

ZTE Leading 5G Innovations

5G FORWARD

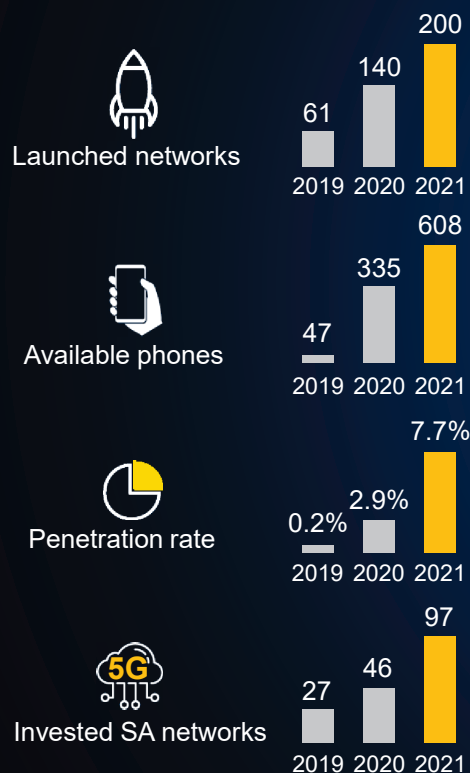
ZTE's Vision & Capability

Topics:

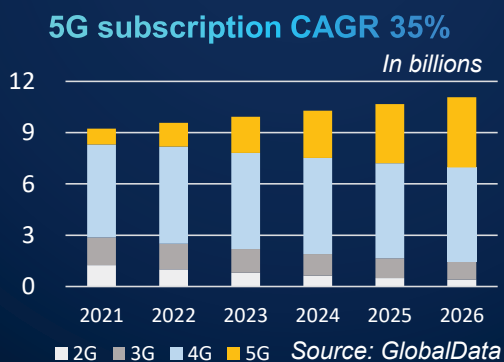
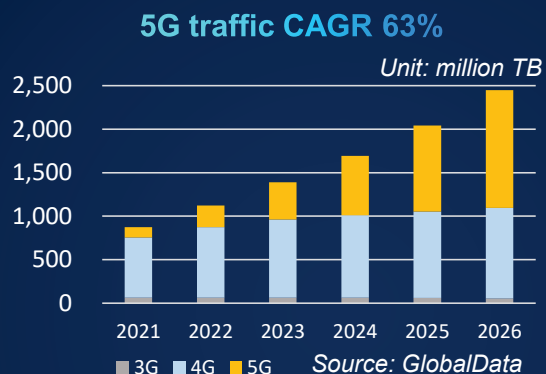
- 1 5G Status & Trends
- 2 5G Frequency Bands and Applications
- 3 2/3/4G to 5G Network Migration
- 4 Spectral Efficiency Technology
- 5 5G Private Network
- 6 Leading 5G to Commercialization

Global 5G commercialization now in the fast track with huge potentials

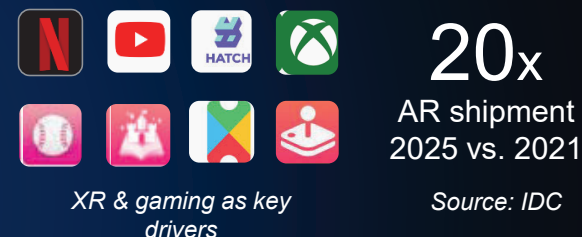
5G in the fast track



5G's huge potentials



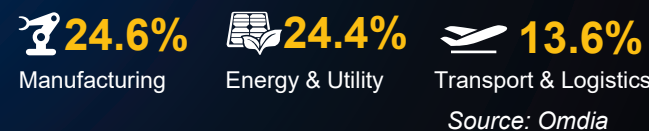
Driven by B2C & B2B



More industries to be transformed by 5G

30.5% B2B mobile market size CAGR 2021-2026

Top 3 private networks (share in 2025)



Different phases and challenges need prioritization and tailored solutions



Initial development



Coverage Hotspot only



Penetration rate > 0%



Service enhancements



Scale development



Coverage Urban



Penetration rate ~10%



More new applications



Massive-scale development



Coverage Urban, suburban & rural



Penetration rate ~20% or higher



More B2C & B2B applications

Easy kickoff

Easy & fast 5G deployment is the top priority

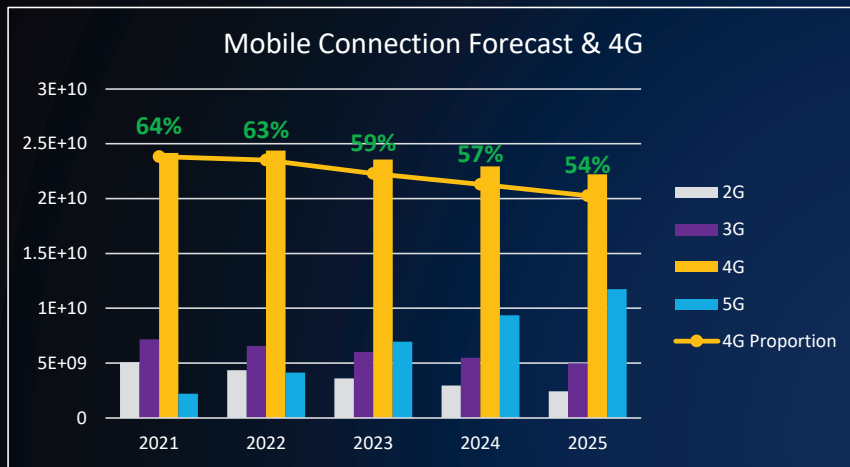
Quality network

High-performance and efficient 5G network is critical to quality

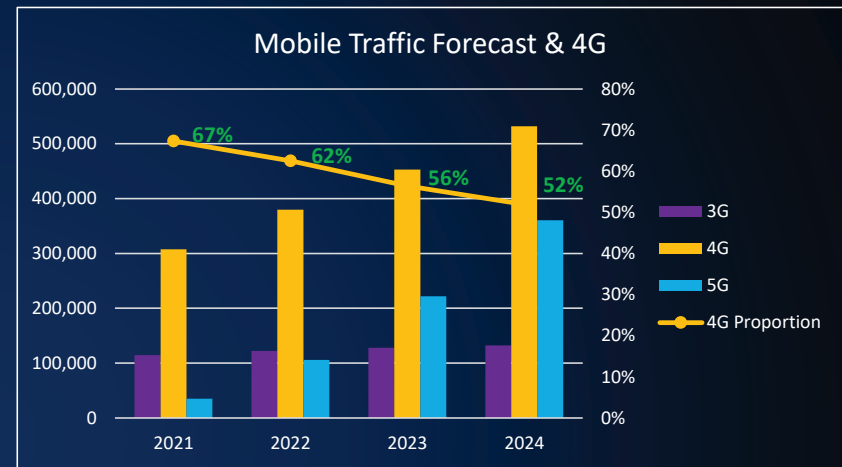
All-round monetization

Monetization is the way to 5G value creation

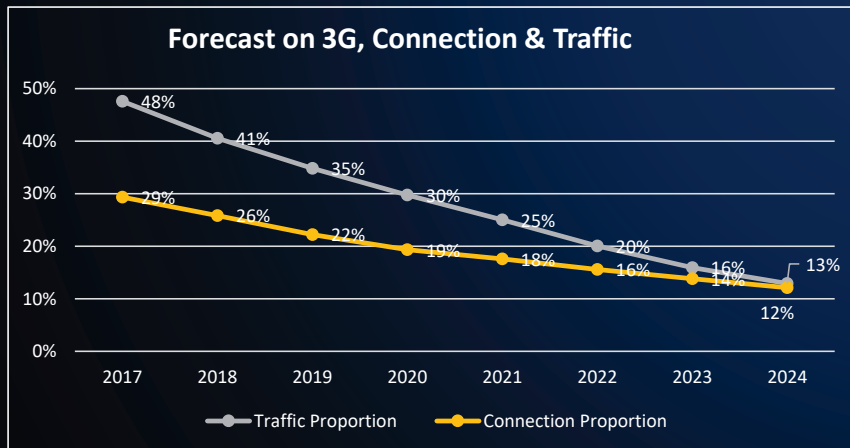
Phasing out 2G or 3G is not easy and 4G will continue to play a key role



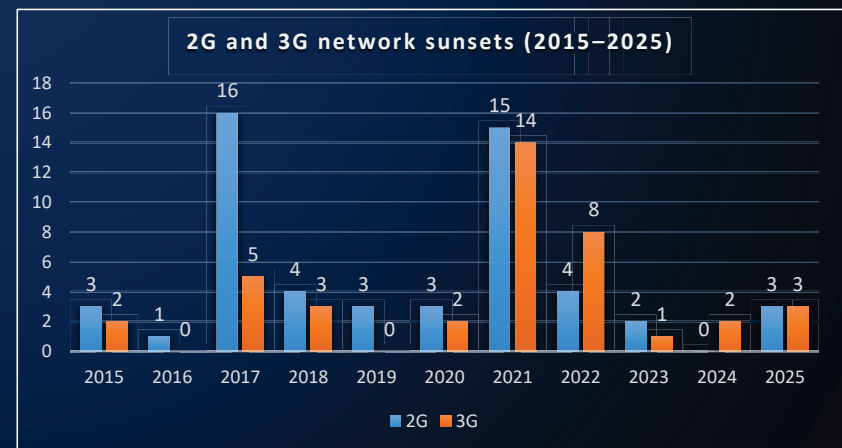
Source: Omdia, Feb. 2021



Source: Omdia, Feb. 2021

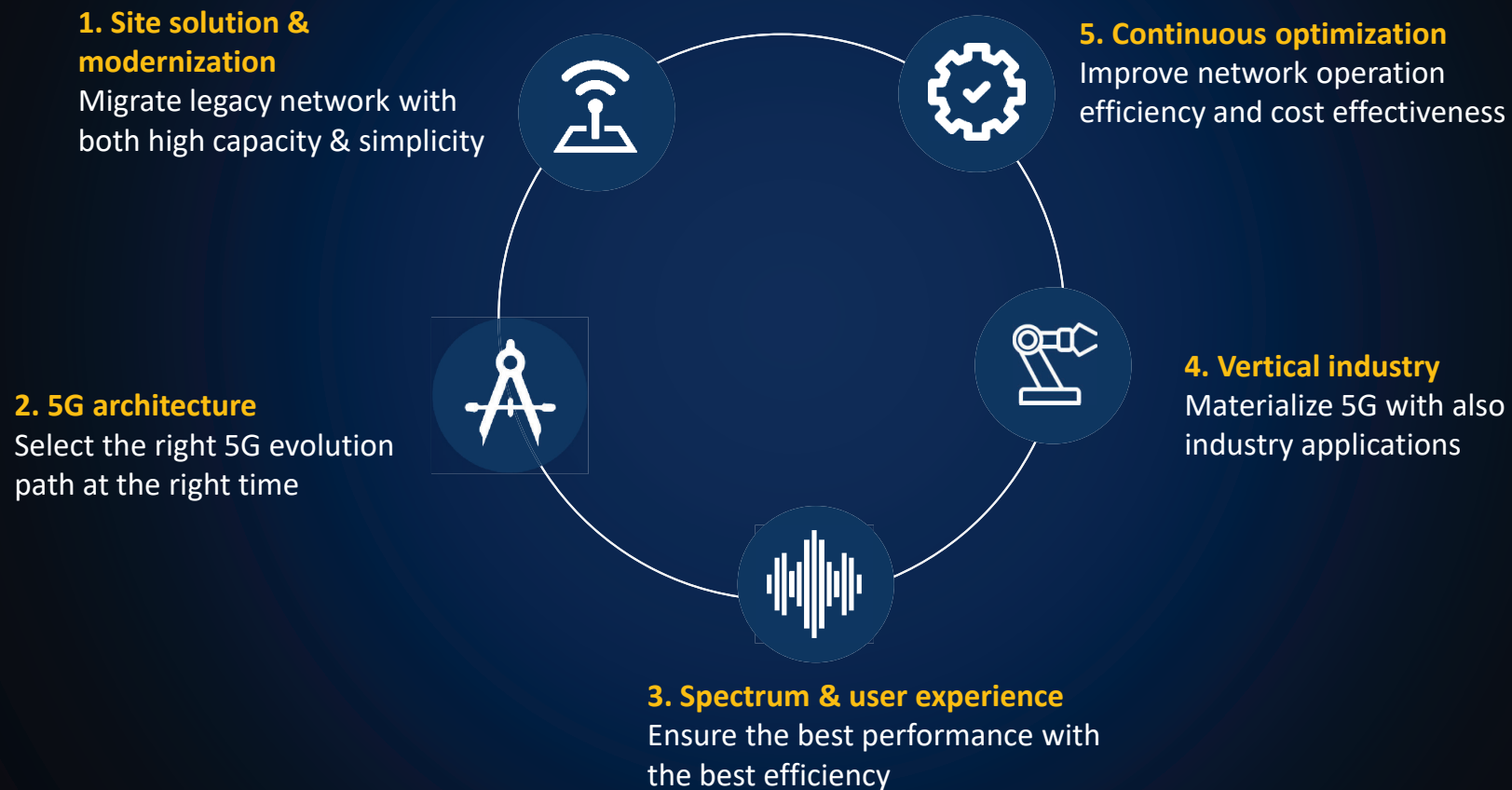


Source: Omdia, Feb. 2021



Source: GSMA, Feb. 2021













Challenges to tackle for materializing 5G









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5G Frequency Band

	<1 GHz	3 GHz	4 GHz	5 GHz	24 – 30 GHz	37 – 50 GHz	64 – 71 GHz	>95 GHz
	600 Mhz	2.5 / 2.6 GHz	3.45-3.55 GHz 3.7 GHz 4.3 GHz	5.9-7.1 GHz	24.25-24.45 GHz 24.75-25.25 GHz 27.5-28.35 GHz	37-37.6 GHz 37.6-40 GHz 47.2-48.2 GHz	64-71 GHz	>95 GHz
	600 Mhz		3.475-3.65 GHz		26.5-27.5 GHz 27.5-28.35 GHz	37-37.6 GHz 37.6-40 GHz	64-71 GHz	
	700 Mhz		3.4-3.8 GHz	5.9-6.4 GHz	24.5-27.5 GHz			
	700 Mhz		3.4-3.8 GHz 3.8-4.2 GHz		26 GHz			
	700 Mhz		3.4-3.8 GHz		26 GHz			
	700 Mhz	2.6-2.62 GHz	3.46-3.8 GHz		26 GHz			
	700 Mhz		3.6-3.8 GHz		26-26.5 GHz			
	700 Mhz	2.5 / 2.6 GHz	3.3-3.6 GHz	4.8-5 GHz	24.75-27.5 GHz	40-43.5 GHz		
	700 Mhz	2.3-2.39 GHz	3.4-3.42 GHz 3.7 GHz 4.0 GHz	5.9-7.1 GHz	25.7 - 26.5 GHz 26.5 GHz 28.9 GHz 29.5 GHz	28.9 - 37.5 GHz 37.5-38.7 GHz		
			3.6-4.1 GHz	4.5-4.9 GHz	26.6 - 27 GHz 27-29.5 GHz	39-43.5 GHz		
	700 Mhz		3.3-3.6 GHz		24.25-27.5 GHz 27.5-29.5 GHz	37-43.5 GHz		
			3.4-3.7 GHz		24.75-27.5 GHz	39 GHz		

 Existing band
  Licensed band
  Unlicensed band
  Local band
  Possible Local band
  Metropolitan band

Sources: [5G Observatory](#), [Qualcomm](#)

N78 will be the Prime Band for Initial 5G Deployments

5G Technology Laid Foundation for New Business



	R15 NSA	R15 SA	R15 Late Drop	R16: NR Enhancement	R17: NR Enhancement
Network	Option 3	• Option 2 & 5	• Option 4 & 7	All Options	All Options
Scenarios	eMBB	• eMBB/uRLLC	• eMBB/uRLLC	eMBB/uRLLC/mMTC	
Technologies	<ul style="list-style-type: none"> DC(dual-connectivity) 5G QoS Enhancement 	<ul style="list-style-type: none"> SBA Network Slicing VoNR 4/5G interoperability 5G MEC 	<ul style="list-style-type: none"> Option 4 & 7 	<ul style="list-style-type: none"> uRLLC mMTC 5G V2X FMC 	<ul style="list-style-type: none"> Tera Hz Accessing satellite

Frequency Bands for the Network Layers

Coverage layer:

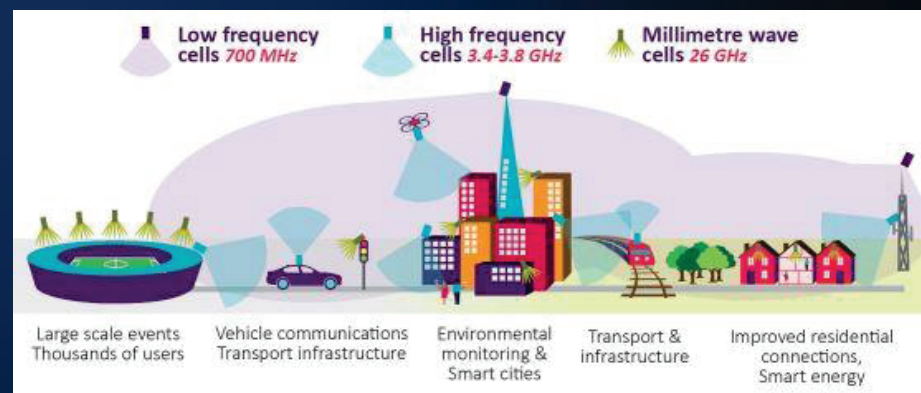
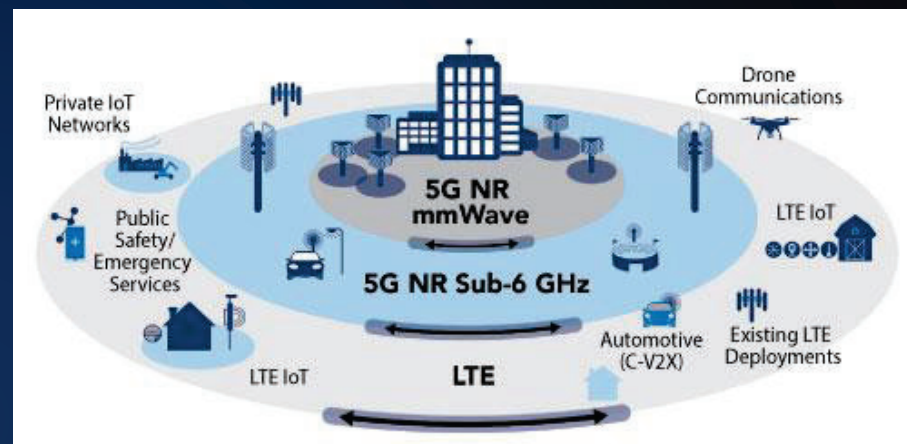
- Low band --- Below 3 GHz bands like 600 MHz and 700 MHz
- FDD legacy band are recommended for widely coverage.
- eg. 700/800/900/MHz can be used for ULRRC/IOT service;
1800/2100/2600 can be used for eMBB service

Capacity layer:

- Mid-band --- Mid 3GHz to 6 GHz bands for higher bandwidth
- Wide bandwidth that can provide ultra high capacity for the system.
- eg. N78 band is used for eMBB service

Hot spot layer:

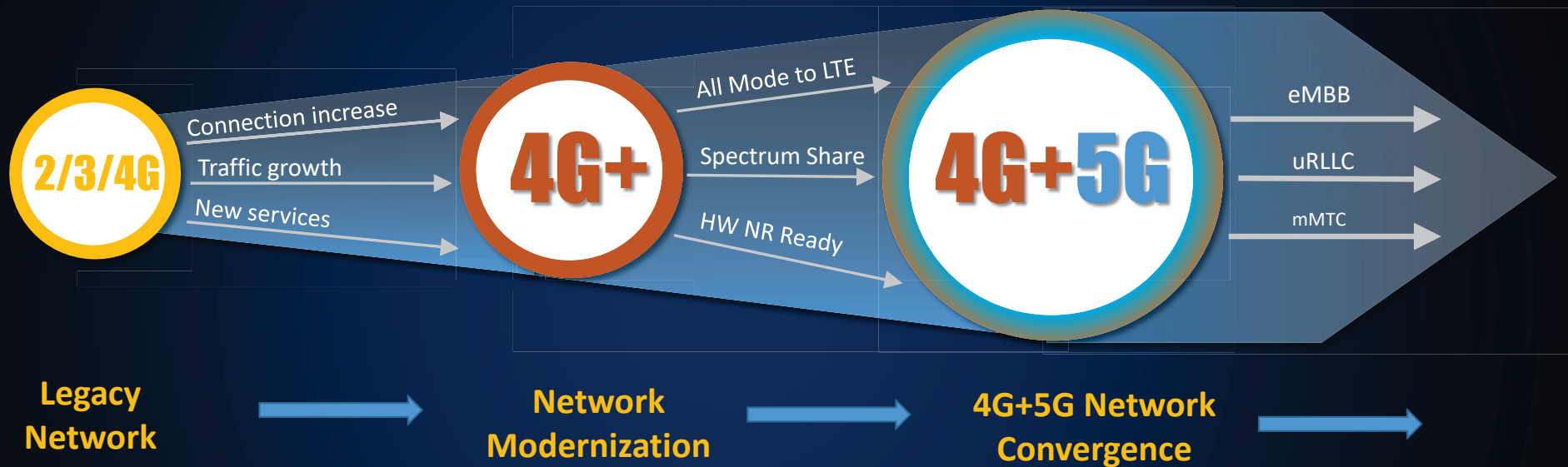
- High band --- mmWave, FR2
- Lays a big role in 5G NR system due to much higher bandwidth
- eg. 26GHz currently is mainly planned for eMBB service



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A Future-oriented 4G is the Answer to a Better 4G & 5G Co-evolution



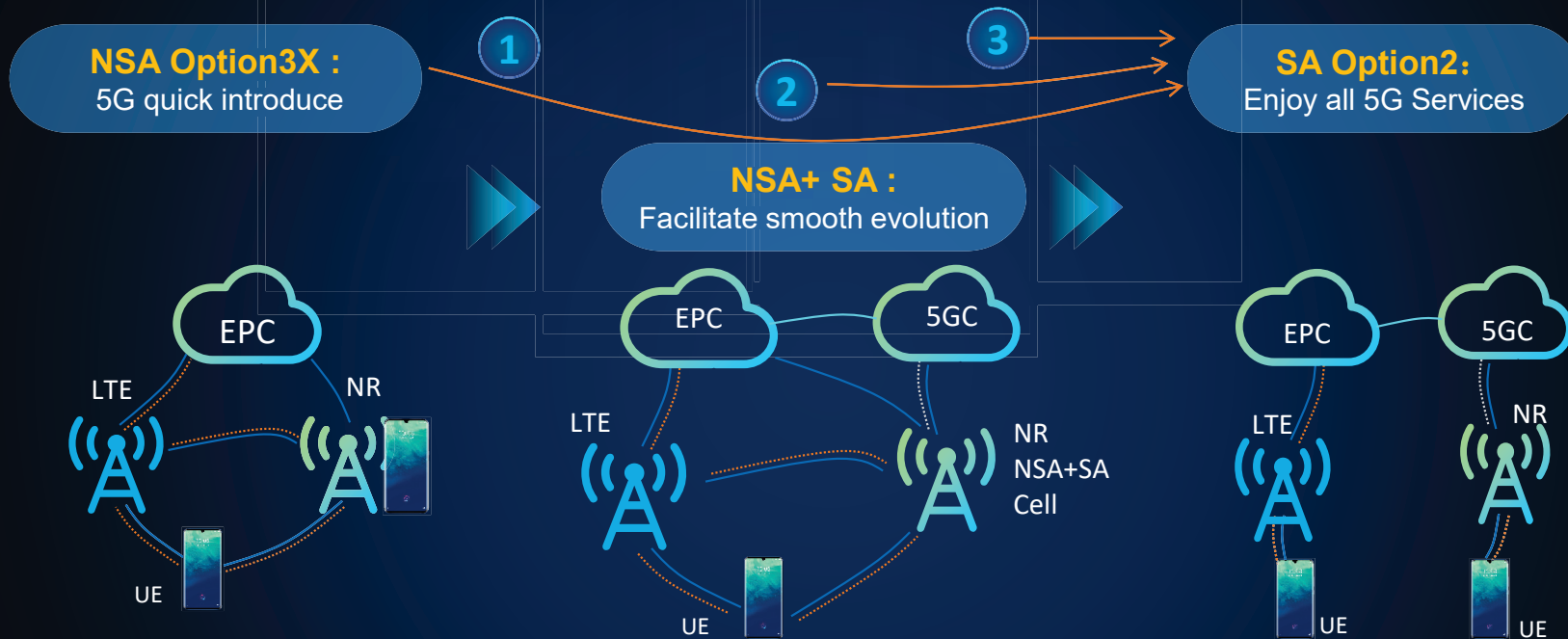
Suggestion

- LTE network should be modernized to meet the requirements of the ever increasing data traffic and various new services, ensuring a long-term success;
- Along with it, the LTE network should be consolidated as ready for 5G and ready for better 4G & 5G co-evolution;

ZTE Solution overview

Architecture	Site	Spectrum & experience	Operation & optimization	Verticals
<p>SA & NSA & SA/NSA hybrid all supported with great flexibility</p> <div>   </div> <p>Massive commercial deployment & migration experience</p>	<p>UniSite NEO Quick 5G rollout & simplest network modernization</p>  <p>With 5nm technology & industry-leading BBU</p>	<p>Usage, sharing, planning & migration</p> <div>  <p>SuperDSS Tri-RAT spectrum sharing</p>  <p>FAST 5G coverage & capacity booster</p>  <p>SSB 1+X 3D coverage made easy</p>  <p>Intelligent orchestration</p> </div>	<div>  <p>UME & tools O&M powered by AI and big data</p>  <p>AAPC Easy 5G M-MIMO rollout & optimization</p>  <p>PowerPilot The next-gen energy saving innovation</p> </div>	<div>  <p>NodeEngine Quick private 5G enabler with BBU-embedded MEC technology</p>  </div>

ZTE SA+NSA Dual-mode Architecture



A Quick Roll-out Option

- eMBB as the main focus
- No 5GC required
- Maximized branding effect
- Lower initial investment

ZTE provides flexible architecture and evolution paths to operators.

Final Roll-out Option

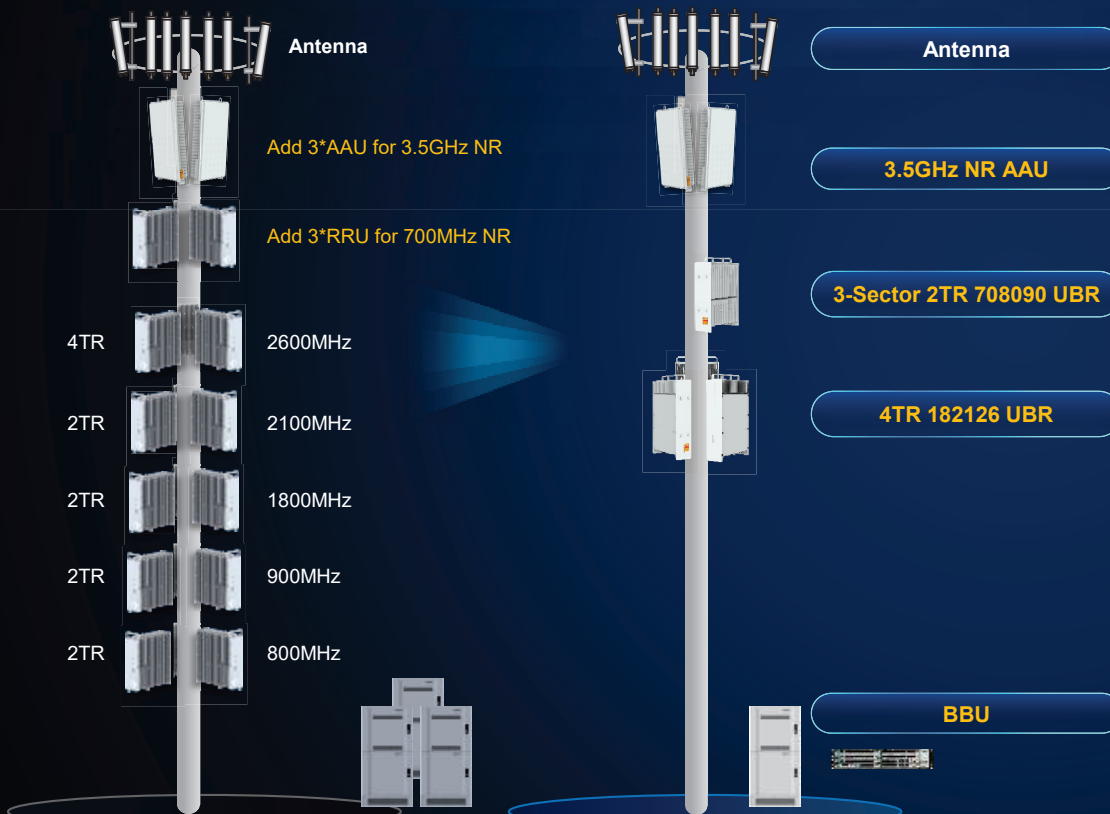
- 5GC is required
- eMBB/URLLC/mMTC
- Relaxed coupling between 4G & 5G
- SA UEs ready in 2020

UniSite NEO: Simplest 4G modernization & 5G evolution

21 Radio

7 Radio

Enhancement, Extension, Efficiency



- **40%** Max. RRU rental saving plus new 5G in 700MHz & 3.5GHz
- **35%** Power Saving with latest products and technologies
- **25%** CAPEX saving In power supply & battery

Pioneer for Evolution

- New 5G AAUs of **lightest, energy-saving** and excellent performance
- Industry's Leading Integration, **7 Units for 3-sector & 7-band**
- Hardware ready for **DSS on FDD bands**
- All **radio units** are **ready for 5G**
- **4*4 MIMO** ready for 1.8GHz, 2.1GHz & 2.6GHz
- All in one BBU, **Most Powerful BBU for all RATs**

UniSite NEO: Industry's leading intergration

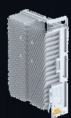
UniSite NEO: 4G Modernization with Extreme Efficiency

**Most Efficient
5G-ready RRUs**

= **High Integration** + **Ultra broadband** + **High Output Power** + **Low Power Consumption**
2TR, 4TR → 6TR, 12TR + **Series UBRs with PIMC** + **2*180W, 4*180W, 6*120W** + **40% reduction for next generation**

4TR Enhancement for RAN Sharing & Large Traffic

**700M + 900MHz
700M + 850MHz**



- 4 x 100 W
- Capacity optimization
- 30L / 30kg

R9224E

Large Capacity

1.8G + 2.1GHz



- 4 x 160 W
- Suitable for RAN sharing
- 35L / 35kg

R9254U

Highest Output Power

1.8G + 2.1G + 2.6GHz



- 4 x 180 W
- Output power sharing
- 35L / 37kg

R9254U

Tri-band High Power

2TR Extension for Multiple scenarios

800MHz + 900MHz



- 2 x 120 W
- Coverage boosting
- 18L / 20kg

R9242E

High Power Rural Site

700MHz + 800MHz + 900MHz



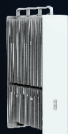
- 2 x 180 W
- PIMC enhancement
- 29.7L / 28kg

R9222H

High Power UBR

12TR & 6TR Breakthrough for Extreme Efficiency

700MHz + 800MHz + 900MHz



- 6 x 120 W
- 2TR per band
- 37L / 39kg

R9256U

Unique & Lightest 3-Sector UBR

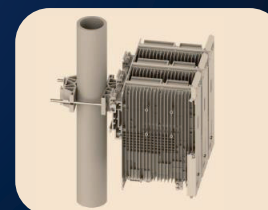
1.8GHz + 2.1GHz



- 12 x 80 W
- 4TR per band
- 45L / 45kg

R9259U

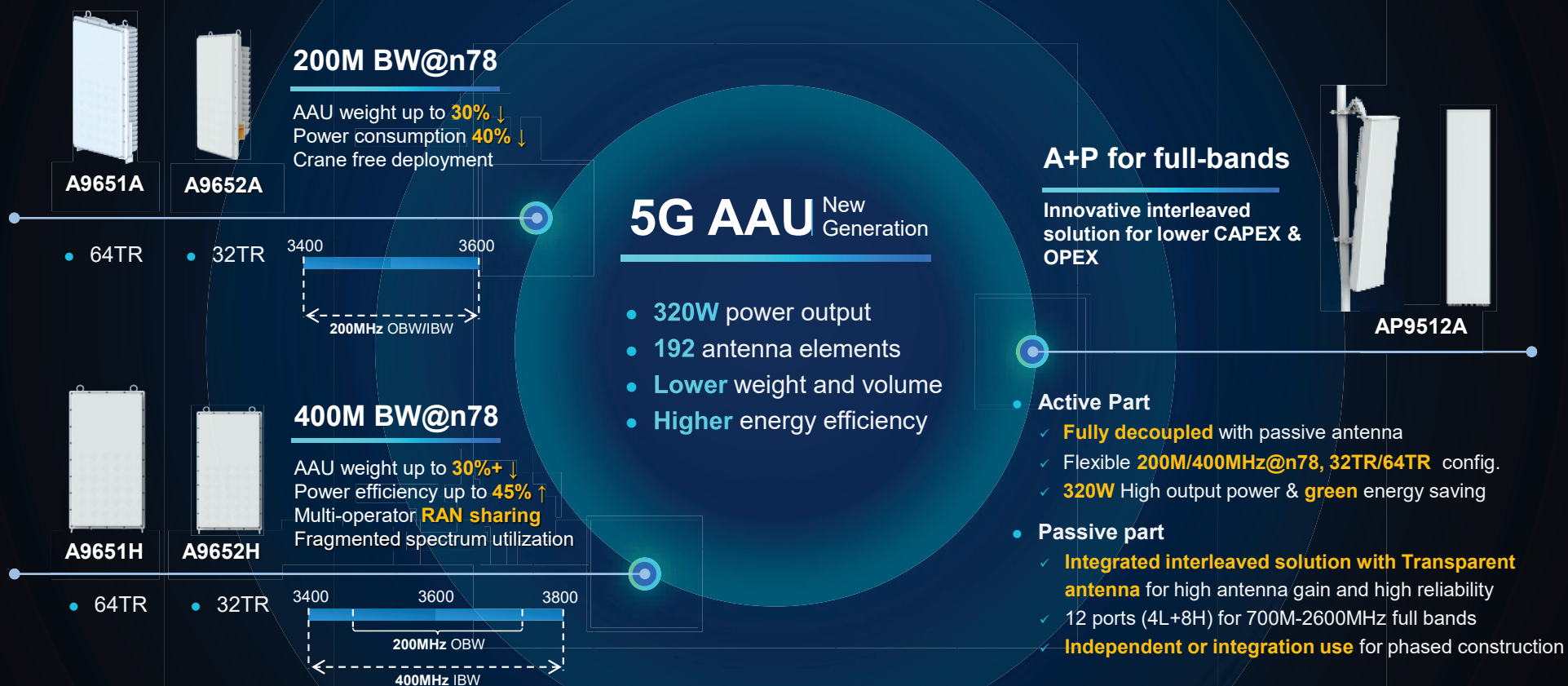
Highest Integration



3 radios into 1 for three sectors

Industry leading UBR series, provides flexible choices with 4G modernization and 5G evolution.

UniSite NEO: New generation AAU to carry 5G capacity



Ubiquitous Deployment 4 “U”

Urban Requirements

- Large capacity
- Continuous Coverage
- Vertical Beamforming

Suburb/rural Requirements

- Low capacity
- Wide Coverage
- Priority to meet coverage requirement



Uni-site NEO

UBR

Unify

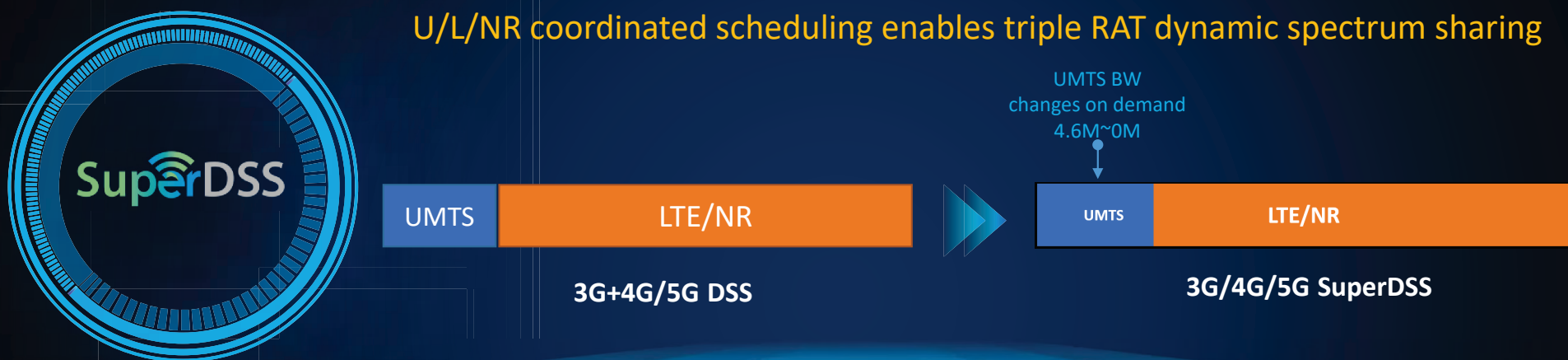
Ubiquitous

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SuperDSS(Tri-RAT Dynamic Spectrum Sharing) facilitates sub3G smooth evolution

U/L/NR coordinated scheduling enables triple RAT dynamic spectrum sharing



User loyalty enhancement

- Avoiding user churn during 2G/3G sunset
- Both static and dynamic SuperDSS can be supported



User experience improvement

- 2G/3G voice service experience guarantee
- 4G/5G user throughput improved



Lean networking O&M

- 5G evolution oriented networking design, one time deployment is the final network status
- Improving network potential



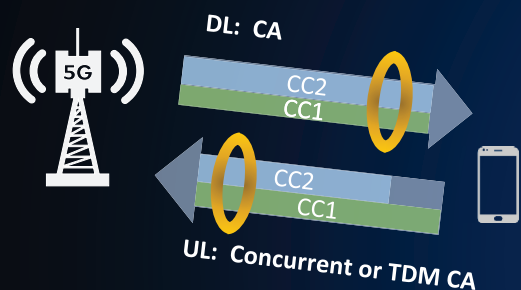
Smooth Evolution

- When UMTS shutdown, SuperDSS can flexibly evolve to DSS or NR without extra configuration

FAST – the 5G coverage and capacity booster

FAST: Fusion Assisting Super TDD

FAST leverages 3GPP-standard carrier aggregation to enhance 5G coverage & capacity



Inter-cell CA & inter-site CA supported

Abundant CA capabilities

- 700M + 3.7G
- 700M + 2.6G
- 2.1G + 3.5G
- 2.1G + 3.7G
- 700M + 2.1G + 3.7G
- ...



Capacity (both UL & DL)

DL & UL benefited from traditional CA. UL also benefited from TDM CA.



Coverage

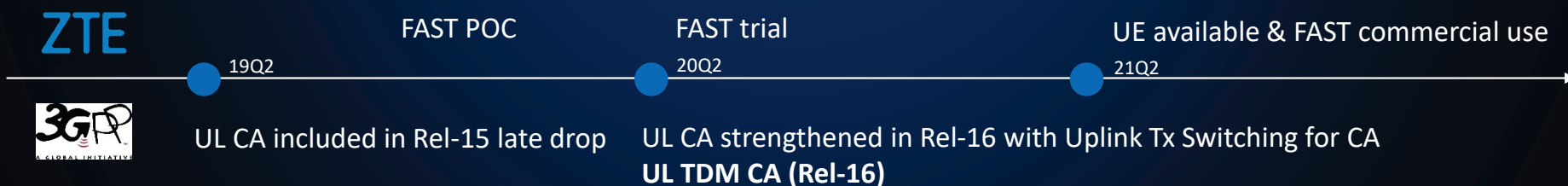
Mid-low band coordination to extend UL coverage.



Latency

With flexible coordination, uplink freq-time resources is increased to reduce latency.

FAST can benefit from both Rel-15 and Rel-16 with increased number of features



Simplest beam design achieves stable H and flexible V collaborative coverage

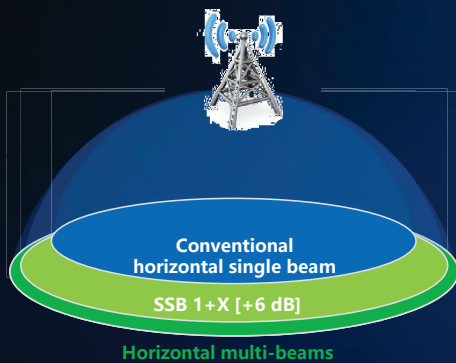


SSB 1+X simplifies 5G network planning & improves performance

- Reduce 5G planning complexity by leveraging 4G planning data
- No change of beam planning required when migrate from NSA to SA
- Both coverage and capacity for high-rise buildings can be enhanced
- Decoupling horizontal and vertical beams
- Simplest beam design, for both H&V coverage
- Intelligent network planning tool for 1+X efficient deployment

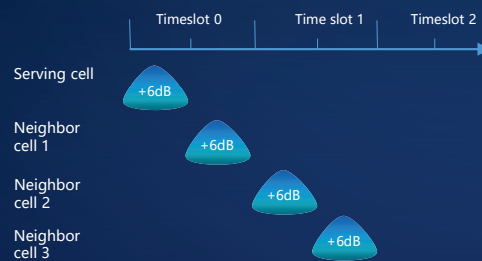
1 +6dB

Enhanced Horizontal Wide Beam



Similar horizontal coverage between 1+X and horizontal multi-beams

Intelligent Planning SSB Staggering in Time Domains



SSB staggering in time domain and service puncturing to control interference.

X $X = \{0, 1, 2, 3\}$

Flexible Vertical Beams

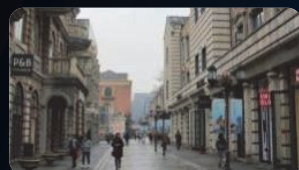
Intelligent planning of X beam weight

Building floor	<8 F	8-16F	16-24F	24-32F, >32F
Number of vertical beams	X=0	X=1	X=2	X=3



Flexible deep coverage solutions fit for diversified scenarios

Scenario



Business street



Scenic spot



Shopping mall



Transportation hub



High Buildings



Residential area

Challenge

- Crowd people in hotspot areas
- Difficult site acquisition for macro BTS

- High value area and indoor high traffic requirement

- Poor coverage in high floors
- EMF concerns

Accurate Scenario Analysis & Matching

Outdoor hotspots

Pad RRU

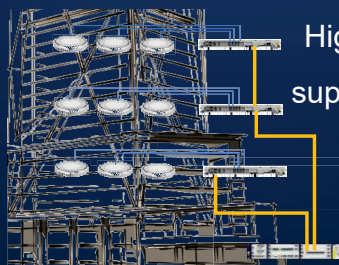
iMacro



High capacity with easy site acquisition

Deep indoor

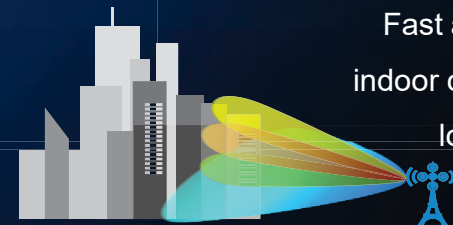
QCell



High capacity and superior experience with indoor digitalization

Outside-in

AAPC, 1+X SSB



Fast and flexible indoor coverage with low cost

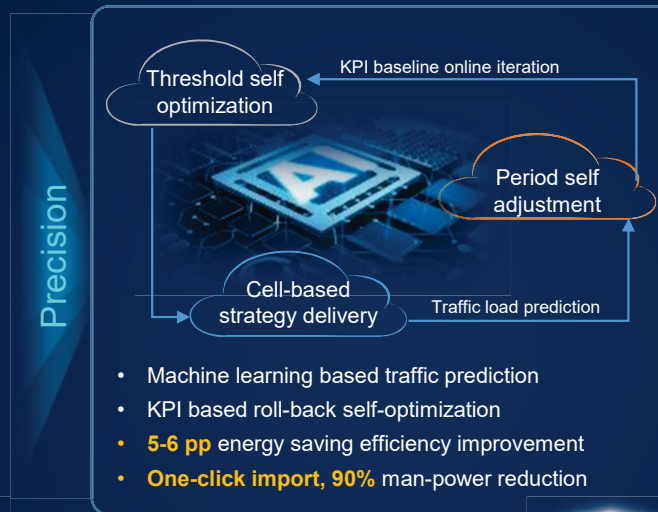
Solution

PowerPilot - Greener network for a more sustainable digital future

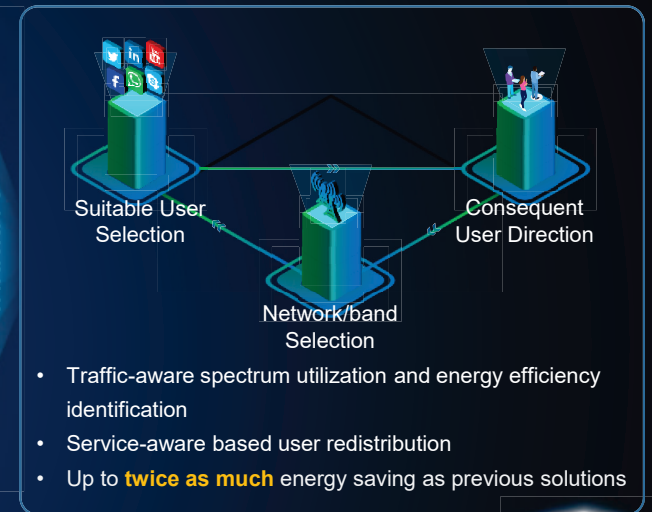
Basic functions facilitates energy saving



AI empowers precise energy saving



Service pilot drives further energy saving



30+ networks, 900,000+ sites



AIS @ Thailand

25% energy reduction
for TDD LTE/NR dual-mode



DIGI @ Malaysia

over 70,000 4G cells
intelligent energy saving



Airtel @ India

twice energy saving
comparing to traditional solution

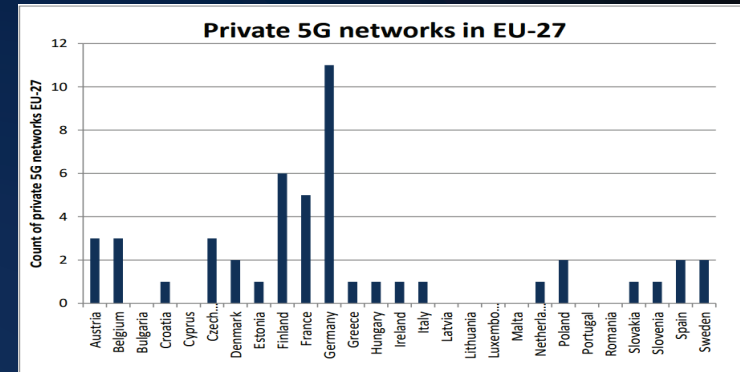
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- 6 Leading 5G to Commercialization

Global 5G Private Network Development



<https://www.paconsulting.com/insights/private-5g-networks-connectivity-industry-4>



< 5G Observatory, Quarterly Report 13, Up to October 2021 >

The **German** telecoms regulator, BNetzA, reserved **100MHz** of spectrum in the **3700MHz-3800MHz** band to private companies. According to the regulator, 33 companies have bought 5G private licenses so far including Bosch, BMW, BASF, Lufthansa, Siemens and Volkswagen.

In **France**, frequencies in the 2600 TDD MHz band (band #38, **2570-2620 MHz**) have been offered to metropolitan businesses by the regulator ARCEP. The airport operator, ADP Group and its subsidiary Hub One, Air France, The major French electricity company EDF, The mobility company TransDev have been granted some bandwidth for years

In the **Netherlands**, spectrum at **3400-3450 MHz** and **3750-3800 MHz** is intended to be made available for local use. Nevertheless, the 3500 MHz auction is planned for 2022 as the band is currently used for satellite communications.

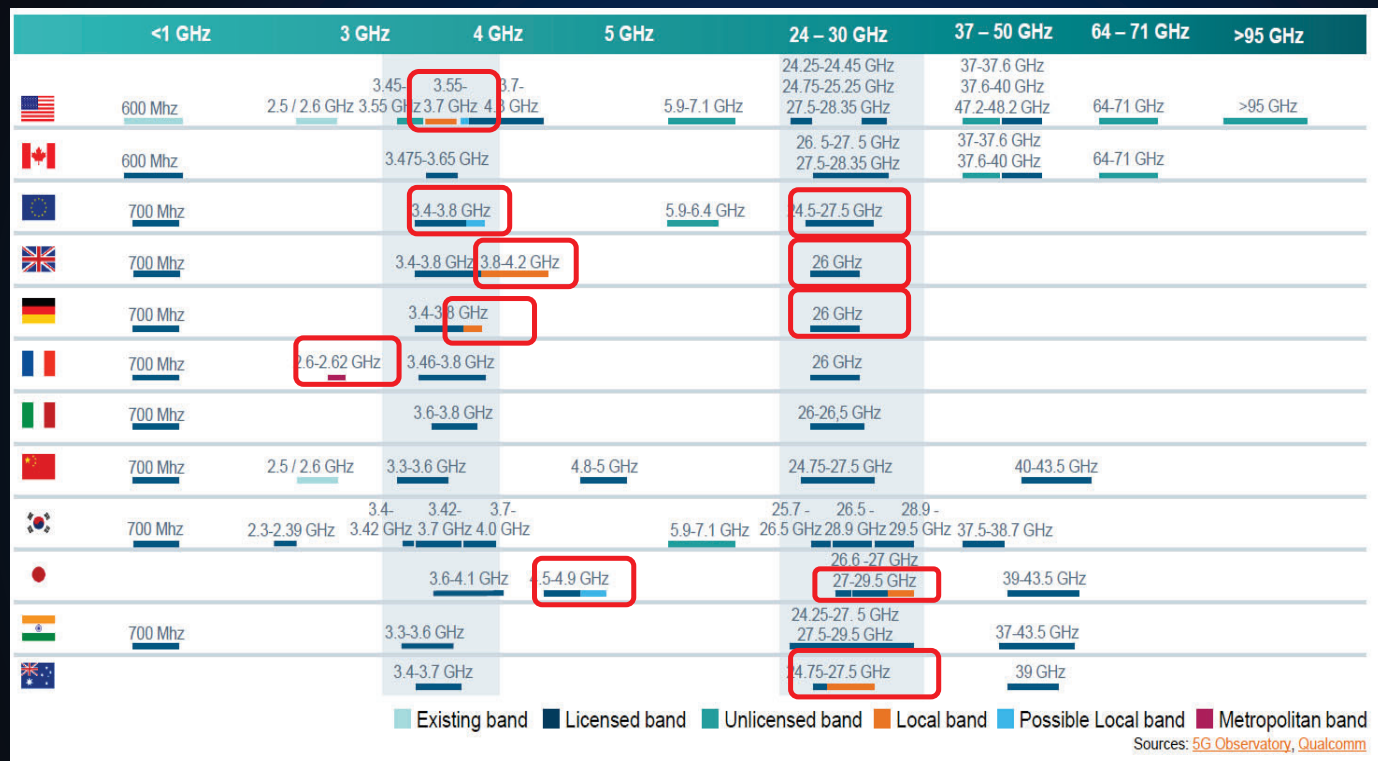
Sweden's 5G auction of the 2.3 and 3.5 GHz bands will reserve 80MHz of frequencies between **3720MHz and 3800MHz** for local and regional licenses.

In the **UK**, OFCOM will dedicate the **3.8-4.2 GHz** band for local deployments, requiring national operators to hand over unused licensed spectrum to enterprises. The lower 26 GHz band will be reserved for private and shared access as well.

Other countries outside Europe including the US, Japan, Australia and China are also moving forward with their plans to identify and allocate spectrum for localized.

➤ **The dedicated 5G spectrum for private network is the most important accelerator for the private network development;**

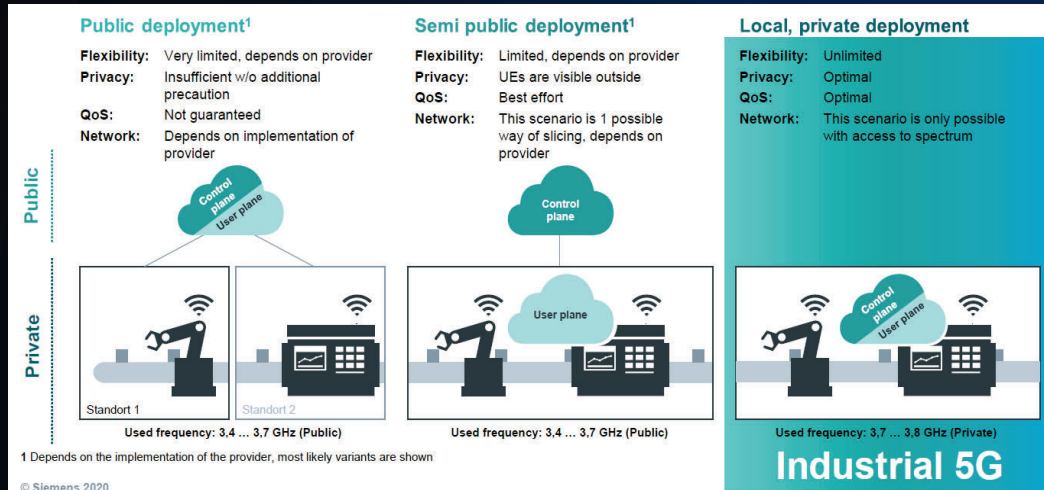
Spectrum for 5G Private Network



< Industrial 5G. For the industry of tomorrow > - [siemens.com/industrial-5g](https://www.siemens.com/industrial-5g)

- 5G Private Network Main Spectrum: 1) N78/3.5GHz; 2) mmWave/26G/28G; 3) 2.6GHz (France) ; 4) 4.9GHz (Jap)

Typical Modes of 5G Private Network



	Costs	Control	Complexity
Self-managed private network	Highest upfront costs Lower total lifetime costs	Most customisation and control over network performance	Requirement for new network infrastructure, support functions, digital capability groups
Outsourced private network	Lower upfront costs Higher total lifetime costs	Performance determined by agreed SLAs, less direct control of network	Requirement for new network infrastructure, most support functions outsourced
Semi-private network via network slicing	Lowest upfront costs Higher total lifetime costs	Performance determined by network slice specifications, least control of network	Easiest to adopt with little infrastructure change, most support functions outsourced

➤ Three Modes of 5G Private Network :

- **Outsourced private network** – the manufacturer requests a proposal for a managed private network based on its connectivity requirements. The service provider is responsible for the network build and is subject to exacting service levels. It might also help develop digital services or platforms to fully realize the benefits of private 5G network capabilities.
- **Semi-private network via network slicing** – a mobile network operator uses network slicing to create a semi-private 5G network for the manufacturer. There's flexibility in tuning the technical capabilities of the product to meet connectivity needs.
- **Self-managed private network** – the manufacturer keeps complete control of the network build and digital capabilities. They can tune the network specifications and performance to exact requirements.

➤ Features of 5G Private Network depend on: 1) **Capex/Opex**; 2) **Network Control** and 3) **Architecture Complexity**

- Selection of Modes: 1) Is there dedicated spectrum? 2) Have the Capability for network design and operation? 3) Have the ability to translate application demands into technical specifications

5G Private Network is Ready for Vertical Industry

5G Dedicated Spectrum for Private Network



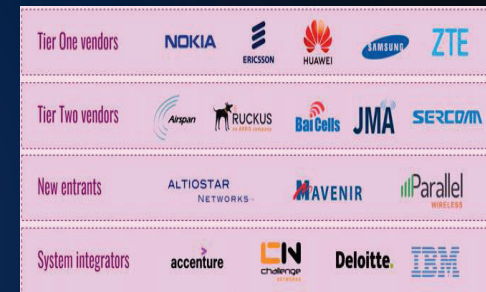
3GPP Release 16 for Industry



Large Investment Expectation



Multiple participant in Eco-system



Industry 5G!

5G Private/Campus Network is Warming up for Entering the Fast Lane.

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ZTE – a Leading 5G Supplier

500+

Industrial
Partners

90+

Operators
Collaboration



Rollout in 350+ Cities in China & 60+ Cities Overseas

The Major Contributor in 5G Standardization



2500+ 3GPP 5G SEP



5000+ 5G Patents



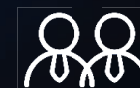
7000+ 5G Proposals



200+ 5G Standard Experts



Leader of Multiple WI in 3GPP

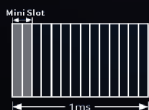


2 3GPP WG Vice Chairman
(1 new in Aug 2019)

5G Technology Innovation in All Aspects

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LDPC



Mini Slot



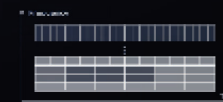
Massive MIMO
Beam Management



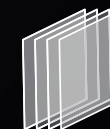
Channel Modeling
@mmWave



FB-OFDM



Unified Frame Structure



Network Slicing

Leading 5G to Commercialization

Reliable Partner of 5G New Journey



Modernization

- Unit-site, simplified site solution
- Flexible spectrum utilization
- Highly efficient O&M



New Business

- Flexible architecture
- New vertical application
- New business

Leading 5G Technologies with Innovations



Standard Contributor

- 3GPP 5G SEP TOP3
- Leading Work Items of key technologies in 3GPP



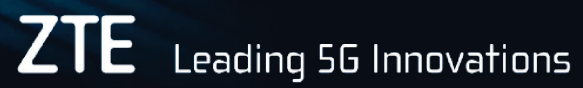
Key Chipset

- In-house designed high-performance 5G chips
- Reduce power consumption of key products



Massive MIMO

- High performance M-MIMO towards commercial scenarios definition
- Varies of enhanced features for M-MIMO with over 5 years experience

The ZTE logo is displayed in a bold, white, sans-serif font. To its right, the tagline "Leading 5G Innovations" is written in a smaller, white, sans-serif font.

ZTE Leading 5G Innovations

The words "Thank you" are centered on the slide in a large, white, sans-serif font. The background features abstract digital patterns of blue and orange light streaks and a grid of white dots.

Thank you