50 Years of SID Symposia – Nurturing Progress in Projection Technology

Pre-SID

Image Generation Devices

- **1902** First recorded operating TV projector based on Nipkow Disk **Unknown**
- **1932-36** Curved faceplate CRTs form projection **Philips, RCA, Fernsehen**
- **1943** Eidophor - oil film light valve **Swiss Fed. Inst. Of Tech.**
- **1953** Color Field Sequential Eidophor **Gretag**
- **1958** Talaria sealed oil film light valve introduced **GE**

Projection Components/ Architecture

- **1938** Acousto-optic light modulators/ scanner for rear-projection TV **Scophony Ltd.**
- **1951** 3 Tube/3 Lens color CRT Projector **RCA**

Projection Lenses

- **1937** f/4.5 projection lens used for CRT projector **Philips**

Illumination Sources

Projection Screens

- **1937** Rear projection screen with controlled gain Philips
- **1940** Fresnel lens for rear projection screens **Strong & Hayward**

Products & Applications

- **1936** Commercial TV broadcasting began in the UK **London Television Service**
- **1937** Projection CRT systems demonstrated **Philips, RCA, Fernsehen**
- **1948** Commercial/consumer CRT rear Projection TV **RCA**
- **1948** Monochrome CRT Theater projection (15" Tube, 80KV anode, 42" Schmidt mirror) **RCA**
- **1950** 75kV, 7" CRT for theater projection RCA
- **1951** NTSC Color CRT theater projection **RCA**
- **1958** Eidophor Enters Production **Gretag**
- **1958** Slide Scratcher color displays for command & control **FF&M, Northrop**

1960's

Image Generation Devices

- **1961** 3 Channel color Eidophor **Gretag**
- **1962** TFT Active matrix **GE**
- **1969 - 1970** Twisted Netmatic LC J. Fergason, W. Helfrich, **M. Schadt**

Illumination Sources

- **1960's** Xenon arclamp for projection **Westinghouse**
- **1960's** Invention of the Laser **Hughes**

Products & Applications

- **1960-63** Rapid-process film color projection systems **ITT, Hughes, Burroughs**

1970's

Image Generation Devices

- **1971** Vertically alignment LCs **Schiekel, Fahreschon, Kahn**
- **1972** Laser (Thermal) Smetic Liquid Crystal Light Valve (LSLCLV) **Bell Labs**
- **1974** ILA -Photo-addressed reflective liquid crystal light valve (LCLV) **Hughes**
- **1975** Liquid crystal on silicon (LCoS) display **Hughes**

Projection Lenses

- **1976** Telecentric projection lens for LCLV **Hughes**
- **1979** f/1.0 aspheric projection lenses **US Precision Lens**

Projection Screens

- **1970** Double Lenticular Screen for CRT RPTV **GE**
- **1979** Lenticular, black stripe screens for rear-projection **Freen Screen**

Products & Applications

- **1973** Giant VideoBeam CRT with integrated Schmidt optics **Advent**
- **1976** Monochrome ILA projector with fiberoptic-coupled CRT input **Hughes**
- **1978** Dual Talaria 1000-line high lumen projector **General Electric**

1980's

Image Generation Devices

- **1981** First projected deformable mirror imager **Texas Instruments**
- **1982** Large Diameter Aperture Gun **Matsushita**
- **1982** High brightness 7" PRT CRT with chemicallystrengthened glass **Hitachi**
- **1985** Commercial development of F-LCOS **Displaytech**
- **1986** p-Si TFT LCD projection light-valve **Seiko Epson**
- **1987** Digital Micromirror (DMD) microdisplay **Texas Instruments**
- **1988** LCDs for projection introduced **Projectionvision Inc.**
- **1989** Interference filter CRT **Philips**

Projection Components/ Architecture

- **1982** Liquid coupling & cooling of flat CRT faceplate **Sony**
- **1985** CRT Liquid coupling/ cooling in rear PTV **Philips**
- **1989** (3) LCD projection system; X-dichroic re-combining prism **Seiko Epson**

Projection Lenses

- **1986** Lens system for aspheric CRT faceplate **Hitachi**

Projection Screens

- **1983** Black stripe rear screen with Fresnel and lenticular lenses **Dai Nippon**

Products & Applications

- **1980** 50" consumer rear projection TV **GTE Sylvania**
- **1986** Full color, 7.5Mpixel LCSLV rear projection display **Greyhawk Systems**
- **1988** Transmissive a-Si TFT LCD projection system **Sharp**
- **1988** Overhead projector (OHP) LCD panel **N-View/Proxima/InFocus**
- **1988** 3-color ILA video projector **Hughes**
- **1988** 3-Chip LCD (3LCD) projector (LC-500) **Kodak**

1990's

Image Generation Devices

- **1992** First full-color DMD image **Texas Instruments**
- **1993** Improved contrast "hidden hinge" DMD **Texas Instruments**
- **1993** First VGA p-Si TFT projection light valve **Epson**
- **1993** Grating light valve (GLV) **Stanford Univ. (Eschelle)**
- **1999** Color Sequential LCoS based on TN effect **Philips**

Projection Components/ Architecture

- **1991** Single LV angular-color-separation projection **Sharp**
- **1993** Scrolling color single light-valve rear projection technology **Philips**
- **1996** TIR Prism for DLP illumination **US Precision Lens**
- **1996** Polarization conversion; double fly-eye integration, PCS **Seiko Epson**
- **1996** First UHP lamp, integrator PBS system projector (ELP-3500) **Epson**
- **1997** Polymer retarder stacks for selective (color) polarization **Colorlink, Inc.**
- **1999** Wire grid polarizer & beam splitter **Moxtek**
- **1999** LCoS Scrolling color with rotating prisms **Philips**

Projection Lenses

- **1992** Ultra-wide angle f.77 mm lenses **US Precision Lens**
- **1995** Zoom lenses for LCD projectors **US Precision Lens**
- **1999** Lenses for High - Resolution Microdisplays **US Precision Lens/OPCN Associates**
- **1999** Telecentric projection lenses for LCD **Minolta, Nikon, USPL**

Illumination Sources

- **1991** Metal halide discharge projection lamp **Iwasaki Electric**
- **1993** UHP High-pressure mercury discharge lamp **Philips**

Projection Screens

- **1999** Rear projection screen for LCD projection **Toppan**

Products & Applications

- **1990** a-Si LCD very high light output projector **Barco**
- **1990** (3) panel p-Si front screen projector **Seiko Epson**
- **1992** Introduction of the LCD "Light Cannon" dooms oil film sysems **Barco**
- **1994** First 3-chip LCD (3LCD) VGA projector **Epson**
- **1995** First LCoS projector - 3-chip **IBM**
- **1996** First commerical 1-chip DLP Proj. **TI, InFocus, nView, Proxima**
- **1996** First commerical laser-based projector **Color**
- **1997** Light-weight (6 lbs) DLP projector **InFocus**
- **1997** First commercial high-brightness 3-chip DLP projector **Digital Projection**
- **1997** 2000 pixel D-ILA LCoS Projector **JVC**
- **1999** First demonstration of digital cinema to paying theater customers **Hughes/JVC & TI**

2000-2012

Image Generation Devices

- **2000** 4Kx2K D-ILA **JVC**
- **2001** "Dark Chip" contrast-enhanced DMD/DLP **Texas Instruments**
- **2001** Begin manufacture of F-LCOS imagers **Displaytech**
- **2002** Last CRT projection paper at SID **Sony**
- **2003** DLP Cinema 2K resolution DMD chip **Texas Instruments**
- **2003** 1080p p-Si TFT 3LCD projection light valve **Epson**
- **2008** DLP Pico chipsets in low-cost package **Texas Instruments**
- **2008** 8Kx4K D-ILA **JVC**
- **2009** DLP Cinema 4K resolution DMD chip introduced **Texas Instruments**
- **2009** 4K2K & WUXGA p-Si TFT 3LD projection light valves **Epson**

Projection Components/ Architecture

- **2001** Scrolling Color Recapture (color wheel) **Texas Instruments**

Projection Lenses

Illumination Sources

- **2001** Arc stabilization of short-arc (UHP) lamps **Philips**
- **2001** External cavity surface emitting lasers **Novalux**
- **2006** Photonic lattice, large area LEDs **Luminus**
- **2010** Direct emission green lasers **Kaai**

Projection Screens

- **2002** Refractive/TIR Fresnel Screen for thin RPTV **Mitsubishi**
- **2005** Contrast-enhanced single lenticular for LCD/DLP RPTV **Toppan**
- **Contrast-enhancing front projections screens**
  - 2002 based on polarization **3M**
  - 2007 based on viewing angle **Dai Nippon**
  - 2007 based on spectrum **Sony**

Products & Applications

- **2000** 3-chip 2K DLP Cinema projectors **Barco, Christie**
- **2002** 4Kx2K D-ILA projector **JVC**
- **2002** Rear-projection DLP HDTV **Samsung**
- **2005** LED illuminated "pocket" (sub-1-lb) DLP projector **Mistubishi, Toshiba, Samsung**
- **2005** First digital 3D in the cinema **Disney, RealD, TI**
- **2006** DLP RPTV with LED illumination **Samsung, TI & Luminus Devices**
- **2006** GLV 4K x 4K laser projector for planetariums **Evans & Sutherland**
- **2008** Laser-illuminated RPTV **Mistubushi**
- **2008** LED/DLP "picoprojectors **Samsung, Optoma**
- **2009** First embedded pico projector (DLP) in a mobile phone **Samsung, TI**
- **2009** 3-D enabled (1-chip) DLP projectors **Multiple Companies**
- **2009** 8Kx4K D-ILA projector **JVC (prototype)**
- **2009** Laser Picoprojectors Introduced **Microvision, Shanghai Sanxin Tech. Dev. Co.**
- **2010** Hybrid (red LED, green phosphor, blue laser) projector **Casio**
- **2012** 4K 55,000 lumen laser cinema projector **Barco**

SID Award Recipients – Projection Displays

Karl Ferdinand Braun Prize

William E. Glenn	1993
William E. Good	1993
Thomas T. True	1993
Larry J. Hornbeck	1999
William Bleha	2005

Special Recognition

William E. Good	1974
Hiroki Hamada	2010

Fellow of the SID

Petro Vlahos	1966
John A. Van Raalte	1975
Eiichi Yamazaki	1997
William E. Glenn	1998
Shinji Morozumi	1998
William P. Bleha	2003
Edward H. Stupp	2003
Arlie Conner	2004
Han-Ping Shieh	2005

Contributors to initially generating (2003) and in 2010/12 revising/updating this Milestone Technology Chart

2003 – **Ed Stupp (chair)** consulting with Pete Baron, Fred Kahn, Robert Melcher, John Rudolph
2010/12 Revision – **Matt Brennesholtz (chief architect)** consulting with Pete Baron, Rina Bhuva, Bill Bleha, Scott Dewald, Dave Eccles, Daniel den Engelsen, Ed English, Larry Hornbeck, Fred Kahn, Wu Ming, Greg Pettitt, Alan Sobel, Rod Sterling

Abbreviations

- **LCLV** - Liquid Crystal Light Valve
- **ILA** - Image Light Amplifier
- **DLP** - Digital Light Processor
- **DMD** - Digital Micromirror Device
- **LCOS** - Liquid Crystal -on- Silicon

CRTs | Oil Films LVs | ILA/LCLV | DMD/DLP | LCDs | LCoS | LED/Lasers

CRTs | Oil Films LVs | ILA/LCLV | DMD/DLP | LCDs | LCoS | LED/Lasers