

5G, the Road to a Better Connected World

Vice President, Huawei Japan Edward Zhou Mingcheng edward.zhoumingcheng@huawei.com

The Evolution of Mobile Technology



Next Decade ...



5G Will Cover Many Industries and Stakeholder Benefits





Technical Requirements of 5G



Throughput

(Kbps/Km



Diversified Challenges and Gaps to Reach 5G





5G Revolutionary Road



NUAWEI 🖗

LTE-Advanced Pro(4.5G) for New Business Expansion

More Capacity 1 Gbps per site

All Online 300K Connections per km² Lower Latency 10ms





Massive MIMO

- Massive CA
- LAA
- 256QAM

NB IOTLTE-D



Shorter TTICloud EPC



Huawei 5G Research Investment

Huawei began 5G research in 2009 at the launch of the world's first commercial LTE network





Global Talents Focusing on 5G Research





Academic Contributions

Joint Research on 5G with 20+ Top Universities around the World





Huawei 5G Collaboration to Drive ECO-System

Industry Collaborations

Cooperation with Operators





Key Concerns for Reaching 5G





Aggregate All Available Bands

New Architecture



One Physical Network Multiple Industries

New Air Interface







5G Will Aggregate All Bands



5G Complementary Bands for Capacity, 45GHz available



A New Architecture to Carry MBB & Verticals



Service oriented cloud-formation

Internet architectural operation



An Innovative Air Interface to Improve Spectrum Efficiency





5G Key Enabling Radio Technologies



F-OFDM (Filtered-OFDM)

Flexible sub carrier bandwidth to carry diverse QoE applications

SCMA (Sparse Code Multiple Access)

3D sparse functions with nonorthogonal sequence to improve connections Grant free to shorten latency

Polar Code

Approach Shannon Limit with no decoder error floor to reduce BER and improve reliability



The Main Issues of OFDM

10% guard band is needed to meet spectrum mask requirement



OFDM can not support asynchronous transmission





OFDM waveform is not flexible, required fixed subcarrier spacing, symbol duration and CP length



F-OFDM: Foundational Waveform for Adaptive Air Interface





	OFDM	F-OFDM
Service-adaptive	Fixed sub-carrier spacing Fixed CP	Flexible sub-carrier spacing Flexible CP
High Spectrum utilization	10% guard band	1 subcarrier minimal guard band
Low Signaling overhead	Synchronous	Asynchronous



New Multiple Access Scheme for 5G - SCMA

SCMA: Sparse Code Multiple Access (One Candidate for 5<u>G</u>)



SCMA : Massive Connectivity & Low Latency



By using low density spreading & high dimension modulation, allocate 6 users to 4 subcarrier, each sub-carrier bears 3 users' information, to increase the connectivity.

HUAWEI

SCMA Performance Based on Simulation Result



 SCMA has SNR gain over LTE(Same rate& same power per user)

SCMA with overloading performance towards single user

300% larger numbers of connected users



 Given the same SNR, SCMA can boost total system throughput up to 300% over LTE(BLER=0.01)



Polar Code is a Breakthrough in 20 Years



What is the Polar codes?

 A new channel code proposed by Erdal Arikan, Bilkent Univ. Turkey, in
 2009

- It can achieve Shannon limit theoretically.
- It can be decoded with simple
 SC(successive cancellation) decoder
 and list SC(successive cancellation)
 decoder



Polar Code: to Achieve Shannon Limit







0.5~2dB gain compared with LTE Turbo Code



Theoretically proven to achieve Shannon limit



Joint Field Test Plan with NTT DOCOMO



- Connecting the Future Through Joint Innovation -



Large Scale 5G New Air Interface Field Trial

@ Chengdu, China

docomo	

- Sub 6G
- 24 TUEs
- 64 TRX
- 100 MHz

- MU-MIMO
- UL SCMA+F-OFDM
- DL SCMA+F-OFDM
- Polar Code
- DPC



DOCOMO-Huawei Joint Test Video





Test Results of Chengdu 5G Joint Test Field Trial

Massive MIMO: Dramatically improves spectrum efficiency



Maximum throughput:
3.6Gbps
Average throughput:
1.34Gbps
10+ times compare with SU-MIMO





F-OFDM: Flexibly support IoT and mobile broadband



- More robust performance with asynchronous transmission
 Both edge band and center band can use for DL
 - data transmission

Polar Code: Provide a higher transmission reliability



 0.5-1.2dB Gain compare with LTE Turbo Code



THANK YOU

www.huawei.com/jp

Copyright©2015 Huawei Technologies Co., Ltd. All Rights Reserved.

The information in this document may contain predictive statements including, without limitation, statements regarding the future financial and operating results, future product portfolio, new technology, etc. There are a number of factors that could cause actual results and developments to differ materially from those expressed or implied in the predictive statements. Therefore, such information is provided for reference purpose only and constitutes neither an offer nor an acceptance. Huawei may change the information at any time without notice.

