

# GV File Understanding Cadence



## Version History

Date	Version	Release by	Reason for changes
27/08/2015	1.0	J Metcalf	Document originated (1 <sup>st</sup> proposal)
09/09/2015	1.1	J Metcalf	Rebranding to Alchemist File
19/01/2016	1.2	G Emerson	Completion of rebrand
07/10/2016	1.3	J Metcalf	Updated for additional cadence controls added in V2.2.3.2
12/10/2016	1.4	J Metcalf	Added Table of Terminology
11/12/2018	1.5	J Metcalf	Rebrand for GV and update for V4.***
16/07/2019	1.6	J Metcalf	Minor additions & corrections
05/03/2021	1.7	J Metcalf	Rebrand
06/09/2021	1.8	J Metcalf	Add User Case (case 9)

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**Table 1: Table of Terminology**

Term	Definition
BFF	An acronym for 'Bottom Field First'. BFF describes the field structure of an interlaced video frame
Cadence	A method of carrying low frame rate content, in a high frame rate video transport, by employing a process of repeating field/frames in a predictable sequence.
Film	Content originally shot on celluloid, usually with a frame rate of 24Hz.
Filmic	Any video content that has a refresh rate of 30Hz, or less.
Metadata	In the context of a video file, is information that describes the video file, such as: frame rate, codec type, file-wrapper type, audio distribution, file bit-rate, etc. Metadata enables a file to be processed with either no, or very little, prior configuration.
Mispaired frames	A progressive video frame that is derived from an interlaced source frame that contains fields from different temporal samples, by a simplistic field pairing process. Often associated with PC applications that don't employ quality de-interlacers.
Mouse-teething	A term describing the result of mispaired fields (see above).
Native	The frame rate and resolution that video content was originally captured, prior to any conversion, or cadence process.
Off-Speeding	A method of achieving a video frame rate conversion, by simply adjusting the running speed of the content. Historically this was a process associated with VTRs, where the speed of the tape was adjusted to the required playout frame-rate. However, this process can now be done in a software application such as GV File. Also referred to as Verispeed.
Orphan field	An orphan field is a field within a cadence process, where the video content does not pair with a sister field to create a complete frame.
Reverse-telecine	A term applied to the process of cadence removal, so recovering the native frame rate of the content.
Synchronise process	In the context of GV File, a Synchronise process (often referred to a 'Synchro') is a process of performing a frame rate change by simply repeating, or discarding, source frames. No picture building, or frame blending processes are taking place, hence the output only contains clean unblended frames. Can create a hoppy appearance at the output.
Telecine	A process of transferring motion picture film into video.
TFF	An acronym for 'Top Field First'. TFF describes the field structure of an interlaced video frame.
Video 1:1	A term describing video that refreshes every field in an interlaced video stream, and every frame in a progressive video stream. i.e. there are no repeats.

# 1. Introduction

Alchemist File features comprehensive cadence handling.

The cadence feature is also applicable to Kronos File. Where files are encountered that contain cadence, a Kronos retiming process that does not consider the cadence pattern, will break the cadence pattern in the output file.

Where the document references Alchemist File, it is also applicable to Kronos File.

Features include:

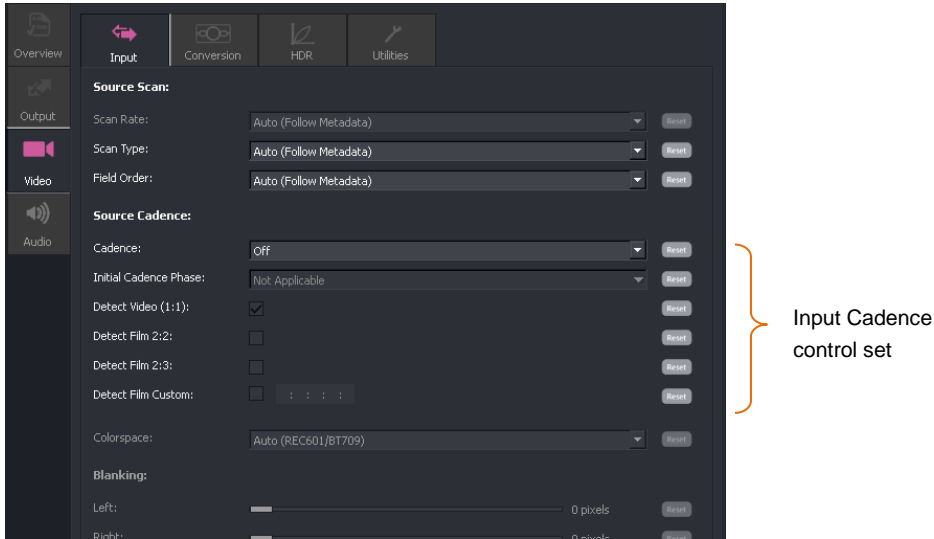
- Cadence removal
- Cadence insertion
- Cadence repair
- Video to Film
- Film to Video
- Off-Speeding and Audio Pitch-Correction

Unlike previous hardware versions of Alchemist that only supported common cadence types such as 2:2 and 2:3, Alchemist File can handle just about any cadence type used in the Broadcast Industry. Cadences such as 2:3:3:2, 2:2:2:4, 5:5 and more, are supported. Alchemist File can also repair broken cadence and can do this even when source content contains multiple cadence types.

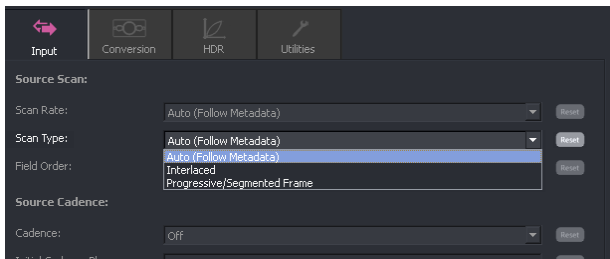
Additionally, Alchemist File can adaptively process content that is a mixture of filmic and high frame rate video content. The corresponding output file can faithfully retain the filmic, or high frame-rate video, look of the source. Alternatively, a User can choose to make the high frame-rate video segments look filmic, or should they desire, make the filmic segments appear like high frame-rate video.

## 2. Alchemist File Input Cadence controls

The input cadence controls can be found in the **Video/Input** menu of the **GV File / Profile Management** window:



### 2.1 Input / Source Scan - Scan Type:



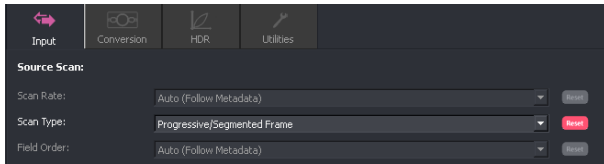
In order to process a source file correctly, Alchemist File must understand the source file. The primary method of doing this is to read the metadata of the source file. If the source metadata is accurate then this method usually suffices. However, there are circumstances where the metadata cannot be relied upon:

- When the metadata is incorrect.
- When the input video format is: *progressive segmented frame (psf)*.

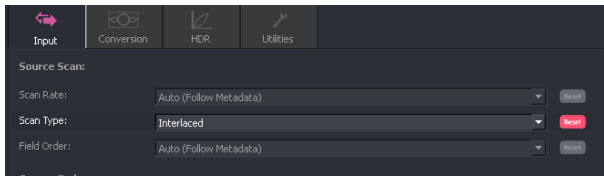
### 2.1.1 Incorrect Metadata

If the metadata is incorrect, this can result in a less than optimal conversion process. In such circumstances it is imperative that the Alchemist File includes a control interface that can counter this eventuality.

With regard to the scan type, it could be a case where the source file contains video essence that is scanned progressively, but the metadata describes the video essence as interlaced. To process a progressive file, treating it as interlaced video, will result in an inferior conversion. In such a circumstance, the **Scan type** control can be used to ensure that the file is processed as a progressive video file:



Another case may be the opposite of the above scenario. A video source file containing interlaced video essence, but with metadata describing the video as progressive, may be encountered. If this file is processed with reliance upon the metadata, a sub-optimal conversion will result. In such a circumstance, the **Scan type** control can be used to ensure that the file is processed as an interlaced video file:



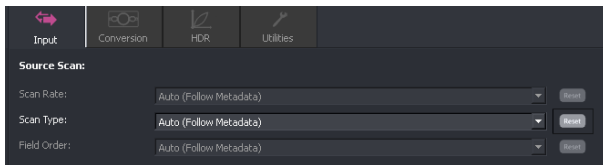
Note that in this scenario, the **Field Order** should also be specified, because in a progressive file, the metadata will not specify field order since the video essence is really interlaced, it is important that the field order correctly describes this parameter. See section 2:2 below.



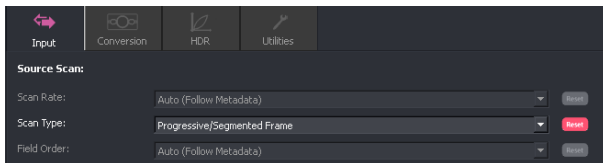
## 2.1.2 Psf Video sources

A segmented frame video structure (known as psf) is a method of carrying a progressive frame in an interlaced video transport. If a 25 psf file is considered, the metadata will identify the video content as 25.00 fps interlaced. However, a source file containing video essence that is normal 50i video, will also describe the video content as 25.00 fps interlaced. The metadata is identical in both scenarios, therefore the metadata cannot be relied upon.

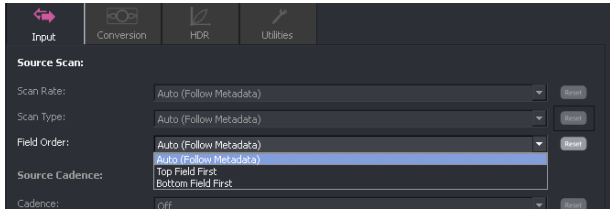
Alchemist File, when encountering a file where the metadata identifies the file as 25.00 fps interlaced, will assume that it is normal 50i video. If this is the case, setting the control **Scan type** to **Auto (follow metadata)** will yield an optimal conversion performance.



However, in the case where the source content is really psf, then the **Scan Rate** control must be set to **Progressive/Psf** in order to achieve optimal conversion performance.



## 2.2 Input / Source Scan - Field order



This control is only applicable when the source file employs an interlaced video structure. The term **Field Order** describes the relationship between the two fields of a particular frame. More common is the field order **Top Field First** (TFF). However, some file types use **Bottom Field First** (BFF) structure. Typically ProRes 525/59i files are generally always BFF, but other file types can vary. Generally it does not matter what field structure is used so long as the associated metadata correctly describes the field order.

With regard to Alchemist File conversions, it is essential that the field order employed in the source file is respected. Normally, it is possible to rely on the file metadata to determine the field order. However, in circumstances where the metadata incorrectly describes the field order, it is essential that the Alchemist File provides a control interface to counter this metadata inaccuracy. Hence the **Field Order** control is included. This has three possible settings:

- Auto (follow metadata)
- Top field first
- Bottom field first

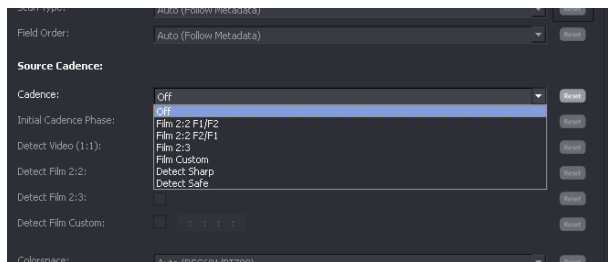
In circumstances where the metadata can be relied upon, the **Auto (follow metadata)** setting can be used. This is the default setting.

In circumstances where the metadata incorrectly describes the field order, a User can manually set the control to either **Top Field First**, or **Bottom Field First**, as appropriate.

In circumstances where the metadata describes an interlaced file incorrectly as 'progressive', a User must set the **Scan Type** as **Interlaced** and set the appropriate field order.

(See glossary, section 6.13 below for a detailed explanation of field order)

## 2.3 Input / Source Cadence – Cadence



In circumstances where the video structure of a file has a certain cadence associated with it, it is important that any conversion process respects this video cadence. However, one of the problems with file based video is that the associated metadata will not describe any video cadence.

For optimal performance via Alchemist File, it is essential that any conversion process respects the source video cadence. This means that either a User must configure the input cadence, or the Alchemist File itself can be configured to 'detect' the cadence sequence of any configured source cadence.

It is important to understand, that Alchemist File cannot determine source cadence. However, once a User has configured what cadences are present in the source, Alchemist File can lock on to the source cadence and process the output, while respecting the cadence type contained within.

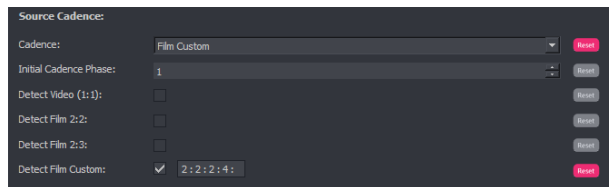
The **Cadence** control interface offers several settings, enabling a User to either set the source cadence type, or to configure the **Detect** mode.

One of the main problems with forcing the input cadence to a specific type is that the cadence associated with a particular source file, must be continuous and unbroken throughout the file. Also, in the case of cadences normally associated with the 59i domain, such as 2:3, the phase of the cadence must also be known. This may require a skilled User to be able to accurately analyse the source file to both ensure that the source cadence is unbroken and determine the '2:3 phase'. In circumstances where there is any doubt about either of these two parameters, the preference should be to use one of the **Detect** modes.

The **Cadence** control has several settings:

- Off
- Film 2:2 F1/F2
- Film 2:2 F2/F1
- Film 2:3
- Film Custom
- Detect Sharp
- Detect Safe

- Off** This is the default setting for this control. This setting should be used when processing source files that contain interlaced video with a normal 1:1 cadence. Also, if just transcoding, this default setting will probably suffice.
- Film 2:2 F1/F2** This setting is appropriate when the source content has an unbroken, continuous 2:2 cadence, with normal field dominance (F1/F2).
- Film 2:2 F2/F1** This setting is appropriate with the source content has an unbroken, continuous 2:2 cadence, with an incorrect field dominance of F2/F1. This control setting ensures that such a source file will be processed correctly. In circumstances where the output file is also interlaced, it will output a correct F1/F2 cadence.  
(See Glossary below, section 6.14, for more information concerning field dominance)
- Film 2:3** This setting is appropriate when the source content has an unbroken, continuous 2:3 cadence. If this setting is configured, it is imperative that the source file does contain continuous unbroken 2:3 cadence.  
(See glossary, section 6.5 for description of 2:3 cadence)  
Note that the act of setting the **Cadence** control to **Film 2:3** will make the control **Initial Cadence Phase** active. It is essential that this be set to accurately describe the 2:3 cadence of the source file. Failure to this will seriously affect the quality of an Alchemist File conversion process.
- Film Custom** This control is appropriate when alternative cadences, other than 1:1, 2:2 or 2:3, are employed in the source file. Other cadence types sometimes used in the 59i domain include: 2:2:2:4, 2:3:3:2, 5:5 and 6:4.  
When the setting **Film Custom** is selected, the **Detect Film Custom** control will become active enabling a User to manually enter the desired cadence type.



Note that when the **Cadence** control is set to the **Film Custom** setting, that the **Detect Film Custom** control now becomes active. However, in this particular case the **Cadence** control is not set to **Detect** and the detection feature is not active. The User must enter the correct **Input Cadence Phase** to ensure optimal conversion performance.

**Detect Sharp/Safe** The **Detect** modes are probably the most useful settings for the **Cadence** control. In either detect mode the Alchemist File will employ the cadence detection feature, to work out what the source cadence sequence is.

There are two **Detect** modes:

- **Detect Sharp**
- **Detect Safe**

**Detect Sharp** This setting should be used when the source cadence has predictable cadences associated with it. Compared to **Detect Safe** mode, this mode retains maximum vertical resolution, and for this reason, this mode is usually favoured over the **Detect Safe** mode.

**Detect Safe** This mode is more resilient to sources that contain mixed and broken cadence types that may cause mispairing of fields when using the **Detect Sharp** mode. Mispairing fields can create 'mouse-teething' effects usually associated with de-interlacing artefacts. These artefacts can be very objectionable. Employing the **Detect Safe** mode will ensure that such objectionable artefacts do not occur. This mode is slightly compromised in terms of vertical resolution.

These modes should be used when:

- The source has mixed cadences.
- The source has broken cadence.
- The source cadence is unknown.
- The cadence phase of the source is unknown.

The **Detect** modes are very useful from a perspective of ease of use. A User can just choose the **Detect** setting and let the Alchemist File work out what the source cadence sequence is.

The **Detect** mode is also very useful from a Watch Folder perspective. A Watch Folder can be pre-configured without any prior knowledge of the video structure of any source files placed into it, and still perform meaningful conversions.

When the **Cadence** control is set to either of the **Detect** modes, the controls **Detect video (1:1)**, **Detect film (2:2)**, **Detect film (2:3)** and **Detect film custom**, will all become active.

**Detect Video (1:1)** When in a **Detect** mode, source files containing normal interlaced 1:1 video will be detected and optimally converted.

**Detect Video (2:2)** When in a **Detect** mode, source files containing video with a 2:2 cadence, will be detected and optimally converted.

**Detect Video (2:3)** When in a **Detect** mode, source files containing video with a 2:3 cadence, will be detected and optimally converted.

**Detect Film Custom** When in a **Detect** mode, source files containing video with an alternative cadence can be detected and optimally converted. This does require that a User manually configure the alternative cadence type. Below a custom cadence of 2:3:3:2 has been configured:



When considering the Detect modes, it may seem that it would be good practice to simply enable all the default cadence types, alongside the custom setting. However, certain cadence types do look very similar and this makes the job of the detector that much harder.

For example, 2:2 and 2:2:2:4, are quite difficult to differentiate between, especially when the video content is not moving. The detection process maybe made even harder if the source contains broken cadence. So, if source content does contain 2:2:2:4 cadence, the ability to disable **Detect video (2:2)** is important, since it is unlikely that source content will contain both 2:2:2:4 and 2:2 cadences. In this scenario, disabling **Detect video (2:2)** shouldn't have a detrimental effect on the conversion process.

Similarly, 2:3 and 2:3:3:2 can be difficult to differentiate; hence the ability to disable **Detect Video (2:3)** is important, when there is a need to detect 2:3:3:2.

**Note detecting 5:5 cadence:**

5:5 is a cadence type that is applied to animation content that is drawn at 12 fps. A 5:5 cadence is usually associated with 60 fps (where it would be native 12 fps), or with 59.94fps (where it would be natively 11.988 fps. This frame rate would be a product of slowing 12fps content by 1 part in 1000).

(for a detailed description of this process see Glossary - part 6.9 below).

If the Detector is configured to detect a 5:5 cadence the resultant output frame rate would be native 12 fps. However, it is unlikely that the desired output video file would be 12fps. Normal practice would be to configure a 24 fps output. A problem with this would be that Alchemist File would try to build the extra frames to turn the native 12 fps to 24 fps. Because the temporal resolution is so low, conversion artefacts may be introduced, and this would probably be deemed as unacceptable.

A more acceptable result would be to simply double up the native 12 fps to make the required 24 fps, so preserving the look and feel of the original source. Alchemist File can perform this task, by setting the output cadence (Profile Management / Output / Cadence) to 2:2.

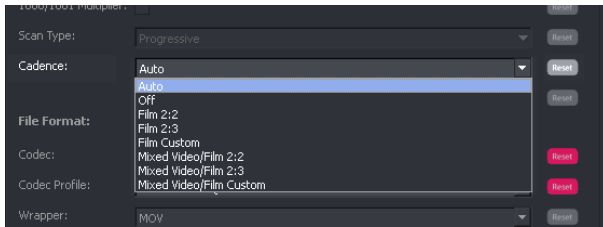
Alternatively, if we consider that the 5:5 cadence is effectively derived when a 2:3 cadence is added to a 24 Hz source that is native 12 fps (cadence upon cadence), then we can choose to detect and remove the 2:3 cadence. This will effectively get u back to 24 2:2.

**Note detecting 7:8 cadence:**

A similar case can arise when source content is derived from a native 8 fps source. It is not unusual to encounter such sources in animation. These 8 source frames are each repeated twice creating 24Hz 3:3 cadence. If subsequently 2:3 is added to the resulting 24Hz stream (slowed to 23.98), 59i content is derived containing a 7:8 cadence (see Glossary section 6.1.10 below).

A reverse telecine process should be set to detect 2:3, so deriving a 23.98 3:3. In such circumstances, it is highly recommended that the Detect Safe mode is employed.

### 3. Output / Cadence



The **Output Cadence** control is used to control the cadence applied to the output file.

The control has several settings available:

#### Auto

Note; the default setting is **Auto**. In this mode, the output will maintain the video, or filmic, quality of the source file.

For example, if the source file is 23.98p and the output frame rate is configured to be 50i, if the Output Cadence control is set to **Auto**, the output generated will be 25psf i.e. low frame rate in, equals low frame rate out.

This also applies when mixed cadence sources are encountered. If the input has for example, segments of 50i 1:1 and segments of 25psf, and the output frame rate has been configured to be 59.94i; where the input is 50i 1:1, the output will be 59.94i 1:1 and where the input is 25psf, the output will be 29.97psf.

See Appendix A (page 51) for more information.

#### Off

This is the default setting for this control. When set to 'Off', the output cadence, if any, will be dictated by the setting of the **Output Scan Rate** control.

#### Film 2:2

When the output **Cadence** control is set to **Film 2:2**, and the output file is interlaced, a 2:2 (psf) cadence will be applied. If the configured output scan rate is progressive, then individual frames will be doubled up to form the output. In such a file, a 50p file would have the appearance of 25p. Similarly a 24 fps output would have the appearance of a native 12 fps file.

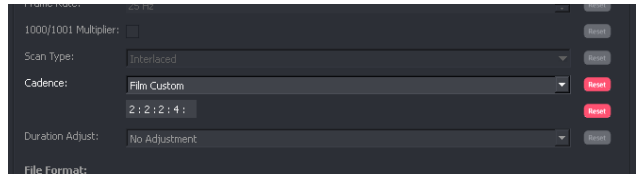
#### Film 2:3

This control should be activated when:

- creating a 59i 2:3 output, from 23.98p.
- implementing a cadence repair process.
- creating a 59P output, from a 23.98p source.
- creating a 60P output, from 24p.

**Film Custom**

This control may be used to apply a custom cadence to the output file. The cadence type must be defined by the User:



In this example, a 2:2:2:4 cadence has been configured by the User.

**Mixed Video/Film 2:2**

In circumstance where source content contains a mixture of both video and filmic cadence and there is a desire to retain the look and feel of these different source sequences, within the output file, then this setting should be enabled.

Where the source is normal high frame rate video (50i, 50P, 59i, 59P, etc), the output will convert to a correspondingly high frame rate.

Where the source is filmic, the conversion to the output will apply a 2:2 cadence, to retain the filmic quality of the source.

**Mixed Video/Film 2:3**

Similar to **Mixed Video/Film 2:2** above, but applicable to the 59.94 domain.

Where the source is normal high frame rate video (50i, 50P, 59i, 59P, etc), conversion to the output will be to a correspondingly high frame rate.

The filmic sections of the source will be converted by applying a 2:3 cadence, in order to preserve the filmic quality.

**Mixed Video/Film Custom**

Where the source is filmic, the User can configure a custom cadence to be applied to the output.

Where the source is normal high frame rate video (50i, 50P, 59i, 59P, etc), the conversion to the output will convert to a correspondingly high frame rate.

Where the source is filmic, the filmic 'look' will be preserved in the output, by adding the custom cadence configured.



## 4. Off-Speed feature

Alchemist File features the ability to achieve a frame rate conversion via an off-speed process. This simulates a VTR off-speed process where a program is recorded onto tape at one frame rate and played out at another frame rate. Alchemist File offers the ability to frame rate convert, via an off-speed process between 23.98, 24 and 25 frames per second, or between 29.97 and 30 fps.

Because an off-speed process inherently modifies the runtime duration of a program, the associated audio content must also be modified to match the run time of the video content. Alchemist File offers two options for the audio:

- **Re-sample audio**
- **Pitch Correct**

**Re-sample Audio:** this mode simulates what happens to the audio as part of a VTR Off-speed process. In off-speed processes that shorten the duration of the programme (i.e. 24 to 25 fps) the pitch of audio rises by a corresponding amount. Similarly, off-speed processes that extends the duration of a program (i.e. 25 to 24 fps), the pitch of the audio will be lowered by a corresponding amount.

**Pitch Correct:** here an algorithm is applied to the audio which restores the pitch of the output file, to be the same as the source, despite the duration change of the associated video.

The advantage of an off-speed process is that the output video content is not compromised by a picture building process. High quality, low frame rate, picture building conversion is inherently more difficult to achieve than normal video conversion because of the lack of data available in the source. Such a conversion can be compromised with conversion artefacts and juddery motion and as such can be deemed unacceptable. An off-speeding process alleviates these inherent problems, if the duration change is deemed acceptable.

### Off-Speeding with regard to Cadence

Off-speeding can be very useful as part of a cadence removal process. A common conversion is the requirement to convert a 59i program that contains a 2:3 cadence, to a program that can be transmitted in the 50i domain. Alchemist File can be used to remove the 2:3 cadence to get back to 23.98 then convert to 25psf by a process of off-speeding, all as a single process.

Note: off-speeding is also known by the term: **Veri-speeding**

## 5. User Cases

### 5.1 User Case 1 – Repair broken 2:3

Broken 2:3 cadence is usually the result of bad editing. When program content, containing a 2:3 cadence, is edited without consideration of the 2:3 sequence, the sequence will invariably break.

Consider a situation where a file has been produced that contains broken 2:3 cadence and a client wishes to perform a cadence repair process, so producing a 59i program with perfect unbroken 2:3 content. The source content does not contain any other cadences.

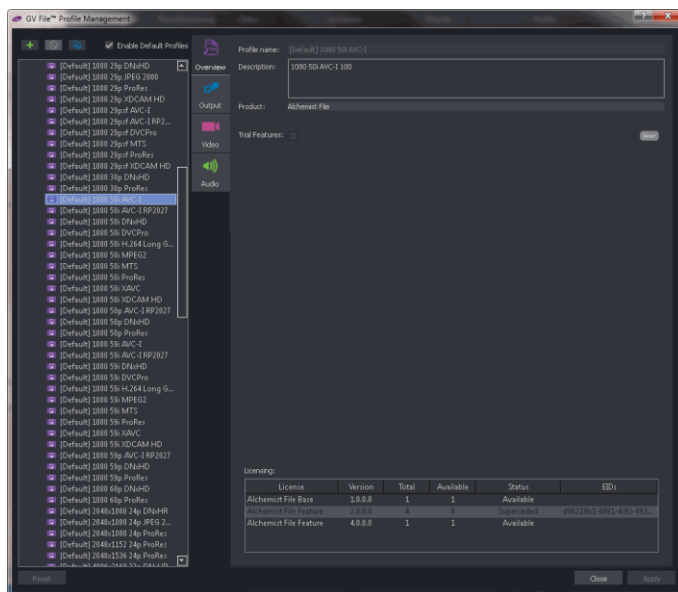
Alchemist File can be used for such a process. In this example it is assumed that the metadata in the source file is correct.

(Note – for 2:3 explanation see Glossary part 6.3 below)

### Alchemist File Profile configuration

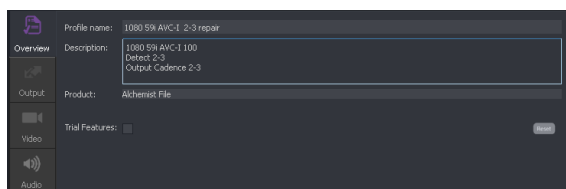
For this User Case, a suitable default profile will be selected and then modified.

1. Select a suitable Default Profile from the list of Profiles:

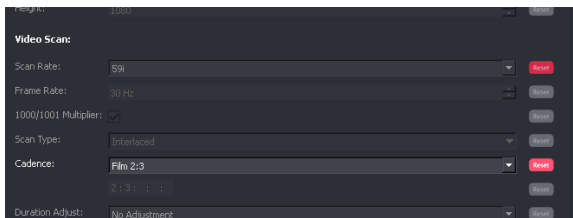


For this example the **Default 1080/59i AVC-I** codec has been selected

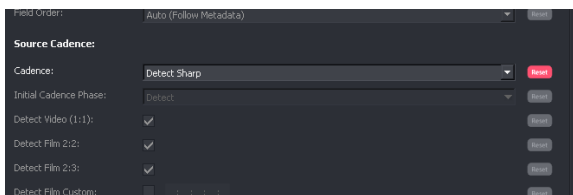
2. Copy this Profile and give the new Profile a suitable name. In this example the new Profile has been named: **1080 59i AVC-I 2-3 repair**



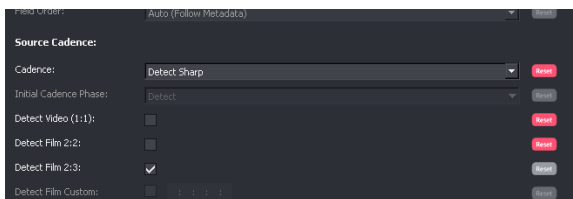
- In the **Output** tab, set the Cadence control to **Film 2:3**.



- In the **Video Input** tab, set the **Cadence** control to **Detect Sharp**.



- Disable the controls **Detect video (1:1)** and **Detect Film (2:2)**



Because the source file only contains 2:3 cadence, it is advisable to disable the other default controls; **Detect video (1:1)** and **Detect Film (2:2)**. This effectively makes the job of the Detector easier and eliminates the possibility that source cadence is wrongfully detected as 1:1 or 2:2. This wouldn't normally happen but since the source does contain broken input cadence, and also where the source content might be slow moving, or static, a detection of 1:1 or 2:2 could occur if these controls were left active. Generally it is safer practice to disable cadence detection of cadences that are known not to be associated with the source.

- Save the Profile and run the job.

## 5.2 User Case 2 – Broken 2:3 removal

Broken 2:3 cadence is usually the result of bad editing. When program content, containing a 2:3 cadence, is edited without consideration of the 2:3 sequence, the sequence will break.

Consider a situation where a file has been produced that contains broken 2:3 cadence, and a client wishes to perform a cadence removal process, so producing a 23.98p program. The source content does not contain any other cadences.

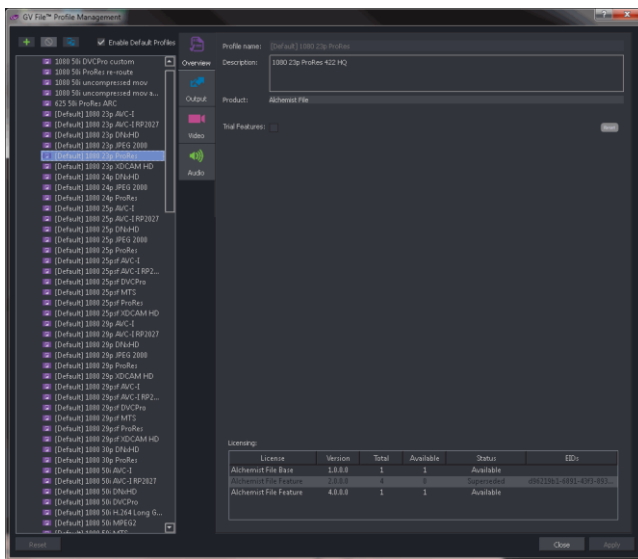
Alchemist File can be used for such a process.

In this example it is assumed that the metadata in the source file is correct.

### Alchemist File Profile configuration

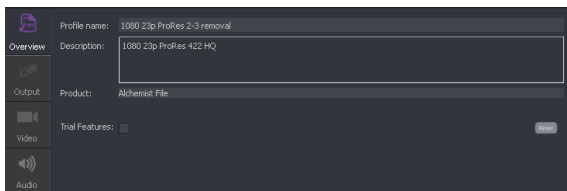
For this User Case, a suitable default profile will be selected and then modified.

1. Select a suitable Default Profile from the list of Profiles:

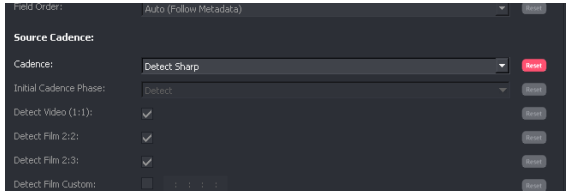


For this example the **Default 1080/23p ProRes** codec has been selected.

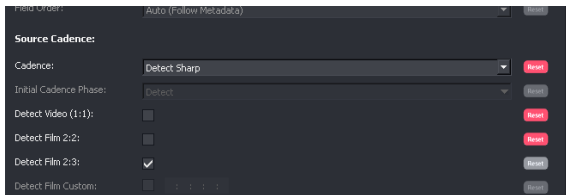
2. Copy this Profile and give the new Profile a suitable name. In this example the new Profile has been named:  
**1080 23p ProRes 2-3 removal**



- In the **Video Input** tab, set the **Cadence** control to **Detect Sharp**.



- Disable the controls **Detect video (1:1)** and **Detect Film (2:2)**



Because the source file only contains 2:3 cadence, it is advised to disable the other default controls, **Detect video (1:1)** and **Detect Film (2:2)**. This effectively makes the job of the Detector easier and eliminates the possibility that source cadence is wrongfully detected as 1:1 or 2:2. This wouldn't normally happen but since the source does have broken input cadence and also where the source content might be slow moving, or static, a detection of 1:1 or 2:2 could occur if these controls were left active. Generally it is safer practice to disable cadence detection of cadences that are known not to be associated with the source.

- Save the Profile and run the job.

### 5.3 User Case 3 – 59i mixed cadence source, to 50i

Sometimes, source files are encountered that contain both filmic cadences and normal video sequences.

In this example, a 59i source file containing sequences of 1:1, 2:2 and 2:3, is to be converted to 1080/50i. The Client requires that the corresponding sequences in the output file retain the cadence qualities of the source. So, where the source is filmic, the output retains the filmic quality and where the source is 'video', the output retains the 1:1 video cadence.

Alchemist File can be used for such a process.

In this example it is assumed that the metadata in the source file is correct.

#### Conversion description

Where the source file sequences are video 1:1, Alchemist File will perform a Ph.C Motion compensated conversion to 1080/50i.

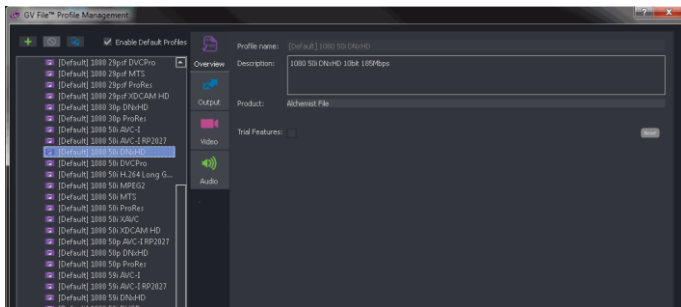
Where the source file sequences have a 2:2 cadence, Alchemist File will perform a Ph.C motion compensated conversion to 1080/25psf, using a low frame rate algorithm.

Where the source file sequences have a 2:3 cadence, the Alchemist File will effectively perform two processes. The first removing the 2:3 cadence from the source so creating 23.98 fps content, then the second performing a Ph.C motion compensated conversion, from 23.98 to 1080/25psf, using a low frame rate algorithm. Alchemist File will actually do this as a single conversion, but thinking of the transition as two separate conversions helps to understand the conversion process.

### Alchemist File Profile configuration

For this User Case, a suitable default profile will be selected and then modified.

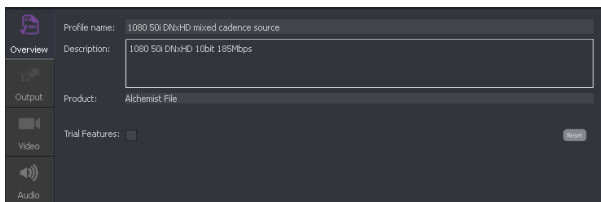
1. Select a suitable Default Profile from the list of Profiles:



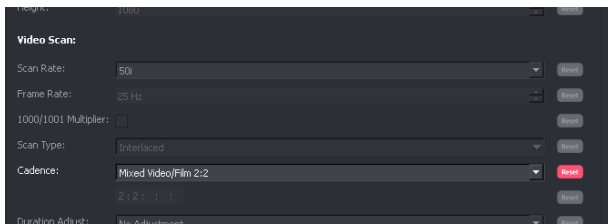
In this example the **Default 1080/50i DNxHD** codec has been selected.

2. Copy this Profile and give it a suitable name. In this example the Profile has been named:

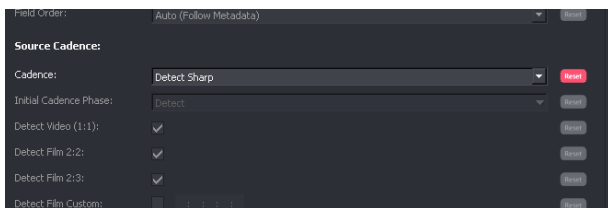
#### 1080 50i DNxHD mixed cadence source



- In the **Output** tab, set the Cadence control to: **Mixed Video/Film 2:2**.



- In the **Video Input** tab, set the **Cadence** control to **Detect Sharp** or **Detect Safe**.



In this example **Detect Sharp** has been configured.

- Save the Profile and run the job.

Note – from GV File V2.2.2.10 build, the output cadence mode **Auto** can achieve the same conversion, provided that the input cadence detector is activated.

## 5.4 User Case 4 – Cadence correction

Consider a 59i source file that is a mixture of 2:3 and 2:2:2:4 cadences. A Client has requested a deliverable file that is 1080/59i that only contains continuous 2:3 cadence.

Alchemist File can be used for such a process.

In this example it is assumed that the metadata in the source file is correct.

(2:2:2:4 explanation available if the Glossary – section 6.7 below)

### Conversion description

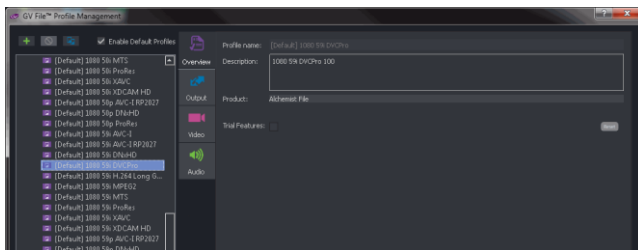
Where source sequences already contain 2:3, Alchemist File will effectively repair any broken cadence associated with the source and produce continuous unbroken 2:3 at the output.

Where the source sequences contains 2:2:2:4 cadence, Alchemist File will remove the repeated frames that are associated with this particular cadence type, so creating a 23.98 fps sequence. Then it will add a 2:3 sequence to make the required 59i output. Any broken 2:2:2:4 cadence associated with the input will effectively be repaired.

## Alchemist File Profile configuration

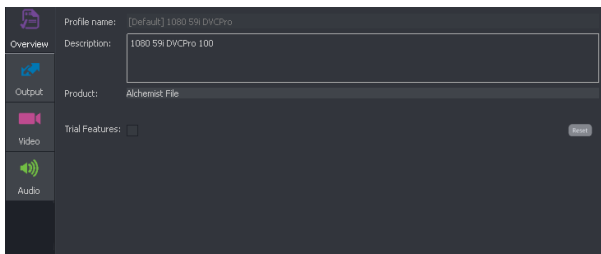
For this User Case, a suitable default profile will be selected and then modified.

1. Select a suitable Default Profile from the list of Profiles:



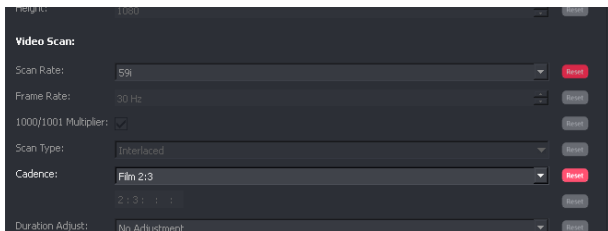
For this example the **Default 1080/59i DVCPro** codec has been selected.

2. Copy this Profile and give the new Profile a suitable name. In this example the new Profile has been named:  
**1080 59i DVCPro 2-3**

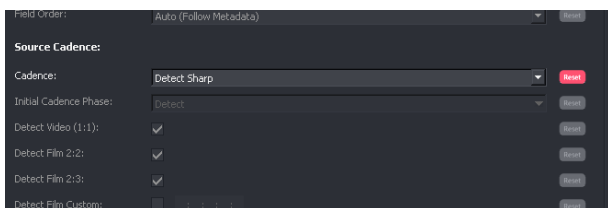




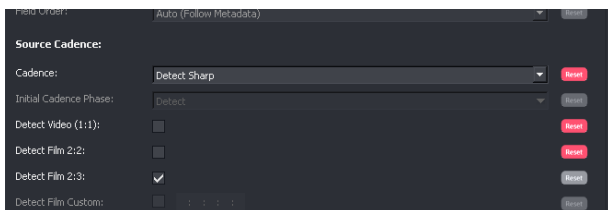
- In the **Output** tab, set the Cadence control to **Film 2:3**.



- In the **Video Input** tab, set the **Cadence** control to **Detect Sharp**.



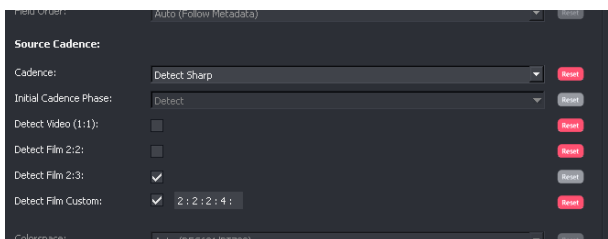
- Disable the controls **Detect video (1:1)** and **Detect Film (2:2)**



Because the source file only contains 2:3 and 2:2:2:4 cadence, it is advisable to disable the other default controls **Detect video (1:1)** and **Detect Film (2:2)**. This effectively makes the job of the Detector easier and eliminates the possibility that source cadence is wrongfully detected as 1:1 or 2:2. In this particular case, it is particularly important to disable **Detect Film (2:2)** because it can be difficult for the detector to discern between 2:2 and 2:2:2:4 cadences, particularly where the source sequences are either slow moving, or static.

Generally it is safer practice to disable cadence detection of cadences that are known not to be present in the source.

- In the **Detect Film Custom** field, first enable the **Detect Film Custom** control, and then enter the custom cadence. In this case enter 2:2:2:4.



- Save the Profile and run the job.

## 5.5 User Case 5 – Unsupported cadence type

Sometimes a source file is encountered that has a cadence type where the sequence is either unpredictable, or is a sequence pattern that Alchemist File cannot detect. Such instances can be associated with animations where the native frame rate is not usual video or filmic frame rates. Sometimes the native frame rate is not even constant which further complicates the issue. Unusual cadences can be applied to such sources and these can be virtually impossible for the cadence detector to latch onto and unpick.

In such circumstances, it is usually very difficult to convert such material, either by reverse telecine, or by interpolation and yield acceptable results. However, Alchemist File has an excellent de-interlacer and this enables a different approach to cadence repair to be employed.

Imagine a scenario where an animation has been drawn both at 12 fps and 24 fps, within the same program. This is not an unusual scenario. Where the source is drawn at 12 fps, these source frames are doubled to make 24 fps (24 2:2). Now this source has been off-speeded to 25fps, where it can now be played in the PAL domain.

Now imagine that there is a desire to add a 2:2:3:2:3 cadence sequence to this content to make it compatible with the 59i domain. Further, imagine that the content is edited in the 59i domain, with no regard to the cadence sequence now associated with the content.

So the result is broken 2:2:3:2:3 that is derived from a source that is both natively 12 fps and 24 fps. The resulting cadence is extremely complex and would be very challenging to analyse.

If there now is a desire to take this 59i content and convert it back for broadcast in the 25 fps domain, conventional conversion techniques will not yield good results. A normal interpolation process will look truly awful. Cadence detection is not possible due to the nature of the cadence sequence.

However, Alchemist File offers a creditable solution. The conversion can be thought of as two separate processes, but Alchemist File can perform these separate processes in one pass. The two processes are:

- De-interlace
- Convert by process of frame dropping.

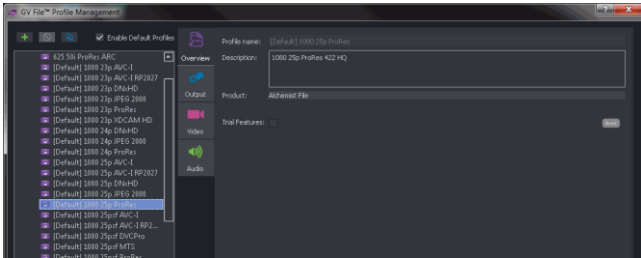
In this example the desired output format is 1080/25p ProRes HQ.

It is assumed that the metadata in the source file is correct.

## Alchemist File Profile configuration

For this User Case, a suitable default profile will be selected and then modified.

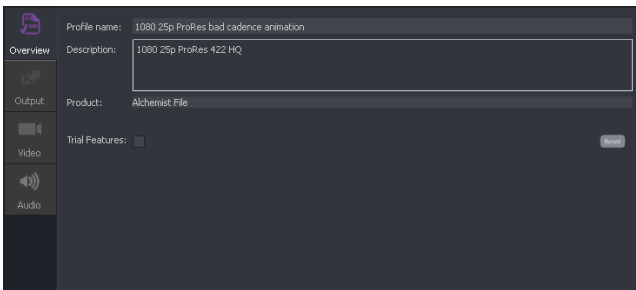
1. Select a suitable Default Profile from the list of Profiles:



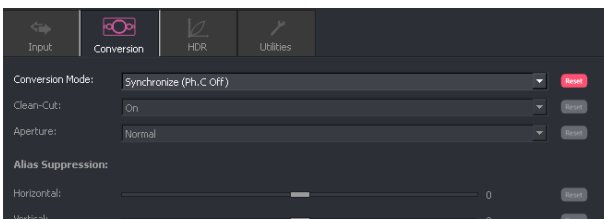
In this example, the default 1080/25p ProRes Profile has been selected.

2. Copy this Profile and give it a suitable name. In this example the new Profile has been named:

### 1080 25p ProRes bad cadence animation



3. Select the **Input/Conversion** tab and set the conversion mode to **Synchronise (Ph.C Off)**:



4. Save the Profile and run the job.

Note about this conversion: For this conversion, first a de-interlacing process will create a 59p version of the source. This will contain a progressive version of the cadence that existed in the 59i input file.

The second part of the process will drop source frames in order to generate the desired 25p output. Note that no picture building has taken place and that output frames will be clean and unblended. The process of dropping source frames can produce a 'hoppy' appearance in the output, but because the source is animation, with a low native frame rate anyway, this is often not noticed by the viewing audience.

No interlacing artefacts should be seen in the final program.

## 5.6 User Case 6 – Processing a bad cadence source

Consider a 59i source file that is a mixture of broken 2:3 and 2:2:2:4 cadences. A Client has requested a deliverable that is 1080/23p. An Alchemist File process has been tried, that utilized the **Detect Sharp** Source Cadence mode, but this has resulted in output file that contains bad field pairing (output frames are derived from different source frames).

**Conversion description:** If, instead of using the **Detect Sharp** detect mode, the **Detect Safe** mode is used, the badly field paired frames should be eliminated from the output deliverable.

When in **Detect Safe** mode, the process can be thought of as two separate processes. The first process de-interlaces the source to create 59p, from the 59i source. During this process, no field pairing is used. Each output progressive frame is directly derived from each input field. Any cadence associated with the 59i source will be replicated in the output file, but will now be a progressive cadence.

The second process removes the cadence from this 59p version of the source. This will get us back to 23p without any frames made from mispaired fields. Each output frame should look clean.

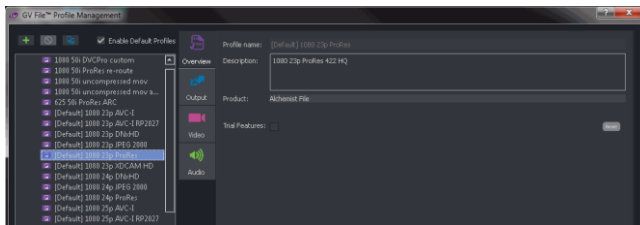
Alchemist File performs the two processes described above, in a single pass conversion.

It is assumed that the metadata in the source file is correct.

## Alchemist File Profile configuration

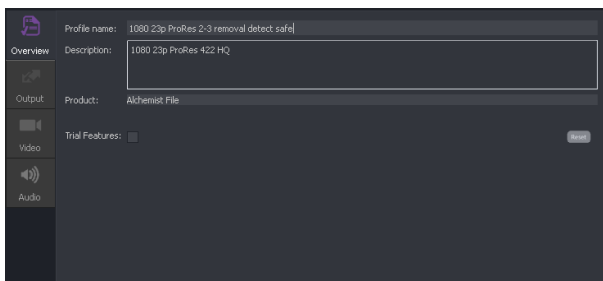
For this User Case, a suitable default profile will be selected and then modified.

1. Select a suitable Default Profile from the list of Profiles:

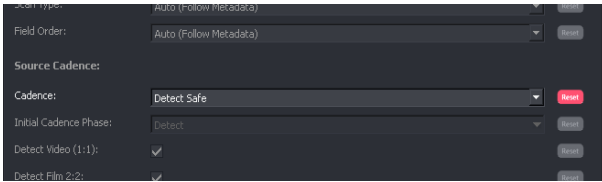


For this example the **Default 1080/23p ProRes** codec has been selected.

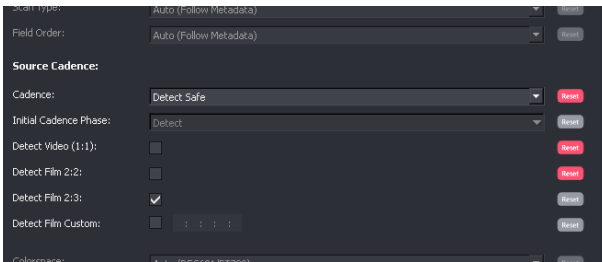
2. Copy this Profile and give it a suitable name. In this example the new Profile has been named: **1080 23p ProRes 2-3 removal detect safe**



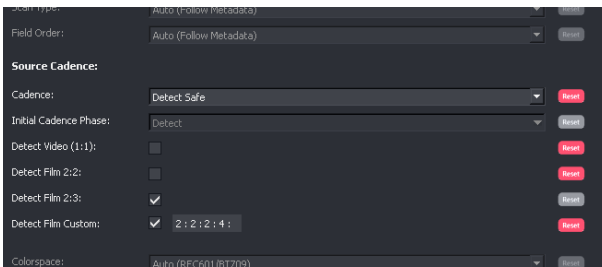
- In the **Video/Input** tab, set the **Source Cadence/Cadence** control, using the drop down menu, to: **Detect Safe**



- In the **Video/Input** tab, disable the controls: **Detect video (1:1)** and **Detect Film (2:2)**



- In the **Detect Film Custom** field, first enable **Detect Film Custom** control, and then enter the custom cadence. In this case enter **2:2:2:4**.



- Save the Profile and run the job.

## 5.7 User Case 7 – Cadence removal and off-speed

Consider a 59i source file that has a 2:3 cadence associated with it. A Client has requested a deliverable that is 1080/25psf. The Client has stated that conversion artefacts in the deliverable are not acceptable.

Alchemist File can provide a suitable solution for this conversion.

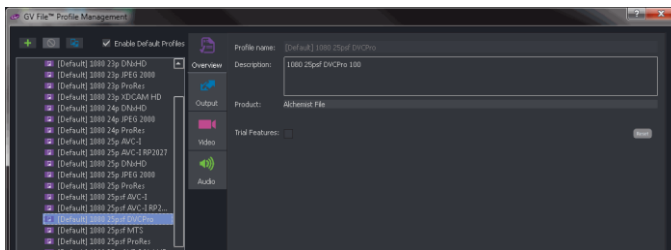
Alchemist File can perform a single pass solution that can be thought of as two separate processes. The first process will remove the 2:3 cadence from the source content, so deriving 23.98p. The second process will off-speed the 23.98p content to 25psf. Audio pitch correction will be applied to ensure the audio pitch of the source is replicated in the deliverable.

It is assumed that the metadata in the source file is correct.

### Alchemist File Profile configuration

For this User Case, a suitable default profile will be selected and then modified.

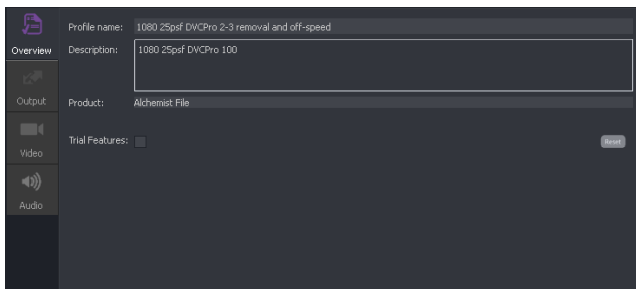
1. Select a suitable Default Profile from the list of Profiles:



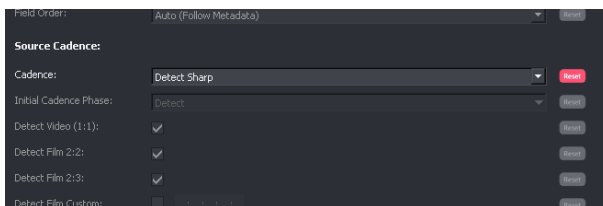
For this example the **Default 1080/25psf DVCPro** codec has been selected.

2. Copy this Profile and give it a suitable name. In this example the new Profile has been named:

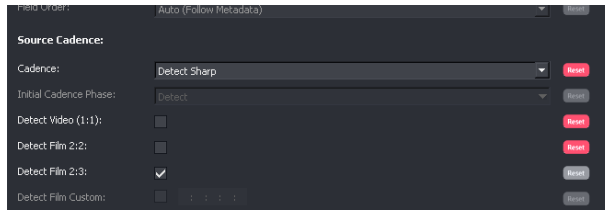
**1080 25psf DVCPro 2-3 removal and off-speed**



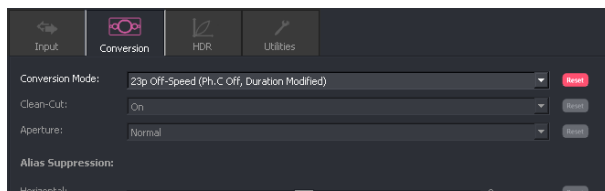
3. In the **Video Input** tab, set the **Cadence** control to **Detect Sharp**:



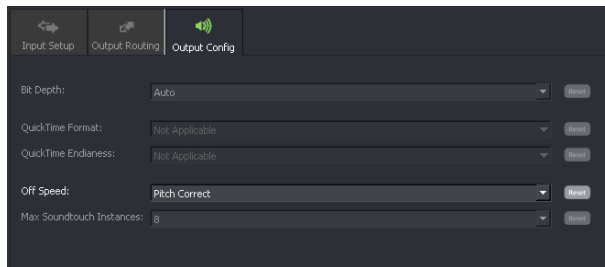
4. Disable the controls **Detect Video (1:1)** and **Detect Film (2:2)**



5. In the **Video/Conversion** tab, set the **Conversion Mode** using the drop down menu, to: **23p Off-Speed (Ph.C Off, Duration Modified)**



6. In the **Audio/Output Config**, confirm that the **Off Speed** mode is set to **Pitch Correct**:



Note – **Pitch Correct** is the default setting.

7. Save the Profile and run the job.

## 5.8 User Case 8 – 25p to 59i by adding 2:2:3:2:3 cadence

Consider a conversion requirement, where filmic 25p content is to be broadcasted in the 59.94i domain. The conversion is to be achieved by adding a film cadence to the source content. There must be no modification to the duration of the program.

For this requirement, adding a 2:3 cadence will not achieve the required frame rate change. 2:3 is actually designed to convert 23.98 to 59.94. If a 2:3 cadence were added to 25p, this would yield 31.25 fps which is clearly not what is required. By modifying the cadence sequence to 2:2:3:2:3, when added to a 25p source, the output will yield 60i. This still does need a further modification to attain the required 59.94i.

There are a couple of practical ways of achieving the 60i to 59.94i. One is to off-speed 60i to 59i, but this will result in a slight duration change and for this particular example, the requirement doesn't allow this. Another way to achieve the slight frame rate change required is to simply drop source fields. Because 59.94i and 60i are very similar frame-rates, this field drop happens very infrequently (approximately once every 16 seconds). Ideally this field drop will be one of the repeated fields which was added as part of applying the 2:2:3:2:3 cadence, so at this point the cadence would be 2:2:2:2:3. The watching audience would never notice this.

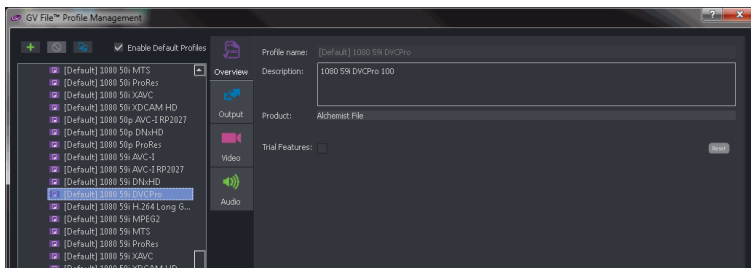
Alchemist File can provide a suitable solution for this conversion.

It is assumed that the metadata in the source file is correct.

### Alchemist File Profile configuration

For this User Case, a suitable default profile will be selected and then modified.

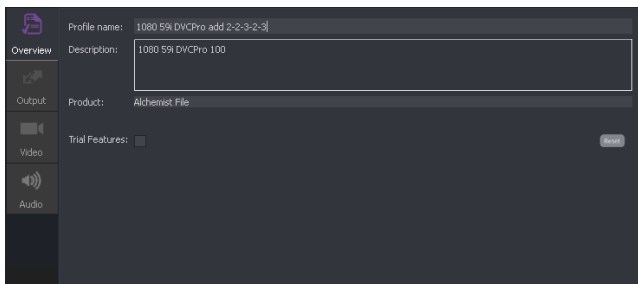
1. Select a suitable Default Profile from the list of Profiles:



For this example the **Default 1080/59i DVCPro** codec has been selected.

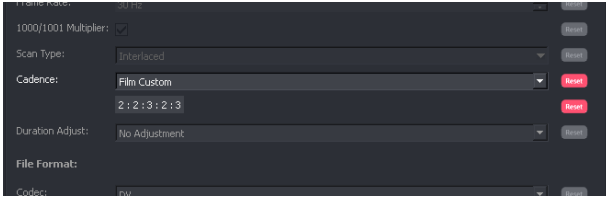
2. Copy this Profile and give it a suitable name. In this example the new Profile has been named:

**1080 59i DVCPro add 2-2-3-2-3**

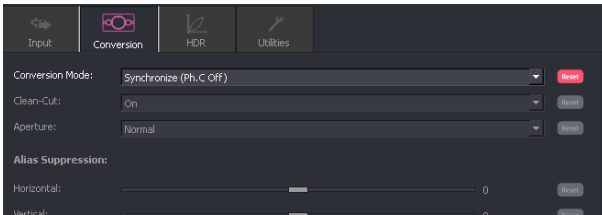




- In the **Output/Output** tab, set the **Cadence** type to **Film Custom** from the drop-down menu and configure the cadence box to add a 2:2:3:2:3 cadence.



- In the **Video/Conversion** tab, set the **Conversion Mode** to: **Synchronize (Ph.C Off)**



- Save the Profile and run the job.

Note - by setting the conversion mode to **Synchronize (Ph.C off)**, we ensure that the 60i to 59i part of the process is achieved by simply field dropping and not by picture building, hence no conversion artefacts are created.

## 5.9 User Case 9 – 59i with unorthodox cadence, to 525/24p

This was an actual User case. The case was raised by ITV and concerned the conversion of a clip called: The Chinese Boxer. This clip is available in the file-based content library, here:

<\\vm-39-engsource\MediaStore\Source\CustomerContent\ITV\Chinese Boxer - bad cadence>

The cadence pattern contained within this content is: 1:1:1:1:2:2:2 (expressing in fields).

Within this 10 field sequence there are 6 events, hence the native frame rate is: 17.98 Hz

$$\frac{29.97 \times 6}{10} = 17.98$$

To make this more complicated, some of the repeats are 'field repeats' and some are 'frame repeats'. Where a 1:1 frame is repeated, the first field of the repeated frame is effectively earlier in time than the previous field, resulting in an odd stuttery motion.

The delivery frame rate is 24p, so the conversion process can be thought of as two conversion processes. The first part is to remove the cadence getting back to the native frame rate of 17.98 fps, then the second part is a frame conversion from 17.98 to 24p.

The process of 17.98 to 24p can either be performed by doing a PhC conversion, or by a repeat frame method.

A PhC conversion will produce smoother motion in the output.

A Synchro conversion will perform a repeat frame process, creating a more hoppy appearance, but clean unblended frames in the output.

Note – Alchemist File cannot be configured to detect this particular cadence and hence any cadence removal will be less than perfect. It was found by experiment that the most effective configuration was to set up the Cadence Detector to detect: 1:1 and 2:2 only, and the detect mode set to Detect Safe.

### Alchemist File Profile configuration

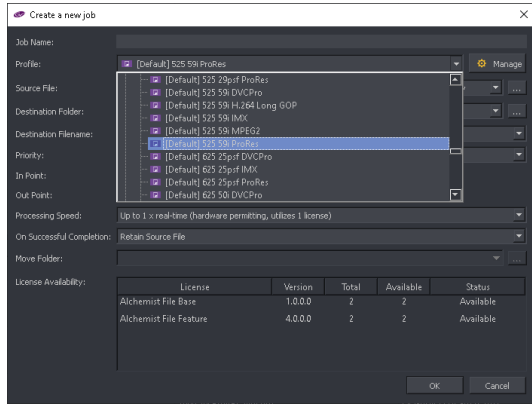
For this User Case, a suitable default profile will be selected and then modified.

Since the deliverable is 525/24p, this is a custom frame rate, hence only certain file types will support this:

- Apple ProRes
- Uncompressed Mov
- DPX

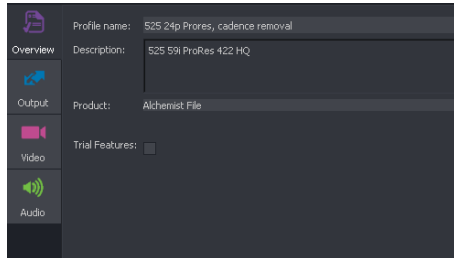
For this example ProRes has been chosen and the conversion mode is PhC.

1. Select the Default Profile: 525/59i ProRes



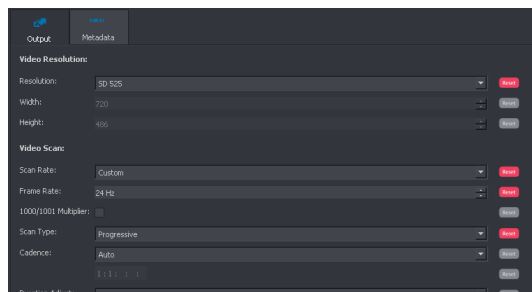
2. Copy this profile and give it an appropriate name. In this example, the Profile has been given the name:

- **524/24p ProRes, Cadence Removal**



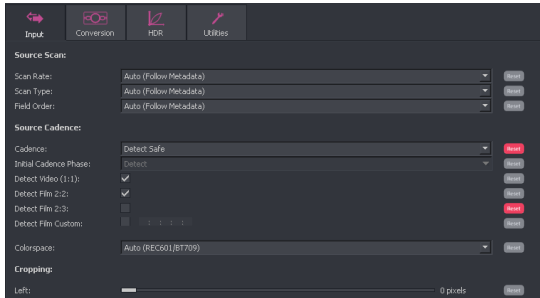
3. In the Output tab, set the following:

- Scan rate to **Custom**
- Frame rate to: **24Hz**
- Scan Type to: **Progressive**



4. In the Input Tab, set the following:

- Cadence to: **Detect Safe**
- Disable: **Detect Film 2:3**



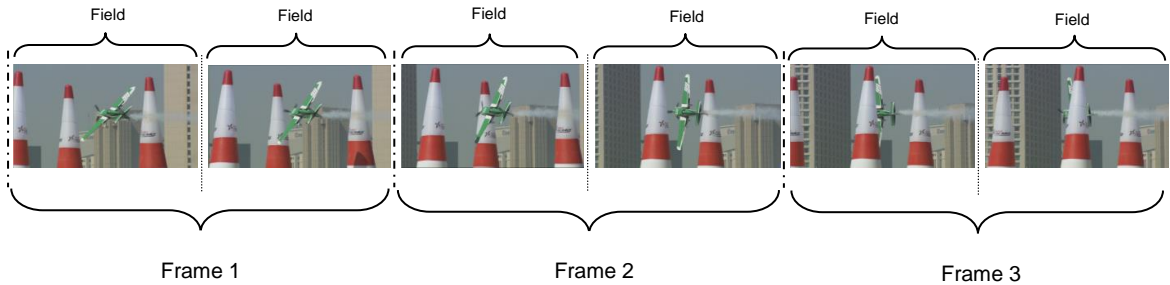
5. Save the Profile and run the job.

## 6. Glossary

### 6.1 Cadence

Definition: A manipulation of source content, to achieve a frame rate change, by a process of duplication of certain source fields/frames, in a continuous, repeating sequence.

#### 6.1.1 Video 1:1



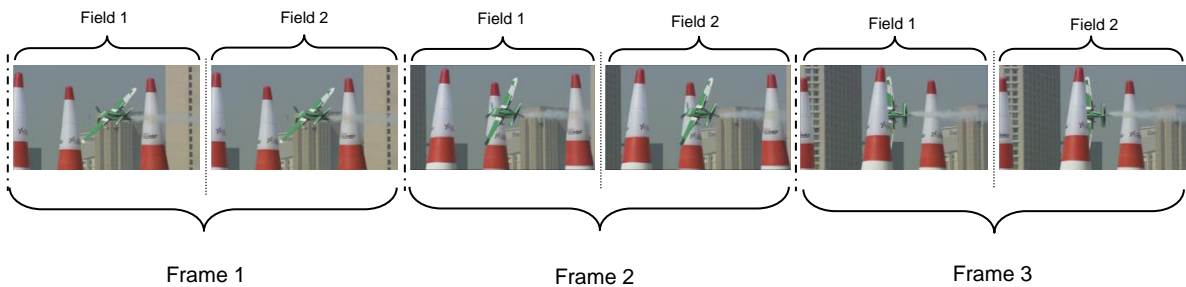
This is a normal video structure, as captured by a video camera. Note that the scene is updated every field and that each frame represents two separate temporal events. So, for example, in a 25 fps system, the scene updates 50 times a second. Similarly, in a 29.97 fps system, the scene updates 59.94 times a second.

A 1:1 sequence is also applicable to progressive content, where each frame represents a unique temporal event (no repeats).

#### 6.1.2 Psf Cadence

Psf is an acronym for: **Progressive segmented frame**.

The following example depicts three fields of a video stream with a psf cadence:



Be aware that psf is also referred to as 2:2. However, 2:2 can refer to cadence added to a progressive video stream. In such a case, the progressive 2:2 content is not the same as psf. However, it would be true to say that 'interlaced 2:2' is the same as psf.

With regard to a psf video content, it can be seen that both fields within a video frame are scanned from the same film frame and so represent the same temporal event. The scene updates every **frame** (not every **field**). A good definition of a psf frame is that if the two fields were combined to make a progressive frame that a perfect progressive frame would result, with no visible interlacing artefacts.

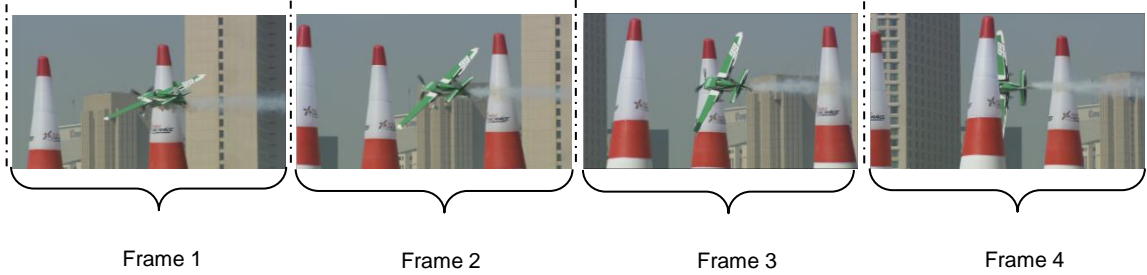
Note that the video transport is identical to normal interlaced video.

Historically, psf content was derived from film at 24 fps. However, it is now commonplace to encounter a psf video structure in the 59i domain as well.

### 6.1.3 Progressive

Where film derived content is converted to video via a telecine process, the telecine scanner can scan progressively. In such a system, 24 fps film will produce 24p video.

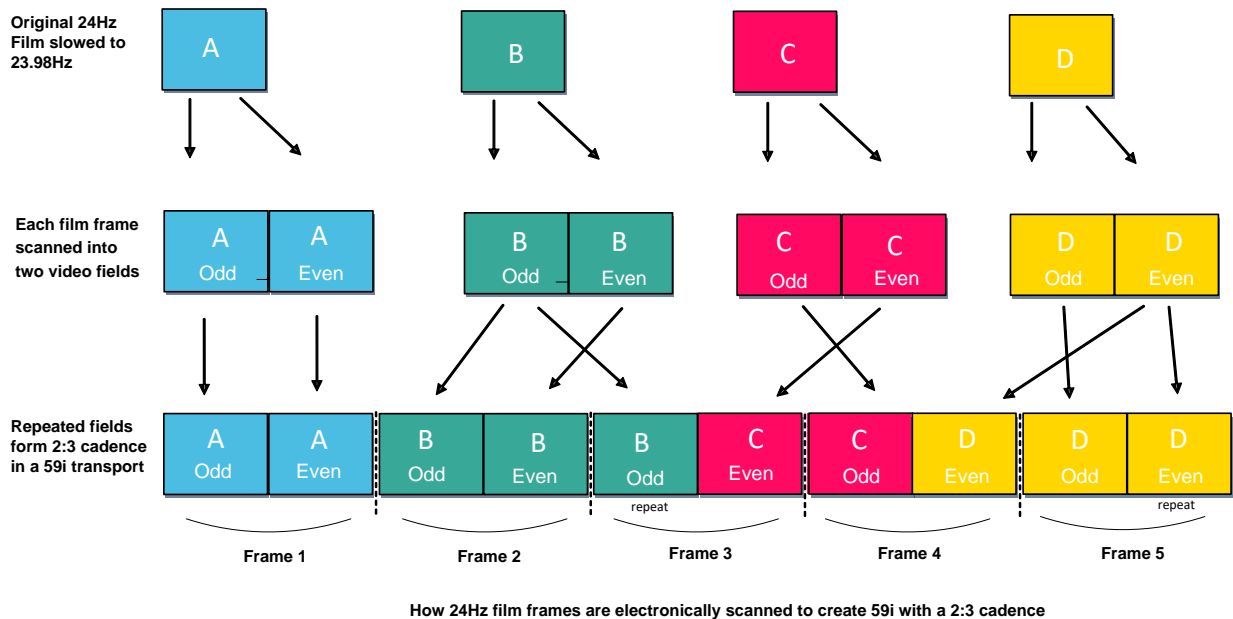
The telecine process scans each optical film frame into one progressive video frame. The telecine scanner may produce 720, 1080, 2K, 4K frames, but the video structure is still 24p.



### 6.1.4 Cadence 2:3

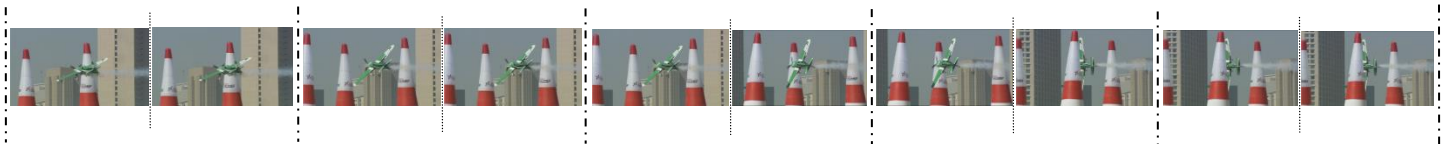
If we consider the requirement to broadcast a 24Hz film, in a 29.97Hz environment, some form of conversion is required. One particular conversion method is to add a 2:3 pulldown sequence. This method simply duplicates certain fields in the input. There is no picture building process, so the output is not affected by conversion artefacts, however the resultant stream does exhibit an increase in perceived judder.

It should be understood that if a 2:3 pulldown process is added to a 24 fps source, a true 30 fps program will result. However, the actual broadcast frequency in the US and other 60Hz countries is 29.97 fps. To achieve the requirement of generating an output of 29.97 fps, an additional part of the process is required. The source is first slowed from 24 fps, to 23.98 fps and then the 2:3 pulldown process is added. This effectively creates the required 29.97 fps program. Note that because the frame rate is very slightly slowed, that the run time is slightly increased. A film with duration of exactly 1 hour will be extended by 3.6 seconds.



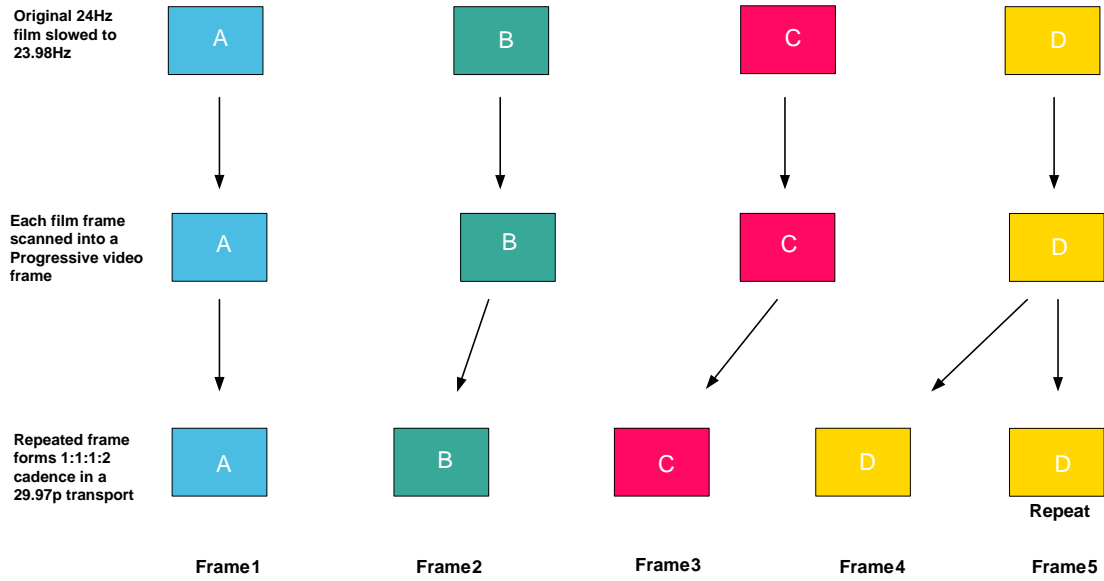
It can be seen that for every 4 input film frames, 5 output video frames are derived. In this way, 24 Hz film is converted to 59.94i.

Below is depiction of an actual video stream containing a 2:3 cadence.



### 6.1.5 Cadence 1:1:1:2

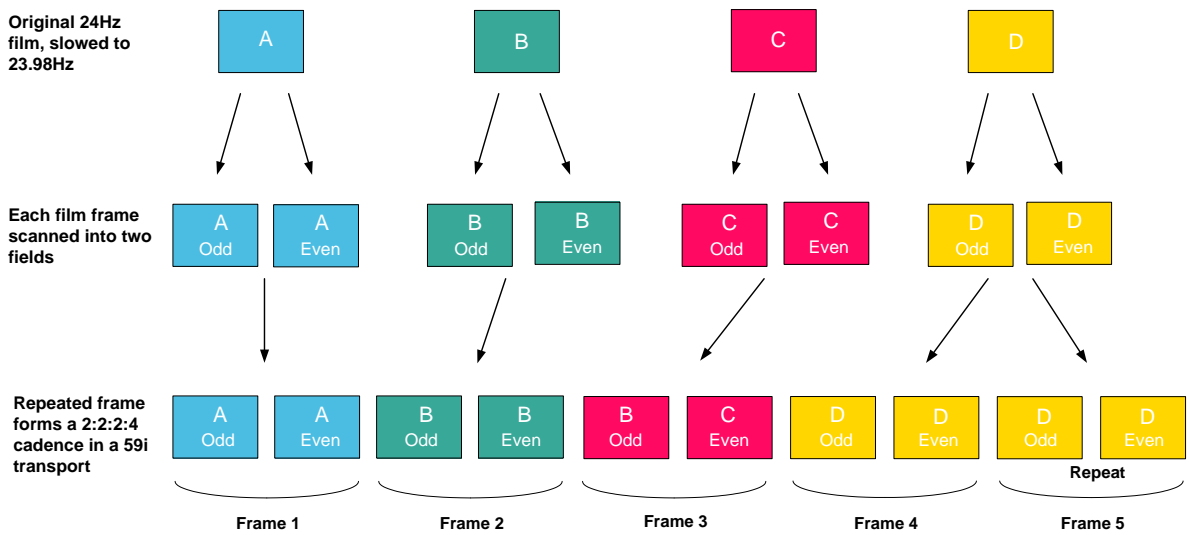
This cadence is used where a progressive solution is required to convert 23.98p to 29.97p, or 24p to 30p.



How 24Hz film frames are electronically scanned to create 29.97p with a 1:1:1:2 Cadence

### 6.1.6 Cadence 2:2:2:4

Similar to 1:1:1:2 cadence, but here the sequence describes psf frames, rather than progressive.

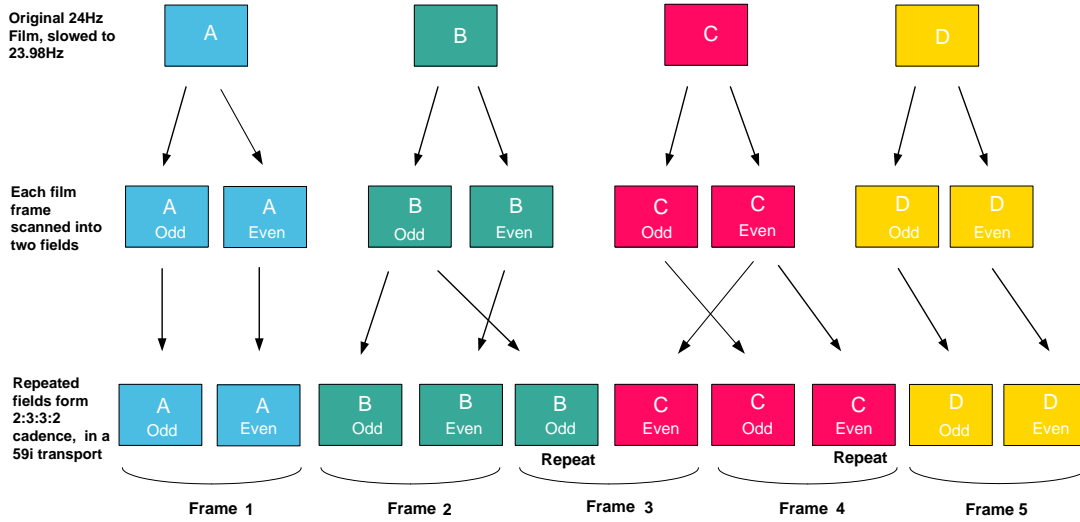


How 24Hz film frames are electronically scanned to create 59i with a 2:2:2:4 cadence



### 6.1.7 Cadence 2:3:3:2

Similar solution to 2:3, 2:3:3:2 is also a pull-down process that derives 59i from 23.98p.

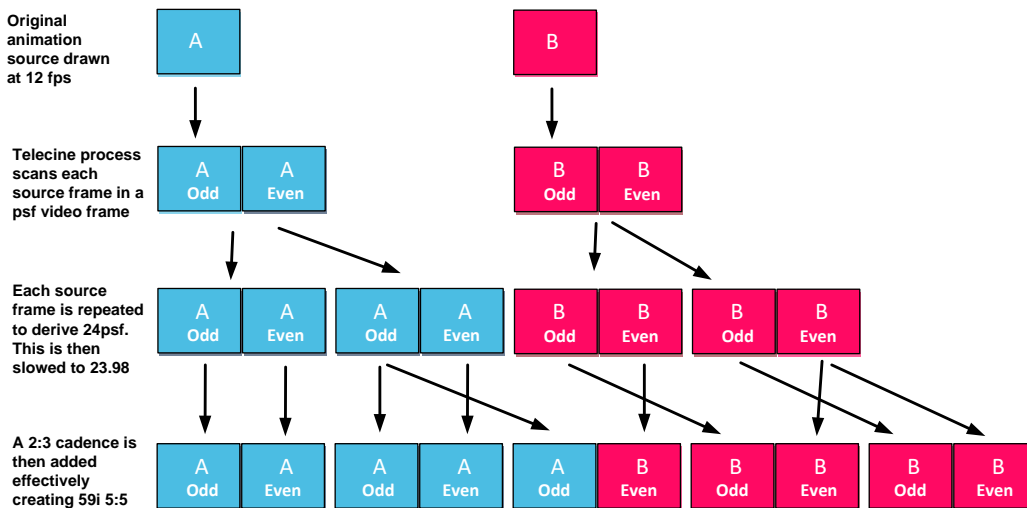


How 24Hz film frames are electronically scanned to create 59i with a 2:3:3:2 cadence

2:3:3:2 is a quite elegant solution in that it only produces one mixed frame (frame 3 in diagram above) in every 5 output frames, compared to 2:3 that produces 2 mixed frames, in every 5 output frames.

### 6.1.8 Cadence 5:5

This cadence is usually associated with animation drawn at 12 frames per second. Each source frame is repeated to derive 24 fps and then a 2:3 cadence is added. If we refer to the 2:3 cadence diagram above, because both the 'A' frame and the 'B' frame are derived from the same drawing, 'A and 'B' are identical, as are 'C' and 'D', hence a 5:5 cadence will result.

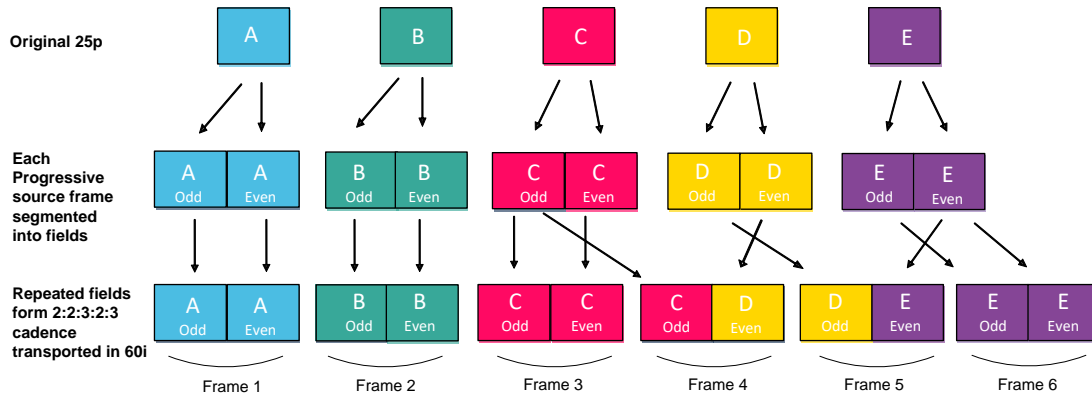


How 12 film frames are electronically scanned to create a 59i video program with a 5:5 cadence

Note that there are only 2 temporal events within the 10 field sequence.

### 6.1.9 Cadence 2:2:3:2:3

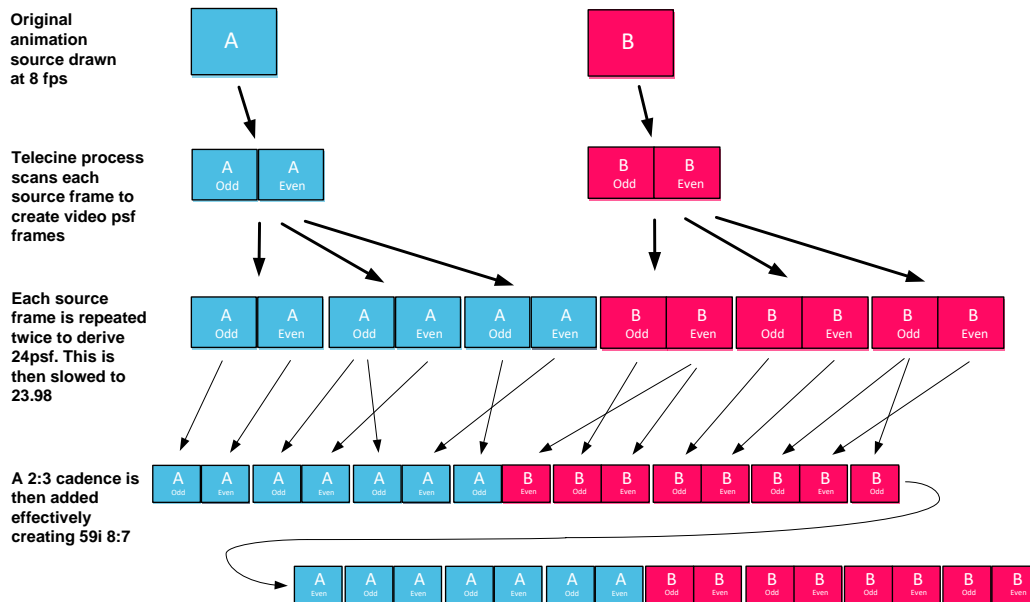
This cadence is employed when filmic content in the 25 fps domain, is to be broadcast in the 29.97 fps domain. In reality, adding this cadence to 25psf (or 25p) content will produce 60i. 59i can then be produced by either employing an off-speeding process (60i to 59.94i), or a process occasionally dropping a field to achieve the 60i to 59i transition. Using the latter process, ideally one of the '3's' would become a '2', so at this point the sequence would become 2:2:2:2:3. This would happen approximately once every 16 seconds.



How 60fps is derived from native 25p by applying a 2:2:3:2:3 cadence

### 6.1.10 Cadence 7:8

This cadence is usually associated with animation drawn at 8 frames per second. Each source frame is scanned into two psf fields and then each psf frame is repeated twice to derive 24psf 6:6. This is then slowed to 23.98 6:6. If then a 2:3 cadence is added, this cadence upon cadence process yields 59.94i 7:8



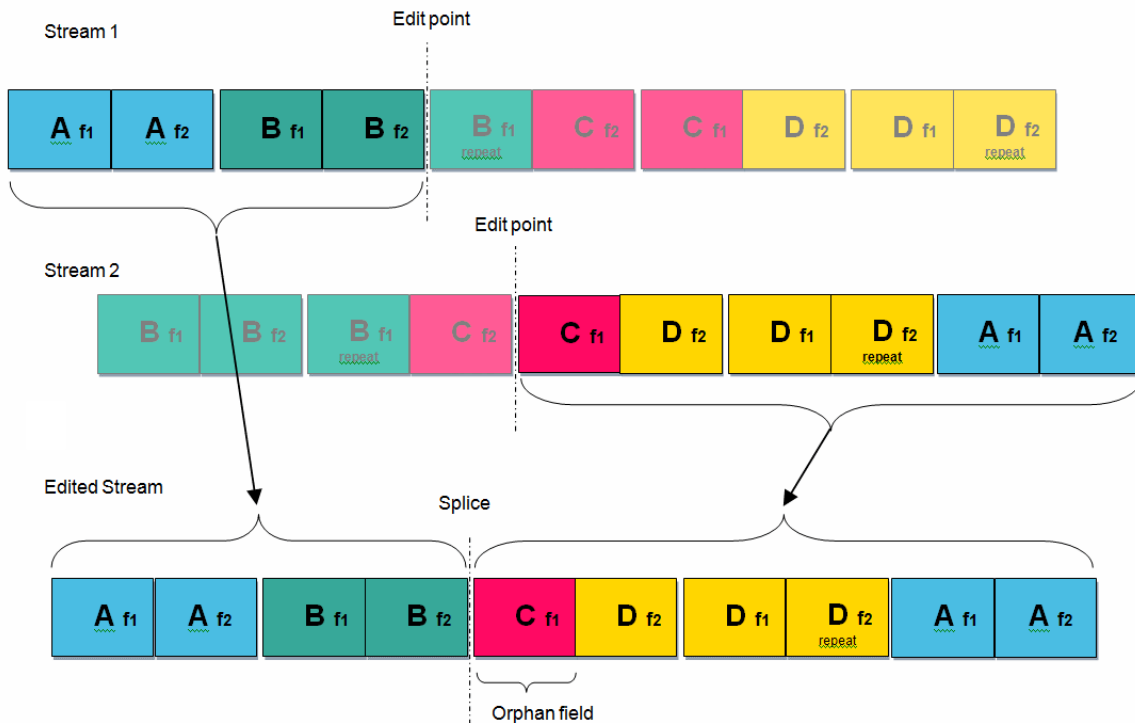
How 8 film frames are electronically scanned to create a 59i video program with a 7:8 cadence

### 6.1.11 Broken Cadence

Broken Cadence usually occurs as a consequence of bad video editing practices. Where source content contains a cadence sequence, such as 2-3, if the content is edited but no consideration is given to the cadence, then the cadence sequence will almost certainly break.

If we consider an editing procedure where two source content streams are to be spliced together and that both source clips have a 2-3 sequence associated with them. If editing points are randomly chosen, where the two clips join, the cadence sequence will likely break.

Below is a pictorial representation of this circumstance:



It can be seen that the resultant stream no longer conforms to the 2-3 sequence, at the point of the splice. The sequence goes: 2:2:1:3:2:3....etc. An orphan field has been produced just after the splice. An orphan field is a field where the video content does not pair with a sister field to create a complete frame.

However, Alchemist File can repair this sequence. If the Alchemist File is configured to detect 2:3, a 59i output file can be made that does correctly conform to the 2:3 sequence.

Alchemist File is able to repair other cadence sequences as well.

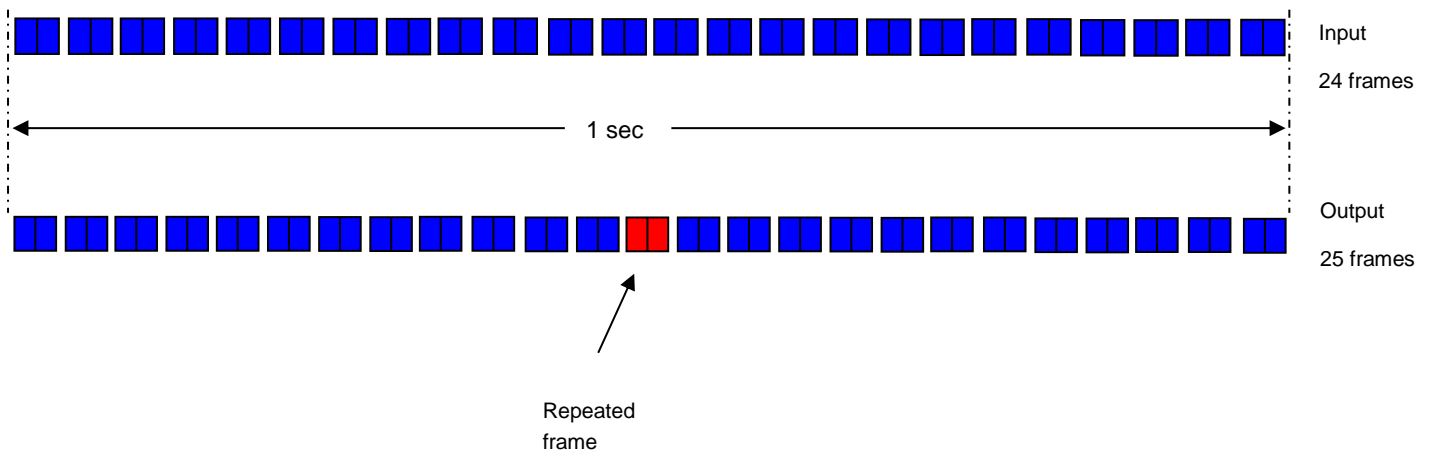
## 6.2 Conversion - 24 fps to 25 fps

In circumstances where the duration of a program must be maintained, a frame-rate conversion will need to be performed. There are various techniques that can be used to achieve this. Some techniques are simpler than others, but the simpler techniques are often deemed unacceptable.

### 6.2.1 Synchro frame repeat method

Considering the fundamentals of this conversion, a 24 fps source must be converted to 25 fps, one extra frame per second needs to be generated. A simple method to achieve this, is to simply repeat one frame per second. This is a simple solution and the psf structure of the video will not be compromised. However, there is a serious downside to this technique. At the point of the repeated frame, there will be a noticeable hop. This can be really intrusive, especially where slow pans are present in the source content.

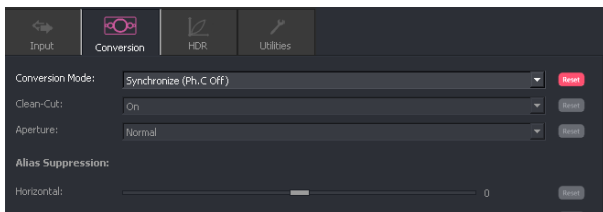
The following diagram depicts 1 second of video. It can be seen that from a 24 fps source, that 25 fps output is derived.



This example shows this simple technique when processing psf content. However, the same technique may be employed when processing progressive content.

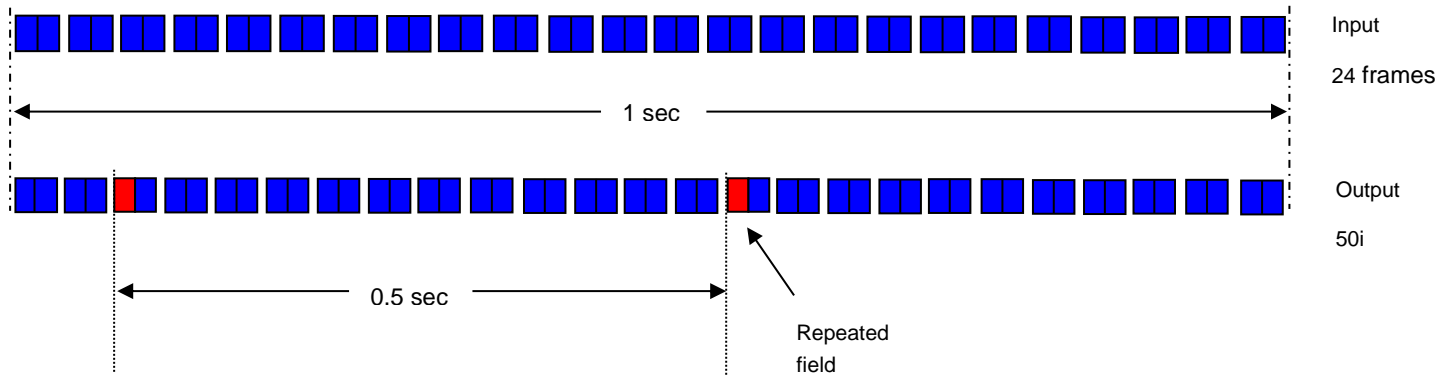
Note that the technique may be used in reverse. 24psf can be derived from a 25psf source by simply dropping one source frame per second. Again the technique can be applied when processing progressive content.

GV File products use this technique when set to the Synchronise mode:



### 6.2.2 Synchro field repeat method

Similar to the frame repeat method above, but instead of repeating a video frame once a second, this technique repeats a video *field* twice a second. Or, to put it another way, a video field is repeated every half a second:



An important consideration of this technique is that the psf nature of the source is not preserved in the output. The resulting content has the appearance of psf, but technically, it isn't.

However, the advantage over the 'frame repeat' method described in part 6.11.1 above, is that the discontinuity cause by the repeat is less noticeable.

This technique is not applicable to progressive content because the concept of fields does not exist.

To achieve such a conversion using Alchemist File, the output would be set to 50i, and the conversion mode set to 'Synchronise (PhC off)'.

### 6.2.3 Conversion interpolation method

Where low frame rate standards conversion is required and the simple field/frame repetition techniques are deemed unacceptable, then a conversion using an interpolation process will be required. In such a process, picture building is taking place. Each output frame is derived from several input frames. Interpolation techniques include simple linear processes where output frames are blended from multiple input frames. In today's broadcast industry, the quality of a linear conversion is often deemed to be unacceptable.

Motion compensation: there are various motion compensated techniques developed by different manufacturers. Some are more simplistic than others. Most would be deemed better than a linear conversion, but for low frame rate, complex moving content, the conversion process is very difficult to achieve without visible artefacts.

Alchemist File offers high quality PhC motion estimation with adaptive fallback. It can often be the case that it is technically very difficult to generate good motion vectors from low frame rate content that exhibits fast complex motion. When processes still use these 'bad' vectors in the picture building process, broken objects at the output will result. However, Alchemist File is unique, in being intelligent regarding the quality of the motion vectors it is producing. Where bad vectors are produced, Alchemist File will not build broken objects, but will instead resort to a simpler linear picture building process. Because this only happens when the source content is fast complex motion, the linear conversion is very difficult to see in real time. Usually, the Achilles heel of any linear or field/frame repeat method of conversion, is slow panning content, where visible hops will be seen. However, with such content, Alchemist File will produce smooth pans, without hops, by using its PhC algorithm. In this way, Alchemist File can adaptively react to changing source content, so producing the best conversion possible.

## 6.3 Off-speeding

Also referred to as 'vari-speed'.

Off-speeding is a technique of achieving a frame rate change by simply speeding the content up, or slowing it down. Historically, this was done by recording the content onto a VTR at one frame rate and playing it back at another. In the file-based domain, video conversion by off-speeding can be achieved by simply modifying the metadata. However, it is the associated audio that makes the off-speeding process more complex, in the file-base domain.

This technique is only really suitable when used between similar source and target frame rates such as 24 to/from 25 fps, or 29.97 to/from 30 fps. An off-speed process between, for example, 25 and 29.97 fps, although possible does yield unnatural motion and would not be deemed an acceptable conversion solution.

The advantage of off-speeding is that it achieves a cheap, uncomplicated, high quality conversion solution. The downside is that the duration of the program is modified. For example, an off-speeding process converting from 24p to 25p, will result in a 4% reduction in run-time.

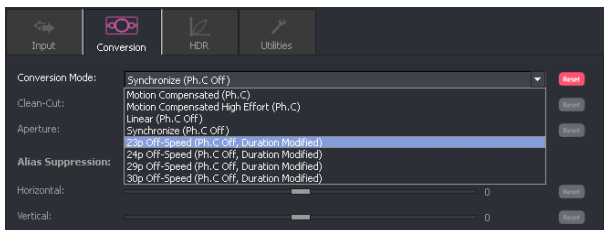
Considering the audio; a VTR off-speed process will modify the pitch of the audio by a corresponding amount. In our 24p to 25p example, the audio pitch will rise by 4%. This will make character's voices change, and this change will be noticeable, when compared to the original. A familiar actor's voice would sound different to the viewing audience. One solution to this pitch shift change, is to employ an audio pitch-corrector. Audio pitch correction is inherently quite a complicated process and commercially available products vary in quality. Sometimes audio pitch-correction of any description is deemed unacceptable. With content such as Classical Music concerts or Opera productions, the quality of the sound is deemed more important than the quality of the video and audio pitch correction is deemed completely unacceptable, as is changing the pitch of the audio, hence for such productions off-speeding is not a suitable conversion solution.

### Alchemist File Off-speed solution

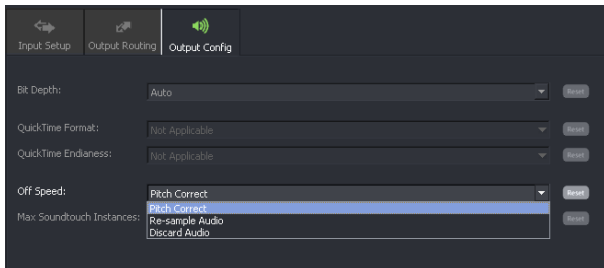
An off-speeding solution is available as an Alchemist File feature. It was introduced with version V2.1.0.12 (released July 2015). Off-speeding between 23.98, 24, 25, 29.97 and 30 fps are all possible.

With respect to audio, Alchemist File has the ability to resample audio (replicating a VTR process where the audio pitch is modified), or pitch-correct the audio. The audio pitch-corrector offered by the Alchemist File is very high quality and generally there is no discernible difference between the source and the deliverable.

Off-speeding menus are found in the **Video/Conversion** tab of the Profile Management window:



Audio pitch-correction menus are found in the **Audio/Output Config** tab of the Profile Management window:



## 6.4 Mouse-teething

This is a descriptive term applied where mispairing of fields has occurred during a de-interlacing process:



Because a progressive frame has been produced by pairing two fields that were derived at different temporal points, an unacceptable progressive frame has been derived.

A popular term for this in the Broadcast Industry is 'mouse-teething'.

## 6.5 TFF / BFF definition

The term **TFF** is an acronym for: **Top Field First**

The term **BFF** is an acronym for: **Bottom Field First**

These terms are used to describe the scan order of an interlaced video signal. If we consider a single frame of an interlaced video signal, each field actually depicts two separate temporal events.

Consider two temporal events that are captured by an interlacing camera:

Temporal event 1



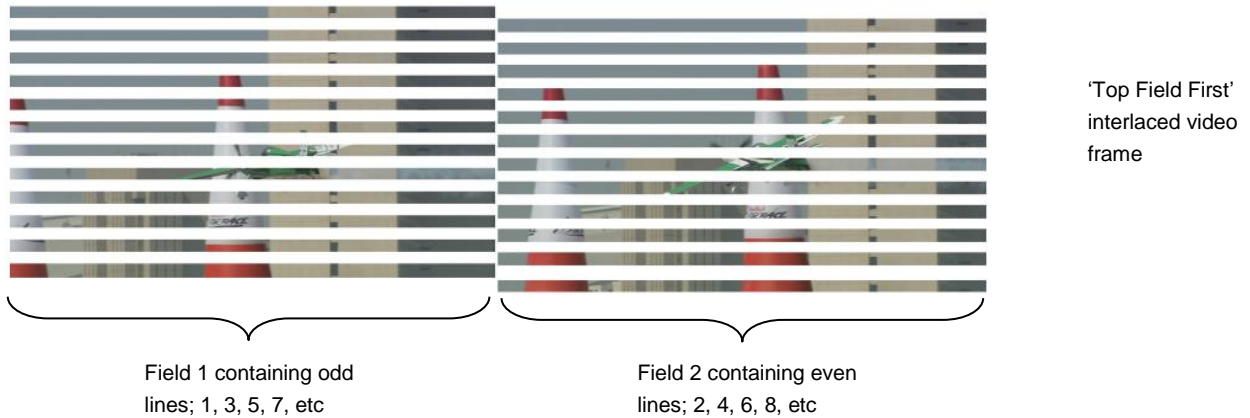
Temporal event 2



It can be seen that **temporal event 1** occurs before **temporal event 2** by the progress of the aeroplane.

### TFF

If the camera is employing a TFF interlacing process, field 1 will contain odd line numbering and field 2 will contain the even lines. The diagram below pictorially depicts such a system:

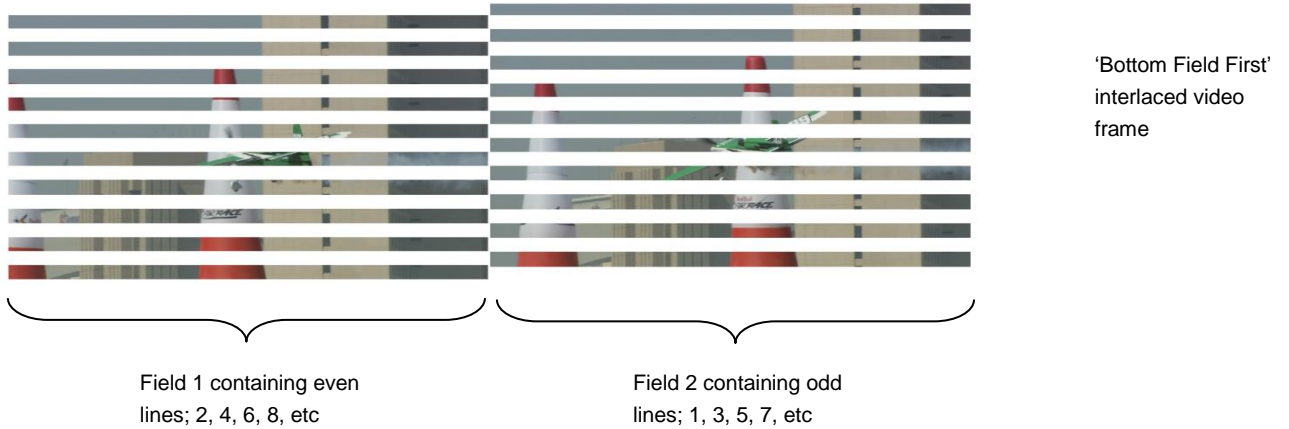


Note that the field containing the 'odd' lines is earlier than the field containing the 'even' lines.



**BFF**

If we consider a Bottom Field First system: Now field 1 (the earlier temporal event) will contain 'even' numbered lines and field 2 (the later temporal event) will contain the 'odd' numbered lines:

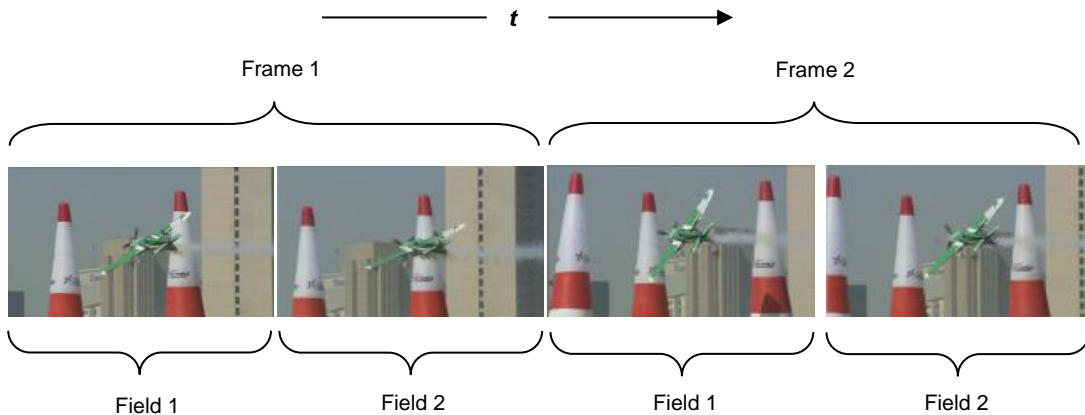


Note that the field containing the 'even' lines is earlier than the field containing the 'odd' lines

Bottom field first files are usually only encountered in the 525 SD domain and this is often dependent upon the codec being employed. Apple ProRes defines SD 525 files as BFF. However, other codec types can use TFF in the 525 SD domain. Whichever method is used is valid, as long as the associated file metadata accurately describes the field order.

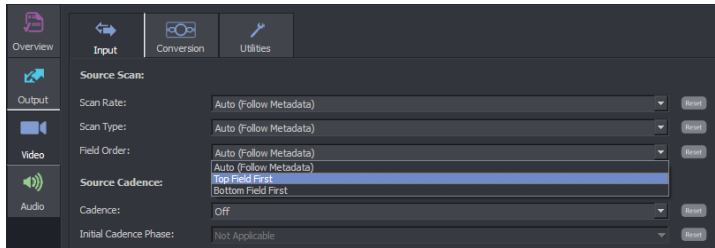
If the associate metadata is inaccurate, with respect to field order, any conversion of such content will be seriously compromised.

Below is a representation of such a file:



If this stream were viewed it would appear very strange. Because of the way the fields are arranged the movement is generally moving forward, but in each field of a frame, the movement is going backwards. So the motion is a kind of large step forward followed by a smaller step back.

This is very undesirable. However, Alchemist File includes a **Field Order** control, which enables a User to manually configure the field order and hence ignore the associated field order metadata.



This control has three possible settings;

- Auto (Follow Metadata)
- Top Field First
- Bottom Field First

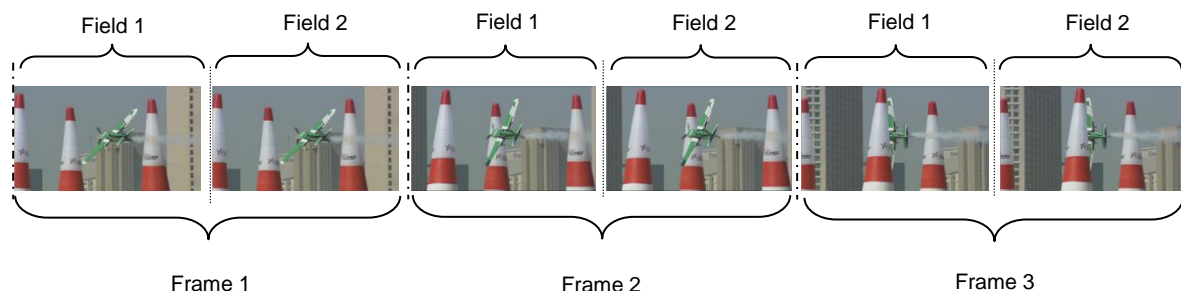
The default setting is **Auto (Follow Metadata)**. When selected, processing the file will rely on the source file Metadata.

In circumstances where the source file metadata cannot be relied upon, a user can manually set the field order to be either TFF or BFF, in order to match the actual field order of the source file.

## 6.6 Filmic field dominance

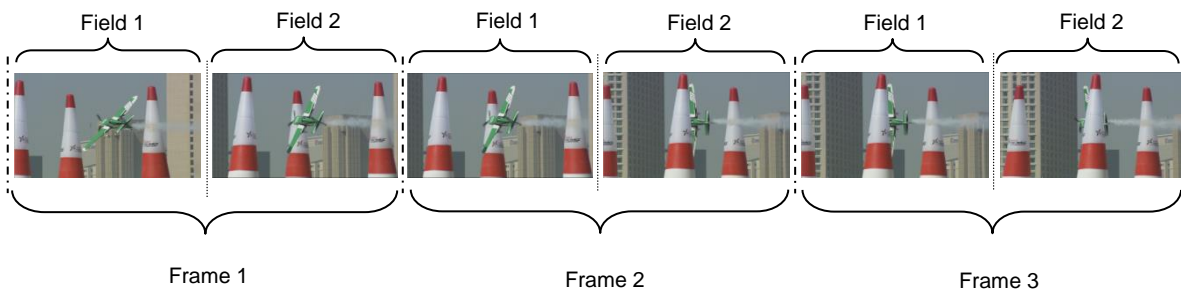
Usually, when filmic content is carried in an interlaced video transport, it has a 2:2 (psf) cadence. If we consider a 24 fps film, this would be converted to 24p film by a telecine process. If this is to be broadcast in the 50i domain, often the easiest way to do this is to off-speed the 24p to 25 fps and carry the program as progressive segmented frame (psf).

If we consider the structure of such a video transport, each video frame contains two video fields that are derived from the same film source frame. The following diagram depicts such a system:



We can describe this video stream as Film 2:2 F1/F2, where F1/F2 describes the field dominance. Note that both fields, within a particular frame, depict the same temporal event.

However, sometimes video streams are encountered where the field dominance is reversed. Such a stream is described below:



Note that the field 2 of each frame depicts the same temporal event as field 1 in the following frame and that the two fields within any particular frame are different temporal points.

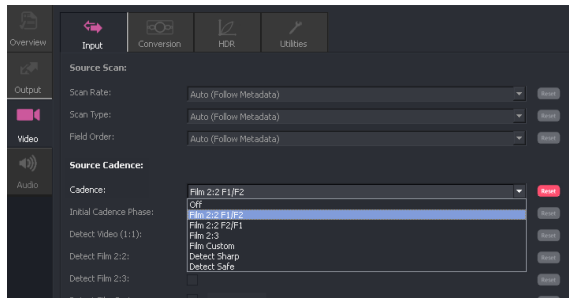
Such a stream is described as Film 2:2 F2/F1.

This would normally be considered to be an illegal video transport. But it can be produced by careless video editing practices.

Alchemist File can handle such source content. In the Cadence Control pulldown menu, there is a setting called:

- Film 2:2 F2/F1

When a video file is encountered that contains such a video structure, with this control set, Alchemist File will process the file in the same way as it would a normal Film 2:2 F1/F2 file.



This control setting can be used to effectively repair such source content. So in affect we can derive a Film 2:2 F1/F2 file from a Film 2:2 F2/F1 source file.

## Appendix A. Output Cadence setting Auto

The following table describes the affect of the **Output Cadence** control set to **Auto**, upon low frame rate inputs, when high frame rate outputs are configured:

Input file scan-rate	Output Scan Rate		50i	59.94i	60i	50p	59.94p	60p
	Output Cadence setting							
23.98p	Auto		25psf	29.97psf	30psf	50p 2:2	59.95p 2:2	60p 2:2
	off		50i	59.94i	60i	50p 1:1	59.94p	60p
24p	Auto		25psf	29.97psf	30psf	50p 2:2	59.95p 2:2	60p 2:2
	off		50i	59.94i	60i	50p 1:1	59.94p	60p
25p / 25psf	Auto		25psf	29.97psf	30psf	50p 2:2	59.95p 2:2	60p 2:2
	off		50i	59.94i	60i	50p 1:1	59.94p	60p
29p / 29psf	Auto		25psf	29.97psf	30psf	50p 2:2	59.95p 2:2	60p 2:2
	off		50i	59.94i	60i	50p 1:1	59.94p	60p
30p	Auto		25psf	29.97psf	30psf	50p 2:2	59.95p 2:2	60p 2:2
	off		50i	59.94i	60i	50p 1:1	59.94p	60p