

Automation Control of Progressive Timings with an Omneon Spectrum™ System

This document provides technical details regarding configuration, timing information, and strategies for automation system integration with Omneon Spectrum servers using progressive timings and/or clips. The intended audience is Omneon development partners.

Progressive timings add the possibility of customers adopting higher frame-rates than many automation systems currently address. This document is meant to show some implications of these timings and other features of Omneon's HD MediaPort devices. Also covered are strategies for using existing automation protocols and extending Omneon Player Control API implementation to fully support Omneon's progressive timing as well as up and down conversion features.

This document contains the following sections:

- Clip-time vs. Timeline-position
- API Calls(And Return Values) Related To Clip-Time And Timeline-Position
- Mixing Clip Frame Rates
- Up and Down Conversion
- Strategies for Integration

NOTE: This document will make reference to progressive timings which include 60p (59.94p) and 50p. Particular focus will be placed on integrating these timings with other systems and clips with interlaced timings including 30i (29.97i) and 25i. Unless otherwise noted all timings will be discussed in units of frames per second (fps). This document also makes use of the abbreviations SD and HD to signify standard-definition and high-definition content.

Player configuration for the 4100 series HD up and down converting MediaPorts can be found in the MIP 4100 Series Addendum

Clip-Time vs. Timeline-Position

Every Player associated with a MediaPort has a timeline. This timeline is where clips to be played by a Player are arranged. In fact Players do not play clips directly; they play their timelines. A timeline may contain many individual clips.

It is important to understand the distinction between clip-time and timeline-position. This distinction is important since in some cases clip-time and timeline-position may be denominated in different frame-rates.

Clip-Time

Clip-time refers to the frame count within an individual clip. The clip-time frame-rate is determined by the essence stored in the clip file(s). This clip-time may be used to specify in and out-points which determine what portion of a clip should be played (a given clip has a beginning and an end, expressed as a clip-time value). Clip-time can also be used to report progress within a given clip as a frame number. And since every frame within the clip is uniquely numbered any of these locations can be expressed using clip-time.

Timeline-Position

Timeline-position is very similar to clip-time. The timeline frame-rate is determined by the Player configuration. A given timeline also has a beginning and an end as specified by the Player Control API values minPos and maxPos . Clips are attached to the timeline and the portions of the attached clips that fall within the minPos to maxPos limits can be played out. The API call OmPlrGetClipData will return the attachment point of a clip on the timeline as a timeline-position.

Timeline-position is used to express a Player's location or progress within the timeline. Like a clip every frame in the timeline is uniquely numbered so each of these values can be expressed as a timeline-position. Unlike clip-time, Timeline-Position can be a negative number. As a result it may be useful to note when consulting the Player Control API documentation that timeline-position values can be identified as having the type int (integer) while clip-time is always positive and always uses the uint (unsigned integer) type.

Player Control API Calls

In addition to timeline-position and clip-time values there are several other expressions of time used by the Player Control API. One of these is system-time which starts at zero when the server boots and increments at the frame-rate of the Player. System-time is used in the Player Control API calls OmPlrPlayAt() and OmPlrRecAt() which take a system-time argument to determine when in the future these scheduled actions will occur.

In Table 1-1 on page 3 you will find clip-time-denominated Player Control API calls and return values. Table 1-2 on page 4 lists the same information for timeline-position-denominated calls. Table 1-3, also on page 4, lists other special time argument and return values not covered in the other two tables.

Table 1-1: Clip-time Denominated Function Calls and Return Values

Player Control API Call:	Argument(s)		Return Value(s)	
	Clip-time	Timeline-position	Clip-time	Timeline-position
OmPlrAttach()	clipIn clipOut			
OmPlrAttach1()	clipIn clipOut			
OmPlrClipCopy()	srcStartFrame copyLength dstStartFrame			
OmPlrClipCopyGetParams()			pSrcStartFrame pCopyLength pDstStartFrame	
OmPlrClipExtractData()	startFrame numFrames			
OmPlrClipInsertData()	startFrame numFrames			
OmPlrClipSetDefaultInOut()	clipDefaultIn clipDefaultOut			
OmPlrGetClipData()			pClipIn pClipOut pClipLen	pPos
OmPlrGetPosInClip()			pPosInClip	
OmPlrGetTime()				pPos
OmPlrSetClipData()	clipIn clipOut clipLen			
Special set – for the below see the OmTcData, OmPlrStatus, or OmPlrClipInfo structures				
OmPlrGetPlayerStatus()			pPlrStatus - currClipIn - currClipOut - currClipLen - currClipFirstFrame - currClipLastFrame	pPlrStatus - pos - minPos - maxPos - firstClipStartPos - lastClipEndPos - frameRate
OmPlrSetTcgData()	tcData			
OmPlrClipGetInfo()			pClipInfo - firstFrame - lastFrame - defaultIn - defaultOut - frameRate	
OmPlrClipGetInfo1()			pClipInfo - firstFrame - lastFrame - defaultIn - defaultOut - frameRate	
OmPlrClipGetStartTimeCode()			startTc	

Table 1-2: Timeline-position Denominated Function Calls and Return Values

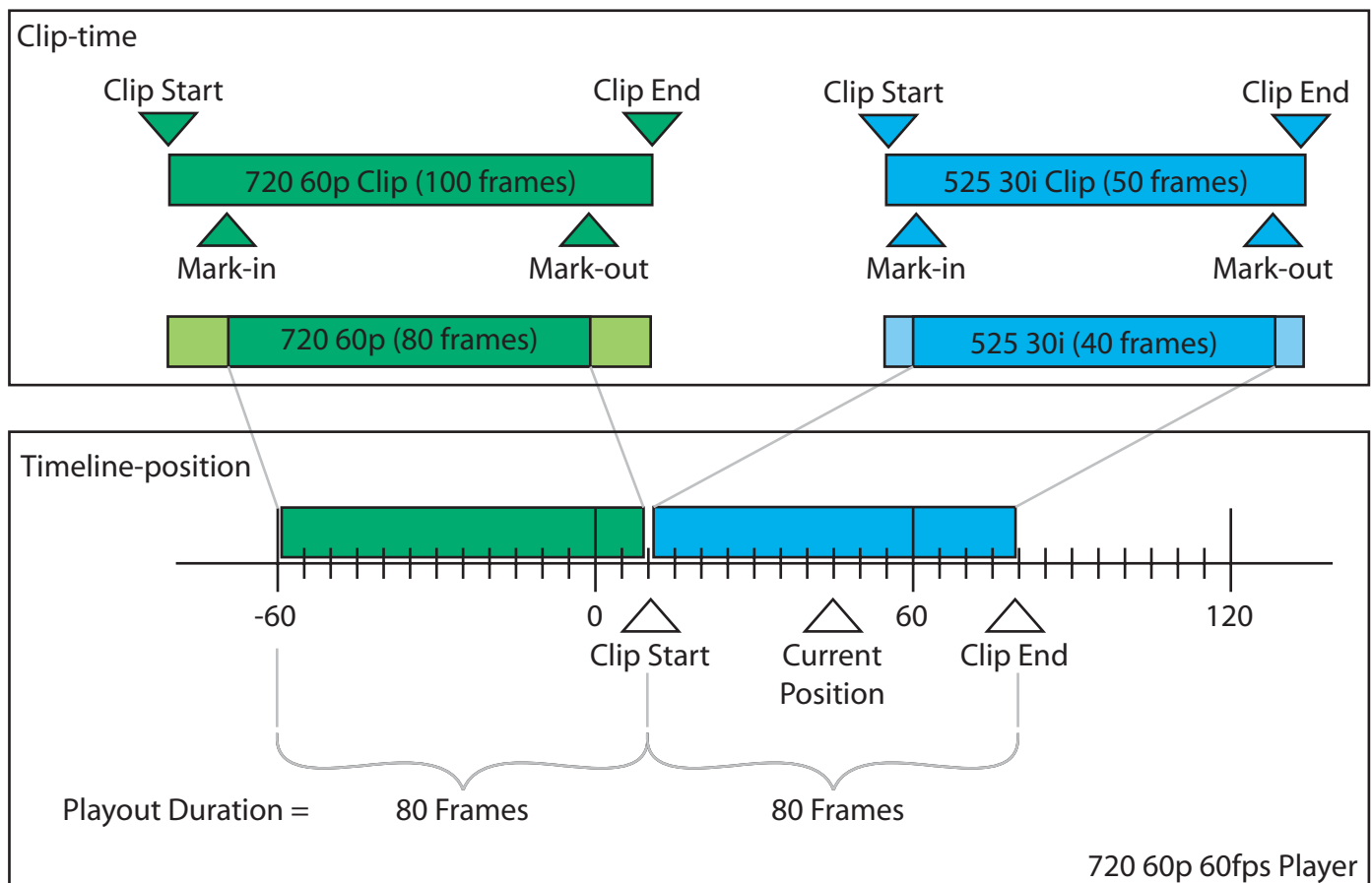
Player Control API Call:	Arguments(s)		Return values(s)	
	Clip-time	Timeline-position	Clip-time	Timeline-position
OmPlrGetClipAtPos()				pClipStartPos
OmPlrGetClipData()			pClipIn pClipOut pClipLen	pPos
OmPlrGetFrameRate()				pFrameRate
OmPlrGetLoop()				pMinLoopPos pMaxLoopPos
OmPlrGetMaxPos()				pMaxPos
OmPlrGerMinPos()				pMinPos
OmPlrGetPos()				pPos
OmPlrGetPosD()				pPos
OmPlrGetPosOfClip()				pPos
OmPlrLoop()		minLoopPos maxLoopPos		
OmPlrSetMaxPos()		maxPos		
OmPlrSetMinPos()		minPos		
OmPlrSetPos()		pos		
OmPlrSetPosD()		pos		
OmPlrStep()		step		
OmPlrStepD()		step		
Special set – for the below see the OmPlrStatus structure				
OmPlrGetPlayerStatus()			pPlrStatus - currClipIn - currClipOut - currClipLen - currClipFirstFrame - currClipLastFrame	pPlrStatus - pos - minPos - maxPos - firstClipStartPos - lastClipEndPos - frameRate

Table 1-3: Special Values

Player Control API Calls:	Argument(s): (description)	Return Value(s): (description)
OmPlrGetRecordTime()		pRecordTime (Available record time in seconds)
OmPlrPlayAt()	sysFrame (system-time)	
OmPlrPlayDelay()	Delay (number of frames at the timeline frame-rate)	
OmPlrRecordAt()	sysFrame (system-time)	
OmPlrRecordDelay()	Delay (number of frames at the timeline frame-rate)	

Mixing Clip Frame-Rates

The illustration below is an example mixing clip frame-rates on a 720 60p timeline highlighting. Points are denominated in clip-time (filled arrows) versus player or Timeline-Position (open arrows). Notably it shows that a 40 frame 30i clip will have the same playout duration in the timeline as an 80 frame 60p clip.



Up and Down Conversion

Support for up and down conversion has been added with the MIP 4100 series HD MultiPorts. This new feature allows for output of an SD-SDI signal from HD clips and/or a HD-SDI signal from SD clips.

Up and down conversion has letterboxing and pillarboxing player configuration implications¹. These settings can be determined by the Player configuration. Support for changing these settings via the Player Control API will be added in a future revision of the API.

More information on letterboxing and pillarboxing as well as Player configuration for HD capable MediaPorts (4100 series) can be found in the MIP 4100 Series Addendum to the user documents.

1. Letterboxing refers to a common method of displaying video content with wide aspect ratio (typically 16:9) completely within a 4:3 aspect ratio frame. This is accomplished by vertically centering and scaling the wide aspect ratio footage to fill the width of the 4:3 frame. Pillarboxing allows for the opposite process; scaling and horizontally centering content with a 4:3 aspect ratio such that it occupies the full vertical height of a 16:9 aspect ratio frame. Both processes intend to preserve the aspect ratio of the source material while maximizing use of the output format resolution. Letterboxing may frequently be used in down conversion and pillarboxing used for up conversion. There is also an option to scale to 14:9 which some may use as a compromise between these two aspect ratios.

Strategies for Integration

To help outline possible schemes for control of MediaPorts in various scenarios this section includes information relating to:

- Using the Player Control API to control Players with progressive timings 60p and 50p
- Controlling progressive Players with VDCP 30i and 25i automation systems.
- Using the Player Control API to control Players with up and or down conversion enabled.
- Using the Player Control API to control Players with mixed SD and HD material on a single Timeline.

A central issue in these scenarios is understanding that a 50p clip will play 50 frames in a given second while a 25i clip will play 25 frames (50 fields) in a given second. Keeping track of the distinction between the timeline frame-rate and clip frame-rate is the primary task necessary for supporting mixed timing format timelines. It is also important to note that all rates are expressed as frame-rates and never as field rates. For the purposes of automation control the atomic unit in each clip is a frame.

Using the Player Control API to control Players with progressive timings 60p and 50p

Using the Player Control API to control Players with progressive timings is as simple as adding the notion of clips and timelines which use the 60p and 50p frame-rates. This means that clips will consist of 50 or 60 (59.94) frames for each second of stored duration. Consequently timelines will have a frame-rate of 50 or 60 (59.94) frames per second.

Controlling Progressive Players with VDCP based 30i and 25i Automation Systems

It is possible to control a Player configured for progressive media (50p or 60p) with an automation system or protocol designed for interlaced (25i or 30i) timings. In using the VDCP protocol limited to 25 or 30 frames per second there are certain constraints. These constraints are limits on the granularity of scheduling that can be achieved. Essentially all progressive clips will increment two frames during the period that the automation system counts a single frame of elapsed time in the interlaced 25i or 30i frame-rate. On a practical level this limits the operator to a granularity

of 2 frames when, for example, assigning the duration a progressive clip will run.

Apart from this limitation the use of these systems and with progressive timings is largely identical to existing practice.

When using the VDCP protocol the VDCP interface inside the Omneon MediaDirector automatically handles converting clip and timeline denominated values. The times passed by the automation will be multiplied by 2 to convert to progressive units; the times returned as status by the VDCP interface will have been divided by 2 to convert to interlaced timings.

Using the Player Control API to Control Players with Up and or Down Conversion

Since up and down conversion behavior is determined via Player configuration there are currently limited differences exposed via the Player Control API. Support for changing these settings via the Player Control API will be added in a future revision of the API. Those differences which are exposed are due to the potential for the Timeline-Position, clip-time, and or output timing standard to be denominated in differing units of frames per second. The above Player Control API tables will help clarify these differences.

Using the Player Control API to Control Players with Mixed SD and HD Material on a Single Timeline

Support for up and down conversion of clips allows for the possibility of mixing clips of various frame-rates within the same timeline. For example it would be possible to have both 30i and 60p clips attached in sequence on a single timeline. The Player which is configured to play this timeline may then simultaneously play this timeline out as standard definition 525 30i as well as high definition 720 60p using the MIP 4100 series HD MultiPorts. The timeline frame rate in this case would be 60 frames per second and the clip-time would vary to match the frame-rate of whichever clip is queried.

A Player can be configured to up and or down convert the clips it plays; it can also be used to generate simultaneous SD-SDI and HD-SDI output. It is possible to mix 1080 25i and 625 25i clips on a single timeline such that as each clip on the timeline is played output can be generated as HD-SDI at 1080 25i and or SD-SDI at 625 25i for every clip regardless of stored resolution. Note that in this case the timeline and clip-time frame-rate denominations will match in all cases since 1080 25i uses the same frame rate as 625 25i.

Implementing control of a mixed timeline requires that the automation system maintain an understanding that clip-time and Timeline-Position may be denominated in different and varying (from clip to clip) frame-rates.

NOTE: Mixing progressive and interlaced HD formats on a single timeline is not supported. For example it is not valid to build a timeline which contains both 720 60p and 1080 30i clips for cross conversion to either 720 60p or 1080 30i. Nor is it valid to mix 50Hz and 60Hz timings (eg. 525 30i and 625 25i) on the same timeline.

Table 1-4: Up and Down Conversion Playout Formats

Clip Format	Playout Formats				
525 30i	720 60p	1080 30i	625 25i	720 50p	1080 25i
625 25i	720 50p	1080 25i	525 30i	720 60p	1080 30i
720 60p	525 30i	1080 30i	625 25i	720 50p	1080 25i
720 50p	625 25i	1080 25i	525 30i	720 60p	1080 30i
1080 30i	525 30i	720 60p	625 25i	720 50p	1080 25i
1080 25i	625 25i	720 50p	525 30i	720 60p	1080 30i
NOTE: Cells shaded in grey are not valid Playout formats for the corresponding clip formats.					

Conclusion

While each control implementation may choose a different method of employing this information this document should serve as a starting point for control of Omneon Spectrum servers with progressive timing and up down-conversion capability.



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