DVD Authoring under Linux

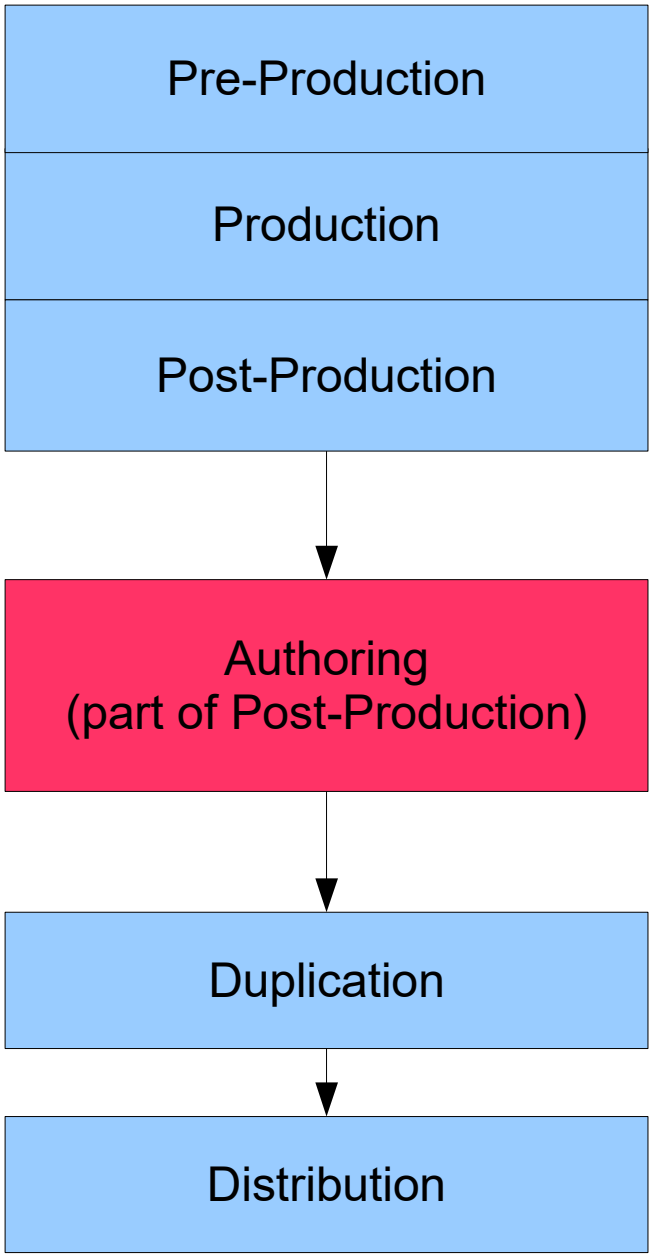
Steffen Bauer, Talk & Workshop 23/3/2010
LUG Linux User Group Frankfurt am Main

Agenda

Part 1 Talk: Introduction to optical media and DVD video

Part 2 Workshop: Creating a DVD from raw video

What is 'Authoring'?



Script, Financing, Casting, Crew hiring,
Location selection

Camcorder, Studio camera, CGI Animation

Editing, Quality improvement, Special effects,
Synchronizing, Background music

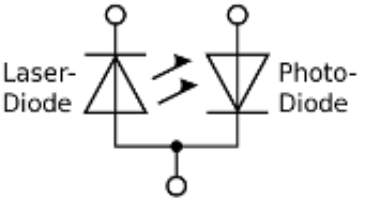
Encoding, Menu structure,
Master file generation

PC DVD-Burner - Mass manufacturing

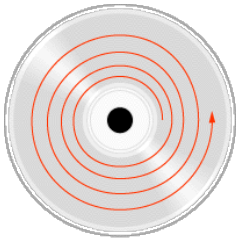
Basics of Optical Media

Information is stored as *change in reflectivity*

Core technology: *Semiconductor laser diode*



Data is encoded as a *single, continuous spiral data track*



Read-only, *write-once* or *limited re-recordable*
(max ca. 1000 re-writes)

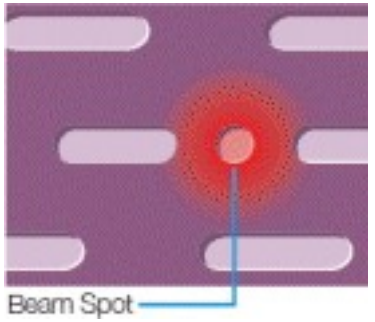
'Quite' rugged medium; susceptible to scratches and degradation

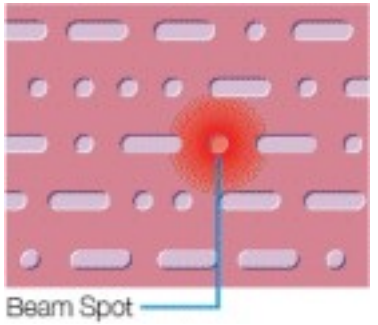
Still one of the best *cost/GB ratio* of mass storage media

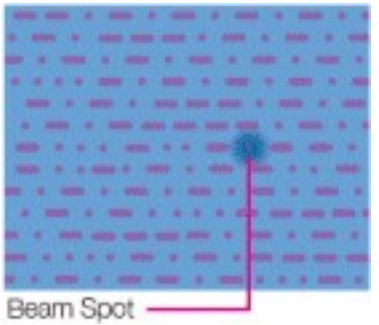
Main application: *Mass distribution* of fixed digital data
(software; digital audio / video)

CD / DVD / BluRay discs

	CD	DVD	Blu-Ray
Capacity	200-900 MB 650/700 MB (usually)	4.7 GB (SL) 8.5 GB (DL) 1.4 GB (Mini-DVD)	23-27 GB (SL) 54 GB (DL)
Data Rate (Mbit/s)	1.17 (1x) 65.62 (56x)	10.55 (1x) 210.94 (20x)	36 (1x) 432 (12x)
Audio formats	PCM, MP2	AC-3, MP2, PCM	AC3, MP2, PCM
Video formats	MPEG-1 (VCD) MPEG-2 (SVCD)	MPEG-2	MPEG1-2, H.264, VC-1
Laser Wavelength	780 nm (Infra-Red)	650 nm (Red)	405 nm (Violet)
Laser Spot	2,1 µm	1,3 µm	0,8 µm







Types of DVD discs

Logo	Type	Comment
	**Video**	Currently dominant consumer format for video
	**-**	DVD formats compliant with *DVD Forum* specifications
	**+**	DVD formats compliant with *DVD+RW Alliance* specifications (may be incompatible with standalone players)
	**R**	Recordable (once) discs
	**RW**	Re-Writable discs (multiple)
	**DL**	Dual (DVD forum) / Double (DVD+RW Alliance) layer discs (double capacity)
	**RAM**	Special format aimed at random r/w access and higher reliability for data storage

Optical Disc File Systems

ISO 9660	Filename 8+3 characters, max file size 2/4 GB (DOS stone-age legacy)
Versions:	
Level 2	Extends filename length to 32 characters
Level 3	Allows fragmented files
9660:1999	Removes most (artificial) restrictions
Extensions:	
TRANS.TBL	File in each directory storing extended filenames
Joliet	Extends filename length / Allows Unicode (Microsoft)
Rock Ridge	Adds POSIX file system semantics
El Torito	Enables media to be bootable (IBM)
HFS extensions	Supports Mac-specific file system features (Apple)
UDF	Replacement file system for ISO 9660
V 1.02 - V 2.60	DVD-Video (1.02); DVD-RAM (1.50); BD-RW (2.50)
Mount Rainier	Packet writing extension; needs MRW capable drive

Digital video format constraints

PAL video	VCD	SVCD	DVD
Resolution	352x288	480x576	720x576, 704x576, 352x576, 352x288
Aspect ratio	4:3	4:3	4:3, 16:9 (only for 720x576)
Video codec	MPEG-1	MPEG-2	MPEG-2
Video bitrate / Framerate	1152 kbps 25 fps	2600 kbps 25 fps	9800 kbps 25 fps
Audio codec	MP2	MP2	AC-3,PCM,MP2
Audio bitrate / Sample rate	224 kbps 44100 Hz	384 kbps (max) 44100 Hz	1536 kbps (max) 48000 Hz

Source: MEncoder documentation

Video DVD file structure

<dir> AUDIO_TS	Only used for Audio DVDs
<dir> VIDEO_TS	Main DVD video directory
VIDEO_TS:	
	VMGM Video Manager „First play item“
VIDEO_TS.IFO	Navigational info
VIDEO_TS.BUP	Backup of info file
VIDEO_TS.VOB	Video stream (Copyright notice; Main menus, etc.)
	Titlesets (min. 1, max. 99)
VTS_01_0.IFO	First titleset navigational info
VTS_01_0.BUP	Backup of info file
VTS_01_0.VOB	Video stream 1 Menu
VTS_01_1.VOB	Video stream 1 Title Part 1
VTS_01_2.VOB	Video stream 1 Title Part 2 (max 9 parts / 1 GB)
...	
VTS_02_0.IFO	Second titleset navigational info
VTS_02_0.BUP	...
VTS_02_0.VOB	
VTS_02_1.VOB	
...	

Video DVD virtual machine scripting language (dvdauthor)

Variables

16 General registers (G0 - G15) (only 12 usable with dvdauthor; 4 used for internals)
24 System registers (S0 - S23)
 audio (S1) Audio track (0-7)
 subtitle (S2) Subtitle track (0-31)
 button (S8) Selected button (No. * 1024)

Expressions

==, !=, >=, >, <=, <, &&, ||, !, eq, ne, ge, gt, le, lt, and, or, xor, not, +, -, *, /, %, &, |, ^, random(EXPRESSION)

Blocks

Single statement (terminated by semicolon ;)
Block of statements (encapsulated in { })

Commands

VARIABLE = EXPRESSION;
if (EXPRESSION) BLOCK; else BLOCK;
jump TARGET; Jump to specified title / menu
call TARGET; [resume CELL] resume; Call specified menu from a title w/ resume

Part 2: Workshop DVD authoring

DVD authoring open source tools

Task	Tool used in this workshop	Alternative tools
Identification	idvid (Tovid suite)	ffmpeg Mplayer
Single frame extraction	ffmpeg	mencoder
Image manipulation	Gimp	ImageMagick
Encoding	ffmpeg	mencoder transcode mjpegtools
Authoring	dvdauthor DVDstyler	qdvdauthor Tovid
.iso creation & burning	genisoimage dvdrecord	

Raw material identification

```
> ffmpeg -i <sourcevideo>

> mplayer <sourcevideo> -vo null -ao null -frames 0

> midentify.sh <sourcevideo>

> idvid <sourcevideo>
```

Single frame extraction

> ffmpeg -i <inputvideo>	Input video
-vframes 1	Number of frames
-ss 00:00:00	Extract at that time offset
-f image2	Output file type
<framename>.png	Output file

Encoding to DVD-compliant MPEG-2 (mencoder)

`> mencoder <inputvideo>`	Source file
`-oac lavc -ovc lavc`	Use libavcodec for audio&video
`-of mpeg`	Output format mpeg
`-mpegopts format=dvd:tsaf`	DVD video with timestamps
`-vf expand=640:360,`	(Optional) 4/3 to 16/9 ratio
`scale=720:576,`	Scale to DVD resolution
`harddup`	No frameskip
`-srate 48000`	Audio rate 48 kHz
`-af lavcresample=48000`	
`-lavcopts`	
`vcodec=mpeg2video:`	Video format MPEG-2
`vrc_buf_size=1835:`	Bitrates as of DVD standard
`vrc_maxrate=9800:`	
`vbitrate=5000:`	
`keyint=15:vstrict=0:`	For standalone player compatibility
`acodec=ac3:abitrate=192:`	Audio format AC3
`aspect=16/9`	Video aspect „Widescreen“
`-ofps 25`	Framerate 25 fps
`-o <outputvideo>.mpg`	Output file

Encoding to DVD-compliant MPEG-2 (ffmpeg)

Encoding to wide-screen, without padding:

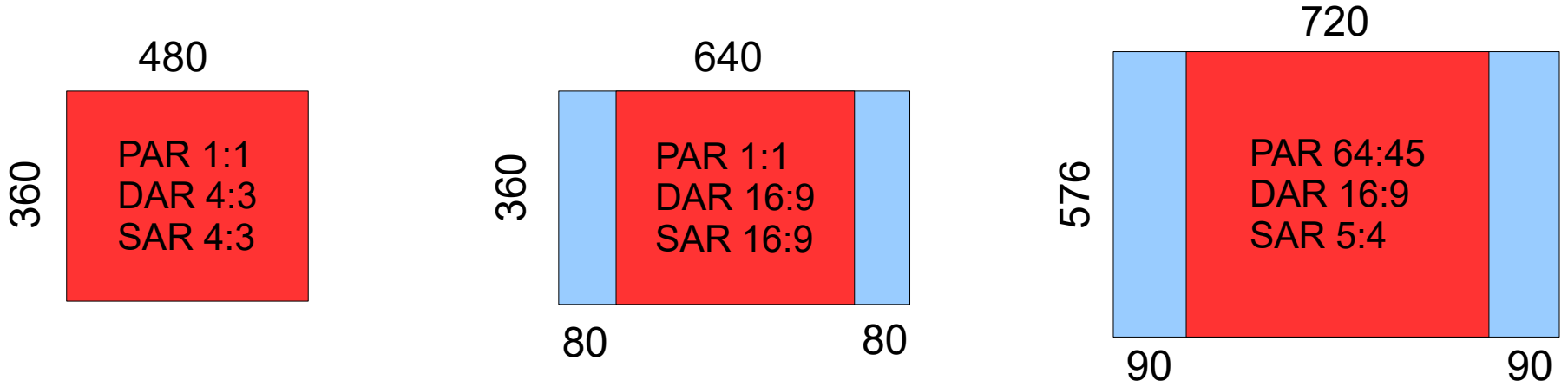
> ffmpeg -i <inputvideo>	Input video
-sameq	Use same quality as input video
-target pal-dvd	Encode into PAL-DVD
-aspect 16:9	Set Display aspect ratio of 16:9
<outputvideo>.mpg	Output video

Encoding 4:3 to 16:9 wide-screen, padding left/right with white borders:

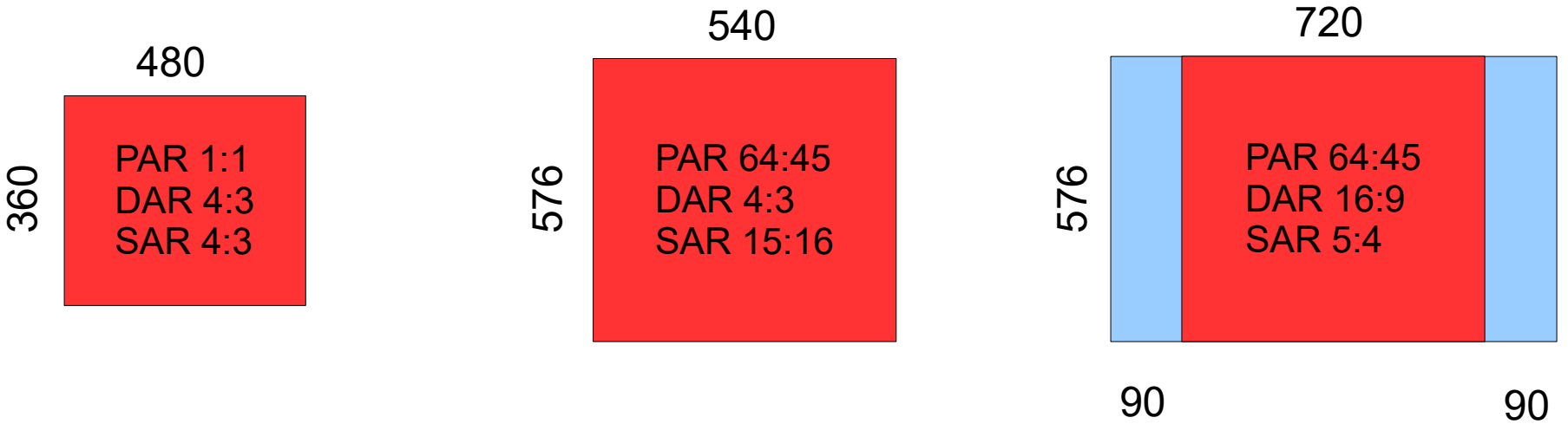
> ffmpeg -i <inputvideo>	Input video
-sameq	Use same quality as input video
-target pal-dvd	Encode into PAL-DVD
-padright 90	Pad 90 pixels right/left
-padleft 90	
-padcolor ffffff	Padding color (here: White)
-s 540x576	Rescale to Pixel aspect ratio 64:45
-aspect 16:9	Set Display aspect ratio of 16:9
<outputvideo>.mpg	Output video

4/3 to 16/9 Widescreen rescaling & padding

Padding 1st -> Scaling 2nd sequence (mencoder)



Scaling 1st -> Padding 2nd sequence (ffmpeg)

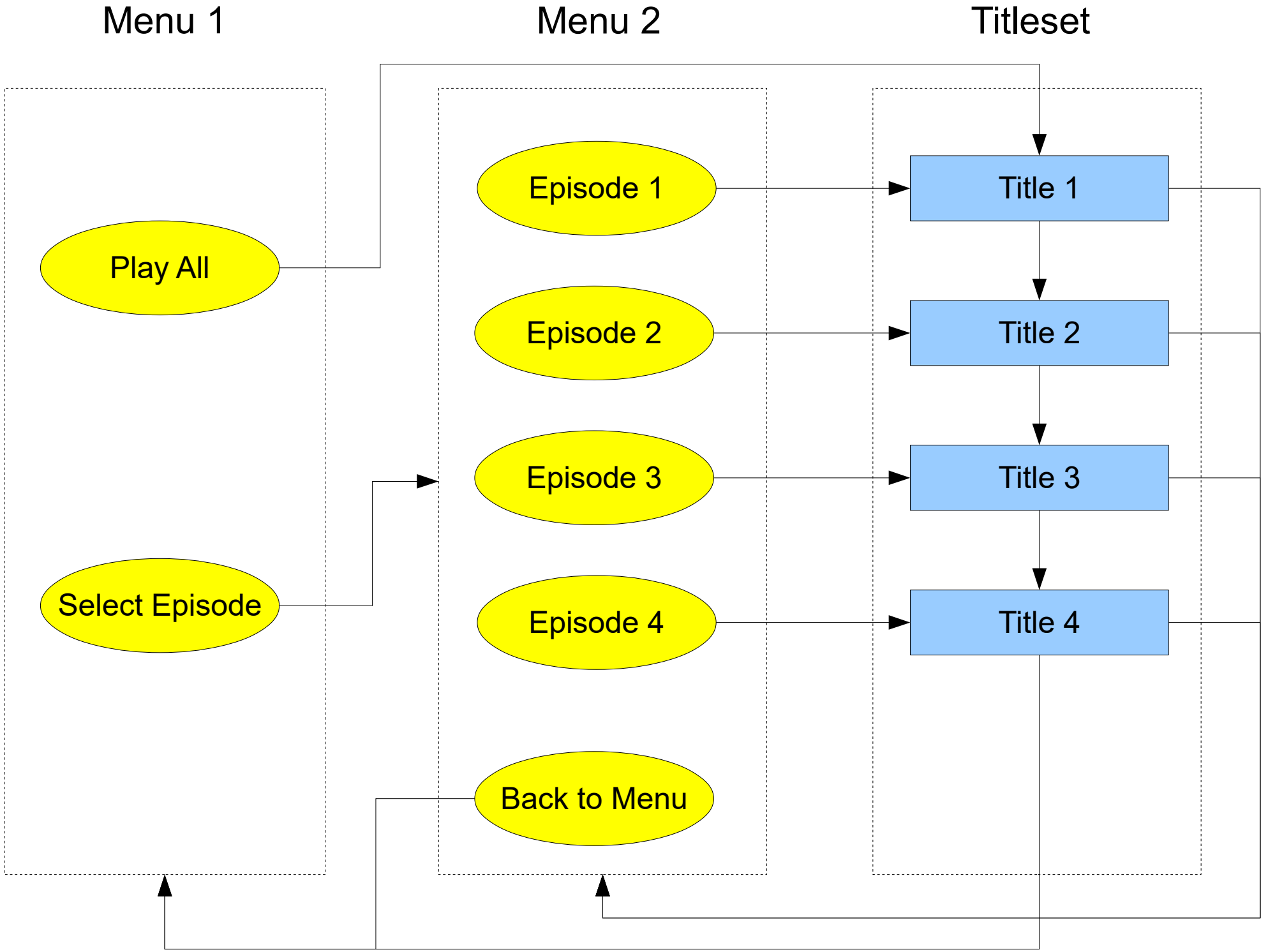


Creating DVD file structure with dvdauthor

```
> dvdauthor -o <DVD path> -x <dvd.xml>
```

Example XML file for a DVD with a single video, no menu:

```
<dvdauthor>
    <vmgm />
    <titleset>
        <titles>
            <pgc>
                <vob file="video.mpg" />
            </pgc>
        </titles>
    </titleset>
</dvdauthor>
```


Menu 1
Menu 2
Titleset
Play All
Select Episode
Episode 1
Episode 2
Episode 3
Episode 4
Back to Menu
Title 1
Title 2
Title 3
Title 4

„Play all“ / "Select Episode" menus with DVDstyler

VMGM menu 1:

Play All button action:	g0=1; jump title 1;
Select Episode button action:	jump vmgm menu 2;

VMGM menu 2:

Play title 1 button action:	g0=0; jump title 1;
Play title 2 button action:	g0=0; jump title 2;
Play title 3 button action:	g0=0; jump title 3;
Play title 4 button action:	g0=0; jump title 4;
Back to Menu button action:	jump vmgm menu 1;

Titleset:

Title 1 post command:	if (g0==1) { jump title 2; } else { call vmgm menu 2; }
Title 2 post command:	if (g0==1) { jump title 3; } else { call vmgm menu 2; }
Title 3 post command:	if (g0==1) { jump title 4; } else { call vmgm menu 2; }
Title 4 post command:	if (g0==1) { call vmgm menu 1; } else { call vmgm menu 2; }

Creating .iso file and burning to DVD

> genisoimage -V "DVD title"	Set DVD title
-o <dvdfile>.iso	Output .iso file
-dvd-video	Generate DVD-video compliant file
<DVD directory>	Path to DVD video file structure

> dvdrecord -v	Be verbose
speed=<writing speed>	Set writing speed
-dao	"Disc at once" mode
dev=/dev/dvd	DVD burner device
<dvdfile>.iso	.iso file

Useful links

Tutorials, forums etc.

http://dvd.sourceforge.net/dvdinfo/index.html	Information about DVD video structure
http://www.tappin.me.uk/Linux/dvd.html	"Some thoughts on DVD authoring"
http://www.videohelp.com/	Lots of tutorials
http://forum.doom9.org/index.php	Anything you want to know about digital video

Open Source projects

http://www.mplayerhq.hu/	Mencoder / Mplayer
http://ffmpeg.org/	FFmpeg
http://tovid.wikia.com/wiki/Tovid_Wiki	Tovid suite (collection of DVD scripts)
http://dvdauthor.sourceforge.net/	dvdauthor
http://www.dvdstyler.de/	DVDstyler (dvdauthor GUI frontend)
http://qdvdauthor.sourceforge.net/	Qdvdauthor (another dvdauthor GUI)
http://www.gimp.org/	The Gimp