



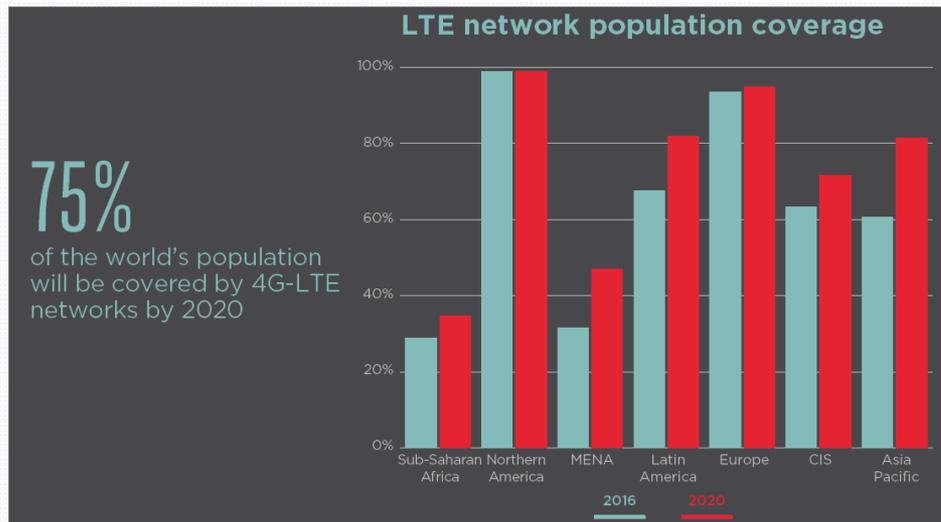
LTE UE capabilities for 5G LTE-NR dual mode phones

Huawei, HiSilicon



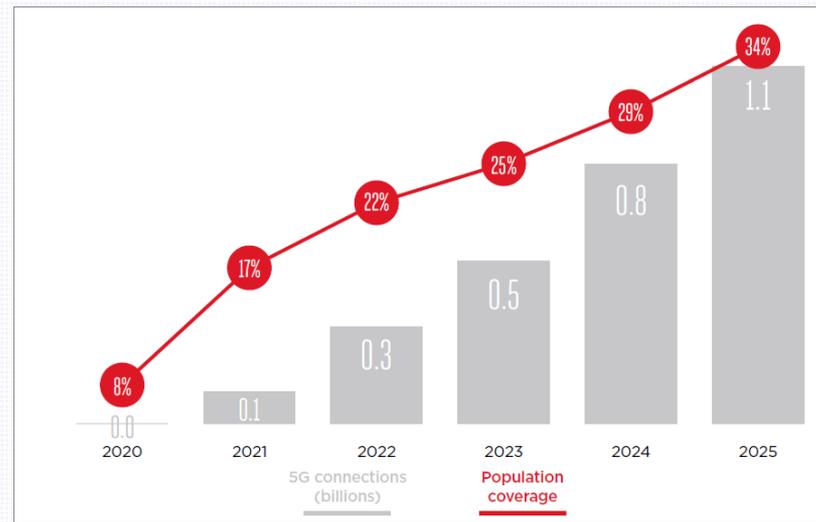
LTE Performance: Important Factor for 5G Terminal Experiences(2/2)

Forecasted LTE population coverage



*Source: Global 4G-LTE forecast: 2012-2020, GSMA Intelligence 2017

Forecasted 5G Population Coverage



*Source: The 5G Era: Age of boundless connectivity and intelligent automation, GSMA, 2017

- By 2020 (5G initial deployment), a mobile phone works in LTE mode for **~70% of the area**
- Initial 5G phone will be multi-mode LTE/NR phone, **LTE performance contributes to major part of the user-perceived experience during the ramping up of NR deployment.**
- Good 5G phone experience will turn to **good 5G phone sales and help the growth of 5G industry**

Make full utilization of Capability of 5G Modem and 5G Device

- Support some selected LTE features to fully utilize hardware capability of 5G modem and devices
 - New multi-mode LTE/NR platform (both at terminal and network side) have stronger capabilities to support LTE features
 - The effort made on 5G device for some features should be made available for both LTE and NR

RF capabilities to share
(e.g., 4Rx/4layers, SRS antenna switch)

Baseband capabilities to share
(e.g., shorter processing time,
DM-RS based data transmission, depending
on the implementation)



Make full utilization of LTE capabilities that have been widely implemented or planned

- LTE has evolved for 8 releases since Rel-8. In the later releases, most of the features have been set to optional for the UEs
- Though having optional features would allow flexibilities for product planning, it also brings the uncertainty of feature availability in the UE implementation, even if the features are needed by operators
- For Rel-15 multi-mode LTE/NR UEs, some of the legacy LTE features with UE capability signaling reports can be reconsidered as mandatory
 - The availability and the plan of some legacy LTE features in the products have been changed compared to the time point when the mandatory/optional decisions were made
 - Some features have been widely implemented and making the features mandatory can accelerate the progress of the related testing and deployment
 - Support of some features share the NR capability available in the device with small extra effort. Making the features mandatory can bring confidence to the vendors and operators to implement and deploy the features

Examples of selected LTE legacy features to be mandated (per UE or on some bands)

Features	Release of the feature being introduced	Current status of UE capability	Proposal
TM9 (Transmission mode 9)	R10	TDD: Mandatory with FGI FDD with 4 Tx port: Mandatory with FGI FDD with 8 port: optional with capability bit	Set FGI bits to '1', for TDD TM9, and for FDD TM9 with 4Tx The capability bit for FDD TM9 with 8Tx is mandated to set to '1'
4Rx/4layers	R10	Per band per band combination capability	Set to '1' for selected bands (at least b41/b42/b7/b38)
UL Tx (1T2R) switch including SRS switch	R8	Optional with capability bit . In Rel-13, per band per band combination capabilities were introduced	Set to '1' for selected bands

Examples of selected LTE Rel-15 features to be mandated/supported (per UE or on some bands)

Features	Proposal
SRS Tx antenna switch (1T4R/2T4R)	UE should support SRS Tx antenna switch in the band where in the same device NR supports SRS Tx antenna in the same band.

Proposals

Proposal1: Set FGI/capability bits to '1' to at least the following LTE features for 5G LTE-NR dual mode UEs or for selected bands of 5G LTE-NR dual mode UEs :

- Transmission mode 9
- 4Rx/4layers at least for band b41/b42/b7/b38
- UL Tx (1T2R) switch including SRS switch for selected bands

Proposal 2: UE should support SRS Tx antenna switch in the band where in the same device NR supports SRS Tx antenna switch in the same band. Special treatment of other Rel-15 LTE features for LTE-NR dual mode UEs can be considered after general Rel-15 feature list discussion is more stable.



Thank you !

Appendix: The capability/FGI parameters related to the proposals

Features	Specification	Name of parameters		
TM9 (Transmission mode 9)	36.331	Annex C:		
		<table border="1"> <tr> <td>103</td> <td>- PDSCH transmission mode 9 when up to 4 CSI reference signal ports are configured</td> </tr> <tr> <td>104</td> <td>- PDSCH transmission mode 9 for TDD when 8 CSI reference signal ports are configured</td> </tr> </table>	103	- PDSCH transmission mode 9 when up to 4 CSI reference signal ports are configured
103	- PDSCH transmission mode 9 when up to 4 CSI reference signal ports are configured			
104	- PDSCH transmission mode 9 for TDD when 8 CSI reference signal ports are configured			
	36.306	<i>tm9-With-8Tx-FDD-r10</i>		
4Rx/4layers	36.306	<i>supportedMIMO-CapabilityDL-r10</i>		
UL Tx (1T2R) switch including SRS switch	36.306	<i>ue-TxAntennaSelectionSupported</i> <i>txAntennaSwitchUL-r13</i>		
SRS Tx antenna switch (1T4R/2T4R)	36.306	<i>ue-TxAntennaSelection-SRS-1T4R-r15</i> <i>ue-TxAntennaSelection-SRS-2T4R-2Pairs-r15</i>		