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Experiences of Using the Microsoft Windows DirectShow Architecture to Handle the DICOM MPEG-2 Transfer Syntax

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Overview of MPEG-2 in DICOM

- Added in 1993 as supplement 42
- First compressed transfer syntax to use a multi-frame approach
- Uses the consumer standard MPEG-2 MP@ML encoding rules

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MPEG-2 as a DICOM Transfer Syntax

- Essentially a complete, unaltered MPEG–2 bit stream within the normal DICOM encapsulated pixel data format
  - Note: Only a single "fragment"
  - So max length is 4 GByte
- Audio is implicit the MP@ML specification
  - So Cine module IOD modified to support it
- DICOM Transfer Syntax exemption for data only held in lossy compressed form applies
  - Conversion to Implicit VR LE would be impractical

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Licensing

- Unlike other MPEG variants, the one chosen by DICOM has recognised patents
- Cost is a fixed $2.50 per application
  - Trivial for medical workstations
  - Significant for CD-R viewers

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Microsoft DirectShow Architecture

- Microsoft proprietary system (and therefore only for Windows), but well documented
- Based on the Component Object Model (COM) system
- Components have “Pins” which are “Connected” like on an electronic breadboard
- Widely used in Consumer Applications
- Choice of Codecs

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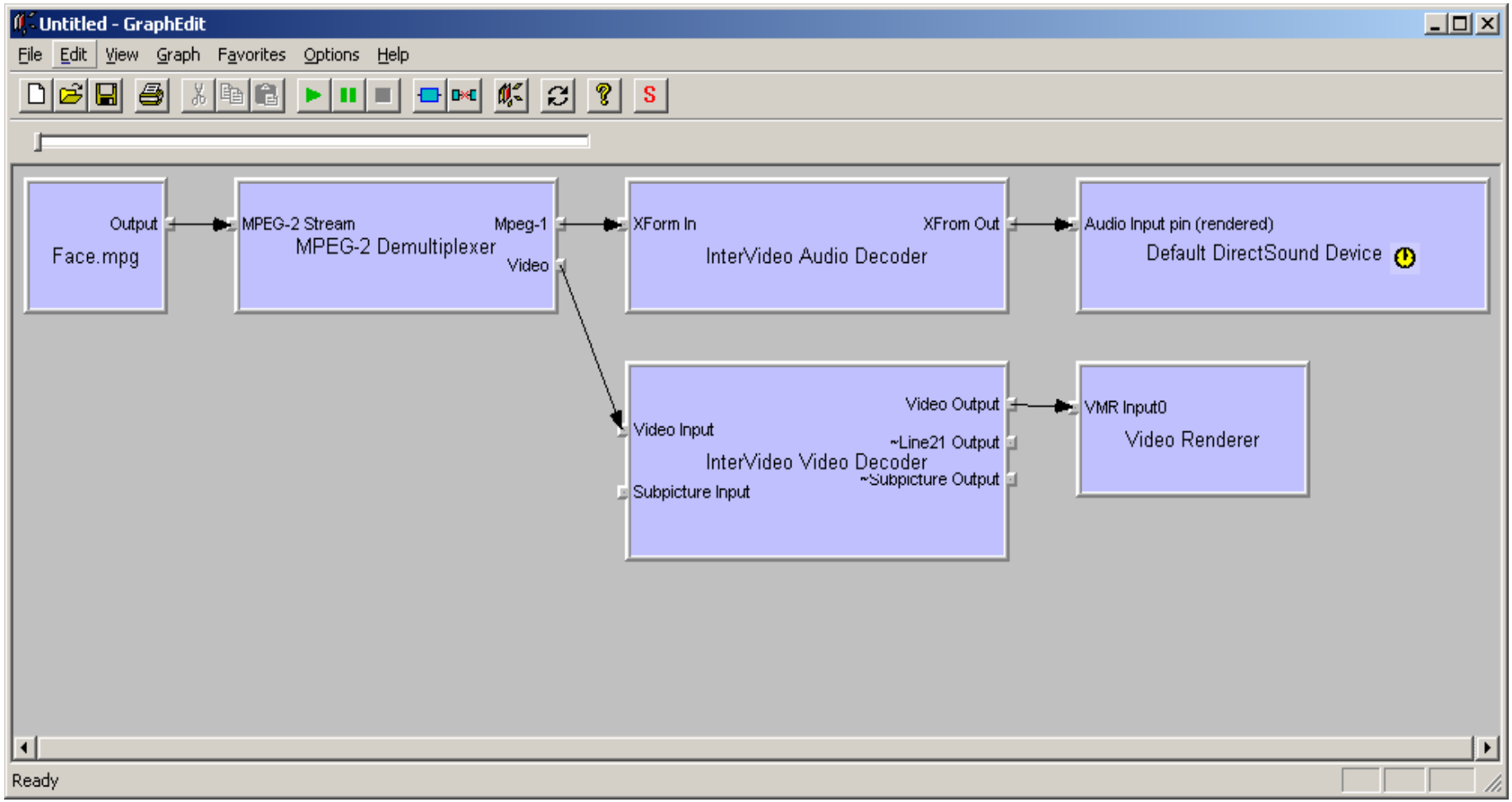
DirectShow Filter Graph



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Benefits of using DirectShow for DICOM Applications

- Optimised use of available hardware
- Choice of Codecs
- Readily available and (reasonably) easy to use
- Can be used for:
  - Import of external MPEG-2 files
  - Decoding
  - Encoding
  - Individual frame extraction

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Practicalities (1)
MPEG-2 Import

- ".mpg" is ambiguous
  - Is this really an MPEG-2 file?
  - Codecs can be "too nice" and hide this
- The DICOM image needs to have matching attributes
  - Image dimensions
  - Number of Frames etc.
  - DirectShow can be used to find these

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Practicalities (2) Decoding/Rendering

- The easiest bit !
- Simply create a “source” which outputs the DICOM encapsulated data
- Well optimised for almost all systems
- Numerous choices for independent window or within an existing window
- Normally handles audio “for free” (harder to disable than enable!)

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Practicalities (3)
Encoding

- Relatively easy, by creating an uncompressed video "source" from standard multi-frame data
- Create a "sink" which accepts MPEG-2 data
- Let DirectShow connect them together!
- Synchronised audio may be harder!

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Practicalities (4)
Frame Extraction

- DirectShow is not **really** intended for this purpose
- Frame seeking is not very accurate
- Need to set up an uncompressed "sink", and let frames "flow" into it
- "Catch" the required frame as it goes past, then stop the flow

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Codec Choice

- Windows will make automatic choice of codecs and format converters to achieve the connections required
- Normally uses "default" codecs
- These can be over-ridden by adding chosen codecs to the filter graph explicitly
- There is a competitive market for 3rd party codecs
- Not all codecs handle all images well for all operations

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Conclusions

- DirectShow greatly simplifies the use of MPEG-2 as a transfer syntax in DICOM
- Allows a "vendor neutral" choice of codecs
- Architecture is generally very easy to adapt to DICOM use
- Single frame extraction is not well catered for and difficult to handle

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