

3D for the Theatre

Matt Cowan

Chief Scientific Officer

RealD

Agenda

- 3D systems – a technology primer
- Chicken Little – a case history

3D

What's the Fuss about?

Exciting new Entertainment Options

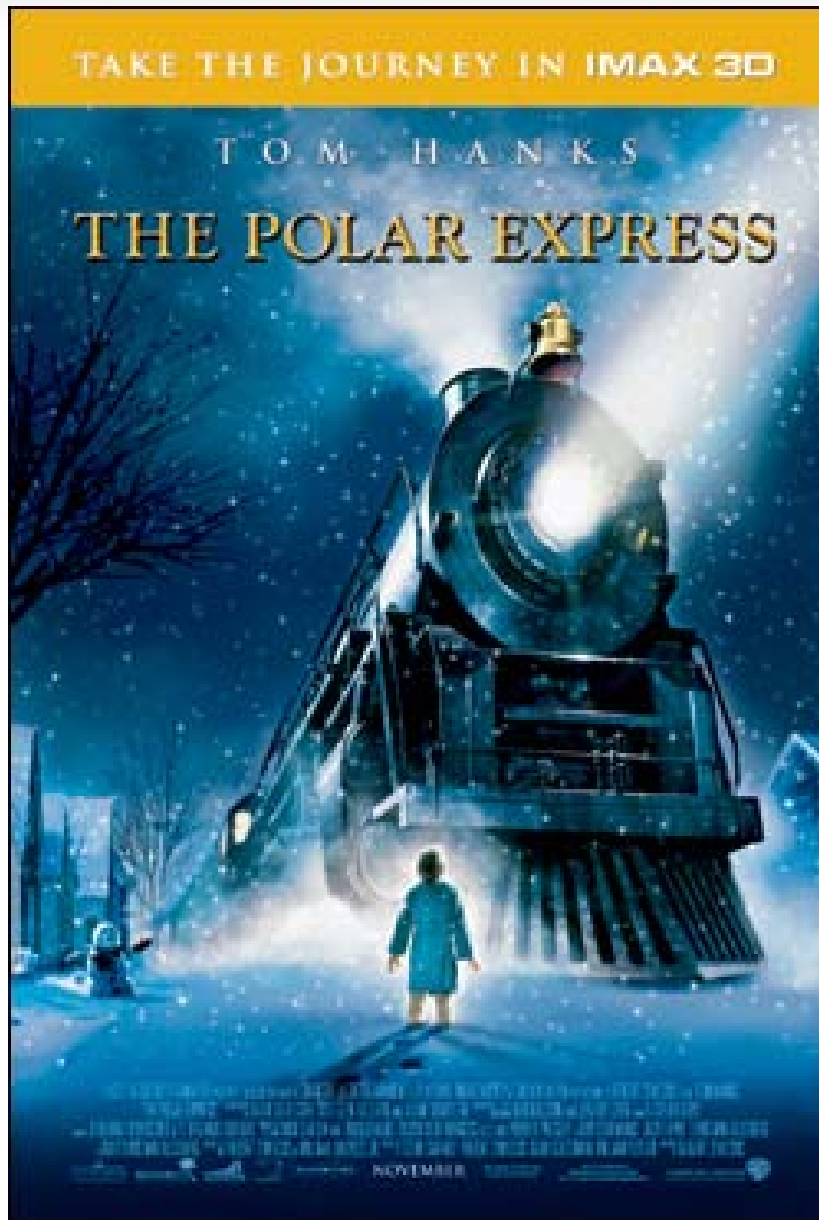


2003

\$33.4M Opening Weekend

\$189M Intl box-office

Anaglyph film & digital in theatres



2004

Imax Release

77 SCREENS

~14 WEEKS

\$45M int'l box office

\$15M additional in 2005

April 6, 2006

Matt Cowan
DigiTraining



THE ADVENTURES OF
SHARKBOY
AND
LAVAGIRL
3-D

DIMENSION
HOME VIDEO

TROUBLEMAKER
STUDIOS

Now Available On DVD

SharkboyAndLavagirlTheMovie.com

© Buena Vista Home Entertainment, Inc.

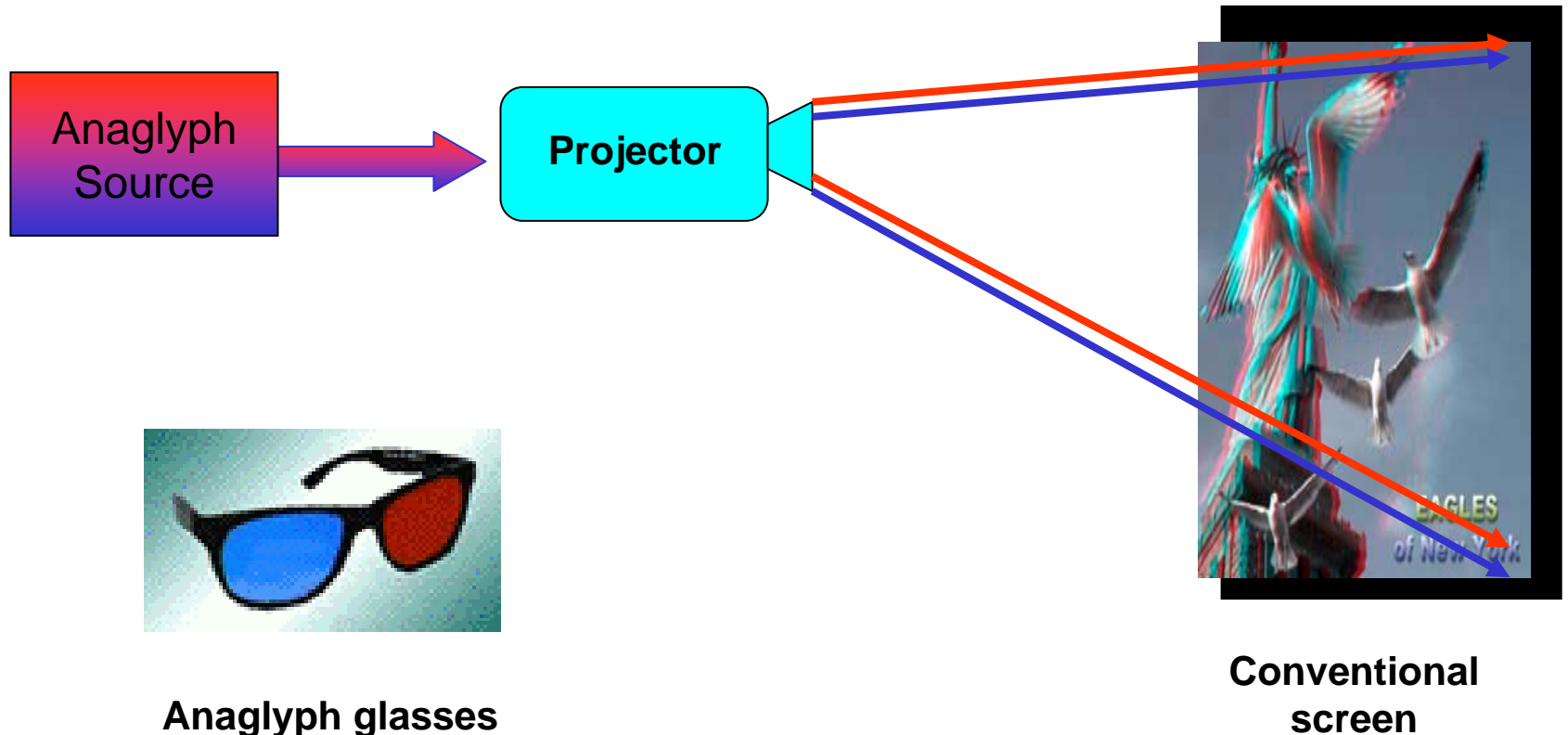
3D Technology Choices

- Anaglyph
- Active Glasses
- Passive Glasses
- 2 projector
- Single projector
- Circular polarization
- Linear polarization
- Triple flash

Anaglyph Projection

- Left and right eyes are tinted heavily red and green or red and blue
- Color tinting separates the channels visually
- Easy and simple to implement
- Inexpensive glasses
- Does horrible things to color
- Does not belong in the next generation of 3D options

Anaglyph Projection



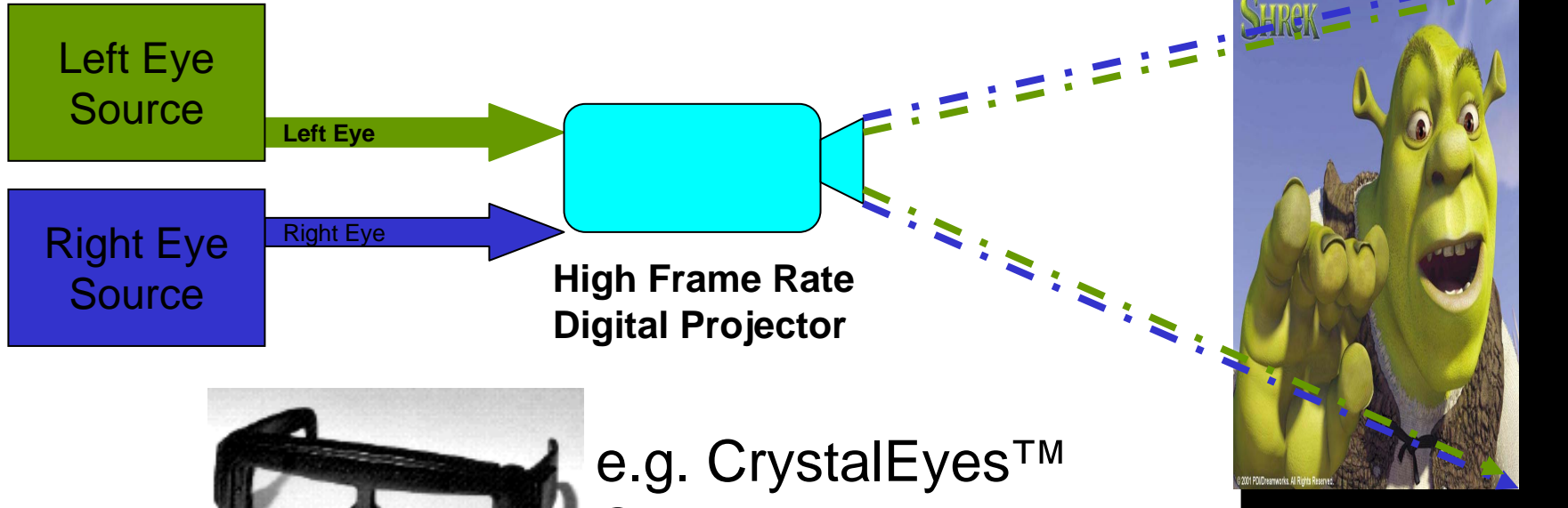


Active Glasses



- Works with single projector
- Projector launches left and right frames in sequence
- Active glasses alternately open and close electronic shutters on left and right eyes in sequence
- Active glasses are wirelessly synchronized with the L-R frames from the projector

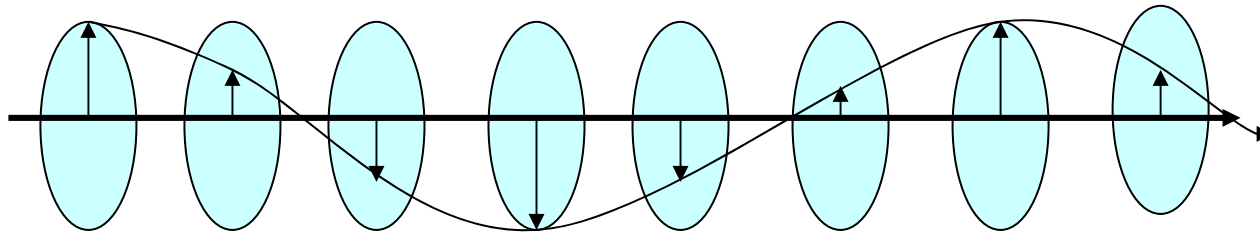
Active 1 Projector Stereo



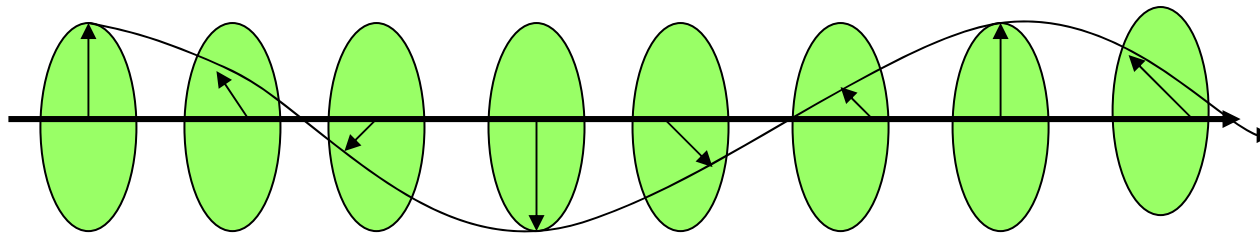
Shuttered glasses: Synchronized with projected source

Frame sequence – L1 R1 L1 R1, L2 R2 L2 R2, L3 etc.

Polarization



Linear Polarization



Circular Polarization

Linear Polarization

- Linear
 - Polarize each eye 90 degrees apart
 - Project polarized light
 - Polarized eyewear
 - Screen maintains polarization states
 - Minimal crosstalk (leakage from one eye to other)
 - Requires 2 projectors
 - Not tolerant of head tilt
 - Ghosting increases when polarizers aren't exactly 90 degrees apart

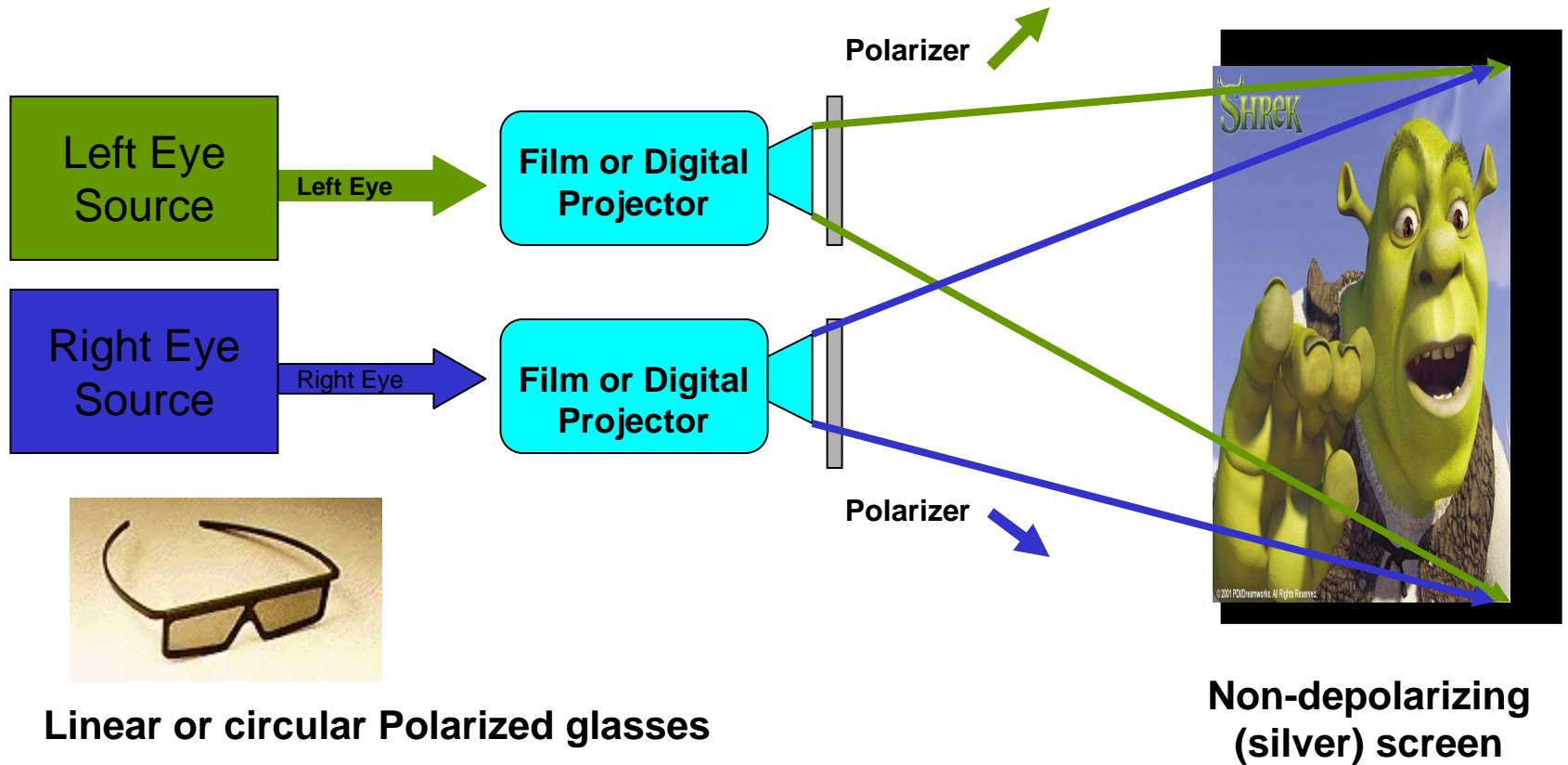
Circular Polarization

- Use left hand and right hand circular polarization to separate images
- Circular “analyzers” for eyewear
- 2 projectors or one using circular polarization switch (“Z screen™”)
- Requires screen that maintains polarization
- Circular polarizers are tolerant of head tilt

Polarization 2 Projector

- Linear or Circular
 - Uses two opposite polarization states separate left and right eyes
 - Requires 2 projectors, each providing one or other polarization state.
 - Uses passive glasses
 - “Non depolarizing” (silver) screen

Passive 2 Projector Stereo (Linear or Circular)

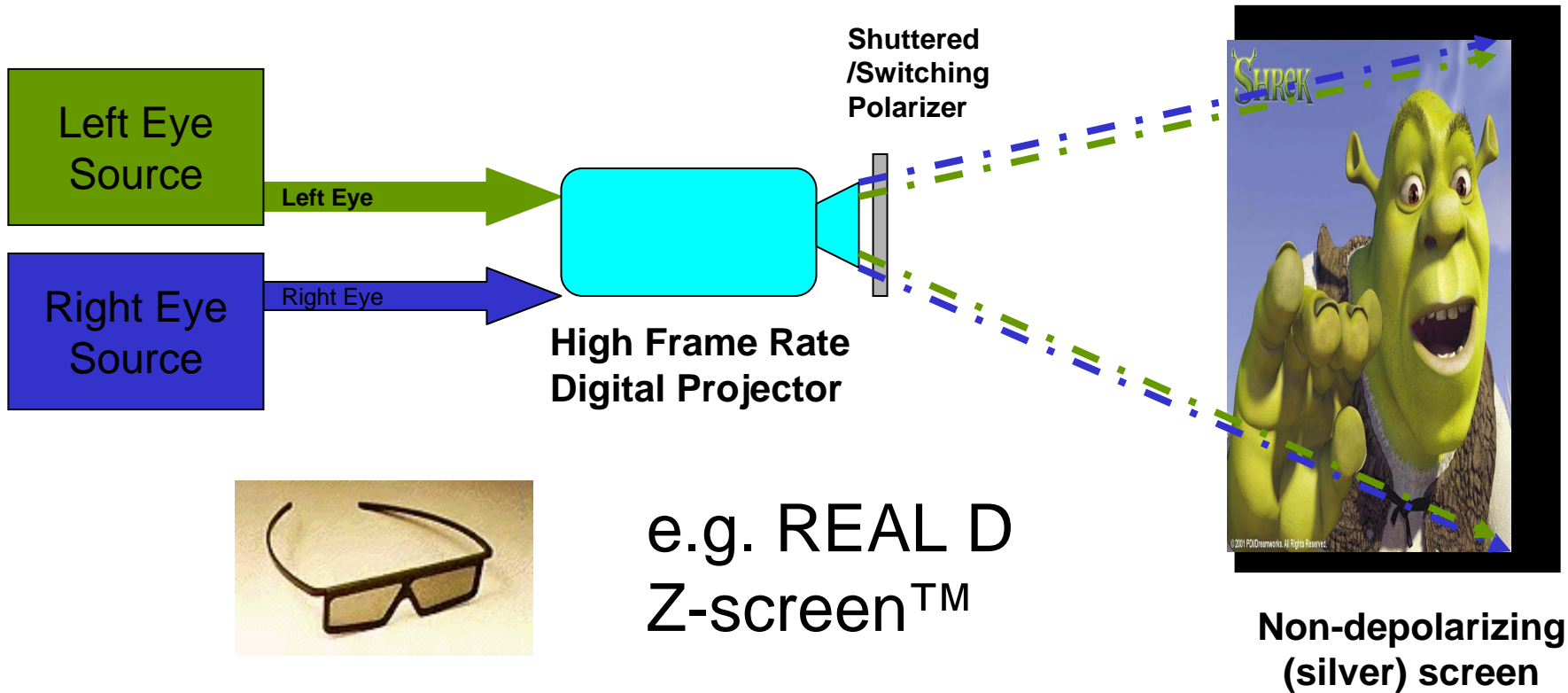


Circular Polarization

1 projector

- Works with single projector
- Projector launches left and right frames in sequence
- “Z screen” changes the polarization from left circular to right circular in sequence with the projector.
- Passive glasses have left and right circular polarization lenses to select the left or right image only.

Passive Glasses 1 Projector Stereo



REALD

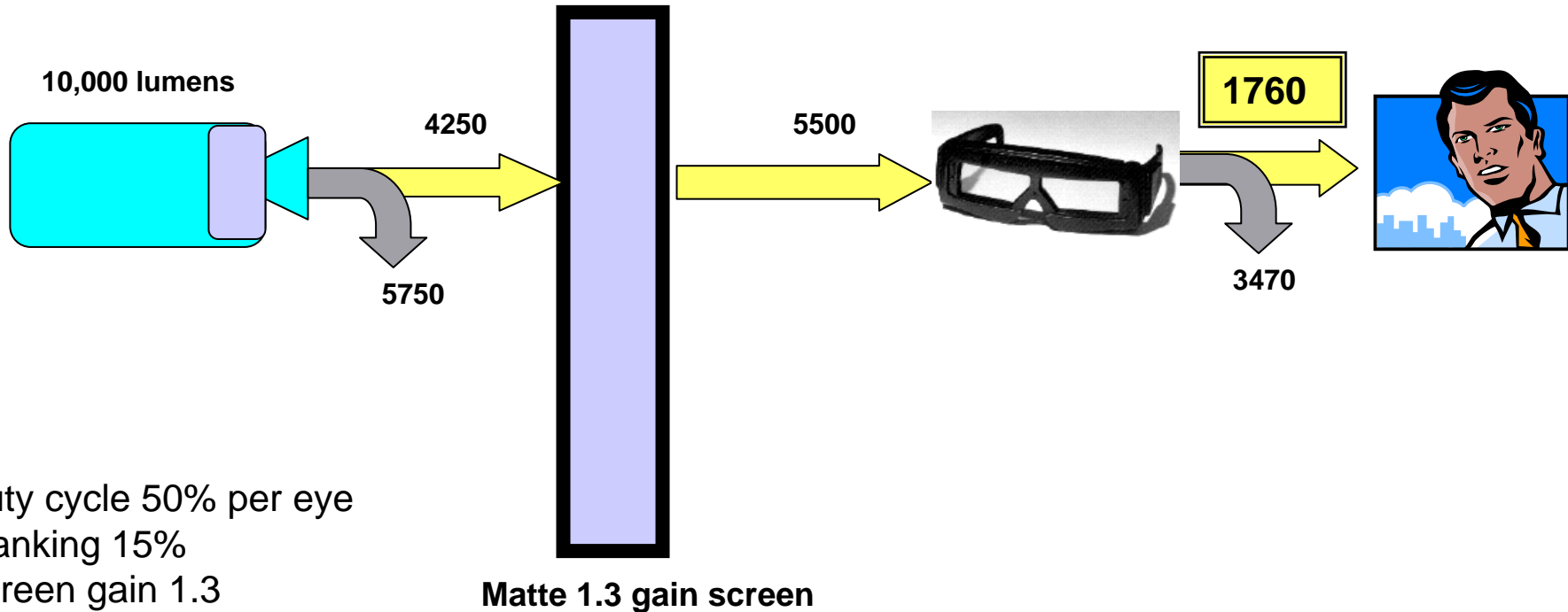
DLP
CINEMA[®]
A TEXAS INSTRUMENTS TECHNOLOGY

Light Efficiency

- Single Projector active glasses
 - Duty cycle
 - Blanking for switching time
 - Matte white screen
 - Glasses efficiency
 - Overall efficiency = 17% (including screen gain)

One Projector Active Glasses Light Efficiency

Light output – modulator loss x screen gain – polarized glasses loss



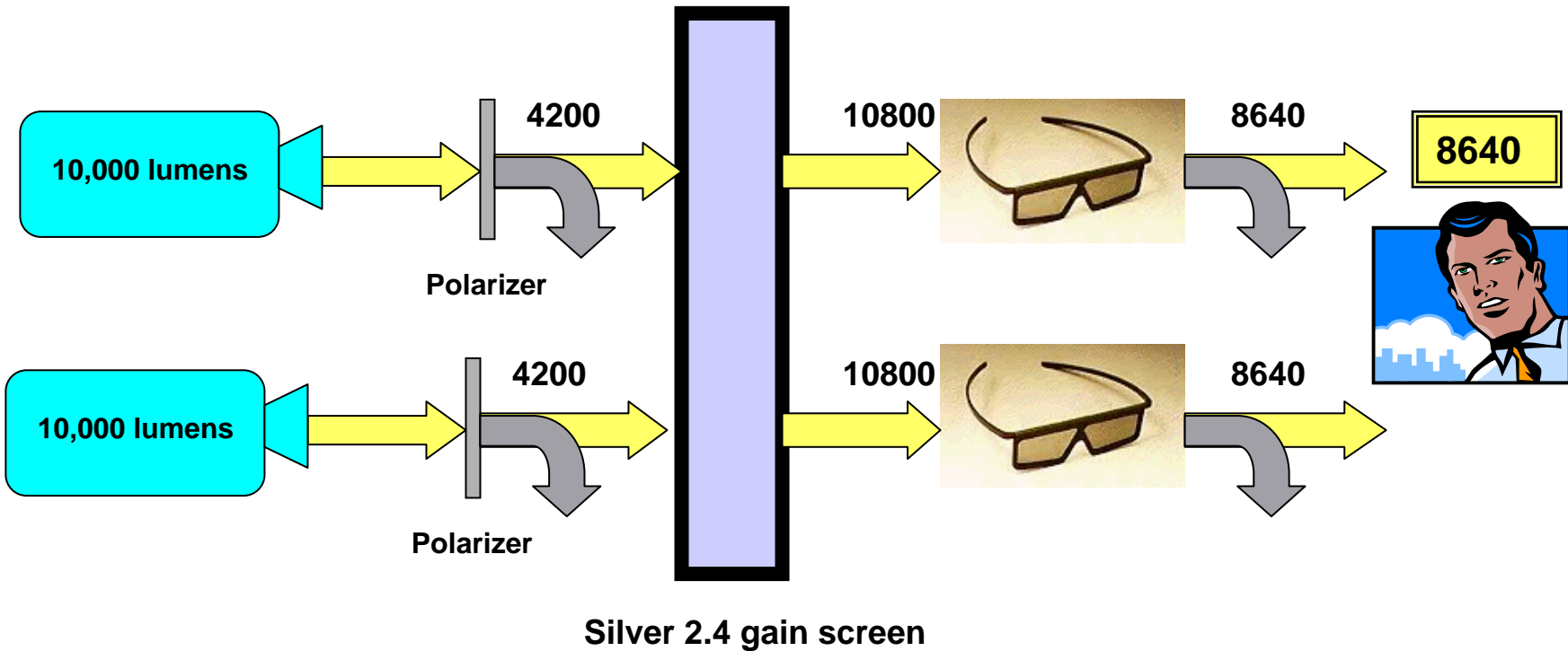
Duty cycle 50% per eye
Blanking 15%
Screen gain 1.3
Glasses transmission 32%

Light Output Efficiency

- 2 projector system
 - Efficiency of polarizers and glasses
 - Silver screen has a gain component (~2.4)

Passive Polarized Light Efficiency

Light output – Polarizer loss X screen gain – polarized glasses loss

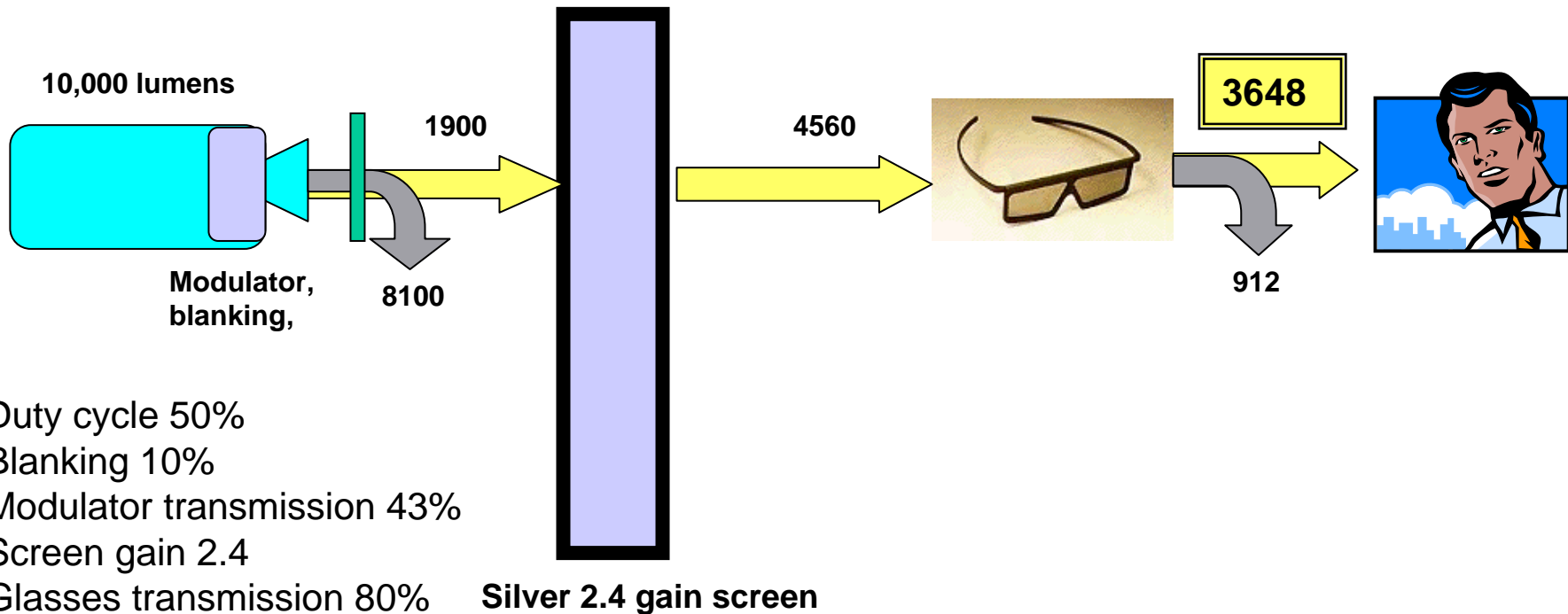


Light Efficiency

- Single Projector Passive Glasses
 - Absorption from active modulator on projector
 - Left eye / right eye only on half the time
 - Blanking between L/R frames for modulator switching
 - Gain in screen
 - Absorption in glasses

One Projector Passive Stereo Light Efficiency

Light output – modulator loss x screen gain – polarized glasses loss



Screens for 3D

- Shutter glasses use conventional matte white theatre screens
- Polarizing systems use silver screens
- Silver screens have traditionally exhibited difficulty with light distribution management (hot spots)
- Recent development programs at MDI, Harkness, Hurley to improve light distribution
- Silver screen provides gain which increases brightness of image.

Motion – Double, Triple

- 24 fps left and right are interleaved and flashed several times – e.g.
 - L1 R1 L1 R1, L2 R2 L2 R2, L3....
 - “Double Flash”
 - L1 R1 L1 R1 L1 R1, L2 R2 L2 R2 L2 R2, L3...
 - “Triple Flash”
- Motion can be confusing at lower flash rates
 - triple flash provides better motion than double.

Comparison Active and Passive glasses

	Active	Passive Circular
Screen	Conventional matte white	Silver-non depolarizing
Switching speed (blanking time)	Slow - >2 milliseconds Supports double flash only	Fast < 600 microseconds Supports triple flash for better motion
Light efficiency	Low	Low
Cost	Tens of \$	Tens of cents
Dynamic Range	Very good	Good
Max screen size for 17 nits image, 20,000 lumens, gain 1.3 matte or gain 2.4 silver	1.3 gain matte - 11 metres 2.4 gain screen - 15 metres	2.4 gain silver 15 metres

Active and Passive glasses

(cont'd)

	Active	Passive Circular
Eyewear	Heavier	Very lightweight
Eyewear Management	Theatre must collect, clean, QC and re-use (Major issue)	Disposable or souvenir
Theatre system	Requires IR synchronization	Requires Z screen modulator attached to projector
System Manufacturers	MacNaughton, (In-Three) REAL D	REAL D

Chicken Little in 3D Case Study



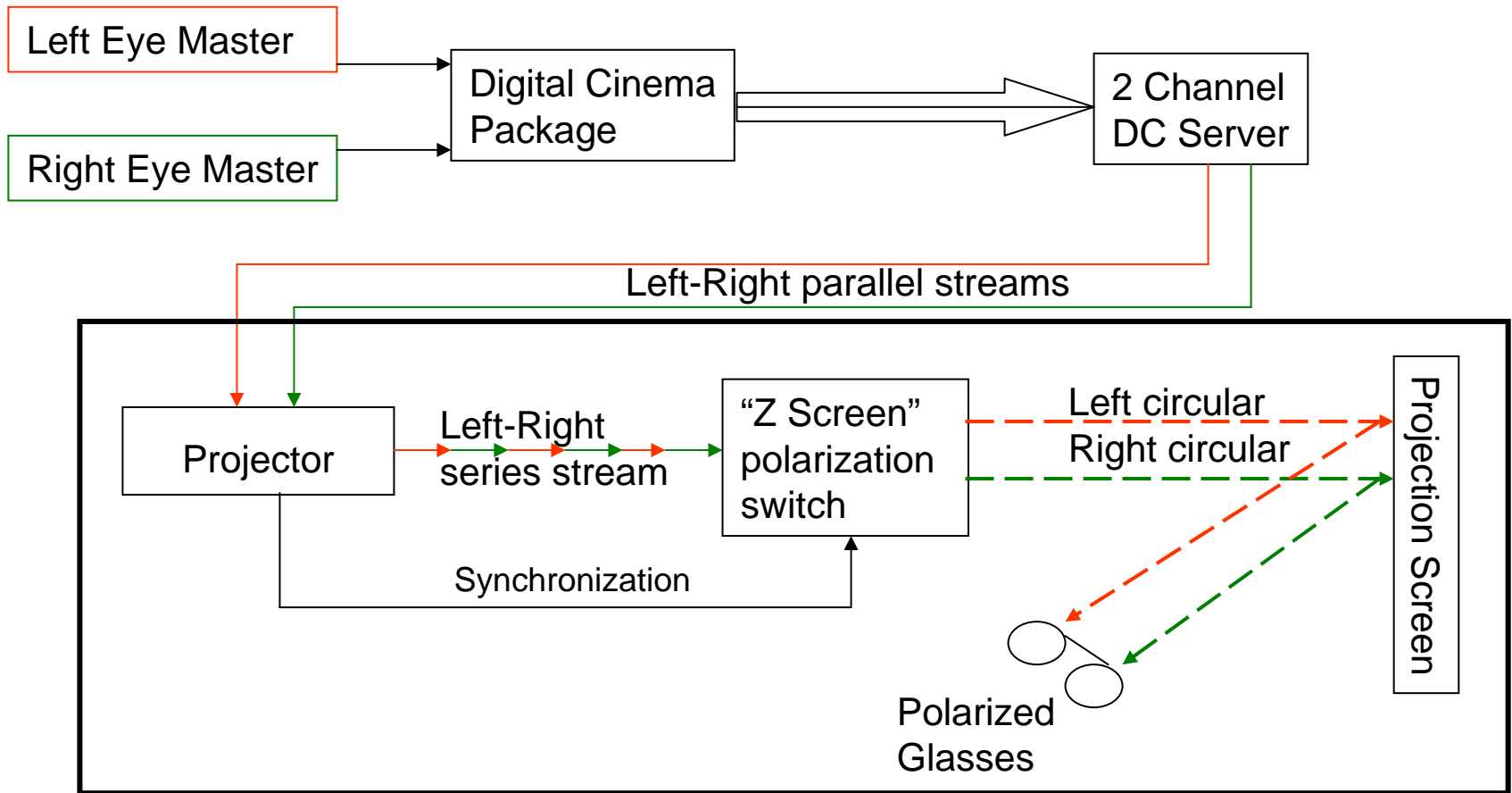
The Challenge

- Install 100 screens in USA and Canada
- 100 days from “go ahead” to completion
- Install in foreign territories in following months
- Operate on many platforms

The System

- Disney chose RealD Circular Polarized glasses system using Z screen and single projector
 - Works with essentially any DLP Cinema projector and any 3D enabled server
 - Provides quality presentation
 - Simple and reliable
 - Easy to operate – disposable souvenir glasses

3D System Architecture



Dimensions

- 85 screens installed on North America
 - Dolby Servers, Barco and Christie projectors
- 4 screens installed Mexico
 - Quvis servers, Barco, Christie
- 5 screens installed Australia
 - Kodak servers, Barco
- 2 screens Germany
 - Dolby, Barco, Christie
- Additional 6 screens Japan, UK
- >30 exhibitors signed up for RealD System

Misc Details

- Light levels at eye – 11 to 19 nits target range (measured through glasses)
- Glasses – souvenir provided by distributor
 - Cost ~1.00

Reliability

- 88 of 89 system operational Nov 4th , all 89 operational Nov 5th
- Many theatres ran for 8 weeks. No reported failures from the field.
- No reported “bad effects” from 3D viewing
- Exhibitors very happy with performance

Economic Results

- 2D and 3D ran side by side in most theatres
- 3D grossed between 2.6 and 3 times 2D
- 3D ticket prices were \$1.00 to \$4.00 higher (average 2.00)
- Average 3D gross per screen = 94K (~15K attendees per screen) = \$30K per screen incremental

From Here

- Monster House (Sony) releasing July in USA in 3D
- Meet the Robinsons (Disney) releasing in Feb 2007 in 3D
- Beowulf (Warner Paramount), 2007
- Negotiations with all major studios for more content
- More exhibitors installing systems

3D Clips

- System:
 - Kodak server
 - Barco projector
 - RealD Z screen system
 - Passive circular polarizer eyewear
- Clips
 - Chicken Little
 - Polar Express
 - Fly me to the Moon – n-Wave

Thank you

Matt Cowan

Mcowan@reald.com

www.reald.com