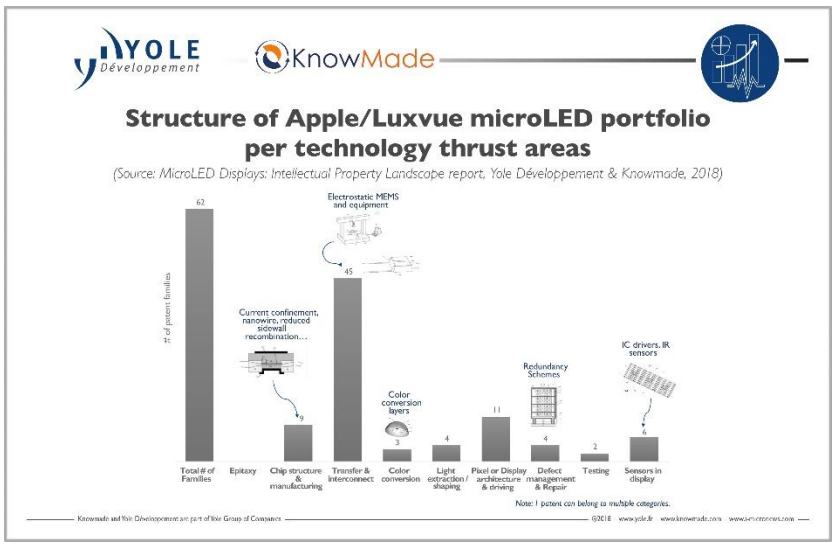
FOR IMMEDIATE RELEASE:

Apple developing all key elements of microLED display technology

Extracted from: MicroLED Displays : Intellectual Property Landscape report, Yole Développement & Knowmade – Release date: January 2018

LYON, France – March 28, 2018: If we did not know before, now we are all aware: microLEDs for display applications is a very hot topic and Apple is strongly commited to the development of its own technology. Las Vegas Consumer Electronics Show 2018[1] and now Bloomberg, the high tech planet is revolving around microLED technologies. Indeed, last week, the financial news media giant published an article highlighting microLED which generated substantial interest and debate from Wall Street[2]. According to Mark Gurman from Bloomberg, despite some ups and downs since it acquired the microLED start up Luxvue in 2014, Apple is still committed to the technology and hoping to begin mass production within the next few years…

The recent report, "MicroLED Displays: Intellectual Property Landscape" released by Yole Développement (Yole) and its partner, Knowmade beginning of 2018, confirms substantial microLED IP[3] development has been underway at Apple. In this patent landscape analysis, Apple ranks first in term of the size, strength and depth of its portfolio with more than 60 patent families. *"Apple has been working on IP development to master all key elements of a new microLED display technology"*, asserts **Dr. Eric Virey, Technology & Market Analyst from Yole**. And he adds *"If successful, the expectation is that they will rapidly move on to establish a supply chain, possibly handling some aspects of design and manufacturing internally"*



Apple's portfolio covers many thrust areas and shows a strong commitment to tackle all the major technology bottlenecks that have so far prevented the technology from reaching the market.

[1] Source: Samsung's giant 146" microLED TV, named "The Wall", was unambiguously one of the stars of 2018's Las Vegas Consumer Electronics Show- Full article published on i-micronews.com
[2] Source : Apple is secretly developing its own screens for the first time, Bloomberg, March 2018
[3] IP : Intellectual Property

The bulk of the development effort, however, is focused on transfer, assembly and interconnects, with more than 40 patents. The emphasis is on the company's MEMS-based microchip transfer technology that was at the core of Luxvue effort.
Other key patents cover multiple aspects of microLED technologies such as improving the efficiency of microLED chips, another challenge that has been vexing companies trying to leverage the large efficiency gains that microLED display could offers. Color conversion, light management, pixel and display architectures, testing, and integration of sensors are other key aspects which Apple is addressing in its portfolio.

"A detailed analysis of Apple's portfolio is a good indication of its technology advancement", explains **Dr. Nicolas Baron, CEO & Founder of Knowmade, partner of Yole**. *"Because of its strong and broad patent portfolio, Apple is showing a clear positioning in this domain and announces its strategy to become a leader in this up and coming industry".*
However, it's not enough to guaranty exclusivity and full freedom of exploitation. While the bulk of the microLED display research effort started around 2010, digging deeper into the global microLED IP landscape reveals some important patents filed by companies like Sony, Sharp and various research organizations all the way back to the early 2000's.

Enabling microLED displays requires bringing together three major levels of expertise: LED, transistor backplanes (glass or Si-CMOS based) and chip transfer. The supply chain is complex and lengthy compared to that of traditional displays. Each process is critical and managing every aspect effectively will be challenging. No one company appears today positioned to execute across these multiple technologies and be able to vertically integrate all of the components. Today the IP landscape reflects those challenges through the variety of players involved. Only a few companies including Apple, have a broad microLED IP portfolio, but enough have patents on key technology bricks to predict that complex licensing and legal battles will arise if and when microLED displays enter volume manufacturing.

MicroLED technology could be the holy grail of display companies. Therefore, it could represent an opportunity to strongly differentiate from the crowded LCD and soon-to-be-crowded OLED display industries. Recent investments by Facebook, Sharp/Foxconn, Google, Intel and Samsung confirm the growing interest and point toward a challenging but exciting future for microLEDs.
"It remains to be seen who will be first to market", asks Dr. Eric Virey from Yole. "*With more than 120 companies involved and the efforts accelerating at all major companies, there is no doubt that the buzz will keep increasing and the industry landscape evolve at an accelerating pace."*

Yole Group of Companies including Yole and Knowmade keeps its fingers on the pulse of this promising technology. The full article is available on i-micronews.com.

And the Group will keep delivering up to date analysis. Dr Virey from Yole is also part of the key microLEDs conferences all year long. Next presentations will take place during the Display Week:

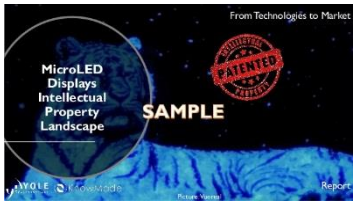
- "*Economic Health of the Display Supply Chain/Where Is the Growth and Profits/Best Investment Outlook*" on May 21 at 8:10AM
- "*Status and Prospects of microLED Displays*" on May 24 at 9:00AM

For more information about both presentations, please contact: Camille Veyrier (veyrier@yole.fr) and stay tuned on i-micronews.com!

ABOUT THE REPORT:

MICROLED DISPLAYS: INTELLECTUAL PROPERTY LANDSCAPE

What are their major thrust areas and portfolio strength? – Produced by Knowmade & Yole Développement



Companies cited in the report:

3M, Aledia, Apple/Luxvue, Atom Nanoelectronics, Au Optronics, Bai Hangkong, Beijing University Of Technology, BOE Technology, CEA, Changchun Institute, CIOMP, CNRS, Columbia University, Cooledge Lighting, Corning, Cree, CSOT, Delta Electronics, Emagin, ETRI, Facebook-Oculus, Focus Lightings Technology, Fraunhofer, Fudan University, Fuzhou University, Glo, Goertek, Google/X Development, Guangdong Poly Optoelectronic, Hahotech, HC Semitek, Epilight, Hiphoton, JD Display, Huawei, III-N Technology, Innolux, Intel, ITRI, Itswell, Jasper Display, Jiangsu Xinguanglian Semiconductor, Junwan Microelectronic Technology, KAIST, Kansas State University, KIMM,... Full list

Authors:

- **Dr. Eric Virey** serves as a Senior Market and Technology Analyst at Yole Développement (Yole). Eric is a daily contributor to the development of LED, OLED, and Displays activities, with a large collection of market and technology reports as well as multiple custom consulting projects. Thanks to its deep technical knowledge and industrial expertise, Eric has spoken in more than 30 industry conferences worldwide over the last 5 years. He has been interviewed and quoted by leading media over the world. Previously Eric has held various R&D, engineering, manufacturing and business development positions with Fortune 500 Company Saint-Gobain in France and the United States. Dr. Eric Virey holds a Ph-D in Optoelectronics from the National Polytechnic Institute of Grenoble.
- **Dr. Nicolas Baron** is CEO and cofounder of Knowmade. He manages the development and strategic orientations of the company and personally leads the semiconductor department. Nicolas has more than 10 years-experience in semiconductor related patent & technology analysis. Previously Nicolas was research assistant at the French research laboratory CRHEA-CNRS where he worked on the development of a new generation of GaN-on-Silicon transistor for power and RF applications. Dr. Nicolas Baron holds a Ph-D in Physics from the University of Nice Sophia-Antipolis, and a Master of Intellectual Property Strategies and Innovation from the European Institute for Enterprise and Intellectual Property (IEEPI), Strasbourg, France.

ABOUT KNOWMADE

Knowmade is a Technology Intelligence and IP Strategy consulting company specialized in analysis of patents and scientific information. The company supports R&D organizations, industrial companies and investors in their business development by helping them to understand their IP environment and follow technology trends. KnowMade is involved in Compound Semiconductors, Power Electronics, RF & Microwave Technologies, LED/OLED Lighting & Display, Photonics, Memories, MEMS & Sensors, Manufacturing & Advanced packaging, Batteries & Energy management, Biotechnology, Pharmaceuticals, Medical Devices, Medical Imaging, Agri-Food & Environment.

Knowmade's experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence and freedom-to-operate analysis. In parallel the company proposes litigation/licensing support, technology scouting and IP/technology watch service. Knowmade's analysts combine their technical and patent expertise by using powerful analytics tools and proprietary methodologies to deliver relevant patent analyses and scientific reviews.

More info on http://www.knowmade.com and follow Knowmade on Linkedin.

ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors, RF Electronics, Solid-state lighting, Displays, software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The "More than Moore" market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business. . For more information, visit www.yole.fr and follow Yole on LinkedIn and Twitter.

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