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DEVCON

Jongshin Shin
VP, Samsung Electronics Co.

MIPI ALLIANCE
DEVELOPERS
CONFERENCE

19 OCTOBER 2018
SEOUL

MIPI.ORG/DEVCON

SAMSUNG

MOBILE TECHNOLOGY FOR THE SMART WORLD

Jongshin Shin, Samsung Electronics

NEXT STEP FOR THE SMART WORLD

AI / Deep Learning

Machine Intelligence
on Various Devices

5G Network

High Speed, Low Latency,
Massive Number of Connections

Smart Mobility

Autonomous Driving
Cars, Drones and more

INTELLIGENCE ON THE DEVICES

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AI/Deep Learning for Wide Industries

Realized by Semiconductor Technologies

Technologies

Intelligent Image Processing

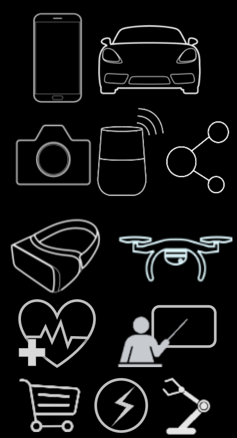
Face/Voice Recognition

Natural Language Processing

Personal Assistance

Pedestrian/Object Detection & Recognition

Autonomous Operation based on Deep Learning



Requirement

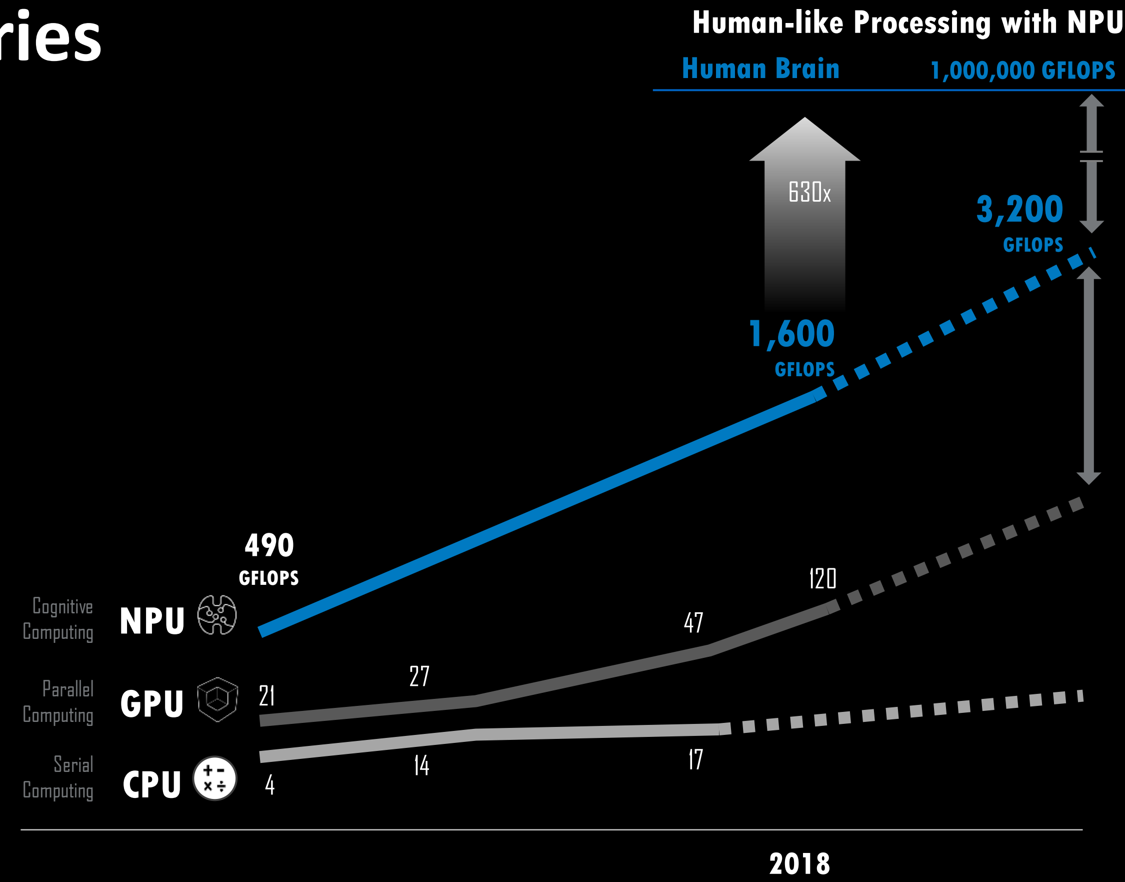
Huge Data Processing

High Speed, Low Latency

Low Power Consumption

Optimized Learning Algorithm

High Resolution Sensors



5G NETWORK

The Mass Connected Era

Inspires creativity in all connected dots

5G

2018	2019	2020
3GPP 5G NR Phase 1 Standard Release	Commercial Device & Service Release	5G NR Commercialization

Enhanced Mobile Broadband
Ultra Reliable & Low Latency
Massive Machine Type Communication

5G Mobile Subscriptions to Reach 1 Billion by 2023

(Ericsson Mobility Report, Nov.2017)

AUTONOMOUS MOBILITY

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The Future Mobility is Near

Powerful Processing

< 10TOPS ▶ 100TOPS+

ADAS Level 2 — Simple Driving Support ▶ ADAS Level 5 — Autonomous Driving

Low Latency with 5G Connection

< 50ms ▶ 1ms

4G LTE ▶ 5G NR

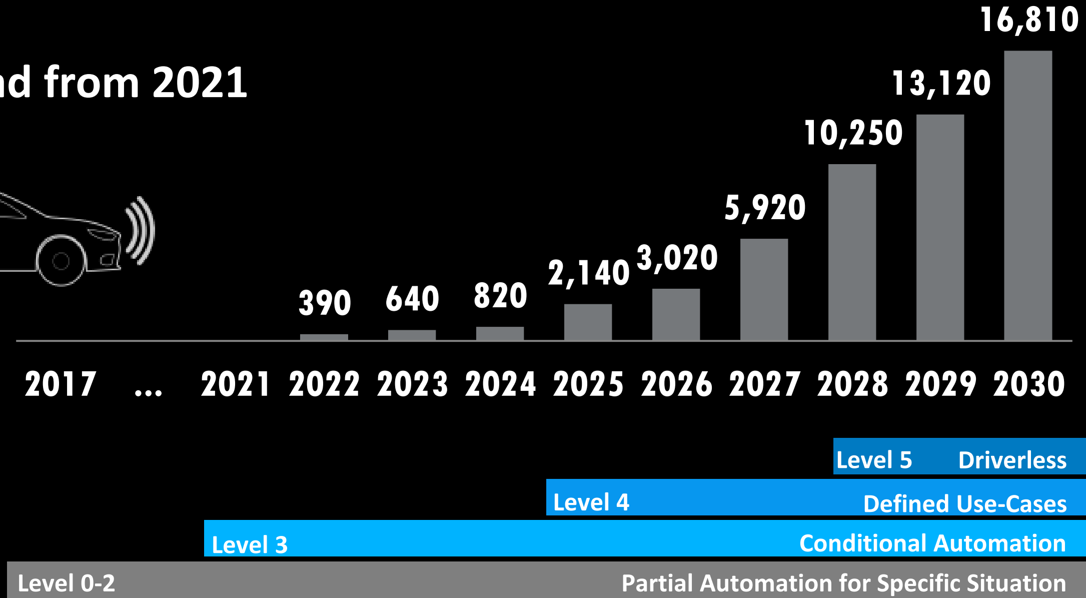
Higher Level Security

Biometric Authentication and Data Encryption

Systems and Supply Chain Data Protection

Level 3 Autonomous Vehicles on the Road from 2021

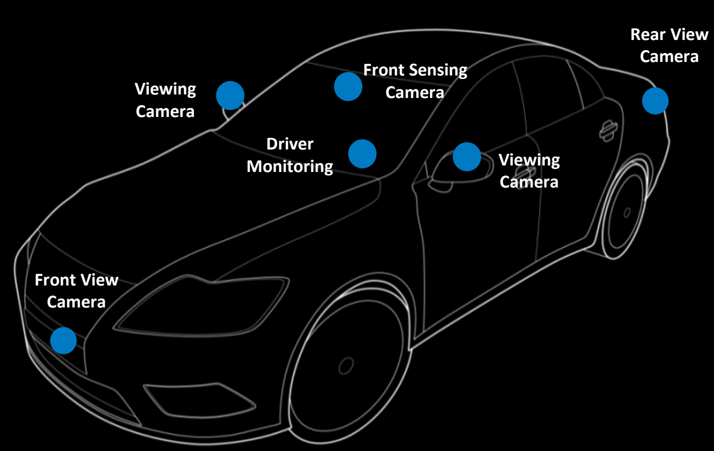
Autonomous Vehicle Market (K units)



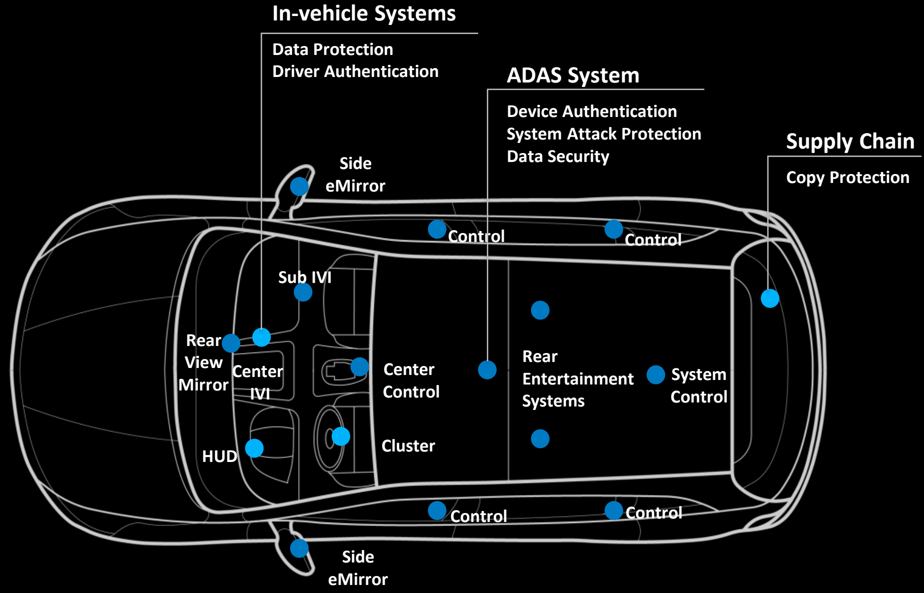
(Experts interview, BCG analysis)

AUTONOMOUS MOBILITY

Cameras, Displays and Security Systems for the Future Autonomous Mobility



Cameras for
ADAS/Autonomous Driving



Displays and Security Systems for
Driving, System Control and In-vehicle Entertainment

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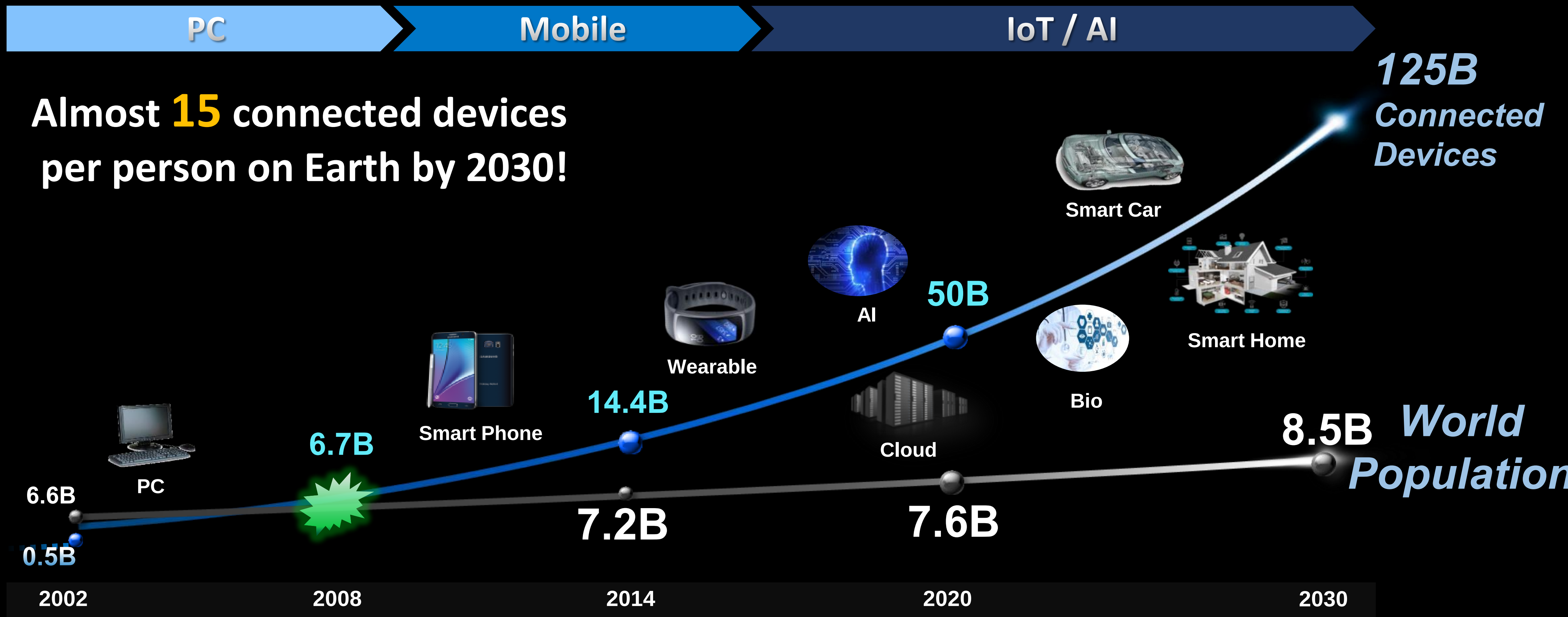
IT'S SMARTER SINCE IT'S CONNECTED

Almost 15 connected devices per person on Earth by 2030!



※ Source : Cisco Global Cloud Index (2016), HIS (2017)

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INTERFACES ARE THE ENABLER

- **Interface within Interposer, package, module, board, system**

  : No chip can work alone. No co-work can be done without interface

- **All the connection will be terminated at the personal device**

  : MIPI will play the main role in the smart world's touch for the people

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PRESENT AND FUTURE OF MIPI

- **Present**

  : Where we are – Samsung's contribution of MIPI interface

- **Future of MIPI Considerations – Standard, Design Technique, Market**

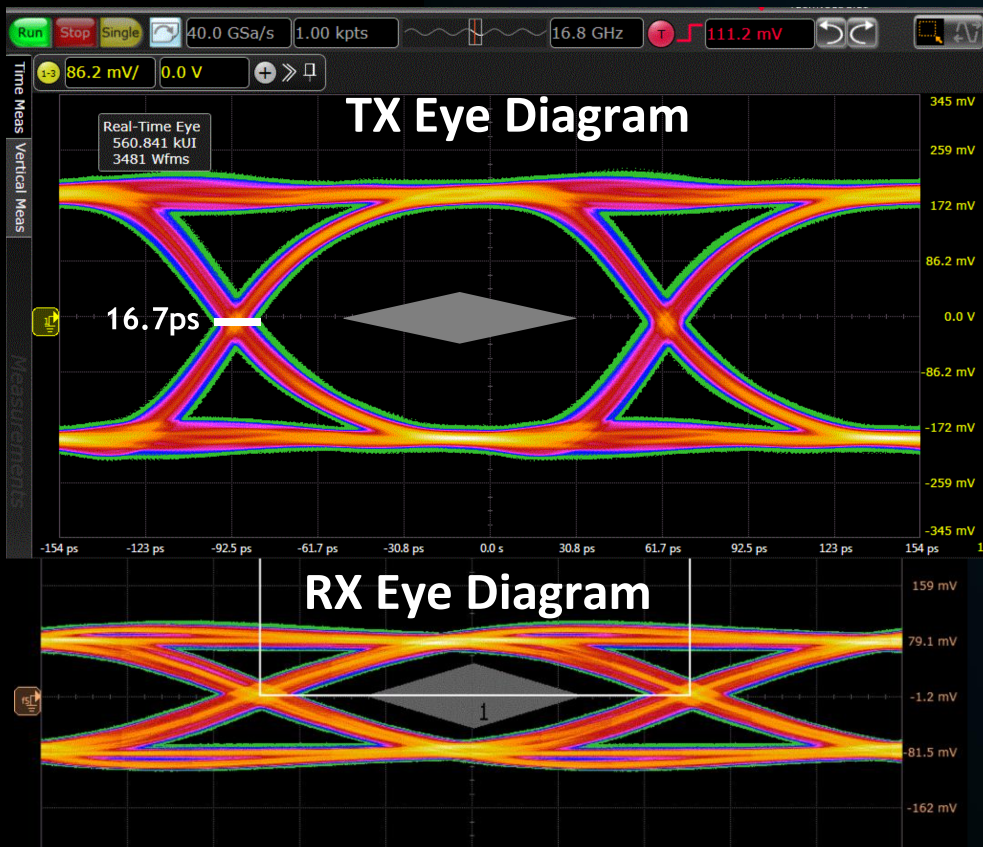
  : Standard - Lower power by better utilization of wire

  : Design Technique - Power integrity aware design

  : Market - Expanding boundary of MIPI for RF interface

MIPI PRESENT - SAMSUNG 7LPP D/C COMBO

7LPP MIPI D-PHY® Master 6.5Gbps Eye Diagram & CTS



KEYSIGHT TECHNOLOGIES

Test Report

Overall Result: PASS

Test Configuration Details	
Device Description	
Fixture Setup	Auto Load Switching
High Speed Data Rate(Mbps)	6500
CTS Version	v2.0 and v2.1
ZID	100 ohm
CLoad	50pF
Test Session Details	
Infiniium SW Version	6.20.801.0
Infiniium Model Number	DSOX91604A
Infiniium Serial Number	MY51420146
Application SW Version	3.70.9008.0
Debug Mode Used	No
Compliance Limits	MIPI D-PHY Test Limit v2.0 and v2.1 (official)
Last Test Date	2018-10-11 13:36:49 UTC -06:00

Summary of Results

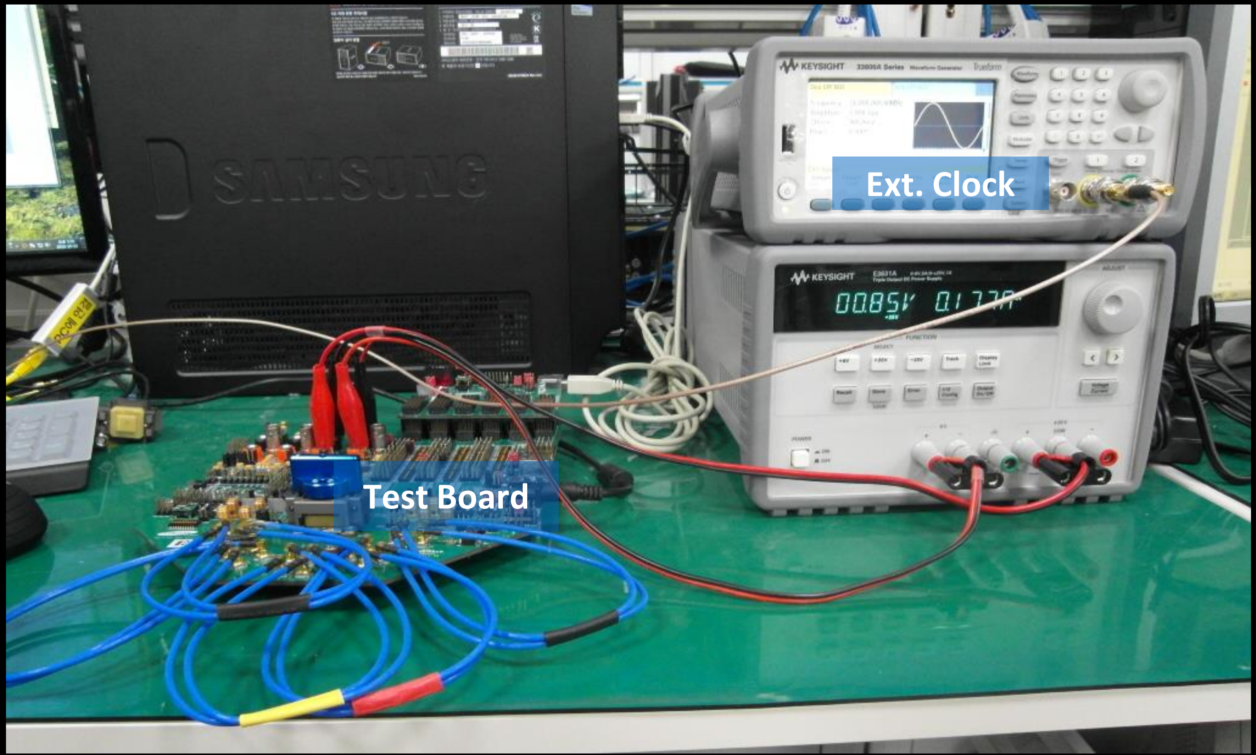
Test Statistics	
Failed	0
Passed	12
Total	12

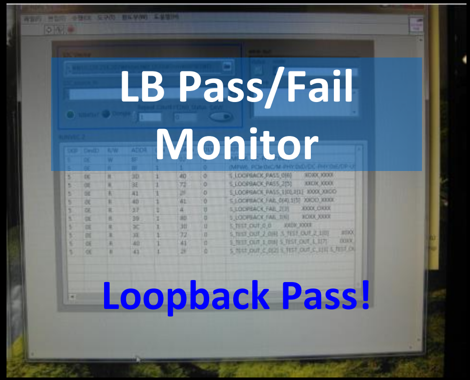
Margin Thresholds	
Warning	< 2 %
Critical	< 0 %

Pass	# Failed	# Trials	Test Name	Actual Value	Margin	Pass Limits
✓	0	1	1.4.18 Clock Lane HS Clock Delta UI (UI variation) [Continuous Clock]	8.28 %	8.6 %	-10.00 % <= VALUE <= 10.00 %
✓	0	1	1.4.20 Clock Lane HS Clock Period Jitter [SSC OFF][Continuous Clock]	2.50 %	25.0 %	-5.00 % <= VALUE <= 5.00 %
✓	0	1	1.5.7 HS Clock Eye Diagram [Continuous Clock]	0.00000	100.0 %	VALUE = 0.00000
✓	0	1	HS Data to Clock Total Jitter [Continuous Data]	111 mUI	63.0 %	VALUE <= 300 mUI
✓	0	1	HS Data to Clock Deterministic Jitter [Continuous Data]	62 mUI	69.0 %	VALUE <= 200 mUI
✓	0	1	HS Data to Clock Random Jitter [Continuous Data]	48 mUI	52.0 %	VALUE <= 100 mUI
✓	0	1	1.5.7 HS Data Eye Diagram [Continuous Data]	0.00000	100.0 %	VALUE = 0.00000
✓	0	1	1.4.19 HS Clock SSC Modulation Rate [Continuous Clock]	31.44 kHz	48.0 %	30.00 kHz <= VALUE <= 33.00 kHz
✓	0	1	1.4.19 HS Clock SSC Deviation (Max) [Continuous Clock]	-4.66154 kPPM	6.8 %	-5.00000 kPPM <= VALUE <= 0.00 PPM
✓	0	1	1.4.19 HS Clock SSC Deviation (Min) [Continuous Clock]	-1.70615 kPPM	34.1 %	-5.00000 kPPM <= VALUE <= 0.00 PPM
✓	0	1	1.4.19 HS Clock SSC df/dt [Continuous Clock]	827.72 PPM/us	33.8 %	VALUE <= 1.25000 kPPM/us
✓	0	1	1.4.20 Clock Lane HS Clock Period Jitter [SSC ON][Continuous Clock]	2.97 %	20.3 %	-5.00 % <= VALUE <= 5.00 %

MIPI PRESENT - SAMSUNG 7LPP D/C COMBO

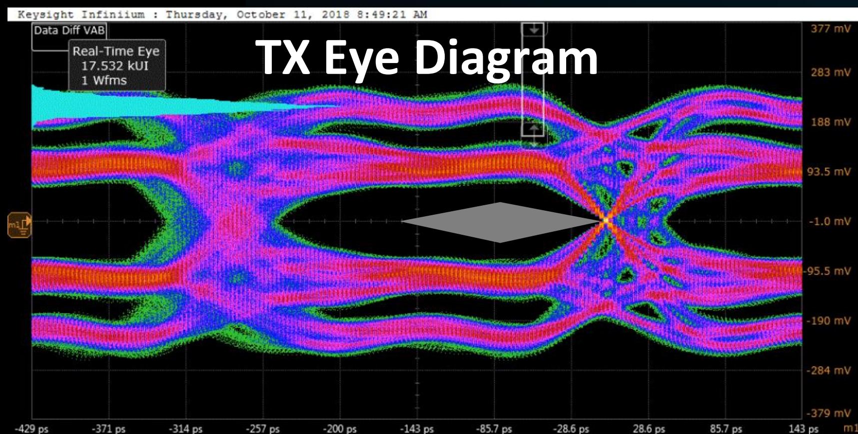
7LPP MIPI D-PHY® Slave 6.5Gbps External Loopback Test

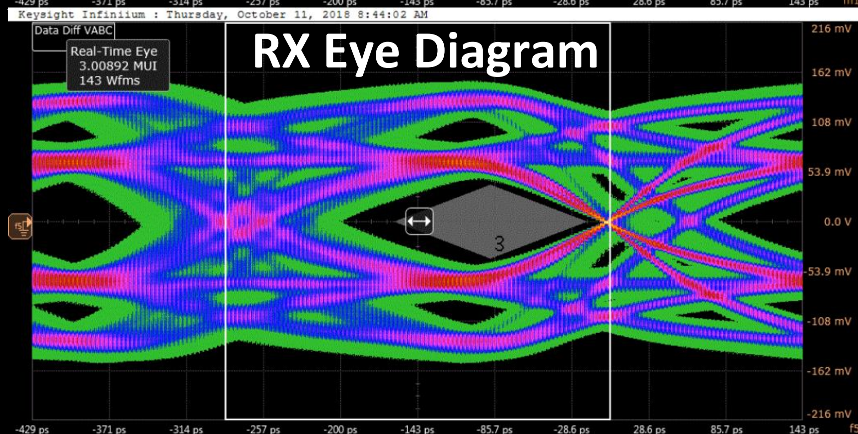




MIPI PRESENT - SAMSUNG 7LPP D/C COMBO

7LPP MIPI C-PHY® Master 3.5Gsps Eye Diagram & CTS





KEYSIGHT TECHNOLOGIES

Test Report

Overall Result: PASS

Test Configuration Details	
Device Description	
Data Type	HS Signal
LPEscapeMode	No
T3ProgSeqMode	No
T3-PROGSEQ Sequence	01234012340123
HS Symbol Rate(Msps)	3500
CTS Version	v1.1
Test Session Details	
Infiniium SW Version	6.20.801.0
Infiniium Model Number	DSOX91604A
Infiniium Serial Number	MY51420146
Application SW Version	1.31.0.0
Debug Mode Used	No
Compliance Limits	MIPI C-PHY Test Limit v1.1 (official)
Last Test Date	2018-10-11 08:50:55 UTC -06:00

Summary of Results

Test Statistics	
Failed	0
Passed	16
Total	16

Margin Thresholds	
Warning	< 5 %
Critical	< 0 %

Pass	# Failed	# Trials	Test Name	Actual Value	Margin	Pass Limits
✓	0	1	1.2.21 HS-TX Eye Diagram (VABC)(C)	Pass	100.0 %	Pass/Fail
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-AB-Strong1) [Mean](C)	218 mV	27.3 %	VALUE < 300 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-AB-Weak1) [Mean](C)	109 mV	12.4 %	VALUE > 97 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-AB-Weak0) [Mean](C)	-110 mV	13.4 %	VALUE < -97 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-AB-Strong0) [Mean](C)	-219 mV	27.0 %	VALUE > -300 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-BC-Strong1) [Mean](C)	216 mV	28.0 %	VALUE < 300 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-BC-Weak1) [Mean](C)	108 mV	11.3 %	VALUE > 97 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-BC-Weak0) [Mean](C)	-107 mV	10.3 %	VALUE < -97 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-BC-Strong0) [Mean](C)	-214 mV	28.7 %	VALUE > -300 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-CA-Strong1) [Mean](C)	215 mV	28.3 %	VALUE < 300 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-CA-Weak1) [Mean](C)	108 mV	11.3 %	VALUE > 97 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-CA-Weak0) [Mean](C)	-106 mV	9.3 %	VALUE < -97 mV
✓	0	1	1.2.7 HS-TX Differential Voltages (VOD-CA-Strong0) [Mean](C)	-215 mV	28.3 %	VALUE > -300 mV
✓	0	1	1.2.8 HS-TX Differential Voltage Mismatch (ΔVOD)(C)	5 mV	70.6 %	VALUE < 17 mV
✓	0	1	1.2.19 HS Instantaneous UI (UIINST_Max)(C)	337 ps	97.3 %	VALUE < 12.500 ns
✓	0	1	1.2.20 HS Delta UI (ΔUI) [above 1Gsps](C)	-420 m%	45.8 %	-5.00 % <= VALUE <= 5.00 %

MIPI PRESENT - SAMSUNG 7LPP D/C COMBO

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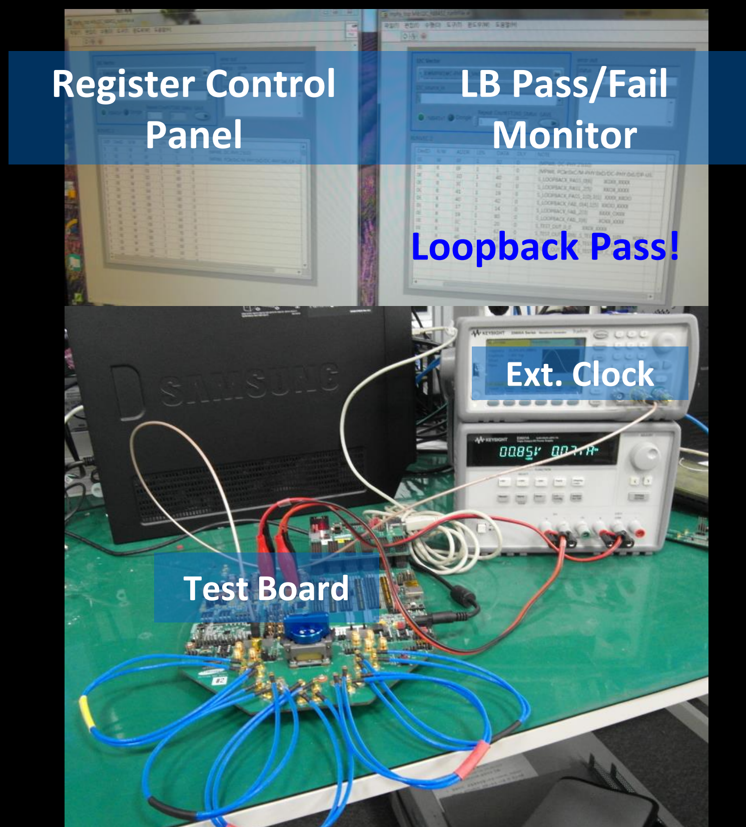
7LPP MIPI C-PHY® Slave 3.5Gsps External Loopback Test



Configure | HS Tests | Test 2.3.1 Amplitude Tolerance Data

Result	VOD [mV]	Min Passed VCPRX [mV]	Min Tested VCPRX [mV]	Min Spec VCPRX [mV]	Max Passed VCPRX [mV]	Max Tested VCPRX [mV]	Max Spec VCPRX [mV]
pass	580	N/A	N/A	95	390	390	390
pass	160	N/A	N/A	95	390	390	390
pass	540	95	95	95	N/A	390	390
pass	160	95	95	95	N/A	390	390

(CTS Test2.3.1) Amplitude Tolerance

Configure | HS Tests | Test 2.3.2 V_IDTH and V_IDTL Sens

Result	VCM [mV]	Min Passed VIDTH/V_IDTL [mV]	Min Tested VIDTH/V_IDTL [mV]	Min Spec VIDTH/V_IDTL [mV]
pass	250	160	135	80

(CTS Test2.3.2) V_IDTH and V_IDTL Sensitivity

Configure | HS Tests | Test 2.3.3 Jitter Tolerance Data0

Result	VCM [mV]	Min Passed VCM [mV]	Min Tested VCM [mV]	Max Passed VCM [mV]	Max Tested VCM [mV]
pass	310	310	310	310	310
pass	175	175	175	310	310

(CTS Test2.3.3) Jitter Tolerance

FUTURE STANDARD – LOW POWER

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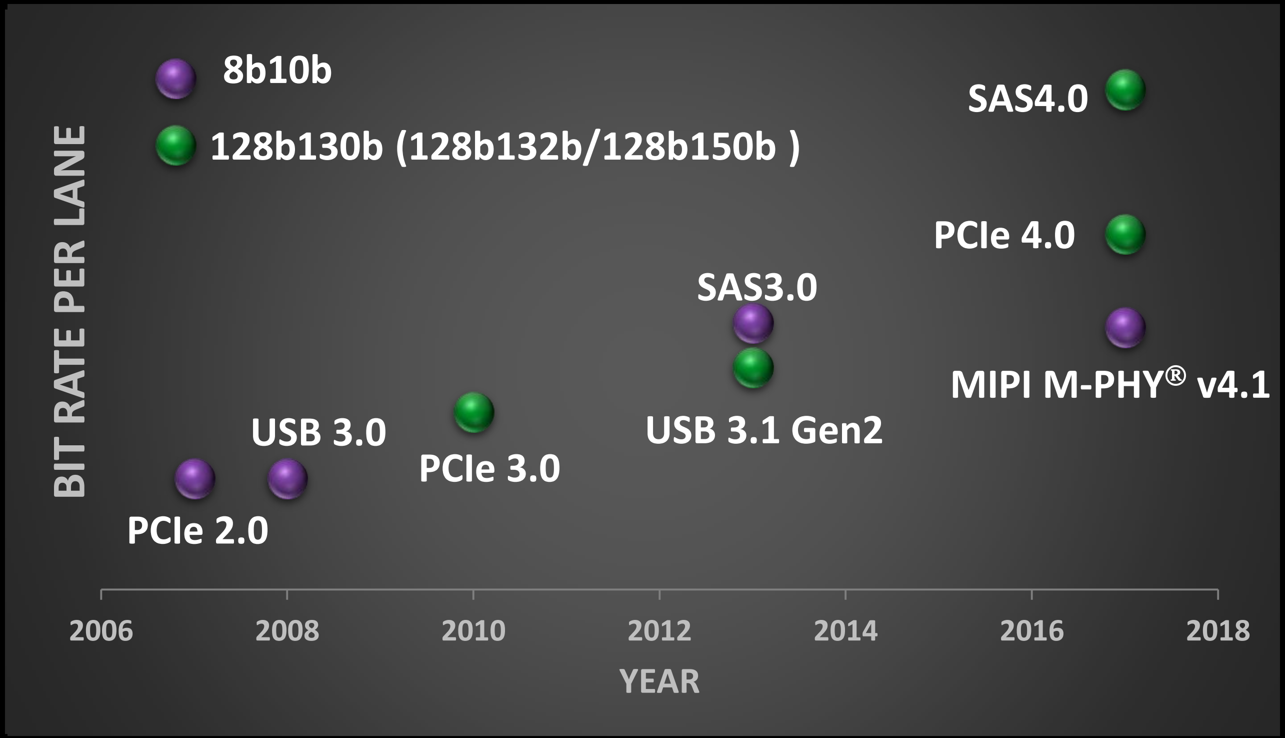
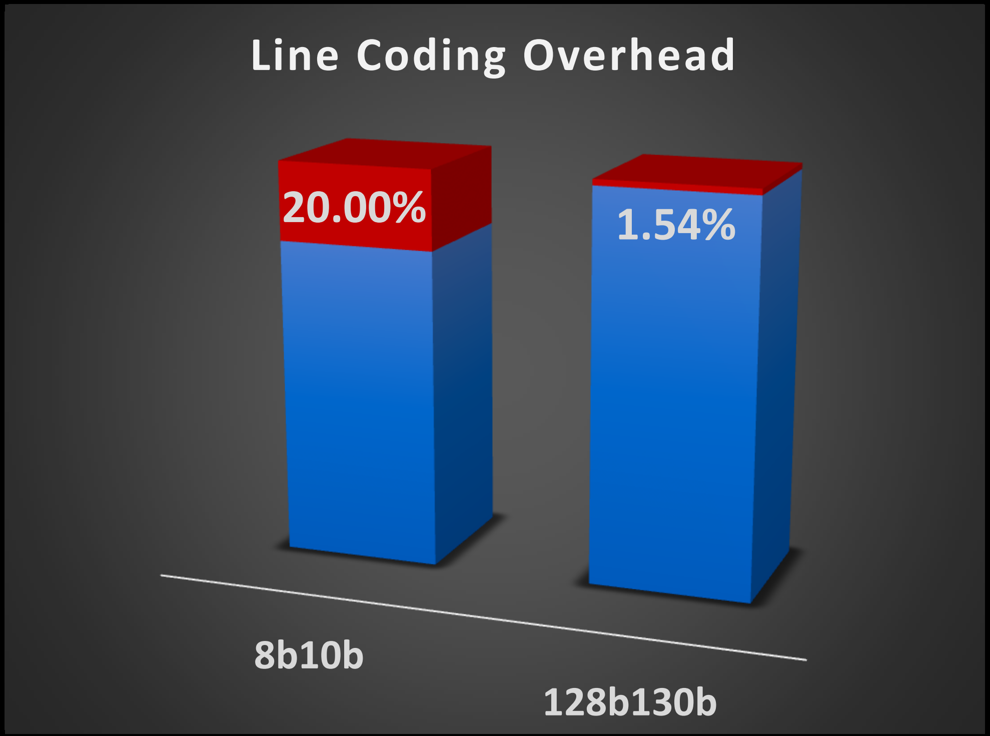
(Power) Overhead by line coding





FUTURE STANDARD – LOW POWER

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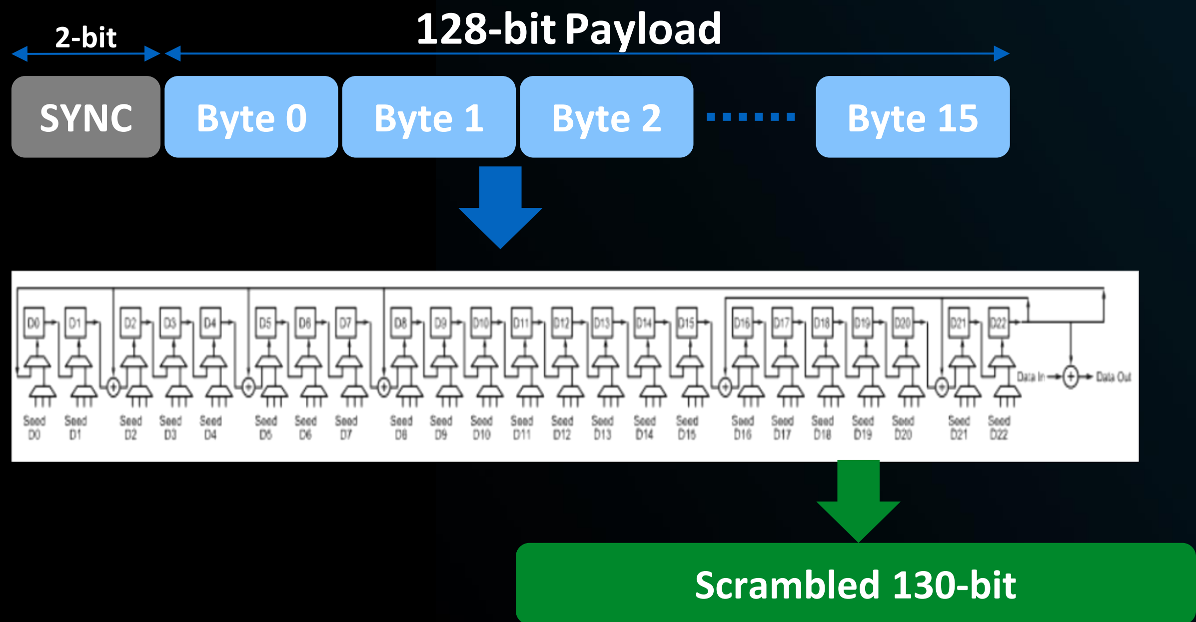
- **128/130b coding**

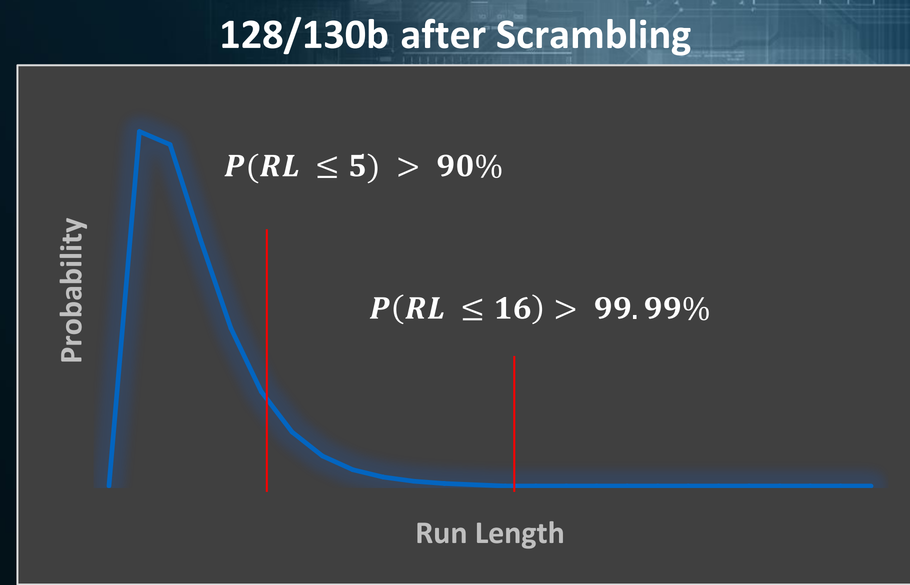
  : Well verified in protocol point of view

  : Advantageous in DC link with no DC-wandering

  : Fits well with less channel loss → small dynamic range for RX input

  : Homework - Full packet base command (ex. End of Burst) , Unipro structure



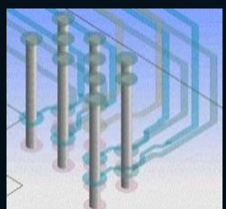


FUTURE TECHNIQUE – PI AWARENESS

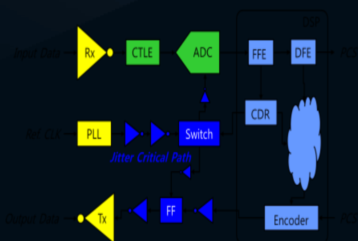
- PI is a stepping stone for higher speed operation

Accurate Modeling for Early-stage PSI Estimation

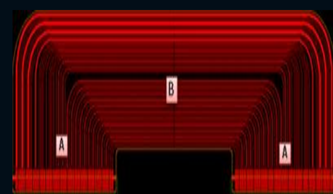
- 3D model extraction & RTL-based current profile



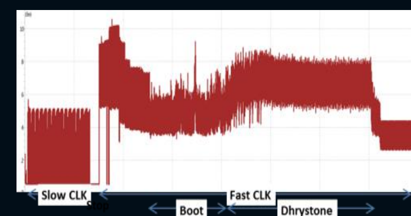
[Interconnect]



[I/O Phy]

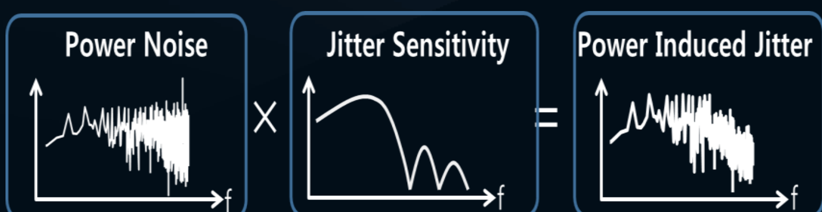


[Channel]

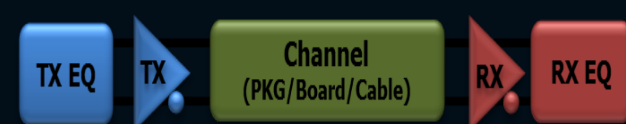


[Test Scenario]

Advanced Analysis Flow (Jitter, Link Simulation)



[Power Supply Induced Jitter]



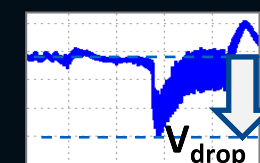
IBIS-AMI model

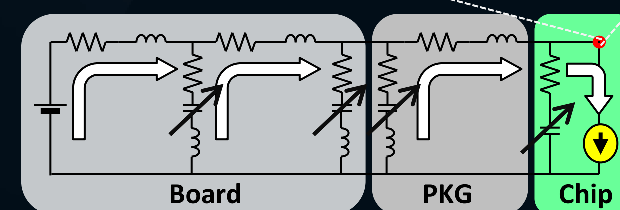
IBIS-AMI model

[DoE-based Full link Analysis]

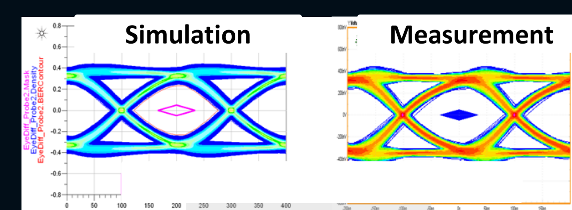
PSI Design Guidance for System-level Optimization

- Power budgeting
- Decap guidance





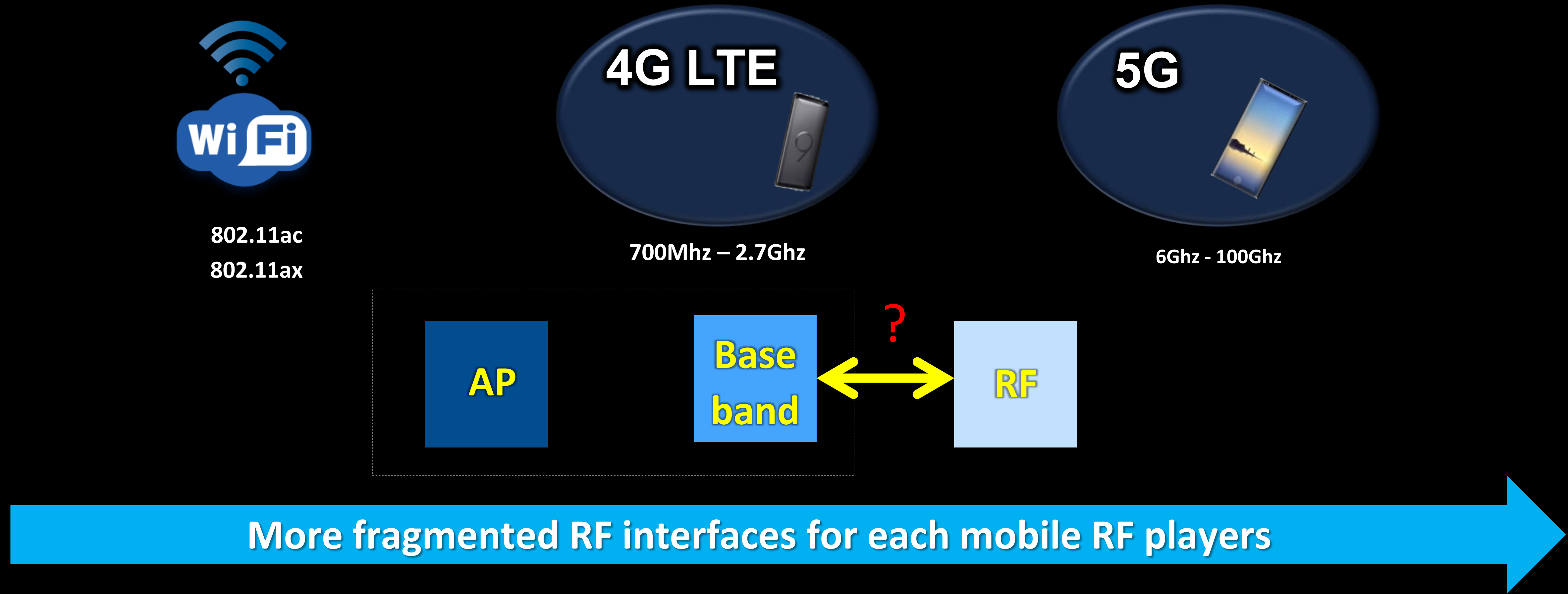
[Chip-package-board PDN]



[Electrical Validation]

FURTURE MARKET – RF INTERFACE

- Finding unified solutions for diverse RF interface between RF and baseband chips



KEY TAKEAWAY

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SMART WORLD

- Explosion in Smart Device
- Intelligence on Everything

CONNECTED

- Smart devices are smarter by connection
- Globally by DC and IoT
- Finally by Personal/Mobile devices

BY MIPI

- MIPI's roles are enabling more mobile connection through challenge
- Better wire utilization, power integrity, unified spec for between RF mobile chipsets