MIDI

- message based protocol
- serial transfer of data
- between music instruments
- 31250 b/s
- developed in 1984
- International MIDI Association (IMA)
- MIDI Manufacturers Association (MMA)
MIDI History

- Piano roll, other mechanical devices to play music
  Subject to later session!
- Voltage control and trigger (CV/Gate)
- Contact between Roland and Sequential Circuits at NAMM (1983)
- Roland implements MPU 401 ISA card for IBM compatible computers
- Prophet 600 by Sequential Circuit: First synthesizer available 1983
- Yamaha releases FM synthesizer DX7 (1983)
- Opcode offers MMA definition of MIDI file format standard (1984)

CV/Gate

- V/OCT CV OUT - Roland, ARP, Oberheim, Sequential and Moog
- HZ/V CV OUT - Yamaha and Korg
- +12v GATE OUT
- +12v TRIGGER OUT - (+) Voltage trigger: Roland, ARP, Oberheim and Sequential. (-) Shorttrigger - Moog
- +5v ACCENT OUT
- +5v CLOCK OUT - for arpeggiator, analogue sequencers and drum machines
- +5v CLOCK RESET OUT - arpeggiator, analogue sequencers and drum machines
Doepfer Schaltwerk - Analogue Sequencer

Roland TR-808 Rhythm composer
MIDI - termini technici

- Channel (16 MIDI channels to address receiving instrument)
- Synthesizer (sound generator)
- Sequencer (storage facility for several MIDI tracks)
- Track (... of a sequencer)
- Voice (sound generating part of synthesizer; synthesizer has several voices)
- Patch (control data to select timbre in synthesizer)
- Pitch (note, played by MIDI instrument)
- Timbre ("sound colour", or instrument, e.g., flute, cello, ...)
- Wavetable (data generated from sound synthesis of real instrument)
MIDI Specifications

- 31.25 KBaud, UART clock 31.25kHz
- 8 databit
- 1 startbit, 1 stopbit
- current loop at 5mA
- 5mA, current on = logical 0

MIDI HW implementation
Sound Synthesis

- FM Synthesizer
- ADSR (Attack-Decay-Sustain-Release)

Sound Synthesis - DAHDSR
Wave forms

Triangle
Sine
Square

Sawtooth
Random

MIDI sound generator
MIDI version 1.0

- Published by MIDI Manufacturers Association in 1983
- Defines
  - media,
  - coding,
  - HW implementation recommendations

Channels
MIDI Data format

- 1 Status Byte
- 1 or two data bytes (except: system exclusive message)
- For each byte of data:
  - 1 start bit + 1 stop bit
  - most data bytes start with 0 and contain 7 bit !!!
- 16 MIDI channel address (nibble)

Channel Voice Messages

- Note Off (1000ccc0nnnnnnn0vvvvvvv)
- Note On (1001ccc0nnnnnnn0vvvvvvv)
- Polyphonic Key Pressure (1010ccc0nnnnnnn0vvvvvvv)
- Control Change (1011ccc0nnnnnnn0vvvvvvv)
- Program Change (1100ccc0ppppppp)
- Channel Pressure (1101ccc0vvvvvvv)
- Pitch Bend Change (11100lllllll0mmmmmmmm)
MIDI Data format

- Channel Voice Messages
- Channel Mode Messages (1011cccc 0nnnnnnn 0wwwwwww)

- System Common Messages (1111xxxx ........ ........)
  - System Exclusive (11110000 0iiiiiii 0ddddddd .... 11110111)
  - Song Position Pointer (11110010 0lllllll 0mmmmmmm)
  - Song Select (11110011 0sssssss)
  - Tune Request (11110110)
  - EOX (11110111)
MIDI Data format

- Channel Voice Messages
- Channel Mode Messages (1011ccc 0nnnnnn 0wwwwww)
- System Common Messages (1111xxxx ......... .........)
- System Real-Time Messages
  - Timing clock (11111000)
  - Start (11111100)
  - Continue (11111101)
  - Stop (11111100)
  - Active Sensing (11111110)
  - Reset (11111111)

Parameter Data

<table>
<thead>
<tr>
<th>byte type</th>
<th>0x50</th>
<th>system exclusive</th>
<th>variable length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x5f</td>
<td>undefined</td>
<td>0x5f</td>
<td>undefined</td>
</tr>
<tr>
<td>0x6f</td>
<td>song select</td>
<td>0x6f</td>
<td>undefined</td>
</tr>
<tr>
<td>0x7f</td>
<td>time code</td>
<td>0x7f</td>
<td>undefined</td>
</tr>
<tr>
<td>0x8f</td>
<td>system exclusive (terminator)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statusbyte 0x80 - 0x8F er ikke tildeelt til musikler

Roland: 0x41
Telex: 0x43
S.I.E.L.: 0x21

Midi data format

<table>
<thead>
<tr>
<th>Statusbyte</th>
<th>Efterfølgende datayte</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x80-0x8F</td>
<td>note off 1 byte pitch, etterlukk av 1 byte velocity</td>
</tr>
<tr>
<td>0x90-0x9F</td>
<td>note on 1 byte pitch, etterlukk av 1 byte velocity</td>
</tr>
<tr>
<td>0x90-0x9F</td>
<td>note on 1 byte pitch, 1 byte pressure (after-touch)</td>
</tr>
<tr>
<td>0x90-0x9F</td>
<td>pitch bend parameter 1 byte parameter number, 1 byte setting</td>
</tr>
<tr>
<td>0x90-0x9F</td>
<td>program change 1 byte program selected</td>
</tr>
<tr>
<td>0x90-0x9F</td>
<td>channel pressure (after-touch)</td>
</tr>
<tr>
<td>0x90-0x9F</td>
<td>pitch wheel 2 byte gitter 1 16 bit value, mindst signifikante 7 bit fæst</td>
</tr>
</tbody>
</table>
GM 1 - General Midi version 1

- Standard for instruments for playing GM files
- Implemented on
  - sound card for computers,
  - sound modules
- Roughly: Defines melody only!

General Midi 2

- Initial Feedback
- Initial Sound to Receive
- Controller Data Setting
- General MIDI Timing Assignment
- Real-Time Instrument Controllers
- MIDI System On
GM 2 INSTRUMENT G.xxx SET
GM 2 PITCHBEND G.xxx SET

Norsk Regnesentral
Wolfgang Leister
DLS-2.1 - Downloadable soundformat 2.1

- Predecessor was DLS-1
- Accepted January 2000
- DownLoadable Sounds
- Standard requires the following:

Requirements for DLS 2.1

1. A sampled sound source with loop and release
2. Two 6-segment envelope generators characterised as DAHDSR (Delay-Attack-Hold-Decay-Sustain-Release)
3. Two Low Frequency Oscillator (LFO) generators
4. A low pass filter with resonance and dynamic filter cut-off frequency
5. Standardised response to MIDI controllers
DLS 2.1: Minimum Device Requirements:

6. Min. 32 digital oscillators, each with individually controlled DCA, DCF, LFO generators (two per oscillator), and envelope generators (two per oscillator).
7. Minimum sample playback rate of 22.05 KHz
8. Minimum sample memory of 1,048,576 x 16-bit words
9. Minimum of 512 waves stored simultaneously
10. Minimum of 256 instruments stored simultaneously
11. Minimum of 1,024 regions stored simultaneously
12. Minimum of 8,192 explicit connections stored simultaneously
13. If the device claims support for both DLS and GM, it must be able to support both of them simultaneously.

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SMF Lyric Meta Event Definition

- MMA document RP-017
- Defines file format for lyrics representation included in MIDI format
  - Approved by MMA 11/14/97
  - Approved by AMEI 10/3/97
The Future of MIDI

- MIDI over 1394 - Firewire
  - 1394 - Developed by Apple (mid 1990)
  - Bandwidth: 400Mbps
  - up to 63 devices on same bus
  - Combines video, audio and MIDI on same bus
- MIDI over USB

MIDI applications

- Sequencers
- Combination of multi track hard disk recording
- control of hardware mixers
- control of other types of HW: e.g., light, robots, …
Literature

- www.midi.org - MMA

End of Part

Thank you for your attention!