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Infinite Possibilities of LED Integration for Safe Driving

DVN US WORKSHOP

HYATT PLACE HOTEL, NOVI, MI | 21 - 22 Sept. 2021

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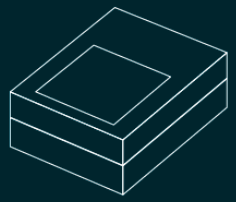
Phase 1

Traditional
Light Source

Phase 2

LED



What's Next?

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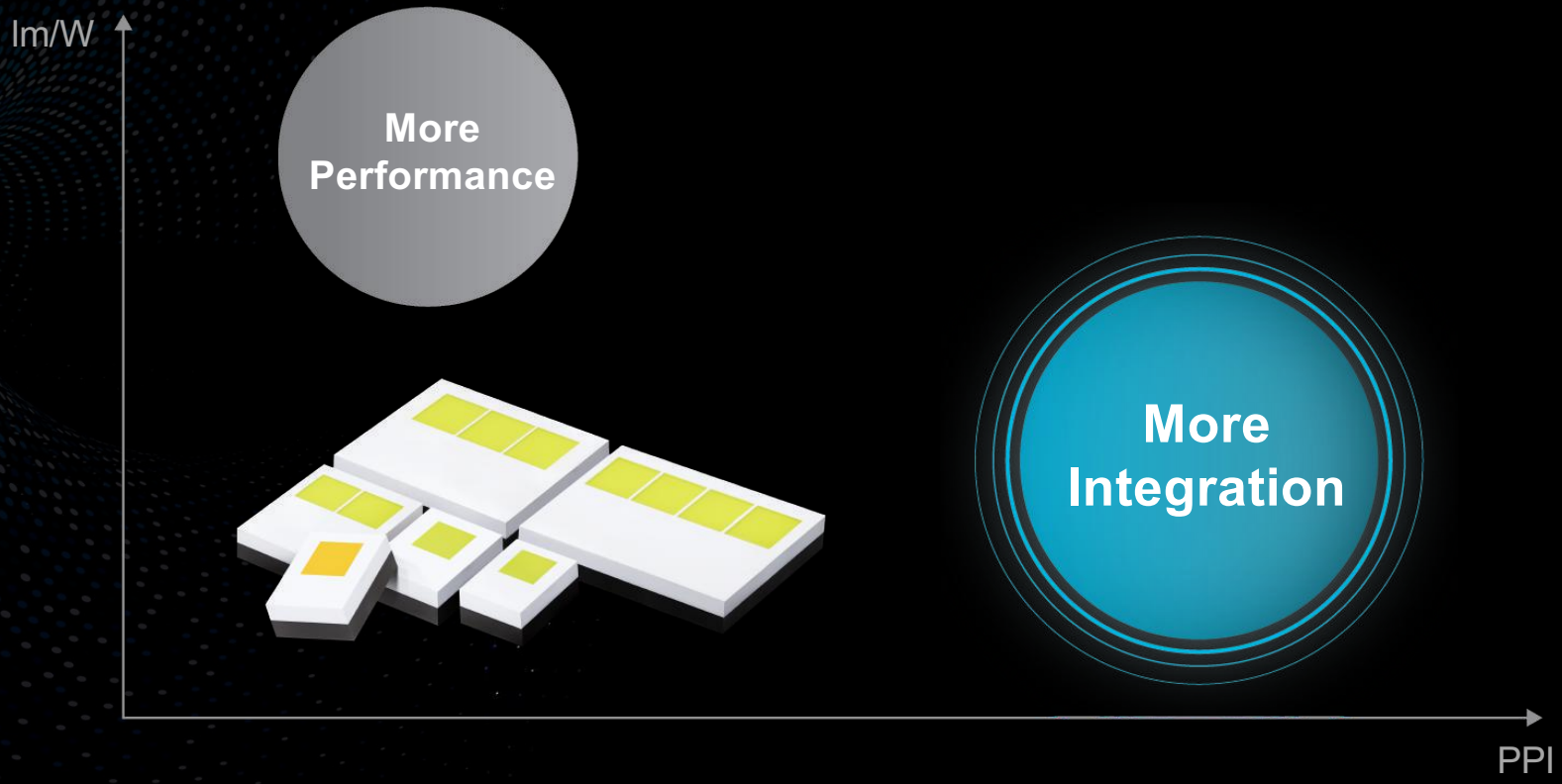
What's Next?



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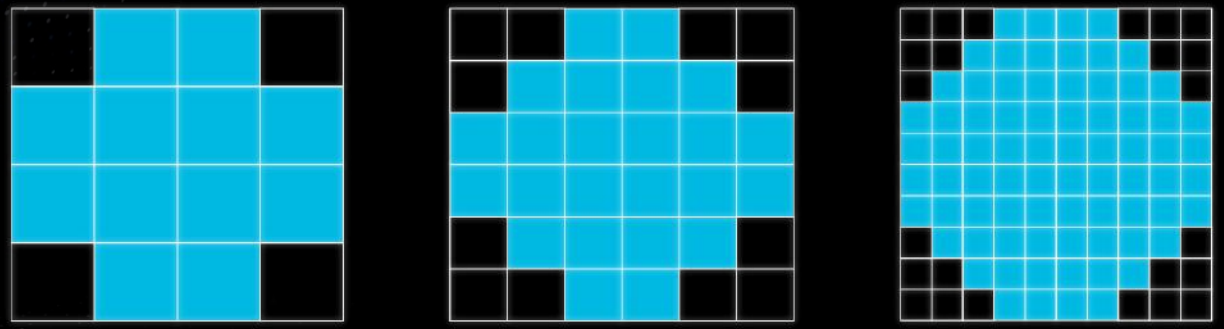
PPI: Pixels Per Inch

Higher PPI provides sharper and clearer image



4 PPI

6 PPI

10 PPI

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Demand for Higher PPI

Future mobility requires higher PPI for headlamps and rear lamps

ADB and road projection

Communication display

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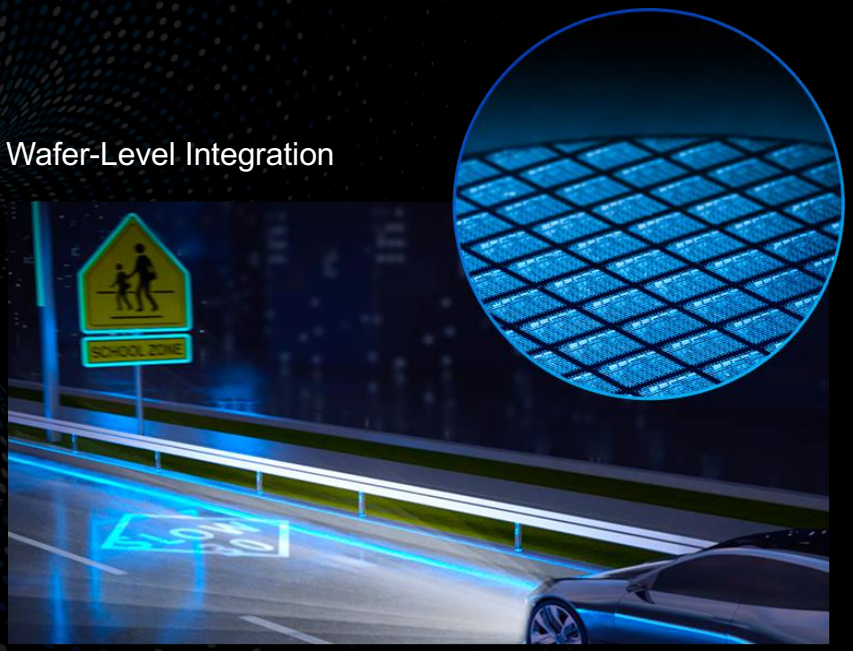
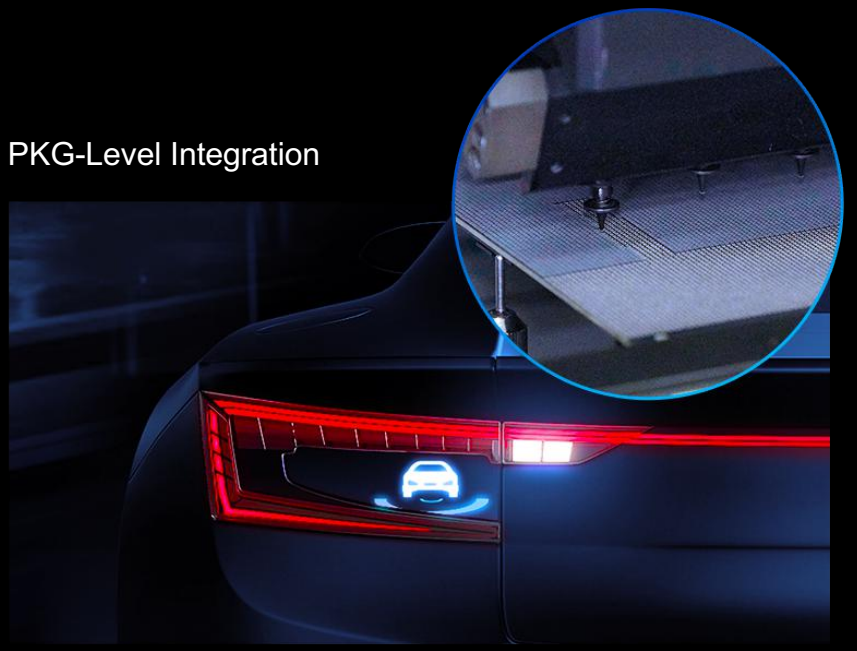
LED Integration

More LED integration enables higher PPI

Wafer-Level Integration



PKG-Level Integration



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Ⅰ. Wafer-Level Integration

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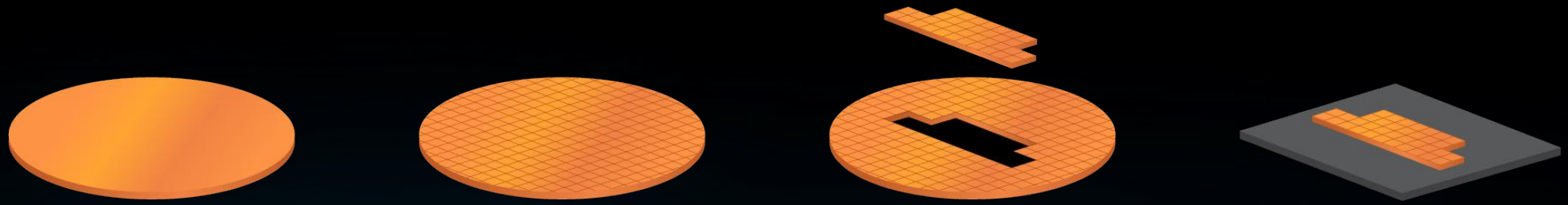
Wafer-Level Integration

LEDs are integrated on a wafer by wafer-level process



Wafer

Wafer-level Process

Dicing

SMT

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Si-based Semiconductor Process

8-inch GaN-on-Si LED technology was developed

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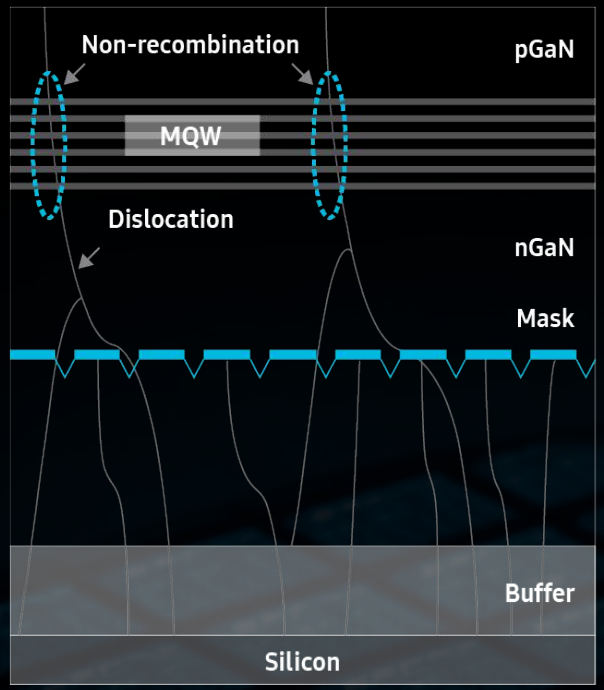
GaN-on-Si Technology

Challenges on epitaxial quality were overcome by years of research and development



	Sapphire	Si	Si (Samsung)	
			Gen 1	Gen 2
Lattice mismatch (vs. GaN)	13%	17%	17%	
CTE mismatch (vs. GaN)	34%	54%	54%	
Defect density (a.u.)	100	> 350	300	**165**

Gen 1 Gen 2

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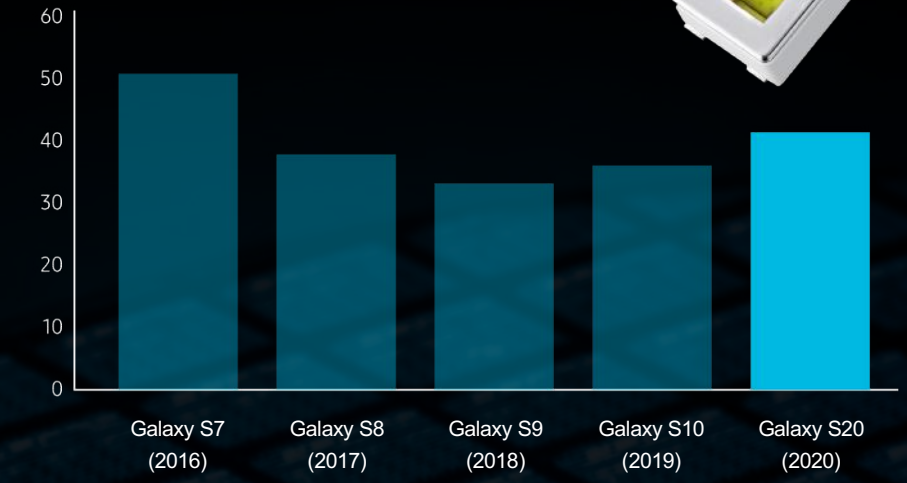
Application in Mobile

Flash LEDs in smartphones since 2016

First year sales



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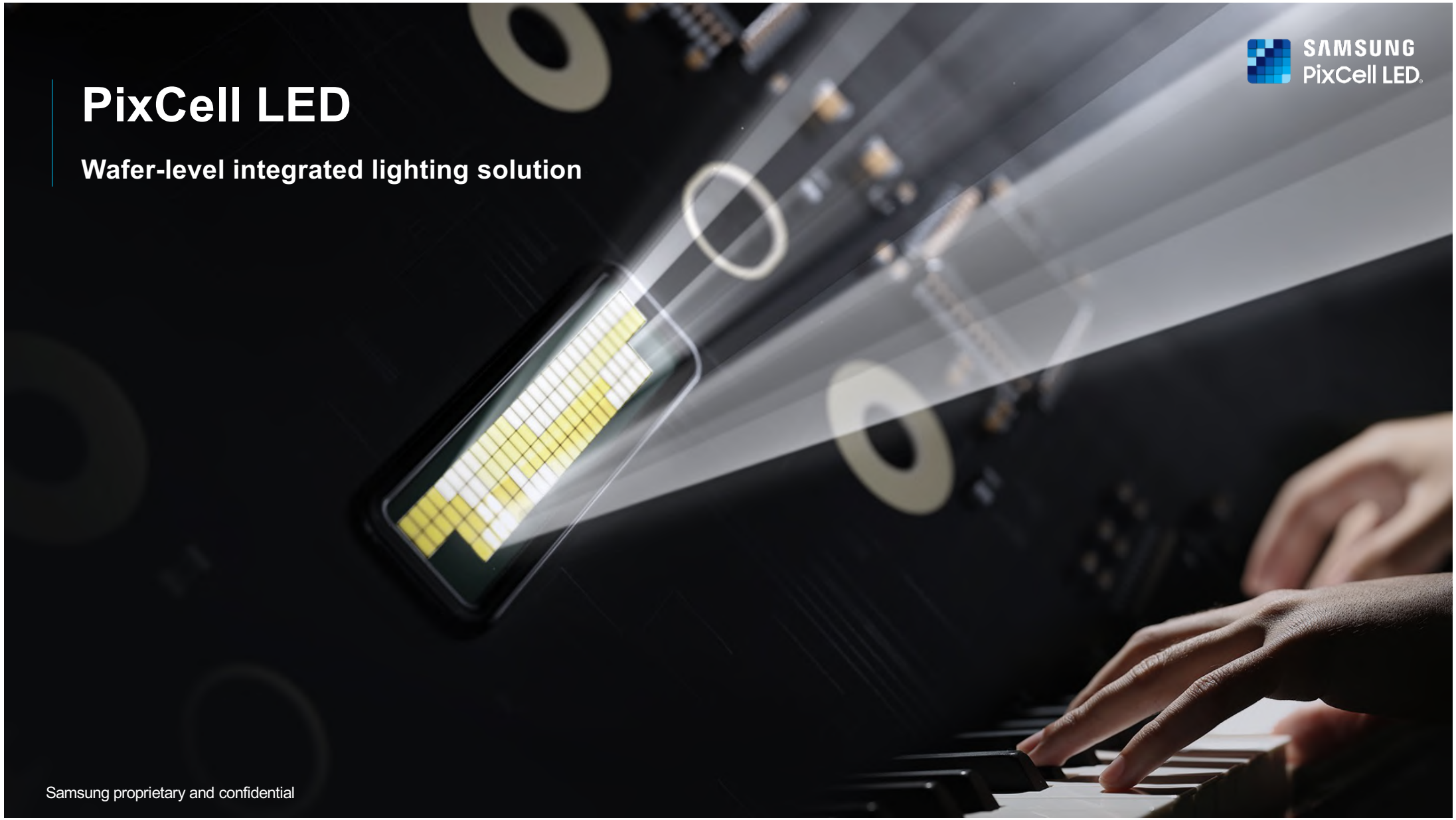
Application in Automobile

Integrated LEDs for ADB headlamps since 2020

40 PPI

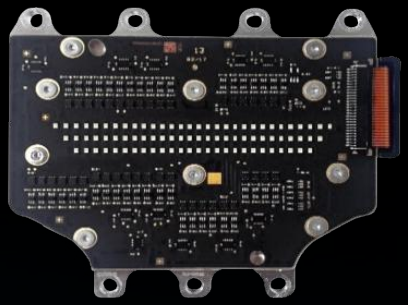


PixCell LED

Wafer-level integrated lighting solution

PixCell LED

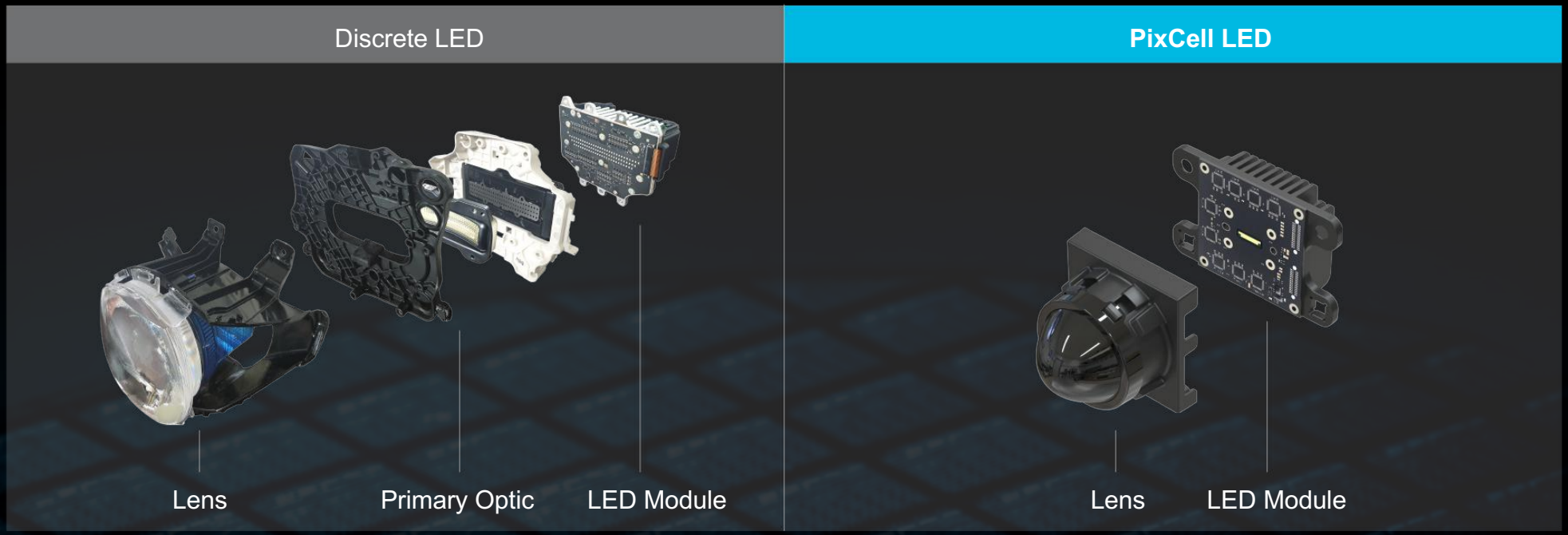
Small pixel-to-pixel distance and compact light emitting area



	Discrete LED	PixCell LED
Unit pixel size	765 x 765 ㎛	550 x 690 ㎛
Space between pixels	2000 ㎛	≤ 25 ㎛
# of Pixel	84	100
Light emitting area	82 x 8.2 mm^2	≤ 15.4 x 2.7 mm^2
Contrast ratio	> 50:1	> 300:1

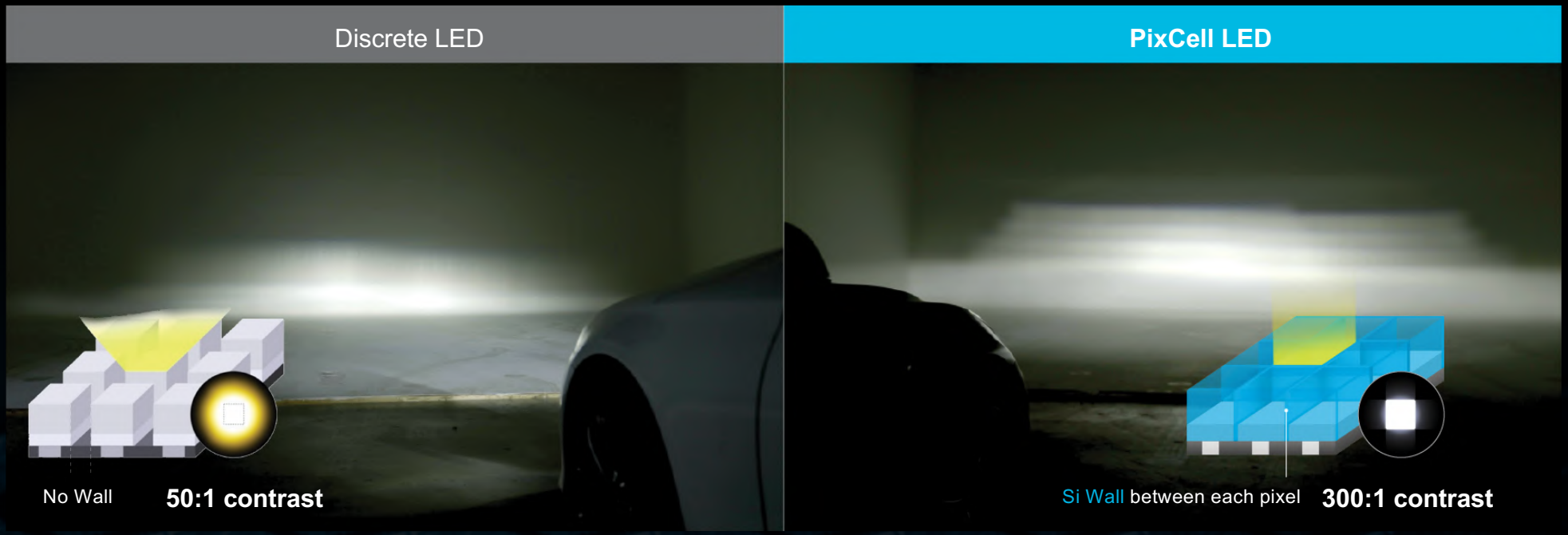
PixCell LED

Simplified optical system and reduced overall volume



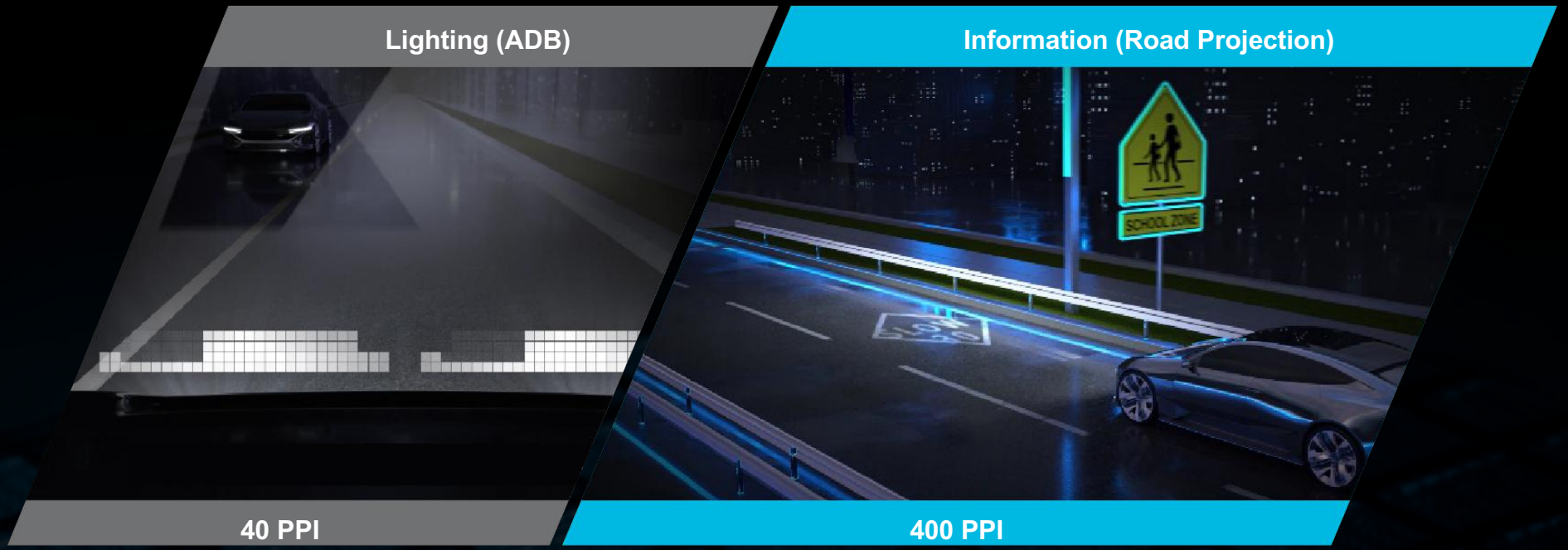
PixCell LED

More digitalized beams suitable for ADB application



Future Outlook

Lighting + Information → Communication through lighting



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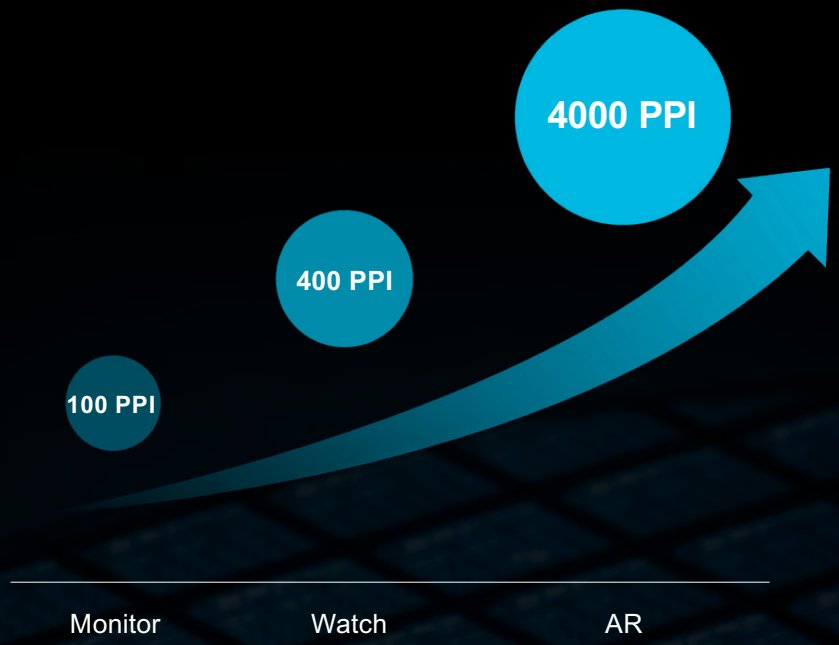
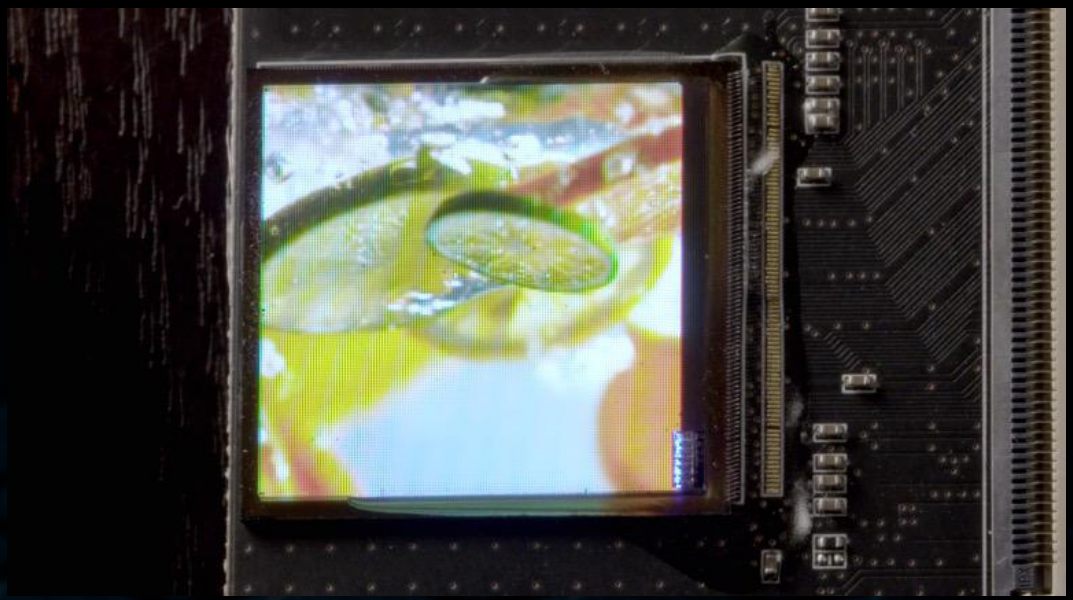
Micro LED | Dot.

Micro LED Technology

Samsung is continuously developing Micro LED technology

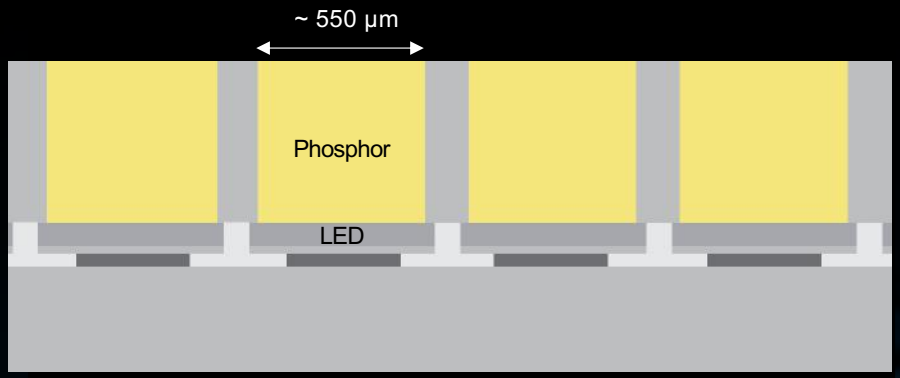
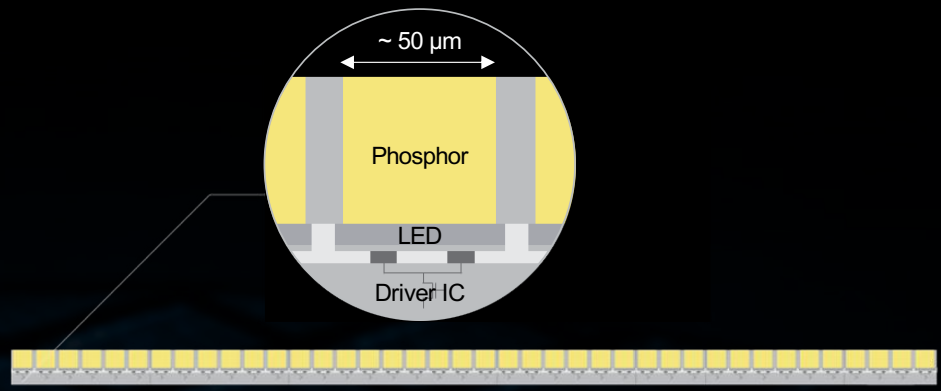




HD (High-Definition) PixCell LED

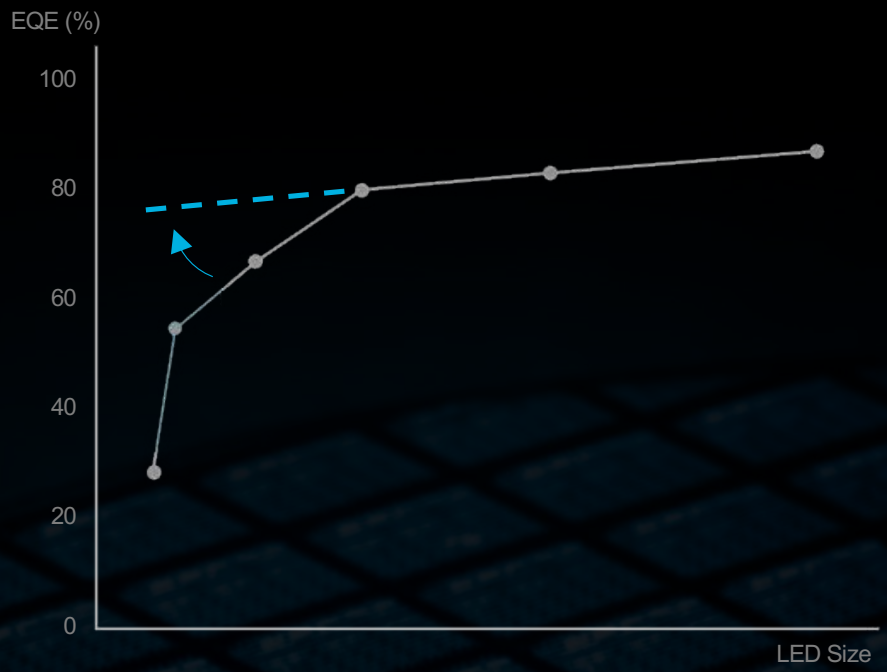
25K ~ 30K pixels with built-in driver IC

SAMSUNG Micro LED | Dot.

PixCell LED	HD PixCell LED (Prototype)
	
100 px	25K ~ 30K px
40 PPI	400 PPI
Separate Driver IC	Built–in Driver IC

HD PixCell LED

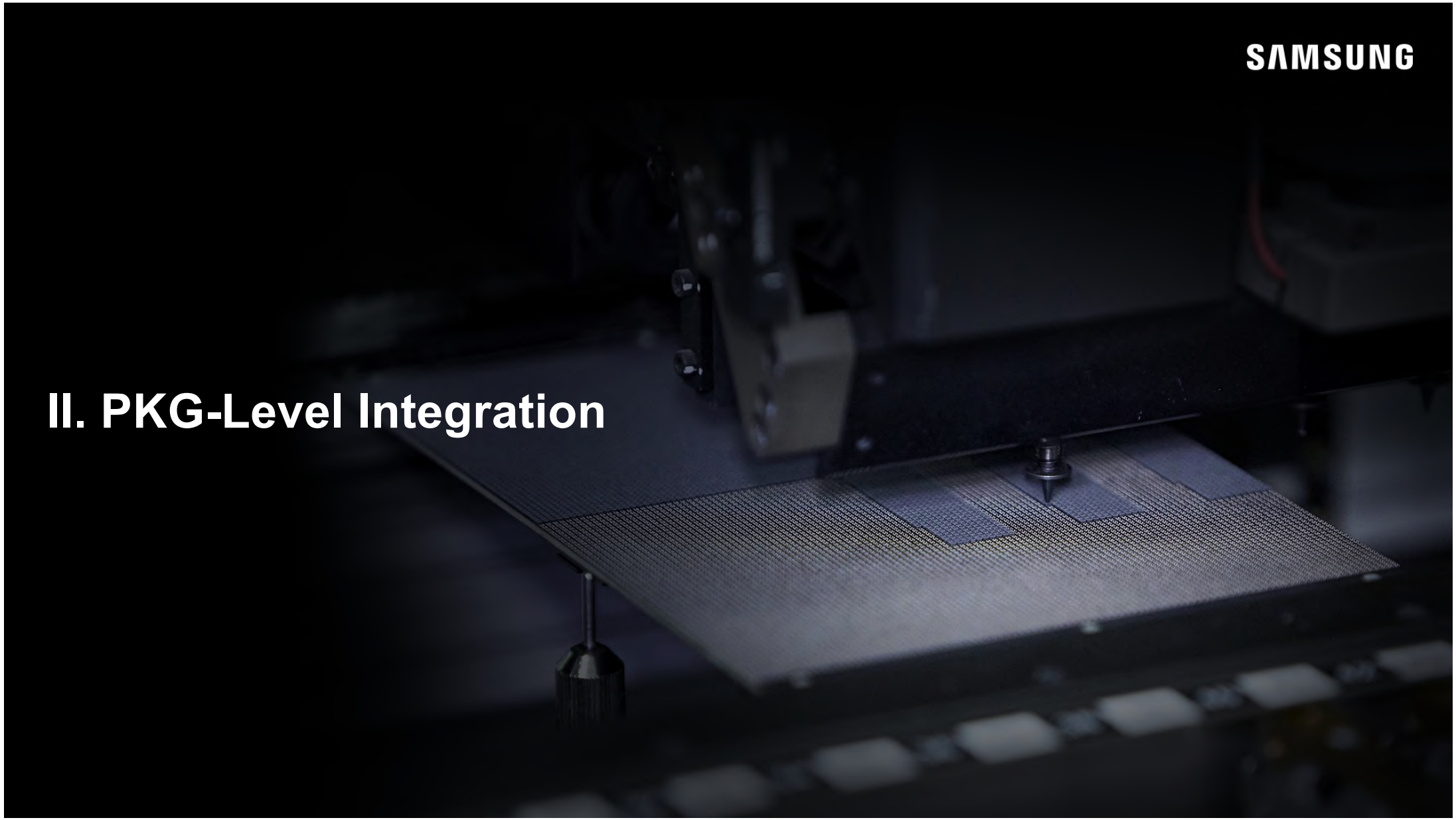
Challenges of scaling down will be overcome by material and process innovation



(1) LED Size

(2) Phosphor Efficiency

(3) Thermal Management



II. PKG-Level Integration

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PKG-Level Integration

LED PKGs are integrated on a PCB by pick-and-place

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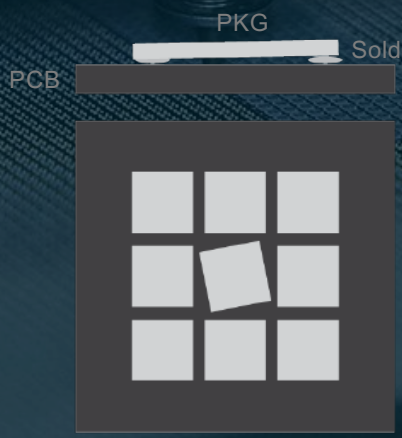
LAM (LED Array Module) Technology

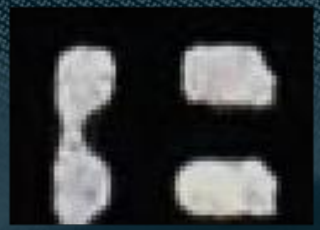
Challenges on quality and productivity were overcome by years of research and development

Shift

Tilt / Rotation



Short / Open



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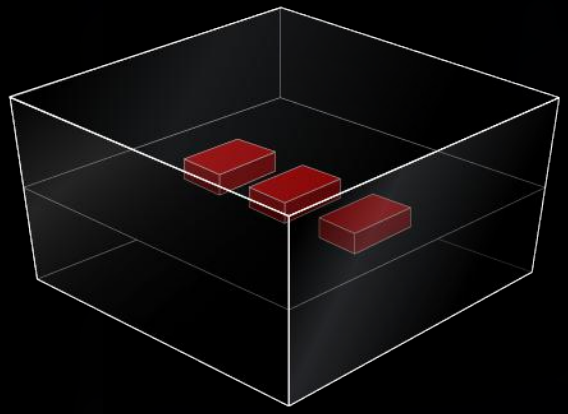
Application in Display

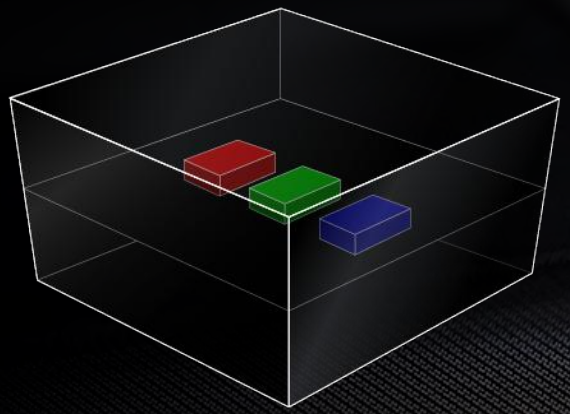
LED modules in a variety of displays and digital signage

Automotive Mini LED

Automotive-grade Mini LED was developed



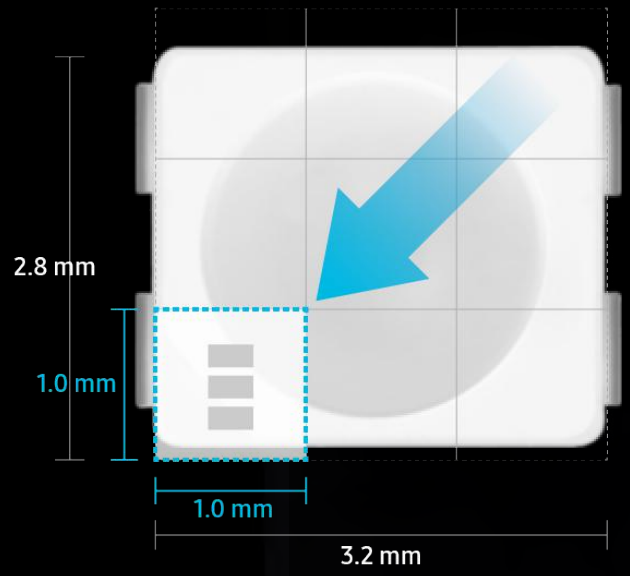
Mini LED (Red)



Mini LED (RGB)

Automotive Mini LED

Compact and reliable light source with a large design freedom



	Red	RGB
PKG Size	1.0 x 1.0 x 0.5 mm	
Iv (mcd)	600 @ 21mA	R 30 / G 70 / B20
Wd (nm)	620	R 621 / G 521 / B 469
Vf (V)	2.2	R 2.2 / G 3.0 / B 3.1
Tj	125°C	

Integrated Mini LEDs

PKG-level integrated lighting solution

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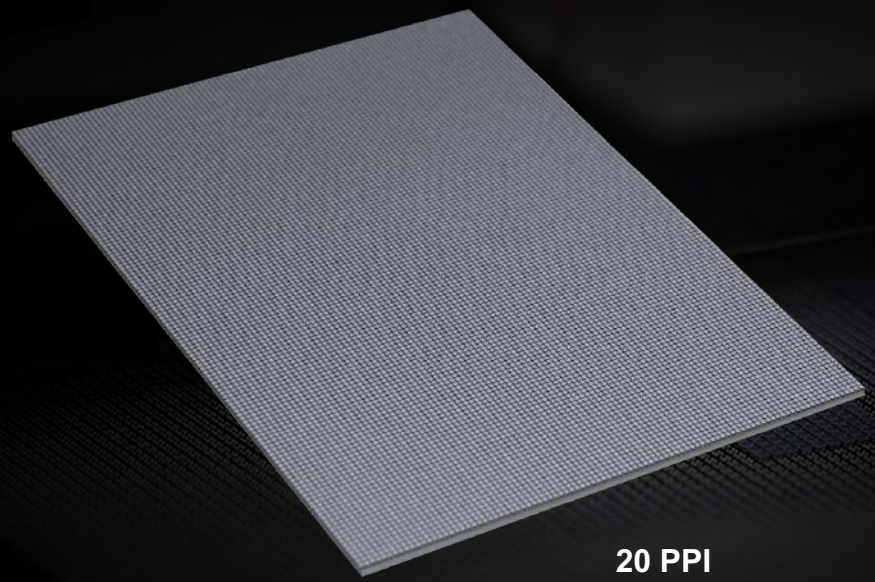
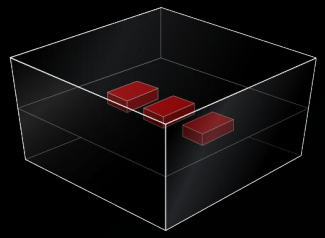
Mini LED | Grid



20 PPI

Red Mini LED

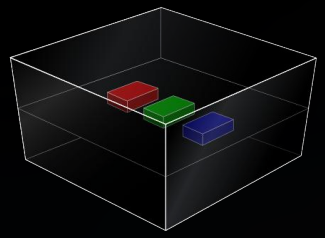
Custom animated rear combination lamp



Application Demonstration		
PKG	Size	1.0 x 1.0 x 0.5 mm
	Color	Red (3 chips)
	Iv (mcd)	600 mcd
Display	Resolution	384 x 128
	LED	49,152 ea
	Pitch	1.5 mm

RGB Mini LED

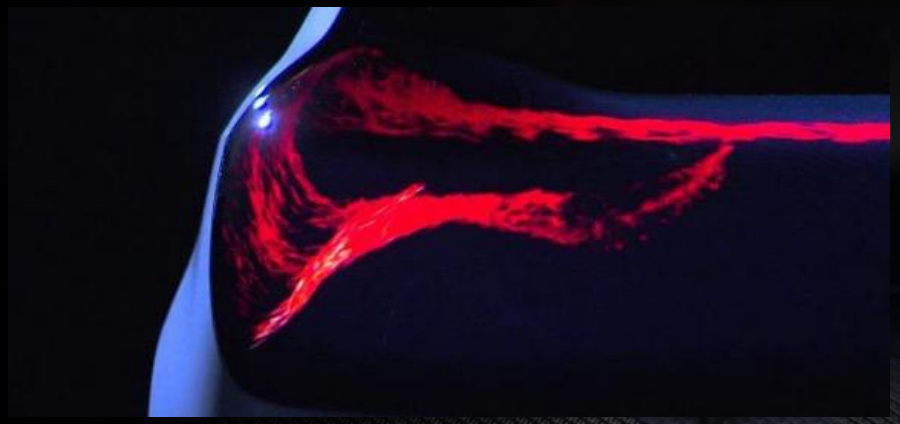
Multi-purpose communication display



Application Demonstration		
PKG	Size	1.0 x 1.0 x 0.5 mm
	Color	Red, Green, Blue
	Iv (mcd)	R 30 / G 70 / B20
Display	Resolution	384 x 128
	LED	49,152 ea
	Pitch	1.5 mm

Mini LED vs OLED

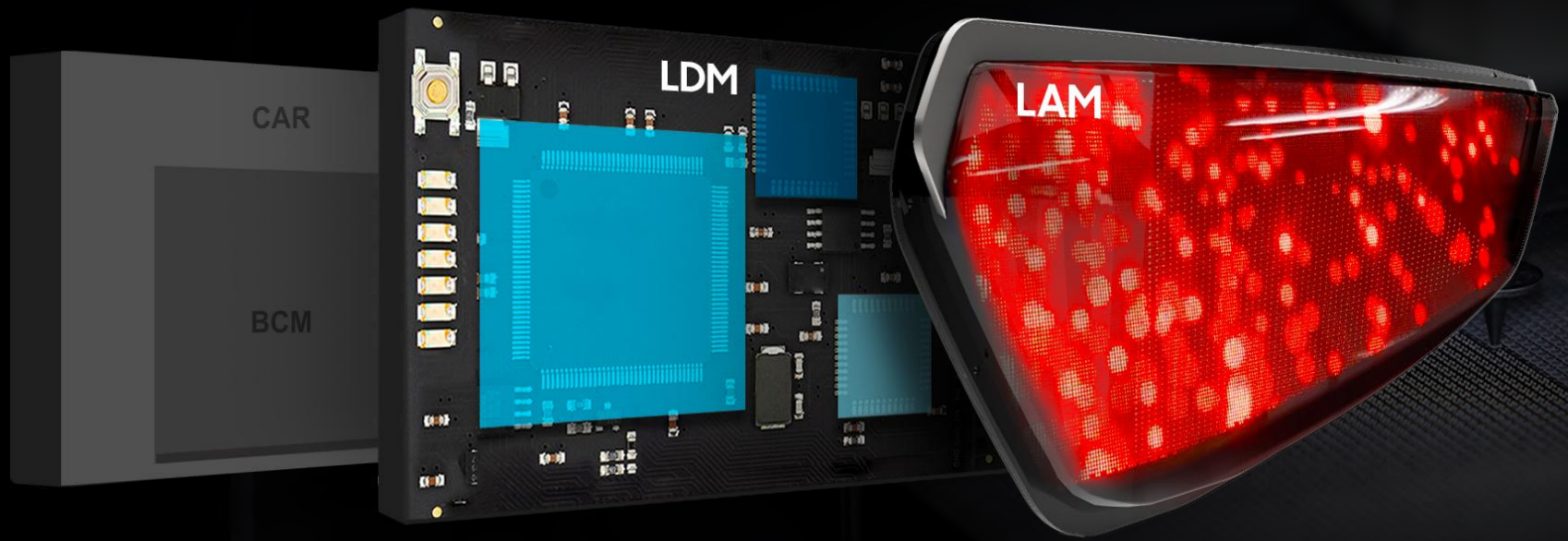
Each technology has pros and cons



Mini LED		OLED
+++	Brightness	++
+++	Reliability	++
+++	Scalability	++
++	Color Quality	+++

Future Outlook

Total display solution for automotive application is under preparation



Summary