The Dawn of 5G

- LTE Today
- History from 1G to 4G
- 5G Technology
- Requirements: 1000x Data, true?

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CTO, EVP and Member of the Board of Directors

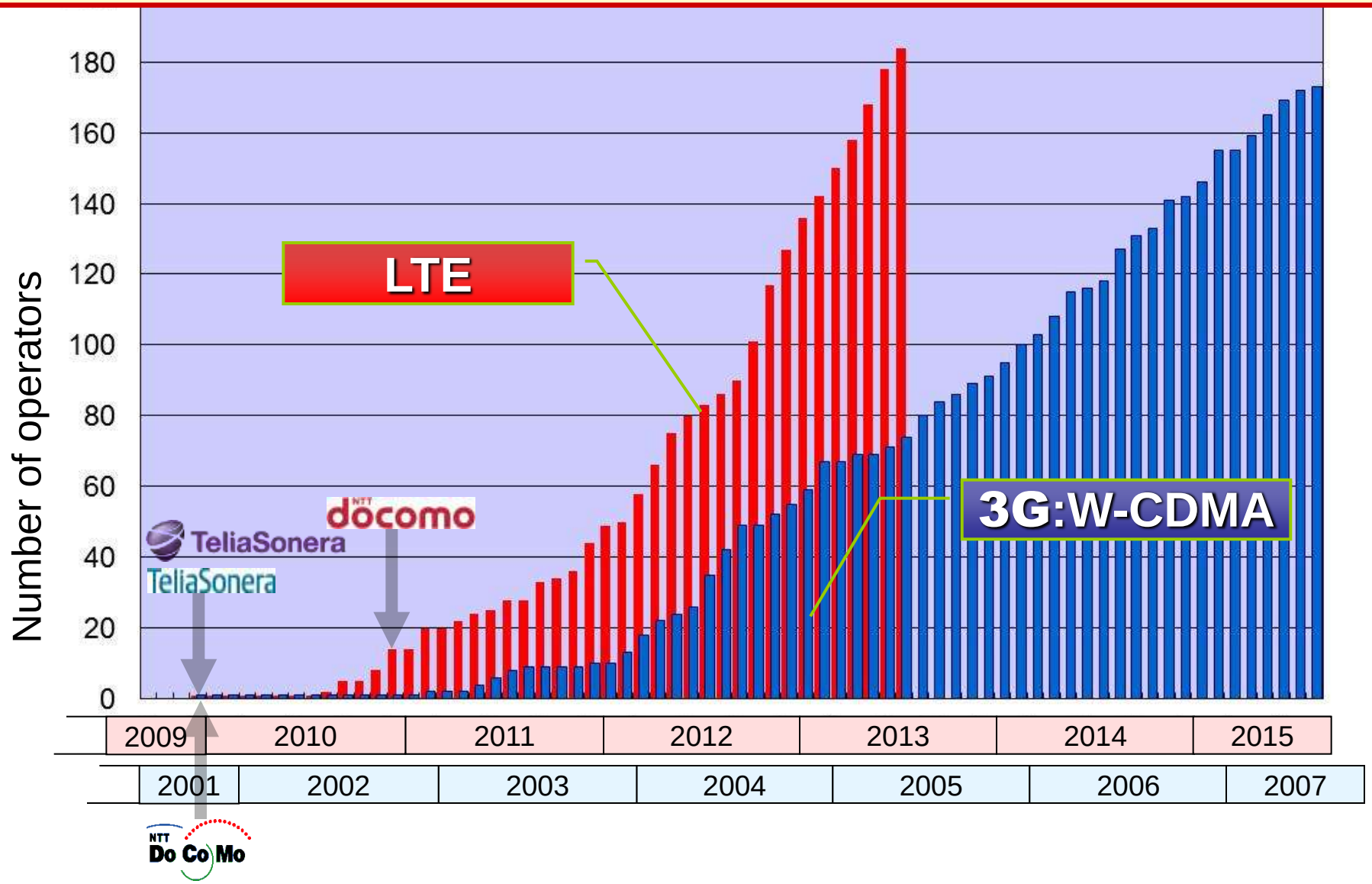
NTT DOCOMO, INC.

LTE Today

Numbers of Operators (Global)

GSA ▷ Subs ▷

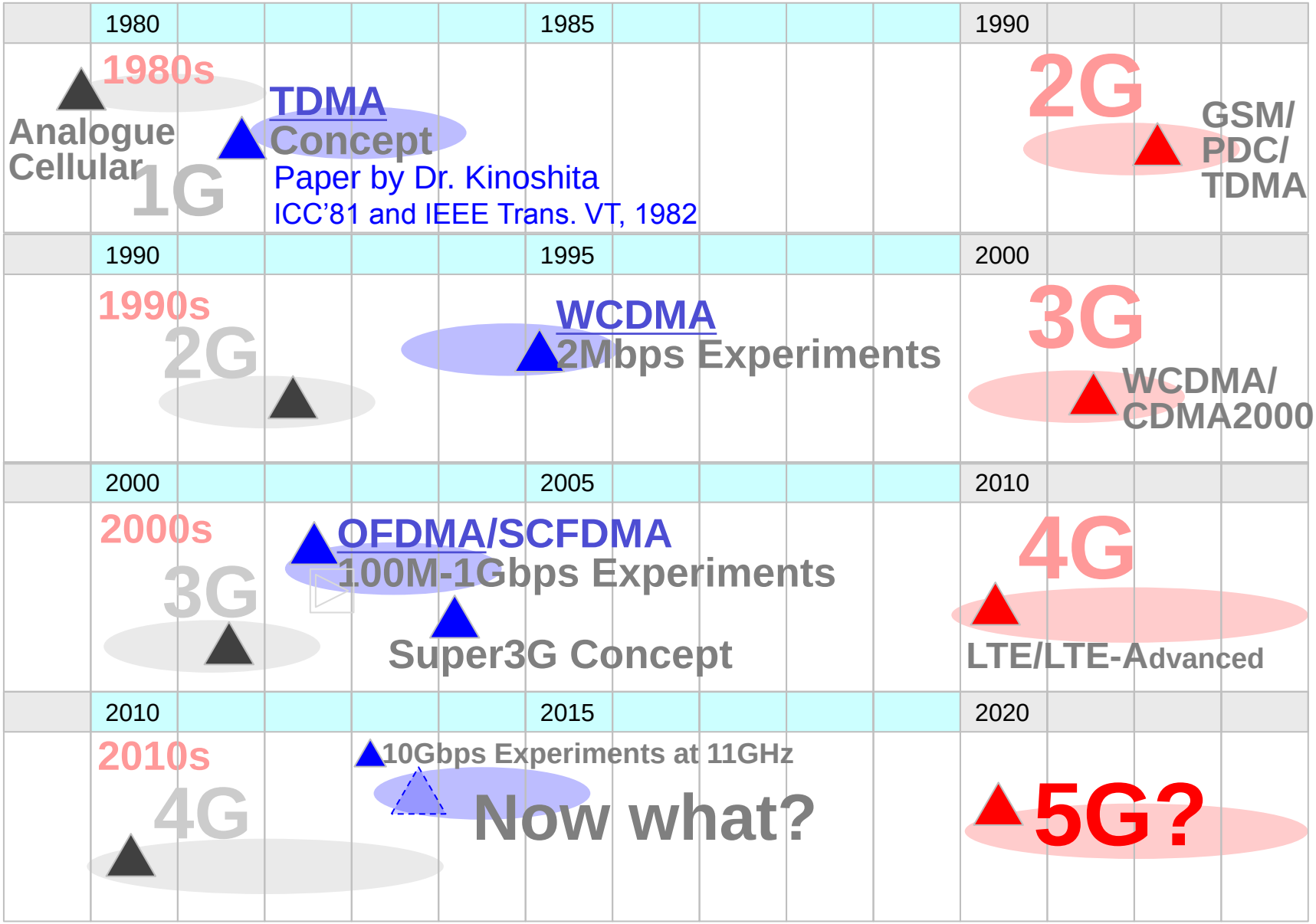
The global deployment of LTE is much quicker than that of 3G.

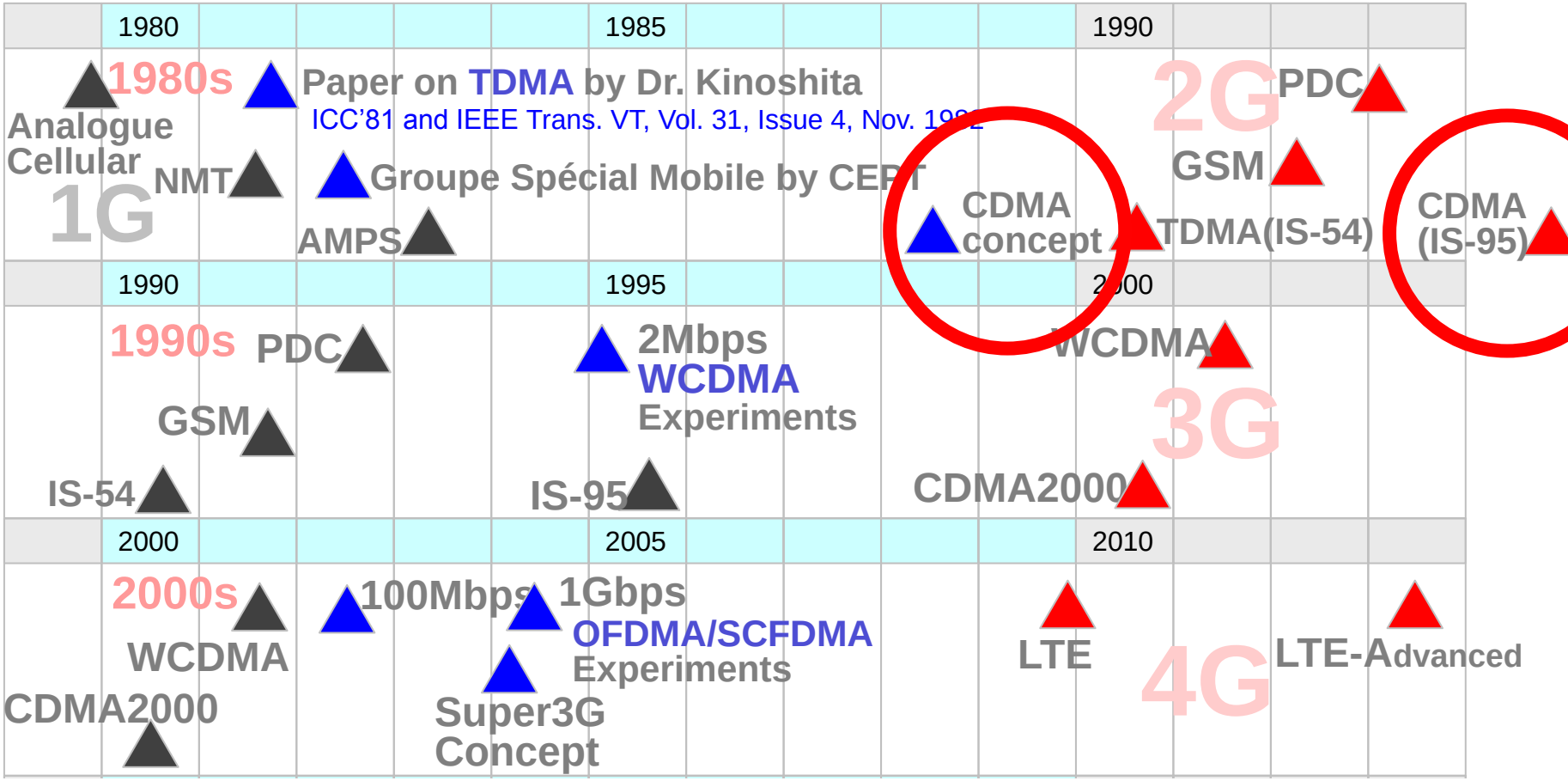


History from 1G to 4G

It's time to start something for 2020s

Details





History of 4G Research at DOCOMO

Background: 4G research outcome of over 1Gbps data transmission

100Mbps
in 2002-2003

5Gbps
in 2006

1Gbps
in 2004-2005

5G Technology

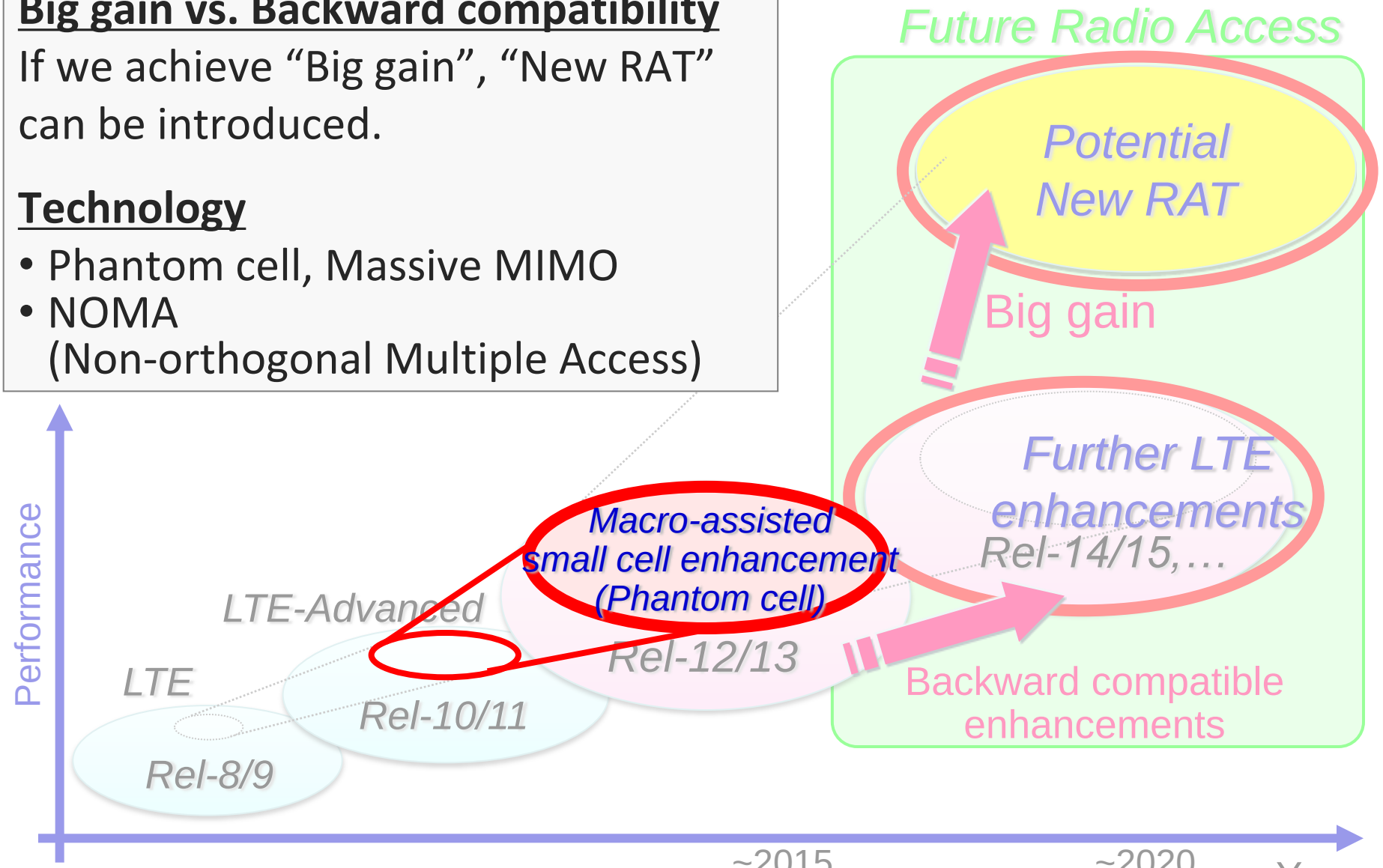
Evolution paths for Future Radio Access

Big gain vs. Backward compatibility

If we achieve “Big gain”, “New RAT” can be introduced.

Technology

- Phantom cell, Massive MIMO
- NOMA
  (Non-orthogonal Multiple Access)



Future Technology

- LTE-Advanced key features
  - **Carrier aggregation** ⇨ This is not so smart technology.
  - **HetNet/ Small cell** ⇨ This is old technology and may become buzzword.

“力業”
“Brute force”

- The combination of Carrier Aggregation and Small Cells with C-RAN will create new excellent features. ➔ **Advanced C-RAN**

➔ Architectural evolution will be the possible area for a new technology.

Macro-assisted small cell enhancement

with current specs ➔ with new specs: **Phantom cell**

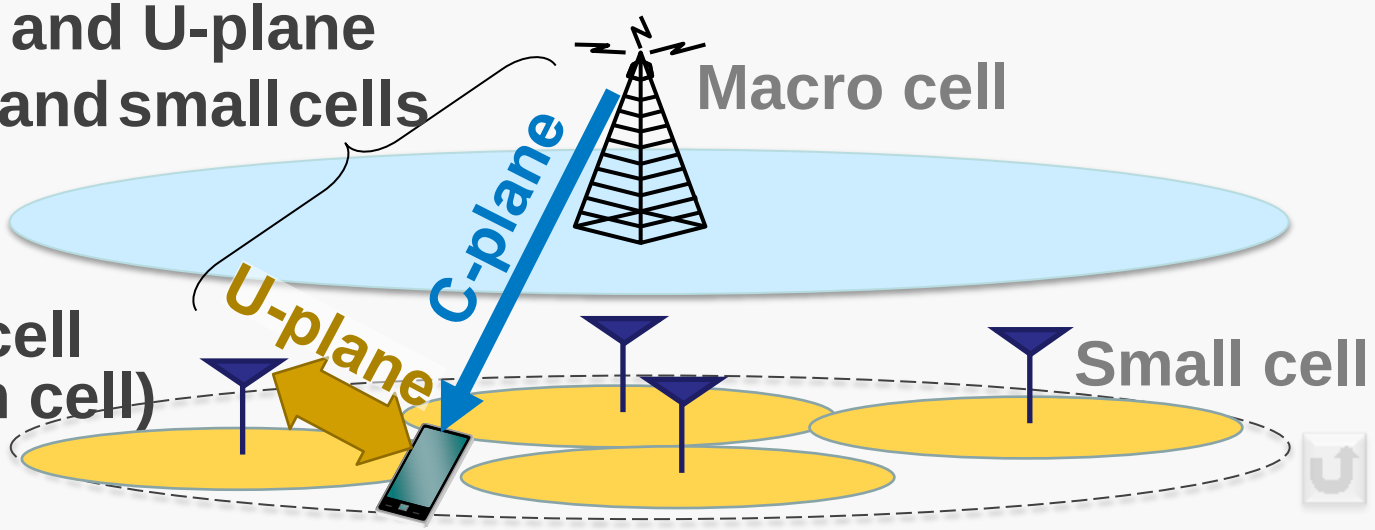
Future Technology

➔Architectural evolution will be the possible area for a new technology.

Macro-assisted small cell enhancement

with current specs ➔ with new specs: **Phantom cell**

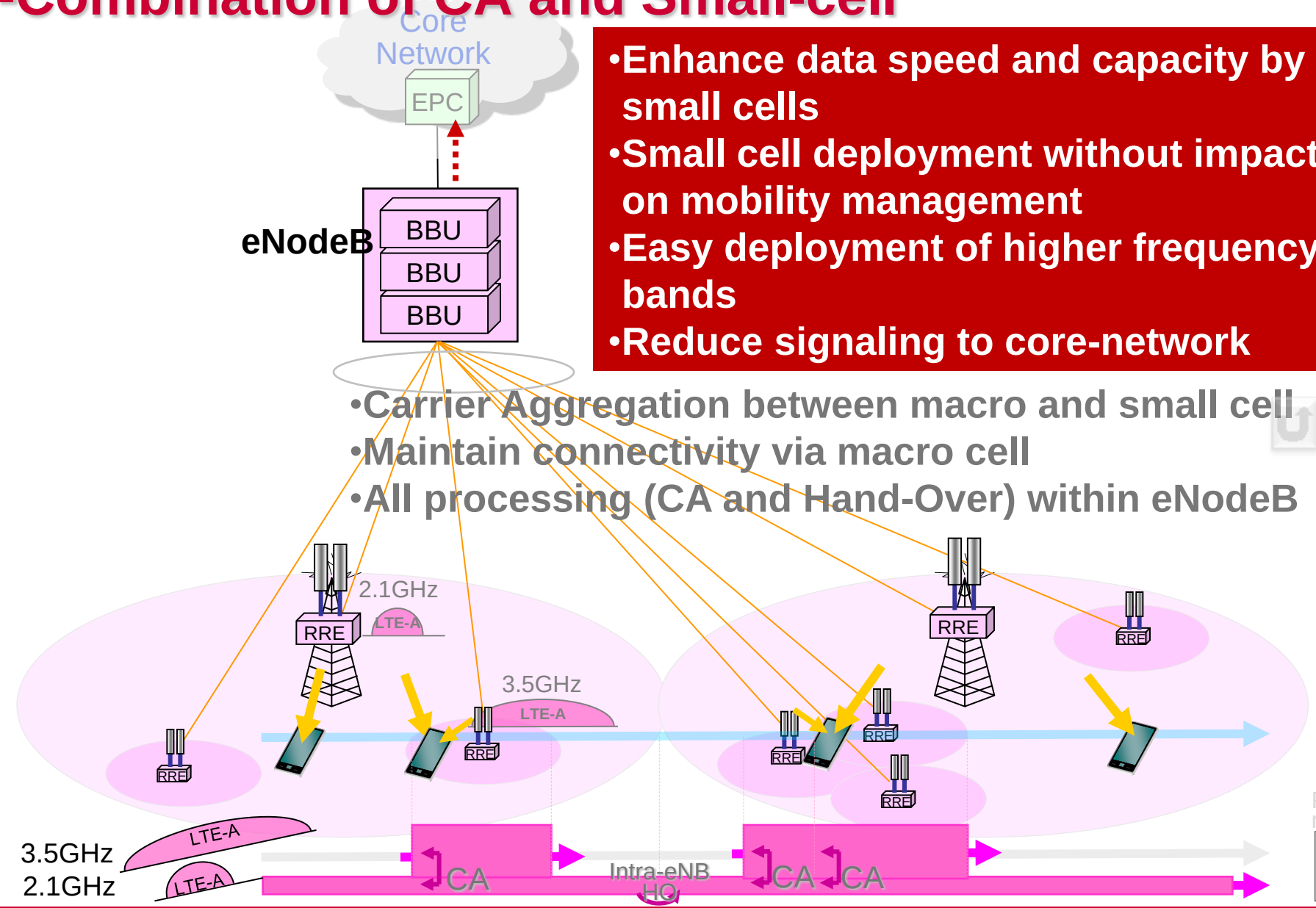
Split of C-plane and U-plane between macro and small cells



Advanced C-RAN Architecture -Combination of CA and Small-cell

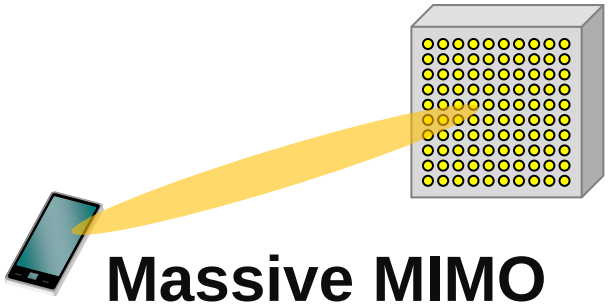
- Enhance data speed and capacity by small cells
- Small cell deployment without impact on mobility management
- Easy deployment of higher frequency bands
- Reduce signaling to core-network

- Carrier Aggregation between macro and small cell
- Maintain connectivity via macro cell
- All processing (CA and Hand-Over) within eNodeB



Press release

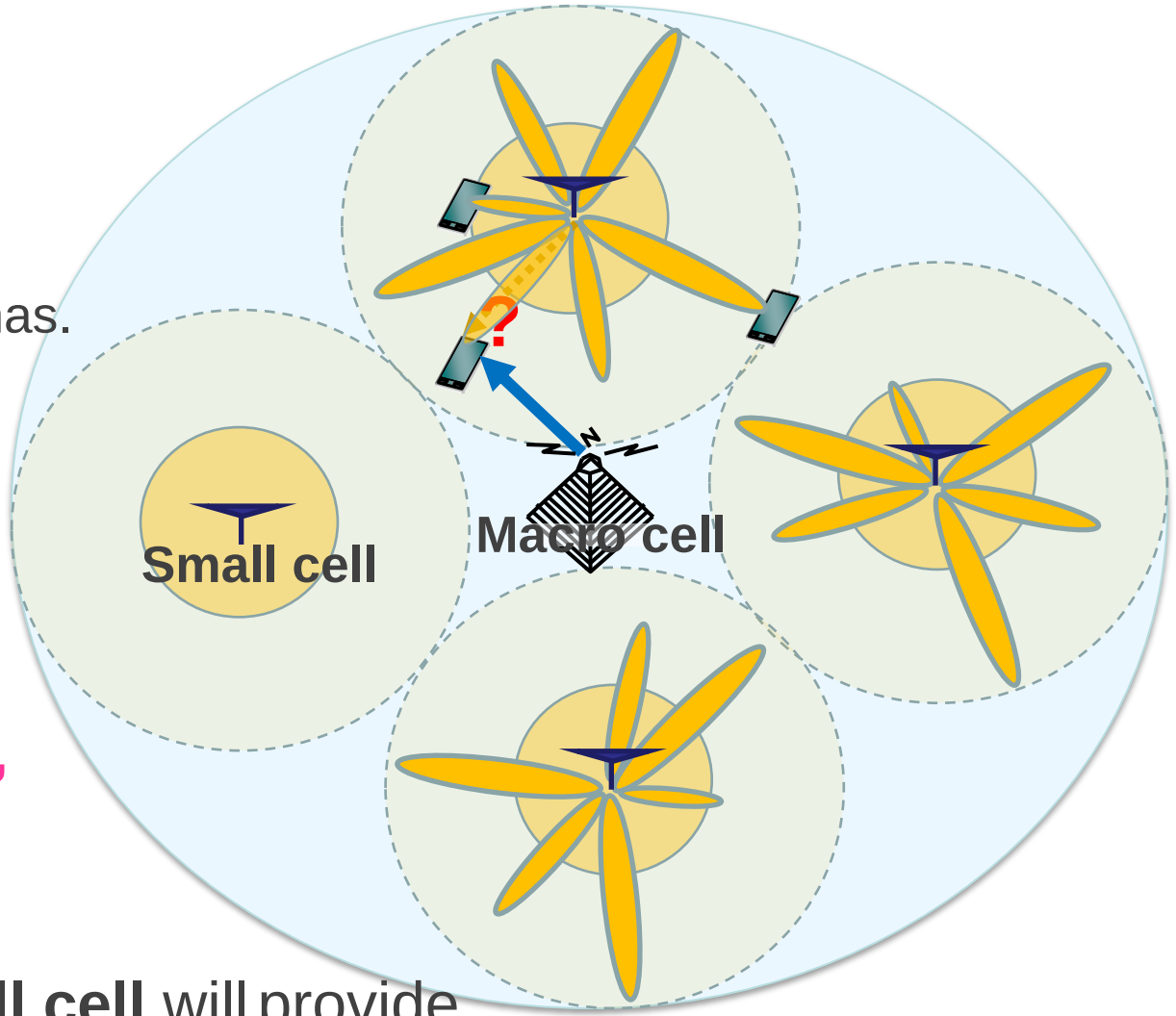
Massive MIMO and Macro-assisted Small cell



Massive MIMO
is about increasing
the number of antennas.

力業“Brute force”

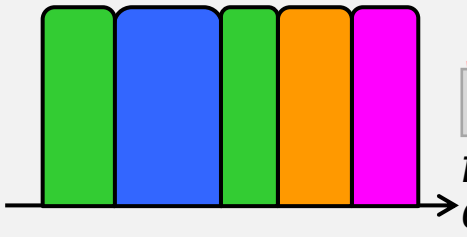
Adaptive Array Systems
had a problem in coverage
for common channels.



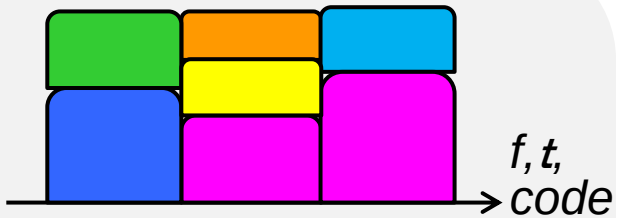
“an excellent feature”

The combination of
Massive MIMO and
Macro-assisted small cell will provide
adequate cell coverage even with higher frequency bands.

Non-Orthogonal Multiple Access (NOMA)



Processing power in Devices



Effort for Orthogonality

Effort to Mitigate Interference

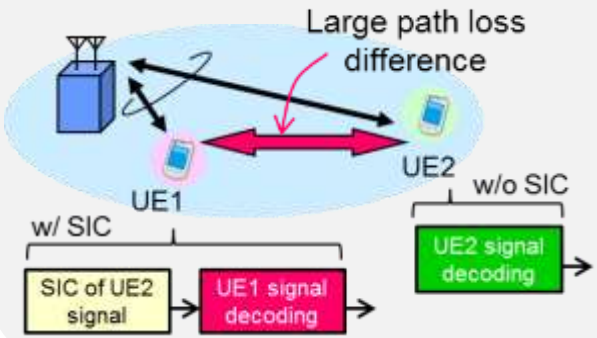
Intentional Non-orthogonality

FDMA,TDMA, CDMA, OFDMA

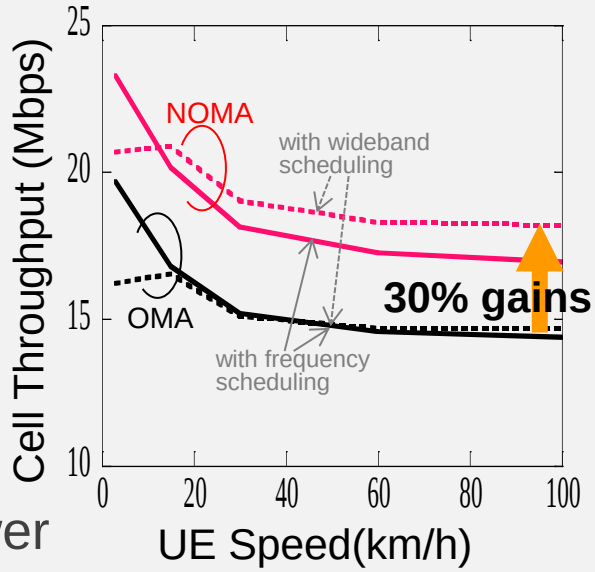
Equalizer, Canceller

MIMO

NOMA



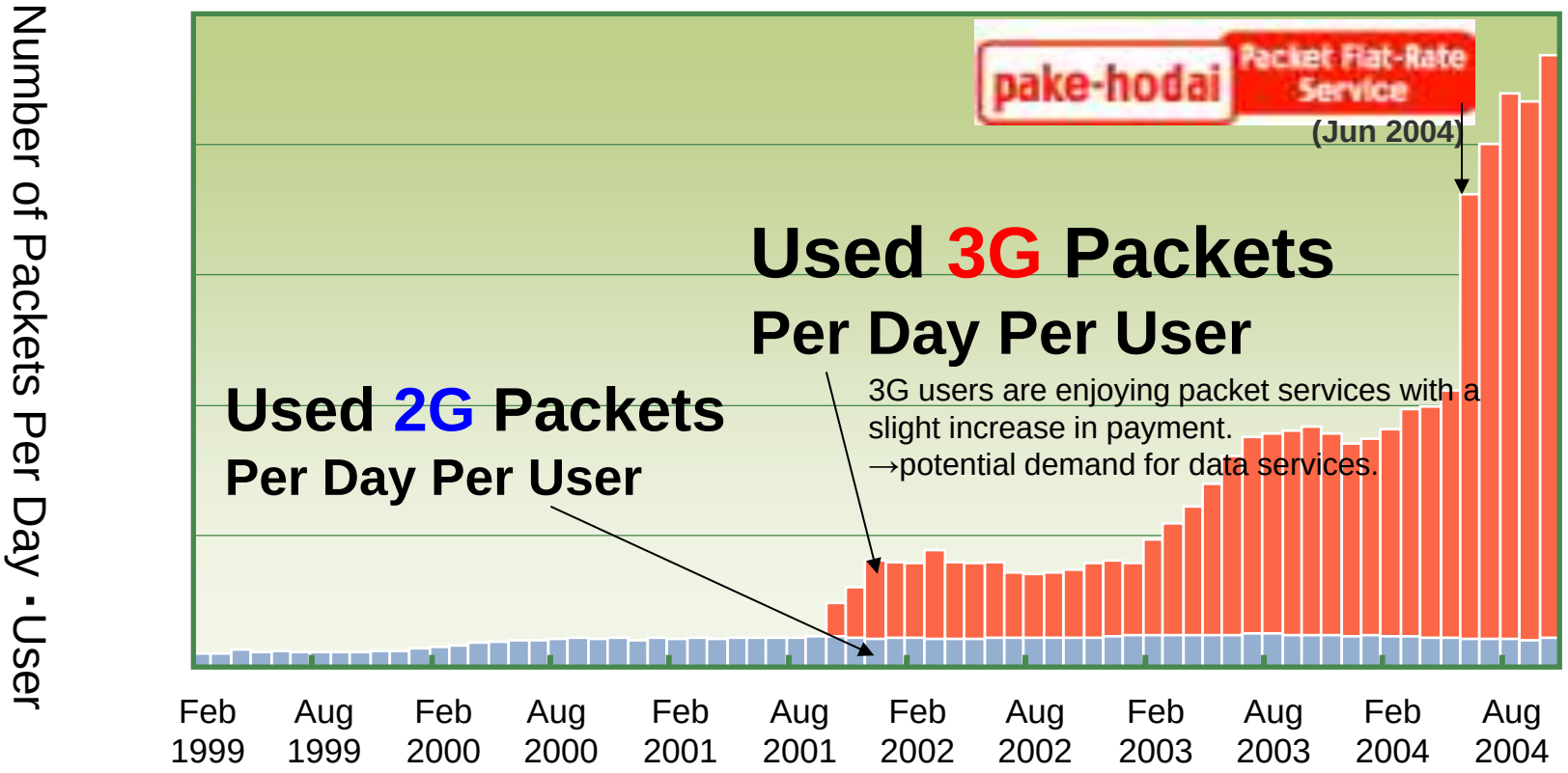
Exploitation of power-domain, path loss difference among users, and UE processing power



The dawn of 5G

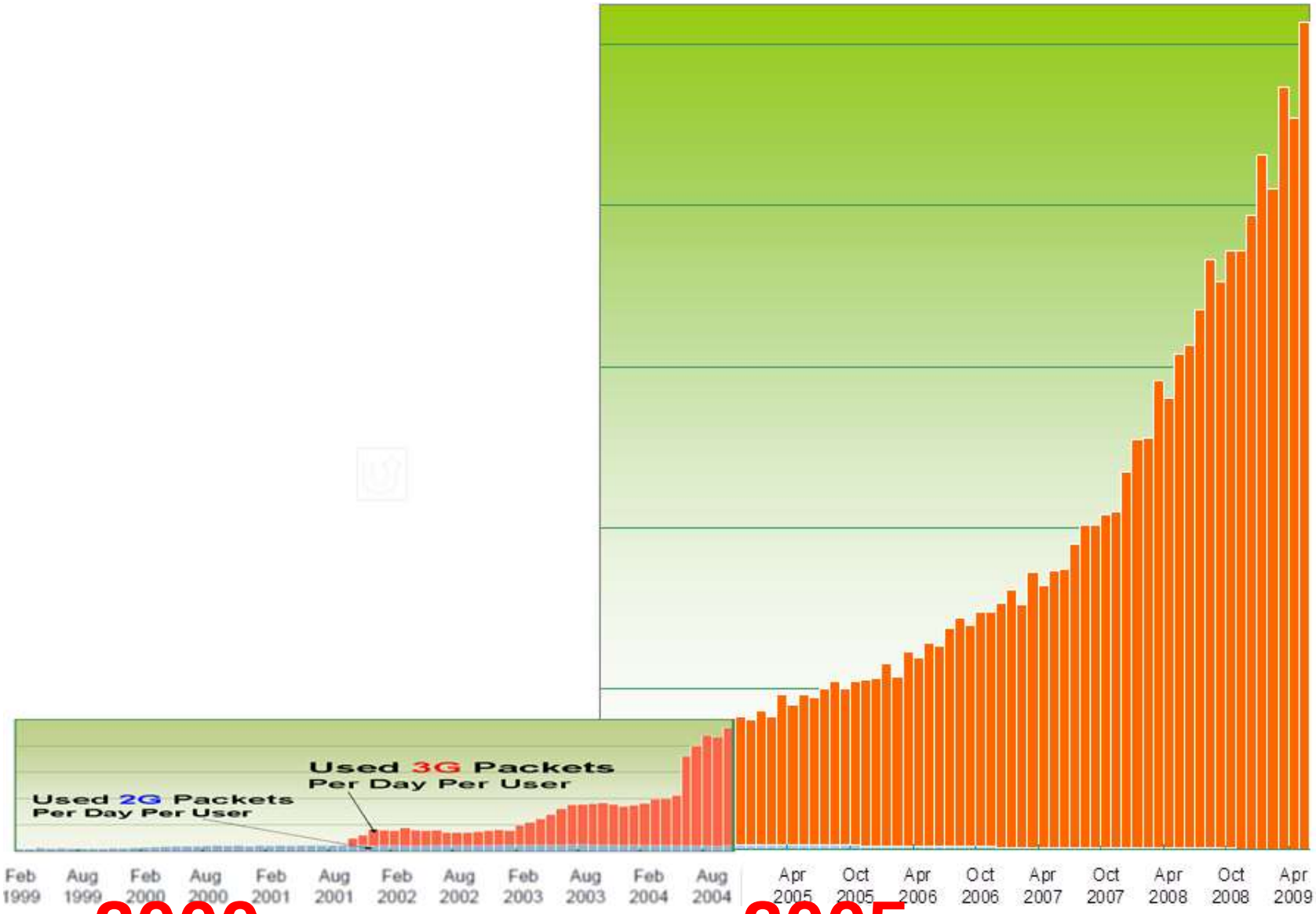
1000x Data, true?

Growth of Packet Data Traffic



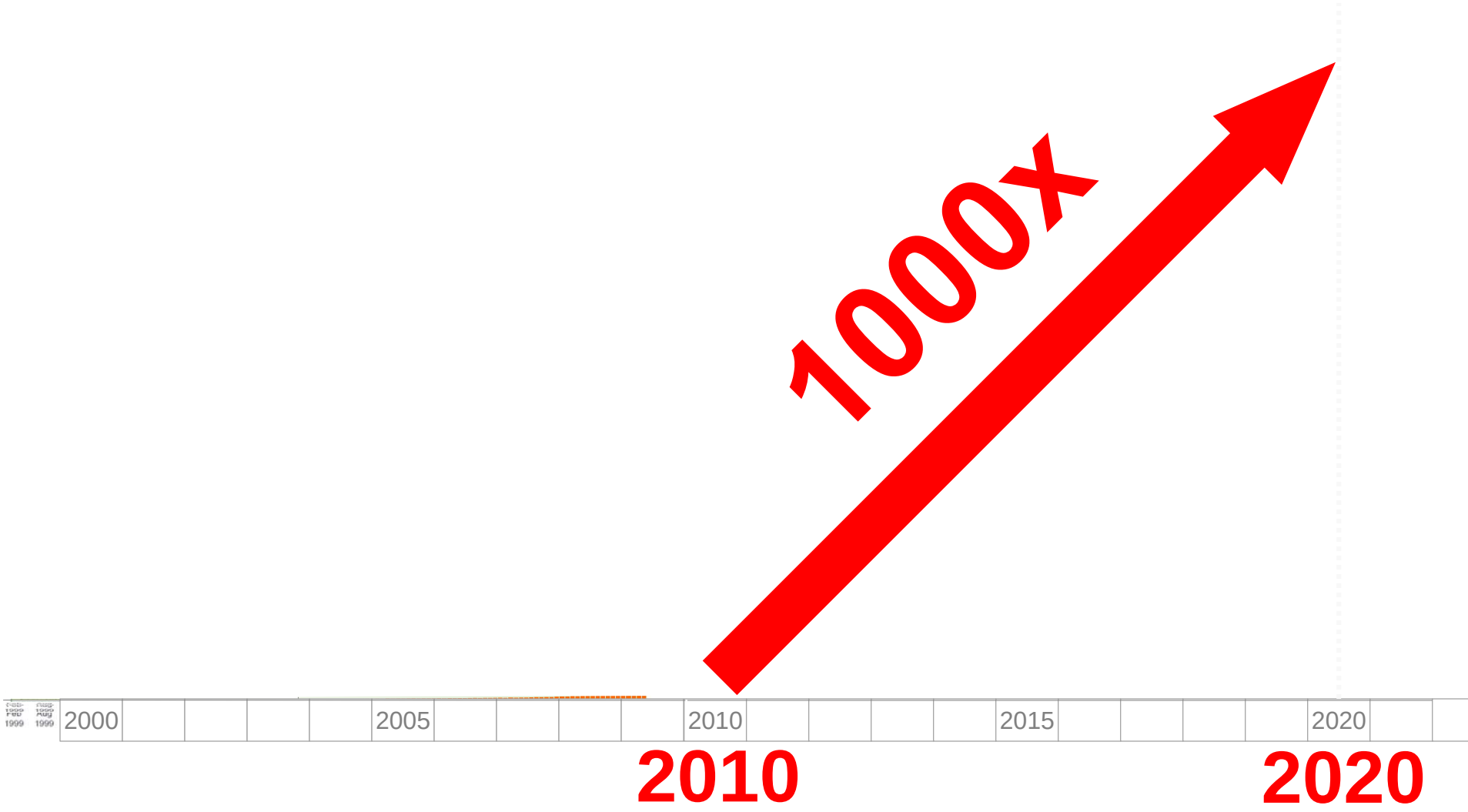
- 3G has a much higher capacity than 2G.
- A potential demand is observed in the increasing traffic.

Growth of Packet Data Traffic

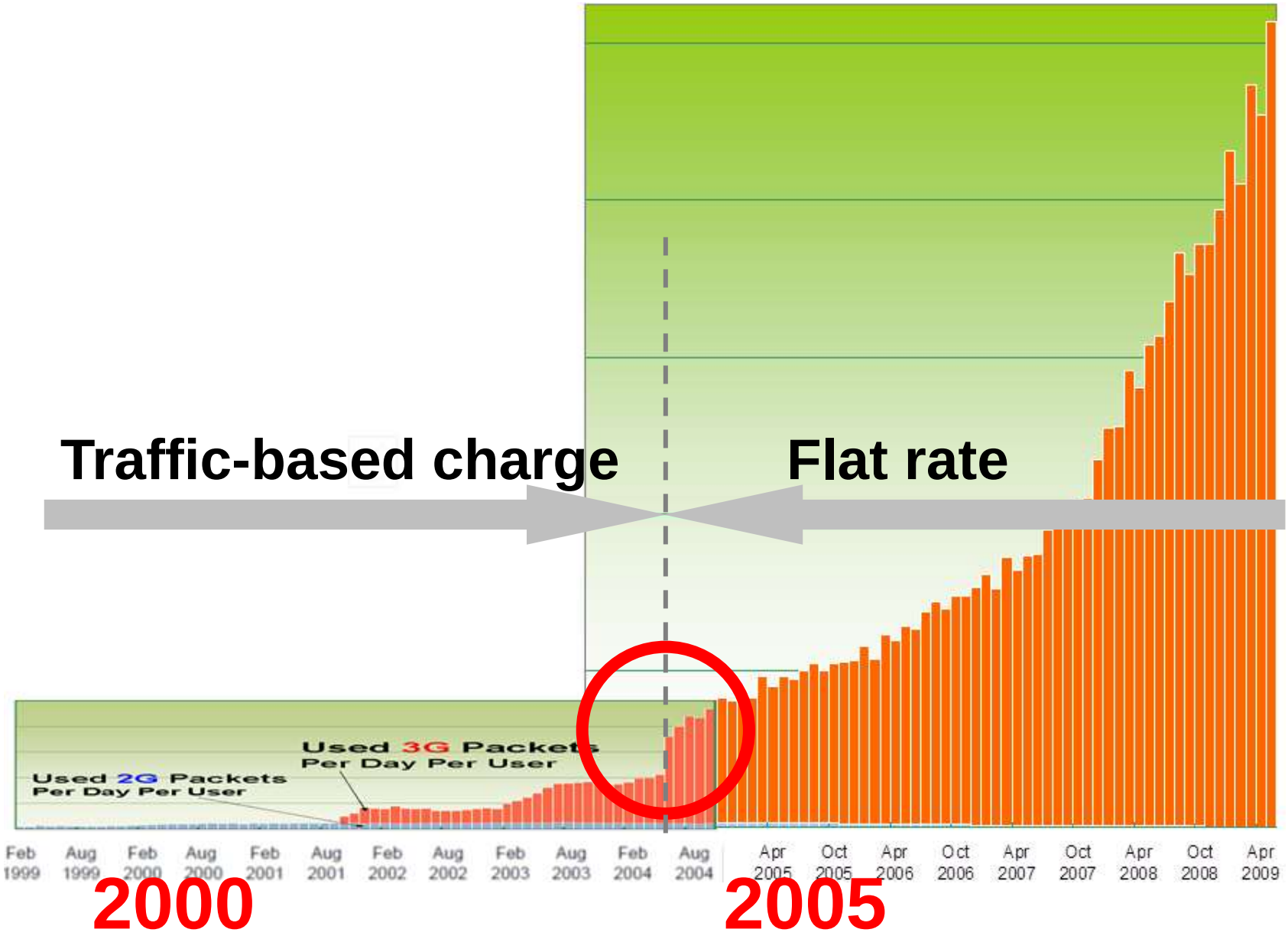


2000 2005 2010

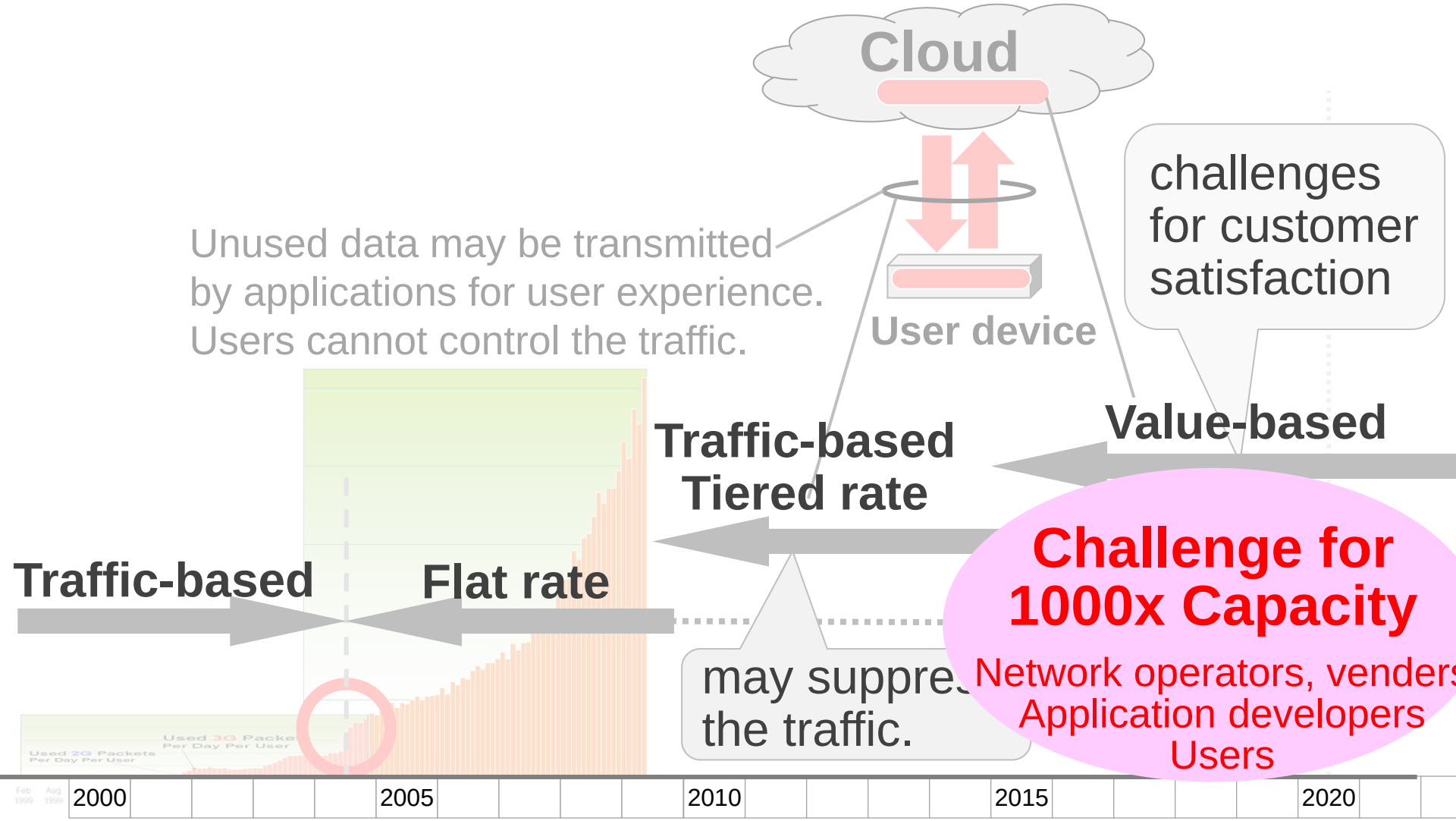
Growth of Packet Data Traffic



Growth of Packet Data Traffic



Growth of Packet Data Traffic

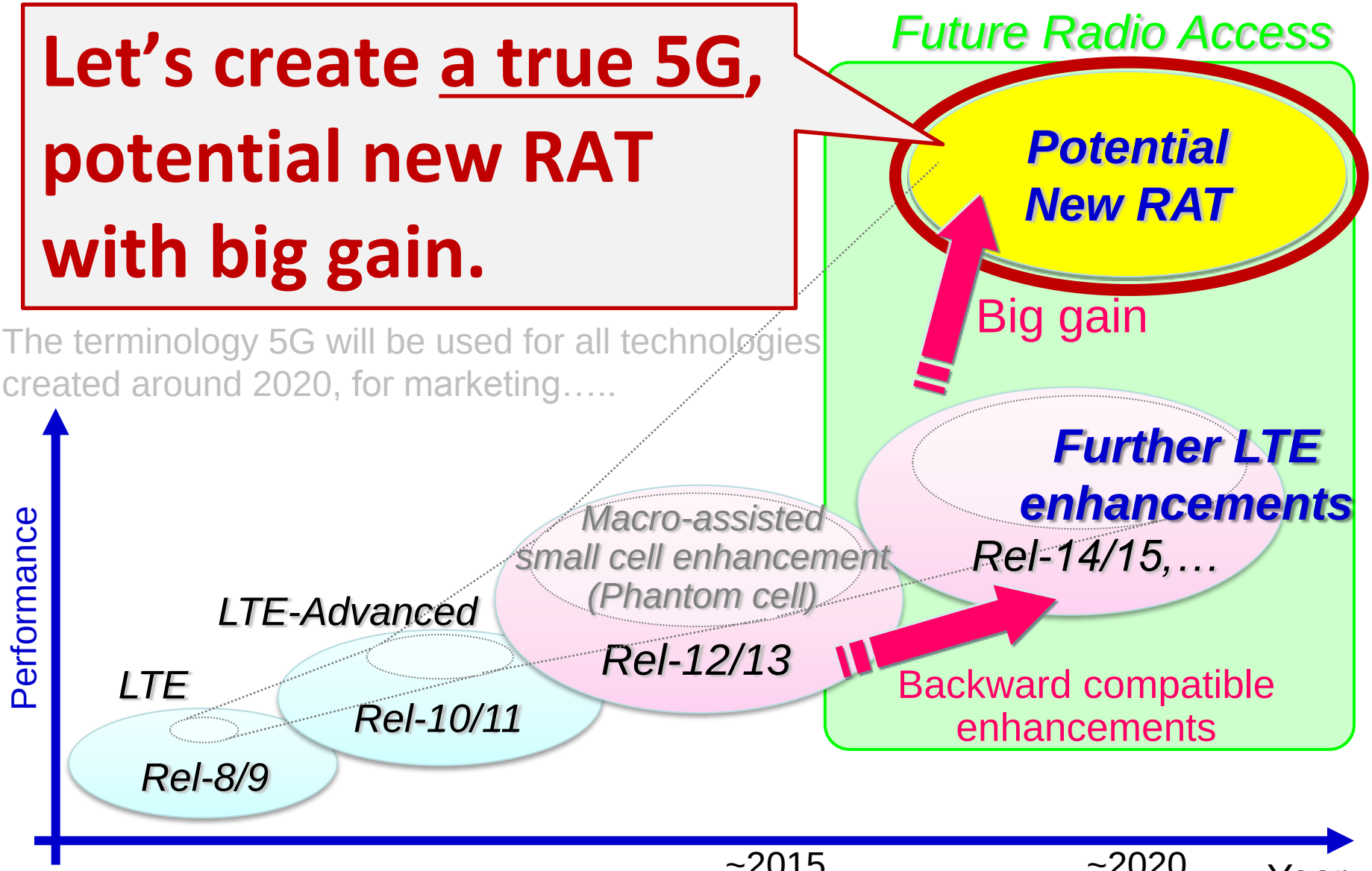


1000x Data happens for user experience in Cloud era.

Evolution paths for Future Radio Access

Let's create a true 5G, potential new RAT with big gain.

The terminology 5G will be used for all technologies created around 2020, for marketing…..

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