



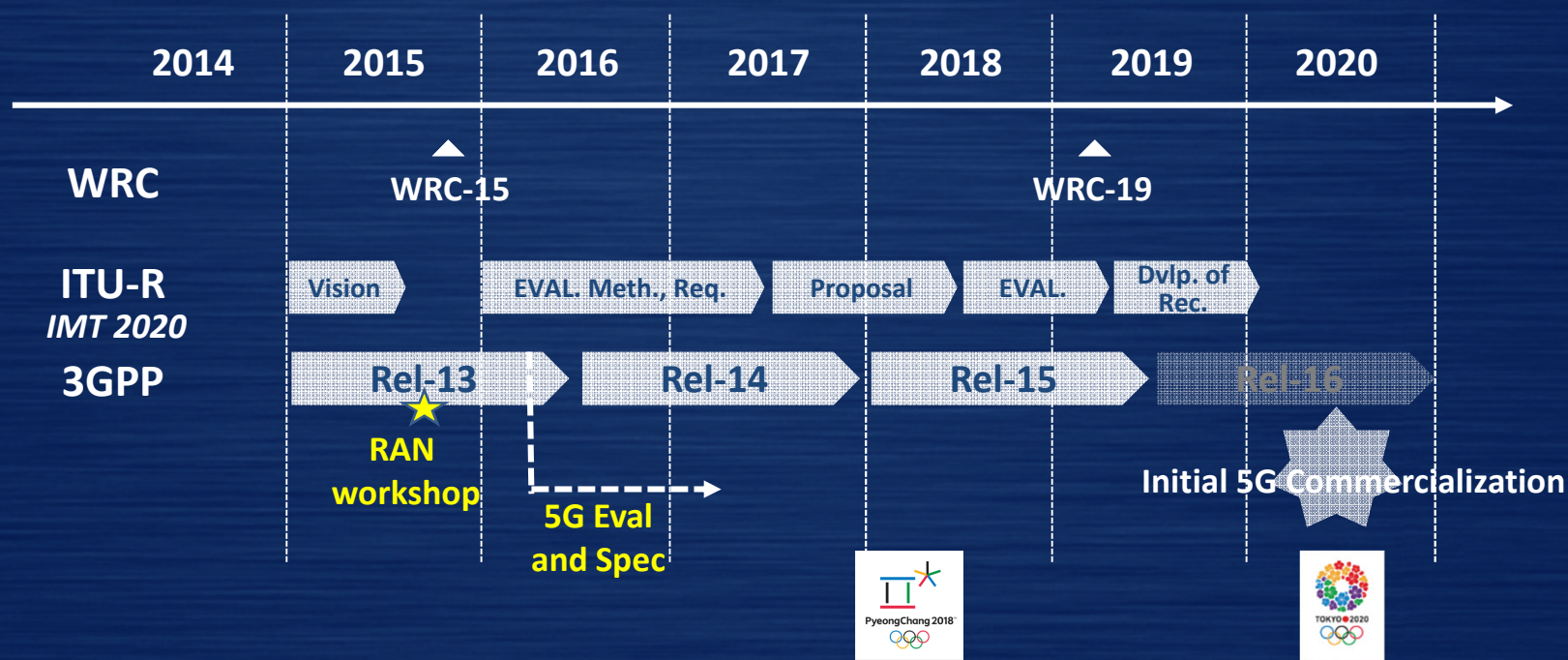
5G WIRELESS FOR 2020 AND BEYOND

*5G Panel on “5G Research and System Design”
WCNC 2015
March 11 2015*

Samsung Research America Dallas (SRA-D)

Expected 5G Timelines

Standards in 3GPP, spectrum allocation in WRC-19, ITU approval in 2020



WRC : World Radiocommunications Conferences
 ITU-R : International Telecommunication Union Radiocommunication Sector
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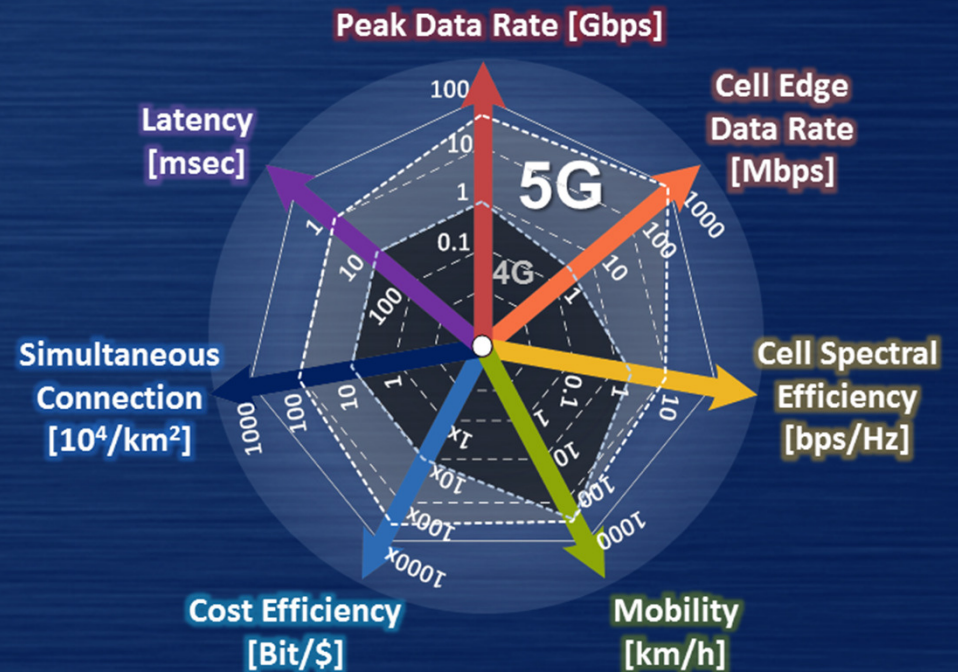
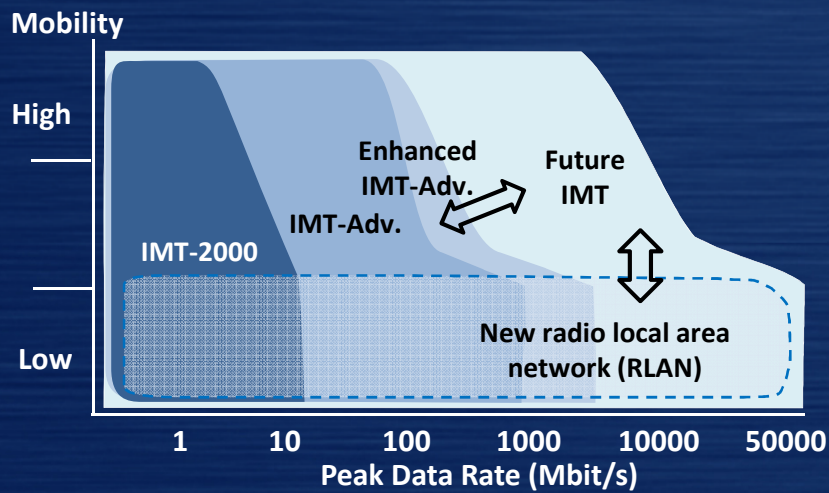
EVAL. Meth. : Evaluation Methodology
 EVAL. : Evaluation

Req. : Requirement
 Dvlp. of Rec. : Development of Recommendation

Samsung 2020 Vision on 5G Requirements



Comprehensive Requirements of “New IMT (5G)” in 7 Categories, Dubbed as “**5G Rainbow of Requirements**”



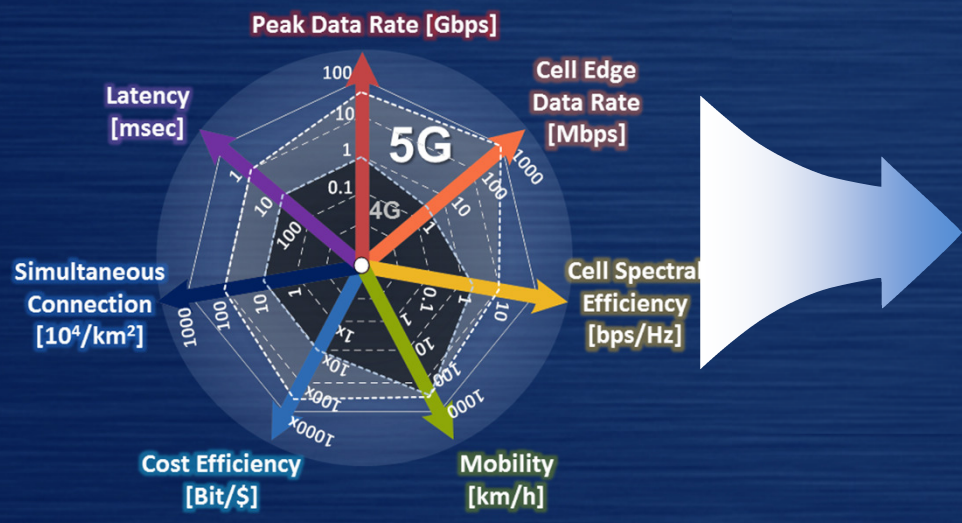
ITU-R WP5D/TEMP/390-E

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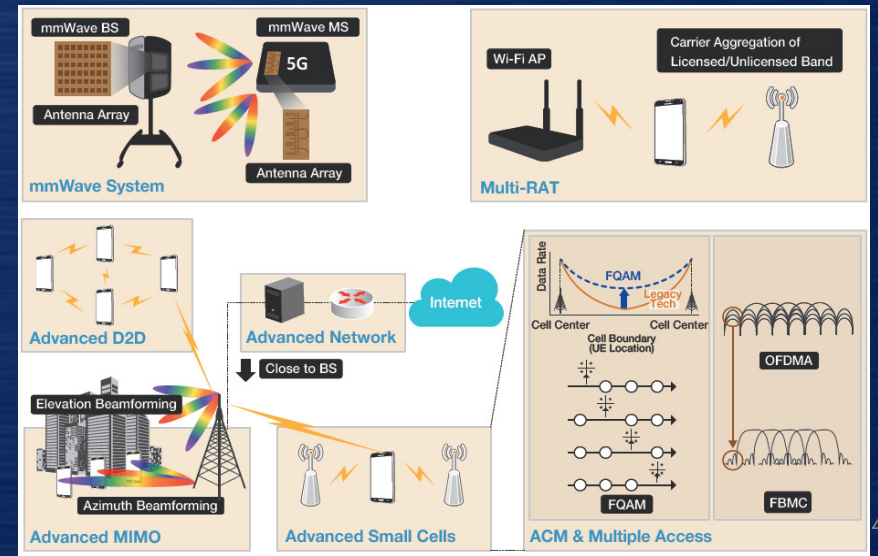
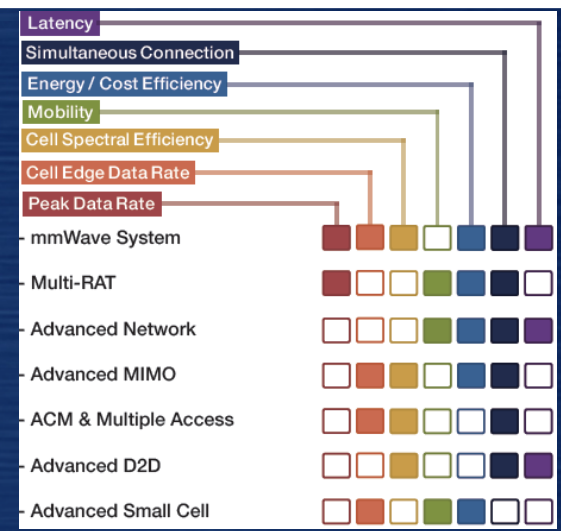
Enabling Technologies - RAN



5G Rainbow of Requirements



Disruptive RAN technologies for significantly enhanced performance



mmWave Testbed - Recent Updates

World's First 5G Data Transmission at Highway Speeds (Oct, 2014)

Record-breaking 1.2Gbps data transmission at over 100km/h, and 7.5Gbps in stationary conditions using 28GHz spectrum



5G Mobility Test
1.2Gbps @110km/h



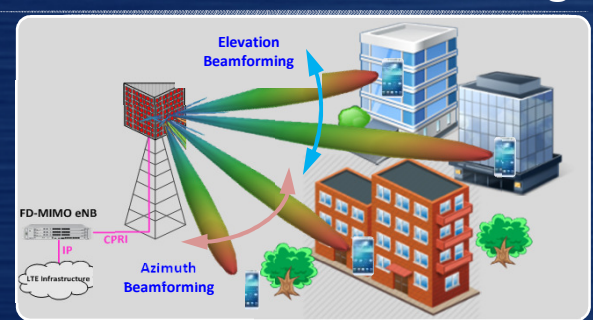
Peak Data Rate
7.5Gbps

[1] "Samsung Electronics Sets 5G Speed Record at 7.5Gbps, Over 30 Times Faster Than 4G LTE", Samsung Tomorrow, 15 Oct 2014. (<http://global.samsungtomorrow.com/?p=43349>)

FD-MIMO (Full-Dimensional MIMO)

Higher Order MU-MIMO with 3D Beamforming - 3-5x network capacity gain (LTE)

MU-MIMO 3D Beamforming



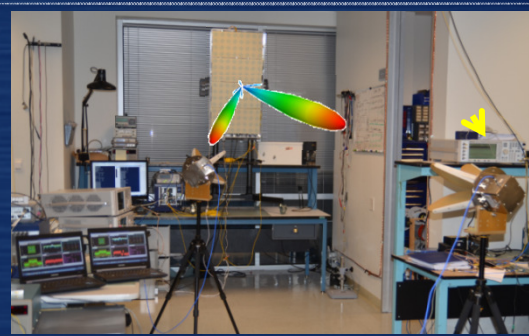
FD-MIMO Prototypes

Macro-Cell BS
(LTE Rel.9)

Small-Cell BS
(LTE Pre-Release)

	Macro-Cell	Small-Cell
Carrier Freq.	2.6GHz	3.5 GHz
BW	10 MHz	20 MHz
Max. Tx Pwr	40 dBm	33 dBm
Array Gain	21 dBi	15 dBi
# TXRUs	32	32
# MU-MIMO	4	8

Indoor Lab. Test

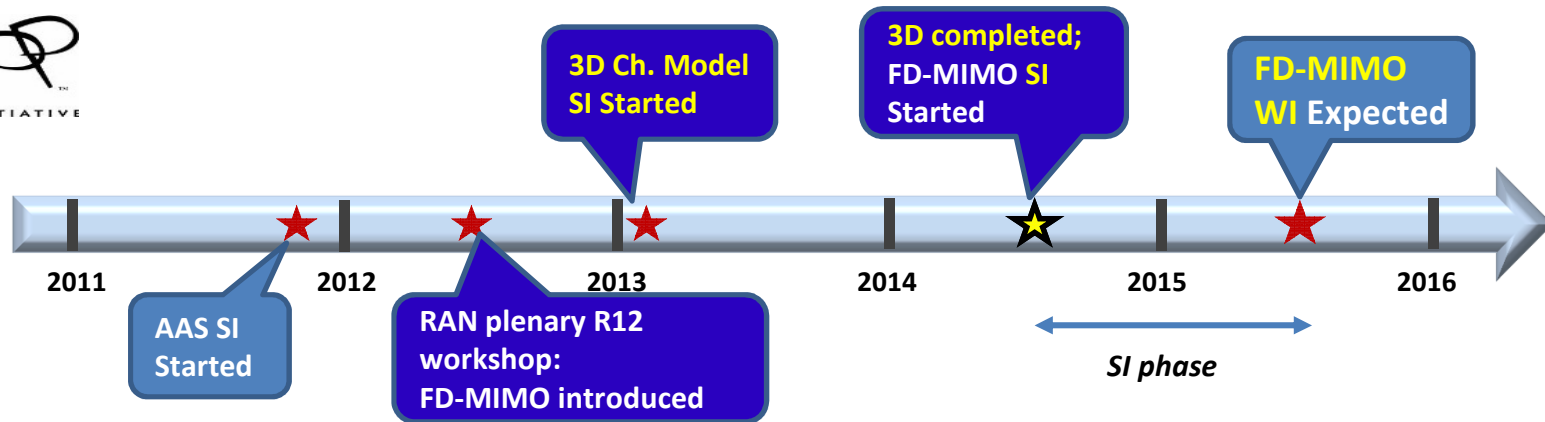


Outdoor Field Test



FD-MIMO in 3GPP LTE Standards

SAMSUNG



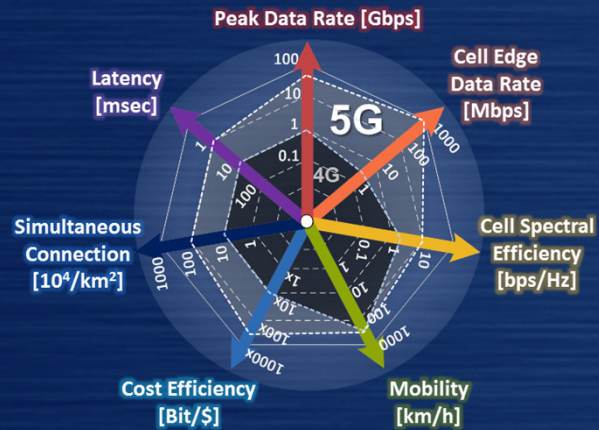
- **R12 workshop**
 - Samsung & Nokia proposed FD-MIMO + 3D channel model
 - Companies agreed to study 3D channel models
- **3D channel model Study Item (SI)**
 - Started from January 2013 to August 2014
 - Samsung served as first Chairman for 3D channel model
- **EBF/FD-MIMO SI**
 - Started October 2014, co-rapporteurs Samsung & Nokia
 - Foundation for potential **R13 Work Item (WI)** leading into specification

Global R&D Activities

Current Global 5G Research Initiatives and Samsung's Active Engagements



Summary: From 2020 Vision to Technologies



Technology	Latency	Simultaneous Connection	Energy / Cost Efficiency	Mobility	Cell Spectral Efficiency	Cell Edge Data Rate	Peak Data Rate
mmWave System	High	High	High	High	High	High	High
Multi-RAT	High	High	High	High	High	High	High
Advanced Network	High	High	High	High	High	High	High
Advanced MIMO	High	High	High	High	High	High	High
ACM & Multiple Access	High	High	High	High	High	High	High
Advanced D2D	High	High	High	High	High	High	High
Advanced Small Cell	High	High	High	High	High	High	High

