

The History of PC Game MIDI

by Eric Wing

Sound Card History on the PC

Serious game music for the mainstream user on the PC started with Sierra back in 1988. Before this, PC's were only equipped with a tiny beeping speaker. Sierra prepared to change all this by creating games that contained serious, high quality musical compositions drawing on add-on hardware. Sierra struck a deal with two companies, Roland and AdLib. Sierra adopted the Roland MT-32 and the AdLib Music Synthesizer. They would compose music for these units starting with King's Quest 4. Sierra would also become a reseller for these units.

The Roland MT-32 was the higher end of these music devices. In today's terminology, it would be labeled a "Wavetable Synthesizer". A wavetable synthesizer usually implies that real instrument sounds are recorded into the hardware of the device. This device can then manipulate them to play them back at the various notes you need. This may not be the most accurate description as the MT-32 had the ability to manipulate parts of its built in sounds using something called "Linear Arithmetic (LA)" synthesis. Technobabble aside, it was a very good device that can rival even today's sound cards (though Tom and other MT-32 users will be quick to point out the lack of a built-in piano patch). It was also a very expensive sound card, costing \$550 through Sierra.

The other option was the AdLib Music Synthesizer. Many of you might not recognize the name, but chances are everybody has heard it because this is the standard that we have been sitting on for the past 10 years. The AdLib used a technology called FM synthesis. This technology was much less expensive than Wavetable. The technology is based on the idea of generating superimposing waveforms to create a sound. Ideally, if you have enough generators and can fine tune the waveforms well enough, you can create a realistic sound. However, to reach this ideal, you need lots of skilled people, lots of money for equipment, and lots of time to develop. The reality is, this is a cheap PC card offering a better alternative than the PC Speaker. Thus, FM synthesis sounded very artificial. However, this was a great improvement over the PC Speaker, so it became popular.

Enter Creative Labs: Sound Blaster

A new company on the block called Creative Labs eventually decided to enter the sound card market. One of their first attempts was the Gameblaster. This was even more pathetic than FM synthesis, so it was quickly abandoned and they introduced Sound Blaster. The Sound Blaster used the same FM synthesis chip as AdLib, and thus became an "AdLib Compatible" device. To give them an edge over AdLib, they incorporated a digital audio unit into their card. This piece allowed them to record and playback real sounds. (In more generic terms, play a .WAV file...but Windows 3.0 hadn't been released yet so .WAV didn't exist.)

This combined with a competitive price eventually allowed Creative Labs to achieve dominance over AdLib. However, it would still be a couple of years before software developers would actually utilize the digital audio capabilities, and most of the time the SB would be used under the "AdLib" option in the game setup.

Creative Labs takes over the world

Due to aggressive marketing and some sneaky legal tactics, Creative Labs achieved control over most of the Sound Card market. AdLib was pretty much destroyed. Other companies that created "Sound Blaster Compatible" cards ended up being sued after these companies made profits for several years on their devices (more money for Creative Labs to take in the lawsuit). Also, Creative Labs was very tricky about their actual compatibility. Often clone cards would not work correctly because it was a DOS world and everybody had to write their own drivers, but more importantly, Creative was constantly changing things on their cards. This was very clever on their part, but it also sometimes made things difficult on Sound Blaster owners because not all Sound Blasters were built the same. Sometimes older Sound Blaster owners would get bumped off the compatibility list. Creative Labs would then offer an "upgrade offer" which would mean buying a whole new card at about full price.

But much of this passed unnoticed, perhaps because there was a bigger fight going on: Apple vs. Microsoft over the look and feel issue.

Eventually the "16-bit" era moved upon us. Marketing from every different company was pushing "16-bit" equipment. In many of these cases, it was all technobabble. Creative Labs joined the bandwagon and pushed Sound Blaster 16.

Basically it was the same card as the older Sound Blaster and the slightly more recent Sound Blaster Pro. It improved the digital audio part (the only thing the 16-bits are useful for), and that's about it. The SB16 also updated the FM chip to OPL3, which is a slightly better FM chip, but it still sounded just as bad. They also added a DSP chip in some models, which would allow voice commands and Q-Sound 3D technology. This was back in 1993, so obviously this stuff didn't catch on.

Creative Labs would continue to push their sound card monopoly with the AWE32 and AWE64, people often confusing the 32 and 64 as "bits". The card is still 16-bit. 32/64 was more marketing than anything else. They claim it is polyphony, but there are exceptions to the way their polyphony works (unlike any normal sound card) so it really is just marketing.

A Step Back

Before we enter the General Midi generation, there is one more branch of sound cards worth noting.

Because wavetable cards were so expensive, and FM synthesis sounded so bad, a new format of music was created on the Commodore Amiga series. This format is called "Tracker" in its most generic sense. More often you will hear (.MOD, .S3M - Scream Tracker 3, and more recently .XM).

Normal MIDI data, like for the MT-32, consists of simple instructions on what note to play with what kind of instrument. This is like a text file for music, hence, the files are very small. However you are dependent on the high cost sound card to produce the instrument sound.

The idea behind Tracker, is to store this data on the notes and the instrument, but to also

digitally record the instruments in the actual music file. That way you only need a cheaper device than merely needs to play digital audio (like the SB).

This format became very popular with certain groups. The format eventually migrated over to the PC. The idea was interesting enough and popular enough for a different breed of sound card to arise. This card was the Gravis Ultrasound (GUS).

The problem with the Sound Blaster kinds of cards was the way it had to mix voices into its one or two output channels. When you mix waveforms, there is a quality loss in the output. The more you mix, the greater the loss. Since a .MOD file could play 4 simultaneous instruments, mixing had to be done. When *Scream Tracker 3* (.S3M - developed by The Future Crew for any enthusiasts out there) became standard, 16 simultaneous channels needed to be supported.

The Gravis Ultrasound solved this problem by creating dedicated digital audio output channels for each track, up to 32 channels. This made the card the tracker enthusiasts' card.

The card could also be coerced into playing midi. The card allowed instrument patches to be loaded into RAM, similar to how instruments are stored on ROM on a wavetable device. Gravis even claimed the card was MT-32 compatible, but that is pretty much a lie because MT-32 composers did too many things with "LA Synthesis" to make this possible.

However, this card was a vast improvement over FM synthesis, and cheaper than the Sound Blaster. This card had many problems though.

Gravis's biggest problem was the card often had compatibility problems. Many software developers had problems supporting this card. There were frequently notes in documentation for games explaining the problems with Gravis support.

And because the Gravis had no FM chip, it was often hard for the card to be Sound Blaster compatible. And with the above mentioned tactics of Creative Labs, SB compatibility rarely worked.

Then the Tracker format of music never became mainstream. Games rarely supported this format partly because of development issues, partly because the Ultrasound was a minority, partly because the songs were so much larger while games were still shipping on floppy disks, and partly because it takes a lot of CPU power to compute. There were some games that used tracker, but not a lot. *Star Control 2* by Accolade may have been the most famous for its incredible sound track. Epic Megagames seems to prefer tracker and uses it in many of its games...most recently Unreal.

There are many debates about "MOD vs MIDI". The complaint about MIDI is you need an expensive sound device, it doesn't sound the same on different sound cards, and it is not as flexible as Tracker where you can record your own samples.

The complaints about Tracker was it was significantly larger in size than MIDI (though still smaller than recorded audio), the sound quality was usually not as high as a good midi device, the devices did not have good support, it took too much processor power to use, and for most people, recording new samples is just not feasible. (To record a good sample for serious recording/composing, you will need a very good digital sampler. Furthermore, (until the recent

.XM) samples in tracker were limited to 8khz. And, then the question is, how is an average person going to get a good sample of something? If they need a sax, will they need to buy a several hundred dollar sax? Will they need to do this with every instrument they need. Most electronic musicians will find a synth with certain sounds they like, and buy the whole synth, just for those few sounds because they know they could never get a better sample than a professional studio.)

The truth about "MOD vs MIDI" is that the style of music of the types of composers is too different for comparison. MIDI was designed for more traditional musicians that use their music keyboard to record. MOD is usually done by musicians that know their PC hardware very intimately, and often will compose using their typing keyboard. By it's nature, MOD lends itself very well to repetitive segments of music. Techno-like songs are very popular in tracker. MIDI tends to lend itself to other types of music (as you probably have discovered through Tom's site).

To the sadness of many Ultrasound enthusiasts, Gravis decided to abandon their sound card line earlier this year.

The .S3M format allowed samples up to 44 kHz. It still only supported 8 bit samples though. The .XM format gave us 16 bit sample capabilities. (There were also lesser used formats that had this and other capabilities, but since they weren't as popular I won't go into that.) It also gave us multi-sampled instruments, as well as envelopes (volume, pitch, panning). Since then the .IT format has appeared. It actually has been around for a while now. The tracker is called Impulse Tracker, and the interface is a lot like Scream Tracker 3, and deliberately so since many people preferred it to Fast Tracker 2 (XM). It also has multi-sampled instruments, but now the samples can be reused in as many instruments as you like. It also has support for resonant filters and a bunch of other cool stuff.

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A call for standards: Enter General MIDI and the Roland Sound Canvas

Back in the MIDI world, there were many complaints about the problems of having hundreds of different synths that are all incompatible with each other. The problem was patch #1 on one synth might be a piano, while on another, it might be a flute. So playback required the original synth it was recorded on. A major conference was held sometime around 1991. An idea was thrown around about developing a standard in which all synths would comply to the same instrument mapping. Most companies dismissed the proposal as unrealistic. Roland people, however, took very careful notes on the specifications.

Soon after, Roland introduced the Sound Canvas, and the birth of General MIDI (GM). Following the guidelines, Roland offered the Sound Canvas as the template to the world for General MIDI. The specification called for 128 instruments, all laid out in a very specific order, defeating the former problem with synths. Patch #0 is a grand piano, and it must be a grand piano for all General MIDI compliant devices.

There was criticism that GM did not allow enough instruments for the long term. There was also criticism that there was not enough flexibility in the standard, and not enough ways for a manufacturer to be creative to market a better device. Roland solved this problem by creating the "GS" standard. (Some claim it is an acronym for General Sound, but there seems to be a lack of solid evidence for this.) GS is a "superset" of GM. This means GS can do everything that GM requires while adding new things.

To address the problem of not having enough instruments, Roland permitted each of the 128 instruments to have 128 variations. So for example, patch #0 is a grand piano, now you are allowed 128 variations of different kinds of grand pianos. However, it is not a requirement that this patch actually be a piano, since Roland controls the GS specification (which is outside GM) So in theory, you have $128 \times 128 = 16384$ instruments. Currently, Roland has actually only defined slightly over a thousand. For compatibility, by the GM specifications, if a song requires an instrument that is not available on your GM/GS device, it will default to the GM instrument.

To address the problem of creativity, Roland returned to "Sysex" or "System Exclusive Data" (which most devices like the MT-32 already used). The idea is every manufacture may have a unique ID code that their device recognizes. If a song activates this code, it will turn on special features of that card, such as reverb or chorus options. For compatibility, if the device does not recognize the sysex, the song will continue to play as a basic General MIDI song without the special enhancements.

(So when Tom makes a song for XG (explained later) or GS, this is what he is doing.)

Not all are created equally...

Creative Labs, having a stranglehold on the market, was slow to move beyond its FM synthesis. With very little competition in its price range, Creative Labs had very little incentive to move beyond FM. (This is why so many people are familiar with FM synthesis...a 1970's technology). However, with the General MIDI specification available to any manufacturer, many companies jumped into market (not necessarily music companies).

The result was a breed of music devices that would give General MIDI a bad reputation. Many of these devices were very poor in sound quality. I should know. I was a victim in this market.

Creative Labs, to compete in this new market invented several devices. The first was the Wave Blaster. Creative Labs designed some of their SB16's to have a special port so you could attach a piggyback board designed to do General MIDI. They would then sell the Wave Blaster as a \$200 option to your sound card, bringing you "Wavetable synthesis" and "MT-32 compatibility".

Dazzled by the two claims, I foolishly bought one of these units. I am no stranger to the MT-32 as one of my friends had one for many years. I always loved the sound quality, but never could afford it. Now here was a device at less than half the price which claimed to be of MT-32 quality. I bought the device and will forever regret that day.

When I put it in, I could tell it was far better than FM, but it still sounded pretty bad. I worked with the card for days, trying to make sure there weren't any options I needed to turn on.

Desperate, I eventually called Creative Technical Support asking why it sounded so bad. They tried to convince me that they personally liked it better than the MT-32. I then realized I had been ripped-off.

How bad did it sound? Well, I usually describe it to people as this: "Imagine a rock hitting a metal plate. That is their idea of a piano. Except...you would expect the metal to vibrate with an echoing sound. The Wave Blaster had no reverb or chorus capabilities whatsoever. So remove the echo from the image. Thus you have an incredibly bad, artificial sound."

Wave Blaster was so bad, they pulled it from the market several months later and introduced Wave Blaster 2. This was an improvement, but still a far cry from the ancient MT-32.

I soon discovered a new sound card coming out. The Roland Sound Canvas Daughterboard. Roland took their normal SC and adapted it to fit in the WaveBlaster slot. I quickly sold my Wave Blaster off to one of my roommates that had probably gone deaf from playing his stereo too loud, and bought this miraculous device. This was 180 degrees from my Wave Blaster. Roland was quick to admit that though the SC actually has MT-32 sounds built into the device, it cannot understand MT-32 sysex, and thus cannot faithfully reproduce MT-32 music. However, it's GM/GS is wonderful.

Meanwhile, to further advance their sound card control, Creative Labs introduced the Sound Blaster 32 and the AWE32. The Sound Blaster 32 was essentially, a SB16+Waveblaster2. This was fully GM compliant, but it didn't sound that good. Creative Labs was more interested in pushing their own proprietary, AWE32. This one is not fully GM compliant. It was cheaper for them to produce, and it accepted, it would allow them to control the next generation of Sound Card standards (as they did with Sound Blaster).

The AWE32 sacrificed some of the required onboard ROM for GM instruments and used RAM so you could load software instruments, very much like the Gravis Ultrasound. However, since this was their own technology, they did not adhere to any standards. Thus you had to find products that supported the AWE32 directly. This was a problem at first, since the world was still DOS based. Games like Doom had problems for awhile supporting the AWE32. Eventually Creative Labs resolved most of their compatibility problems, especially with the introduction of Windows 95. And the AWE32 sold on brand name and technology-specs, without most people even hearing how it sounds.

Furthermore, because some of the technology was a copy of the GUS, many of the features were never utilized for the same reasons. (Tom was recently asked if he could record and download the MT-32 samples into the AWE32 Soundfonts banks, but Tom replied there are just too many MT-32 sounds to be feasible.)

Also, most game manufacturers composed General MIDI on a Roland Sound Canvas. One of the "flaws" of the GM specification was the lack of requirements of how an instrument should sound. The companies argued this was to allow artistic freedom, but it produced cards like Wave Blaster. The particular flaw in this case, however, was the balancing. Certain instruments might sound louder on a AWE32 than a Sound Canvas, making the song sound really bad. Creative Labs did not give much consideration to the Sound Canvas standards and produced a card that had many incorrect balances.

These factors combined, help give General MIDI a very bad name. People were convinced that

MIDI was a little toy, and the MT-32 was so old, that very few knew what it was.

The Death of MIDI

CD-ROM was finally being equipped in every computer. A new fad was born: Red Book Audio (or CD music). People started demanding CD music with games because their MIDI sounded so bad either through FM synthesis, or bad wavetable. The other problem was many midi compositions were not necessarily that good because it requires some work to become a good MIDI musician.

In the early stages, some companies simply composed GM songs on the Sound Canvas and then recorded those songs onto CD for those without Sound Canvases. Warcraft 2 and Hexen are two examples.

But ultimately, MIDI was dropped for CD music completely. This was a disappointment to a minority of gamers that loved the concept of "Dynamic Music". Dynamic music is music played while you are playing a game, but the parts of the music change as you do different things. Perhaps the best implementation of this was in LucasArts' TIE Fighter. Basically, just by the music you could tell what was going on during the whole battle. There was no need for annoying, pointless radio chatter (which should only be used for useful information) because the music could tell you if a wingman died, if you were being shot at, if you scored a kill, if an enemy ship was jumping in, if a friendly ship was jumping in, etc.

But this art died with the push for CD music.

The Present

So here we are. Some how you managed to find Tom's site and discovered the wonderful world of MIDI. And some of you seem to be asking about what MIDI card to buy. That's not an easy question. Often it comes down to personal choice. Ideally, you should listen to all the cards you are considering. Tom has been kind enough to post MP3's of the basic options.

But here is some extra information. The Roland Sound Canvas has been the standard for General MIDI for many years now. So if you are concerned about playing old General MIDI songs or games, the SC would be a good choice. HOWEVER, due to the death of MIDI and the market clout of Creative Labs, Roland seems to have withdrawn from the PC market. They seem to have handed off their Sound Canvas sales to a company called Edirol. Because of this, it is hard to find a SC at a good price, being that Edirol is the only place that seems to sell it.

Your second option is an AWE32/64. These devices have improved over the years, and they are nowhere near the Wave Blaster. However, Creative Labs has been indifferent in their production of their card to other devices, often causing balances to be wrong.

Your third, and perhaps more favorable option, is to go for the Yamaha Waveforce XG cards. Yamaha entered the PC market about 2 years ago. This is when MIDI was already dying. To put it simply, Yamaha built a great card. Having the benefit of developing a device many years after the Sound Canvas, Yamaha built a card that was "GS compliant". This means that the Waveforce can understand GS sysex. Furthermore, using more recent compression technology,

they were able to cram more instruments on the device. To top it off, Yamaha introduced a new standard called "XG". XG is similar to GS, but since it belongs to Yamaha, they get to control how instruments are mapped in the spec, and so forth. XG introduces new special effects that are not present in GS.

However, the best thing about the design of this card was Yamaha's careful attention to the Sound Canvas specifications. I haven't heard it personally, but reading many things from the Internet and Tom, it seems that the balances are very close to the Sound Canvas, so a song will play correctly on either card.

Sound Canvas vs. Waveforce

This is a very hard match up. I have little personal experience with the Yamaha. Most of what I can say was picked off of Tom or the Usenet (about 2 years ago). Unlike many other products (Apple vs PC), the debates of these two cards are very civil. People generally acknowledge that both are high quality products, and you will not be disappointed with either. However, the Usenet seemed to form some general descriptions about the two.

The Sound Canvas will give you more compatibility with existing songs in the world. Also, there is a lot of software written to take advantage of the GS features. The Sound Canvas is considered to have a very good piano, very good orchestra instruments, and very good wind instruments.

The Waveforce is considered to have very good synth instruments, very good electric instruments (like guitars), and very good sound effects. XG also is popular with some musicians because it offers more control that GS didn't allow for.

For both cards, people liked the drumsets, and I think both cards were criticized for their Brass sections, claiming that they still need improvement (not that they are that bad).

Once again, it is a very hard call. Some people get both. You really should listen to them first. The Yamaha cards seem to be considerably cheaper which is an incentive to buy. However, if you want a Sound Canvas and don't want to pay the higher price, I recommend you complain to Roland and then either scout out music stores or mail order, or find a used one.

A Word About XG and GS

Although Yamaha XG does include all the tones defined by Roland GS (including the MT-32 and CM-32P variation tone sets), the manner in which XG's GS tones are presented are usually not comparable to Roland Sound Canvas GS. Volume levels are often quite different and sound qualities may or may not match properly. This doesn't seem to be as much a problem under General MIDI between the two technologies.

XG is capable of producing high quality tones that are comparable to those produced by the Sound Canvas, but these may often only be found in XG sound banks that aren't part of the GS definition. I have found converting between the two standards (XG and GS) often requires a lot of instrument remapping and tweaking in order to match sound and volume output. Some GS sounds are completely different in the two technologies, such as "Fantasy" and "Warm Bell".

Another example would be the Sound Canvas' default GM French horn, which isn't all that great. But it's MT-32 variation French horn is fantastic and mimics the real MT-32 almost identically. This same French horn sound quality can be found in XG's French Horn 2 variation tone, but the bank and patch number used to access it is different than the Sound Canvas. Therefore, to produce the same French horn sound on both devices requires different MIDI program numbers and sound banks -- causing non-compatibility of the MIDI file.

Tom Lewandowski,
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The Future of MIDI?

Game MIDI died at the hands of CD music. However, many gamers have started to become tired of endless looping CD tracks that really have nothing to do with the game. There are rumors that Microsoft will be pushing "Direct Music" which will be dynamic music like LucasArts used to have. It is believed that General MIDI will be called on again to fill the role of Direct Music. Roland has already struck deals with Apple and Microsoft to support software emulators for people that don't have GM cards. I don't recommend these as I have heard the Apple Quicktime 3 sound patches which were produced by Roland. They are quite bad compared to the real Sound Canvas. The Virtual Sound Canvas is closer, but still not perfect, and I got to see it bring a Pentium 133 to a grinding halt due to the processor requirements for emulation.

However, unless Roland plans to compete again in the hardware market, there is a good chance the Yamaha Waveforce will become the standard for the return of General MIDI. It is a quality card that people can afford. Recently, Final Fantasy 7 was released, and they seemed to recommend a Waveforce.

Hope this was helpful.

Eric Wing

The Companion to Gene Roddenberry's Earth: Final Conflict
<http://sdcc10.ucsd.edu/~ewing/companion> (not MIDI related)

It's worthwhile to note that even with the diminished support of MIDI soundtracks in today's PC games, the use of MIDI is alive and well in today's music world, and heard in dozens of other applications! The difference is, instead of offering music to the end user in MIDI format, musicians record the MIDI output to a digital format (MP3, DVD, CDA, etc.)

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