

# Introduction to Dante

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DANTE CERTIFICATION PROGRAM

LEVEL 1

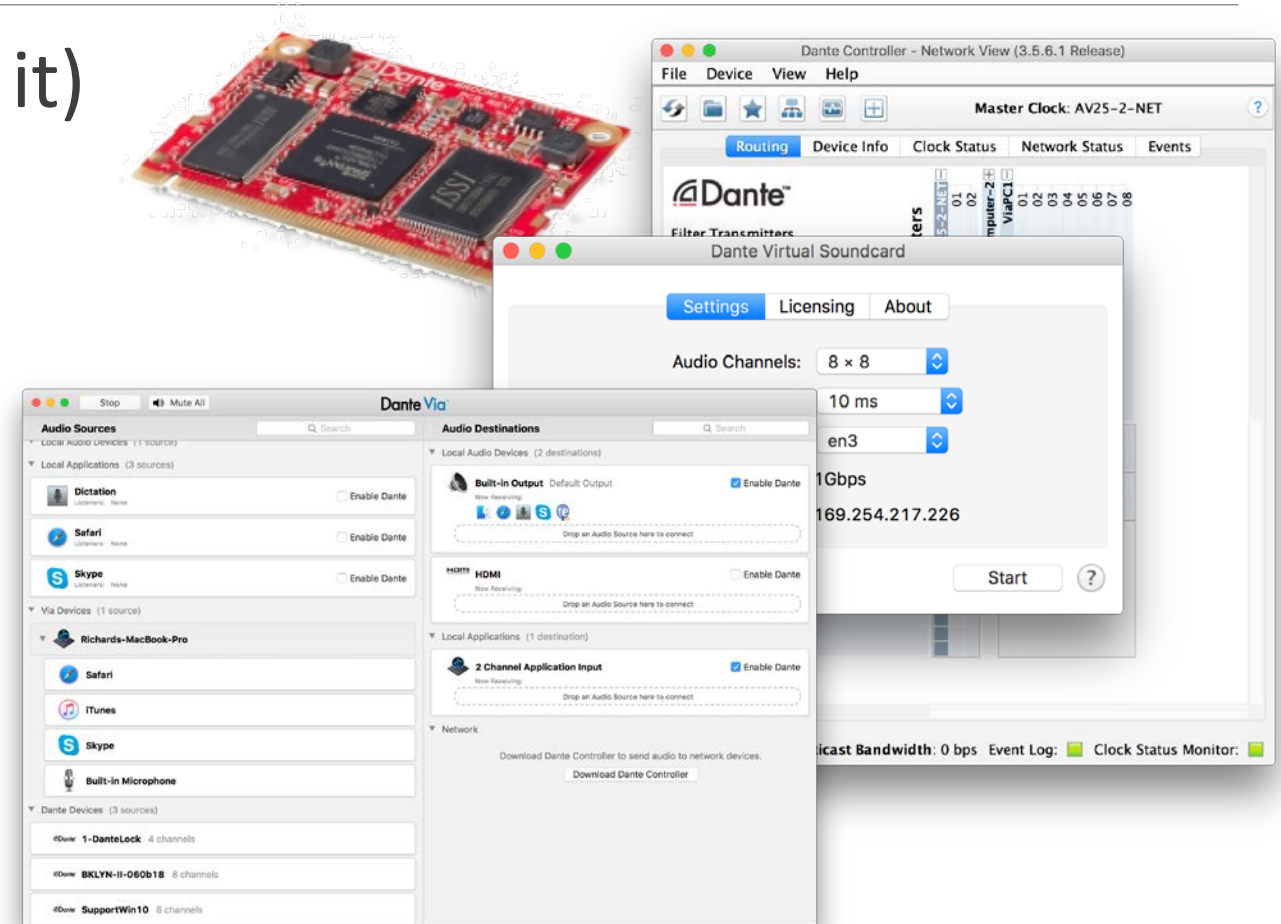
# About Audinate

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- Headquartered in Sydney, Australia
- Network engineers first
- Develop Dante as 100% interoperable solution for all audio manufacturers

# What we make

- Dante technology (all of it)
- Hardware modules
- Development tools
- Software products:
  - Dante Controller
  - Dante Virtual Soundcard
  - Dante Via



# The Dante Certification Program



- Course structure:
  - Level 1: Introduction to Dante
  - Level 2: Intermediate Dante Concepts
- Certificate requires:
  - Pass Level 1 online test
  - Pass Level 2 online test
  - Pass Level 2 in-person hands-on test



# The Dante Certification Program

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- Do your *hands-on* testing for Level 2 **today** at test stations
- All attendees will receive an email within 24 hours detailing next steps if you wish to become certified
- Both Levels 1 & 2 must be passed
  - If you are in Track 2, you will be able to pass the Level 1 online test

# Level 1 Topics

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- Digital audio basics
- IP networking basics
- What is Dante?
- Using Dante

# Digital Audio Basics

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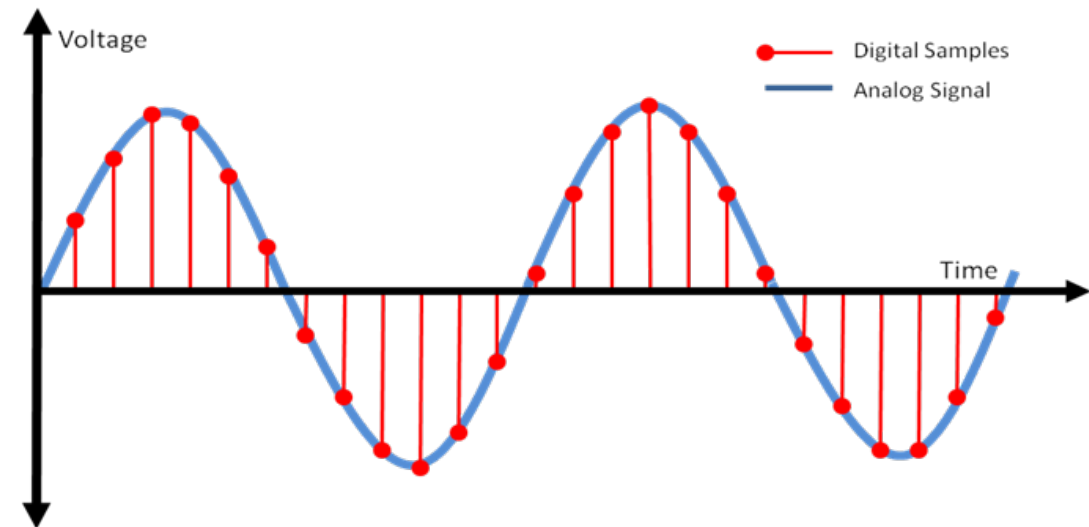
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# Analog to Digital Conversion

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- Analog signal is sampled at constant intervals
- Yields a stream of values in time
- PCM

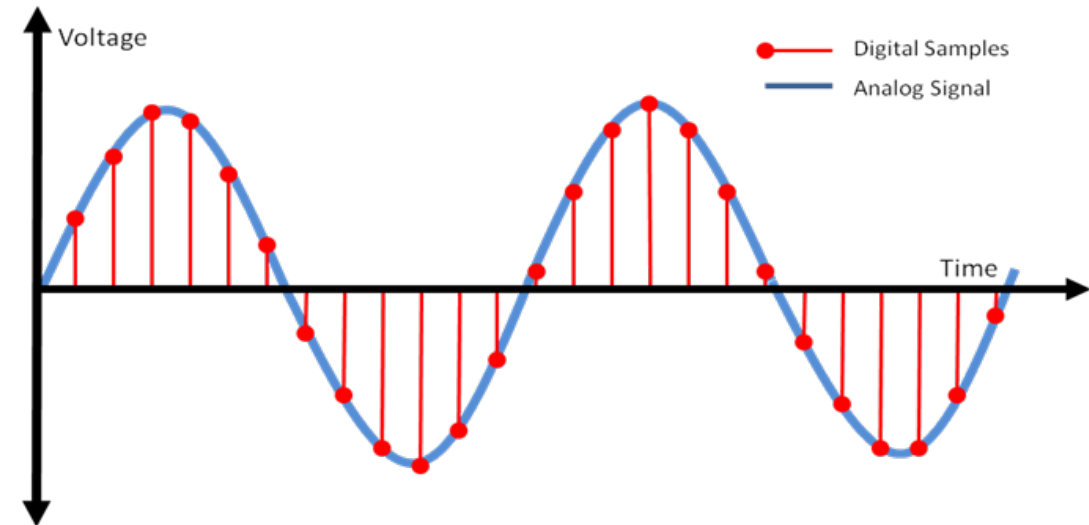




# Sample Rate

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- How often samples are taken
- Nyquist Theorem:
  - Samples must be taken at 2x maximum audio frequency



# Bit Depth

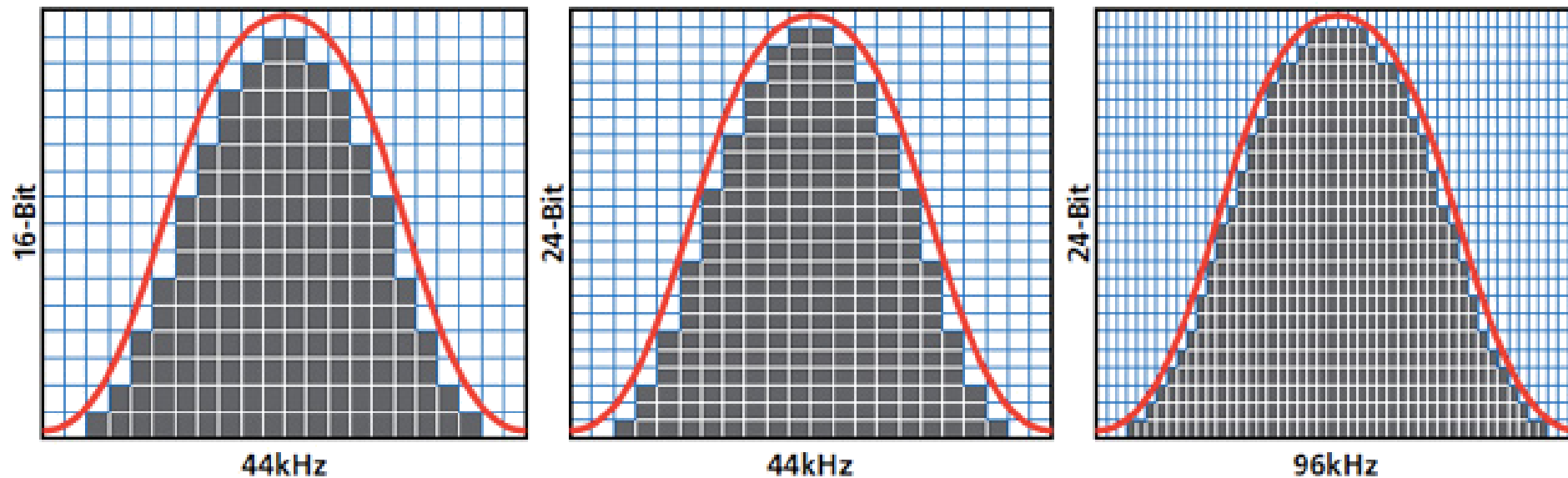
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- How many bits are used to represent amplitude
- More bits -> more accuracy
  - CDs: 16 bits
  - Pro: 24 bits

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

# Combining Sample Rate & Bit Depth

- More of each -> greater fidelity
- Increased bandwidth usage
- Diminishing returns



# Bandwidth

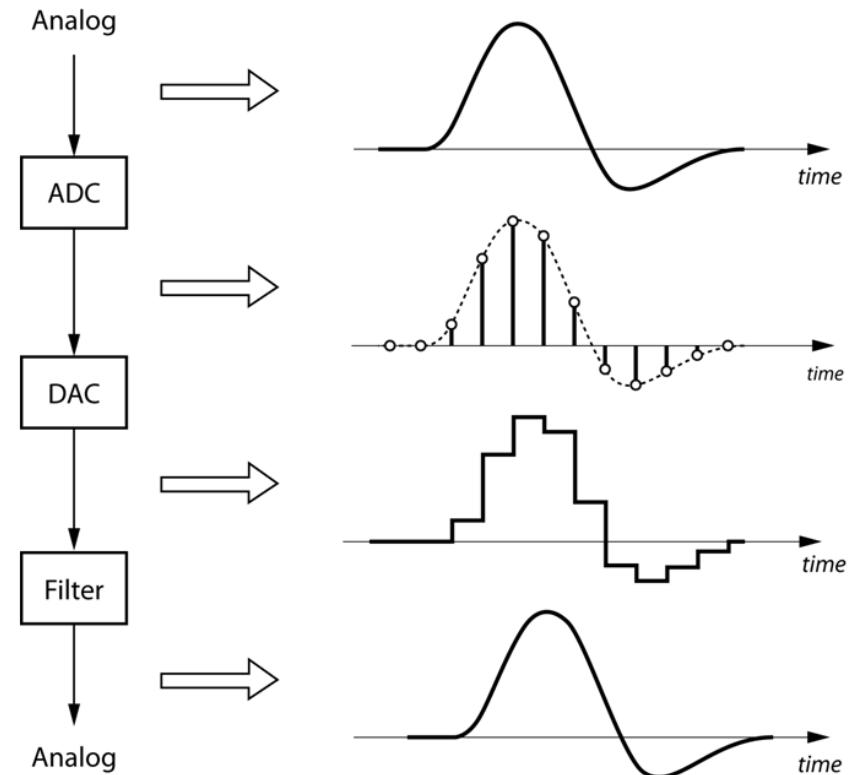
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Bandwidth = (Sample rate) x (Bit depth)

- Example: 48kHz sample rate, 24-bit depth
  - $48,000 \times 24 = 1.152$  mbits/sec per channel
- 64 channels of audio at 48kHz/24-bit
  - $48,000 \times 24 \times 64 = 74$  mbits/sec

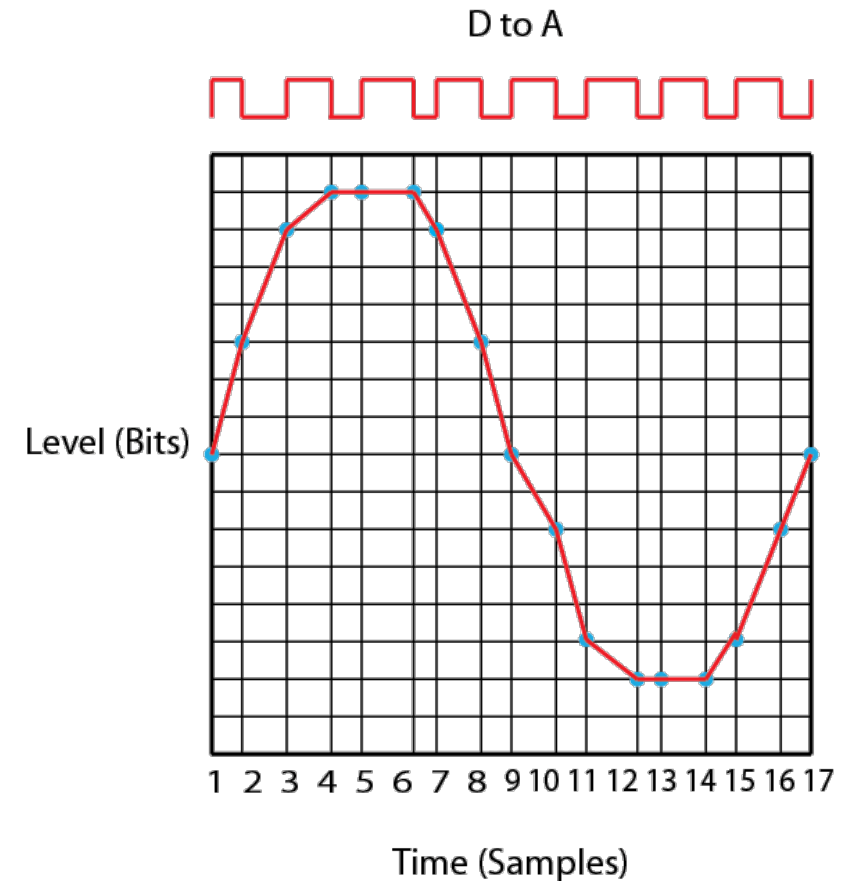
# Word Clock

- The clock that determines when each sample is sampled or played out
- Must match original clock for playout
- Must be consistent for all devices in a digital system



# Jitter

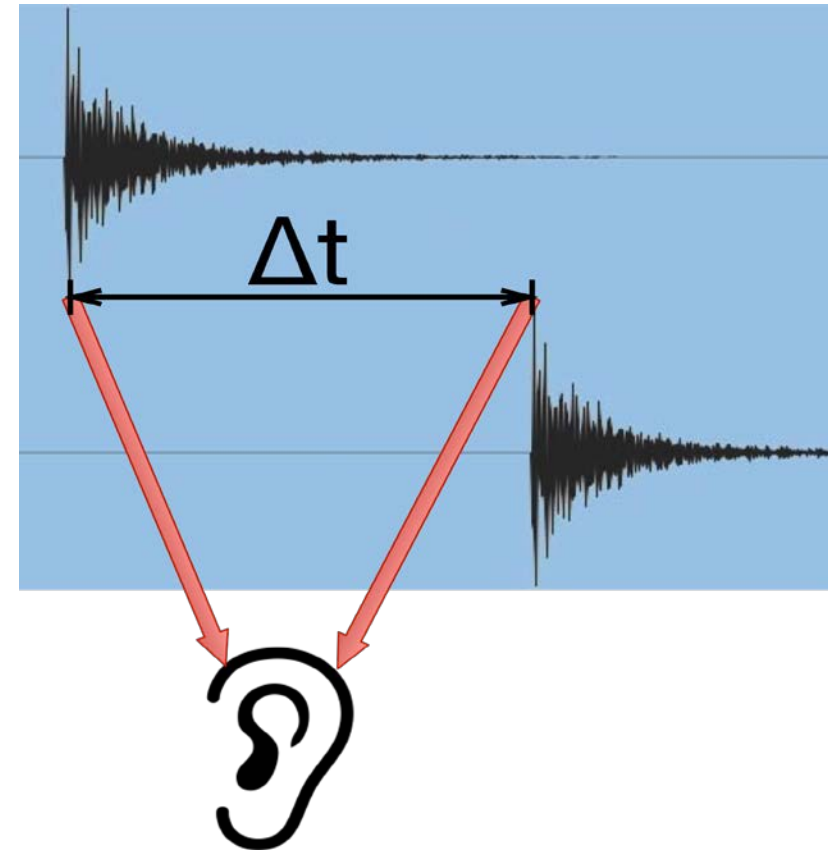
- Distortion caused by inconsistent word clock in playout
- Classic problem with older “daisy chained” digital audio
- AES3, MADI, ADAT, S/PDIF
- Expensive to solve in older systems



# Latency

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- 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)



# Summary

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- Digital audio works by playing out or recording samples
  - Bit depth describes amplitude resolution
  - Sample rate determines maximum frequency
- Word clock must be consistent
- Digital audio produces data that can be transported like any other – time is key that Dante provides



# IP Networking Basics

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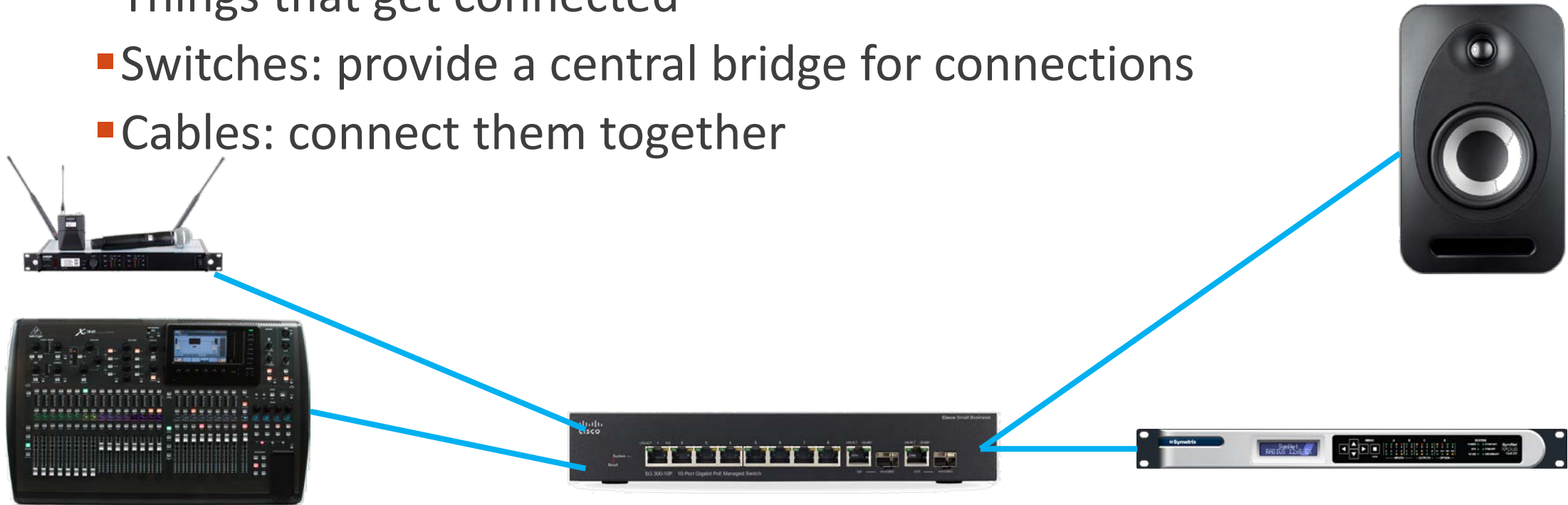
How much networking do I need to know?

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Not very much  
(usually)

# 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



# What kind of cable for Dante?

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- Same as for any regular computer network
- Gigabit rated:
  - CAT5E
  - CAT6
- 300 feet max per run



# What about Wi-Fi?

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- Wi-Fi is another way to connect to IP networks
- Much less reliable than wired Ethernet
- Not compatible with Dante audio
- OK for Dante Controller only

# What about fiber?

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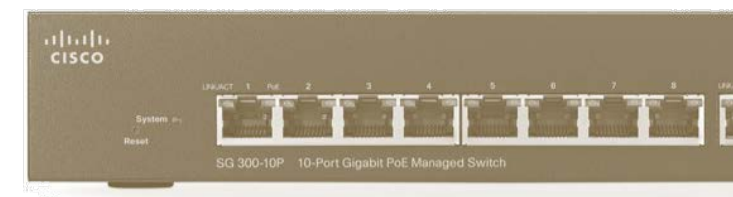
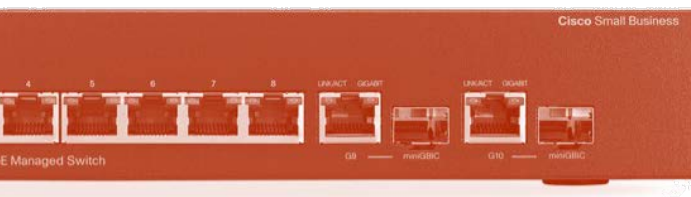


- Just another way to do Ethernet
- Much greater distances if needed
- Requires switches with SFP

# Switches

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- 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 switches!



# Switches – unmanaged & managed

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- Unmanaged switches – plug ‘n play, limited
- Managed switches – many many options and adjustments
- Dante works with either type
- Managed switches needed in “mixed” (e.g., audio + other data) or heavily loaded networks
- Unmanaged switches good in small dedicated audio networks



# EEE Switches

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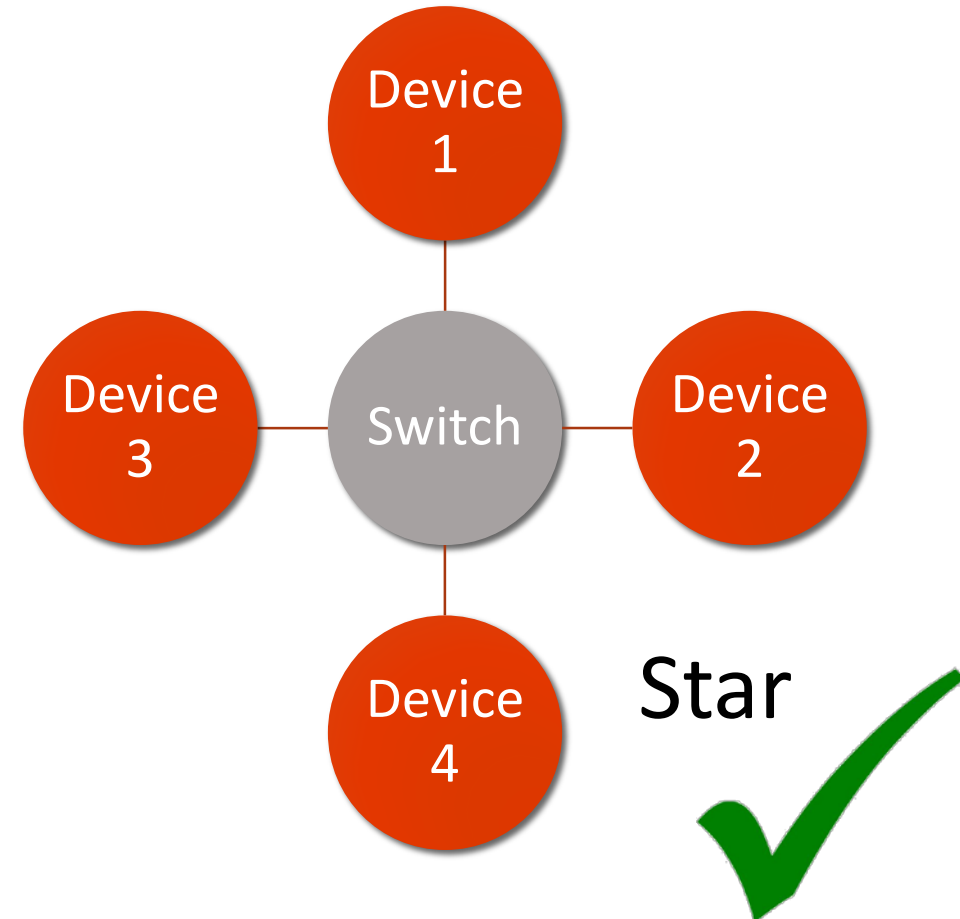
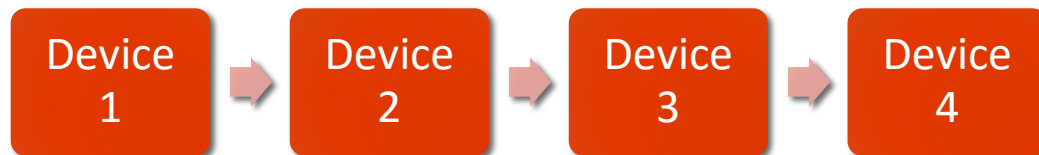
- One special note:
- EEE or “Green” switches are often not a good for real time media
- The energy saving feature will shut down ports and prevent parts of Dante from working properly
- Disable this feature, or use switches that do not support it



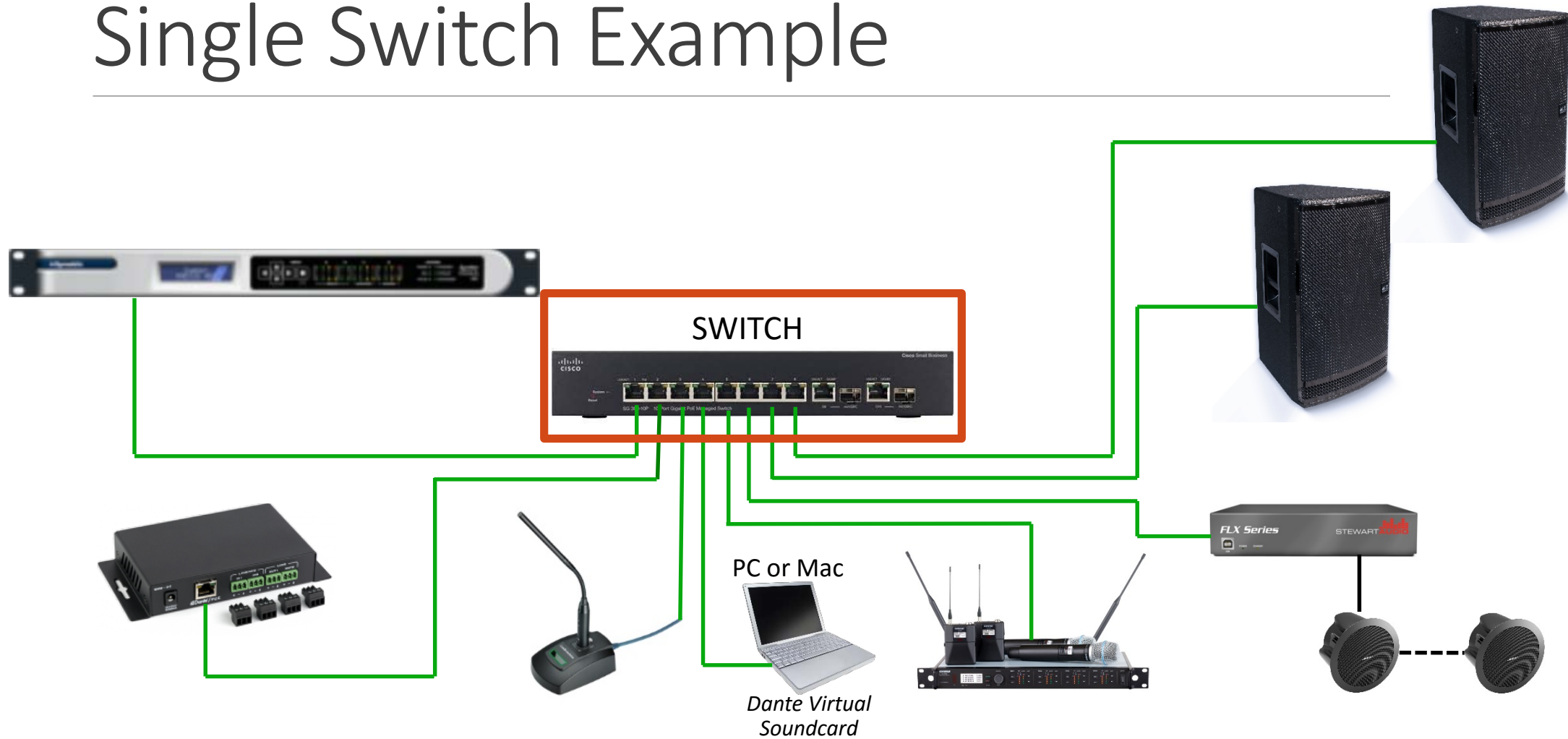
# Topology

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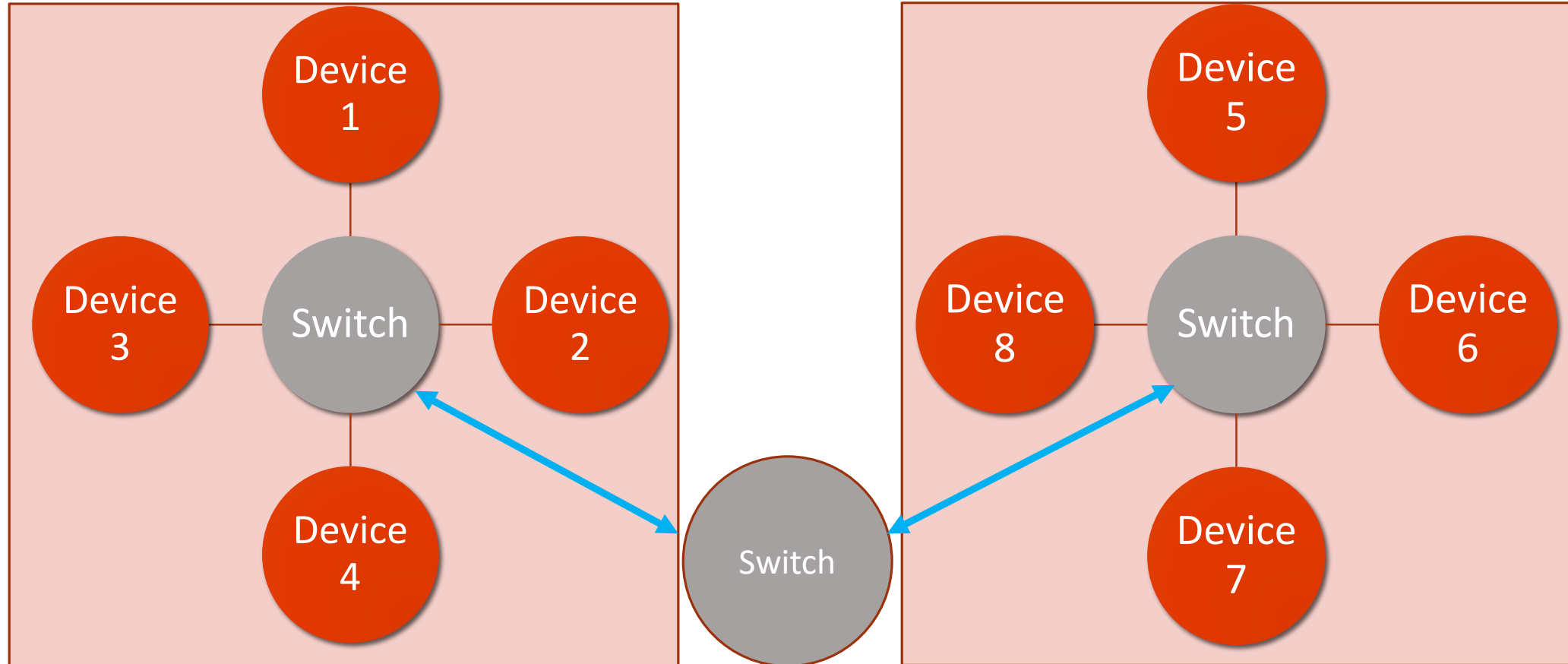
## Daisy chain



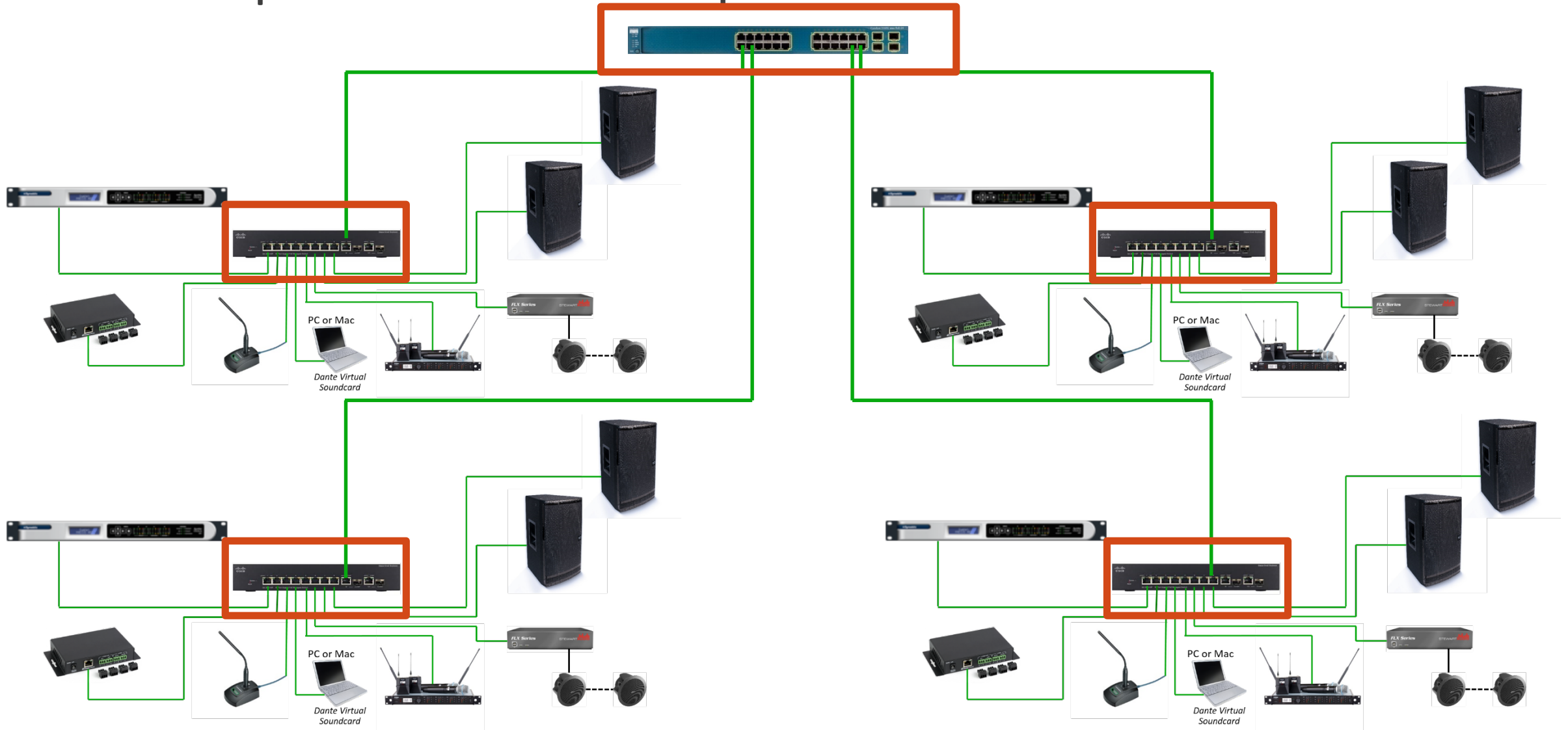
# Single Switch Example



# Multiple stars



# Multiple stars example



# Summary

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- Use gigabit switches
- CAT5E or CAT6 cable
- Fiber for long runs
- Managed or unmanaged switches OK for audio-only networks
- Use a “Star” topology to minimize switch hops
- Avoid or disable EEE

# Logical side of networking

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- Physical wiring diagram not very useful
- All connections “logical” – name-to-name in **software**
- Data delivered in **packets**
- Network technology is neutral; no special gear needed for audio

# A word about network layers

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- Each layer passes data to the next
- Layer 1: physical connections (e.g., cables)
- Layer 2: devices represented by fixed hardware addresses (MAC)
- Layer 3: devices represented by variable IP addresses

Layer 1 - Physical (hardware & cables)

Layer 2 - Hardware addresses

Layer 3 - IP addresses



# What is an IP address?

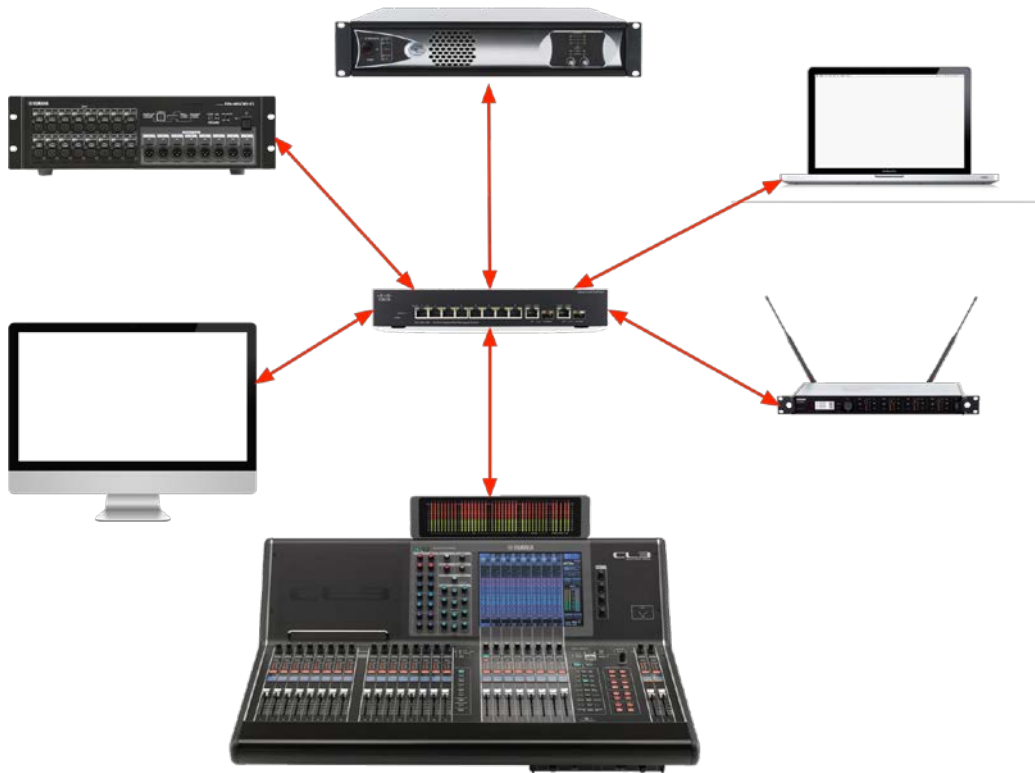
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- Numeric addresses mapped to devices
- Dynamic or user-assigned
- Communication only between devices in the same IP address range
- LAN: all addresses in same range

# What is a LAN?

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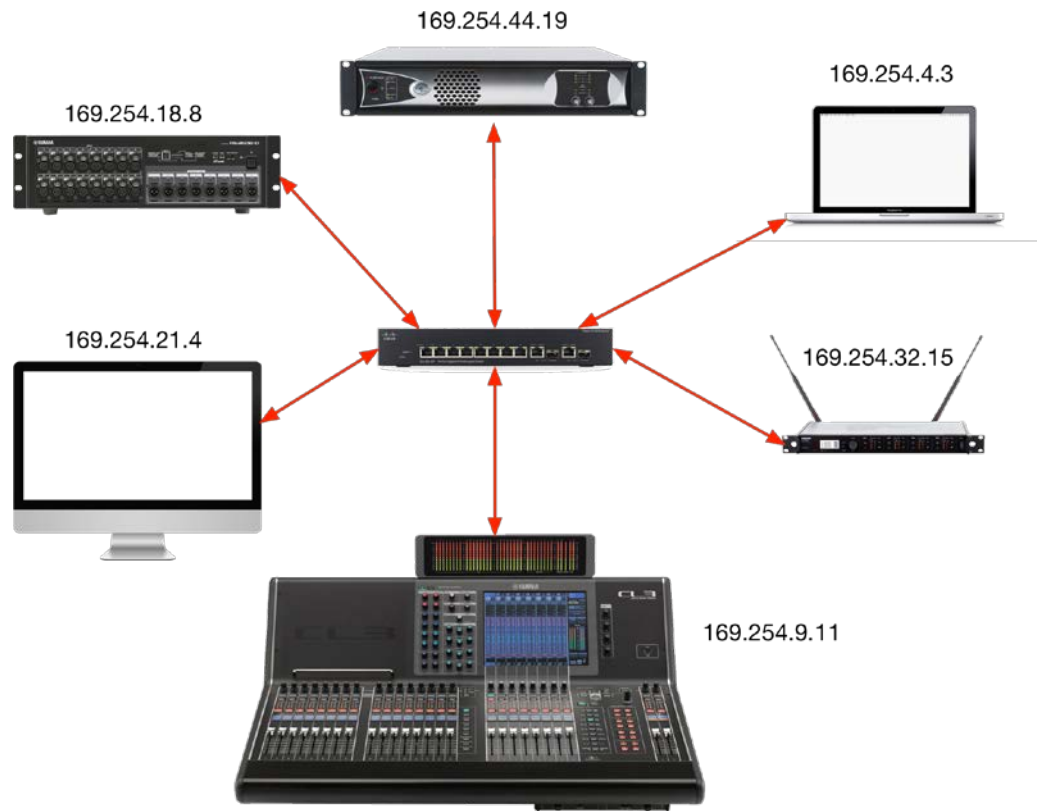
- Local-area Network
- Small number of devices (<200)
- Covers a relatively small area
- Very reliable, fast
- Shares a common IP address range
- Majority of audio networks are LANs

# What is a “stand alone” network?

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- 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

# Automatic addressing



- LAN requires IP addresses in same range
- Automatic addressing enabled by default on Dante devices
- Self-assigned addresses create working LAN

# Summary

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- Layer 3 networking allows use of **IP addresses** for connections
- “Stand Alone” networks are not connected to internet or external resources
- Automatic addressing enables simple “plug and play” use of Dante in stand alone networks – use it!

# What is Dante?

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Dante is a hardware and software solution that transports precisely timed digital audio between devices using standard IP networking

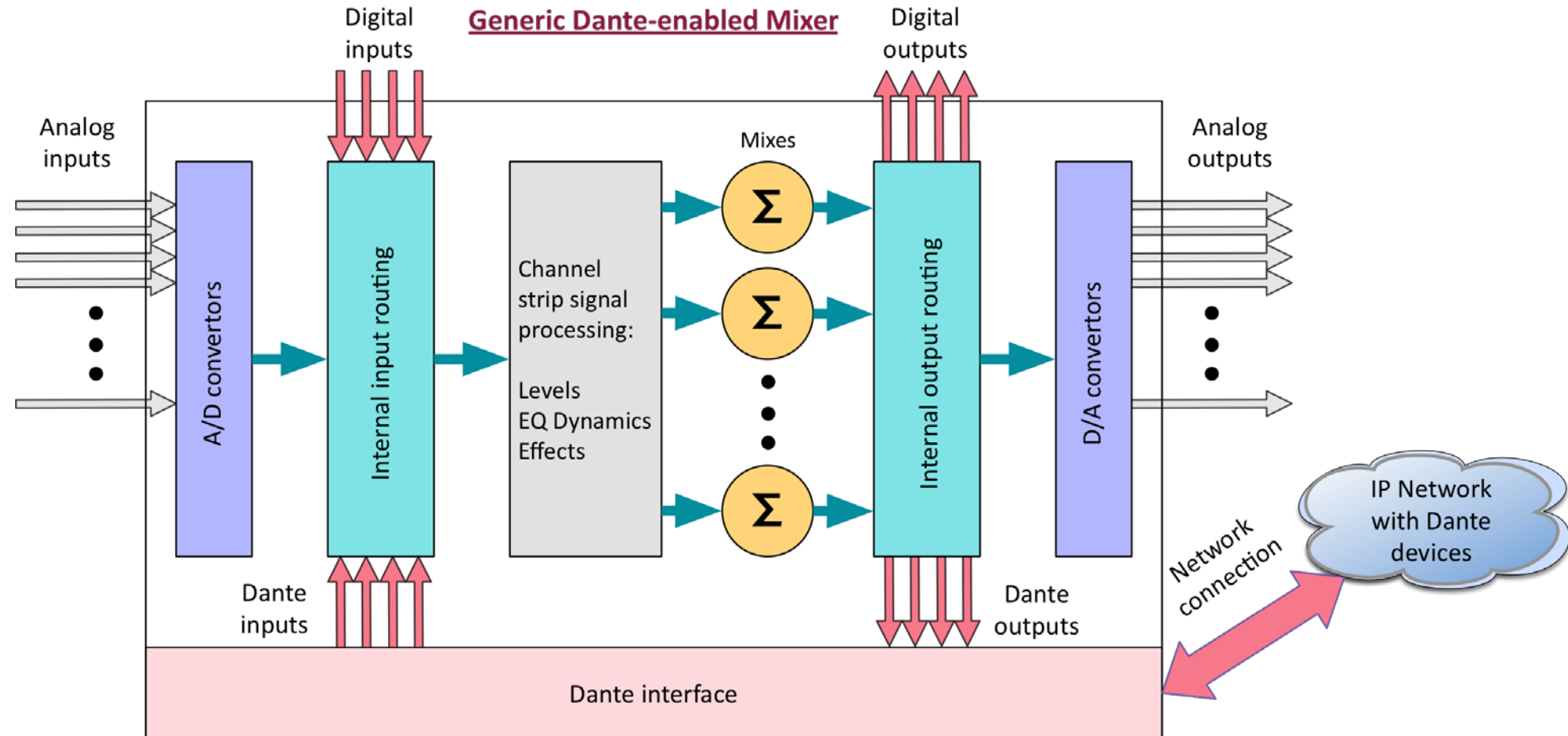
# Dante features and benefits

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- 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

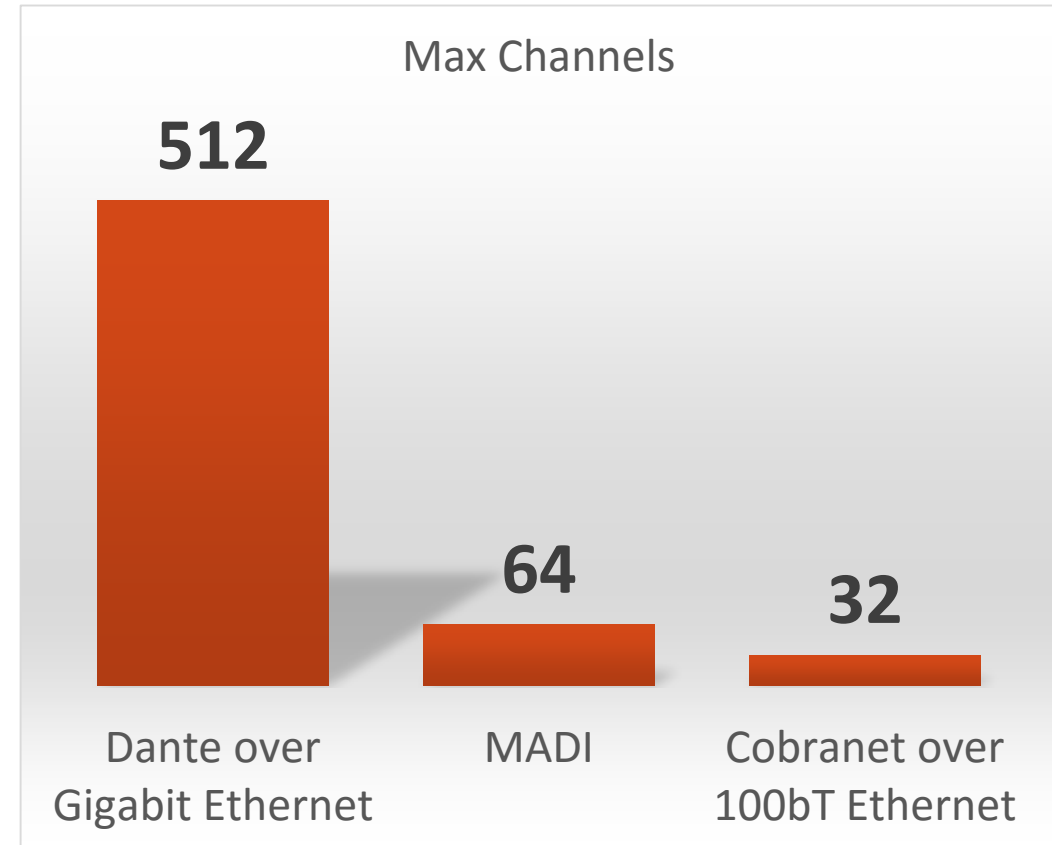


# How is Dante built into products?



# Dante Bandwidth

- Legacy digital systems constrained to lower channel count
- Gigabit means Dante is capable of **512x512**
- Even a large 64 channel console consumes only 1/8 capacity of a single port



# Sample Rate and Connection

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- Only Dante devices using the **same sample rate** may connect
- Multiple sample rates on the same network OK
- Higher sample rates = fewer channels for same bandwidth

# Latency

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- 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

# Clocking

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- 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

# What does Dante NOT do?

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



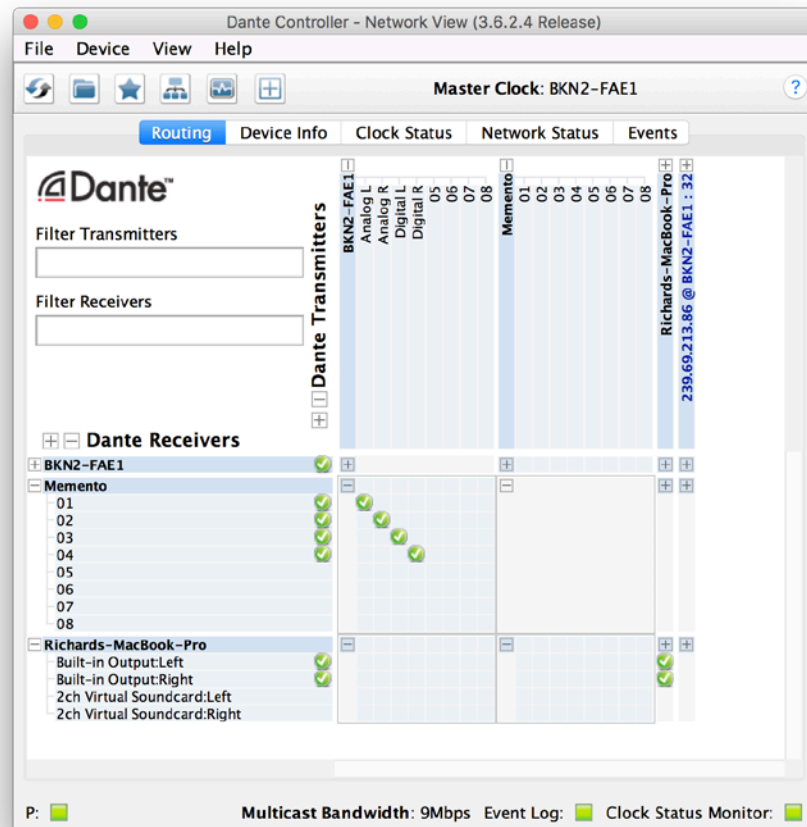
# Using Dante

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# Dante Controller

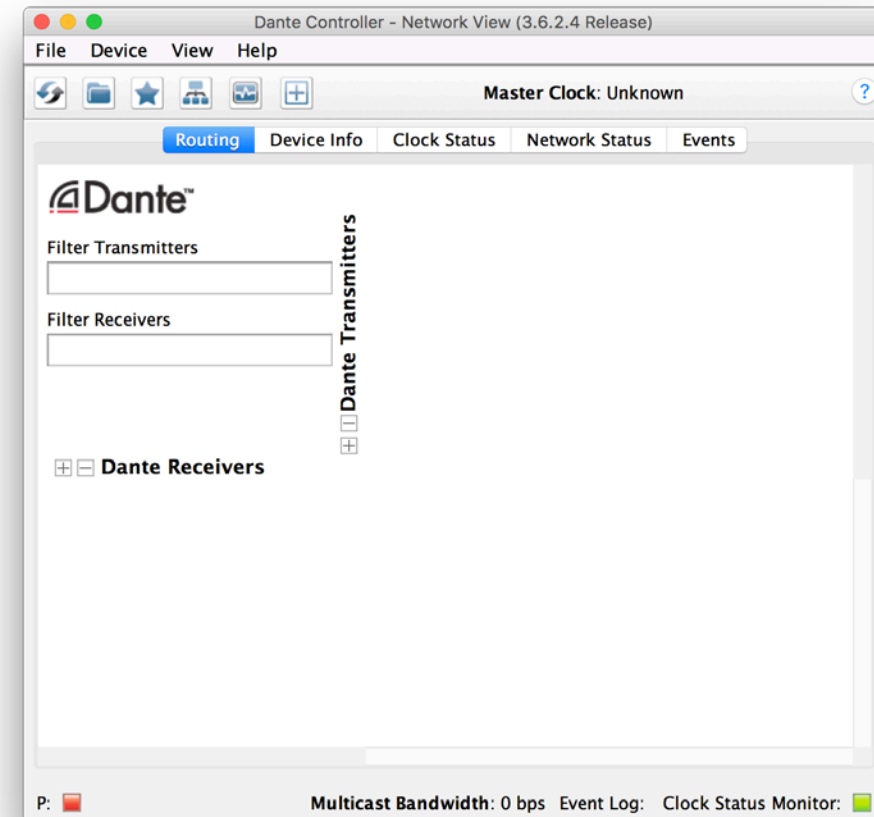


- Primary Dante tool
- Routing: Setup, view, change
- Clock
- Sample Rate
- Latency
- Monitoring

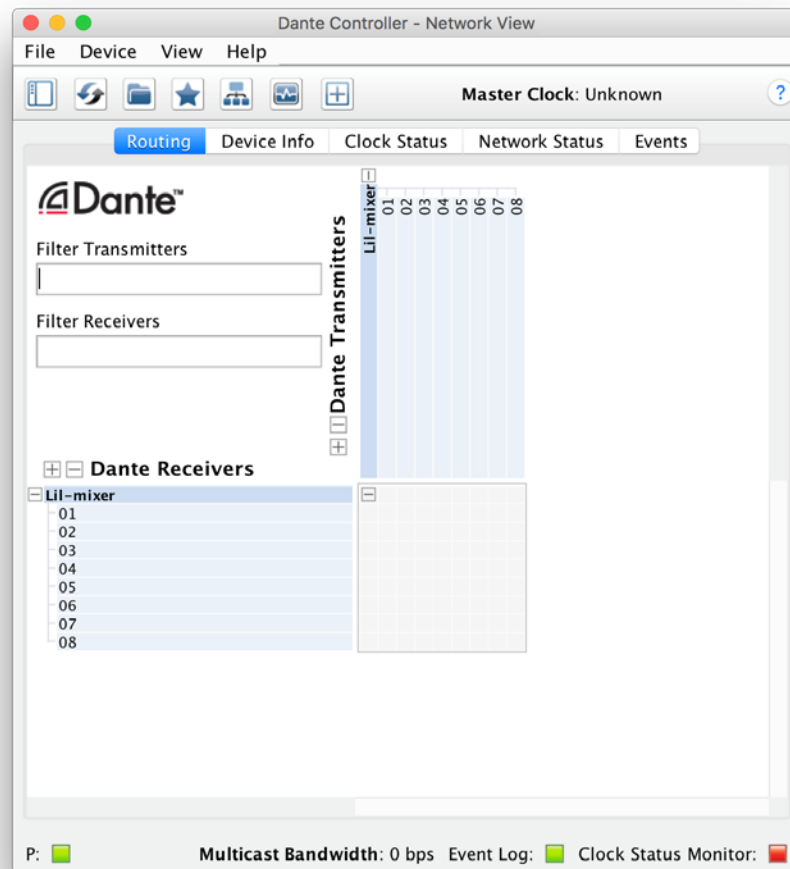


# Discovery and Routing

- If no devices are connected, Dante Controller is empty
- Dante Controller always shows current state of network
- Key concept: network state lives in devices



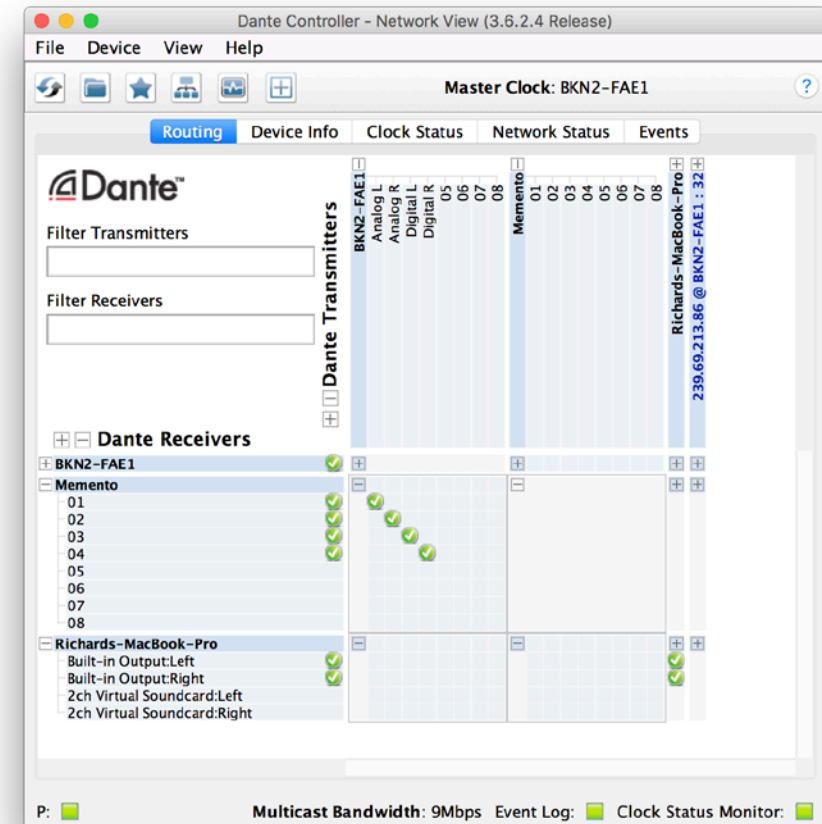
# Discovery and Routing – direct connect



- 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*

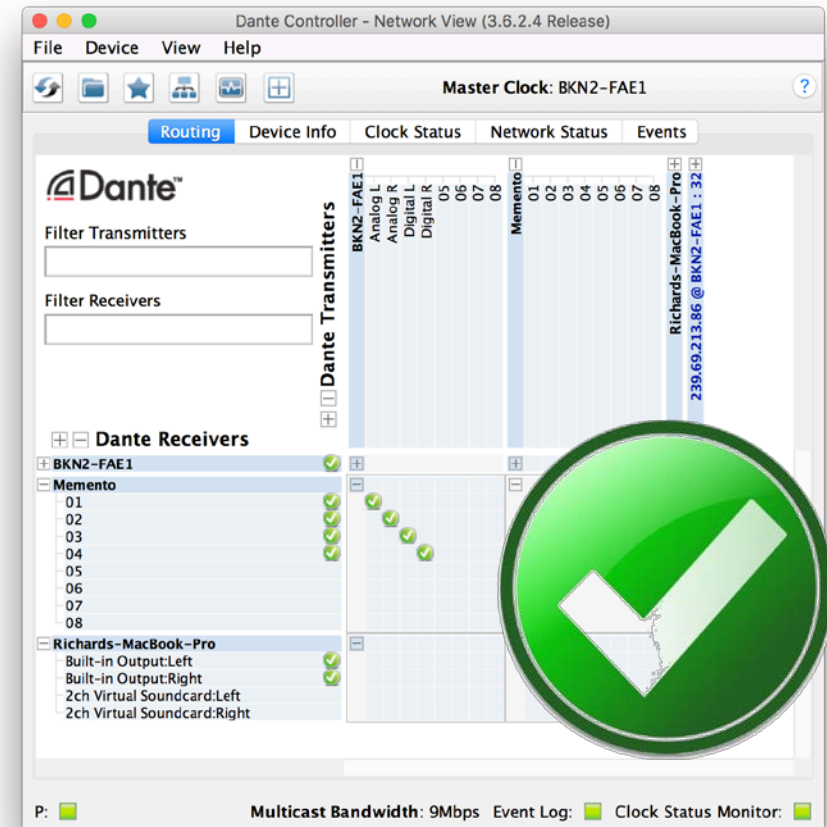
# Discovery and Routing – view channels

- 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

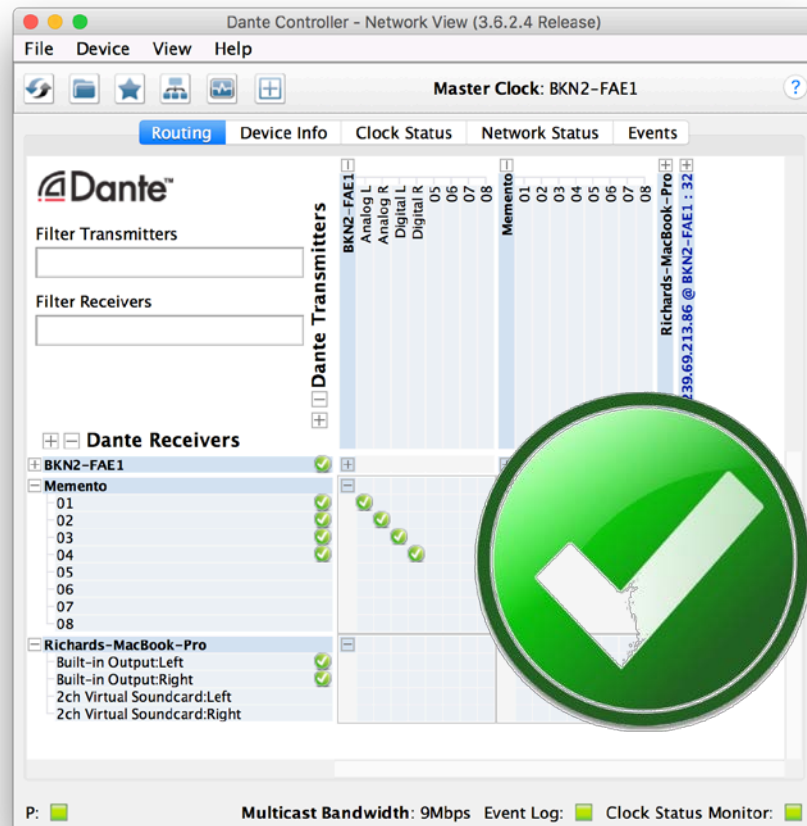


# Discovery and Routing - subscriptions

- 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 match



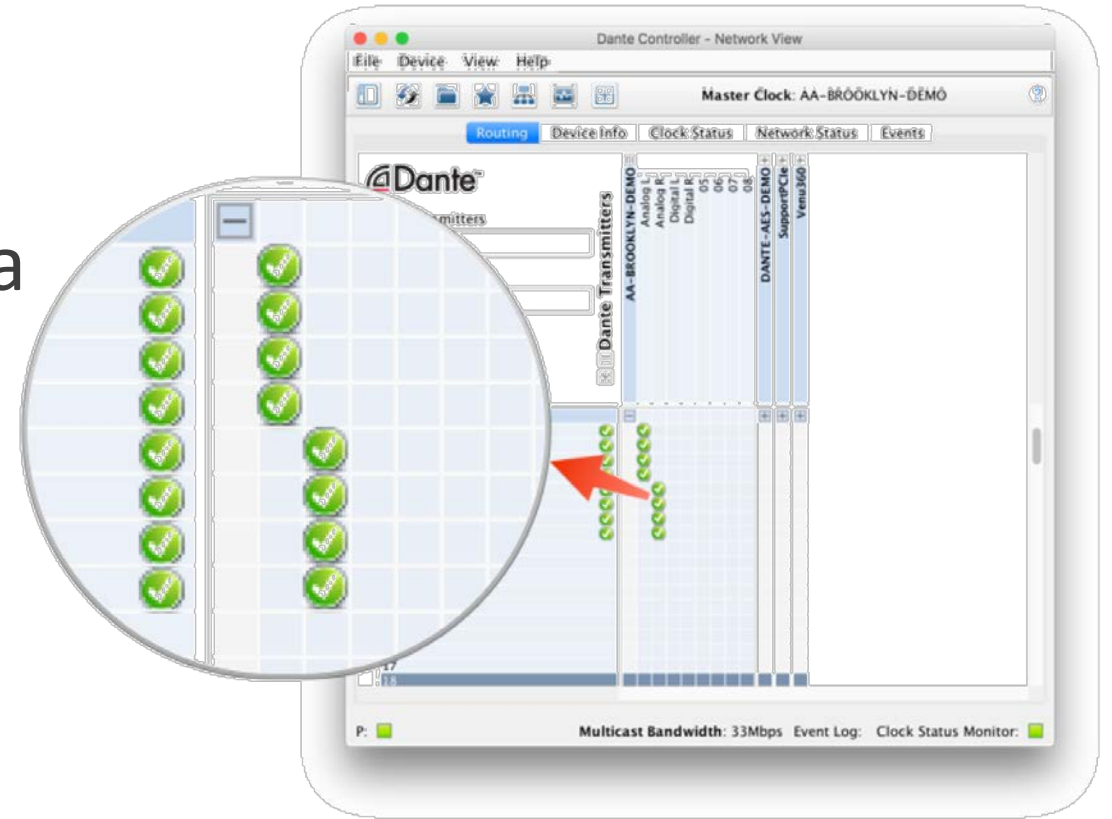
# Discovery and Routing - deleting



- To delete a subscription, click on green checkmark
- Checkmark disappears, subscription deleted

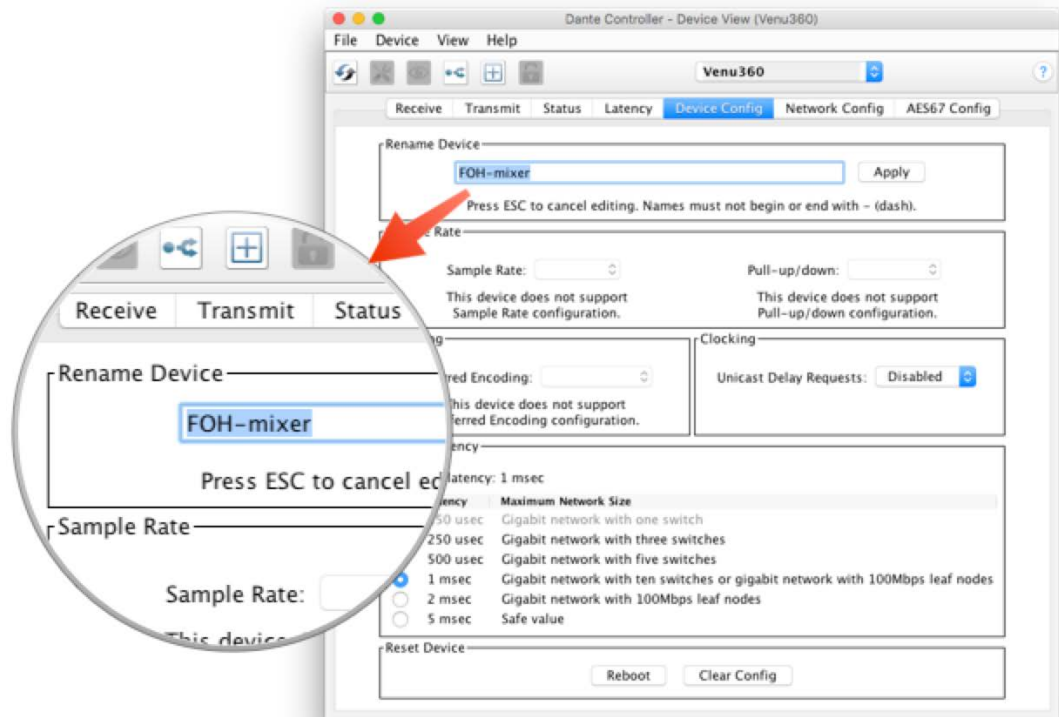
# Discovery and Routing - splits

- Splits are easy with Dante
- Simply click at intersections of multiple receiver channels for a desired transmitter
- Audio sent to all subscribed channels

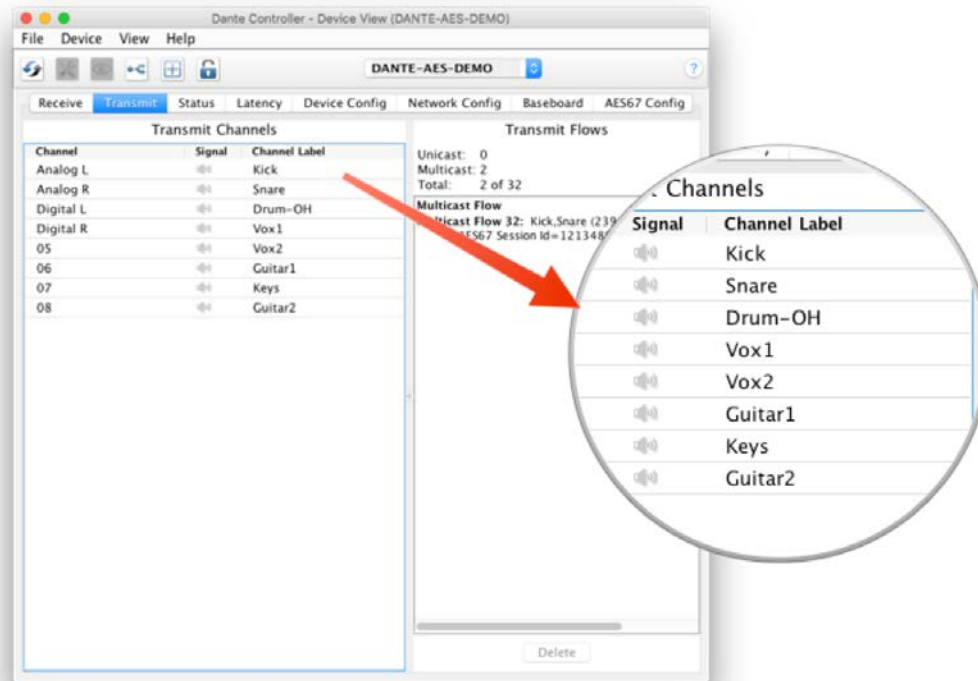


# Device names

- 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



# Channel labels



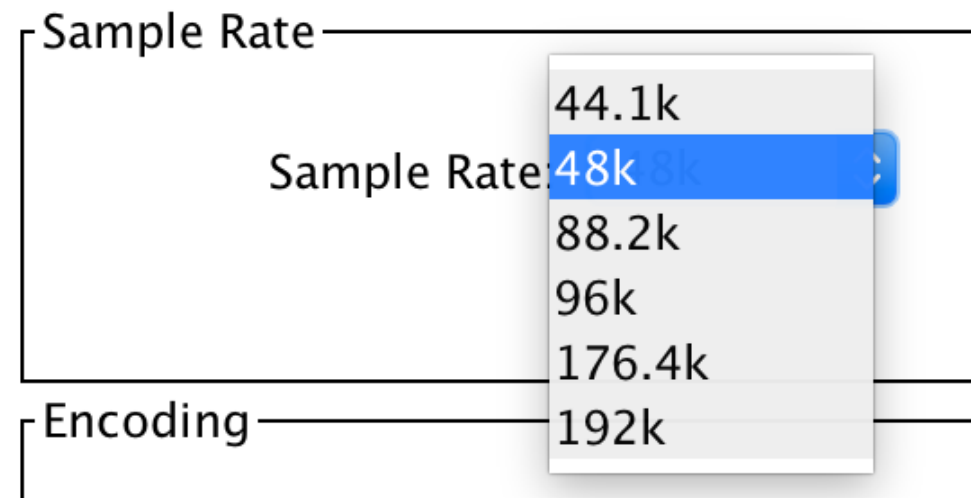
- Labels can be applied to any channels
- Use Device View
- Makes it easy for volunteers or newbies to use system
- Software version of masking tape 😊



# Adjust Sample Rate

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- In Device View -> Device Config tab
- Adjust sample rate and bit depth (Encoding)
- Choices determined by product
- Most common 48kHz / PCM 24



# Power cycle recovery

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- Dante Devices contain settings – not in Dante Controller
- At power up and/or reconnection, all subscriptions are re-established
- Dante Controller **not** required!



Does Dante Controller need to be on the network all the time?

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**No**

# Summary: Key takeaways 1

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- Dante Controller automatically displays connected devices
- Dante devices 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

# Summary: Key takeaways 2

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- 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

# Next steps

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



# Thank you

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DANTE CERTIFICATION PROGRAM

LEVEL 1

