# REAL D 3D System

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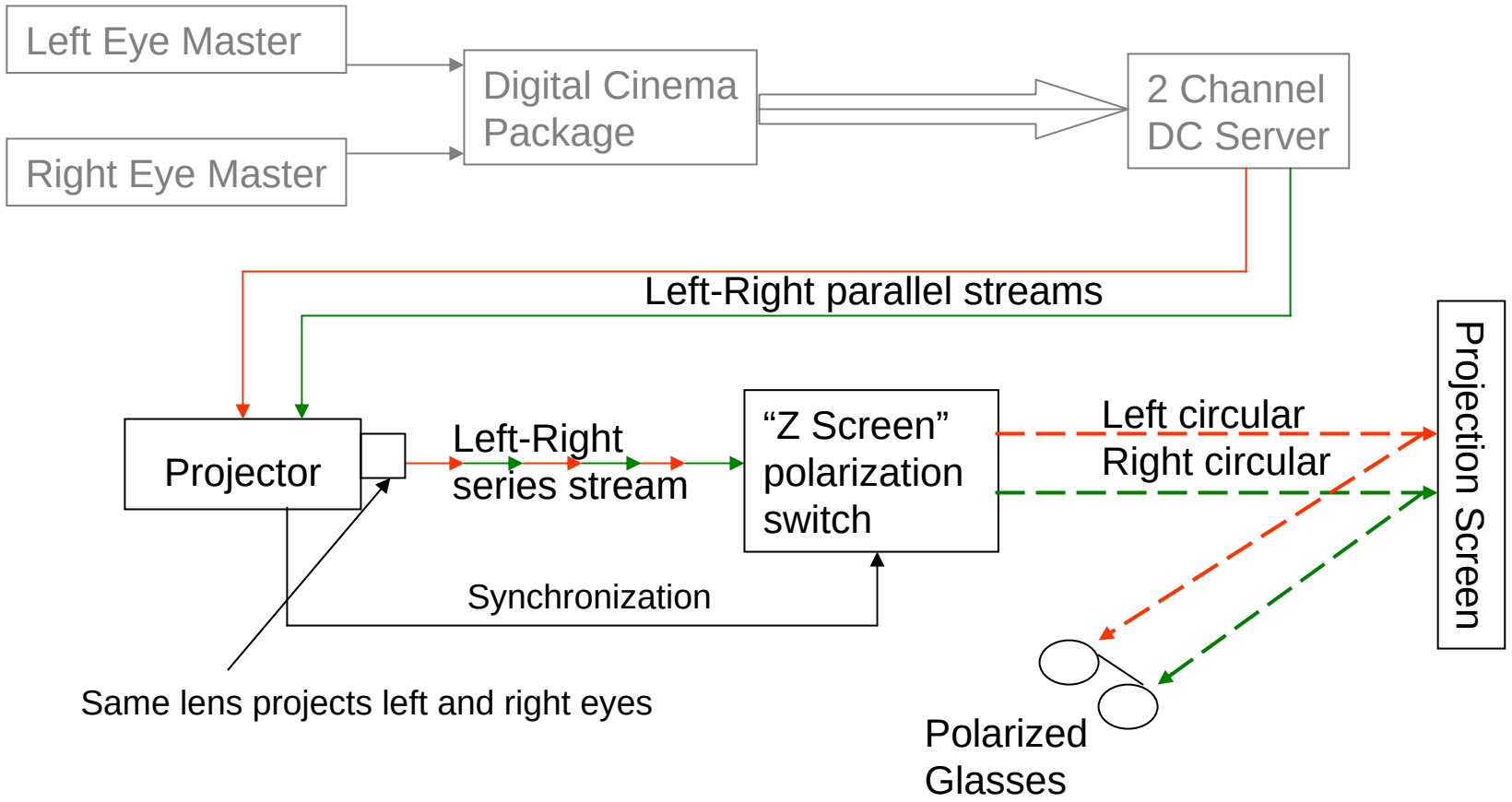
REAL D

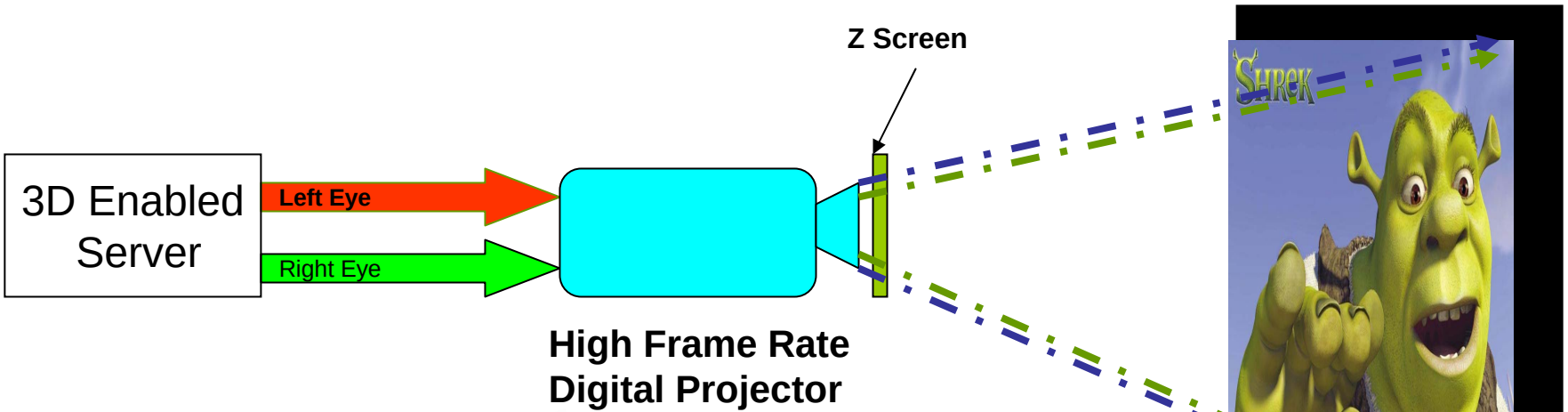
# System Requirements for 3D Theatre

- Quality and comfortable 3D
- Easy for theatre to operate
- Large screen
- Viable economics
- Reliable

# REAL D 3D System Architecture



# REAL D System




**Polarized glasses (Circular)**

**Non-depolarizing screen**

# Advantages of Architecture

- Single projector
  - Cost – 1 projector not 2
  - Alignment - “auto aligned”
  - Luminance distribution – identical for each eye
  - colour – identical for each eye
- Simple system with inexpensive passive eyewear

Geometric, luminance and colour symmetry are very important for comfortable viewing.

# Z-Screen

- Mounts in front of projector
- Synchronized to projector
- Electronically switches polarization for left and right eyes
  - Left circular for left eye
  - Right circular for right eye
- Simple device “single pixel LC”
  - Long life
  - Stable performance
- Driven by controller that sets switching voltages

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# Z Screen Attributes

- Fast switching - <500 usec
  - Minimizes the “off” time required for switching
- High transmission – 42%
  - Maximize light on screen
- Almost colour neutral
  - colour correct through system (set up MCGD)
  - Preserves entire colour gamut of projector
  - Minimizes light loss due to colour calibration

# Circular Polarization

- Head tilt
  - Allows head tilt without ghosting
- Z screen operates symmetrically
  - Same performance for each eye (colour, switching timing)

# Eyewear

- Circular polarization exactly matched to Z screen
- Single use – souvenir or recyclable
- Lightweight, comfortable


# Eyewear Management

- REAL D eyewear is inexpensive - <<$1.00
- Recycling program planned to refurbish eyewear in central location
- No washing, no theft management, no testing

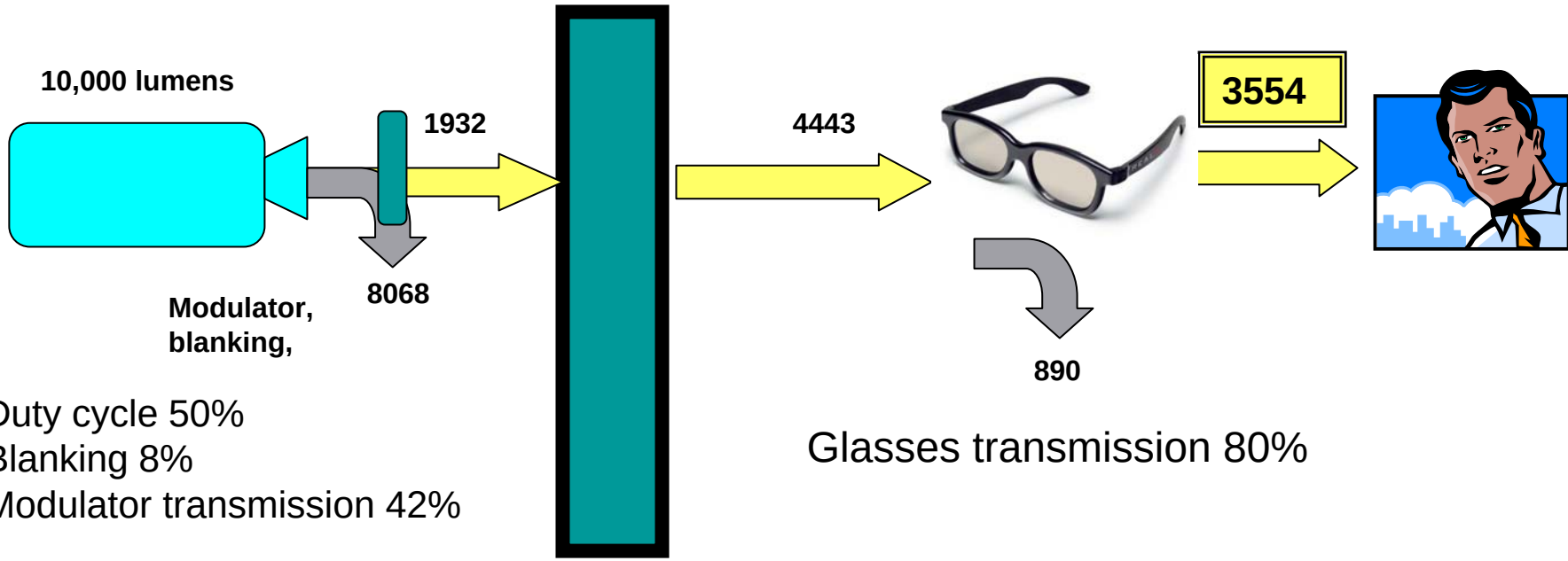
- Easy management is benefit to theatre operator

# Silver Screens

- Needed to maintain polarization states in polarized systems (e.g Z screen)
- Needed for light efficiency
  - All single projector 3D systems are inefficient – (~15%)
  - Silver screen has gain ~2.4
  - Gives brighter image and/or larger screen
  - Lower power in 3D mode
- Quality of reflected surface is improved
  - Hot spot spread
  - Cosmetic (“fixed pattern noise”) eliminated
  - Reflected light is colour neutral
- Reflectivity of surface provides slightly higher contrast and slightly higher colour saturation due

# Light Efficiency

**Light output = Z Screen transmission x screen gain – polarized glasses loss**



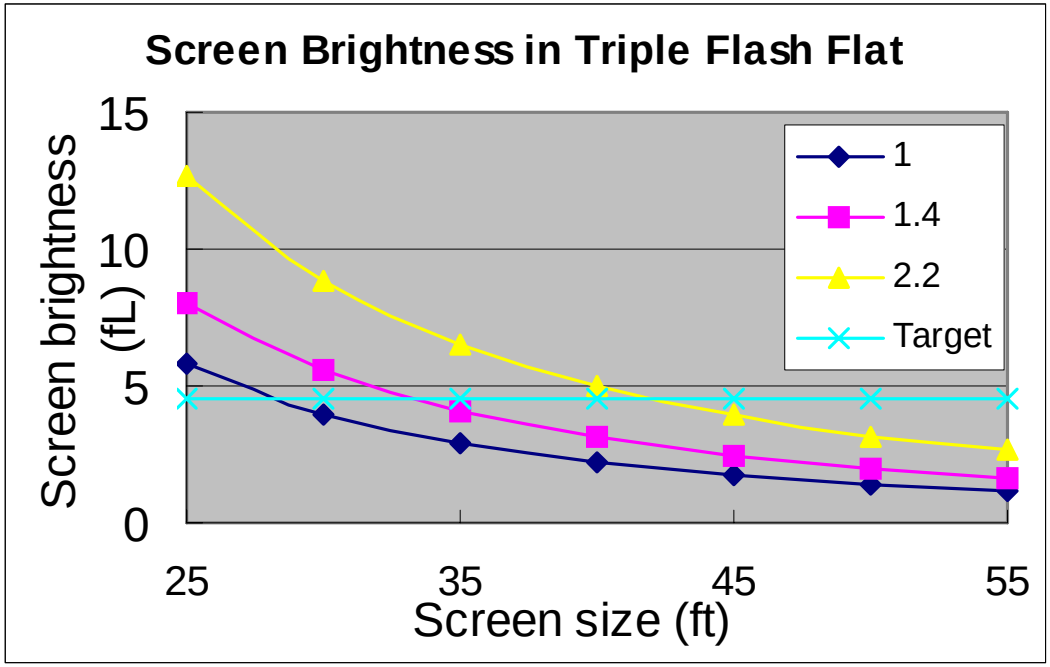

Duty cycle 50%
Blanking 8%
Modulator transmission 42%

Glasses transmission 80%

**Silver 2.3 gain screen**

# Brightness and Screen Size

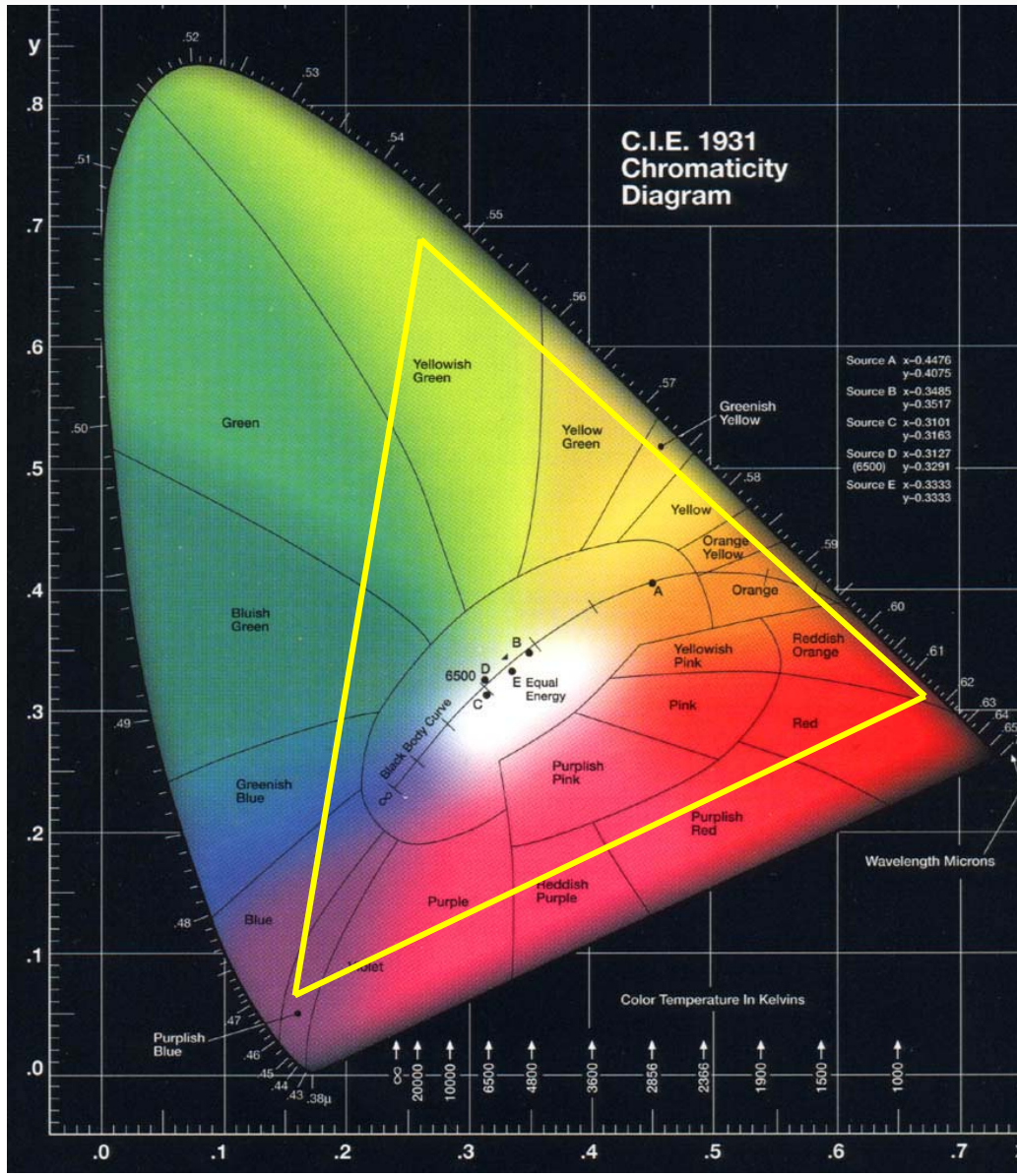
- Current target 4.5 fL “at the eye”
  - Measured with Z screen and glasses in place




Assuming 20,000 actual lumens from the projector

# Colour

- Full DCI colour space
- Z screen and eyewear are almost colour neutral
- Projector calibration provides full DCI colour compliance (primaries and white point)



# Crosstalk

- “Ghosting” or “signal to noise”
- Physical light leakage from of one eye image into the other eye
- All systems exhibit to some degree
- Circular polarization not exempt
- Can be mitigated

# Ghost Busting

- Digital pre processing to reduce ghosting in image
  - Crosstalk model to predict ghosting
  - Real time digital processing box compares left and right images predicts crosstalk and subtracts predicted ghost image
- Currently, ghost pre correction baked into master
- Near future – ghost pre correction installed in theatre as part of REAL D system

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# Triple Flash for Better Motion

- Rapid movement requires higher refresh rate to for smoother performance
- Attempt to make left and right eyes appear at the same time
  - In practice sequential mode causes phase delay one eye to the next
  - Triple flash is L1R1L1R1L1R1 L2R2L2R2L2, etc.
  - Double flash repeats each frame only twice in sequence L1R1L1R1 L2R2L2R2 etc.
  - Creates greater apparent simultaneity of the eyes

# Setting Up Light Levels

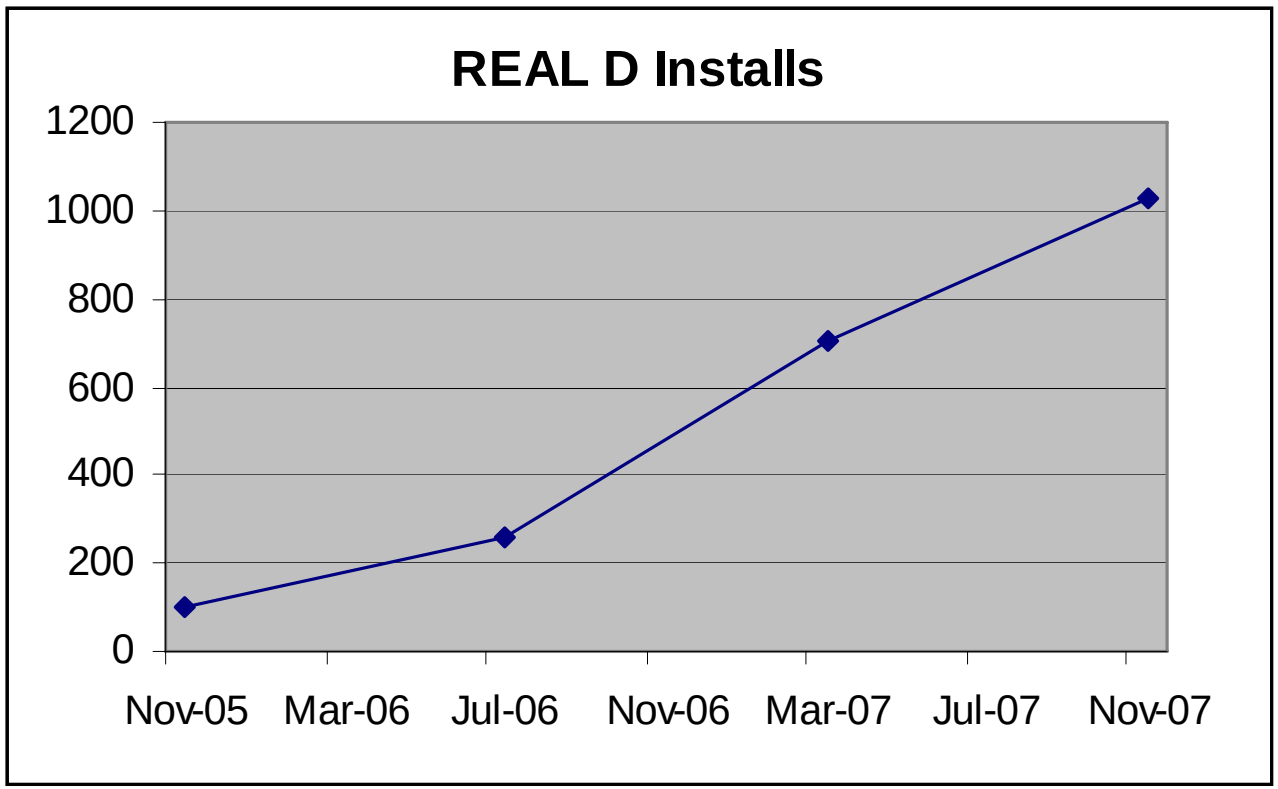
- Need to emulate luminance at eyeball
  - 3.5 to 5.0 fL (current practice)
- Accurate measurement through entire visual system is not easy
- Measure 2D and apply discount based on efficiency of system
- In practice – 30 to 44 fL open gate full screen (2D) white.

# Reliability

- 700 REAL D systems installed as of March-07
- Cumulative running time ~500,000 hours
- No Lost shows due to Z screen operation

# Installed Base

- 1030 sites for Beowulf



# Summary

- Simple system
- High quality images
- Easy for theatre to operate
- Largest screens with single projector
- Reliable

# Demo

# Matt Cowan

## Chief Scientific Officer

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