White Paper
Panasonic HPX3000/P2 Workflow/Blu-Ray Authoring
By Joe Incardona
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My company, Media Source, has been using the Panasonic AJ-HPX3000 P2 HD camcorder since acquiring it in March 2008. The HPX3000 is, without question, the most outstanding ENG/EFP camera I have used in my 23-year career in broadcast/corporate television. It compares quite favorably against the more expensive Sony CineAlta F900 HDCAM, which we used in a TV commercial project in the fall of 2007. In fact, we have found it to be much more user-friendly and lightweight than the F900, and have concluded that it produces a better image, due to its full-raster HD 2.2 million pixel CCDs. We used the CineAlta last fall with a P&S Technic Pro35 adapter and Zeiss prime lenses, which is a configuration I have yet to try with the HPX3000. Given what we've seen so far, though, I believe the HPX3000 with a 35mm lens adapter and prime lenses would produce an absolutely stunning, film-like image.

I think the following statement from Panasonic pretty well sums up the reason I bought this camera:

"With the ability to capture at the same quality in which you master, at full-raster 1920x1080 resolution, this camera is ideal for anyone who's shooting episodic television, high-end commercials, as well as independent movies, even people who are recording HD out to film.

This camera has three 2/3-inch CCDs, as well as the same high-quality optics found in Panasonic's VariCam line of camcorders. It features 4:2:2, 10-bit color-sampling, and allows you to shoot in 24p, 25p, 30p, all natively, as well as 50i and 60i. Since this material is recorded to solid-state P2 cards, you have instant access to your material on the set.

With 5 32GB P2 cards, the HPX3000 provides up to 3.5 hours of 1080 24p recording time for master-quality video."

Here is the complement of P2-ready field and editing equipment we own: (I will give a detailed explanation of how we plan to use each piece individually, and then how all the pieces will be used together.)

- **Panasonic AJ-HPX3000 Native1920x1080 P2 HD Camcorder** With Three 2.2 million-pixel High-Density CCDs for Cinematic Master Quality; **Fujinon 16x6.3 Wide Angle Lens with 2x Extender and Chromatic Aberration Compensation (CAC)**; P2 Solid-State Memory Card Recording in 1080 HD format at 24P, 30P, 50i, and 60i
- **Vocas MB-350 Matte Box system** for AJ-HPX3000 P2 HD Camcorder, with various filters from Tiffen and Schneider Optics

- **Panasonic AV-HS400G Switcher**, with Multiple HD-SDI High-def Video Inputs and Outputs, Multi-View HD Monitoring Capability
- **Panasonic AJ-HPM110 P2 Mobile Multi-Format Player-Recorder**, with Six P2 Card Slots, AVC-Intra Codec Board, Up/Down/HD Cross-Conversion Capabilities, USB Host Mode for Copying Clip Selects to an External Disk Drive; the P2 Mobile is perfect for "Video Village" use in the production of movies, TV, and Commercials.
- **Five 32GB P2 Memory cards and One 16 GB P2 Card** for recording in AJ-HPX3000 Camcorder and P2 Mobile Player-Recorder
- **Panasonic BT-LH1700W 17" HD/SD Multi-format LCD Widescreen AC/DC Field Monitor,** With Dual HD/SDI Inputs, Built-in Waveform Monitor, Runs on House AC or DC from Anton Bauer Brick Battery
- **Two Panasonic BT-LH80W 7.9" HD/SD 16:9 LCD Field Monitors** with HD-SDI Inputs, On-camera mounting arms, Focus Assist Function, DC Power from Anton Bauer Battery
- **MacBook Pro 2.5GHz Laptop with 2 GB RAM and 250GB Hard Drive** for P2 Clip Transfer and Review in the Field, Duel P2 to Express Card Adapter
- **AJA Io HD Portable Input/Output Box** with ProRes422 Codec for Field Editing with MacBook Pro laptop, and for 1920x1080 Field Monitoring
- **AJA Hi5 Portable HD-SDI to HDMI Input/Output Box** for 1920x1080 field monitoring on Sharp Aquos 32" 1080p LCD HDTV

This equipment was purchased between January and April 2008.

Outstanding Features of the AJ-HPX3000 P2 HD Camera

AVC-Intra Compression
This camera is the only full-size ENG/EFP camcorder currently on the market that uses the new AVC-Intra codec to create D5-quality recordings.

Like DVCPRO HD, the AVC-Intra codec employs a bit rate of 100 MB per second. However, it is superior in quality to DVCPRO HD in that each frame, when individually compressed, contains far more information than each frame of DVCPRO HD material. This is what is referred to by Panasonic as intra-frame, rather than inter-frame, compression (DVCPRO HD is inter-frame, while AVC-Intra 100 is intra-frame).

Our most knowledgeable broadcast equipment dealer in the Memphis market, Mike Bradshaw of ProMedia, suggests the AVC-Intra codec is better to use for shooting footage with a great deal of motion, such as sports, fast-moving vehicles or aircraft, etc., due to the fact it is not subject to the artifacting that inter-frame compression suffers from when used for capturing fast-motion footage.

Film-REC Mode
This is a feature brought over from the venerable VariCam DVCPRO HD tape camera. It truly mimics the highly-sought after film look, with a smooth, linear gamma curve. The HPX3000 is the only P2 camera that currently offers this feature, although, according to Panasonic, the upcoming VariCam 3700 (basically the HPX3000 with variable-frame rate

recording from 1 fps to 30 fps, known as undercranking to speed up the action being recorded) will have the Film-REC feature as well.

Dynamic Range Stretching (DRS)
Both the HPX3000 and the lesser HPX2000 share this feature. Think of it as "gain control for contrast." By this, I mean that you can activate this feature with a User button to boost the level of detail in dark subjects against a brightly-lit background.

We discovered the usefulness of this feature while attempting to shoot bronze sculptures in the beautiful Centennial Park in downtown Atlanta while on a recent shoot.

After shooting a massive bronze figure at the Park against a bright blue sky in early March, I noticed that when viewing the footage on our 42" Sharp Aquos 1080p monitor, I couldn't see the fine detail in the statue's face. This is due to what's referred to as "blown highlights" from the high contrast between the bright blue sky and the dark bronze face of the statue.

On a subsequent shoot in Atlanta, we shot footage of the bronze statues of one of my boyhood heroes, home run king Hank Aaron, at Turner Field, where the Atlanta Braves baseball team plays. In this case, we activated the DRS function in the HPX3000, and were able to see remarkable detail in the face of the Hank Aaron statues. Again, we were shooting on a bright, sunny day, against a clear, blue sky.

The most compelling example of how this outstanding DRS feature helps, though, came when we were shooting the lovely Georgia State Capitol building in downtown Atlanta. Even when using the 2x extender on our Fujinon 16x6.3 BERM HD lens, we were able to see amazing detail on the face of the gold-leaf figure at the TOP OF THE CAPITOL DOME! Again, this was shot on what a friend of mine, veteran network videographer Richard Copley, refers to as "an f22 day." Bright, sunny, not a cloud in the sky.

This DRS feature alone would probably have sold me on the HPX3000!

Field Configuration

In the field, we have performed shoots with the HPX3000 P2 HD camera outputting to both the 17" Panasonic BT-LH1700W HD LCD monitor, and to a Sharp Aquos 32" 1080p consumer LCD HDTV, using either the AJA io HD box or the AJA Hi5 box. In my opinion, it is important to use a true 1920x1080 monitor to show the camera's output, as the full-raster 1920x1080 HD capability of the HPX3000 is what differentiates it from the lesser cameras in the P2 line, as well as other HD cameras such as the Sony HDCAM and the Sony XDCAM.

Display of 1920x1080 images in the field and the edit suite:
There are clear advantages to showing the pristine output of the HPX3000 on the 1080p Sharp Aquos consumer LCD HDTV. The Panasonic BT-LH1700W field monitor is only

capable of displaying 1440x720 resolution, while the Sharp Aquos monitor can display the true 1920x1080 resolution being produced by the HPX3000's CCDs.

Another advantage is cost: the Panasonic BT-LH1700W field monitor cost us $2,750 new from our local Panasonic dealer, while the 32" Sharp Aquos consumer LCD HDTV cost $828 new from Sam's Club.

At home, I had converted the entire house in September 2007 to HD, which involved replacing my old analog CRT televisions with HDTVs. I opted to use LCD HDTVs, hooked up to DirecTV's HD DVRs. In our den, we had Best Buy install a 52" Sharp Aquos 1080p LCD HDTV with 120 MHz processing for smooth fast motion images; a 42" Sharp Aquos LCD HDTV was installed in a game room; a 37" Vizio 720p LCD monitor was used in the master bedroom; a 26" Samsung 720p LCD monitor was used in the home office; and a 26" Samsung 720p LCD was mounted in the kitchen.

The outstanding performance and quality of the Sharp Aquos line of LCD HDTVs in my home is what convinced me they would be well suited for field monitoring with the HPX3000 camera. The trick was figuring out how to convert the HD-SDI output from the camera to the HDMI interface that was needed for the 1080p Sharp Aquos monitors.

During my research on HD editing solutions, I had learned that the AJA Io HD input/output box had HDMI input/output capabilities. For several years, we have been using the standard-def AJA Io input/output box in our existing standard-def Final Cut Pro edit system, and have had great success with it; AJA's tech support is among the best I've encountered in my 14 years of doing corporate/broadcast television production. I decided the HD version of this product would make a great addition to our HD FCP edit suite. By having HDMI input/output, I was able to use a 42" Sharp Aquos LCD HDTV (the same model as the one in the game room at my house) as our primary client review monitor in our new HD edit suite. This makes for a very impressive display of the output from the FCP timeline of P2 material edited from the HPX3000. The AJA Io HD can also simultaneously output downconverted standard-def signal to our 20" Sony CRT production monitor in the edit bay; the AJA Io HD has a multitude of input/output selections that can be accessed through the AJA Io HD Control Panel software installed on our MacPro 3.2 GHz quad-core edit computer.

AJA Io HD

   I have been describing this outstanding piece of equipment as "the Swiss Army knife of HD input/output," as it has the ability to do realtime up/down/cross-conversion of 10-bit uncompressed HD video. Here is the company's description of the Io HD:

AJA's new Io HD is the latest in the award-winning Io family of products—an effortless, transportable plug-in solution to working with HD and SD in Final Cut Pro 6 on a Macbook Pro or Mac Pro computer. With a single FireWire 800 connection, Io HD supports the amazing new Apple ProRes

422 Codec—natively, in hardware, to bring production-quality HD editing to laptops!

Io HD is the only device in the world that supports Apple ProRes 422 and Apple ProRes 422 (HQ) in hardware, enabling true 10-bit editing on an Apple laptop. With this high performance hardware and codec, you can work on the road with 720 and 1080 HD, all in full-raster 10 bit 4:2:2— and in realtime!

The Io HD enables you to do uncompressed 10-bit HD field editing using a MacBook Pro laptop and an external SATA hard drive; we have done this with a Sonnet Technologies Fusion F2 portable 640 GB SATA RAID storage system, which is a little bit bigger than the average wallet. You also need Sonnet's Tempo SATA ExpressCard/34 host adapter to connect the F2 portable drive to the MacBook Pro via the ExpressCard slot. Another issue is the fact the AJA Io HD needs to occupy the FireWire 800 bus by itself; and the Fusion F2 drive is powered by a FireWire connection. To use this configuration, we had to buy a FireWire AC power block designed to power and charge the FireWire iPods.

This configuration is obviously good for field editing of P2 material in Final Cut; it also works for field monitoring from the HPX3000's HD-SDI outputs. The AJA Io HD is very rugged and portable, having an integrated carrying handle.

However, the disadvantage of using it for field monitoring is that the camera then must be tethered to the AJA Io HD, which has to be connected at all times to a MacBook Pro laptop. This is fine for stationary situations such as interviews, but in cases where there are a lot of setups, it's not very practical given the amount of connecting and disconnecting involved. Also, there is a cost issue: the AJA Io HD sells for around $3000, which makes it expensive for use solely to output the HPX3000's 1920x1080 video out in the field.

A month or so after getting our HPX3000 and our new HD FCP edit system, I learned that AJA makes a very small HD-SDI to HDMI converter box called Hi5. This box costs around $450, and simply required plugging into AC power; it does not require being tethered to a laptop. I then bought the AJA Hi5, and have been very pleased with its ease of use and the image quality it produces from the HPX3000's HD-SDI outputs, converting to 1920x1080 HDMI signal to the Sharp Aquos 1080p consumer LCD monitor.

Transfer of P2 Material from the Cards: Remember, the P2 Card Is Just Temporary Storage!

This area is one with the most potential pitfalls for those of us who are veterans of the videotape era (when I started in news as a reporter in 1985, the station was still shooting on 3/4 –inch tape).

The people from Panasonic are very clear on this subject: the P2 cards are solely intended to be a temporary means of storing HD video, requiring you to have a well-thought-out, careful plan for transferring (and then backing up) your P2 material from the cards to some other more permanent means of storage.

I witnessed this from the time I saw my first demonstration of the P2 technology in September 2007. I owe a debt of gratitude to the following people who were involved in a Panasonic-sponsored clinic here in Memphis last September:

- Ken Ostmo, Panasonic DSM for our region
- Art Aldrich, a New York-based DP who owns Odyssey Tek, who also works for Panasonic as a P2 workflow specialist (be sure to visit his Web site at www.artaldrich.com; he has white papers on his site that describe all the tools he uses in his P2 workflow)
- John Ladel, who travels on behalf of Sonnet Technologies and AJA to demonstrate their equipment.
- Jim Thomas, a Panasonic field engineer (known as "J.T." to the Panasonic USA people), who is described by many in his organization as "the P2 guru" or "the P2 evangelist."

All four of these gentleman are extremely knowledgeable about P2 technology and the P2 workflow, and have proven to be outstanding resources for me.

Now, here is what we've concluded from the few months we've been using P2 (and by the way, we get new ideas or learn something new about the technology every day):

- It's a good idea to have several different methods in place for transferring the P2 material from the cards to something that offers more permanent storage.
- Our current method of choice: using the P2 Mobile connected to either our MacPro HD edit computer, or to an external USB 2.0 portable hard drive, to get the P2 material off the cards.
- If circumstances dictate that we'll probably fill up the five 32 GB cards during a shoot (we've yet to do that, though), the plan is to hand off each card as it becomes full of data to an assistant cameraman/media manager/media wrangler (the NY production people have given this crew position the title "media manager," while the LA people seem to refer to this person as the "media wrangler.") The media manager/media wrangler will then insert the full P2 card into the P2 Mobile and copy the data on to a USB 2.0 hard drive. To do this, you use the P2 Mobile's "USB Host Mode," which mirrors a function on the HPX3000 itself.
- If we don't anticipate filling up all five cards in the course of the shoot, then I have instructed my staff to dump the P2 material off the cards, as soon as we return to our office from the shoot, directly on to our Sonnet R800 Fusion RAID array.
- If we dump directly to the edit system, I have then required our shooters to immediately make a backup on to an external USB 2.0 hard drive (this can either

be done by connecting that portable drive directly to the MacPro, or by using the P2 Mobile again connected to the portable drive).

- For permanent archival of our P2 material, I have chosen the rock-solid, yet rather expensive Quantum SDLT-600A A-Series tabletop tape backup drive with MXF Aware Technology. We have yet to configure this with our HD edit system, since we haven't yet amassed enough P2 material to worry about permanent archival. The advantages of this device, though, are that you can store 300 GB of uncompressed material from the HPX3000 (that's nearly 10 full 32 GB P2 cards); and that Quantum has worked with Panasonic to build a searchable software database program that enables you to quickly find the .mxf P2 files you're looking for. We have not tested this part of the workflow yet, but will be doing so in the near future, so I will provide an update to this part of my white paper.
- OTHER METHODS FOR FIELD TRANSFER OF P2 MATERIAL: we are now taking our MacBook Pro laptop out in the field on every P2 shoot, along with the P2 Mobile. This gives us another way to dump P2 material from the cards. We have the Duel Express Card to CardBus adapter that was recommended by Art Aldrich; this enables us to insert the P2 card into the adapter and copy its contents to either the MacBook Pro's internal 250 GB hard drive, or to an attached USB 2.0 or FireWire hard drive.
- One more method: in an emergency, if we didn't have the P2 Mobile and/or the MacBook Pro laptop with us (and, by the way, we also have in our arsenal a Sony VAIO PC laptop that has both Express Card and PCMCIA CardBus slots), you can use the HPX3000's "USB Host Mode" to copy the P2 clips directly on to a USB 2.0 hard drive connected to the camera's onboard USB port (again, our drive of choice at this point is the Western Digital Passport drive, which does not require an external AC power supply to function in this manner).

As you may have gathered, the bottom line is that you need to be able to have your P2 material at all times in at least three places (one of which is not on your P2 cards, they're too expensive to use as storage, even for a few days!). We have chosen to have our P2 material moved on to our primary HD FCP edit system while the project is in progress; backed up on to a portable USB 2.0 hard drive (so far, the best option appears to be the Western Digital Passport wallet-sized drive; I recently purchased a 320 GB model for $150 from Best Buy); and then backed up permanently on to DLT tape using the Quantum DLT tape drive.

CAVEAT: INEXPENSIVE EXTERNAL HARD DRIVES CAN FAIL! Recently out of a batch of 3 Western Digital Passport drives, our editors discovered one had gone bad after they moved P2 material on to it.

That's why you might want to consider this as a method for temporarily (or even permanently) storing your P2 material during a project:

- **BLU-RAY DISC ARCHIVING: This represents a promising method for permanent storage, and definitely for handing over P2 MXF files to a producer who wants to take the footage back home for post-production.**

- Thanks to my friend Richard Copley, who, as a former network videographer, knows the importance of having the backup to the backup to the backup, I was able to test the new LaCie D2 External FireWire/USB 2.0 Blu-ray Disc Burner.
- After some hours of trial and error, we were able to get the LaCie Blu-ray Burner to write MXF data on to both a rewriteable and a write-once Blu-ray disc (Richard has a PC laptop, so we had to load the LaCie's Windows XP drivers to be able to do this). Then, because Richard is obsessive (I say that with due respect) about wanting to make sure that not only the material is there on the Blu-ray disc, but also that he and the producer can then view the P2 clips from the Blu-ray disc, we were able to use P2 Viewer to accomplish this.
- To get the Panasonic P2 Viewer for Windows program to view the P2 clips from the Blu-ray disc inside the external LaCie burner, we had to use the "Virtual P2 card" feature in P2 Viewer. You simply set the "virtual P2 card" in the P2 Viewer software to be the same drive letter as the LaCie Blu-ray burner in "My Computer," and then you can play the P2 clips from the Blu-ray disc.

YOU CAN ALSO USE THE LACIE BLU-RAY BURNER TO CREATE A VIEWABLE BLU-RAY VIDEO DISC!

- Thanks to the editors on my staff, we were then able to learn that on a Mac, the outstanding Adobe Encore DVD program (unfortunately, you must have the entire Adobe CS3 Production Premium bundle, you can't buy Encore DVD as a standalone program) can be used to create a viewable Blu-ray video DVD! (NOTE: I believe there are several programs out there, including Sonic DVD, to enable a PC to create a viewable Blu-ray high-def video disc).
- Using this method, we recently created a custom video presentation for a Fortune 500 company that we're prospecting for new business. The viewable Blu-ray DVD was clearly the only way I could truly showcase the amazing full-raster 1920x1080 images from the HPX3000.
- Now, for the real kicker: the "twenty-somethings" on my staff, upon hearing I was going to buy a Blu-ray disc player for this presentation, informed me that the Sony Playstation 3 game console has one of the most advanced Blu-ray disc players in the industry.
- Given the fact this device has an Ethernet port, it allows for continuous updates via the Internet. This is critically important, because the Blu-ray disc technology is changing rapidly.
- Also, HOW ABOUT THE PRICE! I was about to buy a standalone Sony Blu-ray disc player at Sam's Club for $377 when my staff told me about the Playstation 3. At $399, this is an outstanding value: you can show high-def video on a 1080p monitor using the Playstation's HDMI connection to the monitor, and then invite your clients to play "NBA '08" in stunning 1080p picture quality!

- **At the presentation to the Fortune 500 company, the client was absolutely blown away by what we had done. We were among about 20 production companies being interviewed as potential vendors; we were the only one to show anything in high-def, and the only ones to have created a custom high-def presentation tailored to their business!**
- **To show the Blu-ray presentation, I simply hooked up my 32" Sharp Aquos 1080p monitor to the Playstation 3 (you do have to buy the $25 DVD remote for the Playstation 3), put both on my Remin Kartmaster cart's shelves, and wheeled it into the client's multimedia boardroom; I now jokingly refer to this configuration as "the Media Source Mobile HD Wagon."**

Blu-ray disc authoring is thus a powerful tool in the P2 workflow toolkit.

The 50 GB dual-layer Blu-ray disc is sufficient space on which to copy a 32 GB P2 card; obviously, when the 64 GB cards come out later this year, testing will have to done to see how practical it is to split the P2 data across two Blu-ray dual-layer discs).

In all honesty, though, I'm not sure how practical the 64 GB cards will be in general. That's potentially quite a bit of material you would have to transfer to an external hard drive or Blu-ray out in the field. I think I'm going to stick with the 32 GB cards, and have at least a couple of 16 GB cards handy for short-form projects.

I would be glad to answer any questions about any or all of this information. The most efficient way for me to manage inquiries is through e-mail: joeinc@memphismediasource.com

Thank you for your interest in my white paper, and I encourage you to jump in and go out there and use P2!