

# 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

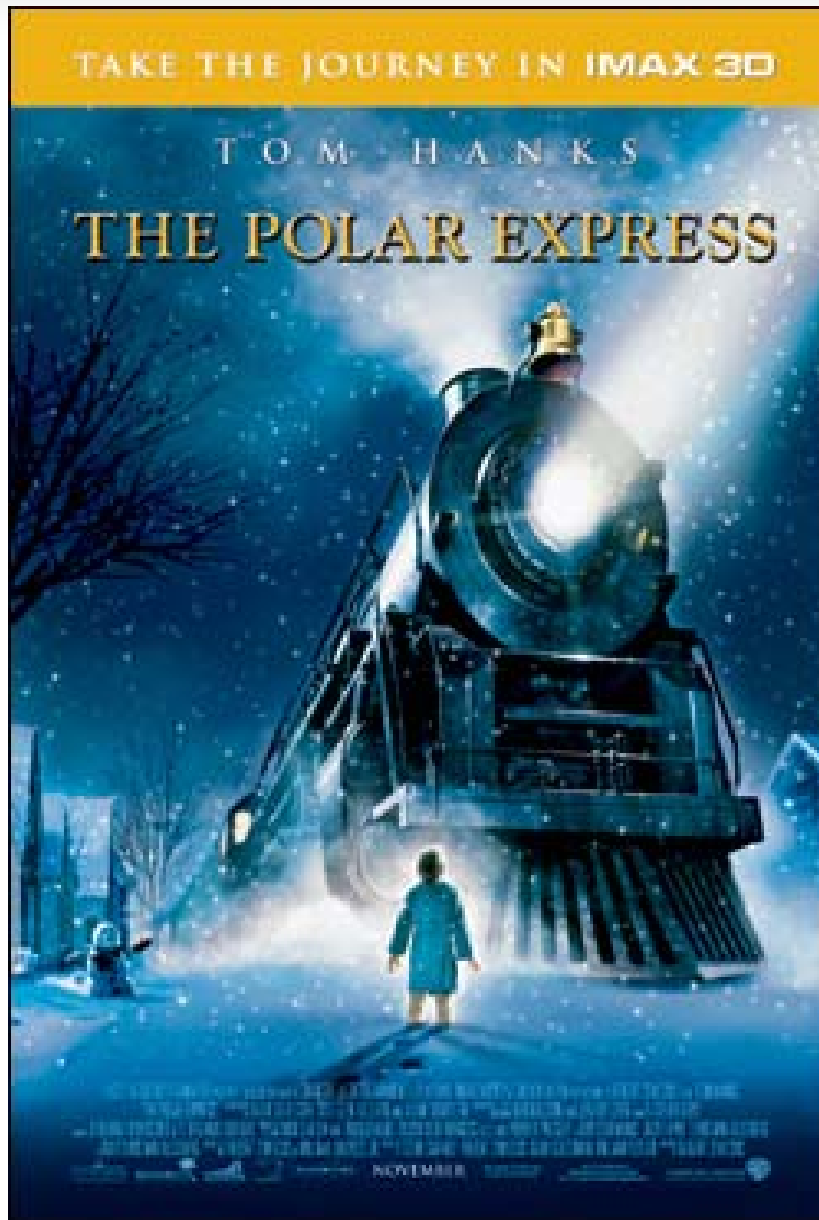


**2003**

**\$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**

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# 3D Technology Choices

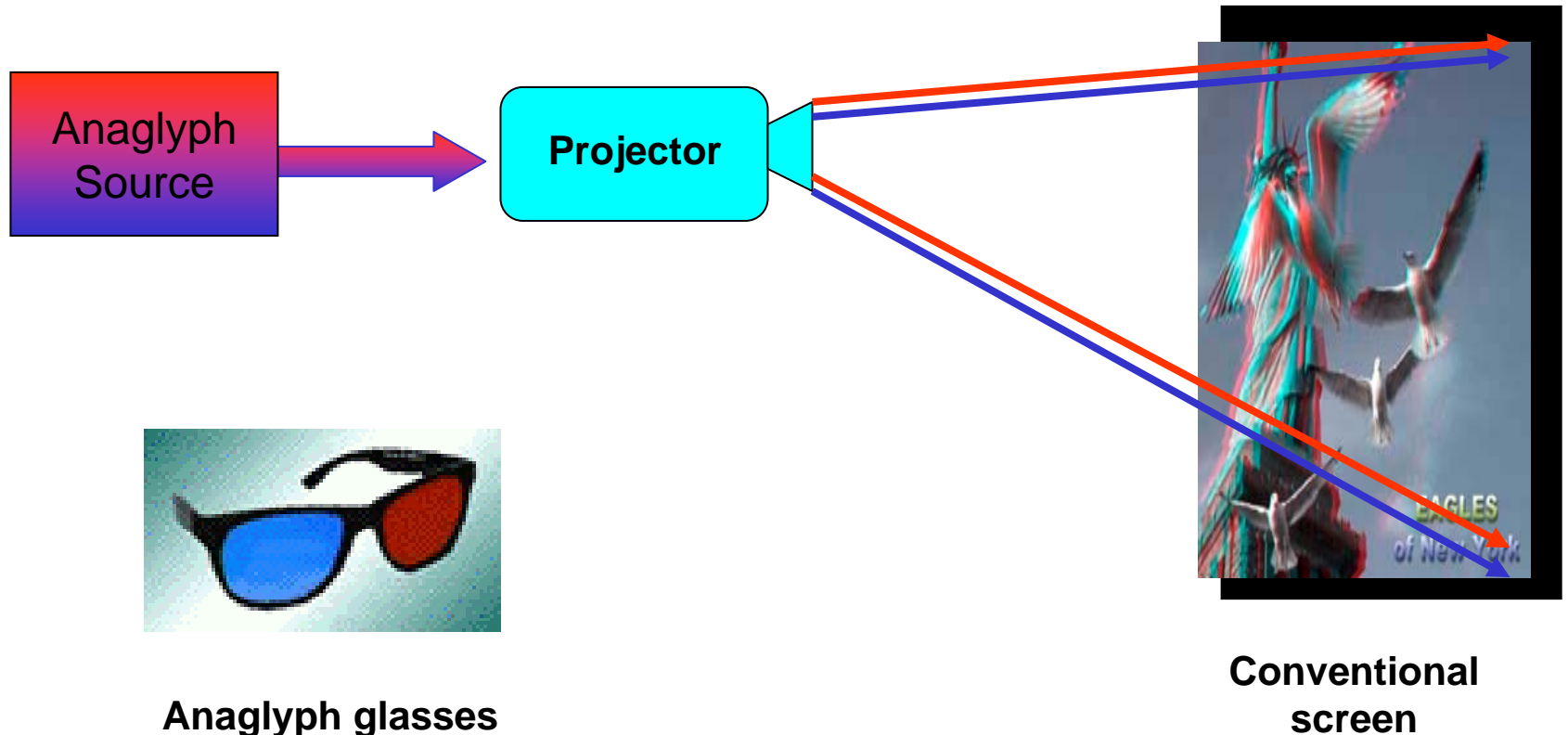
- Anaglyph
- Active Glasses
- Passive Glasses
- 2 projector
- Single projector
- Circular polarization
- Linear polarization
- Triple flash

# 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



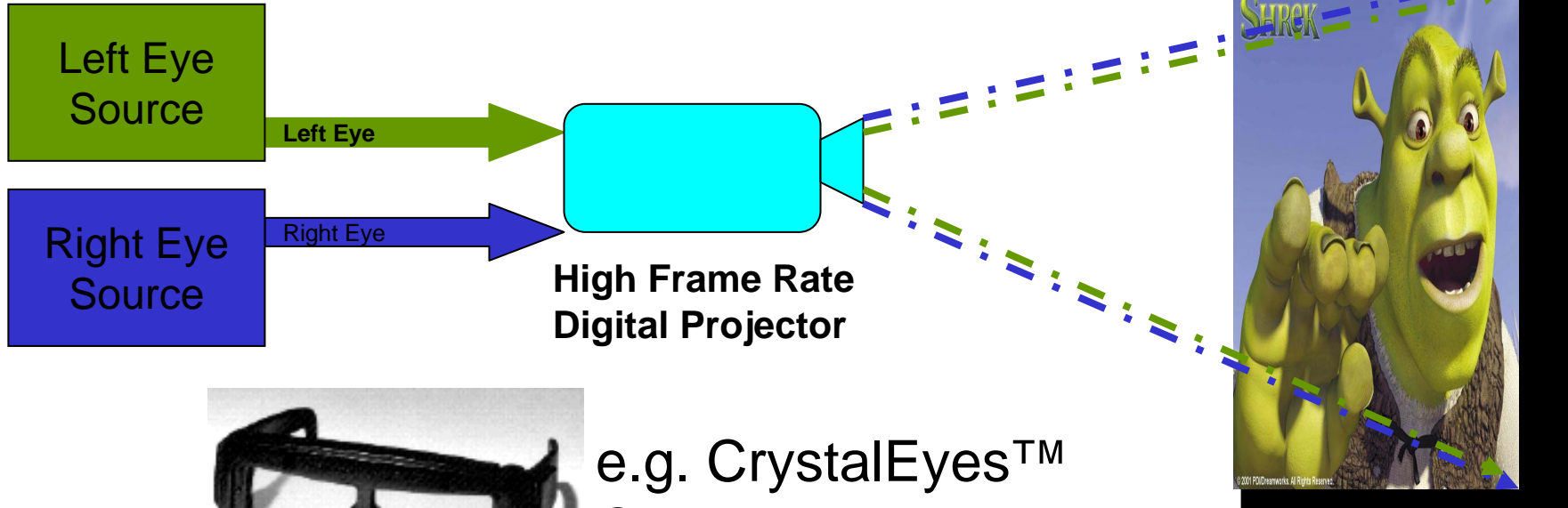


# Active Glasses



- 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

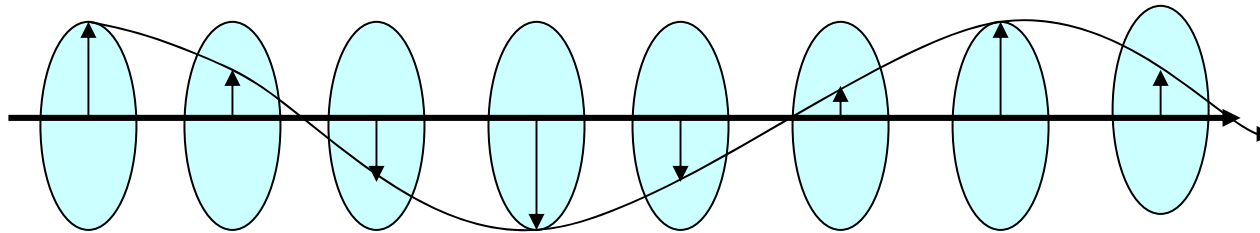


Conventional screen

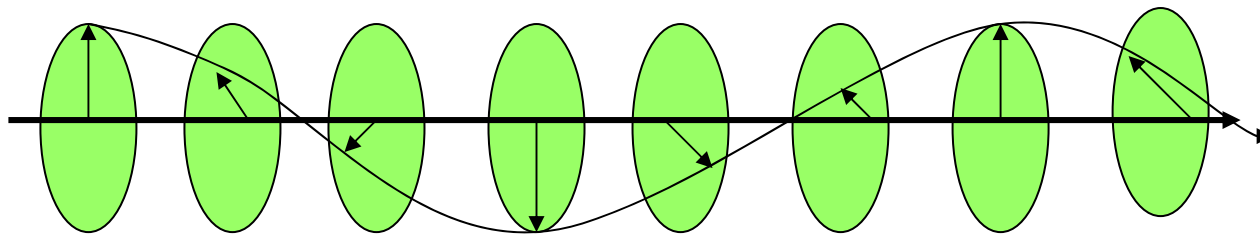
Shuttered glasses: Synchronized with projected source

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

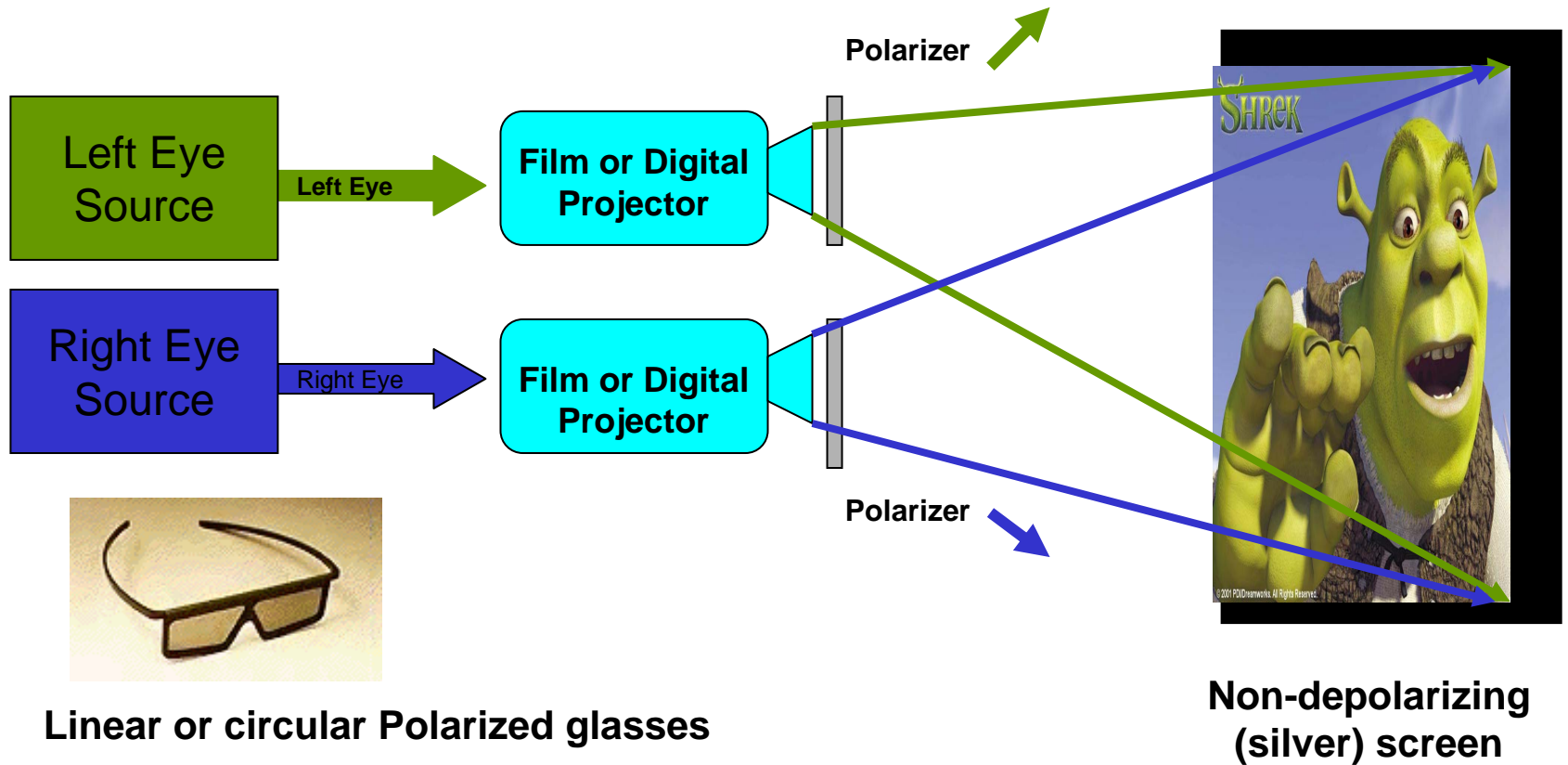
- Use left hand and right hand circular polarization to separate images
- Circular “analyzers” for eyewear
- 2 projectors or one using circular polarization switch (“Z screen™”)
- Requires screen that maintains polarization
- Circular polarizers are tolerant of head tilt

# 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)

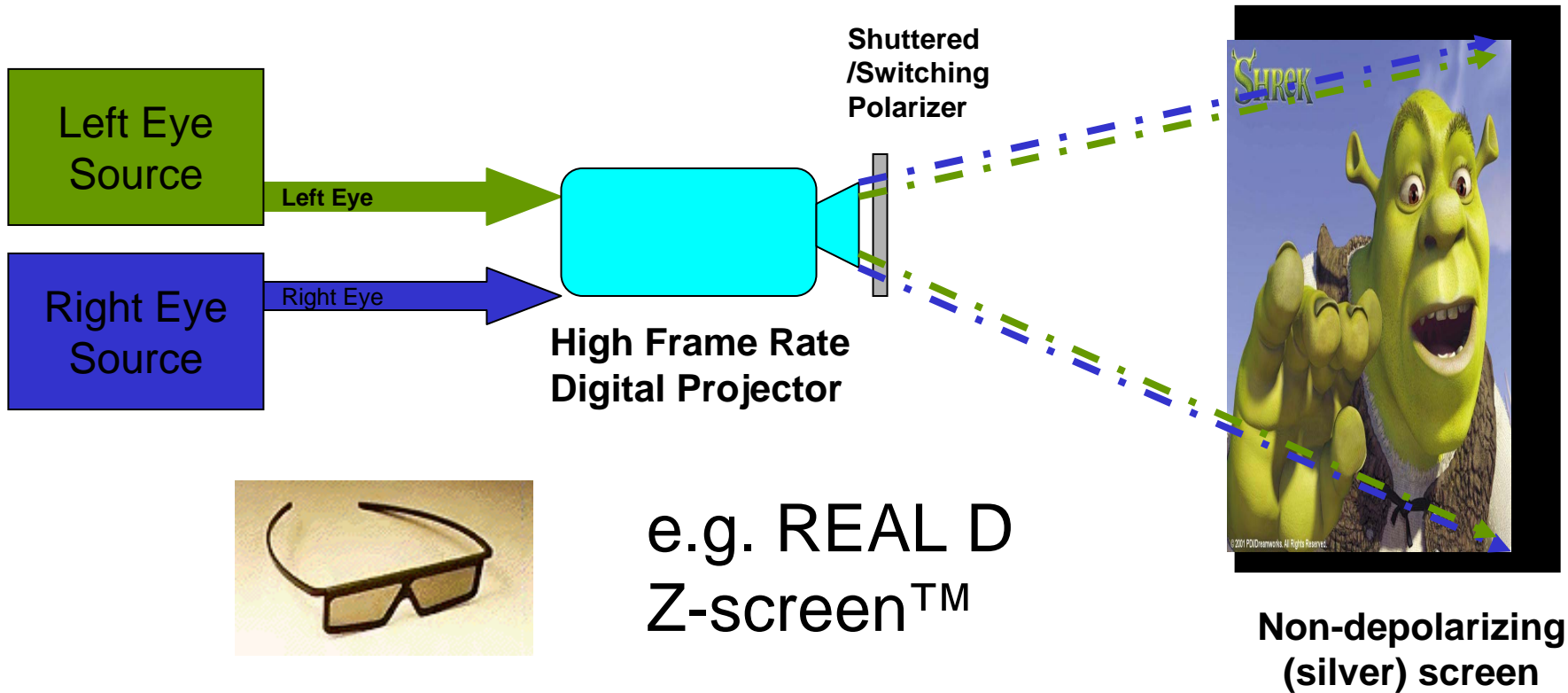


# Circular Polarization

## 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

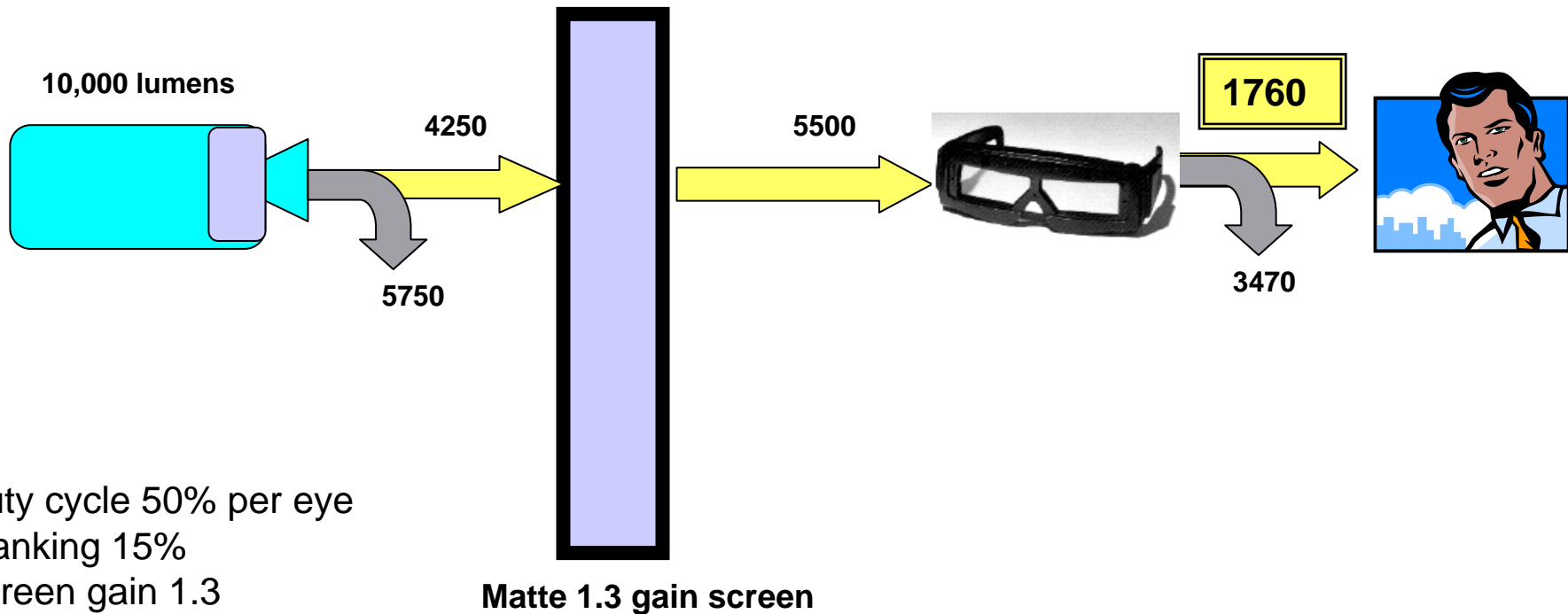
DLP  
CINEMA<sup>®</sup>  
A TEXAS INSTRUMENTS TECHNOLOGY

# 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



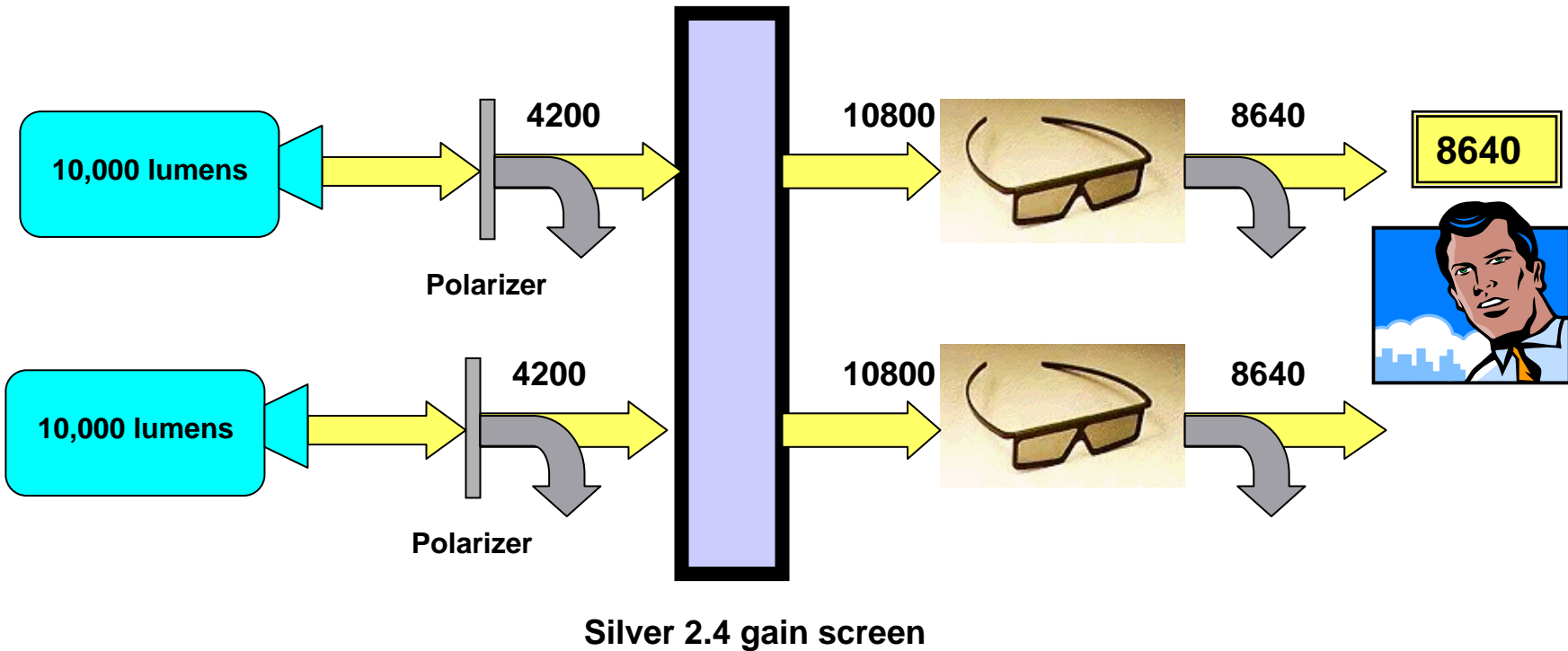
Duty cycle 50% per eye  
Blanking 15%  
Screen gain 1.3  
Glasses transmission 32%

# 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



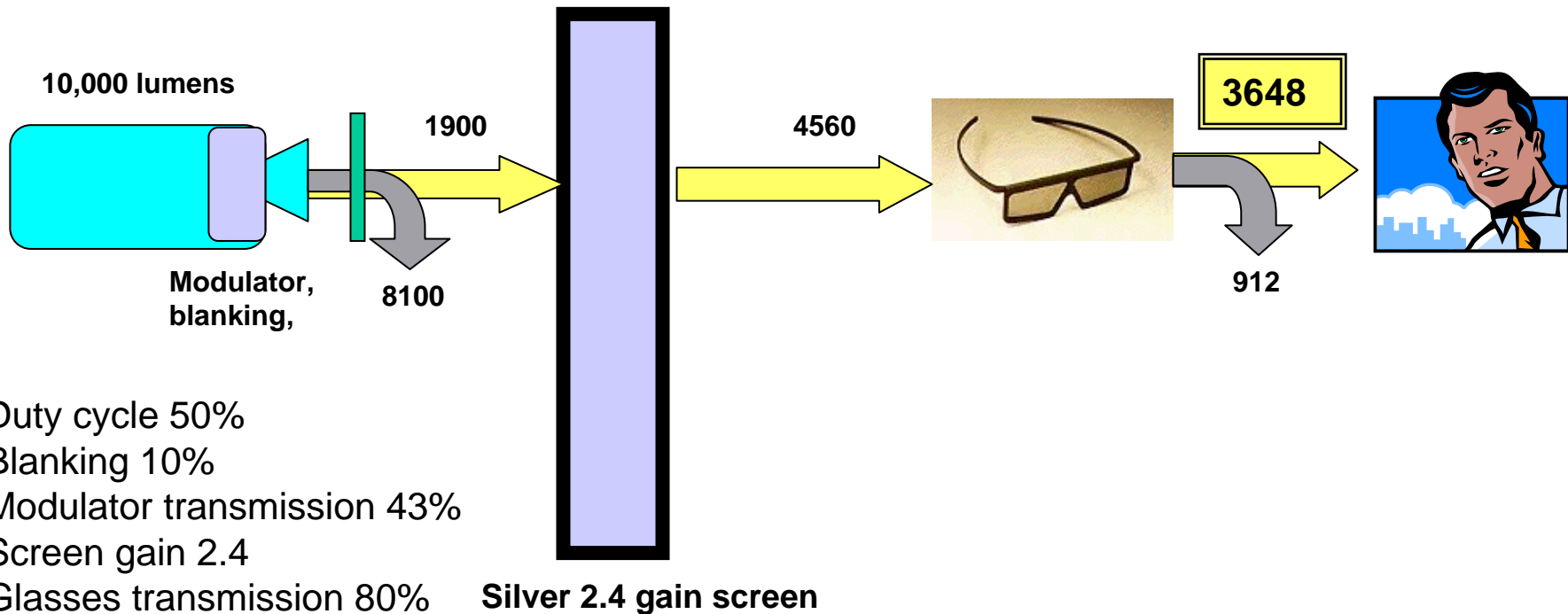


# Light Efficiency

- 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

|   | <b>Active</b>   | <b>Passive Circular</b>  |
|---|---|--|
| Screen  | Conventional matte white  | Silver-non depolarizing  |
| Switching speed<br>(blanking time)  | Slow - >2 milliseconds<br>Supports double flash only            | Fast < 600 microseconds<br>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<br>17 nits image,<br>20,000 lumens,<br>gain 1.3 matte or<br>gain 2.4 silver | 1.3 gain matte<br>- 11 metres<br>2.4 gain screen<br>- 15 metres | 2.4 gain silver<br>15 metres                                       |

# Active and Passive glasses

(cont'd)

|                      | <b>Active</b>  | <b>Passive Circular</b>                           |
|----------------------|--|---|
| 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)<br>REAL D                        | REAL D  |

# Chicken Little in 3D Case Study



# The Challenge

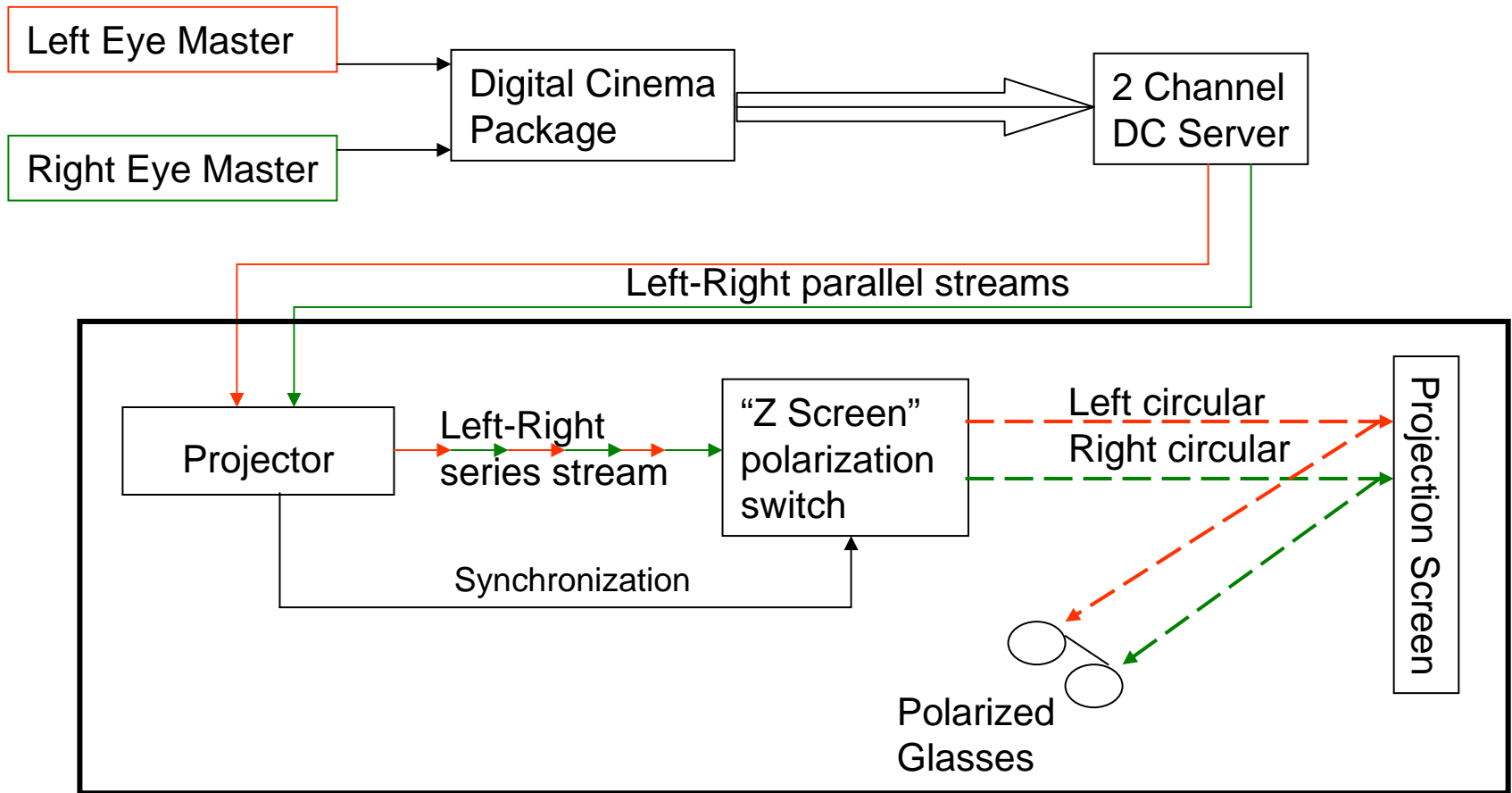
- Install 100 screens in USA and Canada
- 100 days from “go ahead” to completion
- Install in foreign territories in following months
- Operate on many platforms



# 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 4<sup>th</sup> , all 89 operational Nov 5<sup>th</sup>
- 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](mailto:Mcowan@reald.com)

[www.reald.com](http://www.reald.com)