Interview with Reed Killion of UniPixel Display

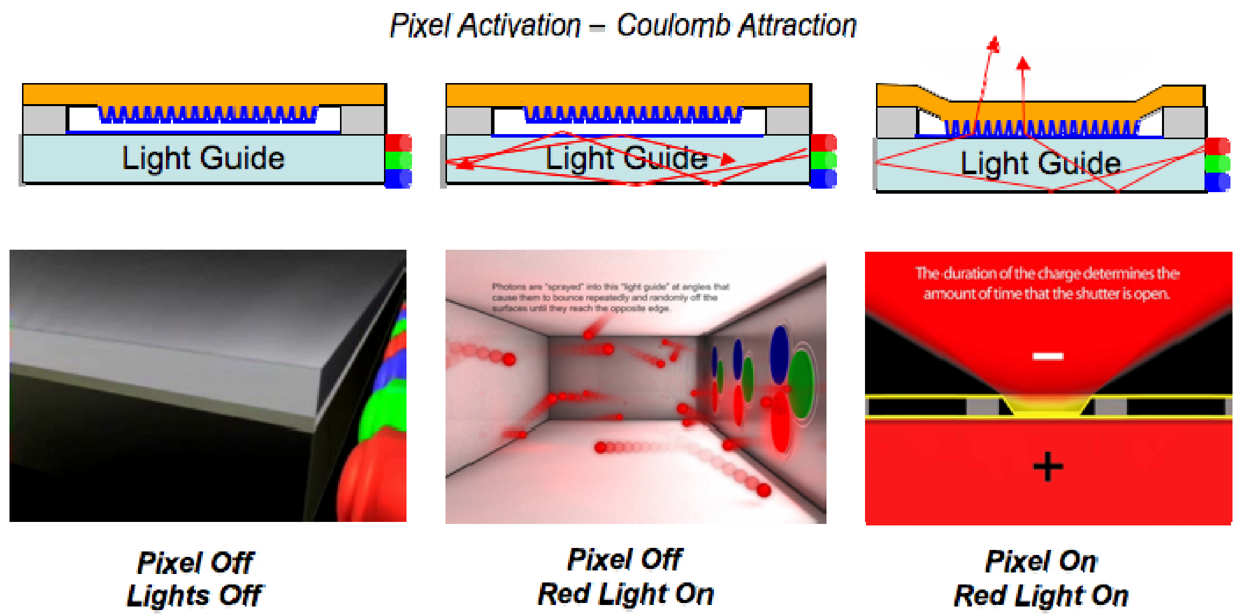
Reed J. Killion is president of UniPixel Displays Inc, a public company. Previously, Mr. Killion served as UniPixel's executive vice president of business development and has been a member of its board of directors since April 2002. Prior to joining UniPixel, Mr. Killion was vice president of business development for LogiCom, a technology consulting firm and manufacturers' representative based in Austin, Texas from 1999 until 2002. Reed holds a Bachelors Degree in Finance from the University of Mississippi and is a trustee of the Texas A&M Research Foundation and serves as the Chairman of the Board for Animal Innovations. Reed is also on the board of directors for the Texas A&M Research Foundation.

Since the time we interviewed your CFO, Jim Tassone about 18 months ago (in issue #8 of our *Flexible Substrate* newsletter) quite a bit has happened at UniPixel. Can you give us an overview about the key changes? Predominately, the changes involve the advancement of TMOS display technology as well as our transition from an early stage development company to a licensing and component manufacturing firm. Our focus has been on optimizing the sub components of the display architecture and rapidly expanding our IP portfolio while starting to evaluate development and commercialization partners for the TMOS ecosystem.

Most start-up companies face the constant challenge of finding an appropriate balance between product and technology development and raising enough money to stay operational. How are you doing with regard to this balancing act? Not having been spared the trials facing most startups, we appreciate that the display space is extremely challenging and have executed a development strategy that leverages current TMOS Ecosystem partner infrastructures with respect to materials, process equipment and engineering resources. These partnerships allow UniPixel to conserve capital and expedite the TMOS sub system development process. Some have stated that the TMOS display technology has progressed faster on less capital than any other display technology. The rapid progress is due, in part, to our use of existing materials, processes, equipment, and infrastructures; while incorporating improvements in nano and micro fabrication. Currently, we are working on closing a $12 million round B financing that will allow us to continue to build out the TMOS ecosystem, optimize its sub systems, and commercialize the technology.

Are you planning to build your business based on a licensing model, or do you intend to become a manufacturer at some level? UniPixel, basically, is a licensing company with a manufacturing component. We will license the TMOS architecture to LCD panel manufacturers, the drive control circuitry to existing semiconductor manufacturers, and the illumination system to current backlight manufacturers. UniPixel will manufacture the active layer component of the TMOS display architecture, selling it to the TMOS panel manufacturing licensees as part of the TMOS BOM.

What exactly is a "Time Multiplexed Optical Shutter"? TMOS is the term we use to describe a patented Frustrated Total Internal Reflection (FTIR) display system (US Patent No. 5,319,491). The fundamental principle of FTIR displays is that light, edge-injected into one edge of a thin planar transparent waveguide, reflectively mirrored at other edges, remains contained within the waveguide. The violation ("frustration") of this trapped condition, called total internal reflection (TIR), causes the light to emerge from the waveguide at the point where the violation occurs. The TMOS method of achieving "frustration" of TIR (FTIR) is performed by moving a membrane to contact (or near contact) with the waveguide, the light inside the guide transfers into the membrane and ultimately propagates toward the observer. Light emitting diodes (LEDs) are attached to one or more edges of the light guide and mirrors are placed on all remaining edges. Red, green or blue light enters a light guide from the edge of the display. Each color cycles for an equal amount of time in rapid succession. The light reflecting off the side mirrors produces a uniform distribution across the entire display. A thin film membrane (called the "active layer") with embedded conductor is added on top of the light guide *(shown in the figure on the following page)*. The active layer is attached to the light guide at the edges of each pixel. Standoff features prevent the membrane from touching the light guide within the active pixel areas. TIR is maintained when no pixels are in contact with the light guide. The active layer is made of a PET type film and is the only moving part in the display structure. This structure creates a simple optical shutter mechanism. The multilayer stack at each pixel is a capacitor – two conductive layers separated by a dielectric or insulator. When a voltage differential is created between the two conductive layers at any given pixel, they attract via Coulomb attraction. The membrane is pulled down between the standoff layer features and when it touches the light guide, light escapes – TIR is frustrated.



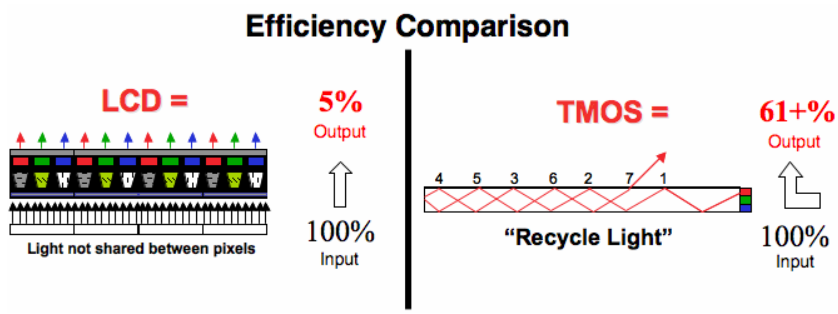
Display cross-section: pixel off represents no charge differential between conductors; pixel on represents a charge differential between conductors (+/+, +/-, -/-). Note that layers and deformation not to scale. The combined layers on the light guide are less than 15 microns thick.

Please give us an update on your technology development. We have advanced all areas of our display technology over the past year, most notably a new, patented micro-optical structure that efficiently extracts light from the TMOS light guide while maintaining a uniformity variation of less than 1% between any two points on the display. The new structure also helps to reduce the stiction typically associated with a MEMs device. We have completed a FPGA for our TMOS field sequential color generation architecture to drive our QQVGA and QVGA prototypes. The control logic has been designed to scale to larger formats and HDTV resolutions and the illumination system also has been optimized to enhance the amount of TIR light that is injected into the light guide.

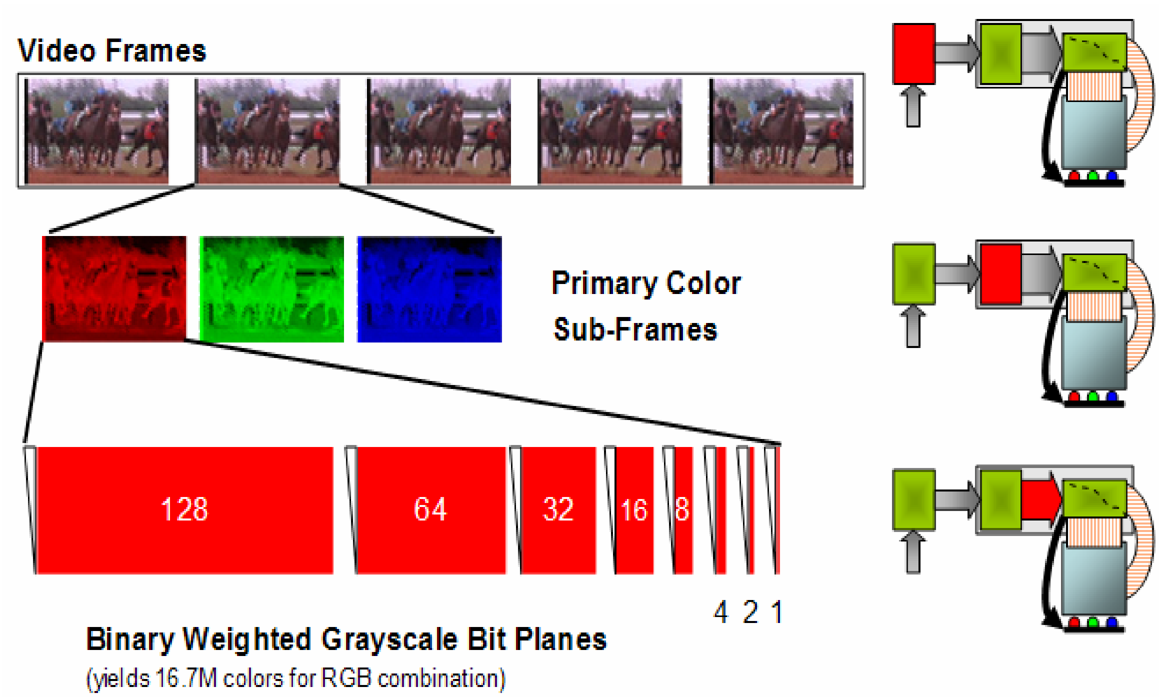
Previously, your technology relied on the use an aero gel, a rather unique material for use in displays. What's the situation today? We have simplified the architecture and advanced the design to the point where a new microlens structure and lamination process gives us the desired operational characteristics thereby eliminating the need for aero gel.

What are the primary technological problems remaining that are still slowing your efforts to reach commercialization? All technologies have growing pains and we are working hard to overcome ours. We have engaged a number of experienced partners to help address our development challenges.

By using the principals associated with total internal reflection, along with an optimized light path, we understand that you boast some very high efficiencies. Please elaborate. The efficiency of light passing through a TMOS display is at least 61%. In comparison, efficiency of light through a typical LCD display has been measured at only around 5%. The TMOS display architecture has as much as a 13:1 advantage over LCD in light efficiency, which translates directly into significant power savings for displays of equivalent brightness This advantage is most notable for mobile display applications.



Your technology also relies on field sequential color. Any interesting breakthroughs in this area? The speed of the LEDs and the TMOS pixels gives us the ability to overcome ghosting and rainbow effects that other field sequential color (FSC) architectures have had trouble resolving. The TMOS architecture provides many differing methods for achieving both billions of colors and an extended color gamut while at the same time eliminating typical FSC artifacts. UniPixel has several patents, filed and issued, that are specific to FSC generation in a TMOS system.

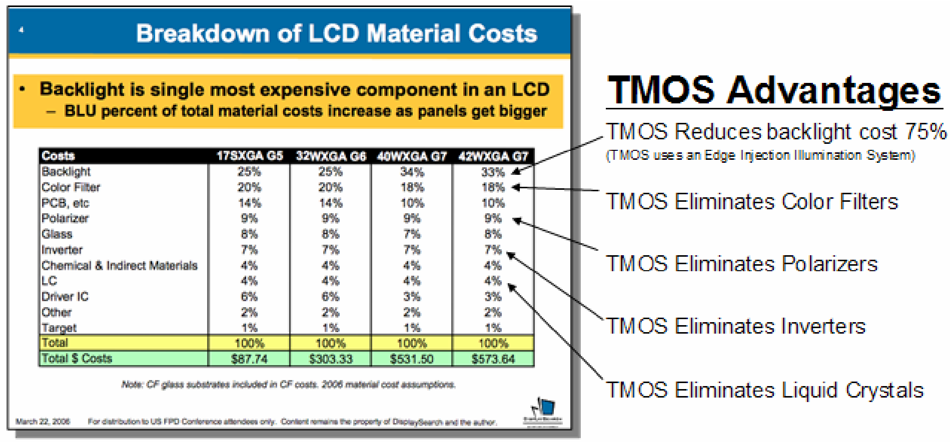


At one point, you were working to develop your technology using a passive matrix. We understand that you are now focused on utilizing the existing TFT LCD infrastructure. Please explain the reasons for this change. We have developed and patented the TMOS simple matrix architecture and will continue pushing it towards production. The TMOS-TFT architecture will be quicker to market by taking advantage of the huge existing TFT LCD infrastructure. By working with us and building TMOS panels, TFT LCD manufacturers can realize significant margin and performance improvements over the current LCD panel manufacturing process. Leveraging the current LCD infrastructure, UniPixel can expedite the path to commercialization.

What are the practical limits of your technology in terms of resolution? We anticipate meeting 300-400 ppi and will be able to push the resolution higher if required. TMOS, which has a single pixel architecture generating the entire color spectrum, holds a distinct advantage over LCD, OLED, and plasma displays which require three or more sub-pixels for each pixel.

Do you foresee any performance parameters where your technology fails to match or exceed existing TFT LCDs? In just about every measurable category we will be superior or as good as existing display technologies. The key to the performance advantages TMOS exhibits is due to the simplicity and elegance of its architecture.

You recently characterized your TMOS solution as a way the TFT LCD industry can reduce costs. Please be more specific. The TMOS display panel manufacturing requirements are a subset of LCD panel manufacturing requirements. TMOS has a reduced Bill of Materials (up to 50% materials reduction for the foreseeable future) and provides a significant reduction in LCD manufacturing process steps. The LCD manufacturing industry can reduce costs as well as increase the performance levels of the flat panels they produce by building TMOS displays.



Costs	17SXGA G5	32WXGA G6	40WXGA G7	42WXGA G7
Backlight	25%	25%	34%	33%
Color Filter	20%	20%	18%	18%
PCB, etc	14%	14%	10%	10%
Polarizer	9%	9%	9%	9%
Glass	8%	8%	7%	8%
Inverter	7%	7%	7%	7%
Chemical & Indirect Materials	4%	4%	4%	4%
LC	4%	4%	4%	4%
Driver IC	6%	6%	3%	3%
Other	2%	2%	2%	2%
Target	1%	1%	1%	1%
Total	100%	100%	100%	100%
Total $ Costs	$87.74	$303.33	$531.50	$573.64

(LCD panel manufacturers can achieve a > 50% reduction in materials cost by switching to a TMOS manufacturing approach)

What markets are you targeting as the most likely initial adopters of your technology? The TMOS display technology projects as a scalable technology that can support multiple sizes from small form factor displays for mobile applications to home theater and even active signage. The initial adopters will be mobile phone panel and portable/hand held computing panel manufacturers that want to take advantage of power savings, high resolution, and sunlight readability.

We understand that Xerox PARC is helping you make some initial prototypes. Can you tell us more about your relationship with them? PARC, who is working on delivering an active back plane for the TMOS TFT architecture, has significant experience with MEMS and display technologies and offers applied expertise to UniPixel's development effort. PARC also has expressed an interest in taking an equity stake in UniPixel for engineering and process development work-in-kind.

You were previously aligned with Lockheed Martin and Sandia National Laboratories. Are these relationships still intact? Yes. Lockheed has an exclusive license for TMOS military and aerospace applications and supports the development of UniPixel's display technology through engineering resources, platform development, drive control electronics, and life/environmental testing. Sandia continues to work with us on materials development and testing.

When can we expect to see a public demonstration of your technology? Our recent testing has produced excellent empirical data that tracks well with our predictive modeling. We anticipate the public demonstration of several prototypes by the end of the year.