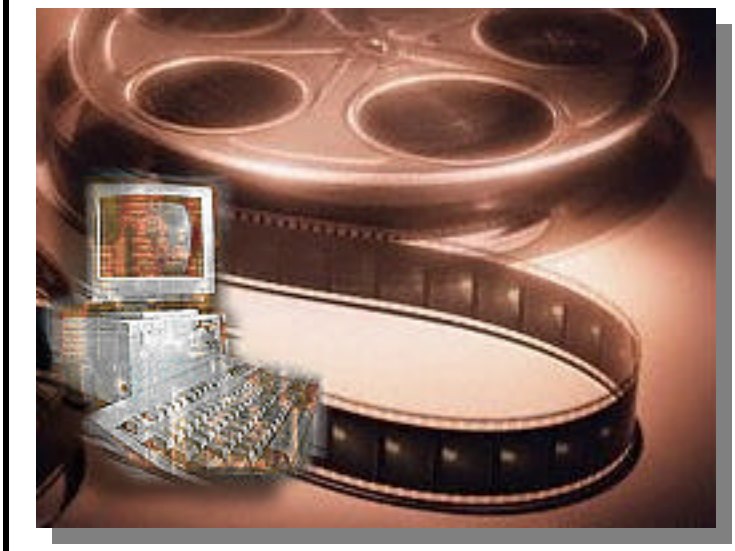
August 2001

UTAH TECHNOLOGY REPORT

DIGITAL FILM EDITING



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EXECUTIVE SUMMARY

From the golden age of Hollywood in the 1940s and '50s to the high-tech movie magic of today, the United States has grown a thriving film industry that boasts the top selling movies of all-time. Since the beginning of the 1990s, the gross US box office revenue has increased 60% to almost $8 billion dollars. In the year 2000, US residents attended 5 movies and purchased over 700 million pre-recorded videocassettes[i]; all of this with 35 millimeter film, a technology that has not changed in decades.

New technologies that have the potential to permanently change the face of the movie industry are on the horizon. Technologies such as digital film are poised to simultaneously save, and generate, hundreds of millions of dollars for the film industry, while enabling it to deliver a better product, and be more responsive to consumers.

Utah can play a role in facilitating the development of digital film and digital cinema technologies.

OBSERVATIONS

DIGITAL FILM AND DIGITAL CINEMA

OBSERVATION # 1: Digital film editing technology, and the entities involved therein, constitute one aspect of the revolutionary digital film value chain. The digital film value chain is a new construct where traditional film industry channels of control may shift.

OBSERVATION # 2: Digital film production, post-production, and exhibition, contain disruptive technologies to the current film industry. Producers and editors will be required to learn the new technologies or possibly lose their employment.

OBSERVATION # 3: The transition from 35mm to digital film seems to be following the same disruptive market conversion process as cassette to CD, traditional photography to digital format, and VHS to DVD.

OBSERVATION # 4: The adoption of digital film technologies in the mainstream film industry will be contingent upon the development of enabling technologies in related industries such as secure satellite transmission, digital and Internet security, and digital compression.

OBSERVATION # 5: Digital film editing (the use of computers to add special effects and edit film digitally) is already widely used among studios. However, the filming and exhibition of movies in the digital format has yet to gain widespread market adoption because digital transmission and Internet security technologies are not yet advanced enough to be used by the film industry to distribute films.

OBSERVATION # 6: The digital film industry has developed most rapidly among amateurs and independent studios that have produced films using relatively inexpensive digital video cameras, software, and computers.

OBSERVATION # 7: Studios hold a powerful position in the production, post-production, and distribution of films. Studios could save up to $1 billion alone in distribution costs by using digital film.

OBSERVATION # 8: All major studios have post-production facilities. Independent post-production facilities are typically used by major studios for technically challenging special effects. Post-production facilities are also used by large and small corporations for advertising films, corporate-related films, and small production pieces.

OBSERVATION # 9: Digital film is easier to store and duplicate than 35mm film, and is more durable over time than 35mm film (the quality of digital film does not degrade with repeated use). Digital film does have, however, inferior resolution and requires a large amount of storage space and processing capability. Many of the drawbacks of digital film are expected to disappear with advances in technology.

OBSERVATION # 10: Theaters will require a new investment in equipment, personnel, and training, in order to show digital films. Some estimate this investment to be $125,000 per screen for equipment alone. After this investment, however, theaters will enjoy flexibility in programming and efficient use of real estate. The most popular films could be shown more frequently, thereby increasing customer convenience and theater revenue.

OBSERVATION # 11: There are only about 30 installations for digital cinema in the world.

OBSERVATION # 12: Efficient distribution of digital film worldwide will necessitate a high degree of compatibility and interoperability between systems in different countries.

OBSERVATION # 13: The first public demonstration of a full-length motion picture from a major studio using digital electronic projectors in movie theatres took place on June 18, 1999 with the showing of George Lucas' *Star Wars*: Episode I *The Phantom Menace* on 4 screens.

OBSERVATION # 14: Technology development in the market at this stage will yield the highest returns in the areas of Digital Film Capture, Digital/Internet Security, Digital Compression, Digital Projection, and Satellite/Cable technologies.

DIGITAL FILM EDITING

OBSERVATION # 15: Digital film editing (or non-linear editing) is the editing of films on a computer rather than the cutting and splicing of 35mm film. Non-linear editing is to video production what the word processor is to writing.[ii] Digital film editing also includes the addition of computerized special effects to a film.

OBSERVATION # 16: All digital (non-linear) editing systems consist of a computer with a significant amount of RAM and external hard drive space, video board, video editing software, audio editing software, and video decks.

OBSERVATION # 17: The most prominent post-production companies are located principally in California, followed by New York. Competitiveness in the post-production industry involves the combination of technology with expertise in the artistic application of that technology.

OBSERVATION # 18: Digital film editing technologies have the potential to enable all post-production to take place digitally on a home computer.

OBSERVATION # 19: The low-end digital film editing systems are approaching the high-end, industry-standard systems in terms of technological capability.

OBSERVATION # 20: Digital film editing offers an enormous savings in time and labor over traditional editing, and an increased ability to experiment by enabling for the creation of multiple versions of a film for comparison.

OBSERVATION # 21: The technology that adds digital effects to films has enabled all types of filmmakers to create art that was not possible before.

OBSERVATION # 22: The majority of filmmaking is still done in 35mm. The process transferring film to a digital format for editing, and then back again to film, is too costly. Ideally, production, post-production, and distribution would be in the same digital format in order for the whole industry to derive the benefits of digital film.

UTAH AND DIGITAL FILM

OBSERVATION # 23: The Sundance Film Institute is a world-renowned film society. The Sundance Film Festival, sponsored by the Institute, has been a forum for all levels of filmmakers and has had an influential role in promoting digital film.

OBSERVATION # 24: Evans & Sutherland (which spawned Adobe and Pixar) is a leader in the development of 3D synthetic worlds. Evans & Sutherland also possesses a Digital Theatre Division that develops products and services for digital theater applications. Evans & Sutherland embodies a competency that maintains Utah's strong presence in digital graphics.

OBSERVATION # 25: Utah does not have industry leaders in post-production, nor does it have the presence of a major studio or production facility. But Utah is an attractive location to film and has ties with influential people in Hollywood.

OBSERVATION # 26: Utah does have a presence in the digital and Internet security portion of the Digital Film Value Chain.

RECOMMENDATIONS

RECOMMENDATION # 1: Be the primary test market for digital cinema. Establish relationships with studios in Hollywood to test and broadcast their digital films in our market. Provide incentives to convert theaters to digital projection. Considering that there are only 30 digital theatres worldwide, ten theatres equipped with digital projection would instantly make Utah the Digital Film Capital of the world.

RECOMMENDATION # 2: Form a coalition between the Utah Film Commission, digital software and hardware providers, theater owners, and studios to develop and show digital films.

RECOMMENDATION # 3: Attract a prominent studio to establish a facility in Utah. With a prominent studio, production facility, post-production facility, and distribution and exhibition network, the State will have the complete infrastructure for film production.

RECOMMENDATION # 4: Help the Utah companies who are developing supporting technologies, such as Internet Security, to establish relationships with studios, theatres, and hardware providers.

RECOMMENDATION # 5: Promote more collaboration between the Computer Science and Theater departments at state-run universities.

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INTRODUCTION

> *Gary Meyer, co-founder of Landmark Theaters, guesses it'll take less than six years for digital projectors to outnumber conventional 35mm projectors in commercial theaters. Richard Brandt, president of Trans-Lux Theaters, believes film projection could be a relic by 2005, and calls digital projection "the biggest revolution since sound."*
> *"There have been innovations and changes over the years, but fundamentally you were still showing the same thing -- it was all film," said Brandt, whose family has been in the theater business since 1914. "But now everyone knows digital projection will happen. We talk about it at our trade meetings and we've seen enough good samples to know."*[iii]

Digital film is a medium in which the audio and visual components of a film are recorded or digitized - just like other digital information - as a stream of 1's and 0's. Digital, or "non-linear," editing systems enable post-production facilities to glean a number of benefits over traditional celluloid-based 35 millimeter film recording.

> *The most important difference between film and digital media is the relative cost of storing and moving information…. (In) terms of the equipment needed, digital production is estimated to be about 1/17 the cost of comparable quality film production. Unlike film, digital formats require very little physical storage space, are easily duplicated, are durable over time and do not degrade with repeated use.*[iv]

CURRENT ADVANTAGES AND DISADVANTAGES OF DIGITAL FILM

ADVANTAGES	DISADVANTAGES
• Distribution cost savings	• Resolution
• Easier to store	• Hard drive/processing requirements
• Easier to duplicate	• Piracy protection
• Editing flexibility and efficiency	• Full screen discrepancy
• Flexibility in theatre programming	
Disrupts current industry structure (good and bad)	

- **ADVANTAGE:** With commercial theaters equipped with digital projections, the studios would no longer have to create, ship, insure and store 35mm prints in the U.S. -- a savings of an estimated $1 billion per year.[v]

• **ADVANTAGE:** Storage of films in digital format takes markedly less physical storage space and does not require as stringent environmental conditions (i.e. humidity and temperature).

• **ADVANTAGE:** Duplication of digital files can be accomplished in a fraction of the time that it takes to duplicate 35mm, just as a copying a WORD document can be accomplished with a few clicks of a mouse.

• **ADVANTAGE:** Digital film can be edited in a third less time than 35mm. Digital film editing also enables editors to easily make multiple versions of a film for comparison.

• **ADVANTAGE:** Digital film files will enable theaters to be more flexible in their programming, and more efficient in their use of real estate.

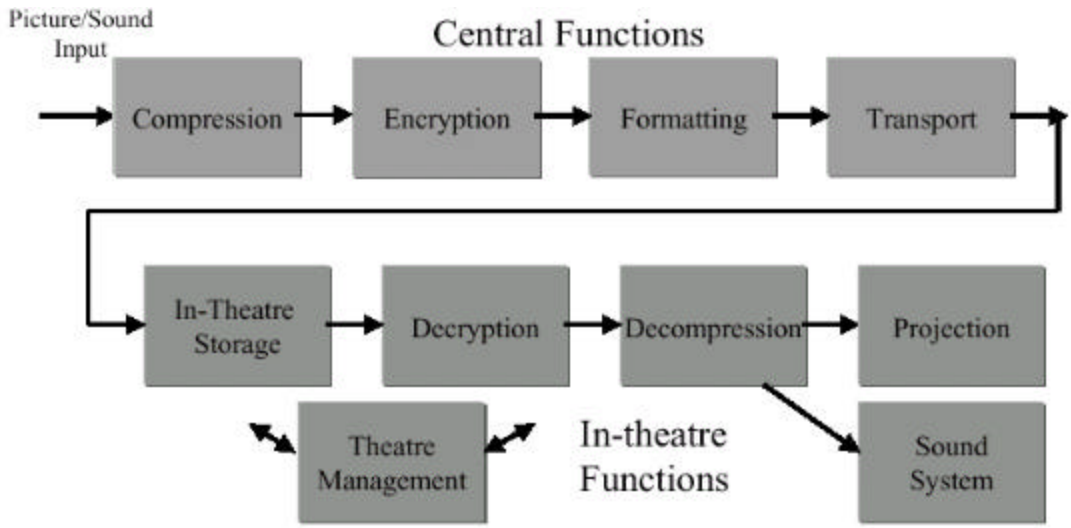


Diagram of digital film studio-to-theater transfer process – www.qualcomm.com

• DISADVANTAGE: Resolution for digital film broadcast in theaters is still slightly inferior to 35mm for the moment.

• DISADVANTAGE: Digital film takes up an incredible amount of hard drive space, and challenges the processing capability of even the best computers. A two-hour film requires 30 gigabytes of storage space.

> *In order for video to be manipulated by a computer, the signal must be digitized into pixels. A high-quality video signal comes in at 720 by 484 pixels per frame, meaning that more than 10 million pixels have to be dealt with every second.*
> *This overwhelms most computers' capacity. Even the most powerful systems are swamped when asked to perform the*

> *everyday video tasks that we take for granted, such as dissolves and simple effects. In addition, the internal pathways from memory to processor to peripherals quickly become clogged when moving just one video stream around, let alone more than one.* [vi]

• DISADVANTAGE:

> *"At this moment, some 270,000 movies are illegitimately downloaded every day. By the end of the year, it is estimated that a million films will be pirated each day…"* [vii]
>
> Jack Valenti
> President and CEO
> Motion Picture Association of America

Piracy is the foremost concern of any company that creates and distributes proprietary digital information. Digital security technology is not reliable enough to entice studios to distribute films in a digital format.

• DISADVANTAGE: Editing in a digital format does not allow an editor to efficiently view films on large screen. Coupled with the problem of resolution, a film's timing and clarity on a computer screen could be different when projected on a large screen.

DIGITAL FILM – A DISRUPTIVE TECHNOLOGY

Digital film is the prototypical disruptive technology. Disruptive technologies[viii]

1. Don't initially meet the needs of the mainstream customers
2. Appeal to only small or emerging markets
3. Introduce a different package of attributes
4. Disruptive technologies perform worse than the industry standard at the outset

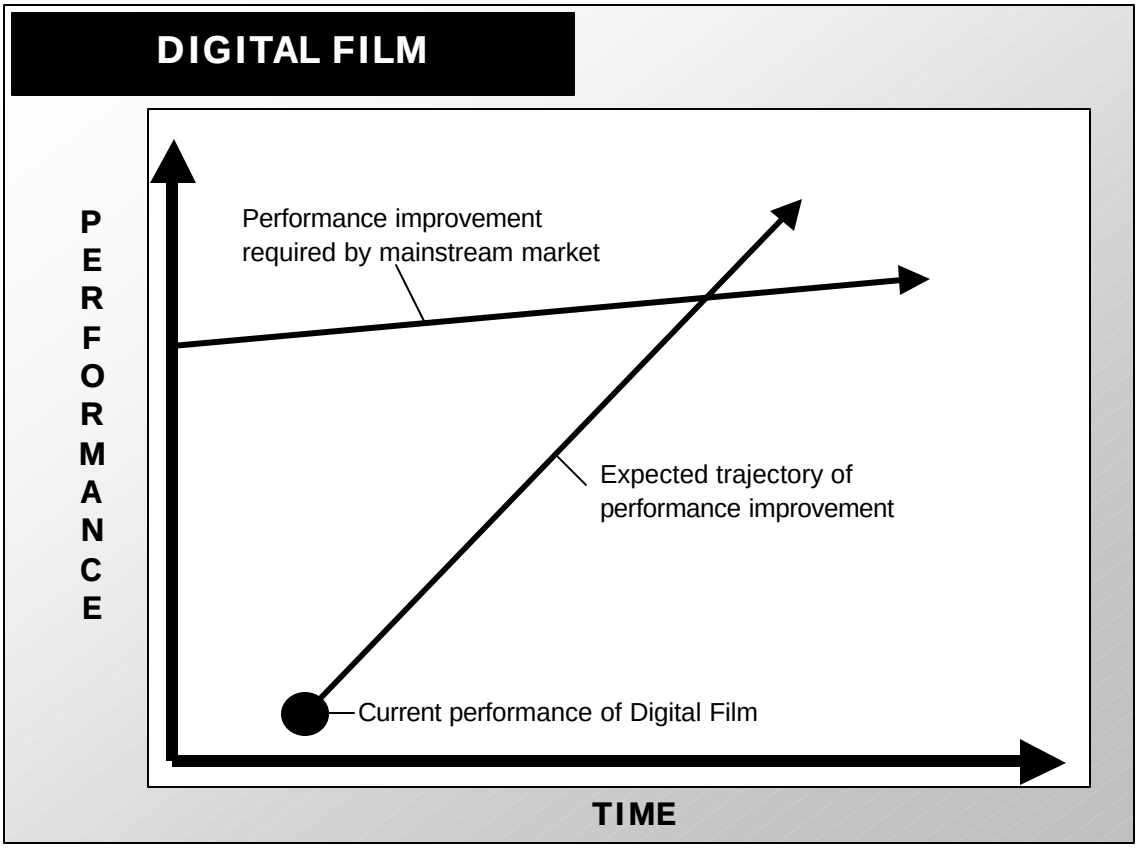
The important characteristic of a disruptive technology is that it eventually exceeds the performance of the mainstream technology. This *disruption* in the market changes the architecture or standard of the whole industry. A whole new purchase of infrastructure is required, as well the development of new skills and knowledge. As mentioned in the above table, this is simultaneously a good and bad thing - good for the companies who can take advantage of it, bad for the companies and workers who ignore it.

The following quote by film critic Roger Ebert points out why digital film is such a disruptive technology (see **Appendix A**):

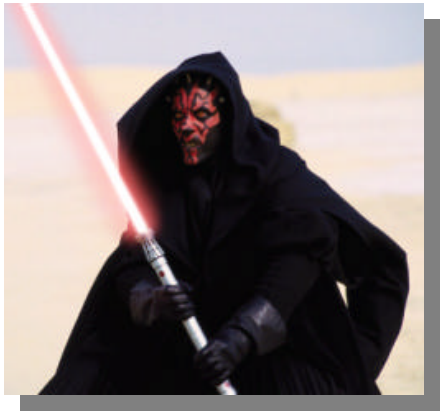
> *With theater chains declaring bankruptcy, the notion of $100,000 to $150,000 per screen for the equipment is not reasonable," Ebert said. "The rest of the world is nowhere near ready for digital ... so since prints are needed for India, China, Europe, Latin America, etc., digital is an extra expense rather than a savings.* [ix]

Digital film technology constitutes a new growth opportunity for a state or other economic region. **Figure 1** illustrates the disruptive performance trajectory of digital film that will eventually overtake the performance of 35-millimeter film.

Figure 1.



CURRENT STATE OF DIGITAL FILM

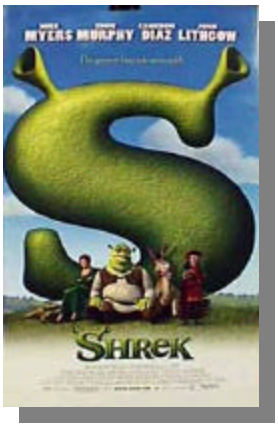


The development of digital film has been driven, most recently, by amateur filmmakers and small studios hoping to overcome the market power of the studios. Digital film technology has enabled individuals and small firms to cost-effectively acquire the means of production and post-production.

Prominent market "visionaries" have also pushed the development of digital film. George Lucas has been an influential figure in the development of digital film with the creation of *EditDroid* in 1984 – the first laser disc based non-linear system and the first to incorporate a graphic user interface. In addition, the first public demonstration of a full-length motion picture from a major studio using digital electronic projectors in movie theatres took place on June 18, 1999 with the showing of Lucas' *Star Wars*: Episode I *The Phantom Menace* on 4 screens. In April of 2001 the USC School of Cinema-Television's Robert Zemeckis Center for

Digital Arts was opened with George Lucas and Steven Spielberg as some of its principal donors.

With LucasFilms' announcement of a new partnership with Panavision to develop all-digital cameras to be used for the filming of the next two Star Wars films, the world moves a giant step closer to a true, popular digital cinema. Like many independent filmmakers, George Lucas envisions a cinema in which film-quality images will be recorded onto electronic hard drives, edited and manipulated on digital editing equipment, and then projected digitally via one of the several competing electronic projection systems currently in development.[x]

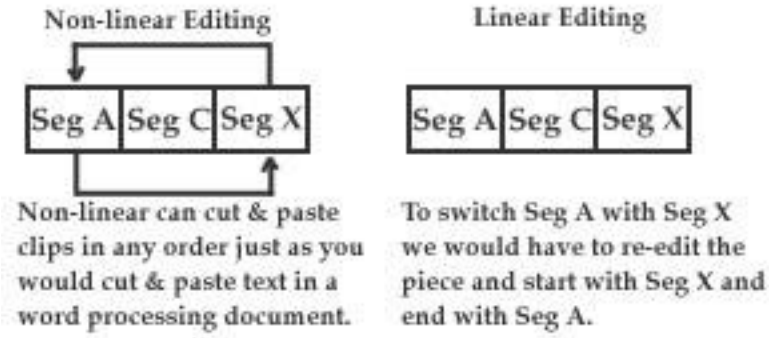


On May 19th, 2001 DreamWorks Pictures' announced that its computer animated comedy "Shrek" would be projected digitally in 11 theatres nationwide and in Canada. It marked the first time a DreamWorks film would be shown in the digital format.[xi]

DIGTIAL FILM EDITING

Non-linear editing is to video production what the word processor is to writing.[xii] You can edit three versions of a project using non-linear editing in the amount of time it takes to edit only one version of a project using linear editing.[xiii]

Figure 2.



Source: Bob DiGregio - http://www.newenglandfilm.com/news/archives/98april/nonlinear.htm

With linear editing, film must be cut in sequence from beginning to end. If the order of the sequence is changed then the piece must be re-edited from the beginning. Non-linear editing enables a change if sequence without the whole re-editing process.

All digital (non-linear) editing systems consist of a computer with a significant amount of RAM and external hard drive space, video board, video editing software, audio editing software, and video decks.[xiv] Digital film editing can also include the addition of digital effects to a film such as rotoscoping, painting, and compositing.

- Rotoscoping - the tracing of digital images to create 3D images.
- Digital painting - the digital addition of light, colors, or objects to a film such as in the film *What Lies Beneath* (right) where part of the room was digitally added.
- Compositing - the digital combination of two pieces of film.

Digital editing technology and its production of "synthetic realism" in movies has given directors powerful tools in creating art that was never possible before.

HISTORY OF NON-LINEAR EDITING

The following is an excerpt from the *New Technologies Report* published by CILECT, the association for the world's major film and television schools:[xv]

> Non-Linear editing has a longer history than most people are aware of. It started in **1983** with the **Montage *Picture Processor*** that utilized a bank of 17 VCRs. Seventeen copies of a source tape were made and a computer kept track of where machines are, in order to provide the illusion of non-linear editing. Similar VTR-based systems were introduced by **Ediflex** Systems and **TouchVision**.
>
> Unsatisfied with VTR-based system, some people in the industry started to experiment with videodisk because of their very fast access time. In **1984** the *EditDroid* (the name tells you that it was developed by **Lucas film**) laser disc based non-linear system was developed and was first to incorporate a graphic user interface. The system disappeared for few years and reappeared in 1990. With the development of recordable laser disc systems, new energy was put into development of a laser discs-based non-linear editing systems with the basic advantage of non-compressed, full screen picture. Ediflex, LucasArts and Amtel still produce such systems.
>
> In fall **1988**, **Editing Machines Corp**. (EMC) introduced a new approach to non-linear editing - the recording of digital video on the hard drives of IBM compatible computers. With the disadvantages of high compression and lower picture quality, the system offered significantly lower costs. In **1989** **Avid Technology** introduced *Avid Media Composer* that utilized **Apple** *Macintosh II* for its platform (which was lately joined by **Silicon Graphics** *Indigo* computer). Since then, both companies developed their products with the introduction of removable, re-usable optical (EMC) or removable magnetic discs (Avid).
>
> Avid and EMC were followed by other major competitors. Montage introduced *System III* and TouchVision *D/Vision* (based at the time on the DVI rather than JPEG compression board). **Digital F/X** added non-linear capabilities to *Video F/X* and British OLE Partnership introduced ***Lightworks*** well known for its user-friendly control console. Being very popular within the film and television industry, non-linear editing systems have attracted a lot of attention - every few months companies advertise new and improved systems.

DIGITAL EDITING SYSTEMS

The industry leader in digital film editing systems is Avid Technology on Route 128 in Boston, MA. Avid's suite of digital editing products is considered the industry standard and is used by most all major studios and post-production companies that are involved in digital editing. Avid's products can run from a few thousand to tens of thousands of dollars. **Appendix A** lists all of the major companies that produce digital editing systems. **Appendix B** is a comparative financial analysis of these companies.

Many of the high-end systems can cost as much as $50,000 and some have even been priced in the six-figure range. Recently, companies such as Apple, Adobe, and Ulead, have produced digital editing systems in the thousand-dollar range that rival the high-end systems in terms of technological capability. These programs have empowered amateur filmmakers and small studios by enabling them to afford the production and post-production of their filmmaking. The advancement of software and hardware technologies to capture and process digital film will potentially enable all post-production to take place inexpensively on a personal computer.

> *Many independent film producers are squeezing expensive electronic film editing systems into their tight budgets. Yet sitting on their desk is probably a computer capable of doing the job…. Just as page layout, photo retouching and even word processing once required expensive workstations that have since been replaced by inexpensive personal computers, film can now be edited with an off-the-self computer.*[xvi]

DIGITAL EDITING SYSTEMS	
COMPANY	**SYSTEM**
Avid	*Avid Cinema, Media Composer, Media Suite, Xpress, Symphony, DV Xpress*
Apple	*Final Cut Pro*
Adobe	*Premiere, After Affects, Photoshop*
Media 100	*EditDV*
Focal Point Systems (acquired by Apple)	*FilmLogic*
Quantel	*IQ*
Lightworks	*Lightworks*
Discreet Logic (acquired by Autodesk)	*Edit, D/Vision, Inferno, Flame, Smoke*
Asymetrix (now Click 2 Learn)	*Digital Video Producer*
eyeon Software	*Digital Fusion*
In-sync	*Speed Razor*
Leitch Technology - DPS	*Velocity*
Sonic Foundry	*Vegas Video*

Ulead Systems	*VideoStudio, MediaStudio*
Adcom	*Night Suite*
CMX (acquired by Chyron)	*Cinema*
Editing Machines Corporation (a division of Broadware)	*EMC Primetime*
Grass Valley	*Video Desktop*
Panasonic Japan	*WJ-MX1000*
Sony	*DLE-100, DNE-300*
Montage	*Montage III, Premium MX60*

Most studios already have post-production facilities in-house. Post-production companies outside the major studios do not possess any technological competitive advantage in digital film editing as the editing software and hardware requisite for digital film editing is, for the most part, ubiquitous. These companies vary in competitiveness based upon the skill and creativity of their personnel in using technology. **Appendix C** lists the major post-production companies. These companies have done everything from making a feather fly in *Forrest Gump*, to making the *Titanic* float…then sink.

Some studios have developed their own software. Pixar uses its proprietary software programs Marionette (modeling, animating, and lighting), Ringmaster (production management), and RenderMan (image rendering) to produce three-dimensional-looking animation.

SAMPLE OF STUDIO POST-PRODUCTION FACILITIES	
STUDIO FACILITY	**WEBSITE**
DreamWorks PDI	http://www.pdi.com
Lucasfilm Industrial Light + Magic	http://www.ilm.com
Fox Studios Post Production	http://www.foxstudios.com/los_angeles/postproduction/postprod.htm
Paramount Studios Post Production	http://www.paramountstudiogroup.com/postproduction/post_prod.html
Universal Studios Post Production	http://www.universalstudios.com/studio/postprod
The Walt Disney Studios - Production and Post Production	http://www.disney.com/StudioOperations
Sony Pictures Imageworks Post Production Facilities	http://www.sonypostproduction.com
Warner Bros. Studios Facilities Post Production Services	http://wbsf.warnerbros.com/cmp/postprod.htm

THE FILM INDUSTRY

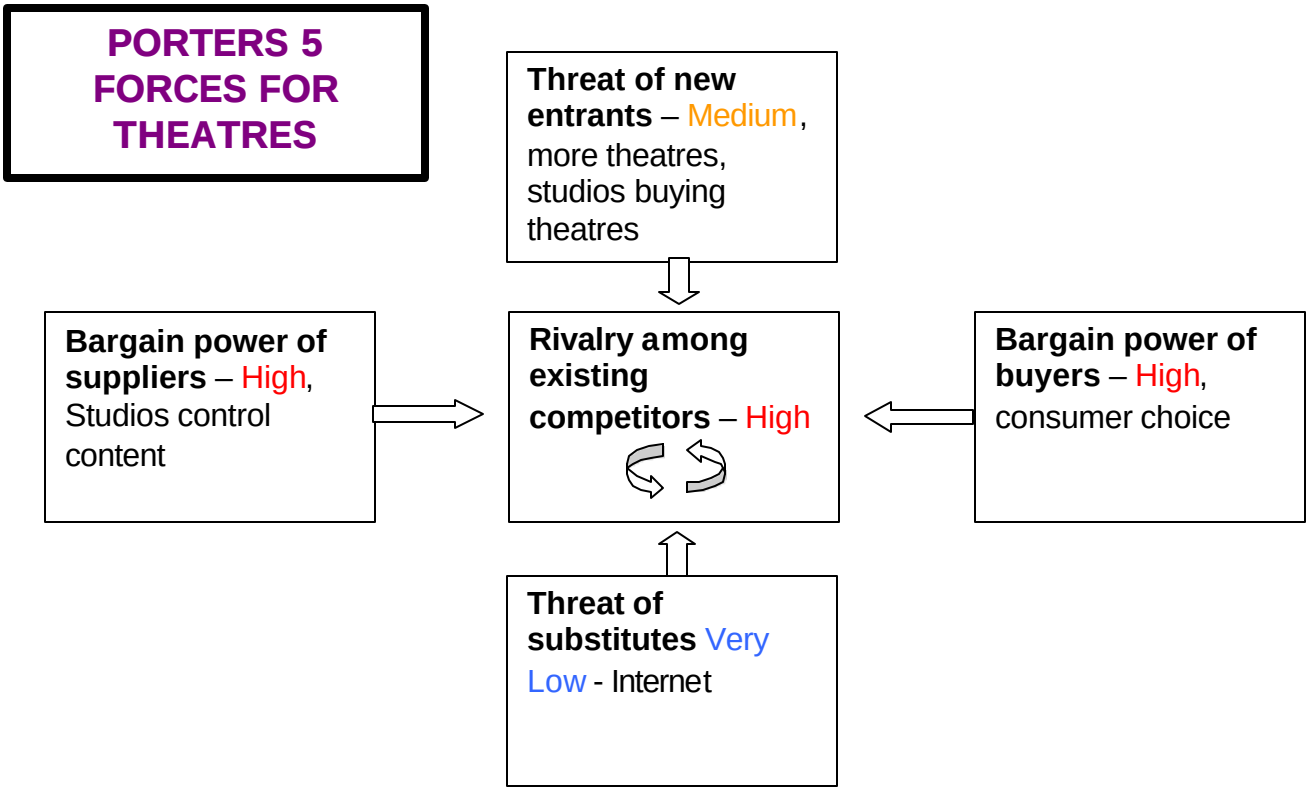
If money follows power, then power in the film industry resides with the Studios. **Figure 3** shows a "5 Forces[xvii]" analysis of the film industry and demonstrates that the studios control over all aspects of production, post-production, and marketing, afford them a powerful, and profitable, position in the industry. **Appendix D** lists the major studios.

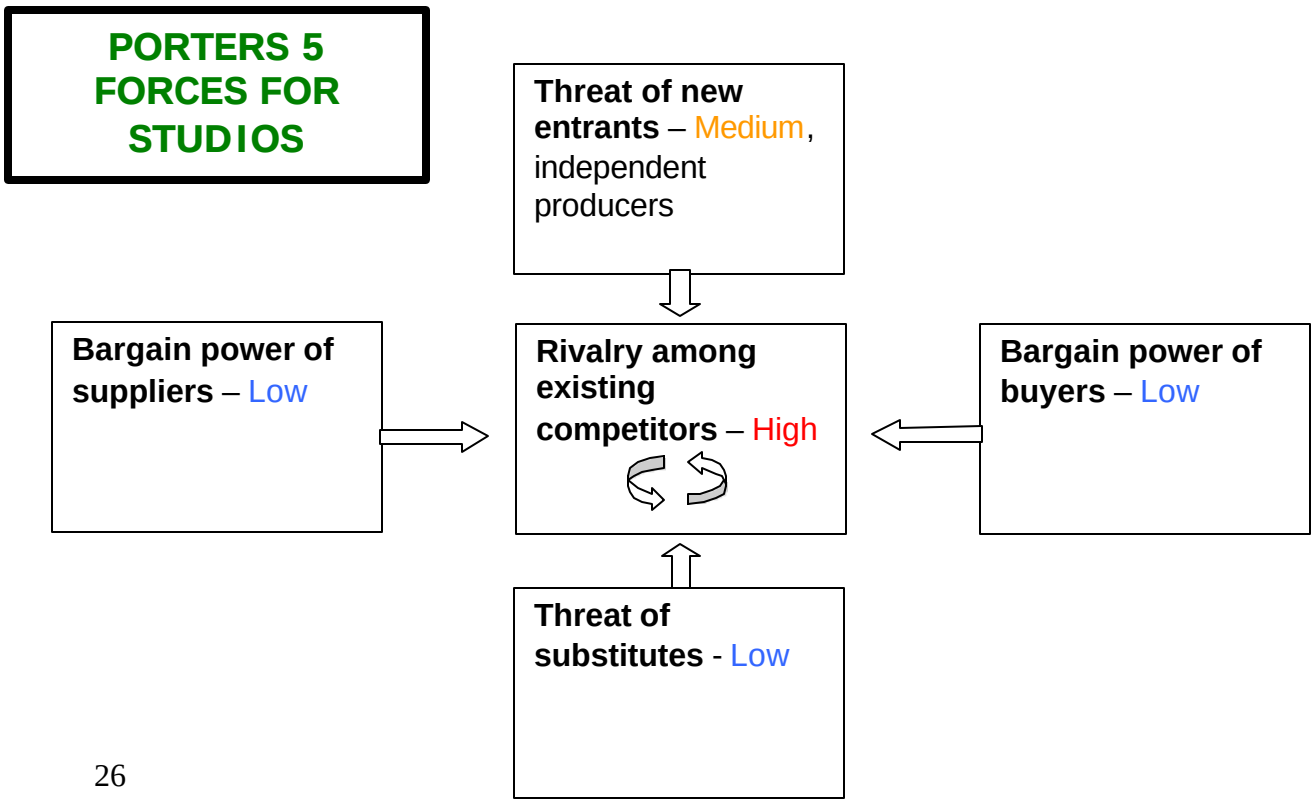
Collectively, the major studios control some 92 percent of the gross revenue earned on domestically released films. As things stand now, if your film is not distributed by one of the major studios, your chances of finding a large audience in the U.S. or Canada are extremely limited.[xviii]

Identifying the studio's position is critical to understanding how the process of the market adoption of digital film could possibly evolve. If studios started sending only digital films to theaters then theaters would be compelled to purchase digital projection hardware. Although this scenario is unlikely to occur, it illustrates the point that studios maintain a commanding position in the value chain. The following quote demonstrates how competition among theaters has exacerbated their problems.

> *The number of movie screens in the U.S. has jumped from 23,814 to 37,185 in the past ten years – a 56 percent rise. Demand for moviegoing, however, is roughly the same as it was in 1949 – about 1.5 billion people per year – according to recent Paine Webber analysis.*
>
> Brian McKernan[xix]

Figure 3.


PORTERS 5 FORCES FOR THEATRES
Threat of new entrants – Medium, more theatres, studios buying theatres
Bargain power of suppliers – High, Studios control content
Rivalry among existing competitors – High
Bargain power of buyers – High, consumer choice
Threat of substitutes Very Low - Internet


PORTERS 5 FORCES FOR STUDIOS
Threat of new entrants – Medium, independent producers
Bargain power of suppliers – Low
Rivalry among existing competitors – High
Bargain power of buyers – Low
Threat of substitutes - Low

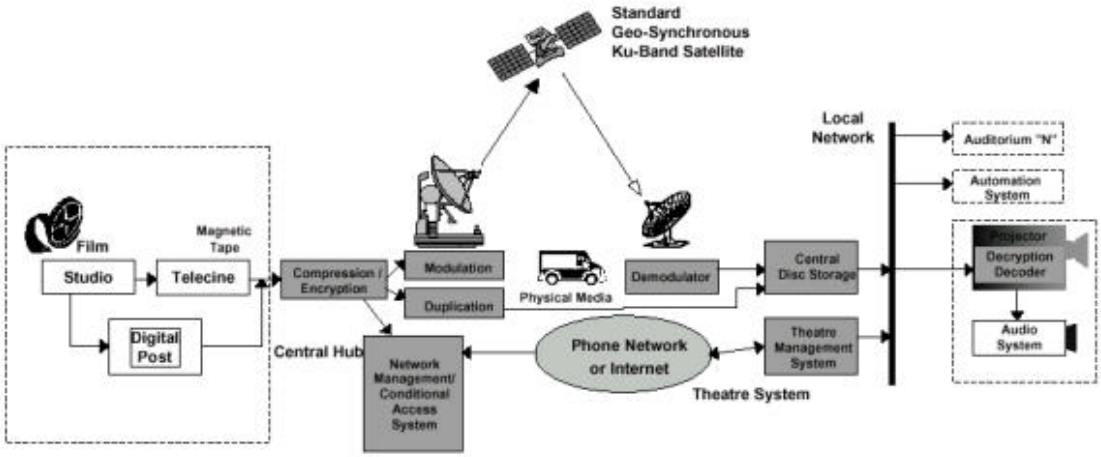
As mentioned previously, digital film and digital film editing are disruptive technologies in the film industry. Digital film editing would force editors to learn the new technology or lose their jobs. There are a host of other technical jobs that would replace non-technical production and post-production personnel. Producers that are unwilling to convert away from 35mm are preventing digital film from becoming more widespread in the market. Either these producers will eventually be compelled to learn the technology, or their generation will give way to a new generation of digital producers. Either way, the benefits of digital film are too great to be ignored for any participant in the value chain.

First-mover advantages and barriers to entry are important in the film industry. Major studios have established relationships and distribution channels that give them authority over decisions, and ultimately profits. Going to the theater is not something that will likely be replaced by the broadcasting of films over the Internet. In addition, major studios will not likely see much competition from independent studios, which are usually purchased as soon as they become a threat. No major changes happen in the film industry without the approbation of the major studios.

NEW FILM INDUSTRY VALUE CHAIN

With a disruptive change in technology, the movie industry will see radical changes in the next ten years in terms of the companies and industries that become involved in the production and distribution of films. For example,

- Miramax Films, Boeing, AMC Theatres and other strategic partners demonstrated theatrical motion picture distribution via satellite with the transmission of the movie *Bounce* in New York on November 14, 2000.



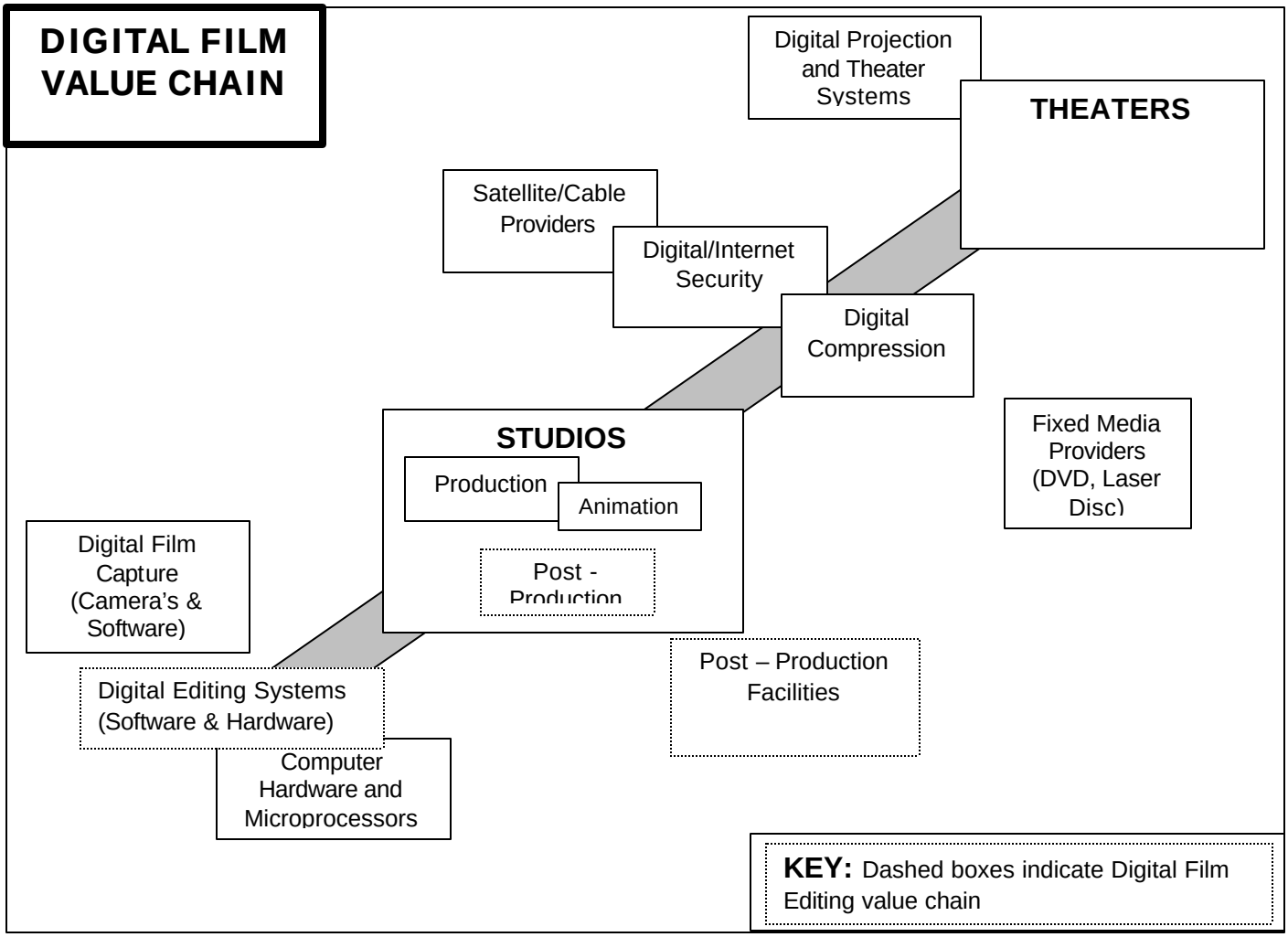
Possible configuration for commercial satellite transmission: www.qualcomm.com

- At Showest - the motion picture exhibition industry's convention – held in March in Las Vegas, Technicolor Digital Cinema, a Studio City, Calif. –based joint venture

between Technicolor and Qualcomm, announced plans to kick-start the digital cinema transition by providing, installing, and maintaining 1,000 digital cinema screens throughout the U.S.[xx]

Utah has the opportunity to become part of this technological disruption. **Figure 3** demonstrates the key players in the production and distribution of digital films. This diagram is a good model with which to evaluate the areas where Utah's competencies could have the most impact.

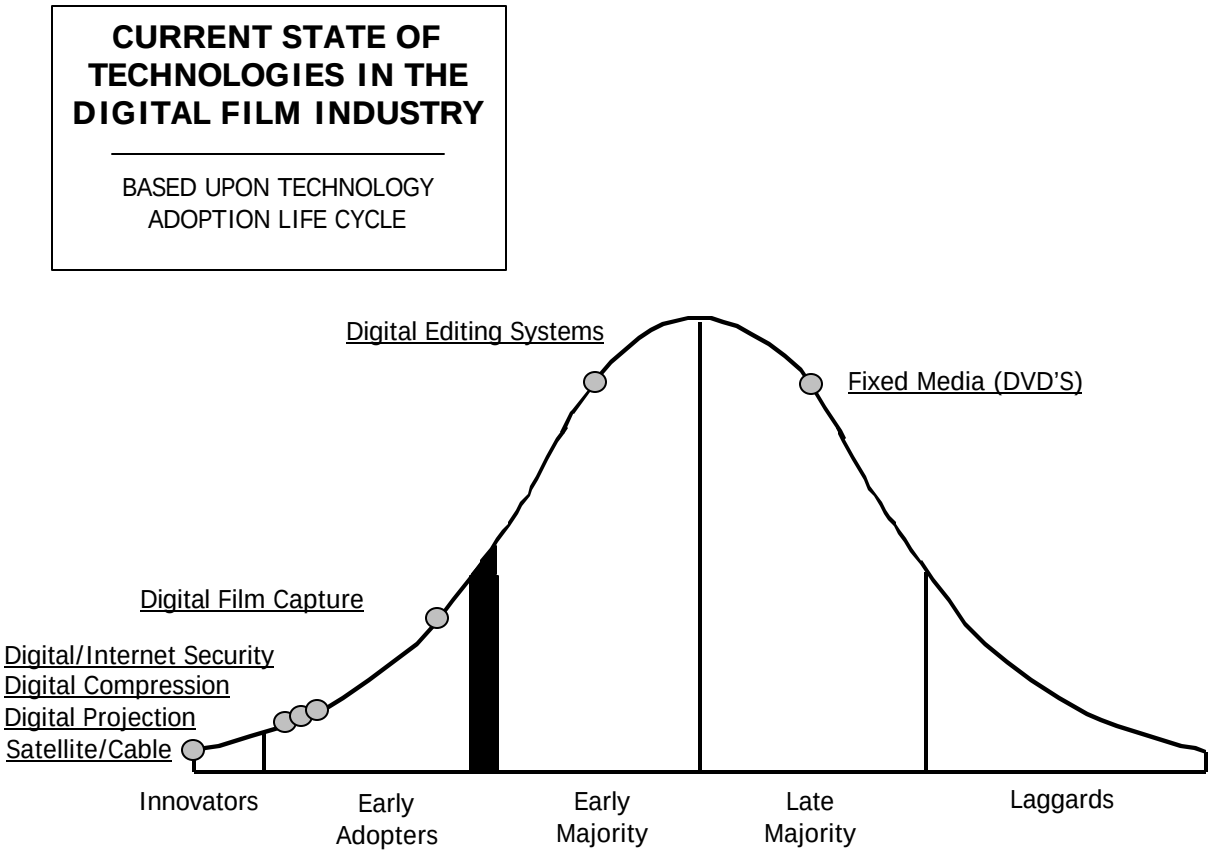
Figure 3.



> *"The promise that these evolving technologies can provide higher quality in motion pictures is a compelling new vision for the entertainment production industry, for theatre owners, for imaging industries, and for the technology providers. For the convergence of information technologies to deliver picture quality in an interoperable and secure system raises significant technical challenges."*
>
> CHARLES FENIMORE
> Program Chair
> Digital Cinema 2001 Conference

Different technologies along the Digital Film Value Chain are at different stages of development and market adoption. **Figure 4** illustrates the current state of these technologies based upon the Technology Adoption Lifecycle[xxi]. As the above quote indicates, the success of digital film will be contingent upon the convergence of these technologies. As can be seen in Figure 4, some of these technologies are already being used by a large portion of the market while some are in the nascent stages of market adoption.

Figure 4.



There are a number of important conclusions that can be drawn from this analysis:

1. Digital film editing - and its concomitant hardware and software components - is already being used by a large portion of the market. Entry into the market at this stage will likely not yield a high return.

2. The adoption of digital film capture into the marketplace is contingent upon the development of enabling technologies such as Digital Compression and Digital Projection.

3. The adoption of Digital Projection is dependent upon the development of Digital/Internet Security and Satellite/Cable systems.

4. Entry into the market at this stage will yield the highest returns in the areas of Digital Film Capture, Digital/Internet Security, Digital Compression, Digital Projection, and Satellite/Cable technologies.

UTAH FILM

Utah's film competencies reside in the beauty and variety of its film locations, its ties to influential people in the film industry, and the ease of production in a smaller market. Utah boasts an impressive list of work filmed in the state, below is just a sample of some prominent feature films:

City Slickers II	Con Air	Dumb and Dumber
Fletch	Footloose	Forrest Gump
Independence Day	Indiana Jones	Mission Impossible 2
Romancing the Stone	Thelma & Louise	Wall Street
2001: A Space Odyssey	Butch Cassidy and the Sundance Kid	Planet of the Apes

In addition there are numerous television series, made-for-television movies, and classic westerns that have been filmed in Utah.

Utah has made its mark on the film industry with the Sundance Film Festival. The festival is sponsored by the Sundance Film Institute, one of the most recognized independent filmmaking societies in the world. The institute, founded by Robert Redford, has guided the film industry by showcasing market innovators – the independent studios and filmmakers. Recently, the Festival has showcased digital film and arranged for films to be broadcast digitally.

> *Sundance's increasing attention to digital filmmaking is really a stamp of approval. It gives recognition to this movement as viable and real. People from all of the [Hollywood] studios are in Park City, and they can suddenly see that digital filmmaking is something more than an amateur movement, something more than people running around with DV cameras.*[xxii]

The state does not have industry leaders in digital film production or editing. Consequently, the State could most effectively spend its time and resources on enabling technologies such as digital security and software, since these will be higher-yield, more beneficial uses of State resources than waiting for digital film to get big, or building a studio in anticipation of high-profile tenants. If the State could, however, attract a high-profile studio, that studio would give market leverage to State and bolster the State's film industry.

RECOMMENDATIONS

RECOMMENDATION # 1: Be the primary test market for digital cinema. Establish relationships with studios in Hollywood to test and broadcast their digital films in our market. Provide incentives to convert theaters to digital projection. Considering that there are only 30 digital theatres worldwide (see **Appendix F**), ten theatres equipped with digital projection would instantly make Utah the Digital Film Capital of the world.

The Sundance Film Festival has taken a leadership position by promoting and exhibiting digital film. The Festival's efforts need to be expanded. The State could show leadership by embracing the technology and encouraging Hollywood to test their digital films in our market first.

RECOMMENDATION # 2: Form a coalition between the Utah Film Commission, digital software and hardware providers, theater owners, and studios to develop and show digital films.

No region in the world produces and exhibits digital films on a commercial basis. The State could organize a coalition between Hollywood studios, the State's high-tech computer sector, local theatres such as Larry Miller's Jordan Commons and Jordan Landing, and the Utah film commission to produce and debut digital films in the State.

RECOMMENDATION # 3: Attract a prominent studio to establish a facility in Utah. With a prominent studio, production facility, post-production facility, and distribution and exhibition network, the State will have the complete infrastructure for film production.

Studios and leading post-production facilities are well established in California. Utah would be better served to try and partner with or attract one of these companies to the State.

RECOMMENDATION # 4: Help the Utah companies who are developing supporting technologies, such as Internet Security, to establish relationships with studios, theatres, and hardware providers.

Utah has a tremendous background in software development and currently is one of the leading states for Internet security technologies. The State could help these companies to partner with studios and other media companies in order to facilitate the market application of their products.

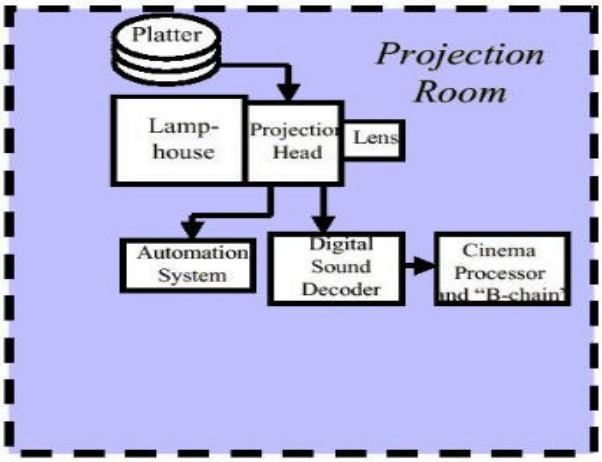
RECOMMENDATION # 5: Promote more collaboration between the Computer Science and Theater departments at state-run universities.

Theater students need to be familiar with the technologies that are driving their industry. Joint computer science/theater projects could yield highly innovative outcomes and spawn entrepreneurial activities.

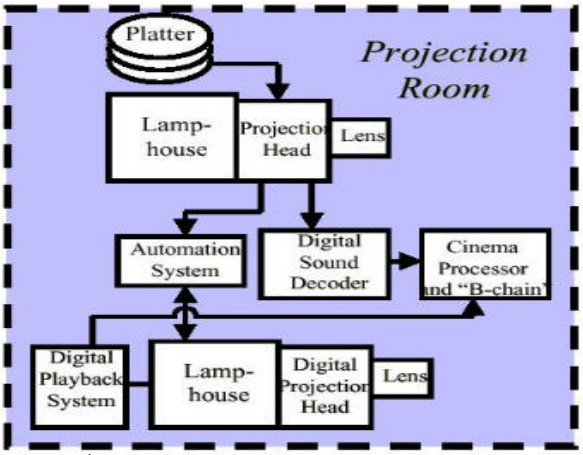
Digital Film is an important case study for future technology development within the State. A strategic analysis of a technology, including a 5 Forces and Product Life Cycle analysis, help to clarify what part of the value chain the State can develop in order to maximize its returns. Whether disruptive, enabling, or sustaining, a technology can yield significant economic benefits if Utah's competencies are effectively applied.

APPENDICES

APPENDIX A DIGITAL PROJECTION EVOLUTION

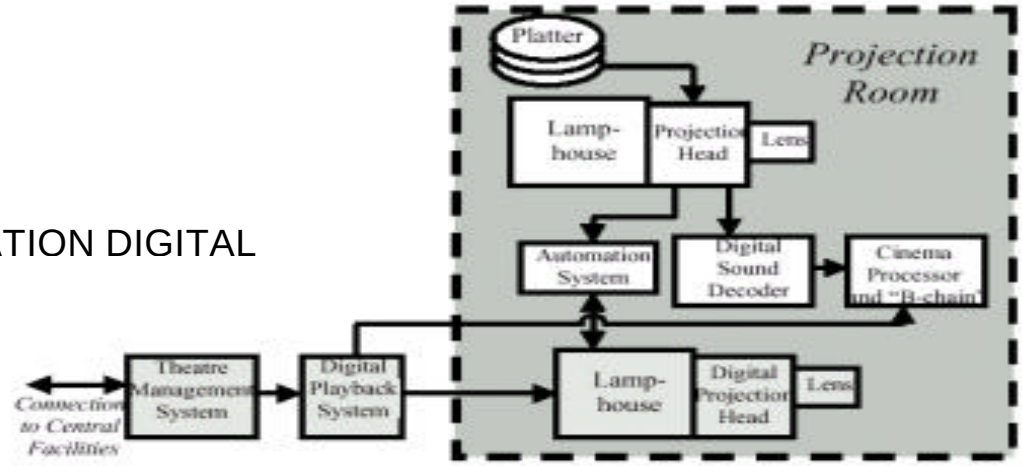


CURRENT

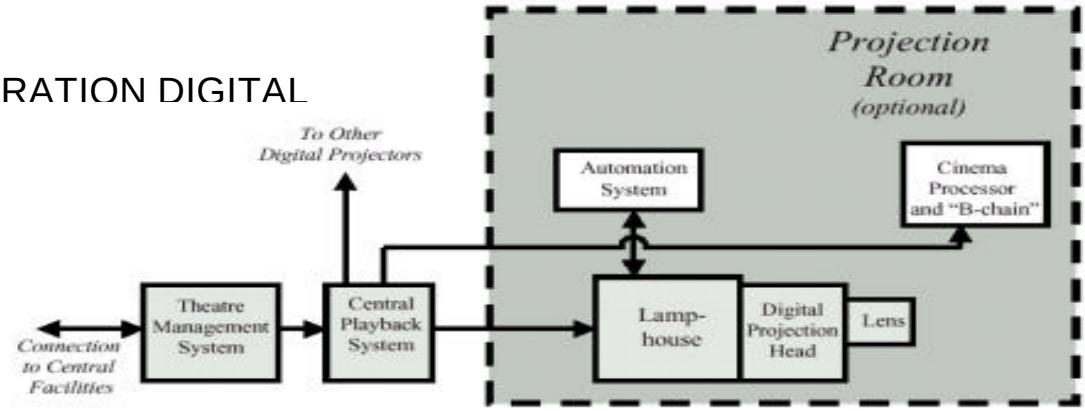


1st GENERATION DIGITAL

2nd GENERATION DIGITAL



3rd GENERATION DIGITAL



APPENDIX B

Source: Hoovers.com

Media - Movie, Television & Music Production Services & Products

SIC Codes Related To This Industry

SIC Code	*Industry Name*
3663	Radio & TV communications equipment
3695	Magnetic and optical recording media
7819	Services allied to motion pictures
7372	Prepackaged Software

COMPANY NAME	CONTACT INFORMATION
Accom, Inc. (immix)	1490 O'Brien Dr. Menlo Park, CA 94025 Phone: 650-328-3818 Fax: 650-327-2511 http://www.accom.com
Adcom	10 Timber Lane Marlboro, NJ 07746 Voice 732.683.2356 Fax 732.683.9792 Email info@adcom.com
Adobe Systems Incorporated	345 Park Ave. San Jose, CA 95110-2704 Phone: 408-536-6000 Fax: 408-537-6000 http://www.adobe.com
Apple Computer Inc.	1 Infinite Loop Cupertino, CA 95014 Phone: 408-996-1010 Fax: 408-974-2113 http://www.apple.com
Asymetrix (now Click 2 Learn)	110 110th Avenue NE Suite 700 Bellevue, WA 98004 425-462-0501 http://www.asymetrix.com
AutoDesk	111 McInnis Pkwy. San Rafael, CA 94903 Phone: 415-507-5000 Fax: 415-507-5100 http://www.autodesk.com
Avid Technology, Inc.	One Park West Tewksbury, MA 01876 Phone: 978-640-6789 Fax: 978-640-1366 http://www.avid.com
Chyron Corporation (discontinued purchased unit CMX in 1998)	5 Hub Dr. Melville, NY 11747 Phone: 631-845-2000

	Fax: 631-845-5210 http://www.chyron.com
Data Translation, Inc.	100 Locke Drive Marlboro, MA 01752-1192 USA Sales: (800) 525-8528 (US & Canada) Tel: (508) 481-3700 Fax: (508) 481-8620 E-Mail: info@datx.com WWW: www.datx.com
Discreet Logic (purchased by Autodesk in 1999)	10 Duke Street, Montreal, Quebec, H3C 2L7 Canada Telephone: (1) 514.393.1616 (2) 1.800.869.3504 Fax: (1) 514.393.0110 (2) 1.800.305.6442 http://www2.discreet.com/index-nf.html
Editing Machines Corporation (a division of Broadware)	Broadware Oostenburgervoorstraat 152 1018 MR Amsterdam The Netherlands
eyeon Software	2181 queen st. e. #201 Toronto, Ontario Canada M4E 1E5 http://www.eyeonline.com
Fast Multimedia AG	Postfach 21 01 07, D-80671 München, Germany Tel: 089 50206-0 – Fax: 089 50206-199 http://www.fastmultimedia.de
in-sync Corporation	7920 Norfolk Ave. 7th Fl. Bethesda, MD 20814 Phone: 301-656-1700 Fax: 301-657-5091 Toll Free: 800-864-7272 http://www.in-sync.com/public_website/
Laser-Pacific Media Corporation	809 N. Cahuenga Blvd. Hollywood, CA 90038 Phone: 323-462-6266 Fax: 323-464-6005 http://www.laserpacific.com
Leitch Technology Corporation (Digital Processing Systems, DPS, is a business unit)	11 Spiral Drive, Suite 10 Florence, Ky 41042 USA Phone 859-371-5533 FAX: 859-371-3729 Toll Free (From Within USA Only): 800-775-3314 http://www.dps.com
Liberty Livewire Corporation	520 Broadway 5th Floor Santa Monica, CA 90401 Phone: 310-434-7000 Fax: 310-434-7001 http://www.libertylivewire.com
LightWorks (formed from Tektronix)	2050 Bleury St. Montreal, Quebec H3A 2J5, Canada Tel: +1 (514) 844-8555

	Fax: +1 (514) 844-3777 http://www.lwks.com
Lucas Digital Ltd. LLC (includes Industrial Light + Magic)	3155 Kerner Blvd. San Rafael, CA 94912 Phone: 415-448-2173 Fax: 415-448-3350 http://www.lucasdigital.com
Mackie Designs Inc.	16220 Wood-Red Rd. NE Woodinville, WA 98072 Phone: 425-487-4333 Fax: 425-487-4337 Toll Free: 800-258-6883 http://www.mackie.com
Media 100 Inc.	290 Donald Lynch Blvd. Marlborough, MA 01752-4748 Phone: 508-460-1600 Fax: 508-481-8627 http://www.media100.com
Metatec International, Inc.	7001 Metatec Blvd. Dublin, OH 43017-3219 Phone: 614-761-2000 Fax: 614-766-3146 http://www.metatec.com
Pinnacle Systems, Inc.	280 N. Bernardo Ave. Mountain View, CA 94043 Phone: 650-526-1600 Fax: 650-526-1601 http://www.pinnaclesys.com.
Quantel	Turnpike Road Newbury Berkshire RG14 2NX t:+44 (0) 1635 48222 f: +44 (0) 1635 815815 http://www.quantel.com
Silicon Graphics (subsidiary is Alias/Wavefront)	1600 Amphitheatre Pkwy. Mountain View, CA 94043-1351 Phone: 650-960-1980 Fax: 650-932-0661 http://www.sgi.com
S.M.A. Real Time Inc.	100 Avenue of the Americas, 10th Fl. New York, NY 10013 Phone: 212-226-7474 Fax: 212-941-0439 http://www.smavid.com
Sonic Foundry	Sonic Foundry, Inc. 1617 Sherman Avenue Madison, WI 53704 608.256.3133 http://www.sonicfoundry.com/products/default.asp
Sonic Solutions	101 Rowland Way, Ste. 110 Novato, CA 94945 Phone: 415-893-8000 Fax: 415-893-8008

	http://www.sonic.com
Ulead Systems Inc.	10F, 45 Tung Hsing Rd. Taipei, Taiwan Phone: +886-2-8768-3899 Fax: +886-2-8768-2699 Toll Free: 800-858-5323 http://www.ulead.com
Videomedia Inc.	Videomedia, Inc. 175 Lewis Rd., #23 San Jose, CA 95111 Phone: 408.227.9977 Fax: 408.227.6707 http://www.videomedia.com/

APPENDIX C

Source: Hoovers.com

COMPANY PROFILES

Based upon year 2000 figures

COMPANY NAME	SALES (in millions)	EMPLOYEES	MARKET VALUE (in millions)	NET PROFIT MARGIN	RETURN ON EQUITY	12 MONTH NET INCOME GROWTH
Avid Technology	$476.1	1629	$232.3	(9.28%)	-	-
Autodesk Inc.	$936.3	3584	$2036.3	9.96%	21.8%	81.6%
Apple Computer Inc.	$7983.0	8568	$8643.7	9.8%	1.8%	30.8%
Adobe Systems Inc.	$1266.4	3007	$9005.2	21.26%	42.2%	1.3%
Media 100 Inc.	$72.9	327	13.7	(29.30%)	-	-
Pinnacle Systems	$252.7	460	$254.3	(23.82%)	-	-
Data Translation Inc.	$15.9	96	$2.8	(9.88%)	-	-
Accom Inc.	$33.5	112	$0.968	5.9%	-	2.4%
Leitch	$110.1	709	$427.3	10.6%	-	-
Laser-Pacific Media	$33.1	225	$23.6	10.09%	18.3%	-
Liberty Livewire Corp.	$253.1	3500	$467.7	(3.87%)	-	-
Sonic Foundry	$27.4	245	$38.0	-	-	-
Sonic Solutions	$16.5	96	$18.8	(40.13%)	-	-
Ulead	N/A	300+	N/A	N/A	N/A	N/A

APPENDIX D PROMINENT POST-PRODUCTION COMPANIES

PROMINENT POST PRODUCTION COMPANIES INVOLVED IN DIGITAL	
AFCG	New York, NY http://www.afcg.com
American Production Post	Seattle, WA http://www.apsnw.com/
Available Light Ltd.	Burbank, CA. http://www.availablelightltd.com
Balsmeyer & Everett, Inc.	New York, NY http://www.balsmeyer-everett.com/
Banned From The Ranch	Santa Monica, CA http://www.bftr.com/
Bouquet Multimedia	Oxnard, CA http://www.bouquet.com/
Buf Compagnie	Paris, France http://www.buf.fr/
C.O.R.E Digital Pictures	Toronto, Canada http://www.coredp.com/
CCI Digital	Burbank, CA http://www.ccipost.com
Celefex	New York, NY http://www.celefex.com
CenterCity Film & Video	Philadelphia, PA http://www.ccfv.com
Centropolis Effects	Los Angeles, CA http://www.centropolis.com
Century III	Orlando, FL http://www.century3.com
Century Productions	Las Vegas, NV http://www.centurylv.com
charlieuniformtango	Dallas, TX http://www.charlietango.com
Chiodo Bros. Productions, Inc.	Burbank, CA http://www.chiodobros.com/
Cine-Byte Imaging, Inc.	Ontario, Canada http://www.cinebyte.com/
Cinesite, Inc	New York, NY http://www.cinesite.com
CIS Hollywood-Composite Image Systems	Hollywood, CA http://www.cishollywood.com/
Click3x	Atlanta, New York, San Francisco, Los Angeles http://www.click3x.com/
Command Post Toybox	Toronto, Canada http://www.compt.com/
Compass Rose Media	Santa Cruz, CA http://www.compassrosemedia.com/
Component Post	Santa Clara, CA http://www.cpost.com
Computer Cafe	Los Angeles, CA http://www.computercafe.com/
Crawford Digital	Atlanta, GA http://www.crawford.com/

Crop Circle Studios	Monterey, CA http://www.cropcirclestudios.com/
Curious Pictures	New York, NY http://curiouspictures.com/
Digital Domain	Venice, CA http://www.digitaldomain.com/
Digital Filmworks, Inc	Los Angeles, CA http://www.dfw-la.com
Digital Firepower	Los Angeles, CA http://www.digitalfirepower.com
Dream Theater Studio	Van Nuys, CA http://www.dreamtheater.com/
Dreamscape Imagery	Hollywood, CA http://www.dreamscapeimagery.com/
Duboi	France http://www.duboi.com/
Duck Soup Produckions Inc.	Los Angeles, CA http://www.ducksoupla.com/
Encore Hollywood / Encore Video	Hollywood, CA http://www.encorevideo.com
Framestore	UK http://www.framestore.co.uk/
FVS Media	San Francisco, CA http://www.fvs.com
Hammerhead Productions	Los Angeles, CA http://www.hammerhead.com/
HMA Digital Post Production	Burbank, CA http://www.hmadigital.com
Intelecon Digital Studios	Dallas, TX http://www.intelecon.com/
Manex Visual Effects	Almeda and Culver City, CA http://www.mvfx.com/
Match Frame	Austin, TX http://www.matchframe.com/
Matte World Digital	Novato, CA http://www.matteworld.com/
Method Studios	Santa Monics, CA http://www.methodstudios.com/
Metrolight Studios	Los Angeles, CA http://www.metrolight.com
Modern Digital	Seattle, WA http://www.moderndigital.com/
National Video Center	New York, Boston, Westport http://www.nationalvideocenter.com/
Pacific Title/Mirage Digital	Los Angeles, CA http://www.pactitle.com/
Pixel Envy	Los Angeles, CA http://www.pixel-envy.com/
Pixel Liberation Front (PLF)	Los Angeles, New York http://www.thefront.com/
Rainmaker Digital Pictures	Canada, California http://www.rainmaker.com/
REZN8	Hollywood, CA

	http://www.rezn8.com/
Rhythm & Hues Studios	Los Angeles, CA http://www.rhythm.com/
Roland House	Arlington , VA http://www.rolandhouse.com
Rushes	London, England http://www.rushes.co.uk/
Spontaneous Combustion	New York, NY http://www.spon.com/
Spots BME, Inc	Chicago, IL http://www.spotsbme.com
Tape House Digital (also known as Blacklogic)	New York, NY http://www.tapehouse.com/
Technicolor	Hollywood, CA http://www.completepost.com/
The Computer Film Company	Los Angeles, London http://www.cfc.co.uk/
The Image Group	New York, NY http://www.image-group.com/
The Mill	UK http://www.mill.co.uk/
The Moving Picture Company	London, England http://www.moving-picture.com/
The Post Group	Hollywood, CA http://www.postgroup.com
Todd AO/Hollywood Digital	Los Angeles, CA http://www.toddao.com/ www.hollydig.com
Traveling Pictures	http://www.tpacs.com/
View Studio	Hollywood, CA http://www.viewstudio.com/
Western Images	San Francisco, CA http://www.westernimages.com
Weta Ltd.	New Zealand http://www.wetafx.co.nz/
Yale Video	Anaheim, CA www.yalevideo.com

APPENDIX E

Source: Hoovers.com

Media - Motion Picture & Video Production & Distribution

SIC Codes Related To This Industry	
SIC Code	*Industry Name*
7812	Motion picture & video production
7822	Motion picture and tape distribution
7829	Motion picture distribution services

COMPANY NAME	CONTACT INFORMATION
DreamWorks SKG	1000 Flower St. Glendale, CA 91201 Phone: 818-733-7000 Fax: 818-733-9918 http://www.dreamworks.com
Lucasfilm Ltd. (Industrial Light + Magic)	5858 Lucas Valley Rd. Nicasio, CA 94946 Phone: 415-662-1800 Fax: 415-662-2437 http://www.lucasfilm.com
Metro-Goldwyn-Mayer Inc. (MGM Pictures and United Artists Films)	2500 Broadway St. Santa Monica, CA 90404 Phone: 310-449-3000 Fax: 310-449-3100 http://www.mgm.com
Paramount Entertainment (business segment of Viacom)	5555 Melrose Ave. Los Angeles, CA 90038 Phone: 323-956-5000 Fax: 323-862-1134 http://www.paramount.com
Pixar Animation Studios (Chairman and CEO Steve Jobs - a co-founder of Apple Computer)	1200 Park Ave. Emeryville, CA 94608 Phone: 510-752-3000 Fax: 510-752-3151 http://www.pixar.com
Sony Pictures Entertainment (part of the Sony Broadband unit of Sony Corporation of America; home to movie unit Columbia TriStar Motion Picture Group)	10202 W. Washington Blvd. Culver City, CA 90232 Phone: 310-244-4000 Fax: 310-244-2626 http://www.spe.sony.com
Studio Canal (Vivendi Universal owns 86% of Studio Canal)	Espace Lumière, 5-13 boulevard de la République 92100 Boulogne-Billancourt, France Phone: +33-1-71-75-99-99 Fax: +33-1-71-75-88-88 http://www.studiocanal.fr
Universal Studios, Inc. (subsidiary of Vivendi Universal)	100 Universal City Plaza Universal City, CA 91608-1002 Phone: 818-777-1000

	Fax: 818-866-3600 http://www.universalstudios.com
Walt Disney Studio Entertainment (Miramax)	500 S. Buena Vista St. Burbank, CA 91521-9722 Phone: 818-560-1000 Fax: 818-560-1930 http://disney.go.com/business_info
Warner Bros. (division of Time Warner Entertainment)	1325 Avenue of the Americas New York, NY 10019 Phone: 212-636-5000 Fax: 212-397-4736 http://www.warnerbros.com

APPENDIX F LOCATION OF DIGITAL CINEMA THEATRES

http://www.mpaa.org/dcinema/LocationofDigitalCinemaTheatres.htm

UNITED STATES, CANADA & MEXICO
Burbank, CA AMC Media Center North
Chestnut Hill, MA General Cinema Theatres
Hollywood, CA El Capitan
Irvine, CA Edwards Irvine Spectrum
Lake Buena Vista, FL AMC Pleasure Island 24
Mexico City Cinemex Mundo E
New York, NY AMC Empire 25 (Two Screens)
Olathe, KS AMC Studio 30
Plano, TX Cinemark Legacy
San Diego, CA AMC Mission Valley 20
San Francisco, CA AMC Van Ness
South Barrington, IL AMC Barrington 30
Tempe, AZ Harkins Theatres Arizona Mills
Toronto, Ontario Famous Players Paramount
Valley View, OH Cinemark Valley View
Vancouver, BC Famous Players Riverport
Tlanepantla, MEXICO Cinemex Mundo E
EUROPE

Brussels, Belgium Kinepolis Ciudad de la Imagen
London, England Odeon Leicester Square
London, England Warner Village Finchley Road
Manchester, England UCI, Trafford Centre
Paris, France The Gaumont Aquaboulevard
Dusseldorf, Germany Dusseldorf
Berlin, Germany Berlin Zoo Palast
Cologne, Germany Cinedom Cologne
Madrid, Spain Kinepolis Ciudad de la Imagen
Barcelona, Spain UCI's Cinesa Diagonal
ASIA
Chiyoda-ku,Tokyo, Japan Nichigeki Theatre
Seoul, Korea Seoul Cinema Town
Tokyo Japan AMC Tokyo Disneyland

Canada
2
United States
5
1
1
1
1
1
1
Mexico
2
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Hawaii
Alaska
Havana
Cuba
The Bahamas
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Europe
Norway
Finland
Sweden
Estonia
Russia
Latvia
Lithuania
Russia
Baltic Sea
North Sea
Denmark
United Kingdom
3
Ireland
Belarus
Poland
Neth.
Germany
3
Ukraine
English Channel
Belgium
1
Lux.
Czech Rep.
Slovakia
Moldov
France
1
Liech.
Switz.
Austria
Hungary
Romania
Bay of Biscay
Slovenia
Croatia
Bos.& Herz.
Serbia
Bulgaria
Italy
Mont.
Mace.
Portugal
2
Spain
Alb.
Greece
Tyrrhenian
Ionian Sea
Aegean Sea
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http://www.mpaa.org/dcinema/

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