



# **UFS Card Superiorities & Industry Collaboration**

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# 1. Mobile Storage Trend and Industry Support

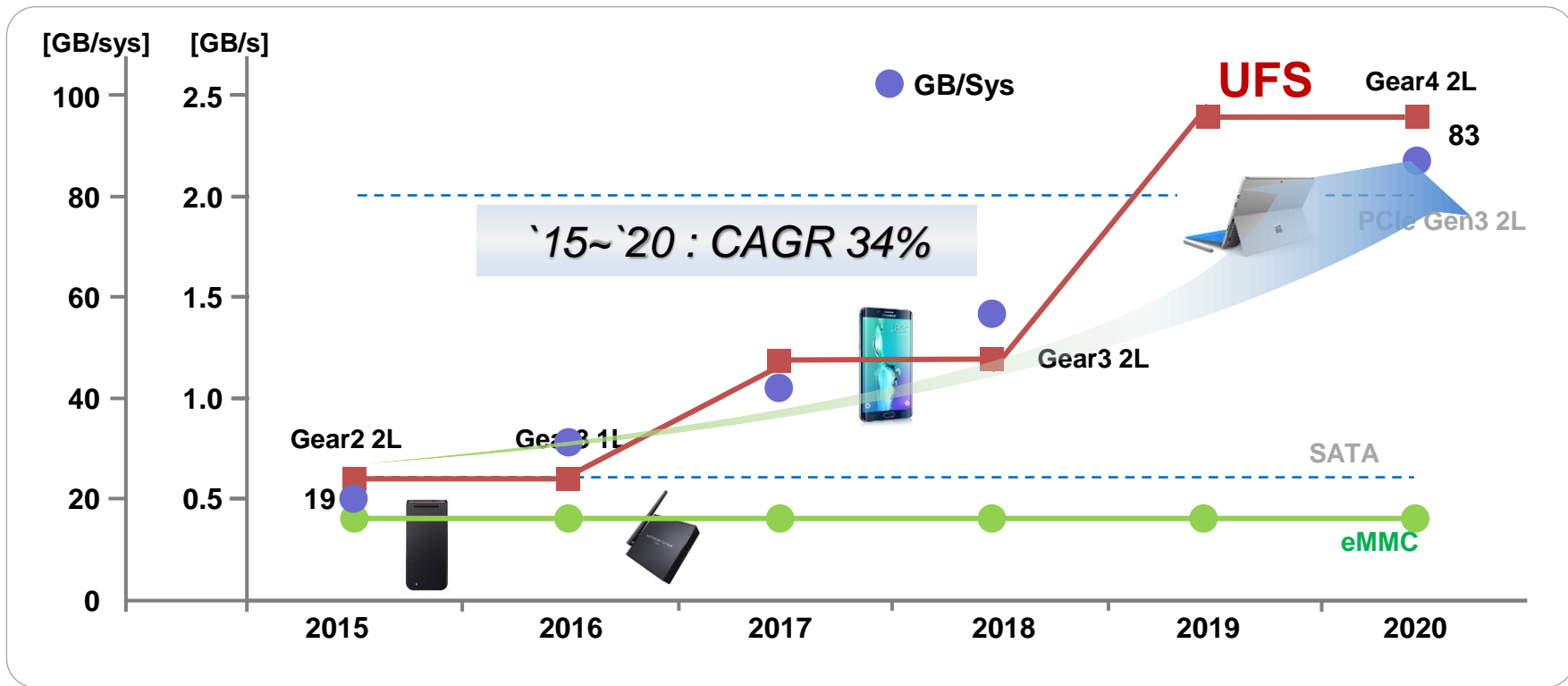
## 2. UFS Card Benefits and Target Applications

## 3. UFS Card ECO System and Vision



# Storage Interface Trend

Mobile storage capacity and interface speed is rapidly increasing

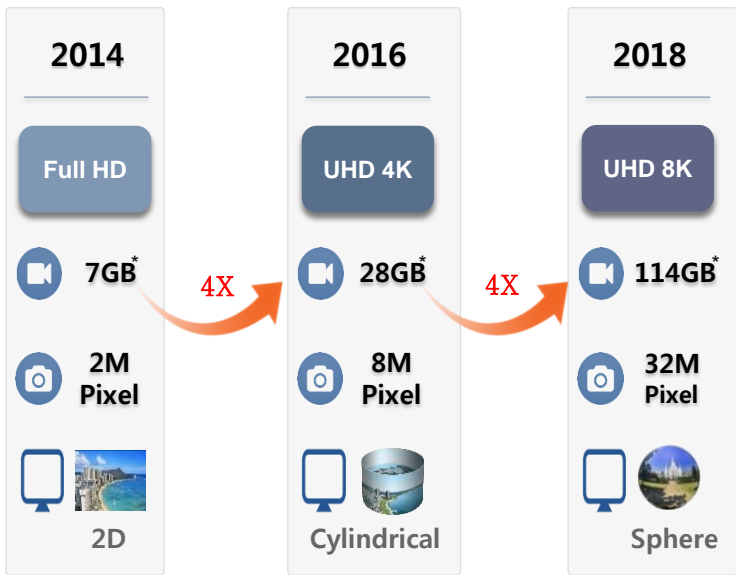




# Factors Driving Higher Density

- High resolution(4K/8K video) requires higher performance external storage

## Content Size



## Sound Quality

	Sound Quality	Storage Requirement
Compressed	MP3 (320Kbps)	9.2 MB
	Original CD (16b/44.1Khz)	49 MB
FLAC	24b/192Khz	338 MB
	DSD128	750 MB
	DSD256	1.4 GB

Note: A red arrow indicates a 150X increase in storage requirement from Compressed MP3 to DSD256.



# UFS New Applications

Flash Memory Summit

■ UFS applications are widely used for diverse purpose

- New IT applications require UFS and UFS Card for external storage as well.





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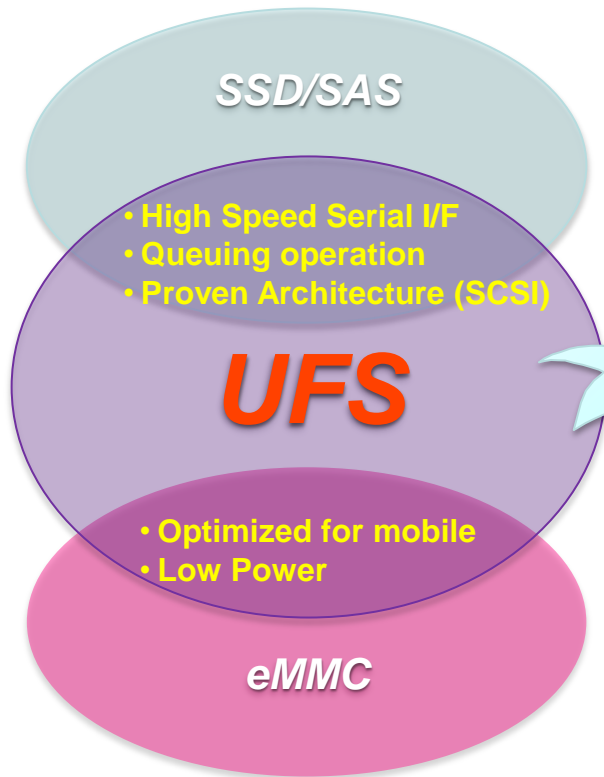
# Why we need UFS/UFS Card?



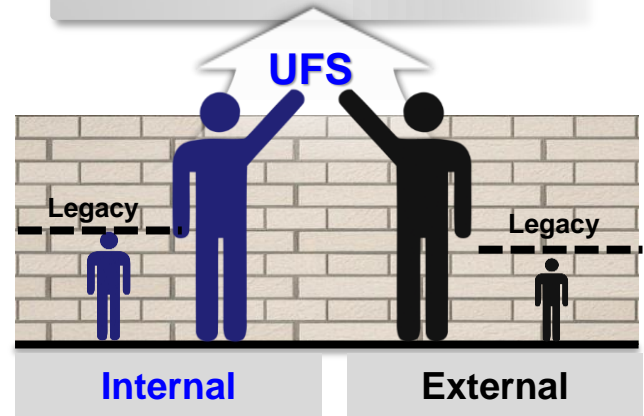


# Storage Integration

■ **UFS** = merits of **eMMC** (Low Power) + **SSD** (High Speed + SCSI protocol)



Overwhelming limitations  
 Encourage new applications  
 More entertainment stories





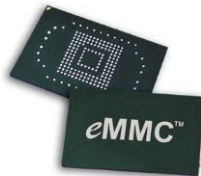


# Unified Storage Interface for Mobile



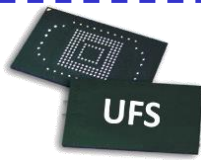
**Embedded Storage**

*Low speed Parallel, Sync IO*



eMMC

**NOW**



eUFS

*High Speed Serial, Advanced Async IO*

**External Storage**

*Low speed Parallel, Sync IO*



Legacy Card



UFS Card

*High Speed Serial, Advanced Async IO*

**One Interface → UFS!!**

*Royalty Burden High*

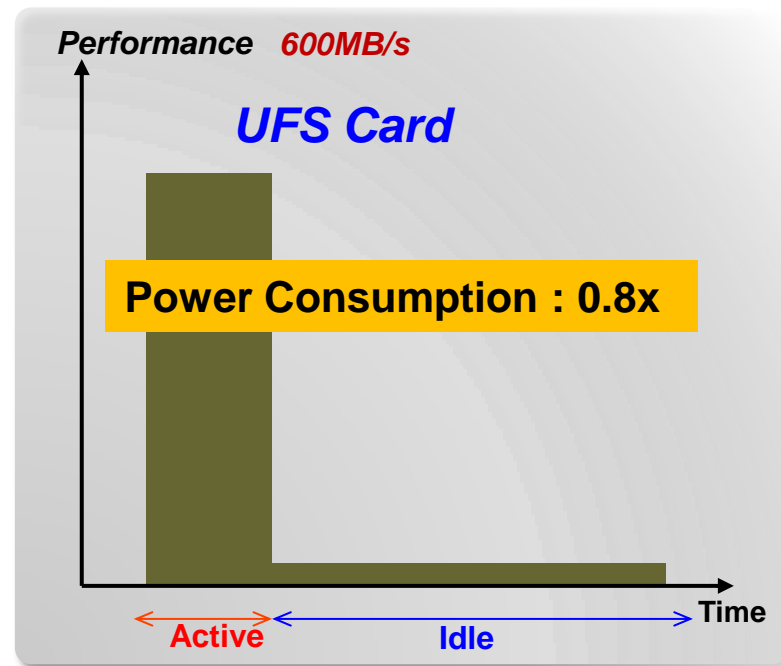
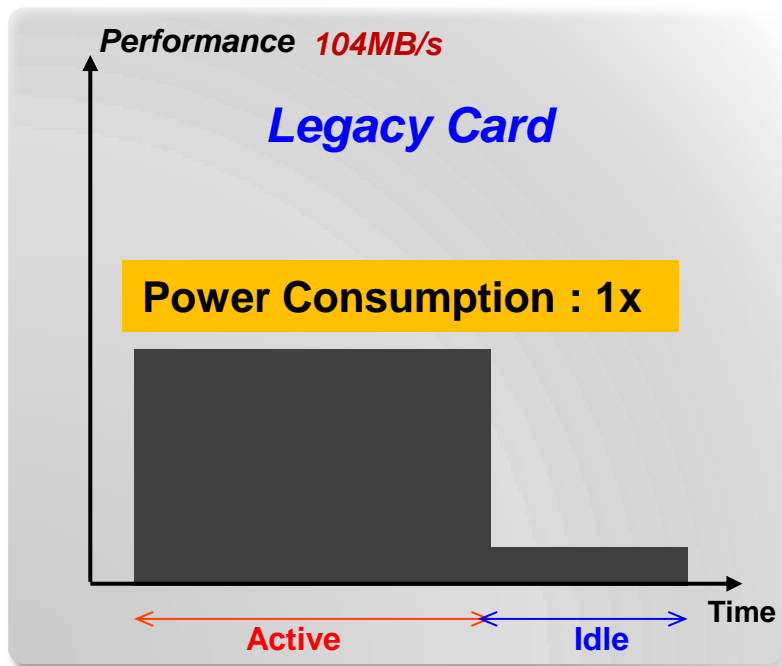


*Samsung's design F/F disclosed as RAND in JEDEC*



# UFS Card Benefit : Low Power

- UFS Card - High Performance(x6) & Lower Power(x0.8) than Legacy Card
  - UFS Card(max. 2.37W), Legacy Card(max. 2.88W)





# UFS Card Benefit : Performance

■ **Multiple applications running in parallel** would unveil better UX of UFS Card

## Movie File Transfer

➤ 1.36GB file copy (@ **USB2.0**)



79

61

28%

\*Lower is better

Legacy

UFS Card

Transfer Time (s)

➤ 1.36GB file copy (@ **USB3.0**)



79

8

425%

\*Lower is better

Legacy

UFS Card

Transfer Time (s)

## Photo Thumbnail

➤ 630 pics loading



15

10

43%

\*Lower is better

Legacy

UFS Card

Loading Time (s)

➤ Upload movie + 630 pics loading



26

10

165%

\*Lower is better

Legacy

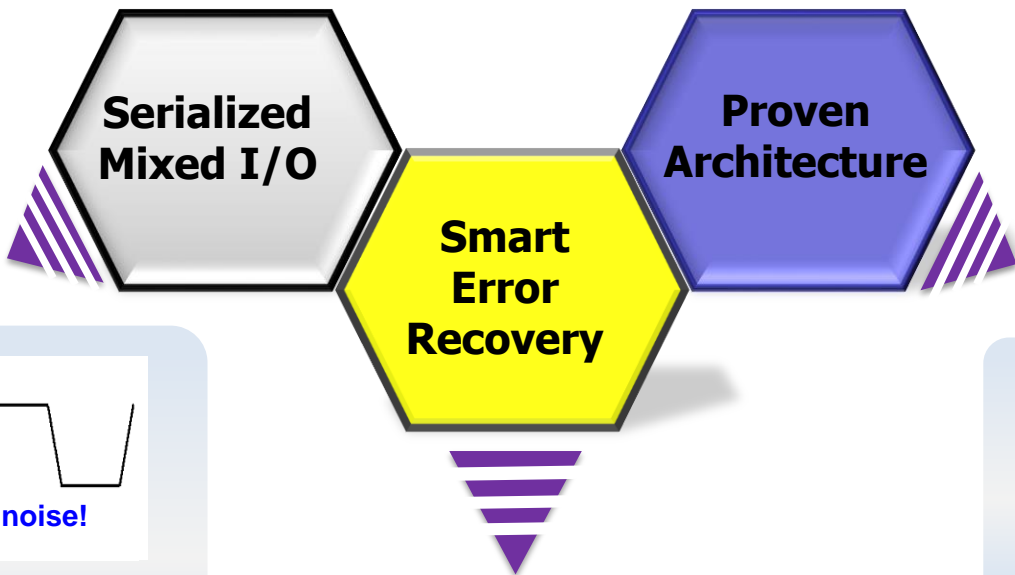
UFS Card

Loading Time (s)



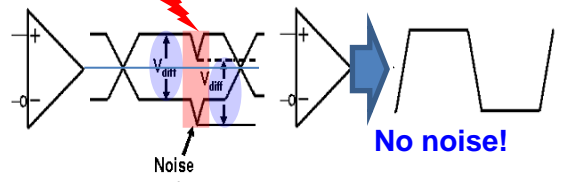
# UFS Card Benefit : Reliability

■ UFS's H/W and S/W architecture ensure higher reliability

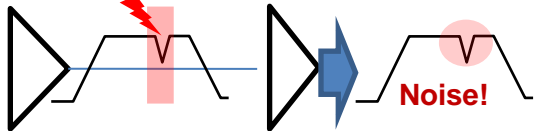


*Strong for Noise*

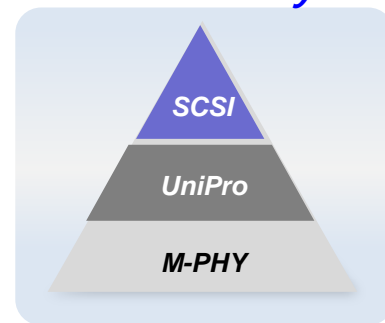
*UFS Card (Serial interface)*



*Legacy (Parallel interface)*



*Key Structure for reliability*



*I/O Error Handling Features*

- H/W Error Detection
- Data Loss Detection
- Fast Error Recovery
- Automatic Retransmission



# UFS Card New Applications

- Multi lens, VR/AR paring, entertainment (game and movie)

## Multi Lens



*360° around*  
*Wide View*  
*High resolution*



## Augmented Reality



## VR / Game / Movie





# Why we need UFS Card?

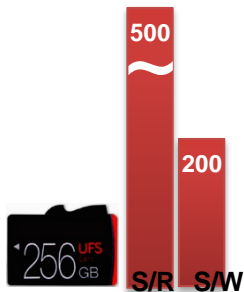
- Industry requires faster & high quality storage device

## Single camera Throughput

- Throughput Coverage
  - Legacy card << UFS Card



VS




Resol.	Pixel (M)	Color depth	fps	No Comp. (MB/s)	Compression (MB/s)		
					1/10	1/15	1/20
4K	8	24	30	720	72	Legacy	36
	8	24	60	1440	144	96 UFS	72
	8	24	90	2160	216	144 UFS	108
	8	24	120	2880	288	192 UFS	144

## 360 degree Multi camera for VR

- Multi Cameras, 4K, Over 60fps


• 6 Cameras, 4K, 60fps



High Quality 

- 30F, 10bit Color
- H.264

Need 75 MB/sec

Cinema DNG 

- 60F, 12bit Color
- H.264

Need 144 MB/sec

**Only UFS Card is suitable**



# Evolution of Storage Solution

- IoT, multi lens camera, drone, automotive as well as mobile devices.

Application								
	As-Is	To-Be	As-Is	To-Be	As-Is	To-Be	As-Is	To-Be
Storage Density	4GB	32GB	32GB	256GB	64GB	Over 1TB	256GB	512GB
Embedded Storage	eMMC	UFS	eMMC	UFS	eMMC	UFS	eMMC	UFS
External Storage	Legacy Card	UFS Card	Legacy Card	UFS Card	Legacy Card	UFS Card	Legacy Card	UFS Card



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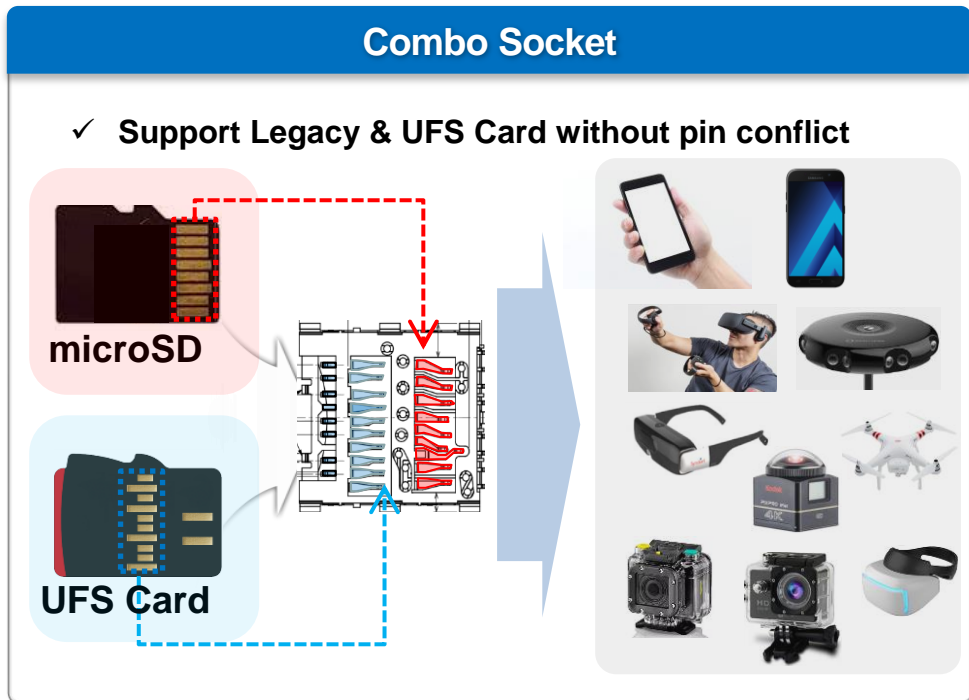
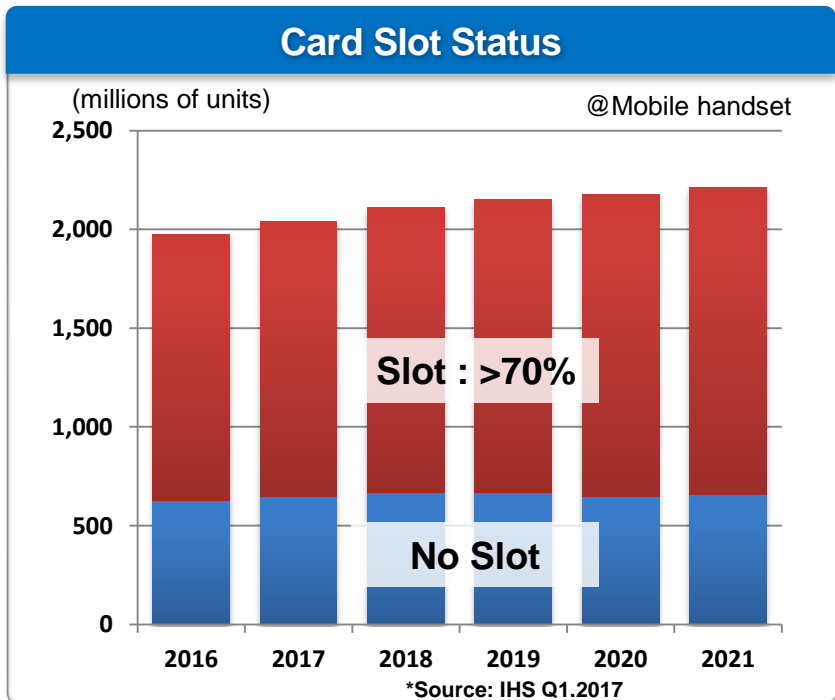






# Combo Socket for Smooth transition

- Card slot adoption rate is continuously increasing in most IT products
  - Smooth transition to combo socket is ready for various applications

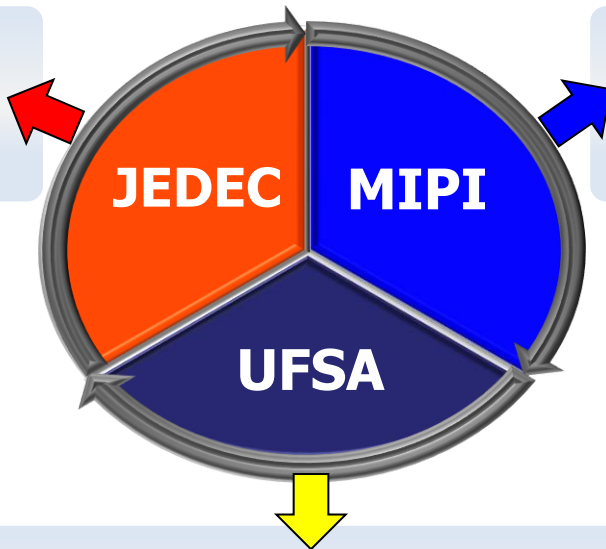




# Collaboration in Standard

- UFS Card technology is supported by three standard organizations

- eUFS spec
- UFS card spec
- UFS command test spec



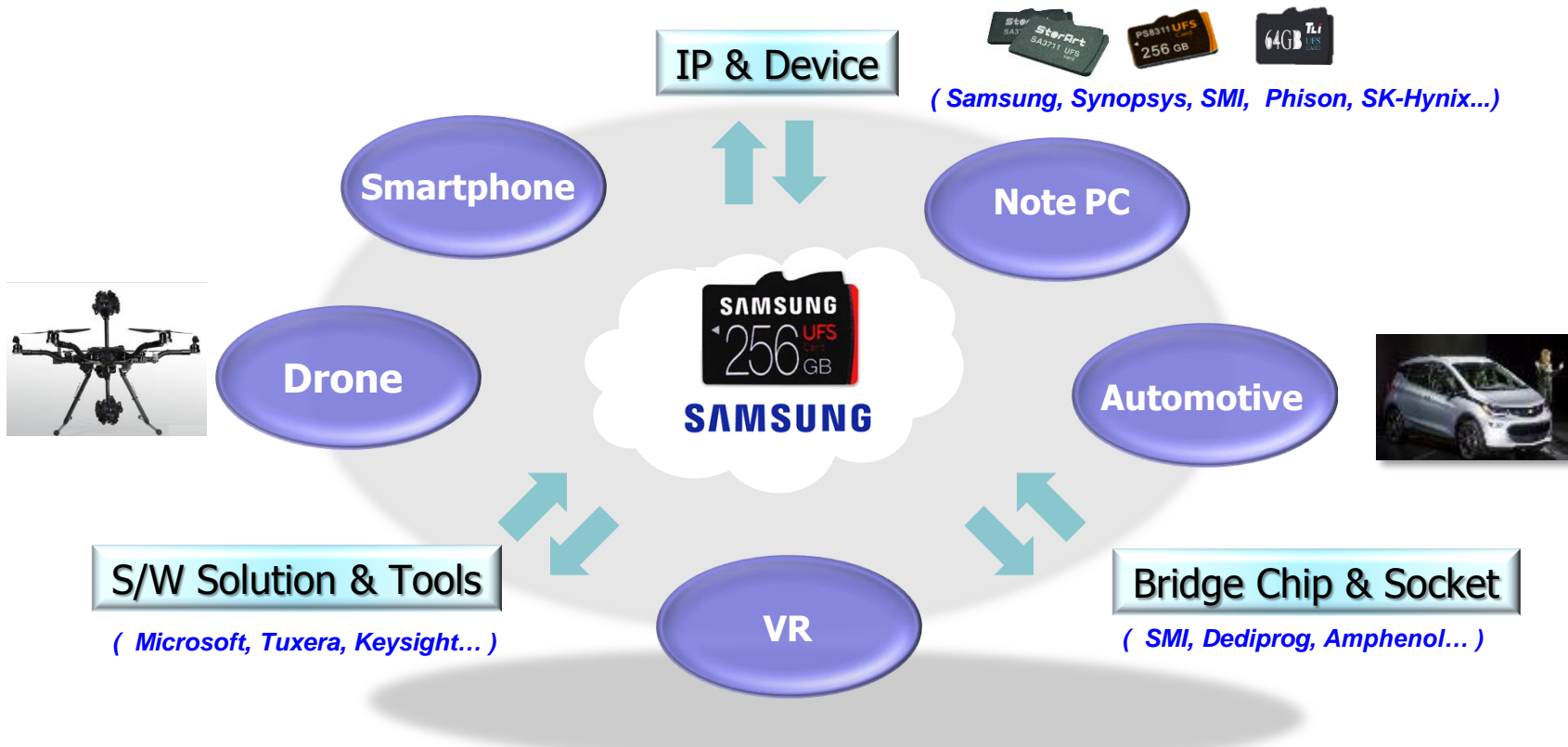
- MPHY Spec
- Unipro Spec
- Unit CTS

- Compliance test spec
- Marketing & Logo program



# UFS Card Ecosystem

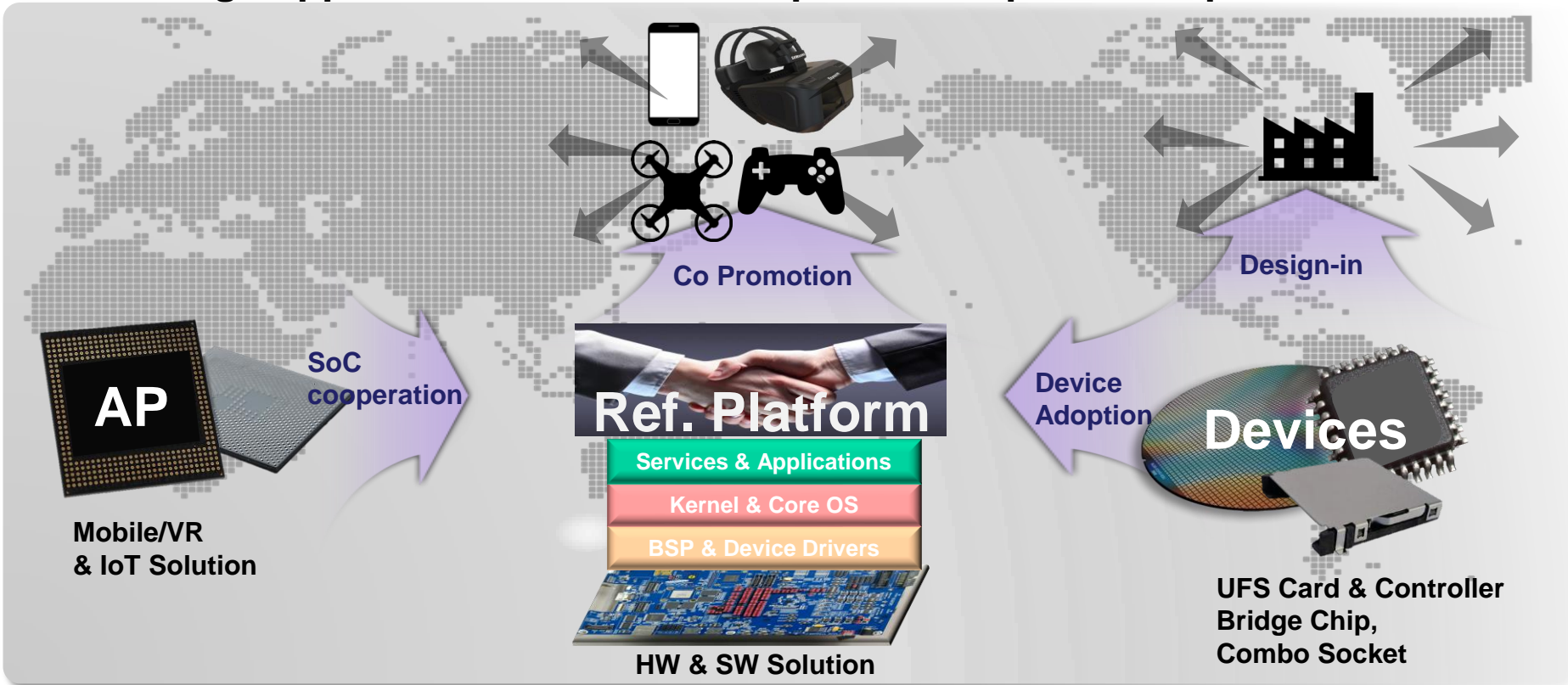
- Eco building is done. Samsung is willing to support UFS Card ecosystem





# Open Innovation & Value Sharing

## ■ Samsung supports to build UFS Card platform & partnership





# Summary

- Now it's time to support UFS Card. You can be a “market leader”





# THANK YOU