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Research Paper 2 Final Version: The History of Computer Music
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What do elevator music, the first ever combat shooting video game, stage lighting in a theatrical production, and a 90's cell phone ringtone have in common? They all employ MIDI: the musical instrument digital interface. Today MIDI is all around us, but in 1983 when Dave Smith had the idea for MIDI, he surely did not anticipate its potential impact on music, technology, and various other corners of everyday life. Rather, Smith simply identified the need for musicians to be able to connect multiple synthesizers. The solution was the Musical Digital Interface (MIDI 1.0), and although the interface has undergone innumerable developments and applications since its conception, the core functionality of this very first model remains relevant after decades. The MIDI 1.0 standard, which was free, practical, and easy to use, allowed synthesizers to communicate with computers and each other, a functionality that would revolutionize music forever; furthermore, its great success was a direct result of the creators' decision to prioritize the advancement of the music production industry over their personal gain.

It is hard to imagine life today without MIDI. Take, for example, Rick Wakeman's legendary piano solo in 1973. He is surrounded by six keyboards**,** his hands and eyes shifting rapidly between the synthesizers as he plays**.** [1] Just a few decades ago, playing and recording music was very different. Synthesizers, electronic instruments that play sounds by generating an electrical current which becomes sound when passed through an amplifier and speakers, could not share musical information with each other. They were "stand-alone electronic instruments" incapable of linking up with one another or computers.[2] You could not record a piece on one

[1] Mitzrael7, *Rick Wakeman's Awesome Piano Solo*.
[2] "The MIDI Revolution."

keyboard and store that musical piece on a computer or play the same piece on another synthesizer. It was difficult to reproduce recorded sounds live and trying to layer various sounds required either many musicians playing simultaneously or the same great agility of Wakeman. “You could play one keyboard with your right hand and another keyboard with your left hand," remembers Dave Smith, the founder of the synthesizer company Sequential Circuits, but couldn't play multiple at once “because there was no way of electrically interconnecting them”.[3] Rock bands recorded and toured with “giant rigs of multiple keyboards” [4][5] and the concept of the home studio was inconceivable. It was expensive, bulky, and inconvenient. The world needed a means to communicate between synthesizers.

In 1978 the “digital microprocessor technology” was introduced. This technology would finally allow data sharing between synthesizers, but the way it was implemented by manufacturers was inconvenient and impractical for the consumer. The microprocessor made it so synthesizers to share musical information with each other; you could record a track on your keyboard and play it on another synthesizer. Each synthesizer manufacturer began creating their version of the “polyphonic” synth, which had a microprocessor and an interface that allowed the interconnection of synthesizers, letting instruments of the same brand communicate. So long as the electronic instruments came from the same company and therefore were compatible, the user could “interconnect several of their own keyboards and drum machines together”. This hugely improved playability: now users could easily layer sounds and record something digitally and then manipulate it by chopping it up, changing the speed, etc.[6][7] However, models from different

[3] Cellan-Jones, “How MIDI Changed the World of Music.”
[4] Rumsey, *MIDI Systems and Control*.
[5] “What is MIDI?”
[6] “What is MIDI?”
[7] “What is MIDI?”

manufacturers were incompatible, which was extremely inconvenient for musicians. The various manufacturers at the time were competitors, and each brand's polyphonic synthesizer employed a different interface, meaning models from different manufacturers could not share musical data. Sequential Circuits put out the Prophet-5 in 1978, Oberheim Electronics put out the OB-X in 1979 to compete with it, the Roland Corporation released the Jupiter-8 in 1981, and Yamaha and Korg also sold models.[8] You could string together three different Yamaha keyboards to get three sounds at once, but you couldn't record a track on an Oberheim synthesizer and play it on a Roland. Musicians had to buy all new synthesizers from the same manufacturer in order for them successfully communicate. Thus, if you planned on using different kinds of electronic instruments you were back to the problem of having "a wall of equipment" and needing to "dash from one keyboard to the next."[9][10] Essentially, the creation of these polyphonic synthesizers capable of interconnection was surely a step in the right direction, but the technology's implementation was neither practical nor economic. Dave Smith of Sequential, Roland founder Ikutaro Kakehashi, and Oberheim Electronics founder Tom Oberheim, understood that these inconveniences for the consumer prevented musicians from taking full advantage of this great new technological ability. They "felt the lack of standardization was limiting the growth of the electronic music industry," so they put aside their position as competitors of the industry to change it.[11]

At the June 1981 National Association of Music Merchants (NAMM) show, Smith, Kakehashi, and Oberheim discussed how to "standardize their control signals" so different

[8] Rothstein, *MIDI: A Comprehensive Introduction*.
[9] Rothstein.
[10] Rothstein.
[11] Kirn, *Keyboard Presents the Evolution of Electronic Dance Music*.

brand's models could be compatible.[12] Since these new polyphonic synthesizers were in essence "digital computers disguised as musical instruments", the group wondered, could the ways computer manufacturers "addressed the challenges of intermachine communication" apply to synthesizers?[13] In other words, since computers of all different kinds could share information, electronic instruments ought to be able to as well. The men looked at "a hardware and software system" called Local Area Network (LAN) that lets computers from different manufacturers "share data and equipment".[14] They found that its characteristics-- simple, inexpensive, and nonhierarchical-- fit their vision for an easy, practical way to interconnect synthesizers.[15] If they employed this LAN system to create an interface that all the synthesizer manufacturers agreed to use in their products, each brand could sell their own model of synthesizer, but all of them could still communicate with one another. Essentially, MIDI was the unification of different manufacturers' systems. Dave Smith wrote a proposal for the standard interface called the "Universal Synthesizer Interface," which he presented at the November 1981 meeting of the Audio Engineering Society.[16] Some Japanese synthesizer manufacturers collaborated with the American companies "to refine and expand the proposed standard," and at the June 1982 NAMM show, the Musical Instrument Digital Interface was unveiled.[17][18] Smith and his colleagues had eliminated the inconveniences caused by brand competition, and had interconnected musicians all over the world.

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[12] Rothstein, *MIDI: A Comprehensive Introduction*.
[13] Rothstein.
[14] Rothstein.
[15] Rothstein.
[16] Rothstein.
[17] Rothstein.
[18] Rothstein.

To understand exactly how MIDI made universal synthesizer communication possible, one needs to understand the nuts and bolts of how MIDI works. The MIDI 1.0 standard was a not a musical language, but rather a data communications protocol that "described a means for music systems and related equipment to exchange information and control signals."[19] Before, when each company created a proprietary design and interface, it meant they created a unique way to transfer data representing sound between synthesizers of that brand. Since each brand used a different interface, cross-brand communication didn't work. Upon proposing MIDI in 1982, the creators essentially said, "let's all agree to designate a new, universal language through which all electronic instruments will represent and share data, and let's all agree to produce instruments compatible with this specification so that consumers may interconnect any two synthesizers regardless of brand."

So, what exactly is this new musical language that computers can understand? How does it "unite synthesizers with computers?"[20] As Tom White, CEO of the MIDI Manufacturers Association explains, MIDI essentially "digitized the process" of pressing a key and generating an electric current that is passed to a speaker.[21] Rather than creating a voltage, with MIDI every time you press a key on a keyboard or turn a knob on a synthesizer, a series of numbers are generated to represent the musical sound. Such numbers are binary data, consecutive ones and zeros, and are the language by which musical sound can be transmitted and stored to a computer, and sent from a computer to any other synthesizer to be played (computers could not make sound yet at this point).[22] These individual numbers are like letters in the English language-- when assembled in different orders and groups they have different meanings, specifying exactly which

[19] Rothstein.
[20] "The MIDI Revolution."
[21] "The MIDI Revolution."
[22] "The MIDI Revolution."

electronic circuits should turn on and for how long. Each series of numbers (byte) describes a characteristic about the music like notation, duration, pitch, amplitude, velocity, or volume, etc. For example, the first data byte tells MIDI what note to play, so when the device reads 00111100 first, it knows to play a middle C.[23] Other bytes indicate what channel the message is for, how loud to play the note, when to turn off the note, etc.[24] All the sound's musical characteristics are embedded in these numbers, transmitted to the computer, stored, and then can be sent to any other MIDI synthesizer, translated back into musical traits., and played[25] In this way, MIDI provides a standard software interface, by way of one universal data format, that lets one reproduce the same musical piece on any electronic instrument.[26] [27]

In addition to specifying a software interface, the creators also declared a hardware interface that manufacturers must use in their products, to facilitate the physical connection between two synthesizers. In other words, MIDI told manufacturers how to build their products so they could successfully connect with other brands' synthesizers. They said all products that intend to employ MIDI need an 'out' jack where musical traits will be translated to data, a MIDI cable that is capable of carrying the data stream of binary data, and an 'in' jack where the numbers will be decoded, allowing the music to be played.[28] Thus, these universally agreed upon software and hardware interfaces replaced the unique proprietary interfaces that the competitive manufacturers had introduced earlier. It was as if everyone was speaking a different language before, and now finally everyone could understand each other. Virtually all manufacturers agreed to this standard because it was free, and, if they didn't their products would become impractical

[23] "Chapter Three: How MIDI Works 4."
[24] "Chapter Three: How MIDI Works 4."
[25] Rothstein, *MIDI: A Comprehensive Introduction*.
[26] Rothstein.
[27] "Chapter Three: How MIDI Works 4."
[28] Rothstein.

and undesirable to the consumer. So, shortly after the release of MIDI 1.0, companies began developing synthesizers according to the given MIDI specifications. Now "virtually any electronic musical instrument could be incorporated into a system with others without difficulty"; one could now record and reproduce sound on any other electronic instrument, play it back and edit it.[2930] This was not only a huge change for music producers and performers but also for the everyday musician. MIDI's simplicity and practicality led to the birth of the home studio and a multitude of creative possibilities for all people wanting to get involved in music making.

Many of the design choices made during MIDI's conception were based on "economic and practical considerations."[31] For example, the choice to use "asynchronous serial communications" (one single data stream carrying data sequentially) meant you only needed a single wire and allowed MIDI to be installed on "relatively cheap items of equipment."[32] It was economic for consumers, "reduced the amount of hardware musicians needed," and thus was "available to as wide a range of users as possible."[33] MIDI was simple, easy to install, and easy to use, making it accessible to just about anyone.[34] Not only was MIDI hugely useful for formal music production and performance, but it also introduced tons of new capabilities for everyday musicians.[35] Now a user with no notation skills could "build complex arrangements," one or two musicians could deliver a performance "similar to that of a large group of musicians," and people

[29] "The MIDI Revolution."
[30] Rothstein.
[31] Rumsey, *MIDI Systems and Control*.
[32] Rumsey.
[33] Rumsey.
[34] Rumsey.
[35] Rumsey.

could mix and record right in their own home.[3637] As Smith explains, MIDI "allowed the first home studios to be born," which would transform music as we know it.[38] There was no shortage of "creative possibilities brought about by MIDI technology." Participation of people around the world in the creation of music increased, "the sales and production of electronic instruments and music software" boomed, and MIDI helped revive the music industry in the 1980's.[39] This success and advancement of music was only made possible, furthermore, by the selflessness of the men who birthed MIDI.

The creators of MIDI could have aimed to make a profit off their invention, but they knew it would only reach as many people as possible and truly advance music if it was free and accessible; they selflessly put aside financial gain for the greater good of music. Although Smith and his colleagues were manufacturing competitors, they saw that their collaboration to allow interconnection between synthesizers would make music producers' lives easier and increase participation in music making. They put their minds together to give musicians MIDI as "free gift to the world." MIDI is essentially the first example of an "open source" technology, like Python or Firefox, meaning that it was universally free, shared intellectual property that everyone in the world had the privilege to benefit from; "of course it would have been even more fun to have made some money off of it, if that were possible," Smith remarks, "but that wasn't part of the plan."[40] By making it free and convincing virtually all the manufacturing companies to adopt MIDI, Smith and his colleagues convinced competitors to put the consumer and the bettering of the music industry before their financial gain. They could have continued letting

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[36] Rumsey.
[37] Huber, *The MIDI Manual*.
[38] Cellan-Jones, "How MIDI Changed the World of Music."
[39] Holmes and Holmes, *Electronic and Experimental Music*.
[40] "The MIDI Revolution."

musicians buy more and more synthesizers from one brand in order to connect their electronic instruments, or they could have charged manufacturers for MIDI. However, Smith "wanted to give it away" to ensure it was "universally adopted", because only then could it have such an impact.[41] Music as we know it would not be nearly the same without their invention and although he surely could have made a fortune, "Smith doesn't even remember discussing much about the possibility of charging royalties or licensing fees. It was just assumed that we would give it away."[42] All in all, it was the creators' magnanimity that "has allowed MIDI to travel far."[43]

Thus, the way in which MIDI was conceived is almost as awe-inspiring as the technology itself. MIDI is "a unique example of how an entire industry collaborated, despite brand competition, on a technology that would change the game for everyone."[44] It was truly "a revolution spawned by a desire for connection and collaboration, not dollars and cents."[45] From the beginning, MIDI was about interconnecting the world, sharing music, and increasing participation and collaboration of all people in music making for the advancement of music itself. It is an example of how selflessness and passion changed the world, driving a revolution in not only music but in technology. MIDI is the "nexus of music, software, and computer technology" which gave us not only the music we love today but also had huge implications for other fields, like video gaming and lighting control.[46] All the while, though, the core functionality of MIDI 1.0 remains relevant and we are indebted to the selfless creators for giving MIDI to the world.

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[41] "The MIDI Revolution."
[42] "The MIDI Revolution."
[43] "The MIDI Revolution."
[44] "The MIDI Revolution."
[45] "The MIDI Revolution."
[46] Rothstein, *MIDI: A Comprehensive Introduction*.

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