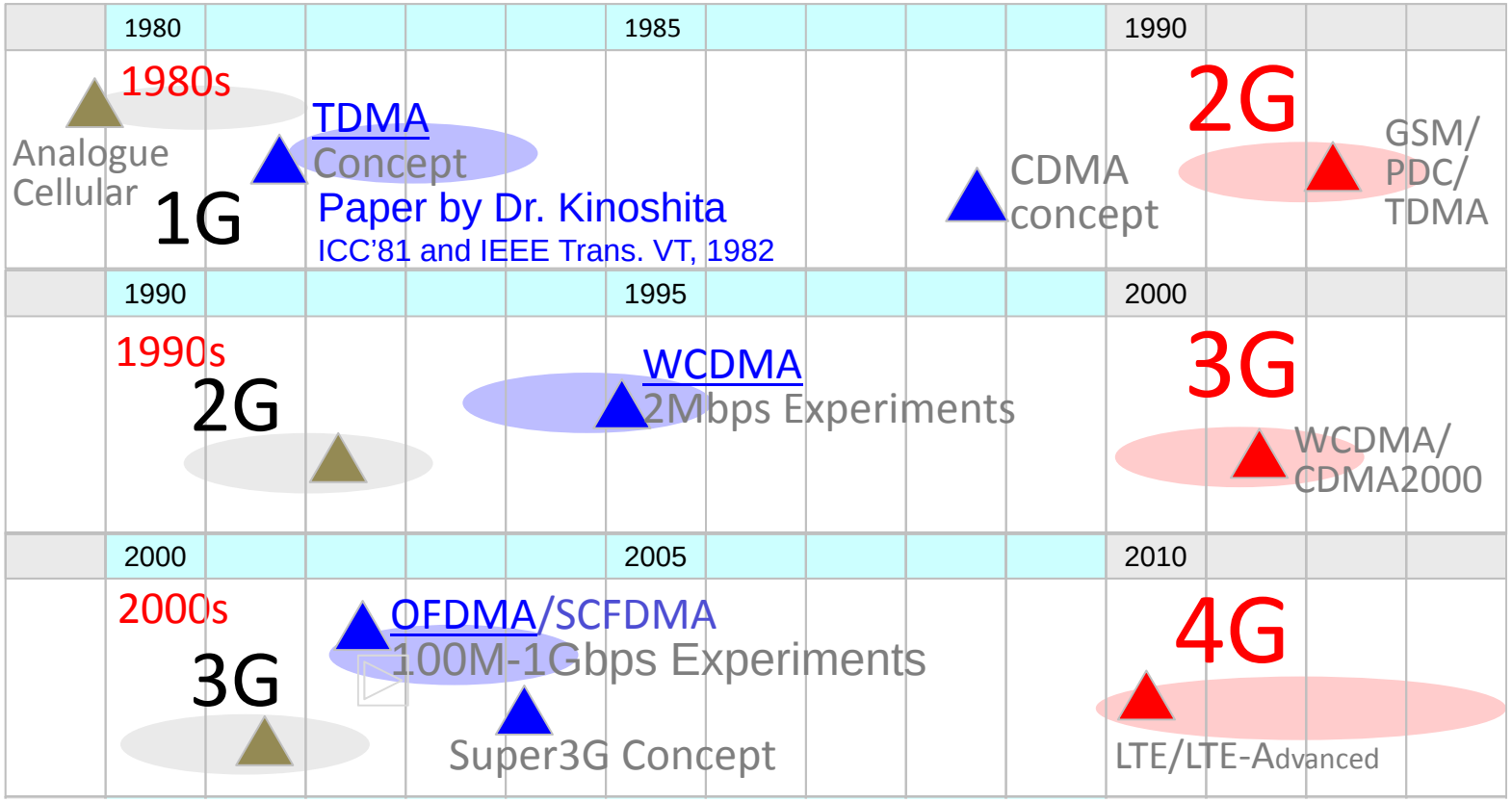
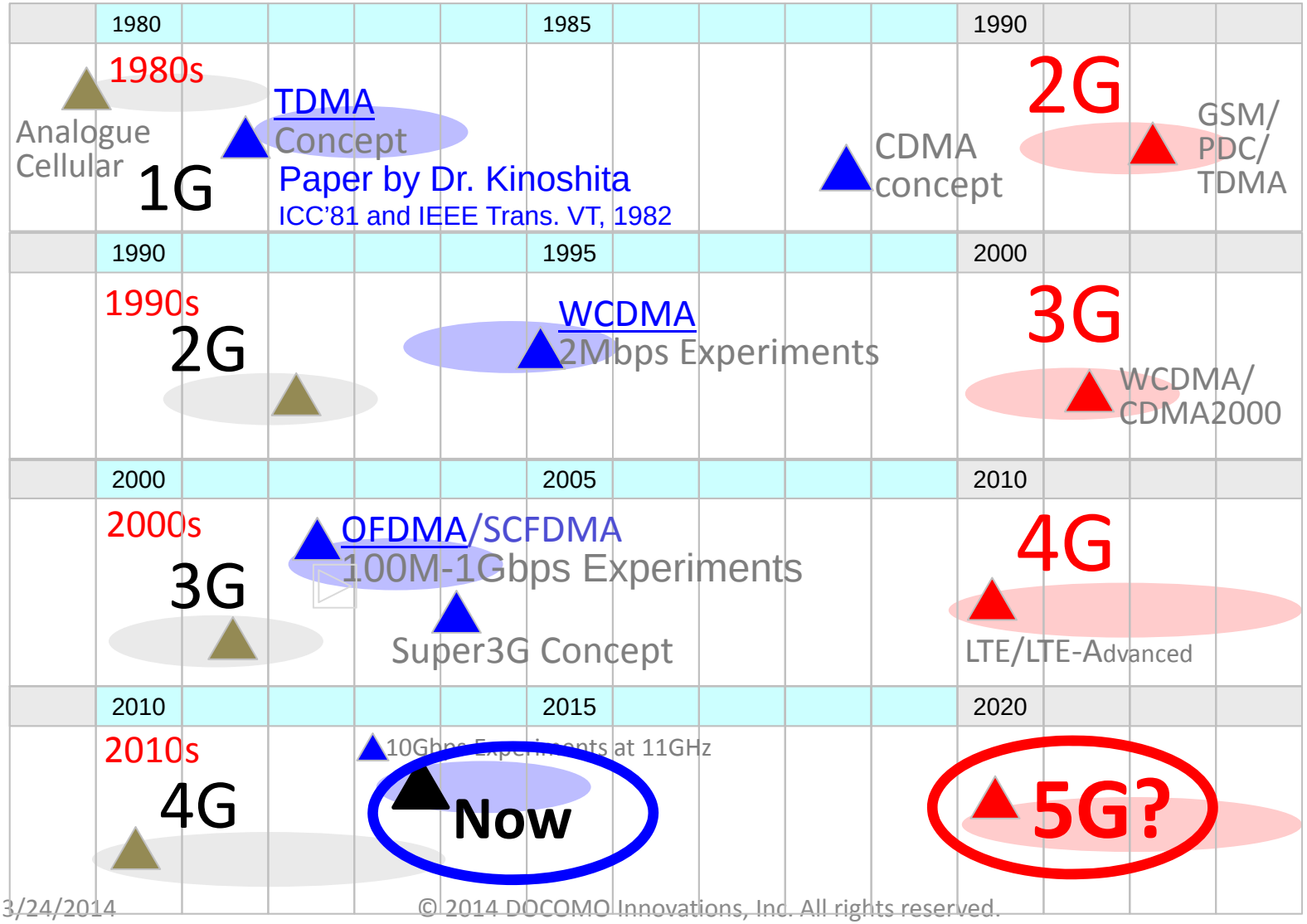
5G and **Wireless Measurements**

DOCOMO Innovations, Inc.

History

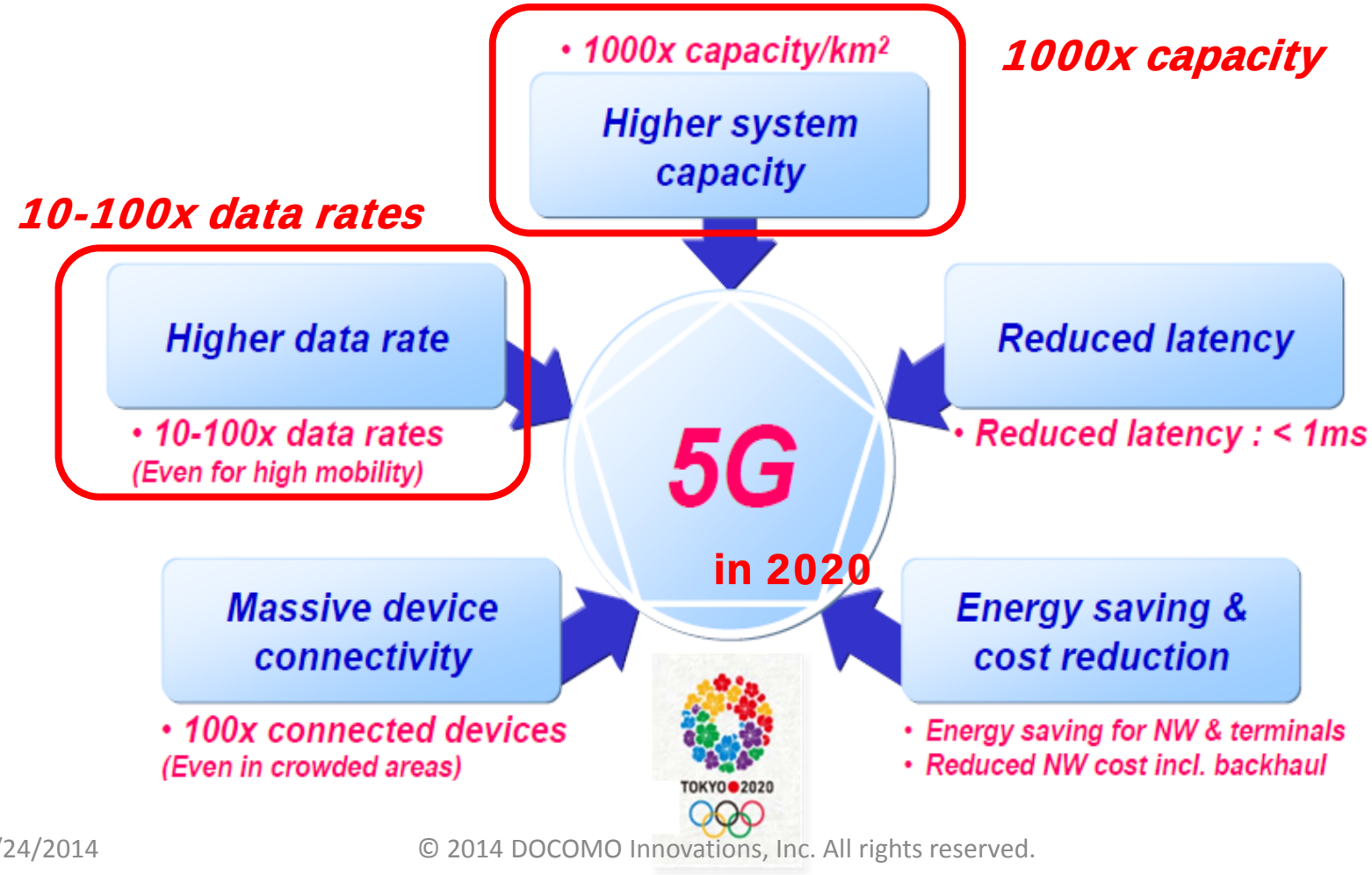


It's time to think about **5G**



Future Radio Access towards 5G

Our vision of 1000x capacity and 10-100x data rates will bring dramatic UX improvement for users in 2020.



Keys for 5G

Our Conventional Business

No Room!!

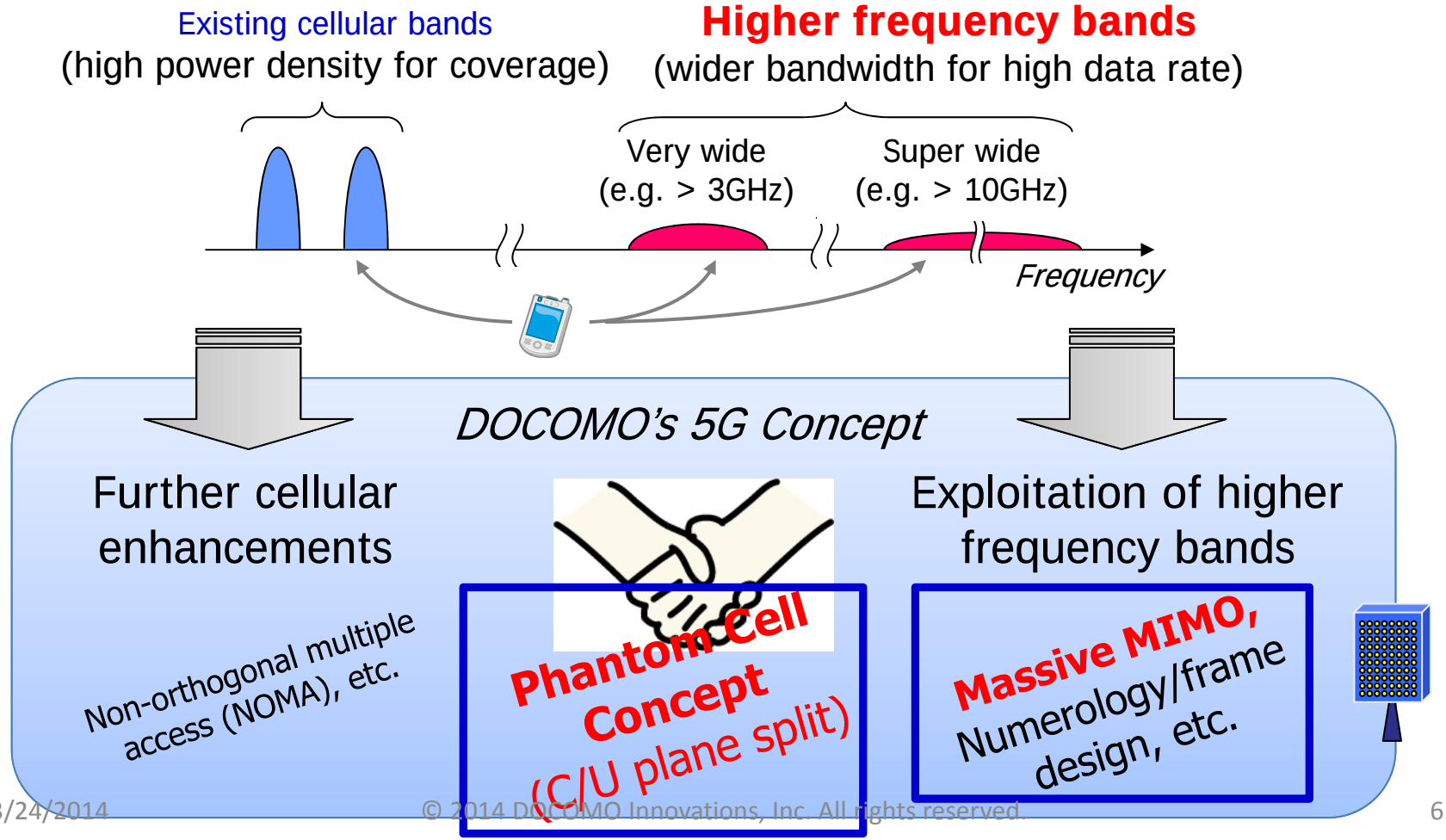
A lot of Space

BUT, No one knows how to use higher frequency bands as Cellular

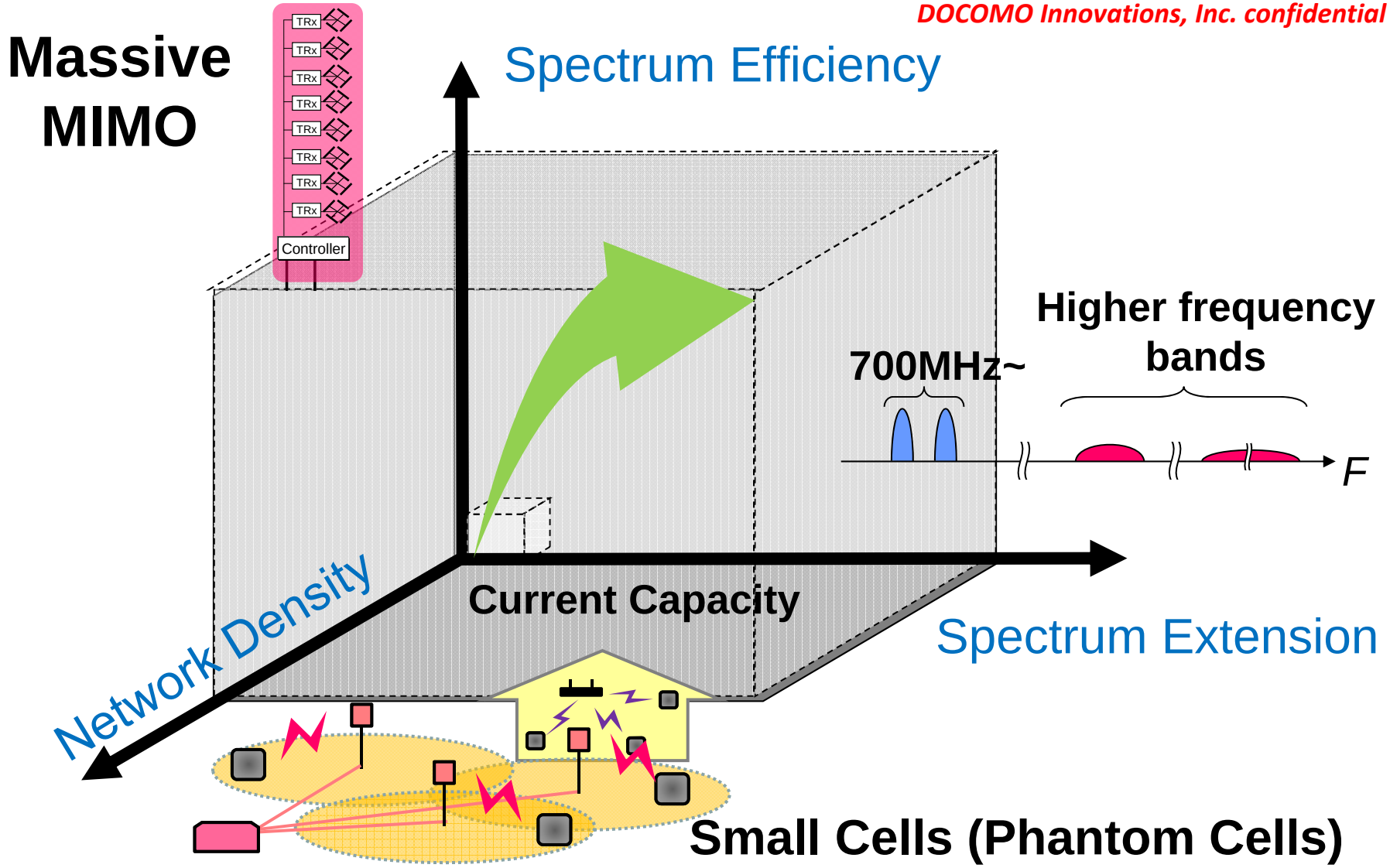
How should we use Higher Frequency Bands???

Concept – DOCOMO's 5G

FRA (Future Radio Access): Combined usage of lower and higher frequency bands

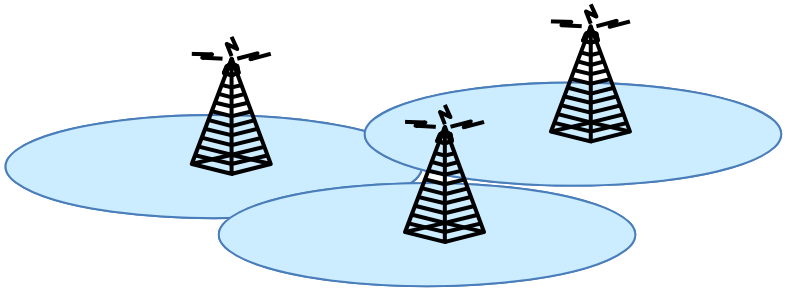


In Summary

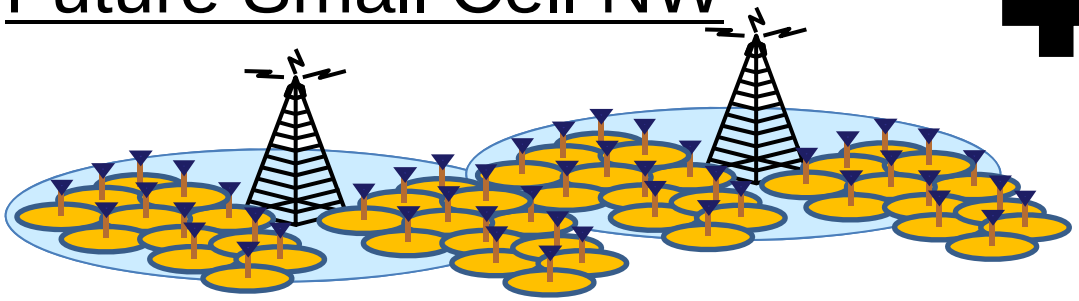


From a Deployment point of view

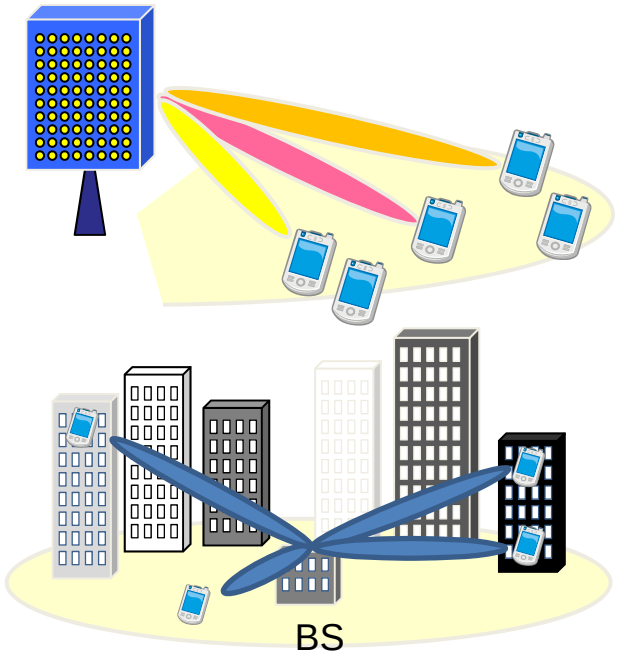
Conventional Cellular NW



Future Small Cell NW



Massive MIMO



- No one knows where/ how future small cells/ massive MIMO cells should be deployed in 5G NW.
- Operation cost would increase as the number of cells increases.

That is,

Deployments would be more and more important in 5G NW.

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Conventional wireless measurements would not be good enough for 5G deployments.

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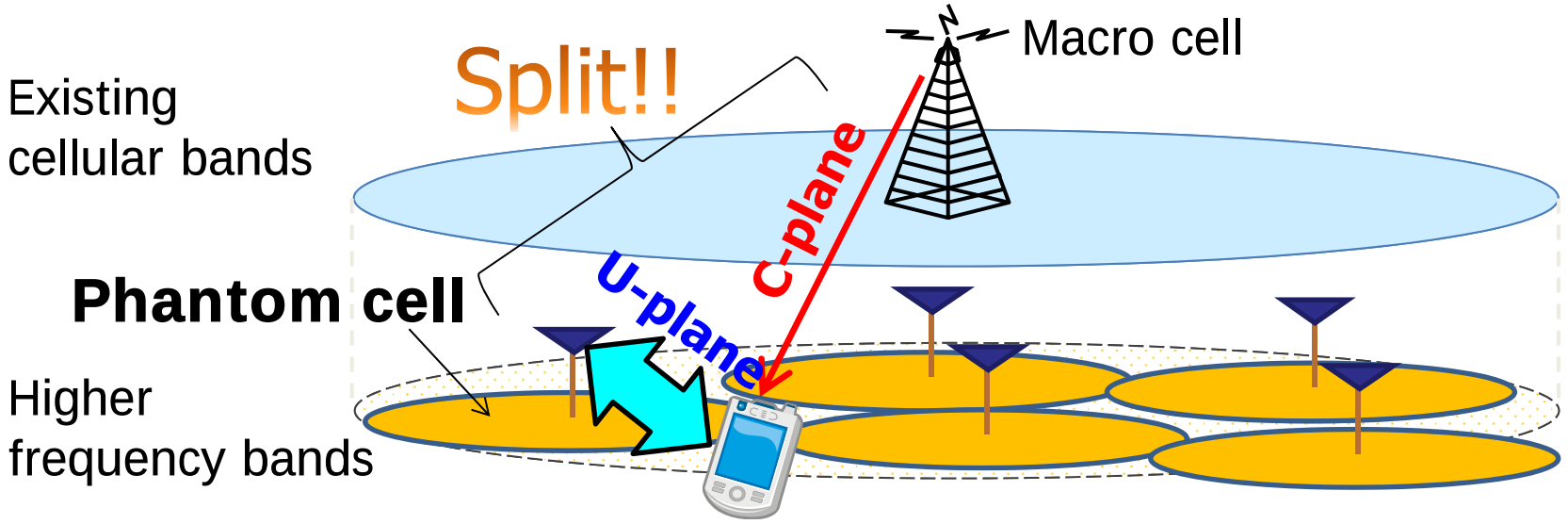
Future Wireless Measurements should be targeted to 5G NW and 5G deployments.

BACKUP SLIDES

Phantom Cell Concept

Phantom Cell Concept: DOCOMO proposed this architecture to utilize higher frequency bands through splitting macro and small cells for C-plane and U-plane in different frequency bands [1, 2]

[1] NTT DOCOMO, 3GPP RWS-120010, June 2012.
[2] H. Ishii et al., IEEE Globecom 2012 Workshop, Dec. 2012.



C-plane: Macro cell maintains good connectivity and mobility using lower frequency bands

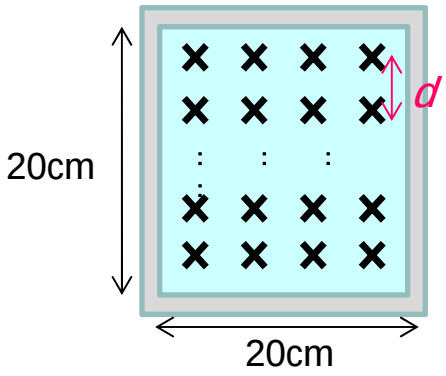
U-plane: Small cell provides higher throughput and more flexible/cost-energy efficient operations using higher/wider frequency bands

Massive MIMO (Multiple-Input Multiple-Output)

Massive MIMO: Beamforming using massive antenna elements in higher frequency band for gain and capacity improvement

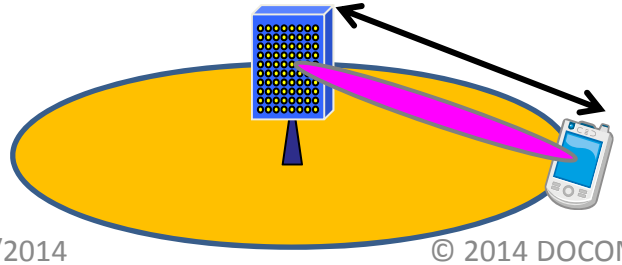
- 4G LTE (today) : 2 antennas (at device) x 2 antennas (at base station)
- **5G** : **hundreds of antennas** at base station!

e.g. Massive MIMO 2D antenna configuration



	Migration	5G Massive MIMO	
Antenna element spacing (*d*)	3.5 GHz (λ = 8.6 cm)	10 GHz (λ = 3 cm)	20 GHz (λ = 1.5 cm)
0.5 λ	16	169	676
0.7 λ	9	81	361

Cell range extension by beamforming gain



Improved spectrum efficiency with (multi-user) spatial multiplexing