



5G IS NOW

MEROUANE DEBBAH

HUAWEI MATHEMATICAL AND ALGORITHMIC SCIENCES LAB

AGENDA

1. 5G MARKET UPDATE

2. 5G DEPLOYMENT ASPECTS

3. 5G USE CASES



The 3rd Paradigm Shift of Mobile Industry is Going to Happen

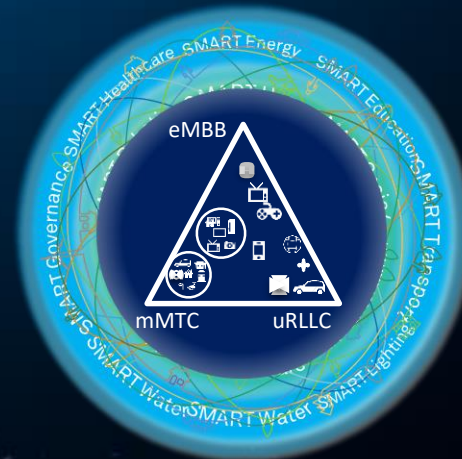
198x



200x



2020~



Voice Era (1G)



MBB Era (3G)



Super Connected World (5G)

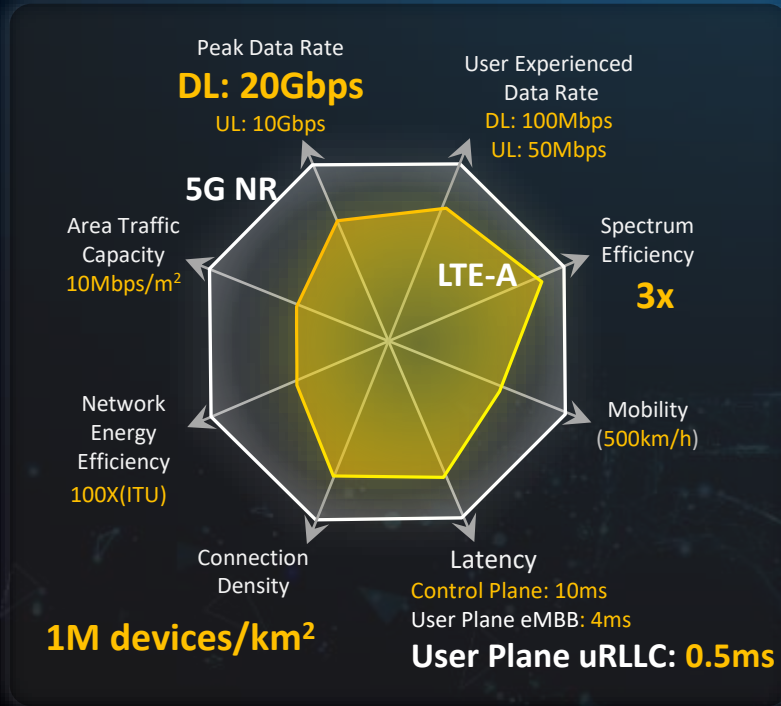
eMBB + uRLLC + mMTC

Connectivity as a Service

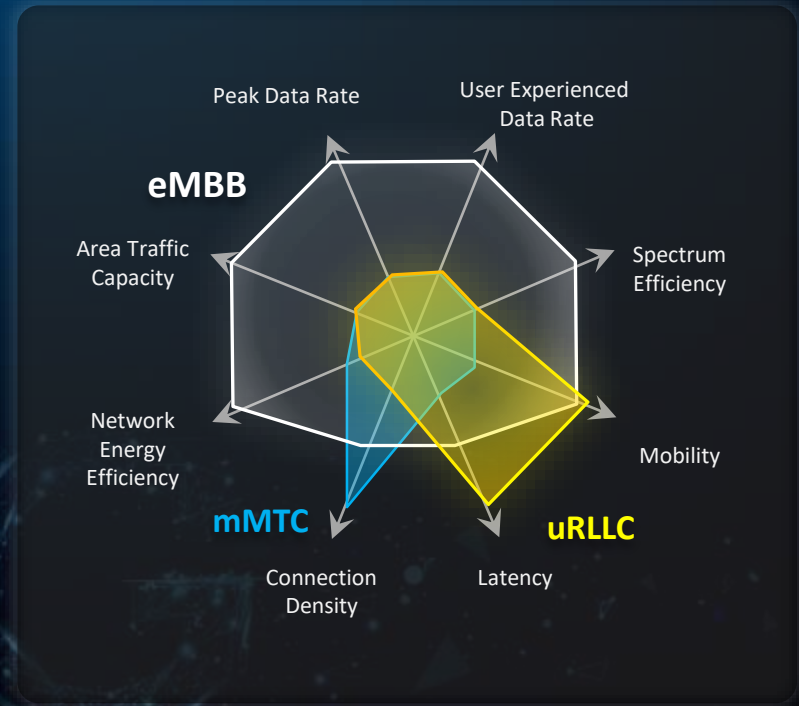
Network Slice as a Service

5G Capability Requirements Defined by 3GPP

3GPP Standardization Targets for 5G NR

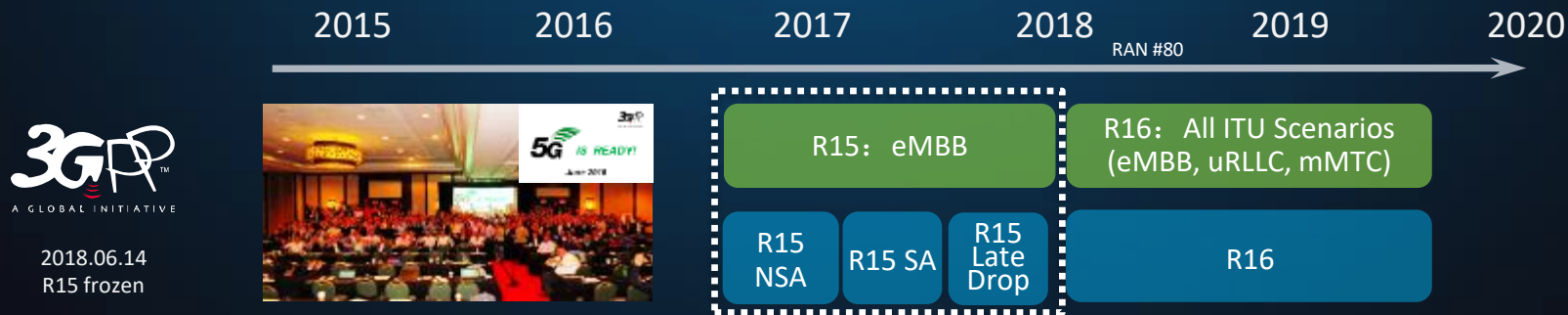


Requirements of Different Services



R15 Enables Ultimate User Experience on eMBB

R15 Builds the Foundation of Commercial 5G Networks



Key 5G Features of Release 15



5G Bandwidth

C band: ~100MHz
mmWave: ~400MHz



NR Air Interface

f-OFDM, Polar Code, LDPC,
UL & DL decoupling



Massive MIMO

4T4R->64T64R
CRS Free, Full Channel BF



eMBB Devices

2T4R as >2.6GHz Basic
Config. HPUE with 26dBm



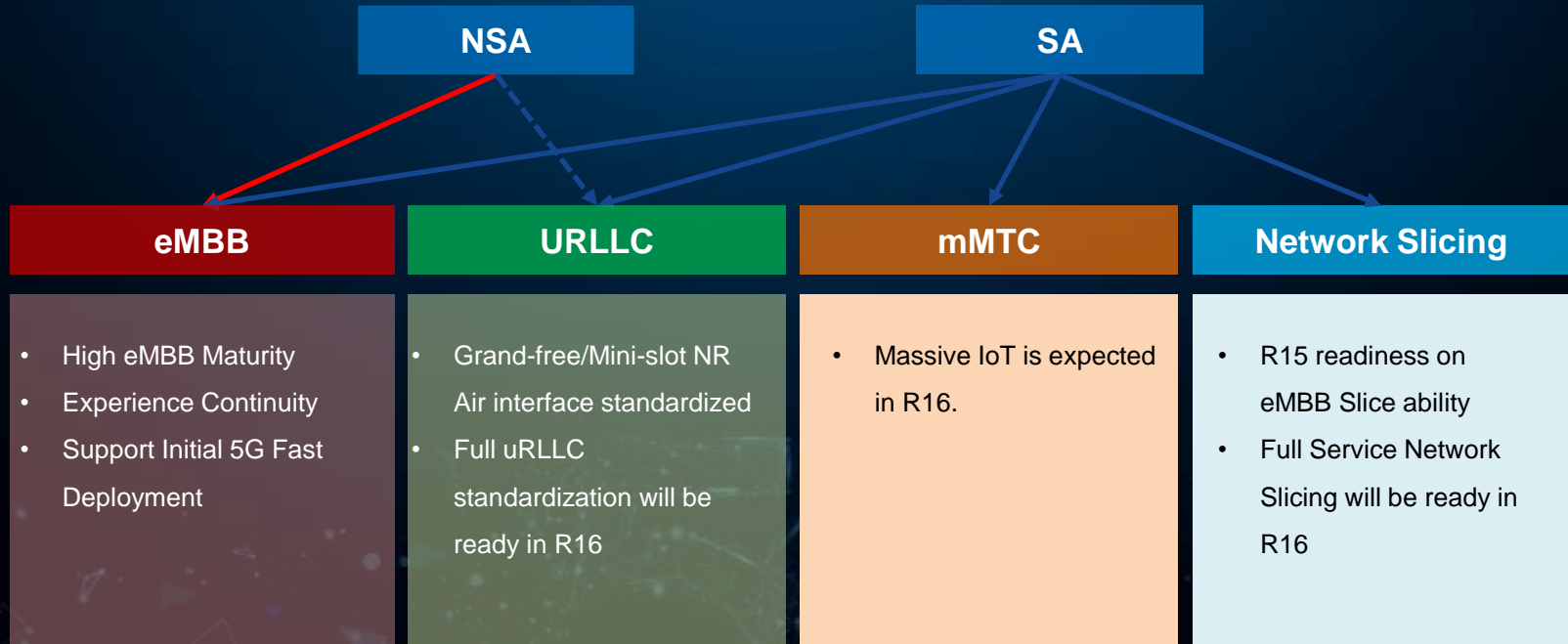
X 10

User Experience

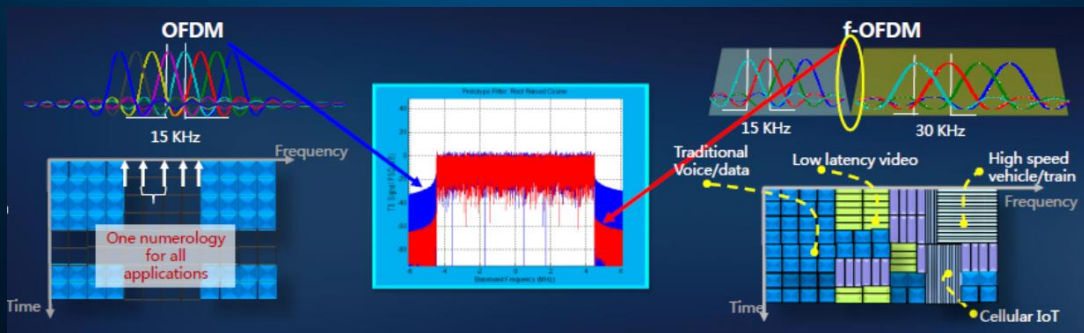
X 20~30

Cell Capacity

NSA Focus on eMBB, SA Support Full 5G Services



NR Flexible Numerology Overview



	NR F-OFDM						LTE OFDM
SCS (kHz)	15	30	60	120	240	480	15
Max BW* (MHz)	50	100	200	400	400	400	20
TTI (ms)	1	0.5	0.25	0.125	0.062	0.031	1
TDD Sync Req	3us	3us	3us***	3us***	3us***	3us***	3us
Guard**	4%	4%	4%	4%	4%	4%	10%

*Max 275RB up to 120kHz, 14 symbols per TTI, 12 SC per RB, same as LTE

** Flexible Spectrum, F-OFDM

*** May need skipping one TDD symbol, some assumption about >6GHz

New Waveform & Channel Coding

F-OFDM



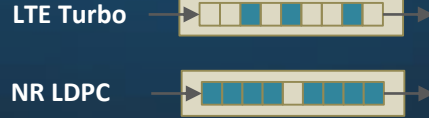
LTE: 10% Guard Band



NR: ~4% Guard Band

Less guard band increase **6%+**
SE

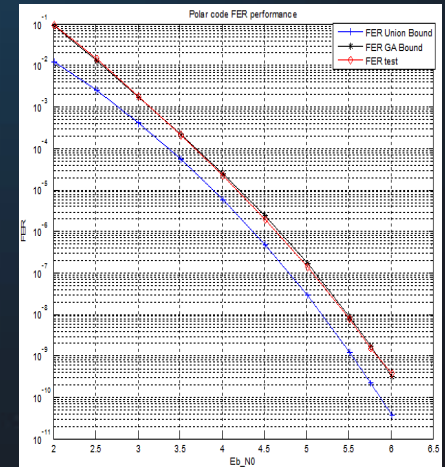
LDPC Coding



	Turbo	LDPC
Decodability	30%	90%
Decode Latency	1X	1/3
Chip Area	1X	1/3
Power Consumption	1X	1/5

eMBB UP
Reduce UE Power
Consumption vs Turbo

Polar Coding



eMBB CP
Coverage gain: ~**0.5dB** vs
Turbo

5G Spectrum Release is Speeding Up

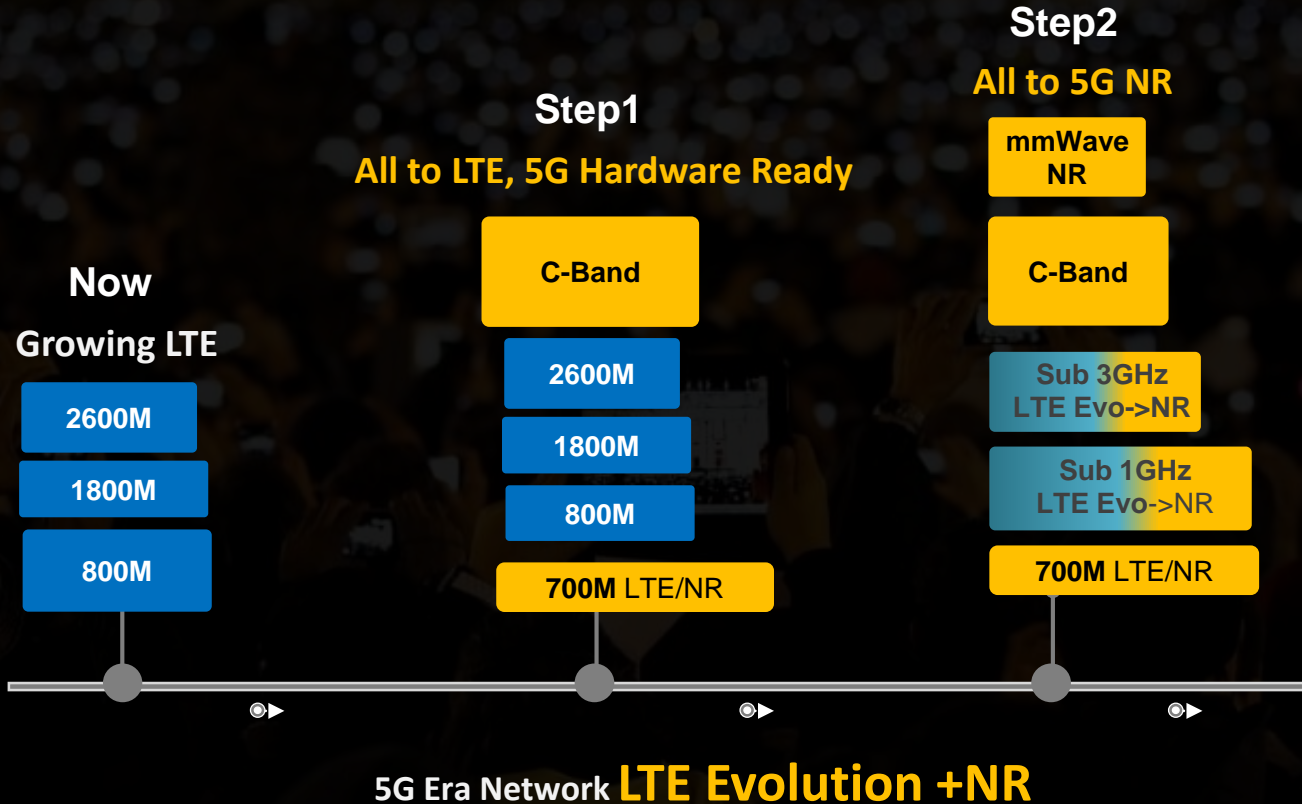


Global 5G Spectrum Auction Plan

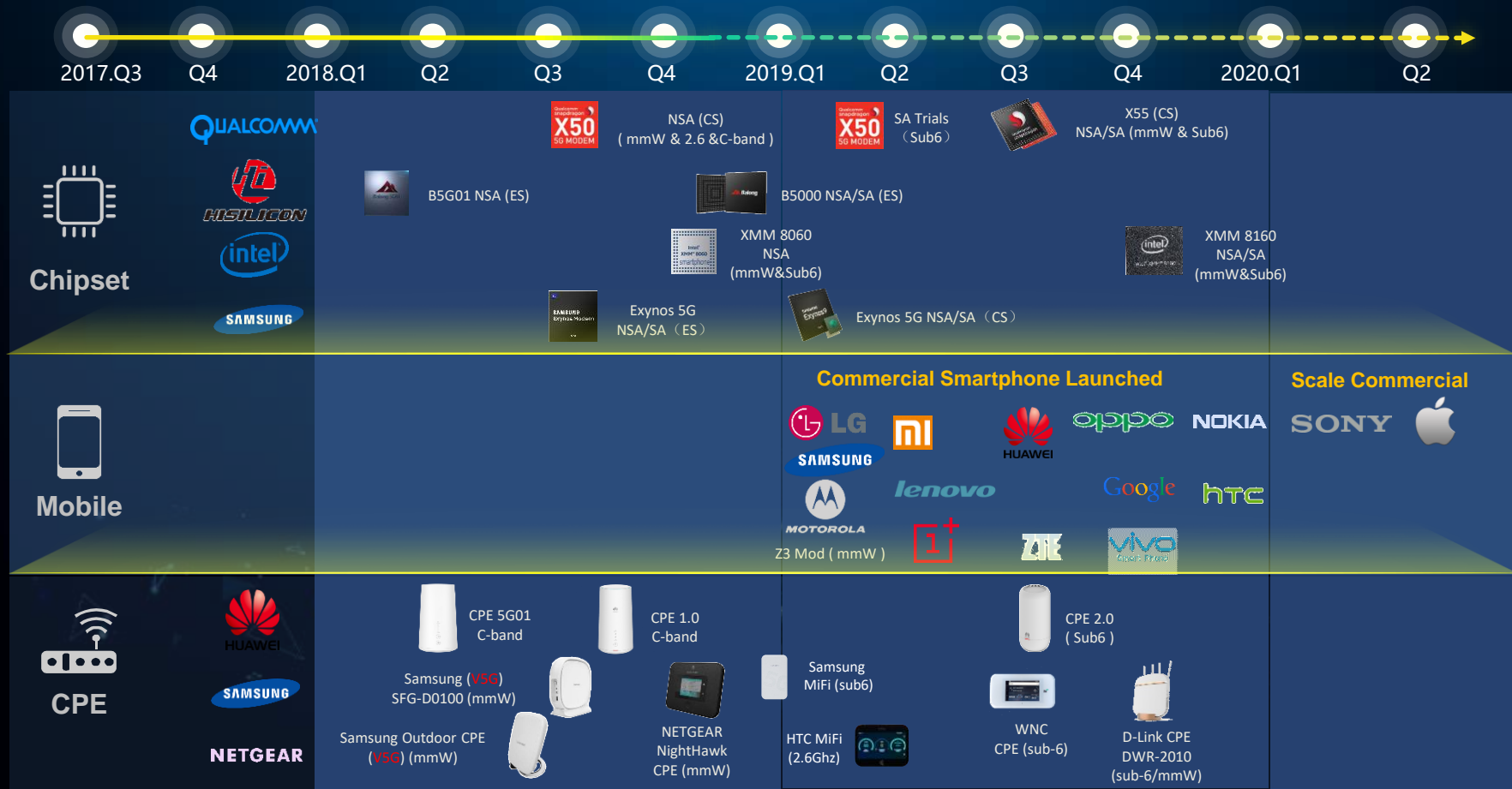


C-Band Becomes Globally Harmonized 5G Spectrum

All Bands Go to 5G



Ecosystem Drive 1st Wave 5G Commercial launch in 2019



5G is Now, Industry

In 2019, Leading Operators will Launch 5G Service...

X,000 sites
C-Band/2.6G/4.9G Trial

2018

London
BT
X,000 Sites
C-Band

Seoul
LG U+
x0,000 sites
C-Band

2019

China, 15 Cities



xx0,000 sites
C-Band/2.6G/4.9G

20+ countries will finish 5G
spectrum Action in 2019:

Australia, Finland, UK, Spain, Korea, USA,
UAE, Kuwait, KSA, Qatar, Bahrain, Oman
Austria, Belgium, China, Denmark, France,
India, Japan ...

2020

World's First E2E 5G Commercial System

5G E2E commercial systems

launched by September 30, 2018



1st
End-to-end 5G system



Core



Transport



C-Band



mmWave



BBU



CPE



5G
smartphone

Ascend 910

Cloud computing AI chip with
greatest computing density

Kunpeng 920

Arm-based Processor with
Highest performance



- No.1 Market Share
- More than 1M pcs
shipment/year



1st 7nm

5G baseband chipset

Kirin 980

World's first commercial 7nm
AI chip for smartphones

3GPP-Based 5G Commercial/Pre-Commercial Cooperation

50

3GPP-Based
5G Commercial/Pre-Commercial Contract
In 20+ Countries



*Due to the limitation of NDA, some of the 5G Commercial contact can't be disclosed.

AGENDA

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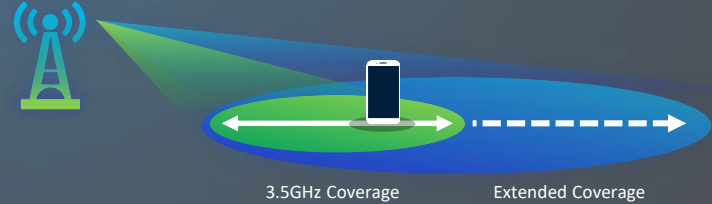


3 Big Challenges from 5G Deployment



1

5G Invests More Sites than 4G



2

High Cost for 5G Sites Modernization
(Antenna, Wind Load, Power)

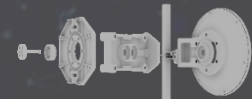


+3000W



3

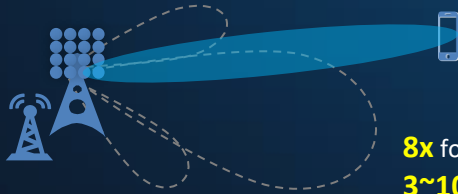
Fast TTM
(Automation, E2E)



5G Massive MIMO Ultimate Experience

Coverage Improvement

Further coverage



8x for horizontal coverage
3~10x for vertical coverage

Deeper coverage



8~20dB gain for vertical coverage
 Better for 30 floors high building

Capacity Improvement



MU-MIMO Pairing maximize cell capacity
16 layers multi-user beam forming
5Gbps DL cell throughput

User Experience Improvement

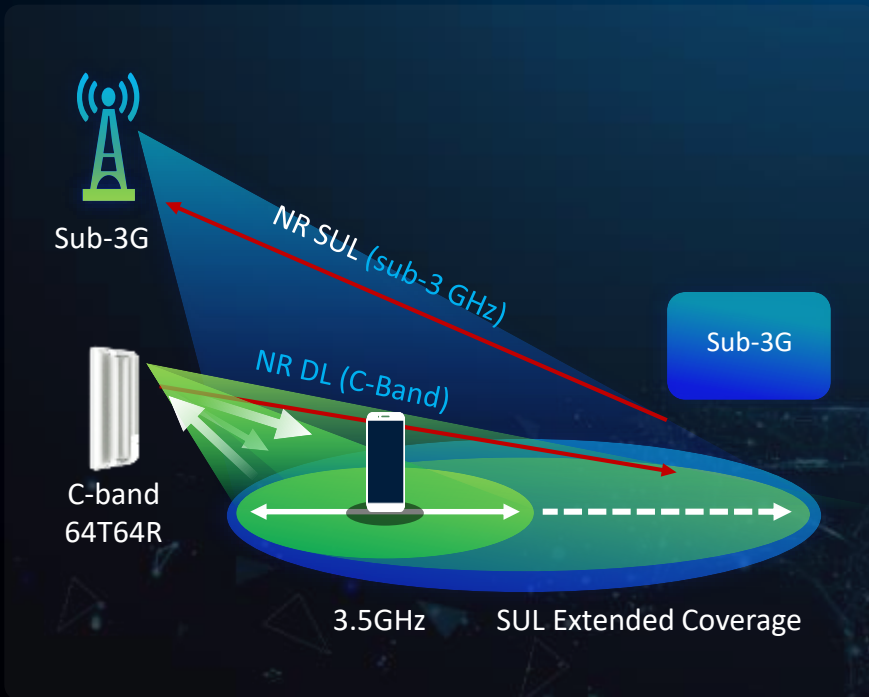


SU-MIMO multiple stream max single user experience
2.8Gbps DL peak THP@ 4T8R
1.5Gbps DL peak THP@2T4R

UL & DL Decoupling Enable Sub-3GHz to Improve NR UL Coverage

Sub 3G for NR SUL

Standard & Industry



Definition of UL & DL decoupling



- DL 3.3G~3.8G + SUL 700/800/900/1800/2100M
- DL 4.4G~5.0G + SUL 900/1800M



Supports SUL Full Bands



UL DL Decoupling IoDT Testing with HW



UL DL Decoupling Planning in 18Q4

...



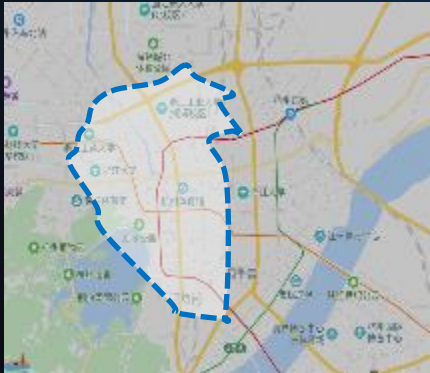
NOKIA

...

UL Spectrum can be dynamically shared between LTE & NR

UL & DL Decoupling Reduces New Sites Acquisition

Decoupling trial in Hangzhou



Hangzhou Wulin

Existing 1.8G sites: 119

Average distance: 346m

Area: 12.2km²

Architecture: SA

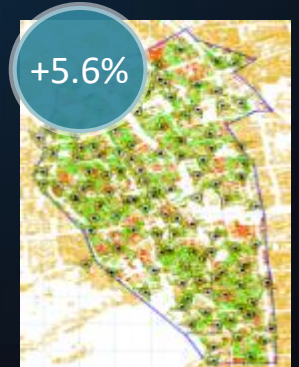
5G target UL data rate: **5Mbps** (90%)

Half Sites Reduction in Dense Urban



Decoupling Disabled

Sites Num. : 143+106



Decoupling Enabled

Sites Num.: 143+8

**2018 May, China Hangzhou, based on SA*

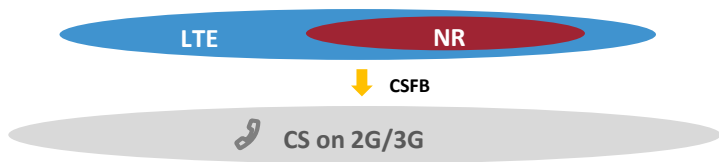
Voice: VoLTE Preferred for NSA, VoNR Preferred for SA

NSA(Option 3x)

- **VoLTE** with good experience, LTE wide coverage, ~2s access

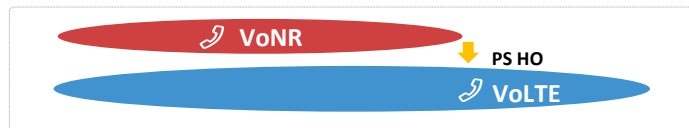


- **CSFB** when VoLTE isn't deployed, 2/3G national coverage, ~6s access

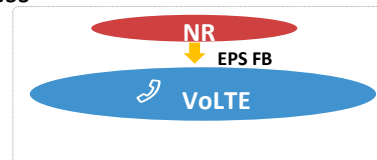


SA(Option 2)

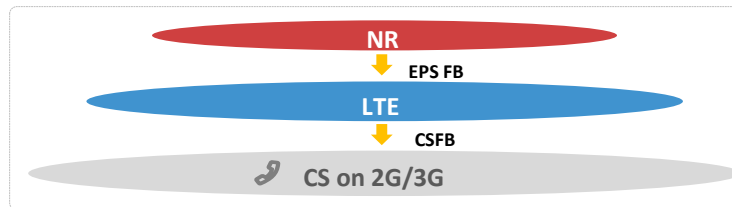
- **VoNR**: 1.5~2s access, PS Handover to 4G VoLTE at cell edge



- **VoLTE** when VoNR doesn't support, EPS FB to 4G VoLTE, 3~4s access



- **CSFB** when VoNR/VoLTE isn't deployed, 2 times FB, ~8s access



SingleRAN Pro Solution for OFR Target Network Site With Only 8 Modules

Multi-band Antenna
Sub-3GHz All-in-one

3 MODELS OF 5G AAU

AAU5613 – 64T64R, 200MHz, 200W
AAU5313 – 32T32R, 200MHz, 200W
AAU5310 – 32T32R, 100MHz, 100W

3 MODELS FOR ALL SUB 3GHZ BANDS

RRU5509t – 7/8/9, 2T4R, 2x140W
RRU5502 – 18/21, 4T4R, 4x80W
RRU5301 – L2600, 4T4R, 4x40W

1 RRU 5G 3500MHZ

RRU5258 – 8T8R, 200MHz, 240W

APM5930
Power & Battery

1 BBU5900
Multimode BBU for All RAT

Simple: 2 poles for 1 sector

Super Capacity: 25Gbps

Convergence: 2/3/4/5G All in One

1 CONTROL BOARD PER SITE

UMPTg

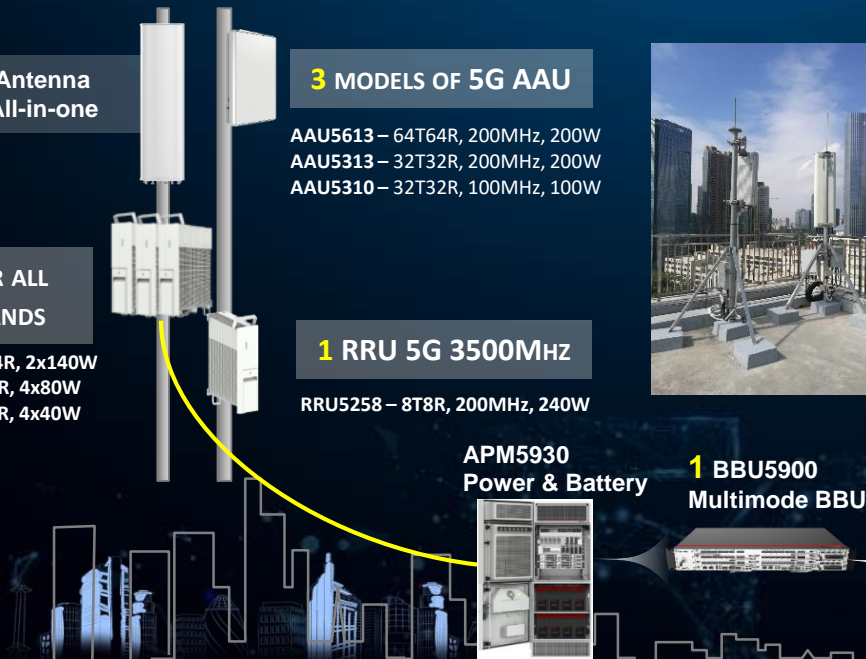
- Cell: 108
- RRC: 7200
- Transmission: 25Gbps

2 BASEBAND BOARDS PER SITE

UBBPg

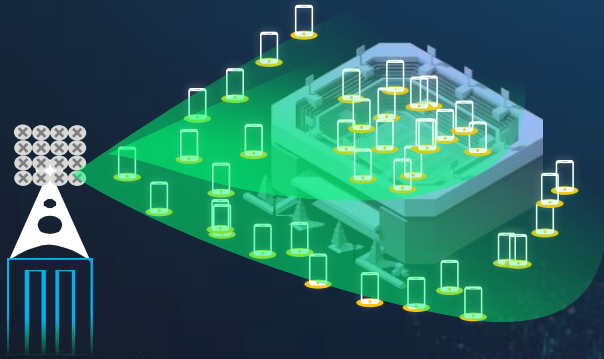
- C-Band: 3*100M
64TRx + 3*20M 4R

UBBPg2a – 3x100M 64T64R + 3x20M 4R
UBBPg2 – 12x20M LTE 4T4R (multi-mode)



Optimal MM Pattern Enables Best Performance Efficiently

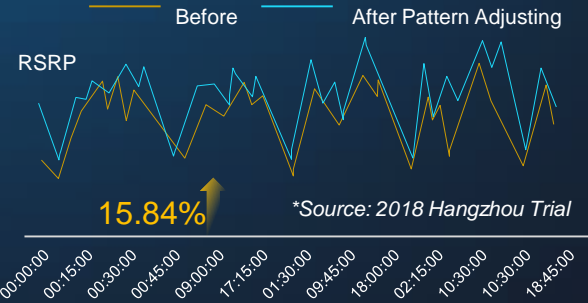
AI-Based Massive MIMO Self-Adaption



Static → Dynamic

Manual → Automatic

15.84% Network Performance Improved



Optimize Time

Performance

Efficiency



< 1 Hour

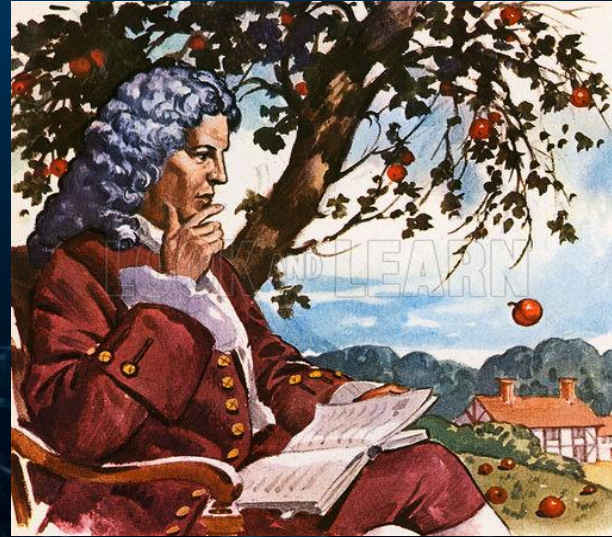
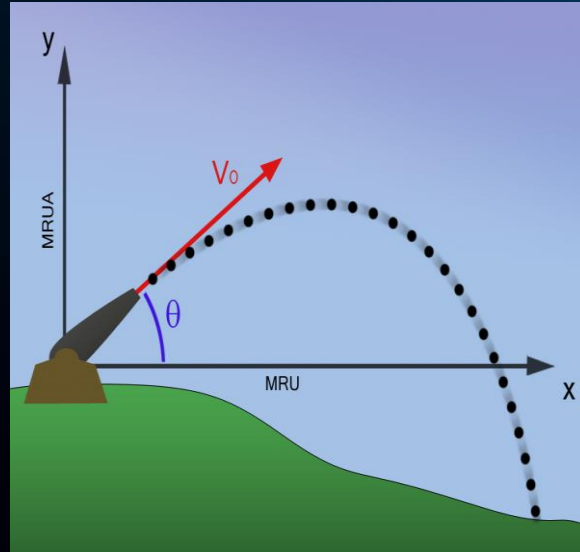


20% ↑



4x

AI based Massive MIMO Self-Adaptation: how does it work?



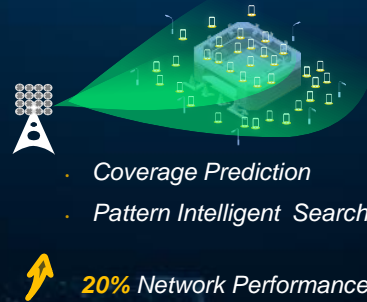
Automation Network Management Ease Multi-RAT & Multi-Service OPEX

Site Automation



PnP:
Quick Deployment
1 Hours Per Site

Network Automation



Smart MM:
AI-Based Feature
20% Extra Gain

Service Automation

Service Provisioning

Service Deployment

Service Evaluation

X Suites: WTTx Suite ...



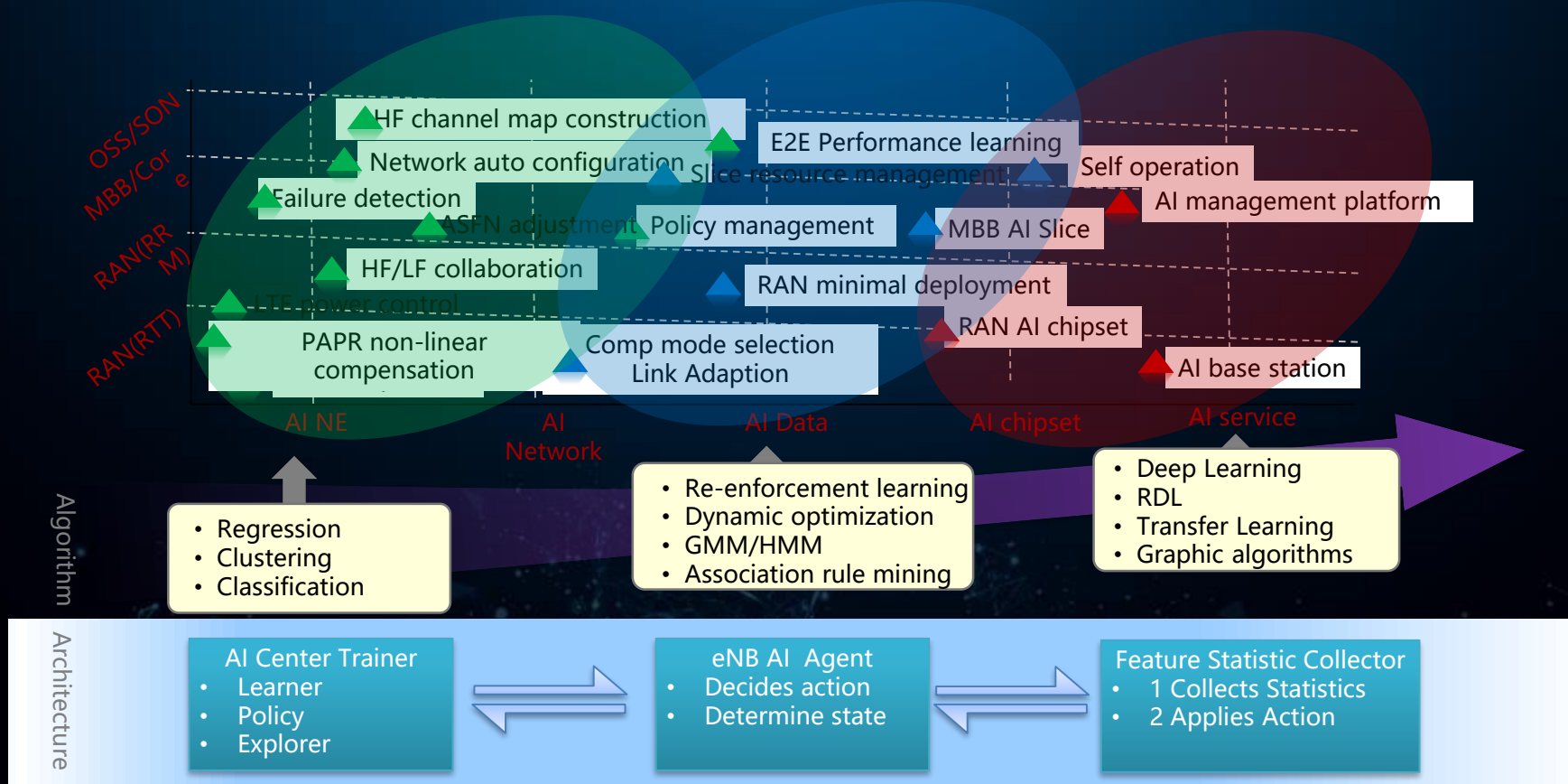
Service Visualization

Network » Service » Terminals



WTTx Suite:
Quick Win WTTx
5 min to issue Service

AI in 5G



AGENDA

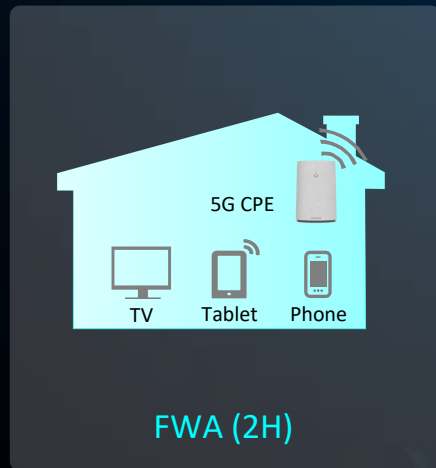
1. 3GPP STANDARD UPDATE, MARKET PROGRESS UPDATE

2. GO FOR DEPLOYMENT: SITE READINESS

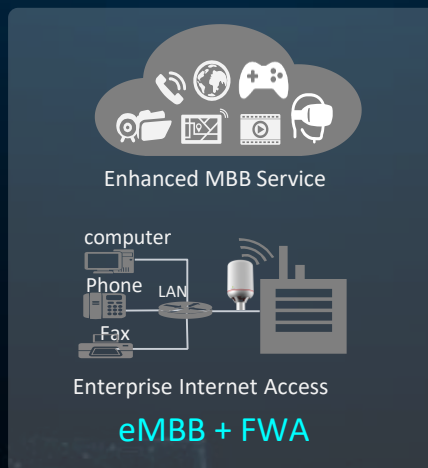
3. GO FOR BUSINESS: USE CASES

Huawei Understanding for 5G Business

2018 Phase I



2019-2020 Phase II



2021- Phase III



Branding: High Value Area

Offloading: High Traffic Area

Coverage: 100Mbps everywhere

Down Link 100Mbps
Up Link 5Mbps
Latency 20ms

300Mbps
50Mbps
10ms

10Gbps
100Mbps
1ms

5G is Now, Business Value

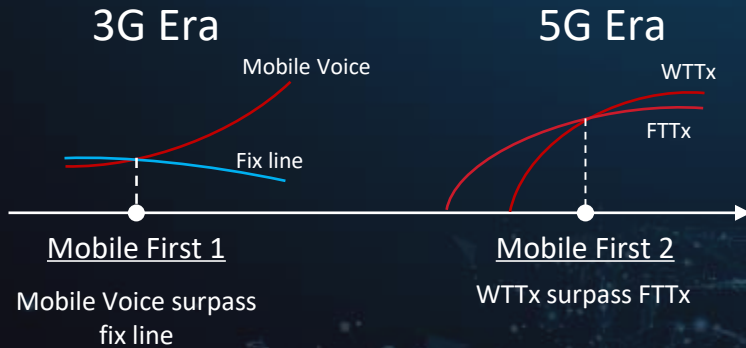
eMBB Brings New Level: WTTx and Video “Mobile First”

Mobile First

WTTx will become mainstream in 5G

All Video

Mobile Video, AR/ VR Will be Boosting in 5G



Already Happened

Will Happen

Monitor Smartphone HD TV VR/AR/Holography



Early Stage: Smartphone, HDTV, ~4K VR

Later: 8K TV/VR

Resolution	2D	3D
720P	~1.5Mbps	-
1080P	~4Mbps	-
2K	~10Mbps	-
4K	~25Mbps	~50Mbps
8K	~100Mbps	~200Mbps

Operators will Get More Revenue from 5G FWA

Tuttimus

The all-in of your choice



As from
€69 /month
during 4 months
+ free installation

+ Webdeal
€30
extra discount



Mobile

+



Internet

+



TV

+



VR

+



CloudX

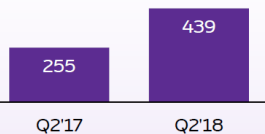
from today **25 USD/mon.** + future **X USD/mon.**



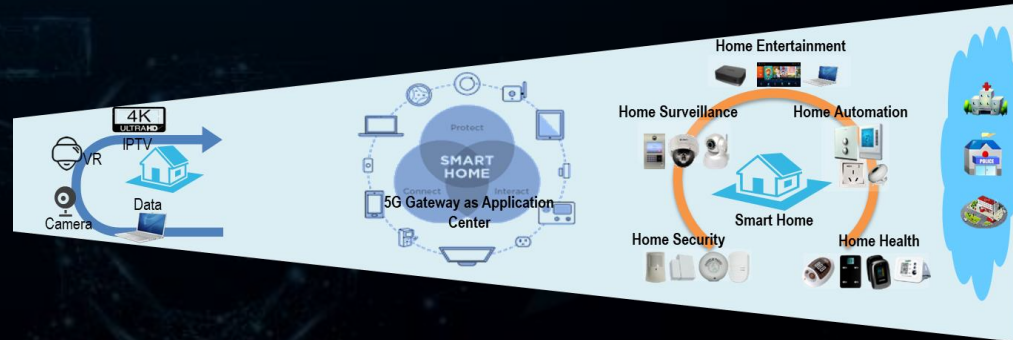
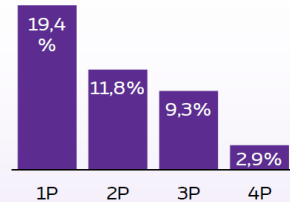
Multi-Play User with Higher Loyalty and Tariff

Strong uptake of all-in offers, increasing 4-Play HH/SO

Tuttimus/Bizz All-in subscribers in '000



More Plays results in lower full-churn levels



FWA is Profitable Business in Kuwait

Simple 5G FWA Business Case



< 3 Years

ROI
Calc.

<i>Basic</i> x Mbps 30 KD/m	63000 HH User	12000 B2B User	Revenue
748 Sites	2M KD/year Spectrum	500\$/site/m OPEX	

~75,000 (70%+30%) Subscribers @30KWD ARPU Pays for >700 5G sites less than 3 years

European Case: 5G FWA Development Plan

2018~
MidCap

30 Mbps DL
Speed

11 FWA Users/Cell

L18 4T4R 20M
L8 2T2R 10M

Peak: 500 Mbps
10% MBB + 60% WBB

2018~
MaxCap
p

100 Mbps DL
Speed

14 FWA Users/Cell

L26 4T4R 20M
L21 4T4R 20M
L18 4T4R 20M
L8 2T2R 10M

Peak: 1 Gbps
10% MBB + 60% WBB

2020
~

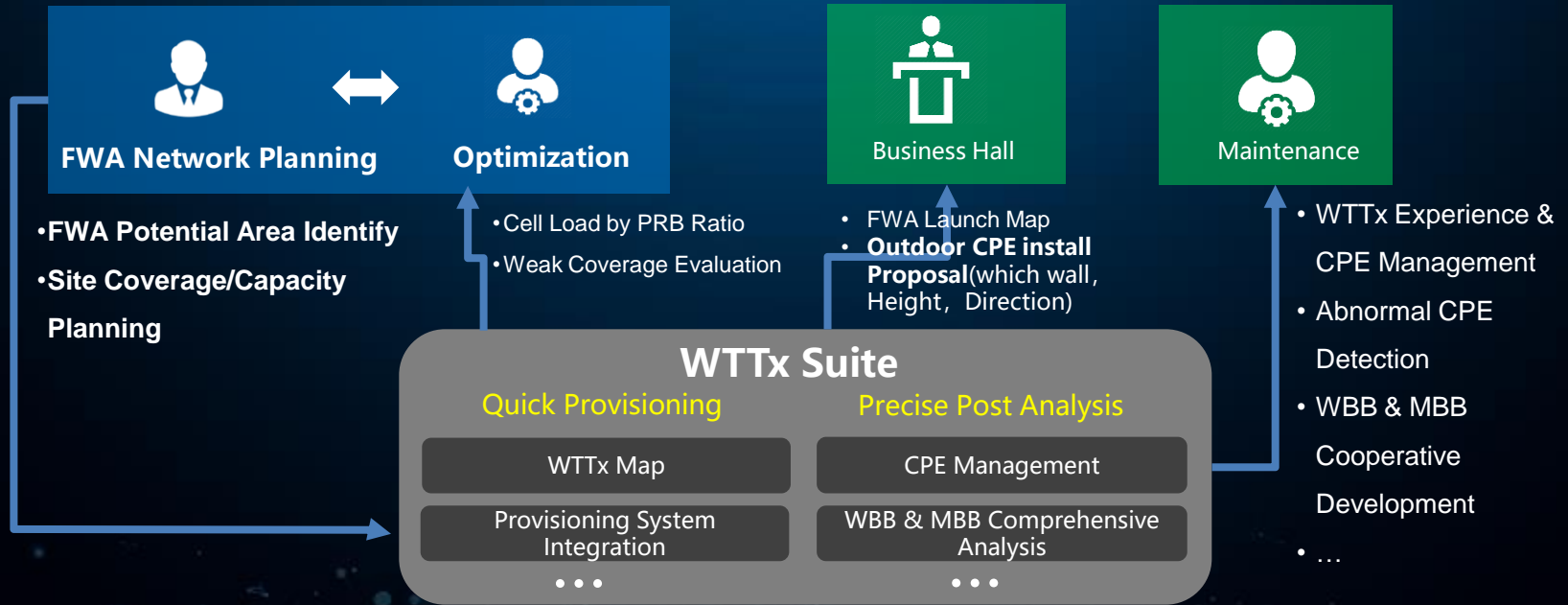
500 Mbps DL Speed
24 FWA Users/Cell

NR 100M
(C-Band)

L26 4T4R 20M
L21 4T4R 20M
L18 4T4R 20M
L8 2T2R 10M

Peak: 6 Gbps
15% MBB + 55% WBB

Enable FWA Quick Win with WTTx Suite



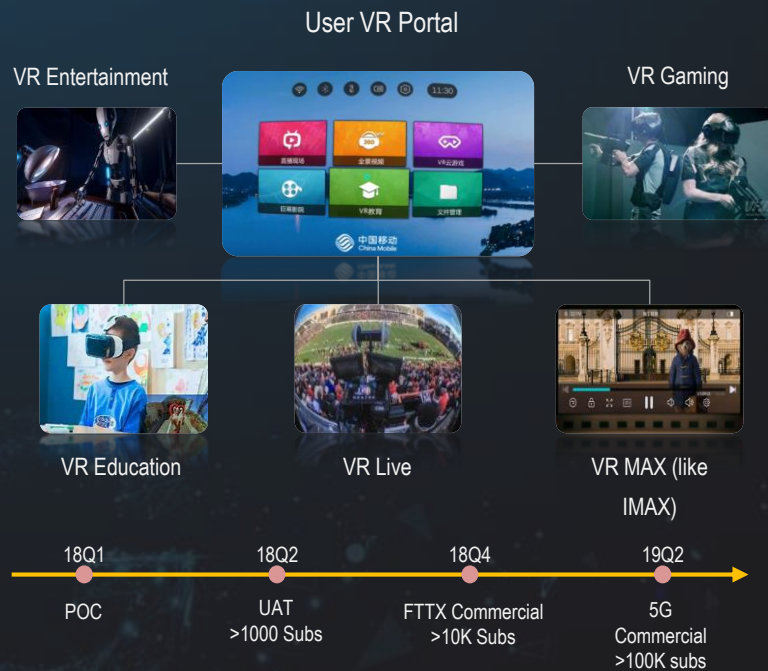
- **Accurate FWA Launch map accelerates market occupation**
- **Easy O&M Reduce TCO & Churn Rate**

Cloud VR Business is Accelerating

Huawei Cloud VR Ecosystem



Fujian Launching 5G Based VR Service

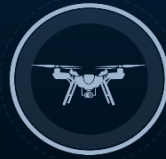


More Services will be Coming in This 5G Network



Cloud VR

60% CAGR (2020-2030)



Drone

60% CAGR (2020-2023)

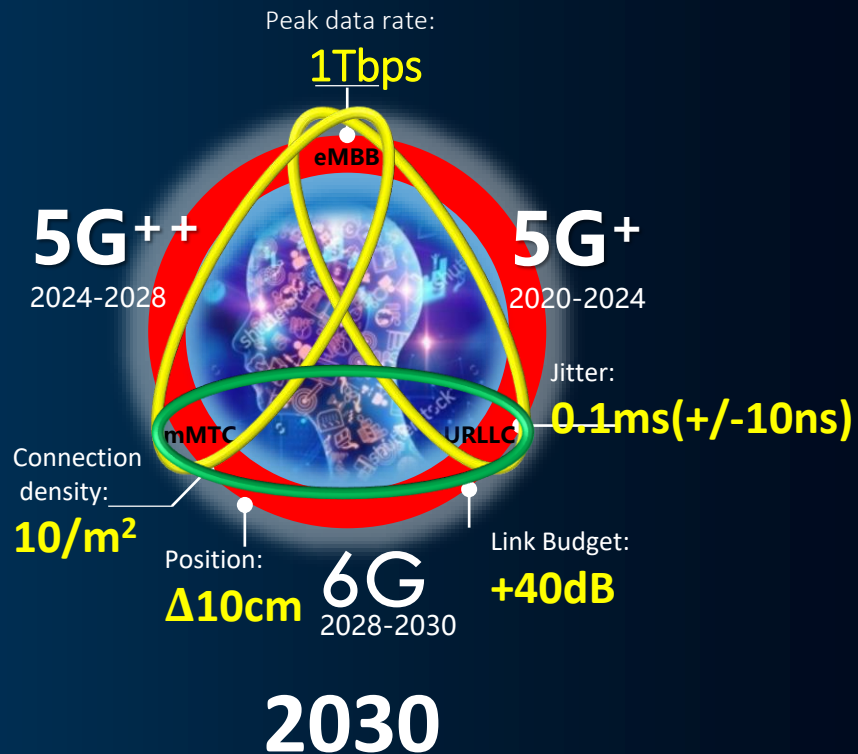
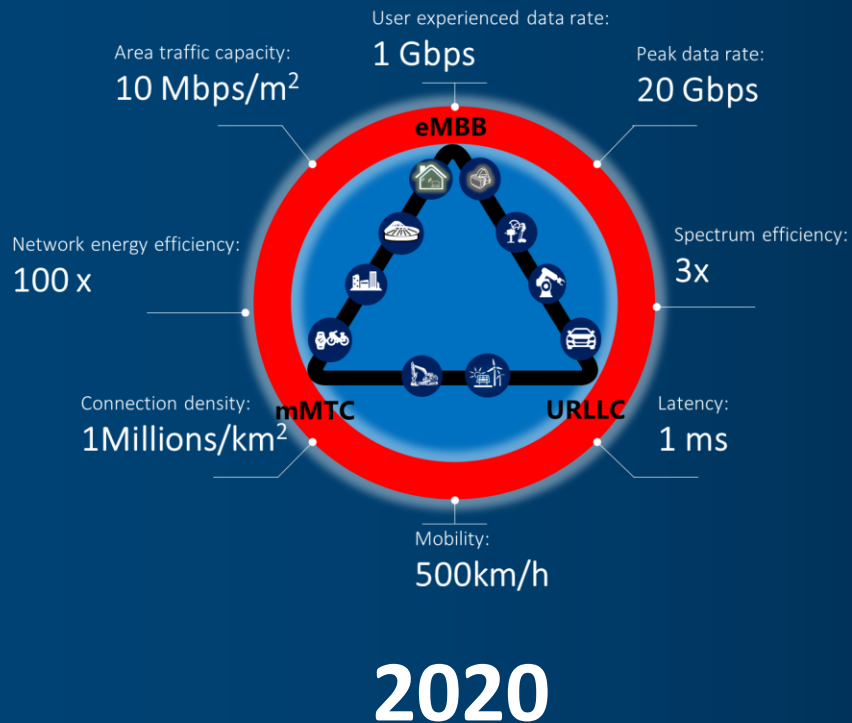


Transportation

58% CAGR (2020-2030)

Source: Analysys Mason

Beyond 5G



Thank You