



■ **Semiconductors enabling XR as a new dimension for human connection**

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How we connect to each other is changing

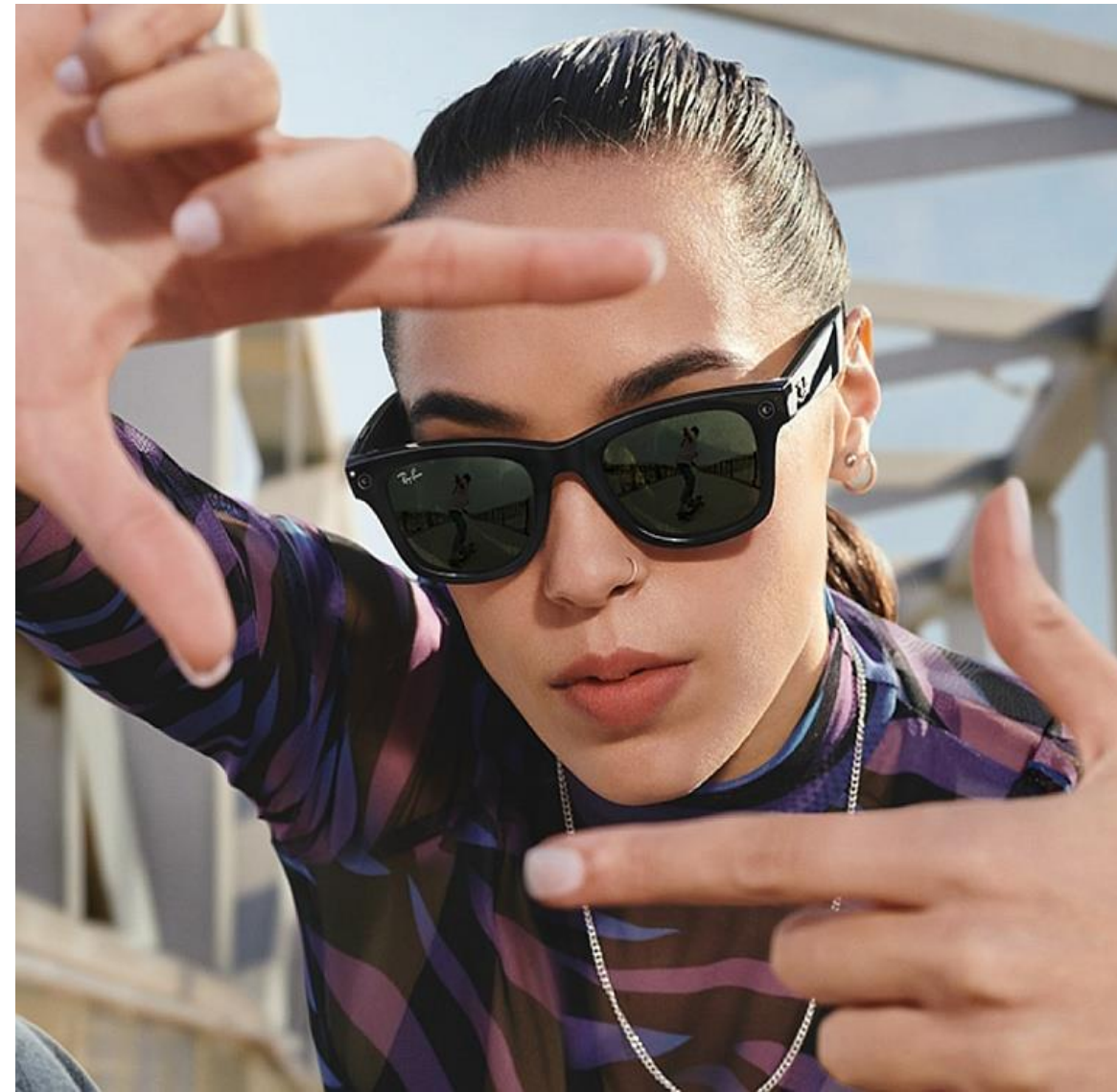


The XR world is right in front of our eyes

Microsoft HoloLens



Facebook Ray-Ban Stories Glasses



XiaoMi Smart Glasses

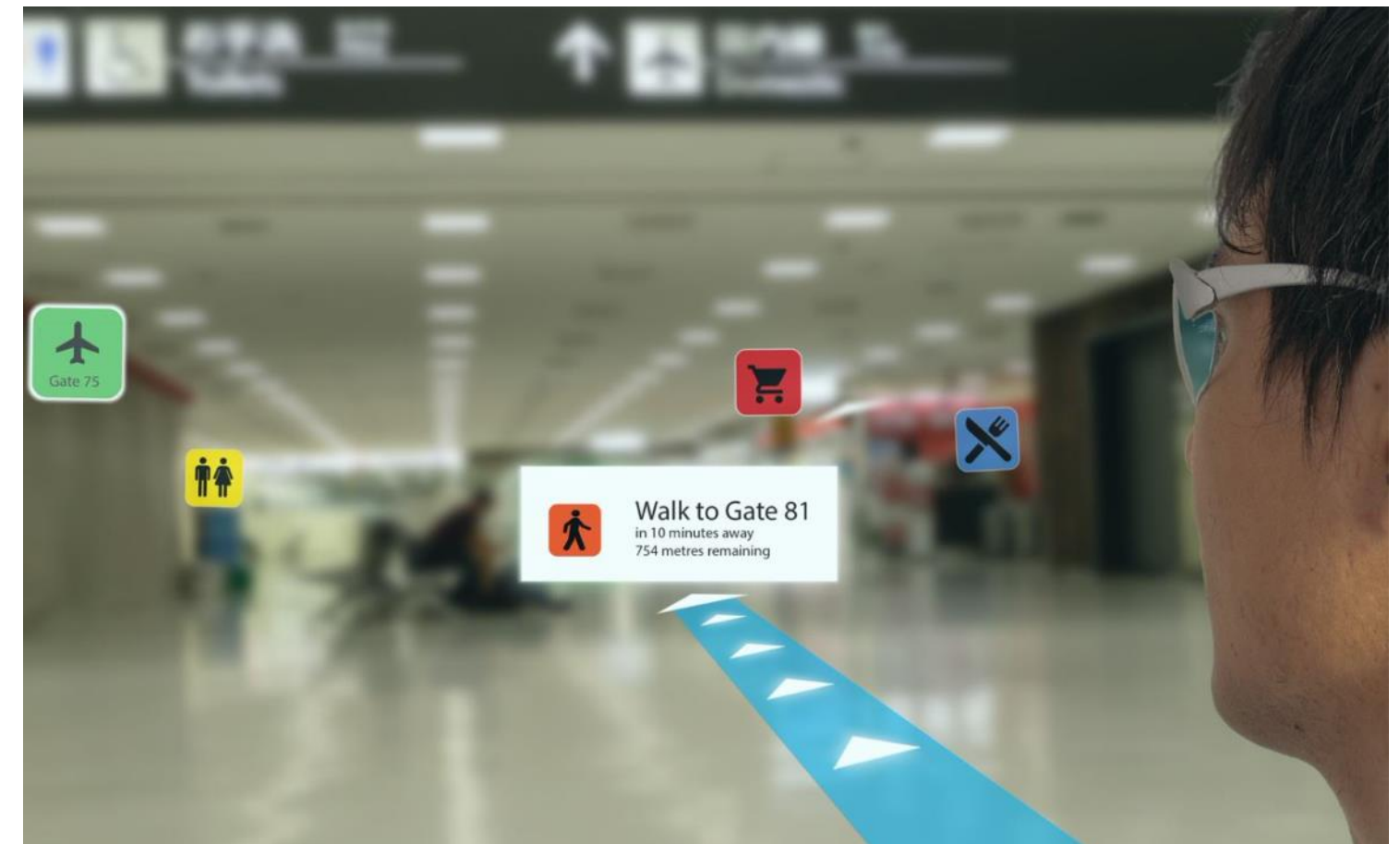


We can experience natural interactions between humans and data with XR

Now



Future



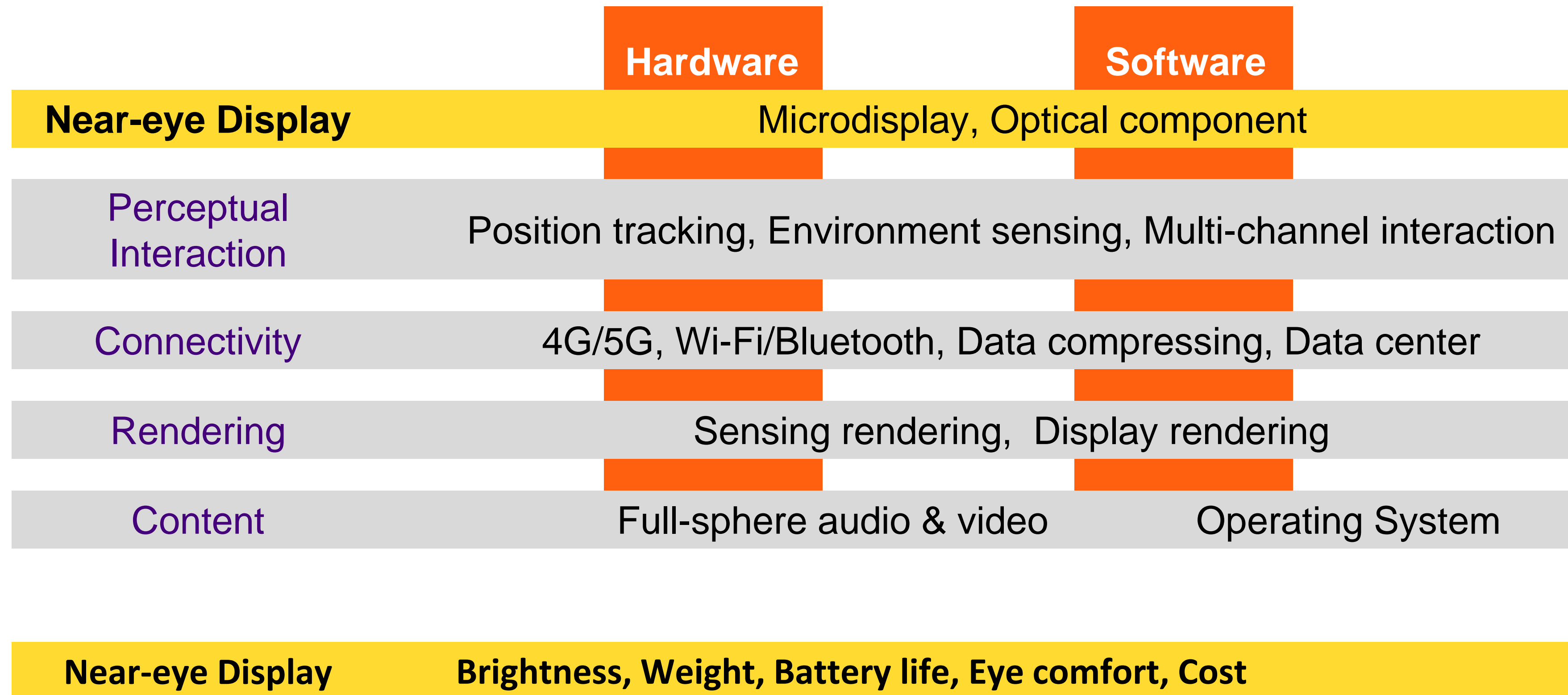
Seamless connection

Always On

Intelligent

Secure

XR technology needs and display challenges



GF[®] technology is enabling XR hardware

Cellular front-end module

8SW
45RFSOI
22FDX™

Transceiver

12LP RF



Cellular front-end module

8SW, 7SW

Transceiver

12LP RF

Power Management

180 BCDLite[®]



Audio amplifier

55 BCDLite



Wi-Fi front-end module

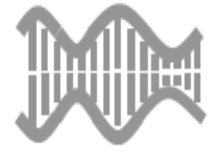
8SW, 7SW

SiGe PA



3D sensing

22FDX, ToF, SPAD
Radar, Lidar



Wireless charging

130 BCDLite



Haptic sensing (voice/touch/gesture)

55 BCDLite



Display driver

55/40/28HV, 22FDX
LCOS, OLED, microLED



Microdisplay technologies all have pros & cons

	LCOS	OLED	microLED
Brightness	Medium	Low	High
Contrast ratio	Low	Excellent	Excellent
Refresh rate	Low	Medium	High
Resolution	High	Medium	High
Power efficiency	Low	Medium	High
Endurance	-10 ~ 85 °C	-50 ~ 70 °C	-100 ~ 120 °C
Manufacturing Maturity	High	Medium	Low

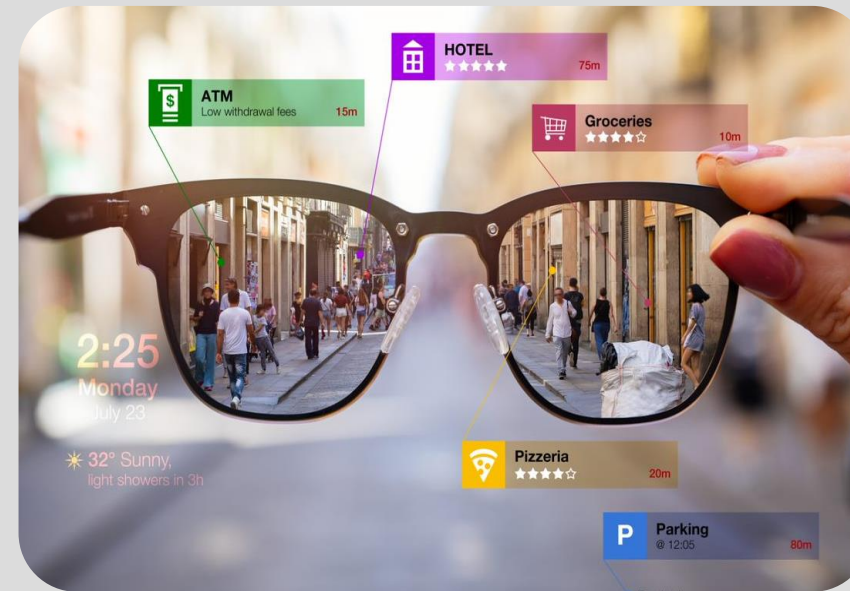
XR display driver IC has unique requirements



VR: Standalone DDIC

Highly integrated source and gate drivers with large display buffer

GF[®] solution in 55/40/28HV



AR: CMOS Backplane

Memory-In-Pixel
Pixel-level driver connection

GF[®] solution in 28/22nm

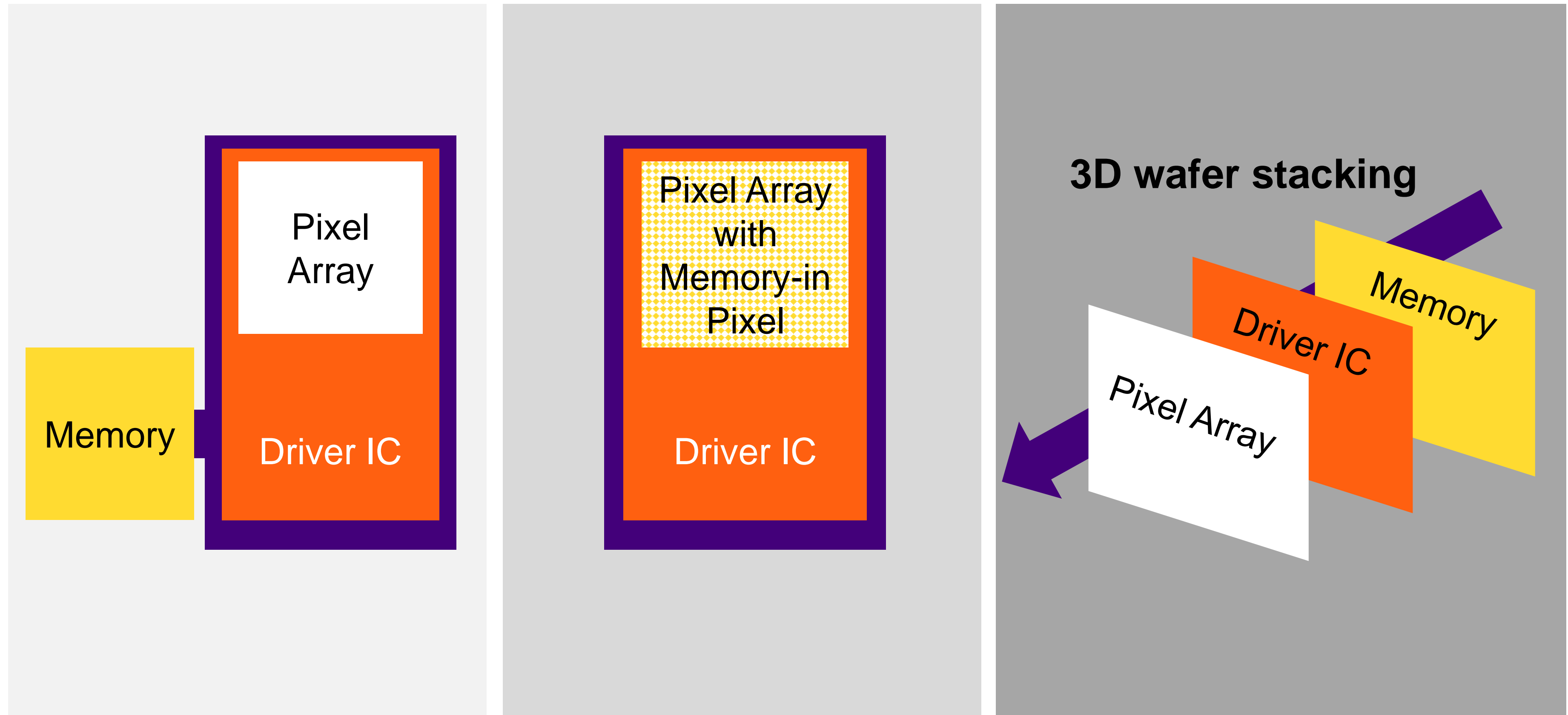


HUD in Car

Automotive qualification requirement

GF[®] solution in 22FDX

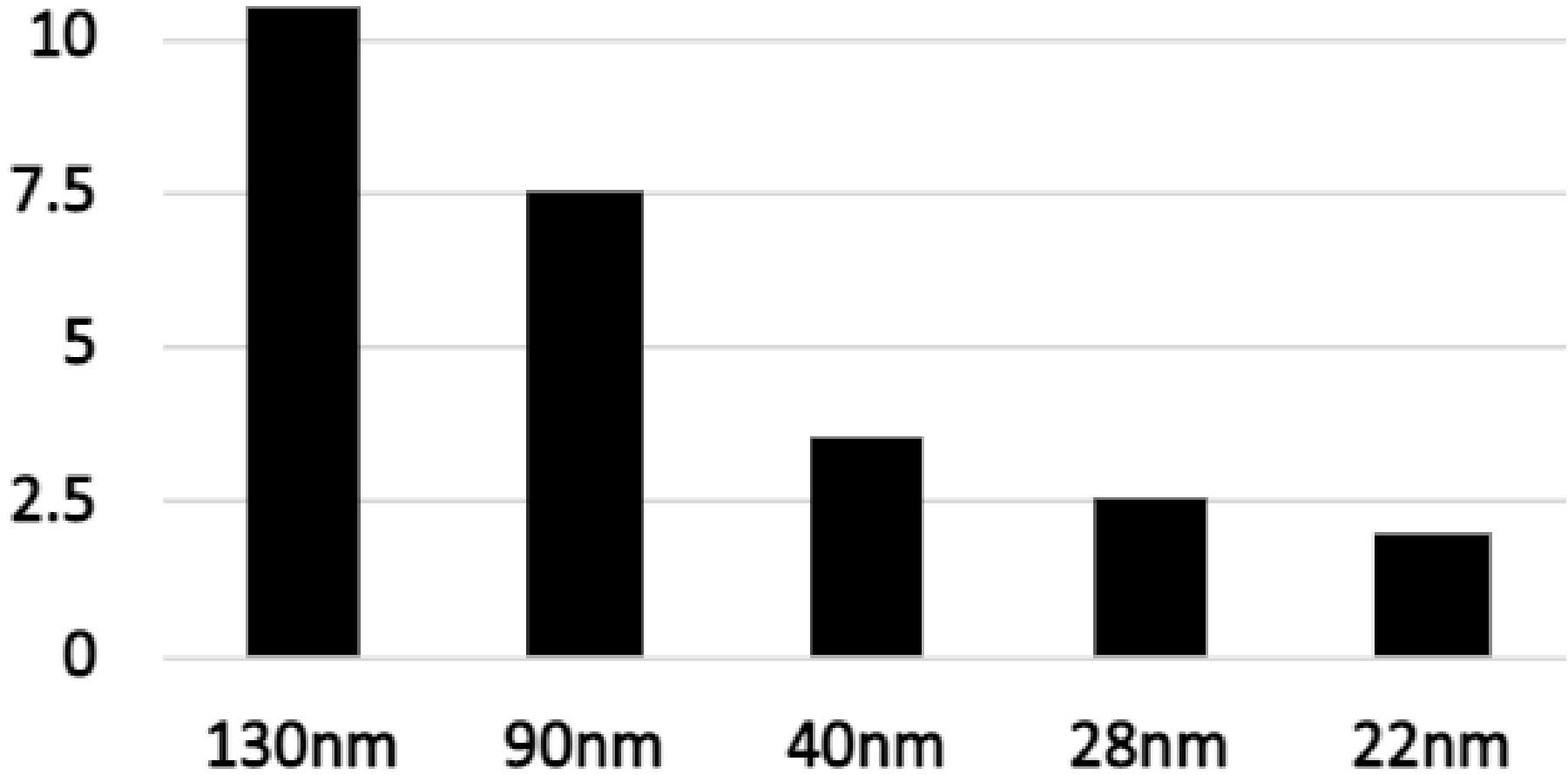
Microdisplay backplane driver architecture



Microdisplay backplane needs CMOS <40nm node

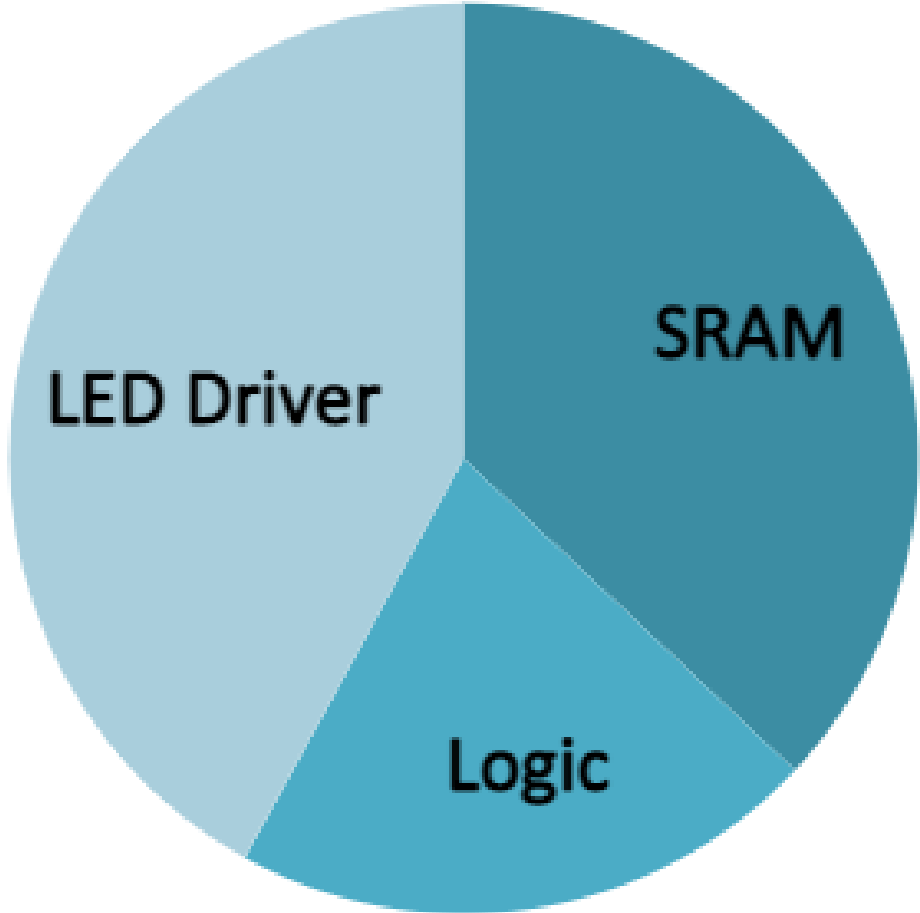
To achieve pixel size <2.5um and 10,000PPI, microdisplay backplane process node needs to be <40nm.

Sub-pixel size estimation (um)



Source: 130-40nm data from Display week 2020 paper Jewoo Seong

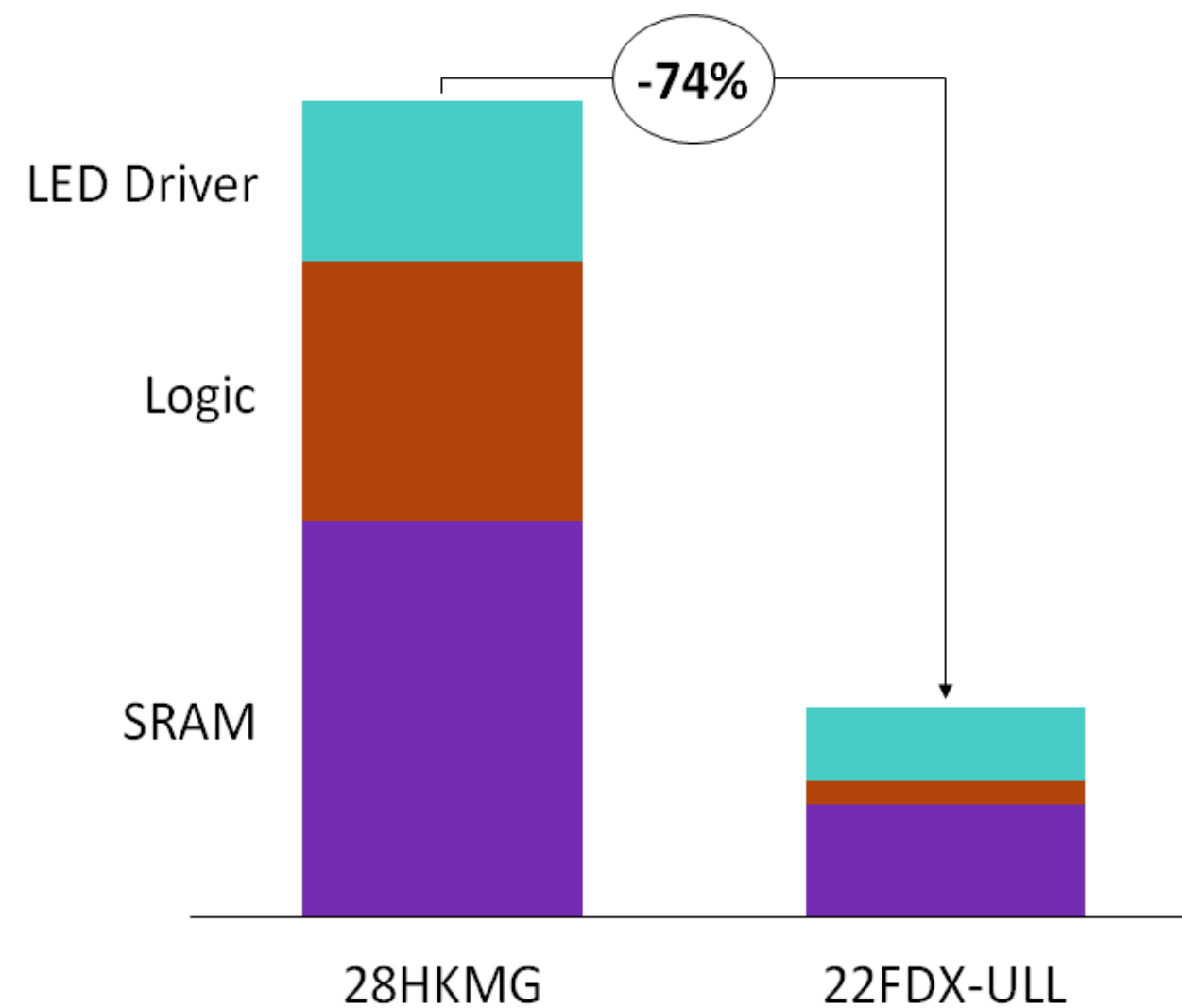
MicroLED backplane pixel area portion with 22FDX™



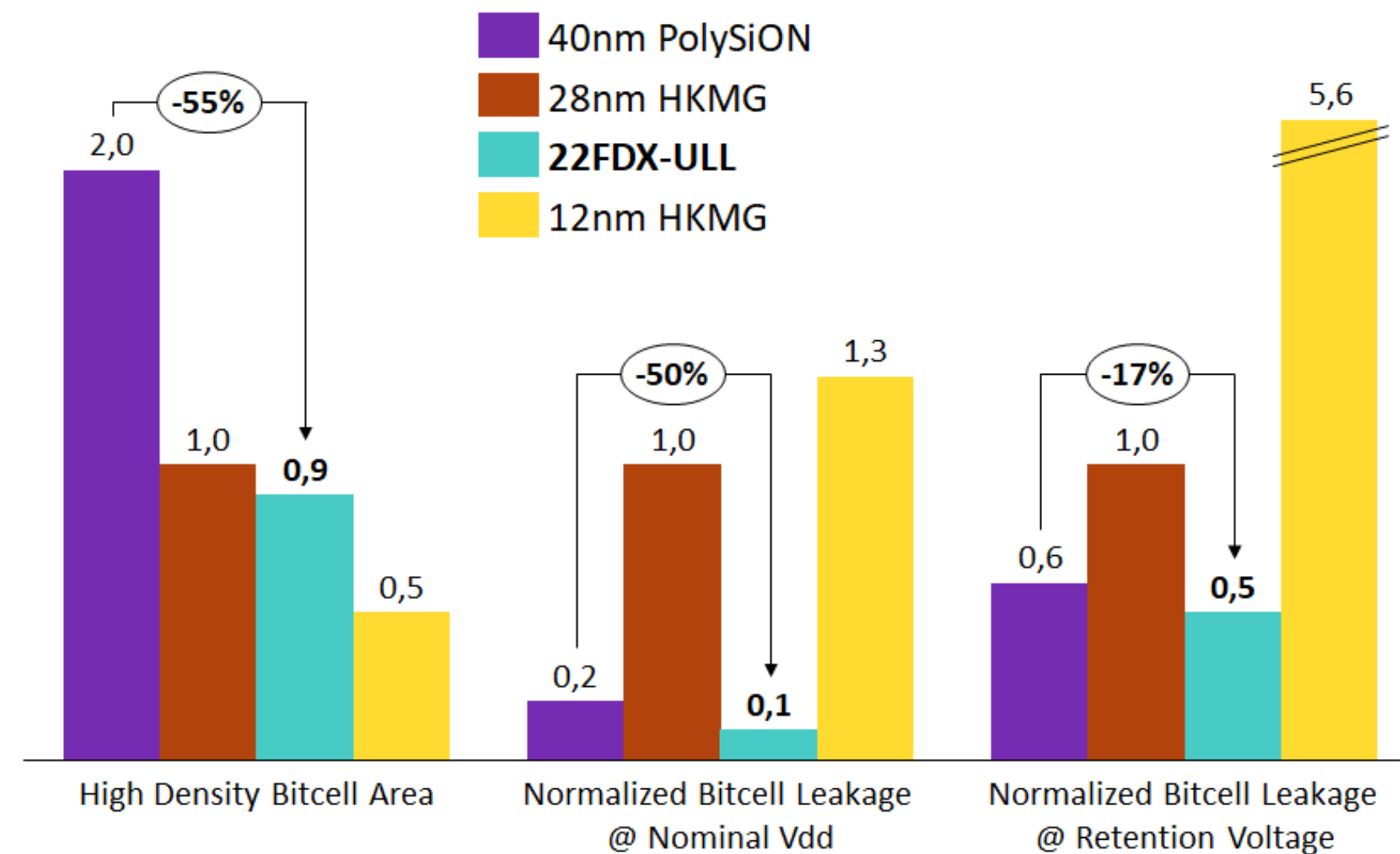
GF[®] 22FDX[™] further reduces microdisplay power consumption to support always-on

GF[®] 22FDX shows leakage reduction comparing to all 40-12nm CMOS technology nodes.

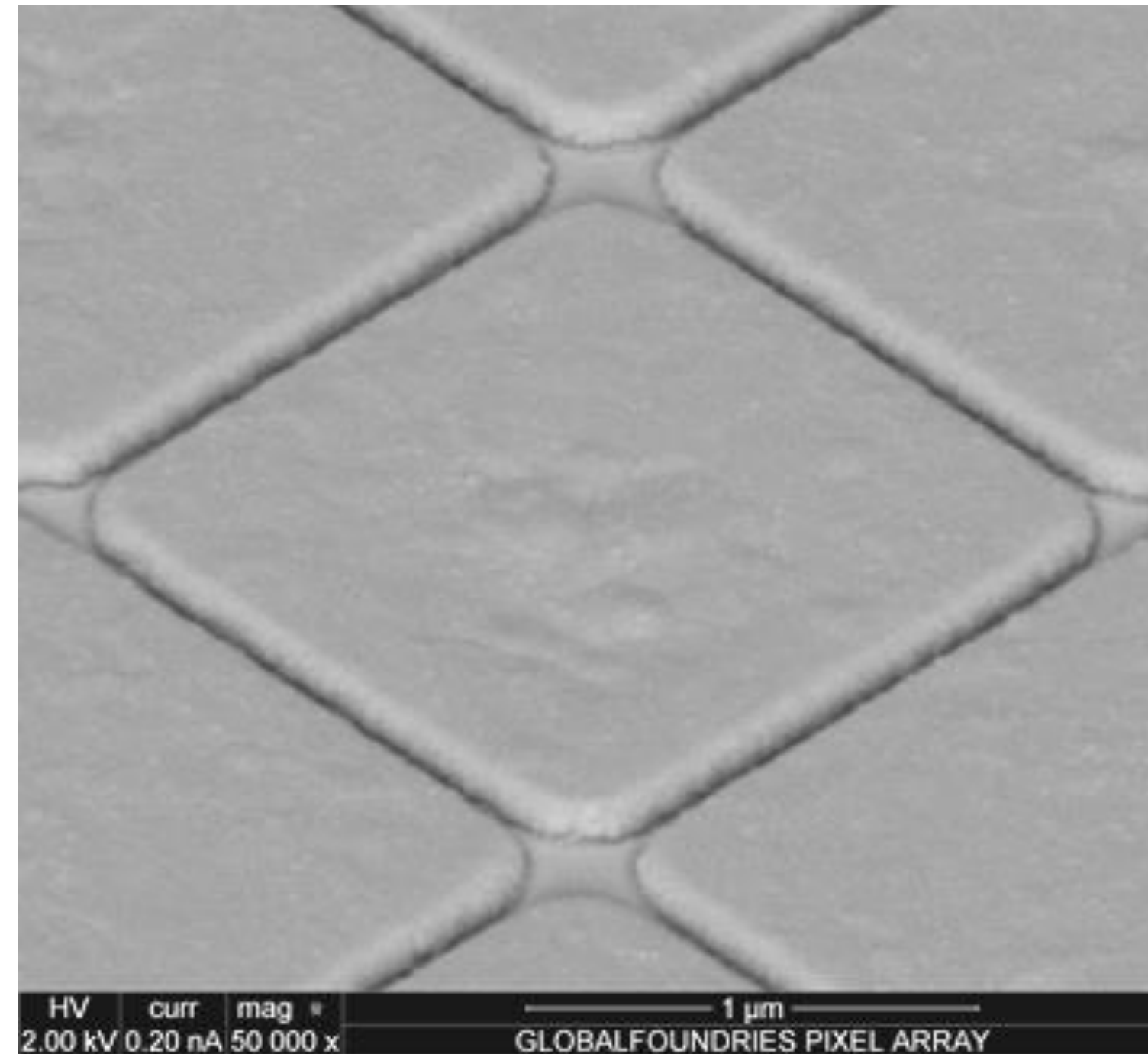
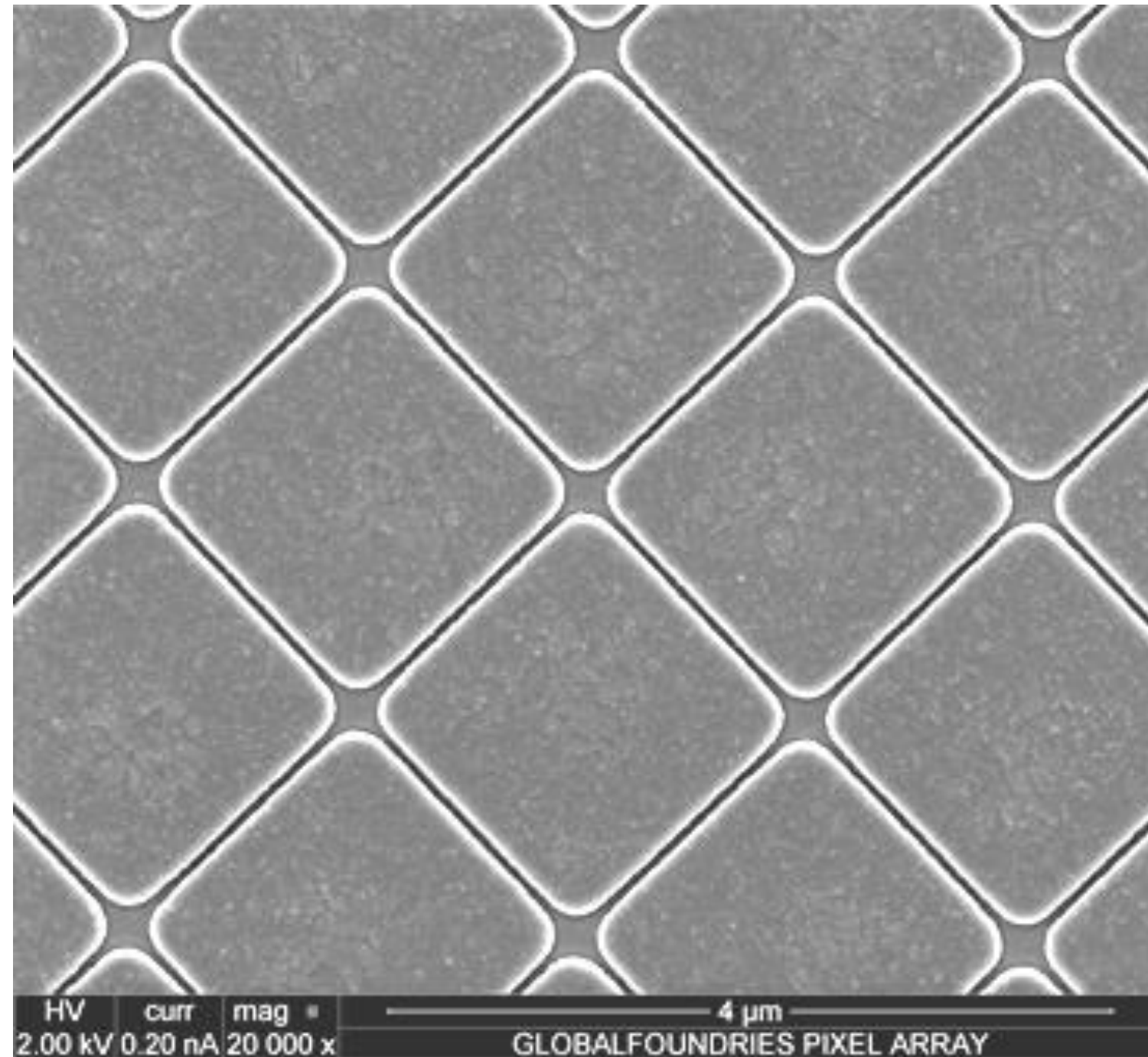
microLED pixel array leakage power



SRAM leakage power 40-12nm



XR display is reaching sub-pixel size <2um.



Let's start to build the future together

Integrator

Foundry

Equipment

Fabless

Materials

IDM

R&D Institute

EDA





Thank You



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