
5G Tokyo Bay Summit
2015

docomo

# The Myths and Realities of 5G

Seizo ONOE
CTO and EVP
NTT DOCOMO, INC.

SYMPOSIA >>
TUTORIALS >>
WORKSHOPS >>
INDUSTRY PANELS >>
PODIUM PRESENTATION >>
LIGHTNING TALKS >>
YOUNG PROFESSIONALS >>

**Tuesday, 24 May 2016**

IF-01: Cellular Technologies in Shared Spectrum: LTE Unlicensed,
Time: 14:00-15:30 (Room: Conference Hall 1, Level 3)

IF-02: 5G Architecture
Time: 14:00-15:30 (Room: Conference Hall 2, Level 3)

IF-03: 3GPP Standards Toward 5G
Time: 16:00-17:30 (Room: Conference Hall 1, Level 3)

IF-04: Dynamic Spectrum Access: The Ways Forward
Time: 16:00-17:30 (Room: Conference Hall 2, Level 3)

**Wednesday, 25 May 2016**

IF-05: Integrating Knowledge of Telecom Standards into Engineering Education
Time: 11:00-12:30 (Room: Conference Hall 1, Level 3)

IF-06: Rising Industrial IoT Applications
Time: 14:00-15:30 (Room: Conference Hall 1, Level 3)

IF-07: Towards 5G: Mobile Network Softwarization
Time: 14:00-15:30 (Room: Conference Hall 2, Level 3)

IF-08: Accelerate 5G and LTE/WLAN Research and Development
Time: 16:00-17:30 (Room: Conference Hall 1, Level 3)

IF-09: 5G for Verticals – Game Changers, Catalysts, and New Players
Time: 16:00-17:30 (Room: Conference Hall 2, Level 3)

**Thursday, 26 May 2016**

IF-10: 5G – The PHY, the MAC, the Network, Anything Else: What will Make it Special?
Time: 11:00-12:30 (Room: Conference Hall 1, Level 3)

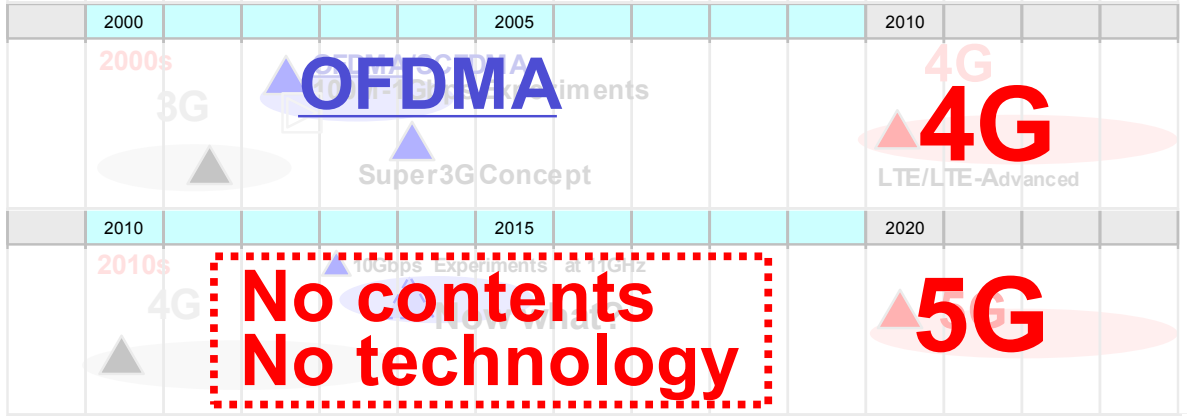
IF-11: IEEE 802.11 in a 5G Landscape
Time: 11:00-12:30 (Room: Conference Hall 2, Level 3)

IF-12: mmWave for 5G: From Theory to Practice
Time: 14:00-17:30 (Room: Meeting Room 310, Level 3)

IF-13: Industry Roadmap to 5G: Standards Timeline and Spectrum Requirement
Time: 14:00-15:30 (Room: Conference Hall 2, Level 3)

# History from 1G to 4G and the Next

**"In early 2000s, there was a concrete 4G technology, but no one called it 4G.**
**Today, there are no contents of 5G, but everyone talks about 5G."**




It's a marketing gimmick after 3G, while technologies were there before 5G

**Boom: 5G is hype?**

No Tech

**No single representative technology, but there are several candidate technologies and the combinations of technologies create new technologies and solutions.**

5G Technology

# The Myths and Realities of 5G

Seizo ONOE
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# The Myths and Realities of 5G

# Myths about 5G

- 5G is millimeter wave technology.
- 5G is a hot spot system.
- 5G needs new 5G spectra.
- 5G is IMT-2020 defined by ITU.
- 5G replaces 4G.
- For 5G, all things need something new.
- 5G needs significant investment.

IEEE SPECTRUM

Tech Talk | Telecom | Wireless

# 5 Myths About 5G

By Amy Nordrum

Posted **25 May 2016 | 13:15 GMT**

http://spectrum.ieee.org/tech-talk/telecom/wireless/5-myths-about-5g

5G will NOT require tons of $ or replace 4G + @seizo_onoe of @docomo will set you straight: https://t.co/2WqWJ9Ahyu @IEEESpectrum **#IEEEICC16**


**5 Myths About 5G**
The CTO of Japan's largest mobile carrier is on a mission to dispel these misconceptions
bit.ly/1s9FD5O

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# Myths about 5G

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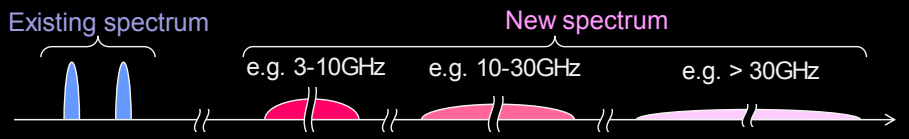



**A wrong story I don't like**

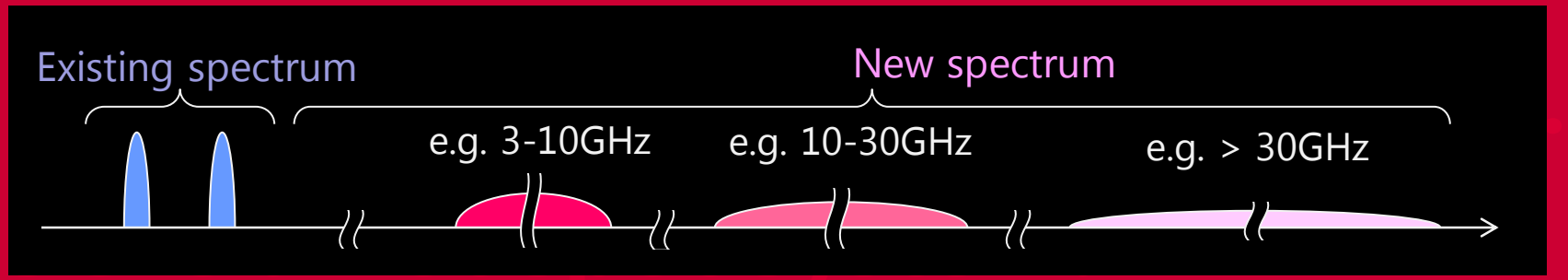
5G provides Higher data speed and Higher capacity.

➔Broader spectrum bandwidth
➔Higher frequency spectrum
➔Larger propagation loss
➔Shorter coverage
➔5G is a ~~Hotspot system for complementary use.~~

---

**Let's tackle the challenge of achieving wide coverage as cellular systems even with higher spectrum.**

# Myths about 5G

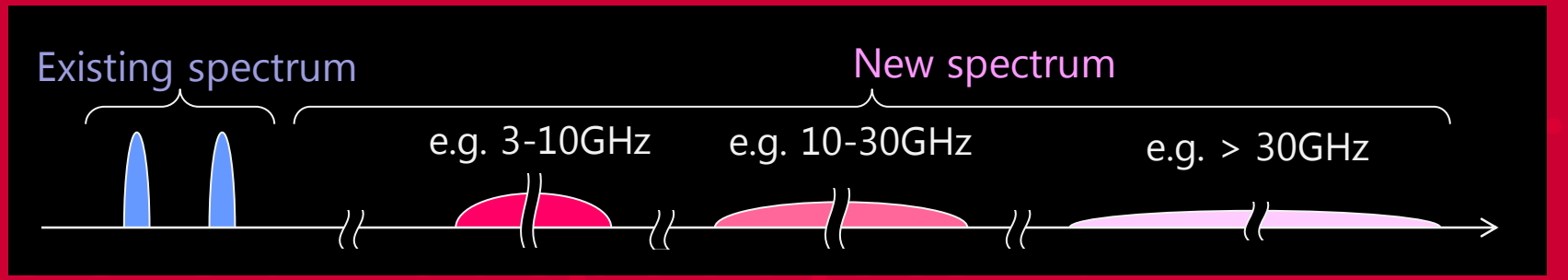



## ➢5G needs new 5G spectra.

- **Spectra are independent of technology generations. (ITU identifies IMT bands, not 5G bands.)**
- **5G doesn't necessarily need new bands, while new spectrum is key to extremely high performance.**

5G uses new bands as well as existing bands with combinations from the beginning (and eventually by refarming).

# Myths about 5G

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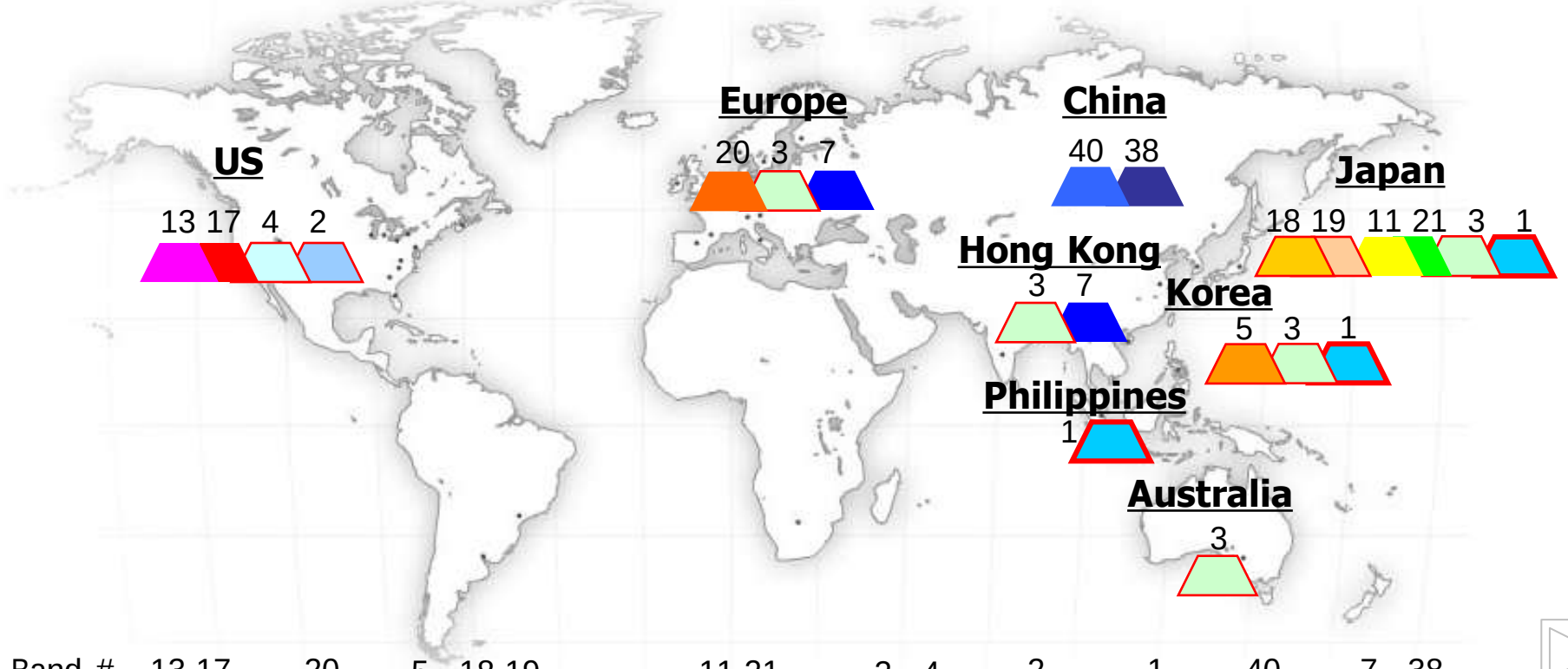
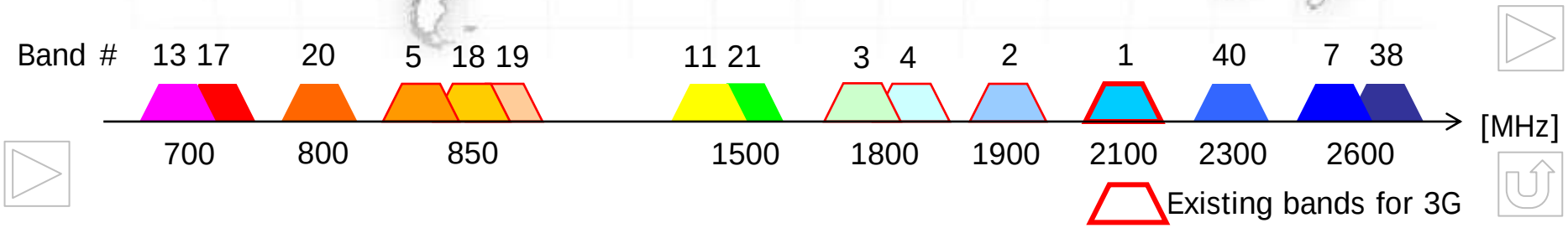
# LTE Spectrum Fragmentation

- We don't need to cry over the LTE spectrum fragmentation.
- Let's use the existing bands for LTE and encourage enhancement of multi-band support in devices.



# 3G and 4G Wireless Blog

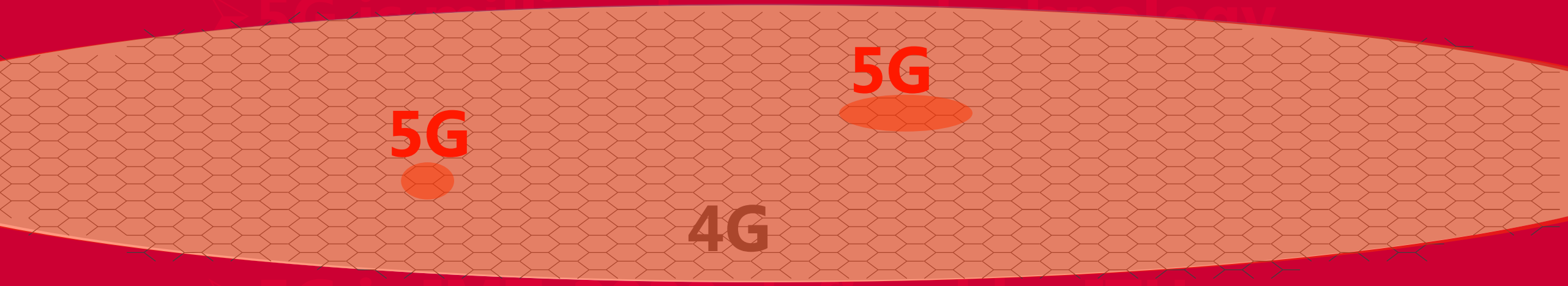
Thursday, 19 May 2011

## Twitter Conversations from the 7th LTE World Summit

**May 19, 2011**

@[redacted]: Seizo Onoe of NTT DoCoMo now on stage to talk about their LTE service called Xi (Crossy)
@[redacted]: NTT DoCoMo: LTE service launched in Tokyo, Nagoya, Osaka (Dec 2010) with a phased coverage increase during 2011/2012.
@[redacted]: NTT DoCoMo decided to share its 2.1GHz spectrum between UMTS and LTE and will deploy LTE at 1.5GHz during 2012.
@[redacted]: Docomo says spectrum needs to be used more efficiently and shared between technologies. I am a fan of efficiency
@[redacted]: DoCoMo pitching LTE2100 shared with HSPA2100. Recommends all phones support LTE2100. Use my band & give me scale economies please!
@[redacted]: Do most operators have enough spectrum at 2.1GHz to implement NTT DoCoMo's suggestion? I.e deploy LTE on existing 3G spectrum
@[redacted]r: @[redacted] Most in Europe have 2x10MHz. Very tough to refarm anytime soon to LTE. 2.1GHz is where all smartphone traffic goes...
@[redacted]: @[redacted] Very true. Risk of cannibalizing UMTS capacity would scare most operators in Europe.
@[redacted]: Deploying LTE at 2.1GHz makes sense in Japan, where indoor systems (DAS, tuned for 2.1GHz) are heavily deployed in urban areas

# Myths about 5G




➢5G replaces 4G.

**It may happen eventually but not in the short term.**
**5G will be overlaid over 4G.**
**Some equipment could be upgraded by software.**

# Myths about 5G


5G SIM

5G Encryption

5G Spectra

5G Roaming

5G Core Network?

**People are trying to jump on the 5G bandwagon.**

- For 5G, all things need something new.
- 5G needs significant investment.

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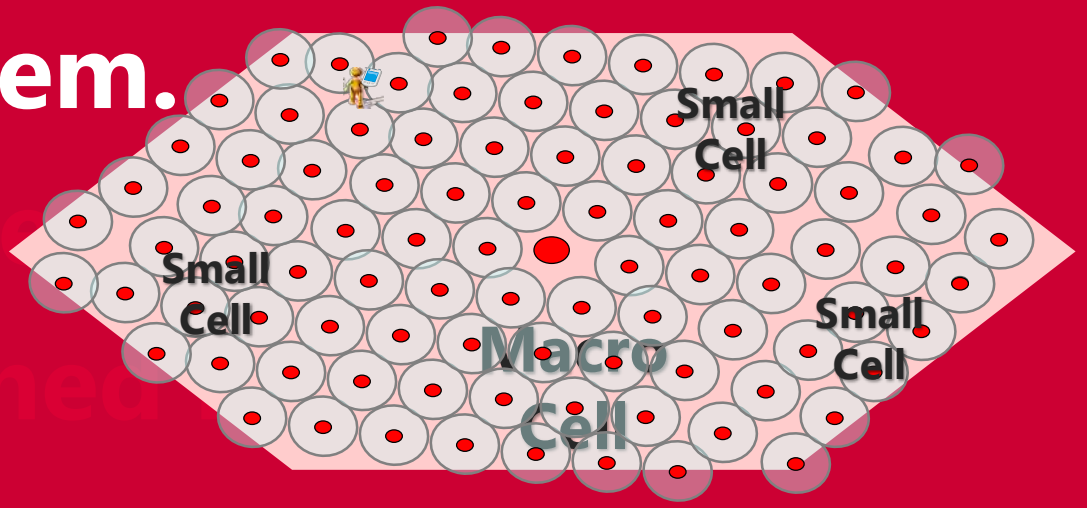

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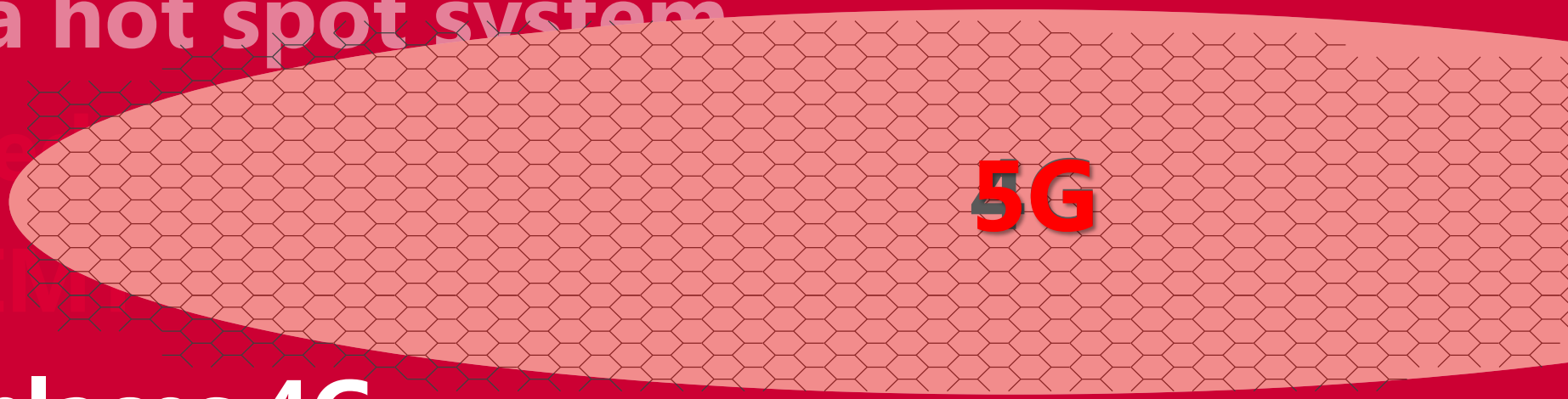
- 5G ne
- 5G is IP

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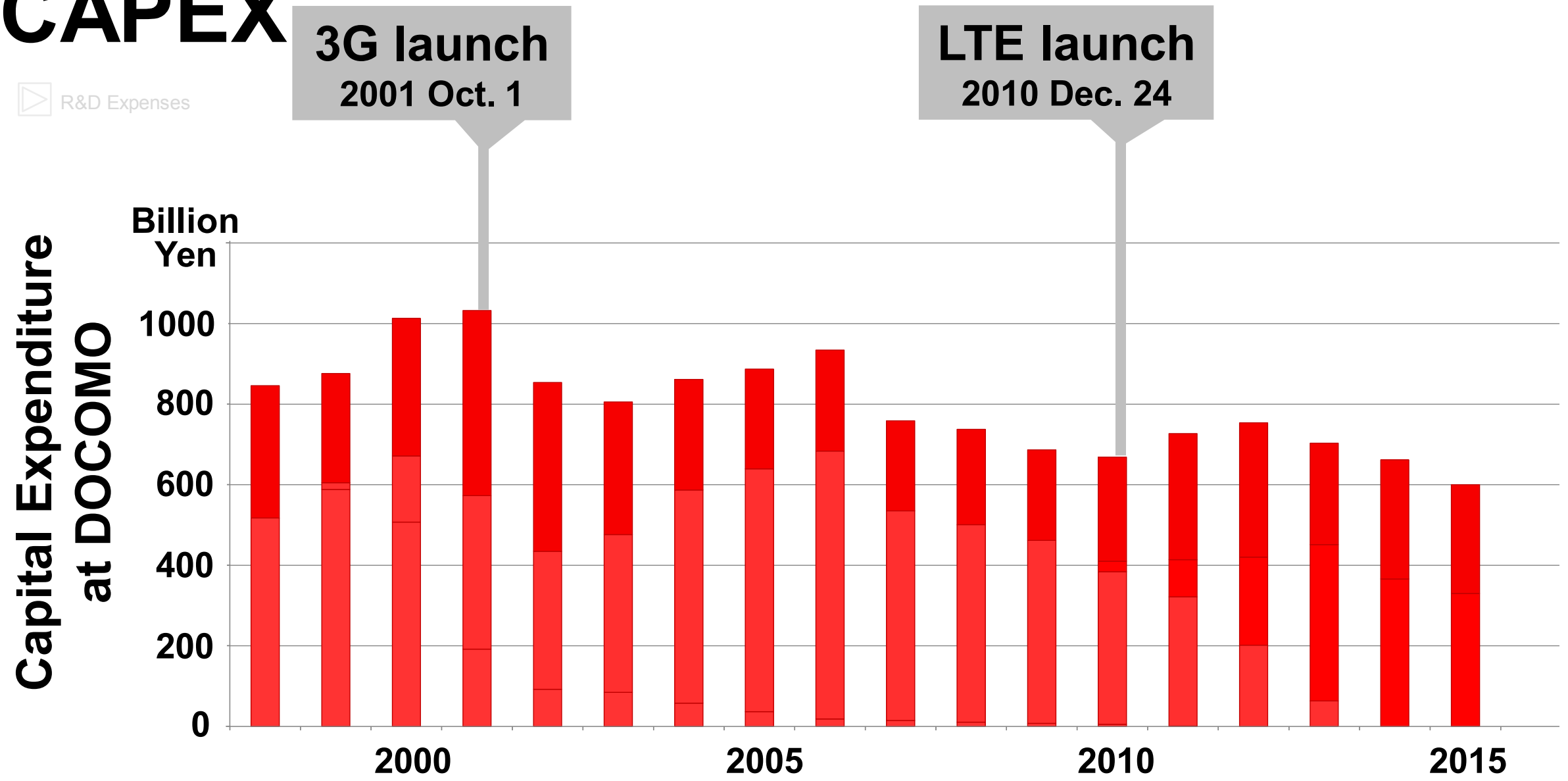
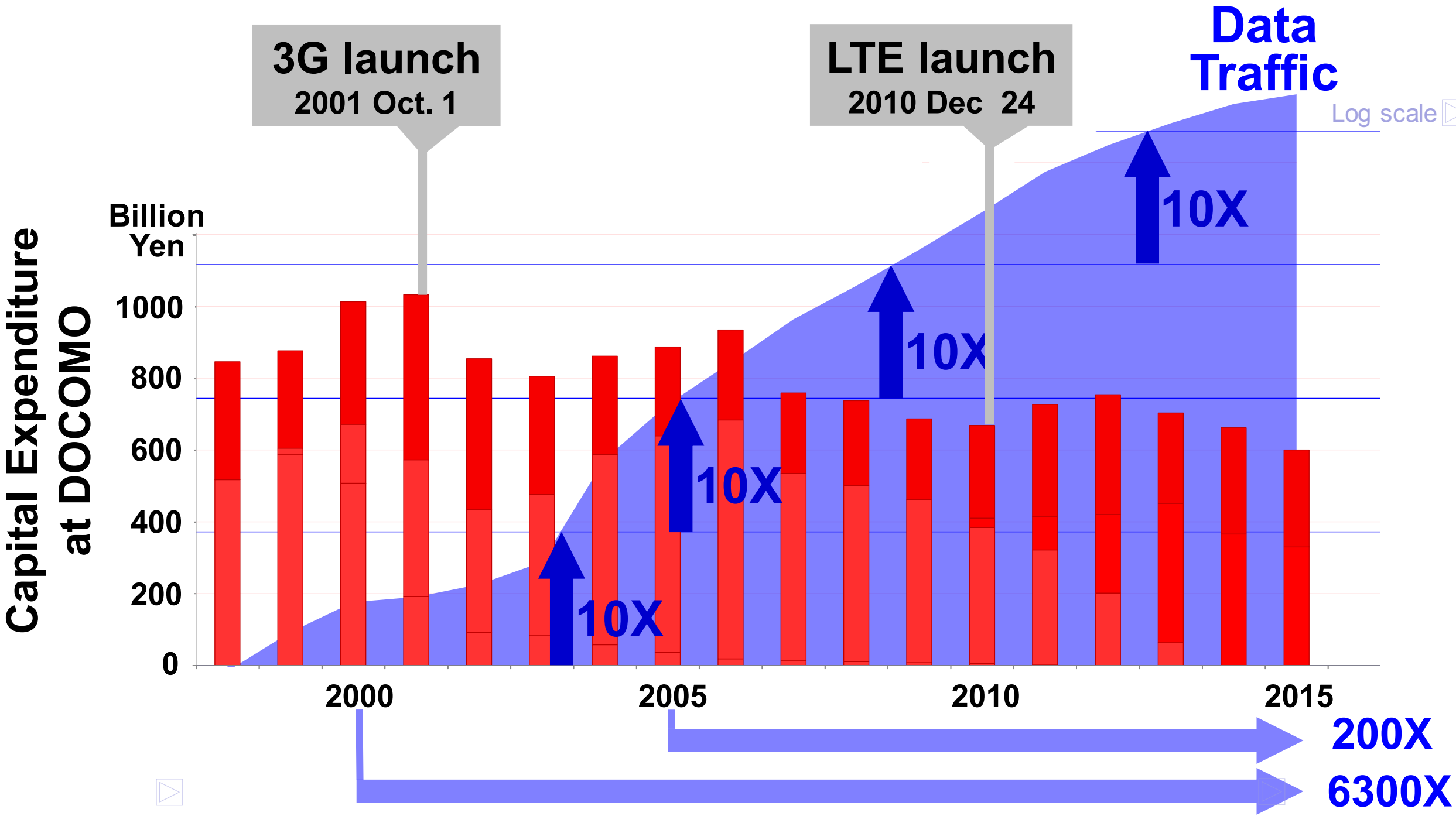
A vague sense of worry

- **5G needs significant investment.**

# CAPEX

R&D Expenses




3G launch
2001 Oct. 1
LTE launch
2010 Dec 24
Data Traffic
Log scale
Capital Expenditure at DOCOMO
Billion Yen
1000
800
600
400
200
0
2000
2005
2010
2015
10X
10X
10X
10X
200X
6300X

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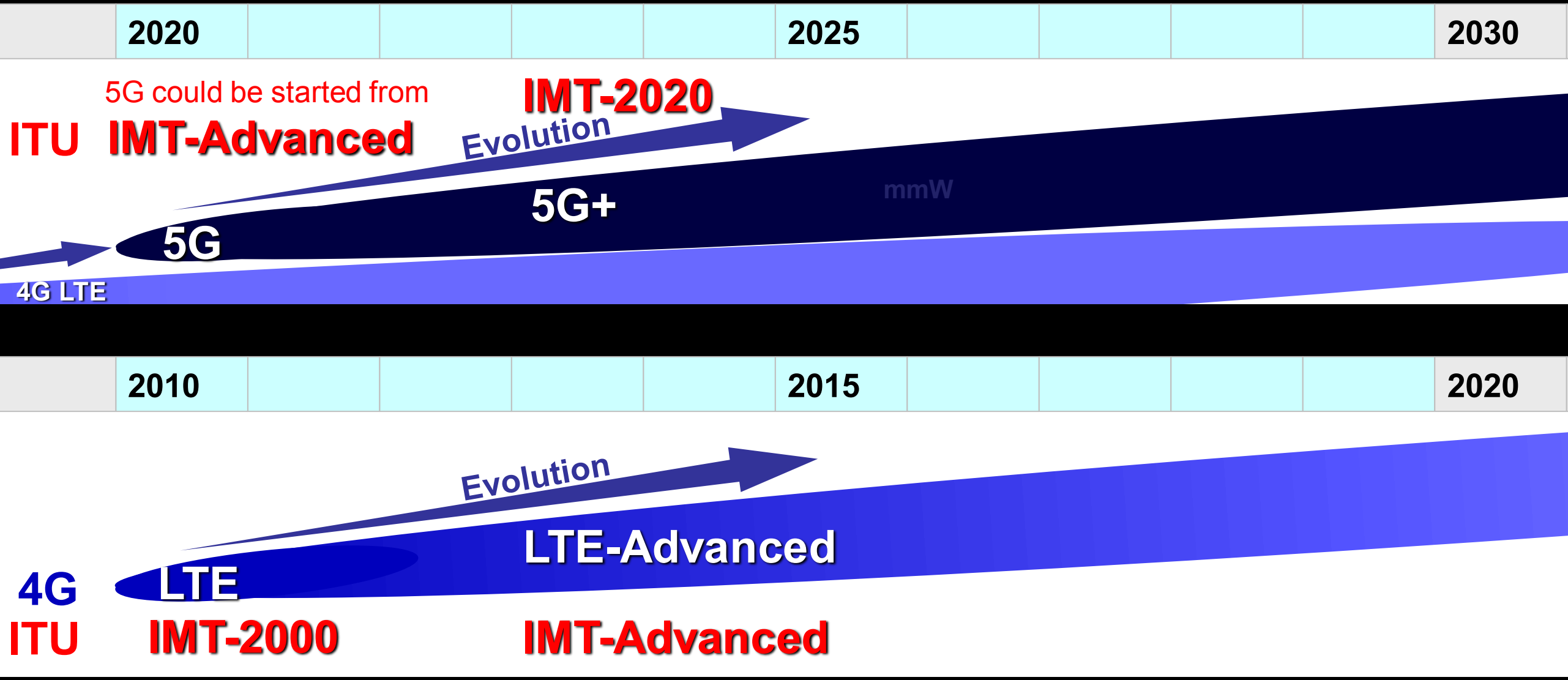
**ITU defines IMT-2020 but it does NOT define 5G in the recommendations.**

# Evolution of Mobile Technology



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**ITU Press Release may cause confusion, like 4G in the past.**

International Telecommunication Union

Newsroom • Press Release

# Dec. 6, 2010

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## ITU World Radiocommunication Seminar highlights future communication technologies

### Focus on international regulations for spectrum management and satellite orbits

**Geneva, 6 December 2010** - The ITU World Radiocommunication Seminar 2010 (WRS-10) opened in Geneva today to discuss international regulations on the use of radio-frequency spectrum and satellite orbits. Discussions during the week will focus as well on some key technological issues, such as future standards for mobile phones.

WRS-10 will also provide participants with essential technical and regulatory background information to assist them to prepare for the upcoming ITU World Radiocommunication Conference to be held in Geneva, Switzerland, 23 January-17 February 2012.

**this term (4G), while undefined, may be applied to the forerunners of these technologies, LTE and… and to other evolved 3G technologies ….**

During the coming week, WRS-10 will also focus on progress made in ITU-R Study Groups and … related to radio standardization and spectrum management.

Following a detailed evaluation against stringent technical and operational criteria, ITU … mined that "LTE-Advanced" and "WirelessMAN-Advanced" should be accorded the official designation of IMT-Advanced. As the most advanced technologies currently defined for global wireless mobile broadband communications, IMT-Advanced is considered as "4G", although it is recognized that this term, while undefined, may also be applied to the forerunners of these technologies, LTE and WiMax, and to other evolved 3G technologies providing a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed. The detailed specifications of the IMT-Advanced technologies will be provided in a new ITU-R Recommen…

4G

# Dec. 20, 2010

**An operator started to call HSPA+ 4G.**

December 20, 2010 3:12 PM PST

# ITU blesses U.S. data networks as 4G

**Dec. 20, 2010**

by Kent German

Font size Print E-mail Share 10 comments

Tweet 103 Share 24 3 Digg

For most of this year, "4G" has became the latest war-of-words battleground for U.S.

**ITU,... officially designates wireless technologies, changed its stance and ...**

weeks ago the ITU decided to cut them some slack anyway. At its December 6 meeting in Geneva, the ITU, an international standards body that officially designates wireless technologies, changed its stance and gave its blessing to Verizon's LTE and Sprint's WiMax networks.

"It is recognized that [4G], while undefined, may also be applied to the forerunners of these technologies, LTE and WiMax, and to other evolved 3G technologies providing a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed," the ITU said in a statement. An ITU spokesman in Geneva did not return calls for additional comment by the time of this writing.

A carefully worded statement, to be sure, but it also means that [redacted] HSPA+ technology will get a 4G designation as well. Though that likely won't sit well with T-Mobile's rivals, th[redacted] welcomed the news today even as it issued a statement claiming it had the fastest data network in 10[redacted]

**...HSPA+ technology will get a 4G designation ...**

competitors' stores and see for themselves that the Web experience is very different from what could be done on a mobile device seven or eight years ago."

**Jan. 5, 2011**

**Another operator started to call HSPA+ 4G.**

# The Myths and Realities of 5G

- Time Plan
- Requirements
- Spectrum
- Technologies
- R&D activities
- Technology Convergence

# Time Plan

- **Myths**
- **Realities** -Time Plan
- -Requirements
- -Spectrum
- -Technologies
- -R&D activities
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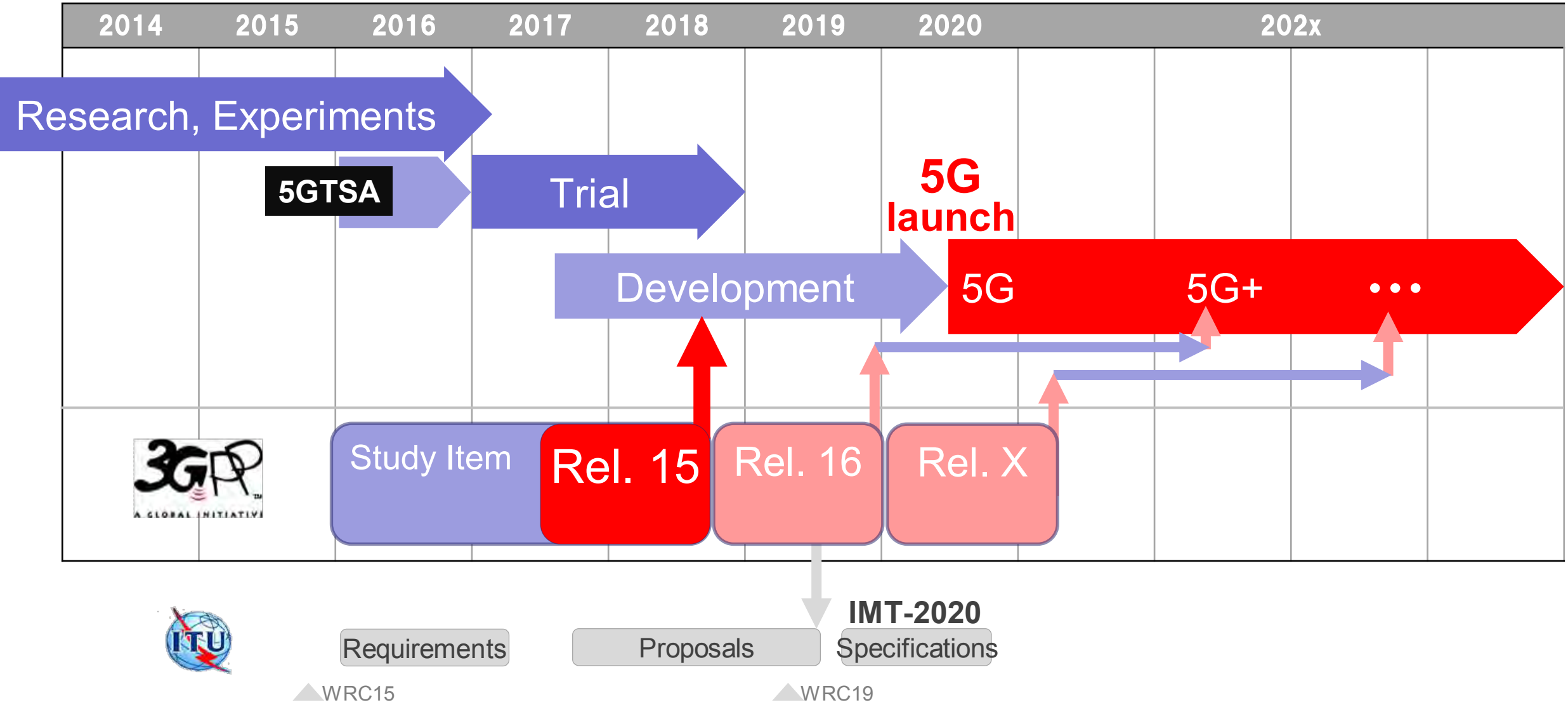
- **Conclusion**

# DOCOMO's Time Plan



# Press Releases

February 22, 2016

## KT, NTT DOCOMO, SK Telecom and Verizon to Form 5G Open Trial Specification Alliance

5GTSA



R&D

KT, NTT DOCOMO, SK Telecom and Verizon have agreed to form a new global initiative, called the 5G Open Trial Specification Alliance. This alliance plans to develop an aligned 5G trial specification that would serve as a common, extendable platform for different 5G trial activity around the world, focused on technical fundamentals and promoting a more inclusive, open, and collaborative approach to the development of 5G trial networks.

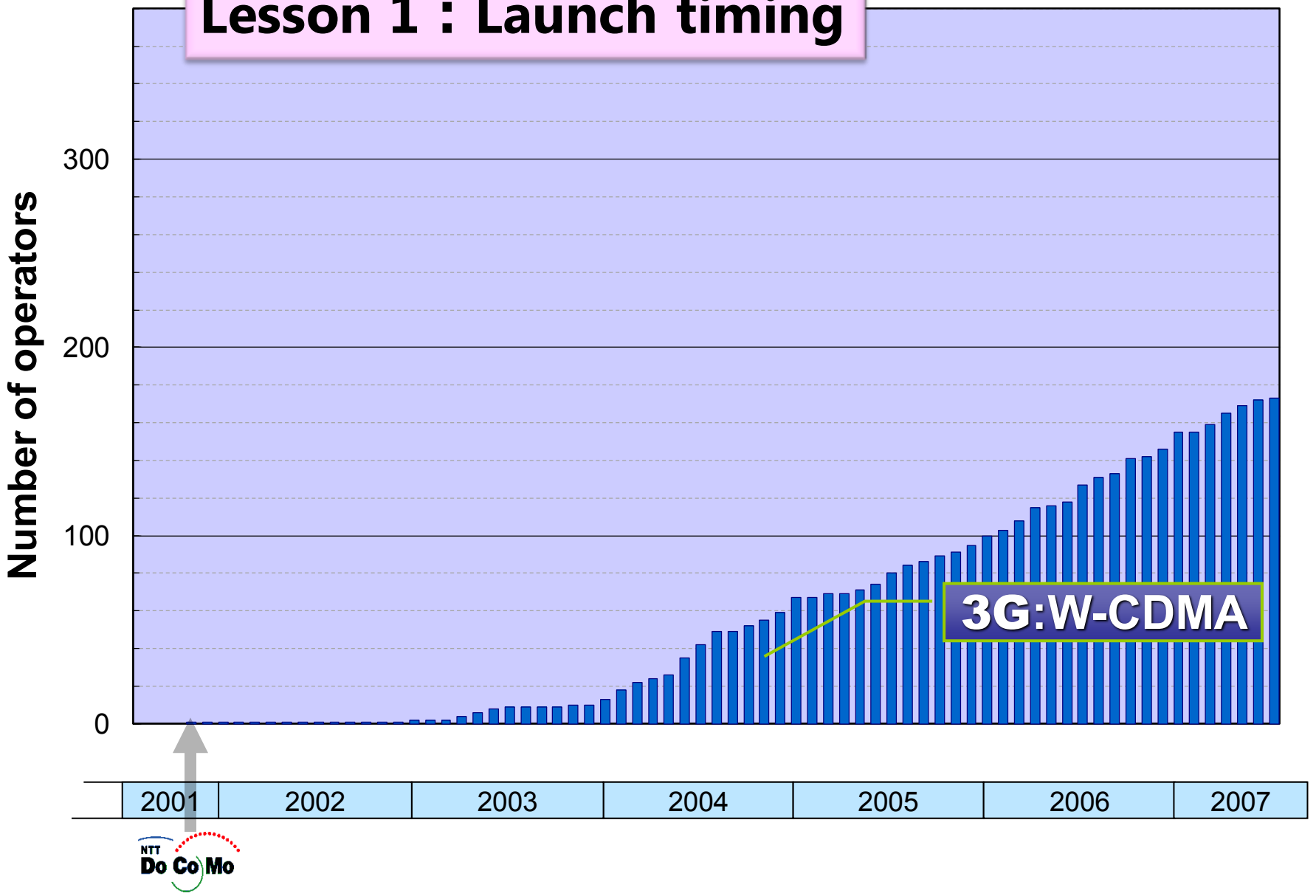
The 5G Open Trial Specification Alliance will focus on 5G radio interface trial activities and aims to provide the wireless industry with the ability to test and validate key technical components. Coordination is already underway, with technical trials occurring in the 2016-2018 timeframe.

# Worry about fragmentation due to early deployment of 5G

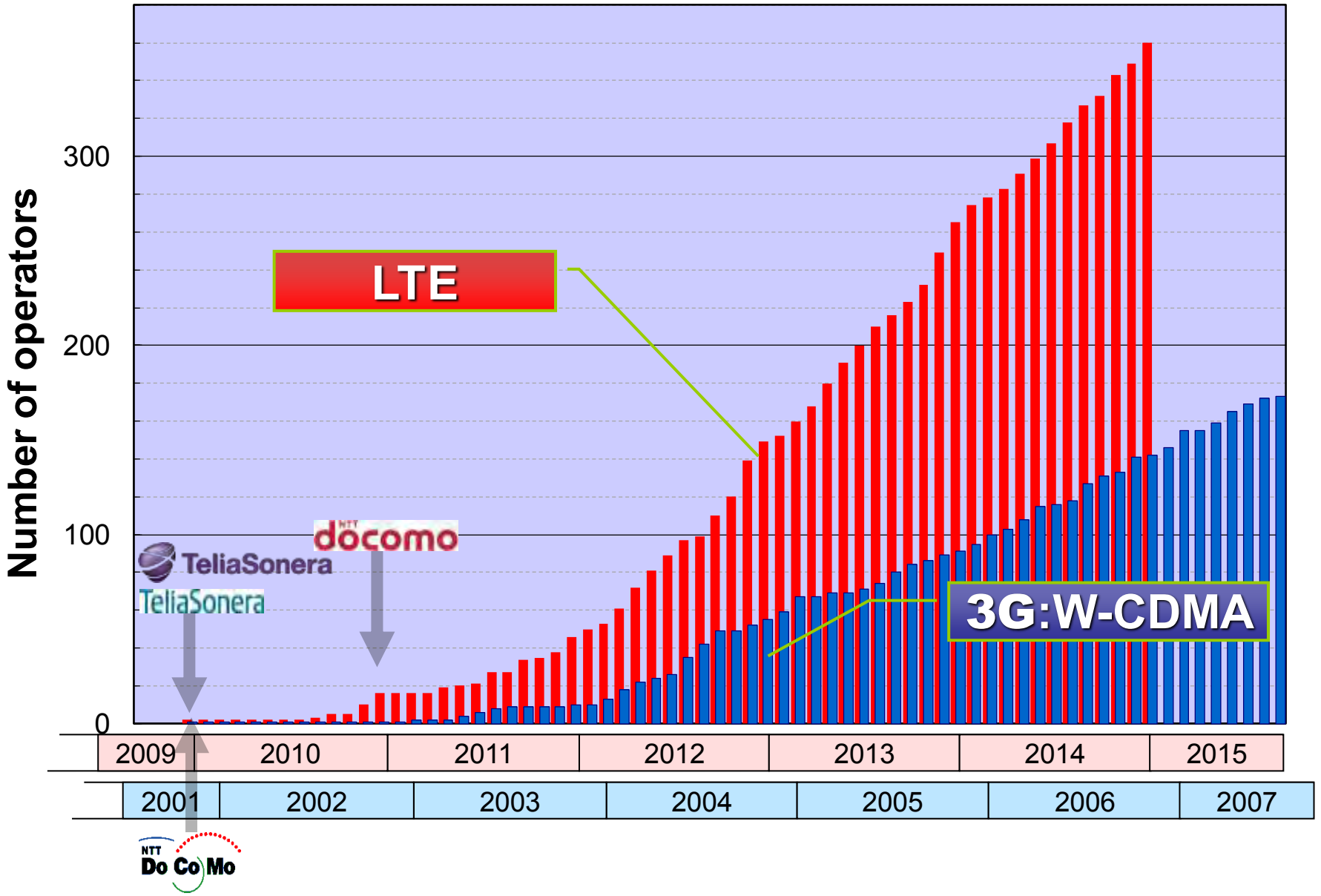


# Numbers of Operators

## Lesson 1：Launch timing

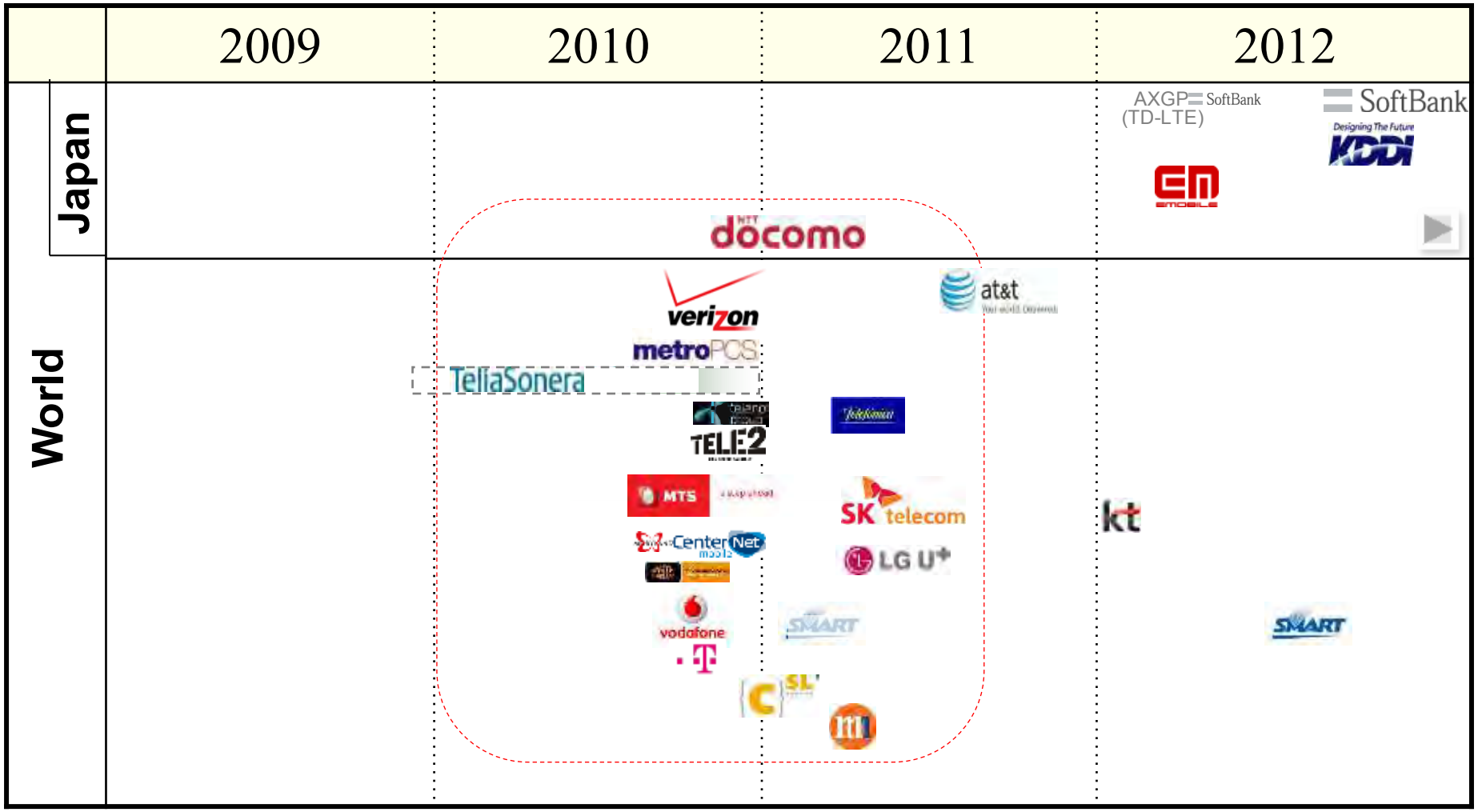


# Numbers of Operators



# Global Status of LTE Deployment

- Globally, many operators have launched LTE.
- DOCOMO launched LTE as one of the leading operators in the world.



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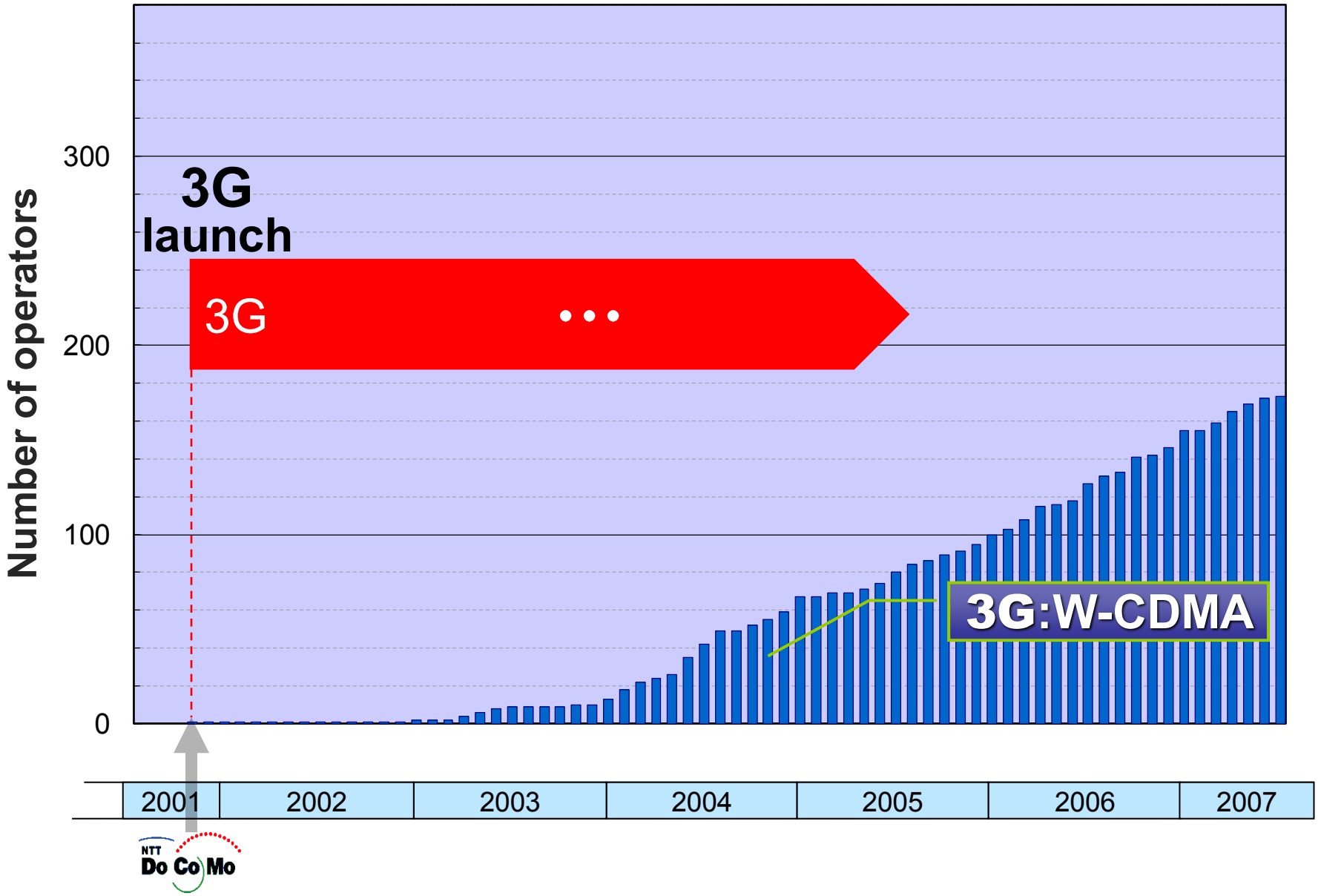

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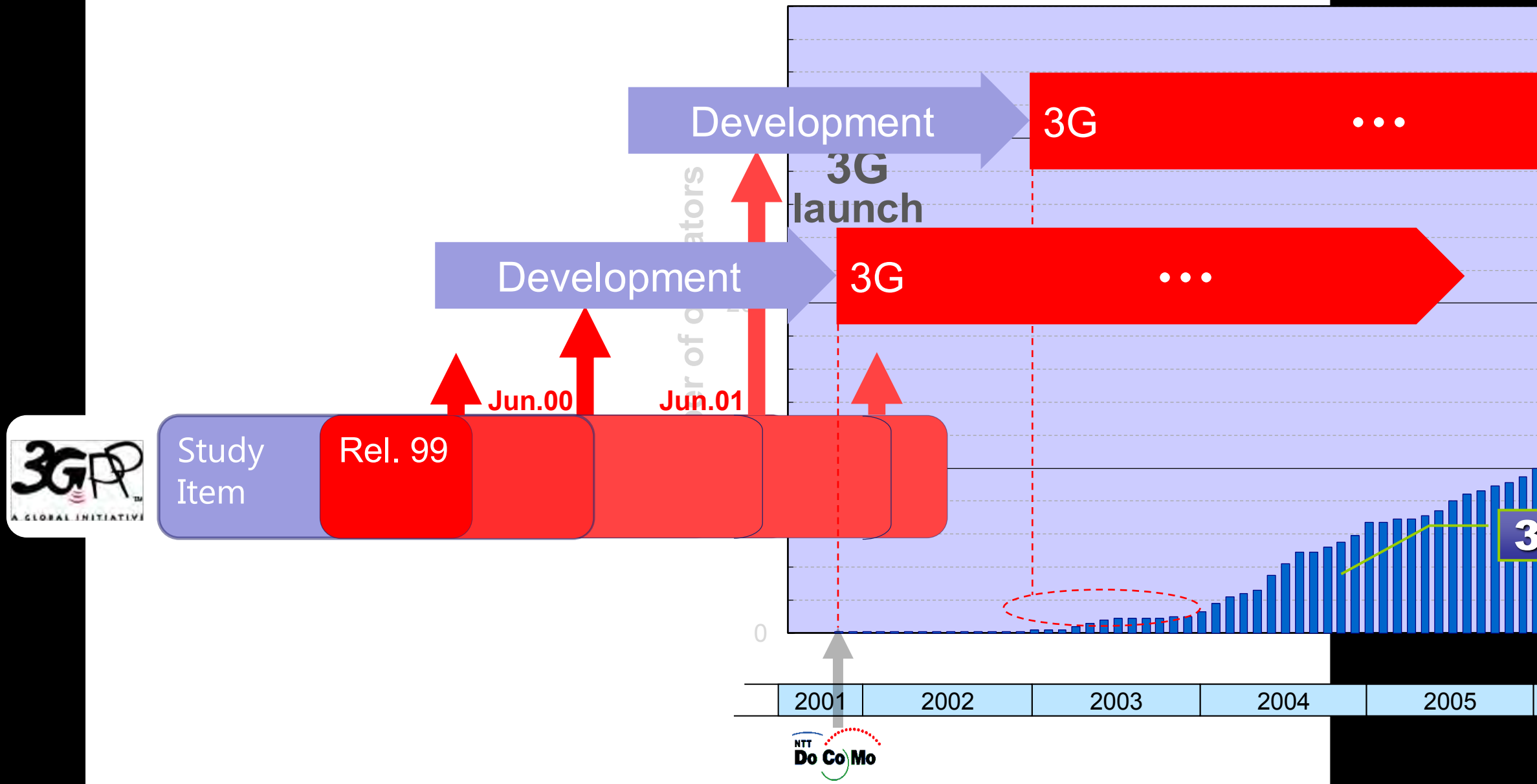
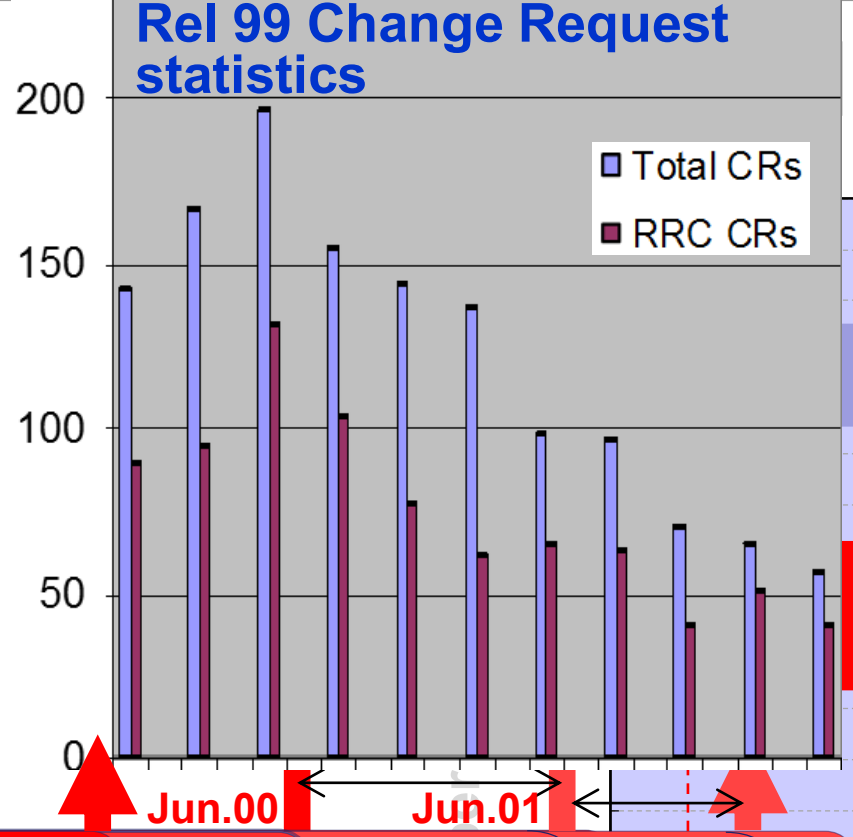


## Rel 99 Change Request statistics

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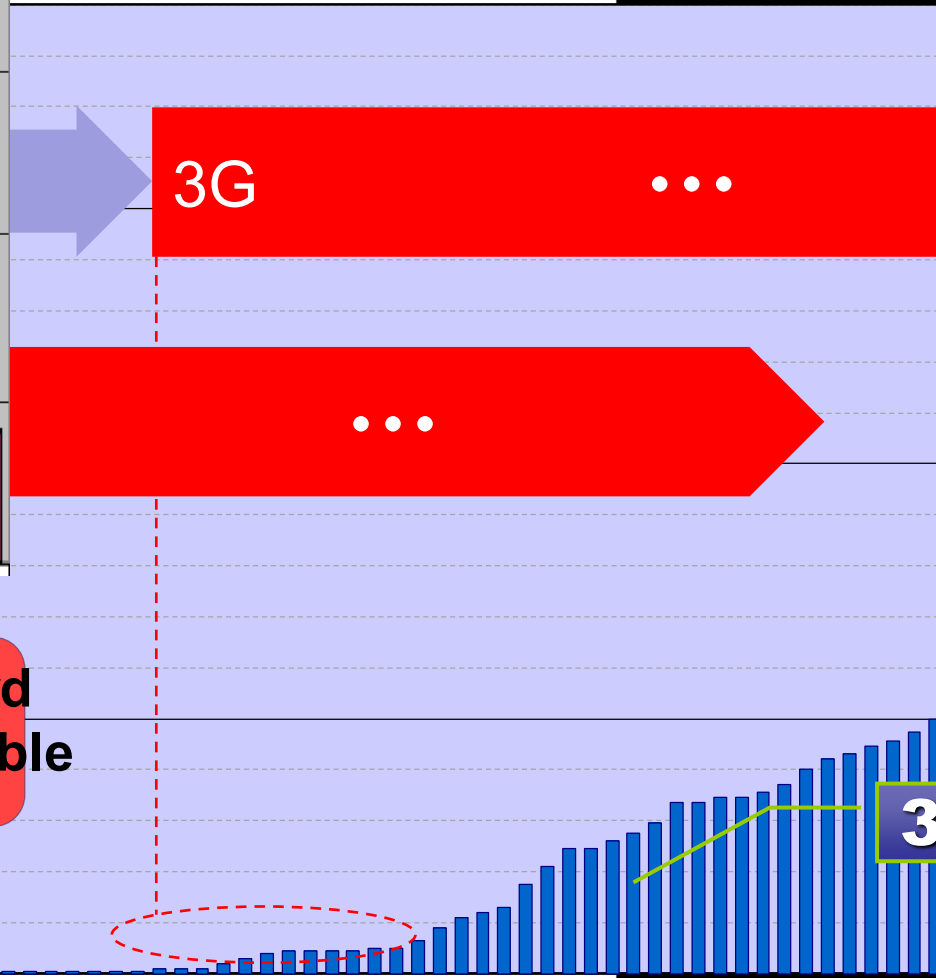






NTT DoCoMo

3GPP A GLOBAL INITIATIVE

Study Item | Rel. 99 | No Backward Compatible | Backward Compatible

TSG-RAN meeting #11
Palm Springs, California 13th to 16th of March 2001

*TSGR#11(01)0206*

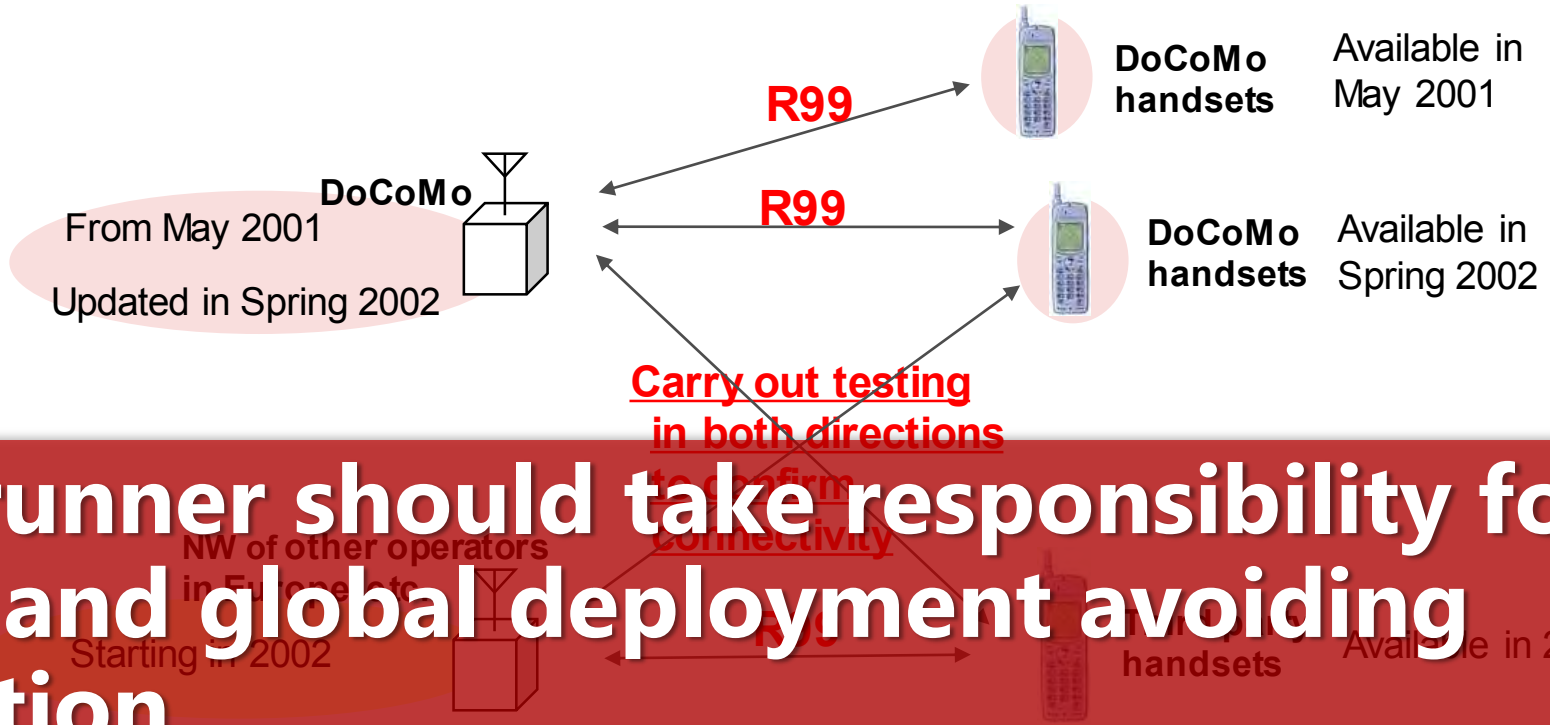
**Agenda Item:** X.Y

**Source:** DoCoMo, Hutchison 3G UK, Japan Telecom, Omnitel/Vodafone, Telia, Telefonica, TIM/TILAB, Vodafone Group Plc, Alcatel, Ericsson, Fujitsu, Motorola, NEC, Nokia, Panasonic

**Title:** **Ensuring backward compatibility for Release 99 specifications**

**DOCOMO's network handles both versions of Rel. 99 protocols, so that DOCOMO can continue to provide 3G services for initial users and global services for new users.**

- Amendments to Release 99 will continue in 3GPP. NTT DoCoMo will also comply with these future changes, and will update network/handsets accordingly.
- DoCoMo will provide global roaming services with operators in Europe, etc. (whose 3G services start in 2002). Connectivity testing to take place prior to offering global roaming service.



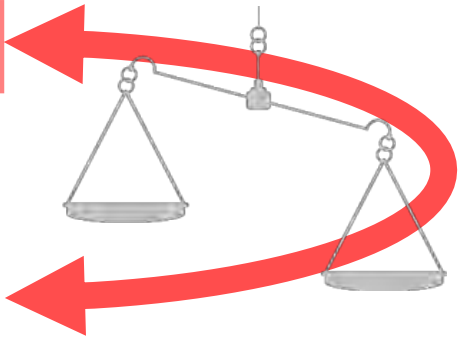

**The front runner should take responsibility for service continuity and global deployment avoiding fragmentation.**

# Requirements
# What is 5G?

- **Myths**
- **Realities** -Time Plan
- -Requirements
- -Spectrum
- -Technologies
- -R&D activities
- -Technology Convergence
- **Conclusion**

# 5G Requirements and Capabilities

- Enhanced **Mobile Broadband**



- **IoT**
  - Massive machine type communications
  - Ultra-reliable and low latency communications

- **New Business Models and Ecosystem across Industries**

2020

Enhanced Mobile Broadband

5G Mobile Broadband

4G LTE/LTE-Advanced

High performance

IoT

Low power

5G-IoT

NB-IoT

Cat.M

Cat.0

Cat.1

4G LTE

2020

Enhanced Mobile Broadband

5G Mobile Broadband

4G LTE/LTE-Advanced

High performance

IoT

5G-IoT

NB-IoT

Cat.M

Cat.0

Cat.1

4G LTE

Low power

2020

Enhanced Mobile Broadband

5G Mobile Broadband

4G LTE/LTE-Advanced

High performance

IoT

5G-IoT

NB-IoT

Cat.M

Cat.0

Cat.1

4G LTE

Low power

# 5G Technology

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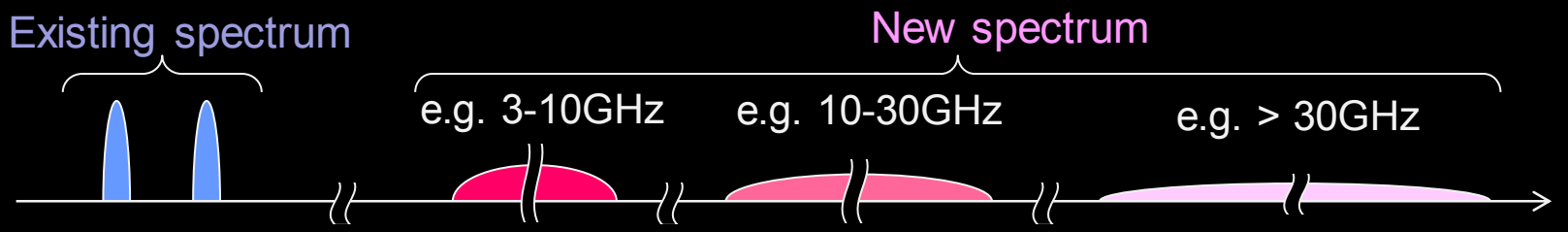



# A wrong story I don't like

5G provides Higher data speed and Higher capacity.

➔Broader spectrum bandwidth

➔Higher frequency spectrum

➔Larger propagation loss

➔Shorter coverage

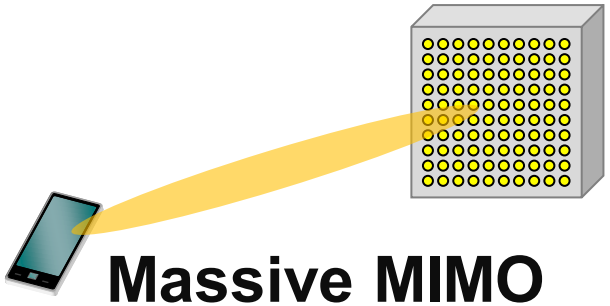
➔5G is a ~~Hotspot system for complementary use.~~

---

**Let's tackle the challenge of achieving wide coverage as cellular systems even with higher spectrum.**

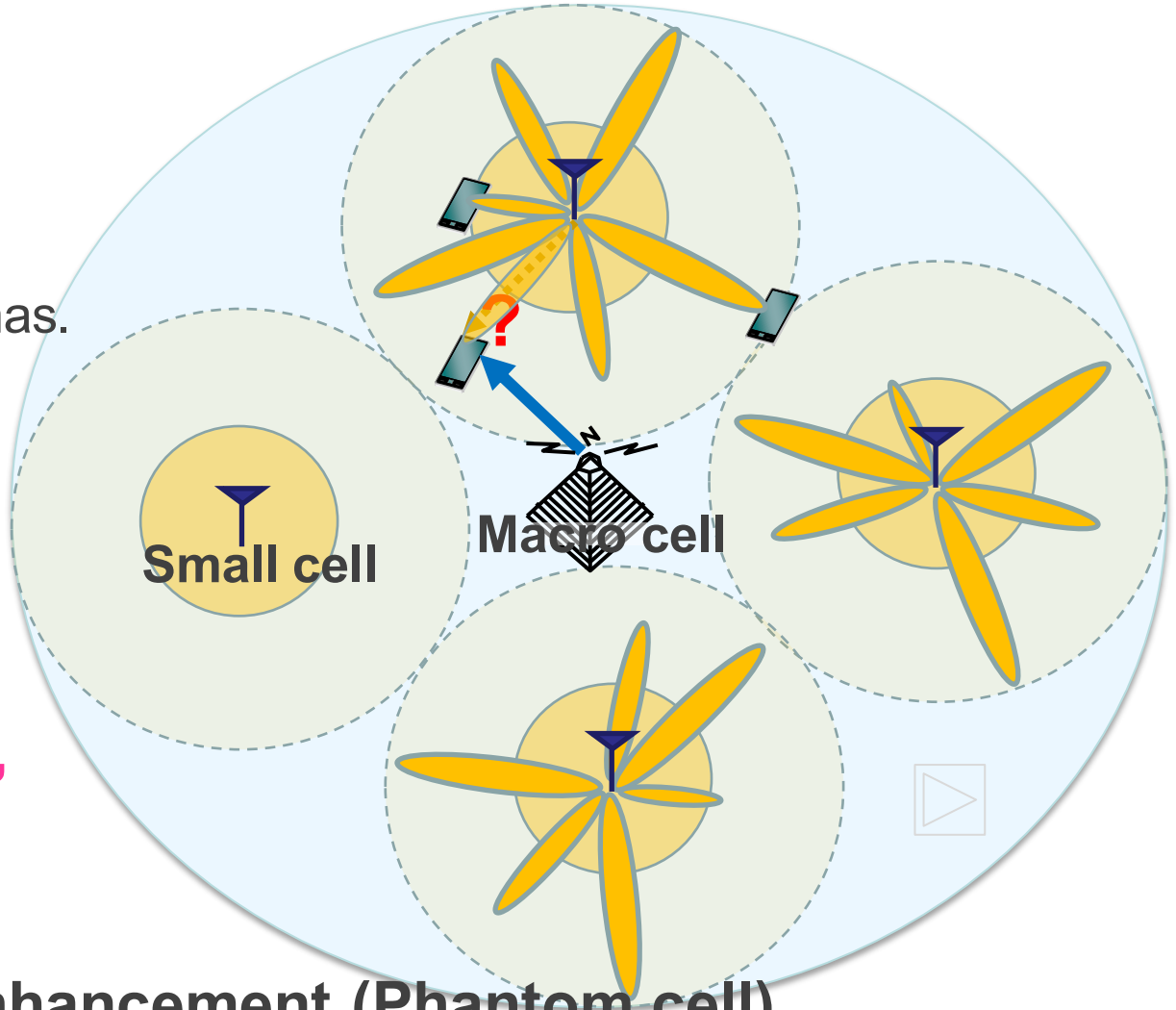
# Massive MIMO and Macro/Small-cell





**Massive MIMO**
is about increasing
the number of antennas.

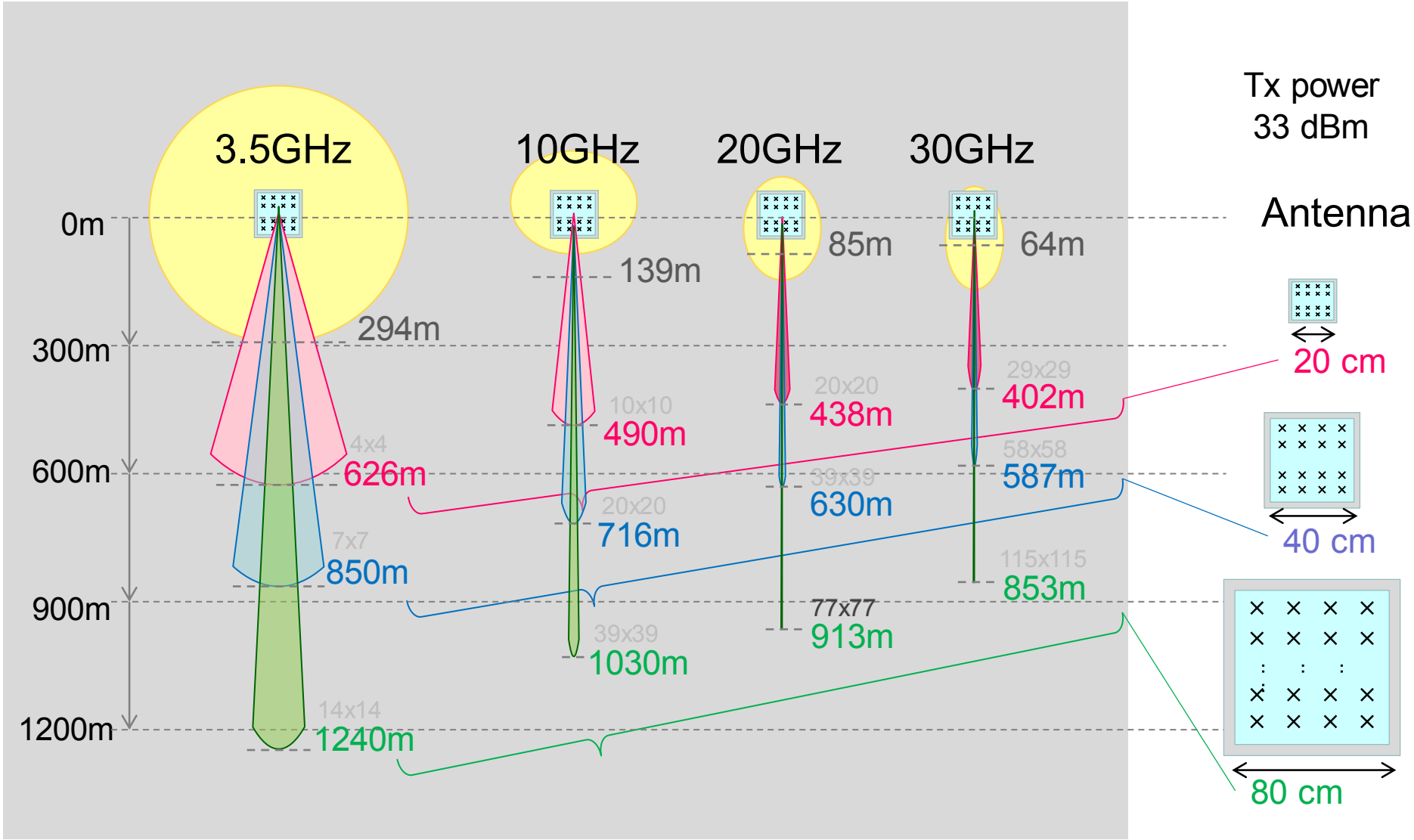
蛮力
~~力業~~"Brute force"




"an excellent feature"
The combination of
**Massive MIMO** and
**Advanced C-RAN Enhancement (Phantom cell)**
will provide adequate cell coverage even with higher frequency bands.

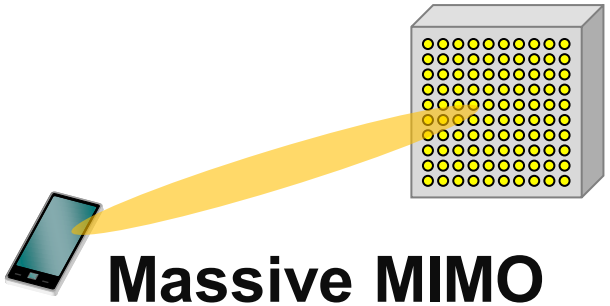
# Massive MIMO: Coverage Extension





# Massive MIMO and Advanced C-RAN (Phantom cell)

NOMA

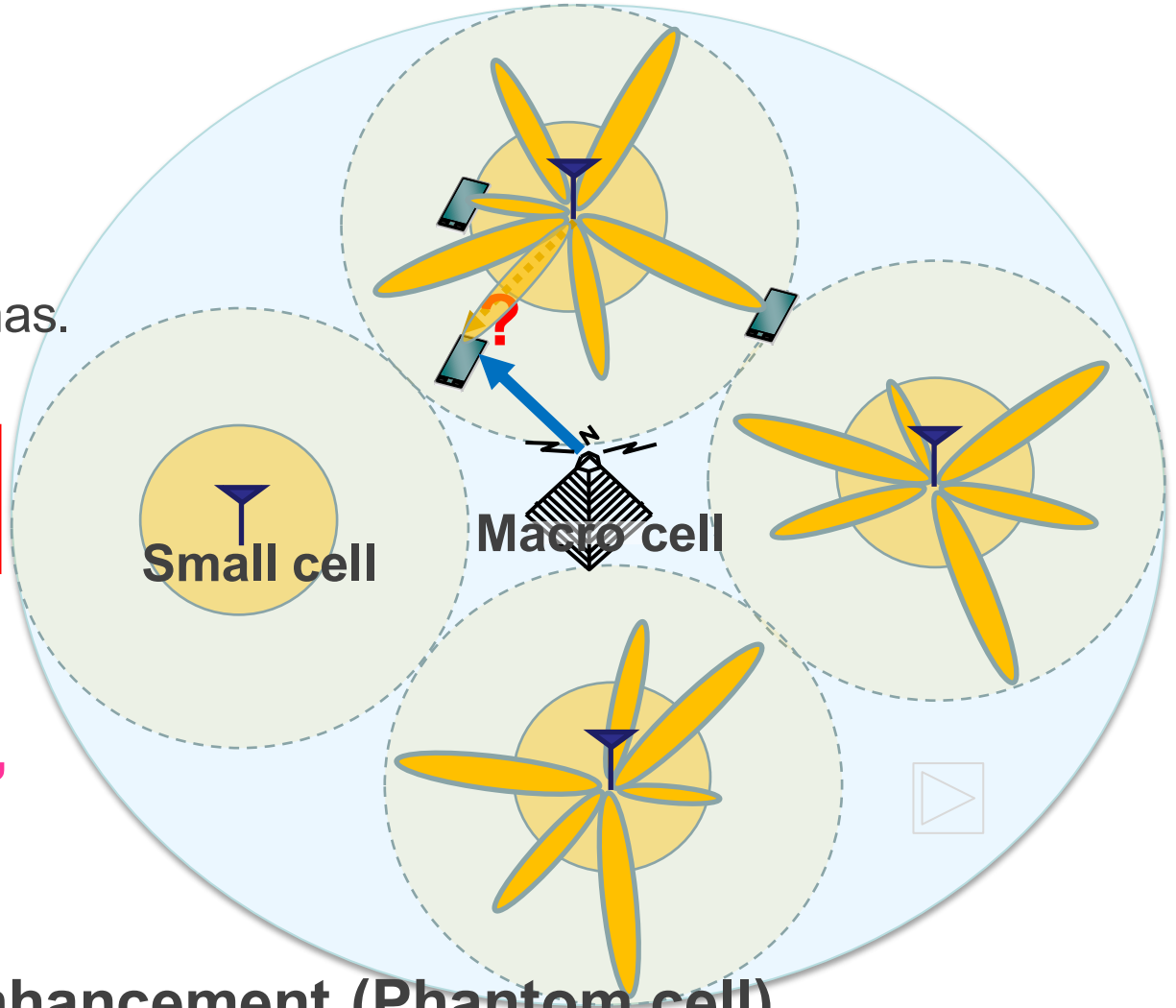


**Massive MIMO**
is about increasing
the number of antennas.

~~蛮力~~
~~力業~~ **"Brute force"**

**The implementation technology is key.**

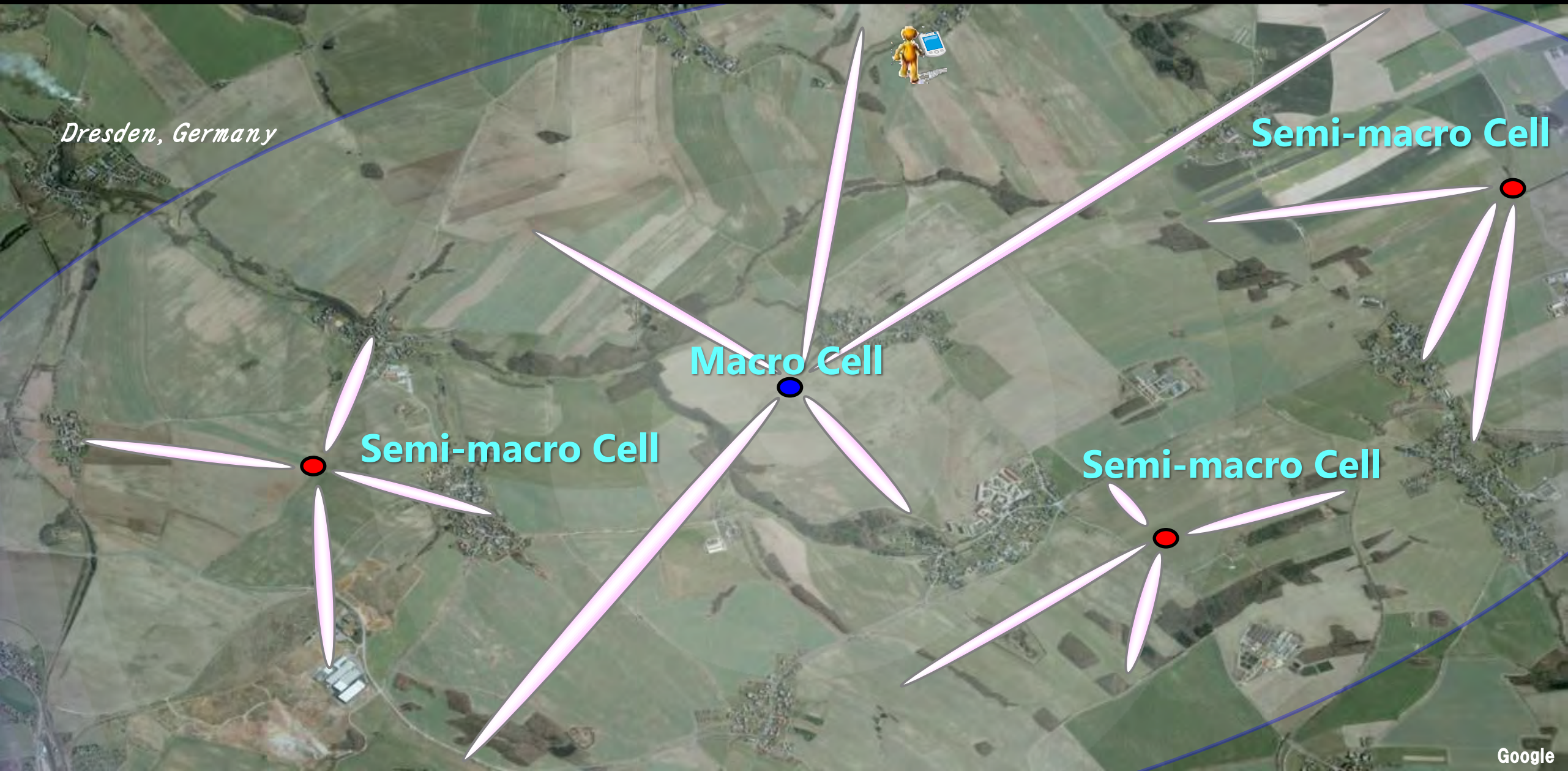
**"Feat of strength"**




**"an excellent feature"**

The combination of
**Massive MIMO** and
**Advanced C-RAN Enhancement (Phantom cell)**
will provide adequate cell coverage even with higher frequency bands.

# Massive-MIMO and Advanced C-RAN (Phantom cell)




Next action: setup
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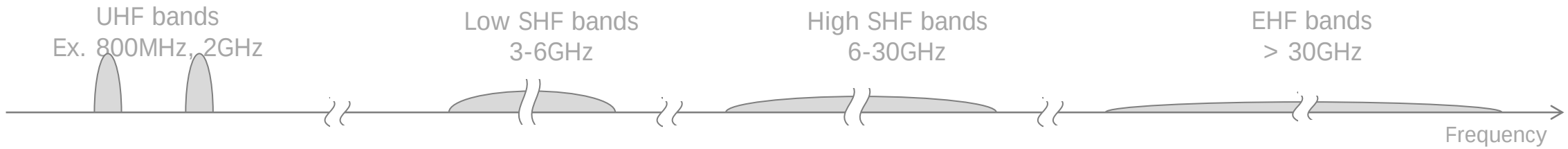
# 5G R&D Activities

- **Myths**
- **Realities** -Time Plan
- -Requirements
- -Spectrum
- -Technologies
- -R&D activities
- -Technology Convergence
- **Conclusion**

# 5G Experimental Trials in DOCOMO with World-leading Vendors

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Panasonic intel MEDIATEK QUALCOMM KEYSIGHT TECHNOLOGIES ROHDE&SCHWARZ

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NOKIA × NTT docomo

# Ultra Wideband @ 70GHz band Beam Tracking for Mobility

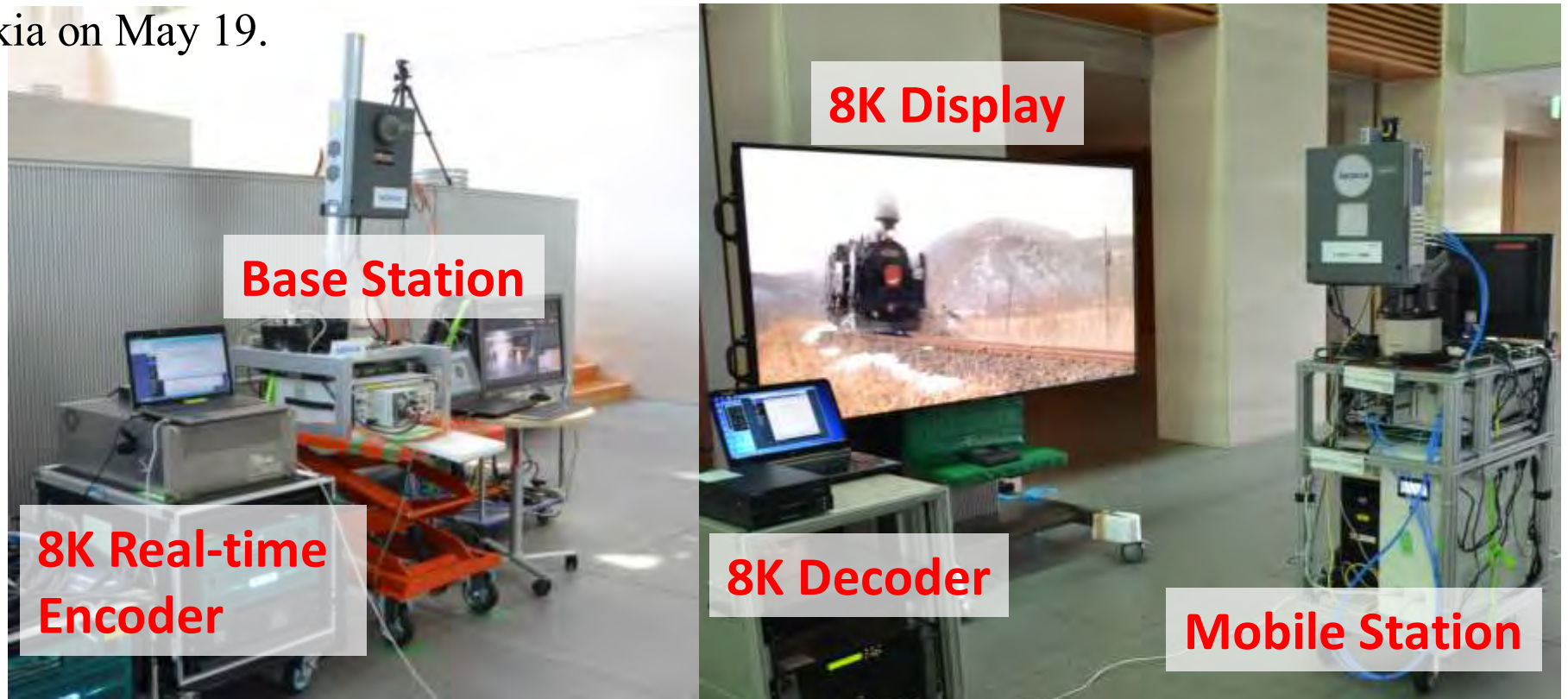

G7 ICT Ministers' Meeting

Press Releases

May 24, 2016

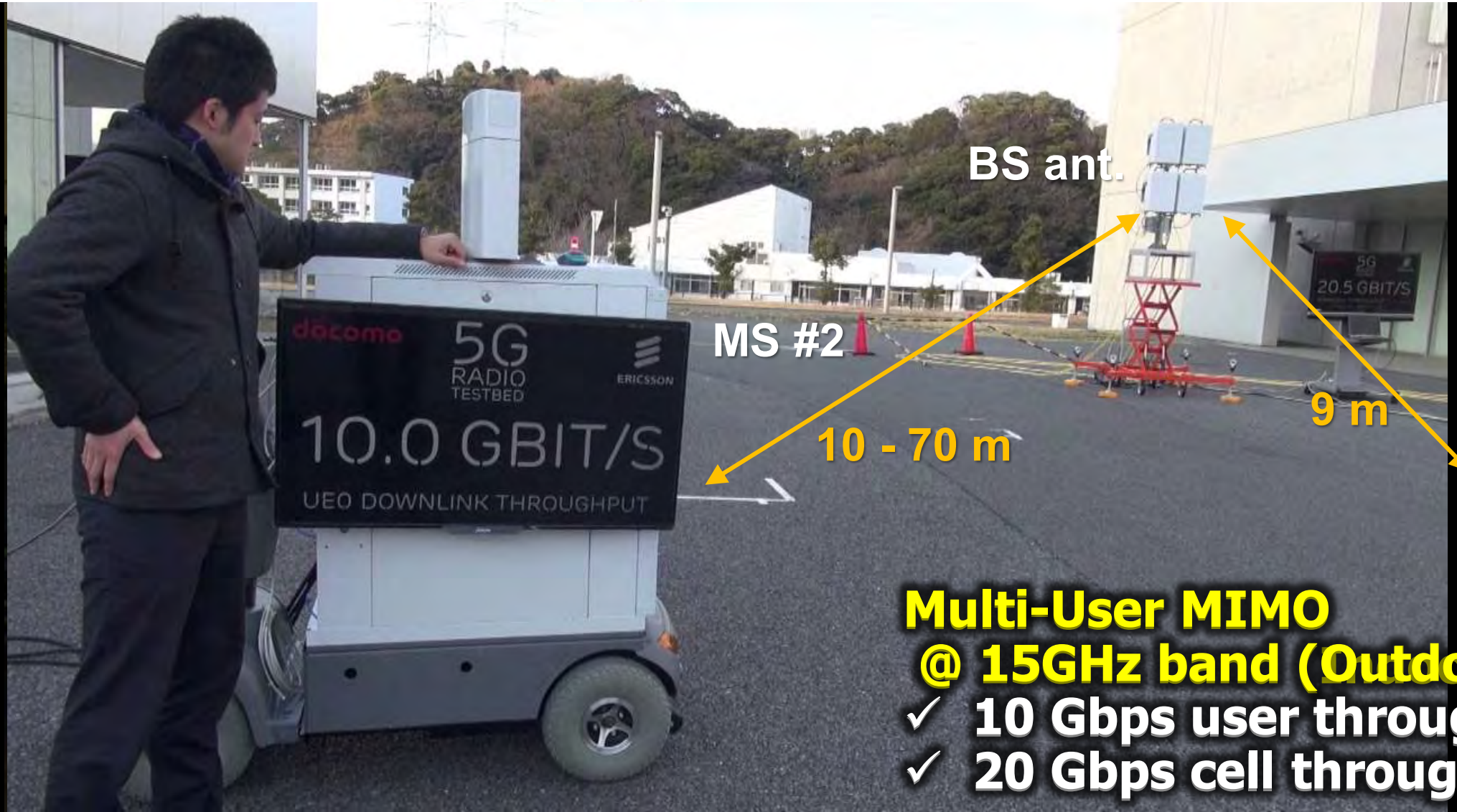
# DOCOMO and Nokia Achieves World's First Real Time 8K Video Transmission Using 5G Radio Access Technology

**TOKYO, JAPAN, May 24, 2016**—NTT DOCOMO, INC. announced today that it has achieved the world's first wireless real-time transmission of 8K video deploying radio access technology for 5G mobile communications systems, in a trial jointly conducted with Nokia on May 19.



Panasonic HUAWEI FUJITSU NEC ERICSSON SAMSUNG MITSUBISHI ELECTRIC NOKIA intel MEDIATEK QUALCOMM KEYSIGHT TECHNOLOGIES ROHDE&SCHWARZ

ERICSSON × NTT docomo




**Multi-User MIMO**
**@ 15GHz band (Outdoor)**

- ✓ 10 Gbps user throughput
- ✓ 20 Gbps cell throughput

# Conclusion

- **Myths**
- **Realities** -Time Plan
- -Requirements
- -Spectrum
- -Technologies
- -R&D activities
- -Technology Convergence
- **Conclusion**

# Conclusion

- 5G is a boom, creating some **myths** about 5G.

- 5G should not end up with hype. Instead, 5G should become **realities** of technology and capability in 2020 and beyond.


The new of today, the norm of tomorrow
NTT docomo