5G标准与终端创新

5G Standards and Device Innovations

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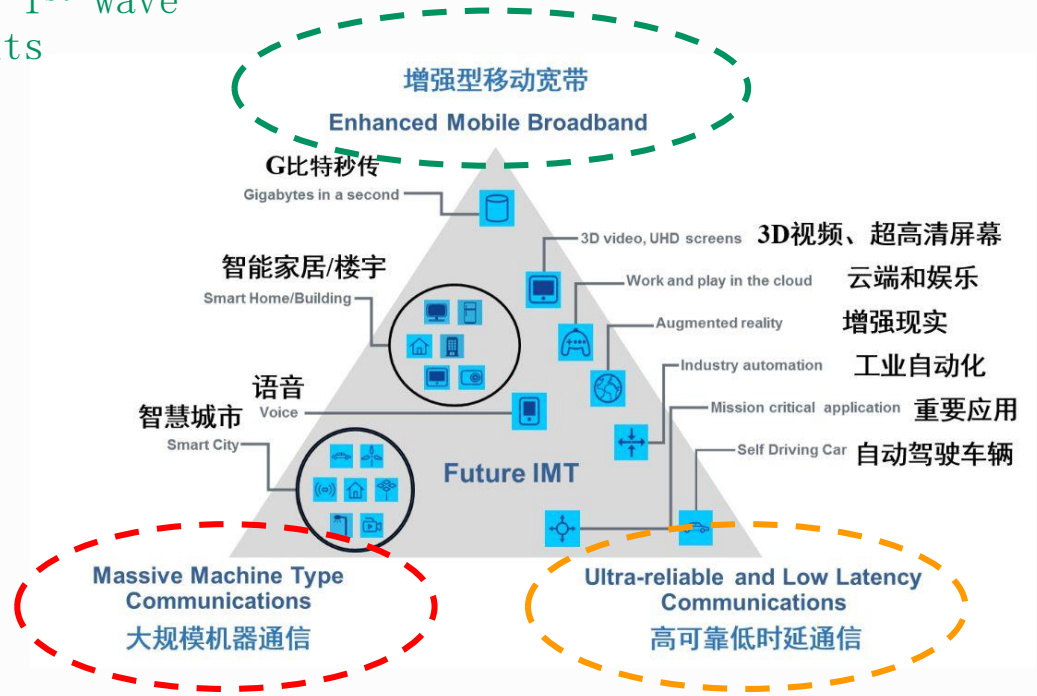
- **5G standards：What we have & not have**
- **5G products：Progress & chanllenges**
- **5G services：Ubiquitous Reality**

5G standardization progress

- R15 NR core specifications frozen, except for the "late drop" for additional system architecture options
  - Finished in 2 years! (R8 LTE spent 4 years)
  - A complete release for eMBB
  - An initial release for URLLC
  - A reused release for mMTC (4G-based)
- Major areas for R16 NR enhancements approved
  - URLLC enhancements
  - NR V2X
  - NR unlicensed
  - NR positioning
  - MIMO enhancements
  - NR UE power saving
  - ...

5G standards: We have and not have yet?

- A competitive eMBB standards compared to LTE
- Ready for success of 1st-wave commercial deployments

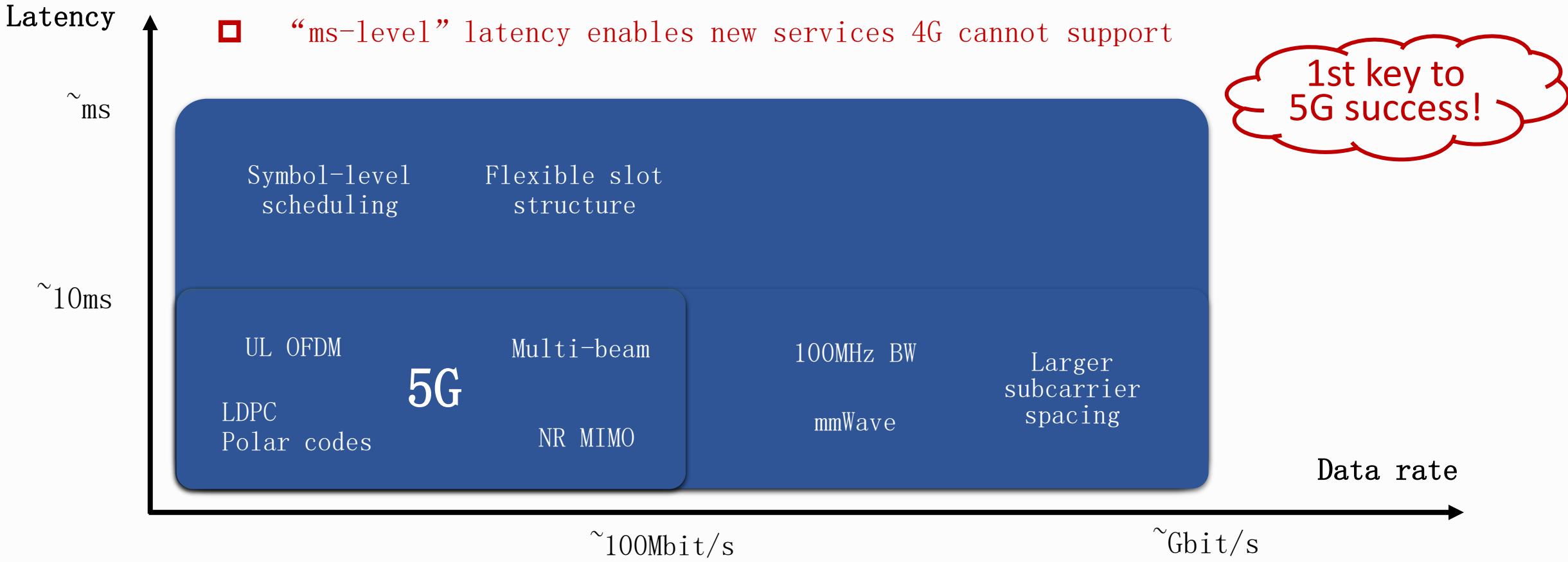


- LTE-based mMTC (NB-IoT/eMTC) only in R15.
- Not clear when to start NR-based MTC standardization.

- Very limited number of URLLC functions specified in R15.
- Only as low-latency as eMBB. Lower-latency in R16?
- Only as reliable as eMBB. Ultra reliable in R16?

eMBB will lead to first success of 5G

- Replace 4G kernel with an improved 5G kernel
- “Gbps-level” data rate makes 5G faster than 4G
- “ms-level” latency enables new services 4G cannot support



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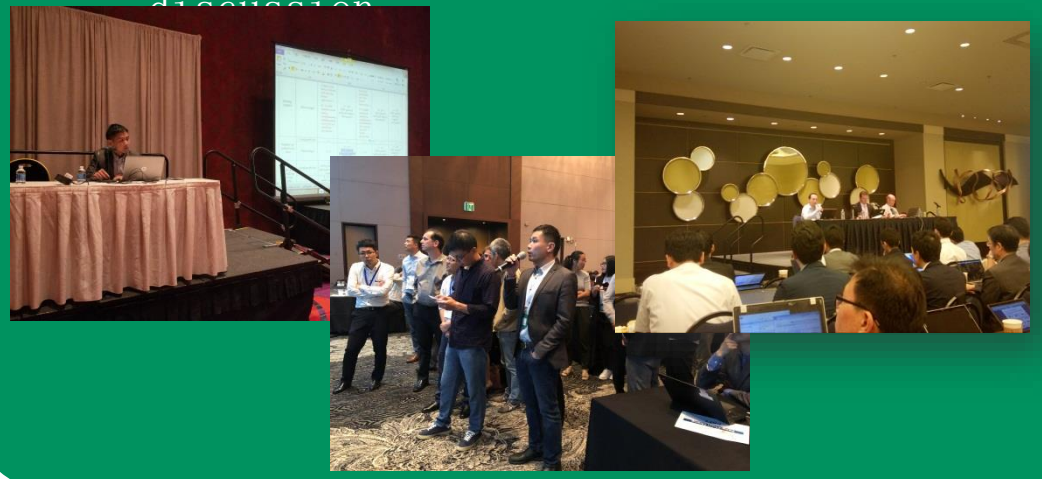
5G in OPPO

3GPP standardization.

- 5G team started in 2015
- Focus on 5G NR and evolved-LTE
- Submitted >1300 contributions
- Act as feature leads of key technologies. Leading offline discussion and email discussion



5G product R&D

- Algorithm, RF/antenna design, service/application
- Test methodology/testbed, RF metrics.
- Cooperate with global academics, e.g. BUPT, NYU, Tsinghua.
- Joined IMT-2020 (5G) PG in 2017. Join ...fications

5G device R&D progress in OPPO

- Status
  - Cooperation with leading chipset vendors &network vendors ongoing
  - “5G + 3D video” demo on May 11 2018
- Plan
  - Make first 5G call 2018H2
  - Pre-commercial 5G smart phone in 2019H2
  - 5G smart phone to market in 2020

Remaining challenges in 5G device R&D

- RF/antenna complexity and tests
  - 100MHz BW + 4 antennae
  - 5G/4G/3G/2G/WiFi multi-mode multi-band
  - mmWave (blockage, spherical coverage)
  - Harmonic/inter-modulation interference
  - MIMO OTA tests
- Fragmented market requirements
  - SA vs NSA
  - Diverse NW evolution paths
- HW/SW capability of smart phone becomes the bottleneck
  - Gbps-level processing capacity
  - Advanced display/camera?
  - AI processor ...

- And, where is the 5G killer application?

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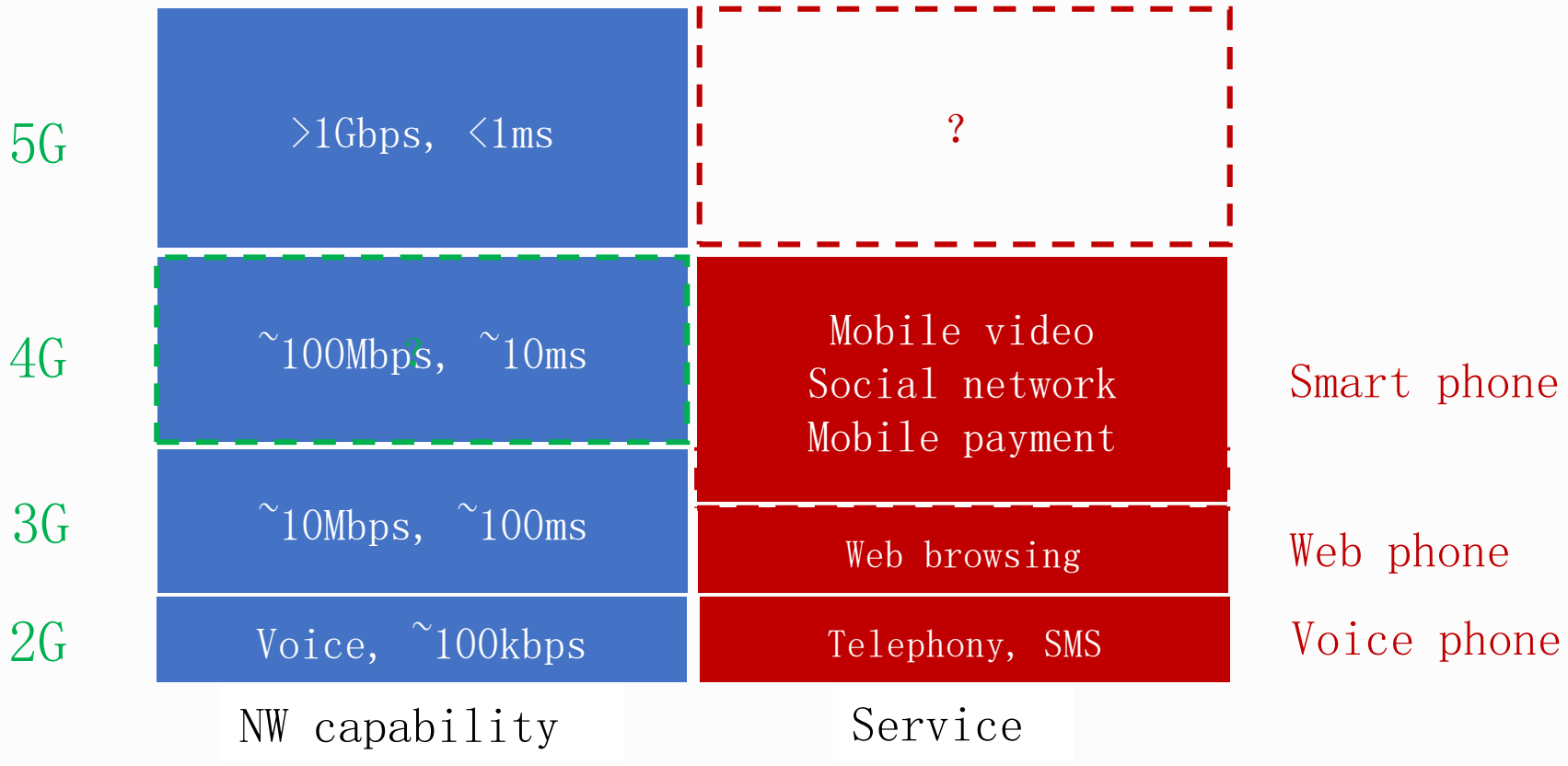
5G techology is waiting for 5G application

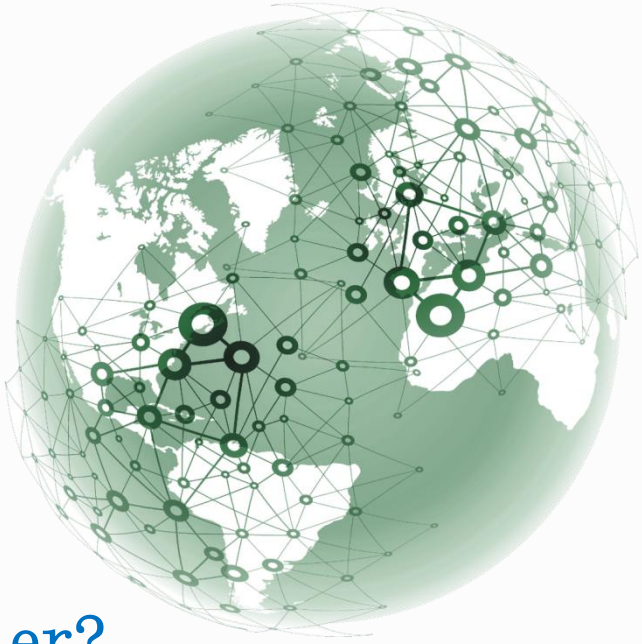
- Similar to early 3G era, the faster 5G network calls for apperance of “5G-specific services”



What 2G, 3G, 4G ever brought to us?

Mobile communications realize the dream “The end of the world is like near the neighbor”

- 2G: Hears voice from the world
- 3G: Accesses data from the world
- 4G: Sees visions from the world



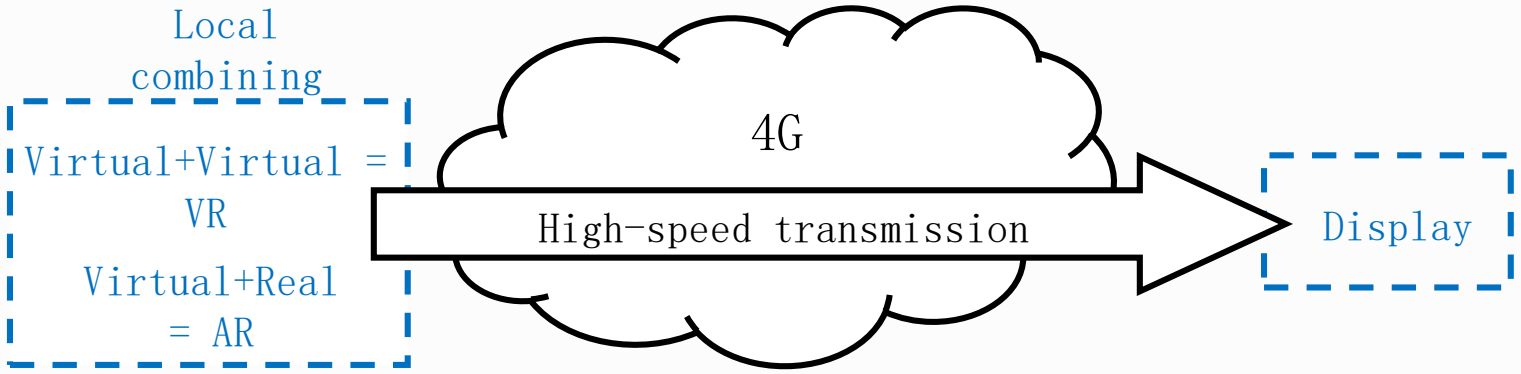
In which dimension can 5G make the world even smaller?

What can 5G do?

1. Immerse in reality over the world (real/virtual):
   - eMBB ⇒ Ubiquitous Reality (UR)
2. Sense environment over the world
   - mMTC ⇒ Ubiquitous Sensing
3. Control things over the world
   - URLLC ⇒ Ubiquitous Controling

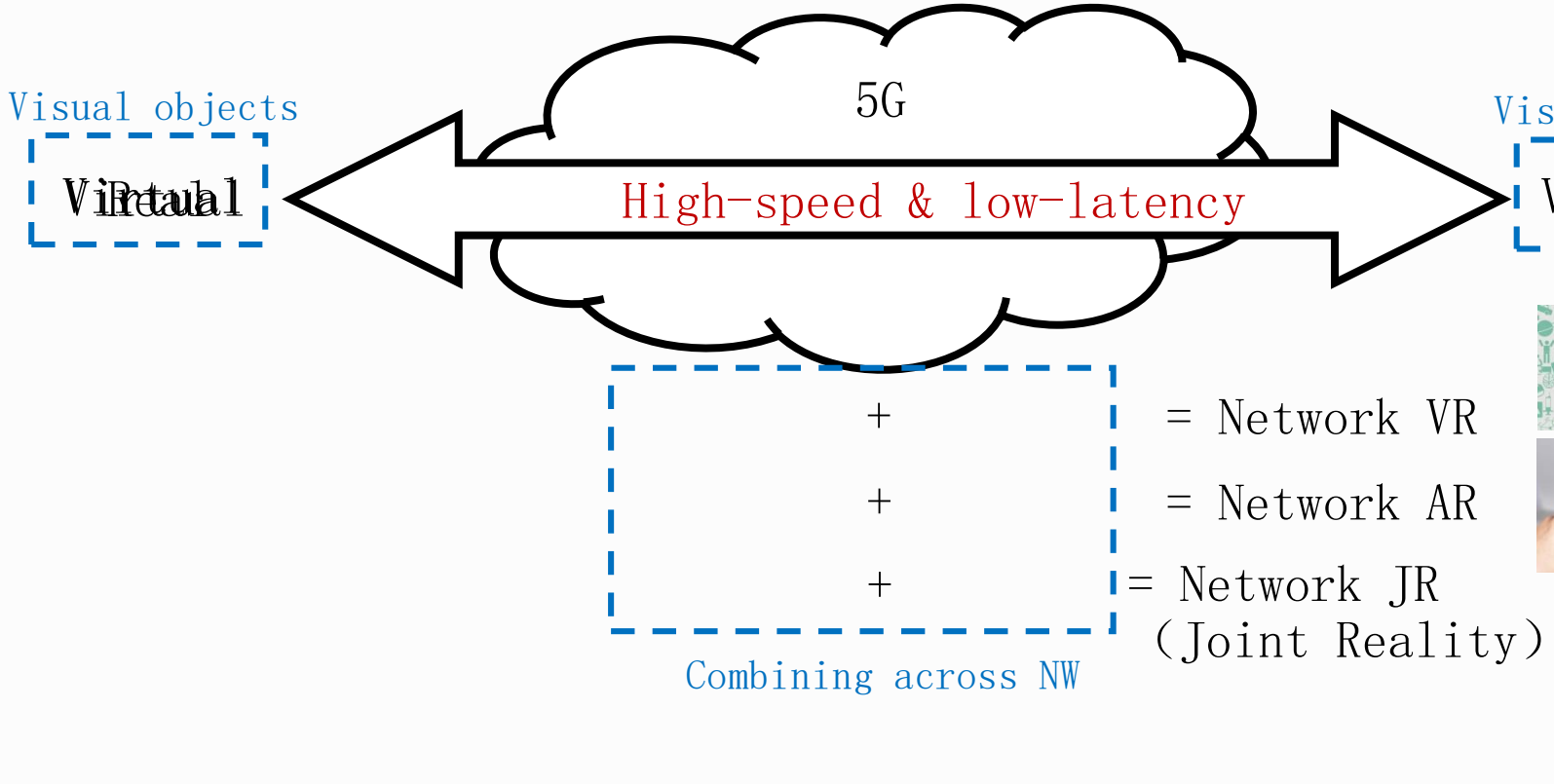
Traditional "local" VR/AR don't require 5G

- Combining visual objects within local area
  - High data rate required (but supported by 4G)
  - Ultra low-latency not required (buffering before display)



Ubiquitous Reality: Service for 5G eMBB

- Instanteneously combine visual objects across 5G network
  - High data rate and low-latency are simultaneously required
- Bring refreshing xReality user experience 4G cannot support



5G standards ready.

5G industry coming into shape.

Thanks.