

# Digital Cinema: Episode II



- **Digital Cinema is not yet ready for prime time.** After writing a relatively bearish report on the subject two years ago, we were able to interview executives from Kodak, Boeing, DreamWorks, Premier, and other industry insiders over the past few months. Our initial bearishness appears to have been warranted with the technology making little progress in that time.
- **Two years ago, some predicted that more than 1,000 digital projection systems would be deployed by now. Less than 100 are operational owing to unfavorable economics. We estimate that total system costs need to be less than \$50,000 to be viable. Current projection systems range from \$100,000-200,000. We pushed out our digital cinema estimate of 5% penetration from 2004 to 2006.**
- **Kodak avoided jumping on the DLP bandwagon and became the technological leader. Its projectors feature 2K resolutions that should meet standards, unlike Texas Instrument's DLP technology, which features only 1.3K. Kodak has a sensible business plan but faces the same economic hurdles as others. Its core film business should face minimal deterioration as the pace of overall screen growth offsets digital. We value Kodak's Entertainment Imaging at \$2 billion.**
- **A small company called MaxiVision finally appears to be getting some industry respect for its projection technology that remarkably enhances the film experience at a fraction of the cost of digital cinema. MaxiVision would result in watch a 50% increase in the amount of origination and print film used.**

---

**research team**

**Gibboney Huske, CFA**  
212/325-2264  
gibboney.huske@csfb.com

**Rick Vallières, CFA**  
212/538-8571  
rick.vallieres@csfb.com

## Executive Summary

### Digital Cinema—Episode II

Two years ago, we wrote a report on digital cinema, which analyzed the state of the technology and the economics. At the time, the hype surrounding the technology was almost overwhelming. We met with management of numerous start-ups that were looking for a piece of the action. Our conclusion in 2000 was that the economics were not compelling and the structural issues in the industry were likely to serve as a major impediment to adoption. We have been revisiting digital cinema over the past few months to get a sense of what has developed. This time around, we got much better access to industry insiders as a result of the wide distribution of the original report. We were able to meet and interview numerous industry players from distribution executives, financiers, cinematographers, Kodak, Deluxe, Boeing, and others. The most surprising thing that we learned was that little has changed. The hype is gone, but the economic reality remains. Two years ago, digital cinema proponents were predicting that there would be more than 1,000 screens by now with the cost of a digital projection system coming down to \$50,000. In fact, there are less than 100 screens with system costs still north of \$100,000.

### Digital Cinema Economics Not Compelling

Proponents of digital cinema cite the hundreds of millions in print costs to be saved. (Some actually cite billions.) What they leave out of the equation is the cost of capital required to deploy digital cinema. Based on the current system costs, it would require \$5.5 billion to install digital projectors in the 37,000 U.S. screens. The annual capital cost of close to \$900 million exceeds the associated print cost of \$680 million. We learned that what studios actually pay for film prints is much less than the publicly discussed numbers, making the real economics less compelling than commonly cited.

### Kodak Gains Technology Leadership

Kodak officially introduced its digital cinema projector this year. The company took a risk by not jumping on the Texas Instruments (TI) Digital Light Processing (DLP) bandwagon; however, its projectors leapfrogged ahead of TI with 2K resolution and 10-bit color (versus TI's 1.3K and 8 bit). Standards are finally emerging, and it appears that 2K will be the minimum requirement. That means that the existing projectors are not likely to meet standards, demonstrating the inherent technology risk in the industry.

### Pushing Back Digital Cinema Forecast to 2006

Although progress has been made in some areas (resolution, standards, and exhibitors emerging from bankruptcy), it has not been made in the matter of economics. Essentially, the cost of a projector has not come down over the past two years. With economics likely to remain a challenge, we pushed back our original 5% penetration estimate for digital cinema screen from 2004 to 2006.

## **Kodak's Entertainment Imaging Holds a Strong Franchise**

Kodak dominates the markets for origination and print film. We estimate the company has 80% share in the origination film business and 75% in the print film business. Unlike other markets where Fuji has chipped away at the company's brand equity, the company is held in high regard in an industry in which quality concerns are paramount. In fact, we spoke with Allen Daviau, the cinematographer for *ET*, who described how they were able to use the original Kodak negative for the twentieth anniversary release this year. The company's entertainment franchise has provided strong returns and margins. We estimate that Entertainment Imaging (EI) generates more than \$900 million in revenue and operating margins in excess of 25%. We believe the unit is poised for a second half recovery after facing production disruptions following proposed strikes and September 11, and weak commercial advertising. We value EI at \$2 billion, or 16% of the current enterprise value.

## **MaxiVision—A Good Idea Whose Time Has Come**

Shortly after we published our last digital cinema report, we were introduced to the management of an emerging company called MaxiVision Technology. Dean Goodhill, a film editor whose credits include an Oscar nomination for *The Fugitive*, founded the company. MaxiVision's technology applies advanced automation and control technologies to film projectors. Film projection technology has remained essentially the same for decades. In addition, Goodhill developed a new film format that eliminates much of the waste in current film technology and expands the frame. By reducing the film required, it becomes economically feasible to shoot and display film at 48 frames per second (fps) as opposed to the 24 fps currently used. The larger frame, doubled frames shown, and advanced controls result in dramatically better quality. We had the opportunity to view the technology in the development lab in San Luis Obispo, California. Even though the projector that was used in the demonstration did not fully make use of the MaxiVision technology, the difference was remarkable in clarity and details. Existing projection systems can be retrofitted with the MaxiVision technology for approximately \$11,000, a fraction of the cost of a digital projector. The MaxiVision technology results in 50% more origination and print film per film. If adopted, it could be a boon for Kodak.

# Market Analysis

## The Conventional Motion Picture Value Chain

In order to understand the implications of digital cinema, it is important to first understand the conventional motion picture value chain. The process by which motion pictures are created and distributed is complex based on antitrust rulings that separate distribution from exhibition. Value is not evenly shared across the chain as a result of various choke points including scarce creative resources, access to capital, etc. The major segments of the conventional cinema value chain are the following:

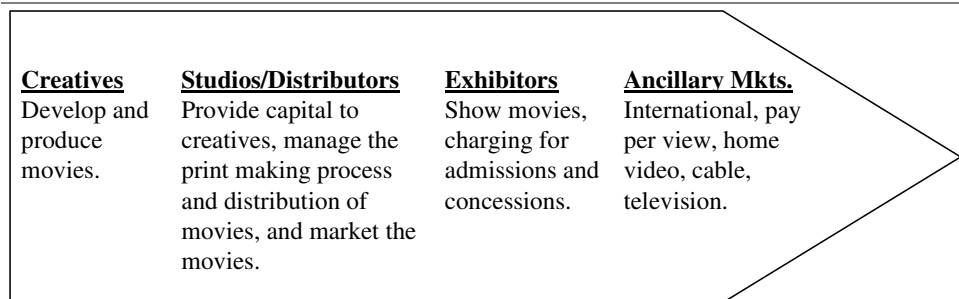
*Production.* Both in-house (studios) and independent producers are involved in the creative task of “making movies.” The segment is so closely aligned to distribution that in many cases the two are indistinguishable (e.g., Disney).

*Distribution.* Distributors are responsible for the marketing and physical distribution of films in theaters. In addition, they sell the films into the various ancillary markets where the majority of value is captured.

*Exhibition.* Exhibitors show movies to the public, generating box office receipts (which are split with distributors) and concession sales (a high-margin revenue stream that is theirs alone).

Historically, distributors have received about 50% of box office receipts. However, in recent years distributors have garnered a larger share, driven in large part by the rise in screen counts and resulting faster payoff of movies. We estimate that the current split averages 55% for the distributors.

### Exhibit 1: Conventional Cinema Value Chain



Source: CSFB analysis.

## The Economics of Making a Movie

Although the trend appears to be abating, the cost of making a full-length feature film has escalated in recent years, driven by the shift toward blockbuster films. Of course, the cost varies dramatically by movie. According to 1999 MPAA figures, the actual production cost averaged \$48 million per movie including studio overhead and capitalized interest. These costs incurred by the producer/studio represent

approximately two-thirds of the total cost. Advertising and print costs, which are incurred by distributors, totaled \$31 million, up significantly since 1999. Digital cinema is intended to eliminate print film costs, which we estimate averaged \$3.6 million per movie (or 4% of the total) in 2001.

## Pros and Cons of Digital Cinema

There remains significant debate over many aspects of digital cinema. It is not simply a matter of a technology shift. Digital cinema has the potential to alter the motion picture value chain. Furthermore, the state of theatrical exhibition is at a critical juncture with several exhibitors emerging from bankruptcy; however, the proliferation of alternative forms of entertainment casts a long shadow. HDTV appears to be gaining momentum potentially diluting the impact of the big screen experience. The case for the technology is simple: reduce industry costs by eliminating expensive prints and improve the quality with more consistent projection. The following is a summary of the pros and cons of digital cinema at the current moment.

### Pros of Digital Cinema

- *Eliminate print film.* We estimate that the annual cost of print film in the United States is roughly \$700 million. This includes the cost of the film in addition to processing. This figure is widely used as what studios and distributors will save under digital cinema. As we will later show, there is not likely to be any savings after the cost of capital is taken into account based on the current cost of projection systems,
- *No print degradation.* Print film has the benefit of being a universal standard, much in the way that 35mm consumer film is. A disadvantage of the technology is that the quality degrades with use, resulting in scratches and burnout. With digital projection, this problem is eliminated. Furthermore, the digital systems feature more precise controls.
- *New revenue streams.* Digital projection will give theaters the ability to show live content such as concerts, sporting events, etc. Advertising is emerging as a necessary evil to industry economics. Digital projection would facilitate targeted and local advertising.
- *Makes distribution costs variable.* Under the current system, distributors are required to order prints prior to having a good estimate of demand. Effectively the cost is fixed. With digital, the cost is variable. DVDs can be made as needed. With satellite distribution, the delivery mechanism is point to multipoint. According to Boeing, the break-even number of theaters for one film is 10-15.

### Cons of Digital Cinema

- *Image quality.* Although film prints do degrade, they do provide better quality images in optimal conditions. The resolution of film is 5K versus 2K for digital cinema. Color gamut is significantly higher for film as well.
- *Economically unviable.* We will provide a more detailed analysis later in the report, but essentially digital cinema provides no net savings to the industry until the cost of a projection system including related hardware is less than \$50,000.

- *Piracy.* The ability to reduce piracy was touted as a benefit to the industry. The experience of the music industry suggests that piracy is more likely to be a negative. History has shown that encryption systems ultimately are broken. This could severely curtail the international box office and other ancillary markets.
- *Harmonizing the experience.* One big industry concern is that the look and feel of digital projection will not differ significantly from HDTV shown on a big screen TV. HDTV does appear to be gaining momentum, as do large screen televisions. Roger Ebert has made the case that the flickering of film induces a dream-like state and that digital is a different experience.
- *Permanent increase in capital requirements.* The faster replacement cycle would result in the annual capital spending in the U.S. exhibition industry increasing by 5 times to over \$900 million annually.

---

**Exhibit 2: Annual Capital Requirements of Projection Technology**


---

	Film		Digital	
Screens		36,764		36,764
Average Projection Systems Cost	\$	30,000	\$	75,000
Average Life		7		3
<b>Annual Capital Spending</b>	<b>\$</b>	<b>157,560,000</b>	<b>\$</b>	<b>919,100,000</b>

---

Source: CSFB estimates.

## Technology

### Technology Standards Emerging

One thing that is universally agreed upon is the need for technology standards so that distributors will not be required to support multiple formats, as was the case for digital sound. In the case of digital sound, three separate standards developed creating inefficiency in production. There are a number of organizations currently working on standards for digital cinema. The major studios have created an entity, "newco" as a vehicle for establishing standards. The Society for Motion Picture & Television Engineers (SMPTE) has a working group. The Motion Picture Association of America (MPAA) has put out a set of ten requirements including one that digital cinema quality be equal to film in optimal conditions. In other words, it is not enough to argue that digital cinema quality exceeds film when it has been scratched after multiple uses. The creative community in general supports a high-quality standard with a few exceptions (George Lucas being the most notable).

### Minimum Requirements for Digital Cinema Projection

Resolution is the most visible standard. For motion picture purposes, resolution is measured in horizontal pixel count. High-definition video resolution is 1,920 pixels per frame, or 2K. Resolution for high-speed film is 4,850 pixels per frame, or 5K by comparison. It appears that the studios will force a 2K standard for the United States. Steve Poster, the president of the American Society for Cinematographers (ASC), told us that a group called the International Telecommunications Union (ITU) associated with the United Nations, is pushing for 1K as an international standard. The ASC is fighting this. We encountered mixed views on whether 2K would be a fixed standard or the bar would be raised as the technology improves. Given the cost of the equipment, it may be impossible to change the standard even on a phased basis post facto. The market is likely to play a greater role.

### Developing an End-to-End Digital Cinema System

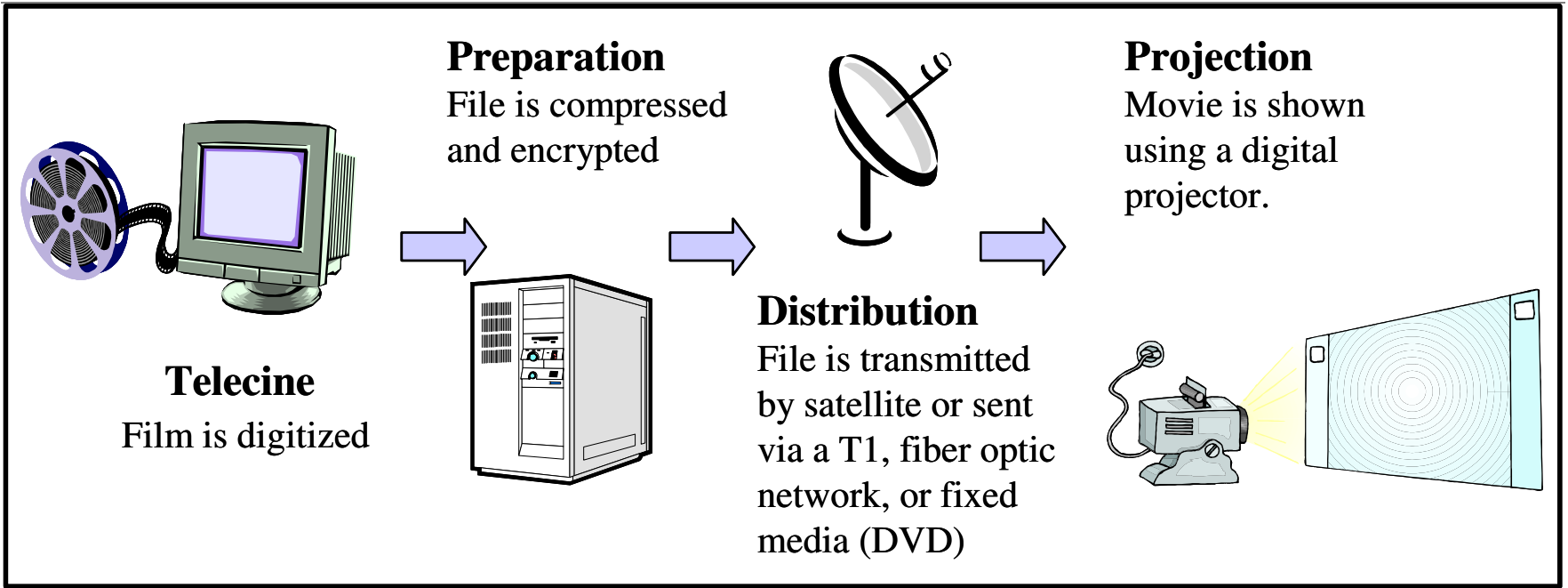
Digital cinema is more than just a projection system; it requires a change in technology throughout the process. The key elements are as follows.

- *Telecine.* The vast majority of movies are shot on origination film, although digital special effects may be inserted throughout. The master film print is generally digitized to create videos using a telecine. In order to produce the quality required for projection on a wide screen, digital cinema will require some changes at the telecine process. First, high-definition telecine must be used. Second, the telecine equipment has to be optimized for the projection technology used. Accordingly, if two types of projection technologies were adopted, a separate telecine system would be required for each process.
- *Preparation.* When a film is digitized, it creates an enormous file that must be compressed. For example, a typical two-hour movie would result in a 1,000-gigabyte file, or 1-terabyte file, uncompressed. Even compressed, a feature length movie could result in a 60-80 gigabyte file resulting in significant storage requirements at the cinema. In addition to the cost of storage, the transmission limitations must be

considered. To transmit a full-length movie uncompressed using a satellite system would take approximately 110 hours. A variety of compression technologies are possible including MPEG-2, layered MPEG, and wavelet. Once the file is compressed, it must also be encrypted. This step is critical to prevent a digital file from being intercepted and distributed via the Internet and other means. There are multiple encryption technologies that have been proposed. To limit piracy, a file would need to be encrypted at every stage until it reached the projector.

- *Distribution.* There are several options for delivering the digital file to the cinema. Although there are no major technological barriers to multiple delivery channels, there are scale advantages in consistency. From our discussions with industry players, there seemed to be a general consensus that fixed media should be used in the beginning. Essentially, DVDs would be delivered to theaters using the existing delivery system. Fixed media has the advantage of being a relatively low-cost approach, which does not require a significant change in behavior. At a later point, the system could evolve to one in which files are transferred using T1 lines, fiber optic networks, etc. The most interesting approach involves satellite transmission, which has benefits particularly in emerging markets. The advantage of transmitting files whether using a secure network or satellite technology versus fixed media is that live events could conceivably be presented using the same infrastructure. As a result, there are incremental revenue opportunities available with this type of distribution. According to Boeing, it would take six to eight hours to send a feature film by satellite. As this is point-to-multipoint technology, the distribution cost would be relatively low. We were told a ballpark figure per distribution would be \$1,000, resulting in a break-even point of 10-15 theaters. (Of course this ignores the cost of the projectors.)
- *Projection.* Regardless of the delivery method, exhibitors will have to install storage and other back-end technology to support digital projection. Of course, the critical technology is the projector. A 35mm projector currently costs about \$35,000 and lasts for many years. A digital projection system includes the projector and one or more servers. It also requires more powerful lighting, which results in higher operating costs. Digital projectors and the related hardware cost approximately \$150,000-\$200,000. In our report two years ago, we assumed that the cost by this time would have come down significantly. In fact, there has been no meaningful cost reduction. The normal benefits from Moore's law do not fully translate to display technologies, as optics that do not scale at the same rate are involved. Furthermore, for cinema quality projection, there is no scale. If the global screen count is only 108,000, the maximum annual shipments are 36,000. Relative to other semiconductor applications, that is tiny.

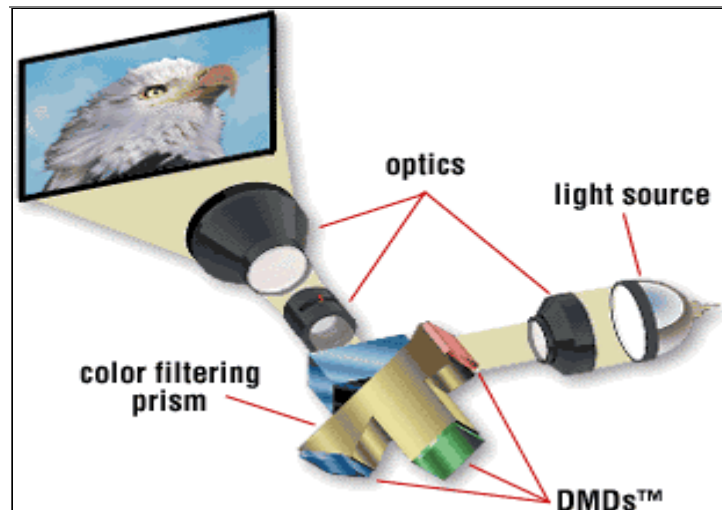
Exhibit 3: Digital Cinema Process



## Texas Instrument's DLP Technology

TI developed Digital Light Processing (DLP) technology as a high-quality projection system. Although TI's goal is to eventually bring the technology down to the consumer market, it has worked with a variety of vendors to create digital cinema solutions. At the core of DLP technology are Digital Micromirror Devices (DMD™), which are semiconductors with thousands of tiny mirrors, each representing a pixel. Images are created by tilting the mirrors up and down 10 degrees in order to switch each light on and off to up to 5,000 times per second, utilizing frequency adjustments to create grayscale in a process called pulsewidth modulation. The existent digital cinema projectors are primarily based on TI's DLP technology. TI has a limited number of licensees who actually deploy the projectors including Barco and Christie. Boeing is using Barco projectors based on TI technology. The current DLP chips feature resolution of 1.3K, which will likely fall short of standards. We believe TI will introduce 2K chips in 2003.

**Exhibit 4: Texas Instrument's DLP Projection Technology**



*Source: Company data.*

## Kodak's Projectors Based on JVC's D-ILA

When we met with Kodak's entertainment group two years ago, the company's technology direction was less clear. Kodak did not jump on the DLP bandwagon, choosing instead to work with JVC to develop its direct-drive image light amplifier (D-ILA) technology. The JVC chips finally went on the market this year, leapfrogging the DLP technology with 2K resolution and 10-bit color. Kodak adds value to the technology with its image science delivered mostly in the form of software. The color management technology allows the digital projector to be configured to match the color of the film print. Evidently, the company has had some conversations with TI about licensing elements of the technology. Kodak has also developed a cinema operating system that will manage the exhibition process at the cinema. The Kodak system is designed with a multiple digital screen configuration in mind. There is a central server that directs the

digital file to miniservers, which support each projector. This approach builds in redundancy. Kodak uses three key encryptions that (1) jumbles frames, (2) jumbles pixels, and (3) trades pixels among frames.

The file is encrypted at post-production, distribution, and inside the projector. Kodak is targeting a systems cost of \$100,000, but more important, it has developed a business model that attempts to replicate the current dynamics between distribution and exhibition.

#### Exhibit 5: Kodak's Digital Cinema Projector



Source: Company data.

#### Exhibit 6: Comparison between Kodak and TI Technology

	Kodak	TI
Core Technology	JVC's D-ILA	TI's DLP
Development Status	Ships early 2003	units worldwide
Resolution	2K	1.3K
Bits	10 bits	8 bits
Estimated Cost	\$100,000	\$150,000

Source: Company data, CSFB estimates.

# The Economics of Digital Cinema

## Implementation Issues

One of the complications in implementing digital cinema is the allocation of costs and benefits. Currently, exhibitors pay for the projection equipment. With multiple theatre chains emerging from bankruptcy, few chains appear to have the financial wherewithal to support a major deployment of digital based on the current economics. Distributors appear to achieve most of the benefits by eliminating the cost of prints. Direct negotiations are potentially problematic as a result of the Paramount Decree, which separated distribution from exhibition.

## A Distributor's Perspective

We spoke with two distribution executives in our research. Although they would appear to be the major beneficiaries of digital cinema, we noted a clear lack of enthusiasm for the technology. There was the general recognition that the economics are not even close to working at current costs. One of the often touted benefits to the exhibitors is the ability to offer alternative content such as live events. Alternative content is a major issue for distribution, as it could tie up screens during peak hours. Advertising is increasingly being used at theaters to bolster revenue. One distributor told us flat out that advertising was forbidden by contract; however, no action was being taken given the economic issues associated with exhibitors. Another issue is the extent of digital cinema deployment. As distributors will need to support both formats for the foreseeable future, it actually increases costs. Piracy is a major concern as an Internet version of *Attack of the Clones* appeared before the movie premiered. There is a risk that pirated versions will be widely available by the time a movie reaches Europe, potentially reducing international box office. Another potential threat to distribution is that it will be disintermediated. A content-provider, such as George Lucas, could opt out of the studio system and distribute directly instead.

## Current System Economics

The costs associated with the existing system for distributing movies can be divided into infrastructure costs (projectors) and distribution costs (print films, shipping, insurance, etc.). Under the current distribution process, the studios are aligned with either of the major film processors (Technicolor and Deluxe) to create prints. These two companies purchase print film from Kodak, Fuji, and Agfa. Taking the original negative from the studio, they create an interpositive that is used to create a duplicate negative (internegative). Prints can then be made from the internegative without disturbing the original negative. For this service, distributors are charged approximately \$0.12 per foot. With a typical feature length film requiring 10,000 feet of print film, the cost comes to an average of \$1,200 per print. This calculation excludes various rebates and discounts. We were told that for a major film, studios can pay as little as \$800 per print. We believe an average cost is closer to \$1,000 plus \$200 for distribution, storage, etc. For our analysis, we are using this \$1,200 figure. Generally, 2,000-3,000 prints are created for U.S. distribution, resulting in an average print cost of approximately \$2.4-3.6 million per release. Although the number of screens has decreased over the past two years, films are going into wider release and running off faster.

*Case study.* The current box office showdown between *Attack of the Clones* versus *Spider-Man* provides a good illustration of the dynamics. Most accounts indicate that *Spider-Man* will probably generate greater box office than *Attack of the Clones*. One of the reasons is that *Spider-Man* was released to about 7,500 screens. George Lucas imposed restrictions limiting *Attack* to theaters with digital sound. Fox, the distributor, estimated that this requirement eliminated about 200-300 screens. Furthermore, theaters were required to show the movie for at least four weeks, which reduced demand in smaller cities. The total screens opening weekend were about half the total number for *Spider-Man*.

We estimate the complete systems economics as follows:

*Screens.* According to the MPAA, there were 36,764 screens in North America at year-end 2001, down from 37,185 in 1999. Although our analysis focuses on the domestic market, most estimates for worldwide screens range from 100,000 to 130,000. Kodak's estimate is 108,000.

*Projector costs.* Conventional projectors cost approximately \$25,000-35,000 and are generally replaced every 25 years or more.

*Print costs.* The high cost of prints is a critical part of the justification of digital cinema. We have heard estimates as high as \$4-5 billion for the global cost of prints. We were told by sources from various points of the movie value chain that the costs of prints is generally overstated in public accounts. There is apparently a fairly structured set of discounts and rebates (such as "Kodak dollars") that don't get factored in. We estimate that Deluxe is the largest film processor. Deluxe's reported film processing revenue in 2001 was £341 million, or approximately \$500 million. We estimate Deluxe's share at around 55%, implying total industry revenue of less than \$1 billion on a global basis. In fact, Deluxe's film processing revenue includes items not associated with creating prints. We heard mixed reports on pricing trends. Deluxe generally seemed bullish on the prospects for its business with a strong box office and faster payoffs. The company grew film-processing revenue 14% in 2001, although foreign exchange probably played some role. We estimate U.S. print film costs at around \$680 million based on an average print cost of \$1,200, an average release of 3,000 screens, and the total MPAA releases of 189 last year.

#### **Exhibit 7: Domestic Print Film Analysis**

<b>Based on 2001 MPAA data:</b>	
Domestic screens:	36,764
MPAA releases:	189
Average film print costs:	\$3.60
MPAA print costs:	\$680

*Source: MPAA estimates, CSFB estimates.*

**Exhibit 8: Print Film Revenue Summary***US\$ in millions, unless otherwise stated*

<b>Print Manufacturing</b>	<b>2001 Rev.</b>	<b>% of Total</b>
Kodak's Print Film	500	75%
Others (Fuji & Agfa)	167	25%
<b>Total Market</b>	<b>\$ 667</b>	

<b>Print Services</b>	<b>2001 Rev.</b>	
Technicolor & Others	406	45%
Deluxe	496	55%
<b>Total</b>	<b>\$ 902</b>	

*Source: Company data, CSFB estimates.***The Need for an Intermediary**

Competing financial interests, the Paramount Decree, and the financial limitations of exhibition all favor the creation of intermediaries in the deployment of digital cinema. The role of the intermediary is to provide financing, equipment support services, and in some business models, to mediate between distributors and exhibitors in negotiating terms. Two years ago, there were a number of start-ups that tried to position themselves in this role. Most are gone. The industry is very opposed to the idea of a gatekeeper of any type. Currently, distribution has two major choices for print film and for processing. Currently vying for the role of intermediary are the following companies:

**Technicolor**—Owned by Thomson Media, Technicolor's digital cinema strategy has undergone several changes in the past two years. The company has a joint venture with Qualcomm to deploy digital projection systems. Technicolor uses TI's DLP technology. TI attempted to seed 1,000 theaters by charging 12.5¢ per theatergoer, but it fell short.

**Boeing**—Boeing is trying to get digital cinema started to drive its satellite business. It is using Barco projectors. After speaking with Boeing management, it was not clear that there is a real business plan there. The company's estimates of print film costs were way too high.

**Kodak**—Kodak is also looking to take the role of an intermediary using its Digital Cinema Projector system. Kodak's business model facilitates the negotiations between distribution and exhibition, rather than stepping in between them. We detail Kodak's business model later.

**Digital Cinema Economics**

All of the talk about the ability to save print costs never seems to mention the capital cost associated with deploying digital cinema. The days of free capital are over. We

believe a relatively high cost of capital should be assigned to digital cinema financing as a result of the early stage of the technology. For example, there are currently around 94 digital cinema systems deployed at last count. All are based on DLP technology. As a result, none of these initial systems are likely to meet standards when they are finally set. As TI and JVC advance their technologies, resolutions are clearly going to move higher. It is not hard to see filmmakers setting minimum requirements for resolution in the future. In fact, given how picky George Lucas was for *Attack of the Clones*, it will be interesting to see if he will allow the next episode to be shown on the very 1.3K projectors installed just for the release of *Attack*. We believe the lifecycle for a digital projector will be about three years over the next decade as the technology matures. Assuming an average systems cost per screen of \$150,000, it would require \$5.5 billion in capital to finance a full conversion to digital cinema in the United States. We estimate the cost of capital to be 15.9% as detailed in Exhibit 9.

**Exhibit 9: Estimated Cost of Capital for Digital Cinema**

	Weighting	Pre-tax Cost	Weighted After-tax Cost
Debt	75%	12.0%	5.9%
Equity	25%	40.0%	10.0%
<b>WACC</b>	<b>100%</b>		<b>15.9%</b>

Source: CSFB estimates.

## Intermediary Economics

We can develop the inherent economics of digital cinema by analyzing the requirements of an intermediary. Our analysis focuses on the systemic economics, in this case, the U.S. market. Rather than focus on the current cost of equipment, we are assuming a future cost of \$50,000 including all related hardware. Based on the current screen count, total U.S. conversion would require \$1.8 billion in capital. The intermediary would need an after-tax cash profit of \$291 million to achieve its cost of capital of 15.9%. We can use the intermediary earnings requirement to calculate the systemic cost savings. The big assumption to be made is the inherent profitability of the intermediary, which determines revenue and therefore the cost to distribution.

*Base case.* Assuming a 60% operating profit margin and a 35% tax rate, the intermediary would need to generate revenue of \$747 million. Unfortunately, the current cost of prints is only \$680 million resulting in no incremental savings.

*Lower tax rate.* High depreciation cost may result in a lower cash tax rate and probably a lower margin than the 60% operating margin in the base case. If we assume a 50% operating margin and a 0% tax rate, the intermediary's revenue is \$583 million, resulting in just under \$100 million in systemic cost savings.

*\$35,000 projector.* The base case with a \$35,000 projection system results in approximately \$157 million in systemic cost savings.

The conclusion of our analysis is that, even at \$50,000 digital projectors, the cost savings is marginal. Furthermore, our analysis uses very high-margin assumptions

implying a minimally competitive environment. Distributors are unlikely to accept such an environment with the industry fear of a gatekeeper.

#### Exhibit 10: Intermediary Economics

US\$ in millions, unless otherwise stated

##### Intermediary Economics

<b>Assumptions:</b>	
Number of screens	36,764
Cost of equipment	\$ 50,000
Capital Required (# of screens x cost of equip.) (\$ in millions)	\$ 1,838
Hurdle Rate	15.9%
Intermediary operating margin	60%
Tax rate	35%
<b>Proforma Financials</b>	
Intermediary Revenue (\$ in millions)	\$ 747
Operating Profit	448
Operating Profit Margin	60%
Income Tax Provision	157
<b>Net Income</b>	<b>291</b>
<b>Systemic Savings (\$680 million in print costs less revenue) (67)</b>	

Source: CSFB estimates.

#### Exhibit 11: Sensitivity Analysis—Systems Cost versus Intermediary Margin

US\$ in millions, unless otherwise stated

		<b>Intermediary Pre-tax Margin</b>			
		<b>80%</b>	<b>60%</b>	<b>50%</b>	<b>40%</b>
<b>Equipment Cost</b>	<b>\$35,000</b>	<b>288</b>	<b>157</b>	<b>52</b>	<b>(104)</b>
	<b>\$50,000</b>	<b>120</b>	<b>(67)</b>	(216)	(441)
	<b>\$75,000</b>	(160)	(441)	(665)	(1,001)
	<b>\$100,000</b>	(441)	(814)	(1,113)	(1,561)

Source: MPAA data, CSFB estimates.

**Exhibit 12: Sensitivity Analysis—Intermediary Margin versus Tax Rate***US\$ in millions, unless otherwise stated*

		<b>Intermediary Pre-tax Margin</b>			
		<b>80%</b>	<b>60%</b>	<b>50%</b>	<b>40%</b>
<b>Tax Rate</b>	<b>0%</b>	<b>316</b>	<b>194</b>	<b>97</b>	(48)
	<b>15%</b>	<b>252</b>	<b>109</b>	(6)	(177)
	<b>25%</b>	<b>194</b>	<b>33</b>	(97)	(291)
	<b>35%</b>	<b>120</b>	(67)	(216)	(441)

*Source: CSFB estimates.***The New Motion Picture Economics**

To illustrate how the new distribution system would work, we have included a side-by-side comparison of the current system and the theoretical economics of the new system developed in our model based on total U.S. conversion. We started with the U.S. 2001 box office of \$8.4 billion, which represents the major revenue stream to the exhibitors. Out of this, the exhibitors pay on average 55%, or \$4.6 billion, to the distributors in the form of film rents or splits. In turn, the distributors pay \$680 million for prints. Under digital cinema, the print cost is replaced with a payment to the intermediary. Using our assumed operating margin of 60% and \$50,000 system cost, the payment to the intermediary is \$747 million. As the savings is the difference between print costs and the payment to the intermediary, there would be negative systems savings of \$67 million. In other words, either the distributors pay more or the intermediary loses money.

**Exhibit 13: Comparing System Economics***US\$ in millions, unless otherwise stated*

	<b>Current System</b>	<b>New System</b>
<b>Exhibitors</b>		
Revenue (Total U.S. Box Office)	8,413	8,413
Film Cost (based on 55% split)	4,627	4,627
<b>Contribution</b>	<b>3,786</b>	<b>3,786</b>
<b>Distributors/Studios</b>		
Revenue (Film rent/split)	4,627	4,627
Print Costs	680	-
Payment to Intermediary	-	747
<b>Contribution</b>	<b>3,946</b>	<b>3,880</b>
<b>Intermediaries</b>		
Revenue		747
<b>Net Savings</b>		<b>(67)</b>

*Source: CSFB estimates.*

## Irrational Behavior

Our analysis assumes economically rational behavior. The past few years have shown that there is such a thing as dumb money. There may also be noneconomic drivers such as George Lucas's efforts to force digital cinema on the industry. When digital cinema was at the peak of its hype, we believe a number of companies took a long hard look at the business model. That there have been no meaningful initiatives to fund digital cinema efforts probably supports the economic case that we have made. Our original report was evidently widely distributed through the industry. As a result, more doors were opened to us in our research. As we did our research, it became clear that there is a type of digital cinema correctness in the industry. Few industry players seem to want to openly criticize the technology or economic implications, but privately those who understand the economics were largely dismissive. Although Lucas is a major advocate, there also seems to be a strong but less visible opposition until the quality improves and costs decline.

## The Lucas Effect

There is a scenario in which George Lucas takes the position that he will only show the next *Star Wars* movie on digital screens. *Attack of the Clones* opened to about 3,600 screens, so this scenario is not impossible. The box office showing for *Attack* appears to be headed for about \$300 million for the U.S. box office, down from the \$431 million estimate in our *Episode I* report. At that level, we are not sure if the digital-only threat carries as much weight. We calculated the basic economics. Assuming projection costs decline to \$50,000 and that the number of screens is 3,600, there would be \$180 million in capital required to meet a digital requirement. The cost of capital would be \$28.6 million. This compares with film print costs of \$4.3 million, assuming \$1,200 per print. (In reality a film this big would probably cost \$800-900 per print.)

### Exhibit 14: The Lucas Effect

*US\$ in millions, unless otherwise stated*

U.S. Screens		36,764
Screens showing Star Wars		3,600
Projection Cost in 2005	\$	50,000
Capital Required		180,000,000
Cost of Capital		28,620,000
Film Print Cost		4,320,000

*Source: CSFB estimates.*

## Digital Cinema Not Yet Ready for Prime Time

In our original report, we forecast that digital cinema screen penetration would reach 5% worldwide by 2004 implying 5,500 screens in total. With less than 100 screens installed to date (many added in recent weeks in advance of *Attack of the Clones*), little progress has been made, in our view. The cost of equipment has not declined in any significant way. Now that the hype has abated, industry players appear to have more rational expectations and less of an incentive to jump on the bandwagon. Therefore, we are pushing back our estimate for 5% screen penetration to 2006. Although the industry is experiencing improving health, the economics are daunting. Furthermore, concerns of piracy mean that there are bigger economic stakes than just the cost of print film. We look for digital cinema to progress at a steady pace. There is a case to be made that incremental screens added globally are more likely to be digital. We are not so sure this is the case. First, many of those incremental screens are in emerging markets, particularly emerging Asia where piracy is rampant. Second, incremental screens are more likely to be added outside of the big cities where audiences are large enough to support an expensive projection system. We believe it is too early to judge which intermediaries and projection vendors will be the winners. What is clear to us is that they will tend to be well-financed companies with staying power.

# Kodak's Entertainment Imaging Business

## A Change of Regime

Since we last profiled Kodak's Entertainment Imaging (EI) unit, Joerg Agin, the company's long-standing president has retired. He was replaced by Eric Rodli, who joined Kodak in 2000 from his position as president of Bexel, the largest U.S. broadcast video rental service. Bexel's mandate is to develop Kodak's digital strategy. The company has made real progress in the past two years. In 2000, Kodak took a real risk by betting on the JVC technology when DLP was the toast of the town. That bet appears to have paid off. Kodak's Digital Cinema projector appears to have clear technology leadership over the DLP-based projectors. We believe the company also has been more sensitive to industry concerns in crafting its business model than others. At the same time, EI has suffered through a tough 2001, during which potential strikes and September 11 events disrupted production. The weakness in commercial advertising had an impact on its origination business. After some tough comparisons in the first half, we expect EI revenue and earnings to recover.

## A Real Franchise

In our months of research (the company never thought we would finish this report), not one person mentioned Fuji unprompted. In addition to Steve Poster, head of the ASC, we also spoke with Allen Daviau, the cinematographer for such films as *ET*, *The Color Purple*, etc. He told us that when they reissued *ET* this year; they were able to use the original Kodak negative that had been in cold storage for 20 years. Year after year, the vast majority of nominees for Best Picture are shot on Kodak film. We estimate that the company has 80% market share in origination film for motion pictures. Its share of the print film market is nearly as high. Our message is that Kodak holds a very strong franchise in the motion picture business. We believe the company's EBIT margin in EI exceeds 25%, higher than Consumer Imaging and Health Imaging at its peak. We estimate that EI generated \$0.58 per share in earnings in 2001 on revenue of approximately \$900 million.

## Entertainment Imaging Overview

Kodak's Entertainment Imaging unit is made up of three major business lines:

*Origination film.* This is the film on which movies, television shows, and commercials are shot. For movies, film is almost always used for major features as it captures significantly more visual information. Digital is used occasionally to achieve a video look or to save money. George Lucas used digital for *Attack of the Clone*, in which extensive use of computer graphics required less resolution. For television shows, as a rule of thumb, film is used for dramas, while video is used for sitcoms. The growing adoption of HDTV has boosted film use as producers aim to future proof, since HD quality is superior to video. Some high-quality commercials are shot on film. Kodak assumes that the introduction of a broader range of HD cameras will result in some ongoing pressure on the origination business. George Lucas gets a lot of attention for his commitment to digital; however, there are probably even more directors who are committed to film

(Steven Spielberg and Martin Scorsese to name a few). This unit earns the highest margins.

*Print film.* Print film is the film sent to movie theaters.

*Cinesite/post-production.* Cinesite is Kodak's special effects and post-production unit.

## The Impact of Digital Cinema on Kodak's Film Business

We developed a model to estimate the impact of digital cinema on Kodak's print film business. To be clear, we have simplified this business fairly dramatically. We calculated the amount of revenue Kodak achieves per screen (worldwide). In 2001, this revenue amounted to \$4,630. We adjust this amount for average pricing changes (we are assuming negative 2%) and then multiply by our digital screen assumption for 2006 (6,260 screens). Essentially, revenue is about flat during the period ending at \$498 million. In reality, we expect revenue to increase and then decrease as digital gains momentum in later years.

### Exhibit 15: The Impact of Digital Cinema on Kodak's Film Business

US\$ unless otherwise stated

#### Assumptions:

Kodak Print Film Revenue in 2001 (in millions)	\$	500,000
Worldwide Screens		108,000
Average Revenue per Screen		4,630
Worldwide Average Screen Growth (2001-2006E)		3%
Estimated Worldwide Screens 2006		125,202
Average Price Decline		-2%
Digital Cinema Penetration in 2006		5%

Digital Screens in 2006		6,260
Total Revenue Impact in 2006	\$	26,197
Total Revenue in 2006	\$	497,749

		Digital Cinema Penetration			
		0%	5%	10%	15%
Screen Growth	-2%	408,536	388,110	367,683	347,256
	0%	451,960	429,362	406,764	384,166
	2%	499,001	474,051	449,101	424,151
	4%	549,879	522,385	494,891	467,397
	6%	604,825	574,584	544,342	514,101

Source: CSFB estimates.

## Kodak's Digital Cinema Business Model

The central thesis underlying Kodak's digital cinema business model is that distributors are used to paying approximately \$350 per week per screen. This money is paid to the film processors in the current model. Kodak as the intermediary replaces the film processor. The distributor would pay Kodak a weekly charge approximating what is paid now to Deluxe or Technicolor. The exhibitor would pay commensurate with incremental revenue from advertising or alternative content. The weekly negotiations between the distributors and exhibitors would occur as they normally do with the exception that the result would be access to the encryption keys for movies, rather than a print being shipped. Assuming no operating costs for purposes of illustration, Kodak would need to charge about \$450 per week per screen with a systems cost of \$50,000 to breakeven. Not surprisingly, Kodak faces the same economic challenges that others in the industry do.

### Exhibit 16: Kodak's Digital Cinema Business Model

Weekly Charge	450
x 52 weeks	52
Annual Revenue per projector	23,400
Digital Screens	1,000
Capital Required (# Screens x Cost)	50,000,000
Cost of Debt	12%
<b>Kodak Revenue</b>	<b>23,400,000</b>
Depreciation	16,666,667
EBIT	6,733,333
Interest Expense	6,000,000
Pre-tax income	733,333
Income Tax	212,667
Net Income (Loss)	520,667

Source: CSFB estimates.

## Valuing Entertainment Imaging

Kodak's guidance for revenue growth in EI is approximately 2-3% over the next three years. With industry fundamentals improving, we believe EI will return to a growth mode later this year. Our revenue assumptions have growth of 2% through 2003, after which growth decelerates. We have not included revenue associated with digital cinema, as it is far too early to estimate. We assume that margins will recover to previous levels by 2003. Based on these assumptions, discounted cash flow analysis suggests an enterprise value for EI of \$2 billion. If we allocated debt based on a percentage of sales methodology, equity value would be \$1.8 billion, or \$6 per share. We estimate that this translates into an unleveraged PE multiple of 10 times, which seems pretty reasonable given the franchise and margins, albeit limited growth prospects. As Entertainment Imaging is buried in the massive Photography reporting segment along with the consumer and professional units, we believe EI is yet another of Kodak's hidden assets.

**Exhibit 17: Entertainment Imaging Discounted Cash Flow Analysis***US\$ in millions, unless otherwise stated*

	1999	2000	2001	2002E	2003E	2004E	2005E	2006E	2007E	2008E	2009E	2010E	2011E
Revenue	1,018	987	938	957	976	986	996	996	996	976	956	937	918
\$ Change from 1999	-	(31)	(80)	(61)	(42)	(32)	(22)	(22)	(22)	(42)	(62)	(81)	(100)
% Change	-4.4%	-3.0%	-5.0%	2.0%	2.0%	1.0%	1.0%	0.0%	0.0%	-2.0%	-2.0%	-2.0%	-2.0%
EBIT	300	282	254	264	275	280	286	286	286	274	263	253	243
EBIT Margin	29.5%	28.6%	27.1%	27.6%	28.1%	28.4%	28.7%	28.7%	28.7%	28.1%	27.5%	27.0%	26.4%
NOPAT	198	186	168	187	195	199	203	203	203	195	187	179	172
NOPAT Margin	19.4%	18.8%	17.9%	19.6%	20.0%	20.2%	20.4%	20.4%	20.4%	20.0%	19.5%	19.1%	18.8%
Kodak's WACC	9.00%												
Net Present Value of Cash Flows	\$1,241												
Residual Value	1,914												
PV of Residual Value	808												
Enterprise Value	2,050												
Less: Debt Allocation	256												
Equity Value	1,794												
Equity Value per Share	\$ 6.16												
Equity Value/Unlevered EPS	9.6												

Source: CSFB estimates.

## MaxiVision Technology

### A Good Idea Whose Time Has Come

Shortly after we published our last digital cinema report, we were introduced to the management of an emerging company called MaxiVision Technology. Dean Goodhill, a film editor whose credits include an Oscar-nomination for the *Fugitive*, founded the company. MaxiVision's technology applies advanced automation and control technologies to film projectors. The underlying film projection technology has remained essentially the same for decades. In addition, Goodhill developed a new film format that eliminates much of the waste in current film technology and expands the frame. By reducing the film required, it becomes economically feasible to shoot and display film at 48 frames per second (fps) as opposed to the 24 fps currently used. The larger frame, doubled frames shown, and advanced controls result in dramatically better quality. We had the opportunity to view the technology in the development lab in San Luis Obispo, California. Even though the projector that was used in the demonstration did not fully make use of the MaxiVision technology, the difference was remarkable in clarity and details. Existing projection systems can be retrofitted with the MaxiVision technology for approximately \$11,000, a fraction of the cost of a digital projector.

### How the Technology Works

The basics of the technology rely on inefficiencies in current motion picture film. First, there is significant film wasted in between frames by the current 4 perforation (perf) format pull-down system (the film is pulled down in 4 perf increments). There remains space allocated for analog sound that could be eliminated as well. The MaxiVision technology increases the frame by using 3-perf technology and eliminating the analog track. The projector itself can switch between 48 fps and 24 fps in real time essentially providing backward compatibility. In addition, the company reduces misregistration by a process called active crystal registration (ACR). This is important, as changes in the location of a pixel get magnified on the screen. Finally, the gate that is used reduces the friction applied to film significantly. As a result, the scratches created over time would be greatly reduced.

### Challenges and Opportunities

MaxiVision is compelling because it enhances the quality of the movie, not just the experience in the way that stadium seating and other improvements have accomplished. As HDTV, home theaters, and potentially movies on demand grow in adoption, theaters could face admission declines if they do not differentiate their offerings. MaxiVision would provide this kind of differentiation. The company has received significant support from the creative community including directors Martin Scorsese, Michael Mann, the aforementioned Allen Daviau, and film critic, Roger Ebert. In addition to offering a superior viewing experience, MaxiVision gives directors greater latitude particularly in shots involving motion or action as twice the visual data is captured. MaxiVision seemed to be swimming against the tide in 2000 in the face of massive digital cinema hype. With expectations of digital cinema tempered, the company appears to have renewed interest within the industry. The primary obstacles that the company faces are a lack of funding and the incremental cost of origination and print

film. Essentially, about 50% more origination and print film is required (double the number of frames but reduced size). Our conversations with distributors indicated that the additional cost would not be dismissed out of hand but would be one of a number of costs that get evaluated movie by movie.

## Kodak—Friend or Foe

The company that stands to benefit the most from the adoption of MaxiVision is Kodak. Ironically, Kodak has not been publicly supportive of the company. We suspect the company was initially deterred by the digital cinema frenzy of 2000. The technology does need a certain level of critical mass to become successful. One of the things that has hurt MaxiVision in its efforts to raise money is the lack of backing by Kodak given the benefits that would accrue to it. Management is positioning MaxiVision as a premium experience, so the company does not need or expect to be the new de facto standard. We understand that there is a fair amount of risk associated with the opportunity, but it doesn't make sense to us that Kodak is not more supportive of the technology publicly or financially. In the past three years, Kodak has invested in far more speculative ideas with less visible payoffs (eMemories and YesVideo to name two). By Kodak's own estimates, digital penetration is likely to be limited over the next five years. One of CEO Dan Carp's critical few strategies for growth is to expand the benefits of film. MaxiVision appears to fit the bit.

---

N.B.: CREDIT SUISSE FIRST BOSTON CORPORATION may have, within the last three years, served as a manager or co-manager of a public offering of securities for or makes a primary market in issues of any or all of the companies mentioned. Closing prices are as of May 31, 2002:

Boeing (BA, \$42.65, Buy, Target \$50)\*  
Eastman Kodak (EK, \$33.27, Buy, Target \$50)  
Fuji Photo Film (4901, ¥3,970, Hold, Target \$3,800)\*  
Qualcomm (QCOM, \$31.64, Buy, Target \$45)  
Rank Group (RANKY, \$8.06, Not Rated)  
Texas Instruments (TXN, \$28.67, Buy, Target \$42)\*  
Thomson Multimedia (TMS, \$27.55, Not Rated)

\*Covered by another CSFB analyst.





AMSTERDAM ..... 31 20 5754 890  
 ATLANTA ..... 1 404 897 2800  
 AUCKLAND ..... 64 9 302 5500  
 BALTIMORE ..... 1 410 659 8800  
 BANGKOK ..... 62 614 6000  
 BEIJING ..... 86 10 6410 6611  
 BOSTON ..... 1 617 556 5500  
 BUDAPEST ..... 36 1 202 2188  
 BUENOS AIRES ..... 54 11 4394 3100  
 CHICAGO ..... 1 312 750 3000  
 FRANKFURT ..... 49 69 75 38 0  
 HOUSTON ..... 1 713 890 6700  
 HONG KONG ..... 852 2101 6000  
 JOHANNESBURG ..... 27 11 343 2200

KUALA LUMPUR.....603 2143 0366  
 LONDON .....44 20 7888 8888  
 MADRID .....34 91 423 16 00  
 MELBOURNE .....61 3 9280 1888  
 MEXICO CITY .....52 5 283 89 00  
 MILAN .....39 02 7702 1  
 MOSCOW.....7 501 967 8200  
 MUMBAI.....91 22 230 6333  
 NEW YORK.....1 212 325 2000  
 PALO ALTO .....1 650 614 5000  
 PARIS.....33 1 53 75 85 00  
 PHILADELPHIA .....1 215 851 1000  
 PRAGUE .....420 2 210 83111  
 SAN FRANCISCO.....1 415 836 7600

SÃO PAULO .....55 11 3841 6000  
 SEOUL .....82 2 3707 3700  
 SHANGHAI .....86 21 6881 8418  
 SINGAPORE .....65 6212 2000  
 SYDNEY.....61 2 8205 4433  
 TAIPEI .....886 2 2715 6388  
 TOKYO.....81 3 5404 9000  
 TORONTO.....1 416 352 4500  
 WARSAW.....48 22 695 0050  
 WASHINGTON.....1 202 354 2600  
 WELLINGTON .....64 4 474 4400  
 ZURICH .....41 1 333 55 55

Copyright Credit Suisse First Boston, and its subsidiaries and affiliates, 2002. All rights reserved.

This report is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or which would subject Credit Suisse First Boston or its subsidiaries or affiliates (collectively "CSFB") to any registration or licensing requirement within such jurisdiction. All material presented in this report, unless specifically indicated otherwise, is under copyright to CSFB. None of the material, nor its content, nor any copy of it, may be altered in any way, transmitted to, copied or distributed to any other party, without the prior express written permission of CSFB. All trademarks, service marks and logos used in this report are trademarks or service marks or registered trademarks or service marks of CSFB.

The information, tools and material presented in this report are provided to you for information purposes only and are not to be used or considered as an offer or the solicitation of an offer to sell or to buy or subscribe for securities or other financial instruments. CSFB may not have taken any steps to ensure that the securities referred to in this report are suitable for any particular investor. CSFB will not treat recipients of this report as its customers by virtue of their receiving this report. The investments and services contained or referred to in this report may not be suitable for you and it is recommended that you consult an independent investment advisor if you are in doubt about such investments or investment services. Nothing in this report constitutes investment, legal, accounting or tax advice, or a representation that any investment or strategy is suitable or appropriate to your individual circumstances, or otherwise constitutes a personal recommendation to you. CSFB does not advise on the tax consequences of investments and you are advised to contact an independent tax adviser. Please note in particular that the bases and levels of taxation may change.

Information and opinions presented in this report have been obtained or derived from sources believed by CSFB to be reliable, but CSFB makes no representation as to their accuracy or completeness. CSFB accepts no liability for loss arising from the use of the material presented in this report, except that this exclusion of liability does not apply to the extent that such liability arises under specific statutes or regulations applicable to CSFB. This report is not to be relied upon in substitution for the exercise of independent judgment. CSFB may have issued, and may in the future issue, other reports that are inconsistent with, and reach different conclusions from, the information presented in this report. Those reports reflect the different assumptions, views and analytical methods of the analysts who prepared them and CSFB is under no obligation to ensure that such other reports are brought to the attention of any recipient of this report.

CSFB may, to the extent permitted by law, participate or invest in financing transactions with the issuer(s) of the securities referred to in this report, perform services for or solicit business from such issuers, and/or have a position or holding, or other material interest, or effect transactions, in such securities or options thereon, or other investments related thereto. In addition, it may make markets in the securities mentioned in the material presented in this report. CSFB may, to the extent permitted by law, act upon or use the information or opinions presented herein, or the research or analysis on which they are based, before the material is published. CSFB may have, within the last three years, served as manager or co-manager of a public offering of securities for, or currently may make a primary market in issues of, any or all of the entities mentioned in this report or may be providing, or have provided within the previous 12 months, significant advice or investment services in relation to the investment concerned or a related investment. Additional information is, subject to duties of confidentiality, available on request. Some investments referred to in this report will be offered solely by a single entity and in the case of some investments solely by CSFB, or an associate of CSFB or CSFB may be the only market maker in such investments.

Past performance should not be taken as an indication or guarantee of future performance, and no representation or warranty, express or implied, is made regarding future performance. Information, opinions and estimates contained in this report reflect a judgement at its original date of publication by CSFB and are subject to change without notice. The price, value of and income from any of the securities or financial instruments mentioned in this report can fall as well as rise. The value of securities and financial instruments is subject to exchange rate fluctuation that may have a positive or adverse effect on the price or income of such securities or financial instruments. Investors in securities such as ADR's, the values of which are influenced by currency volatility, effectively assume this risk.

Structured securities are complex instruments, typically involve a high degree of risk and are intended for sale only to sophisticated investors who are capable of understanding and assuming the risks involved. The market value of any structured security may be affected by changes in economic, financial and political factors (including, but not limited to, spot and forward interest and exchange rates), time to maturity, market conditions and volatility, and the credit quality of any issuer or reference issuer. Any investor interested in purchasing a structured product should conduct their own investigation and analysis of the product and consult with their own professional advisers as to the risks involved in making such a purchase.

Some investments discussed in this report may have a high level of volatility. High volatility investments may experience sudden and large falls in their value causing losses when that investment is realised. Those losses may equal your original investment. Indeed, in the case of some investments the potential losses may exceed the amount of initial investment and, in such circumstances, you may be required to pay more money to support those losses. Income yields from investments may fluctuate and, in consequence, initial capital paid to make the investment may be used as part of that income yield. Some investments may not be readily realisable and it may be difficult to sell or realise those investments, similarly it may prove difficult for you to obtain reliable information about the value, or risks, to which such an investment is exposed.

This report may provide the addresses of, or contain hyperlinks to, websites. Except to the extent to which the report refers to CSFB's own website material, CSFB has not reviewed any such site and takes no responsibility for the content contained therein. Such address or hyperlink (including addresses or hyperlinks to CSFB's own website material) is provided solely for your convenience and information and the content of any such website does not in any way form part of this document. Accessing such website or following such link through this report or CSFB's website shall be at your own risk.

This report is issued and distributed in Europe (except Switzerland) by Credit Suisse First Boston (Europe) Limited, One Cabot Square, London E14 4QJ, England, which is regulated in the United Kingdom by The Financial Services Authority ("FSA"). This report is being distributed in the United States by Credit Suisse First Boston Corporation; in Switzerland by Credit Suisse First Boston; in Canada by Credit Suisse First Boston Securities Canada, Inc.; in Brazil by Banco de Investimentos Credit Suisse First Boston S.A.; in Japan by Credit Suisse First Boston Securities (Japan) Limited; elsewhere in Asia/ Pacific by whichever of the following is the appropriately authorised entity in the relevant jurisdiction: Credit Suisse First Boston (Hong Kong) Limited, Credit Suisse First Boston Australia Equities Limited, Credit Suisse First Boston NZ Securities Limited, Credit Suisse First Boston (Thailand) Limited, CSFB Research (Malaysia) Sdn Bhd, Credit Suisse First Boston Singapore Branch, and elsewhere in the world by the relevant authorised affiliate of the above. Research on Taiwanese securities produced by Credit Suisse First Boston, Taipei Branch has been prepared and/or reviewed by a registered Senior Business Person.

In jurisdictions where CSFB is not already registered or licensed to trade in securities, transactions will only be effected in accordance with applicable securities legislation, which will vary from jurisdiction to jurisdiction and may require that the trade be made in accordance with applicable exemptions from registration or licensing requirements. Non-U.S. customers wishing to effect a transaction should contact a CSFB entity in their local jurisdiction unless governing law permits otherwise. U.S. customers wishing to effect a transaction should do so only by contacting a representative at Credit Suisse First Boston Corporation in the U.S.

Please note that this research was originally prepared and issued by CSFB for distribution to their market professional and institutional investor customers. Recipients who are not market professional or institutional investor customers of CSFB should seek the advice of their independent financial advisor prior to taking any investment decision based on this report or for any necessary explanation of its contents. This research may relate to investments or services of a person outside of the UK or to other matters which are not regulated by the FSA or in respect of which the protections of the FSA for private customers and/or the UK compensation scheme may not be available, and further details as to where this may be the case are available upon request in respect of this report.