

# Deployment Realities of 5G

**Seizo ONOE**  
**CTO and EVP**  
**NTT DOCOMO, INC.**

# Topics



 ➤ **History and Future** Secret story 

 ➤ **Basics of 5G**

 ➤ What 5G provides and creates

 ➤ Economics of 5G

 ➤ **Road to 5G Launch**



 ➤ **Extra Topic**

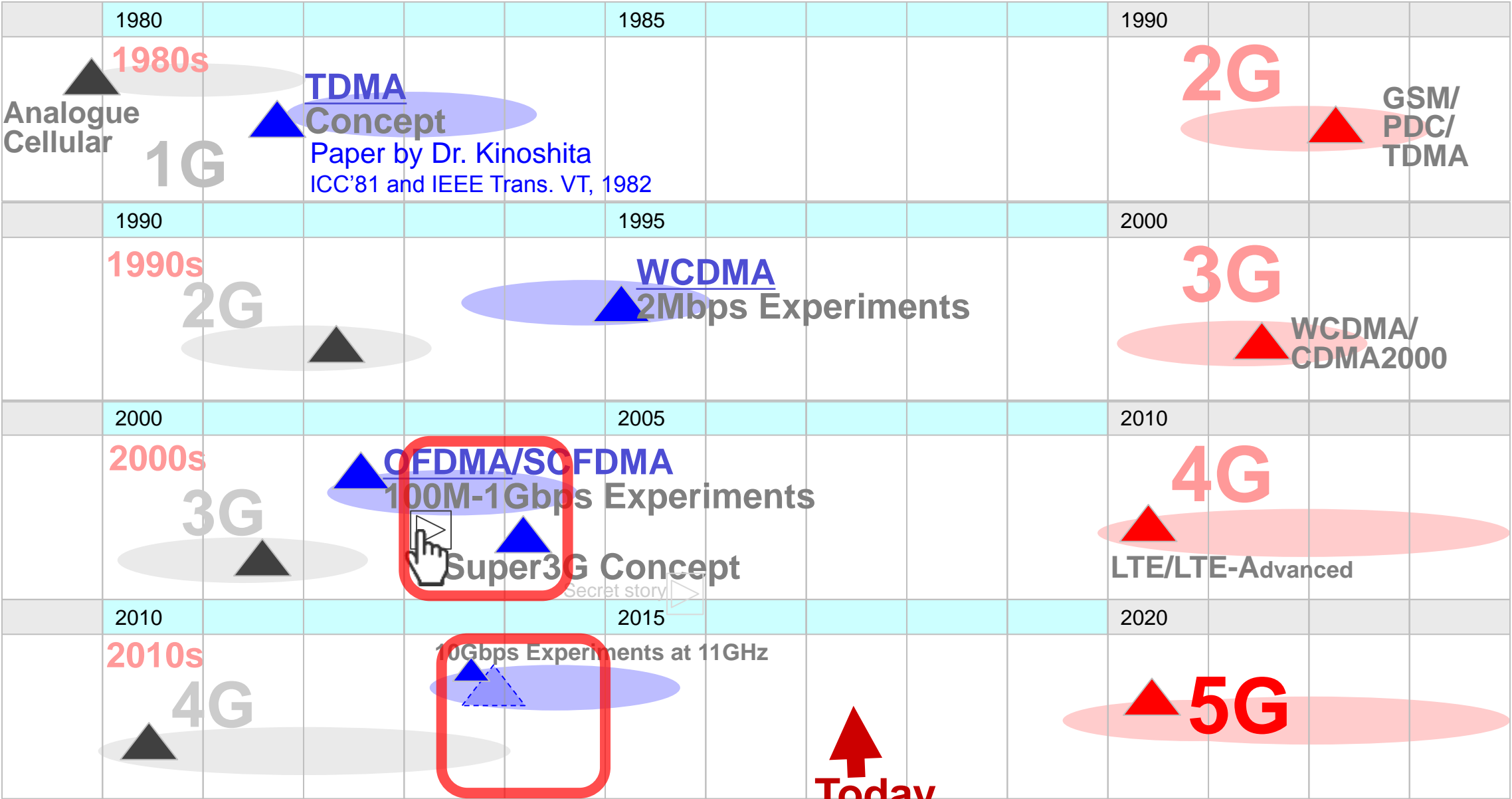
 ➤ Previous Generations' Boom

 ➤ Law of Great Success

# History from 1G to 4G and the Next

Details 

Chronological table



  
**Today**

# 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

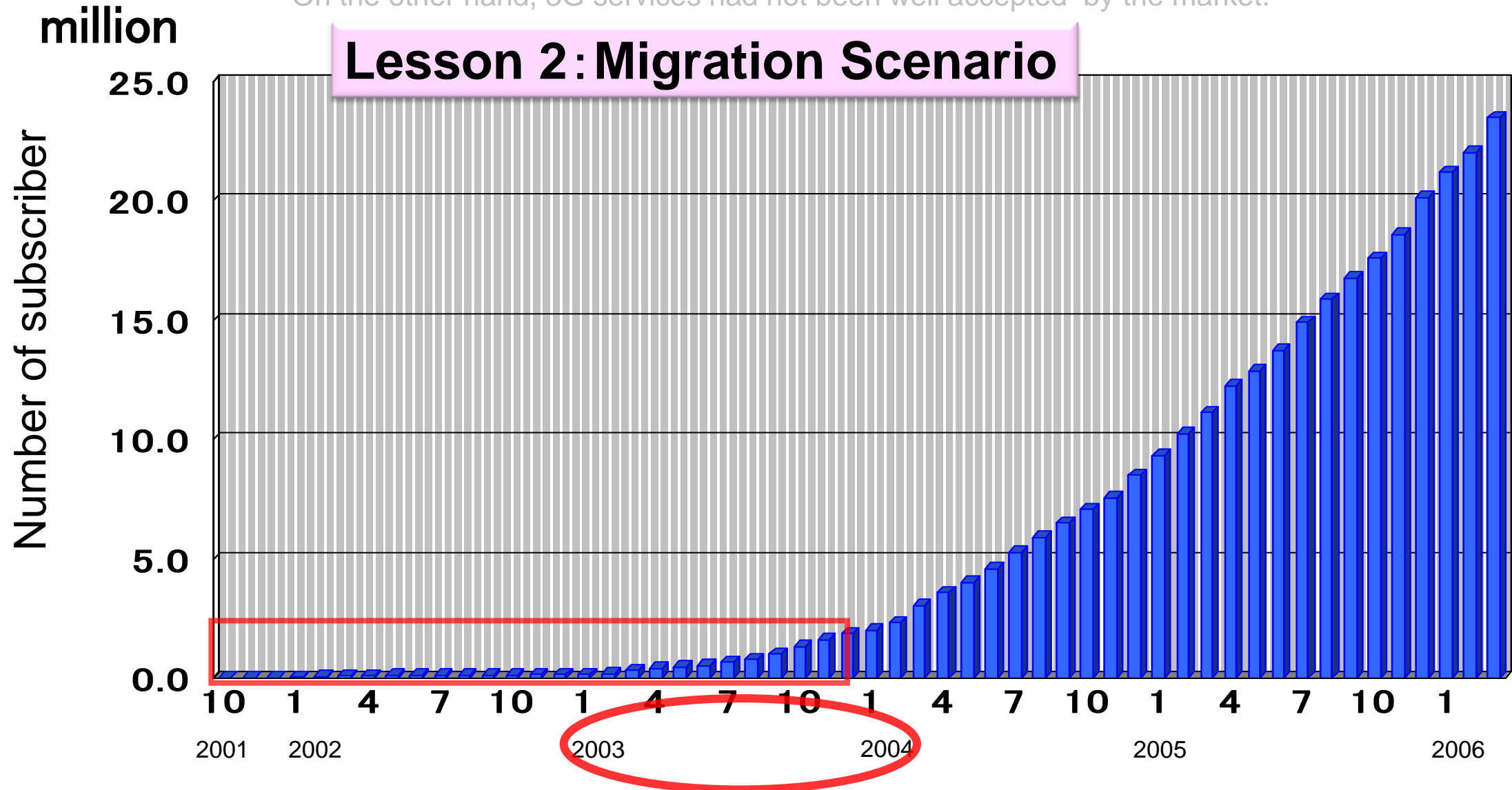


# 3G Subscriber Growth



On the other hand, 3G services had not been well accepted by the market.

## Lesson 2: Migration Scenario



# Super3G Concept

Smooth path to the next generation was essential.

⇒ In, 2004, DoCoMo proposed Super3G concept for the smooth path to 4G.

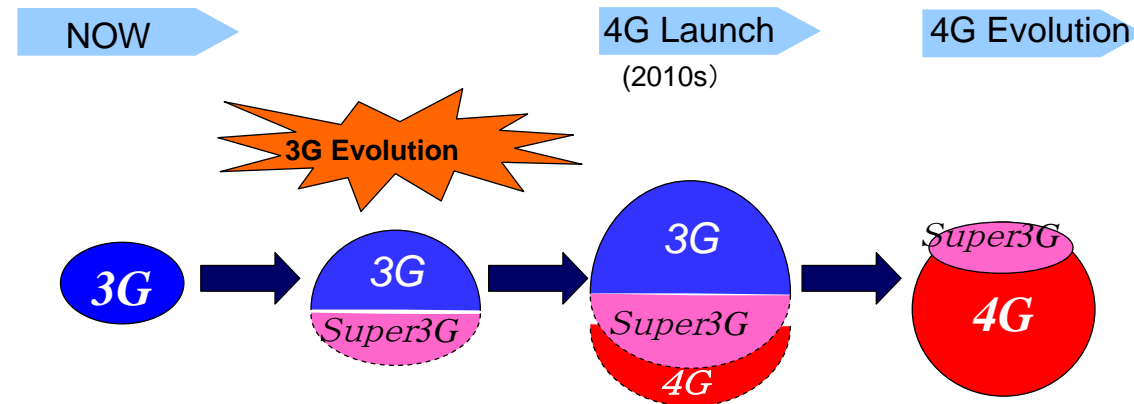
## Ideas on migration to 4G (3)

**Scenario 3 : First evolve 3G, then build 4G on top**

→ Extensibility is greater than Scenario2

→ Cost is lower than Scenario1

*(Innovative 4G evolution possible)*



**26<sup>th</sup> May 2004,  
ICB3G**

※ Super3G : The name of Enhanced3G called in DoCoMo

26<sup>th</sup> May 2004, ICB3G

NTT DoCoMo

**Most people didn't like the term "4G".**



# 3GPP document contributed by DOCOMO and 25 co-sources



TSG-RAN Meeting #26

RP-040461

Athens, Greece, 8-10, December, 2004

**Agenda Item:8.12**

**Source:** NTT DoCoMo, Alcatel, Cingular Wireless, CMCC, Ericsson, Fujitsu, Huawei, LG Electronics, Lucent Technologies, Mitsubishi Electric, Motorola, NEC, Nokia, Nortel Networks, Orange, Panasonic, Philips, Qualcomm Europe, Samsung, Sharp, Siemens, Telecom Italia, Telefonica, TeliaSonera, T-Mobile, Vodafone

**Title:** Proposed Study Item on Evolved UTRA and UTRAN

**Document for :** Discussion and approval

In the RAN Future Evolution Workshop, many of the presentations pointed out the need of 3G long-term evolution to meet the future demand and to maintain its competitive position for coming decades. Several interesting new technology components such as OFDM with a flexible and broader RF bandwidth were presented as potential candidates for the evolution. It was pointed out such a technology enhancement should be applied to UTRAN architecture as well as the UTRA radio interface.

It is proposed that 3GPP should initiate the feasibility study of the long-term evolution accounting for the above situation. In this paper, a Study Item Description is presented for this study.

Concerning the time plan, we propose to complete the feasibility study by June 2006 and envisage all relevant core specifications by June 2007.



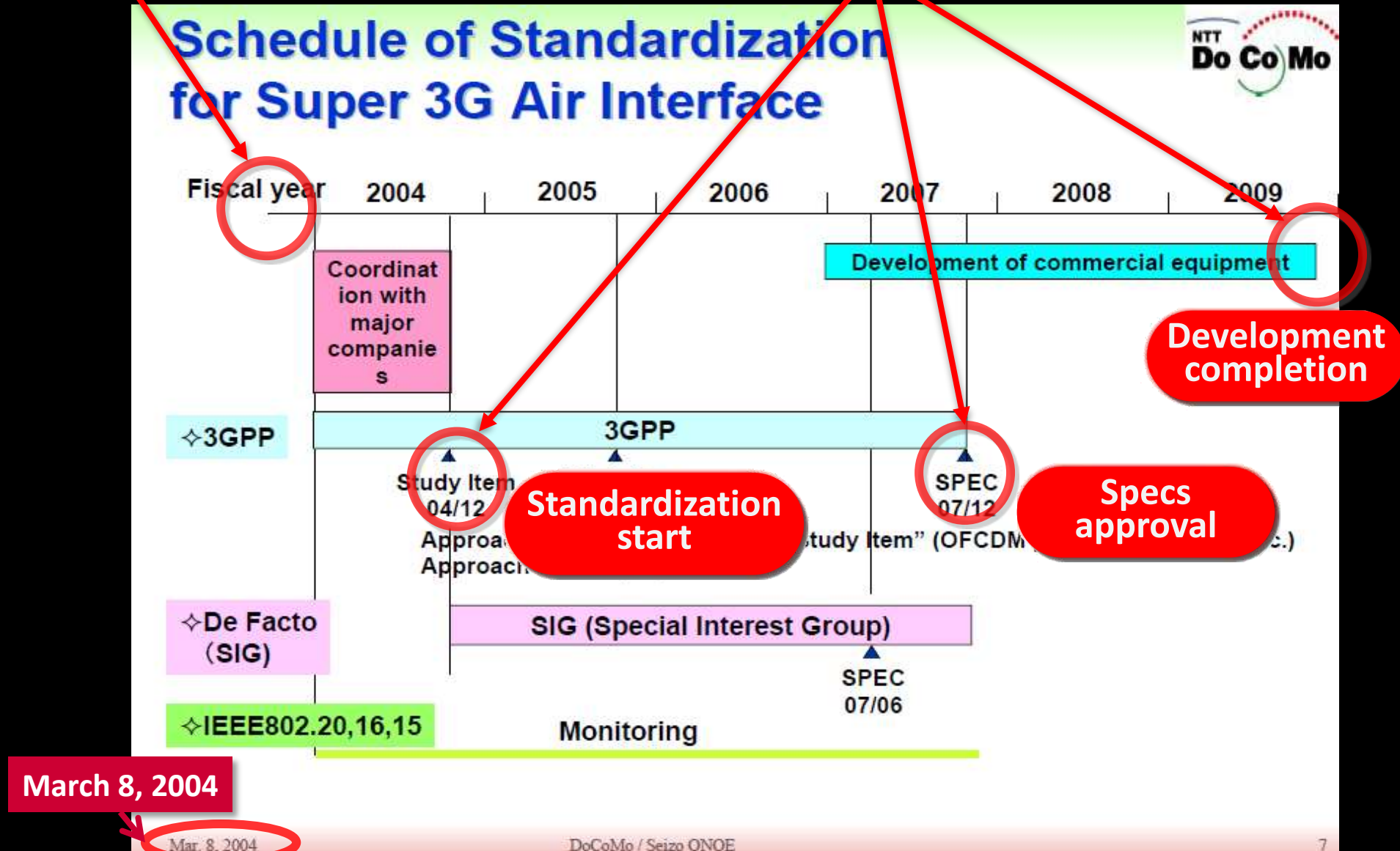
# **Secret Story of LTE Birth** - a petit boast -

## **- Prehistory of LTE Standardization -**

# A Slide used for initiating the standardization



In early 2004, DOCOMO predicted the milestones, which actually happened.



# Topics

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▶ Extra Topic

▶ Previous Generations' Boom

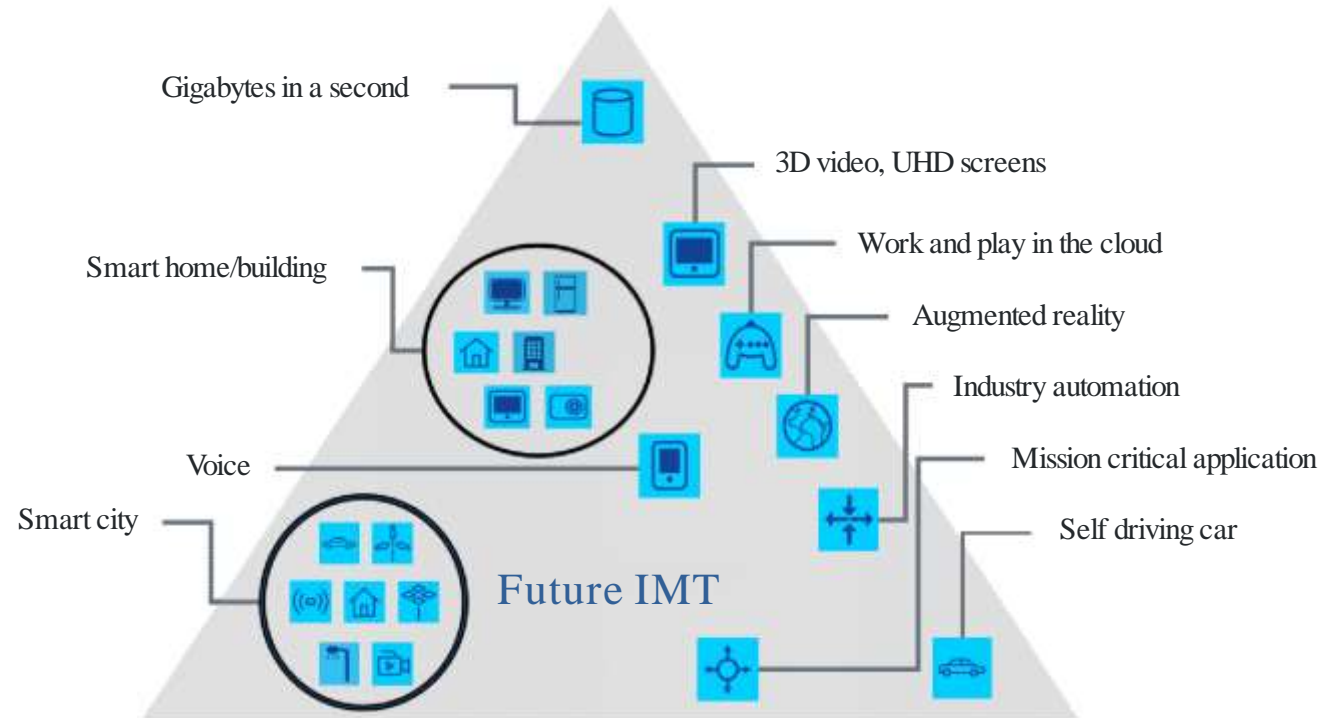
▶ Law of Great Success





# eMBB

Enhanced mobile broadband



Massive machine type  
communications

# mMTC



Ultra-reliable and low latency  
communications

# uRLLC

11.2018-02

**Another Aspect**

# Myths about 5G

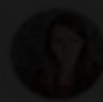
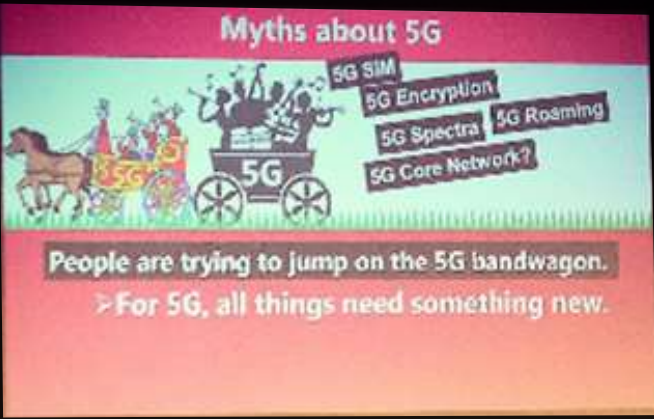


**People are trying to jump on the 5G bandwagon.**

➤ **For 5G, all things need something new.**

➤ **5G needs significant investment.**





amynordrum  
MetroTech Center

FOLLOW

seizoonoe and formidable\_v like this

amynordrum One of the most popular (animated!) slides from today's #Brooklyn5Gsummit on the next generation of wireless networks. Everyone wants 5G but no one knows quite what yet.



Andrew Nix @CSN\_Andy · 4月21日

Dr Seizo Onoe, CTO, NTT DoCoMo expresses interesting views on #5G bandwagon. #BKLYN5G 5G must be something new!



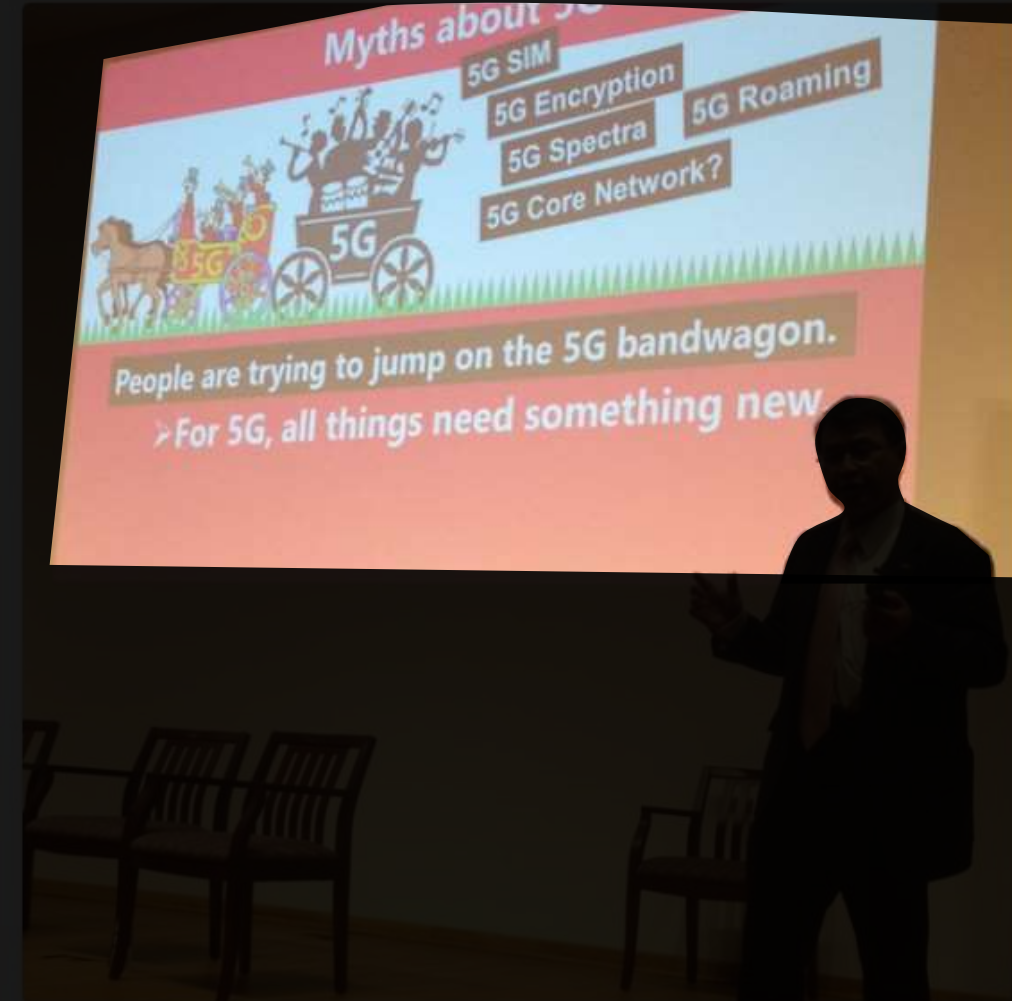
Patty Wong  
@Patty\_Tam



フォロー

@docomo Mr. Seizo Onoe mythbusting #5G  
@brooklyn5gsummit @nokianetworks  
@NYUWireless

翻訳を表示



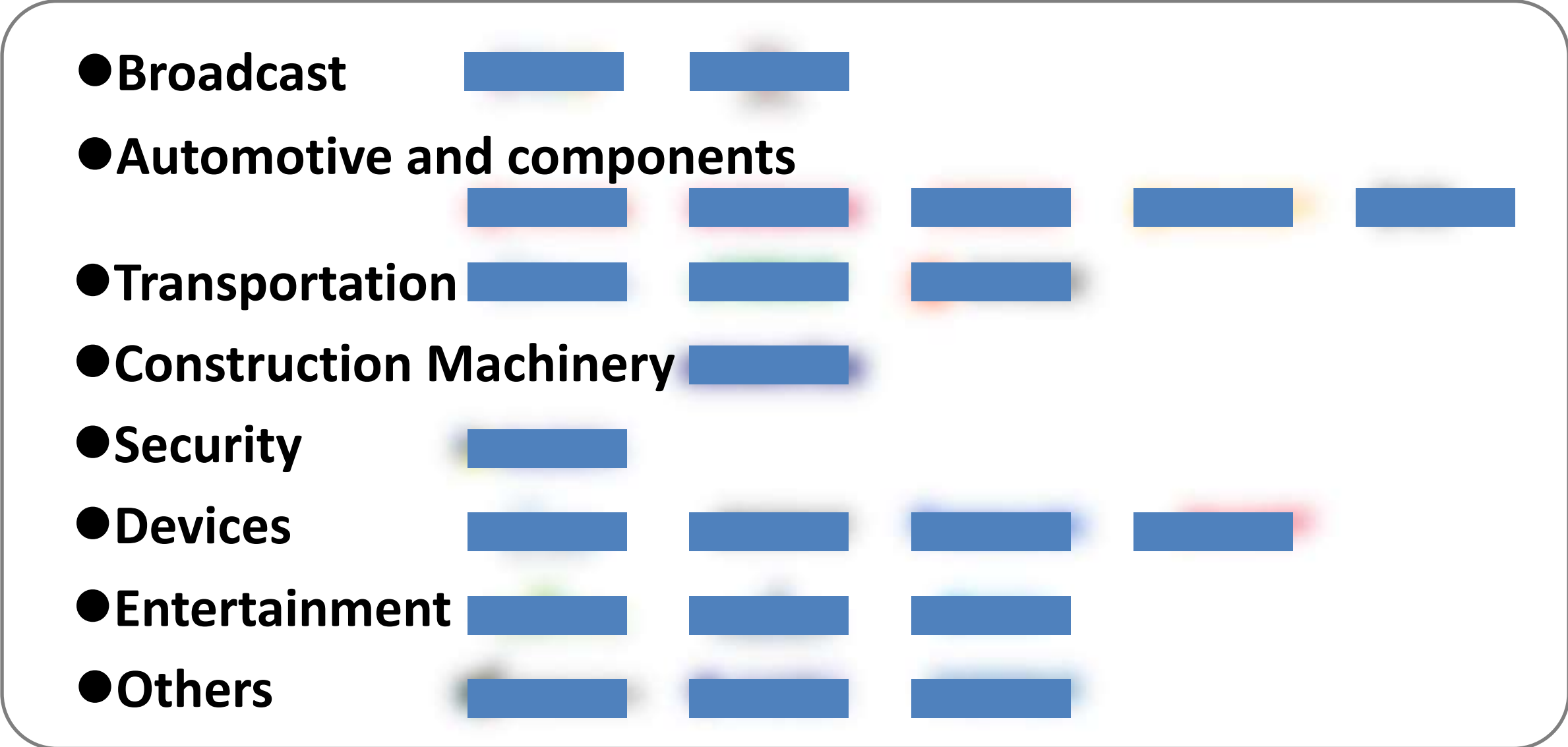
# 5G



**Let's get on the 5G bandwagon**  
and create new business models  
through the collaborations across industries.

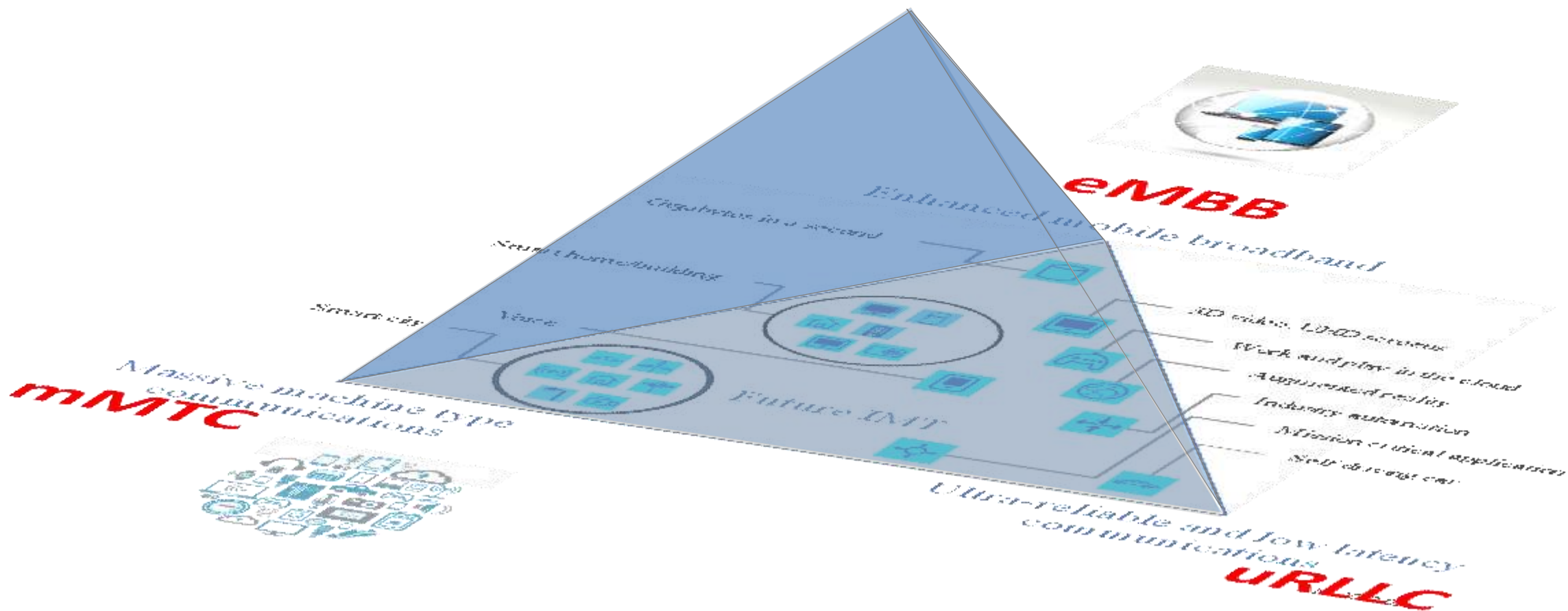
# DOCOMO's Case: Collaborations with various industries

## Ongoing Collaborations for 5G Trials





# New Business Models and Ecosystem across Industries







IEEE Radio Frequency Integrated Circuits Symposium  
4-6 June 2017  
Honolulu, Hawaii

*Catch the 5G Wave!*



***Catch the 5G Wave!***

***Let's ride on the 5G wave!***

***And develop the 5G technologies.***

***And create new business through cross-industry collaborations!***

# Topics

▶ History and Future

▶ Basics of 5G

▶ What 5G provides and creates

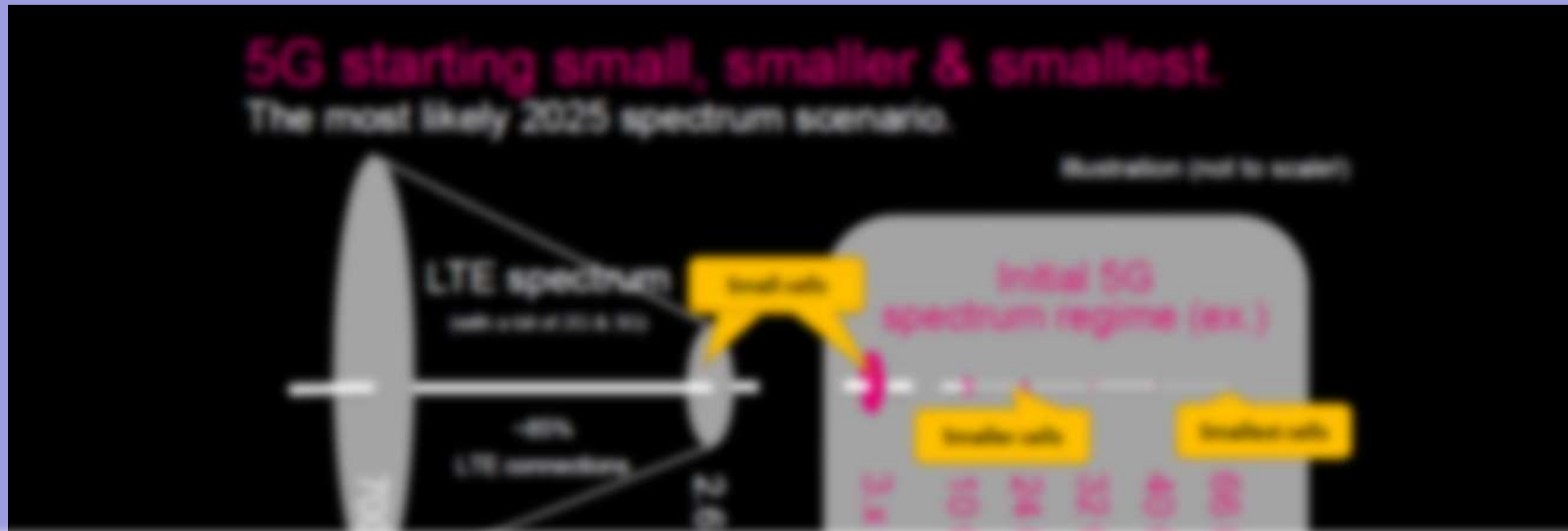
▶ Economics of 5G

▶ Road to 5G Launch

▶ Extra Topic

▶ Previous Generations' Boom

▶ Law of Great Success



5G economics take away.

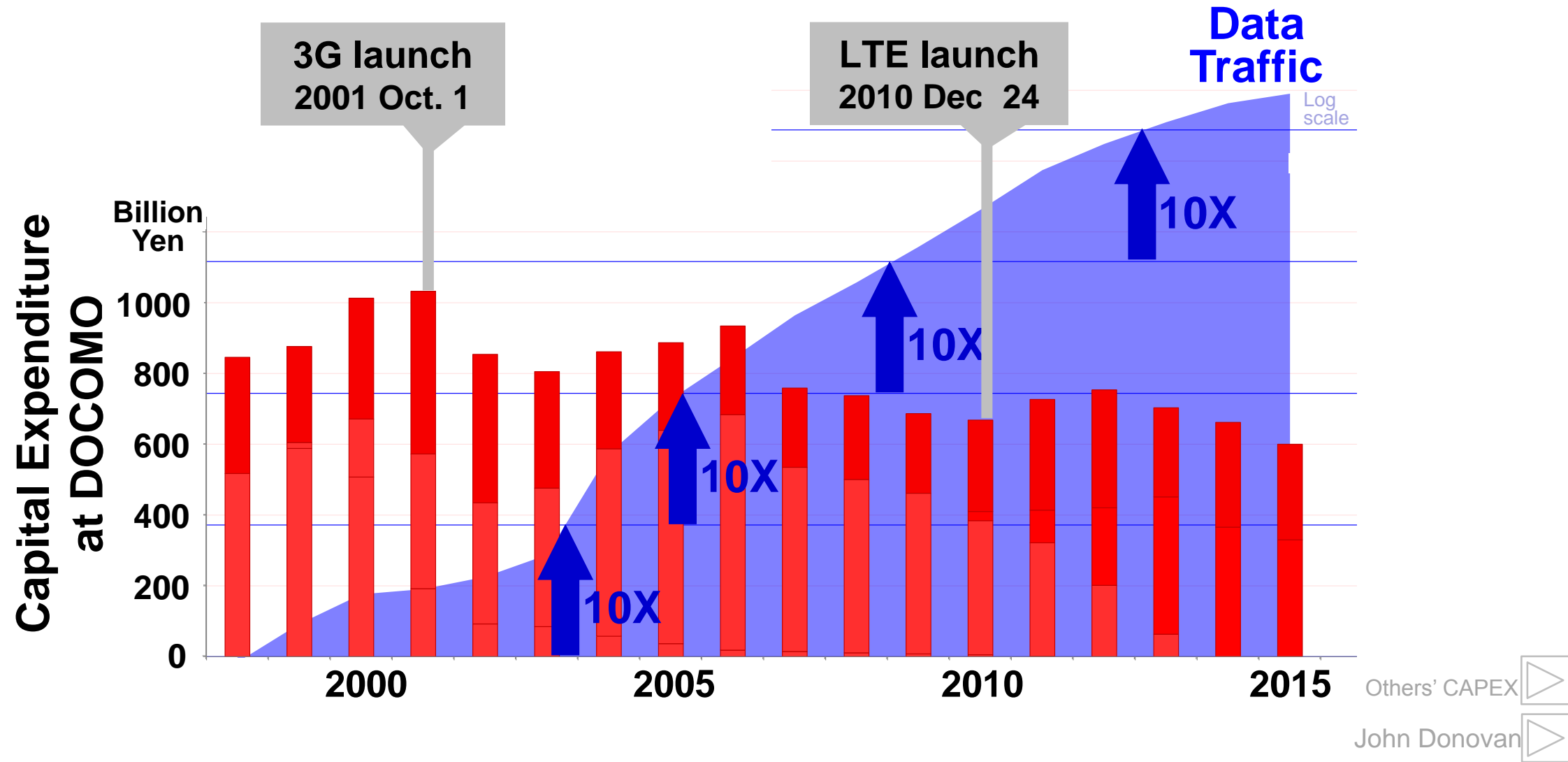
5G economical challenges.

Few Telco's might be able to return on their 5G investment (**at least initially**).

Massive demand for cell densification likely leading to substantial Capex & Opex pressures - Despite technology leapfrog in efficiency.



The data capacity enhancement with no increasing trend in CAPEX can be one of the 5G killer services.



# Myths about 5G

➤ 5G is millimeter wave technology.

➤ **5G is a hot spot system.**

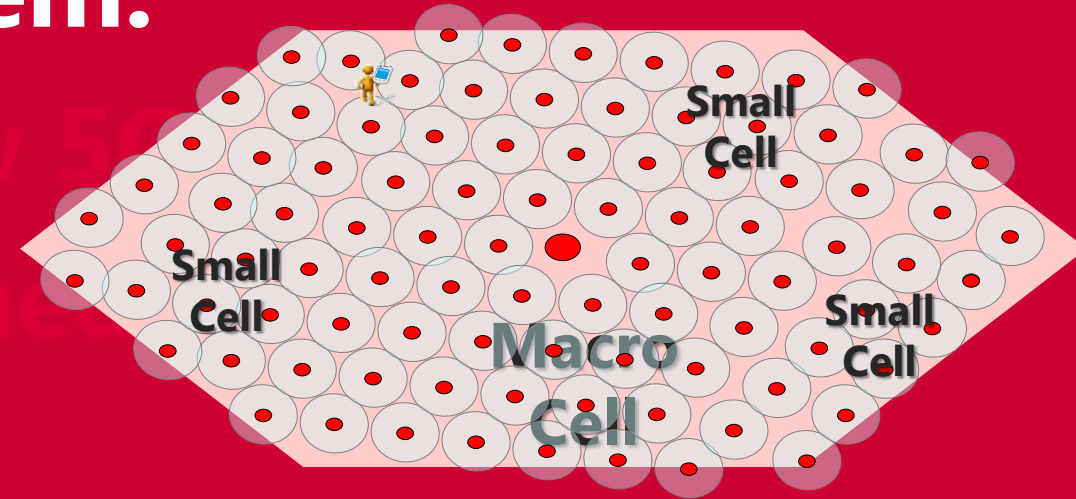
➤ 5G launch needs new 5G spectrum.

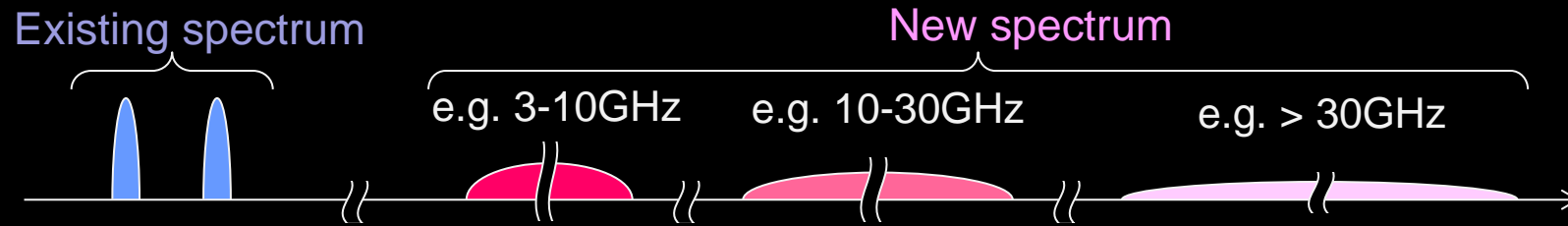
➤ 5G is IMT-2020 defined.

➤ 5G replaces 4G.

➤ For 5G, all things need something new.

➤ **5G needs significant investment.**





## 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.~~

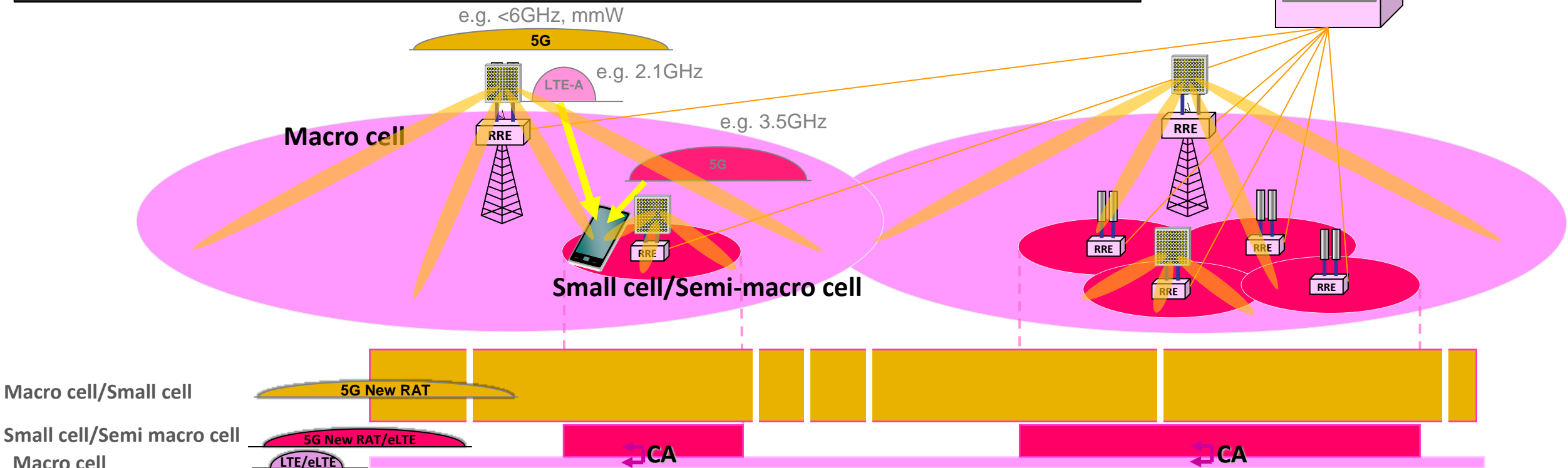
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**Let's tackle the challenge of achieving wide coverage as cellular systems even with higher spectrum.**

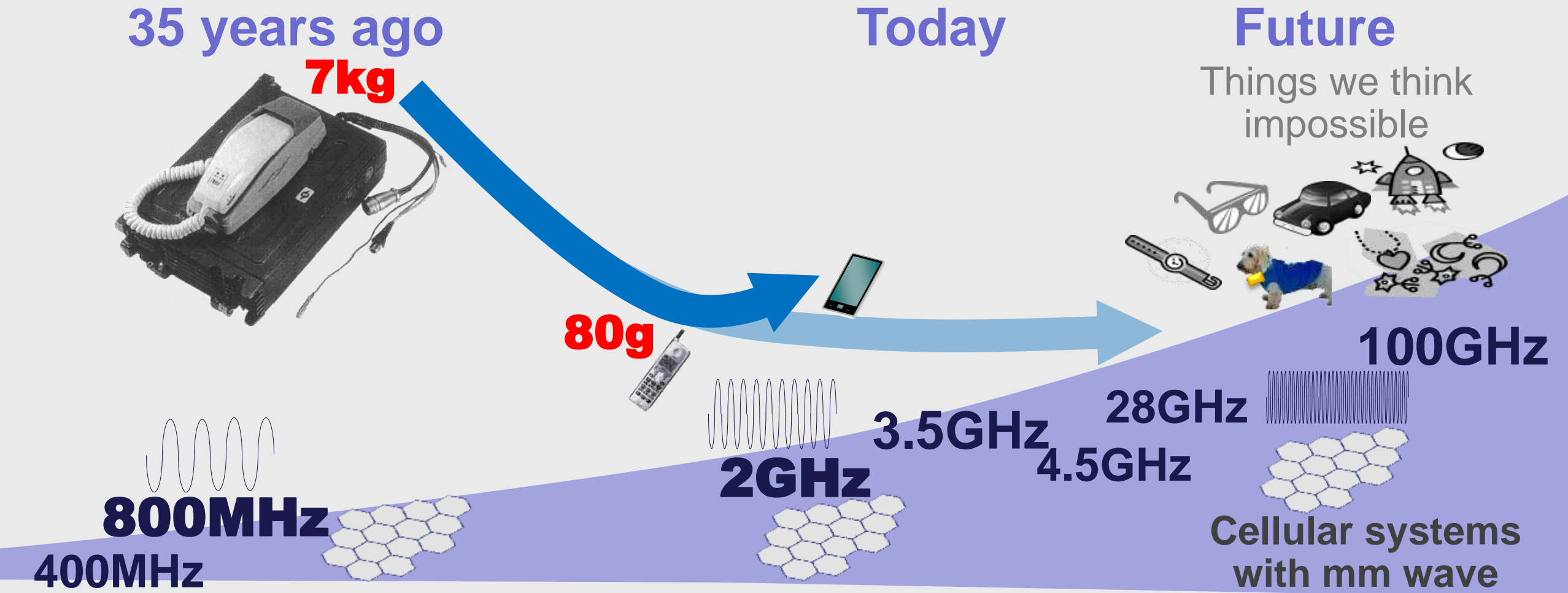
# Massive-MIMO and Advanced C-RAN

## Challenges of RFIC

- RF devices for wide-range frequency bands and bandwidths (0 to 100GHz)
- **High density implementation** of RF and power devices



**We achieved many things we had thought impossible.  
In the future, we can make what we think impossible today.**



# Topics

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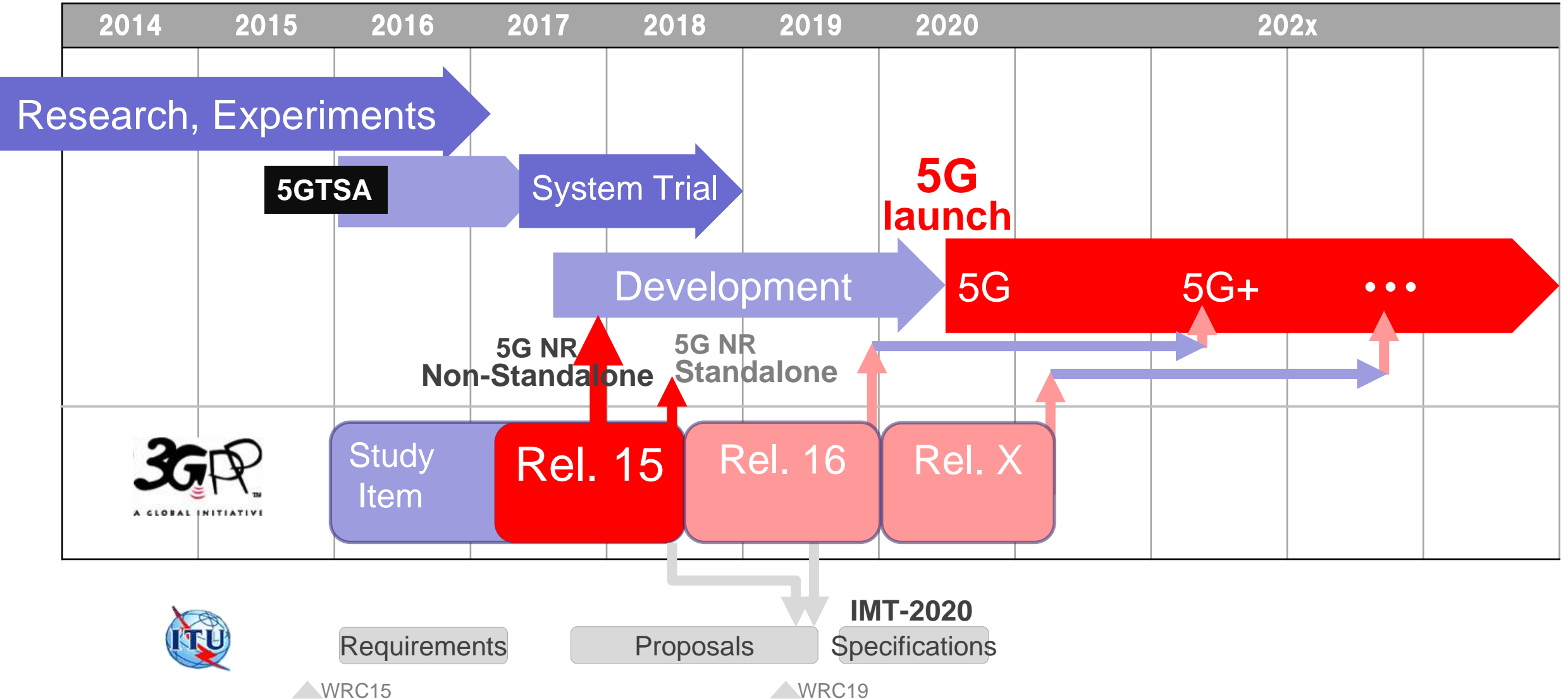
▶▶ Extra Topic

▶▶ Previous Generations' Boom

▶▶ Law of Great Success



# DOCOMO's Time Plan







The Bro

April 20-22, 2016

Verizon announced pre-standards deployment. What is your expectation to the standard body?

We should avoid **fragmentation due to the early deployment.**

Moderator

Oh, Oh

The trial specification activities are helpful.

Moderator

C Spire  
Formerly Sprint

Verizon

AT&T

DOCOMO

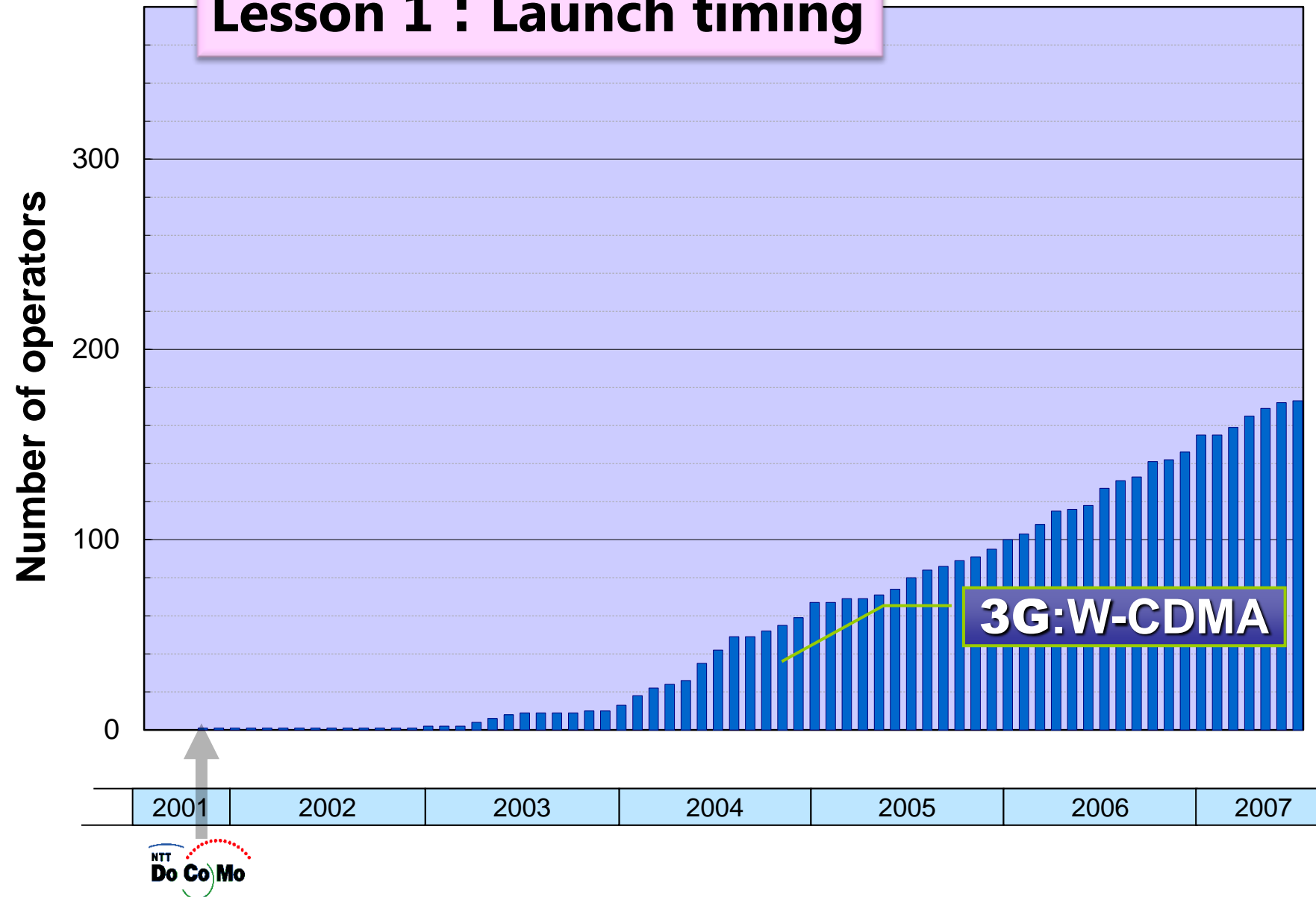
Qualcomm

Vodafone

I can talk about **DOCOMO's experience in 3G.**  
The front runner should take risks.

# Numbers of Operators

## Lesson 1 : Launch timing



**DOCOMO's network handles both versions of Rel. 99 protocols.**

**DOCOMO does NOT intend to repeat this for 5G...**

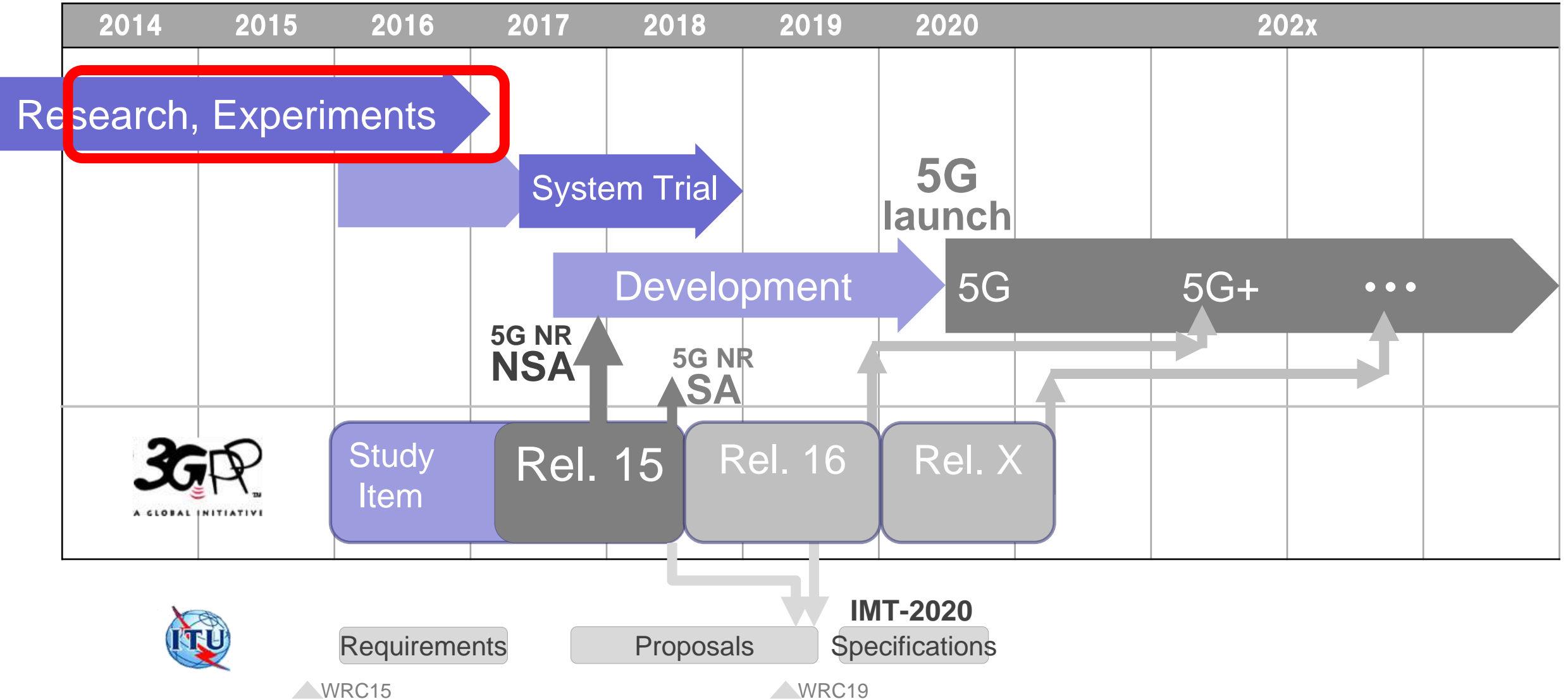
We, as one of the front runners, will continue the effort to accelerate the 3GPP work and implementation with stable specifications.



**The front runner should take responsibility for coping with fragmentation.**

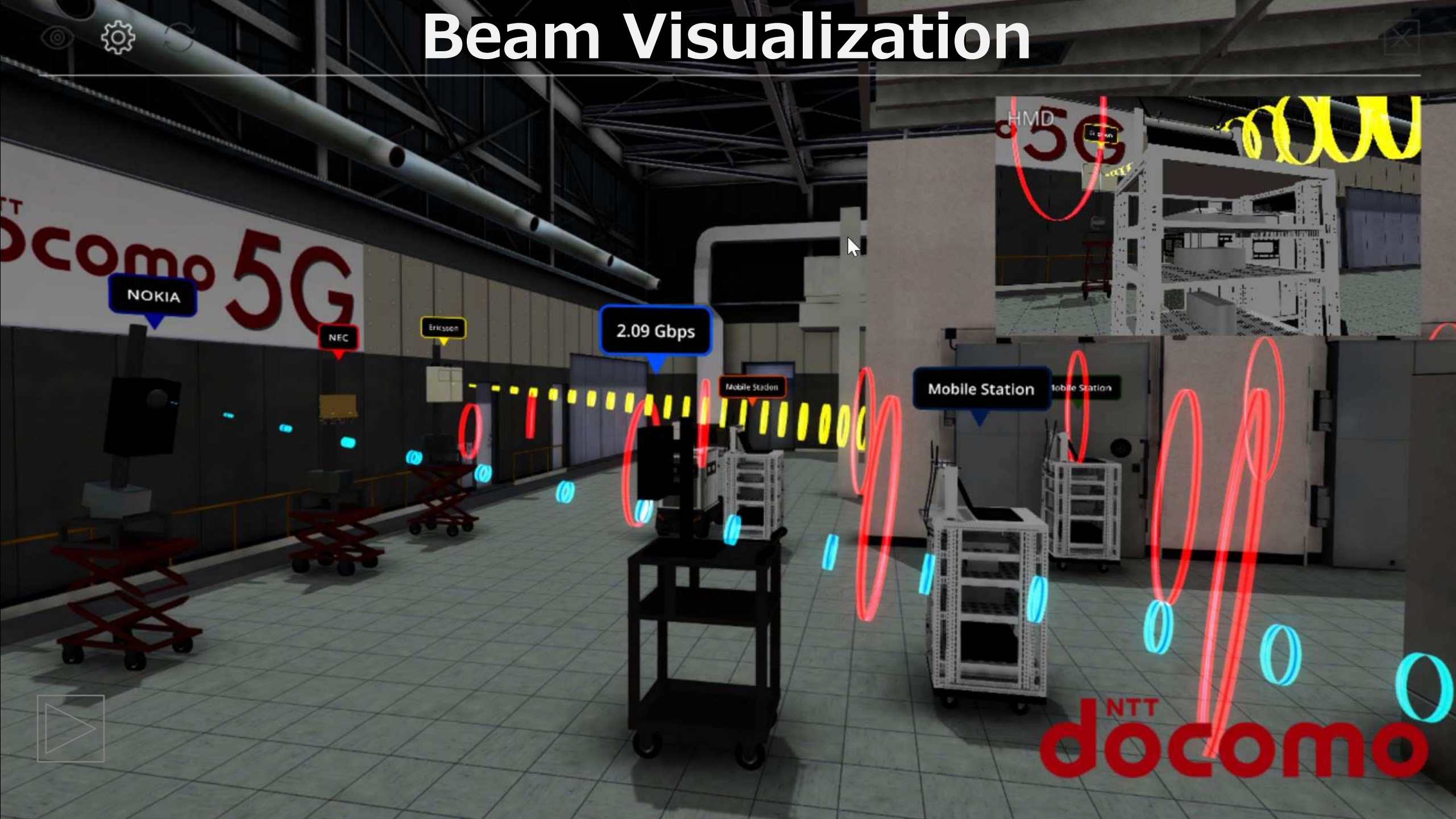


# DOCOMO's Time Plan





# Beam Visualization



# 5G Factory





# High-Speed Drive Test at Fuji Speedway

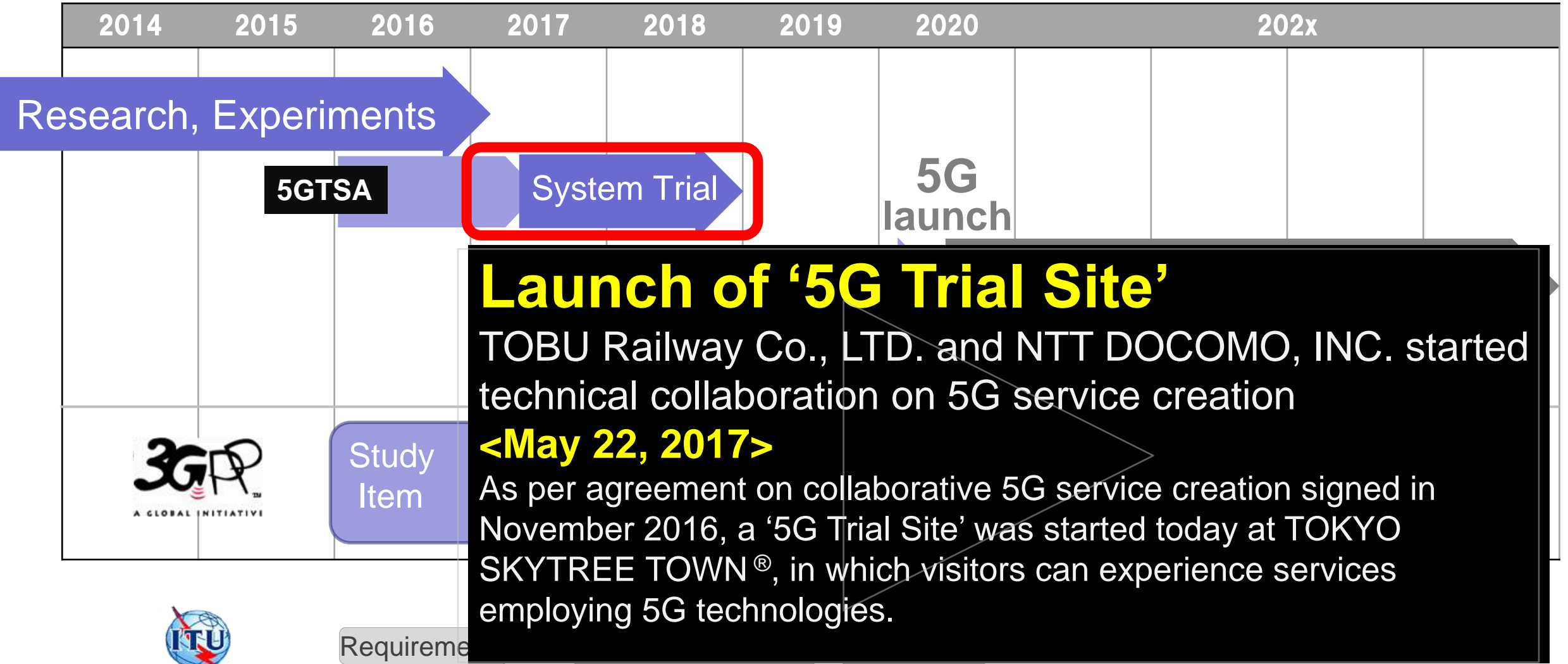
DOCOMO TEAM  
DANDI RACING  
Driver: Tomoki Nojiri



**Max 2.58 Gbps**



# DOCOMO's Time Plan



# Topics

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▶ What 5G provides and creates

**Previous Generations' Boom  
Just Before the Launch of Next Generation**

▶ Road to 5G Launch

▶ Extra Topic

▶ Previous Generations' Boom ▶ Law of Great Success



# 4G regains popularity just before 5G launch

■ This actually happened in previous generations.

- HSPA+ (enhanced 3G) was booming just before 4G(LTE) launch.

- EDGE (enhanced 2G GSM) flourished just before 3G(W-CDMA) launch.



2009 (1.5 years before LTE launch)

**HSPA+ Emerges Immediately**

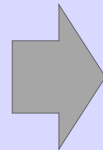


**HSPA+ Plays The Leading Part,  
LTE Be a Minority.**

Nikkei Communications, 2009/03/15

2008 (2.5 years before LTE launch)

**100Mbps Mobile starts in  
2 years  
LTE Covers All Over  
The World**



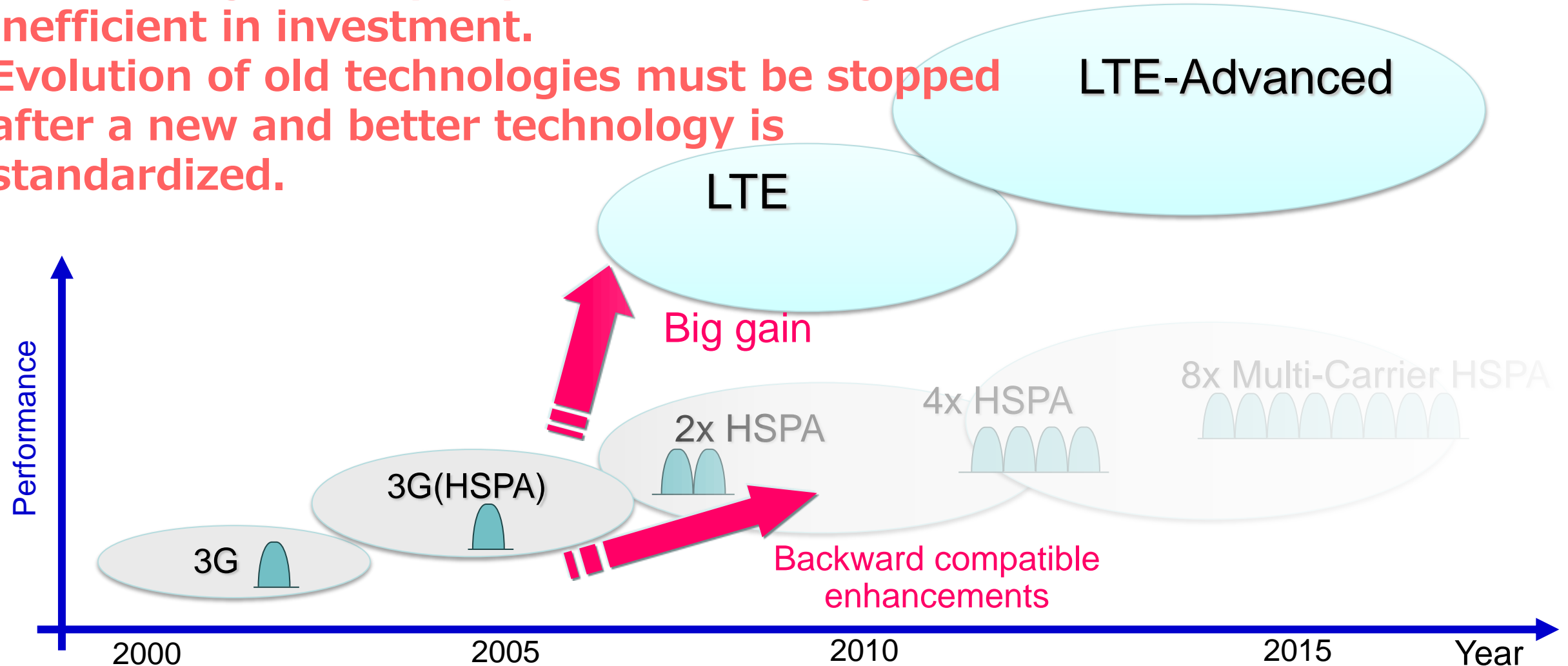
Nikkei Communications, 2008/06/01

# Evolution paths to 4G

Big gain vs. Backward compatibility

Introducing halfway improved technologies is inefficient in investment.

Evolution of old technologies must be stopped after a new and better technology is standardized.



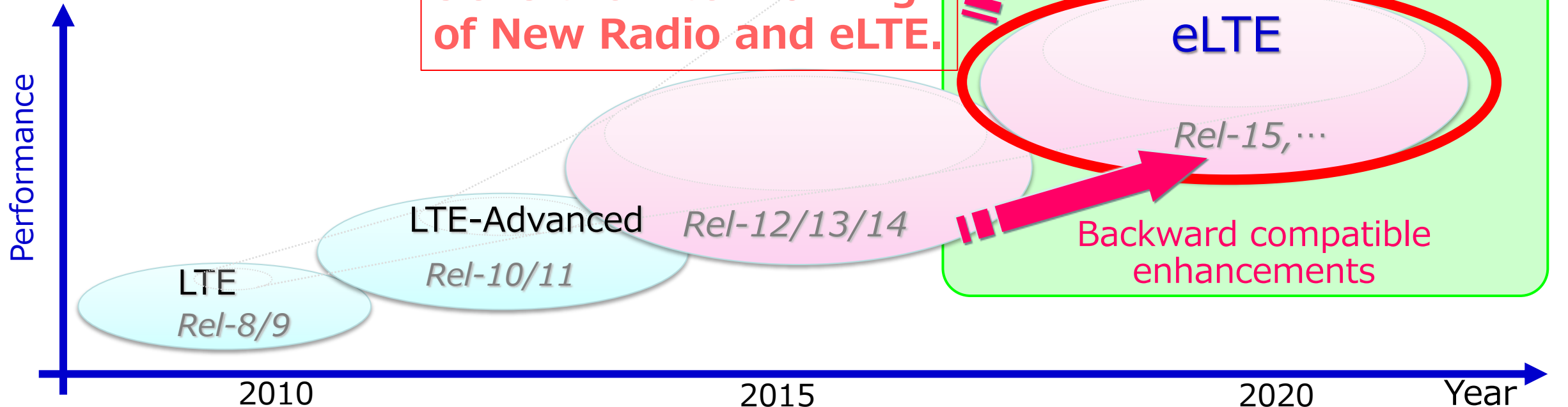
# Evolution paths to 5G

## Big gain vs. Backward compatibility

Introducing halfway improved technologies is inefficient in investment.  
Evolution of old technologies must be stopped after a new and better technology is standardized.


However, the LTE/5G relationship is tricky.

**5G is the interworking of New Radio and eLTE.**





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- This actually happened in previous generations. 
  - HSPA+ (enhanced 3G) was booming just before 4G(LTE) launch.
  - EDGE (enhanced 2G GSM) flourished just before 3G(W-CDMA) launch.
- 3GPP Work items trying to adopt the technologies designed for 5G NR for LTE.

2008 (2.5 years before LTE launch)



Nikkei Communications, 2008/06/01

2009 (1.5 years before LTE launch)



Nikkei Communications, 2009/03/15

It's tricky. 5G is the interworking of 5G New Radio and eLTE.

As a marketing gimmick, evolved 4G will likely be called "5G."

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**Law of Great Success  
Only in Even-Numbered Generations**

▶ Road to 5G Launch

▶ Extra Topic

▶ Previous Generations' Boom

▶ **Law of Great Success**

# Law of Great Success Only in Even-Numbered Generations

- A de-facto global standard
- More-than-expected demand

Rapid global deployment.  
LTE is the single global standard  
(no other standard implemented).  
More-than expected demand.



**2G**

**4G**

**6G**

**1G**

**3G**

**5G**

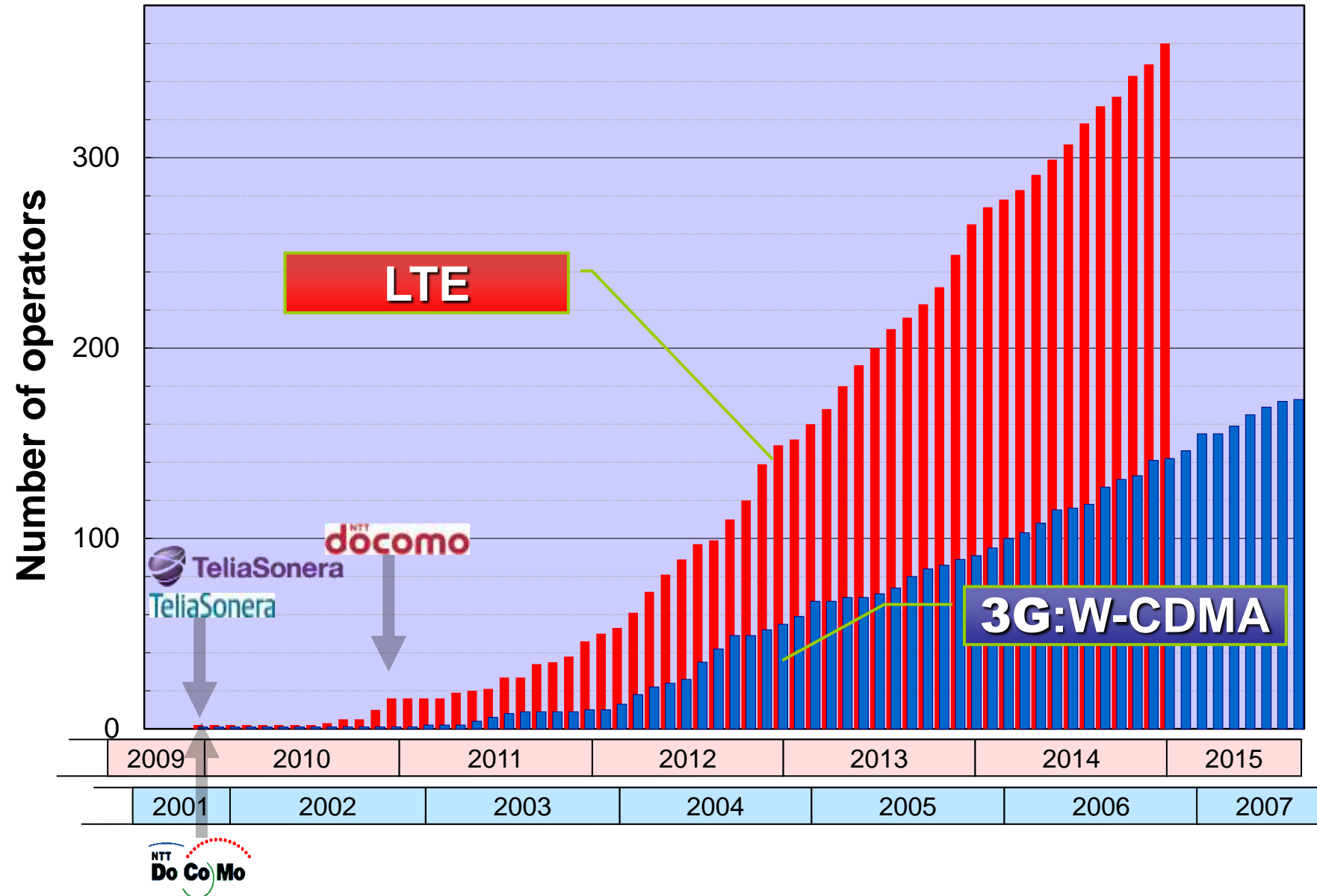
Fragmented standards  
Limited deployment

Slow deployment  
Spectrum auctions & economic situation  
Less-than-expected demand

? ? ?  
LTE-based technology


? ? ?

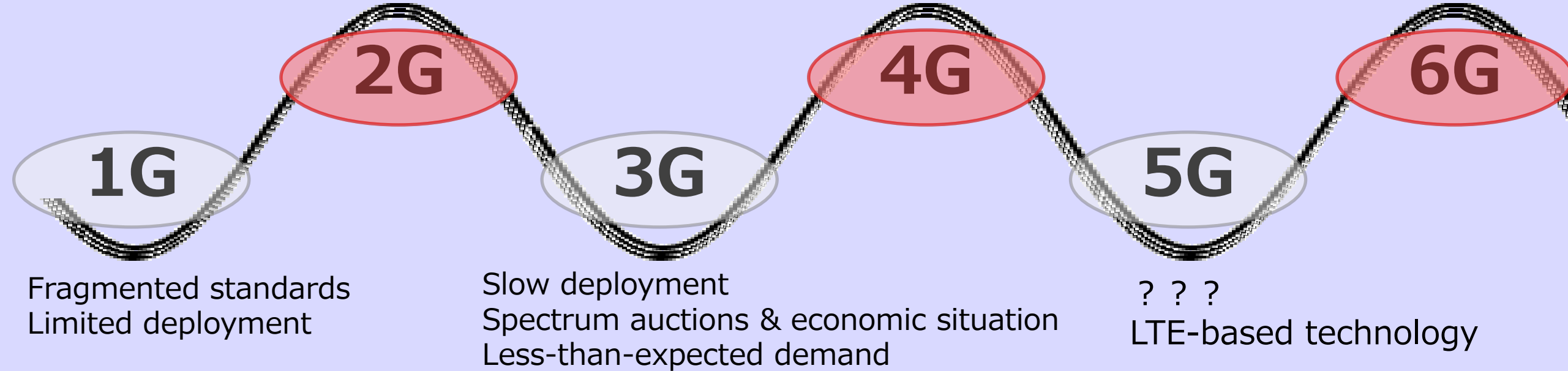
# Numbers of Operators



# Law of Great Success Only in Even-Numbered Generations

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(no other standard implemented).  
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We have to wait until 6G to see our expectations for 5G fulfilled.  
6G will be the complete form of 5G, or 5G will be the final generation  
that will keep evolving ever after 2030.

**Regardless of technological generations, cross-industry collaboration  
will create new business models and ecosystems.**

# 5G Progress, Realities Set in at Brooklyn 5G Summit

By [AMY NORDRUM](#)

Posted 21 Apr 2017 | 19:30 GMT



## 4. Will 5G live up to the hype?

Over the past few years, engineers and executives have set sky-high expectations for 5G. They've spoken of 5G as the wireless network that will unleash radical new technological advances in every possible realm, and promised that it will enable autonomous cars, streaming virtual reality, and remote surgeries. Much of the talk at this year's summit was as bold as ever. In a keynote about how 5G would improve industrial systems, [Kenneth Budka](#) of Bell Labs predicted that 5G technologies would “fundamentally transform human existence.”

This year, though, such grandiose statements were also punctuated with more sobering analyses. A generous helping came from [Seizo Onoe](#), chief technology officer of NTT DOCOMO, who has developed something of a reputation for [pouring cold water](#) on 5G expectations.

During his keynote, Onoe said he has noticed an informal law during his time at DOCOMO: The wireless industry manages to achieve great leaps of success only in even-numbered generations. By his measure, 2G and 4G were truly transformational, while the improvements that came with 1G and 3G were mostly incremental.

“Applying this law to 5G, I would say we have to wait until 6G to fill all the expectations of 5G,” he said. Stay tuned.



# Conclusion

- 5G will be successful.
- 5G is attracting interest from a wide variety of industries.
  - **Let's get on the 5G Bandwagon!**
- RFICs are key to realize 5G technologies, and will enable what we think impossible.
  - **Let's ride on the 5G wave!**



The new of today, the norm of tomorrow

**NTT**  
**docomo**