

Using the ArcGIS Full Motion Video 1.3.1 Add-In



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Full Motion Video

ArcGIS Desktop supports capabilities for working with full motion video. These capabilities help a broad range of customers visualize and analyze full motion video (FMV), and integrate them with traditional GIS datasets and analysis.

This User's Manual is organized into 7 sections. The first sections address installing the FMV 1.3.1 Add-In application properly. The next sections focus on usability of the different functional components of the FMV Add-In, and address optimum settings and techniques to best exploit the functionality in operation environments. This is followed by the Menu Map which contains a list of all the buttons and functions contained in the FMV 10.3.1 Add-In. These include the FMV Toolbar, Video Manager, Video Player, Metadata Viewer, Properties Viewer, and Geoprocessing tools.

System requirements

System requirements

The system requirements for Full Motion Video are the same as the version of ArcGIS Desktop.

- ArcGIS 10.2.x Desktop System Requirements
- [ArcGIS 10.3 Desktop System Requirements](#)
- [ArcGIS 10.4 Desktop System Requirements](#)

Licensing and software requirements

- ArcGIS 10.2.x, 10.3.x or 10.4.x Desktop must be installed.
- The FMV add-in and geoprocessing tools will work with a Basic, Standard, or Advanced license.
 - Mosaicking requires a Standard or Advanced license.
 - The ArcGIS Full Motion Video Add-In is now available [here](#). Scroll to the bottom of the page and either call TeleBusiness or to go to My Esri.
- Your video stream and files must have metadata that is Motion Industry Standards Board compliant. It is highly recommended that you review the latest MISB description which can be downloaded by going to http://www.gwg.nga.mil/misb/zip_pubs.html and downloading the latest Composite Documents Zip File > Opening ST0601.9.pdf.
- You must have installed an extraction utility, such as 7-Zip. You can download 7-Zip for free at <http://www.7-zip.org/>

Release notes

New Features

- More efficient video playback, panning and zooming
- Improved multiplexing giving users the ability to customize bit rate
- Full support for TIFF and JP2 image format for video mosaics, including full image map transformations for more accuracy
- New geoprocessing tools for mosaicking archived and live video streams, and video frames
- New Zoom to Frame tool making it easier to find your videos on the map
- UI Updates
- Full support for ArcGIS Desktop 10.3.x and 10.4.x
- New time shift template to be used in the video multiplexer geoprocessing tool. This and the field mapping file is in C:\Program Files (x86)\ArcGIS 10.4 Full Motion Video Geoprocessing Tools\Video Multiplexer Templates
- Images from a live stream can be captured and mosaicked.

Tips and Best Practices

- Recording, mosaicking, time-syncing, and displaying map features on the video are all computationally intensive operations.
- Please keep this in mind when running these operations on multiple videos at the same time or when using other computationally intensive ArcMap tasks.
- Positional accuracy of digitized features declines with increasingly oblique angles of video. For best accuracy, digitize over video collected at near nadir or vertical angles (e.g. from as directly above as possible).
- High video frame-to-metadata ratios will typically result in smoother map geometry and more accuracy when running full motion video functions, such as digitizing or measuring.
- To digitize features on a video, start an edit session and use a feature template.

Known Issues

- Bookmarks may need to be clicked more than once in order to zoom to their locations. Each additional time a bookmark is clicked a larger search is run for the closest metadata packet to the requested frame. This is required because metadata packets may either be in front or behind the requested frame.
- On some systems a video player window may resize very slowly, in small increments. To prevent this, activate the **Manually resize player windows** option from the **Video Manager**. This option is off by default.
- When playing videos with minimal metadata and using the 'Display features from the map on the video' tool features may appear 'choppy'. To prevent this, enable the **Check to maintain smooth playback** option under the **General** tab of the video properties. This will animate the features using a built-in timer for a smoother display.

Existing Features

- Use the video search capability to create search indexes and perform targeted video searches. Search based on location, time, and selected features as filters. Sort search results to create a video

queue and export clips complete with full metadata. Export search results to share within your organization.

- The Video Multiplexer geoprocessing tool enables users to create motion industry standards board (MISB) compliant video data from synchronous or asynchronous video and accompanying IMU data. UNIX time stamp values are now displayed across the UI using MISB 0601.5 7.2 Tag 2: UNIX Time Stamp Conversion format (e.g. Jun. 24, 2015. 00:11:12.775)
- Pan and zoom while videos are paused, playing, or streaming live.
- Create video clips directly from the Video Player to one of 12 different video formats by positioning the time sliders and clicking the export button (e.g. h264, mpg, mp4, ts, etc.).
- Create video clips by using bookmarks to create beginning and end times.
- Record live streams to new video files with support for 12 different video formats (e.g. h264, mpg, mp4, ts, etc.).
- Snap video frames from both zoomed and panned states while paused or playing. Frames can be saved as jp2, jpg, tif, ntf, png. jp2 and tif Images are georeferenced and automatically added to the map.
- PowerPoint integration for capturing the current video frame, the map with all graphics and features, associated MISB metadata, key MGRS coordinates, and bookmarks.
- Slow motion playback, which allows more detailed analysis of high frame-rate videos
- Measure distances directly on a video in metric or imperial units
- Map features can be displayed on a video while playing, panning, and in a zoomed state.
- Slow-motion slider allows fine grained control of slow motion play
- Marks can be displayed on a video while playing, panning, and in a zoomed state.
- Play videos using Key Frames only playback, which allows full metadata parsing, so no details are missed. Using Key Frame only playback frees up resources allowing more videos to be played simultaneously.
- The Accuracy option, which includes DEM, DTED, and elevation constant integration, increases locational accuracy while displaying map features, editing, and marking on the video. Accuracy also supports increased accuracy while panning and zooming the video.
- Video graphics are drawn more efficiently and are now updated while stepping forward and time sliding (marks, frame outline, platform, frame center, and field of view).
- **Follow** options allow following video graphics at full extent, full extent expanded, and with a manual option. There are also options for Follow All Videos and Stop Following All Videos.
- Video Player windows automatically resize. There is a manual resize option for users with Windows Classic or Windows High Contrast.
- Improvements to the video marking tool, including save and remove marks options in the context menu. Marks also remain until explicitly cleared by the user.
- The 'Refresh Graphics Tool' allows users to clear platform trails, frame outlines, and frame centers that are "off" due to bad data or video resets while leaving Marks in place.
- Shortcuts have been added to context menus allowing users quicker access to key functionality.
- Copy and paste values directly from the metadata viewer
- The FMV geoprocessing tools include a 'Full Motion Video Tools.tbx' file installed with the toolset. The toolbox can be found under ArcCatalog > Toolboxes > System Toolboxes > Full Motion Video Tools.
- Right-click the clip and ship slider handles or use CTRL + E for a video export shortcut.

- Performance improvements and tools including:
 - Key frame only playback
 - Hardware Acceleration and Software Only modes for better performance allowing users to customize their FMV for their CPU/GPU configurations.
 - Linear resampling and High Resolution modes have been added allowing users to further customize their FMV performance environment.
 - Easy to use on/off video graphics controls allowing users to manually reduce the load incurred from graphics rendering. Users can turn graphics on and off from the Video Manager and from each individual video.
- Video metadata recording is supported in both file and enterprise geodatabases (Oracle, SQL Server, DB2, Informix, Netezza, PostgreSQL).
- FMV geoprocessing tools with support for metadata recording, mosaicking, and video extent extraction allow for data capture at over 25x normal play speed.
- Metadata can now be recorded at user defined rates.
- Video frames can be mosaicked at user defined rates.
- The FMV add-in projects video metadata on the fly to any projected or geographic coordinate system. Base maps can be any coordinate system.
- The Intersect tool supports interaction with feature classes in any geographic or projected coordinate system.
- Increased support for dropped or interrupted live streams, videos no longer have to be removed and re-added if a live stream is lost.
- Customizable field-of-view graphic showing the relationship between the camera and the frame outline on the map.
- Increased metadata accuracy improves calculations during video digitizing, marking, and intersecting.
- The Add Live Video Stream tool is supported by auto-complete functionality, which remembers frequently used streams.
- Improved bookmarking with a new elapsed time field and XML import and export, which allows commas in the Description field. Bookmarks can be imported or exported as CSV or XML.
- The zoom tool zooms to the extent of all open videos with a single click.
- The follow tool lets the user set, adjust, and maintain a custom map scale while following.
- Automatically follow more than one video at a time by simply selecting videos of interest and unselecting them to stop.
- Updated the player window with improved on-open scaling. The player window now opens to an optimal height and width ratio for each video.
- An improved UI with Intersecting Features and Time Query shortcuts in the Video Manager window.
- An improved video editing UI with cursors and vector and line graphics that emulate an ArcMap edit session.
- Feature Intersect can be enabled and disabled from an individual video's context menu.
- Easily sketch Map-to-Video and Video-to-Map points and save them using the new Mark Map and Video tools.
- Increased accuracy and improved graphics when digitizing polygons directly on a video.
- The accuracy of the video player clock has been greatly improved.
- Video player controls are sized proportionally when the video player window resizes.

- It is easier to resize the video player with the set initial display size, fit player to video, and fit player to display tools. The video can be resized with a single click while preserving aspect ratio and max display and video resolution.
- The Maximum Player Size calculations account for a Windows task bar.
- The Bookmark Manager shows Elapsed Time and UNIXTimeStamp making it easier to find the time and place you're looking for.
- A video's source, archive or live stream address, can be copied directly from the Video Manager dockable window to the clipboard.
- The video player window automatically resizes to fit the user-defined window size and the aspect ratio of the video. There are also tools that help the user maximize the video to best fit its recorded resolution.
- Full Motion Video Toolbar with Live Stream, Archive Play, and Video Manager tools
- Built on the easy to install, uninstall, and share Microsoft Add-in technology
- Recognizes and plays ps, ts, mpg, mpeg, mp2, mpg2, mpeg2, mp4, mpg4, mpeg4, H.264, vob, and mt2s videos
- Supports the MISB video standards <http://www.gwg.nga.mil/misb/>
- Supports [STANAG 4609](#)
 - Full DVR control set
 - Full support for live video streaming (UDP and RTSP streams over IPv4)
 - Time synced playback with time-aware layers
 - Easily create and load raster mosaics by simply playing a video
 - Image snap shot recorder for .ntf, .tif, .png, and .jpg recording
 - KLV (key-length value) parsing and Metadata recording with the ability to save platform, footprint, and target vector information to feature classes
 - KLV/metadata viewer and recorder lets the user see and record metadata streams as videos play in real-time
 - Video to Map digitizing for points, lines, and polygons using feature templates and feature classes
 - Automatic map follow and refresh capability for platform, footprint, and frame center objects
 - Video bookmarking for taking notes and saving and returning to locations within a video
 - Ability to set symbology for individual videos using the Esri symbol set, as well as, custom symbols
 - Ability to play and manage multiple videos simultaneously
 - Easily manage videos in the Video Manager dockable window
 - Videos and custom properties are saved within your .mxd's and are easily accessible for later use
 - ESD Metadata Support
 - The ESD metadata standard is fully supported along with MISB 0601.5 and MISB 0104.5.
 - Live Streams
 - Full support for live video streaming (UDP and RTSP streams over IPv4)
 - Smart Metadata Parsing
 - Users no longer have to explicitly define a single metadata standard. The application will now automatically figure out the video's standard or standards and parse them accordingly.
- Feature Scan

- Point, line, and polygon map features are shown on the video, in real-time as the video plays.
- Complex geometries, such as multi-points, multi-lines, and polygons with donut holes and islands are fully supported.
- Show Map Geometry on Video and Clear Map Geometry from Video tools: These tools let the user query all point, line, and polygon features contained within the current video frame and show them on the video with a single click.
- Display x/y on Video Tool
 - This tool lets the user click on the map and see a corresponding point show up on the video giving the user a quick look at relative accuracy and location.
- Digitizing
 - Digitized features can be added with full Esri template support.
 - Geometry can be immediately seen after sketching on the video using Feature Scan
 - Finish and delete sketch items have been added to the context menus
 - Digitized geometries can be completed by right-clicking and selecting Finish Sketch from the context menu or by double-clicking the video
- Bookmarking
 - Bookmarking is supported by a dedicated Bookmark Manager
 - Support for export and import via .csv file
 - Support for add, remove, delete, and search using the name, and description fields
 - Bookmarking is also supported by tick marks on the time-slider and a dedicated menu with individual search capabilities
 - Bookmarks can be added by using the Ctrl+B shortcut
- Drag Drop Support
 - Drag/Drop is supported within the Video Manager dockable window for easy organization of videos
 - Drag/Drop is supported from ArcCatalog and Windows Explorer for adding videos to the Video Manager
- Shortcut Buttons
 - Record, Mosaic, and Time-Sync all have single-click-to-start buttons on the Video Manager dockable window for ease of use
- Menus
 - Menus have been simplified and reorganized to support improved workflow
- Metadata Viewer
 - Accuracy and performance have been improved and items are now shown alphabetically

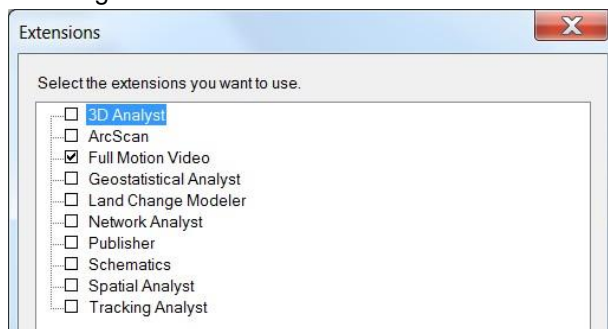
Installing the FMV Add-In

There are two ways to install the FMV Add-In. If you are updating from a previous version of FMV, you will need to uninstall it first.

Installing FMV for the first time:

Steps:

1. In the Windows file manager, navigate to the location where you downloaded the zip file package containing the Add-In.
2. Unzip the package.
3. Double-click the Add-In file, named "ESRI.ArcGIS.Video.FullMotionVideoAddin.esriAddIn".
4. Click the **Install Add-In** button to confirm the file installation of the ArcGIS Full Motion Video Add-In 1.3.1. The utility copies the Add-In file to your default ArcGIS Add-In folder.
5. Click **OK**.
6. Open ArcMap.
7. Click the **Customize** menu in ArcMap and click **Extensions**. The Full Motion Video check box should be selected. If it isn't, close and restart ArcMap to ensure that the add-in is recognized.



8. Click **Close**.
The Add-In is now ready to use.

Updating a previous version

Removing a previous version of FMV from the Add-In Manager:

Steps:

1. Open ArcMap.
2. Click **Customize > Add-In Manager**
3. Under **My Add-ins** select the previous version of Full Motion Video that needs to be removed.
4. Select **Delete this Add-in**.
The previous version of FMV will be removed
5. From the **Add-In Manager**, click **Customize**.
6. On the **Customize** dialog box click **Add From File**
7. Browse to the "ESRI.ArcGIS.Video.FullMotionVideoAddin.esriAddIn" Add-In file, click the file to select it, and click **Open**.

8. Click the Install Add-In button to confirm the file installation. The utility copies the Add-In file to your default ArcGIS Add-In folder. A list of the added objects is displayed.
9. Click **OK**.
10. On the **Toolbars** tab of the **Customize** dialog box check the ArcGIS Full Motion Video toolbar.
11. Click **Close**.

The ArcGIS Full Motion Video toolbar will appear.



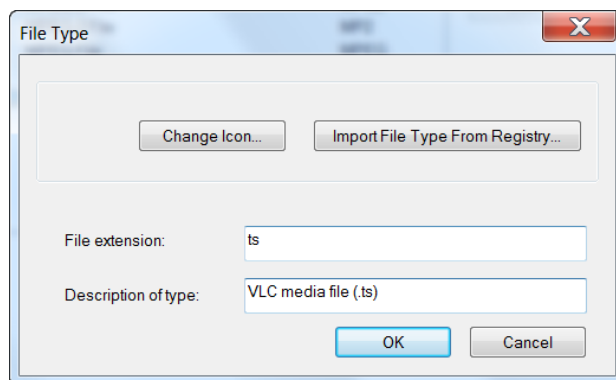
12. Click the **Customize** menu in ArcMap and click **Extensions**.
13. **ArcGIS Full Motion Video** should now be listed and checked on. If it is not, close and restart ArcMap.
14. Click **Close**.
15. Full Motion Video will now be listed under Add-Ins in the **Add-In Manager**.
16. Click **Close**.
The Add-In should be ready to use.

Add video file types in ArcCatalog

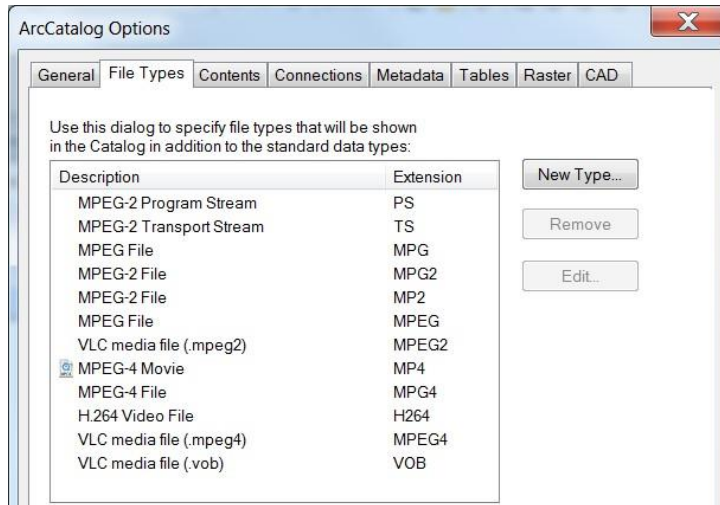
The ArcGIS Full Motion Video 1.3.1 Add-In is now ready for use. The first step is to add the recognized video file formats.

Steps:

1. Open ArcCatalog.
2. To see what video file types are currently supported open the **Customize** menu and click **ArcCatalog Options**.
3. Navigate to the **File Type** tab.
The File Types tab lists supported file types and allows the user to specify new file types that will be shown in Catalog.
4. Click the **New Type** button.
5. In the **File Type** dialog box type the file extension, as well as a description of the file type.
Note: in this example an MPEG-2 Transport Stream, which has a '.ts' file extension, is being added.



6. Click **OK**.
The file type is added and will now be visible in ArcCatalog.



7. Click the **Apply**.
8. Add any other video file types that need to be displayed in ArcMap using steps 4 - 7.

The following is a comprehensive list of the supported file types:

Description	Extension
H.264 Video File	H264
MPEG File	MPG
MPEG File	MPEG
MPEG-2 File	MP2
MPEG-2 File	MPG2
MPEG-2 File	MPEG2
MPEG-4 File	MP4
MPEG-4 File	MPG4
MPEG-4 File	MPEG4
MPEG-2 Program Stream	PS
MPEG-2 Transport Stream	TS
ESD File	VOB

9. Click **OK** to close the **ArcCatalog Options** dialog box.

Add the Full Motion Video Toolbar to ArcMap

The ArcGIS Full Motion Video 1.3 Add-In provides a toolbar for working with video files in ArcMap. If it is not visible, add the toolbar to ArcMap. To do so:

Steps:

1. In ArcMap, click **Customize**, point to **Toolbars**, and click **ArcGIS Full Motion Video** to show the toolbar.

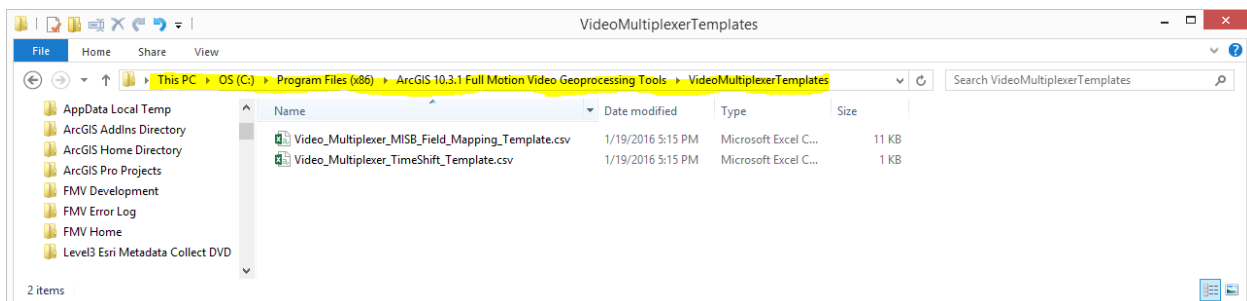
Installing the FMV geoprocessing tools

The geoprocessing tools that come with the Full Motion Video Add-In are designed to extend the utility of the FMV functionality. These tools extract or properly prepare metadata for use in the Add-In, search video archives depending on feature, time and/or location, and mosaic datasets from your videos. The tools can be used independently, in python scripts or in geoprocessing models. To install the tools:

Steps:

1. If you are updating a previous version of the FMV geoprocessing tools, you must first explicitly uninstall the previous version:
 - a. Control Panel > Programs > Programs and Features > Uninstall or change a program
 - b. Right click on ArcGIS 10.x Full Motion Video Geoprocessing Tools and select Uninstall
 - c. The program asks if you are sure you want to uninstall the program, select yes
2. Navigate to the software subfolder where FMV was installed. Here you will see a folder containing the geoprocessing tools specific to the version of ArcGIS that you requested.
3. Double click setup.exe to start the installation, and follow the steps on the wizard. The installation package now creates a toolbox on the user's behalf. The toolbox is located in ArcCatalog under **Toolboxes > System Toolboxes > Full Motion Video Tools.tbx**. The toolbox is installed to the user's install directory. For example, C:\program files (x86)\arcgis\desktop10.3\ArcToolbox\Toolboxes\Full Motion Video Tools.tbx.
4. After installation, click on the Customize tab and select Extension to ensure the Full Motion Video extension is added and checked on.
5. If the Full Motion Video extension is not visible in the list of available extensions, exit ArcMap and restart the ArcMap application. Click on the Customize tab and select Extension to ensure the Full Motion Video extension is added and checked on.

Note: The multiplexing field mapping and time shift templates are available after the Geoprocessing tools are installed. Go to your install directory and look for a folder called Video Multiplexer Templates. A typical location is C:\Program Files (x86)\ArcGIS 10.3.1 Full Motion Video Geoprocessing Tools\VideoMultiplexerTemplates. The files are titled Video_Multiplexer_MISB_Field_Mapping_Template.csv and Video_Multiplexer_TimeShift_Template.csv. ”



Using the ArcGIS Full Motion Video 1.3.1 Add-In

Overview

The FMV Add-In is comprised of 3 main functional components, the Video Manager, Video Player and Geoprocessing tools designed to extend the utility of the FMV application to accommodate common real-world operational scenarios. These functional components are integrated to work together, and result in a robust Full Motion Video experience. Each of these components are addressed in turn according to a generic workflow.

Play an archived video file

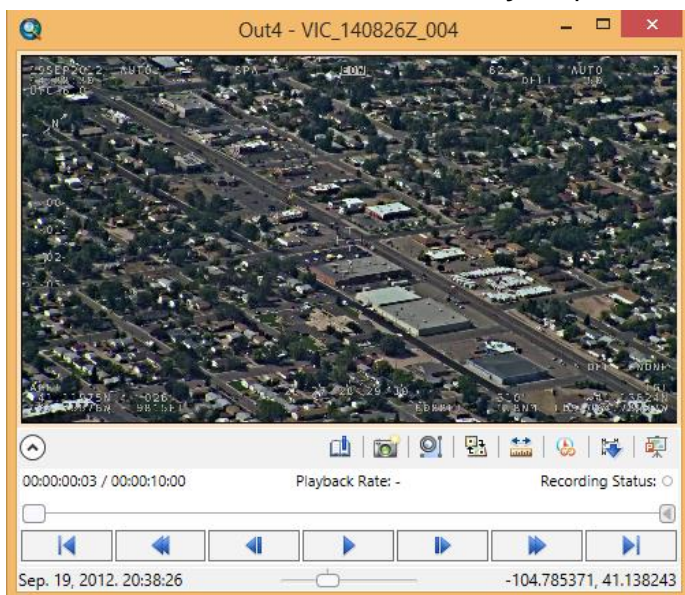
To play an archived video file, you need to know its location.

Steps:





1. From the toolbar click the **Add An Archived Video File** button.



2. Navigate to the video file, highlight it, and click **Add**.
The **ArcGIS Full Motion Video Player** opens.



The lower part of the **ArcGIS Full Motion Video Player** has buttons to control the playback of the video. The following table describes what each of the buttons on the interface do.

Button	Functionality
	Create a bookmark (Ctrl + B)
	Take a screenshot of the current frame
	Start/Stop displaying features from the map on the video
	Enable/Disable marking



Measure



Start/Stop querying time-aware layers



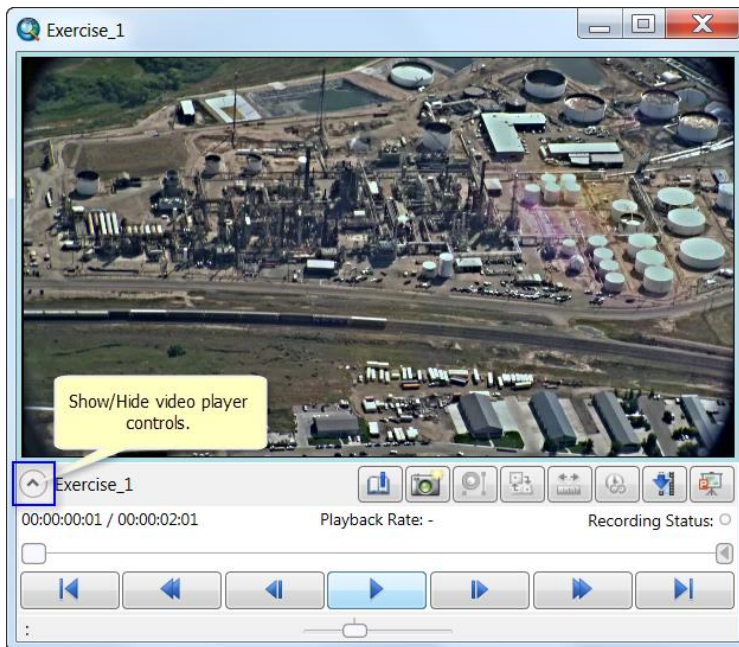
Clip the video



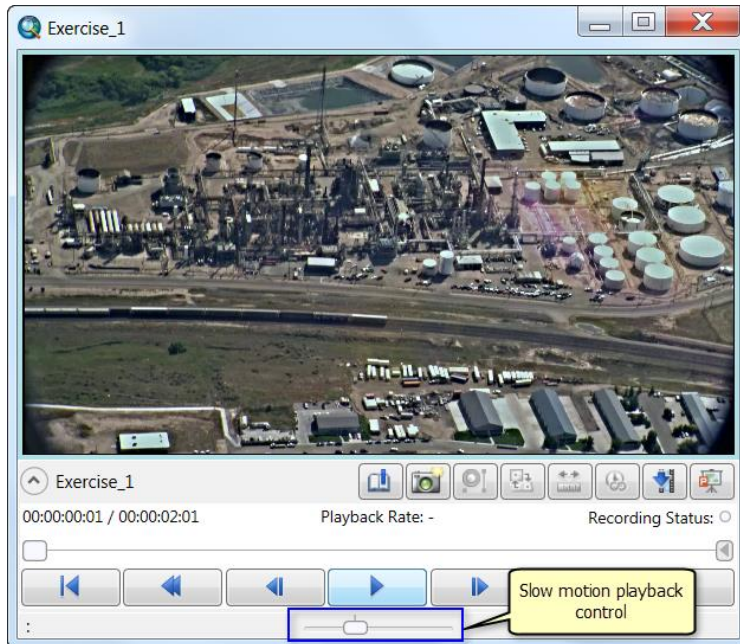
Export to Power Point

The **ArcGIS Full Motion Video Player** displays the recording status, where it is white for not recording, and red for recording.

3. Click the up arrow to hide the **ArcGIS Full Motion Video Player** buttons while viewing a video. Click the down arrow to show the buttons again.



4. To play the video at a rate less or more than normal playback, use the slow motion control at the bottom of the video player. The slow motion control allows fine-grained control over playback speed. The range of values extends from 0.00x to 3x play speed. The tick in the middle of the control is 1x speed, or normal playback speed.



Some key points about slow motion control:

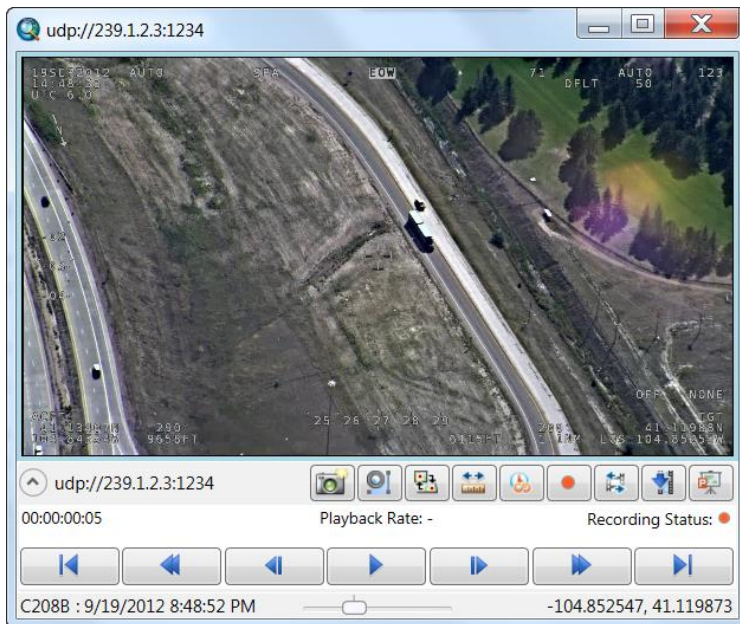
- Values below 1x can be changed in increments of 0.01 by using the left and right arrows on the keyboard.
- 0.00x is the equivalent of pause.
- Double click the slow motion slider to automatically return to a playback speed of 1x.
- The slow motion playback rate is reset to 1x whenever any of the time slider or standard DVR controls are used.
- The slow motion control can be used with live streams by clicking the **Review the previous 30 seconds of live stream** button. If you are watching a live stream, but not reviewing the previous thirty seconds then the slow motion control will have no impact.

Play a live video stream










To play a live video stream, you will need either the UDP, RTSP, or MJPG address of the video stream.

Note: The Full Motion Video player currently supports Internet Protocol version 4 (IPv4) addresses and both the User Datagram Protocol (UDP) and the Real Time Streaming Protocol (RTSP). MPEG TS streams can be broadcast as UDP unicast or multicast and can include MPEG-1, MPEG-2, and H.264 video decoding, and KLV metadata parsing. RTSP playback is supported for live RTSP streams that use any of the following video codecs: MPEG-1 Video, MPEG-2 Video, H.264, and MJPEG.

The interface when streaming a video is different that when playing an archived video.



The following table describes the functionality of each button when streaming a video.

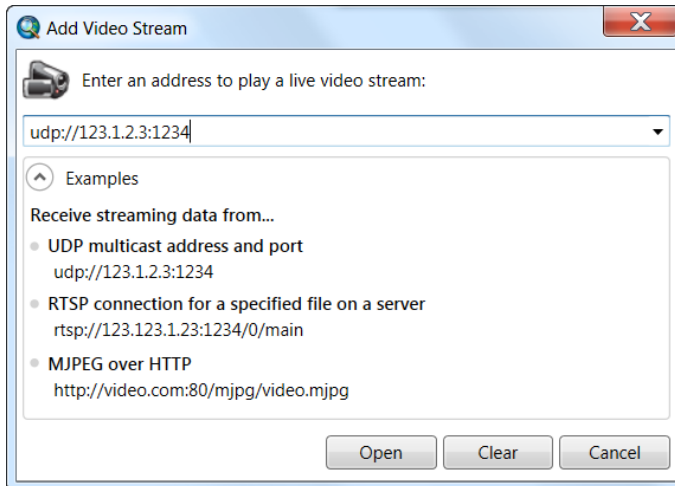
Button	Functionality
	Take a screenshot of the current frame
	Start/Stop displaying features from the map on the video
	Enable/Disable marking
	Measure
	Start/Stop querying time-aware layers
	Start/Stop recording
	Resume stream
	Export the previous 30 seconds of the stream
	Export frame to Power Point

Steps:

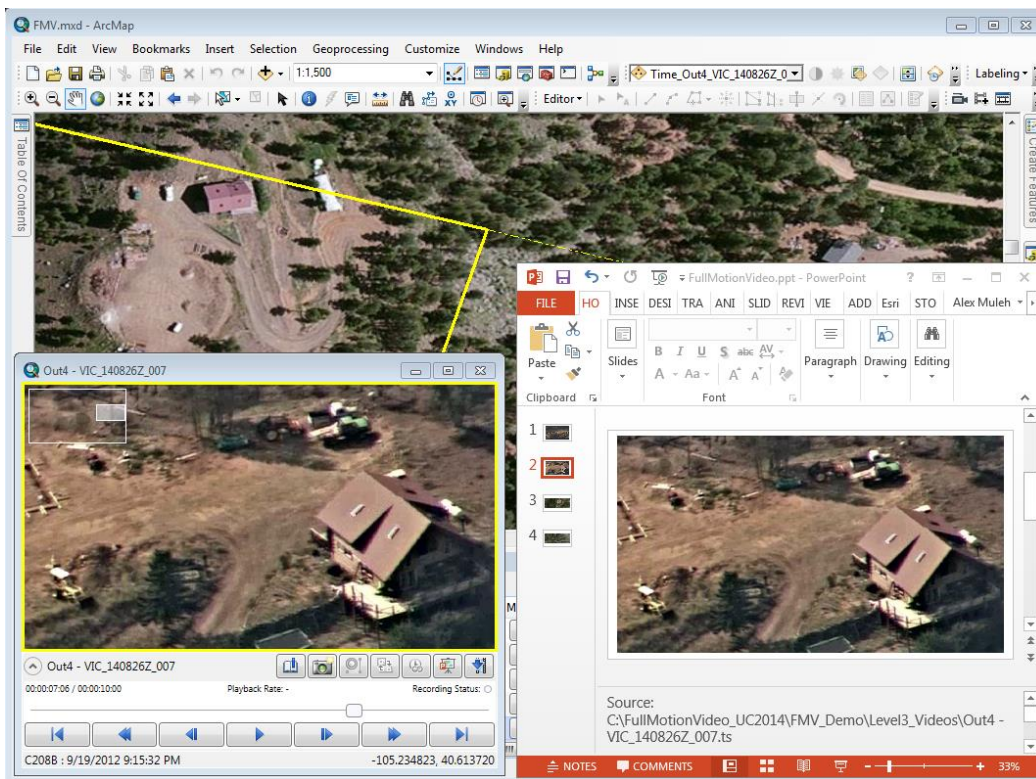
1. Click the **Add A Video Stream** button.



2. The **Add Video Stream** dialog box opens.



3. Type the address of the video stream in the dialog box.
4. Click **Open**.



Automatically Follow Videos


The follow tool allows the map extent to automatically refresh around the metadata of one or more videos. Follow can be set on a video- by-video basis or for all videos at once.

To set Follow on an individual video right-click on the video player and select **Follow**.

To set Follow for all videos, from the Video Manager **View > Follow > Follow Videos**. To stop following all videos, from the Video Manager **View > Follow > Stop Following Videos**.

Follow can be customized from the Video Manager **View > Follow**. There are three choices:

- Full Extent - automatically zooms the map into the metadata for each enabled video at a ratio of 1.2
- Full Extent Expanded - automatically zooms the map into the metadata for each enabled video at a ratio of 2.2
- Manually Set Extent - allows the user to customize the envelope around the video metadata by using ArcMap's built in zoom controls and settings

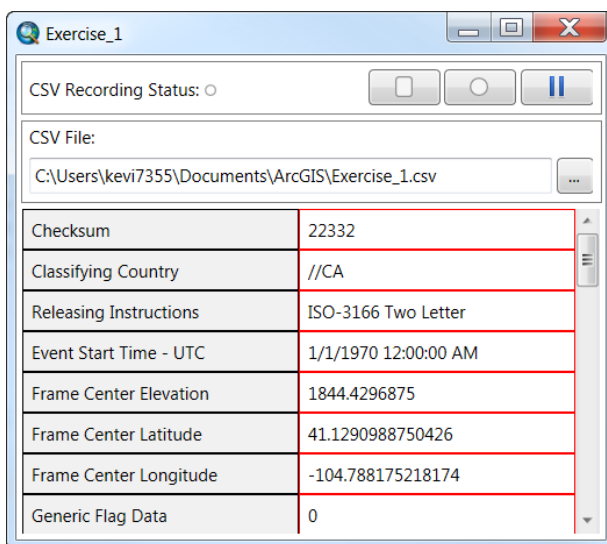
 **Note:** This can be a computationally intensive process if you have a large amount of data on your map or slower service-based layers.

Manually Resize Video Players

By default, when a video player window is resized, the player window snaps to the video's default aspect ratio. This capability is on by default and can be turned off and on by going to the Video Manager.

Recording Metadata

The **Metadata dialog box** allows you to view and record the video's metadata stream and export it as a .csv file. Open the **Metadata dialog box** by right-clicking on the video in the video player and selecting **Metadata**.



You can specify where to save the recorded metadata as a CSV file. Click the red **Record** button to start recording metadata while your video is playing. The video metadata is shown in the Metadata dialog box as the video plays.

Record and save the previous 30 seconds of a live stream


As a live stream plays it is buffered and the last 30 seconds are constantly saved to memory. Click the **Review previous 30 seconds** button to playback and review the buffer at your own pace. Once in playback mode you can review the video, take image snaps, save metadata, mosaic, and watch in slow motion. You can also save the clip to a new file by clicking the **Export the previous 30 seconds to a video clip** button. The naming convention is the current date and time the recording is started in UNIX time. For example, November 11, 2014 at 2:34:23 pm is expressed as 20141110T143423.mpg.

Clipping an archived video

Steps:

1. Grab the handle that is at the beginning of the time slider and move it to the point in the video when you want to begin the export.
2. Grab the handle at the end of the time slider and position it where you want to end the clip.
3. Click the **Export Clip** button on the **Full Motion Video Player**.
Additionally, you can right-click on one of the handles or use the Ctrl + E shortcut to export.

The portion of the video between the two handles will be saved. The naming convention is the name of the original video_start clip time_end clip time. For example, if a video called MyVideo.mpg is 10 minutes long and the clip starts at three minutes forty seven seconds (00:03:47) and ends at 00:07:42 then the name of the clip will be MyVideo_00-03-47_00-07-42.mpg.

 **Note:** To return the handles to their original position, double click on one of the handles. Alternatively, you can drag both handles to the beginning and end of the original video.

Video Search tool

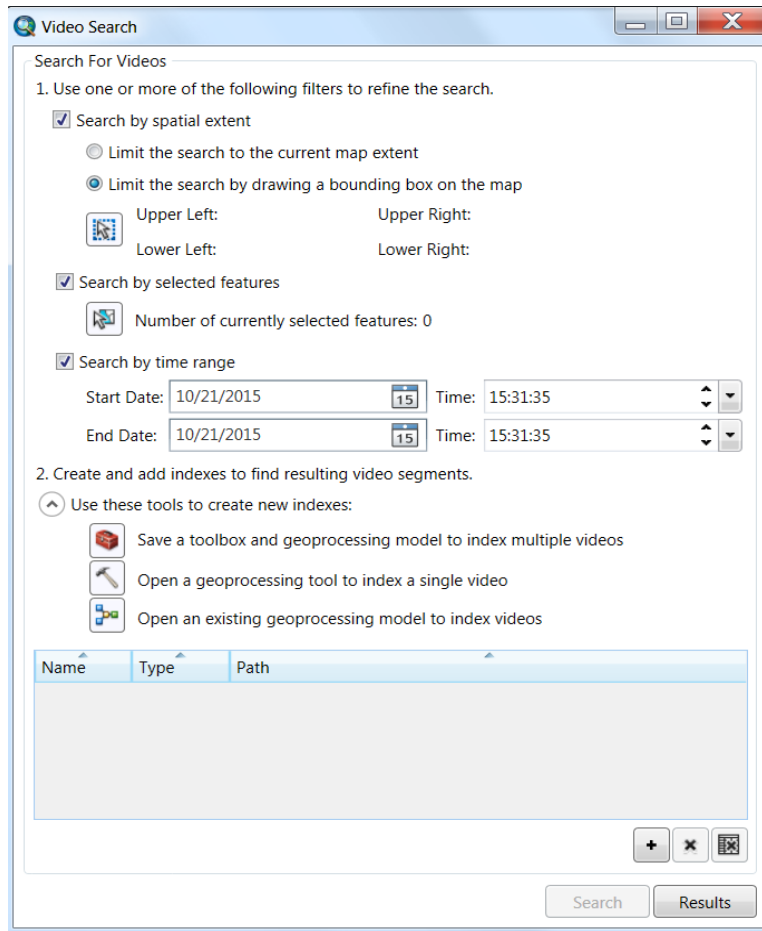
The video search tool is designed to search through a video collection and quickly identify the segments of videos that have recorded an area, time, or feature of interest. For instance, you may have identified a feature of interest and want to see which segments of all videos have recordings of that feature, or a subset of attribute fields. You can select the fields you are interested in and then use this tool to create video clips of the segments when those fields are in view. You can also create segments based on time, and a geographic coordinate.



Steps: Open the **Search Video** tool from the **Full Motion Video toolbar**, or from the **Video Manager**. This opens the Video Search dialog.
First, you need to limit the scope of your search.

Use the options in the first section to define your search terms. To limit the extent of the search, you can constrain it to only videos that have recorded what is currently displayed in the map. Alternatively, you can draw a bounding box to limit the search area.

1. If you want to identify video segments that have recorded a feature of interest, make the selection from the map, and then check on **Search by selected features**.



2. To find videos that have recorded during a specific time range, use the **Search by time range** option and input the correct starting and ending time and date. You can use any or all of these options to limit the search.

Second, you need to tell the tool which videos to search.

Steps:

1. Use the second section of the **Video Search tool** to search either one video or multiple videos. Remember that this tool is not just identifying which videos meet the search criteria; it will create clips of the video segments based on that criteria.
2. Start with saving a toolbox and geoprocessing model to index multiple videos. This will prompt you to save the toolbox to a location. Once you have done so, use the ArcCatalog pane to navigate to that toolbox. Right-click on extract metadata from multiple videos and **Edit** the model. This will open up the Model Builder view.

3. Populate the fields for the location of videos. You can navigate to the folder or drag and drop from the ArcCatalog Pane.
4. The output workspace must be a file geodatabase or an enterprise geodatabase. Save and close the model.

By creating this model, you have set up a workflow where you can easily manage the regular arrival of new videos. To use this model, you either save new videos into this folder, or you can update the folder that the model looks for.

5. To create new indexes, select Open Existing Geoprocessing Model or use the geoprocessing tool (if you are working with a singular video) and browse to the model that you want to edit. Note that indexes are created quickly. It's encouraged to create them as often as you see fit.
6. From ArcCatalog, navigate to the geodatabase where the indexes were written to. At the top of the ArcCatalog pane there is an icon for a tree structure, click on this and at the bottom of the pane you will see all of the feature classes that were indexed.

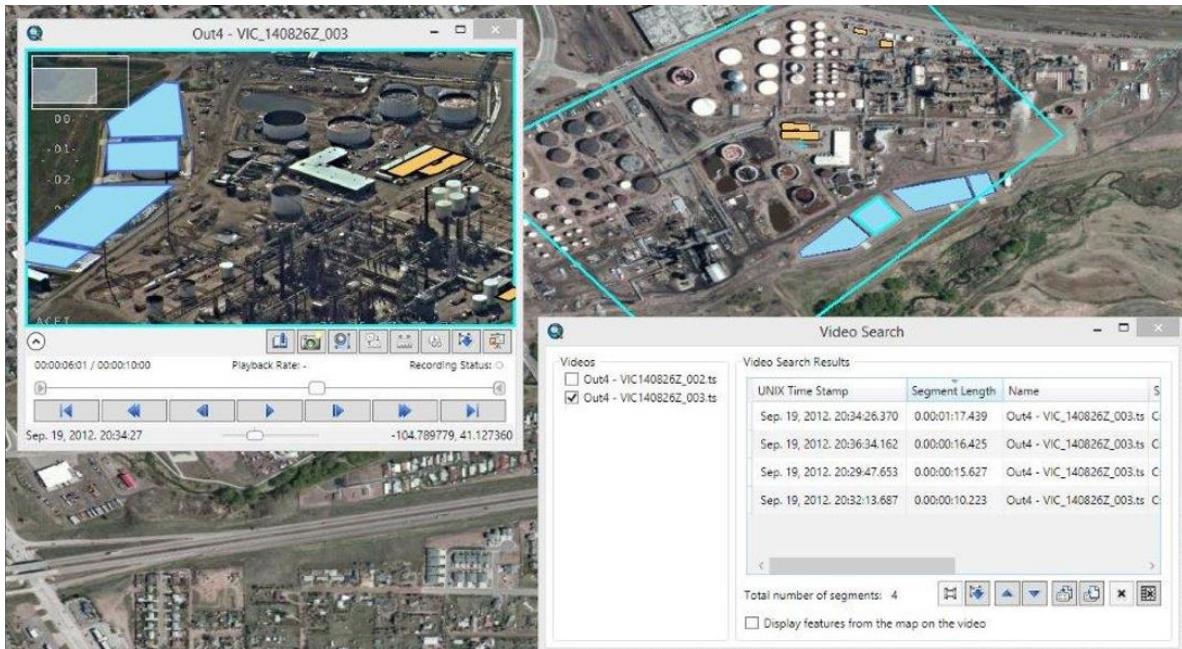


7. Create a new feature dataset, following all of the defaults, and add all of the existing feature classes into that feature dataset. Once complete, use the plus button at the bottom of the Video Search tool to add the feature dataset.
8. Click Search.

Finally, you want to view the results of your search.

Steps:

1. When the search is complete, open the Results window.
2. If you have multiple segments, it is encouraged to sort the segments by their length. Usually, the videos that spend the most time over the feature or area of interest have the best video.
3. To view a particular segment, right click on it, and select **Queue Video**. If you used a selection as part of your search, check on the **Display features from the map on the video** box. The videos will play with the selected feature highlighted.
4. You can save the results of your search as an .xml file. This is useful when working with colleagues and all videos are stored in a shared location.



Marking and digitizing features

The **Mark Map and Video** button lets you click a point on the map within the video footprint, and see where that point is on the video. It also lets you click a point on the video and see where that point is on the map. The point that is created is temporary. To save points, right click on the video and select **Save Marks**. Marks are useful for determining relative accuracy. When enabled, you can mark points directly from the video window or from the map document.

Steps:

To mark point features directly from the map or video:

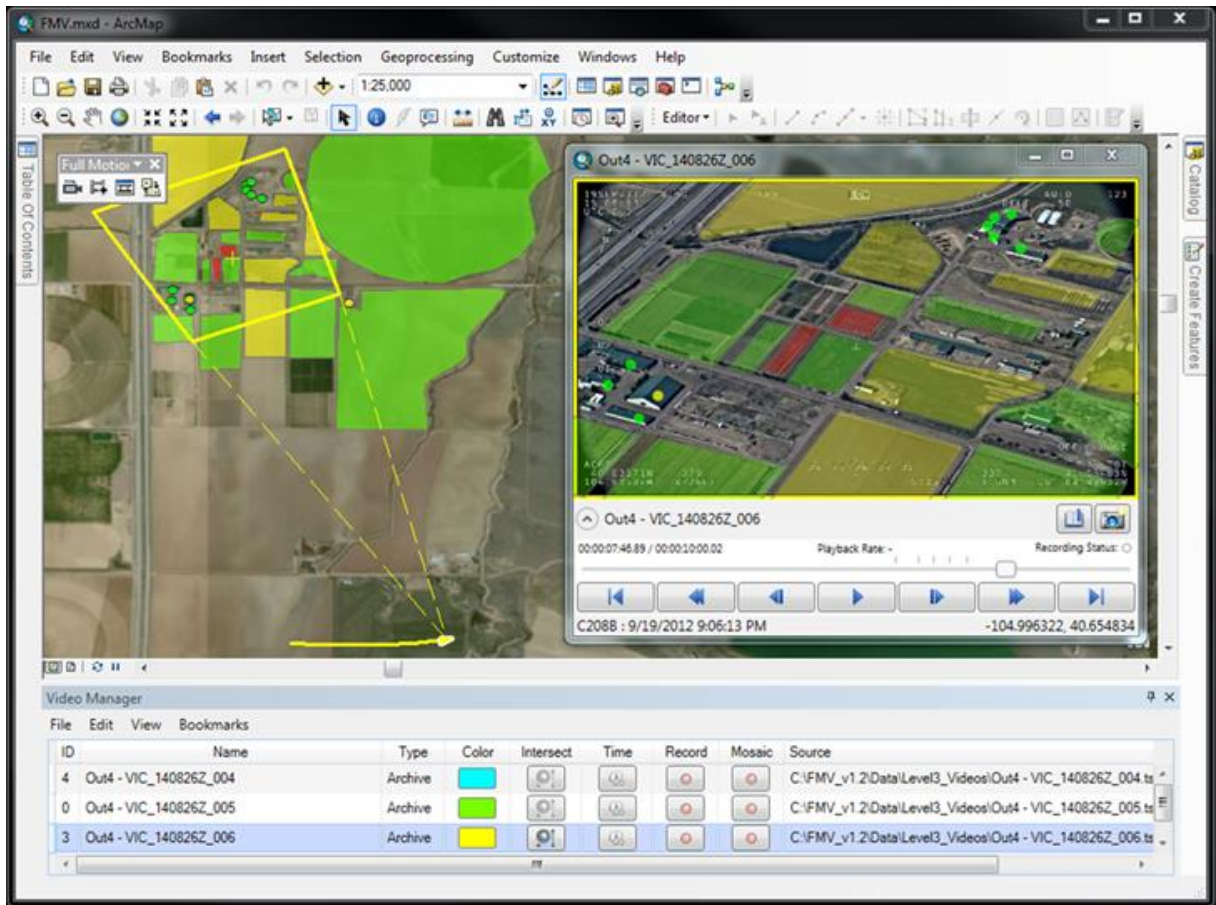
1. Click the **Mark Map and Video** button to start using the tool.



2. Click once on the map and a corresponding point will appear on the video. You can click on the map again to see additional points on the video. If you have several videos, the tool will detect each video's footprint and add points to each video for which the point falls within the video footprint.
 - a. Once you've completed using the tool, you can save the points as a feature class.
3. Right-click on the video and click **Save Marks**.
4. To clear the graphics from a selected video, right-click the video and click **Remove Marks and Graphics**.
5. To clear the graphics from all of the videos, select **Remove Marks and Graphics** from the **Edit** menu in the **Full Motion Video Manager**

Digitizing features is a more robust workflow that integrates seamlessly with the ArcGIS editing tools and feature templates. Whereas marking allows you to create points, digitizing allows you to create

points, lines, and polygons. When you digitize features you can add values to the attribute table of the features.



Features digitized in the video are displayed on the map, and features displayed and digitized in the map are displayed on the video in a seamless bi-directional manner.

To digitize point, line, polyline or polygon features, you will need to open an editing session. Learn more about [editing features](#).

Make measurements from video

Measure distances as well as the perimeters of features with this tool directly from the video. At this time, measuring areas is not supported. To make a measurement from the video:

Steps:

1. Start playing the video and pause it when the feature perimeter or distance you want to measure is on the screen.
Accuracy will be improved if the sensor is looking directly down at the feature and if you have incorporated an elevation dataset.
2. Click the measure button.
3. Click once at the point where you want to begin the measurement from. Click again at the second point.

- To measure a perimeter, click on the corners of the feature until you get to the original point. Double click to finalize the measurement.

Export to PowerPoint

Video content, such as the current frame, current video player extent (zoom/pan), full extent of the frame outline, and full extent of the frame center, frame outline, and platform, can be exported to PowerPoint.

New PowerPoint slides are first created in any open and active PowerPoint presentation by default. If there are no open presentations, a new presentation is created using the default directory and filename. This allows you to push data to any active presentation by first clicking on the PowerPoint to make it active and then clicking on the **Create PowerPoint slide from the current video frame** button. By default, a slide is created showing the current frame without pan and zoom. To add additional slides to the PowerPoint, go to **Video Manager > Customize > PowerPoint Presentations** and include the **Current video player extent**, **Full extent of the frame outline**, or **Full extent of the frame center, frame outline, and platform**.

Metadata pertaining to the video clip is also exported to the PowerPoint presentation. This includes the source video name and file location, UNIX time stamp, Platform latitude and longitude, Frame Center, and Frame Corner location in latitude/longitude.

Manage Videos

The **ArcGIS Full Motion Video Manager** window lets you set properties and control the videos in your map.

Steps:

- Click the **ArcGIS Full Motion Video Manager** button.



The **ArcGIS Full Motion Video Manager** opens.

Video Manager						
File Edit View Bookmarks Search Customize						
ID	Name	Type	Color	Metadata	Mosaic	Source
0	Exercise_1	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
1	Exercise_2	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
2	Exercise_3	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
3	Additional_Video_1	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
4	Additional_Video_2	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi

Using the ArcGIS Full Motion Video Manager Menus

Video Manager						
File Edit View Bookmarks Search Customize						
ID	Name	Type	Color	Metadata	Mosaic	Source
0	Exercise_1	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
1	Exercise_2	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
2	Exercise_3	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
3	Additional_Video_1	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi
4	Additional_Video_2	Archive		<input type="checkbox"/>	<input type="checkbox"/>	C:\Users\kevi

You can drag and drop videos from ArcCatalog and Windows Explorer onto the Full Motion Video Manager. The **File** menu allows you to stream, add, and remove videos from the video manager.

The **Edit** menu lets you remove all marks from the map and each video.

The **View** menu lets you zoom to the extent of all videos, follow what the video is recording on the map, control graphics, enable key frames, and set the refresh rate.

The **Bookmarks** menu provides quick access to any frames in any of the videos that you have bookmarked.

The **Search** menu allows you to search for videos based on location, time, and intersection with selected features. You can also import search criteria.

The **Customize** menu lets you add an elevation model to enhance positional accuracy. Additionally, you can resize the video player, set the properties for exporting to Power Point, and you can reset the time extent for ArcMap to its default. From this menu, you can set the units of measurement to metric or imperial.

Note: The options on the **Edit**, **View**, and **Customize** menus apply to all videos.

Note: Set the following options to increase performance.

- Stop following videos. **View > Follow > Stop Following Videos**

Hide graphics. **View > Graphics > Hide Graphics**. This hides video frame footprints, ground track and other graphical information associated with the video.

Try both **Software rendering** and **Hardware acceleration** to see which works best for your system. **View > Graphics > Software rendering/Hardware acceleration**

- Use linear resampling. **View > Graphics > Linear resampling**
- Use key frames only **View > Key frames > Enable key frames**

Accessing the Property Pages

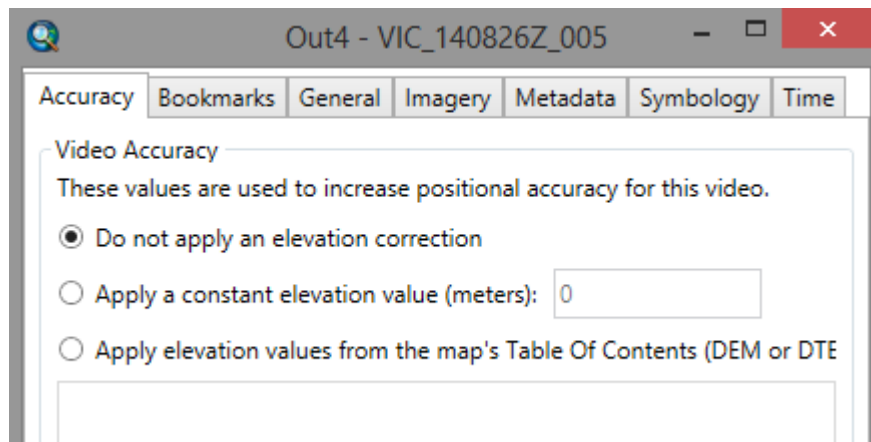
To view and configure the properties associated with an individual video, use the property pages. The capabilities of each page are described in the following section.

Steps:

1. From the manager, right click on a video and select Properties from the context menu to launch the **Properties** dialog box.
The **Properties** dialog box opens.

Accuracy Tab

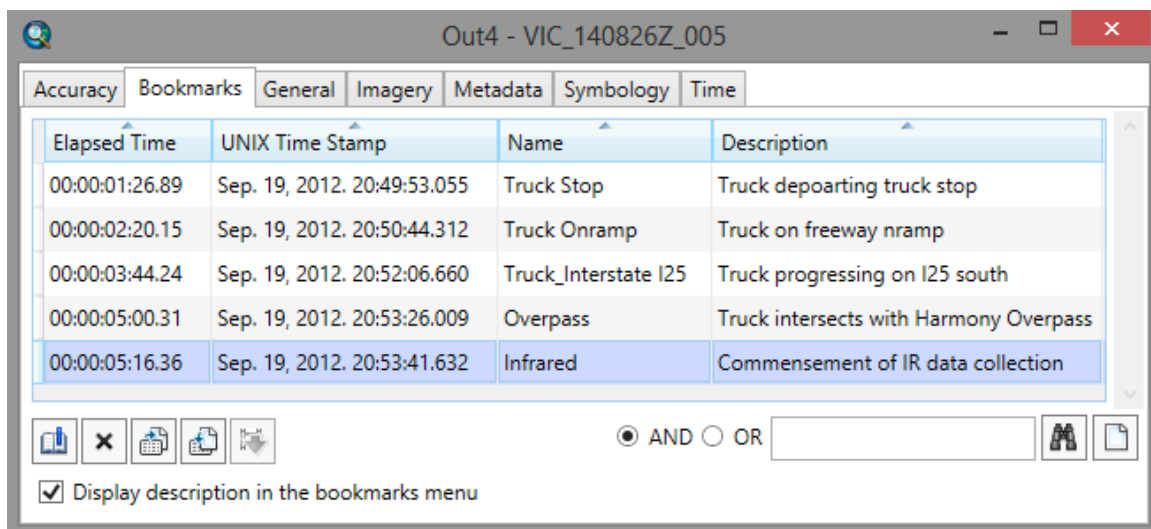
Use the **Accuracy** tab to enhance to positional accuracy of features and graphics on both the video and map using an elevation model. The increased accuracy applies to video digitizing, video marking, and displaying features from the map on the video. The dataset must be a single band elevation dataset, such as the Esri elevation image service.



Bookmarks Tab

The **Bookmarks** tab shows all of the bookmarks that you have created for this video and allows you to manage them. The menu is empty until you add a bookmark to capture a specific time within the video. Check the **Display description in the bookmark menu** box to show or hide long descriptions in the bookmark menu. Use the **Import bookmarks** button to import bookmarks from a .csv file or from an .xml file. To clip part of a video using bookmarks, select the bookmarks that represent the beginning and end points and click the







Select two bookmarks to export a video clip button.



Note: You can add a bookmark from the bookmark button in the video player window, from the button in the Bookmarks properties dialog box, and by using

the Ctrl + B shortcut when the video properties window is in focus. Bookmarks are indicated by tick marks on the time-slider of the video player.

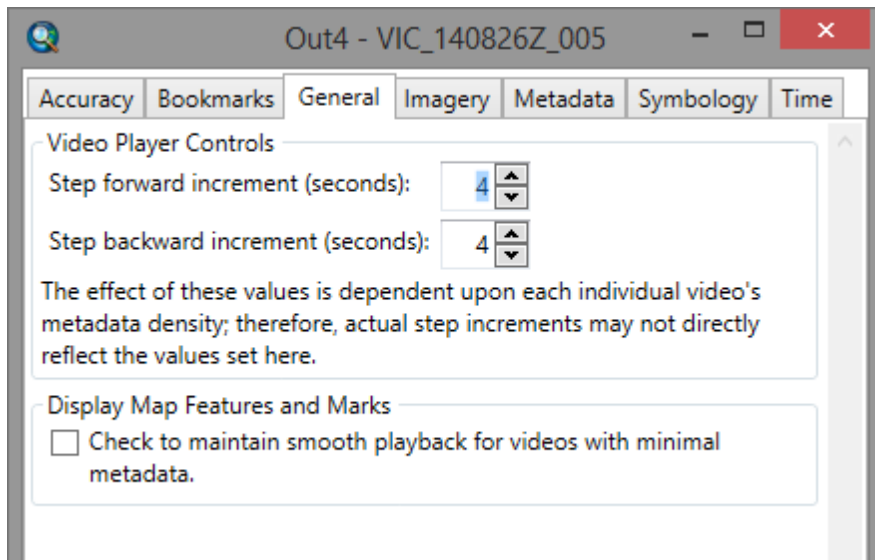
The following table describes the functionality of the buttons on the **Bookmarks** property page.

Button	Functionality
	Create new bookmark
	Delete bookmark
	Export bookmarks
	Import bookmarks
	Clip using bookmarks
	Search

General Tab

The **General** tab gives you options for adjusting the duration of each step forward and backward increment. The effect of these values is dependent upon each individual video's metadata density; therefore actual step increments may not directly reflect the values set in the increment controls.

When displaying map features and marks, check the box "Check to maintain smooth playback for videos with minimal metadata".

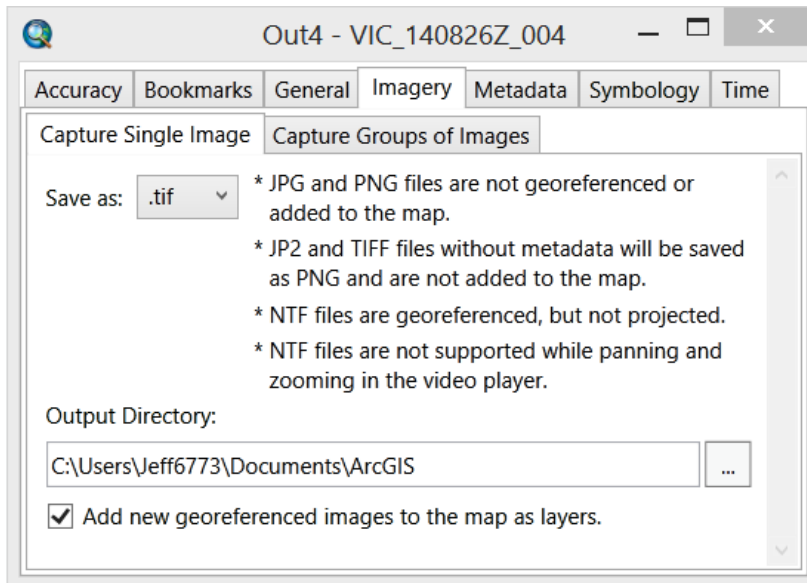


Imagery Tab

The Imagery tab is where you set the properties of video frame images saved to disk. There are two sub tabs for setting properties of the 2 modes of capturing imagery; either as single frames or as groups of images. Each mode has specific property setting options for capturing video frames.

Capture Single Images

The Capture Single Images is invoked when the camera icon button is pressed on the video player. The camera button captures single digital video frames to disk, either when the video is in the pause state, or during video playing an archived video or a live stream video. Several popular image formats are included, and georeferencing information is included for formats that inherently handle it. For example .tif and .JP2 support georeferencing data while .png and .jpg do not.



Images may be saved in any of the supported image formats including:

Supported Image file formats	Notes
.tif	<ul style="list-style-type: none"> TIFF files without metadata will be saved as PNG and are not added to the map
.jp2	<ul style="list-style-type: none"> JP2 files without metadata will be saved as PNG and are not added to the map
.jpg	<ul style="list-style-type: none"> JPG files are not georeferenced or added to the map.
.ntf	<ul style="list-style-type: none"> NTF files are georeferenced, but not map projected NTF file format is not supported while panning and zooming in the video player. The video player must be in Pause mode to capture NTF files.
.png	<ul style="list-style-type: none"> PNG files are not georeferenced or added to the map.

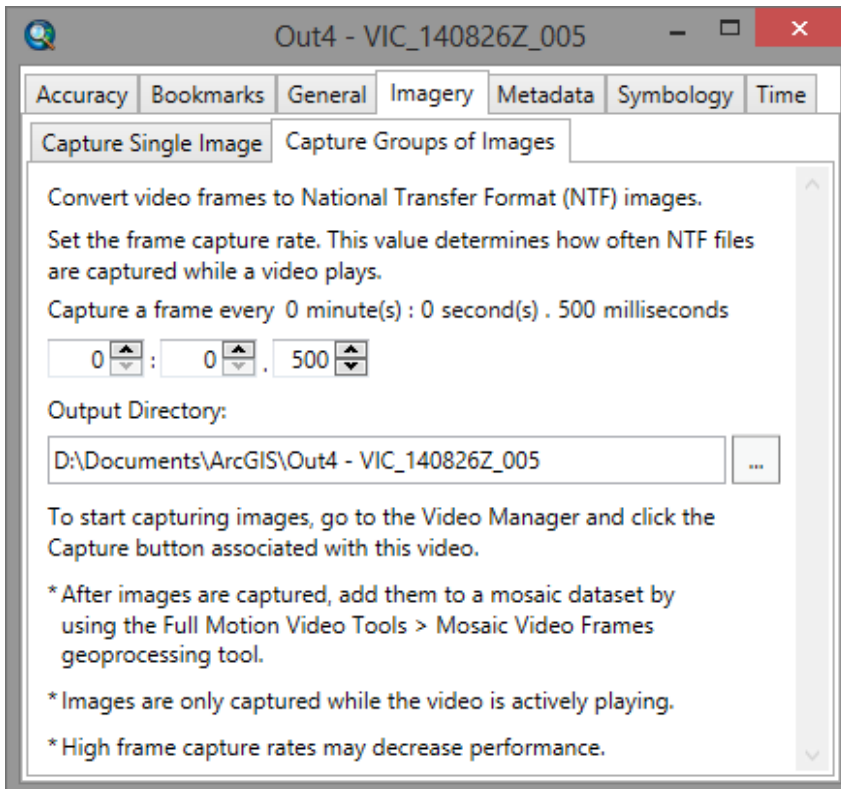
Output Directory:

Specify the directory for the captured images to be saved to disk. The default directory is D:\Documents\ArcGIS

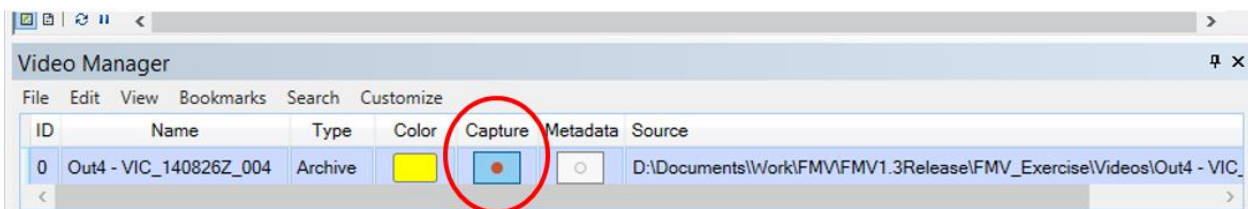
Captured georeferenced imagery may be added to the map as they are saved to disk by checking the checkbox.

Capture Groups of Images

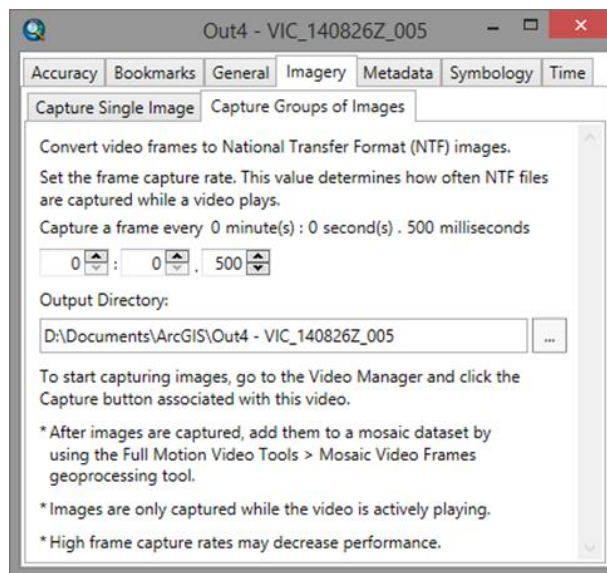
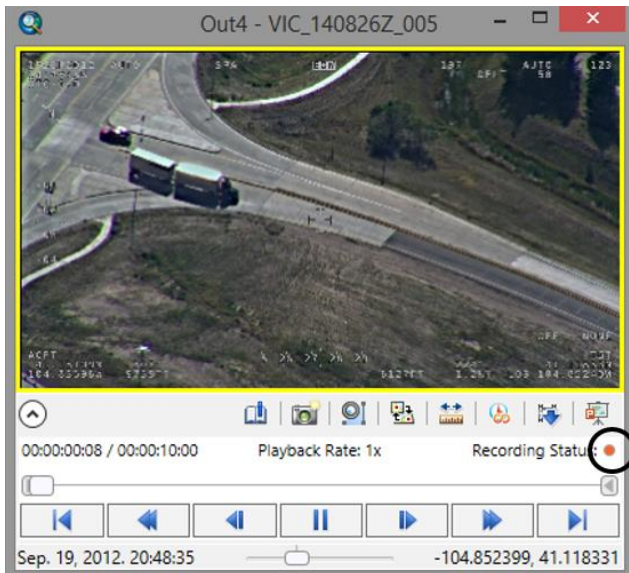
Capturing groups of images is the workflow where multiple video frames are captured at a specified interval as the video player is playing an archived or live streaming video. These groups of images usually have good overlap and are conducive to generating mosaic datasets via integrated geoprocessing tools. Since these collections of images are georeferenced and can be saved in standard formats they can also be easily imported into other image processing environments such as orthorectification and exploitation applications.



To start capturing digital video frames to disk, go to the Video Manager and click the Capture button associated with the video. The video may be a live streaming of archived video. Video frames are only captured while the video is playing. Capture stops when the video player is in pause or stop modes, or the capture button on the Video Manager is deselected with a click.



When video frame capture is turned on in the Video Manager, the Recording Status in the Video Player is turned to red (i.e., active, see below).



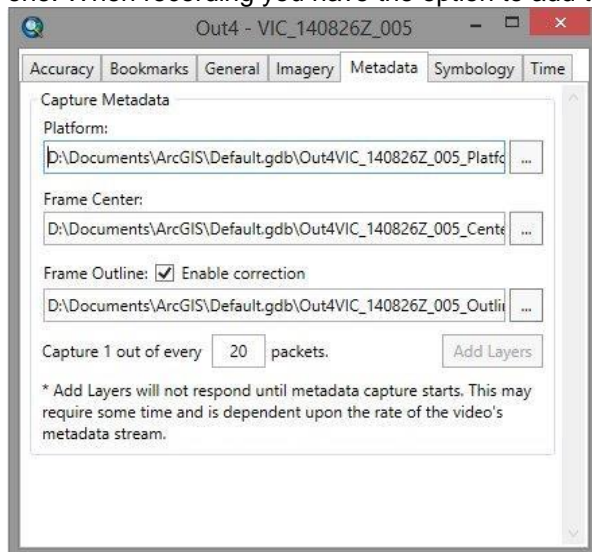
The group of video frames are captured in the NTF format and saved to the specified directory. The first step is to set the video frame capture rate. This value determines how often NTF files are captured while a video plays. For example, if your video is recorded at 30 frames per second and you specify a capture rate of .500 milliseconds, 2 video frames per second will be captured to disk. High capture rates resulting in large numbers of digital video frames saved to disk may decrease performance of the video player playback.

The output directory of the collection of video frames is specified via the output file browser. If no directory is specified, the default capture directory is D:\Documents\ArcGIS\Input_Video_File_Name

After video frames are captured, you can add them to a mosaic dataset straightforwardly by using the Full Motion Video Tools > Mosaic Video Frames geoprocessing Tool. The mosaic dataset workflow is addressed in the section following this Property Page section.

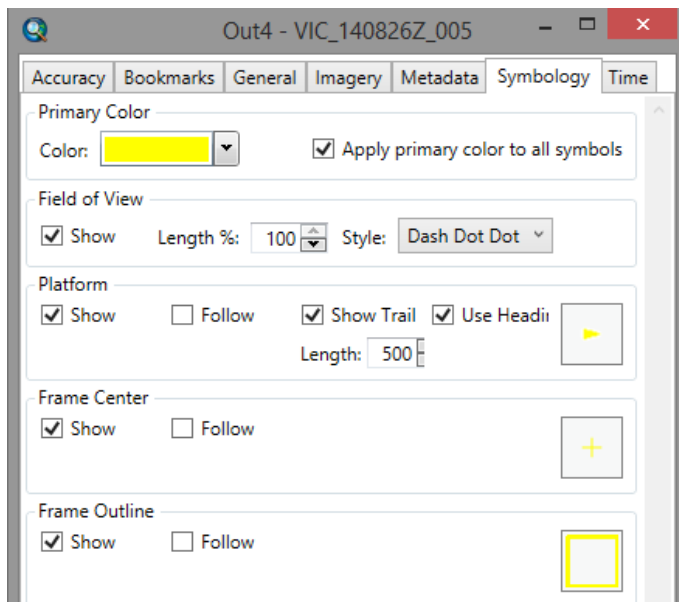
Metadata Tab

The **Metadata** tab controls where you save the platform, frame center and frame outline when recording metadata. You can either use the default feature classes, select an existing feature class or create a new one. When recording you have the option to add the layers to the map as they are captured.



Symbology Tab

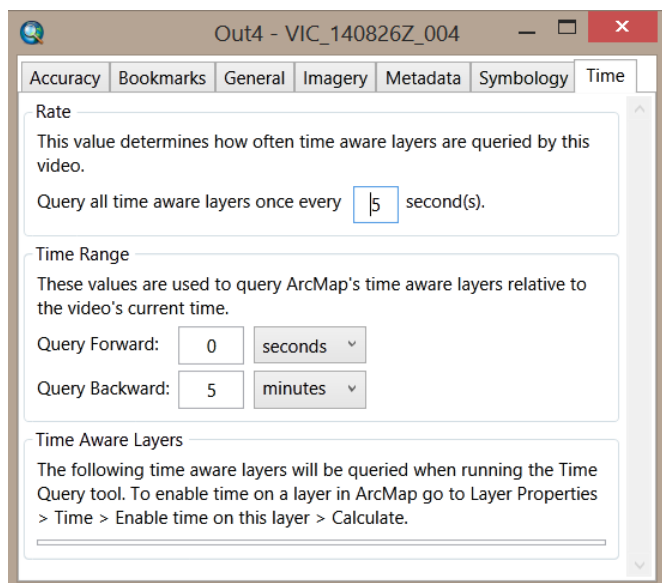
The **Symbology** tab allows you to change the symbol color and style for the field of view, platform, frame center, and frame outline. You can add a trail following the platform, and you can set its length. You can check boxes here to make the map automatically pan to follow the platform, the center of the video frame, or the outline of the video frame. The follow capability is also available by right-clicking on the video in the video player and clicking **Follow**



Time Tab

The Time tab lets you determine how often to query time-aware layers. Use the Query Forward and Query Backward options to create a time window before and after each frame. This is useful if you want to see if features occupy the current video frame at a given time.

Note: For each time-aware layer that will be queried, it is important to enable time.



Steps:

1. From the ArcMap table of contents, right-click on a time-aware layer to open the Properties dialog.
2. Click the **Time** tab.
3. Check **Enable time on this layer**
4. Click the **Calculate** button to create a valid time step interval.

In the video manager, the **Time Query** button allows you to query time-aware layers.

Note: Time querying may require significant resources depending on the number of time-aware layers and features. After running a single time query, ArcMap will be left in a queried state. At this point it may be necessary to use the **Reset Time Extent** button on the **Customize** menu of the Video Manager to view the full time extent of all of the layers in ArcMap.

Workflow to create a mosaic dataset from video frames

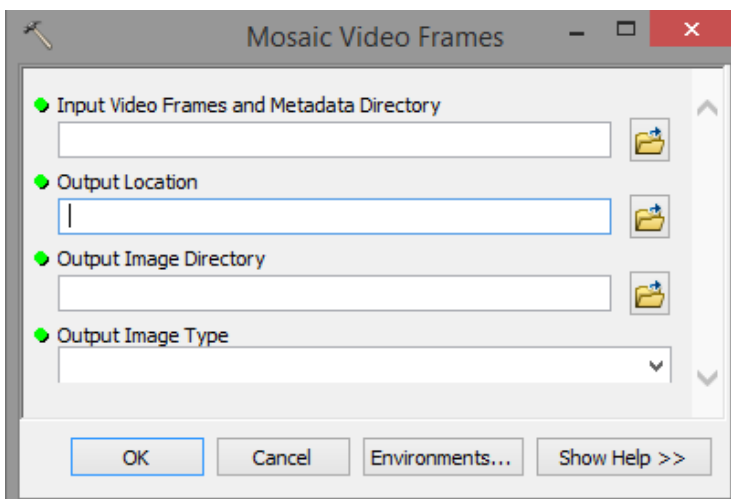
The video frame image mosaicking workflow in this FMV 1.3.1 Add-In release is different than previous FMV Add-In releases. This new workflow accommodates the newly supported file formats such as .tif and jp2, and thus supports more flexible and robust workflows and easy integration with different applications.

Two different workflows are supported for processing video frames into a mosaic dataset. The first workflow is interactive while the second method is a “batch mode” workflow. The interactive workflow is addressed first.

Interactive Mosaic Dataset

Interactively mosaicking digital video frames is a two-step process. The first step is to capture groups of video frames in .ntf format to an output directory described above in the Imagery Tab of the Property Page section. When viewing a video, a user decides to generate a mosaic dataset of a segment of the video as it plays in the Video Player. The video frames are stored in an output directory staged for creating the mosaic in the second step. The next step is to create the image mosaic dataset using the Mosaic Video Frames geoprocessing Tool.

In the second step, the Mosaic Video Frames geoprocessing tool is used to mosaic the captured video images staged in the output directory in .ntf format. Video Frames geoprocessing Tool is designed to easily



mosaic the captured video frames into a mosaic dataset. When completed, the tool will automatically build footprints, boundaries, and overviews for the mosaic dataset.

The geoprocessing tool for creating the mosaic dataset is simple and robust. There are four required input to the Mosaic Video Frames tool as follows:

Input Video frames and Metadata Directory - this is typically the directory specified when capturing video frames, specified in the video's Property Pages, Imagery Tab > Mosaic Groups of Images. Of course it can be changed as long as the directory contains all the video frames and associated metadata.

Output Location – the name and location for saving the created Mosaic Dataset. This must be a Geodatabase (.gdb).

Output image Directory – The video frames are originally stored in native .ntf format. Video frames stored as .ntf are georeferenced, but not warped to a map projection. In order to create a mosaic using video frame images in a map projection, they must be converted to .tif or .jp2 format using the georeferencing metadata contained in the .ntf files. This conversion is done automatically; thus simply specify the output directory where the map projected .tif or jp2 files are to be stored.

Output Image Type – specify your choice of two types of image formats; .tif or jp2.

Click on the OK button to create the mosaic dataset and write it to disk. The Mosaic Video Frames geoprocessing tool automatically creates the mosaic and associated statistics, and builds footprints, boundaries, and overviews for the mosaic dataset. Load the mosaic dataset into ArcMap.

The screenshot displays the ArcMap interface. On the left, the Table of Contents shows a project folder containing a geodatabase with several layers: 'Output_Images', 'Boundary', 'Footprint', and 'Image'. The 'Image' layer is expanded to show 'RGB' with three sub-layers: 'Red: Band_3', 'Green: Band_2', and 'Blue: Band_1'. The central map view shows a road scene with a green footprint overlay. On the right, the Properties window for 'Output_Images : 2' is open, showing the following information:

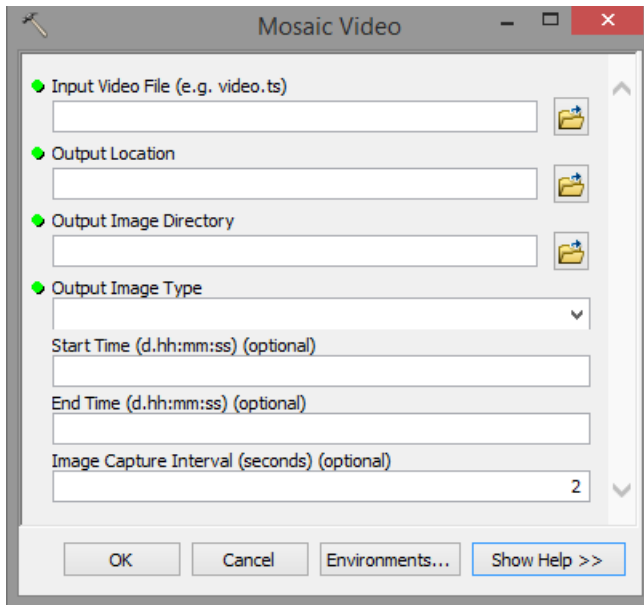
Property	Value
Raster Information	
Columns and Rows	1920, 1080
Number of Bands	3
Cell Size (X, Y)	1.1215952e-006, 1.2618028e-006
Uncompressed Size	5.93 MB
Pixel Type	unsigned integer
Pixel Depth	8 Bit
NoData Value	255
Extent	
Top	41.1175518036
Left	-104.854062
Right	-104.852979502
Bottom	41.1161890566
Spatial Reference	
Linear Unit	GCS_WGS_1984
Angular Unit	Degree (0.017453292519943295)
Datum	D_WGS_1984
Statistics	

Below the map, a table titled 'Output_Images\Footprint' is displayed, showing the following columns: OBJECTID, Raster, Name, MinPS, MaxPS, LowPS, HighPS, Category, Tag, GroupName, ProductName, CenterX, CenterY, and ZOrder. The table contains 18 rows of data, with the first row selected.

OBJECTID	Raster	Name	MinPS	MaxPS	LowPS	HighPS	Category	Tag	GroupName	ProductName	CenterX	CenterY	ZOrder
1	<Raster>	09_19_2012_20_48.06.90	0	0.000011	0.000001	0.000001	Primary	Dataset			-104.854092	41.116875	<Null>
2	<Raster>	09_19_2012_20_48.07.52	0	0.000011	0.000001	0.000001	Primary	Dataset			-104.854062	41.116884	<Null>
3	<Raster>	09_19_2012_20_48.08.14	0	0.000011	0.000001	0.000001	Primary	Dataset			-104.854007	41.116898	<Null>
4	<Raster>	09_19_2012_20_48.08.74	0	0.000011	0.000001	0.000001	Primary	Dataset			-104.853932	41.116913	<Null>
5	<Raster>	09_19_2012_20_48.09.36	0	0.000011	0.000001	0.000001	Primary	Dataset			-104.853884	41.11693	<Null>
6	<Raster>	09_19_2012_20_48.10.00	0	0.000011	0.000001	0.000001	Primary	Dataset			-104.853849	41.116941	<Null>
7	<Raster>	09_19_2012_20_48.10.64	0	0.000012	0.000001	0.000001	Primary	Dataset			-104.853818	41.116955	<Null>
8	<Raster>	09_19_2012_20_48.11.27	0	0.000012	0.000001	0.000001	Primary	Dataset			-104.853769	41.116967	<Null>
9	<Raster>	09_19_2012_20_48.11.89	0	0.000012	0.000001	0.000001	Primary	Dataset			-104.853735	41.116979	<Null>
10	<Raster>	09_19_2012_20_48.12.51	0	0.000012	0.000001	0.000001	Primary	Dataset			-104.853695	41.116994	<Null>

The graphic above illustrates the mosaic dataset created from the captured video frames and loaded into the ArcMap display. In the Table of Contents shows the mosaic dataset including the .gdb, the boundary, footprints and imagery contained in the mosaic dataset. The attribute table of the mosaic dataset is displayed along with the property page of an individual video frame image in the mosaic; item 2 of the mosaic dataset in this example. Please refer to the [Desktop help](#).

The mosaic dataset is created according to the tool's parameter settings as follows.



Input Video File – The video must be one of the supported video file types; i.e., .ps, .ts, .mpg, .mpeg, .mp2, .mpg2, .mpeg2, .mp4, .mpg4, .mpeg4, .h264, .vob, or .mt2s.

Output Location - The geodatabase where the mosaic dataset will be saved.

Output Image Directory - The directory where the map projected image files used in the mosaic dataset will be saved.

Output Image Type – choose .tif or jp2 image format. The images in the specified format will be written to the Output Image Directory described above.

Start Time - This optional value sets the recording start time from the beginning of the video. The input format is d.hh:mm:ss and the default start time is 0.00:00:00. This parameter allows you to specify the desired segment of video data from the whole video file.

End Time – This optional value sets the recording end time. The input format is d.hh:mm:ss. If left unset, the value will default to the end of the video. This parameter allows you to specify the desired segment of video data taken from the whole video file

Image Capture Interval – This optional parameter sets the rate of image capture from the video. A value of 1 means that an image will be captured once every second. If left unset, the value will default to an interval of one video frame captured every two seconds. The minimum capture interval is 0.1 seconds

Click OK to create the mosaic dataset containing the specified video frames. Load the mosaic dataset specified in the “Output Location” above.

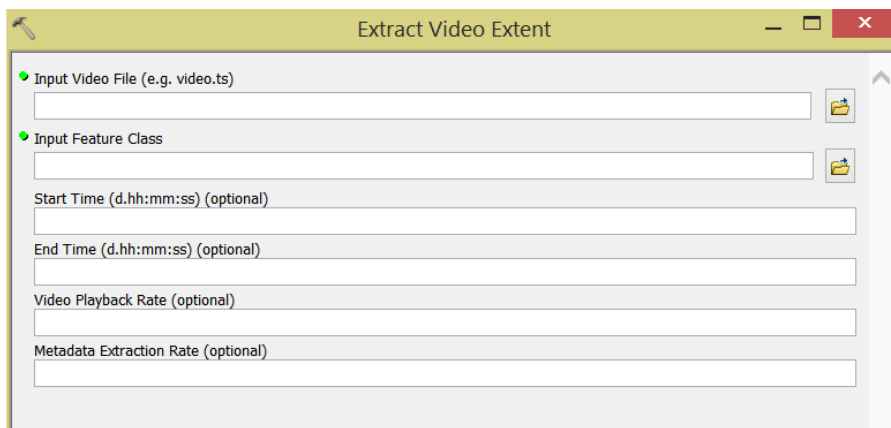
After the mosaic dataset is created, it is highly recommended that the user generates statistics of the mosaic dataset, then builds footprints of the video frame images and generates overviews, in that order. For more information about the mosaic dataset workflow, please refer to the [Desktop help](#).

Using the FMV Geoprocessing Tools

There are five tools that come with the Full Motion Video add-in: Extract Video Extent, Extract Metadata from Video, Mosaic Video, Mosaic Video Frames and Video Multiplexer. These tools enable you to manage and prepare your video data for use in the video player and manager. The “Mosaic Video” and Mosaic Video Frame” geoprocessing tools were previously described in the Mosaic Workflow section of this document. The remaining three tools are summarized below. The video multiplexer geoprocessing tool is described in more detail because it enables you to format your video data into MISB-compliant data that can be fully exploited in the FMV Add-In.

Extract Video Extent Geoprocessing Tool

Use this tool to extract the spatial extent and related attributes from a video which can be displayed on a map.



Input Video File (e.g. video.ts)

The video must be one of the supported file types: .ps, .ts, .mpg, .mpeg, .mp2, .mpg2, .mpeg2, .mp4, .mpg4, .mpeg4, .h264, .vob, or .mt2s.

Input Feature Class

Select an existing polygon feature class to record the spatial extent from the video. This feature class must have a WGS84 Geographic map projection.

Start Time (d.hh:mm:ss) (optional)

This value sets the recording start time from the beginning of the video. The input format is d.hh:mm:ss and the default start time is 0.00:00:00. Metadata time stamps are not used in this field.

End Time (d.hh:mm:ss) (optional)

This value sets the recording end time. The input format is d.hh:mm:ss. If left unset, the value will default to the end of the video. Metadata time stamps are not used in this field.

Video Playback Rate (optional)

This value represents the playback rate of the video during extraction. A value of 1 is normal playback speed, 2 is equal to 2x normal speed, and 10 is equal to 10x normal speed. Faster playback rates result in shorter extraction times and less recorded metadata. The default is to play at normal speed.

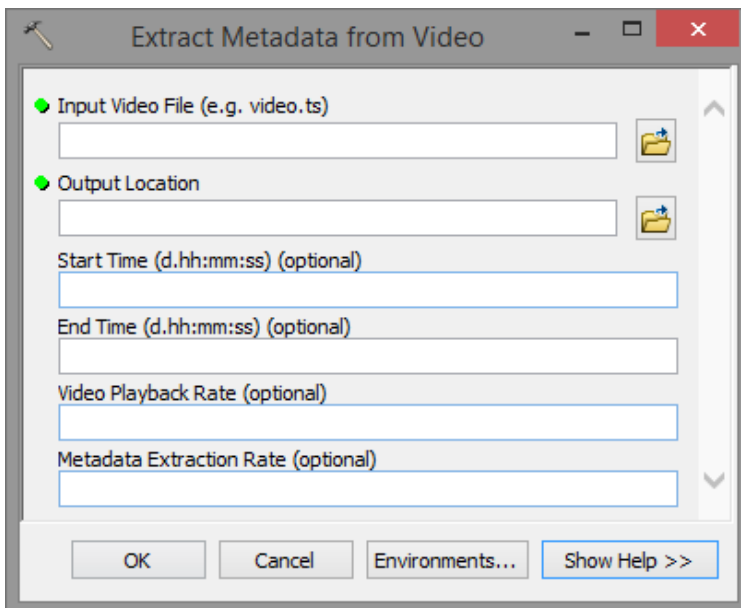
Metadata Extraction Rate (optional)

This value represents the metadata extraction rate. Enter a value of 1 to record all available metadata packets, 2 to record every second packet, and N to record every Nth packet. The default is to record all metadata packets.

Extract Metadata from Video Geoprocessing tool

Data management quickly becomes an issue with users who collect video data on a regular basis. This tool allows you to quickly extract video metadata and create feature classes that represent the platform, frame center, and frame outline. This tool is particularly useful because it can be run at high speeds. For example, one of the input variables is called Video Playback Rate. This variable allows you to fast forward your video at high speeds, such as 50 or 75 times the normal play rate, thus making it easy to quickly archive large amounts of metadata. Experiment with the Video Playback Rate and other variables. Extremely fast playback rates may result in less metadata per video time. Most users have success with a 50x playback rate with videos of 30 frames per second with metadata collection speeds at 2-3x per second.

Once the metadata is archived you use it with the FMV Search Tool as the required indexes. The video FrameOutline feature class is used in the video search tool to determine intersection with the extent of the ArcMap display or location of features. Or you can use it to do post-flight analysis using ArcGIS.

**Input Video File (e.g. video.ts)**

The video must be one of the supported file types: .ps, .ts, .mpg, .mpeg, .mp2, .mpg2, .mpeg2, .mp4, .mpg4, .mpeg4, .h264, .vob, or .mt2s.

Output Workspace

The workspace where the output feature classes will be saved. This location must be an SDE or File Geodatabase.

Start Time (d.hh:mm:ss) (optional)

This value sets the recording start time from the beginning of the video. The input format is d.hh:mm:ss and the default start time is 0.00:00:00. Metadata time stamps are not used in this field.

End Time (d.hh:mm:ss) (optional)

This value sets the recording end time. The input format is d.hh:mm:ss. If left unset, the value will default to the end of the video. Metadata time stamps are not used in this field.

Video Playback Rate (optional)

This value represents the playback rate of the video during metadata extraction. A value of 1 is normal playback speed, 2 is equal to 2x normal speed, and 10 is equal to 10x normal speed. Faster playback rates result in shorter metadata extraction times and less recorded metadata. The default is to play at normal speed.

Metadata Extraction Rate (optional)

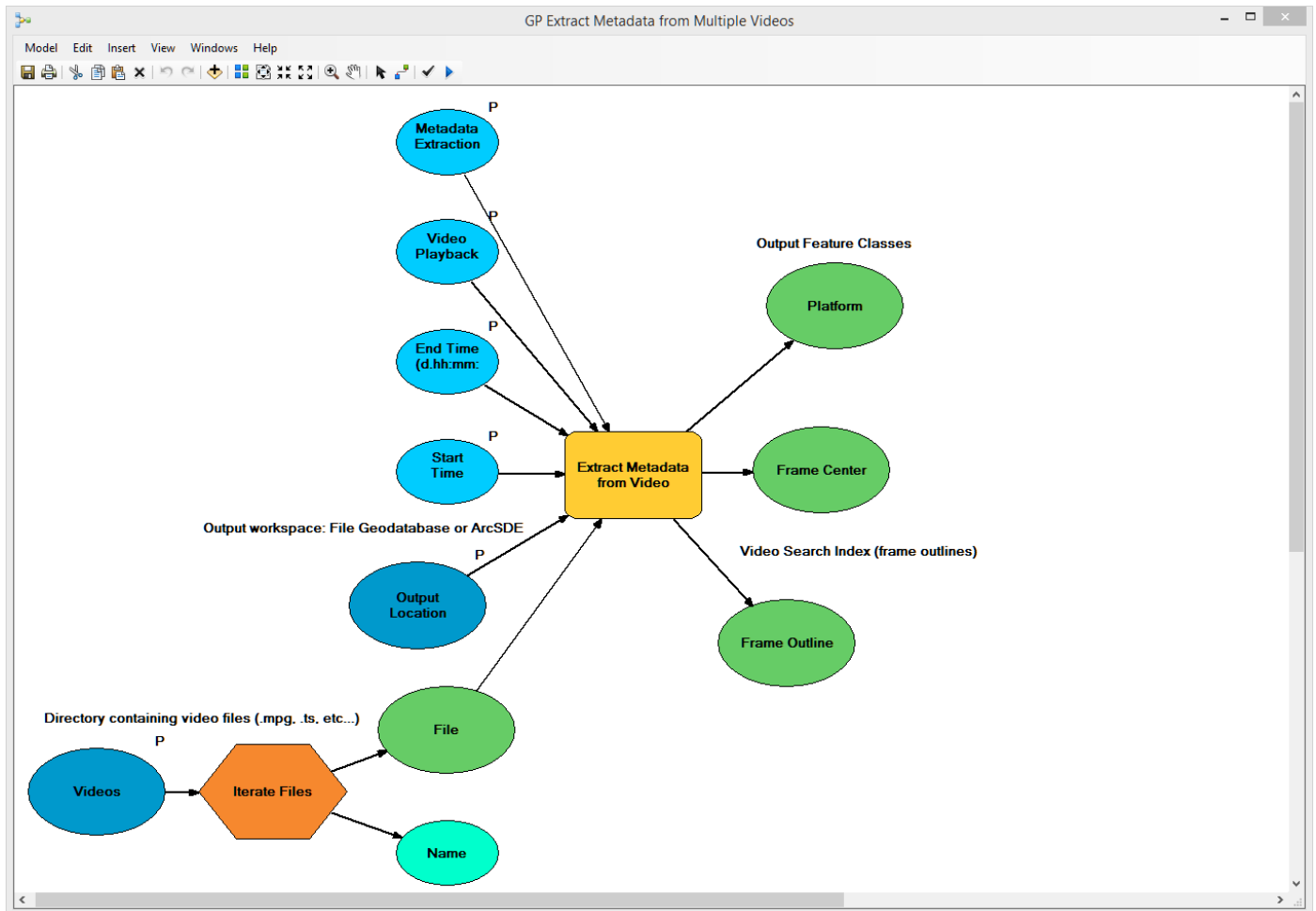
This value represents the metadata extraction rate. Enter a value of 1 to record all available metadata packets, 2 to record every second packet, and N to record every Nth packet. The default is to record all metadata packets.

Extracting Metadata in Batch Mode

Extracting metadata can be a time consuming activity and challenging to organize, especially if you collect video data on a regular basis. This activity can be done iteratively in batch mode using a GP model, and the extracted metadata can be used immediately in your video searching.

Every time you collect a set of new videos simply put them into the Iterators folder and run the tool. An example of the model is shown below.

Add a new model > Edit > Insert > Iterators > Files



Video Multiplexer

The Video Multiplexer takes metadata, in a CSV format, and combines it with video data into any one of twelve supported video file types. The resulting video file is then fully MISB compliant and ready for Esri FMV.

One of the major components of FMV data is calculation and/or display of the four corners of the video image frame, also called the frame outline, as shown on the map in the image above. Once you have four corner data you can perform many useful activities such as digitize a video, mark a video, measure distance on a video, create and georeference images, and more. Often videos from drones, pole mounted cameras, or other sources do not have four corner data. The FMV Video Multiplexer can create the four corner data assuming the metadata contains the proper information from an Inertial Measurement Unit (IMU) which records the orientation of the platform and sensor, and GPS which records the position of the platform and sensor. The minimum metadata requirements, and formatting into a CSV file ready for ingest into the Video Multiplexer tool are discussed in this section.

The multiplexing field mapping and time shift templates are available after the geoprocessing tools are installed. Go to your install directory and look for a folder called Video Multiplexer Templates. A typical location is C:\Program Files (x86)\ArcGIS 10.3.1 Full Motion Video Geoprocessing Tools\VideoMultiplexerTemplates.”

The Need for the FMV Multiplexer tool

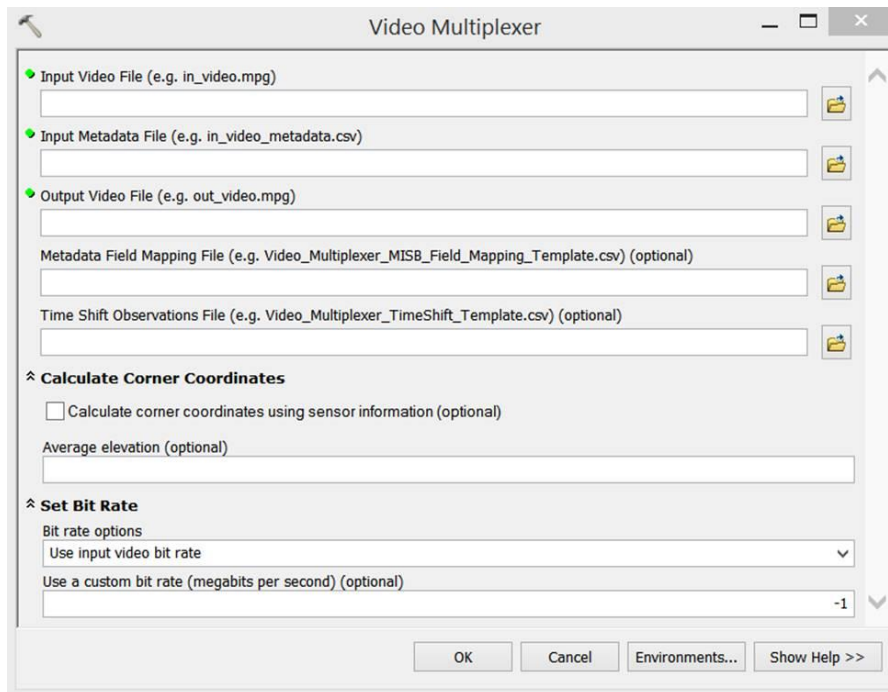
Multiplexing is a technical term that in the context of Full Motion Video is a process that combines your flight data, sensor metadata, and video stream into a single MISB-compliant video. Only videos that meet the MISB standard can be used within the Esri FMV Add-in. High-end sophisticated camera sensors are able to collect and combine the GPS, timestamps, metadata and video in real time as it is collected. However, the vast majority of cameras available today do not collect or multiplex all of the flight, time and sensor metadata that you need to include with the video stream. In order to work with this latter kind of video, you will need to interpolate the flight, time and sensor metadata and then combine it with the video stream into a single MISB-compliant video file. To do this this, you will be working with the Video Multiplexer geoprocessing tool.

How do I know if my video needs to be multiplexed?

The easiest way is to start playing the video and either zoom into it or start following the video track on a map in the ArcMap display. If the video is not in the right location (often it will be where the prime meridian and equator meet) it either does not include the proper metadata, or the metadata needs to be corrected via the multiplexer.

Another common scenario is that the timing in your video is off by a few seconds. There may have been an issue with the clock on the camera and the GPS not being synchronized that caused a delay. This may be constant if the aircraft is moving at a constant speed, or the time shift may increase and decrease if the velocity of the aircraft is not consistent.

Description of the Multiplexer Tool



Input Video File (e.g. in_video.ts)

The video must be one of the supported file types: .ps, .ts, .mpg, .mpeg, .mp2, .mpg2, .mpeg2, .mp4, .mpg4, .mpeg4, .h264, .vob, or .mt2s.

Input Metadata File (e.g. in_video_metadata.csv)

This is a CSV file containing metadata about video frames for individual times. Each column represents one metadata field, and one of the columns must be a time reference. The time reference is Unix Time Stamp (seconds past 1970) multiplied by one million (i.e., microseconds), stored as an integer with no decimal places. This is done so any instant in time (down to one millionth of a second) can be referenced with an integer. Consequently a time difference between two entries of 500,000 represents one half of a second in elapsed time. The first row contains the field names for the metadata columns. These field names can be matched to their corresponding MISB field names using a MISB Field Mapping CSV file, if needed. Each subsequent row contains the metadata values for the time indicated in the time field. A template file called Video_Multiplexer_MISB_Field_Mapping_Template.csv is included with installation software and is discussed below in the Metadata Field Mapping File section. See example of a CSV metadata file containing the minimum metadata parameters needed to calculate the 4 corners and thus the outline of the video frame footprint and display it on the map.

	A	B	C	D	E	F	G	H	I	J	K
1	UNIX TimeStamp	PlatformHeading	PlatformPitch	PlatformRoll	SensorLatitude	SensorLongitude	SensorAltitude	HorizontalFOV	SensorRelativeAzimuth	SensorRelativeElevation	SensorRelativeRoll
2	1433429777800780	276.689403	0.043947	6.382946	27.405409	-82.126628	174.209201	52.301213	351.138175	-52.055159	0
3	1433429777960930	276.22797	0.043947	6.613361	27.405412	-82.126687	173.635462	52.301213	351.751714	-52.073371	0
4	1433429778121090	275.854429	0.076907	6.503494	27.405414	-82.12674	173.348592	52.301213	352.37272	-52.117671	0
5	1433429778281250	275.579767	0.175787	6.283761	27.40542	-82.126794	173.061723	52.301213	352.778056	-52.270578	0
6	1433429778480460	275.371023	0.29664	5.932798	27.405422	-82.126864	172.487984	52.301213	353.086939	-52.405107	0
7	1433429778640620	275.239185	0.42848	5.558947	27.405425	-82.126917	172.201114	52.301213	353.219183	-52.555692	0
8	1433429778800780	275.06276	0.736106	5.174413	27.405428	-82.126976	171.627375	52.301213	353.174594	-52.854694	0

Output Video File (e.g. out_video.ts)

Must be specified with a file suffix, which must match one of the supported types: .ps, .ts, .mpg, .mpeg, .mp2, .mpg2, .mpeg2, .mp4, .mpg4, .mpeg4, .h264, .vob, or .mt2s. The new video file will be the same duration as the original video, but the size will likely be different depending on the bit rate settings (see below).

Metadata Field Mapping File (e.g. MISB_field_mapping.csv) (optional)

This is a CSV (comma separated values) file containing 5 columns and 95 rows, based on a template file included with the original software (Video_Multiplexer_MISB_Field_Mapping_Template.csv). Each row represents one of the standard MISB metadata tags (e.g., sensor latitude). The first two columns contain the MISB index and MISB tag name and the third column contains the field name as it appears in the Metadata CSV file (if present). The fourth and fifth columns represent the units and any notes associated with the tag. When the third column is populated the program can match the CSV metadata field names to the proper MISB metadata tags. See an example of the field mapping file.

MISB Tag	MISB Field Name	Your column heading
2	UNIX Time Stamp	TimeStamp
23	Frame Center Latitude	
24	Frame Center Longitude	
25	Frame Center Elevation	
26	Corner Latitude Point 1 (UL)	
27	Corner Longitude Point 1	
28	Corner Latitude Point 2 (UR)	
29	Corner Longitude Point 2	
30	Corner Latitude Point 3 (LR)	
31	Corner Longitude Point 3	
32	Corner Latitude Point 4 (LL)	
33	Corner Longitude Point 4	
5	Platform Heading Angle	PlatformHeading
6	Platform Pitch Angle	PlatformPitch
7	Platform Roll Angle	PlatformRoll
13	Sensor Latitude	SensorLatitude
14	Sensor Longitude	SensorLongitude
15	Sensor True Altitude	SensorAltitude
16	Sensor Horizontal Field of View	HorizontalFOV
17	Sensor Vertical Field of View	VerticalFOV
18	Sensor Relative Azimuth Angle	SensorRelativeAzimuth
19	Sensor Relative Elevation Angle	SensorRelativeElevation
20	Sensor Relative Roll Angle	SensorRelativeRoll
3	Mission ID	
4	Platform Tail Number	
8	Platform True Airspeed	PlatformTrueAirSpeed

Time Shift Observations File (e.g. time_shifts.csv) (optional)

Ideally the video images and the metadata are well synchronized in time. When this is the case the image footprint in FMV surrounds features that can be seen in the video image. However, sometimes there is a mismatch between the timing of the video and the timing in the metadata. This leads to an apparent time delay between when a ground feature is surrounded by the image footprint and when that ground feature is visible in the video image. If this time shift is observable and consistent the multiplexer can adjust the timing of the metadata to match the video. The time shift observations file is a CSV (comma separated values) file containing two columns (elapsed time and time shift) and one or two data rows. A row for column names is optional.

Calculate Corner Coordinates

Use the Calculate corner coordinates using sensor information (optional) checkbox to compute the corner coordinates, and thus the video frame outline.

Average elevation (optional)

If calculating the frame corner coordinates, an average ground elevation or average ocean depth is required. The accuracy of the frame coordinates depends on the accuracy of the average elevation. In order to calculate frame corner coordinates, the average elevation value must be less than the elevation value in the metadata. For example, if the video was filmed at an elevation of 10 meters and higher the valid average elevation could be 9 meters or less. If a video was filmed underwater at a depth of -10 meters and deeper the valid average elevation (relative to sea level) could be -11 or deeper. If the Sensor Altitude value is less than the average elevation value, the four corner coordinates will not be calculated for that record. The data range of the Average Elevation is a number between -900m and 19,000m.

Set Bit Rate

Bit rate options

Bit rate is the number of bits that are conveyed or processed per unit of time. A video's bit rate is related to its quality and file size. In general, a lower bit rate will result in a higher rate of compression, require more time to multiplex, and output a smaller file with potentially lower quality. A higher bit rate will typically result in less compression, less processing time, and bigger files with potentially higher quality. When deciding whether to multiplex a video at a lower or higher bit rate, one may consider whether they want to stream and share their videos (lower bit rate) or archive their videos at maximum quality (higher bit rate).

There are four different ways to enter bit rate for multiplexing:

1. Custom bit rate - Manually input a bit rate value into the "Use a custom bit rate field".
2. Use input video bit rate - Use the same bit rate as the Input Video File.
3. Use video dimensions - Use the Input Video File's height and width to estimate the new bit rate. Values calculated this way will tend towards lower bit rates relative to the original video. This method may be more appropriate for streaming or sharing a video after multiplexing.
4. Low, medium, and high action level - These values help to automatically calculate an optimized bit rate based on the Kush Gauge equation. The Kush Gauge equation can be helpful if you plan to stream or share your video after multiplexing and you don't know your user's exact bandwidth. Low, medium, and high action levels refer to how much things "move" within a video and help to calculate an optimized bit rate. For example, a video of a car race would have a high action level, a person walking may have a medium level, and a static façade of a building might be low.

Use a custom bit rate (megabits per second) (optional)

When Custom bit rate is selected under Bit rate options, a bit rate in megabits per second (mbps) must be entered. This bit rate must be equal to or greater than 1.5 mbps. A value of -1 indicates that the custom bit rate will be ignored during processing. If a custom bit rate is entered, the Bit rate options parameter is disabled.

Multiplexing Background

The following graphic highlights a typical onboard multiplexing process using a flight computer. This is an example where the Esri FMV Video Multiplexer is not needed. This graphic workflow illustrates what the multiplexer replicates in a ground processing system.

In summary, the GPS, Inertial Motion Unit (IMU) or other metadata sources, and video capture systems are all initiated. The Flight Computer then combines the different metadata sources and video into time-stamped metadata. The time-stamped metadata is then combined with the video data to create a single transport stream.

The Video Multiplexer plays the role of the Packet MUX compressor in the image below. The goal of this geoprocessing tool is to combine your metadata and video data into a single MISB compliant video file for use in the FMV add-in.

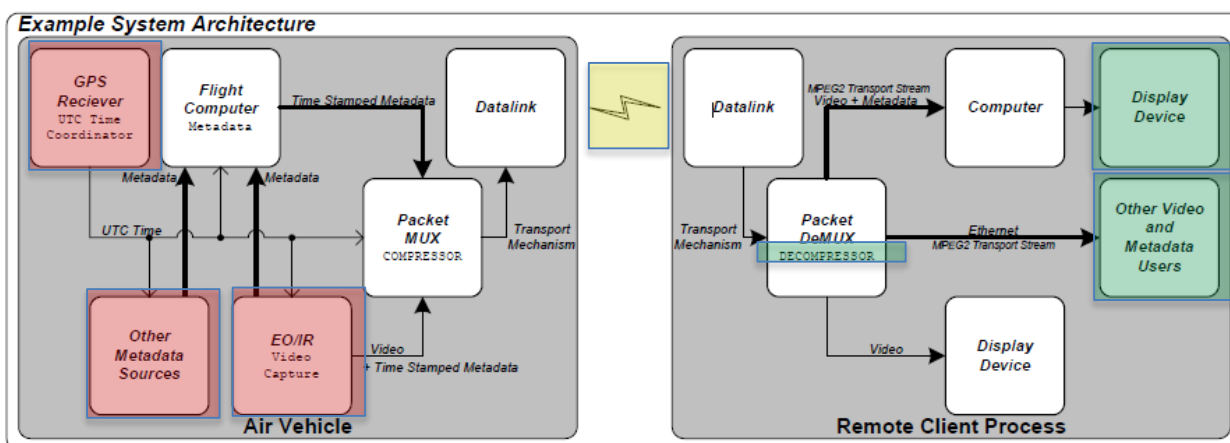


Image Courtesy of <http://www.gwg.nga.mil/misb>

FMV Video Multiplexer

If your video imaging system does not employ an onboard computer that captures and multiplexes the proper metadata into the video stream to create a MISB-compliant video, you can utilize the Esri FMV Multiplexer tool to properly combine the metadata with the video stream.

The multiplexer tool utilizes the metadata and timestamp from a GPS, IMU, video, other metadata sources and combines or multiplexes them together into a single MISB-compliant file. It is assumed that your system captures the sensor orientation information from an Inertial Measurement Unit (IMU) or similar, platform positional information from airborne GPS or similar, linked to a time stamp, camera field of view, focal length and other pertinent metadata information. This information is often stored in a CSV (comma separated values) file or spreadsheet. This metadata needs to be stored in a CSV or excel spreadsheet for input into the multiplexer tool. Please refer to the **MISB Field Mappings** section for more details about preparing metadata files for ingest into the multiplexer tool.

The Video Multiplexer tool ingests all of the location information about the position and attitude of the aircraft and sensor, together with the timestamp information, and inserts this information into the proper location in the video transport stream to estimate where each video frame footprint should lay on the map. It is common that this metadata is inserted at intervals into the video stream, determined by the timestamp. For example, metadata is inserted after every 5th video frame, and the position of the video frame footprint on the map is interpolated from the metadata interval.

The image illustrates the workflow of the Video Multiplexer tool. At the top left, a table lists metadata for video frames, including timestamps and platform orientation data. To the right, a grid of video frame thumbnails is shown, each labeled with an output file name (e.g., Out4 - VIC_1408262_002.ts). Below these, a map displays a yellow polygon representing a video frame footprint. The main part of the image is the Video Multiplexer software interface, which includes fields for input video and metadata files, an output file field, and a metadata field mapping file. A detailed view of the 'Long Form BER Packet Length Encoding' is shown, illustrating the structure of a UAS LDS Packet with fields for Length, Value, Timestamp, Metadata, and Checksum.

TimeStamp	PlatformHeading	PlatformPitch	PlatformRoll	Sensor
1433429777800780	276.689403	0.043947	6.382946	2
1433429777960930	276.22797	0.043947	6.613361	2
1433429778121090	275.854429	0.076907	6.503494	2
1433429778281250	275.579767	0.175787	6.283761	2
1433429778440460	275.371023	0.29664	5.932798	2
1433429778600620	275.239185	0.42848	5.558947	2
1433429778760780	275.206226	0.736106	5.174413	2
1433429778920930	275.283131	0.999786	4.933317	2
1433429779121090	275.392996	1.109653	4.910428	2
1433429779281250	275.502861	1.08768	4.922636	2
1433429779440460	275.623713	1.032746	4.878384	2
1433429779600620	275.78851	0.900906	5.108798	27.405438
1433429779800780	275.953307	0.824	5.343284	27.405438
1433429779960930	276.052186	0.812013		27.405438
1433429780121090	276.096132	0.75808		27.405438
1433429780320310	276.129091	0.867946		27.405444
1433429780480460	276.173037	1.1536		27.405444
1433429780640620	276.173037	1.38432		27.405444

The multiplexer uses video frame corner information from the metadata to display the video frame on the map. If video frame information is not available in the metadata, the Video Multiplexer calculates the size, shape and position of the video frame footprint projected onto the map utilizing a minimum set of sensor and collection platform position and orientation information.

Required fields to calculate the video frame outline

In order to see the relative corner points of the video frame footprint as a frame outline on the map you will need data from the following fields. If you collect the following metadata, the FMV Video Multiplexer will calculate the video frame corners, and thus the size, shape and position of the video frame outline and display it on the map.

UNIX Time Stamp: Coordinated Universal Time (UTC) represented in the number of microseconds elapsed since midnight (00:00:00), January 1, 1970. Derived from the POSIX IEEE 1003.1 standard. Resolution: 1 microsecond.

PlatformHeading: Aircraft heading angle. Relative between longitudinal axis and True North measured in the horizontal plane.

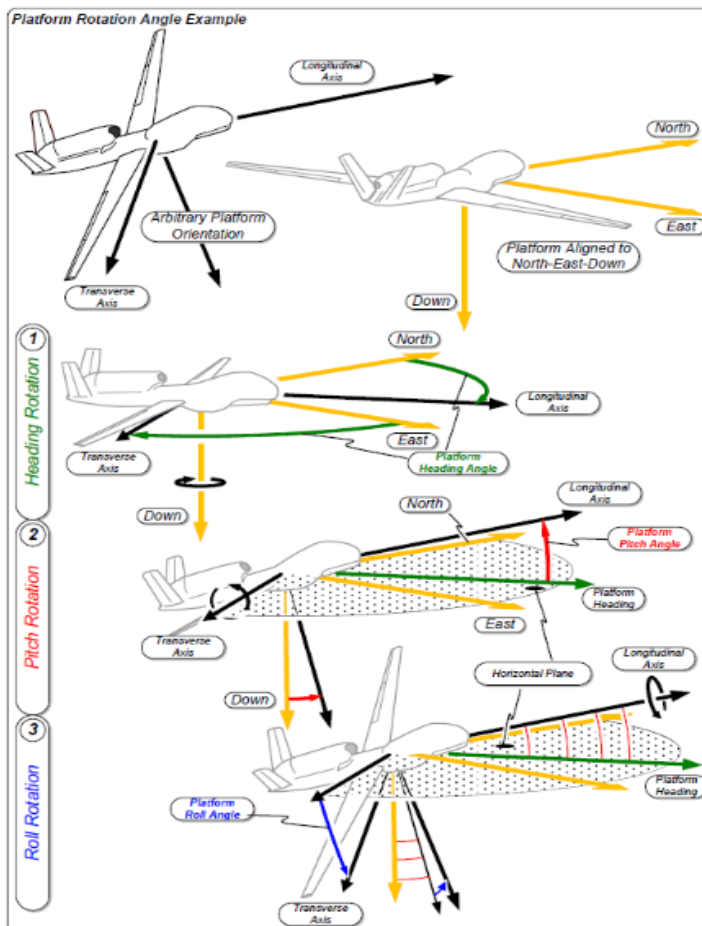
PlatformPitch: Aircraft pitch angle determined by the rotation around the side-to-side axis of the collection platform, also described as nose up or nose down.

PlatformRoll: Aircraft roll angle determined by the rotation around the front-to-back axis of the collection platform. This occurs when one airplane wing is higher or lower relative to the other wing.

SensorLatitude: The latitudinal position of the sensor aboard the aircraft. Based on WGS84 ellipsoid.

SensorLongitude: The longitudinal position of the sensor aboard the aircraft. Based on WGS84 ellipsoid

SensorAltitude: The height above mean sea level of the sensor aboard the aircraft.



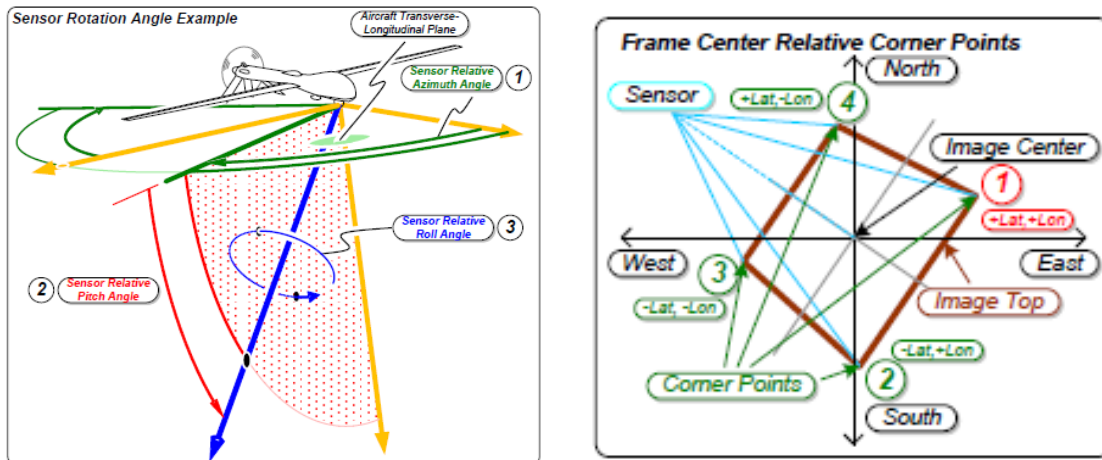
Graphic courtesy of <http://www.gwg.nga.mil/misb>

HorizontalFOV: Horizontal field of view of selected imaging sensor, in milli degrees.

SensorRelativeAzimuth: Relative rotation angle of sensor to platform longitudinal axis. Rotation angle between platform longitudinal axis and camera pointing direction as seen from above the platform, in nano degrees.

SensorRelativeElevation: Relative Elevation Angle of sensor to platform longitudinal-transverse plane. Negative angles down, in nano degrees.

SensorRelativeRoll: Relative roll angle of sensor to aircraft platform. Twisting angle of camera about lens axis. Top of image is zero degrees. Positive angles are clockwise when looking from behind the camera.



The graphic on the left serves to describe the relative sensor orientation while the graphic on the right illustrates the how the video corners are projected onto a map. Graphic courtesy of <http://www.gwg.nga.mil/misb>

MISB Field Mappings

Because commercial full motion video is a nascent industry, there is not one standard that sensor manufacturers adhere to. The result is that while Esri Full Motion Video needs videos to be MISB compliant, the camera you are using may not have organized the data to this standard. To assist you with getting your CSV fields in the proper structure, there is a field mapping template (FMV_MISB_Field_Mappings_Template.csv) which is included in the Add-In. Use this file to cross-reference your column headings in your metadata CSV file to the MISB-compliant field names. An example of how to prepare your metadata for input to the multiplexer tool follows.

Metadata from different sensors can take many forms depending on manufacturers of IMU and GPS instruments. Most output the metadata into a CSV file, XML or another file format that can be easily imported into a spreadsheet application such as Excel to generate a CSV file. Once the metadata is in a spreadsheet in CSV format it is ready to be cross referenced to the field mapping template. Getting the myriad of different metadata types into the proper format and mapped to the template is based on the procedures outlined in this document, as well as knowledge, art and intuition. With a little practice, users have become adept at using all these qualities to map a large variety of metadata schemes to the field mapping template to generate MISB-compliant video data.

As mentioned previously, the minimum MISB fields needed to project the four corners of the video frame onto a map are shown in the Esri field mapping template below. Having the video frame corners enables you to more fully exploit the robust functionality of the FMV Add-In. Minimum metadata information needed to project the four corners of the video frame onto a georeferenced map is shown below.

MISB Tag	LDS Name	Local	Units	Notes
2	UNIX Time Stamp		Microseconds	Coordinated Universal Time (UTC) expressed as microseconds since midnight (00:00:00), January 1, 1970. (Unix time stamp multiplied
5	Platform Heading Angle		Degrees	Aircraft heading relative to True North, measured clockwise in the horizontal plane looking down. Compass direction, range 0.0 to 36
6	Platform Pitch Angle		Degrees	Aircraft pitch relative to horizontal plane with positive angles for nose above the horizontal plane.
7	Platform Roll Angle		Degrees	Platform roll angle relative to horizontal plane with positive angles for left wing above the horizontal plane.
13	Sensor Latitude		Degrees	Sensor Latitude. Based on WGS84 ellipsoid. Range -90.0 to 90.0
14	Sensor Longitude		Degrees	Sensor Longitude. Based on WGS84 ellipsoid. Range -180.0 to 180.0
15	Sensor True Altitude		Meters	Altitude of sensor as measured from Mean Sea Level (MSL).
16	Sensor Horizontal Field of View		Degrees	Horizontal field of view of selected imaging sensor.
17	Sensor Vertical Field of View		Degrees	Vertical field of view of selected imaging sensor.
18	Sensor Relative Azimuth Angle		Degrees	Relative angle of sensor pointing direction to platform longitudinal axis as seen from above the platform. Compass direction, range 0
19	Sensor Relative Elevation Angle		Degrees	Relative angle of sensor pointing direction to the platform horizontal plane. Negative angles down.
20	Sensor Relative Roll Angle		Degrees	Relative roll angle of sensor to aircraft platform. Top of image level is zero degrees. Positive angles are clockwise when looking from

A summary of the steps to multiplex a typical asynchronous metadata file with the associated video data stream are listed below. These steps may vary according to the type and format of your recorded metadata information.

Steps:

1. Convert GPX to CSV (<https://www.gps-data-team.com/convert.php>), or
2. Convert from CSV to XML (<http://www.convertcsv.com/csv-to-xml.htm>)
3. Use Excel and open the file specifically as type XML
4. Open the MISB 0601.8 document for reference
5. Rename columns as needed or use the Esri field mapping spreadsheet so that the column names are MISB compatible and ready for the Multiplexer.
6. Convert time to Epoch time if needed. Use a website such as <http://www.epochconverter.com/> to do the initial conversion and then use Excel to increase time values in equal increments (e.g. 1 second).
7. Cross check and make sure you have the minimum required fields for four corner offset calculation, if needed: UnixTimeStamp, PlatformHeading, PlatformPitch, PlatformRoll, SensorLatitude, SensorLongitude, SensorAltitude, HorizontalFOV, SensorRelativeAzimuth, SensorRelativeElevation, SensorRelativeRoll
8. Run the FMV multiplexer tool.
9. Check your video with the FMV Add-in and make adjustments to the multiplexer as needed: time shifts, field mappings, etc.

Each of these steps is explained in detail using the example case below.

The example below is metadata in GPX format, or GPS Exchange Format, which is an XML schema designed as a common GPS data format for software applications, see https://en.wikipedia.org/wiki/GPS_Exchange_Format for more details. Since GPX is a XML format, and XML is imported into a spreadsheet straightforwardly, the GPX file was renamed to have an .XML file extension. This file was then imported to excel using the defaults to create a CSV file shown below.

```

<?xml version="1.0"?>
- <gpx xmlns="http://www.topografix.com/GPX/1/1" creator="Mission Planner 1.3.17"
  - <trk>
    - <trkseg>
      - <trkpt lon="-123.0252553" lat="47.0937785">
        <ele>44.12</ele>
        <time>2015-01-19T09:53:58-08:00</time>
        <course>86.3</course>
        <roll>0.94</roll>
        <pitch>0.06</pitch>
        <mode/>
      </trkpt>
      - <trkpt lon="-123.0252556" lat="47.0937788">
        <ele>44.24</ele>
        <time>2015-01-19T09:53:59-08:00</time>
        <course>86.31</course>
        <roll>0.91</roll>
        <pitch>0.41</pitch>
        <mode/>
      </trkpt>
    </trkseg>
  </trk>
</gpx>

```

Sample of metadata in GPS Exchange Format (GPX), which is an XML file

The first thing to notice is that most of the basic information needed is available, and is described below. The MISB field names are in bold text

Sensor Latitude information – contained under the lat field

Sensor Longitude information – contained under the long field

Sensor True Altitude information – contained under the ns1:ele field. These values look to be the altitude of the platform, but we are not yet sure if this is height above ground or height above mean sea level, and the units (e.g., meters, feet).

When viewing the video, it commenced with a close-up view of grass where the individual blades of grass were visible; thus it is likely that the Altitude values are above mean sea level. Sorting the ns1_ele field for the lowest value provides the ground elevation value used in the Video Multiplexer tool to establish the datum. This was verified by displaying the Esri WorldElevation - TerrainMap for the latitude/longitude location in ArcMap using the “Identify” tool in ArcMap.

UNIX Time Stamp information – is contained in the ns1:time field. The time is not in Epoch, or UNIX, time so it needs to be converted. Use a website like <http://www.epochconverter.com/> to do the initial conversion from readable time to Epoch (UNIX) time.

Steps:

1. Type the first timestamp record value from the spreadsheet into the Epoch time converter.
2. Notice the timestamp on the spreadsheet – it gives an 8 hour offset from Greenwich Mean Time, so when you enter the date and time values into the converter, add 8 hours.
3. The converter gives the time in milliseconds, whereas the MISB standard requires time in microseconds. Add three zeros to the converter time stamp value to transform milliseconds into microseconds. Enter this value into a new field (column) in the spreadsheet with the field heading name “UNIX Time Stamp”.
4. Select the entire UNIX Time Stamp column in the spreadsheet (without including the column heading, “UNIX Time Stamp”) and format the cells to “Number” with zero decimal places. You will see a time stamp that looks similar to 1421690042746890.

5. Convert the last time stamp in the spreadsheet to Epoch time as described above and enter it in the appropriate cell (i.e., last record, new UNIX Time Stamp field). Thus, you now have the first and last Epoch UNIX timestamp values for the video.
6. Select the entire UNIX Time Stamp column in the spreadsheet and format the cells to “Number” with zero decimal places.
7. Subtract the first record UNIX Time Stamp value from the last time stamp value to derive the length of time of the video in Epoch UNIX time.
8. It is common that the IMU records metadata at a regular interval. **If the metadata is not recorded at a regular interval, use the “batch convert” option in <http://www.epochconverter.com/>**
9. In a separate blank cell in the spreadsheet, divide the time length of the video above by the number of data records to get the average time span between records.
10. In a different blank cell in the spreadsheet, add the average time span number to the UNIX time stamp value in the first record. This yields the incremental time increase between the first and second records (i.e., metadata packets). The next step is necessary due to one of those quirky Excel things:
11. Copy the UNIX Time Stamp value you just computed and copy it into a new cell in the spreadsheet with a right click, select “paste special” and choose “paste values”. This copies the value of the computation rather than the formula for the value. Next, copy this value (not the formula) and paste it into second record in the UNIX Time Stamp field.
12. You now have 3 time stamp records in the UNIX Time Stamp field; the first 2 records and the last record. Use the last record as a check by copying it and pasting it into a blank field.
13. Select the first 2 records in the UNIX Time Stamp field, then select the lower right corner of your selection and drag all the way to the bottom of the column to the last UNIX Time Stamp record. This will populate the entire column with each record increased by the average time increment.
14. Verify that the last record in the UNIX Time Stamp column is the same or very close to the value that you copied and pasted for verification.

Platform Heading Angle information – is contained under the metadata field name of ns1:course

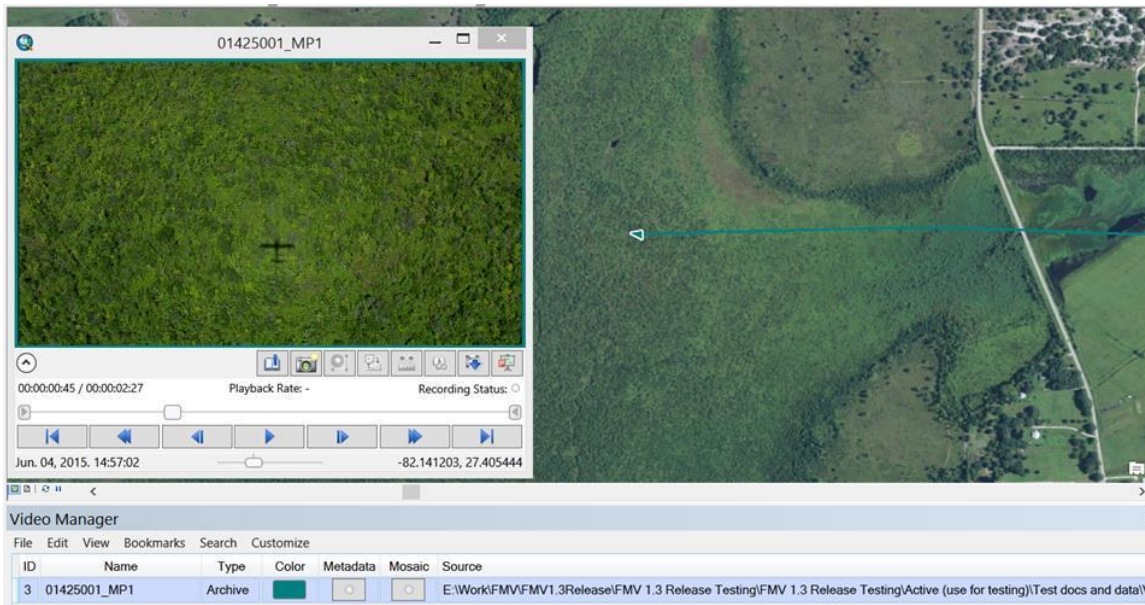
Platform Pitch Angle information – is contained under the metadata field name of ns1:pitch

Platform Roll Angle information – is contained under the metadata field name of ns1:roll

Save the CSV file, which now looks like the example below.

1	creator	lat	lon	ns1:ele	ns1:time	ns1:course	ns1:roll	ns1:pitch	UNIX Time Stamp
2	Mission Pla	47.09378	-123.025	44.12	2015-01-19T09:53:58-08:00	86.3	0.94	0.06	1421690038000
3	Mission Pla	47.09378	-123.025	44.24	2015-01-19T09:53:59-08:00	86.31	0.91	0.41	1421690038215
4	Mission Pla	47.09378	-123.025	44.22	2015-01-19T09:54:00-08:00	86.38	1.04	0.36	1421690038431
5	Mission Pla	47.09378	-123.025	44.26	2015-01-19T09:54:00-08:00	86.39	0.99	0.33	1421690038647
6	Mission Pla	47.09378	-123.025	44.3	2015-01-19T09:54:00-08:00	86.41	0.95	0.3	1421690038863
7	Mission Pla	47.09378	-123.025	44.43	2015-01-19T09:54:01-08:00	86.47	0.91	0.25	1421690039078

The metadata information above is the minimum needed to display the sensor position and heading on the ArcMap map display. Input the metadata field names from the spreadsheet into the MISB metadata mapping template.



Graphic shows the sensor heading (i.e., the direction the arrow is pointing) and sensor ground track.

In order to display the 4 corners of the video frame onto the map, cross reference the sensor field of view and relative orientation information from the CSV file to the MISB field mapping template.

Sensor Horizontal Field of View – This information is usually available from the camera manufacturer. In this case it is 64.4. Add this value to the spreadsheet and copy it to all cells for all records. Name the field (i.e., column heading) Sensor Horizontal Field of View

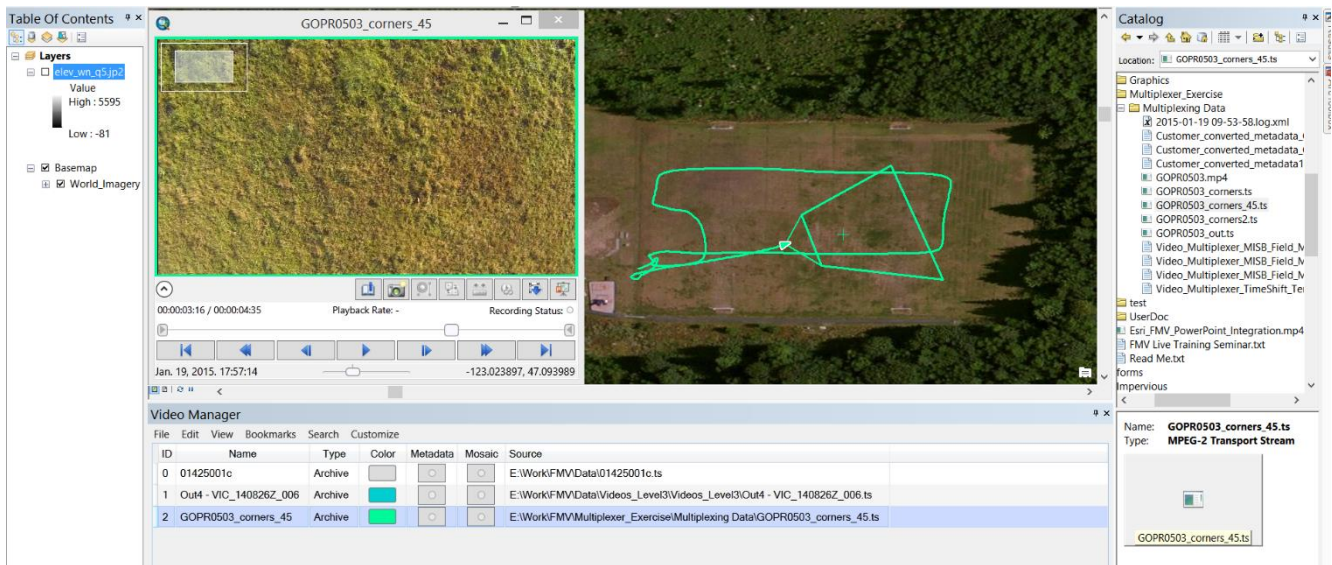
Sensor Vertical Field of View – The multiplexer can compute this value from the file properties of the video file, so it is often not necessary to input this value.

Sensor Relative Azimuth Angle – is the direction the sensor is pointing relative to the heading of the platform. In this case the camera was nadir looking, i.e., pointed vertically down, so this value is 0. Add this value to the spreadsheet and copy it to all cells for all records. Name the field (i.e., column heading) Sensor Relative Azimuth Angle

Sensor Relative Elevation Angle – Since the camera was pointing down, this value is -90. Add this value to the spreadsheet and copy it to all cells for all records. Name the field (i.e., column heading) Sensor Relative Elevation Angle

Sensor Relative Roll Angle – Since the sensor was fixed to the imaging platform, (the sensor was not mounted on a gimbal) there is no relative sensor roll angle and the value is 0.

Once the metadata CSV file is updated with this information and the MISB field mapping template updated with the information above, multiplex the video and metadata again. Once the video and metadata is multiplexed play the new video. If multiplexing was successful, you will see the sensor position, heading and four corners of the video frame displayed on the map.



FMV video multiplexed with metadata used to derive the 4 corners of the video frame on the map

Time Shifts

Ideally the video images and the metadata are time-synchronous. When this is the case the image footprint in FMV surrounds features that can be seen in the video image. However, sometimes there is a mismatch between the timing of the video and the timing in the metadata. This leads to an apparent time delay between when a ground feature is surrounded by the image footprint and when that ground feature is visible in the video image. If this time shift is observable and consistent, the multiplexer can adjust the timing of the metadata to match the video. The time shift observations file is a CSV file, FMV_Time_Shift_Template.csv, containing columns for elapsed time and time shift, and two data rows. A row for column names is optional.

Example 1: The video image seems to lag the FMV image footprint by 5 seconds. This can be noticed near the beginning of the video and also near the end. The observation file would contain one line:

Elapsed Time into video (days.hours:minutes:seconds)	Time Shift (seconds).
0.00:00:13	-5

The entire video is shifted 5 seconds.

Note: Video relative to metadata. If video lags footprint, use negative values

Example 2: There is a 5 second lag at 0:18 into the video and a 9 second lag at 2:21 into the video. The time observation file would contain two lines.

Elapsed Time into video (days.hours:minutes:seconds)	Time Shift (seconds).
0.00:00:13	-5
0.00:02:13	-9

In this case the video is shifted differently at the beginning and end.

Note: Video relative to metadata. If video lags footprint, use negative values.

Summary

The Esri FMV 1.3 Add-In User's Manual addressed many aspects of the software, including new features, how to uninstall older versions, installation instructions for the Add-In and the associated geoprocessing tools, menu map for all the functionality, and details on how to use the three main components; the video player, video manager and the geoprocessing tools. A few of the more noteworthy enhancements in this release include the working with realtime video, the video search capability and the video multiplexer. A lot of attention was given to the Multiplexer Geoprocessing Tool with special focus on the field mapping of metadata because it enables many types of video data with accompanying metadata to be converted for use in FMV Add-in.

The core capability, coupled with the new FMV 1.3 features, results in a robust full motion video experience that is unparalleled in the commercial geospatial video industry today.

For more information about Esri's Full Motion Video Add-In, please visit the FMV Page at <http://www.esri.com/FMV> and [Esri GeoNet](#). This FMV resource site includes, but is but not limited to,

- Free Trial software
- Order FMV 1.3 Add-In
- GeoNet correspondence and info
- User's Manual
- Blogs
- Tutorials and data
- FAQ and other customer service information
- Presentations

Your feedback on the software capability and functionality, user experience, user help, documentation and customer support is much appreciated.