

**DANTE**

# **CERTIFICATION PROGRAM**

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LEVEL 1



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# THE DANTE CERTIFICATION PROGRAM

Training program from Audinate

•  
Official certification lets your customers know that you have the knowledge and skills to implement Dante networks

•  
Ensures a consistent set of methods and knowledge



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- The Dante Certification Program is a training program being offered by Audinate.
- This official certification lets your customers and peers know that you have the knowledge and skills required to successfully design and roll-out Dante networks
- We're doing this to provide a consistent set of methods and general knowledge about audio networking. This is sure to become increasingly important as the technology becomes widespread and is adopted by more and more vendors, installers and customers.

# THE DANTE CERTIFICATION PROGRAM

## With Dante Certification, you receive:

- Use of the Level 1 and Level 2 “Dante Certified” logos
- A certificate of completion for each level passed.
- Optional listing in directory of Dante Certified professionals



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- With your Dante certification, you get use of the “Dante Certified” logo for yourself. You also have the option to be listed in a directory of fellow Dante Certified professionals at [audinate.com](http://www.audinate.com).

# THE DANTE CERTIFICATION PROGRAM

## Level 1: Introduction to Dante

- In-person and online delivery
- Background
- Basic signal routing with Dante Controller
- Setting up Dante in simple systems (approximately 6 devices, 1 switch)
- Recording with Dante Virtual Soundcard



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- Level 1 of the Dante Certification Program will be available online as well as “in person”
- It provides a background in digital audio concepts
- It covers basic automatic and signal routing using Dante Controller
- Setting up Dante in simple systems
- Using Dante Virtual Soundcard to record audio
- Level 1 may be all you need to successfully use smaller Dante networks, typically with 6 or so devices and 1 network switch.

# THE DANTE CERTIFICATION PROGRAM

## Level 2: Intermediate Dante Concepts

- Delivered in-person
- Larger systems (approx. 12 devices)
- Clocking options
- Understanding unicast & multicast
- Latency
- Redundancy
- Dante Virtual Soundcard and Dante Via in depth



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- Level 2 of the Dante Certification Program is generally delivered in person at various events conducted by Audinate and partners.
- It is targeted towards more experienced users who are running larger systems
- It covers details of Dante clocking options
- It outlines unicast and multicast network traffic and how Dante allows you to use both types
- It covers adjustment and monitoring of Dante latency
- It covers redundant Dante networks
- And it covers Dante software in depth, such as Dante Virtual Soundcard and Dante Via.

# THE DANTE CERTIFICATION PROGRAM

## Required steps:

- Level 1: Pass Level 1 **online** exam
- Level 2: Pass Level 2 **online** exam  
PLUS “hands on” skills test



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- Taking a class like these is the first step to certification.
- All tests are conducted online at [audinate.com](http://audinate.com)
- There are 2 basic requirements to becoming Dante Certified:
  - Pass the Level 1 online exam
  - Pass the Level 2 online exam PLUS “hands on” exam at a live event

# INTRODUCTION TO DANTE

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LEVEL 1



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# ABOUT AUDINATE



Headquartered in  
Sydney, Australia



Network  
engineers first

 Dante™

Develop Dante as  
**100%**  
**interoperable**  
**solution**  
for all audio  
manufacturers

 Dante™  
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A bit about Audinate, first.

- We are headquartered in Sydney, Australia.
- We are founded by, and employ many network engineers who deeply understand how networking and network standards work, and how best to maximize performance for audio.
- We develop Dante as a 100% interoperable solution for ALL audio manufacturers. In this respect we are unique. We offer the same technology to everyone, ensuring that every product that uses Dante can freely connect to any other, no questions asked.

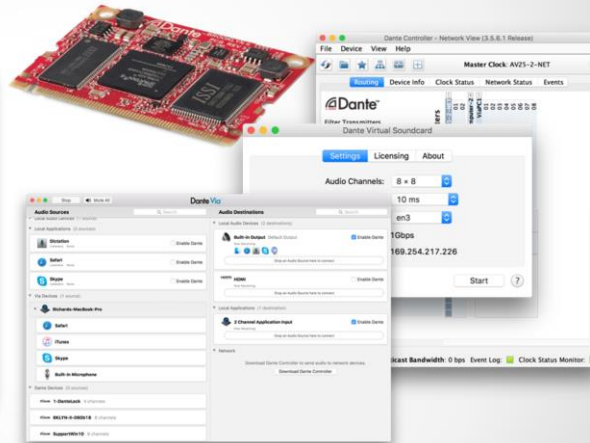


# WHAT WE MAKE

**Dante technology**  
(all of it)

**Hardware modules**  
**Development tools**  
**Software products:**

- Dante Controller
- Dante Virtual Soundcard
- Dante Via



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What do we make?

We are the sole creators and developers of Dante audio networking technology. We make all of it, from:

- Hardware modules and chipsets, sold to manufacturers in order to quickly and easily integrate Dante into their products.
- Development tools for manufacturers, so they can customize Dante to suit their needs and designs.
- And software products that allow audio professionals to use Dante;
- Dante Controller, which is the essential tool for managing a Dante network
- Dante Virtual Soundcard, software that lets you use any Digital Audio Workstation software you prefer directly on a Dante network, and;
- Dante Via, another software product that allows you to put connected audio products and applications directly on a Dante network.

## LEVEL 1 TOPICS

Digital audio  
basics

IP  
networking  
basics

What is  
 Dante™

Using  
 Dante™



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Level 1 topics:

- Digital audio basics
- IP networking basics
- What is Dante?
- Using Dante, with tools such as Dante Controller and Dante Virtual Soundcard

# **DIGITAL** **AUDIO BASICS**

LEVEL 1

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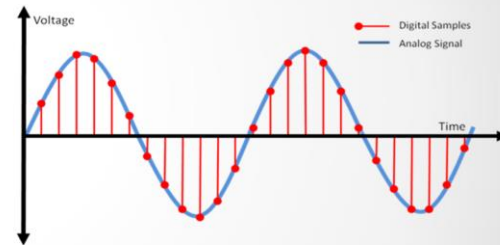
We'll start with a refresher on digital audio basics. There are a few key concepts here that help us to understand how Dante works, and how to understand requirements surrounding subjects like bandwidth and latency.

# ANALOG TO DIGITAL CONVERSION

Analog signal is sampled at constant intervals

•  
Yields a stream of values in time

•  
Pulse Code Modulation (PCM)



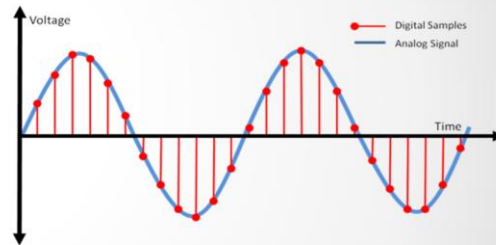
When we convert analog audio to digital, the analog signal is sampled at constant intervals of time. At each interval, the amplitude of the analog signal is captured, and then represented as a number. This method produces a stream of values in time, and is known as Pulse Code Modulation, or PCM. It is the most common format for digital audio, used in CD players since the very beginning.

PCM audio itself is uncompressed, by definition.

# SAMPLE RATE

Interval at which samples are taken

•  
Nyquist Theorem:  
Samples must be taken at  
least 2x maximum audio  
frequency



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The Sample Rate is just what is sounds like – how fast are the audio samples being taken? The math tells us what to do; the Nyquist theorem states that if samples are taken at least twice the maximum analog frequency we wish to capture, then we can faithfully reconstruct the entire signal.

Human hearing is generally agreed to be in the range of 20Hz to 20kHz, which indicates that a sample rate of 40kHz is sufficient. In practice, this rate is pushed up to 44.1kHz (the old CD Redbook standard) or 48kHz (the most common value in pro audio), as these values fit nicely with frame rates used in film and video standards. Higher sample rates allow for higher frequencies to be captured.

# BIT DEPTH

How many bits are used to represent amplitude

•  
More bits -> more accuracy

CDs: 16 bits

Pro: 24 bits

Number of Bits	Number of Values
1	2
2	4
4	16
8	256
16	65536
24	16777216
32	4294967296

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Bit Depth determines how accurate each audio sample can be, by determining how many possible values our scheme can represent.

If, for example, I were to use only 4 binary digits – 1s and 0s – to represent my audio, I'd have only 16 possible levels of amplitude with which to describe each sample. Not very good, really.

Remember those old video game soundtracks, like on Atari? That stuff is 8 bits of resolution, or 256 possible levels of amplitude.

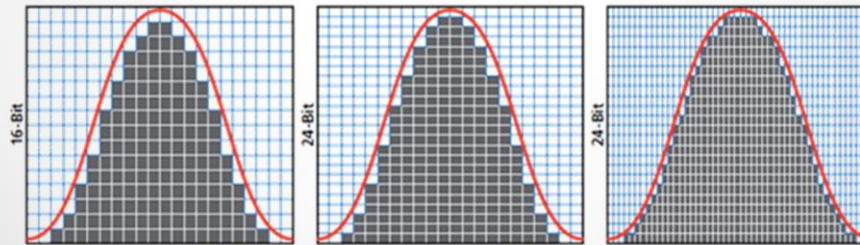
The CD uses 16 bits, and we all know how that sounds – pretty darn good, allowing 65,536 possible values. When we jump to 24 bits, we have 16,777,216 possible values!

## COMBINING SAMPLE RATE & BIT DEPTH

More of each -> greater fidelity

•  
Increased bandwidth usage

•  
Greater sample rates -> fewer I/O channels



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44kHz

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44kHz

96kHz

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From a purely technical perspective, increasing both sample rate and bit depth will improve the absolute fidelity of a system, as they each represent more data per second being captured. There are many differing opinions regarding the human perception of audio, and Dante does not impose any judgment in this regard.

It makes sense that increasing both sample rate and bit depth increases the bandwidth required to transmit the digital signal – a higher sample rate means more samples per second, and a higher bit depth means that each sample is that much bigger. For this reason, many products that support multiple sample rates offer reduced channel counts at higher sample rate values, as they are constrained by the rate of data they can provide.

## BANDWIDTH USAGE

PCM Audio Bandwidth = (Sample rate) x (Bit depth) x (No. of channels)

Example: 64 channels of PCM audio at 48kHz/24-bit =  
 $48,000 \times 24 \times 64 = \underline{74 \text{ mbits/sec}}$

With network overhead, 64 channels  $\approx$  96mbps

**Less than 10% of a gigabit link**



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Now we can think a bit about bandwidth – that is, the amount of data required per second for digital audio.

Ignoring for a moment the overhead required for networking, audio bandwidth is easily described – it is simply the sample rate times the bit depth, times the number of channels.

As an example, in a common pro configuration of 48kHz and 24-bit depth, 64 channels of pure PCM audio will consume 74mbits/sec, as shown here.

Once we fold in network overhead (which is more variable) we arrive at a figure of approximately 96mbits/sec for 64 channels of Dante networked audio. It's easy to see that on a gigabit network - that is 1000mbit/sec - **even 64 channels of audio consume less than 10% of the available bandwidth on a single link. The bandwidth constraints of earlier systems are simply not an issue with gigabit systems.**

Note that in audio networking, calculating the exact bandwidth required is not as simple as merely multiplying sample rate and bit depth. Nonetheless, this provides us with a sense of the capacity offered by modern audio networks.



## WORD CLOCK

The clock that determines where in the data an audio sample begins

•  
Must be consistent for all devices in a digital system so that data is read the same way

•  
Single Clock Master for multi-device systems



The Word clock is the clock that determines how data is interpreted in a digital system. Once audio has been sampled and is represented as a series of digital values in time, we need to make sure that all devices in our system agree about how to read those values in time. They need to agree about when each sample begins in a stream of 1s and 0s, so that the values can be faithfully converted back into analog signals.

For this reason, digital systems always rely upon a single Clock Master as a reference.

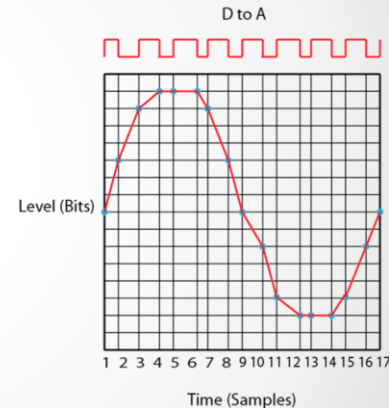
# JITTER

Distortion caused by inconsistent word clock in playout

•  
Exists in all Digital Audio Systems

•  
AES3, MADI, ADAT, S/PDIF

•  
Expensive to solve in older systems



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You've probably heard the term "jitter". You may have even heard actual jitter. Jitter is a type of distortion that results from a word clock being inconsistent. The samples no longer are played out exactly when they are supposed to.

While jitter exists in all digital audio system, it is recognized as a potential problem in legacy transports like AES3, MADI and ADAT. In those systems, the word clock is embedded in the audio signal as a "start of frame" message which must be "unpacked" from the data stream, which contributes to misalignment under some signal conditions, especially when connecting many devices together.

The classic solution was to use an expensive external clock that would "slave" each device, and thus force clock alignment between them. Dante uses a highly accurate clock synchronization method that ensures outstanding jitter-free performance for any number of connected devices without the need for any external clock sources.

Note that the image shows an impossibly large amount of jitter, for visual purposes. In the vast majority of real-world digital systems, jitter is inaudibly and nearly unmeasurably small.

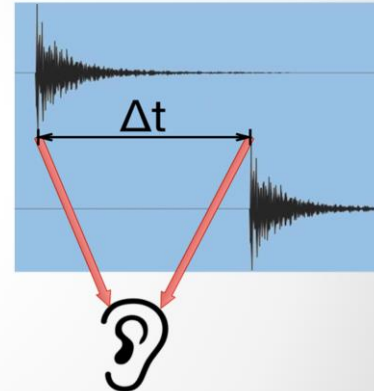
# LATENCY

Audio signal delay in a system

•  
Transport and processing

•  
Mainly a problem when we hear delayed and un-delayed signal simultaneously

•  
Problem for legacy networking systems (VoIP)



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Latency is an issue in all audio systems. It is the delay incurred by the transport and processing of audio signals. This is really only a problem in settings where the delayed and un-delayed signals are heard simultaneously, as in a recording studio when doing overdubs on a digital recording system or floor wedges on stage that are combined with the sound of live instruments.

Of course, audio latency is very pronounced without any electronics at all. Since sound travels at about 343 meters per second, each 34cm requires about 1 millisecond. This air travel delay is why towers are used to align speaker output with the heavily delayed audio coming from the stage. If you'd like to hear what a system sound like with about 2ms delay between sources, stand in the middle of 2 stereo speakers and move just 34 cm to the left or right.

In earlier audio networking solutions, such as VoIP, high latency was a real issue. As we'll see, this is an area where Dante gives you complete control.

## SUMMARY

Digital audio works by playing out or recording samples

Bit depth describes amplitude resolution

Sample rate determines maximum analog frequency



Word clock must be consistent and correctly sync'd



Digital audio produces data that can be transported like any other – *time* is the key that Dante provides



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To summarize this section –

Digital audio works by playing out or recording samples

The bit depth describes the amplitude resolution, and sample rate determines the maximum frequency that the system can handle.

The word clock is key to the accurate transport of digital audio, because it's all about data being processed as a function of time. This is why Dante uses a clock distribution scheme that is designed to be robust and tightly synchronized even between hundreds of devices.

Networks can easily transport digital data. As we'll see, "time" is part of the special sauce that Dante brings.

# IP NETWORKING BASICS

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In this section, we'll cover some very basic, essential networking concepts and help to clarify things that many audio professionals wonder about.

# HOW MUCH NETWORKING DO I NEED TO KNOW?

NOT VERY MUCH  
(USUALLY)



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This is the first question that many audio professionals ask. When a new technology arrives, they naturally want to make sure that they understand it.

Fortunately, the correct answer here is:

Not very much. Usually.

As we'll see, modern networking standards and Dante work together to make most setups incredibly easy.

## PHYSICAL SIDE OF NETWORKING

Modern small networks are made of 3 things:  
Things that get connected  
Switches: provide a central bridge for connections  
Cables: connect them together



From a networking perspective, most Dante systems are small and simple – they are usually doing only one thing, passing Dante audio and control. There are really just 3 types of object on a simple network:

1. The things you are connecting – in this case, audio devices and probably a computer or two.
2. A switch or switches – these act as bridges that connect everything together
3. Cables that connect them.

## WHAT KIND OF CABLE FOR DANTE?

Same as for any regular  
computer network

•  
Gigabit rated:  
CAT5E  
CAT6

•  
100 meters max per run



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We often see this question arise – what kind of networking cable should I use for Dante?

The answer is: the same cable you'd use for any network. Audio traffic isn't special in this regard. It's just data.

Since gigabit network speeds are recommended for Dante, that means using CAT5E or CAT6 cable.

CAT6 is rated for greater noise resistance in electrically noisy environments. CAT5E will work fine the vast majority of the time.

All copper Ethernet cables are limited to runs of 100 meters or less.



## WHAT ABOUT WI-FI?



Wi-Fi is another way to connect to IP networks

•  
Less reliable than wired Ethernet

•  
Not compatible with Dante audio

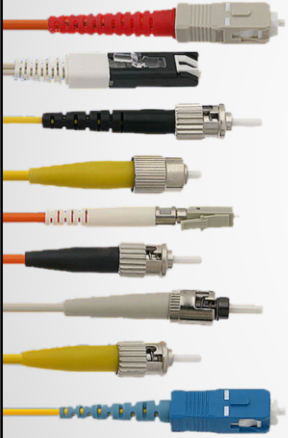
•  
OK for Dante Controller only

We are often asked about Wi-Fi. Isn't that another medium for IP connections? Yes it is.

However, Wi-Fi differs a great deal from wired Ethernet. At present, Wi-Fi is not yet capable of supporting the low latency and drop-out free performance of Ethernet cables, even under excellent conditions. For this reason, Dante devices will not recognize wireless networking as a valid means of connection.

You may use Wi-Fi to connect a computer running Dante Controller to a Dante network. All control functions will work over Wi-Fi.

## WHAT ABOUT FIBER?



Just another way to do Ethernet

Much greater distances if needed

Requires switches with SFP

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People also ask if Dante works with fiber.

- Since this is just another way to do an Ethernet connection, the answer is simply “yes”.
- Fiber has advantages with distance, and can go several kilometers when required.
- Fiber requires switches that have fiber connections (Small Form-factor Pluggable, or SFP)

# SWITCHES

Switches connect devices on a common network

•  
Available small (5 ports) up to large (48 ports)

•  
Switches support all ports going full speed all the time

•  
Use gigabit (or faster) switches!



Switches are always a big topic, but in many ways, they don't have to be.

As mentioned previously, a good way to think of a switch is as a focal point that connects all your network devices together.

You can get switches to fit your needs, from very small to very large.

Switches are "smart". They contain mechanisms that allow them to optimize traffic in many cases, and allow all the ports to go "full speed" all the time, in both send and receive directions at once.

We strongly recommend that you only use gigabit speed switches. That extra bandwidth makes your life a lot easier.

## SWITCHES – UNMANAGED & MANAGED

Unmanaged switches – plug 'n play, limited

Managed switches – many, many options, tests and adjustments

Dante works with either type

Managed switches useful in “mixed” (e.g., audio + other data) or heavily loaded networks

Unmanaged switches good in small dedicated audio networks



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There are 2 basic types of switches you can buy: managed and unmanaged.

Unmanaged switches are less expensive, and offer no adjustments or settings.

Managed switches offer many different options and adjustments.

Which type do you need for Dante?

Nearly all the adjustments offered by a managed switch pertain to “mixed” networks in which you combine audio and other data – such as a business that uses one network to do everything. If you are working with very heavily loaded networks, or putting Dante on an existing shared network, a managed switch will likely be necessary.

Managed switches can help you with trouble shooting (e.g. bad cables), by having tools such as a web page which reports packet errors on a switch port (as one example).

The answer is that either one can work just fine. If you are implementing a small, audio-only network, you can probably use an unmanaged

switch with no problems at all.

In the examples we use here, no switch management is used. For dedicated audio networks, there is little need.

# THEN YOU DON'T NEED A MANAGED SWITCH

If you use only **one** switch to connect your Dante devices...

And you are **only** using the network for Dante audio...



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Here's a helpful thing to know:

- If you are using only one switch to connect your Dante devices, and
- You are only using the network for Dante audio

Then you don't need a managed switch!

It is very common for small Dante systems to use only a single switch, and the settings that are recommended for very busy or mixed use networks simply aren't needed under those conditions. You can safely use unmanaged switches in these small networks.

## EEE SWITCHES

One special note:

- EEE or “Green” switches are often not good choices for real time media

- The energy saving feature will shut down ports and prevent parts of Dante from working properly

- Disable this feature, or use switches that do not support it



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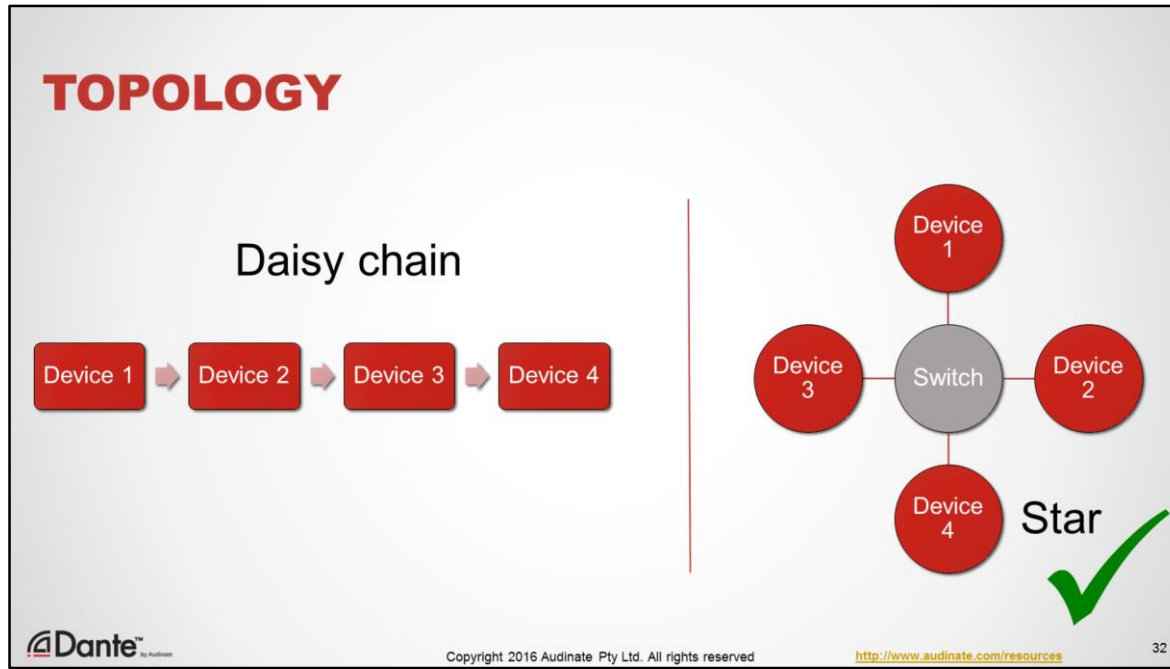
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A special note about “green” energy efficient switches

The way that many are implemented may cause trouble with audio and other real-time media systems like Dante. This is especially true when connecting multiple switches together.

In general, it is safer to disable or avoid switches with this feature.



In earlier digital transport systems, you may have used a “daisy chain” topology for connecting your devices. This made sense in the analog days, as we thought of each device as contributing some function in “series” with others: a mic goes to a preamp, which goes to some EQ, which goes to be mixed, etc.

This can be done with networked audio products that contain switches in them. The data “hops” from one switch to another, which is very convenient for small sets of interconnected devices. However, this type of topology doesn’t scale very well, as each “hop” incurs a potential latency penalty. Too many and you cannot achieve low latency at all points on the network.

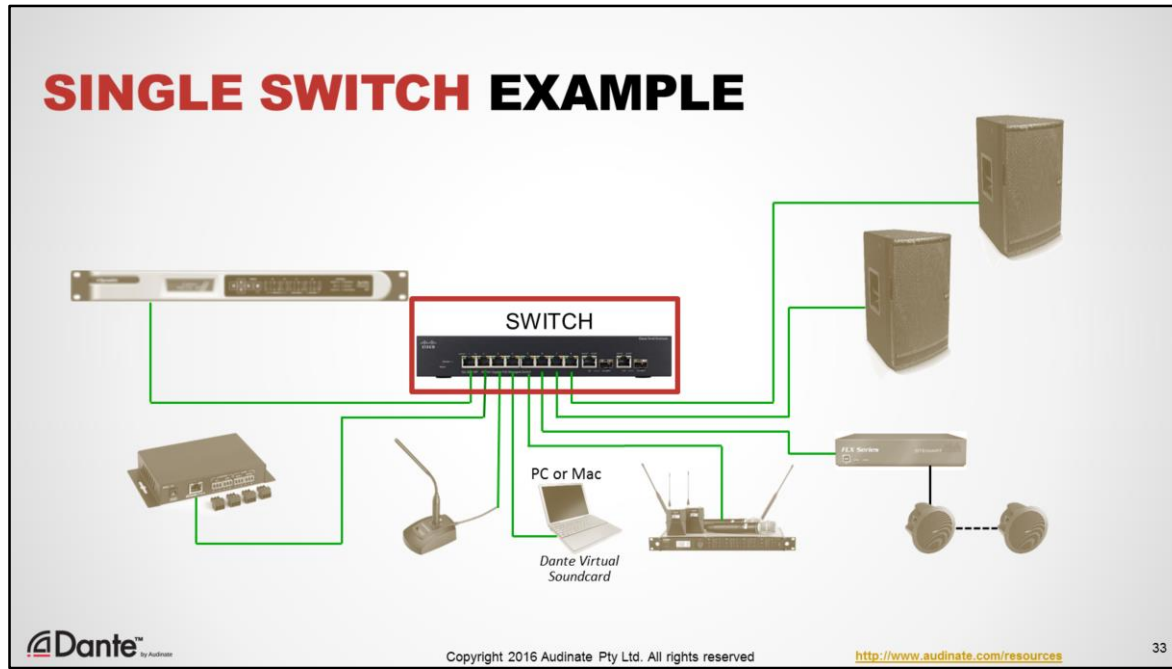
How many? In most cases of well-behaved switches, each hop imposes a very small penalty – typically several microseconds per switch hop. However, the latency settings in Dante are based upon “worst case” assumptions and are thus quite conservative. If a “daisy chain” is desired, we recommend that you test it to ensure that it works with the gear you have.

The primary problem with any “daisy chain” isn’t latency – it’s that failure of any device in the chain will break connections to devices further “downstream”. In general, switched networks are best thought of using a “star”, or “hub and spoke” topology. In such a setup, all devices on a star are connected to a single switch. If any one device fails, the others continue to communicate. As the network gets larger, additional switches may be brought in to extend the network. This method is generally how a network engineer would connect computers,



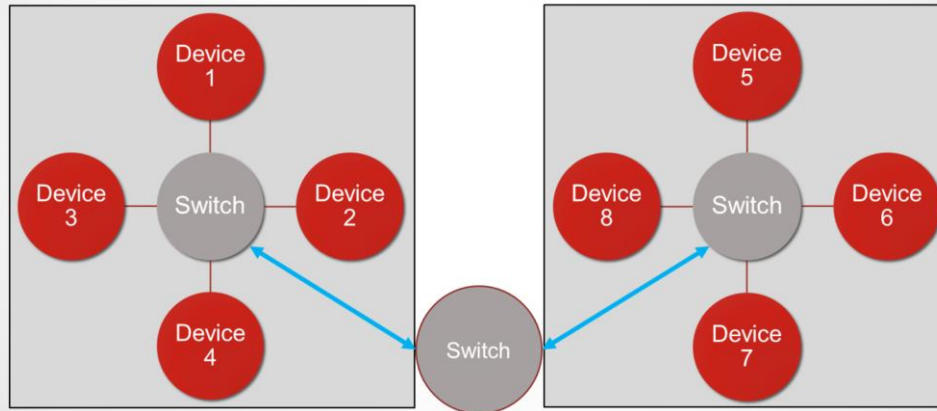
for similar reasons.

## SINGLE SWITCH EXAMPLE

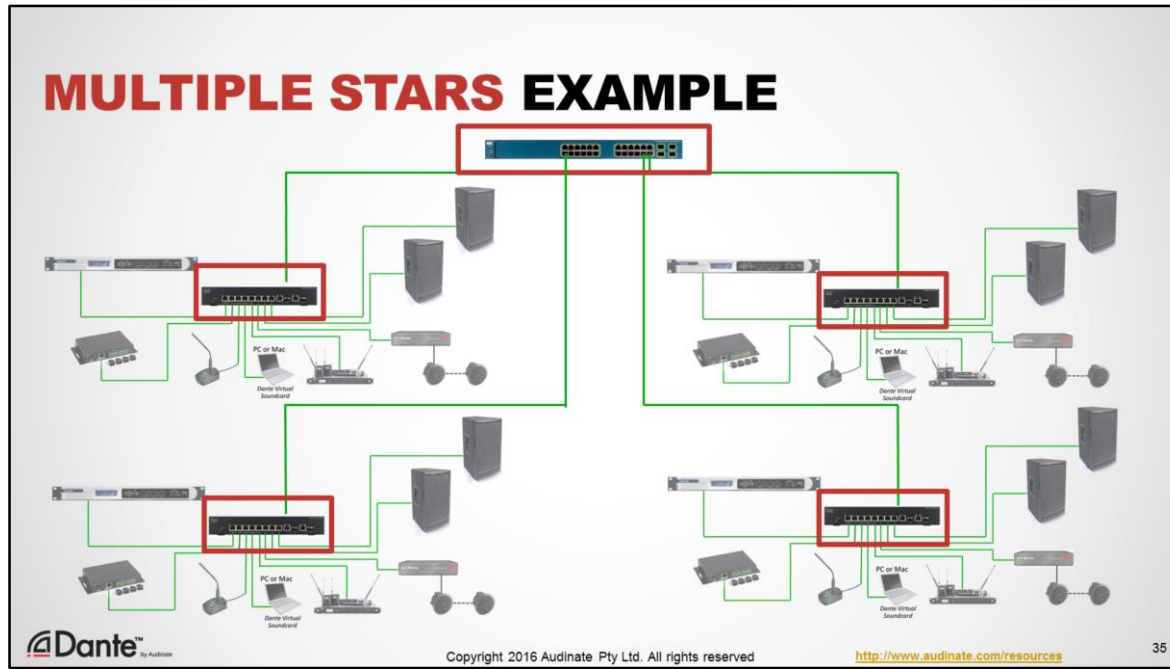


The diagram here is a good example of a “Star” topology in a Dante network. All devices – mics, a DSP, amplifiers and speakers are all connected to a single switch. The switch is the center of the star to which all devices are connected. Note that the physical connections shown here do not reflect the “flow” of audio through the system.

## MULTIPLE STARS



The star topology is easily extended to larger systems – here are two small star networks joined together with another switch to form a larger network. No device is more than 4 “hops” away from any other, making this a sensible design choice.



In this larger example, 4 smaller stars are joined together by one switch to form a very substantial network in which no device is more than 4 “hops” from any other. In this example, we have 32 Dante devices connected – quite a bit for most audio applications, but very small for an IP network.

## SUMMARY

- Always use gigabit switches
- Use CAT5E or CAT6 cable
- Use fiber for long runs (over 100 meters)
- Use either managed or unmanaged switches for smaller networks
- Dante-only networks with one switch do not require management features, and may safely use unmanaged switches.
- Use a "Star" topology to minimize switch hops
- Avoid or disable "green" or EEE features

Let's summarize this section:

- Always use gigabit switches
- Use CAT5E or CAT6 cable
- Use fiber for long runs (over 100 meters)
- Use either managed or unmanaged switches for smaller networks
- Dante-only networks with one switch do not require management features, and may safely use unmanaged switches.
- Use a "Star" topology to minimize switch hops
- Avoid or disable "green" or EEE features

## LOGICAL SIDE OF NETWORKING

In analog, physical wiring showed signal paths  
•  
In networks, connections “logical” – name-to-name  
•  
Each cable carries many signals for many devices  
•  
Data delivered in packets  
•  
Network technology is neutral; no special gear needed  
for audio

This area is harder to grasp - not physical.

In old analog systems, a wiring diagram went a long way towards explaining what the system does – channels were physical cables that went from outputs to inputs. But as we’ve seen in networks, the actual connections are logical – that is, they exist in software.

When devices are connected together in a Dante network, they communicate to one another by sending data from name to name, controlled by software

Network cables are carrying lots of signals for lots of different devices. The wiring doesn’t tell you what the signals are or where they are going.

Networking delivers data in **packets** that are addressed and sent to destinations. The data is reassembled at the destination.

Network technology is neutral to the type of data being transported. There is no need for a “special” audio network equipment.

## A WORD ABOUT NETWORK LAYERS

**Each layer passes data to the next**

**Layer 1:** physical connections (e.g., cables)

**Physical** (hardware & cables)

**Layer 2:** devices represented by fixed hardware addresses (MAC)

**Hardware addresses**

**Layer 3:** devices represented by variable IP addresses

**IP addresses**



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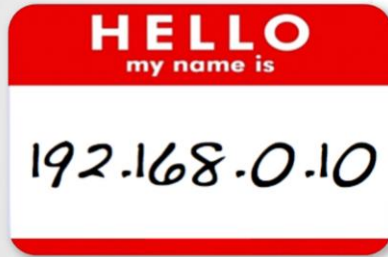
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When you hear people talking about networking, you often hear about “network layers”. We don’t really need to deal with them in Dante, but let’s clear up what they are.

Layers are a model for how IP networking works. In the full OSI model, there are 7 layers (!)  
In audio networks, we are only concerned with the bottom 3 layers. Here’s what they are:

- Layer 1 – the physical layer. This is the actual physical medium being used to carry the traffic. For us, this means copper wire (CAT5E or CAT6 cables) or fiber, connected to a port. As long as this layer conforms with standards, it freely allows us to build upon it, and create:
- Layer 2 – the data link layer. This is the layer at which hardware devices may recognized by their unique, **fixed** hardware addresses, usually referred to as MAC or Ethernet addresses, Devices may now communicate using these numeric addresses.
- Layer 3 – the Network layer. This is the layer at which devices are assigned **variable** numeric addresses called IP addresses. Devices may now communicate using these numeric addresses. The other members of the network don’t need to know the MAC address.

# WHAT IS AN IP ADDRESS?



Numeric addresses associated with devices

On a LAN, direct communication only possible between devices in the **same** IP address range

LAN: all addresses in same range

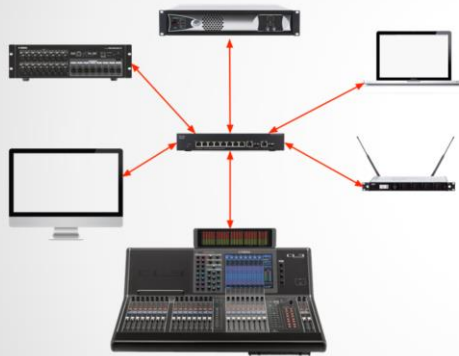
Dynamic (preferred) or user-assigned

Avoid manual (static) addressing to avoid duplicates or unreachable addresses

- An IP address is a numeric value that is mapped to a device. It is not part of the device, and can be changed.
- A key point is that IP addresses define lines of communication. Devices can only directly communicate with others in same address range on the network. A device with an IP address different from this defined range will not be able to communicate with others.
- In a LAN or stand-alone network, all IP addresses must be in the same range – and so we need a method that ensures that they are.
- IP addresses can be manually assigned, but are usually done automatically. They can be dynamic.
- Avoid manual, static IP addresses. They are rarely required and often result in problems due to human error, resulting in difficult to solve problems such as duplicate IP addresses or unreachable devices that are out of the defined network range.



## WHAT IS A LAN?



Local-area Network

•  
Small number of devices (<200)

•  
Very reliable, fast

•  
Shares a common IP address range

•  
Majority of audio networks are LANs

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The term LAN stands for local-area network. This kind of network is extremely common, and is typically what we have in our homes with a Wifi access point and a few connected devices.

A LAN is a computer network that contains a relatively small number of devices (typically less than 200). Devices on an Ethernet LAN share a common IP address range, which allows all devices to freely communicate with one another to send data and share resources. On a wired Ethernet LAN, speeds are very high and reliability is excellent. Typical Dante installations are always on LANs.

Large business networks are commonly comprised of multiple LANs that are linked by routers. This practice provides useful segmentation of groups of devices for security and traffic management.

## WHAT IS A “STAND ALONE” NETWORK?

A single LAN



Usually dedicated to one purpose



Not dependent upon external resources  
(e.g., internet, servers)



Not connected to other LANs through a router



Commonly used to separate responsibilities of AV installer



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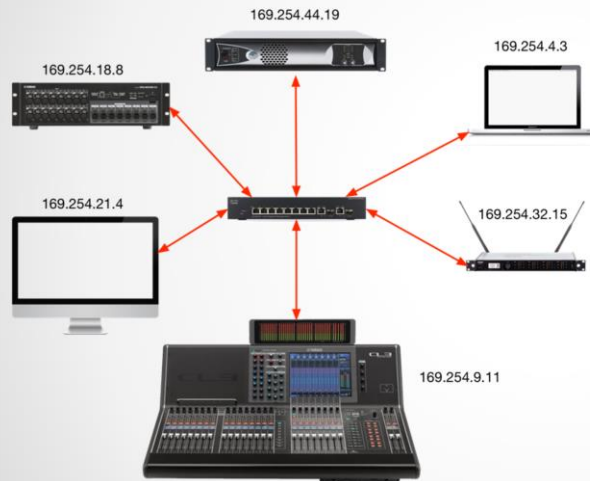
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In audio networking, we often hear about “stand alone” networks. These are networks that are themselves LANs, all using a common range of IP addresses. They are usually dedicated to a single primary purpose, and they are not connected to external resources such as the internet or servers shared by other LANs. They are not connected to other LANs, but are islands of data traffic.

“Stand alone” is not really a technical term for distinguishing networks, but is a common method for separating responsibilities. For example, an AV group may wish to have a separate network simply to avoid sharing costs and management tasks with an IT department. If anything goes wrong, it is clear who needs to respond.

# AUTOMATIC ADDRESSING



LAN requires IP addresses in a common range

• Automatic addressing enabled by default on Dante devices

• Self-assigned addresses create a working LAN

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- Because IP addresses are really important to a working network, Dante supports **automatic addressing**.
- When devices are connected together, Dante devices will self-assign addresses that create a working LAN, with no conflicts.
- No other components or configuration are necessary.
- Note that Dante fully supports all common means of managing IP addresses. They can be configured manually, or you can use a DHCP server if you have one. But most Dante systems are stand alone networks using self-assigned addresses.

## SUMMARY

Layer 3 networking allows use of **IP addresses** for connections

Automatic addressing enables simple “plug and play” use of Dante in stand alone networks – use it!

“Stand alone” networks are commonly used to separate and simplify responsibilities

To summarize:

1. Layer 3 is what enables the use of IP addresses in networking
2. Automatic addressing enables true “plug and play” use of Dante in stand alone networks.
3. Stand alone networks are useful for keeping AV responsibilities separate from others – but not necessary from a technical perspective.

# WHAT IS DANTE?

DANTE CERTIFICATION PROGRAM  
LEVEL 1



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**DANTE IS A HARDWARE AND  
SOFTWARE SOLUTION THAT  
TRANSPORTS PRECISELY  
TIMED DIGITAL AUDIO  
BETWEEN DEVICES USING  
STANDARD IP NETWORKING**

---



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Dante is technology comprised of hardware and software that transports precisely timed digital audio between devices using a standard IP network.

Audinate develops this technology for the audio industry, ensuring that all manufacturers have a 100% interoperable high performance solution, no matter what the brand.

## DANTE FEATURES AND BENEFITS

All devices use human-readable names

Precise time alignment of all audio

Automatic device discovery

One-click routing

Low, deterministic latency

Virtually jitter-free

Automatic re-connection after power cycles



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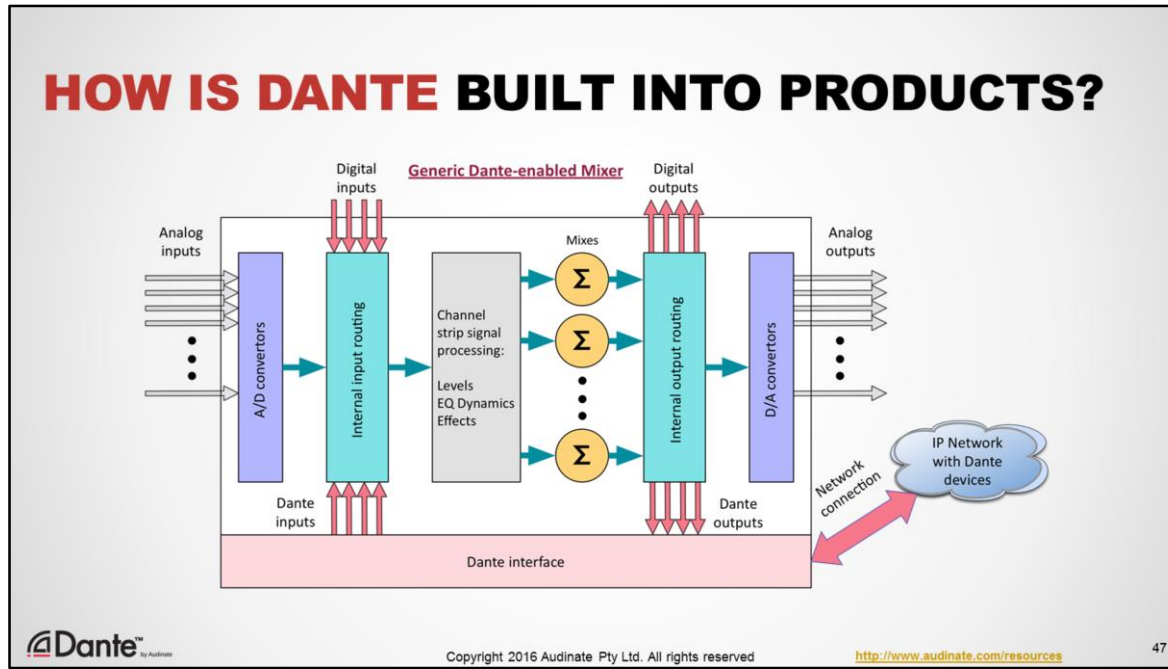
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Dante builds upon IP networking to provide a host of features designed to make audio systems easier to deploy and use, while delivering pristine, bit-perfect sound.

- All Dante devices use human readable names
- All audio is synchronized to a tolerance of 1 microsecond, for precision time alignment
- All devices are discovered automatically upon connection – no need to configure devices
- One-click routing of channels
- Low, 100% deterministic latency
- A clocking scheme that eliminates sources of jitter and clock propagation problems
- Automatic re-connection of all channels after power cycle or tear-down/setup.

# HOW IS DANTE BUILT INTO PRODUCTS?



- In products, Dante interfaces are internally connected in just the same way as other digital I/O you might use, such as MADI, AES3 or Ethersound.
- The difference is that rather than going from point to point with cables, the audio is placed on a network where it can be freely distributed to as many other devices as you like, using software.
- As in many products that use interface cards, additional configuration is required to “tell” the product to use audio from a particular card.

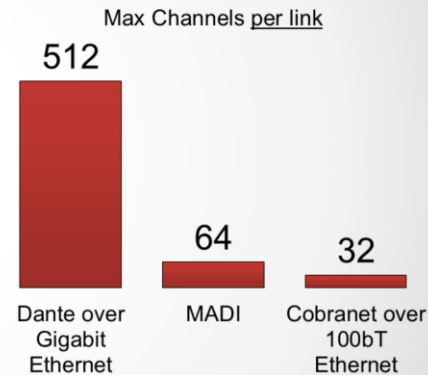


## DANTE BANDWIDTH

Legacy digital systems constrained to lower channel count

Gigabit means Dante is capable of **512x512 at each link, many more for entire network**

Even a large 64 channel console consumes only 1/8 capacity of a **single port**



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A moment about bandwidth. Because many audio professionals have experience using older digital transports such as CobraNet or MADI, they are accustomed to seeing strict channel count limitations, typically in the range of approximately 64 channels. It is natural to assume that Dante might have similar constraints.

But it doesn't. The use of standard gigabit networking allows Dante to scale far beyond earlier systems, supporting as many as 512 bidirectional channels of audio for a single device on a single network port.

Referring back to our discussion of audio bandwidth earlier, we can see that with typical settings of 48kHz sample rate and 24 bit depth, a 64 channel bidirectional Dante device using all channels consumes only 1/8 the capacity of a gigabit link. This means that a Dante network can safely handle hundreds or even thousands of channels overall.

Don't worry about running out of room with Dante.

## SAMPLE RATE AND CONNECTION



Only Dante channels using  
the same sample rate  
may connect

•  
Multiple sample rates on the same  
network OK

•  
Higher sample rates = fewer  
channels for same bandwidth

•  
All common sample rates supported

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- Recalling the description of sample rate, we know that it is key to communicating digital audio. Because Dante doesn't convert sample rates, you may only connect channels of devices that are running at the same sample rate. If you attempt a subscription between channels with unequal sample rates, you will receive a clear error message.
- You may use different sample rates at one time on a Dante network, but only devices with common sample rates will be able to connect.
- Finally, recall that as sample rate increases, so does the amount of bandwidth required for each second of audio transmitted. As a result, devices that support 64 channels at 48kHz may only support 32 channels at 96kHz (double the sample rate, double the bandwidth per channel, half the number of channels)
- Dante supports all commonly used sample rates, from 44.1kHz up to 192kHz. Different products will typically support a subset of sample rates that match the internal capabilities for that product.

# LATENCY

- 100% deterministic – always well-defined
- Default Dante latency 1ms – suitable for large networks (10 hops!)
- Adjustable to suit needs
  - Minimum 150µs
  - Maximum 5ms
- Set per Device

Device Latency

Current latency: 1 msec

Latency	Maximum Network Size
<input type="radio"/> 150 usec	Gigabit network with one switch
<input type="radio"/> 250 usec	Gigabit network with three switches
<input type="radio"/> 500 usec	Gigabit network with five switches
<input checked="" type="radio"/> 1 msec	Gigabit network with ten switches or gigabit network with 100Mbps leaf nodes
<input type="radio"/> 2 msec	Gigabit network with 100Mbps leaf nodes
<input type="radio"/> 5 msec	Safe value



We defined **latency** earlier as the time required for a system to deliver audio from an input to an output.

- In Dante, latency is strictly defined and consistent. Default latency device latency is 1 millisecond, far below the threshold of noticeability for live performances or studio overdubs. At this setting, receiving devices can be as much as 10 switch hops from transmitters, a situation applicable only to very, very large networks.
- You can set Dante devices to go as low as 150 microseconds, or as high as 5 milliseconds to suit different situations.
- This setting is made on a per-device basis.



# CLOCKING

Dante handles clocking **automatically**

- Clock Master is determined by election
- All devices sync'd to Master
- Each device has a clock
- New Clock Master elected as needed

 Dante

When discussing digital audio fundamentals earlier, we talked about how important the work clock is. So how does Dante handle clocking?

- While many adjustments are permitted, the important thing to know is that by default, Dante handles clocking 100% automatically.
- Dante uses an election process that chooses the best Clock Master among devices, and all devices on the network use that clock as a reference for synchronization.
- While a Clock Master is used to synchronize devices on the network, each Dante device incorporates its own high quality clock.
- By using this approach, jitter is eliminated as a problem on a Dante network, regardless of size.

## WHAT DOES DANTE NOT DO?

Sample rate conversion  
•  
Level control  
•  
MIDI  
•  
SMPTE time code  
These are handled by products  
Control and other data runs alongside Dante  
on network



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Dante is strictly audio transport. The audio data is not modified in any way, and is delivered bit-for-bit from any source to any destination.

Dante does not perform tasks other than transporting audio, such as:

- Sample rate conversion
- Level control
- MIDI
- SMPTE time code

These other items are handled inside products that support Dante. Control data such as MIDI or level control can easily be transmitted alongside Dante audio between devices, but Dante is not involved.

# USING DANTE

DANTE CERTIFICATION PROGRAM  
LEVEL 1

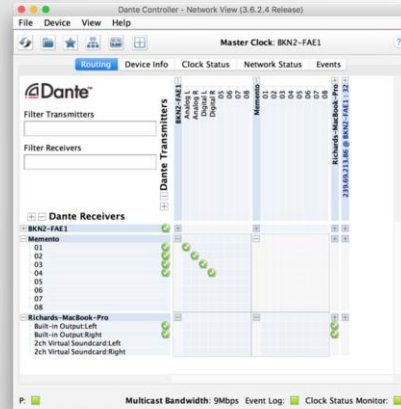


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# DANTE CONTROLLER



- Primary Dante tool
- Routing: Setup, view, change
- Clocking adjustments
- Sample Rate settings
- Latency settings
- Clock and Latency monitoring



Dante Controller is free software from Audinate that works with all Dante-enabled devices from any manufacturer. It is the primary tool used to setup and use Dante networks

Dante Controller is used to:

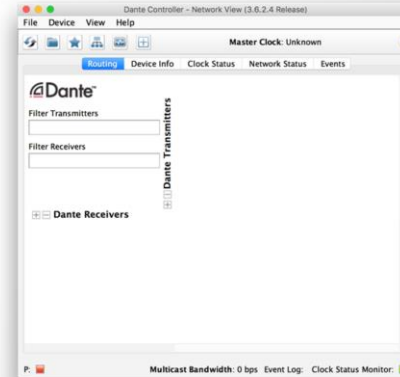
- Setup, view and or change audio signal routing
- Configure clocking (as needed)
- Adjust individual device parameters such as sample rate, etc.
- Monitor system health by observing actual latency behavior and clock quality.

# DISCOVERY AND ROUTING

If no devices are connected, Dante Controller is empty

Dante Controller always shows the *current state of the network*

Key concept: Dante configuration lives in *devices*, not on your computer



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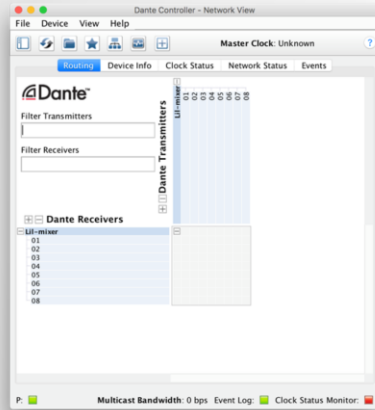
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- LIVE DEMO PREFERRED
- When Dante Controller is launched with no devices connected, it appears empty.
- That's because Dante Controller always shows the current state of the network, regardless of history.
- It's important to understand that the state of a Dante network – the subscriptions, labels and settings – all reside on the Dante devices themselves.
- This means that all copies of Dante Controller connected to a network will all “see” the exact same things.



# DISCOVERY AND ROUTING DIRECTLY CONNECT ONE DEVICE



When they are connected to network,  
Dante devices automatically appear in  
Dante Controller

•  
No pre-configuration

•  
Human readable names

•  
*A Dante device can be connected  
directly to a computer*



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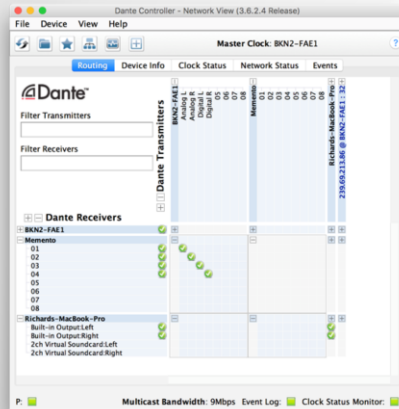
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- LIVE DEMO PREFERRED
- Let's connect a Dante device **directly** to our computer and see what happens – the device simply appears.
- This brings up a key point about Dante: all devices are self-discovering without pre-configuration.
- Note that the device has a human readable name. We can adjust that name, plus the names on the individual channels. No need for cryptic numbers.
- This also bring up an important use case: a Dante device can simply be directly connected to a computer and be seen in Dante Controller. No switch is necessary for this single connection. This type of setup can be very useful as a simple recording rig with a mixing console and Dante Virtual Soundcard.

# DISCOVERY AND ROUTING

## MULTIPLE DEVICES AND CHANNELS



- Use switch to connect multiple devices
- Click “+” sign to view device channels
- Click “-” sign to hide channels
- Transmitter channels on horizontal
- Receiver channels on vertical



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- LIVE DEMO PREFERRED
- Now let's use a switch to connect several devices at once, and they appear automatically just like the first.
- Now we can see two or more devices, so we can make a connection.
- Click the “+” sign by the words Dante Transmitters and Dante Receivers to reveal the individual channels.
- Use the “+” sign by each device name to open channels for only that device.
- Most Dante devices are both Transmitters and Receivers – analogous to Sources and Sinks for those who prefer that terminology.
- The transmitter channels always appear on the horizontal axis, the receivers on the vertical.

# DISCOVERY AND ROUTING SUBSCRIPTIONS



Dante connections are “subscriptions”

•  
With device channels showing, click at intersection of desired transmit and receive channels

•  
Green checkmark means subscription is OK  
Sample rates and types match



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Let's send some transmitter channels from (A) to receiver channels (B)

## LIVE DEMO PREFERRED

- In Dante, we call these connections **subscriptions**.
- Click the + sign to show the Transmitter channels on device A
- Click the other + sign to show the Receiver channels on device B
  - Comment: this is like a big spreadsheet. We can see all the available channels on every device
- Remember from above: in order to connect, our devices must be using the same sample rate and bit depth. These devices are both set to use a default of 48kHz/24-bit
- To subscribe this transmitter channel to this receiver channel, we simply have to click at the intersection on the grid
- A green checkbox appears, and that means we're connected. That's it.
  - If our sample rates, bit depths and format types did not match, we would see an error message instead of the green checkmark.
- Let's make a few more subscriptions with these two devices. Just click at intersections and you're done.
  - It's that easy!

# DISCOVERY AND ROUTING DELETING



To delete a subscription, click on  
green checkmark

•  
Checkmark disappears,  
subscription deleted



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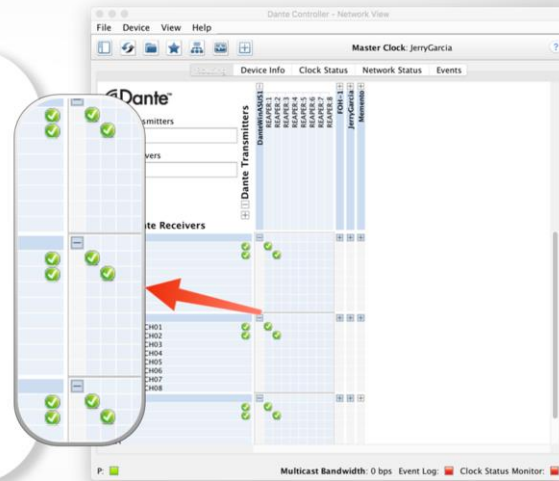
- LIVE DEMO PREFERRED
- Deleting a subscription is just as easy
- Simply click on the green checkmark to disconnect a subscription.
- The icon disappears, indicating no connection.

# DISCOVERY AND ROUTING SPLITS

Splits are easy with Dante

•  
Simply click at intersections of  
multiple receiver's channels for a  
desired transmitter

•  
Audio is sent to all subscribed devices  
and channels



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”Splits” – sending one channel to multiple devices and destinations– was hard with many legacy solutions, but it’s easy with Dante.

- LIVE DEMO PREFERRED
- Simply click at the intersections of the desired transmitter channels and multiple receiver channels. That’s it. No special hardware or settings are required.
- The transmitter audio is sent to all receiver subscriptions. When splitting audio to more than 3 receiving devices, Dante Controller will present a “Fan out” message, indicating that multicast use is recommended for optimal network efficiency. The topic of multicast is covered in Level 2.

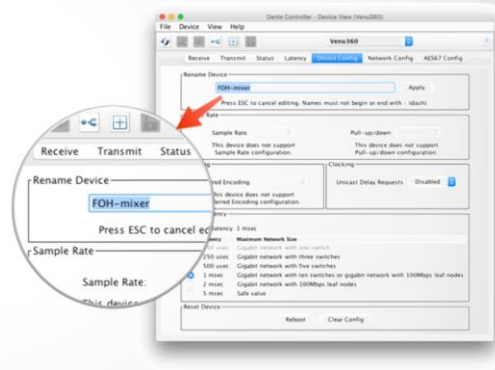
# DEVICE NAMES

Recommended: Name first, then route

You can use device names of your choice

Double click device in Routing view, go to Device Config tab

Edit name



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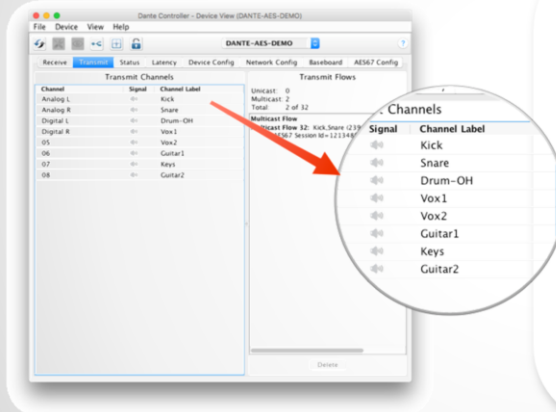
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Devices and associated channels can be given names of your choosing. **It is highly recommended** that you name your devices before doing routing, in order to keep things clear.

## LIVE DEMO PREFERRED

- To change a device name, double click the device name in the Routing view
- In the Device View that appears, click on the Device Config tab
- Edit the name as you please
- Click "Apply", and it's done

# CHANNEL LABELS



Labels can be applied to any channels

Use Device View

Makes it easy for volunteers or  
newbies to use system

Software version of masking tape 😊



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- LIVE DEMO PREFERRED
- In addition to naming devices, you can use the Device View to label individual channels of transmitters or receivers.
- This is great for quickly identifying individual channels in a live mix, and makes it easy for volunteers or newbies to use the system.
- Think of it as a software version of the masking tape we typically find on consoles!

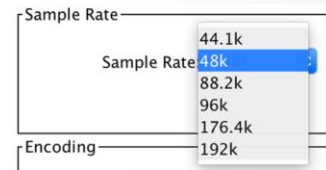
# ADJUST SAMPLE RATE

In Device View -> Device Config tab

Adjust sample rate and bit depth  
(Encoding)

Choices determined by product

Most common 48kHz / PCM 24



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In order for Dante devices to successfully subscribe to one another, they must be using the same audio format – in other words, sample rate. This is adjustable for each device, in the Device View.

To access the Device View, double click the name of the device you wish to adjust

## LIVE DEMO PREFERRED

- Navigate to the Device Config tab
- There you may adjust the sample rate and bit depth, here labeled as “encoding”
- Some manufacturers may allow only certain sample rates and encoding to be used, depending upon the product.
- By far the most common combination is 48kHz/PCM 24.



## POWER CYCLE RECOVERY

Configurations are stored in Dante devices – not in Dante Controller

•  
At power up and/or reconnection, all subscriptions are re-established

•  
Dante Controller **not** required!



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### LIVE DEMO PREFERRED

What happens when we disconnect or power down devices?

We all have to do this all the time, tearing down and setting up

- When we unplug or power down devices, they disappear from Dante Controller.
- Remember: Dante devices, not Dante Controller, contain the information about subscriptions. So what happens when we reconnect the devices?
- When our devices are powered back up or plugged back in, they reappear in Dante Controller.
- All the subscriptions reappear as well!
  
- This brings up a great feature of Dante: the devices always remember what they are connected to. When you setup a system in a new location, all the device subscriptions are automatically reestablished.
- You don't even need Dante Controller for this to happen. Dante devices will automatically re-establish connections themselves.

# NO

DOES DANTE CONTROLLER NEED TO BE  
ON THE NETWORK ALL THE TIME?



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One final note – people often wonder if Dante Controller must be present for a Dante network to work.

No.

It is only required for making changes to the network – that's all.

## SUMMARY: KEY TAKEAWAYS 1

- Dante Controller automatically displays connected devices
- Dante devices and channels have user-definable names
- Dante Controller displays both transmitter (source) and receiver (sink) channels
- Channel to channel connections are called **subscriptions**
- Subscriptions are made and deleted by clicking at the intersection of transmit and receive channels

Key takeaways from this section:

- Dante Controller automatically discovers and displays connected devices
- Dante displays devices with user-definable names
- For each device, Dante Controller displays both transmitter (source) and receiver (sink) channels.
- Channel to channel connections are called subscriptions
- Subscriptions are made and deleted by simply clicking at the intersection of transmit and receive channels for each device you are connecting

## SUMMARY: KEY TAKEAWAYS 2

Subscriptions may only be made between devices running the same sample rate, adjusted in Device View

•  
Dante devices “remember” settings and subscriptions

•  
Dante automatically selects a Master Clock

•  
Dante Controller does not need to remain on network

•  
Dante does not alter audio data in any way



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- Subscriptions may only be made between devices running the same sample rate and bit depth (encoding)
  - Sample rate and encoding are adjustable (within manufacturer’s limits) in the Device View in Dante Controller for each device.
- Dante devices “remember” settings and subscriptions and automatically re-establish subscriptions upon power cycle or re-connection.
- Dante automatically selects a Master Clock from among the connected devices. There is usually no reason to change this selection.
- You don’t need to keep Dante Controller running on the network. It’s only needed for changes.
- Dante does not alter audio data in any way.

# RECORDING WITH DANTE VIRTUAL SOUNDCARD

DANTE CERTIFICATION PROGRAM  
LEVEL 1



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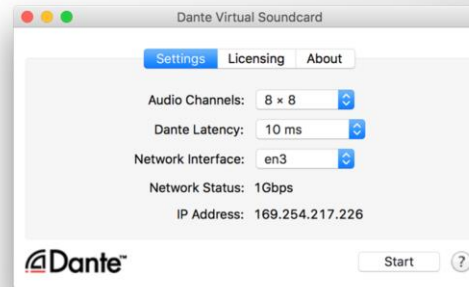
In this section, we'll introduce an incredibly useful tool, Dante Virtual Soundcard. Level 2 of this training contains a more in-depth look at this product, but we'll show you how you can start using it immediately using what you've learned here.

# WHAT IS DANTE VIRTUAL SOUND CARD? (DVS)

Soft Soundcard for Mac or PC

•  
Connects to Dante network

•  
Record and playback from 2x2 up  
to 64x64 channels using any  
DAW software



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- Dante Virtual Soundcard is software from Audinate that you install onto your Mac or PC.
- It behaves like a regular hardware soundcard in your computer, but instead of connecting to attached hardware, Dante Virtual Soundcard connects to other Dante devices using a regular wired network connection.
- With Dante Virtual Soundcard, your computer becomes part of the Dante network. You can easily record and playback up to 64 channels of audio directly on your computer, using your favorite applications such as Logic, ProTools, Cubase, etc.

## CONNECT TO A DAW

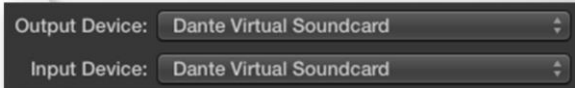
Launch Dante Virtual Soundcard

Set number of channels and Start DVS

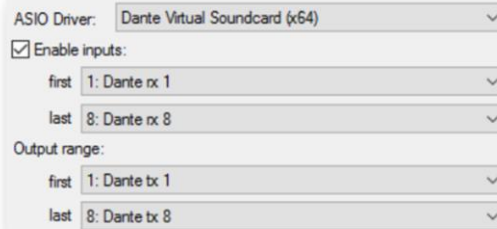
DVS will appear as audio device on computer

Mac – Core Audio  
Windows – ASIO or WDM

Select as I/O device in DAW preferences



Output Device: Dante Virtual Soundcard  
Input Device: Dante Virtual Soundcard



ASIO Driver: Dante Virtual Soundcard (x64)  
 Enable inputs:  
first: 1: Dante rx 1  
last: 8: Dante rx 8  
Output range:  
first: 1: Dante tx 1  
last: 8: Dante tx 8



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When Dante Virtual Soundcard is turned ON, it appears to be a regular audio device to your computer, just like any audio hardware you might connect via USB, etc.

- Launch Dante Virtual Soundcard
- Set the necessary number of channels
- Start Dante Virtual Soundcard using the Start button

How Dante Virtual Soundcard appears as a device:

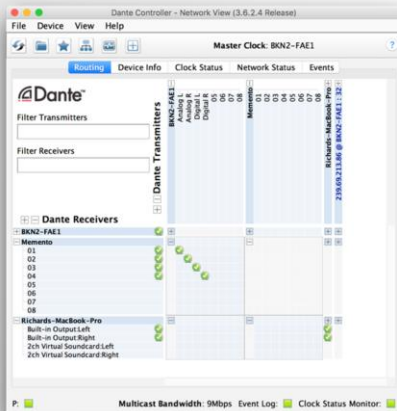
- On Mac OS X, Dante Virtual Soundcard appears as a standard Core Audio device.
- On Windows PC, Dante Virtual Soundcard supports either ASIO (very common for use with high performance recording software) or WDM (very common for use with “consumer” audio products on Windows, such as Windows Media Player)

In the audio application you wish to use, connect to Dante Virtual Soundcard exactly as you would any physical sound device:

- Open the audio preferences for the application
- Choose Dante Virtual Soundcard from the list of possible audio devices to use as source and/or destination

That’s it.

# SUBSCRIBE CHANNELS



Open Dante Controller

•  
Computer with DVS appears as Dante device

•  
Subscribe channels to Dante devices on network

•  
Record and Playback with DAW



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- Open Dante Controller (this can be on the same, or a different, computer on the Dante network)
- When Dante Virtual Soundcard is turned ON, your computer will appear in Dante Controller like anything other Dante device
- The name of the Dante device is the same as your computer's name, by default. This can be changed in Dante Controller like any other Dante device.
- The computer will display the number of transmitter and receiver channels configured in Dante Virtual Soundcard, above.
- Subscribe these channels like any other Dante device to send or receive audio.
- Example: to record a show from a mixer, we configure that mixer to send pre-fader outputs to its Dante card. We then subscribe those Dante transmitter channels to the receiving channels of Dante Virtual Soundcard, and send the audio directly to our DAW.



# NOW WHAT?



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## NEXT STEPS

- Want to know more?
- Take Level 2!
- Go in depth on:
  - Dante Controller
  - Dante Virtual Soundcard
  - Using Multicast
  - Redundant Dante networks
  - More!



We strongly recommend that you continue on your path towards becoming a Dante expert. Level 2 gets in-depth on Dante Controller, Dante Virtual Soundcard, and more about using networked audio effectively.

## TAKE THE TEST

<http://www.audinate.com/certify>

- Create Audinate account if you don't have one
- Login at URL
- Take Level 1 test
- Certificate automatically generated

Now that you've completed this session, we encourage you to take the online test and become Dante certified at Level 1.

- Create an Audinate account if you don't already have one
- Navigate to <http://www.audinate.com/certify> and login with your Audinate credentials
- Choose the Level 1 test
- Once successfully completed, your certificate will be automatically generated and emailed to you.

**THANK  
YOU**



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