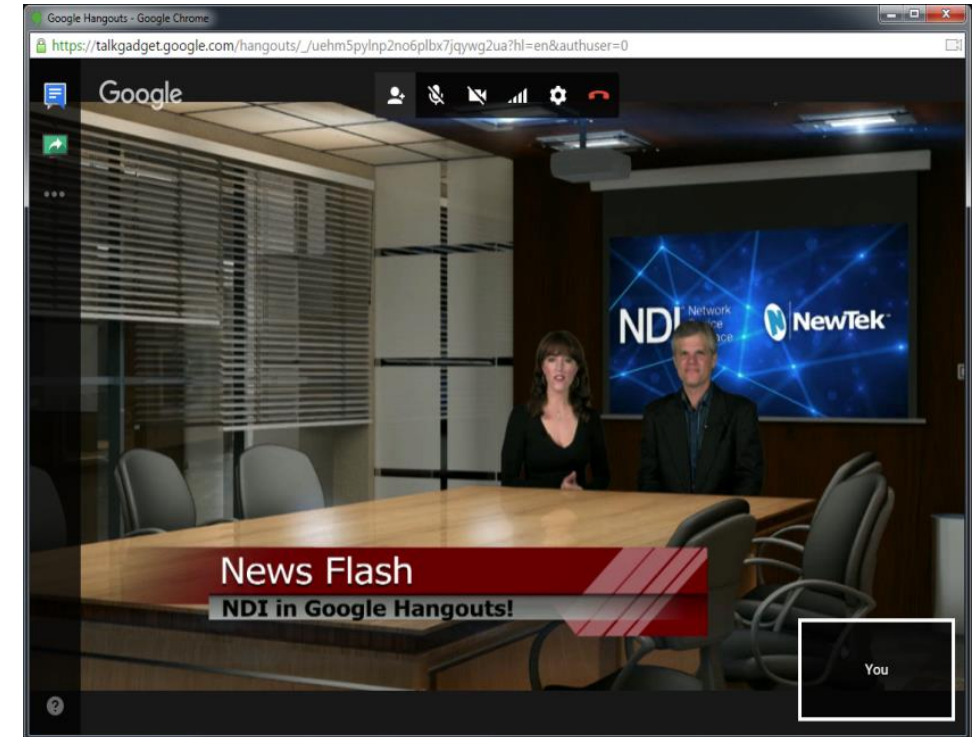
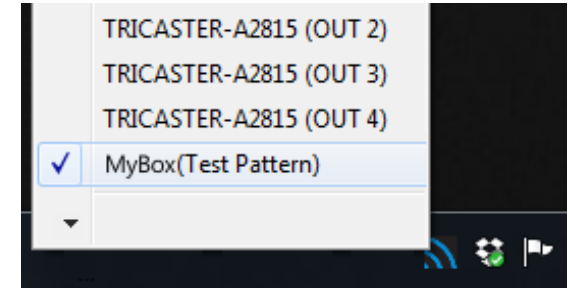
# Send NDI® Video to Hangouts, YouTube, and More ...

Likewise, the output from Virtual Camera can be sent detected and by such applications as Google+ Hangouts (and Hangouts On Air), YouTube Live, Adobe Flash Media Live Encoder, VLC media player, and many others.

- Configure a suitable NDI® source in the *Virtual Camera* menu.
- Select the output from *Virtual Camera* in your desired application, in the same manner as you might previously have selected a webcam.

The gorgeous video quality NDI supplies to your viewers will make you and your message look great\*.

\* Note that, by default, Hangouts shows your video source as a mirror image on your local display (only).



## 8 NDI® for Adobe® Creative Cloud

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In almost all production environments, each graphic, animation, and video is reviewed many, many times. Even when graphics applications support realtime playback, it is usually necessary to render the project to a media file that can be provided to various stakeholders for review each time.

With NDI® for Adobe Creative Cloud, simply playing a project in a supported Adobe application lets anyone on the network can view it on their local monitor in realtime (using NDI Monitor).

While you'll not likely escape rendering entirely, NDI for Adobe CC can really accelerate the creative process.

### Live To Air/Drive/The World

Let's consider a few more examples:

- Sending After Effects® output live-to-air, directly injecting it into your broadcast pipeline.
- View SpeedGrade® output on a centralized calibrated monitor, and send it to air at the same time.
- Use NDI® IsoCorder™ to capture output from CC applications to file anywhere your network runs.
- Use NewTek NDI Transmit™ (see [ndi.NewTek.com](http://ndi.NewTek.com)) with this plugin to use almost any application accepting webcam input (Skype™, Google+ Hangouts Live™, etc.) to collaborate across the globe.

These are just a few of the ways you can combine the large and growing number of free and commercial NDI tools to enhance your workflow, and show off your creativity.

# Installation and Configuration

This section covers the steps required to install the software and configure the Adobe® applications.

## System Requirements

Minimum system requirements:

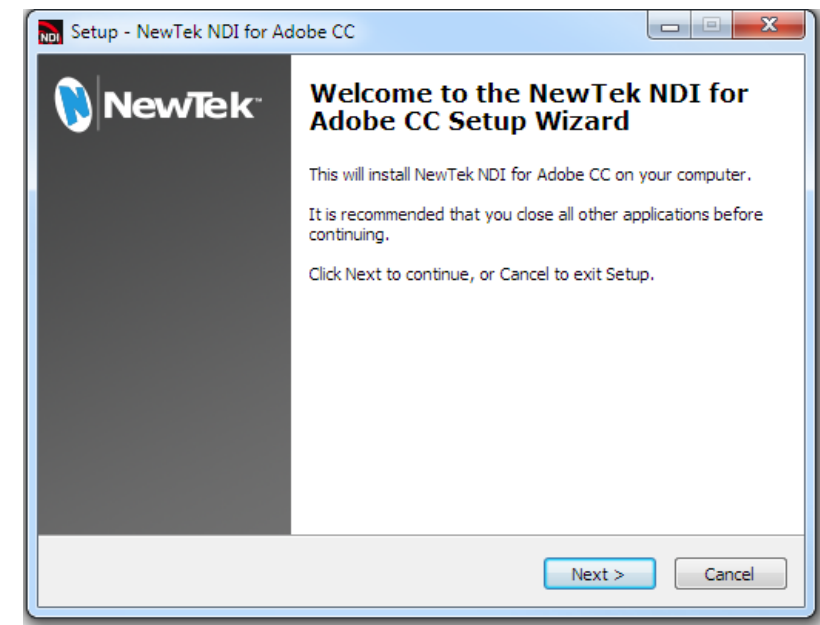
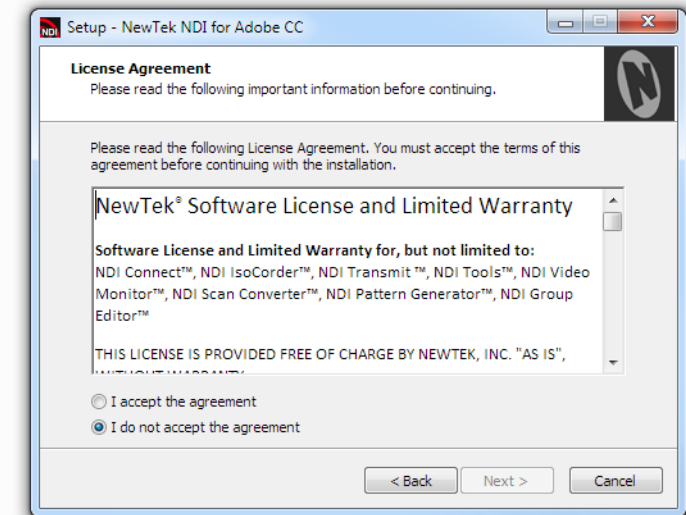
- 32-bit or 64-bit Microsoft® Windows Vista® operating system or better
- Minimum Intel i3 Sandy Bridge CPU (2008 or later), better strongly encouraged.
- Gigabit LAN connection for signal transmission over IP via NDI® Technology

## Installing the NDI Software

1. Begin by double clicking the Installation file to begin the set up process. The first page you will see is the *Welcome* page – click “Next” at the bottom.
2. The *License Agreement* is shown after the *Welcome* page. Please read this, select a switch in the footer to indicate whether you accept the agreement, and click *Next*.
3. The next few pages establish where the software will be installed and Start Menu shortcuts will appear. As the defaults should be just fine, click *Next* on these two pages.
4. The *Select Components* page allow you to customize your installation. When you are ready click *Next*.
5. You will see a menu verifying where and what files will be installed. Click *Next*, and a confirmation page will soon pop up to indicate a successful installation.

## Configuring Applications

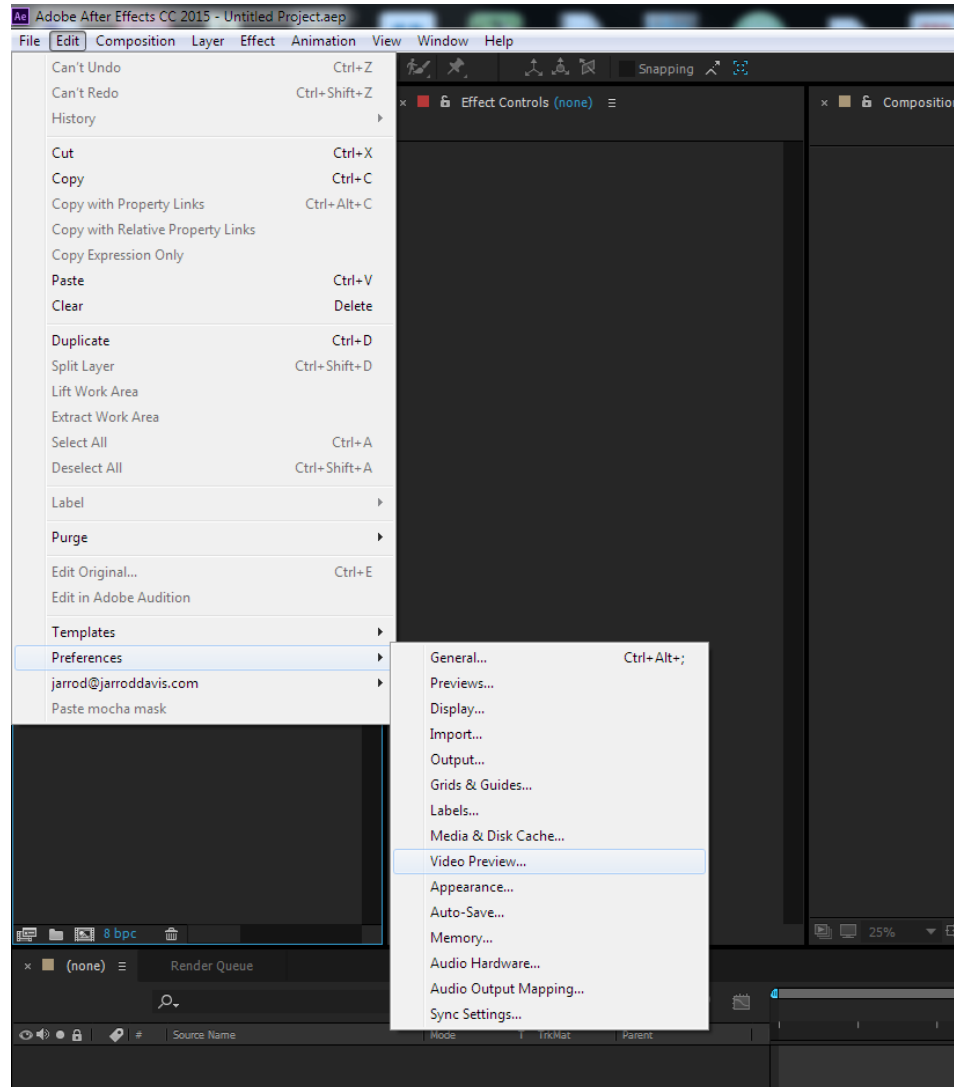
After installation, you must activate NDI output in your various Adobe® Creative Cloud® applications before you can start using it.



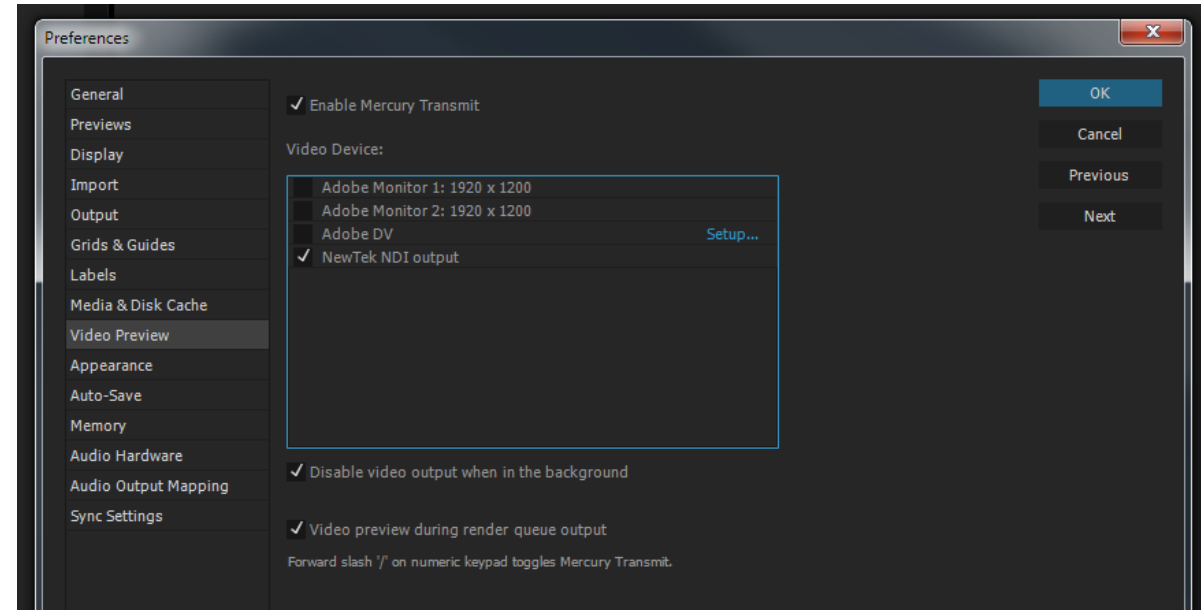


## Adobe After Effects CC

1. To activate NDI output for Adobe After Effects® CC, go to Preferences>Video Preview in the Edit menu.



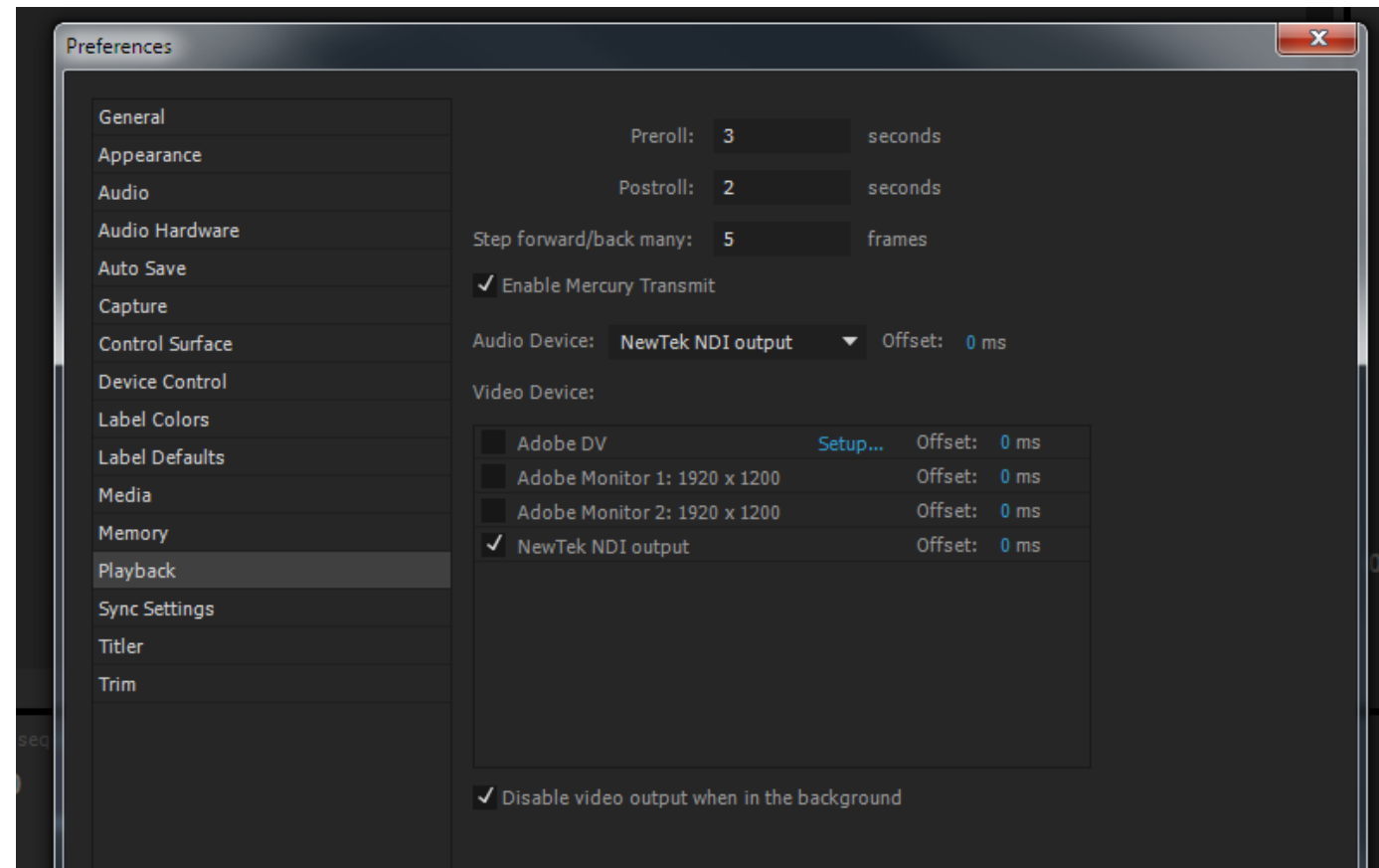
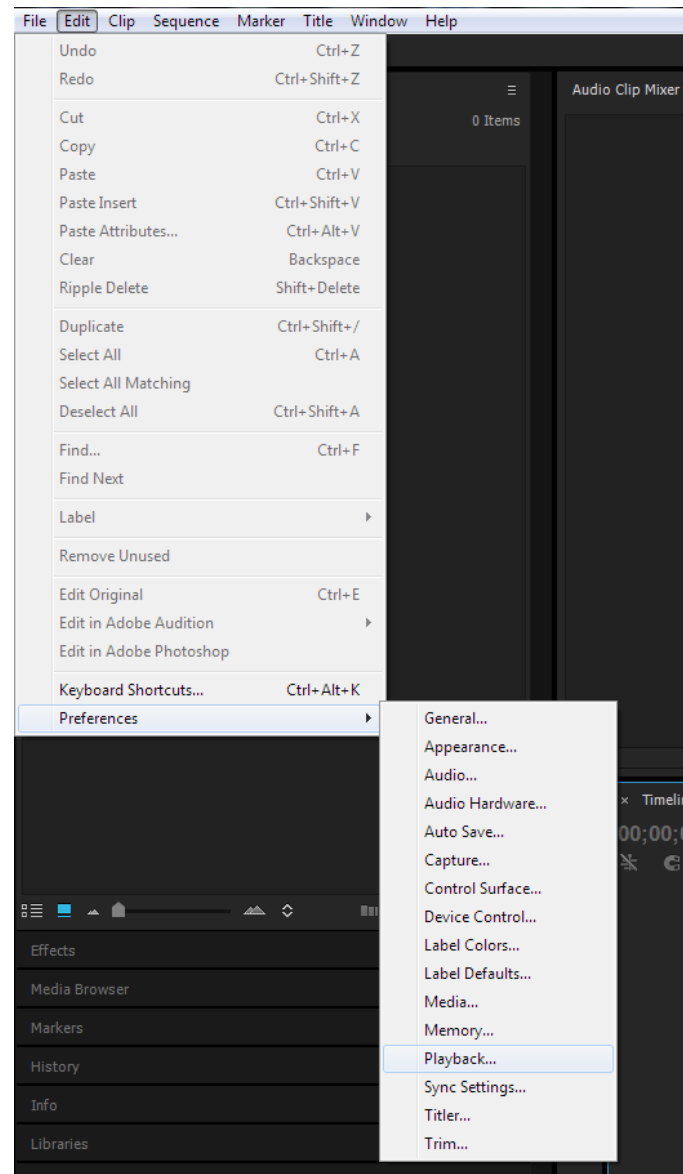
2. To activate NDI output for Adobe After Effects® CC, use the Edit menu to go to Preferences>Video Preview.





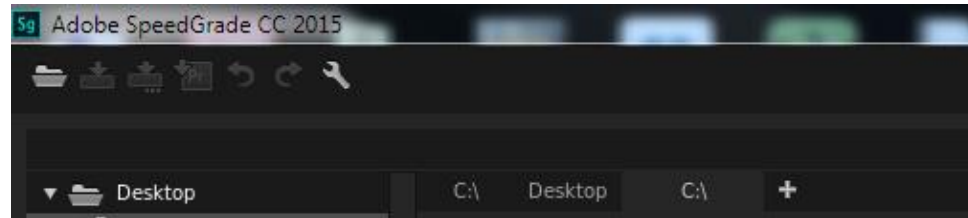
## Adobe Premiere Pro CC

1. In Adobe Premiere Pro® CC, go to Edit>Preferences>Playback.
2. This will open the Preferences panel. There you will find NewTek NDI output as an option under Video Device.

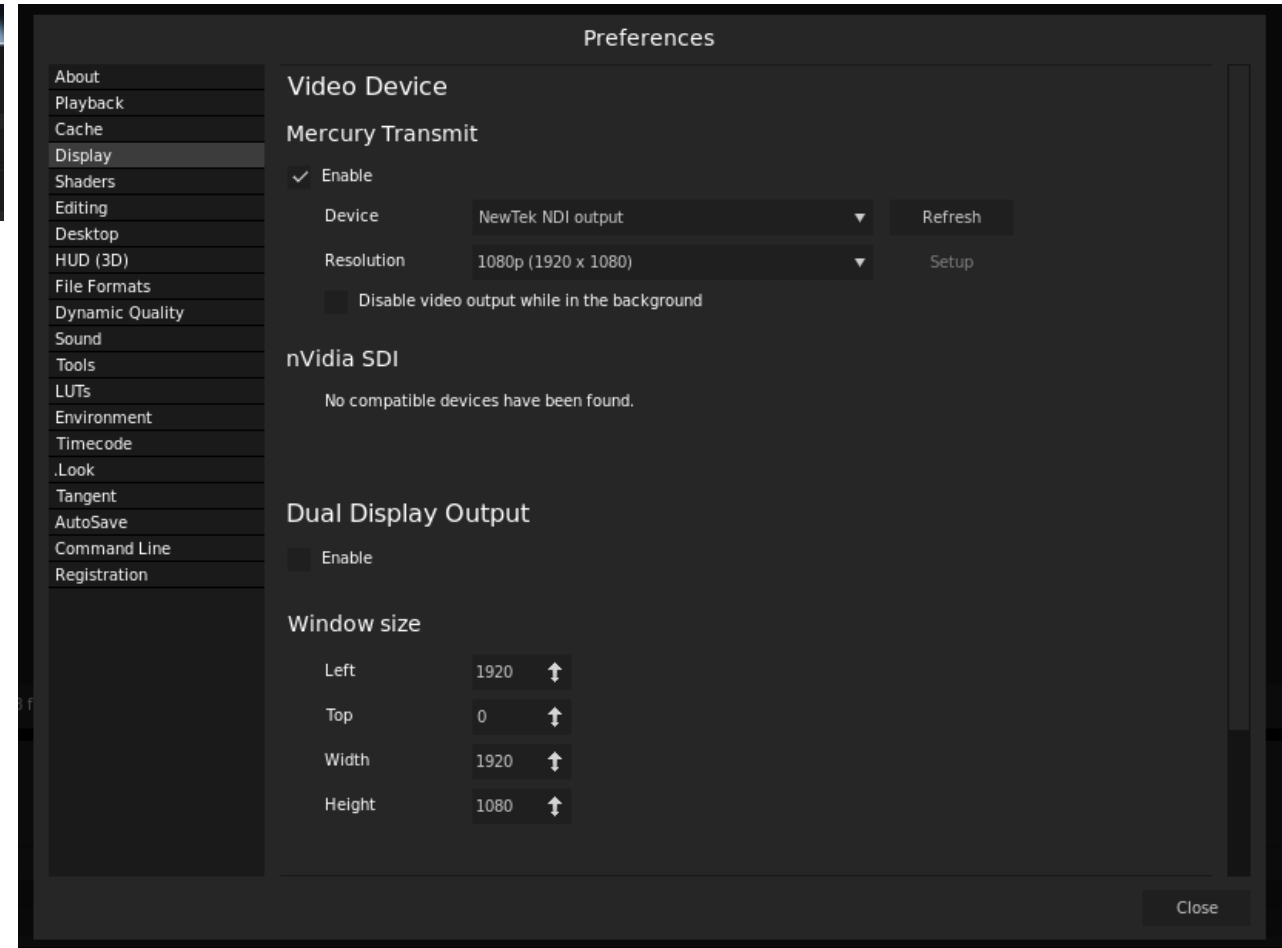


## Adobe Speedgrade CC

1. In Adobe SpeedGrade® CC, click the 'wrench' icon in the titlebar to access the Preferences panel.



2. This will open the Preferences panel. There you will find NewTek NDI output as an option under Video Device.



3. Use the Device menu in the *Mercury Transmit* control group at right to select *NewTek NDI Output*, and close the *Preferences* panel to continue.

## 9 Control Access to NDI® Channels

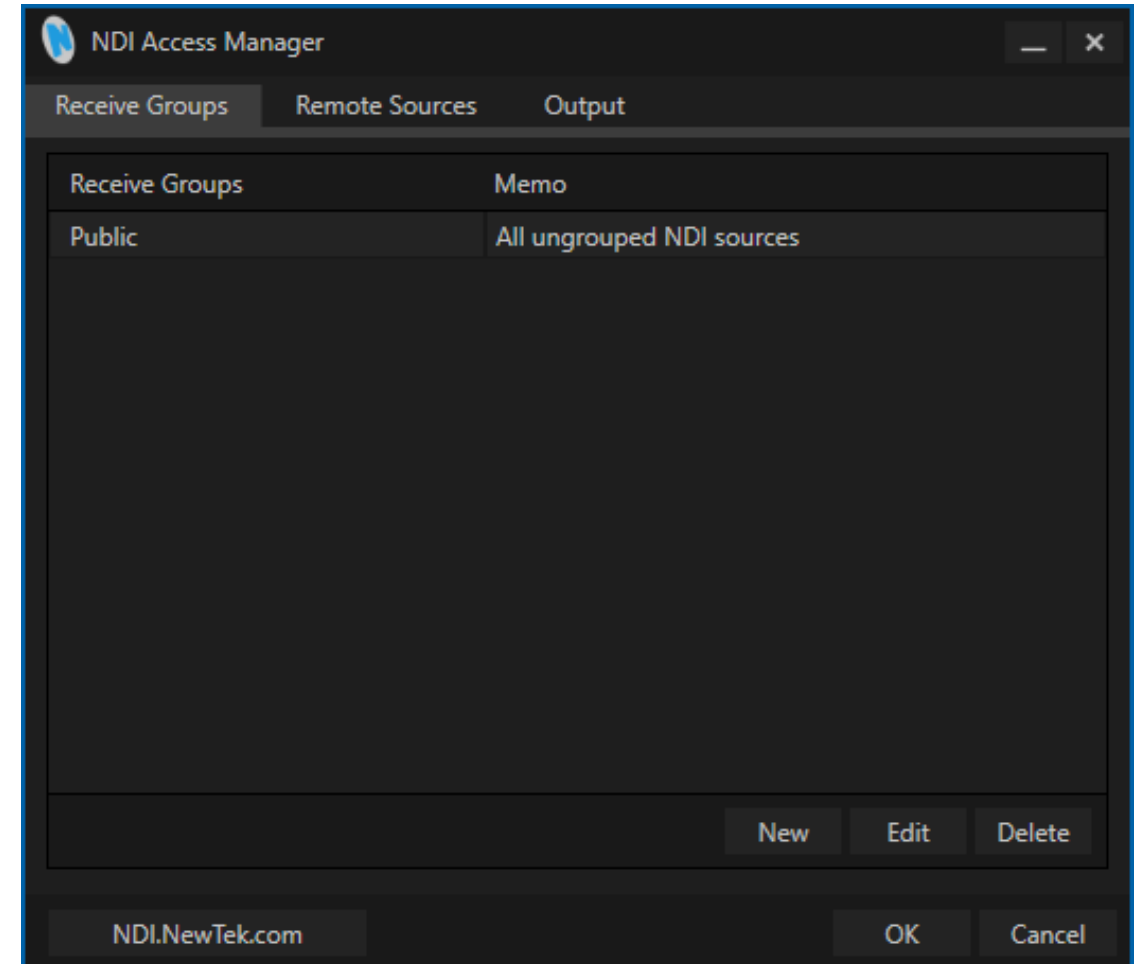
As you come to appreciate the power of NDI®, you'll doubtless want more and more of such convenient video sources. You could easily wind up having hundreds of video sources available (clearly, this was impossible before NDI).

Often, though, you will want to limit visibility of NDI channels to specific systems. Or may need access to NDI channels from another subnet. The *NDI Access Manager* lets you assign sources to groups, and choose which of these various systems receive. You can also access NDI sources from other subnets.

At times, though, you may want to limit visibility of NDI channels on your local network to selected viewers. Or you may need access to NDI channels from another subnet.

The NDI Access Manager lets you assign sources on individual host systems to groups, and choose which of these group that you receive. You can also access NDI sources from other subnets or even other networks.

*Note: This document details NDI Access Manager for Microsoft Windows, but NewTek provides a similar application for OS X users. The interface and functionality of the latter differs only slightly from the Windows version as illustrated in this discussion.*



## Receive and Output Groups

The *Receive Groups* tab lists all NDI groups from remote systems visible to the local host. By default, all NDI sources contribute to the “Public” group, visible to all NDI clients on the same subnet whose host systems include a matching “Public” entry in their own *Output* tab.

Conversely, custom groups in the *Output* tab let others with matching entries in their *Receive* group access your NDI output. If you remove “Public” from your *Output* groups, only systems listing your custom groups will see your NDI output. Similarly, from your Receive entries groups tells your local system to ignore channels that aren’t supplied by a *Receive* groups. To add a custom group to either the *Receive* or *Output* tab, click the *New* button in the footer of the panel.

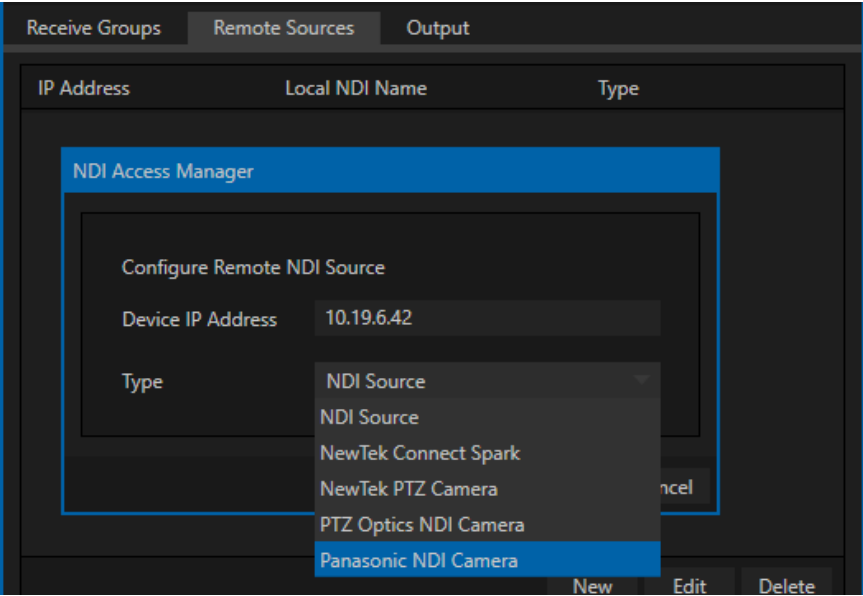
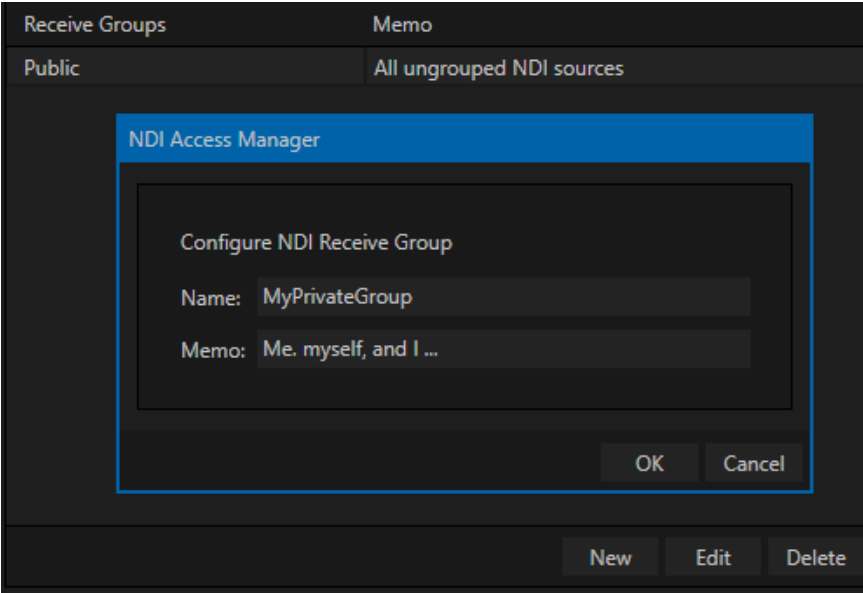
## Remote Sources

The *Remote Sources* tab is similar to *Receive*, in that its entries add sources to the list of those visible to NDI enabled applications on the local host.

The difference is that that entries in the *Remote Sources* list do not identify NDI groups, but rather individual remote NDI and NDI|HX sources (including Panasonic cameras supporting NDI|HX). Remote sources are identified in this panel by their IP address, rather than their NDI device or channel name.

Note that sources listed in this panel can traverse subnets on the local network, and even connect across different networks when specific criteria are met. This may require your IT team to open specific ports for this traffic.

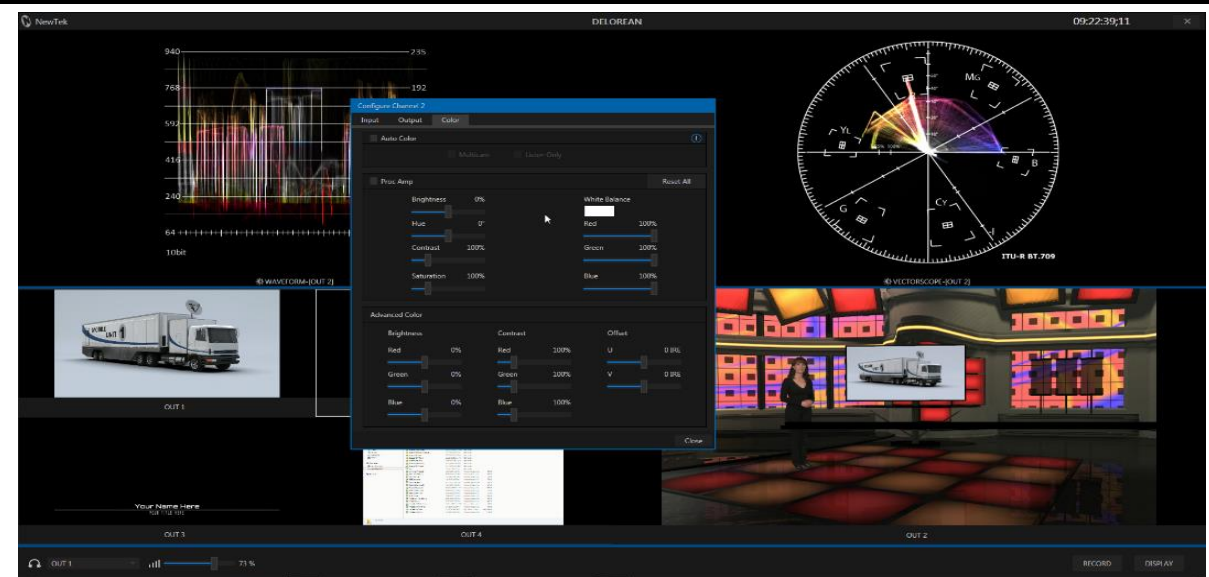
Since an IP Address can serve multiple NDI channels (e.g., *NDI Scan Converter* can supply 1 channel or many more), the channel count matters. When crossing network boundaries, you must ensure that – starting from port 5960 – enough network ports are available for the maximum supplied NDI sources *plus one*, for NDI server messaging. For example, adding an IP Address for a system supplying one NDI channel to the *Receive from IP* list means ports 5960 and 5961 must be available. A source serving eight NDI channels would need ports 5960 – 5968 to be free, etc.



# 10 Connect to Hardware

We've used computer sources to this point, but input from cameras and similar source is obviously important too. You may want to send NDI® video across the network to devices and displays connected to video output cards at the far end of the building. Or you may need video from a camera for use both inside and outside your control room. Thankfully, NDI provides full connectivity to and from traditional production devices.

Perhaps you already rely on hardware audio-video I/O cards, such as the fine products from Bluefish444, TeraDek, AJA Video systems, Blackmagic Design, or DELTACAST, using these for capture or display of audio and video. Imagine how useful it would be if sources you connect to those cards were immediately available as NDI channels for use anywhere on your network, or conversely, if NDI sources could be sent to the card's video outputs.



You could then connect a high quality camera to the input the card and (with the help of *NewTek NDI Transmit*) stream to YouTube Live or Google+ Hangouts, etc. Alternatively, you might display remote NDI sources on local monitors connected to a card's outputs located anywhere in your studio, office building or campus that the network runs. The free *NewTek NDI Connect* software does all of this and more, and is available at <https://www.newtek.com/ndi/>. Here's a partial feature list for NewTek NDI Connect Pro Version:

- 4 NDI output channels; accepts NDI channels as sources, but also supports Bluefish444, Blackmagic, DELTACAST, AJA, Matrox, Teradek devices and others, along with webcams and custom sound cards for professional connectivity (including XLR).
- Separate Key/Fill Input and Output (convert key and fill supplied to a card to a single 32bit NDI channel on your network, and vice versa).
- Supports 8-channel audio I/O, with per-channel level control
- Supplementary NDI Viewer (e.g., for program return), and versatile display configurations, including dual monitor workspaces
- Media file playback (with *Autoplay* for systems supporting NDI tally)
- Integrated Waveform/Vectorscope and Color Correction, including White Balance and Auto-color
- Overlays (VUs, Title Safe, 4:3, Checkerboard, Center Cross)

# 11 Capture NDI® Sources

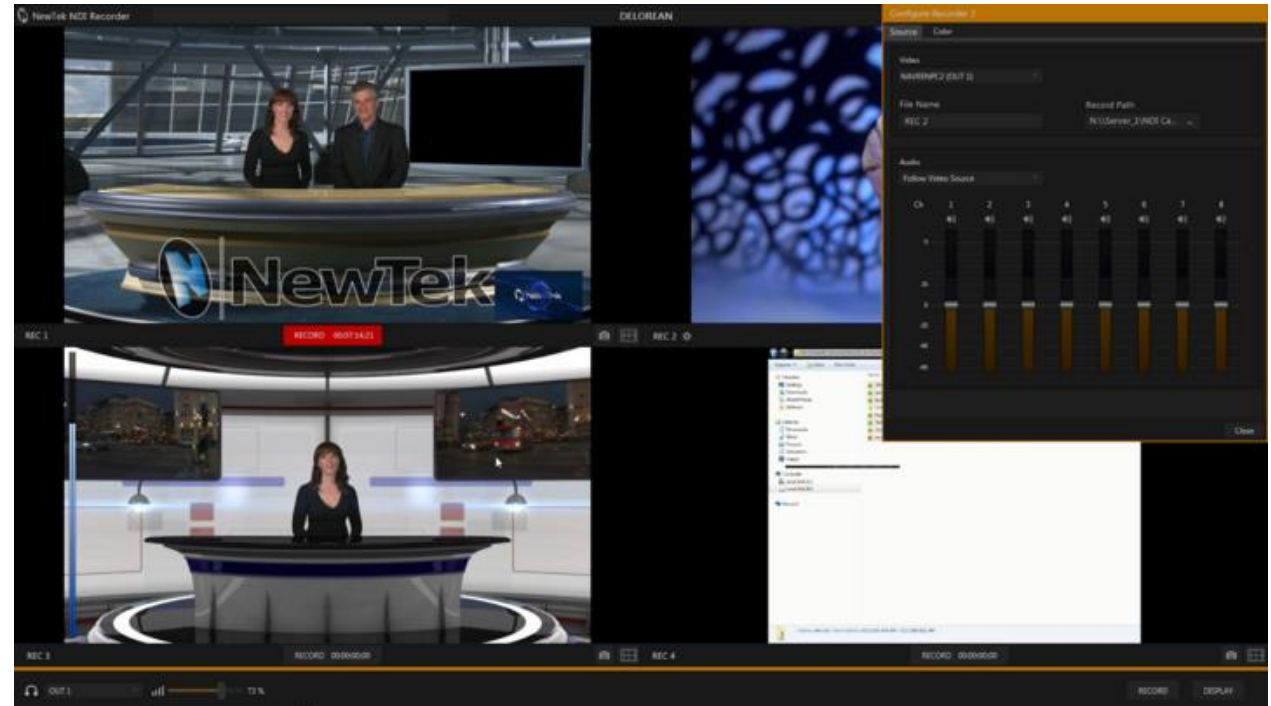
Obviously you will often want to capture video sources to media files. The previous generation of video production methods, although digital, required specialized cabling and systems for video transmission; in turn this meant that specialized devices were needed to record it.

In the IP realm, that is no longer the case. Your local Ethernet infrastructure carries a plethora of video feeds, and these can also be recorded to drive at any convenient location served by the network.

The ability to record *any* media to storage *anywhere* is part of the IP-based revolution. And it will soon be the case that a show—and all of the media that was used to produce—it are available for use in a conveniently stored format.

Studio Monitor provides some recording capabilities, but for more complex requirements, NewTek NDI IsoCorder™ and IsoCorder Pro provides more powerful functionality and features (the latter allows a huge number of channels to be monitored and recorded all at once).

Capture from different sources can be started and stopped independently or simultaneously, and files are encoded to a broadcast quality Quicktime format compatible with all common production software.



## 12 The NDI® SDK

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As the foundation technology of the NewTek Advanced IP Workflow, NDI® employs refined encoding and communication protocols to efficiently package and send information over a standard LAN.

NewTek's NDI Software Development Kit (SDK) supplies all of the information, tools and examples needed to build applications and products with native NDI support. Both inputs and outputs of devices and applications (including switchers, graphics engines, laptops, etc.) you prepare using this SDK can serve as video sources exposed to other NDI-enabled devices on a shared network. Interested parties are encouraged to visit <https://www.newtek.com/ndi/> for further details.

The specific goal of the NDI SDK is to make it as quick and easy for you to create software and hardware applications that allow you to create and use video over IP as is physically possible. Indeed, if you have the ability to render video frames, we believe that NDI sending functionality can be added in less than 10 lines of code.



# 13 Advanced Topics

## Studio Monitor in Depth

As we learned in 5 (Viewing NDI®), *Studio Monitor* allows you to view NDI® sources from anywhere on your network. However, it does much, much more too!

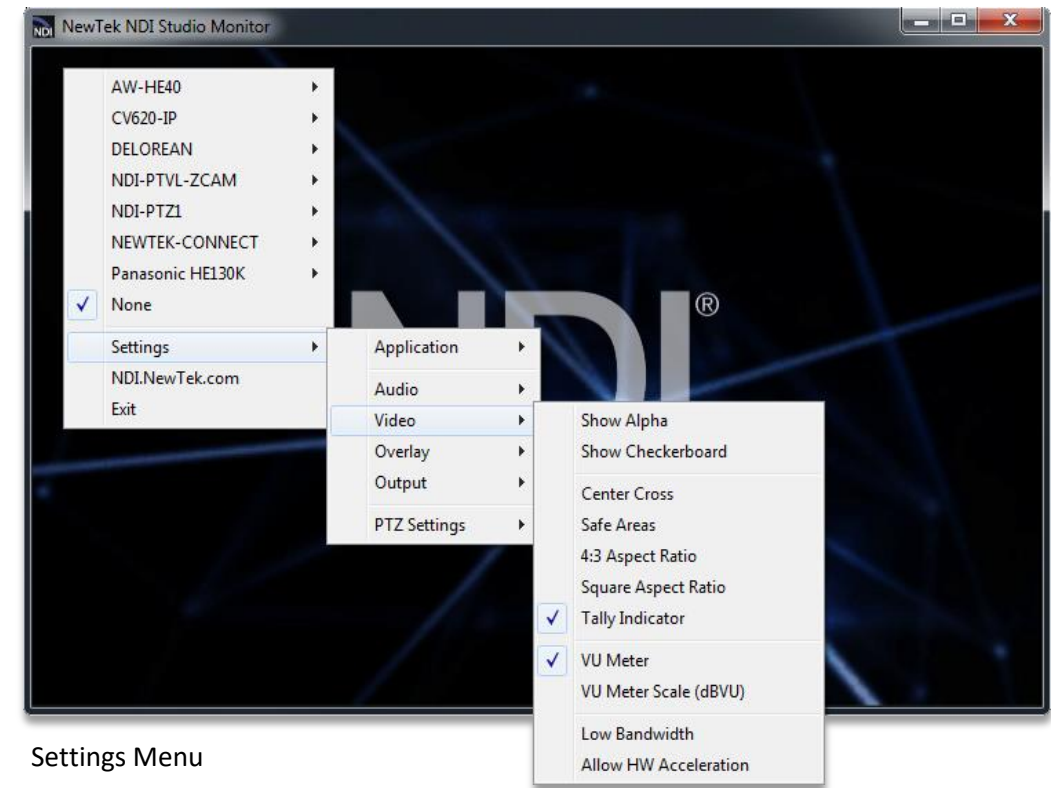
*Nearly endless features are provided by the Studio Monitor's Settings menu* (opened by clicking the 'hamburger' icon shown at upper-left on rolling the mouse over the video window, or by right-clicking anywhere on the window). These, and a few other features supported in the interface are detailed below.

### Main Video Features

- Display NDI or NDI|HX sources (requires NDI|HX driver)
- Display NDI video sources in custom windows, full-screen, on selected monitors, or even across multiple screens.
- Open multiple instances of Studio Monitor to display an array of video sources, creating custom multiview displays or even video walls with a few clicks.
- Auto-run Studio Monitor to show complex setups on bootup without any user intervention.
- Optionally show a checkerboard pattern behind video sources with an embedded alpha (transparency) channel.
- Toggle full color or alpha matte output for video sources with an embedded alpha (transparency) channel.
- Enable tally to display red/green notification when a source is being utilized on systems supporting NDI tally signaling.
- Optionally show various safe area and alignment guides.
- Use Hardware video acceleration when available to minimize CPU processing demands.

### Audio Features

- Mute or transmit audio output, and adjust it to respect regional audio standards such as EBU or SMPTE audio levels.



Settings Menu

- Optionally overlay VU meters (with or without a scale) on your Studio Monitor's video output.
- Send output to system playback devices, including third-party hardware outputs and virtual soundcards (such as Audinate's Dante Virtual Soundcard).

## Overlay Features

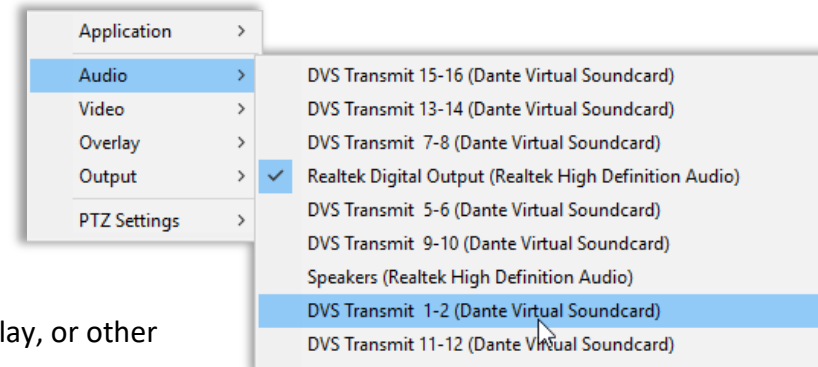
- *Add a secondary NDI video source – whether a static title or graphic, or full motion video – over your NDI video source.*
  - Use Scan Converter to supply both your webcam and a Power Point presentation, game display, or other desktop source, and compose it as a Picture in Picture element.
  - Or add a full-frame overlay with embedded transparency in front of your primary video source.

You might use a simple logo graphic loaded into the NDI Test Pattern application as a 'bug', animated graphics from one of the many professional CG applications supporting NDI output or Adobe® After Effects (using the Adobe CC NDI driver), or even chromakeyed video played from NewTek Connect Pro™.

## Output and Multiviewers

- Display Studio Monitor in its own application window, or full-screen.
- Optionally display Studio Monitor in front of all other desktop applications
- Hide the window borders and arrange multiple instances of Studio Monitor to create multiviews and custom video-wall arrangements.

*Hint: Shift Double-click the monitor to automatically fit it to a screen quadrant.*



- Assign multiple Studio Monitors to auto-run at system startup in the Settings>Application menu, respecting each one's individual source settings and other configuration options.

## PTZ Control (and Virtual PTZ)

- *Take direct control of NDI-enabled PTZ cameras from NewTek and other manufacturers right from Studio Monitor.*
- Pop-up PTZ controls let you adjust Zoom, Pan, Tilt, Focus and Iris settings manually, or store and recall presets with the mouse.
- Or punch keyboard number keys to recall PTZ presets (hold down ALT while doing so to store a preset).

*Actually, you don't really even need a PTZ camera to use these features!* Studio Monitor supports virtual PTZ operations for NDI output from NewTek's Connect Spark series NDI converters and the free media player VLC from Videolan.

## Hardware Joystick Support



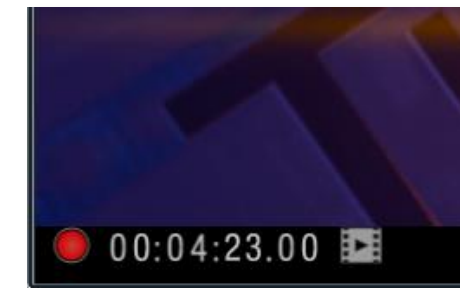
Assign a Windows hardware joystick connected to the Studio Monitor host to control a PTZ camera (or the virtual PTZ feature supported by selected NDI|HX sources). Pan and tilt using the left thumbstick, zoom and focus with the right, and toggle autofocus mode using the controller's buttons.



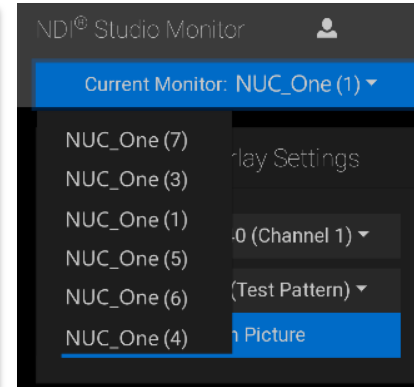
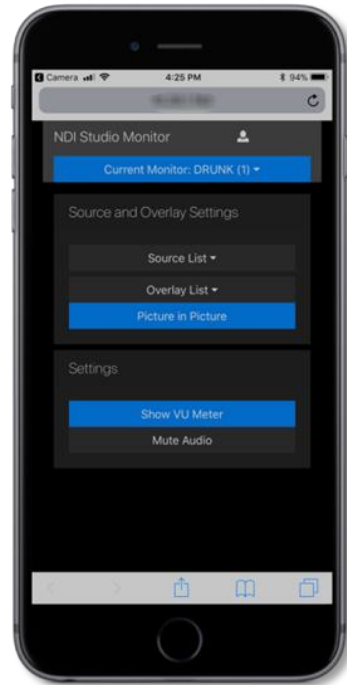
## Recording

- Studio Monitor displays a red record icon in the lower left corner for NDI sources (like NewTek's TriCaster or NC1 Studio I/O Module) supporting remote capture control. Click this to enable or disable capture by the source device.
- *NDI|HX sources support local capture right on the Studio Monitor host* in similar fashion.
- A timecode display runs during recording, and the nearby filmstrip icon provides quick access to captured files.

*Note: This document details NDI Studio Monitor for Microsoft Windows. For OS X users, NewTek provides a similar application, called NDI Video Monitor. The feature set and interface of the latter differs somewhat from NDI Studio Monitor. In particular, it presents controls and settings in the application menu at the top of the desktop.*



## Web Interface



- *Scan the QR code on a mobile device to open Studio Monitor's web app.*
- Select any Studio Monitor instance from among all those discovered on any system on your network.
- Take advantage of optional password protection to prevent tampering.
- Update the source, audio and overlay settings of every Studio Monitor display remotely – perfect for signage or remote display applications!

## NDI Source Device Web Access

If the selected NDI video source supports web configuration (e.g. NDI Connect™ Spark or your NDI-enabled PTZ camera), a configuration button (gear) is shown at lower right when the mouse is over Studio Monitor. Clicking this gadget opens a web browser to the corresponding configuration page, allowing you to modify source settings without any need to identifying its IP address.



## Scan Converter in Depth

Scan conversion is virtually a necessity in today's video production, e-sports, and presentation environments. Hardware solutions run from a few hundred dollars per video stream to several thousand dollars for professional systems.

Connecting a hardware scan converter typically requires one or more unused computer graphics card ports, and cumbersome connections comprising VGA or HDMI video cabling on one end, and the hassles of HDMI or expense and bulk of SDI on the other.

In this light, the inclusion of our powerful Scan Converter in the free NewTek NDI Tools bundle can save you thousands of dollars in both gear and setup time.

Even better, Scan Converter provides features that exceed what 'mere' hardware adapters typically provide, as discussed next

### High Quality Desktop Capture

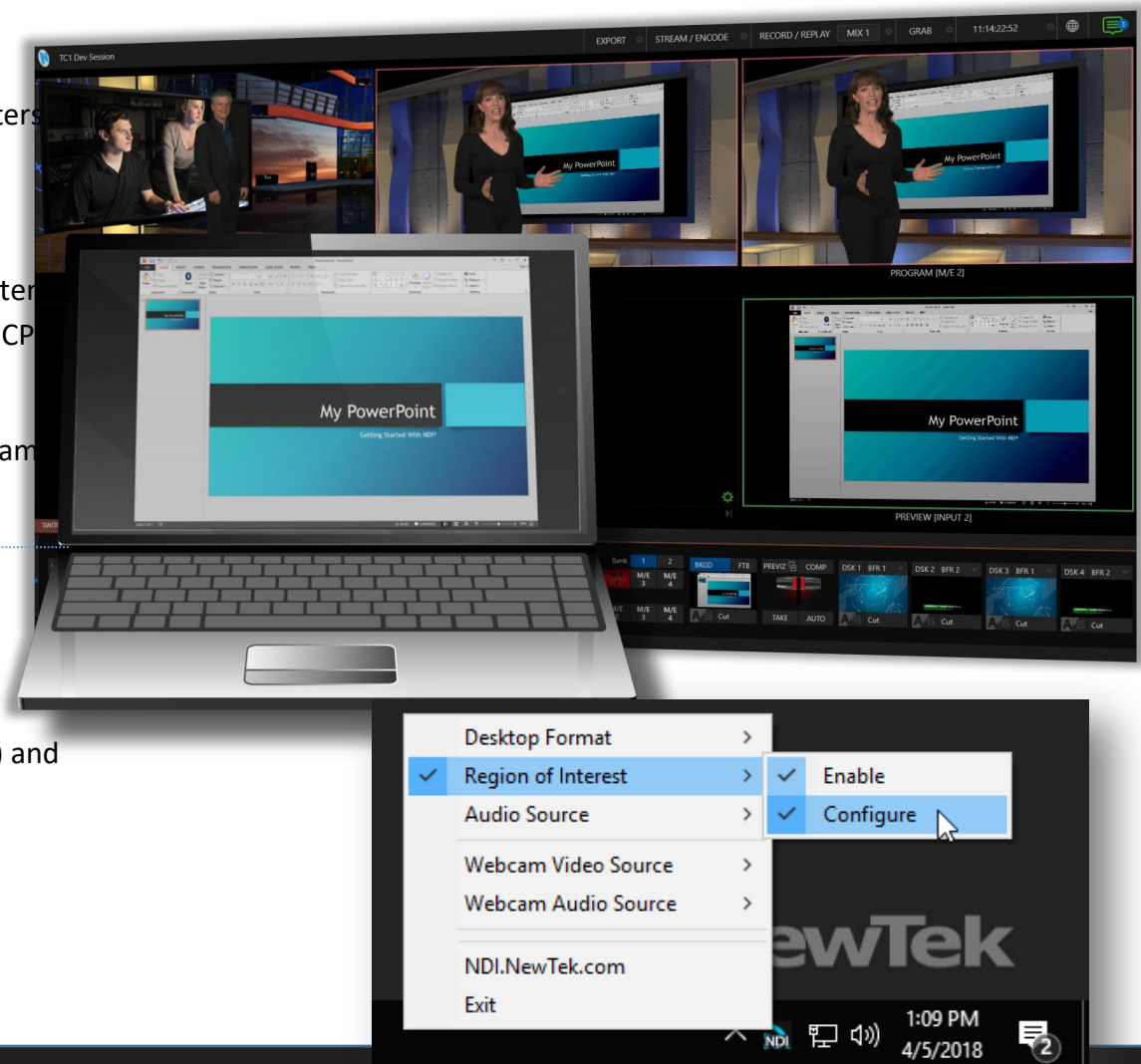
Supply 'desktop quality' video output to your downstream, NDI-enabled production system and software at frame rates up to 60Hz with virtually no visible latency, and almost not CPU processing burden.

Simply launch Scan Converter, and it will immediately begin to supply an NDI video stream to your network for each monitor output your graphics card provides.

#### DESKTOP AUDIO OPTIONS

Choose which audio source accompanies your screen capture, including system audio, connected headsets, and the like. You can even take advantage of virtual sound cards, such as Audinate's Dante Virtual Soundcard, or AES67 solutions. Now you can play a computer game or Power Point presentation with audio (with no impact on frame-rate) and supply it as an NDI source.

### Region of Interest

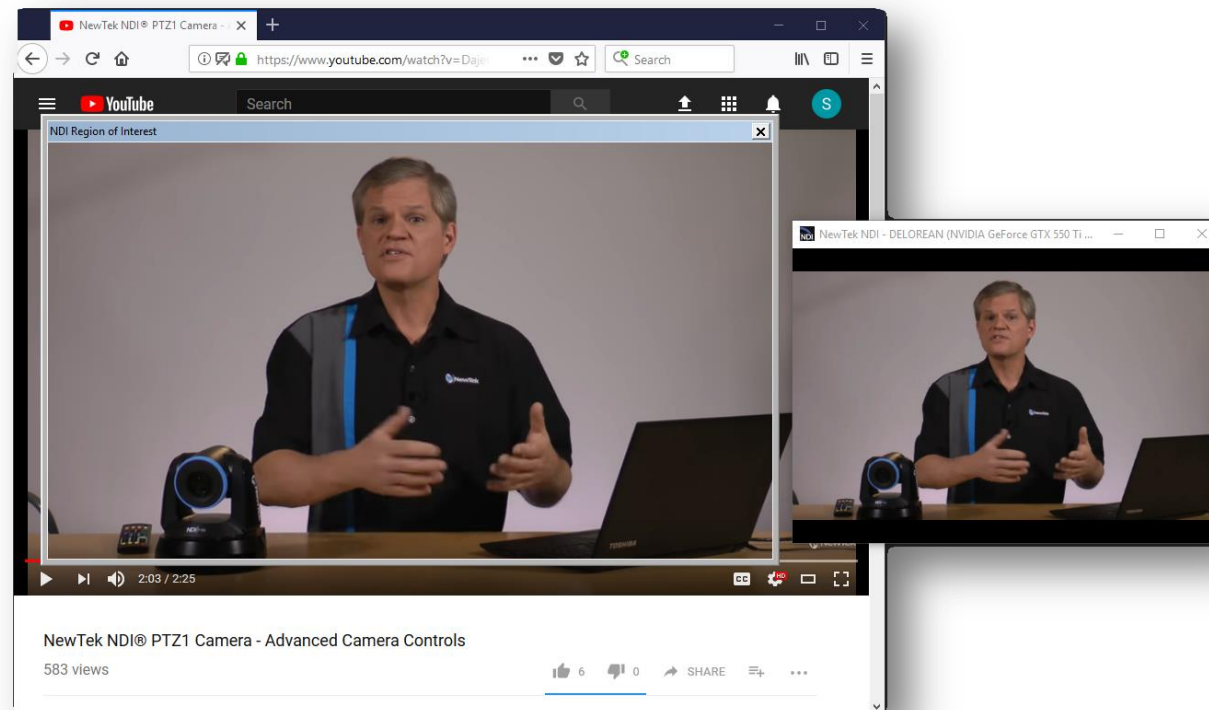


Choose Region of Interest > Configure from the Scan Converter settings menu to pop up the Region of Interest frame. Adjust its window borders to taste, and the video desktop content within this frame is transmitted to the associated NDI output.

You can use Region of Interest to isolate and send high quality, high frame rate video from computer game windows, websites and video streaming servers and applications, or desktop software to your NDI-enabled video systems and software.

Or use the Virtual Camera application included in NDI Tools to send a selected part of your screen to video over IP services.

For example, show PowerPoint presentations to your audience anywhere in the world using popular online services like Skype, Hangouts, GotoMeeting, Zoom, etc. (really pretty much anything that supports webcam input).



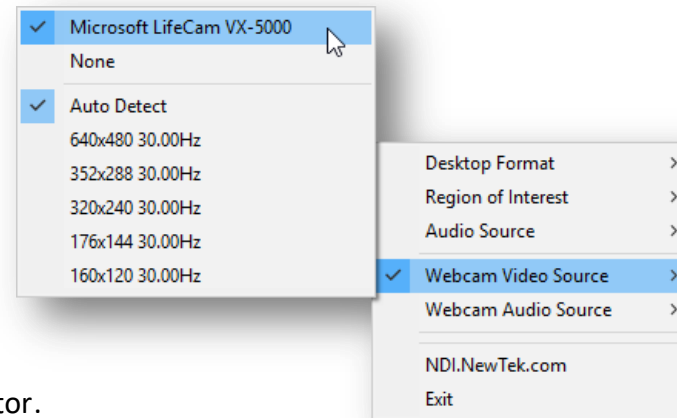
## Webcam to NDI Video

Speaking of webcams, Scan Converter now also supports webcam input.

Connect an inexpensive webcam to your Windows system, select Webcam Video Source from the settings menu, then choose your camera and, if you wish, specify its video format too.

Immediately, you have a new video source for your presentations.

Consider, too, that your webcam can now be assigned as a Picture in Picture overlay on the output of a game or other application courtesy of Studio Monitor.



## WEBCAM AUDIO OPTIONS

The webcam NDI output independently enjoys all the same audio options as Scan Converter's NDI desktop outputs, too. Select the camera's own mic, your headset or another high quality mic, or the output from any audio source recognized by the system.

Scan Converter Note: The GPU is now used to capture the screen, and handles the lion's share of color conversion, processing and NDI transmission. This version uses the DirectX 11 API, thus requires Windows 8 or better.



# 14 Frequently Asked Questions

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It all seems too good to be true, doesn't it? No doubt you have many questions. We want to comment on a few of the more common ones here, in order that you can come to the conclusion that there's really nothing preventing you from trying NDI® out for yourself right away.

We're confident you'll be happy you did.

## IS IT COMPLICATED?

Nope. NDI is no harder to use than the worldwide web (maybe easier).

## WHAT IF OUR PIPELINE IS ALL SDI?

NDI is fully compatible with SDI, and can easily be implemented alongside your existing infrastructure without disruption. You can augment and extend your existing systems without expensive investment or downtime.

## IS LATENCY AN ISSUE?

Forget about it. NDI transmission speed typically requires considerably less than one video frame.

## WHAT ARE THE SYSTEM REQUIREMENTS FOR CAPTURE?

On most Windows®-based systems with a gigabit network connection and reasonably fast hard drive (i.e., write speeds >20 Mb/Sec per NDI channel recorded), the NewTek NDI IsoCorder application can capture two different HD NDI channels to disk at once.

## WILL IT COST ME A FORTUNE?

NewTek NDI is available without cost. While a number of providers offer NDI-enabled products for sale (and more are on the way), a variety of NDI solutions with powerful capabilities are being offered to you without charge.

## WON'T ALL THAT VIDEO OVERLOAD MY NETWORK?

Only if you try really, really, hard. NDI's extremely efficient encoder supplies broadcast quality audio video that is shockingly 'small'. Data demands are from 50-100 Mbps per channel.

## WHAT ABOUT UHD?

Got it covered. NDI supports any and all resolutions, frame rates, audio sample rate and channel count, from HD to 4K and beyond.

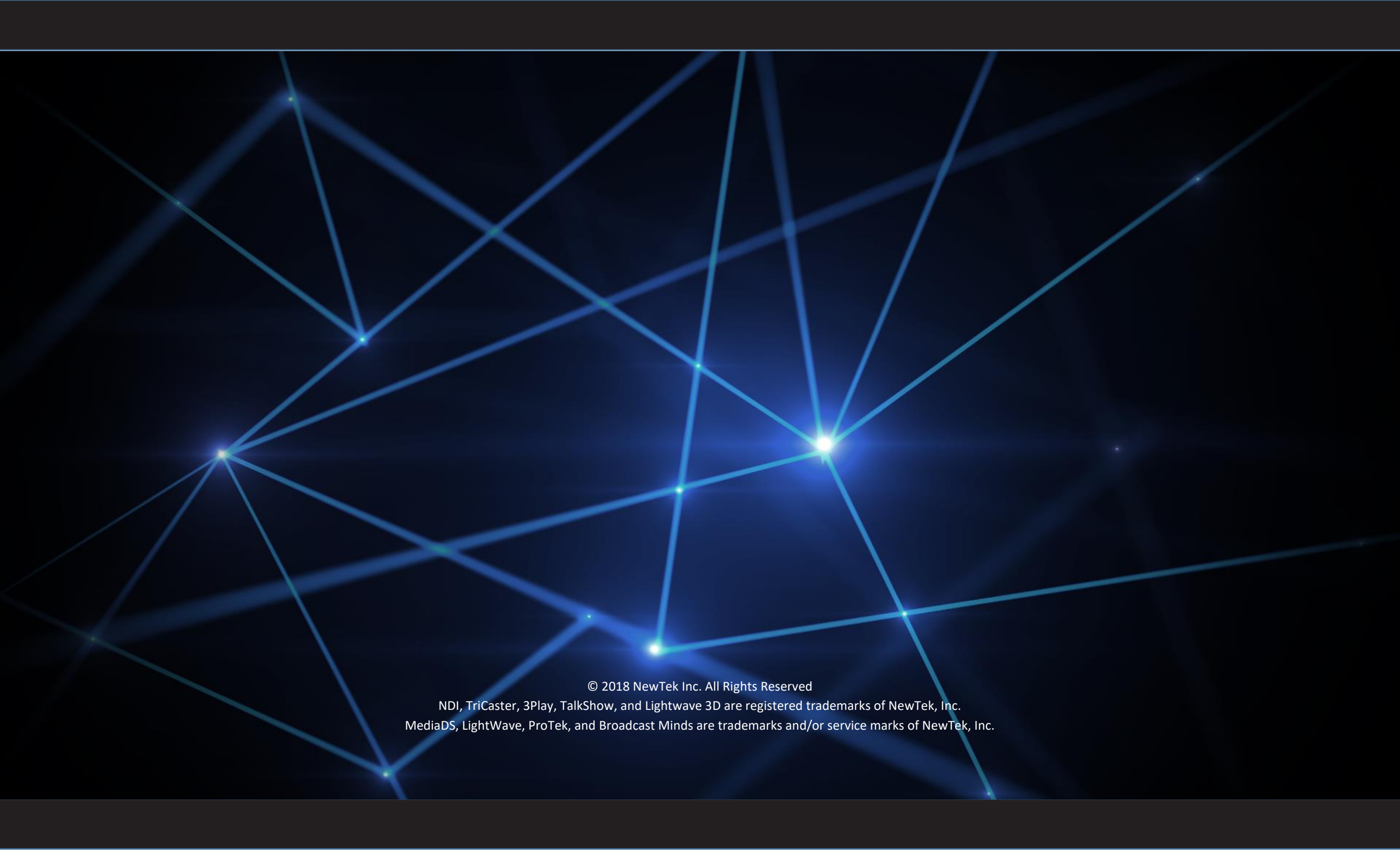
## IS IT COMPATIBLE WITH SMPTE 2022, ETC.?

NewTek strongly believes in interoperability, and in making NDI work with other popular IP infrastructures wherever possible.

For example, it is our goal for NDI enabled-applications to automatically support SMPTE 2022/6, too.

We expect to extend this standard-agnostic philosophy further, as hardware supporting other IP video transport methods advance from the planning phase to real world availability.

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