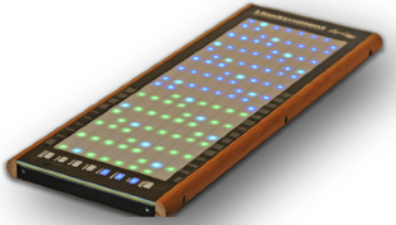





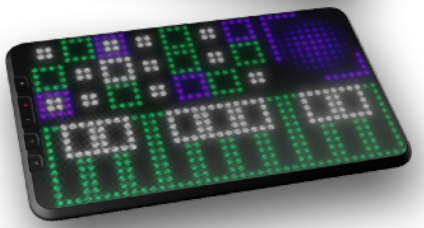



MPE/MIDI 2 for Instrument Creators

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CCRMA Open House 04/16/2024

This Presentation Can be Found at:

http://www.moforte.com go to the “News and Media” section

What is MPE?

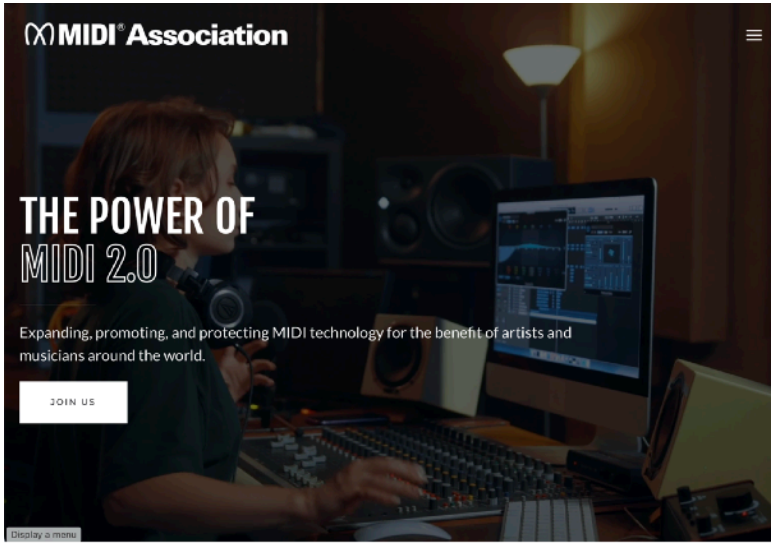
- MIDI Polyphonic Expression (MPE) makes it possible for artists to perform independent gestures for each musical note using three dimensions of expression. With MPE, every note a musician plays can be expressed individually, leading to more human, emotionally engaging performances.

- It's a set of *conventions built on MIDI 1.0* to communicate per-note/per-row *multidimensional (x|y|z) control data*.

- MPE has broad support from many DAWs, Synthesizers and Controllers, over 200 hardware and software products.

- Specs
  - The original spec was ratified in January-2018.
  - A clarification revision was released April-2022:
  - The MPE for MIDI 2 Profile was released April-2024

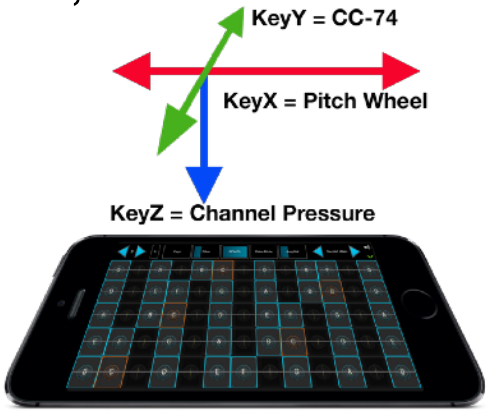
Where to Get Specs and Tools: midi.org and midi2.dev



- All specs and tools are available FREE
- You don't need to become a MIDI Association member access the specifications.

MPE in a Nutshell

- Derivative of MIDI Modes 3/4; enabled with RPN-6
- Can be Channel-Per-Note (for Keyboards, like the Seaboard) or Channel-Per-Row (String) (GeoShred, LinnStrument, Guitar Controller).
- Expression Control Conventions (per Channel)
  - KeyX – Pitch Bend (Roli calls this *Glide*)
  - KeyY – CC-74 (Roli calls this *Slide*)
  - KeyZ – Channel Pressure (Roli calls this *Press*)



- Provides for Manager Channel (typically 1 or 16) that globally controls the MPE Member Channels (ie modWheel to all Member Channels)
- Provides for a low/high split, and each split can have it's own Manager Channel.

History

- Similar to how Guitar Controllers have used MIDI 1.0 for 35 years.
- The Haken Continuum (x|y|z) expression (1999, Lippold Haken)
- The LinnStrument is one of the first instruments to implement MPE (2014, Roger Linn and Geert Bevin)
- Roli later adopted MPE for the original Seaboard (2014, Roland Lamb)

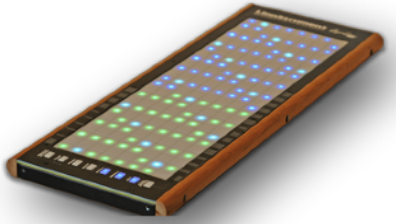
Modeling Synthesis and MPE

- Models are parameterized and as such can be musically expressive.
- Until recently, the options for expressing musical parameters were limited, *and affected all notes,* pitch wheel, mod wheel, knobs…
- **MPE creates a standard for individual expressive control on a per-note or per-row (string) basis.**

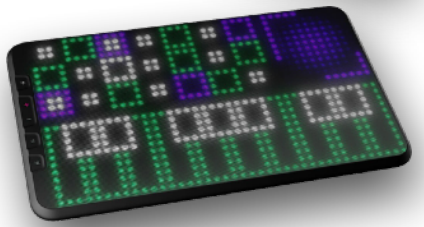
MPE + Modeled Synthesis
… **BIG DEAL**

- MPE makes a whole new generation of controllers possible. **Whatever instrument makers dream up!**
- MPE offers an expressive performance mechanism for parameterized synthesis methods. Physical Modeling, Virtual Analog, FM, … others
- **Together, whole is greater than the sum of the parts!**

Some 3D Controllers Based on MPE



- Haken Continuum
- Lumi Keys
- KMI K-Board Pro 4
- Ere Touch
- Sensel Morph
- Osmose
- Artiphon INSTRUMENT 1
- Joué
- GeoShred
- Seaboard
- LinnStrument



Some MPE Modeled Synths

- GeoShred

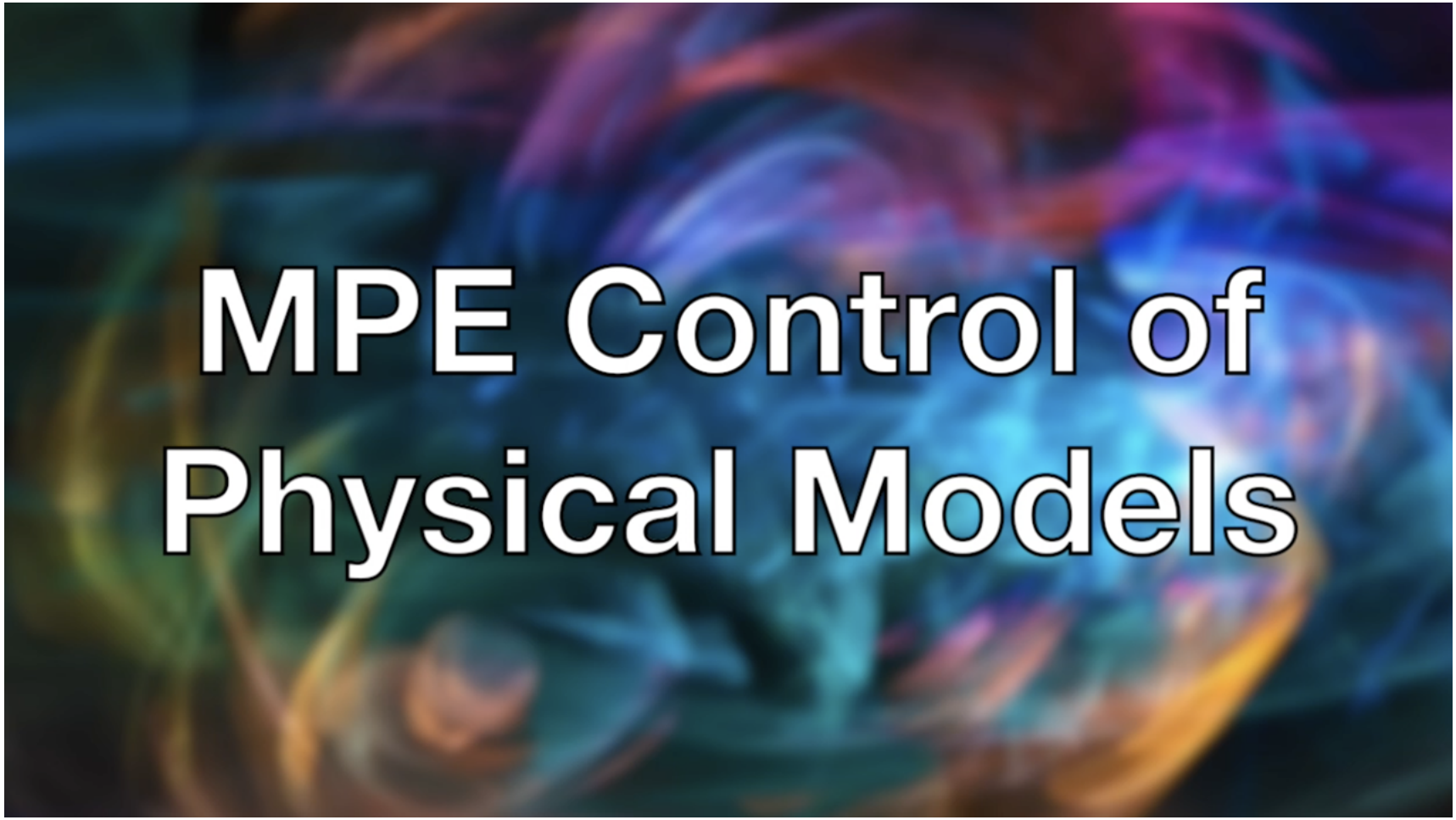
- SWAM

- Animoog
  Model-D
  Model 15

- [Roger Linn's list of MPE sound sources]

- [Roli's List of MPE Products]

Demos



Ok Instrument Creators, Here's What Ya Gotta Do!

- Decide if you want to support Channel-Per-Note (MIDI Mode 3, Aka Poly) or Channel-Per-Row (MIDI Mode 4, AKA Mono).
- Program your instrument to send the MCM, MPE Configuration Message with RPN6. The MCM will identify the Manager Channel (usually 1) and the number of Member Channels (usually 15).
- Program your instrument to send Pitch Bend Sensitivity with RPN0. The default Pitch Bend Sensitivity for MPE receivers is +/- 48
- The default MIDI Mode for MPE receivers is Channel-Per-Note (MIDI Mode 3). If you implement Channel-Per-Row (MIDI Mode 4), you will need to send MIDI Mode messages to configure the receiver for MIDI Mode 4.
- Send MIDI Channel Voice Messages, NoteOn, NoteOff on individual channels.
- Send (x|y|z) expression using Pitch Wheel Change, Channel Pressure and CC#74 on individual Channels. You may need to send reset values for these before the Note On to clear the channel.

The MCM

[REGISTERED PARAMETER NUMBER]

CC#101 (MSB)	CC#100 (LSB)	Function
00	06	MPE Configuration RPN

Message Format: `[0xBn 0x65 0x00] [0xBn 0x64 0x06] [0xBn 0x06 <mm>]`

Where `n` = MIDI Channel Number:

`n=0x0:` Lower Zone Manager Channel

`n=0xF:` Upper Zone Manager Channel

All other values are invalid and should be ignored.

And *mm* = Number of Member MIDI Channels in the Zone:

`mm=0x0:` MPE is Off (No Channels)

`mm=0x1 to 0xF:` Assigns that number of MIDI Channels to the Zone (see below)

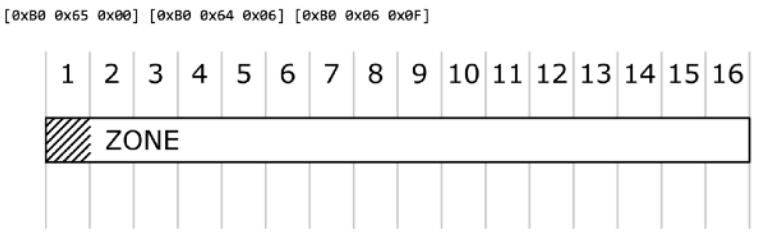


Figure 1 Single Lower MPE Zone

About MIDI 2

- MIDI 2 changes MIDI from a monologue to a dialog.
- This enables negotiation between MIDI senders and receivers.
- Higher resolution, more channels, greater interactivity.
- MIDI 2 includes MIDI 1 for compatibility.
- Already implemented for Linux, Android, Apple, Windows in 2024

Techie Stuff

- MIDI 2 negotiation (JSON) and includes
    - Profile Negotiation
    - Property Exchange
    - Process Inquiry.
- New Universal MIDI Packet (UMP) includes MIDI 1 messages and automatic translation between MIDI 1<->2 messages
- 256 channels, 64k velocity levels, controller resolution is 4B, 16k registered controllers, 16k assignable controllers, per-note controllers

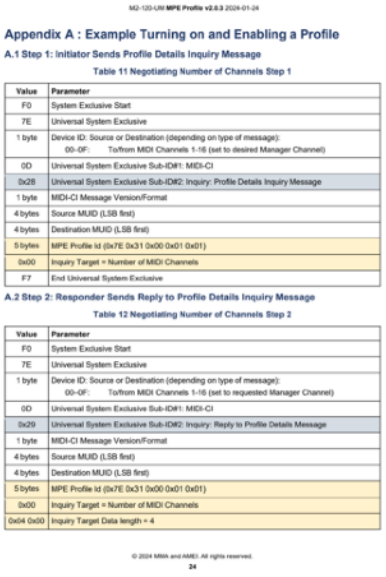
MPE in MIDI 2

- MCM is replaced with MPE MIDI-CI profile negotiation
- Profiles are receiver centric. The receiver will report back the range of channels that it can support and the sender will adapt.
- Zones are gone and are handled by enabling multiple profiles.
- A profile can use any base channel as the Manager Channel, not just 1, 16.
- Will work with legacy MIDI 1.0 or MIDI 2, Profiles, CI, UMP.
- **The Bonus. Easy migration to MIDI 2**

  If a MIDI 1 MPE device replaces the MCM with Profile Negotiation, it will be fully MIDI 2 compliant and can operate in the MIDI 2 environment, even if it is speaking MIDI 1.

MPE Profile Negotiation in MIDI 2 (Appendix A from the MPE Profile)

1.Initiator sends a “Profile Inquiry” message
2.Responder sends a “Reply to Profile Inquiry”
3.Initiator sends a message to “Request Number of Channels” and base channel
4. Responder sends a “Reply to Profile Details”, declaring the max number of channels
5. Initiator sends a “Set Profile On” message with the desired number of Channels
6. Responder sends a “Profile Enabled” message
7. MPE communication can begin.



M2-120-UM **MPE Profile v2.0.3** 2024-01-24

Appendix A : Example Turning on and Enabling a Profile

A.1 Step 1: Initiator Sends Profile Details Inquiry Message

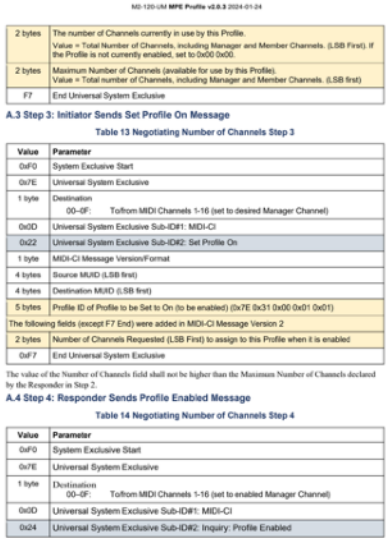
Table 11 Negotiating Number of Channels Step 1

Value	Parameter
F0	System Exclusive Start
7E	Universal System Exclusive
1 byte	Device ID: Source or Destination (depending on type of message): 00–0F: To/from MIDI Channels 1-16 (set to desired Manager Channel)
0D	Universal System Exclusive Sub-ID#1: MIDI-CI
0x28	Universal System Exclusive Sub-ID#2: Inquiry: Profile Details Inquiry Message
1 byte	MIDI-CI Message Version/Format
4 bytes	Source MUID (LSB first)
4 bytes	Destination MUID (LSB first)
5 bytes	MPE Profile Id (0x7E 0x31 0x00 0x01 0x01)
0x00	Inquiry Target = Number of MIDI Channels
F7	End Universal System Exclusive

A.2 Step 2: Responder Sends Reply to Profile Details Inquiry Message

Table 12 Negotiating Number of Channels Step 2

Value	Parameter
F0	System Exclusive Start
7E	Universal System Exclusive
1 byte	Device ID: Source or Destination (depending on type of message): 00–0F: To/from MIDI Channels 1-16 (set to requested Manager Channel)
0D	Universal System Exclusive Sub-ID#1: MIDI-CI
0x29	Universal System Exclusive Sub-ID#2: Inquiry: Reply to Profile Details Message
1 byte	MIDI-CI Message Version/Format
4 bytes	Source MUID (LSB first)
4 bytes	Destination MUID (LSB first)
5 bytes	MPE Profile Id (0x7E 0x31 0x00 0x01 0x01)
0x00	Inquiry Target = Number of MIDI Channels
0x04 0x00	Inquiry Target Data length = 4



M2-120-UM **MPE Profile v2.0.3** 2024-01-24

2 bytes	The number of Channels currently in use by this Profile. Value = Total Number of Channels, including Manager and Member Channels. (LSB First). If the Profile is not currently enabled, set to 0x00 0x00.
2 bytes	Maximum Number of Channels (available for use by this Profile). Value = Total number of Channels, including Manager and Member Channels. (LSB first)
F7	End Universal System Exclusive

A.3 Step 3: Initiator Sends Set Profile On Message

Table 13 Negotiating Number of Channels Step 3

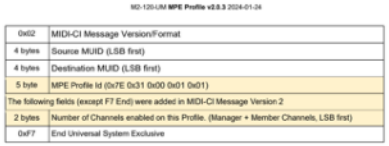
Value	Parameter
0xF0	System Exclusive Start
0x7E	Universal System Exclusive
1 byte	Destination 00–0F: To/from MIDI Channels 1-16 (set to desired Manager Channel)
0x0D	Universal System Exclusive Sub-ID#1: MIDI-CI
0x22	Universal System Exclusive Sub-ID#2: Set Profile On
1 byte	MIDI-CI Message Version/Format
4 bytes	Source MUID (LSB first)
4 bytes	Destination MUID (LSB first)
5 bytes	Profile ID of Profile to be Set to On (to be enabled) (0x7E 0x31 0x00 0x01 0x01)
The following fields (except F7 End) were added in MIDI-CI Message Version 2	
2 bytes	Number of Channels Requested (LSB First) to assign to this Profile when it is enabled
0xF7	End Universal System Exclusive

The value of the Number of Channels field shall not be higher than the Maximum Number of Channels declared by the Responder in Step 2.

A.4 Step 4: Responder Sends Profile Enabled Message

Table 14 Negotiating Number of Channels Step 4

Value	Parameter
0xF0	System Exclusive Start
0x7E	Universal System Exclusive
1 byte	Destination 00–0F: To/from MIDI Channels 1-16 (set to enabled Manager Channel)
0x0D	Universal System Exclusive Sub-ID#1: MIDI-CI
0x24	Universal System Exclusive Sub-ID#2: Inquiry: Profile Enabled



M2-120-UM **MPE Profile v2.0.3** 2024-01-24

0x02	MIDI-CI Message Version/Format
4 bytes	Source MUID (LSB first)
4 bytes	Destination MUID (LSB first)
5 byte	MPE Profile Id (0x7E 0x31 0x00 0x01 0x01)
The following fields (except F7 End) were added in MIDI-CI Message Version 2	
2 bytes	Number of Channels enabled on this Profile. (Manager + Member Channels, LSB first)
0xF7	End Universal System Exclusive

A.5 Step 5: Profile Enabled

Initiator knows that the Profile is enabled and how many Channels have been allocated.

Make Some New Expressive Instruments!

Questions?

You can reach me at
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gps@moforte.com