

SBR Technology

**Roadmap of IC packaging materials to meet
next-generation smartphone performance requirements**

May 30th 2019 rev01
SBR Technology Co., Ltd.
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- Heterogenous Integration toward 6G era
- Smartphone for eMBB and URLLC
 - Application processor
 - mmWave antenna
- To be covered detail roadmap by material leaders

5G to 6G performance trends

Semiconductor and package material companies has been focus toward 6G

eMBB: Enhanced mobile broadband
and data up and down load

6G: CY2030 -
(>300Gbps, <0.0x msec)

URLLC: Ultra Reliability and Latency Communications



Smart Phone



Hologram



Virtual Reality
Augmented Reality



Smart Sunglasses



Connected Police Officer

Wearable

5G: CY2020 -
(20Gbps, <0.1 msec)

2030 (1.7PT bytes)^(*2)

Transportation

Healthcare



Medical



Auto Drive

2021 (49EX byte)^(*1)



Security



Drones

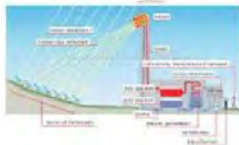
4G: CY2010 -
(1Gps)

mMTC: Massive Machine-Type Communications

2019 (24EX byte)^(*1)

Industry automation

(*1) Cisco Global Mobile Data Traffic Forecast Up date, 2016-2021 White Paper



Infra. monitoring



Smart farm

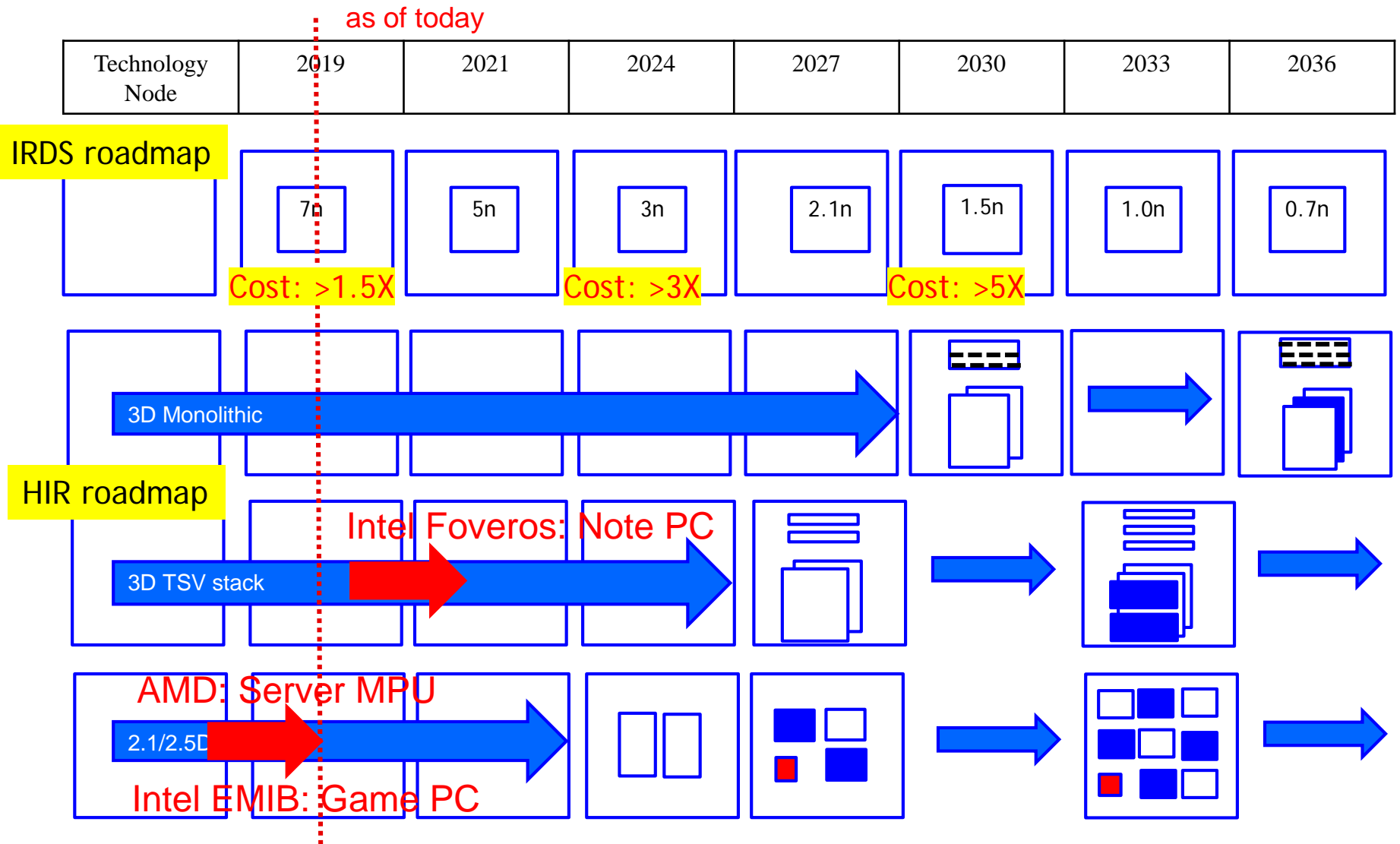


IoT Sensors

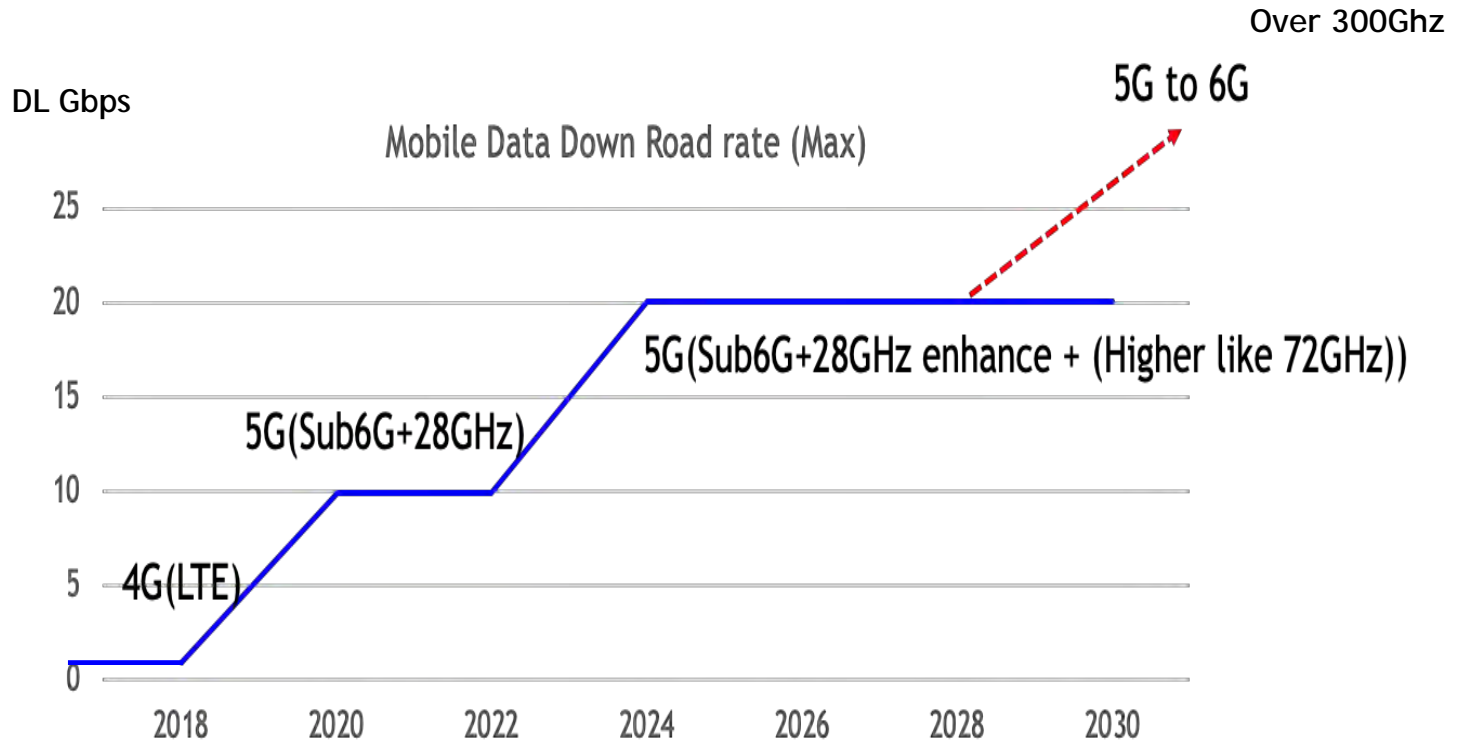


Robots

IRDS roadmap & Die partitioning



AP performance requirements toward 6G



	Production year					
	2018	2021	2024	2027	2030	2033
BB antenna performance	1Gbps	10Gbps	20Gbps	20Gbps +	100Gbps	200Gbps
Data down load rate (*1)	350Mbps	1Gbps	2Gbps	3Gbps	5Gbps	10Gbps

(*1): estimated max in smartphone

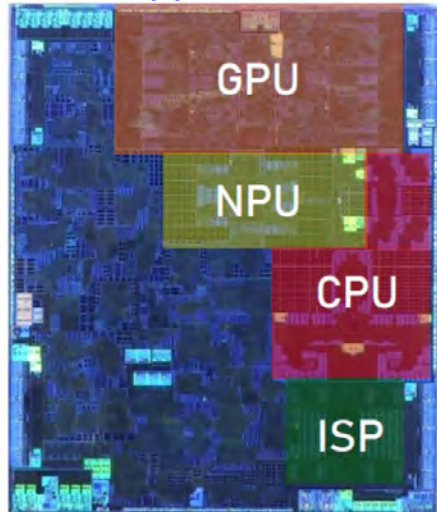
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Package technology and design optimization for AI application processor

Signal Integrity
for high frequency memory bus



Apple A12



Tekanalye technical report

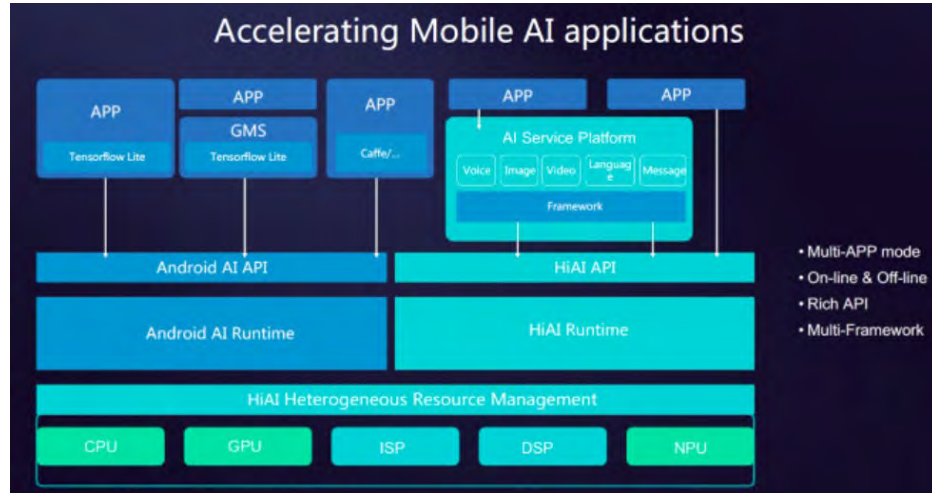
Power integrity
for multi cored CPU/GPU/DSP



Thermal management
for higher performance



HiSilicon Kirin AP

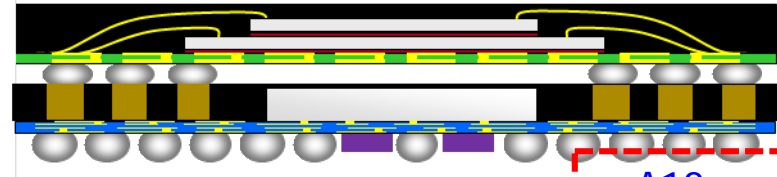
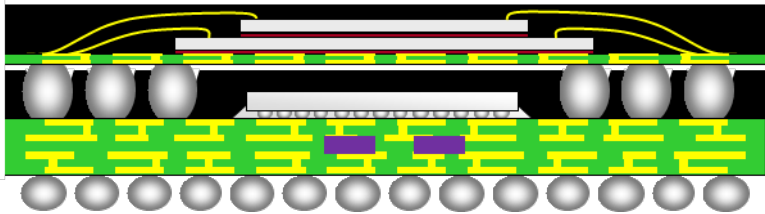


<https://www.anandtech.com/show/12195/hisilicon-kirin-970-power-performance-overview/5>

EMI management
for high frequency power switching

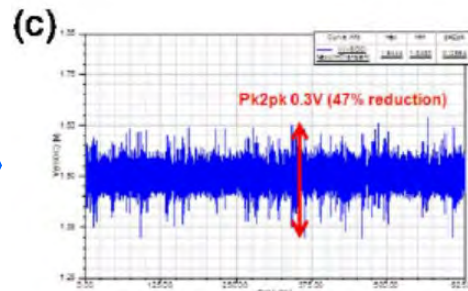
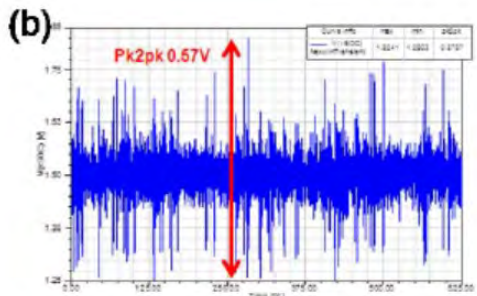


Power integrity improvement with FO-WLP



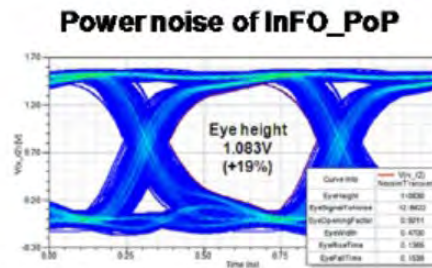
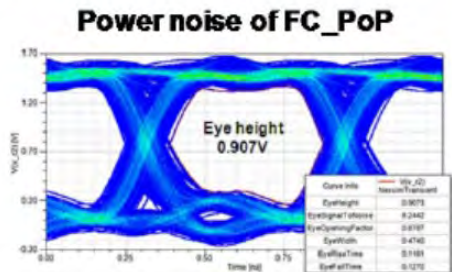
TMV - PoP

InFO PoP



Power noise
47% reduction

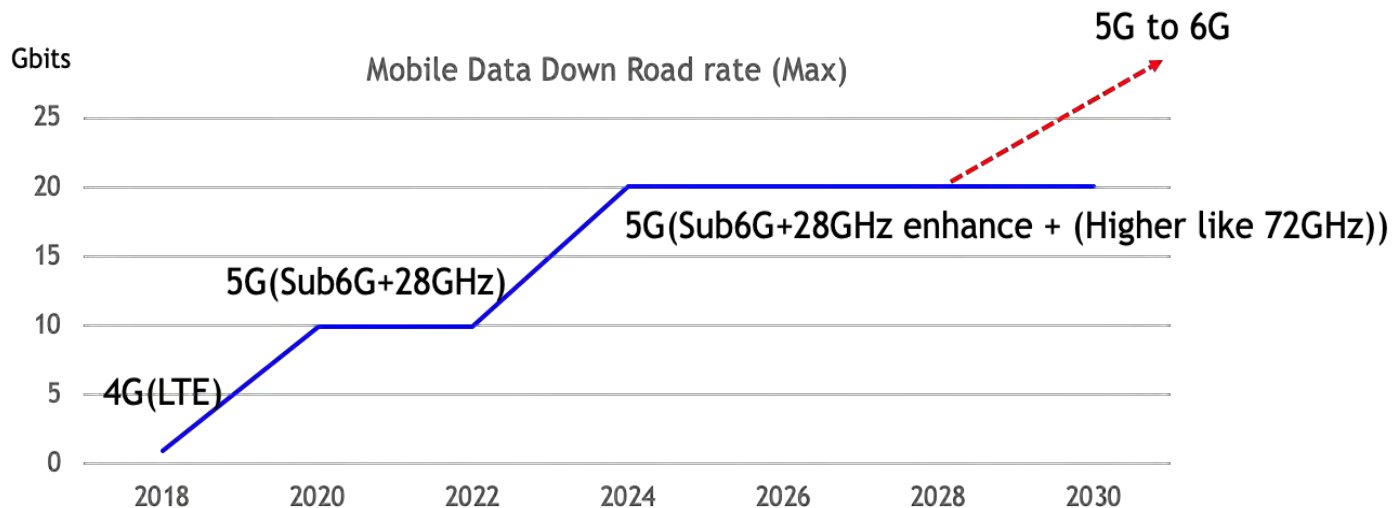
Tekanalye technical report



Operation voltage
19% reduction

InFO (Wafer Level Integrated Fan-Out) Technology:Chien-Fu Tseng., etal, TSMC, ECTC 2016

AP performance requirements toward 6G



	Production year					
	2018	2021	2024	2027	2030	2033
AP performance (index)	1.00	1.75	2.66	4.05	6.15	9.36
Data down load rate (*1)	350Mbps	1Gbps	2Gbps	3Gbps	5Gbps	10Gbps

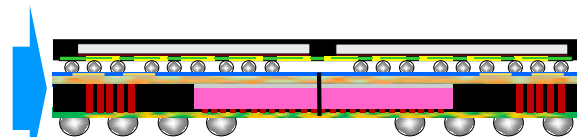
FO-WLP (Die first)



RDL: 5/5 μm
Df < 0.015

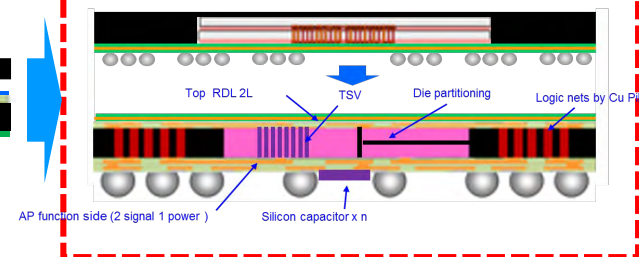
(*1): estimated max in smartphone

FO-WLP (Die first) - Die partitioning



RDL: 2/2 μm
Df < 0.008

FO-WLP (Die first) - 3D Die partitioning



Material requirements for AP package

Mold

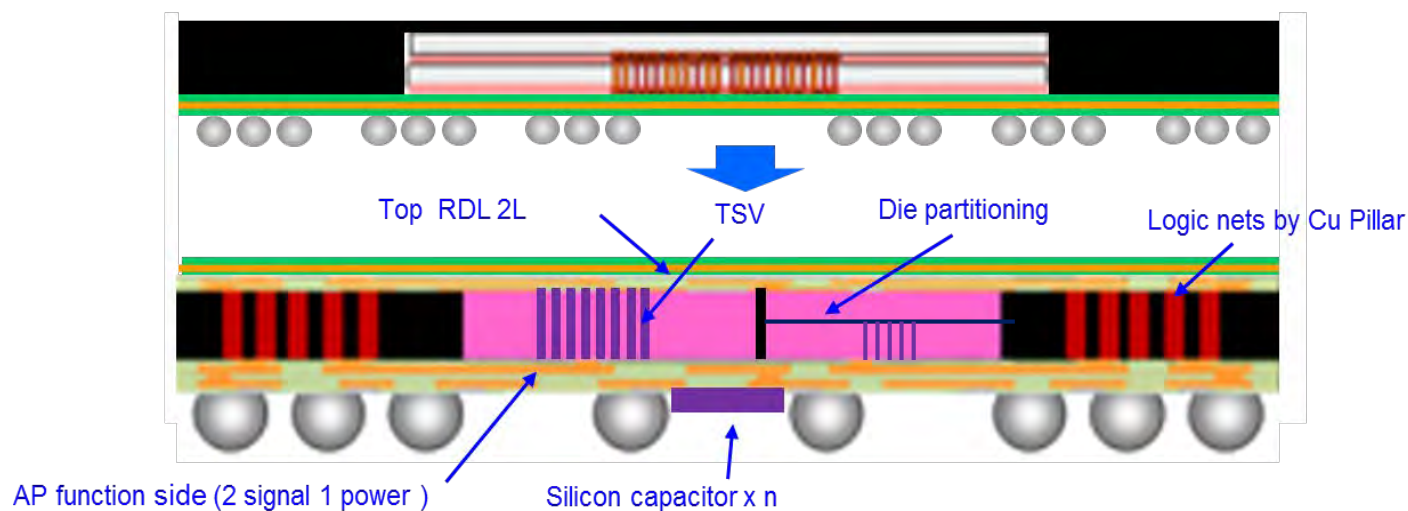
- ✓ Higher STIFFNESS with lower stress
- ✓ Higher ADHEISION with Silicon Dies
- ✓ Minimum VOLUME SHRINKAGE in curing process
- ✓ Lower THERMAL REGISTANCE

by Nagase

3D TSV

- Higher yield TSV PROCESS
- Die to Die dense INTERCONNECTION
- High through put and reliable NCF
- Bond and De bond for temporally bonding

FO-PLP for Wide bus memory



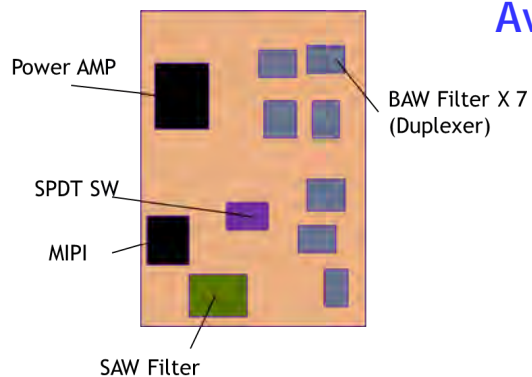
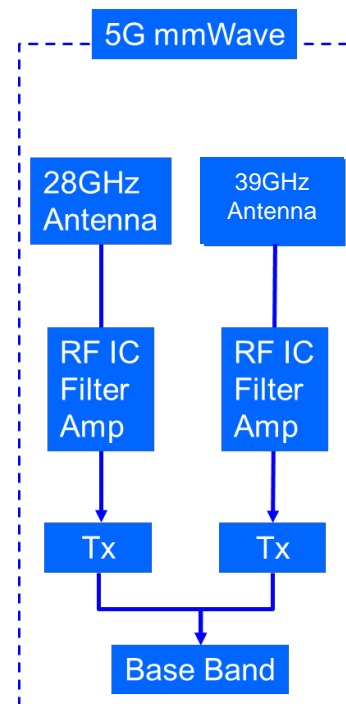
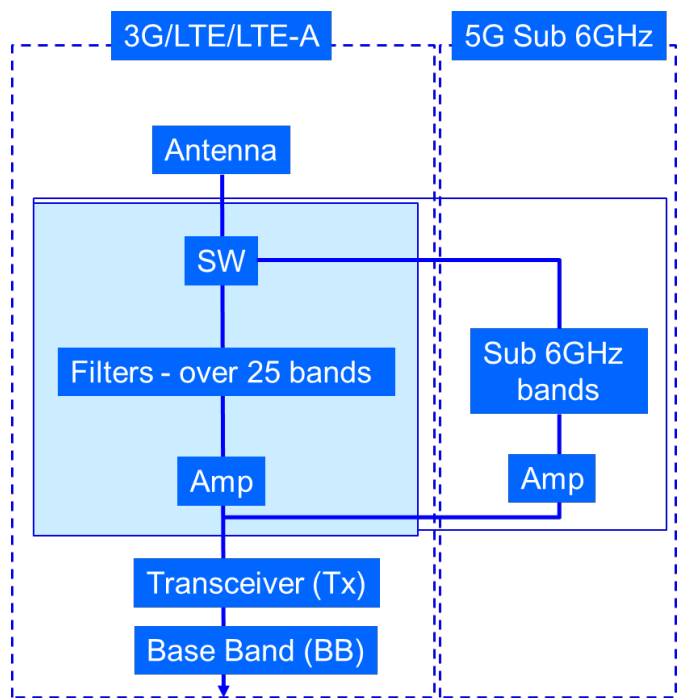
RDL

- ✓ Higher ELONGATION for CTE mismatch
- ✓ Required L/S and VIA SIZE
- ✓ MIGRATION FREE for the design rule
- ✓ Lower Dk and Df

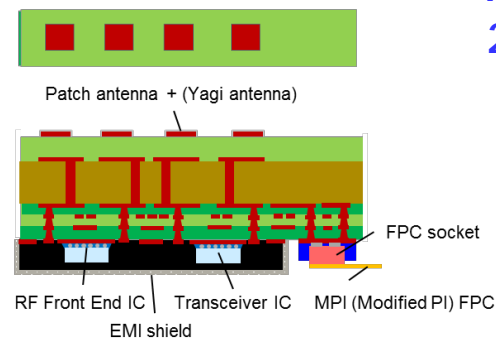
by JSR

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5G antenna and RF IC concept

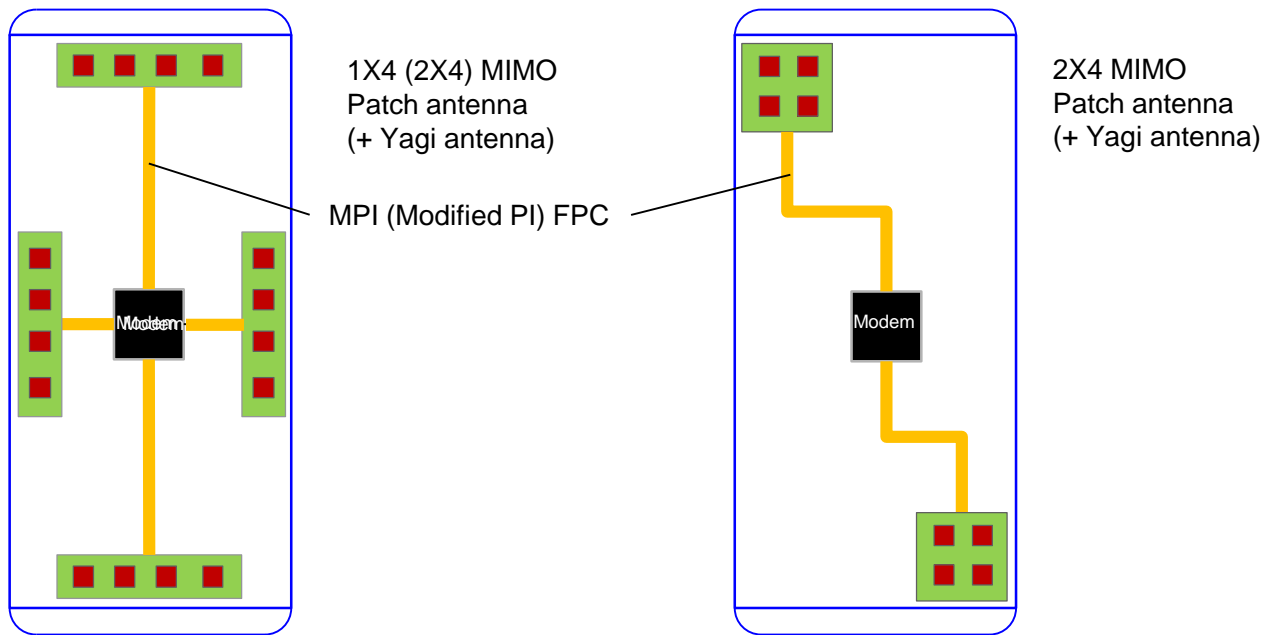
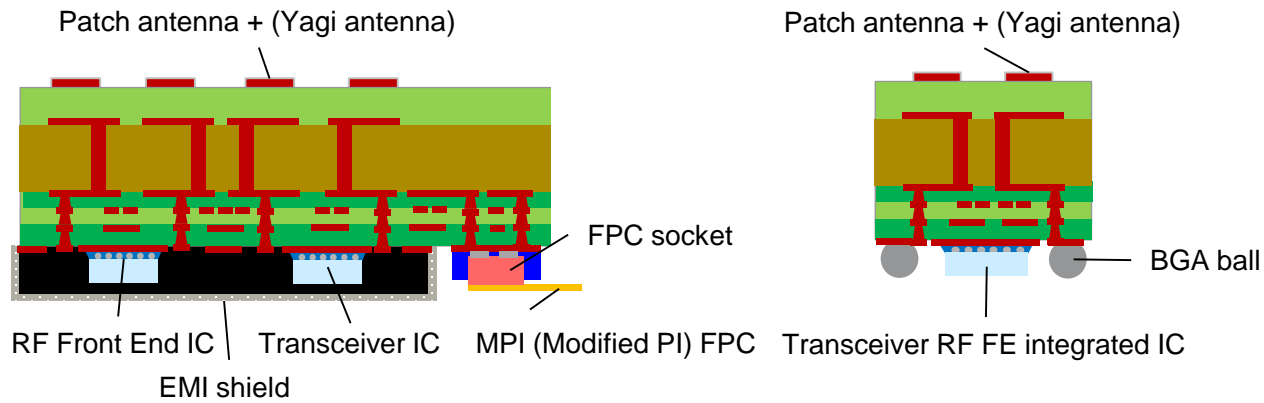


Average 3.5 SiP



Additionally 2-4 SiP

5G mm Wave AiP(Antenna in Package) concept

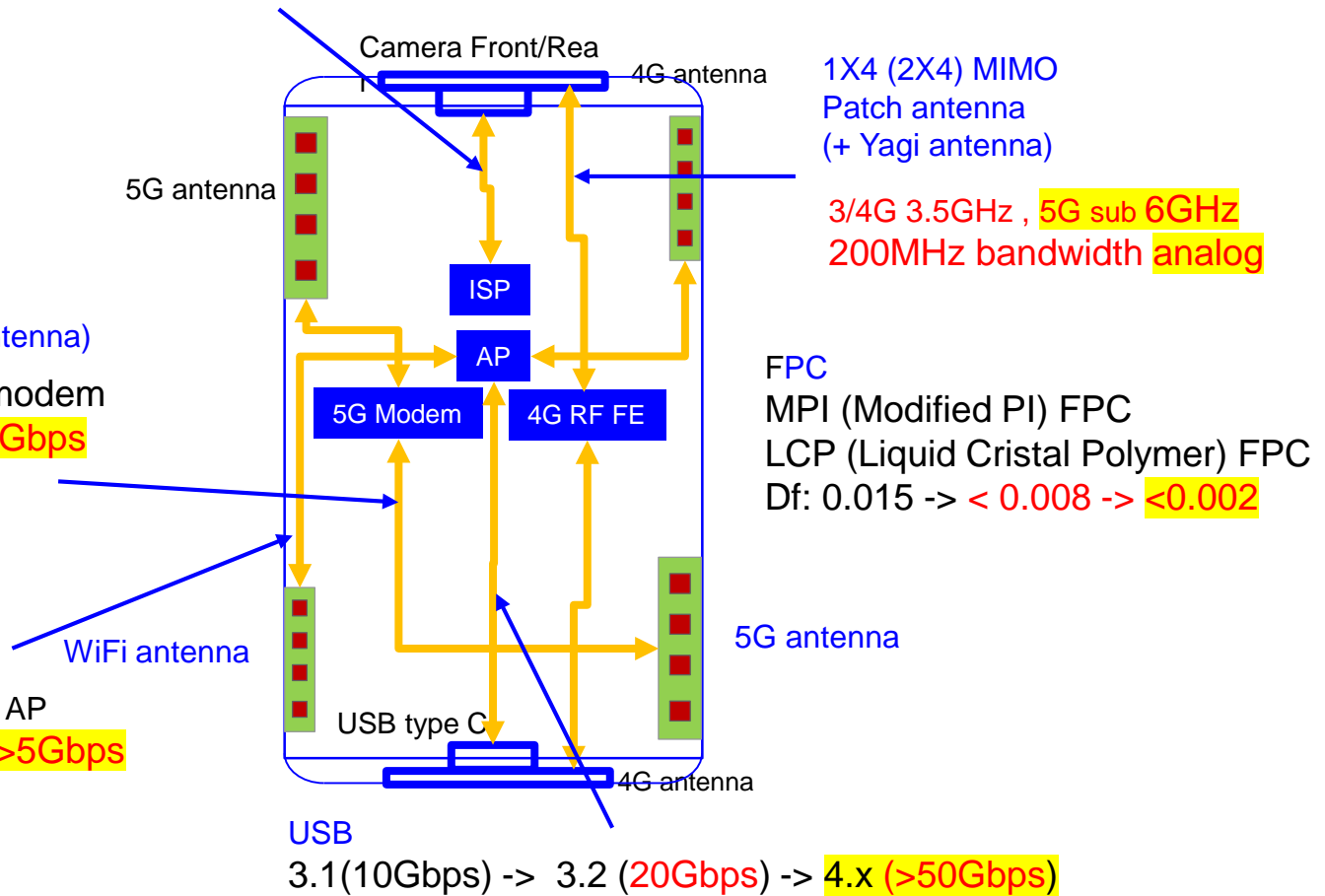


High speed bus

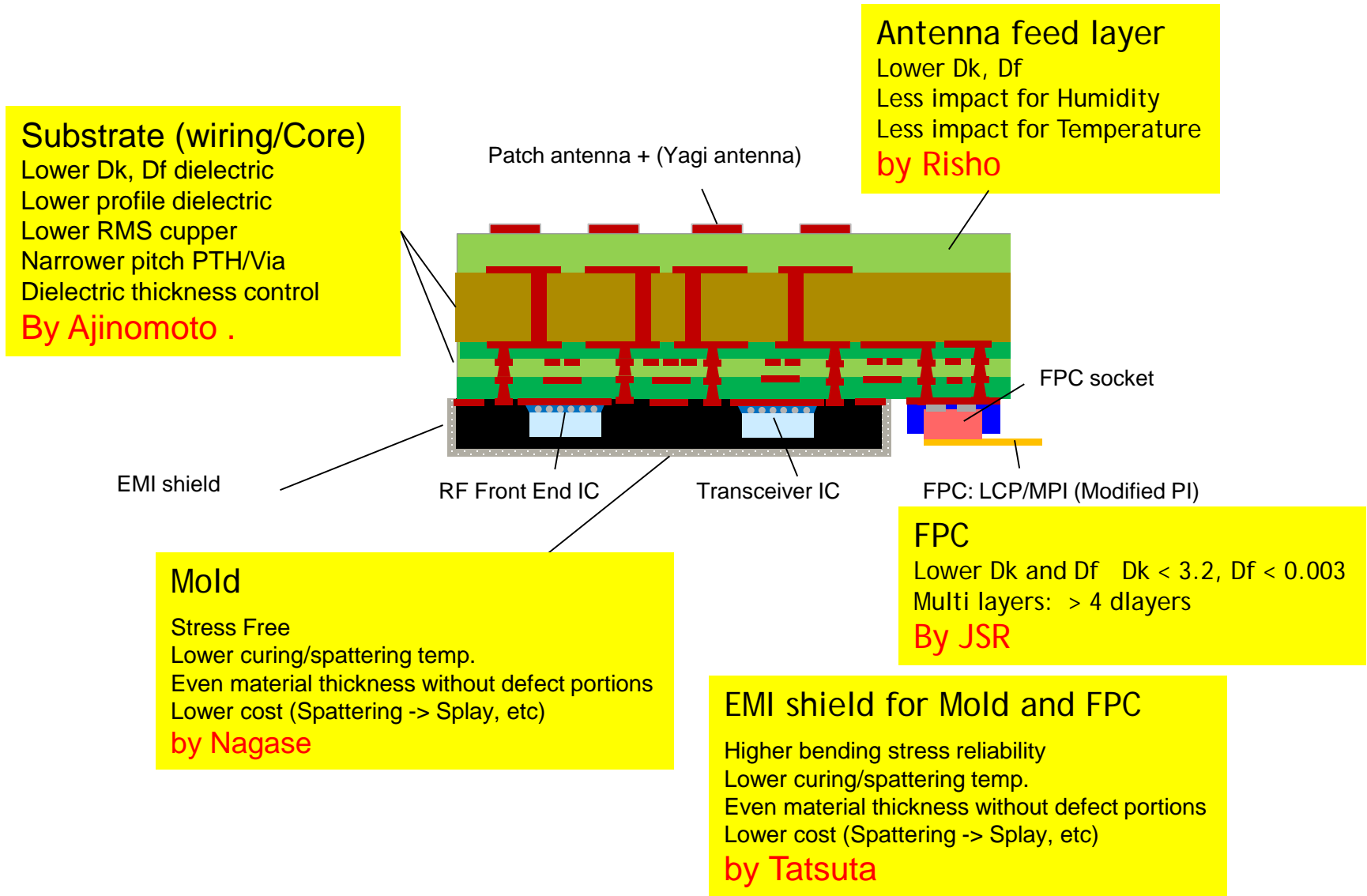
Camera bus
 MIPI D-PHY
 2.5 -> 4.5 -> 10 Gbps -> >20Gbps

Patch antenna + (Yagi antenna)
 mmW Transceiver to modem
 0.5 -> 2 Gbps -> > 10Gbps

WiFi transceiver to AP
 0.5 -> 2Gbps -> >5Gbps



Material requirements for AiP



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Thanks for your attention !
