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# mmW RCN Workshop Panel 1: State of 5G and mmWave Technology

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July 23, 2019

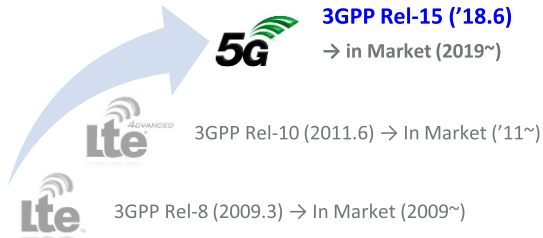


# 5G Ready for Global Deployment

More than 150 trials worldwide including Verizon, AT&T, TMobile, Sprint, SKT, KT, DoCoMo, KDDI  
5G first launched in KR/US in 2019, 5G Devices of \$97B and 5G Equipment of \$33.8B in 2025

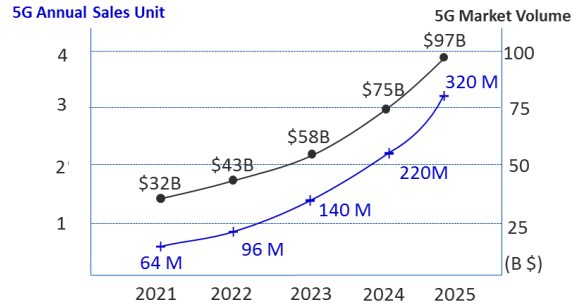
## 5G Market Open

Aged LTE → 5G launch (2019 ~ )



154 trials worldwide  
[GSA Report, 2018.7]

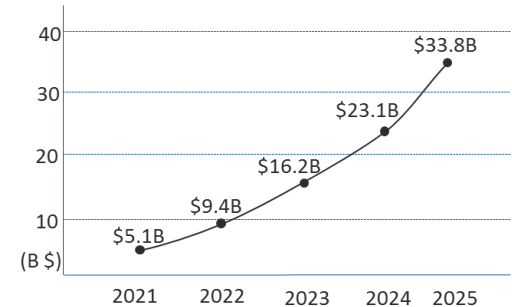
## 5G Device Market



### Global 5G Smartphone Sales

\* Average prediction from 20 org. of GSMA, Strategy Analytics

## 5G Equipment Market



### Global 5G Network Sales

\* Average prediction from 20 org. of GSMA, Strategy Analytics

# mmWave 5G: Journey from Vision to Reality

Nearly a decade of technology innovation, prototyping, trials and commercialization effort

2012-2014

5G mmWave Testbed



Base Station      Mobile Station

1 Gbps up to 2 km distance

2015 - 2016

5G mmWave  
Multi-cell Handover &  
High Speed Test



Avg. 1.7 Gbps at 25 km/hr (2015)  
2.6 Gbps at 150 km/hr (2016)

2017 - 2018

5G Fixed Wireless Access  
Customer Trial  
Service in the US



Trial service in 8 cities

2019

mmWave 5G phone



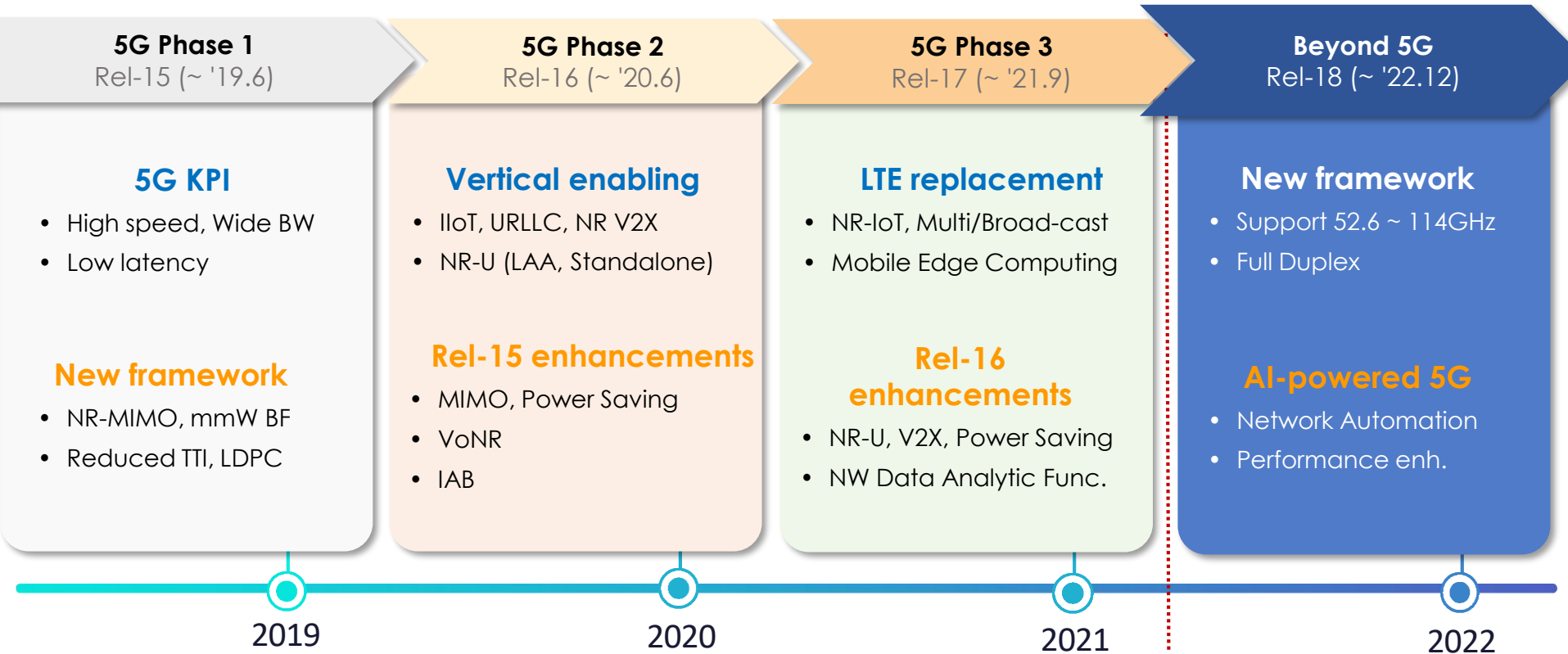
Millimeter Waves May Be the Future  
of 5G Phones

Samsung's millimeter-wave transceiver technology  
could enable ultrafast mobile broadband by 2020

By Ariel Bleicher

Galaxy S10 5G

# 5G Standard towards Beyond 5G



# Rel-17 RAN Work Areas

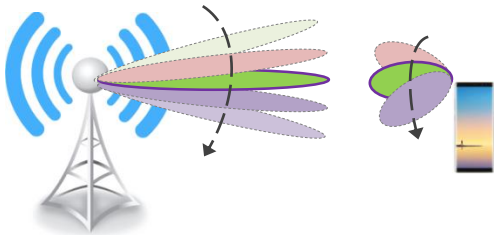
- Selected 17 candidate work areas which will be discussed further for formal study/work item approval in December

Category	Work Area	Description	Category	Work Area	Description
<b>eMBB enh.</b>	MIMO enh	Beam management, UL MIMO enh.	<b>New services</b>	NR-Light (IoT)	NR for wearables, HD CCTVs, etc
	Coverage enh.	Extending NR coverage beyond LTE		D2D (Sidelink)	For 5G public safety, V2X
	IAB enh.	Mesh network, mobile IAB nodes		Positioning enh.	3D positioning with cm-level accuracy
	RAN data collection	UE data collection for the support of SON and AI functionalities		Multi/Broadcast	For V2X, 5G public safety
	Power saving	PDCCH		IIoT/URLLC enh	Optimization for industrial deployments (eMBB+URLLC)
	Small data	Small data / inactive state data TX		NTN	NR based satellite communications
<b>New spectrum</b>	Above 52.6GHz	New RAT for support of 52.6 – 114GHz spectrum		<b>Others</b>	NB-IoT/MTC
	NR-U enh.	60GHz unlicensed band, better coexistence mechanism	Multi-SIM		Dual Standby/Single Active

# mmWave Beam Management Challenges

- 5G NR standard should further introduce low latency/overhead beam management and recovery mechanism
- Implementation based solutions are also pursued and adopted by the network and UEs

## Beam Sweeping and Acquisition



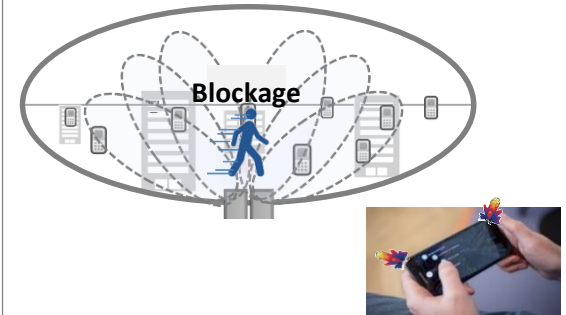
- Large number of BS-UE beam pairs (e.g., 512 for 64 BS x 8 UE beams)
- Much time to sweep and acquire
- Worse in carrier aggregation cases

## Mobility



- Beam change due to mobility and terminal rotation
- A new set of beams should be quickly acquired to maintain the link

## Blockage



- Blockage from objects, human body
- Fast recover and acquisition mechanism is necessary



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**Thank you!**

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