



# 次世代顯示技術 Micro LED

## Next Generation of Display Technology Micro LED

# Commercialization of Micro LED

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主辦單位:



協辦單位:



合作單位:



# Industrialization of Micro LED

Micro LED's Role in Evolution of Display

Challenges of Micro LED's Commercialization

Micro LED's Potential and Market Development

# LED Display Applications- Backlight and Pixel Light (1/2)

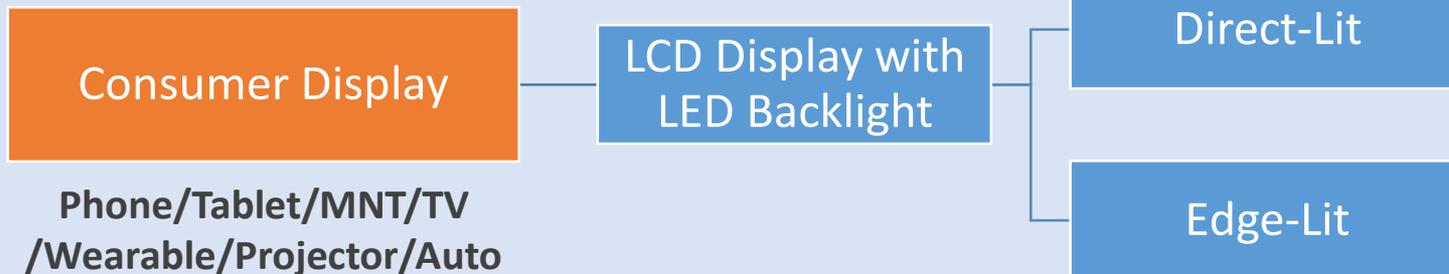
## Application Segment

## Display Technology

### ➤ LED as Pixel



### ➤ LED as Backlight



# LED Display Applications- Backlight and Pixel Light (2/2)

## TV



LED Type: White LED  
 LED Size: 3 mm X 3 mm  
 Pixel Control: Liquid Crystal  
 Backplane: TFT Glass  
 Brightness: 300~400 nits  
 PPI: 40~100



## Signage



LED Type: RGB LED  
 LED Size: 0.8 mm X 0.8 mm  
 Pixel Control: LED  
 Backplane: PCB  
 Brightness: 500~1000 nits  
 PPI: 10~20

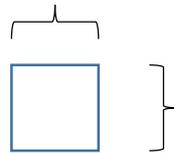


# LED Larger than Pixel-Backlight

Pixel Size

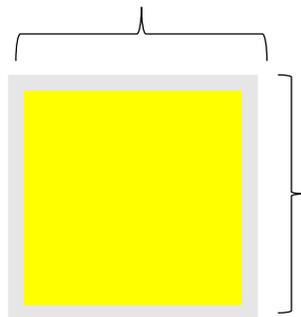
55" 4K TV

200  $\mu\text{m}$



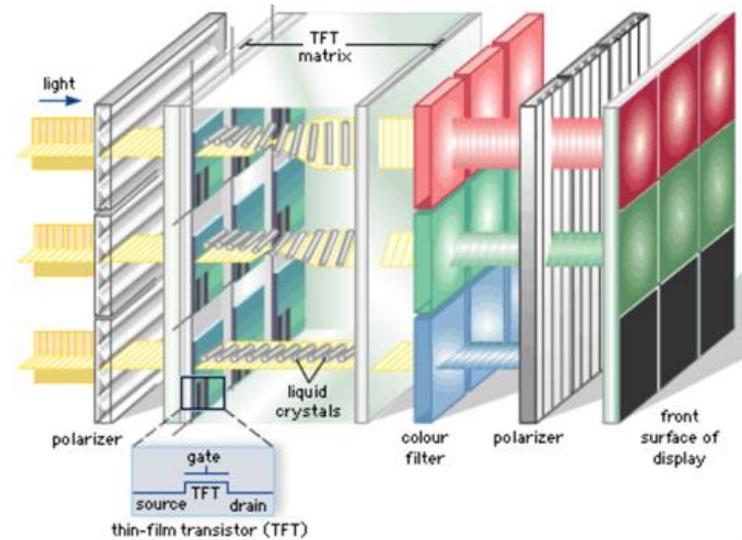
200  $\mu\text{m}$

3,000  $\mu\text{m}$



3,000  $\mu\text{m}$

LED Size



Light

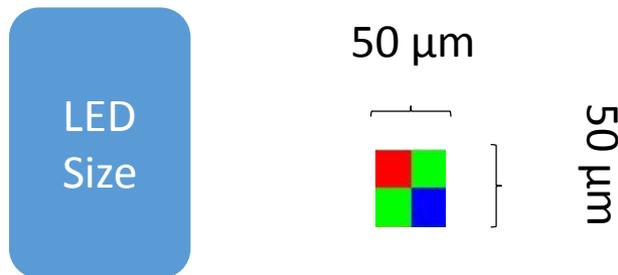
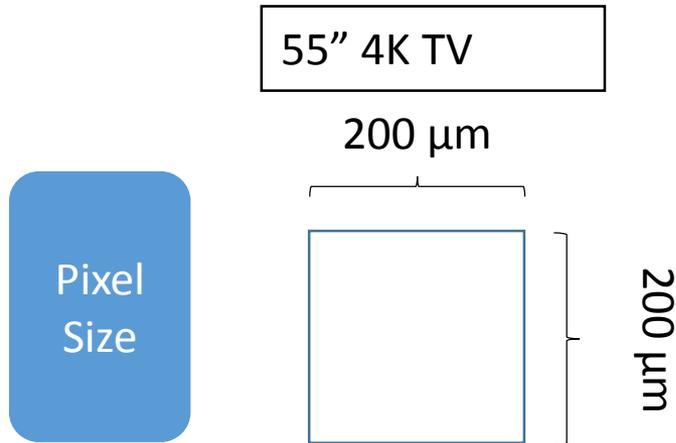
Pixel Control

- ◆ Plane light source used as backlight
- ◆ Optical Design
  - Lens (D)
  - LGP (E)

- ◆ LCD and polarizer realizes pixel gray scale and switch
- ◆ Pixel Control
  - Pixel  $\rightarrow$  L/C
  - Sub-Pixel  $\rightarrow$  C/F



# Pixel Larger than LED-Micro LED



Light

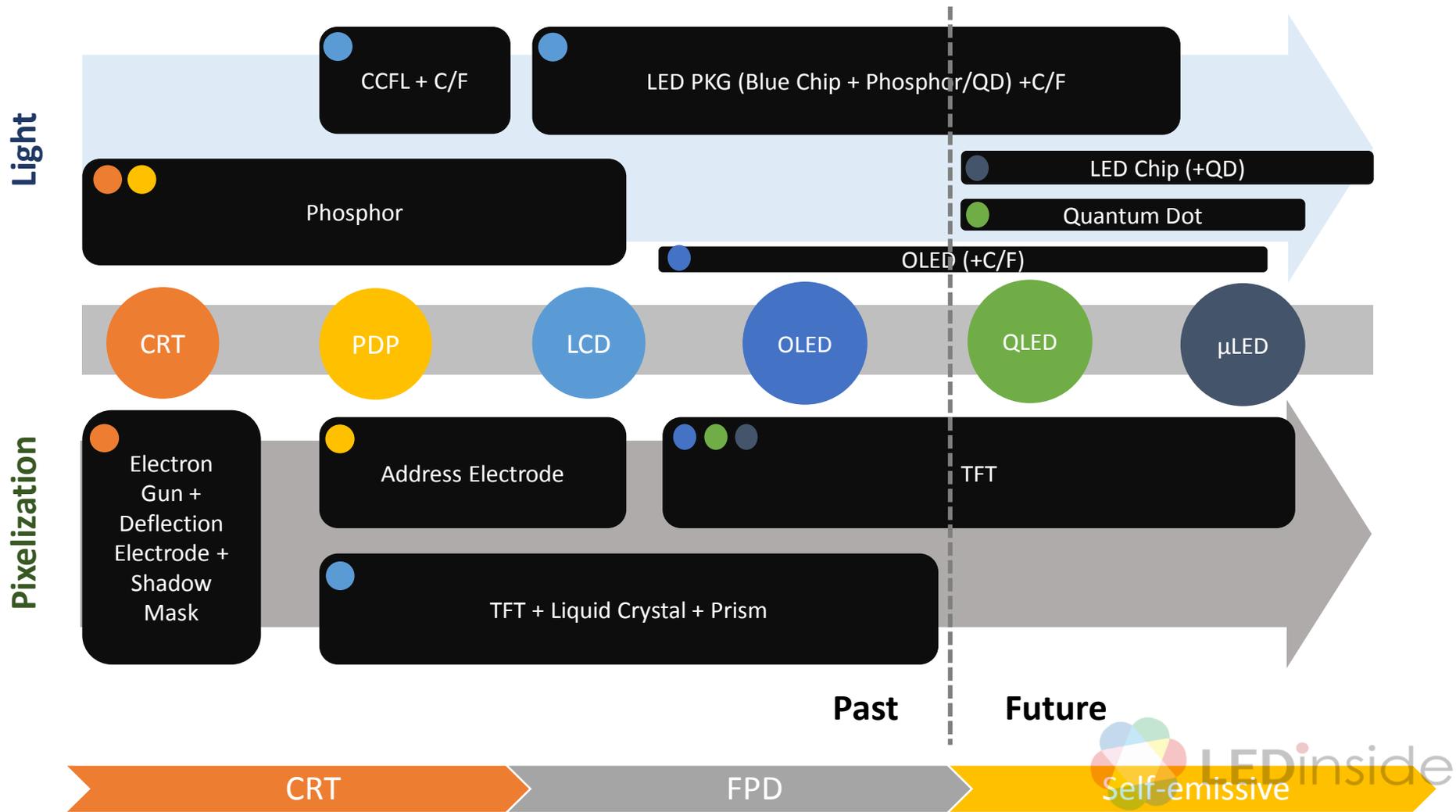
Pixel Control

- ◆ Using point light sources as the emission layer
- ◆ The process is similar to the cell procedure in TFT process.

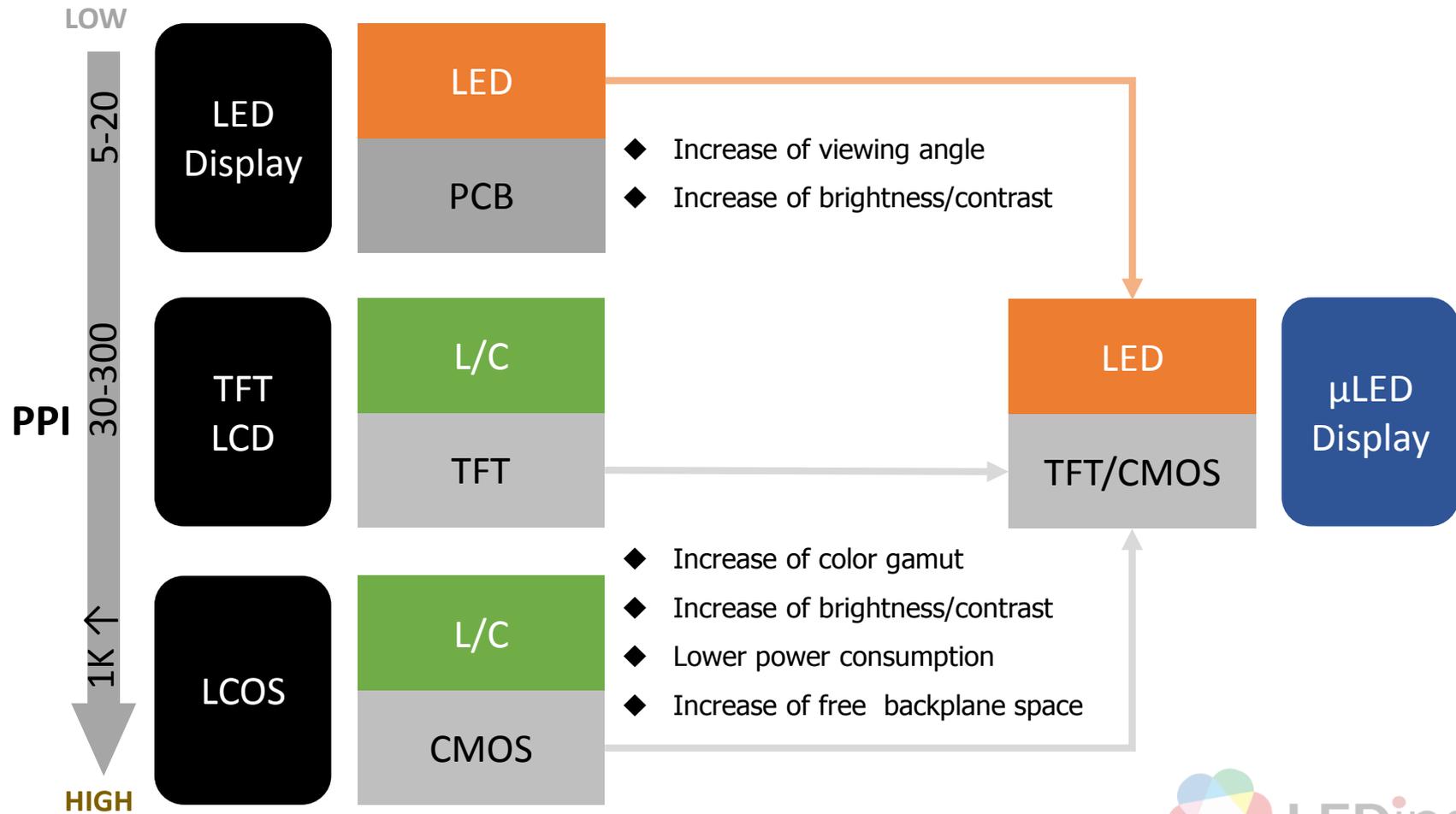
- ◆ Direct pixel control with  $\mu\text{LED}$ , similar to OLED
- ◆ Pixel Control
  - Pixel  $\rightarrow$   $\mu\text{LED}$
  - Sub-Pixel  $\rightarrow$   $\mu\text{LED}$



# Light Source and Pixel is the Core of Display (2/2)

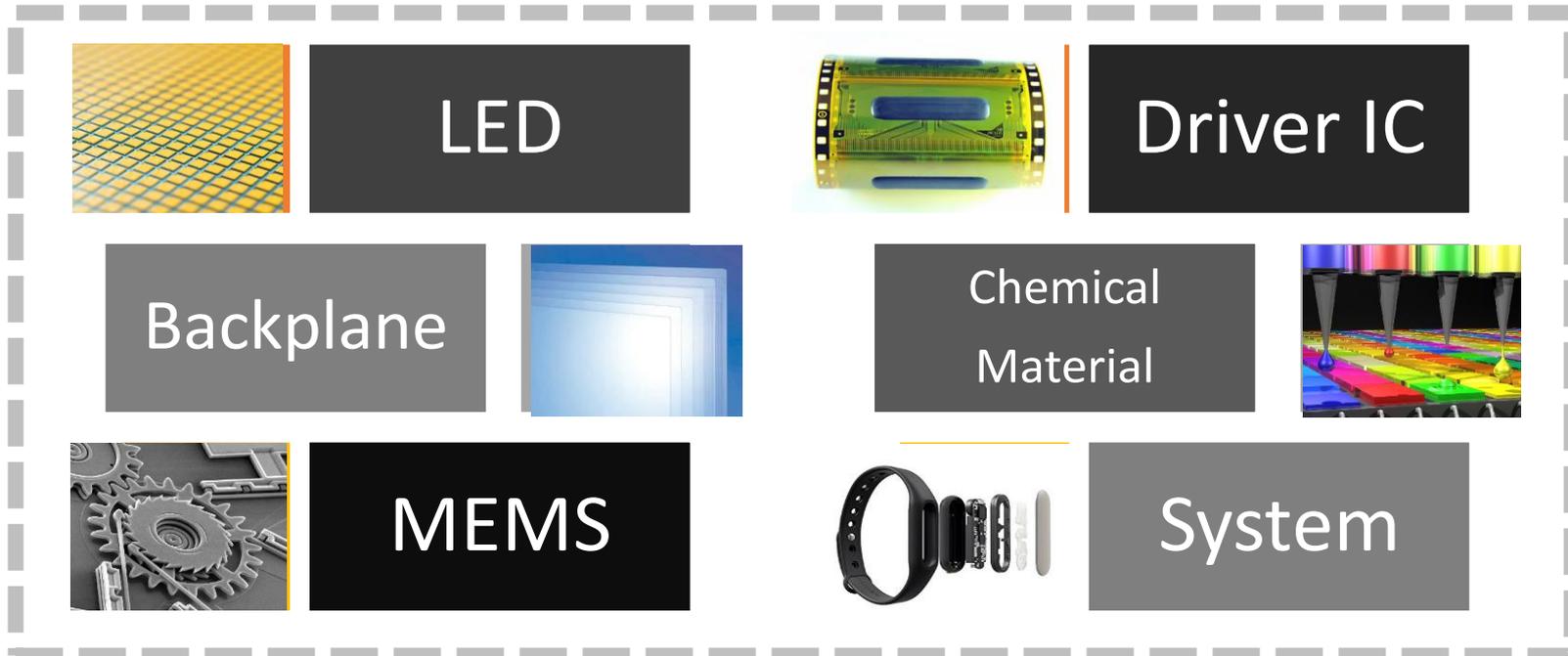


# Combination of High Density Circuit and High Density Light Source

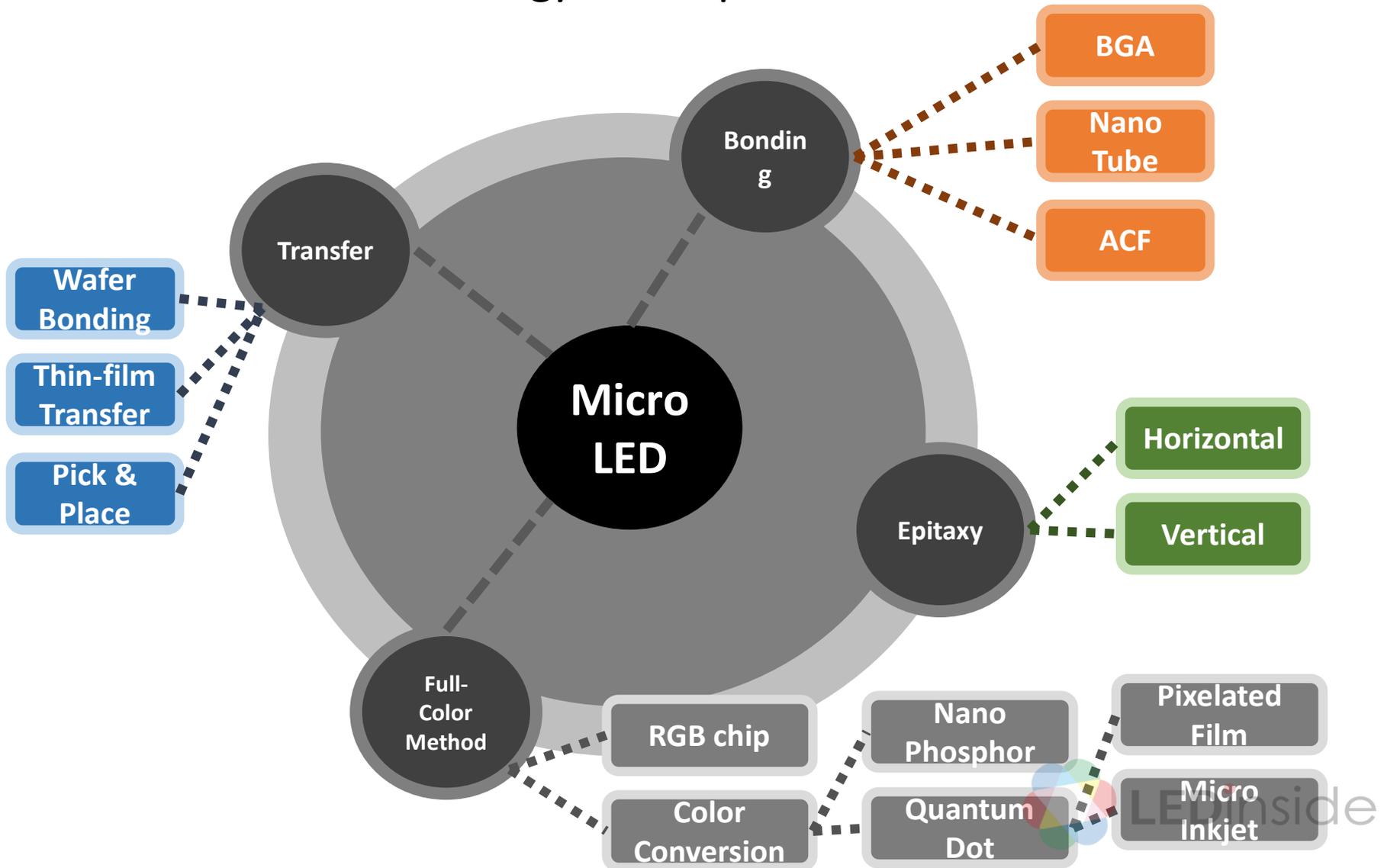


# Challenges of Micro LED's Commercialization

# Micro LED Requires Highly Supply Chain Integration



# Varied Micro LED technology Development



# Multifaceted Technical Barriers for Micro LED to Overcome

## LED Epitaxy

- Uniformity
- Height
- Substrate Lift-off

## Transfer

- Accuracy/Precision
- Temporary Substrate/Adhesive
- Mems/Nozzle

## Bonding

- Bonding Force
- Electric Conductivity
- Heat-resistant

## Others

- Optic (Crosstalk/Mura)
- Color Conversion
- Circuit/Driver

# Apple and Sony's Micro LED Commercialization

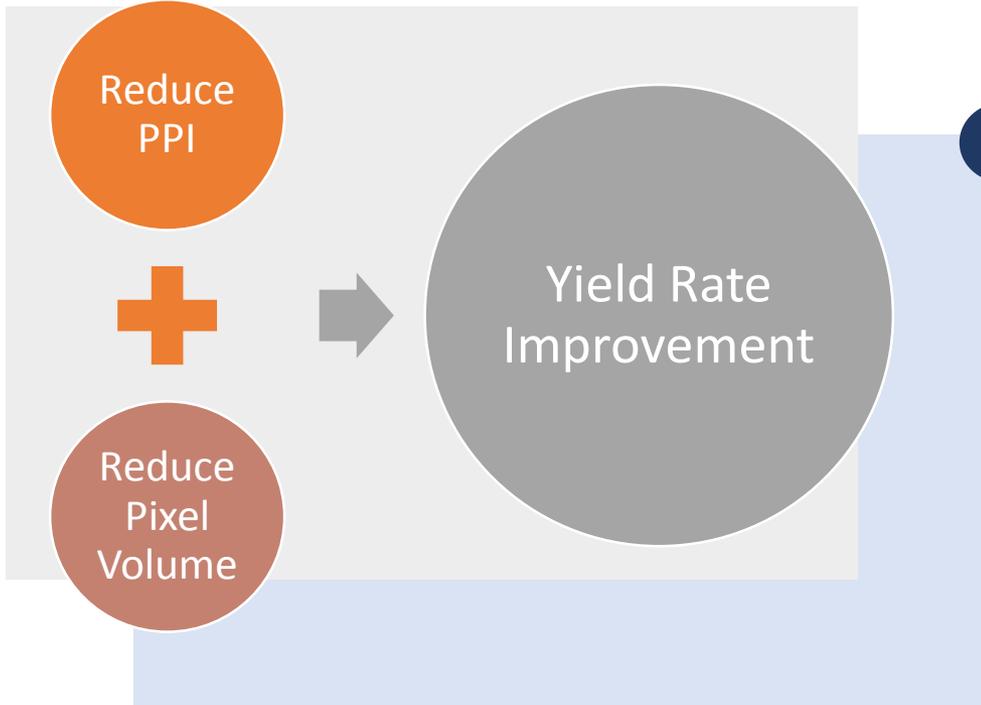
Company	Product	PPI	Sub-Pixel Qty.
Sony	Crystal LED Display	40	6,220,800
Sony	CLEDIS™	15	345,600
Apple	Apple Watch 38mm	290	277,440
4K Display (3840 X 2160)		By Size	24,883,200



## Small Size



## Big Size

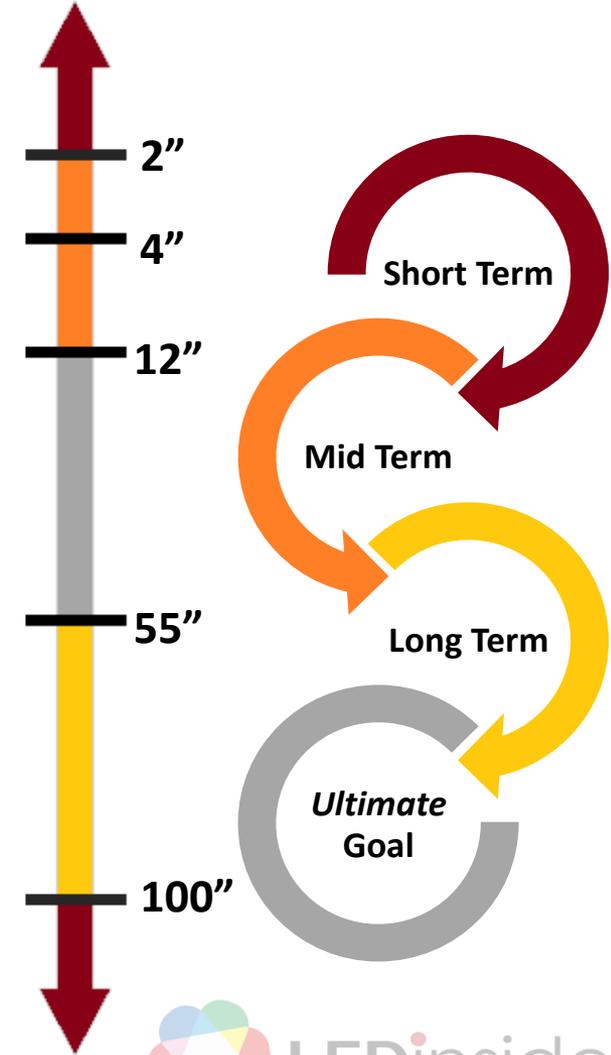


# Micro LED's Potential and Future Market Development

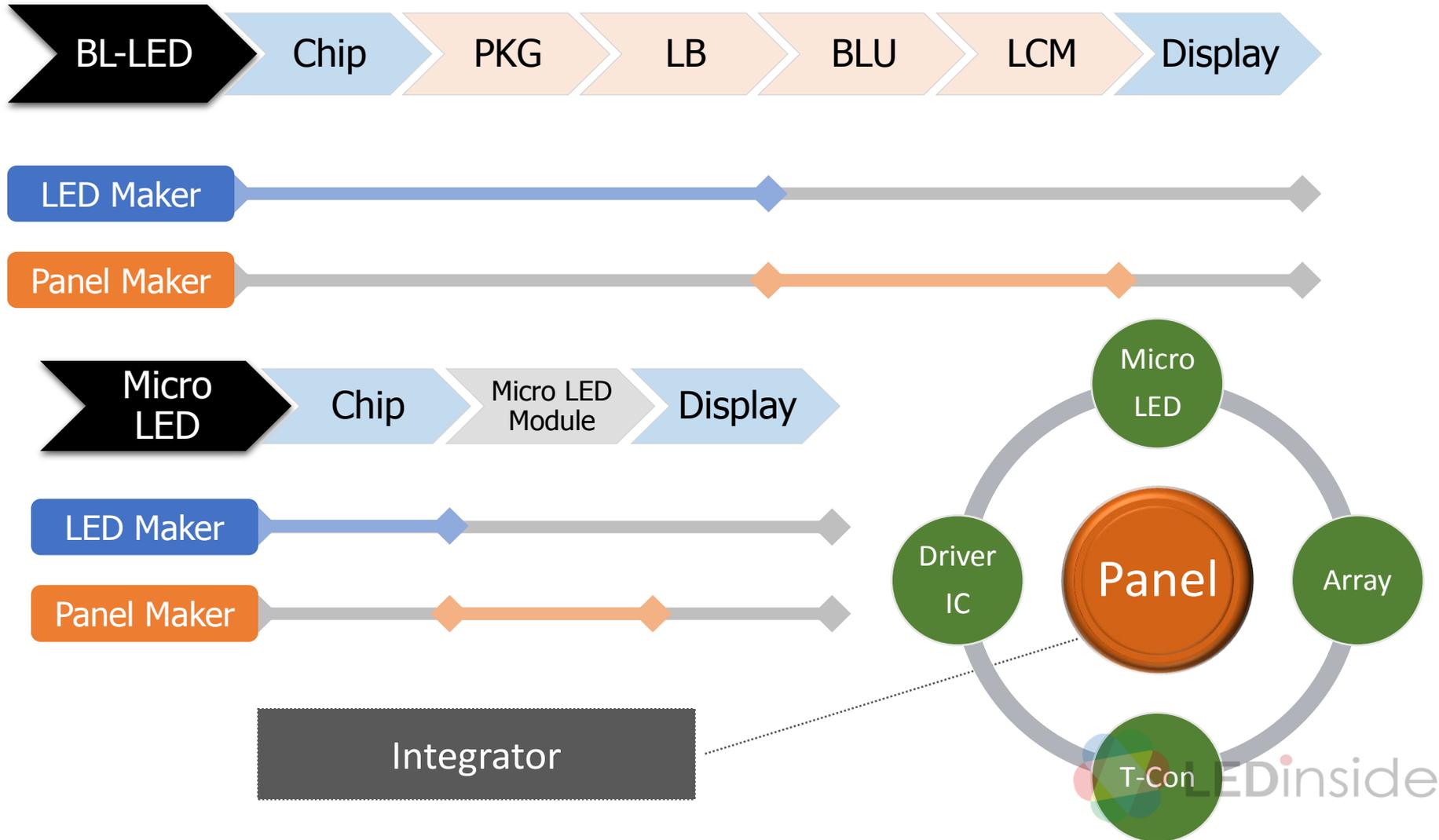
# Micro LED Potential Market Opportunity



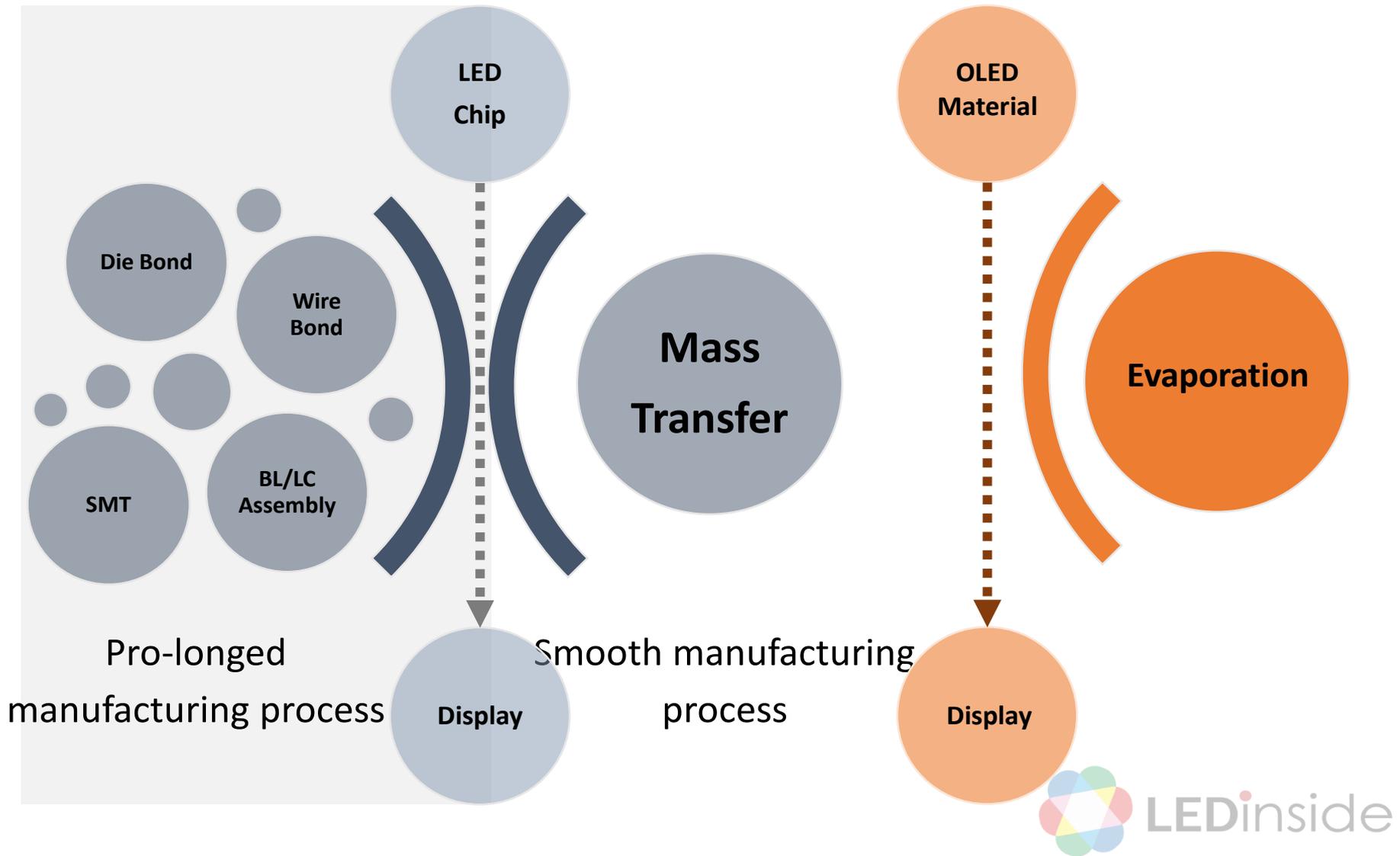
Panel Size



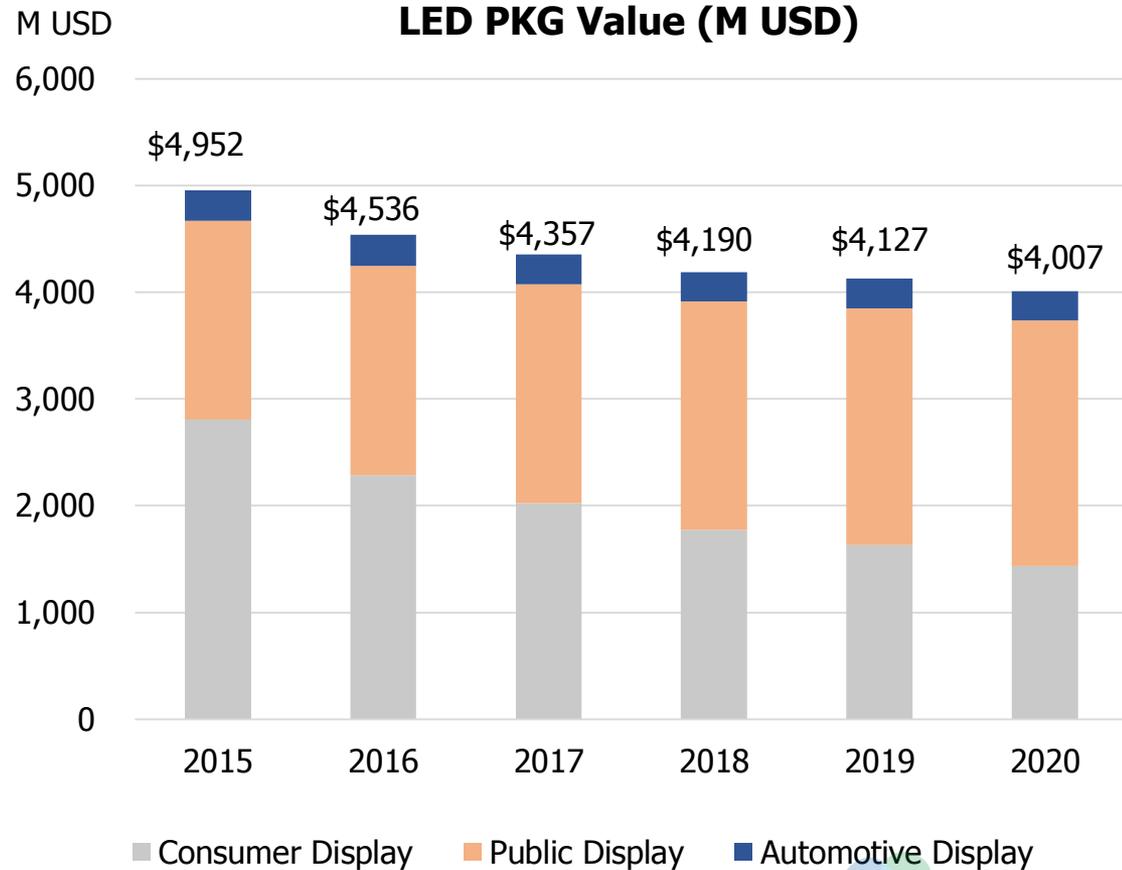
# Micro LED Triggers Supply Chain Reshuffle (1/2)



# Micro LED Triggers Supply Chain Reshuffle (2/2)



# Market Value and Output of Display Related Applications

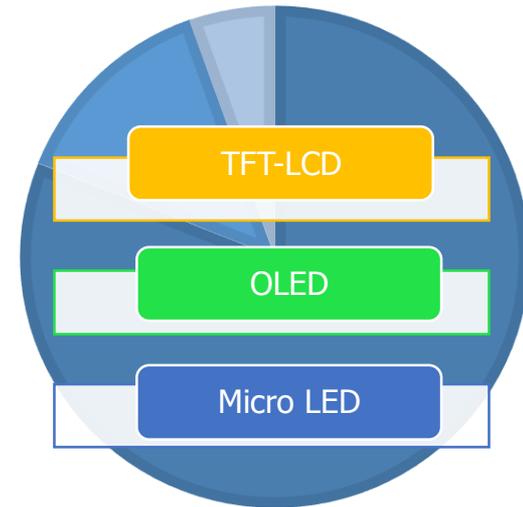


# Micro LED as Replacement in Existing Display Market

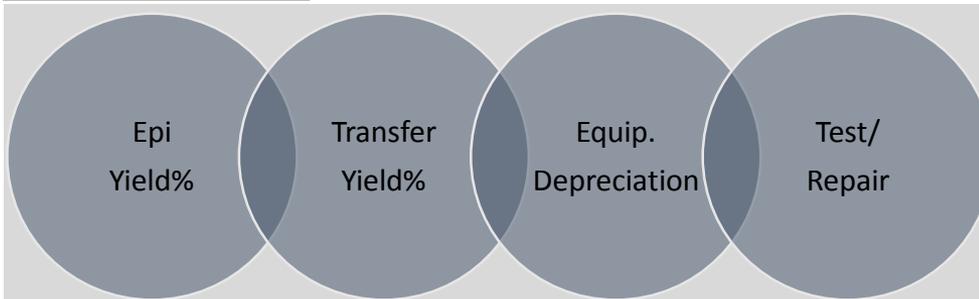
## Demand Side

	Technology Replaced by Micro LED	Total Revenue (M USD/Year)
Consumer Display	Back Light Unit Liquid Crystal Polarizer Color Filter	\$30,000
Automotive Display		\$5,000
Public Display	PLCC RGB LED	\$2,000

■ Consumer Display ■ Automotive Display ■ Public Display

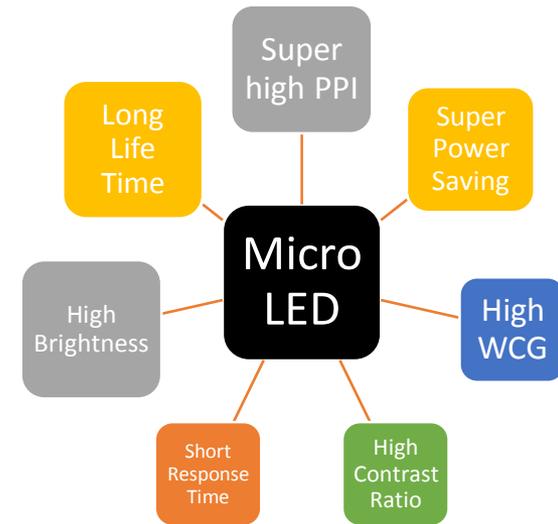
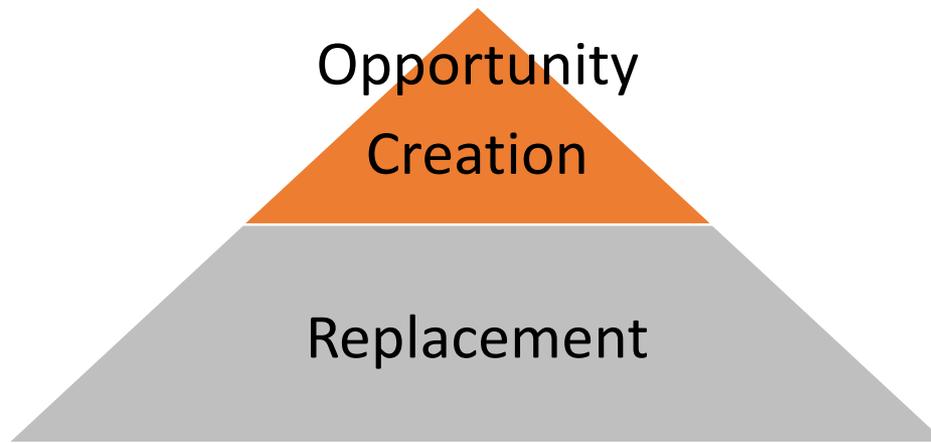


## Supply Side



# Cost Barrier

# Will It Create Opportunities or Simply Replace Existing Technology?



# Micro LED and its Unlimited New Market Potential

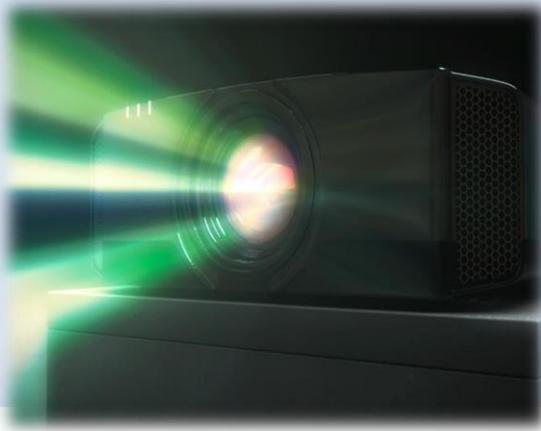
Smart  
Lighting



HUD



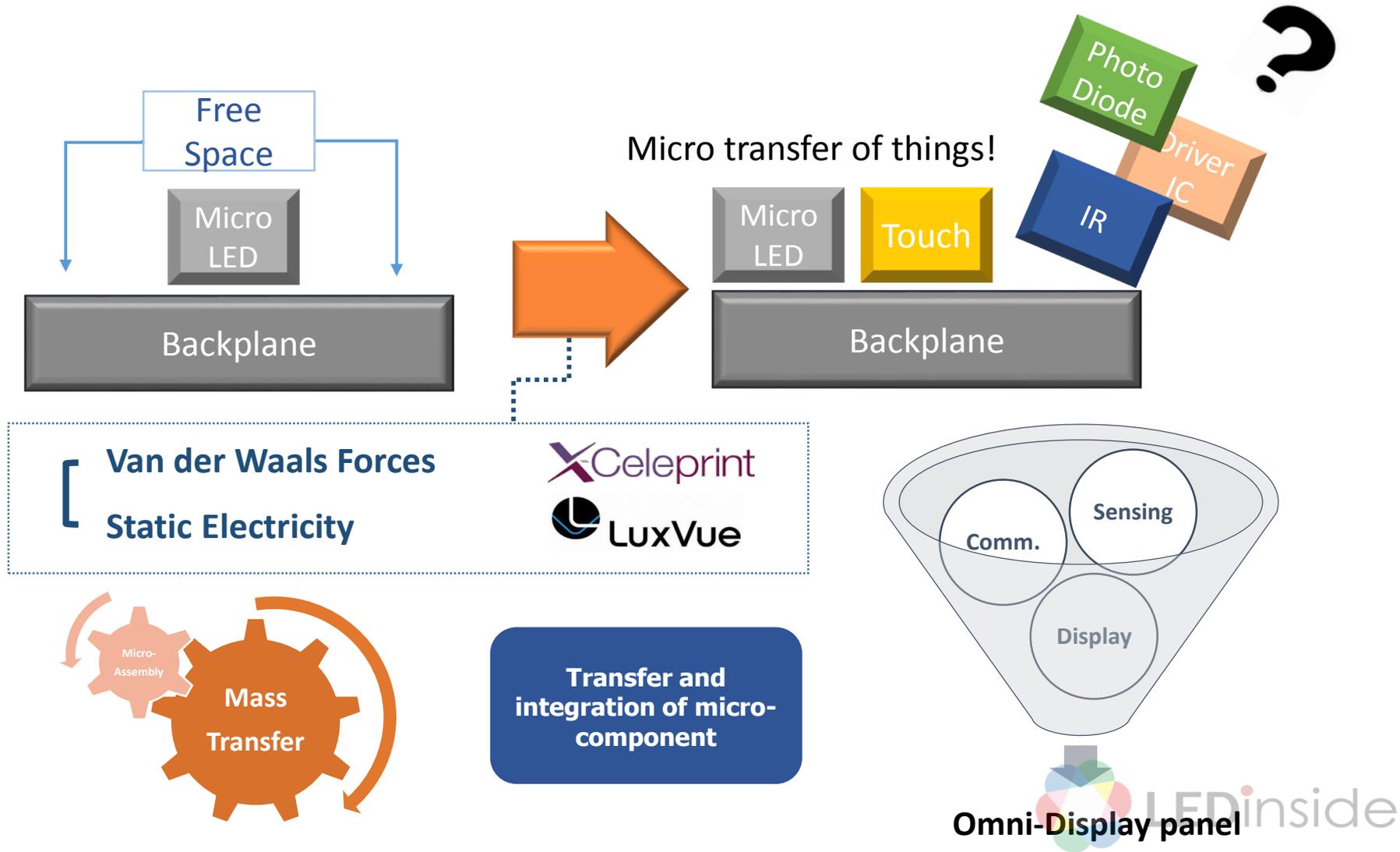
Projector



AR/VR



# Micro LED Technology is a Revolution and Paradigm Shift



# Thank you!

LEDinside

EnergyTrend

TrendForce

TRI

WitsView

DRAMeXchange

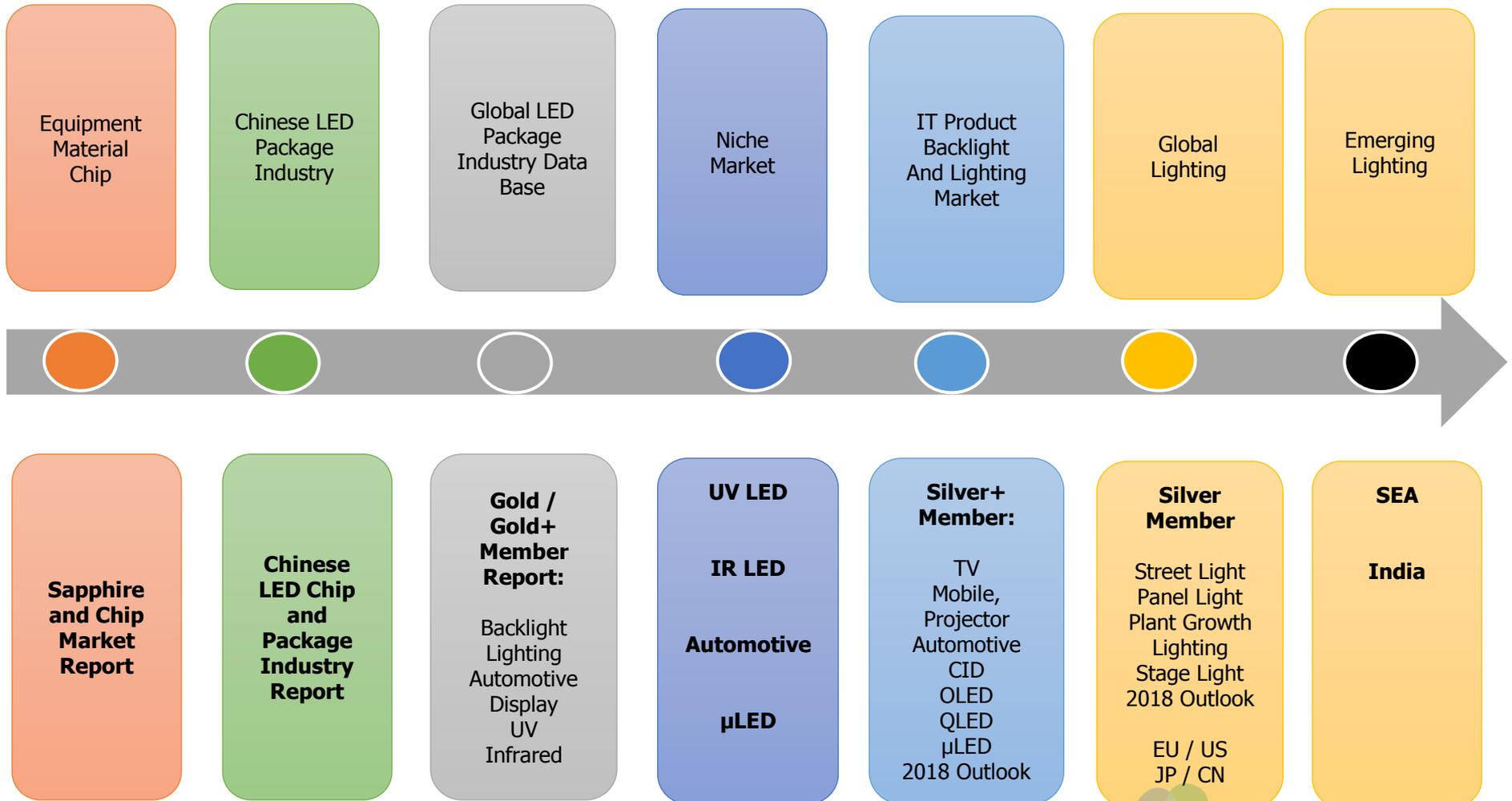


[www.ledinside.com](http://www.ledinside.com)

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LEDinside	Content	Characteristics	Format	Frequency	Price
<b>Silver</b>	Lighting Market Trend	Lighting Market Demand (Street Light / Panel Light / Plant Growth Light / Stage Light / 2018 Outlook), Market Scale, Product Specification and Price, Policy and Standards, Player Strategy	PDF	Quarterly / Annual	USD 4,000
	LED Price Survey	2835, 5630, 3030, 7070, 1~3W LED, 1~5W LED, COB	EXCEL		
		40W/60W Equiv. LED Lamp Price	EXCEL		
	Exhibit Report (TBD)	Guangzhou Lighting Fair	PDF		
<b>Silver+</b>	Lighting Market Trend	Lighting Market Demand (Street Light / Panel Light / Plant Growth Light / Stage Light / 2018 Outlook), Market Scale, Product Specification and Price, Policy and Standards, Player Strategy	PDF	Quarterly / Annual	USD 5,000
	IT Product and Backlight Market Trend	IT Product and Backlight Market Trend (TV / Mobile / Projector / Automotive CID / OLED & QLED & $\mu$ LED / 2018 Outlook) Branding Shipment, LED Market Scale, Product Specification and Price, Supply Chain	PDF		
	LED Price Survey	2835, 5630, 3030, 7070, 1~3W LED, 1~5W LED, COB	EXCEL		
		40W/60W Equiv. LED Lamp Price	EXCEL		
		LED Price- Mobile Backlight, Flash LED, Tablet, TV, Monitor, and NB	EXCEL		
Exhibit Report (TBD)	Guangzhou Lighting Fair	PDF			



LEDinside	Content	Characteristics	Format	Frequency	Price
<b>Gold</b>	Demand	2015-2020 market demand in backlight, lighting, automotive, display, UV, infrared, SSL like and son on	1Q/3Q EXCEL 2Q/4Q PDF	Quarterly Update / Annual Report 1Q/3Q: Excel 2Q/4Q: PDF	USD 13,200
	Supply	Chip market revenue (external sales, total sales) WW new MOCVD chamber installation volume / WW accumulated MOCVD chamber installation / WW new and accumulated MOCVD by K465i Epi wafer market demand (total / by size)			
	Chip	Top 10 Chip vendors' MOCVD installation, wafer capacity, and revenue			
	Package	LED package vendors' revenue and LED revenue Top 10 LED package revenues in backlight, lighting, COB, automotive, and display			
	Price	Sapphire / Chip / LED / Bulb			
<b>Gold+</b>	Demand	2015-2020 market demand in backlight, lighting, automotive, display, UV, infrared, SSL like and son on	1Q/3Q EXCEL 2Q/4Q PDF	Quarterly Update / Annual Report 1Q/3Q: Excel 2Q/4Q: PDF	USD 16,000
	Supply	Chip market revenue (external sales, total sales) WW new MOCVD chamber installation volume / WW accumulated MOCVD chamber installation / WW new and accumulated MOCVD by K465i Epi wafer market demand (total / by size)			
	Chip	Top 10 Chip vendors' MOCVD installation, wafer capacity, and revenue			
	Package	LED package vendors' revenue and LED revenue Top 10 LED package revenues in backlight, lighting, COB, automotive, and display			
	Price	Sapphire / Chip / LED / Bulb			
	LED Industry Quarterly Update	Major Manufacturer's Movement EU / the US / Japan / Korea / Taiwan / China Financial, strategies, product technology and trend	PDF	Quarterly Update / Annual Report PDF	



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