

特別講演 「Beyond 5G時代に向けた国際標準化のビジョン」

International Standardization toward 6G Era

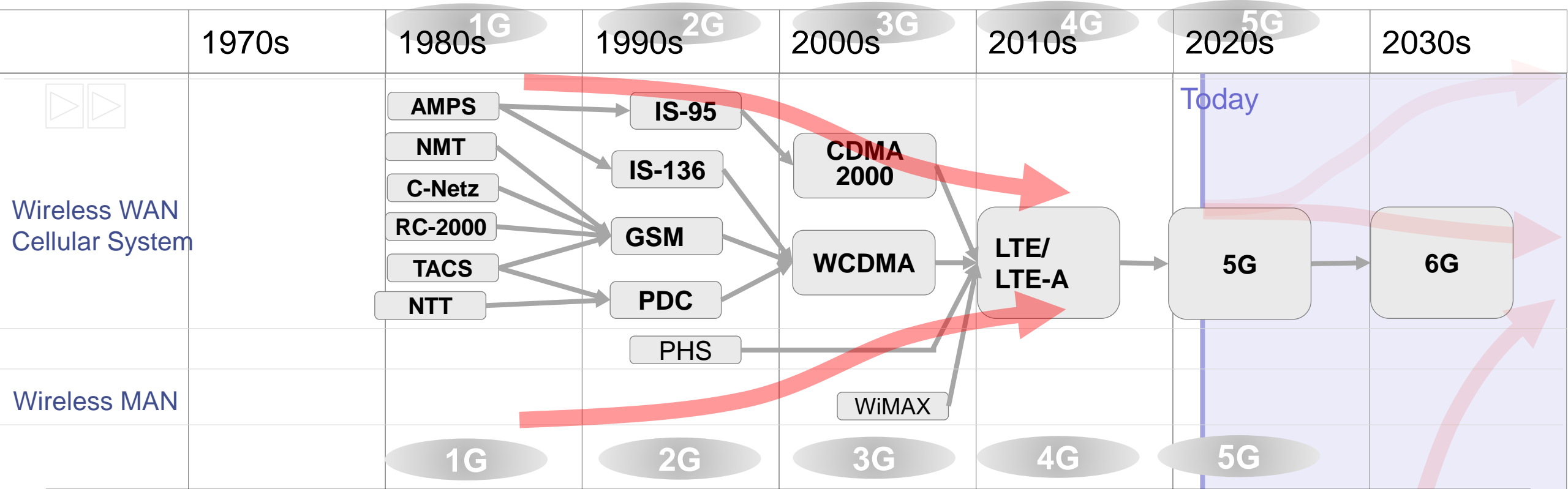
Director-elect of ITU Telecommunication Standardization Bureau
EVP and Chief Standardization Strategy Officer of NTT CORP.
Fellow of NTT DOCOMO, INC.

Seizo ONOE

Topics

- **History of Generations: 1G to 5G**
- **Future Beyond 6G toward 12G**

GSMA



“Throughout its long history, telecom standardization has helped make people's lives more convenient and society more efficient.”

- Global coverage of services
- Cost reduction by economies of scale and competition principle

More effort is needed to achieve a truly affordable and even better ecosystem.

1G



Analogue Cellular

Each country developed and deployed different systems.

No effort for a global standard

Evolution of Cellphones

携帯
前史



Japan



TZ-801
1979 Dec. Car phone
6600cc, 7kg, 5W



TZ-802A
1985 Sept. Portable
1500cc, 2.9kg, 5W



TZ-802B
1987 Apr. Mobile
500cc, 900g, 1W



TZ-804B
1991 Apr. (mova)
150cc, 230g, 0.6W

Source: <http://history-s.nttdocomo.co.jp/list.html>

US

DynaTAC 8000X
1984
Around 800g

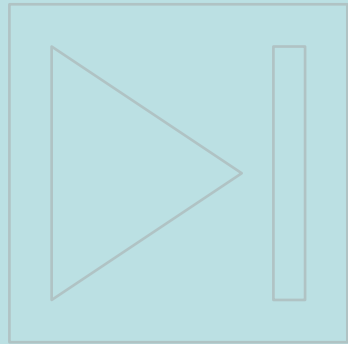


MicroTAC 9800X
1989 Apr.
303g



Source: WIRED "The 12 Cellphones That Changed Our World Forever"
<https://www.wired.com/2013/04/influential-cellphones/>

2G



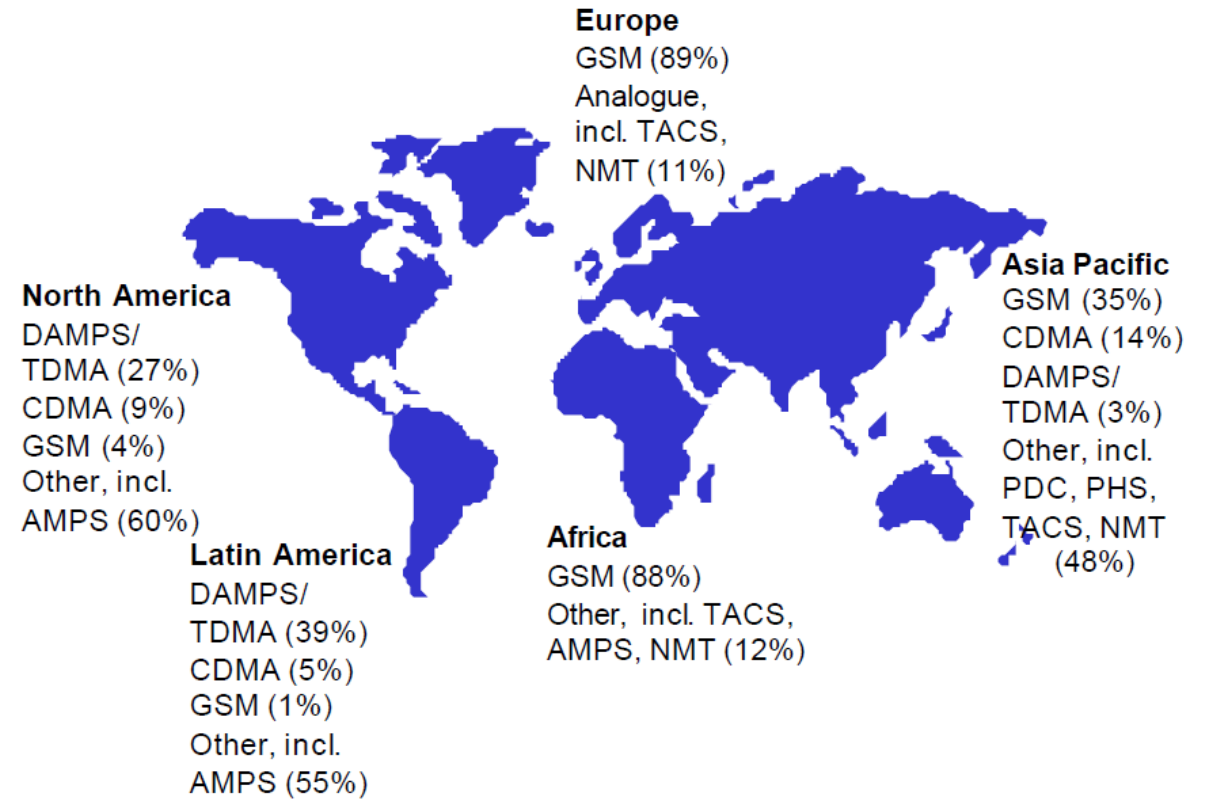
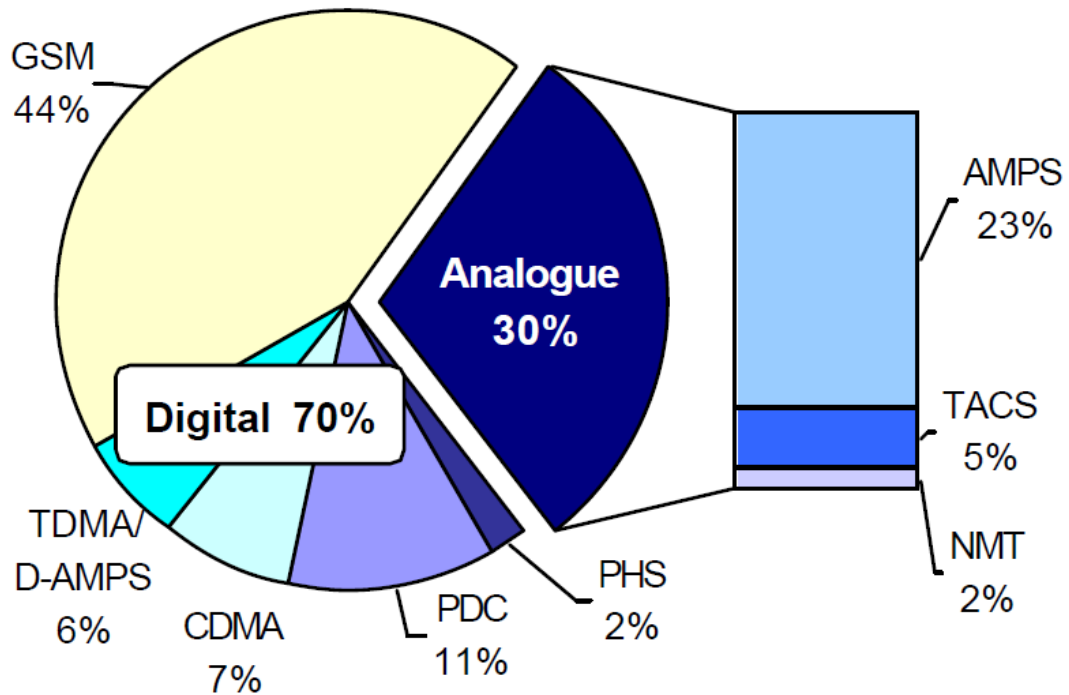
Digital Cellular

European standard GSM became a de facto global standard.
Some effort to seek commonalities against the backdrop of world's economic competition

**Result of market efforts after
completion of standards**

Global Deployment

Worldwide cellular subscribers by technology, 1998



Source: ITU adapted from Ericsson, GSM MoU, CDMA Development Group.

3G



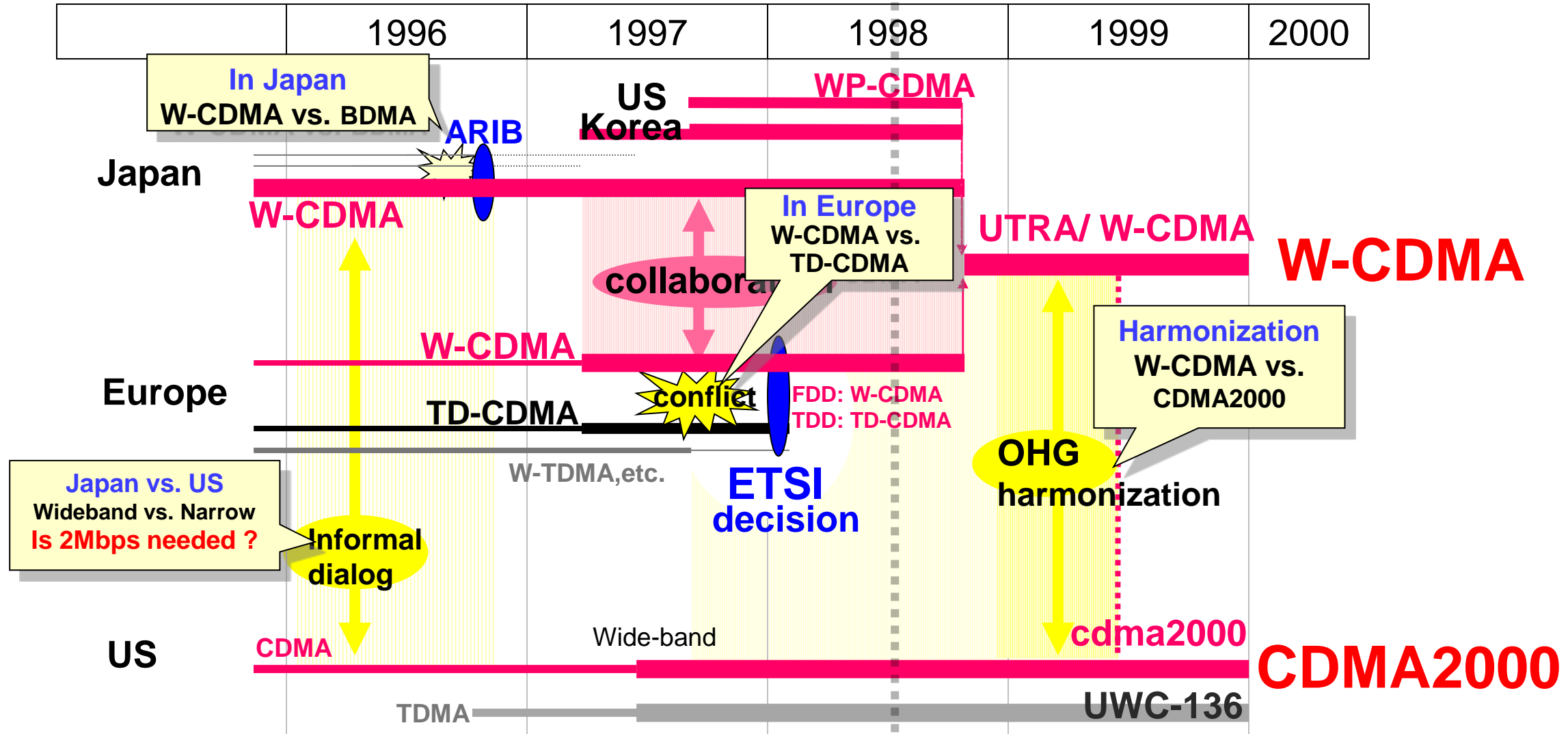
IMT-2000

Since 3G standardization aimed at a globally unified standard, after fierce discussions, the number of standards was narrowed down.

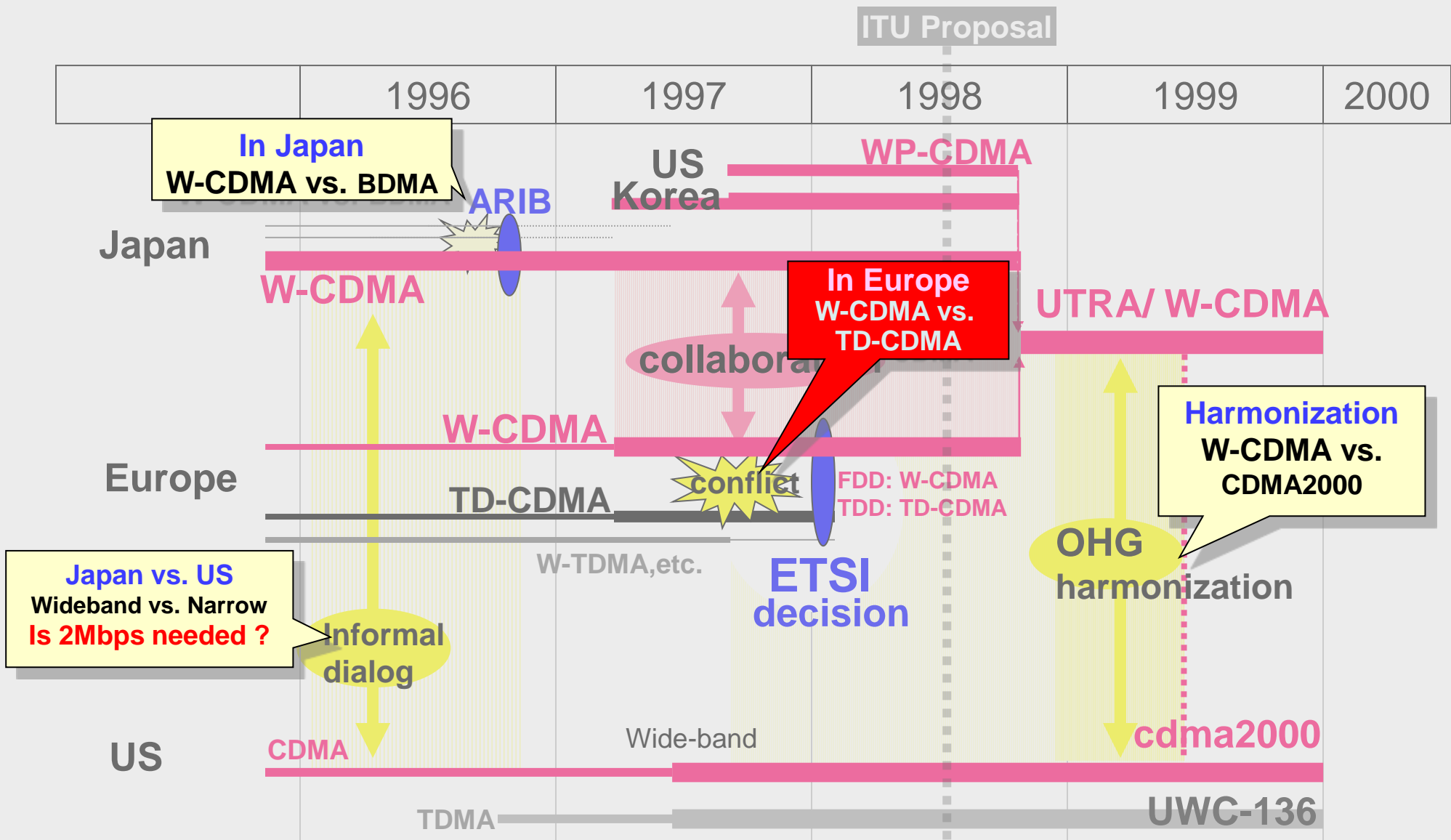
Maximum effort toward unified standard, but failed to achieve a single standard

3G Standardization Discussions

Since 3G standardization aimed at a globally unified standard, after intense discussions, the number of ITU proposals was narrowed down.



3G Standardization Discussions

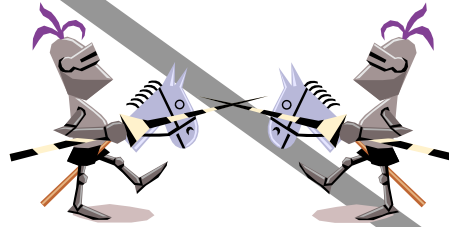


TD-CDMA versus W-CDMA

SIEMENS



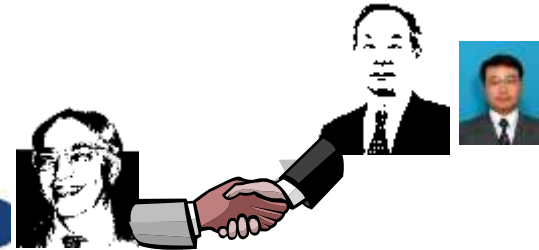
SONY



ERICSSON 
TAKING YOU FORWARD

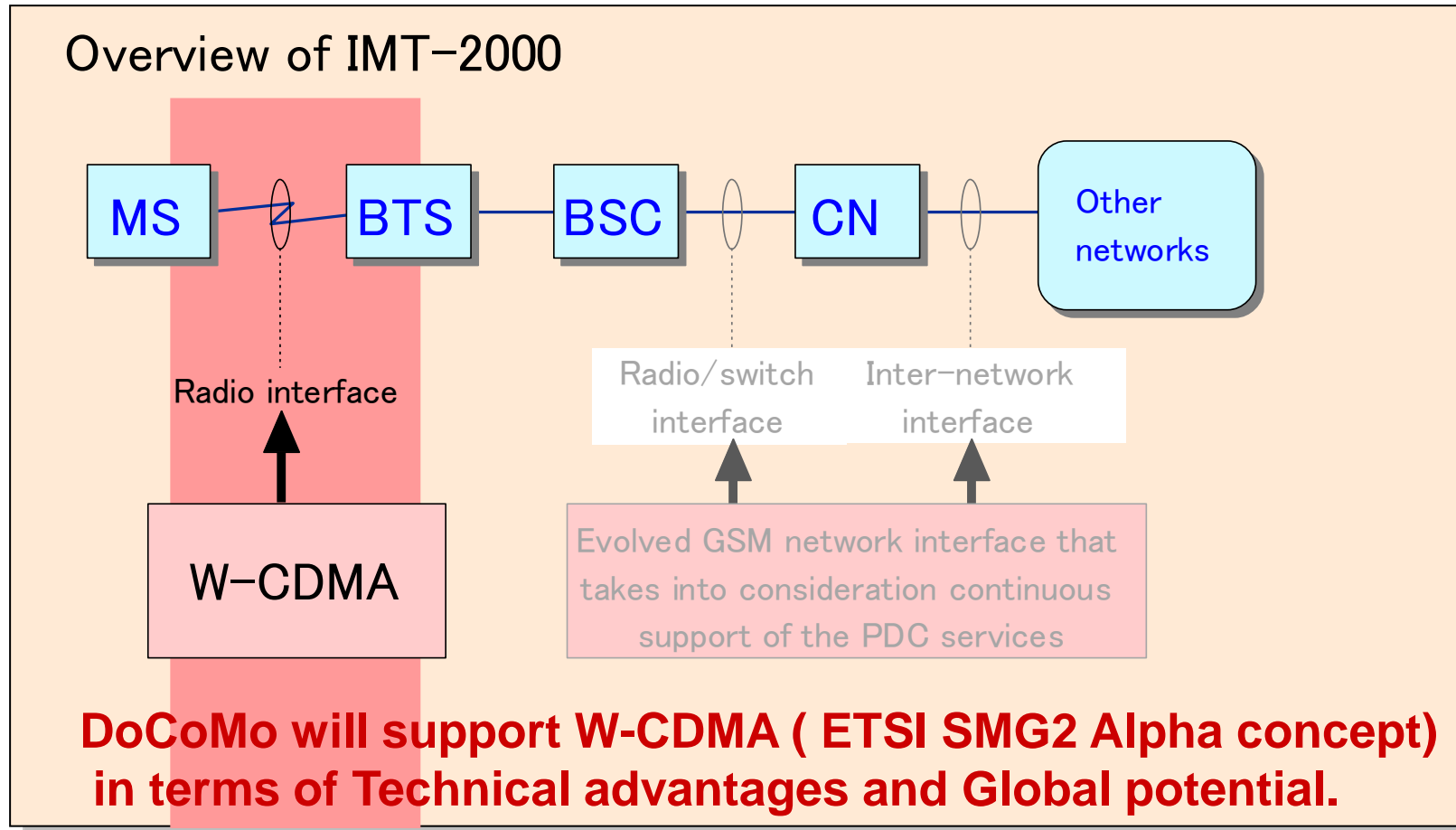
NOKIA
Connecting People

NTT
Do Co Mo



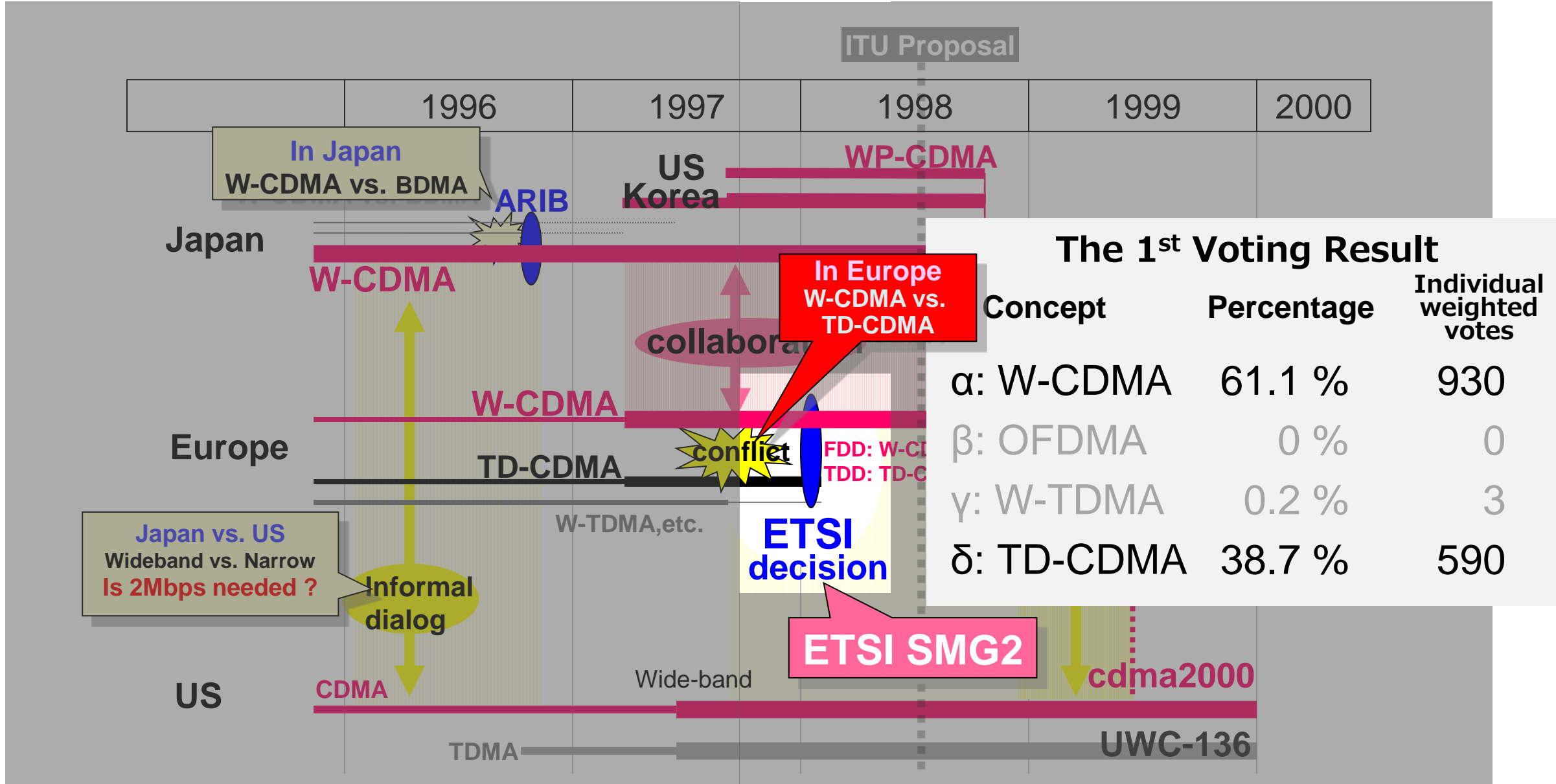
W-CDMA採用への働きかけ

ドコモは、世界に普及した**GSMコアネットワーク**をベースとすることを受け入れる一方で、無線インタフェースは**W-CDMA**とすることを主張した。



当時、欧州オペレータに提示したスライド

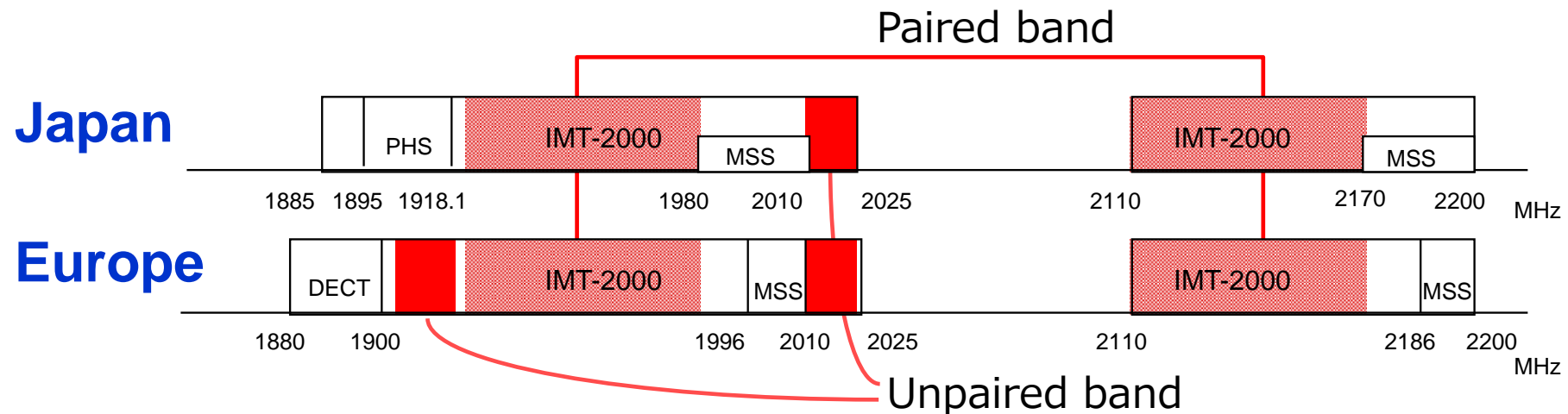
3G Standardization Discussions



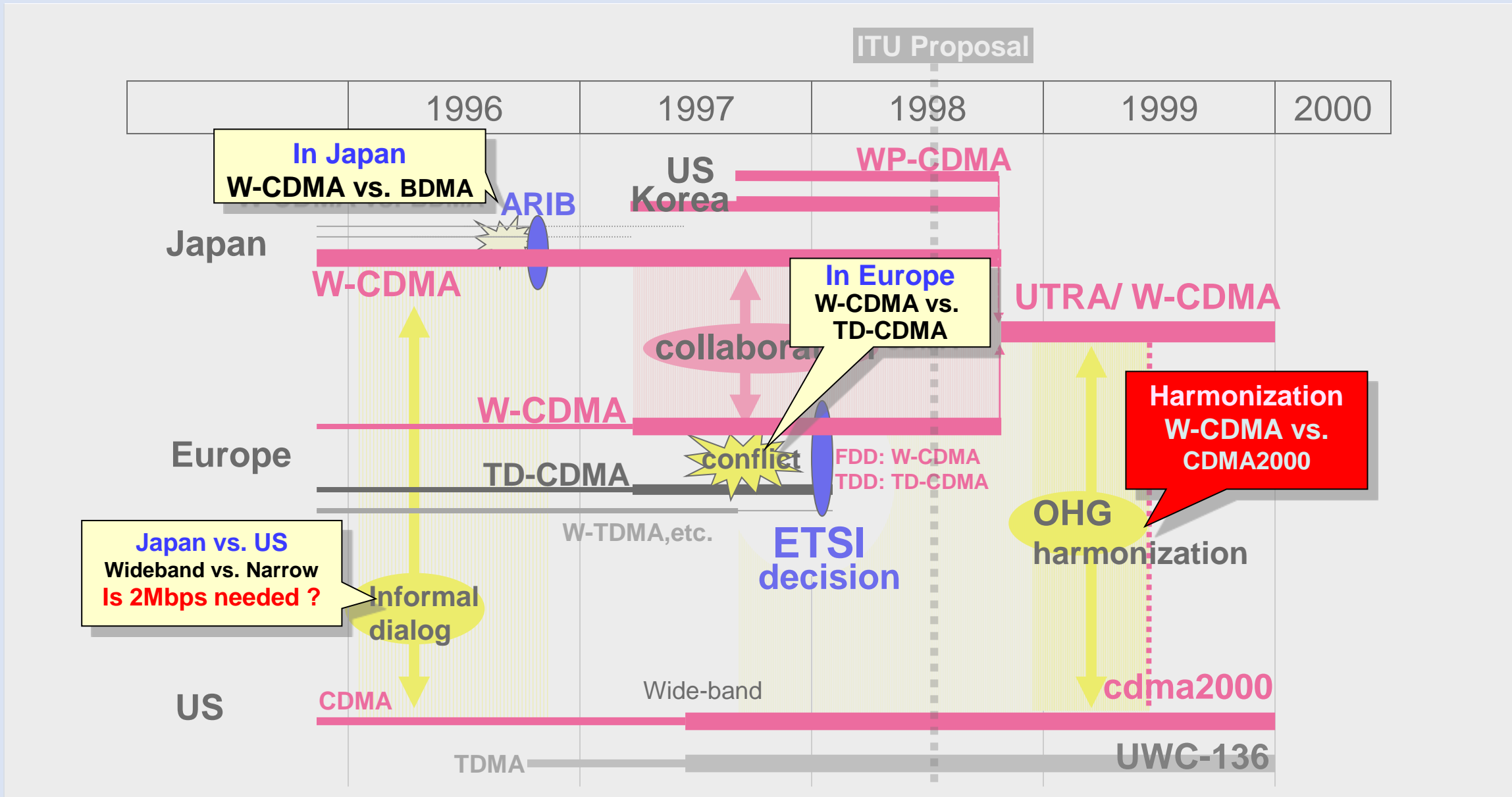
ETSI Consensus Decision

A compromise was agreed to adopt both concepts, where W-CDMA is applied to major frequency bands.

- Paired band: W-CDMA of ETSI Alpha group ← **FDD**
- Unpaired band: TD-CDMA of ETSI Delta group ← **TDD**
- Additional objectives
 - Low-cost terminal
 - Harmonization with GSM
 - FDD/TDD dual-mode operation
 - Fit into 2*5 MHz spectrum allocation

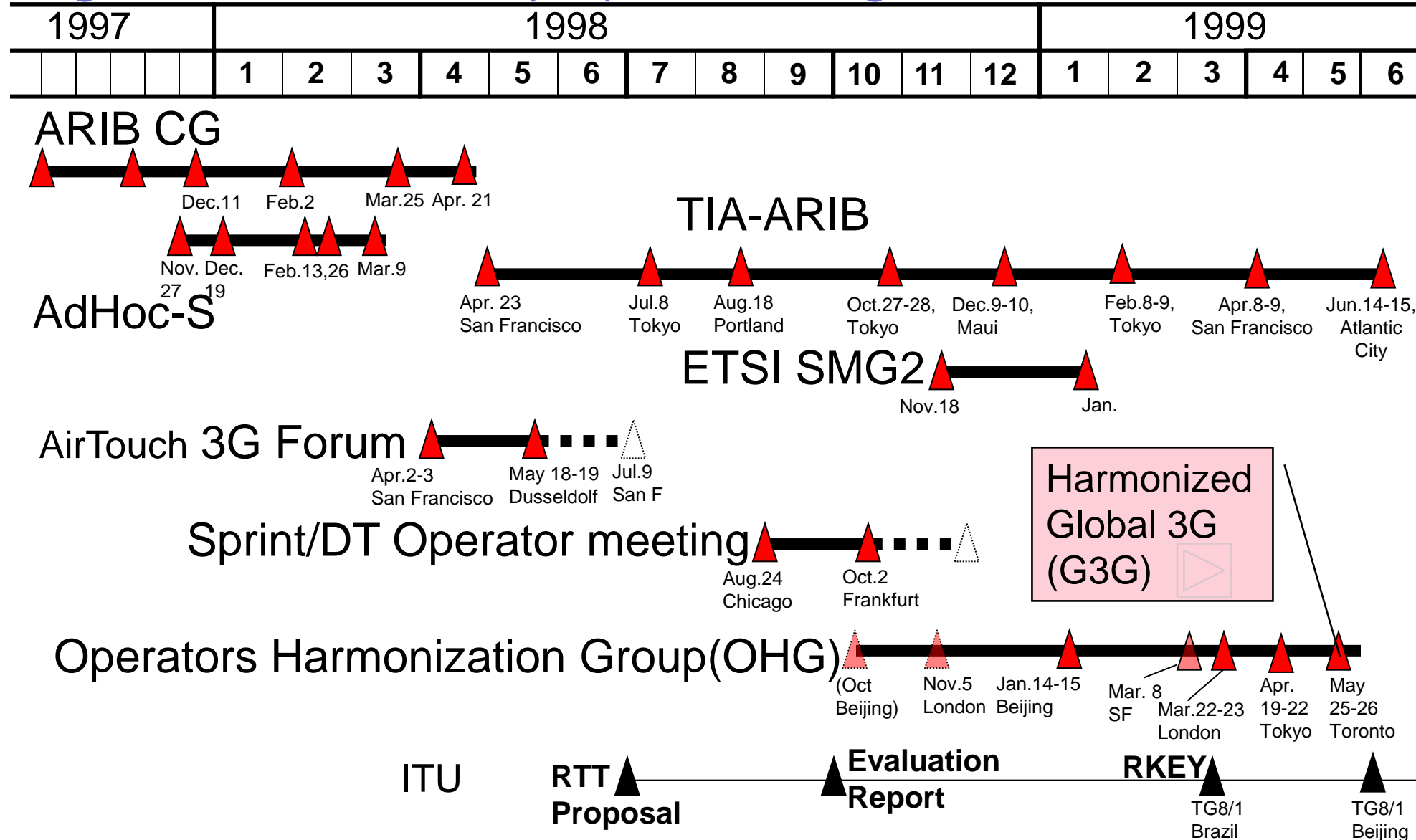


3G Standardization Circumstances

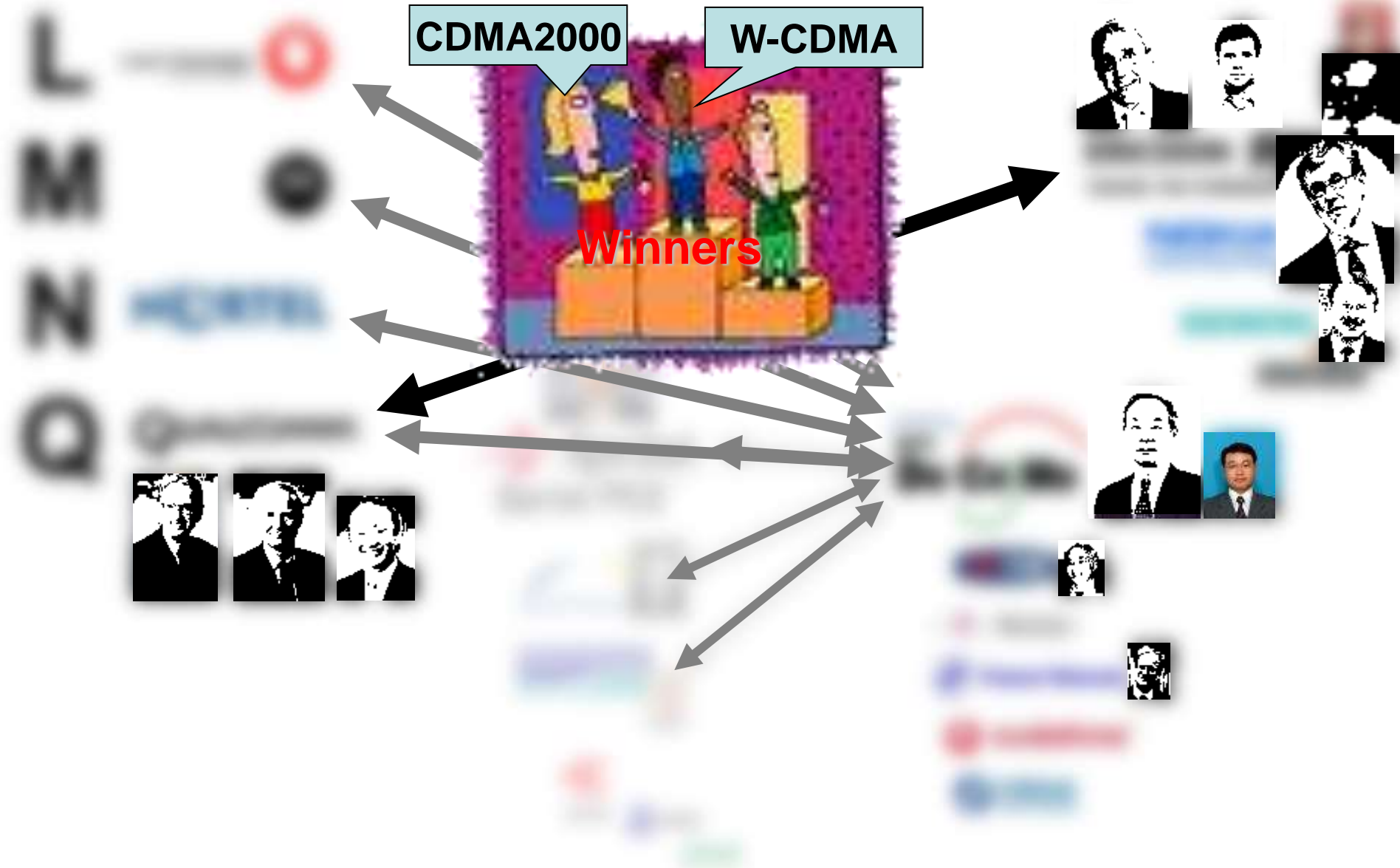


Harmonization between CDMA2000 and WCDMA

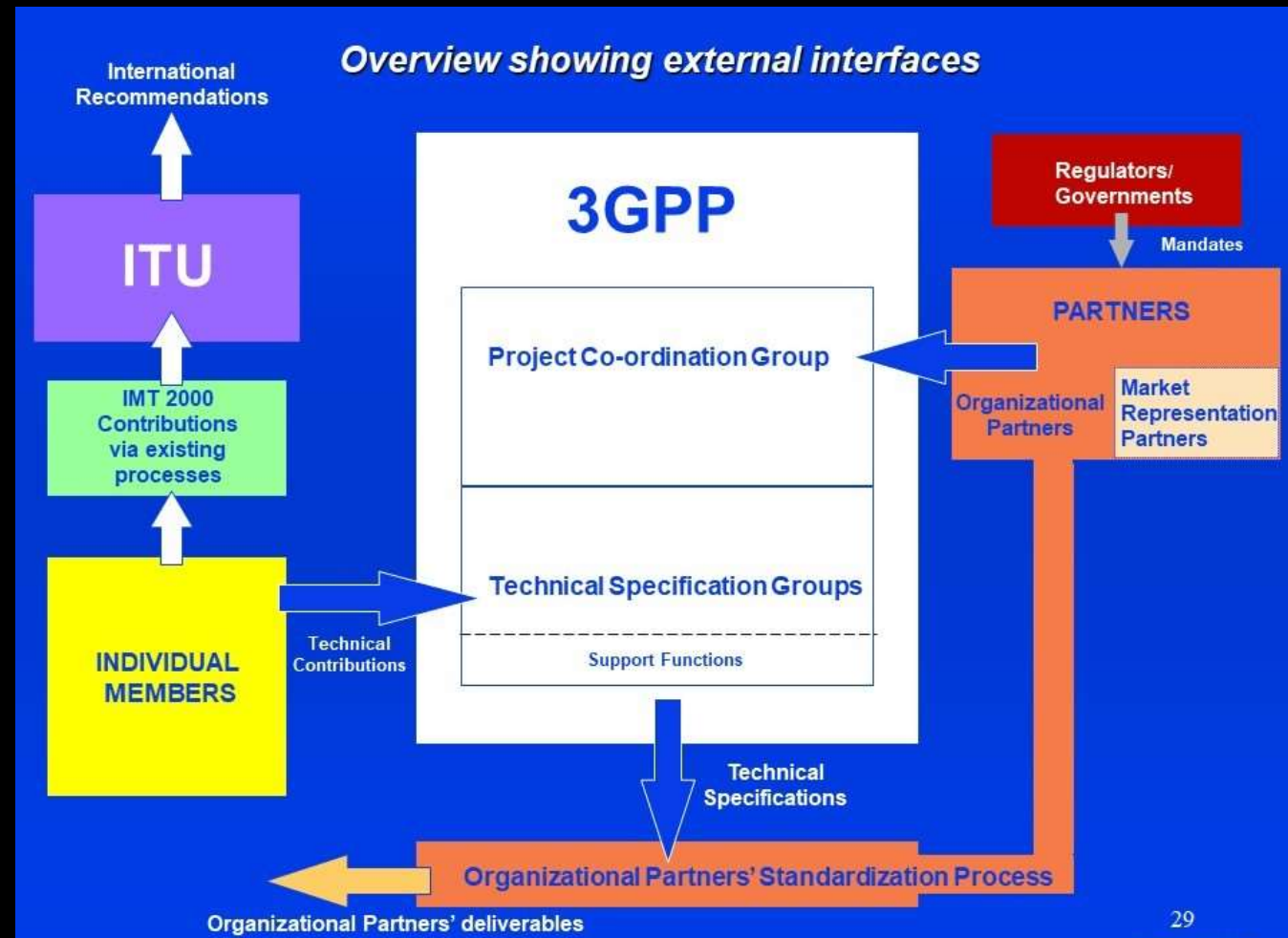
SDOs held a meeting for harmonization, but the discussion was prolonged. Harmonization proposal was agreed at OHG.



CDMA2000 versus W-CDMA



3GPP was established.



New standardization framework with 3GPP, regional SDOs and ITU

4G

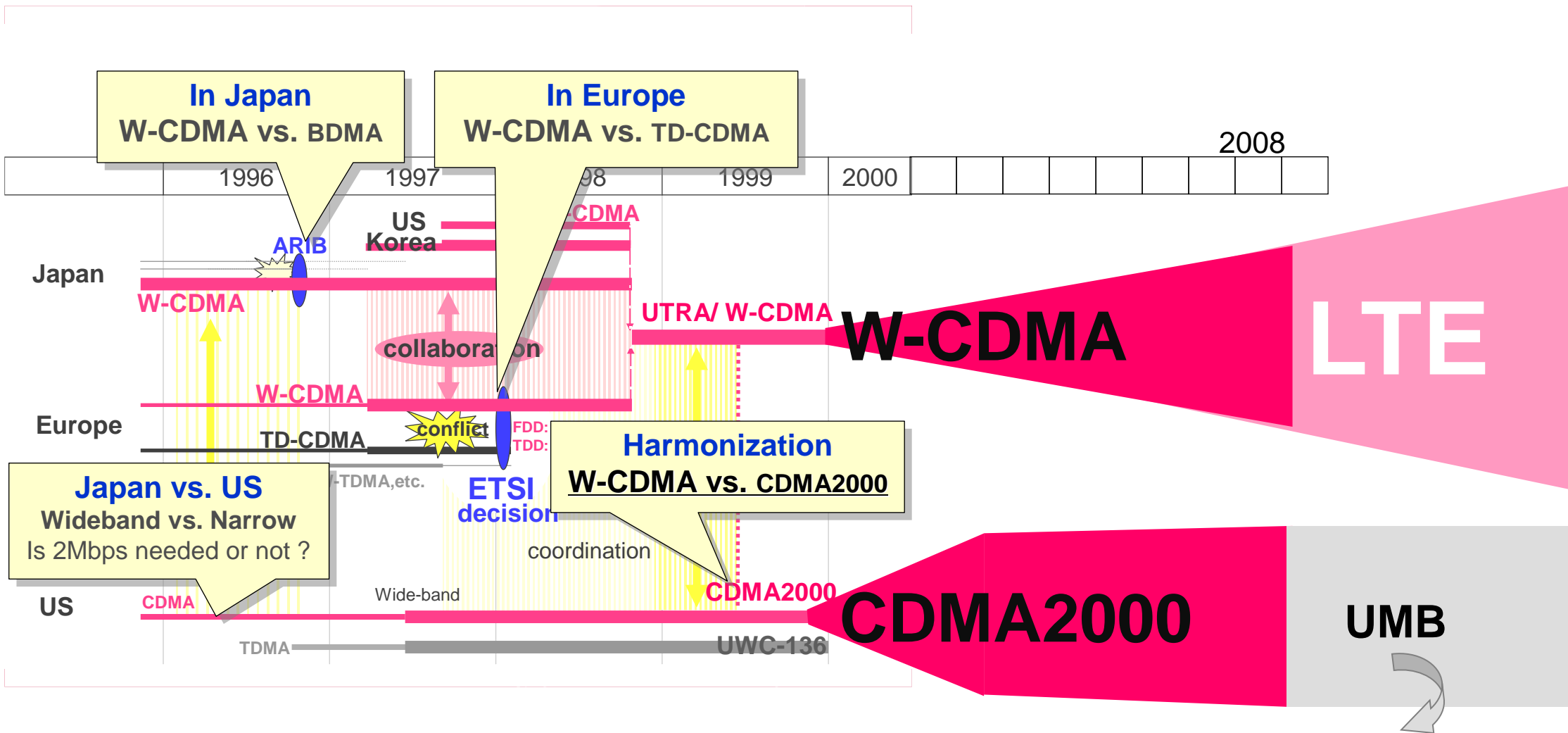


LTE (IMT-2000/IMT-Advanced)

LTE, which is a long-term evolution from W-CDMA, having market potential, became the mainstream.

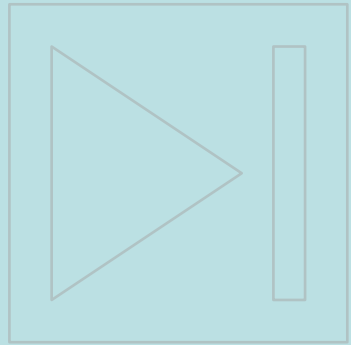
A single standard determined by the market, not standardization

3G Standardization History and Epilogue



The market determined the standard 10 years after the standardization.

4G



LTE (IMT-2000/IMT-Advanced)

LTE, which is a long-term evolution from W-CDMA, having market potential, became the mainstream.

New G, 4G, was not welcomed in the early stage just after huge 3G investment

History of 4G Research at NTT DOCOMO



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

100Mbps
in **2002-2003**



5Gbps
in 2006

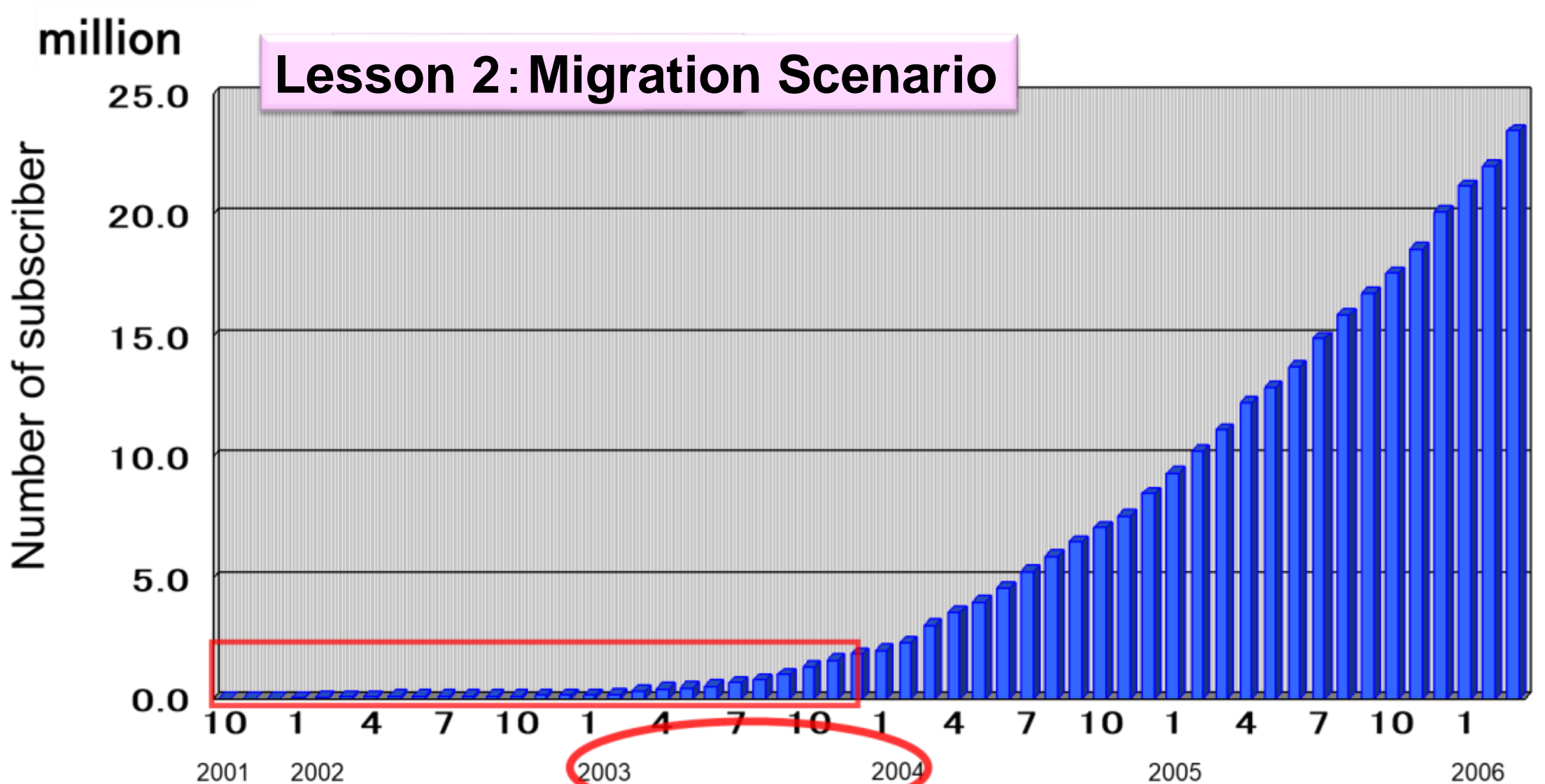


1Gbps
in **2004-2005**



3G Subscriber Growth

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



Super3G concept



Advocated the Super 3G concept for the smooth introduction of 4G. First evolve 3G, then build 4G on top. The first evolved 3G was called Super 3G.

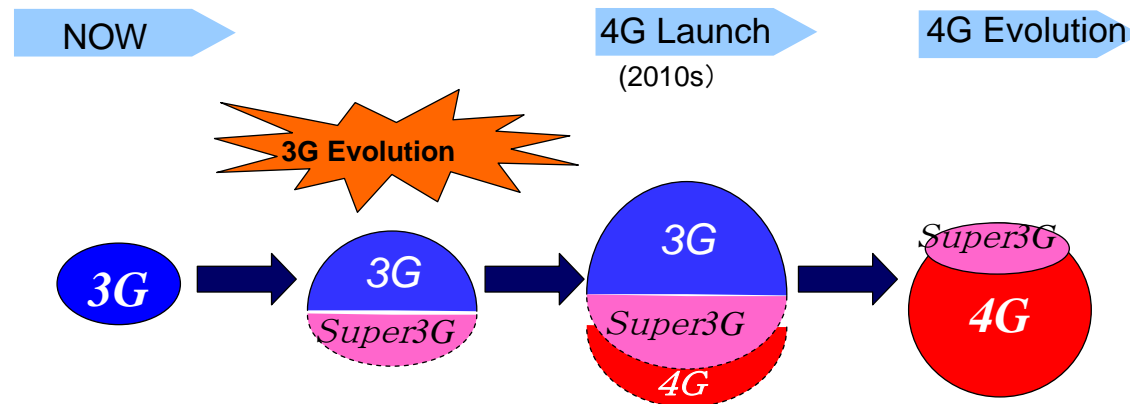
Ideas on migration to 4G (3)

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

→ Extensibility is greater than Scenario2

→ Cost is lower than Scenario1

(Innovative 4G evolution possible)



**26th May 2004,
ICB3G**

※Super3G : The name of Enhanced3G called in DoCoMo

26th May 2004, ICB3G

NTT DoCoMo

Input Document to the 3GPP RAN Plenary Meeting

The document for the Study Item did not have the term "4G" nor "LTE", only used the general term "3G long-term evolution". Later, the abbreviation for the Work Item name became LTE, and it came to be called LTE.

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.

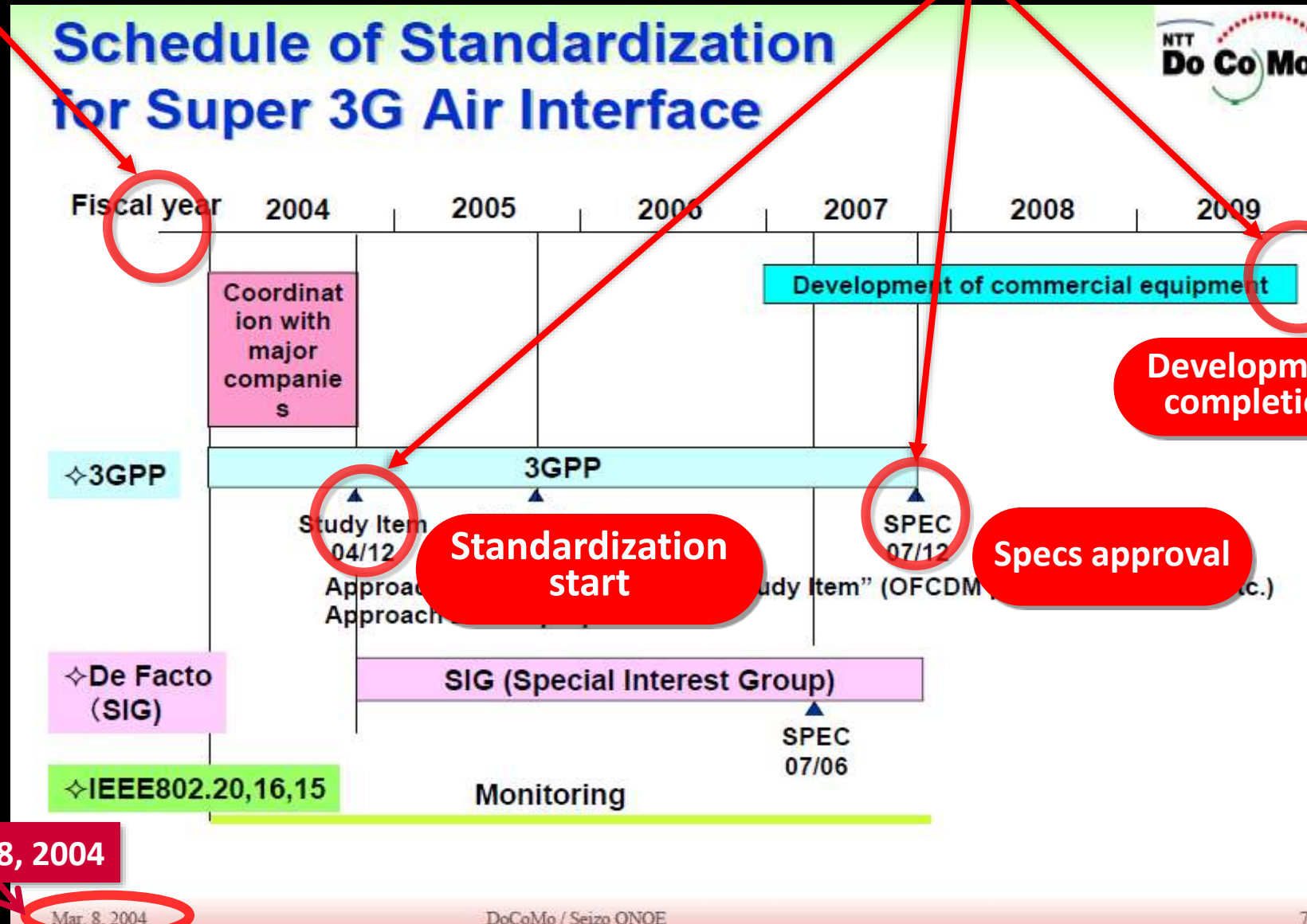
It is proposed that 3GPP should initiate the feasibility study of the long-term evolution accounting for the above situation. In this paper, a Study Item Description is presented for this study.

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

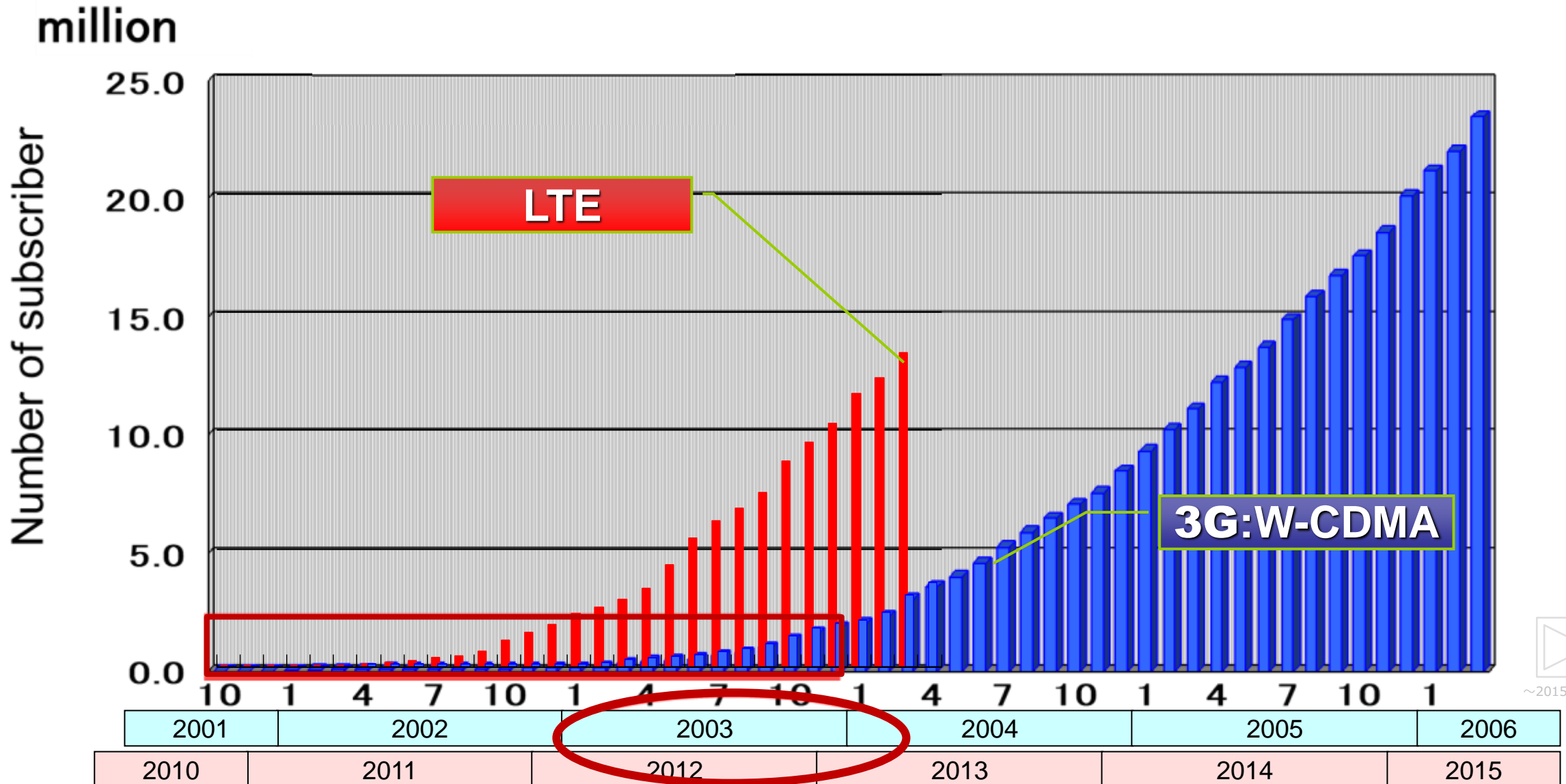


A Slide used for initiating the standardization

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



LTE/3G Subscriber Growth



Numbers of 3G(W-CDMA) Operators

Lesson 1 : Launch timing

The world's first is not always necessarily good.



3-5. Deployment of Mobile Broadband Using LTE

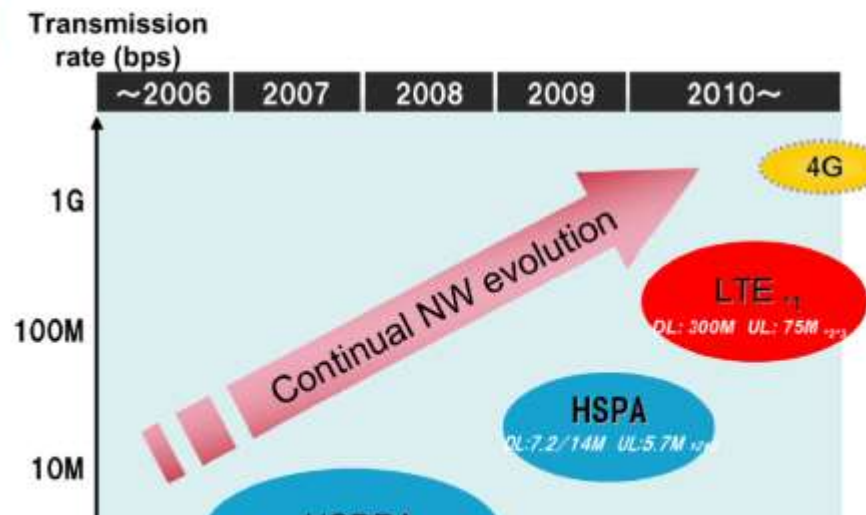


To facilitate a widening array of advanced mobile broadband services, DOCOMO will construct a high-speed, low-latency, large-capacity network by implementing LTE from 2010.

International standardization and network roll-out of LTE

- ◆ Customers’ demands for stress-free access to video and other rich content are expected to rise.
- ◆ Network traffic is expected to grow steadily due to widespread adoption of flat-rate services and increased availability of rich content.
- ◆ Many markets outside Japan are likely to follow similar trends.

◆ Adoption of LTE*1 is becoming the mainstream strategy

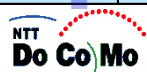
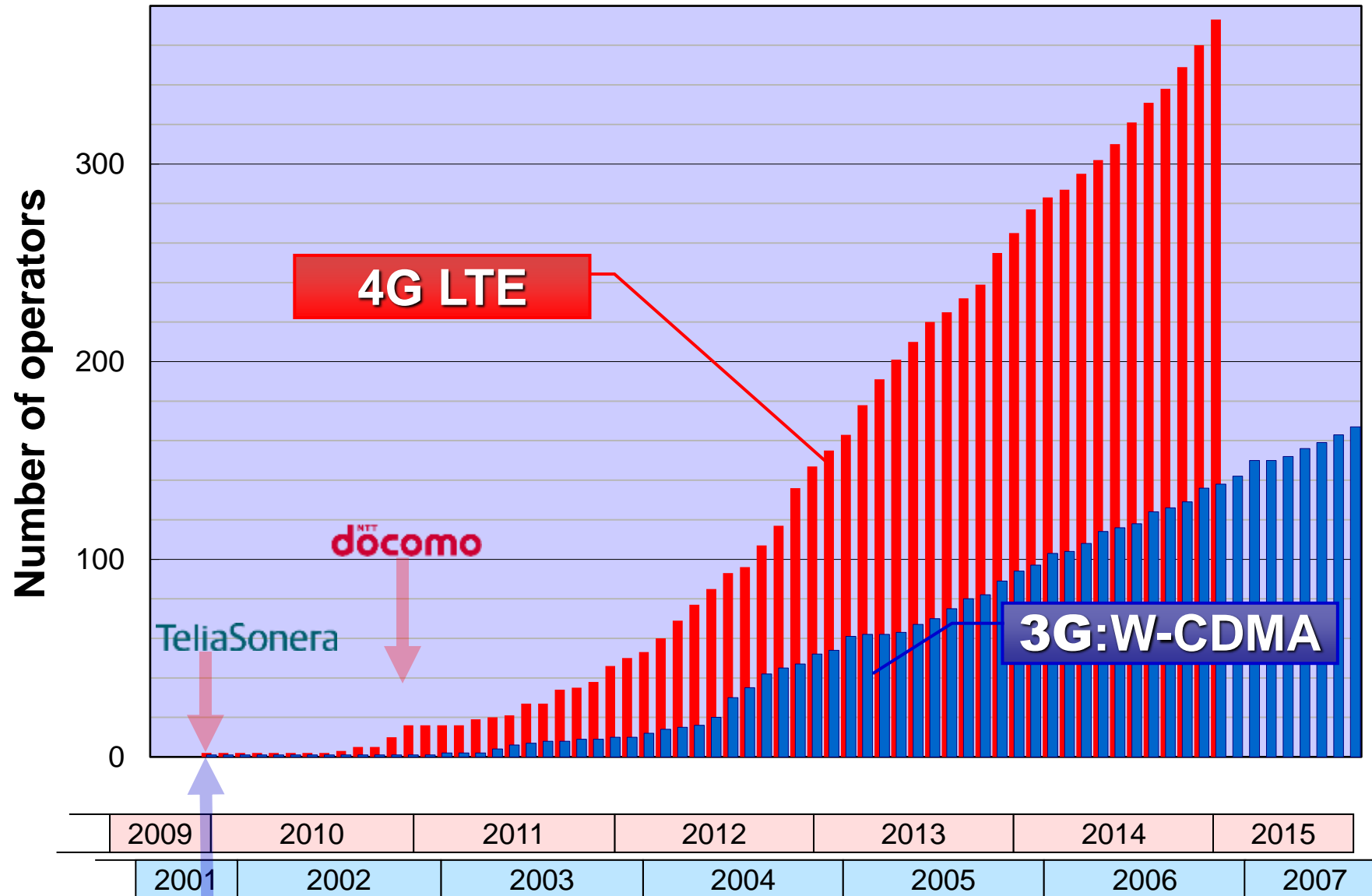


DOCOMO plans to roll-out LTE from 2010, as one of the first **One of the First Group** high-speed, large-capacity network of high spectral efficiency at low costs in an efficient manner.

CEO Mr. Yamada



Numbers of 4G LTE Operators



Episode

The Father of LTE



▶ **Laws of Mobile Communication Generations**

- ▶ ● **1st Law: Law of Previous Generation Boom just before the Next**
- ▶ ● **2nd Law: Law of Great Success Only in Even-Numbered Generations**
- ▶ ● **3rd Law: Law of Advent of Next Generation Services after Network Launch**
- ▶ ● **3rd Law of Triviality: Law of Birth of Next Generation Services in Previous Generations**



Previous Generation Boom just before the Next

(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)

— 特集 HSPA+ Emerges Immediately

MSとノキアがアプリ流通参戦、HSPA+が急浮上



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

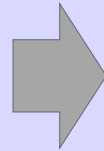
Nikkei Communications, 2009/03/15

2008 (2.5 years before LTE launch)

100Mbps Mobile starts in 2 years
LTE Covers All Over The
World 世界を覆う

100Mbps Mobile starts in 2 years
LTE Covers All Over The
World 世界を覆う

Nikkei Communications, 2008/06/01



WirelessMoves

Thoughts on the evolution of wireless networks and the mobile web 2.0.

[◀ MWC: Author Session, Television and More](#) | [Main](#) | [Nokia and Mobile Home Services](#) ▶

MWC: Roundup

Another Mobile World Congress has come to an end. Thursday is usually a bit strange as everyone is already quite tired and just waits for the closing bell to ring. To my surprise, my Thursday was quite different.

Good that most other operators have quite a different view on that and out of the many other presentations I especially liked Seizo Onoe's presentation for NTT DoCoMo on Deployment and Realities of LTE. The most interesting chart for me was how DoCoMo plans to deploy LTE. It seems that they already have a deployment in which the UMTS radio module sits on the mast and is connected via a fiber cable to the digital module of the UMTS base station. For LTE, they will reuse the existing antennas and hook their digital LTE module into the fiber link that is already in place. Quite cost effective. In the Q&A the presenter was asked by a representative of T-Mobile (who also push very hard for LTE and don't want to invest much more into the HSPA network) what he thought of HSPA+. Seizo Onoe seems to be one of the "fathers" of LTE, if one can say so, so he was of course not quite in favour of HSPA+ and said with a smile on his face that he doesn't like it, it makes things too complicated in the mobile devices and one should go to LTE straight away. I had to smile as well, that was brought over very well. But no matter, HSPA+ will go into handsets anyway, that's my opinion.

• About



• The Books to this Blog

• The 3G Traveler Wiki

• International Prepaid
Wireless Internet Access

• Speaking Engagements

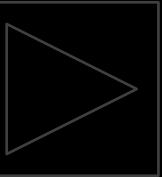
Martin Sauter is also a regular presenter and speaker at mobile industry conferences and public and private company events.

In 2008, he presented at events such as the Hortal Technology Conference in Orlando on next gen. group communication, on web 2.0 for Bursen & Marsteller in Brussels and on future wireless technologies for Deutsche Bahn in Frankfurt.

In 2009 he will among other engagements host a talk on LTE for Hortal in Germany and feature courses on LTE services and on next generation mobile networks and devices at the University of Oxford.

For more details on his work, please visit his website: www.martin-sauter.com

第1法則結束



Onoe seems to be one of the "fathers" of LTE,

February 21, 2009

<https://blog.wirelessmoves.com/2009/02/mwc-roundup.html>

Episode 2

The Father of 5G ?



• • • •

Also, a big thanks to Secretary-General Mr. Houlin ZHAO, • • •

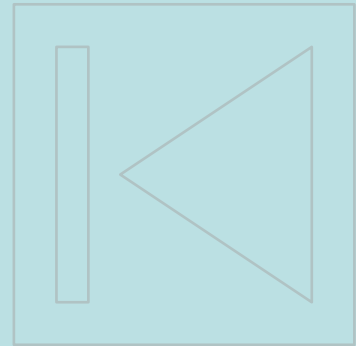
The Secretary General, Houlin ZHAO-san, started calling me **“the father of 5G”** since his address at Japan’s reception during WTDC in Kigali this last June.

I'm delighted to be approved as “the father of 5G” by the ITU Secretary-General. It is a humbling blessing to be called the father of LTE and the father of 5G.

In my private life, **I'm the proud father of two children** both of whom are now independent adults. I must express gratitude to my wife whose support raised good children while helping me be a better father.



5G



5G

5G standard was developed based on LTE, attracting attention from various industries, and is expected to create new businesses.

A natural evolution from 4G LTE
Positive/negative aspect by 5G boom

2010 2013 2014 2015 2016 2017 2018 2019 2020

5G Boom started. No.1 Buzz word in MWC headlines

MWC 2019

China needs better policies to drive 5G ecosystem

China Unicom's balance performance

Ericsson chief takes aim at Europe's 5G policies

DT launches 5G-ready factory carriage network

Small companies advised to prep for 5G

5G acceleration to drive strong connection growth

Nokia ramps private 5G LAN opportunity

LG previews 5G phone with a foldable twist

5G will need all spectrum including mmWave

T-Mobile exec calls for sound policy to streamline 5G rollouts

T-Mobile could lead with mmWave for 5G

Qualcomm president hails 2019 as the year of 5G

ZTE joining 5G wave with Axon 10 Pro

Oppo touts 5G ahead of 5G revolution

Verizon's RYOT power XR will 5G

Business leaders vouch for 5G security issues

EC vows swift resolution of 5G security issues

Sprint gears up for 5G launch

Operators should prepare for the unexpected with 5G

Red Hat pushes native cloud architecture for 5G

China Mobile ramps up 5G in 4 cities

Web bosses disagree on 5G

MWC19 Barcelona hosts 5G surgery breakthrough

China Telecom head highlights 5G readiness

ZTE chief sees 5G driving network simplification

Asia Pacific striving for seat at mobile's top table; but 5G isn't the only thing on the menu

MWCS 2019

China Telecom head highlights 5G readiness

ZTE chief sees 5G driving network simplification

Asia Pacific striving for seat at mobile's top table; but 5G isn't the only thing on the menu

MWC2015

Europe needs to start 5G trials, say tech leaders

Ericsson CTO questions 5G connected car

NGMN unveils 5G operator wishlist

EU digital chief hails collaborative 5G effort

2020 Olympics will demo 5G NFV use case

Operator growth depends on 5G appealing to verticals

KT Telecom eyes 2018 5G network; Nokia aims to be top 2 player

5G network densification starts with 4G

Huawei and Qualcomm differ on 5G

Industry battles to secure IoT ahead of 5G

Sprint aims for IoT mobile 5G launch

Qualcomm takes aim at 5G rivals with module launch

Ericsson CEO, Nord America, Asia driving 5G

Telefonica CTO

5G requires radical structural changes

Ericsson CTO questions 5G connected car

5G net densification starts

DT chief says Europe not behind on 5G

Nokia unveils 5G First to provoke early adoption

SK Telecom outlines keys for 5G success

Europe needs to start 5G trials, say tech leaders

Mobile heavyweights back plan to speed 5G NR

2020 Olympics will demo 5G/NFV use case

Operator growth depends on 5G appealing to verticals

MNOs call for slack to afford 5G capex

Qualcomm steps up 5G push

FCC charts new course for 5G

DT talks up smart glasses as 5G use case

Philips CIO pushes for "equitable access" to 5G

US operators draw 5G battle lines

Telenor Norway wants to lead the way in 5G

Airtel see 5G as 'simple solution' to multiple obstacles

NGMN sees reason for 5G optimism, but hurdles lie ahead

Huawei signs 43 5G MoUs with operators

China Mobile to start 5G field trials in Q2

Europe at risk of falling behind on 5G use cases

MWC2018

MWCS2018

MWCS2017

5G Boom

Simple, efficient and collaborative. ZTE turns 5G on

Investing in 5G

MOBILE WORLD DAILY

5G needs more than speed to succeed

Verizon ramps 5G deployment plans

SK Telecom kicks off 5G open trial initiative

Verticals: At the heart of the 5G Rain

Ericsson 5G's will

BT chief aims to spearhead UK 5G

Make IoT secure before it is deployed - ARM CEO

Intel focuses on 5G "beyond the Powerpoint"

Verizon boasts momentum for IoT platform

AT&T head calls 5G ROI assurance

SKT, DT join forces on IoT 5G

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MWCS2015

MWC 2017

MOBILE WORLD DAILY

5G: Creating Value

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Myths about 5G



People are trying to jump on the 5G bandwagon.

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

➤ **5G needs significant investment.**



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The 4th Meeting of the APT Preparatory Group for PP-22

1-5 August 2022 Bangkok, Thailand



5G Bandwagon

Beyond 5G
INTERNATIONAL CONFERENCE 2022

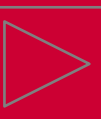


5G



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

The cross-industry collaboration will be the key to success for 5G.
6G discussion has begun: Hope to discuss standards for sustainable further evolution for 6G and after.



2016 Jan.-May

Operators declaring 5G launch before 2020

Verizon Eyes 5G Deployment in 2017

Tue, 03/01/2016 - 2:00pm by Diana Goovaerts, Associate Editor, [@DiaMariesbeat](#)

Verizon Doubles Down on 2017 Deployment of

5G Verizon to Commercially Deploy 5G Wireless Networks in 2017

Thu, 04/07/2016
by Diana Goovaerts

ZACKS By Zacks Equity Research
April 22, 2016 3:19 PM



Verizon to be first to field-test crazy-fast 5G wireless

It expects "some level of commercial deployment" to begin by 2017 for next-generation wireless. That's much earlier than the common industry belief that 2020 will mark the start.

Verizon is getting ready to kick its wireless network up another notch.



AT&T's Mair: Like Verizon, AT&T will have pre-standards 5G gear by end of 2017

May 12, 2016 | By Monica Allevan

In the meantime, Mair said AT&T expects to conduct a lot of work. "There's going to be a lot of labs work going on, a lot of labs testing, lots of proofs of

KT on target to offer 5G at Winter Olympics in 2018

16 Feb 2016

[South Korea](#)

South Korean mobile network operator KT Corp has reportedly said that it is on track to be able to provide 5G services at the Winter Olympics venue in 2018 as scheduled, according to Yonhap News Agency. It is understood that KT is aiming to complete 30% of network construction by the end of this month, with the infrastructure project set to be completed by the end of the year, with a view to starting the first services in 2017. As the official network service provider of the 2018 PyeongChang Winter Olympics, KT meanwhile has also said that its wireless platforms will be able to serve up to 250,000 devices at the same time at the event.

Showcasing 5G Network Services KT to provide 5G Network Services for 2018 Winter Games in PyeongChang



SK Telecom Claims 5G Trial Milestone

3/31/2016

SK Telecom (Nasdaq: SKM) has previously announced plans to have some kind of 5G service in operation for the Winter Olympics that will take place in Pyeongchang in **2018**.

Several other Tier 1 service providers have announced similar plans over the next few years, including Japan's NTT DoCoMo Inc. (NYSE: DCM), US operators AT&T Inc. (NYSE: T) and Verizon Communications Inc. (NYSE: VZ), Russia's Mobile TeleSystems OJSC (MTS) (NYSE: MBT) and MegaFon and Sweden's Telia Company. (See AT&T Lights Fire Under 5G, Plans 2016 Trials, TeliaSonera, Ericsson Join 5G Early Movers, Russia's MTS to Trial 5G in **2018**,



At meetings during MWC

Feb. 22-25, 2016



DOCOMO
EVP and CTO

I understand, but ...
Anyway, say "No".
You should say that you can't

Onoe-san, help me. Please do
something about a US major operator.
I can't say that.
Dropped from the project.



A vendor
SVP and CTO



DOCOMO
EVP and CTO

I understand.
He believes it's possible because you say "I can".
You should say that you can't do what you can't do.

Onoe-san, help me. Please do
something about a US major operator.
ect.



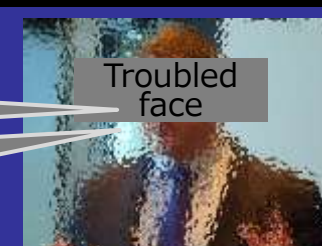
A vendor
Group President



DOCOMO
EVP and CTO

I understand.
He believes it's possible because you say "I can".
You should say that you can't do what you can't do.

Onoe-san, help me. Please do
something about a US major operator.
ect.



A vendor
President, EVP

The content of the conversation for illustrative purposes only. Actual content varies.



April 20-22, 2016

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

Moderator

Moderator

C Spire
Formerly Sprint

Verizon

AT&T

DOCOMO

Vodafone

Qualcomm

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

No problem. The specs are open.

The scenario to standards should be shown.
The front runner should take responsibility.



Verizon
US

FCC
MIC
Executives of regulators
in US and Japan

KT

DOCOMO
Japan

May 27, 2016

2010

..

2013

2014

2015

2016

2017

2018

2019

2020

2018年10月1日

ベライゾンが固定5Gサービスを開始

09.11.2018 | Network

verizon[✓]

5G is here

Online orders start Thursday, Sept. 13 Verizon 5G Home broadband

NEW YORK – “5G is here,” said Hans Vestberg, Verizon Chief Executive Officer.

**Cut the cord.
Go 5G Home.**



世界初の商用5Gサービス
「ベライゾン5Gホーム」
10月1日に開始。9月13日
からオンライン申し込み。

The world's first commercial 5G service, Verizon 5G Home, is live on Oct 1; service is available for order on Thursday



The world's first 5G Smartphone

verizon^v

04.03.2019 | Network

Customers in Chicago and Minneapolis are first in the world to get 5G-enabled smartphones connected to a 5G network

Apr.3rd, 2019



NEW YORK – Today, Verizon officially turned on its 5G Ultra Wideband network in select areas of Minneapolis and Chicago a week ahead of schedule. For the first time ever, customers can access a commercial 5G network with the world's first commercially available 5G-enabled smartphone*, the moto z3 combined with 5G moto mod. Customers using Verizon's 5G Ultra Wideband network in Chicago or Minneapolis could see speeds of up to 1 Gbps.

SK telecom

Press Release

SK Telecom Announces the World's First 5G Smartphone Subscribers

2019.04.04

Apr. 4th, 2019



SK Telecom (NYSE:SKM) today announced that it has activated 5G service for six celebrities representing Korea as of 11:00 p.m. April 3, 2019.

The world's first 5G smartphone subscribers are Baek-hyun and Kai from EXO (K-pop idol group), Kim Yu-na (Olympic medalist), Lee Sang-hyeok ("Faker", esports player), Yoon Sung-hyuk (para-swimmer) and Park Jae-won (SK Telecom's longest subscriber).

They were chosen as ambassadors of SK Telecom's 5G services at the 5G launching ceremony held yesterday at the company headquarters.

For general customers, the company will begin selling 5G smartphone 'Samsung Galaxy S10 5G' at authorized retail stores and official online store from Friday, April 5, 2019.



Topics


- History of Generations: 1G to 5G
- **Future Beyond 6G toward 12G**

GSMA

Will Onoe's Law of generations hold?
second

Law of Great Success Only in Even-Numbered Generations (Onoe's second Law)

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



Fragmented standards
Limited deployment

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

? ? ?
LTE-based technology

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.

How far the generation goes up?



IPSJ Magazine

【巻頭コラム】 [Foreword]

移动通信のデータ速度は どこまで上がるか？ (パート 5)

How Much Faster Will Mobile Communication
Data Speed Be? (Part 5)

■ 尾上 誠蔵

Seizo ONOE



移动通信の世代はどこまで上がるか？ 新たなテーマである。

How far will the generation go up? It's a new theme.



Operator Keynote: Seizo Onoe - B5GS 2019



Published on May 15, 2019

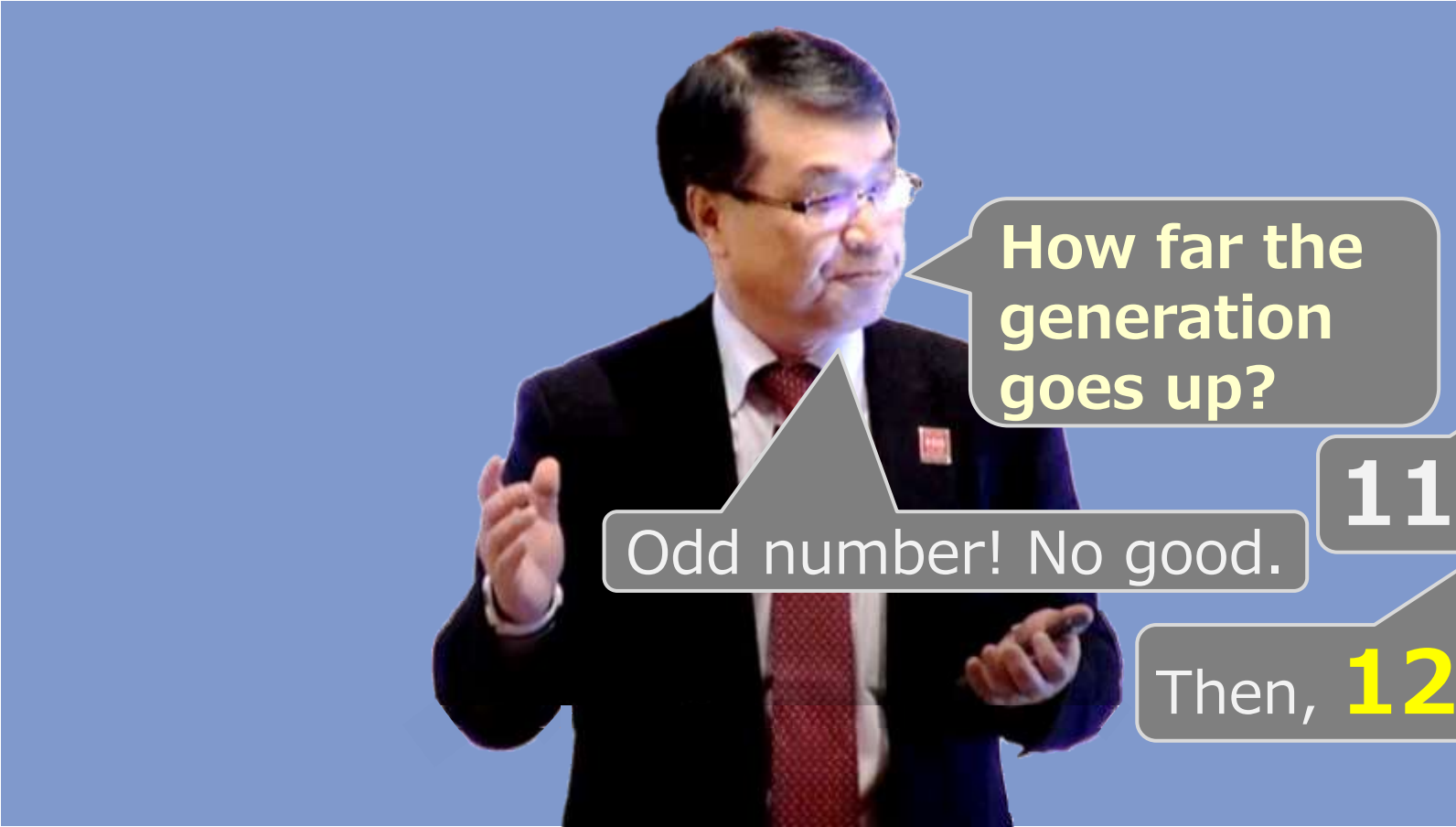
1870 views

[IEEE Communications Society](#) [#Brooklyn 5G Summit](#) [#2019](#) [#B5GS](#) [#5G](#) [#Future Networks](#) [#mobile](#) [#internet](#)

Mr. Seizo Onoe, NTT DOCOMO, presents his famously entertaining 5G review and summary of what's happening within the communications industry regarding 5G networks and encourages cross-industry collaborations. Deployment scenarios, post-launch, and next-generation services are also discussed.

<https://ieeetv.ieee.org/operator-keynote-seizo-onoe-b5gs-2019>

At an event hosted by a vender



How far the generation goes up?

Odd number! No good.

11G

Then, 12G

At totally different occasion with former supreme boss

...(Later, come to think)...

A time may come when network and user equipment will be connected by automatically negotiating without standards, assuming progress of softwarization and ultra low power consumption.

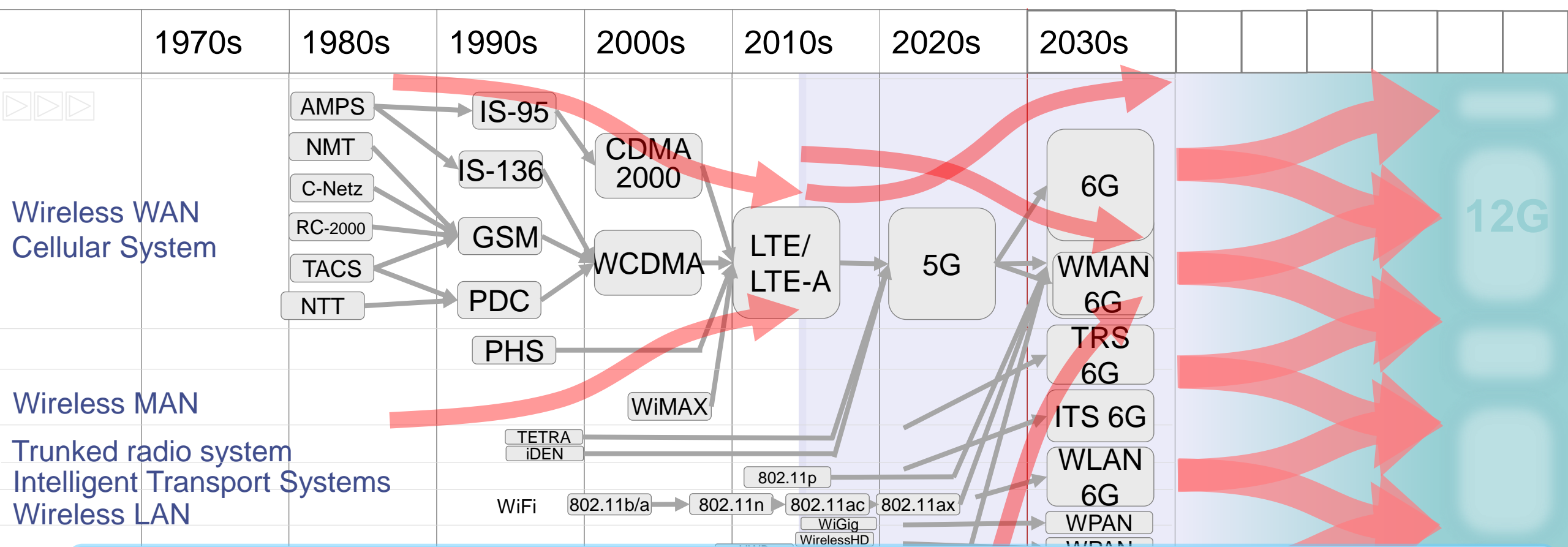
It may happen in 10G or **12G** era.



Is Standardization necessary? You are still involved in that.

Of course.
To connect the world.

...I think it may be correct.



In 12G era, there is no border of standards.

(Automatic protocol negotiation even for radio interface)

Even if radio technology evolution continues, hardware technology will be established that allows to change the interface and processing by updating software without sacrificing cost or power consumption.

All-photonics circuits become inexpensive and versatile COTS.

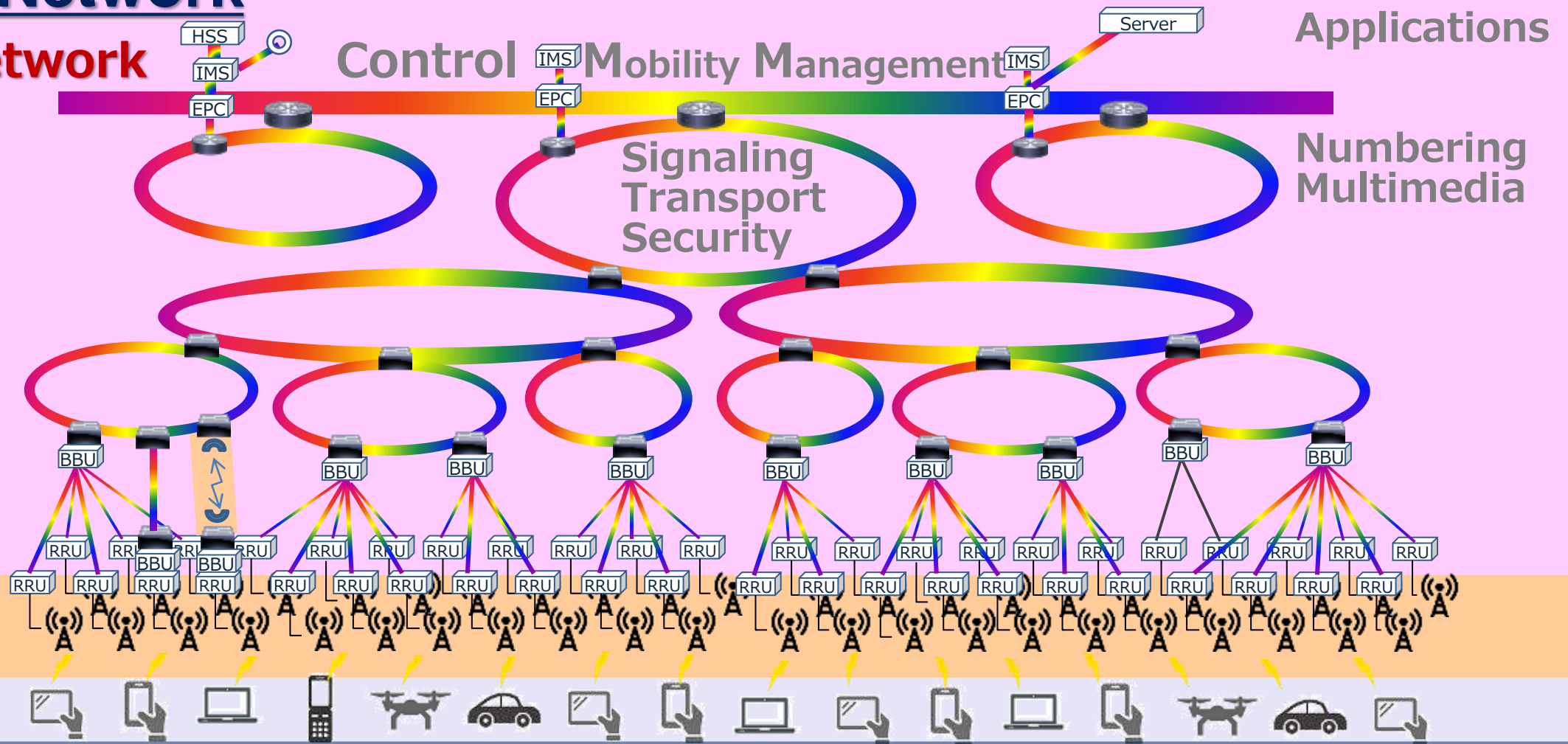
Topics

- History of Generations: 1G to 5G
- Future Beyond 6G toward 12G
- **Other thoughts on ITU-T**

Mobile in Telecom Networks

Mobile Network

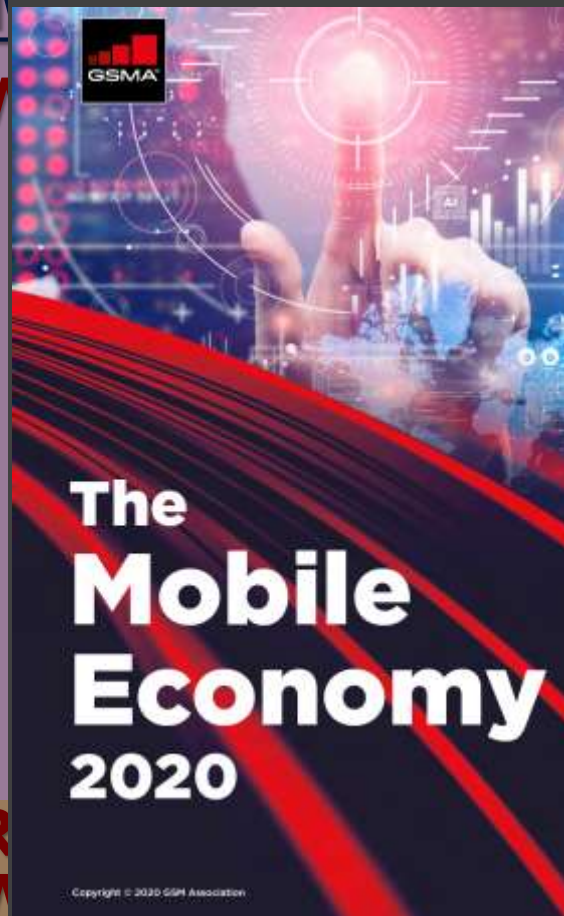
Wired Network



Mobile networks have become from minor to major, and to ordinary networks.

Mobile in Telecom Networks

Mobile Network



Global Market

MOBILE INDUSTRY CONTRIBUTION TO GDP

2019

2024



\$4.1tn

\$4.9tn

4.7%

of GDP

4.9%

of GDP



In 2019, mobile technologies and services generated 4.7% of GDP across the globe - a contribution that amounted to \$4.1 trillion of economic value added. (Source: GSMA Intelligence)

(I expect ITU-T to focus a bit more on mobile network aspects useful for implementations again.)

Standardization Gap

1G

2G

3G

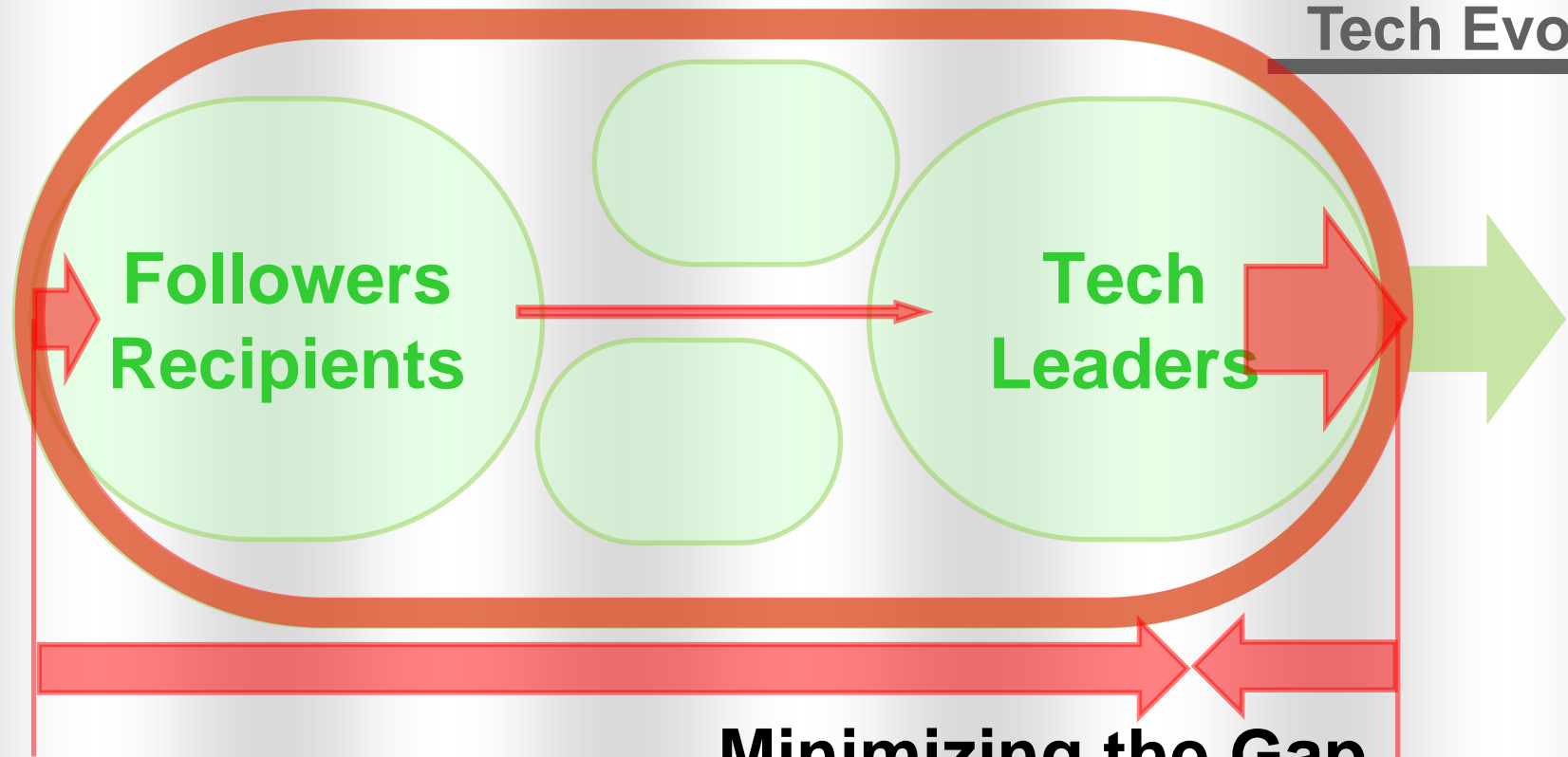
4G

5G

6G

7G

Tech Evolution →



Minimizing the Gap

Conclusion

- It is important to continue sustainable evolution without being misled by marketing gimmicks.
- The role of the developed countries is to lead the technology. The wide spread of technology will bring benefits to the whole world.
- Bridging the gap is a major role of the ITU, and requires greater engagement of countries and the private sector.

GSMA

Thank you