Close Encounters of the Third Dimension
IRT Kolloquium
Munich – September 20, 2010
Close Encounters of the Third Dimension
3D is no Science Fiction

- 1890: Teleview system patented
- 1900: First anaglyph 3D tests
- 1910: Polarized system patented
- 1920: Approx. 40 3D movies released
- 1930: First stereo 3D TV tests patented
- 1940: First anaglyph 3D tests
- 1950: First digital 3D movie
- 1960: First anaglyph color movie
- 1970: BSkyB and Sky Germany
- 1990: IMAX 3D
- 2000: Sky 3D
- 2010: Avatar

3D side-by-side patented (Stereoscope)
Close Encounters of the Third Dimension
3D boomed every 30 years ... so far.
Cinema’s Hype!
2D versus 3D revenue

source: Screen Digest – UK box office data

Sky HD-3D – IRT Kolloquium - 20 Sep 2010
Cinema‘s Hype!
Digital 3D screens

source: Screen Digest – international data
3D Boom
What is different this time?

CE manufacturers are looking for innovations
• 2D/HD displays are a commodity and prices are falling
• in the home HD flat panels allow for a more realistic 3D experience

Movie theatres need to differentiate again
• consumer can experience high-quality HD content in their home today

Gaming industry is looking for a more intense experience
• want to sell more (new) software and hardware

3D production equipment/tools available and mature
• more precise calibration of left and right pictures
• more flexibility due to file-based storage and editing
• no compromise in picture quality

There is money to be earned
From Silver Screen to Flat Panel
Yet another dimension in the living room?

3D glasses
• need to be worn in both the movie theatre and at home
• might feel a little odd to wear 3D glasses at home

Screen size
• much smaller screen in the home (3D cinema content needs to be adapted to the 3D in-home display)
• viewer feels to be more in the scene in the movie theatre
• in the home it feels like watching through a window (puppet theatre effect)

Viewing conditions
• ideal in the movie theatre (dark auditorium)
• typically less ideal in the home
Cinema’s Hype = Broadcaster’s Hope?
Lots of questions to be answered ...

What Broadcast Technology to use for 3D content?
Is there enough 3D Content available yet?
What about Live 3D Production?
How much bandwidth is necessary?
Is there a need for a 24/7 dedicated 3D channel?
What are the costs involved?
What business model will cover those costs?
What 3D equipment will the customer need?
Are there health issues to be considered?
Broadcast Technology
Broadcast Technology – Phase 1
Independent of the technology of the 3D display!

Phase 1: Frame compatible

- left and right picture will be squeezed into a conventional HD signal either “side-by-side” or “over/under” (also called “top/bottom”)
- the receiver will pass the unchanged signal on to the 3D display which will render a 3D pictures (polarized, shutter or auto-stereoscopic)

**Pros:** Existing HD broadcast infrastructures and HD receivers can be used. The customer won’t need a special 3D receiver.

**Cons:** Loss of half the horizontal or vertical resolution, which is compensated for by the high similarity between the left and right picture.
Broadcast Technology – Phase 2
Independent of the technology of the 3D display!

Phase 2: Service compatible
• depth information or the difference signal between the left and right picture will be transmitted in addition to the conventional 2D content
• the receiver will pass on the signal in different manners to the 3D display which will render a 3D pictures (polarized, shutter or auto-stereoscopic)

**Pros:** The signal is (technically, not as regards content) 2D compatible, i.e. it can also be received/watched by customers without a 3D display.

**Cons:** Additional bandwidth is necessary for the ancillary data. The consumer will need a special 3D receiver.

![Diagram showing 2D input with depth information leading to a 3D display](image)
3D Content
3D Content
There appears to be an abundance of 3D movies ...

<table>
<thead>
<tr>
<th>1920s</th>
<th>1930s</th>
<th>1940s</th>
<th>1950s</th>
<th>1960s</th>
<th>1970s</th>
<th>1980s</th>
<th>1990s</th>
<th>2000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>≈15</td>
<td>8</td>
<td>≈16</td>
<td>≈148</td>
<td>≈19</td>
<td>≈41</td>
<td>≈59</td>
<td>≈19</td>
<td>≈57</td>
</tr>
</tbody>
</table>

≈382 3D movies

... but it’s not enough to fill a 24/7 3D channel.
3D Content

But number of 3D titles produced is on the rise

source: Screen Digest – international data
3D Content

List of upcoming 3D movie releases (excerpt)

The Adventures of Tintin: Secret of the Unicorn (2011)
Alpha and Omega (2010)
Alvin and the Chipmunks: Chip-Wrecked (2011)
Amphibious 3D (2010)
The Cabin in the Woods (2011)
Cars 2 (2011)
Drive Angry (2011)
Gnomeo and Juliet (2011)
Green Lantern (2011)
The Green Hornet (2011)
Gulliver's Travels (2010)
Happy Feet 2 (2011)
Harry Potter and the Deathly Hallows (2010/2011)
Hugo Cabret (2011)
Jackass 3D (2010)
Judge Dredd (2012)
Kung Fu Panda 2: The Kaboom of Doom (2011)
Legend of the Guardians: The Owls of Ga'Hoole (2010)
Mad Max: Fury Road (2012)
MegaMind (2010)
Men in Black III (2012)
My Soul to Take (2010)
One Way Trip (2011)
Piranha 3-D (2010)
Pirates of the Caribbean: On Stranger Tides (2011)
The Power of the Dark Crystal (2011)
Resident Evil: Afterlife (2010)
The Ring 3D (2012)
Saw 3D (2010)
Shark Night 3D (2011)
Spy Kids 4: Armageddon (2011)
Step Up 3-D (2010)
The Smurfs (2011)
Titanic 3D Re-Release (2012)
Transformers 3 (2011)
Tron: Legacy (2010)
Yogi Bear (2010)
### 3D Content
The tightrope walk of producing good 3D content

<table>
<thead>
<tr>
<th>The Good</th>
<th>„Native“ 3D Production</th>
<th><img src="Avatar.jpg" alt="Avatar" /></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planning production as 3D from the start</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shooting with depth always in mind</td>
<td></td>
</tr>
<tr>
<td>The Bad</td>
<td>2D to 3D Up-conversion</td>
<td>![Flash Titans](Flash Titans.jpg)</td>
</tr>
<tr>
<td></td>
<td>Subsequent conversion of 2D production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clash of 2D and 3D stylistic devices</td>
<td></td>
</tr>
<tr>
<td>The Ugly</td>
<td>Plain and simple bad 3D Production</td>
<td><img src="YouTube.jpg" alt="YouTube" /></td>
</tr>
<tr>
<td></td>
<td>Ignoring the basic rules of 3D production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wrong calibration of equipment, etc.</td>
<td></td>
</tr>
</tbody>
</table>

check out e.g. [YouTube](https://www.youtube.com)
Live 3D Production
## Live 3D Production

Sky Germany’s early 3D experience

<table>
<thead>
<tr>
<th>Date</th>
<th>Event details</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-Feb-10</td>
<td>Production partner: VfB Stuttgart, FCB, internal test run</td>
</tr>
<tr>
<td>14-Mar-10</td>
<td>Production partner: Bayer Leverkusen, live showcase for invited guests</td>
</tr>
</tbody>
</table>
Some impressions from Leverkusen (14-Mar-10)
Camera plan for Leverkusen (14-Mar-10)

14 conventional HD cameras

9 additional 3D cameras (shown with bold black frame)

one OB van each for conventional HD production and for additional 3D production
Some impressions from Munich (14-Mar-10)
Live 3D Production

Key findings

3D cameras

- fewer cameras / different positions
- proximity is key for good 3D effect
- large action area = less depth

3D shooting

right mix between 3D and coverage
- avoidance of (fast) panning
- avoidance of zooming

On-screen graphics

- positioning is critical
- if fixed, 3D object could be in front
- if flexible, graphics will „pulsate“

Depth

- consistency/leveling of depth
- avoidance of „wow“ effects
- depth as new stylistic device

A lot more experience/practice is needed!
3D Channel

Sky Germany will launch a 3D event channel

Broadcast Technology
- frame compatible approach (side-by-side) will require same bandwidth as conventional HD (sport) channel
- transponder capacity was the final critical issue required for the “go” decision

3D Content
- mixing 2D and 3D content on the same channel would cause customer confusion
- lack of existing 3D content requires own (live) 3D productions (e.g. sports)
- documentaries, music and much more will complete the multi-genre approach

Dedicated 3D Event Channel
- allow the consumer to sample 3D content at any time (3D show reel by day)
- 3D highlights/events at primetime a few days per week (event character)
- consumers won’t watch 3D every day anyway (focus on event highlights)
3D Business Model
3D Business Model
What are the costs for broadcasting 3D?

3D Content
• content owners and producers usually seek to charge extra for 3D content

Live 3D Production
• higher costs due to parallel 2D and 3D production

Bandwidth / Play-out
• additional costs for transponder capacity and channel handling

3D Business Model for Sky Germany
• final model not decided yet
• free of charge to all HD subscribers during the launch phase
3D Consumer Equipment
3D Consumer Equipment
What will the consumer need?

- Sky Germany will broadcast HD-3D content – as most other broadcasters as well - in the frame compatible side-by-side format

**Broadcast in side-by-side format**

**Subsequent use of Sky HD receiver**
Minor software update required for HDMI 1.4a support, 3D OSDs (e.g. volume bar, EPG)

**New acquisition of 3D display**
The technology (shutter or polarization) is irrelevant!
## 3D Consumer Equipment
### Different 3D display technologies

<table>
<thead>
<tr>
<th></th>
<th>Anaglyph</th>
<th>Polarization</th>
<th>Shutter</th>
<th>Auto-stereoscopic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available since</td>
<td>1853</td>
<td>1936</td>
<td>2007</td>
<td>2005</td>
</tr>
<tr>
<td>Technology</td>
<td>Red-Green filter</td>
<td>Polarization filter (circular)</td>
<td>Fast alteration of L/R pictures in sync with glasses</td>
<td>Lenticular surface</td>
</tr>
<tr>
<td>Development costs</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Very high</td>
</tr>
<tr>
<td>Pros</td>
<td>compatible with 2D displays</td>
<td>simple, cheap glasses</td>
<td>Full HD per eye</td>
<td>No glasses necessary</td>
</tr>
<tr>
<td>Cons</td>
<td>Ghosting effects; visible loss of color</td>
<td>Only half the horizontal resolution; darker picture</td>
<td>Active glasses with batteries; glasses only work with respective display model</td>
<td>small resolution, small viewing angle</td>
</tr>
<tr>
<td>Picture quality</td>
<td>Poor</td>
<td>Good</td>
<td>Very good</td>
<td>Poor</td>
</tr>
<tr>
<td>Costs of glasses</td>
<td>Very cheap</td>
<td>Cheap</td>
<td>Expensive</td>
<td>n/a</td>
</tr>
<tr>
<td>Compatible with today's displays</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Main use</td>
<td>Special Events</td>
<td>Professional</td>
<td>Consumer</td>
<td>Marketable in 5-10 y.</td>
</tr>
</tbody>
</table>
Consumer 3D devices
All major TV manufacturers already launched 3DTVs

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>LG</th>
<th>Panasonic</th>
<th>Philips</th>
<th>Samsung</th>
<th>Sony</th>
<th>Toshiba</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasses type</td>
<td>Polarized Shutter</td>
<td>Shutter</td>
<td>Shutter</td>
<td>Shutter</td>
<td>Shutter</td>
<td>Shutter</td>
</tr>
<tr>
<td>Panel type</td>
<td>LCD</td>
<td>Plasma</td>
<td>LCD</td>
<td>Plasma LCD</td>
<td>LCD</td>
<td>LCD</td>
</tr>
<tr>
<td>Screen sizes</td>
<td>32”-55”</td>
<td>50”-65”</td>
<td>37”-56”</td>
<td>40”-67”</td>
<td>40”-60”</td>
<td>55”-65”</td>
</tr>
</tbody>
</table>
3D ready TV Displays
Household penetration in Western Europe - forecast

source: DisplaySearch, Screen Digest, Futuresource

Sky HD-3D – IRT Kolloquium - 20 Sep 2010
Consumer 3D willingness & interest
Results for German market

“Fernsehsendungen und Filme auf Blu-ray-Disc (DVD-Nachfolger) gibt es bald dreidimensional, wie im Kino. Planen Sie, sich einen Fernseher zu kaufen, der Filme dreidimensional darstellen kann?”
- every sixth consumer (approx. 12 million) plans to buy a 3D display – even more in the 30 to 49 years age group
  - 3% plan to buy a 3D display by the end of 2010
  - 13% plan to buy a 3D display, but not in 2010
  - 3% already own a 3D display

“Wie viel wären Sie bereit für einen 3D-Fernseher mehr zu zahlen als für einen normalen Fernseher?”
- two thirds of the potential buyers are willing to pay more for a 3D display
  - 14% are even willing to pay more than €500 more for a 3D display

source: BITKOM – survey conducted 26 to 29 July 2010 in 1.004 German households, published end of August 2010
Health Issues
Health issues
How to avoid the typical 3D headache?

Basics of Stereoscopic 3D
• spatial perception is based on monocular and binocular inputs
• stereoscopic image is generated in the brain (by combining optical signals and stored experiences)
• virtual 3D works with an average eye distance of 65 mm
• viewing virtual 3D is different from viewing real 3D
  – viewer always needs to focus eyes on the screen (separation of accommodation and convergence)
  – viewer cannot sidestep approaching 3D objects
  – focus won’t adapt if viewer’s eyes scan the scene

Long-term impact of 3D consumption
• there are almost no studies about long-term impacts of virtual 3D consumption
• the occasional 3D movie theatre visit appears to be less critical
• 3D in the home, however, will create 3D watching opportunities more often
Summary & Next Steps
Summary & Next Steps

Why 3D TV didn’t happen over night

Current Situation
• 3D equipment for consumers is finally available
• growing quantity of (good) 3D movie content
• increasing experience in live 3D production (for television)

Next Steps
• 3D is a logical next step of Sky Germany’s HD offer, but
  – it took five years to establish HD (from 3 to now ten channels)
  – it will also take several years to establish 3D

Sky Germany’s 3D Roadmap
• launch of Sky 3D channel on 3 October 2010 (DTH and KBW)
• free to all Sky HD subscribers until end of 2010
• movies, documentaries, entertainment, etc. but mainly sports event driven in the beginning
• Sky Sportsbars are likely to be able to offer 3D from early 2011
Thanks for your attention

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