Digital Developments
70’s – 80’s

Hybrid Synthesis "GROOVE"

- In 1967, Max Mathews and Richard Moore at Bell Labs began to develop Groove (Generated Realtime Operations on Voltage-Controlled Equipment)
- In 1970, the Groove system was unveiled at a "Music and Technology" conference in Stockholm.
- Groove was a hybrid system which used a Honeywell DDP224 computer to store manual actions (such as twisting knobs, playing a keyboard, etc.) These actions were stored and used to control analog synthesis components in realtime.
- Composers Emmanuel Gent and Laurie Spiegel worked with GROOVE

Details of GROOVE

GROOVE System included:

- 2 large disk storage units
- a tape drive
- an interface for the analog devices (12 8-bit and 2 12-bit converters)
- A cathode ray display unit to show the composer a visual representation of the control instructions
- Large array of analog components including 12 voltage-controlled oscillators, seven voltage-controlled amplifiers, and two voltage-controlled filters

Programming language used: FORTRAN

Benefits of the GROOVE System:

- 1st digitally controlled realtime system
- Musical parameters could be controlled over time (not note-oriented)
- Was used to control images too:

  In 1974, Spiegel used the GROOVE system to implement the program VAMPIRE (Video and Music Program for Interactive, Realtime Exploration)

•

Laurie Spiegel at the GROOVE Console at Bell Labs (mid 70s)

The 1st Digital Synthesizer "The Synclavier"

- In 1972, composer Jon Appleton, the Founder and Director of the Bregman Electronic Music Studio at Dartmouth wanted to find a way to control a Moog synthesizer with a computer
- He raised this idea to Sydney Alonso, a professor of Engineering at Dartmouth and Cameron Jones, a student in music and computer science at Dartmouth.
- Alonso suggested that they ignore the Moog entirely and build something completely digital.
- The concept led to the Dartmouth Digital Synthesizer finished in 1975. Alonso designed the hardware in consultation with Appleton, and Jones designed the software (KLANG and SING).
- The Dartmouth Digital Synthesizer used a network of integrated circuits connected to a microprocessor.

The Synclavier con't.

- In 1975 Alonso and Jones formed the New England Digital Corporation
- By 1977, they finished creation of the Synclavier, a much improved descendent of the Dartmouth Digital Synthesizer.
- Details of the Synclavier
  - Used a specially designed 16-bit microprocessor called "ABLE"
  - Memory bank (used primarily as a sequencer)
  - Synthesis engine with a bank of timbre generators, each providing 24 sine waves for each voice (1st Synclavier had 8 available voices)
  - Five-8ve keyboard
  - Push-button envelope controls (for overall envelope and envelope controls of individual harmonics)
  - Alpha-numeric keyboard for programming controls
  - Digital display to show numerical reading of the current settings
  - Optional FM controls for each voice

The Synclavier – 1977

Alonso, Appleton, & Jones

Benefits of the Synclavier:

- 1st entirely digital synthesizer
- More portable than most analog synthesizers
- Could be used for realtime performance (unlike computer music at the same point in time)
- Was attractive to academic composers and affluent commercial musicians

Synclavier II (1979–80's)

- Could be run with battery
- Added a sample-to-disk option, to keep up with the new competition with samplers.

The Synclavier II
Appleton on the Connecticut River

Brush Canyon – 1986

The Origins of Sampling
"The Fairlight CMI"

- In the Mid-70s, two Australians, Peter Vogel and Kim Ryrie formed the company Fairlight Instruments and designed a prototype audio processor known as the QASAR M8 by 1978.
- By 1979, The Fairlight "Computer Music Instruments" (CMI) was complete.
- The Fairlight CMI was the first digital synthesizer to use sampling technology.

Details of the Fairlight CMI

- Externally generated sounds are digitized, and stored in memory for processing and re-synthesis
- Manufacturer provided voice module cards as an alternative to recording new sounds
- 2 8-bit microprocessors were used in the 1st version, later being replaced by 16-bit technology
- The Fairlight CMI also included:
  - 2 six-octave keyboards to transpose samples
  - An interactive graphics unit controlled by a light pen to edit or create sounds by drawing wave forms
  - an alpha-numeric keyboard
  - optional foot pedals

The Development of MIDI (Musical Instrument Digital Interface)

- As more digital synthesizers became available (late 70s-early 80s), it became clear that an industry standard for a communications protocol was needed.
- 1981-1983, Roland and Sequential Circuits collaborated on a prototype, and decided to use a serial interface (inexpensive and fast enough for consumer market)
- In January 1983, at the National Association of Music Merchants (NAMM), Roland and Sequential demonstrated the first prototype by hooking up a Roland with MIDI to a Sequential with MIDI, which demonstrated that notes played on the keyboard of one synthesizer could be heard on the other.
- By August 1983, Roland, Yamaha, Korg, Kawai, and Sequential refined the prototype, calling it the version 1.0

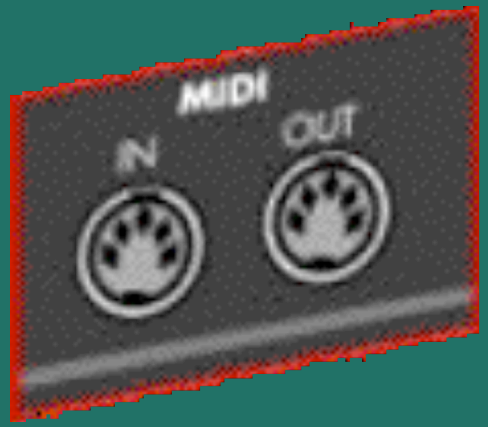
Features of MIDI

- Serial communications protocol - all commands and data are transmitted as a single sequential stream of bits down a single cable. Information flow is one-way only.

  NOTE#1: MIDI sends information, not sound

  NOTE#2: MIDI cannot make an instrument do something it is not designed to do.
- Connects to instruments via a MIDI interface and 5-pin DIN connectors
- 3 types of MIDI ports : MIDI IN, MIDI OUT, and MIDI THRU
  - MIDI THRU used to pass information from one device, through a second device, and into a third device (MIDI OUT port does not necessarily echo information received in MIDI IN port)
- 16 channels
- Can connect to computer using special interface and simple serial or (more recently) USB cables

MIDI Hardware



Types of MIDI Messages

- Note On - turns on a note (Velocity 0 - 127, Pitch 0 -127, middle C=60)
- Note Off - turns a note off (actually a note on message with a velocity of 0)
- Polyphonic Pressure - pressure is transmitted for each note
- Channel Pressure - pressure is transmitted to all notes on a channel
- Control Change - switches between controllers (ex. Foot pedal, pitch bend wheel, etc.)
- Program Change - changes a patch by sending a number for that patch

  Note #1: patch numbers between instruments are often inconsistent

  Note #2: General MIDI helps to standardize patch numbers between instruments
- Pitch Bend - transmits pitch bend data in a stream of numbers

The First MIDI Synthesizer – 1983 "The Yamaha DX7"

- Inexpensive -under $2000
- Used the patented Chowning FM algorithms
- Velocity sensitive (can sense speed at which key is struck) and pressure sensitive (aftertouch)
- 16 channels
- Stored 32 sounds in internal memory