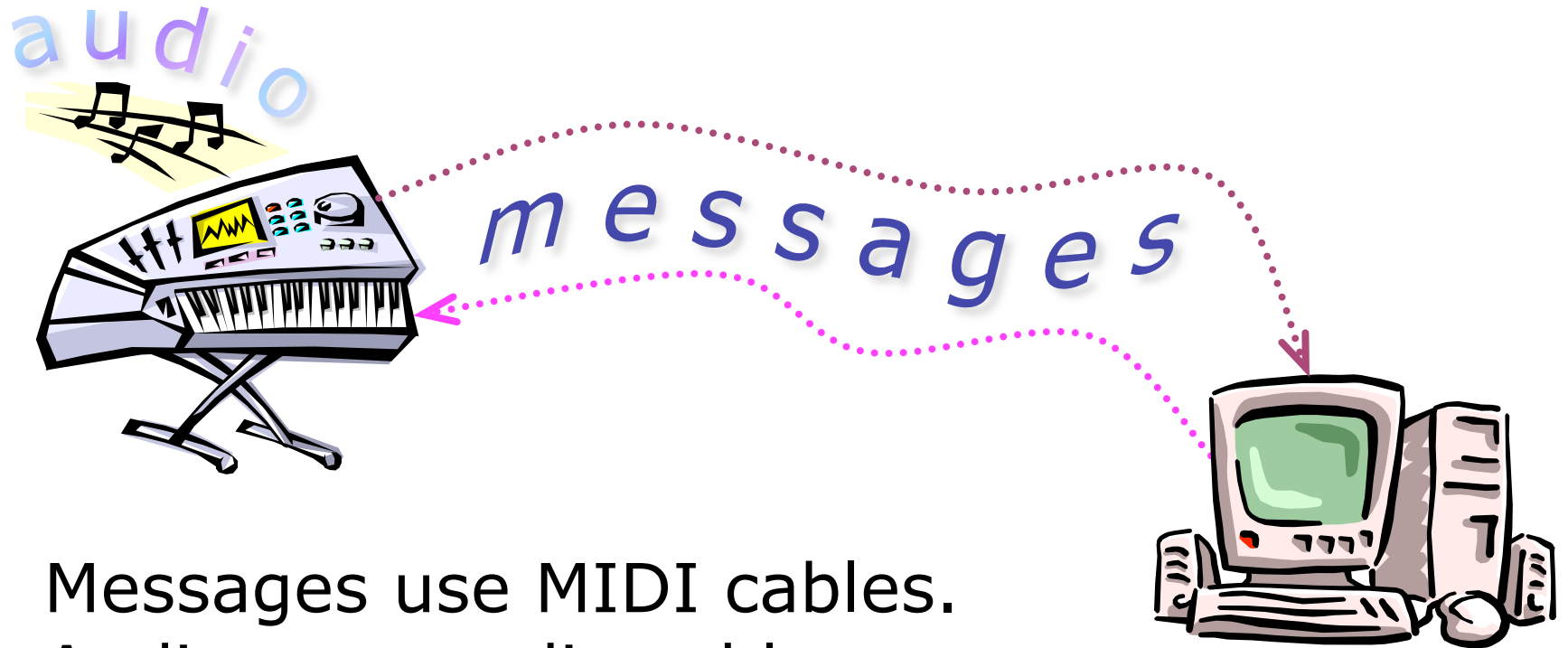


# M I D I

## **M**usical **I**nstrument **D**igital **I**nterface

The MIDI protocol — a “language” that lets synthesizers, computers and other devices talk to each other.

# The MIDI Language

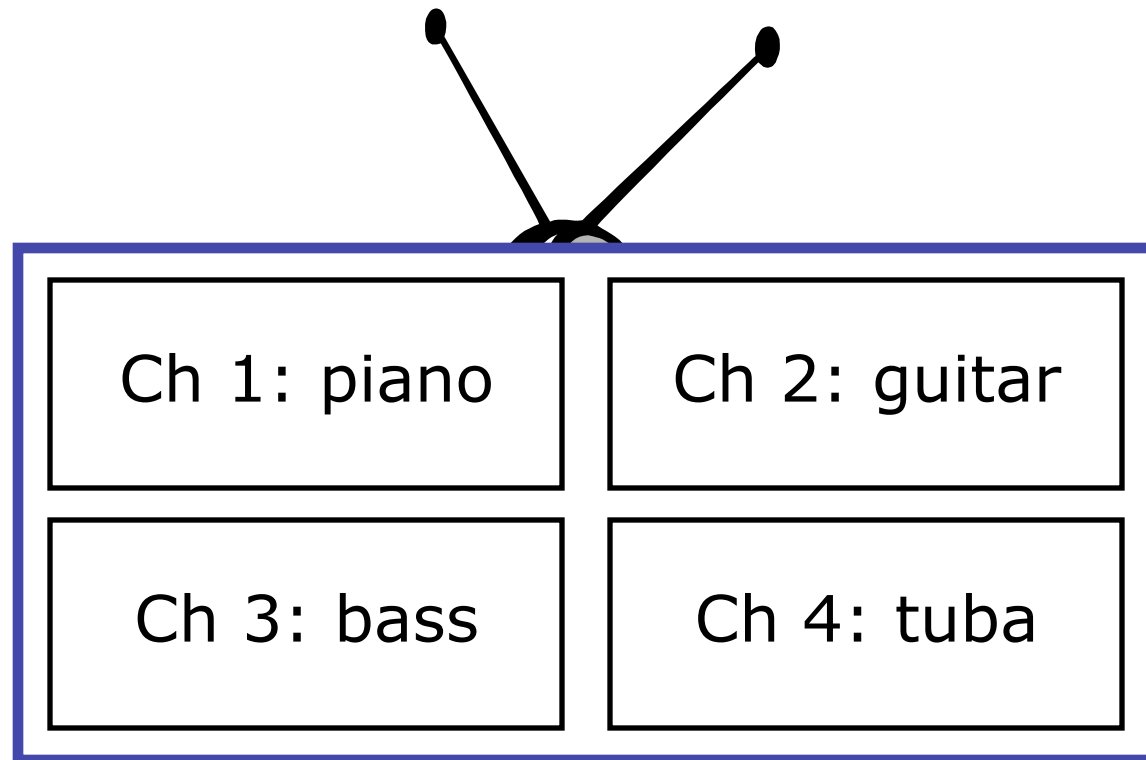


Messages use MIDI cables.  
Audio uses audio cables.

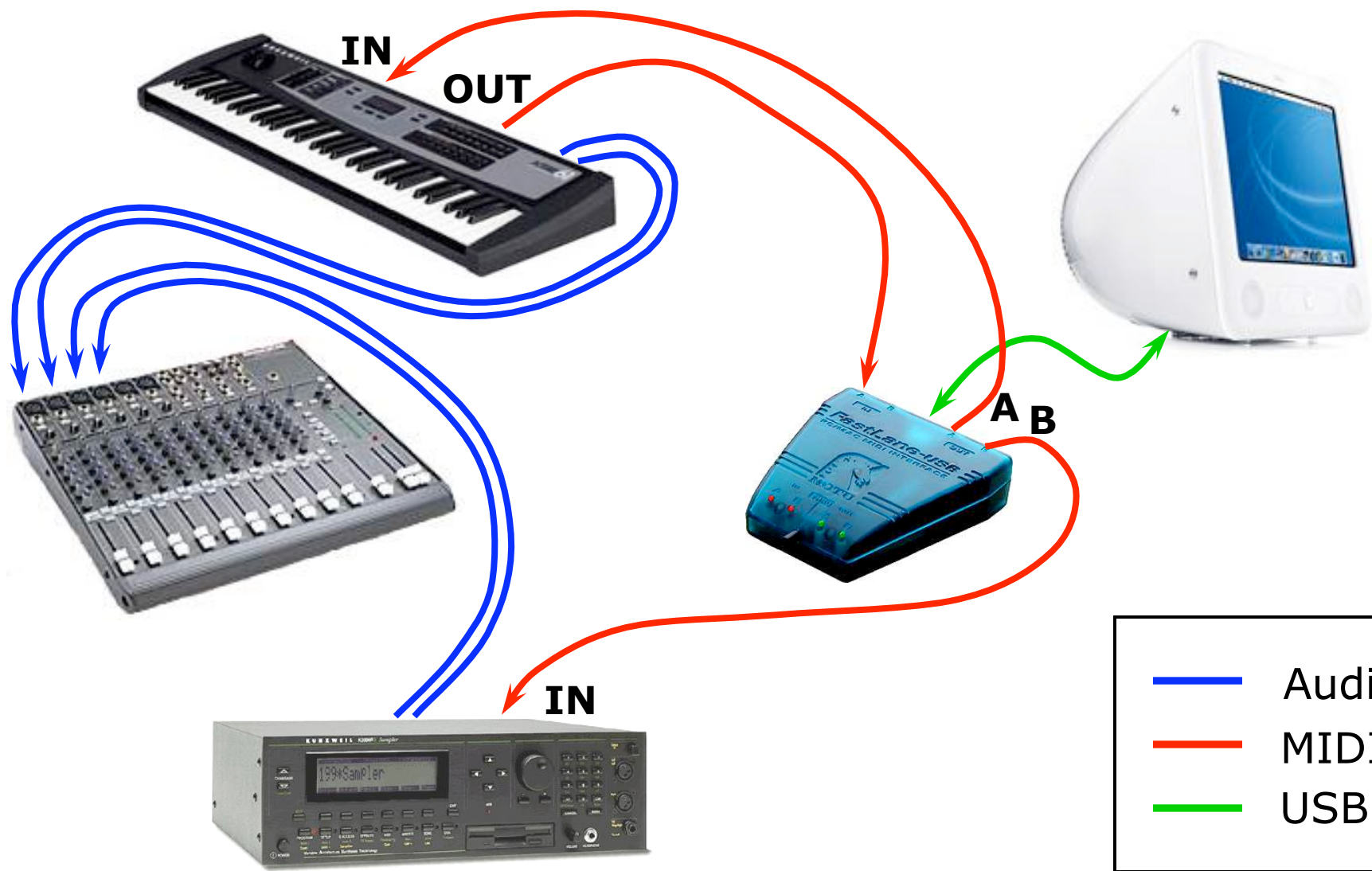
# MIDI Messages




- Note on
- Note off
- Program change (patch change)
- Pitch bend
- Controller change
- Polyphonic pressure (aftertouch)
- Monophonic pressure (aftertouch)

# MIDI Channels



MIDI cable carries **16 channels**



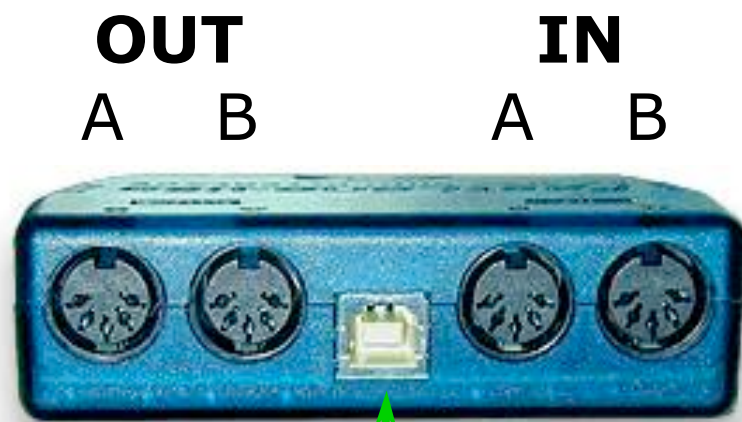
	Audio
	MIDI
	USB

# Multi-port MIDI Interface (2 in/out pairs)



Lights!

**Thru** switch – connects In to Out,  
for use without a computer  
**Leave in 'out' position for sequencing!**



USB port



# Multi-port MIDI Interface (**8** in/out pairs)



Front

MIDI Outputs

MIDI Inputs



Back

Each MIDI cable can carry **16** channels.

USB port



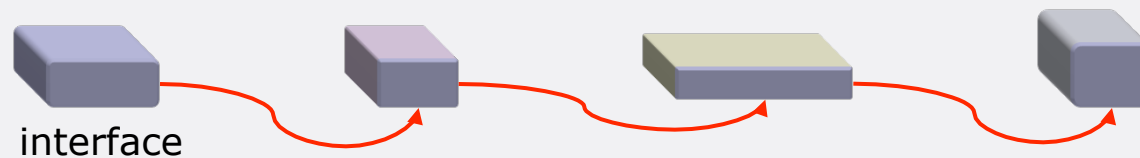
# Two Kinds of MIDI Network

Purpose: provide pathways for MIDI messages



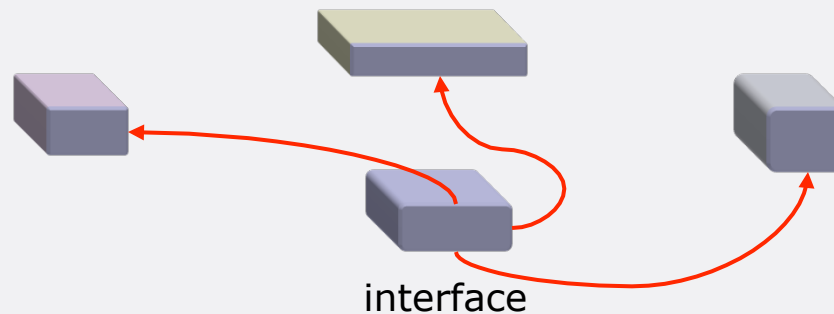
## MIDI Daisy-chain Network

Devices connected in series:

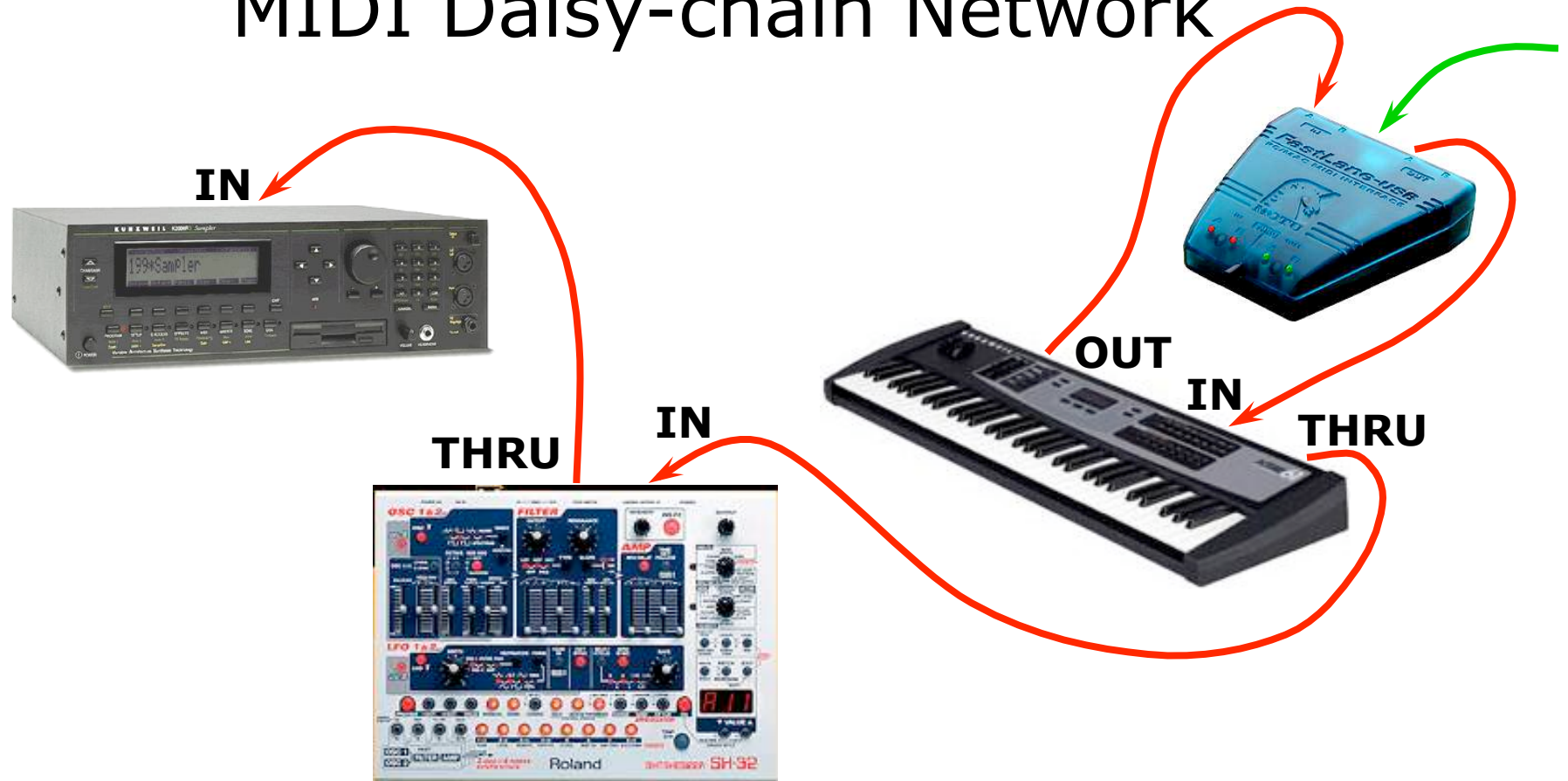


## MIDI Star Network

Devices connected in parallel:



# MIDI Daisy-chain Network



**THRU** port: transmits copy of messages from **IN** port  
The 3 devices must **share 16 channels**.



# MIDI Star Network



Each device has **16 channels** all to itself.  
Any device can act as a **controller**.



# Pros and Cons



## **MIDI Daisy-chain Network**

- does not require multi-port MIDI interface



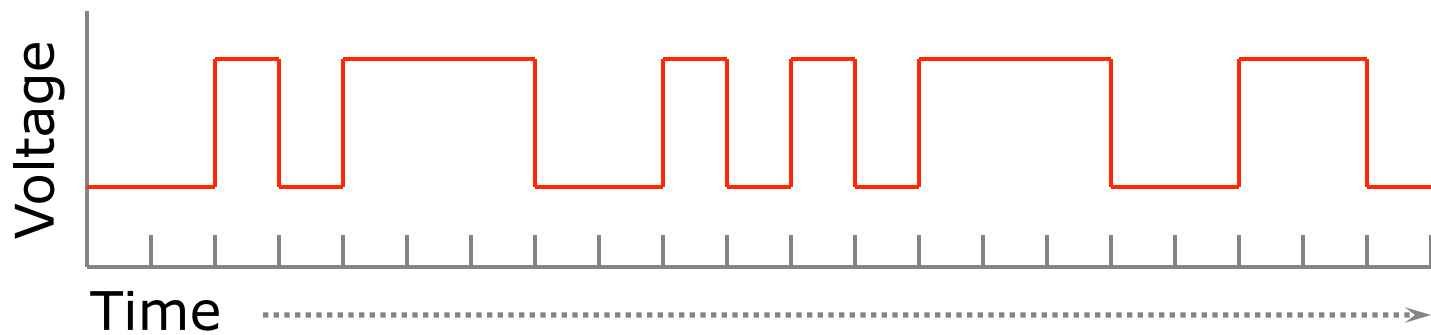
## **MIDI Star Network**

- more accurate timing
- more channels
- more than one device can act as controller

# MIDI Data Transmission

What goes through the MIDI cable?

Timed pulses of electricity – **31250 per second**



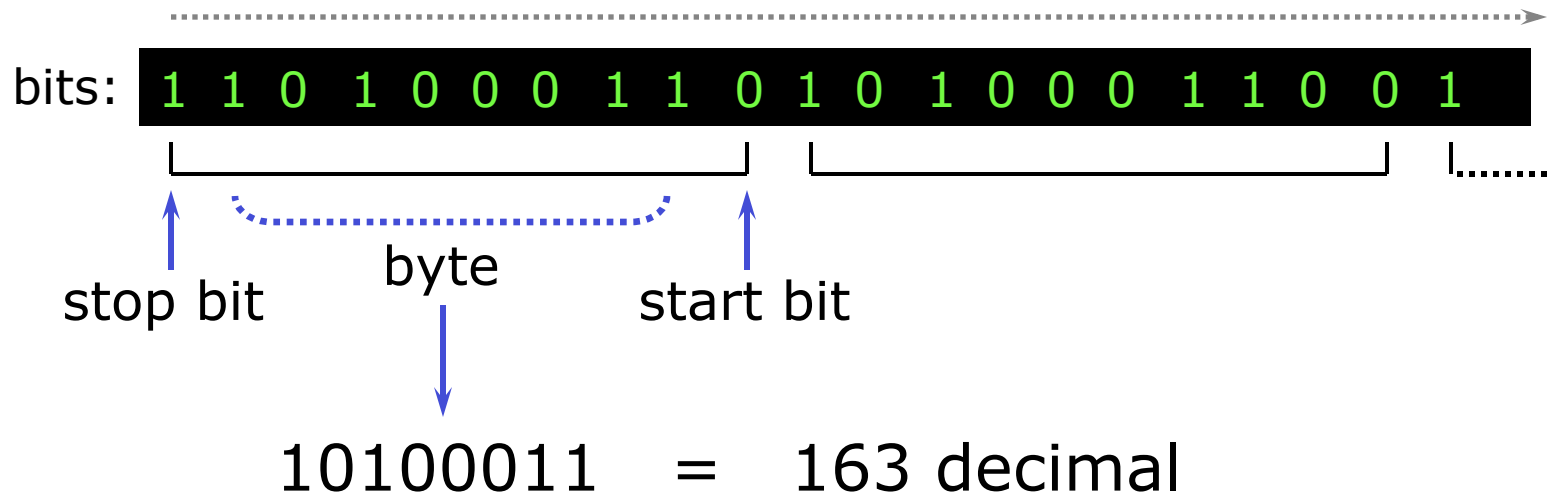
voltage: lo hi lo hi lo hi lo hi lo hi lo hi lo hi lo

bits: 1 1 0 1 0 0 0 1 1 0 1 0 1 0 0 0 1 1 0 0 1



# MIDI Data Encoding

The bits encode numbers, in groups of 8 bits.



Byte: an 8-bit binary number

# MIDI Message Bytes

Stream of bytes parsed into MIDI messages.

Each message contains one or more bytes...

First byte: **Status Byte**

- what type of message [e.g., *note-on*]
- what channel (for some message types)

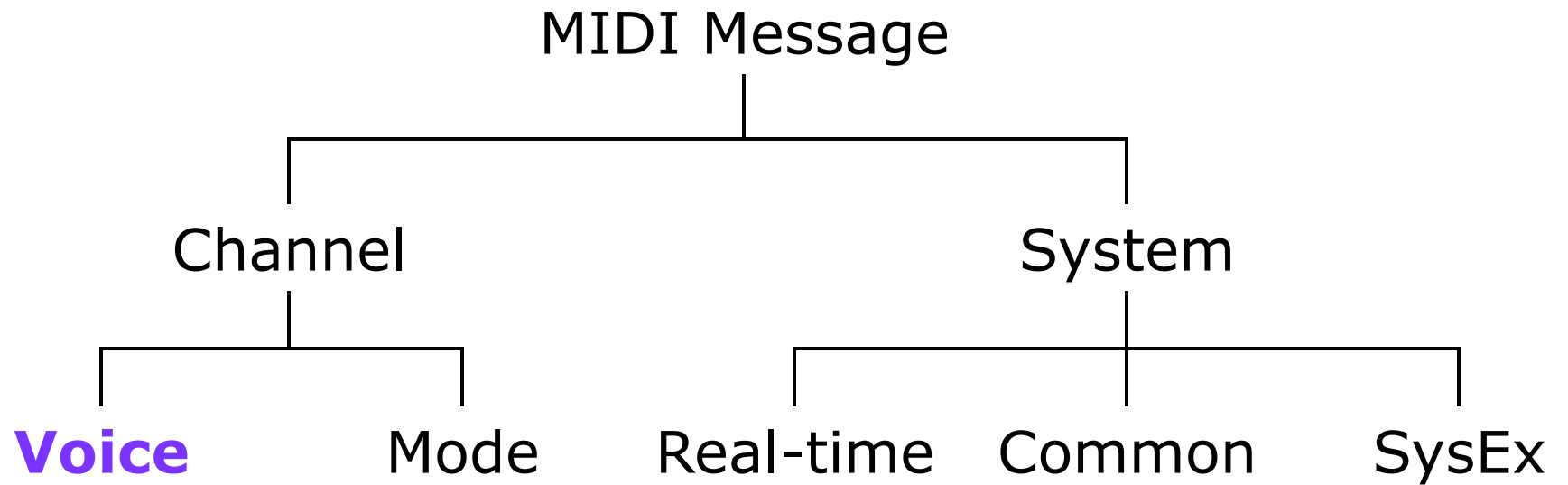
Then, zero or more **Data Bytes**

- meaning and number of bytes depend on type of message
- each byte has a range from 0 to 127 [128 values]

# MIDI Data Rate

- 31250 bits / second = 3125 10-bit bytes / second
- Typical messages have 2 to 3 bytes.
- So MIDI can handle between 1000 and 1500 messages per second.
- Sounds like a lot, but it's easy to clog the stream with controller and pitch bend messages

# Types of MIDI Message



# Channel Voice Messages

<b>Type</b>	<b>Data 1</b>	<b>Data 2</b>
Note on	Note num	Velocity
Note off	Note num	Velocity
Program change	Program num	-
Pitch bend	Bend amount	
Control change	Controller num	Value
Mono pressure	Value	-
Poly pressure	Note num	Value

- All values 0 to 127, except Pitch bend: -8192 to 8191

# Channel Voice Oddities

- Program change can select only 128 programs.  
Bank Select (a type of Control change message) lets you select 128 programs within each bank.
- Pitch bend has much wider range (16384 values).  
Why? Our ears more sensitive to pitch changes.
- Note off rarely used.  
Instead, note on with velocity = 0

# Different meanings for “control,” “controller”

1. An instrument that controls others  
[guitar controller, wind controller, keyboard controller, etc.]
2. Physical controls on an instrument  
[mod. wheel, joystick, foot pedal, breath controller, etc.]
3. MIDI control change messages  
[volume controller, pan controller, controller #6, etc.]

# Control Change Message

- One of the 7 Channel Voice messages
- Data byte 1: controller number
- Data byte 2: value [0-127]
- Lots of controller numbers in common use
- Effect on sound dependent on synthesizer patch

# Common Control Change Messages

<b>Controller Name</b>	<b>Controller Number</b>
Modulation wheel	1
Breath controller	2
Foot controller	4
Data entry	6
Volume	7
Pan	10
Sustain (damper) pedal	64

- Sustain pedal is a *switch controller* – it's either on or off.