UFS Helps Solve Mobile Storage Challenges

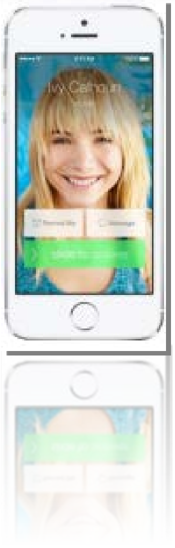
Hezi Saar, Staff Product Marketing Manager

hsaar@synopsys.com

High End Mobile Market Commands Premium and Drives Innovation

- **High end mobile device**
  - Feature-rich smartphones, tablets and laptops
  - Multiple image sensors
  - Very high resolution display

- **High data traffic to the storage device**
  - Data transmission
  - Image, video capture and playback



Mobile Storage: Performance, Capacity, Low Power, Small Footprint, Security

High Performance Efficiency / Responsiveness

Instant ON → Instant Play

Multi-tasking
Multi-Processing
Productivity Apps
PC-like Gaming
Fast App Loading/
App Swapping

Low Power Longer Battery Life

Quad/Octa-Core CPU
Multi-tasking
Larger screens
AOAC

High Capacity More Memory

- More Apps, Richer Apps
- HD Video, High Res Photos
- 3D Graphics/4K Content

Security / Reliability

New Security Challenges

- Robust Memory
- Enterprise/BYOD
- Mobile Shopping

Small Package Thinner is Better

- High Capacity in Small Form Factor
- Small & Slim Pkg: Z-height is Key

Battery Capacity not Keeping Up with Advanced Performance and Features

	2010		2020	(Growth compared to 2010)
Cellular Bandwidth	2~5Mbps	→	50~100Mbps	x20
Ba				
Re				
Video Resolution	720p H.264	→	4Kp H.265	x34
Battery capacity	5.76W/h	→	13W/h	x2.2

Key Mobile Memory Requirements

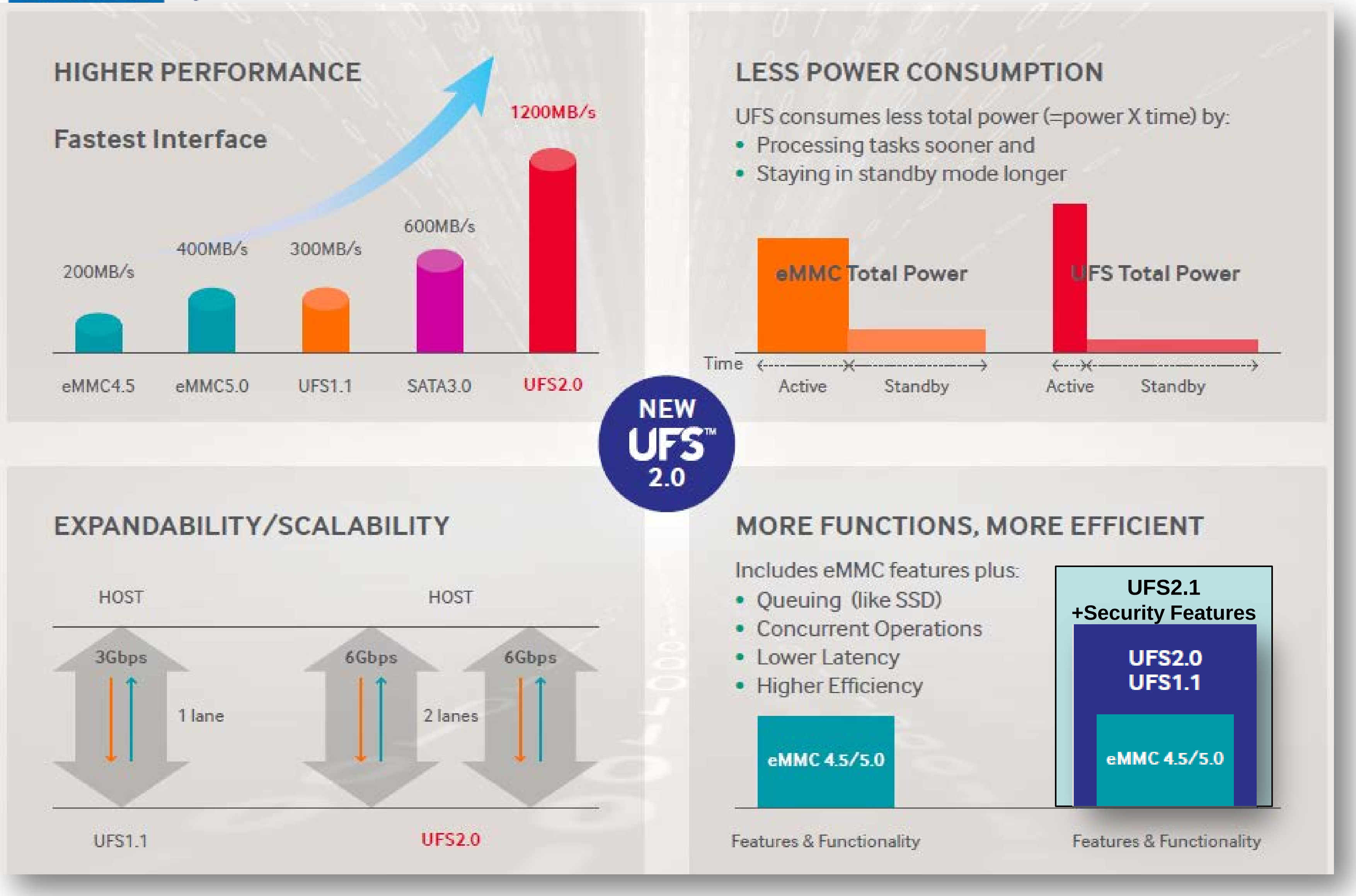
→ Faster Performance & More Capability

→ Maintaining Low Power Consumption

Source : ARM

JEDEC UFS v2.0 Benefits

Higher Performance, Lower Power, Scalable



HIGHER PERFORMANCE

Fastest Interface

LESS POWER CONSUMPTION

UFS consumes less total power (=power X time) by:

- Processing tasks sooner and
- Staying in standby mode longer

EXPANDABILITY/SCALABILITY

MORE FUNCTIONS, MORE EFFICIENT

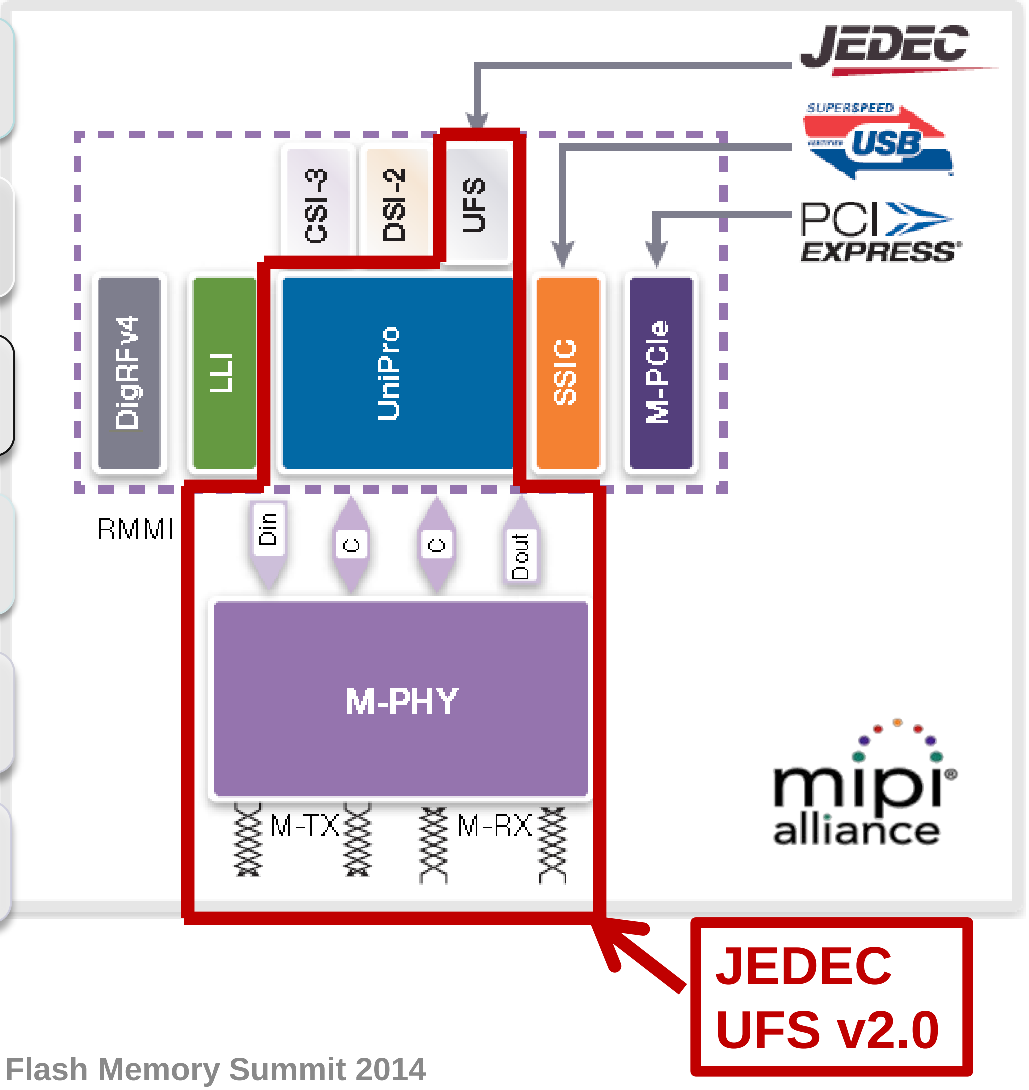
Includes eMMC features plus:

- Queuing (like SSD)
- Concurrent Operations
- Lower Latency
- Higher Efficiency

MIPI M-PHY “Mobile Friendly”

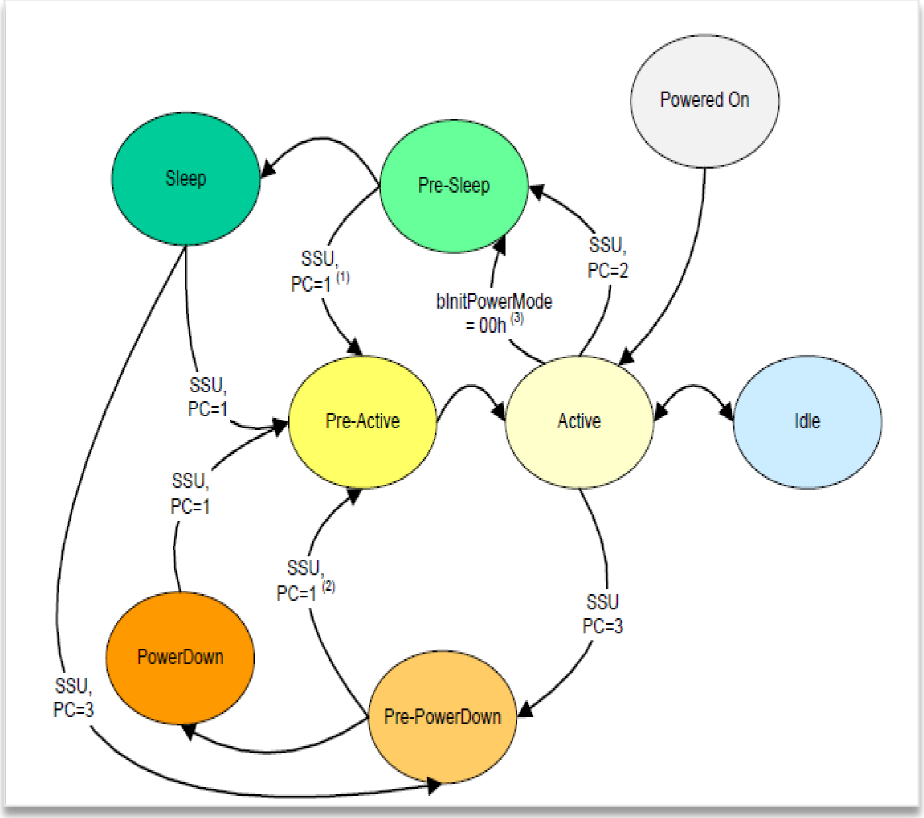
Reduce Power, Scalable, Multiple Protocols

Variety of speeds	•High- and low-speed modes
Low power	• Many power saving states
Very fast transitions	• To and from power saving states
No training sequences	• When entering HS-Burst
Architectures can be modified	• Coherent activity to reduce total system power
M-PHY “mobile friendly”	• Less pins, low EMI, low active and standby power, low latency



JEDEC UFS v2.0

UFS Power Mode State “Machine”



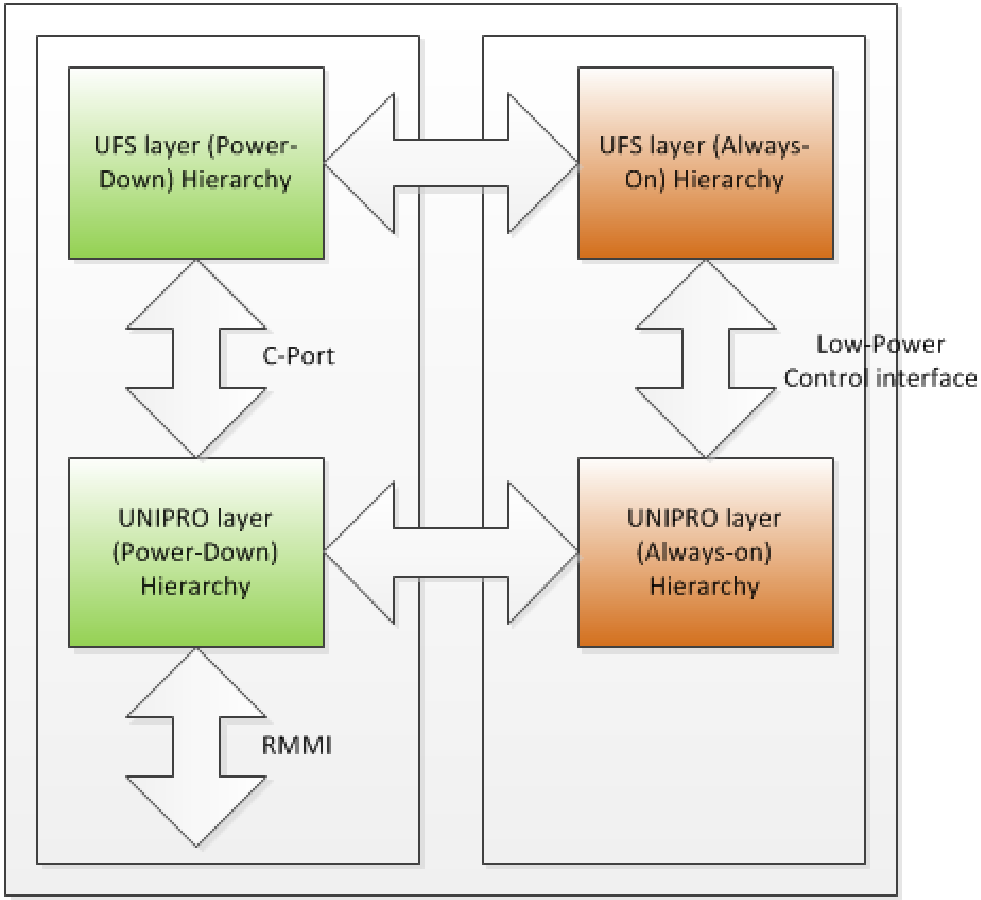
UFS Power States

- **MPHY low power states**
  - HIBERN8
  - STALL
  - SLEEP
- **UniPro low power states**
  - HIBERN8
  - SLEEP
- **Further hooks**
  - DEEP SLEEP
  - DEEP STALL

Additional Power Savings with Low Power Features and Techniques

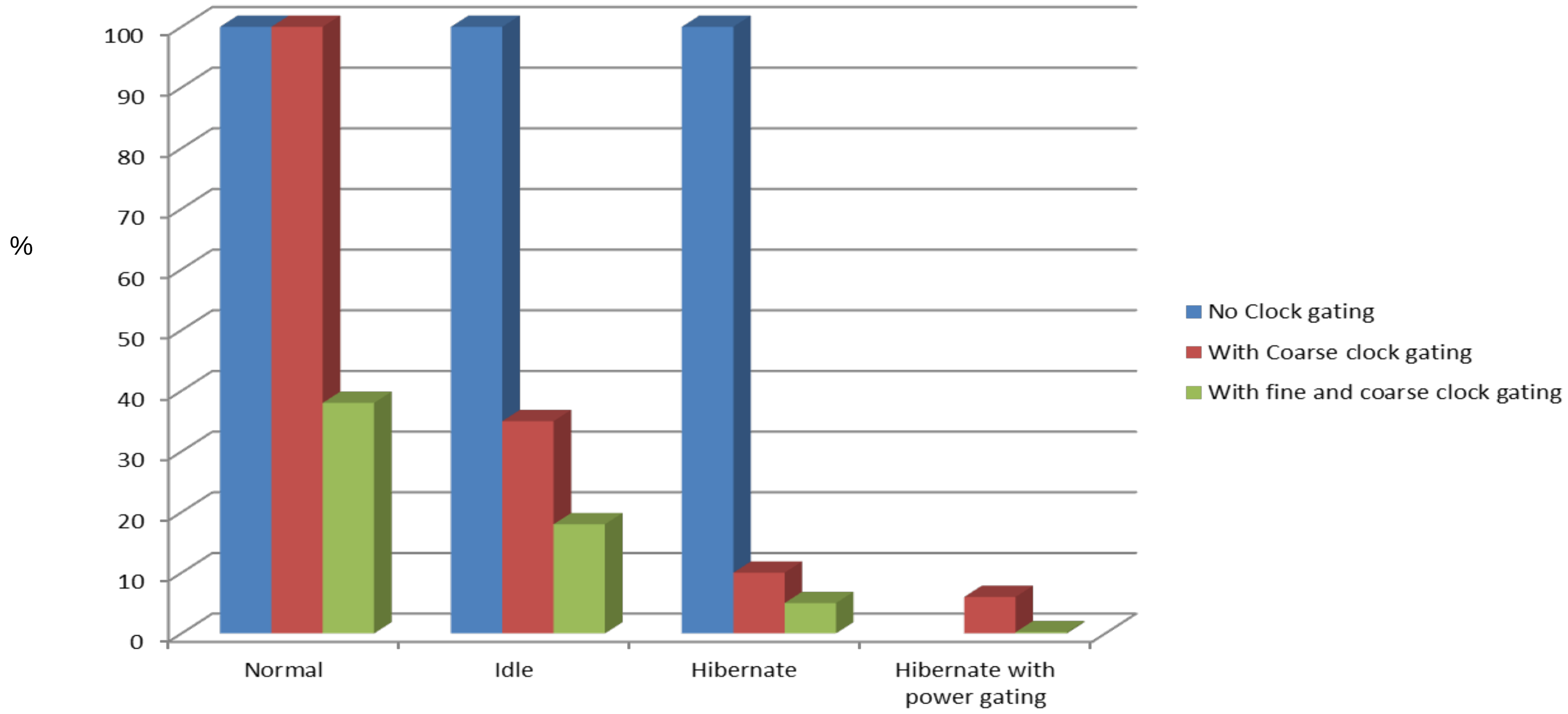
- **Clock Gating at various functional levels**
  - Reduces the dynamic power
- **Power Gating – Multi power rails**
  - Reduces the leakage power
  - Deep power saving in Hibernate power state
  - Only a small portion of the entire UFS Controller hierarchy will be on ‘Always-On’ Power Domain; Rest of the core can be switched off

Multi Power Rails Implementation


UFS layer (Power-Down) Hierarchy
UFS layer (Always-On) Hierarchy
C-Port
Low-Power Control interface
UNIPRO layer (Power-Down) Hierarchy
UNIPRO layer (Always-on) Hierarchy
RMMI

- **Always On Domain:** Modules in this power domain are not switched off in Hibernate
- **Power-Down Domain:** Modules in this power domain can be switched off in Hibernate
- **Power Domains are well mated** to the UniPro and M-PHY layers

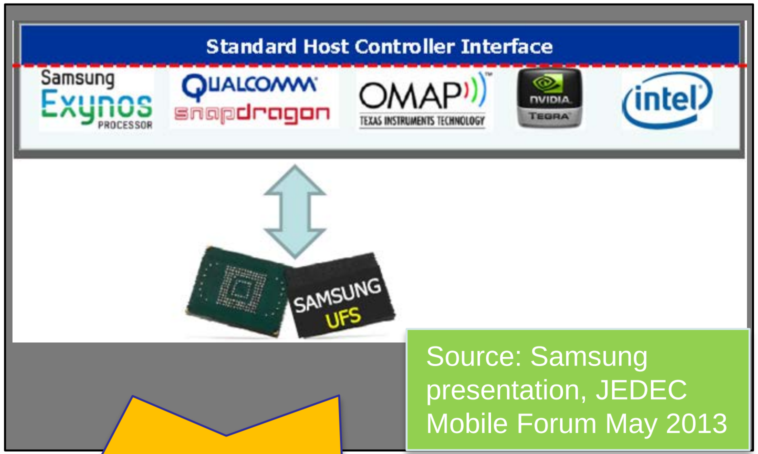
Power Savings Achieved – Few Examples



The numbers are normalized values with respect to Normal mode without any power saving technique applied

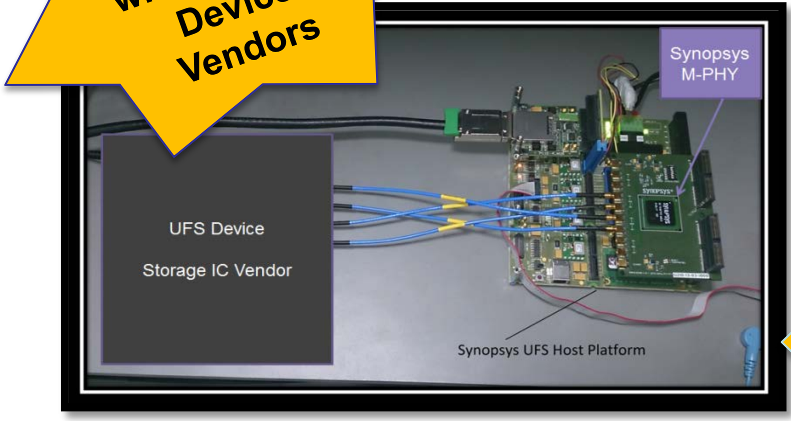
DesignWare UFS v2.0 for Mobile Apps

Future Proof, Interoperable Host & Device Solution



Source: Samsung presentation, JEDEC Mobile Forum May 2013

Proven Interoperability with Multiple Device Vendors



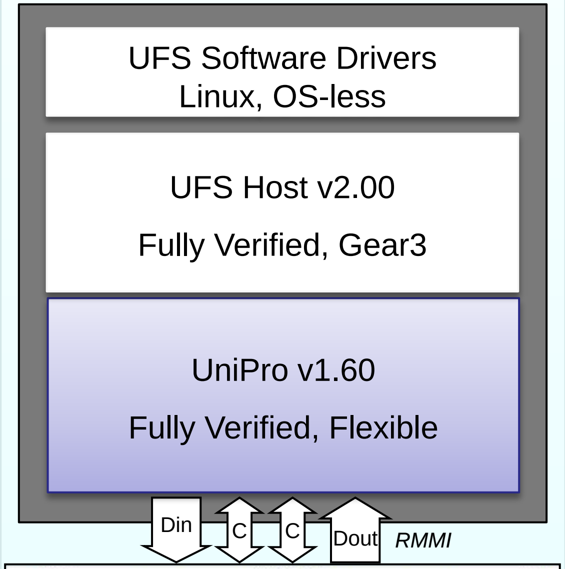
Future Proof M-PHY, UFS IP

Power Modes

Compact and Configurable

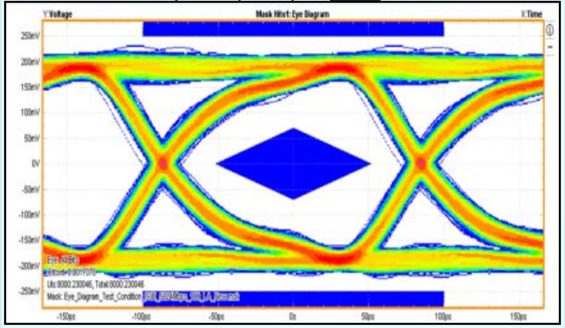
Host and Device Customers

Prototyping System Deployed


UFS Software Drivers
Linux, OS-less

UFS Host v2.00
Fully Verified, Gear3

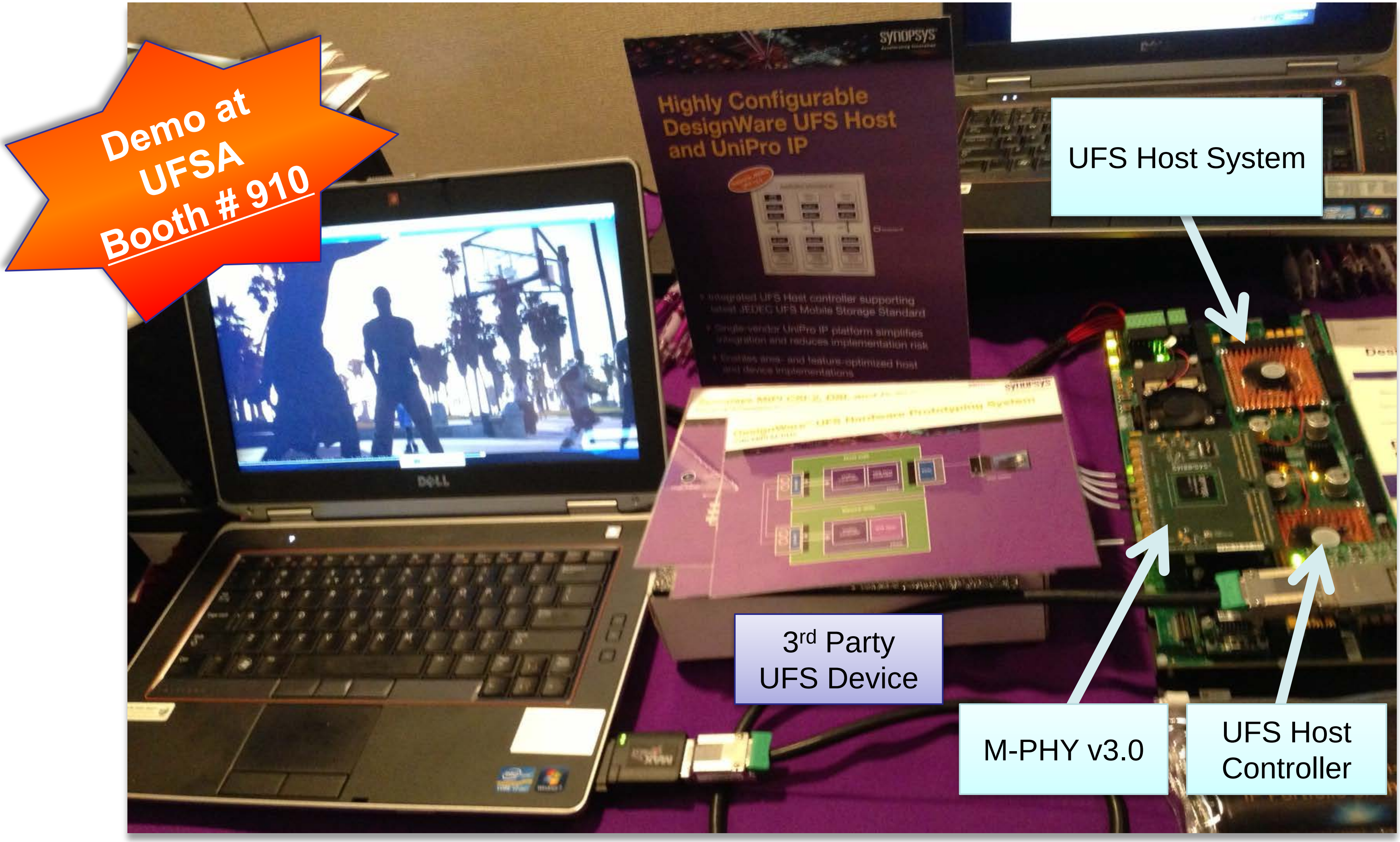
UniPro v1.60
Fully Verified, Flexible



Silicon-Proven M-PHY HS-Gear3 B

Synopsys UFS Host Solution in Action

Reads HD Video Stream from UFS Device and Plays on PC



Demo at UFSA Booth # 910

UFS Host System

3rd Party UFS Device

M-PHY v3.0

UFS Host Controller