Pamela Vizner Oyarce
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Professor Ann Harris
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The last beats of analog: The MII videotape

Introduction

This paper will address the history, technology and preservation issues of the Panasonic MII videocassette format. In order to understand the context in which this technology was developed, it is necessary to describe and explain some other contemporary technologies, as well as historic facts related to people and enterprises involved in this complex process. The history of the MII format began with its parent format, the M, which was created to compete in the market with the Betacam videotape format. But the battle did not end there; Betacam SP would appear, continuing the struggle to leading the market in the professional field. The days of standards and agreements were over, and, not much time later, the digital formats would start gaining ground in the broadcast market, leading to the final obsolescence of the analog formats including MII tapes.

Finding information about this particular technology is not an easy task. Even in the world of audiovisual preservation this format is somewhat unknown. In some cases the information I could gather are only small mentions in a paper or journal, therefore the process of writing this paper has been somewhat of a puzzle. I hope that this paper contributes to the knowledge of this forgotten, but not-so-old format, and also to the knowledge of the market's recent history. This can lead us, as audiovisual archivists,to

a better understanding of the birth of digital technology as well as knowing how to deal with the preservation of this obsolete format.

The market before MII videocassettes

In order to fully understand how matters combined to finally lead to the development of the MII (sometimes M-II or M2) videocassette tape, we must go back to the beginning of the 1980's. In the professional market,the U-matic[1]videocassette was a widely used standard: JVC, Matsushita and Sony agreed to share the market.[2]First intended for the consumer market, the U-matic ended up being used in the professional field.[3] However, image quality was not its strength, and other technical and practical issues needed to be solved. The industry was looking for a solution and that solution was brought by Sony.

The Sony Betacam[4]is a half-inch analog videotape format launched in 1981-it did not take long before it became a wide standard for field recording. This was not only because of the enhanced video quality – accomplished by the use of component video recording, the same system used by MII videotape - but also because its size was considerably smaller[5] making it very suitable for field recording using camcorders.[6] These features allowed this format to replace the previous U-matic format in the broadcast industry.

[1] Texas Commission on the Arts: *Videotape Identification and Assessment Guide*, 2004, pg. 10.
[2] Lardner, James, *Fast Forward, Chapter 10: Divorce, Japanese style*, pg. 136.
[3] Marlow, Eugene, Secunda, Eugene, *Shifting time and space, Chapter 6: The home video market*, 1991, pg. 109.
[4]Texas Commission on the Arts, pg. 17. Description of Betacam and Betacam SP tapes.
[5]The Betacam videocassette was developed in two different sizes: large cassettes were used in decks for editing and small cassettes were used in cameras.
[6] Newcomb, Horace, *Encyclopedia of Television Vol. 1: Betacam,* 2004, pg. 250.

The answer would not be long in coming. The Matsushita's response to Betacam videocassettes was the M format, developed in a combined effort with RCA and launched in 1982. Just as its competitor, the M format was developed as a component video recording system. The main differences were the loading system and the way in which the component signal was recorded. The M format got its name because of the M-loading system used to thread the tape around the drum - which contains the reading heads – emulating an M, as an opposite to the U system used by U-matic. This loading

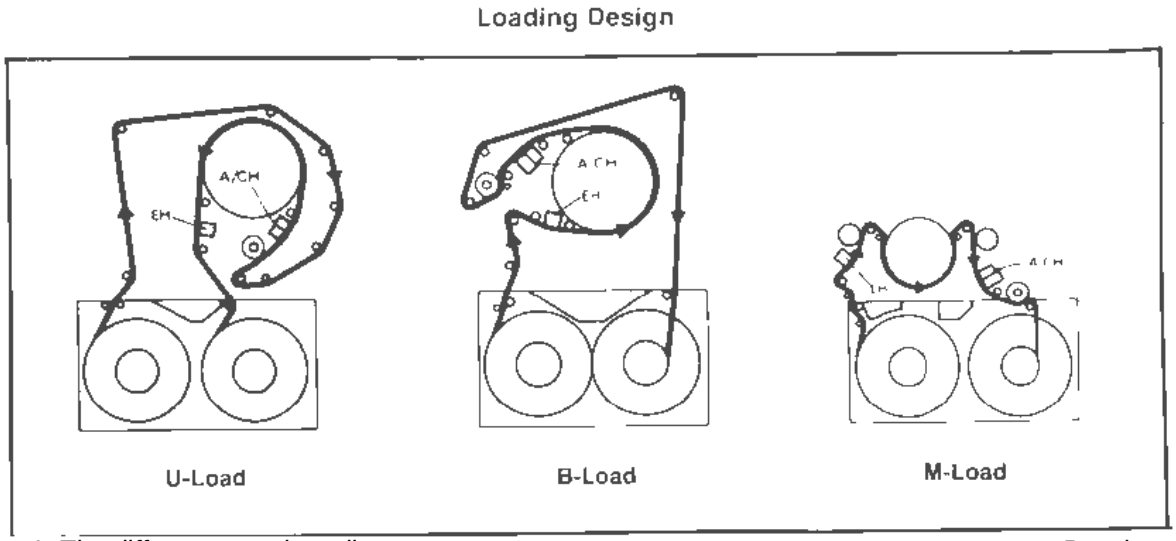

Figure 1: The different tape threading systems Bensinger, Charles, *The Video Guide,* Video-Info Publications, 1981, pg. 146.

system was the same used by VHS; in fact, the tape used for this system was the same asVHS but the recording process was different[7].Although the mechanical system needed to thread the tape using the M-loading is much more simpler, it has some drawbacks foremost of which is that the tape has to absorb much more stress when passing through the guides, therefore increasing tape wear. Thus, In order to diminish tape stress in fast forward andrewind modes the tape needed to be unthreaded,

[7]http://www.videointerchange.com/video-history.htm*M Format.*

increasing the time between these modes and playback and also not allowing the implementation ofa picture search mechanism[8].

On the other hand, the video signal was recorded in both Betacam and M tapes using chroma components or component video– in opposition to composite video used by U-matic. The component video has a better image quality than composite video, because the chroma signals, i.e. the color information, are recorded separately, therefore preventing interference between them.[9]However, M format recorded this signal simultaneously but separated in frequency (the signals were FM recorded) - which was only suitable for its use in NTSC systems[10] - while Betacam recorded both signals in one channel but sequentially. Because the M format used a VHS type tape and because of the amount of information needed to record component signal, the recording time was only 20 minutes. The M format was cheaper than Betacam and had the same image quality but, finally, the M videotapes turned out to be a big commercial failure. All these facts and the little marketing effort done by the manufacturer finallylead to an end of this format very soon after its launch.[11]

In 1986, Sony developed the Betacam “SP” system – standing for Superior Performance - an enhanced version of the previous Betacam. This improvement was achieved by increasing the horizontal resolution to 340 lines and by changing the chemical formulation of the tape itself from ferric oxide to metal-formulated tape. Analogously, the MII format was an enhanced version of the M format, although the differences with its parent format were much more radical.

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[8] Lardner, pg. 136, 156.
[9] Weise, Marcus, Weynand, Diana, *How Video Works*, 2007, pg. 108-109.
[10] Livingstone, Philip, *The MII Format, Broadcast Engineering*, April 1986, pg. 96.
[11] http://www.videointerchange.com/video-history.htm

MII: Technical Features

The MII analog magnetic videocassette was developed by Matsushita Electric Industrial Co. (Panasonic in the U.S.A.[12]) and NHK (Japan Broadcasting Corporation) in 1986 as a response to the Sony's Betacam SP format. Matsushita and NHK worked together with Fuji Photo Film to develop an improved metal particle videotape.This type of tape, since it is much thinner, allows fora longer recording time.[13]

The MII format was then ready for the competitive market;it is an analog ½ inch videocassette with triple-coated metal particle tape and component video recording system, which allows 90 minutes of recording time. This last feature was one of its primary strengths as it enabled more recording length in a small size cassette, making it very suitable for field recording,[14]although this tape was also widely used for editing purposes.[15]This quality was not only due to the new tape formula, but also because of the way in which the color or chroma information was recorded.

Technically, the MII format recorded 6 different tracks: two audio tracks, a control track, a time-code track – all of them linear - and the video information separated in chroma (R-Y and B-Y) and luminance (Y). To fit both chroma signals into one, the systems uses a process called chroma time-compression multiplexing (CTCM). This compression system reduces the length of both signals to half of the time, therefore occupying the same amount of time than luminance. As both chroma signals are generated at the same time in the camera, the B-Y signal is delayed to permit a

[12]Matsushita Electric Industrial Co. was the name of this company since 1918. Widely known as Panasonic, the company adopted this as its corporate name in 2008.
Home Theater Magazine, May 2008, pg. 18.
[13]Livingstone, pg. 96.
[14] Englefield, Bruce, *Hands on with MII,* Image Technology, April 1989, pg. 156.
[15]*Hands on with MII,* Image Technology, December 1988.

sequential order of the chroma signals to pass through the CTCM system. This process takes a certain time to happen which, if not corrected, would cause an evident offset of chrominance and luminance. However, this problem was fixed by adding a 2.5 MHz to the luminance signal and a 1.25MHz burst to both chroma signals, thus when time-compressed, all signals are synchronized.[16]This whole process allows the tape to record more informationas compressing both chroma signals uses less space than recording one after the other as Betacam does. Overall, the advantage of component video over composite video is that having both signals separated decreases the chances of interference between them because less encoding and decoding processes are needed; therefore, many copies can be made without showing too much image distortion.[17]

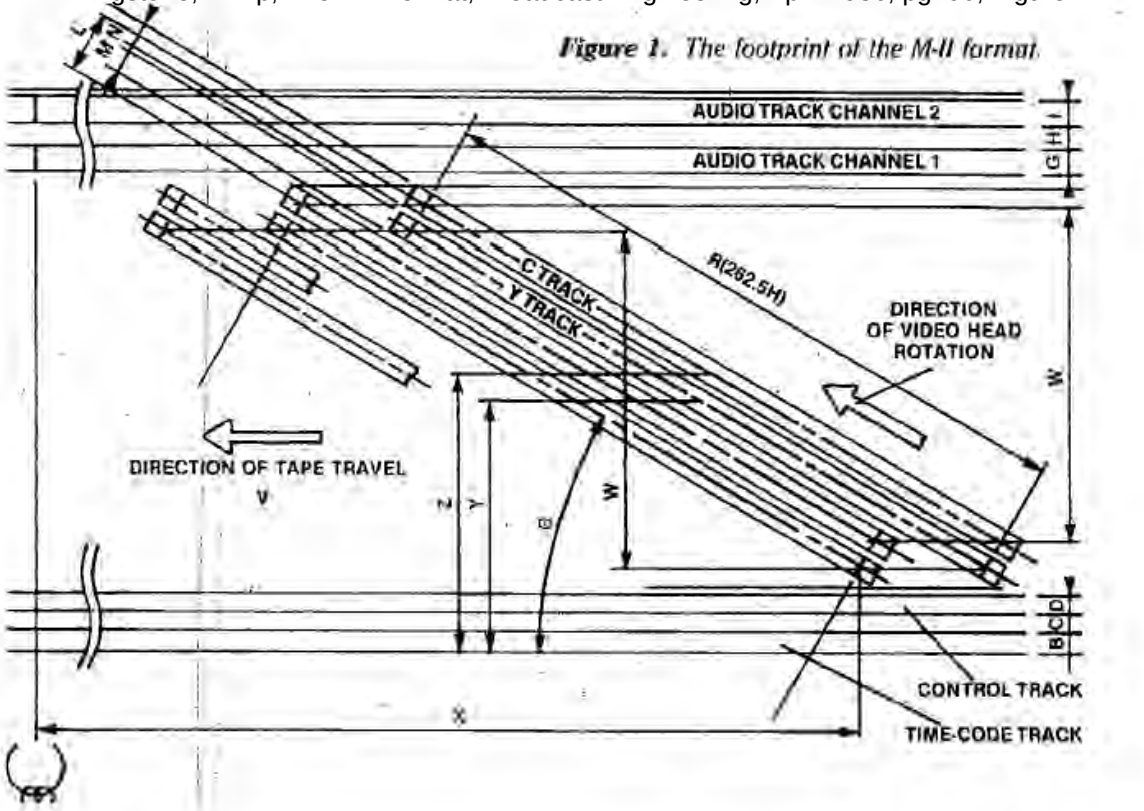
All of the features described above are the reason why this videocassette can record 90 minutes. The linear speed of the tape is considerable less than the one used in other tape formats. The running time is not the only advantage: the MII videotape allows a faster search in fast modes without causing too much tape wear.[18]

The MII tape has other important features to be highlighted. The metal tape formulation allows for a better S/N ratio and a higher coercivity, as well as longer heads life because of the smoothness of its surface. The threading path (B-load), which I mentioned before as different from M type, is described in the article*The MII Format* and the tape tracks are shown in the figure below:

[16]Livingstone, pg. 98, Figure 2.
[17]Weise, Weynand, pg. 106.
[18]Livingstone, pg. 96

Figure 2: The MII tracks.

Livingstone, Philip, The MII Format, Broadcast Engineering, April 1986, pg. 96, Figure 1.



Betacam SP v/s MII

After discussing the technical features of MII videotapes the question that arises: is the MII technology better than Betacam SP? The answer is very simple-neither of them was better than the other. Both videotapes are metal-formulated, both systems use component video, both tapes are roughly the same size and both were used to fulfill the same tasks. They just basically are not the same technology,both work under different standards and SMPTE (Society of Motion Picture and Television Engineers), at that time, was never able to decide which one was the best to be adopted as component standard.

The main difference between Betacam SP and MII was the signal used as reference for luminance and chrominance. For 100% luminance MII system used a signal of 700mV, while Betacam SP used 714mV. Analogously, for 100% chrominance MII used 934 mV peak to peak, while Betacam SP used 648mV p-p[19].

Finally, what really determined the success of the Betacam SP videocassette over MII was marketing. The Sony and Matsushita marketing strategies are discussed in detail below.

Cassettes and playback equipment

The MII cassettes were developed in two different sizes. The large one was very close to the size of VHS cassettes, and the small ones are around 3.6 by 5 inches.[20] They were also available in different durations, from 10 to 90 minutes long. The product name of the tape provided this information very easily: M10S was a small MII 10 minutes cassette, and the M90L was a MII 90 minutes large cassette.[21]

The first equipment designed to work with MII videocassettes was the Panasonic AU Series, with the AU-600 as the first prototype. The AU-600 was an editing/playback machine. The AU-400 was the Camera Recorder, a very light and small equipment; both are proof of the portability of this format. An example of both systems is pictured below.

[19]Epstein, Steve, *CAV Standards,* Broadcast Engineering, May 1999, pg. 62.
[20]http://www.video99.co.uk/MII_to_dvd_transfers.html
[21]http://orders.mediadistributors.com/Library/InfoManage/Items.asp?category=187

AU-400

MII

Figure 3:
Left: Panasonic AU-600. **http://www.videointerchange.com/video-history.htm**.
Right: Panasonic Camcorder AU-400. **http://www.bcs.tv/store/model_detail.cfm?id=10054**

Other machines followed, like the AU-620, AU-640 and AU-650, which, in general terms, allowed real time monitoring, use of big and small size cassettes without the use of adaptor, built-in TBC (Time-base Corrector), time code generator, 4 audio channels, Dolby-C Noise Reduction and separate edition for audio and video.[22]

Other models of the AU series are the AU-W Series[23], only used for playback; other companies, such as JVC also manufactured similar machines. Recognizing these machines is actually very easy- all the playback machines for this format have the distinctive logo “MII” (as shown in the picture above) on the front.

However, as this technology was designed to be used in the professional field, there are no “cheap” or home playback decks. Some of them can still be found in the second-hand market but they are rare and often very expensive.

[22] http://www.broadcaststore.com/store/model_detail.cfm?id=11871
[23] http://www.oldvcr.tv/collection/index.html?Mode=View&Brand=Panasonic&Model=AU-W33H&Ref=3

The Market

As mentioned above, the commercial marketplace played an important role in the final success or failure of the video formats at that time. Since both formats, Betacam SP and MII, were similar in image quality and practical issues, a judge – the market, not a very impartial member of the equation, by the way – needed to decide the future of videocassettes in the professional field.

After the creation of U-matic videocassette, JVC, Matsushita and Sony, the big companies behind the VCR market, came to an agreement to consider U-matic as the standard for broadcast use.[24] But differences were around the corner; friendliness was no longer going to be reigning for either the home market or for the professional field, although companies tried to overcome their differences.

The U-matic format was too big in size and too expensive for the home market, therefore a new format was needed,[25]Every company could agreed on that, however, the arguing began with the development of home market videocassettes, where VHS and Betamax prototypes were shown to analyze their technical features to determine weaknesses and strengths in order to determine which format was more suitable for home use.They all knew that a smaller videocassette was needed, but they could never agree on technical details; some of them thought that the M-loading system was better because it was simpler than the U-loading, but others did not agree arguing that the M-loading provoked more tape stress. Ultimately, each company would follow their own beliefs therefore declaring the well known “format war”, which was finally won by VHS.[26]

[24] Foisi Nmungwun, Aaron, *Video Recording Technology,* 1989.
[25]Marlow, Secunda, pg. 109.
[26] Foisi Nmungwun, Chapter 7.

Let's go back to the professional battleground for a moment. U-matic was certainly more portable and easy to use than Type C tape.The former format was already a standard-what was the problem then? The truth about U-matic is that the technology had some important disadvantages. Everybody agreed that Type C videotapes had a better image quality, therefore the manufacturers needed to find a small size videocassette, as U-matic or smaller; and a higher quality image, as Type C or better, but the companies were no longer working together in this task. However, some commercial alliances started, though they would not translate into one standard and several video formats were launched at the time.

Television agreements[27]

The format war continued, not only in the home market but also in the professional field. In order to make a successful market introduction the manufacturers had to make alliances with the major broadcast companies. The first alliance was, as named before, between Matsushita and NHK, who were looking for a new, cheaper, high quality format to replace all the type C one inch-tapes. This alliance turned out to be successful as Matsushita responded with the MII videocassette and NHK had a format that was less then half of the price of a full-equipped type C recorder with a comparable image quality.

However, Matsushita's idea was not only to lead the Japanese market but the global market as well, therefore they needed to make some international alliances and turned their heads towards the U.S. In February of 1986 a paper by NHK described its

[27] Abramson, Albert, *The History of Television 1942 to 2000, Chapter 12,* 2003. All facts and notes in this section are explained in this book.

role in the development of the Panasonic M-II format showed at the 20th Annual SMPTE Television Conference in Chicago.

But the contest was fierce and by that time the Betacam SP format was already in the market and Sony had its own partners. Ampex, Philips, Bosch and Thomson had signed an agreement to produce Betacam SP tapes citing the following reason:

> *"Sony's sales of Betacam had already reached 25,000 units with 5,000 to 6,000 sold in the USA alone".*[28]

Matsushita was not going to surrender and by April of 1986 they already had an agreement with NBC to buy MII machines. The station made this decision based on the experience presented by NHK. NBC kept using this equipment for a couple of years; however, other TV stations went another way. CBS and ABC decided to use Sony's Betacam SP for the following reasons:

> *"Ed Johnson, director of engineering for ABC, admitted that the decision was made 80 percent for business reasons and 20 percent for technical reasons. Sony had "featured a better network pricing deal than Panasonic". Sony was always ready to cut its price in order to make a deal…"*[29]

Some people believe that Panasonic did not do enough marketing in order to increase the product's popularity and probably the decisions made at that time were not the best, considering the fierce campaign Sony has rolled out. However, I believe that the analog video was living its final years, at least in the professional market, and that the digital era was finally what made this technologies disappear.

[28] *Abramson, pg. 210.*
[29] *Ibid, 213.*

The digital era

Although some may argue different reasons forthe quick disappearance of this format, I believe that the MII format was displaced by the digital systems. Even before the MII format was launched the professional industry was already discussing the use of digital technology. As a matter of fact, in the early 1980s some standards included digital features, such as the ITU-R Recommendation BT.601, published in 1982, which states the recommendations for digital encoding of video.[30]

The first all-digital television production was shown at the 127th Technical Conference of the SMPTE in October-November 1985.[31] Nonetheless, some technical and practical facts were needed to convince professional users of the advantages of this technology. At this time, digital recording was a novelty, and thus not enough for the industry to adopt it without any prove of reliability. But that proof would not take too much longer to appear. In that same year the D-1 broadcast quality format was approved by the SMPTE and published as a standard in 1986.[32] This standard was based in the BT.601 ITU-R Recommendation and has the following features: uncompressed component video, YCbCr encoded at 4:2:2, PCM audio tracks, ¾ inch videocassette. It could also be used for PAL and NTSC standards.

Manufacturers would not wait longer and in the 64th Annual NAB Convention (Dallas, April 1986) Sony presented the new digital video recorder, the DVR-1000, which used the D-1 recording system. However, this new recorder had some drawbacks. This new equipment was very expensive – about $120,000 at that time –

[30] Wood David, *Rec. ITU-R BT.601 - the bridge that joined the analogue and digital worlds*, available at http://www.itu.int/ITU-R/index.asp?category=information&link=rec-601&lang=en
[31] Abramson, pg. 209.
[32] Ibid, 215.

and the fact that uncompressed component video was used forced the use of a very big bandwidth, therefore a higher bit rate.[33]

In 1987 Ampex presented the new D-2 format, a cheaper alternative that, according to the manufacturer, had a better performance in post-production tasks. Aside from the price – which was around $75,000- Ampex claimed that this new machine could generate up to 20 copies without noticeable degradation. Although it is still an uncompressed video format, the bit rate was decreased by the use of composite video.[34]

Panasonic quickly replied and in 1988 they launched the D-3 video recording format. It was also a composite uncompressed video format that used the same tape transport as the MII analog video format. Unlike the D-1 and D-2 this tape was ½ inch wide and because of its smaller size it was suitable for many different applications, especially for field recording. Panasonic also claimed that this format would diminish the overall costs because of its lower tape consumption[35].

Although at that time analog tapes were still used, it was very clear that the professional and broadcast marketplace was quickly moving towards the digital formats. In the particular case of Panasonic, by the early 1990s the company was still marketing the MII videotapes but their presence in the broadcast industry was not strong, so they started to search for another format that would facilitate some television applications, such as newsgathering, and they started focusing on their new format: DVCPRO.[36]

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[33] Abramson, 210 - 211
[34] Ibid 221 – 223.
[35] Ibid, 224.
[36] Kerschbaumer, Ken, *Realizing Sony's Vision,* Broadcasting & Cable, May 14, 2001, pg. 54.

MII Preservation Issues

As a magnetic recording medium, the MII videotape has the same degradation problems as VHS or Betacam, such as sticky-shed syndrome, tape physical damage or lose of content due to bad storage or handling conditions. Therefore, as a general rule, these tapes must be kept in a controlled environment and all the components – such as cases and playback machines, if you have them, must be constantly cleaned and correctly maintained.[37]

However, I would say that one of the main concerns about the preservation of this format is obsolescence. While some machines can still be found and some vendors still work with them, they are not easy to get. As a result of the format war explained above, the playback machines are not always compatible with multiple formats, and the rare existence of MII videotapes in archives would never justify purchasing a corresponding playback machine.

Moreover, in terms of content, the MII tapes where used for field recording and video editing. While some materials found in these tapes can be copies, it is most likely to find original footage or original editions. Most of their provenance is broadcast or production. Therefore, if you have several of these tapes it might be a good reason to look for the playback machine, or finding a vendor to make a transfer, because it is very likely that you have a unique material in your hands. In particular, the broadcast station NBC still has MII videotapes in their archives, but, at the time of this writing, I could not find any more details about their content.

[37] Wheeler, Jim. *Videotape Preservation Handbook*, 2002, pg. 8.

On the other hand, given the fact that in the broadcast field was very common to reuse the tapes, you might find some MII tapes in very bad conditions of with wear or signal loss, thus in these cases tape inspection and environmental control are critical to prevent further damage.

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