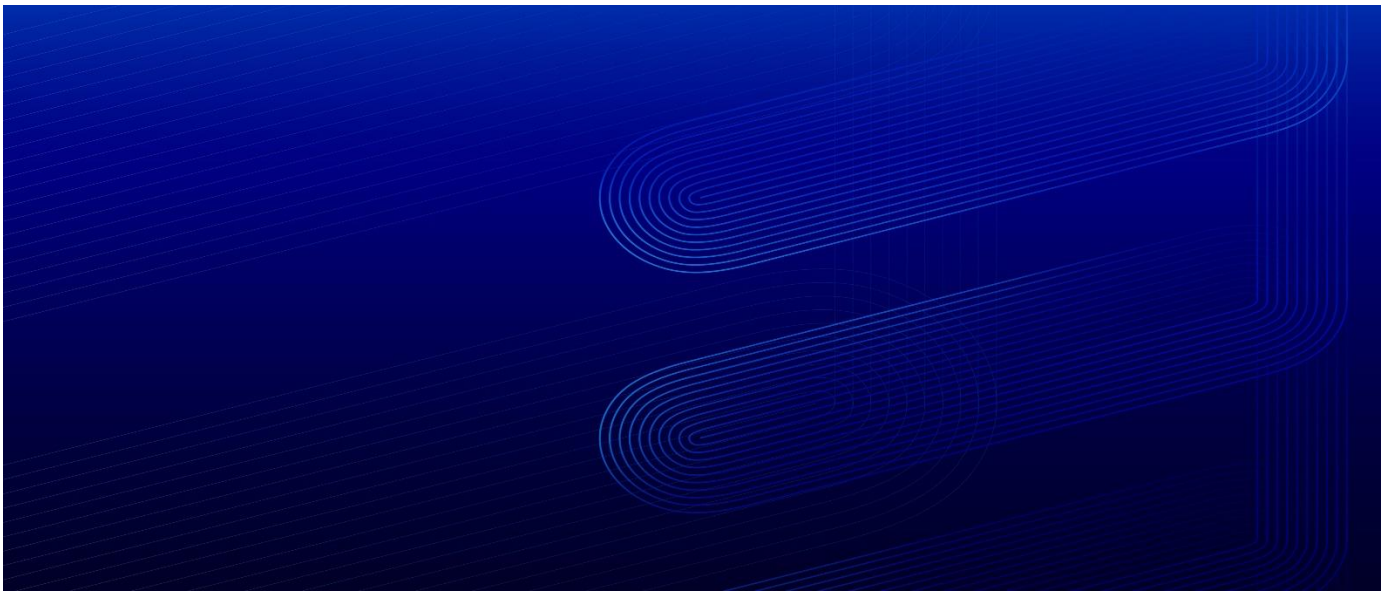
Réponse Ericsson à la consultation ARCEP « Préparer le futur des réseaux mobiles » ouverte du 23 mai au 23 septembre 2022.

23 septembre 2022



Ericsson remercie l'ARCEP pour cette possibilité de contribuer au débat et à la réflexion collective sur ce sujet d'importance.

Nous avons fait le choix de ne pas répondre à toutes les questions, estimant en particulier que certaines questions s'adressaient plus particulièrement, par exemple, aux opérateurs.

Par ailleurs, et nous nous en excusons, nous avons rédigé nos réponses en anglais. Cette réponse étant le fruit d'un travail collectif impliquant un certain nombre d'experts du groupe Ericsson, il était plus aisé de garder la trame en anglais.

Réponses Ericsson

Question 1. Quelles sont les évolutions les plus pertinentes apportées par les Release 16 et Release 17 de la 5G ? A quelles échéances ces évolutions seront-elles disponibles dans les réseaux et les terminaux ? Le cas échéant, quels besoins nouveaux en fréquences ces évolutions vont-elles susciter ?

ERICSSON :

In Release 16 the main features to highlight are:

- Enhancements on MIMO, Carrier aggregation and Dynamic Spectrum sharing
- Enhancements to URLLC and Industrial IoT, including support for TSN
- NR positioning support
- NR access on unlicensed spectrum aka. NR-U
- Integrated access backhaul (IAB)
- Vehicular to anything communication (V2X)

There is also a large number of additional features available in Rel-16, seen at the 3gpp.org web-site.

Public information on features in Rel-16 is available here: 3GPP releases 16 & 17 overview – 5G NR evolution - Ericsson (Ericsson Review article on Rel-16 and Rel-17), 5G NR release 16 – start of the 5G Evolution - Ericsson (early Ericsson blog post), Release 16 (3gpp.org) (3gpp.org on Rel-16 content).

We would like to point the following bands that were added t Rel 16 and 17, respectively:

New bands in Rel-16

n14

n18

n26

n29

n30

n47

n48

53 (LTE)

n53

n65

n89

n90

n91

n92

n93

n94

n95

New bands in Rel-17

n13

n24

n46

n67

n85

n96

n97

n98

n99

n100

n101

n102

103 (LTE)

n104

n262

n263

n255

n256

However, we note that the introduction of new frequency bands in 3GPP is release independent. This means that bands that are specified can be implemented in the network and terminals independent of which 3GPP release that products support from a functionality point of view.

On a general level, features from a release take 6 months to more than a year after the finalization of a specification until it appears in network or terminal products. This is given there is a commercial interest to implement the feature.

Release 16 was completed in June 2020.

In Release 17 the main features to highlight are:

- Support of frequency range up to 71GHz (from 52.6GHz)

- Multi-cast and Broadcast services

- Redcap (Reduced Capability user equipment)

- Not-terrestrial networks (NTN)

- Various additional enhancements on MIMO, DSS, URLLC

There is also a large number of additional features available in Rel-17, seen at the 3gpp.org web-site.

Public information on features in Rel-17 is available here: Toward 5G Advanced: overview of 3GPP releases 17 & 18 - Ericsson (Ericsson Review article on Rel-17 and Rel-18), Release 17 (3gpp.org) (3gpp.org on Rel-17 content).

Release 17 was completed in Mars 2022.

Question 2. Même question pour la Release 18 (« 5G Advanced »), la 6G et le Wifi 7.

ERICSSON :

In Release 18 the main features to highlight that are being worked on are:
- Study on network energy savings for NR
- Study on AI/ML for NR air interface
- Study of Enhancements to better support Extended Reality (XR) devices
- Study on further NR Redcap UE complexity reductions
- NR for dedicated spectrum less than 5MHz (FR1)
- NR support for UAV (Uncrewed Aerial Vehicles)

The following work items/study items on band definition exist for Rel-18 and we expect more to come.

NR:

TBD	663–703 / 612–652	5 - 35	FDD
TBD	5925 - 7125		TDD

TBD [4]	27500 – 30000 / 17700 – 20200		FDD
NOTE 4: referred to NR NTN band in WID (considering partial or full Ka band)			

LTE:

TBD	LTE-based 5G broadcast	470 – [617], [694] or [698]

TBD	LTE TDD 1670-1675	1670 - 1675

There is also a large number of additional features available in Rel-18, seen at the 3gpp.org web-site. Public information on features in Rel-18 is available here: The 5G Advanced, an evolution towards 6G - Ericsson (Ericsson Review article on Rel-18), Release 18 (3gpp.org) (3gpp.org on Rel-18 draft content) Release 18 is planned to be completed in September 2023.

6G is still early, but features being explored are:
- Joint Communication and Sensing
- Zero energy devices
- Cloud-native
- AI
- Distributed MIMO

A tentative completion date for 3GPP work on 6G would be mid-2028.
Public information on 6G is available here: 6G research is ramping up - Ericsson (ericsson.com on 6G)

The main new features in Wi-Fi 7 are the following:

- Multilink operation: Conceptually similar to carrier aggregation used in cellular networks, allowing simultaneous operation in multiple frequency bands.
- 320 MHz carrier bandwidth: 160 was max bandwidth for the previous Wi-Fi generation.
- R-TWT (Restricted target wake time): Allowing for better support for low latency applications.

We expect that some pre-standard Wi-Fi 7 products might be available as early as this year, with the bulk of product launches coming in the subsequent years.
According to Wi-Fi alliance the Wi-Fi 7 release 1 will be certified in 2023

Question 3. Identifiez-vous d'autres évolutions des technologies mobiles pour des usages spécifiques, qui pourraient susciter des besoins nouveaux en fréquences, par exemple les communications entre terminaux ou le broadcast/multicast ? Si oui, lesquelles et pour quels usages ?

ERICSSON :

These are early days for 5G and the defined use cases are still on the rise. As an example, the Metaverse is quickly evolving and while today we see the first steps of AR/VR, by 2025 with connectivity requirements of up to 60 Mbps DL and 30 Mbps UL and 10ms latency per device are expected, and by 2027-2030 when we expect "all day AR" these may increase to 100 Mbps DL and 50 Mbps UL and 10ms latency (one-way RAN+CORE) per device. The improvement of latency with the evolution of mobile makes it possible use cases such Metaverse, which are critical in particular in terms of latency. Around 2030 and beyond, holograms are expected, requiring even more challenging requirements.

Taking into account the European Commission and French net zero goals, we expect smart cities to become « the new normal «, including e.g. transportation. The evolution of Artificial Intelligence will also help to digitalize industries and comes at a key point to help climate change.

Considering the spectrum usage today and the technology evolution, spectrum beyond what is available today in France is indeed needed. In fact, the GSMA estimates that an average of 2 GHz of spectrum is needed in the 2025-2030 timeframe1 to meet the IMT-2020 requirements (100 Mbps DL and 50 Mbps UL) across cities and enable use cases such as Metaverse and smart sustainable cities. Outside the cities, the spectrum will help addressing fixed connectivity by Fixed Wireless Access, increase the capacity needed in busy transport routes and industry 4.0. This calculation includes a large degree of densification both with macro and small cells (indoor and outdoors) as well as usage of mmWave.

This calls ARCEP to take careful consideration of the upper 6 GHz (6425-7125 MHz) as this is the only available band with such characteristics, noting that it has already being standardized by 3GPP in Rel-18 (3GPP n104)

[1] Estimating the mid-band spectrum needs in the 2025-2030 time frame

DL and UL total (including baseline) mid-bands spectrum need [MHz]														
	World Bank	Activity factor 10%			Activity factor 15%			Activity factor 20%			Activity factor 25%			City
	Income	High bands offload			High bands offload			High bands offload			High bands offload			Aver.
City	Group	30%	20%	10%	35%	25%	15%	40%	30%	20%	45%	35%	25%	need
Tehran	Upper Middle	730	810	890	910	1020	1140	1040	1200	1350	1140	1330	1530	1110
Amsterdam	High	940	970	1010	1010	1130	1260	1150	1320	1480	1260	1460	1660	1230
Munich	High	870	940	1030	1050	1180	1300	1200	1370	1540	1300	1520	1730	1280
Marseille	High	950	990	1040	1060	1200	1330	1220	1390	1570	1330	1540	1760	1300
Hamburg	High	890	970	1060	1080	1220	1350	1240	1420	1600	1350	1580	1800	1320
Minsk	Upper Middle	920	1010	1100	1120	1260	1400	1290	1470	1650	1400	1630	1860	1370
Baku	Upper Middle	920	1010	1110	1130	1270	1410	1290	1480	1670	1410	1640	1880	1380
Makkah	High	1150	1190	1230	1240	1360	1510	1390	1580	1780	1510	1750	2000	1470
Milan	High	980	1030	1130	1150	1300	1450	1330	1520	1720	1450	1690	1940	1410
Lyon	High	990	1060	1160	1190	1340	1500	1370	1570	1780	1500	1750	2010	1460
Rome	High	1000	1090	1190	1220	1380	1540	1400	1610	1830	1540	1800	2060	1500
Berlin	High	1030	1150	1260	1290	1460	1630	1490	1720	1950	1630	1920	2210	1590
Amman	Upper Middle	1130	1230	1350	1380	1550	1720	1580	1810	2040	1720	2010	2300	1680
Tashkent	Lower middle	1180	1320	1450	1490	1690	1900	1720	2000	2270	1900	2240	2580	1850
Johannesburg	Upper Middle	1160	1300	1440	1480	1690	1900	1730	2010	2300	1900	2260	2610	1850
Bangkok	Upper Middle	1240	1380	1530	1560	1780	1990	1810	2100	2380	1990	2340	2700	1940
Riyadh	High	1290	1430	1580	1610	1830	2050	1870	2160	2450	2050	2410	2770	2000
Barcelona	High	1250	1400	1550	1590	1810	2040	1850	2150	2450	2040	2410	2790	1980
Madrid	High	1260	1410	1560	1600	1830	2060	1870	2170	2480	2060	2440	2820	2000
Bogotá	Upper Middle	1290	1450	1600	1640	1880	2110	1920	2230	2550	2110	2510	2900	2060
Mexico City	Upper Middle	1380	1540	1700	1740	1980	2220	2020	2340	2660	2220	2620	3030	2160
Istanbul	Upper Middle	1420	1590	1760	1800	2050	2300	2090	2430	2760	2300	2720	3140	2240
Jakarta	Upper Middle	1370	1540	1710	1750	2000	2260	2040	2380	2720	2260	2680	3100	2190
Beijing	Upper Middle	1470	1640	1820	1860	2130	2390	2170	2520	2880	2390	2830	3270	2330
Paris	High	1410	1590	1770	1810	2080	2350	2120	2480	2830	2350	2790	3230	2280
Nairobi	Lower middle	1370	1560	1740	1780	2050	2330	2100	2460	2820	2330	2780	3230	2260
Cairo	Lower middle	1400	1580	1760	1810	2080	2360	2130	2500	2860	2360	2820	3270	2290
Tokyo	High	1450	1620	1810	1850	2130	2420	2180	2560	2930	2420	2890	3360	2350
Ho Chi Minh City	Lower middle	1520	1720	1910	1960	2250	2540	2300	2690	3080	2540	3030	3510	2470
New York	High	1530	1730	1930	1980	2280	2580	2330	2730	3130	2580	3080	3590	2510
Moscow	Upper Middle	1580	1780	1990	2040	2340	2640	2390	2800	3200	2640	3150	3660	2570
Sao Paulo	Upper Middle	1620	1830	2040	2090	2410	2720	2460	2870	3290	2720	3240	3760	2640
Mumbai	Lower middle	1610	1850	2090	2150	2510	2870	2570	3050	3530	2870	3470	4070	2780
Hong Kong	High	1730	1980	2220	2280	2650	3020	2710	3200	3690	3020	3630	4240	2930
Yangon	Lower middle	1900	2140	2390	2450	2810	3180	2870	3360	3850	3180	3790	4410	3090
Lagos	Lower middle	2140	2440	2740	2810	3260	3710	3340	3940	4540	3710	4460	5210	3600

Source: Coleago

Additionally, as France tries to bring equality to all citizens, in particular to rural areas, additional spectrum in low bands remains critical (i.e. 600 MHz). GSMA estimates that adding 2x35/2x40 MHz of spectrum in the 600 MHz to existing low bands will raise download speeds by 30-50% in rural areas[2].

Further in 2030 and beyond, with new applications being enabled by 6G, spectrum would be needed in the essential centimetric range 7-15 GHz and will be complemented by the sub-THz range (above 92 GHz) for niche use cases, with focus on W (92-120 GHz) and D band (116-182 GHz)[3]**.** These bands are also of importance for FS, specially Dband which will allow innovation and new use cases for FS, thus further considerations on Dband depending on co-existence with FS is to be made. Within 7-15 GHz, we are currently focusing on the bands: 7.125-8.5 GHz; 10.7-13.25 GHz and 14-14.8 GHz. We note that further analysis and discussions with industry and regulators are needed on specific frequency ranges within the centimetric and subTHz ranges.

Question 8 Quels autres usages et fonctionnalités attendus identifiez-vous ?

ERICSSON

We could also mention:

- Machine-to-machine communication
- Smart cities, including transport, digitalization of buildings via sensors, etc to achieve sustainability goals
- V2X communication

[2] Maximising the socioeconomic value of spectrum (gsma.com)

[3] The 6G vision – Why is spectrum fundamental - Ericsson

- The need for very high download data rates in some configurations (video, large files,…)
- The specific needs of professional users in a mobile context (access to intranet/VPN, voice/video/data communication,…)
- The Fixed Wireless use cases, with an additional focus on TV/streaming needs
- The connectivity of enterprises sites (as an alternative or backup to fiber), but also for "mobile" enterprises sites (like ambulances that can be connected to the mobile network with a 5G router)
- Some use cases, especially in the monitoring of complex systems like a city, will mix several of the above mentioned use cases (sensors, real-time interactivity, critical communications…)
- artificial intelligence/machine learning
- Holographic communication for consumer and professional use cases
- The internet of senses
- Network &computing convergence, setting new requirements for edge cloud coordination for AR/VR, autonomous driving, holographic communications. This will also set requirements on the delays in the transport networks
- Ubiquous mobile connectivity, including satellite solutions complementing terrestrial networks in the most remote areas

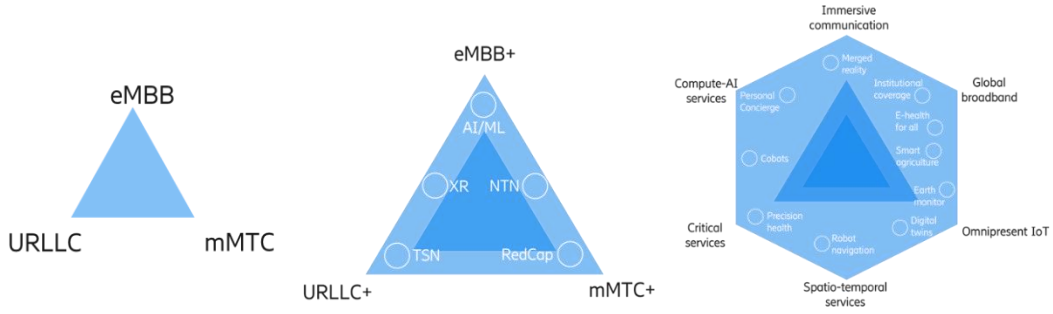
Question 9. Quels marchés seraient visés par ces usages ? Avec quelles perspectives d'évolution et à quelle échéance ?

ERICSSON

These usages are relevant for several markets, including:
- The consumer segment
- The business/professional communication needs especially in light of the growing remote and home office trends
- Critical communications and industrial needs
- Public services needs

We expect different time-lines in terms of technology evolution and availability of spectrum to address the use cases. 5G use cases are being addressed at the moment (e.g. smart cities, V2X, Mobile Broadband), while enhancements of 5G use cases, and support new use cases leading towards 6G will happen between 2025-2030 with 5G-Advanced (including as example Artificial intelligence, large scale Metaverse or XR). 6G with initial deployments expected by 2030 in some parts of the world and with large deployments beyond 2030 will enable new use cases within the cyber-physical world (e.g. Cobots, digital twins, holograms).

5G 5G-Advanced 6G



Question 10. Parmi ces usages, certains d'entre eux sont-ils plus spécifiquement appelés à se développer dans un environnement fixe, à l'intérieur de bâtiments par exemple, ou bien en mobilité ? Le cas échant, pour quelles raisons ?

ERICSSON

All use cases above target mobility both indoors and outdoors. In an indoors environment mobile 5G NR and its evolutions offer higher QoS, lower latency and higher security than unlicensed solutions (such as WiFi). This is for example key for use cases such Metaverse, while only Mobile can provide outdoors coverage on-the-move, the Metaverse needs 5G NR even indoors (Why the metaverse-5G relationship is fundamental - Ericsson). The following video explains the challenges we see today in terms of UL feedback and latency : Imagine Possible Perspectives in XR over 5G – With Varjo & One Reality - YouTube

We believe that the indoor usage of mobile networks will increase both for interpersonal communications and for machine-to-machine connectivity. Licensed 3GPP technology can provide higher QoS of service, and efficiency, than unlicensed, which is valued in a number of cases

Question 11. Le cas échéant, quelles nouvelles technologies mobiles seraient nécessaires pour couvrir l'ensemble de ces usages ? Pour couvrir vos usages en tant qu'utilisateur ?

ERICSSON

See also response to Question 9

- Communication will evolve to include also holographic communication, including in a contexte of metaverse applications (for consumer and professional use cases), probably around a few hundred mbps for example
- Tactile and haptic internet applications, with very high requirements on latency (sub 1 ms typically)
- Network &computing convergence, setting new requirements for edge cloud coordination for AR/VR, autonomous driving, holographic communications. This will also set requirements on the delays in the transport networks
- Extremely high rate information showers (with local data rates around 1 Tb/s)
- Increased capacity for the connectivity of "everything"
- Ubiquous mobile connectivity, including with satellite solutios for the most remote areas

- One can also think of some more disruptive and uncertain use cases such as chip-to-chip communication (Wired connections can become bottlenecks and optical and/or THz connections can replace wired links)

Question 12. Quels nouveaux besoins en fréquences identifiez-vous pour répondre à ces usages avec les technologies existantes, et, le cas échéant, avec l'introduction de nouvelles technologies ? Pour quelles raisons (capacité, débit, couverture...) ?

ERICSSON

See response to Question 3 in relation to spectrum needs.
In particular, we would like to emphasize that additional spectrum in the mid-bands (below 7 GHz) is critical to improve wide-area coverage in cities to address the predicted capacity needs in the time frame 2025-2030. This spectrum is also required to improve fixed capacity (via FWA) outside the cities. In this context, the 6 GHz (6425-7125 MHz) is the only available band.

While capacity increases in the cities and connectivity evolves where people live, move and work, nations need to ensure that equality remains to the extend possible for those in rural areas, for which additional capacity in the low bands is required, in particular within 470-694 MHz. This spectrum will also be important to improve connectivity in hard-to-reach areas, including deep indoors.

Moving forward to address use cases expected to start in 2030 and growing beyond spectrum that allows wide-area usage will remain key (for example to allow holographic communication across an area), thus a special focus should be given to the centimetric range (7-20 GHz), the lower the frequency, the wider the coverage and thus the focus on the range 7-15 GHz. The sub-THz is also of interest for niche use cases with Tbps speeds (requiring extreme bandwidth), in particular W (92-120 GHz) and D band (116-182 GHz)[4].

Question 13. Quelles perspectives la 5G offre-t-elle au tissu économique et industriel français ? En quoi les évolutions prévues (latence réduite, nombre massif d'objets connectés, débit amélioré) peuvent-elles s'avérer nécessaires pour embrasser l'ensemble des usages envisagés par les utilisations professionnelles de cette technologie ? Quel marché ces évolutions représentent-t- elles ? Quels bénéfices économiques peut-on attendre de l'appropriation de ces nouveaux services par les verticaux en général, ou par votre secteur en particulier ?

ERICSSON

We believe that the opportunity and the stakes are huge. 5G can reinforce the competitiveness of the French industry and eventually contribute to its growth. The approach needs also to be holistic as the needs span from the connectivity of the industrial robots to the efficiency of the more global transport and logistic system.

[4] The 6G vision – Why is spectrum fundamental - Ericsson

5G is also a fantastic tool to support a sustainable and energy efficient approach. We want to stress that it is indeed a tool to do "first time right" (with digital twins/simulations), optimize site energy consumption, maximize the use of assets, improve logistics efficiency,… but again a challenge will also be to adopt these tools in the best way.

Question 14. Quels pourraient être les besoins spécifiques de mise à disposition de ressources temporaires pour des occasions particulières (chantiers, événements ponctuels) ?

ERICSSON

The need for temporary usage is a very relevant use case. We should also consider the benefits of slicing to allocate locally and temporary capacity and QoS for needs connected to construction work for example.

Question 15. Quels sont les besoins spécifiques des entités implantées dans plusieurs pays ? Identifiez-vous des besoins spécifiques aux très petites, petites ou moyennes entreprises (TPE et PME) ? Quels pourraient être les enjeux concernant les ressources fréquentielles qu'ils requièrent (quantité de fréquences, qualité de service associée, etc.) ?

ERICSSON

SMEs are less likely to have the capacity to build and operate their own network, further on they will need to be connected to a larger web involving transport, logistics, suppliers, customers,…

We believe that the best approach will be to offer different solutions, to cope with different needs, but we should also acknowledge the need to be able to offer more global connectivity and compatibility.

Question 16. Pour quels usages et quels besoins le recours à chacun des trois types de réseaux listés *supra* semble-t-il être le plus pertinent ? Pour quelles raisons ? Quelles sont les exigences et prérequis afin que le recours à ces types de réseau puisse satisfaire ces besoins ? Quelles sont les bandes de fréquences qui permettraient le mieux de satisfaire ces besoins ? Quels sont les acteurs qui pourraient offrir ces solutions ?

ERICSSON

The 3 different kinds of networks (private, hybrid, public) will most likely co-exist and will answer to different requirements. In the end it will be a trade-off between different needs: competence required, cost, customization, interconnection/coverage, security/resilience, scalability…

The private network can obviously be deployed and operated by different stakeholders, including a public operator, and the rationale is more to have a tailor-made solution, including with the localization of data and the full control of the QoS and the operation.

A hybrid network makes a lot of sense for industrial players with localized needs, but also requirements to connect distant sites (e.g. automated trains/trucks between sites) or connectivity needs with suppliers/customers.

The public network will obviously have a very strong offering with the global coverage and the service

differentiation capabilities (slicing).
As a side note, it should be mentioned that a private network always requires certain ITU governed numbering schemes to operate such as PLMN ID. For a global solution, Ericsson recommends the use of MCC=999 in for standalone non-public networks (SNPN), with a possible future option to use the IANA assigned NID that is specified in 3GPP Rel-16. For hybrid deployments, 3GPP defines a new identifier called Closed Access Group (CAG) that can be used together with the operator PLMN ID.

Question 17. S'agissant des réseaux hybrides, pour quelles raisons le mix/la complémentarité entre les deux types de réseau pourrait-il être requis (résilience, complément de couverture, continuité d'accès au réseau …) ? Quels seraient les schémas d'hybridation (distribution des éléments/des fonctionnalités entre réseau privé et réseau opéré) les mieux adaptés pour répondre aux besoins ou usages identifiés *supra* (par exemple accès sur le réseau public, cœur privé) ? Quel rôle joue l'accès aux fréquences dans ces différents schémas ?

ERICSSON
For hybrid networks the most likely reason would be related to coverage. A player might have a dedicated coverage on its sites but might also need to connect different sites (for example with automated trains/trucks). A logistic/transport company might have private networks on its premises but rely on public networks for vehicles and employees circulating between the sites or delivering products. One could also consider that only some specific applications require a private network while the others would function better on the public network.

The architectural split can also vary:
- The core network can be shared with the public network and thus with just the dedicated RAN for the private network
- There could also be a local break out of the core network

Question 18. Toujours concernant les réseaux hybrides, quels types d'acteurs pourraient se positionner pour contribuer aux différents schémas d'hybridation ? Quels modèles d'affaires seraient alors envisageables pour la fourniture de telles solutions (par exemple modèle d'opérateur neutre) ?

ERICSSON

For the hybrid solution, an option could be to have a provider delivering both legs of the solution (the commercial part, as a MNO or MVNO, and the private part)

For questions 16-18, Ericsson would like to also point to the examples on actors and business models in the EU Project 5G-SMART, deliverable D1.3 "Operator Business Models for Smart Manufacturing"

Question 19. Partagez-vous cette analyse des tendances en matière d'intermédiation et en identifiez- vous d'autres ? Comment voyez-vous le développement de l'écosystème autour de ces différents modèles ? Quels sont les avantages et les inconvénients des différents modèles ?

ERICSSON

The vertical market will be more complex as there will be different configurations (public/hybrid/private) different needs and associated KPIs, and also largely varying sizes of companies.

This will also probably open up to new ways to address the customers, including with offers dedicated to private networks.

Then to the question whether there is a role for pure aggregators (virtual slice operators) we would tend to believe that there is probably not a role per se, but that that space could be created by the regulator if there is a perception that this would improve the market efficiency. Such a decision would probably have to be pushed to a later stage (if and when a market failure is a fact).

Question 24. Quelles sont les évolutions attendues des usages à l'intérieur des bâtiments ? Pour répondre aux besoins, quelles seraient les solutions techniques et les modèles d'affaires (par exemple opérateur neutre) les plus appropriés ? quels types d'acteurs seraient susceptibles de les déployer ? Quels seraient les enjeux concurrentiels, techniques, réglementaires ou d'autre nature liés à ces solutions et modèles d'affaires ?

ERICSSON :

A large number of users are indeed inside building. The increase of capacity needs also affects inside the buildings. All the new usages cited in answer to Question 3 will impact the indoor traffic to a high extent.
Macro outdoor to indoor coverage with new high bands will not be enough to bring the right capacity and quality of service. Therefore indoor small cells have to be deployed in buildings and venues where the traffic and quality will be needed.

Question 25. Quelles fréquences supplémentaires pourraient permettre de répondre aux besoins de couverture et de qualité de service *indoor*, et de quelle manière ? En particulier : la bande 26 GHz est-elle adaptée pour des solutions *ad hoc* en *indoor* ? Les bandes 450 MHz et 1,4 GHz pourraient- elles permettre, vu leurs qualités de propagation, un gain de couverture en *indoor* via les réseaux mobiles ? Quelles autres fréquences pourraient être envisagées pour répondre à ce besoin de couverture ?

ERICSSON :

- Low bands (spectrum within 470-698 MHz) could help improving MNOs capacity in deep indoors environments thanks to the propagation characteristics of this spectrum range. 1.4 GHz can also add

capacity but will not be able to penetrate outdoor-indoor as deep as spectrum below 700 MHz.

- Indoors 26GHz BS can also deliver high capacity. However, due to the propagation conditions, a number of sites will be needed to cover one floor.
- Indoor small cells in the existing and expected to be allocated mid-bands can also help addressing traffic increase indoors. Again, the propagation characteristics and the size of the building will define the number of needed sites to cover the building.

Question 26. Quel rôle joue le Wifi dans l'ensemble des solutions pour fournir des services à l'intérieur des bâtiments ? Le cas échéant, pour quels usages le Wifi n'est-il pas une technologie appropriée, et pour quelles raisons ?

ERICSSON :

For any service provider for indoor coverage it is advisable to consider the following:

- Reliability requirements of the traffic
- Critical low-latency requirements
- The need for mobility and continuity of connectivity
- A complete and future proof solution addressing current and future needs

RLAN technologies (e.g. Wi-Fi) are suited to indoor or local area deployments and use cases requiring high speed, and best-effort traffic. But since Wi-Fi operates on unlicensed spectrum, its reliability and availability cannot be guaranteed. In critical use cases requiring highly reliable, low-latency connectivity, it's usage could be questioned for the following reasons:

- It is not designed to fulfill QoS requirements for a much broader range of use cases (e.g. massive MTC, eMBB, critical IoT, TSN)
- No support of fully flexible end-to-end QoS differentiation with a single network (that could be aligned with outdoor QoS policy)
- No interconnection and continuity between wide-area and local indoor coverage with full mobility (Wi-Fi 6 is limited to local coverage and more basic mobility)
- Wi-Fi specifies primarily layer 1 and layer 2 and has no end-to-end specifications covering a complete system architecture
- No end-to-end security neither a global identity management

Some specific use cases, for example XR or the Metaverse indoors, are now heavily discussed. When this is happens indoors, we expect both RLAN and licensed 5G to deliver it, depending on the QoS required. 5G NR (or licensed 5G) offers high computing power and low latency, contrary to RLAN technologies, which is required to avoid for example motion sickness for the user.

RLAN technologies may also be used to address some specific industrial needs, however, this will just complement 5G networks as 5G NR is required to secure availability of spectrum, interference-free operation and thus reliability on the network. These are necessary to secure investment.

Question 27. Les dispositions existantes vous paraissent-elles satisfaisantes et suffisantes ? En particulier, pensez-vous nécessaire de prévoir des nouvelles dispositions pour assurer la généralisation du « très haut débit » ou permettre aux utilisateurs qui le souhaitent une redondance des réseaux filaires par des technologies hertziennes ? Avez-vous des propositions à faire ?

ERICSSON

There is still a bias towards fixed connectivity while fixed wireless access could provide, in a number of cases, an efficient solution for some connectivity needs. In particular, at a certain abstraction level, one could consider that fixed connectivity is subsidized while fixed wireless connectivity is taxed (through spectrum fees and other specific taxes).

The authorities could then mitigate that situation by further subsidizing fixed wireless connectivity (for example with CPE funding)

Question 28. Concernant les besoins pour les usages professionnels, identifiez-vous d'autres besoins que celui, évoqué *supra*, d'une connexion redondante afin de garantir la continuité de l'accès en cas d'interruption de service ? Quelles dispositions souhaiteriez-vous voir mises en œuvre ?

ERICSSON

The redundancy need is a real one but still fairly limited. In some markets, like the US, small offices can have wireless connectivity (through 5G wireless routers) as their sole network connectivity.

A large site, with several buildings, can also favor wireless connectivity.

Question 29. Avez-vous des propositions (leviers d'action, moyens, stratégies etc.) à partager en matière de gestion du spectre ou d'attribution de fréquences pour réduire l'impact environnemental des réseaux et plus généralement promouvoir un numérique soutenable ? Quelles exigences ou prérequis seraient nécessaires pour rendre opérant, le cas échéant, ce levier (disponibilité de données, cohérence méthodologique, contrôle/audit *a posteriori* etc.) ?

ERICSSON

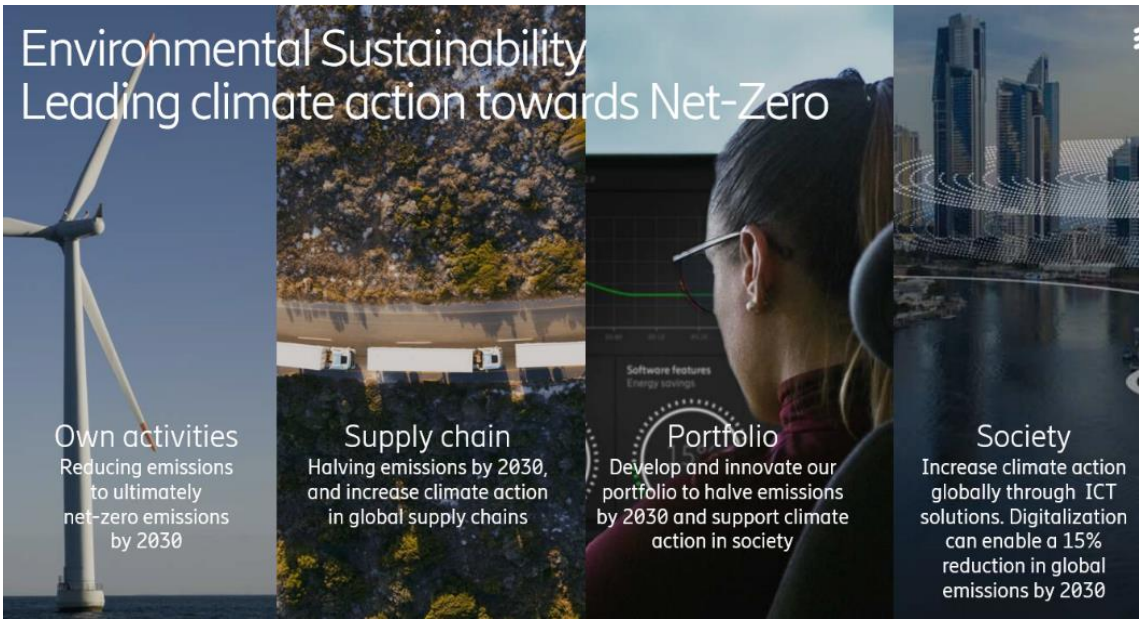
We see a few tracks, related to spectrum management, to reduce the environmental impact of networks :

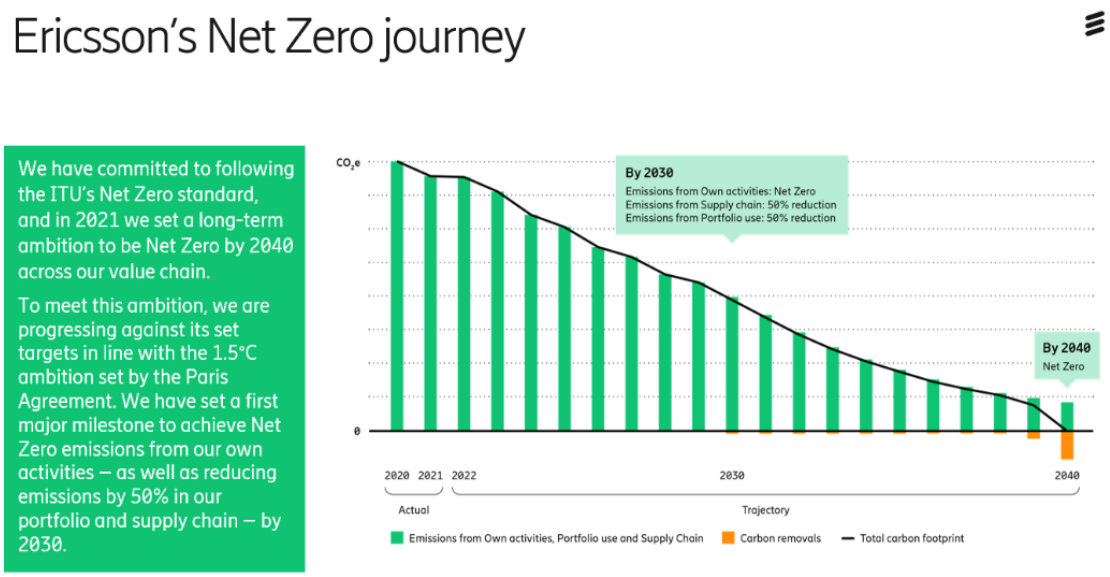
- The allocation of large blocks of spectrum will improve the efficiency of the system (and the throughput per MHz)
- Network densification and availability of new spectrum by the regulator need to be combined in the optimal way.

Question 30. En tant qu'opérateur ou entreprise, disposez-vous d'une stratégie environnementale ou de réduction des émissions de gaz à effet de serre au niveau de votre organisation ? Comporte-t- elle un volet réseau ou numérique ? Avec quels outils ou quelle méthodologie contrôlez-vous le respect de cette stratégie ? De quelle manière la sollicitation et l'utilisation de fréquences jouent un rôle dans cette stratégie ?

ERICSSON

As Ericsson we have a very clear sustainability strategy:





Question 31. Pour chacune des bandes de fréquences mentionnées en partie 4, identifiez-vous des impacts environnementaux positifs ou négatifs propres à l'utilisation de ces bandes de fréquences ?

ERICSSON

Allocation of new spectrum translates into upgrade of existing sites, as example if spectrum on the 6GHz (6425-7125 MHz) range is allocated to licensed usage, operators will upgrade existing sites including 3.5 GHz. This would reduce the overall amount of BS and power consumption. GSMA estimates 1.8x power consumption in Paris if additional mid-bands are not allocated and operators need to densify to address the capacity needs[5]. Similarly, additional low band spectrum within 470-694 MHz can be added to 700 MHz sites.

The allocation of spectrum for mobile usage can turn into a very positive climate impact, in fact, in particular with digitalization of industries. Digitalization means controlling the amount of electricity, water, etc. that an industry is using and can also optimize production, potentially leading to less hours needed to use resources. Digitalization of industries can indeed be done in different ways as explained by ARCEP, Industries can either use MNO spectrum resources (as it could be the case with 6425-7125 MHz) or their own spectrum, which would be the case for 3.8-4.2 GHz, being at the moment harmonized in Europe for a more localized usage. Not only industries, but also agriculture is key to digitalize to reduce the total emissions, for which low band spectrum in the 600 MHz range (470-694 MHz) is required. Ericsson estimates that ICT has the potential to reduce the global greenhouse gas emissions by up to 15%[6].

Question 33. Dans quel environnement (par exemple : *indoor*/*outdoor*, zone dense/moins dense, etc.) la mutualisation des petites cellules serait-elle la plus appropriée ? Pour quels gains ? Au contraire, dans quel environnement serait-elle la plus problématique ? Pour quelles raisons ? Quels sont les enjeux concurrentiels et/ou stratégiques liés à la mutualisation des petites cellules que vous identifiez ?

ERICSSON :

The sharing of indoor and in-building infrastructure is well known to trigger the coverage of those areas thanks to the sharing of the cost. This is possible thanks to tightly designed products allowing high flexibility. The sharing of small cell in outdoor sounds a bit complicated to realize due to very sparse requirements between operators, tedious interworking with macro layers (not shared) and a costly deployment with stringent safety and security requirements.

Question 34. Parmi toutes les bandes de fréquences listées ci-dessus et détaillées par la suite, lesquelles apparaissent prioritaires pour vos besoins ?

ERICSSON :

Ericsson sees a clear need to secure availability of spectrum in the low (sub 1GHz), mid (below 7 GHz) and high bands (24-50 GHz) in the 5G timeframe.

[5] 5G-Mid-Band-Spectrum-Needs.pdf (gsma.com)
[6] ICT's potential to reduce greenhouse gas emissions in 2030 - Ericsson

The band 3.4-3.8 GHz is one of the 5G pioneer bands, as such France licensed the range that was available within this band. This is the most successful band for 5G globally because of the large degree of harmonization and because of the favorable propagation characteristics to address wide-area use cases. Thus, it is key that France allocates this band for 5G usage.

Additionally, we also envision 26 GHz being allocated as soon as possible as another 5G pioneer band (in the mmWave range) band in France and considering that the deadline set by the European Commission to allocate this band for MFCN has already passed.

The bands 470-694 MHz and 6425-7125 MHz are also of priority to allocate considering the needs explained in previous questions in the cities, outside the cities and in deep rural areas. Additionally, we believe that 42 GHz should be allocated once harmonized.

Work on 3.8-4.2 GHz needs to be followed in CEPT to understand what this implies from an industrial perspective in terms of technical conditions.

Looking further at the 6G timeframe (around 2030 and beyond) we need additional spectrum that allows for wide-area deployments, thus, we put our focus in the centimetric range 7-15 GHz, which is not mentioned by ARCEP. We would strongly suggest ARCEP to include this range among spectrum priorities in its horizon and consider spectrum above 90 MHz as complementary as it may address very high capacity is smaller areas.

Ericsson would also like to note that 66-71 GHz will not help addressing the 5G (or future 6G needs) as CEPT decided to harmonize the band for unlicensed use. Ericsson expects that the allocation for unlicensed use in France will help the unlicensed community to benefit from the high bands which offer high capacity to offload the mid-bands needs (just as mobile operators will use 26 GHz and future 42 GHz when available)

Question 36. Parmi les bandes de fréquences qui font l'objet de questions ci-dessous, lesquelles semblent les plus appropriées à une attribution localisée ? A une réutilisation par usage secondaire ?

ERICSSON :

Ericsson agrees with ARCEP that the higher in frequency, the more localized usage and thus technically helps co-existence. While spectrum in the high bands, mmWave range today and future subTHz (beyond 90 GHz) are important to address high/very high capacity needs, these can be addressed in a more localized manner and cannot replace mid-bands.

Despite the more localized coverage of high bands, the benefit of licensing/auctioning the band in a wider-manner (e.g. metropolitan areas) is the incentive to investment for operators as they have the certainty to own the band and thus expand its deployment as/when needed in the very high capacity areas.

Analysis on the licensing régimes (local or wider) for spectrum beyond 90 GHz (mentioned in chapter 4 but not below this question) needs further analysis towards the 6G area considering both sharing with existing services as well as business cases.

Question 37. Le cas échéant, si ces bandes de fréquences voient coexister usage mobile et autres usages (satellite, lien fixe …), quels modes de partage vous apparaissent pertinents ?

ERICSSON :

Co-existence with existing services is important to consider in all bands listed above. For all bands listed under chapter 4.2, CEPT has done the relevant co-existence studies and proposed technical conditions/tools to allow for coordination.

Ericsson notes that the range 6425-7125 MHz is not listed among frequencies below. However, we would like to point out that while sharing studies are still on-going in ITU WP-5D, the vast majority of technical sharing studies submitted by both administrations and industry indicate that compatibility of IMT-2020 (including macro BS) and satellite uplink is feasible. We invite ARCEP to review the studies and we are open to any discussions that may be needed. Sharing with FS has also been proven to be feasible and in fact, individual licensing associated with IMT networks is always preferred for co-existence with the FS as it allows coordination (i.e. positions of both IMT and FS stations are known) and it also greatly enhances the ability of administrations to identify potential sources of interference and to take mitigating action in line with license conditions. In fact, from a FS perspective, allocating the same band for both FS and license-exempt WAS/RLAN use has not proven to be successful since the FS operator loses the certainty of interference-free operation and thus the incentive to invest. Even in those cases when technical conditions are developed with FS protection in mind, license-exempt devices cannot be controlled.

Question 38. Pour quelles bandes de fréquences un partage « dynamique »[10] du spectre entre titulaires d'autorisation pour un usage mobile, ou entre titulaires d'autorisation pour des usages différents, vous semblerait pertinent ? Avec quelles modalités de mise en œuvre possibles ?

ERICSSON :

Dynamic sharing may look an effective way to share spectrum in paper. However, it is not in reality. In fact, 5G network investment both by public (MNO) and private (enterprises) users requires reliability on spectrum availability and interference landscape. Neither of these can be secured when dynamic sharing as spectrum is available depending on other users and thus neighbors both in co-channel and adjacent channel may differ at times. From an implementation perspective, this type of sharing also has implications, for example the radio site is required to support a wider bandwidth that it will used, which affects cost price/performance, weight and energy consumption.

Question 39. Compte tenu de cette contrainte pérenne, estimez-vous pertinent que ce bloc soit proposé pour attribution ?

ERICSSON

Even if lower power, it can be relevant for specific CSPs and use cases (as example IoT). Thus, we suggest to allocate this 5 MHz of spectrum together with the rest of the band

Question 40. Quels impacts pourraient avoir respectivement ces niveaux de seuils sur les utilisations potentielles de la bande 1,4 GHz et les déploiements que vous pourriez envisager ?

ERICSSON :

The pfd limits will ultimately limit the output power of deployments within 1492 - 1517 MHz. How much the power is limited will depend on the distance to the potentially affected MSS terminals. Limitations on the BS power affects the area that can be covered by the BS.

Question 42. Cette situation nécessite-t-elle de prévoir des modalités particulières pour assurer la coexistence entre ces faisceaux hertziens et les réseaux mobiles utilisant la bande 1,4 GHz ? Le cas échéant, quelles pourraient être ces modalités ?

ERICSSON

Coordination with a limited number of FS is possible by one of several of these means pointing the MFCN BS away from the main lobe of the FS and/or ensuring enough physical separation and/or separation in frequency.

Question 43. Compte tenu des protocoles normalisés, des équipements et terminaux disponibles, quelles sont les bandes de fréquences, actuelles ou à venir, auxquelles la bande 1,4 GHz pourrait être appairée, en fonction de la technologie (4G, 5G …) et de la sous-bande considérée (bande cœur ou bande complète) ? Veuillez préciser, le cas échéant, le calendrier de disponibilité de ces protocoles, équipements ou terminaux permettant cette utilisation.

ERICSSON :

3GPP specified aggregation of 4G SDL band B32 with low and mid-band FDD (B1, B3, B7, B20, B8, B28) and TDD bands (B38, B42, B43) bands. It also specified the aggregation of SDL LTE B75 with B20. Whether chipset and terminal vendors will implement Band B75 with LTE is still to be seen. It appears not all terminals support SDL B32 as of today however the number of supporting terminals is increasing. Which

band could be aggregated will depend on the operator deployment of bands, on their strategy whether it is for capacity or for throughput coverage reasons.

3GPP specified aggregation of NR SDL band n75 with low band FDD namely n8, n20 and n28. As of today, the number of terminals supporting n75 is close to zero, as the ecosystem is still building up and no harmonized request has been formulated by operators at this stage.

Additional band combinations with 4G SDL B32, 4G SDL B75 or 5G SDL n75 can be brought to 3GPP as per operators' needs.

Question 44. Quels sont les débits envisageables dans cette bande sans agrégation de porteuses ?

ERICSSON

The SDL band is not possible to use as a standalone band and could not generate any traffic without being aggregated with another band to benefit from the UL data and control channels necessary for the Ack/Nack at applicative and radio signaling levels. For the example adding 20 MHz of SDL band with 2 Tx aggregated to another band will increase the peak throughput by around 150Mbps (perfect conditions).

Question 45. Compte tenu notamment des possibilités d'agrégation de porteuses permises par les protocoles et équipements actuels et à venir dans cette bande, quelle largeur de bande maximum par canalisation (en MHz) peut être utilisée dans la bande 1,4 GHz, selon la technologie utilisée (4G, 5G …) ? Le cas échéant, quels sont les schémas d'agrégation intra-bande permis par les standards et à quelle échéance seront-ils disponibles dans les équipements ? Quels débits peuvent être obtenus selon la quantité de fréquences et le schéma d'agrégation utilisés ?

ERICSSON

In 4G with band 32 a maximum of 20MHz per carrier is allowed. In 5G with band n75 a maximum of 50MHz per carrier is allowed. See answer to question 43 for possible combinations of inter-band carrier aggregation. Availability of these combinations is mainly driven by terminal availability in the market.

Intra-band CA in B32, n75 (given than that the primary cell PCell is in another band with UL via inter band CA) is also technically possible although today not specified by 3GPP.

Question 46. Les équipements actuellement disponibles ou à venir permettraient-ils le partage d'installations actives (par exemple *via* des *Multi-Operator Core Networks*) dans la bande 1,4 GHz ? Comment s'effectuerait ce partage dans le cas de réseaux déjà mutualisés ? Y aurait-t-il des difficultés particulières ?

ERICSSON

The usage of SDL band while in MOCN should be possible (in combination of other bands). The sharing of the SDL band is also possible as any other band in shared networks, with special focus on the IBW of the radio equipment in case it is intended to be shared.

Question 47. Parmi les utilisations listées ci-dessus, pourriez-vous préciser ceux qui vous paraissent les plus pertinents, compte tenu notamment de la nécessité d'appairer cette bande avec une autre bande de fréquences, des technologies disponibles et, le cas échéant, en tant qu'opérateur, de la couverture actuelle ou programmée de votre réseau ?

ERICSSON

We do foresee SDL band as a capacity band which value comes in congested areas where current licensed spectrum is deployed but not sufficient to handle the traffic in busy hours. This happens for mobile usage mainly in urban and dense urban areas. Outside city areas, the band can add DL user throughput in fixed sites. However, we see low bands more relevant for deep rural or difficult to reach areas.

While SDL can help adding throughput to existing bands, licensed FDD duplex spectrum and 5G TDD spectrum can also help addressing the fixed usage needs.

Fixed Wireless Access can be seen as a coverage extension of fiber connectivity as it reaches places that fiber cannot do due to the economics.

Question 48. Identifiez-vous d'autres utilisations de cette bande ? Avec quelles technologies ?

ERICSSON

We envision this band as a throughput extension to an existing network. This can be either for mobile or FWA or even for industrial applications if DL is required.

Question 49. Pour chacune de ces utilisations, veuillez préciser la quantité de fréquences de la bande 1,4 GHz qui permettrait de le développer de façon optimale.

ERICSSON

There is not a single number in terms of amount of spectrum for each use case. In general, the larger the bandwidth in the SDL band, the more capacity will be added. A larger bandwidth is desired.

Question 50. Quels compléments à la couverture en très haut débit et notamment en fibre optique jusqu'à l'abonné (FttH) l'utilisation de la bande 1,4 GHz pour des services de 4G/5G fixe pourrait- elle apporter ?

ERICSSON

The SDL band could add DL throughput to both 4G and 5G FWA. To add capacity to existing networks in terms of connected users and UL bandwidth to sustain the increase of DL throughput, aggregation with Mid-bands is recommended.

Question 51. Dans quelle mesure les différentes utilisations susmentionnées sont-elles réalisables de façon pertinente « à réseau constant », c'est-à-dire uniquement en installant de nouveaux équipements sur des sites mobiles déjà existants ou prévus à moyen terme ?

ERICSSON

The SDL band could be deployed by operators on their existing grid with no addition of (unplanned) sites.

Question 52. L'utilisation de la bande 1,4 GHz peut-elle se substituer à l'utilisation d'une bande existante ou s'ajouterait-elle nécessairement aux fréquences que les opérateurs peuvent déjà utiliser ? Favoriserait-elle l'extinction d'une technologie ?

ERICSSON

The 1.4 GHz band is SDL and as explained earlier cannot be used stand alone but in Carrier Aggregation mode with other band. Please see answer on Question 47. Thus, this band will add to the frequencies that the operator already has. Legacy bands are usually reused with 4G or 5G, as regulations are technology neutral in France , hence all traffic could be handled within the same band. SDL exists for both 4G and 5G and thus not promoting one or another technology although we expect operators to always deploy the latest and most efficient mobile technology available. SDL should not have any specific impact on Sunset of low bands unless these bands are restituted to regulator, in which case SDL could compensate for a part of the data traffic (under coverage) but not for voice traffic due to no UL.

Question 53. Le fait que cette bande nécessite d'être appairée afin d'être utilisée favorise-t-il la mise en veille ou l'extinction de ses émetteurs ?

ERICSSON

SDL only works in CA mode, this means that it will only be active if there is data that needs to be transmitted to the UE. If there is no data, SDL is not active. Additional software features functionalities can be included when there is certain data to be transmitted by CA device in CA mode.

Question 54. Estimez-vous pertinent d'attribuer simultanément l'intégralité des fréquences de la bande 1,4 GHz ? Quand souhaiteriez-vous disposer des fréquences de cette bande ?

ERICSSON

We think that bands should be allocated simultaneously for spectrum efficiency (i.e. avoid non-

contiguous blocks that may turn from auctions at different timing) and to allow operators to plan for the right product since the beginning. It should also avoid having discontinuous spectrum bands and should maximize the value of spectrum.

Question 56. Quels sont d'après vous les avantages et inconvénients de ces deux options ? Avez-vous une préférence pour l'une d'entre elles ? Pour quelles raisons ? En voyez-vous d'autres ? Concernant la première option, quelle serait la taille pertinente des blocs à attribuer ? Dans le cas de la seconde option, quelles seraient, d'après vous, les obligations qu'il serait nécessaire d'introduire, notamment en matière d'accueil des autres opérateurs ?

ERICSSON

Allocating the band in the « conventional » way by means of auction would allow operators to take into consideration the value of the spectrum taking into account other assets and thus we would recommend this alternative. We expect the band to be highly used in areas where there is high capacity, typically dense and urban areas. The larger the spectrum blocks for each operator, the most efficient from all perspectives.

Looking at rural areas, rather than partitioning the band into 45 MHz blocks, we would recommend to incentivize sharing (active and passive), this has been proven to be a successful technique in other countries. As an example, Sweden allowed both passive and active network sharing including spectrum pooling for up to 70% population coverage (rural), which translated into a 3G population coverage of 99.59% with geographical coverage of ~50%.

Question 57. Quels sont les cas d'usages que vous attendez avec cette bande de fréquences ? Identifiez-vous des freins à leur déploiement ?

ERICSSON

This band will be necessary to address high capacity in very dense areas while leveraging on the aggregation with mid-band to keep as much as possible the advantage of the high UL throughput offered by this band, and the extended DL capacity thanks to the UL handling on mid band.

Additionally, this band is also very important for enterprises requiring very low latency requirements. This band also allows for easy coordination due to the propagation characteristics, giving more flexibility in terms of TDD pattern to use.

The ecosystem of this band is progressing well, and several deployment possibilities are offered ranging from Macro, outdoor micro and indoors deployments.

Question 58. Quelle largeur de bande minimum vous semble pertinente pour exploiter un réseau mobile et fournir les usages que permet cette bande de fréquences ?

ERICSSON

Ericsson recommends 1 GHz of contiguous spectrum per operator to unleash the full potential of 5G. At the same time, Ericsson recognizes that this needs to be balanced with the amount of spectrum available, number of operators and whether there is a desire to also make local area spectrum licenses available. Multiples of 200 MHz seems a reasonable approach.

Question 59. Cette bande de fréquences peut-elle être déployée dans un réseau sans que d'autres bandes de fréquences plus basses (bandes d'ancrage) soient utilisées par ce même réseau ? Si non, pourquoi et quelles autres bandes de fréquences seraient nécessaires, en 5G NSA et 5G SA ?

ERICSSON

The 26GHz band can be deployed both in stand alone and non-stand alone mode. It requires at least an LTE anchoring band when in NSA mode, and when SA mode, it can in theory be implemented on its own (in very good conditions with no mobility and very good coverage, while ecosystem is lacking today), or deployed while using an aggregation band from a lower band in in NR-NR Carrier Aggregation or in NR-NR Dual connectivity.

We expect this band to build on the existing public operator spectrum holdings. When addressing local usage for enterprises (either via MNO or other owner of spectrum), we also expect a combination with other bands with larger coverage (both in NSA and SA mode)

Question 60. A quel horizon souhaitez-vous voir l'attribution de cette bande de fréquences ? A court/moyen terme, l'attribution de la sous-bande comprise entre 26,5 et 27,5 GHz vous semble- t-elle suffisante pour assurer les cas d'usages que vous avez identifiés ?

ERICSSON

Ericsson think that 1GHz for all operators will not be sufficient to fulfil the needed capacity and introduction of new use cases. Ericsson recommends 1 GHz of contiguous spectrum per operator in this range to reach the full potential of 5G.

Question 61. Partagez-vous le constat lié aux difficultés de cohabitation entre les services mobiles et les faisceaux hertziens présents dans la sous-bande comprise entre 24,25 et 26,5 GHz ?

ERICSSON

Ericsson is also of the view that separation distance is needed between mobile services and FS to ensure co-existence. 26 GHz is expected to be used mainly in dense areas and thus while coordination may be possible with a few links, if the number is very high, these would need to be relocated.

Question 63. Quels scénarios de cohabitation entre le service fixe par satellite et le service mobile seraient envisageables ?

ERICSSON

Studies in preparation of WRC-19 concluded that there is a considerable margin for sharing between mobile and FSS UL and expected mobile deployments in urban and sub-urban areas. It is Ericsson's view that co-existence between FSS and the mobile service is possible both for local licenses (see response to Q 64), for commercial deployments by MNOs. Ericsson is also aware of and participating in further discussions in relation to this issue both in CEPT and ITU as a result of potential revision of Art 21.5 of the Radio Regulations for further guidance on co-existence with FSS UL in this band.

Question 64. Quelles modalités géographiques d'attribution de la bande 26 GHz vous semblent pertinentes ? Pourquoi ? Dans les différents cas, quelles devraient être les largeurs de bandes attribuées ?

ERICSSON

As stated in previous responses, Ericsson recommends 1 GHz of contiguous spectrum per operator to unleash the full potential of 5G. At the same time, Ericsson recognizes that this needs to be balanced with the amount of spectrum available, number of operators and whether there is a desire to also make local area spectrum licenses available. Multiples of 200 MHz seems a reasonable approach.

If there is a need to also make local area spectrum licenses available then it is recommended that the Finnish approach is considered which can offer a balance between users, if needed, where the upper portion of the spectrum is for nationwide or city/suburban wide licenses and the remainder for local licensing.

Question 66. Quelle bande de garde sera nécessaire pour que les équipements 5G soient en mesure de respecter le niveau de puissance défini par la CEPT tout en assurant la coexistence avec les radars du ministère des armées utilisant les fréquences sous 3,4 GHz ? À quel horizon voyez-vous la possibilité d'utiliser une bande de garde plus faible ?

ERICSSON

As long as the level of -59dBm/MHz is required in France, a guard band of 20MHz is needed for the products to fulfil that level of protection.

Question 67. Concernant la première option, quel(s) usage(s) justifierai(en)t l'utilisation d'une quantité de fréquences supérieure à 100 MHz dans la bande 3,4 - 3,8 GHz ? Les équipements actuels permettent-ils l'utilisation de blocs de fréquences non contigües dans cette bande ? Si ce n'est pas le cas, à quelle échéance serait-ce possible ? Un réaménagement de la bande serait-il nécessaire ? Le cas échéant, pour quelles raisons ?

ERICSSON

As a general matter, the more bandwidth the higher traffic and capacity available for users. Today, at least 100 MHz of contiguous spectrum is recommended in the mid-bands range. However, we predict larger contiguous blocks necessary in the short term to address the combination of 5G enhanced use cases that are expected with 5G-Advanced across wide-areas, such as "All day AR". The use of more than 100MHz yields two separate carriers hence the need to use carrier aggregation to benefit of the higher throughput offered. Both intra-band contiguous and non-contiguous CA are supported by 3GPP standards in this range.

Question 68. Concernant la deuxième option, quelle serait la granularité minimale de fréquences à attribuer par titulaire ? Quelles modalités de coexistence entre les différents titulaires d'autorisation de fréquences dans la bande 3,4 – 3,8 GHz faudrait-il mettre en place ?

ERICSSON

If local licenses are needed in France, we would recommend ARCEP to allocate the frequency 3.8-4.2 GHz which is currently being harmonized within CEPT at the moment for this usage, and consider only Option 1 for the range 3.4-3.8 GHz. In this way France would allocate 400 MHz of spectrum for public users and up to 400 MHz for local usage.

Question 69. Quelle option, parmi celles présentées ci-dessus, estimez-vous la plus pertinente ? Pour quelles raisons ?

ERICSSON

The choice for that band will also depend on the decision for the band 3,8-4,2 GHz and the learnings from that allocation (as well as from the 2,6 GHz TDD band)

See response to Question 68

Question 72. Quels sont, selon vous, les cas d'usages attendus avec cette bande de fréquences ?

Envisagez-vous de répondre au guichet d'expérimentation ?

ERICSSON

The expected use cases are those localized usages that require certain coverage and low latency, as example, connecting a campus or a factory.

Question 73. Voyez-vous un intérêt à utiliser cette bande pour de la 5G ou une autre technologie mobile ? À quel horizon ? Avec quelle quantité et quel périmètre géographique ? Pour fournir quels services ?

ERICSSON

This band is indeed of interest for 5G Industry 4.0 use cases being delivered by MNO or enterprises. Among other technical conditions, CEPT is considering the output power (low/medium) as mentioned by ARCEP, we are of the view that for the success of the band, it is key that these do not restrict any of the potential use cases, both indoors and outdoors.

Regarding the geographical definition of the licenses. Ericsson would like to emphasize that industry 4.0 use cases would greatly benefit from a real-state based license, while for other use cases involving less investment as well as being simpler technically such as a small private network at the office/home a more localized license could work. Other use cases aiming for digitalization such as smart cities (example transport) or smart grid require wider geographical licenses.

Question 74. Quelles conditions de cohabitation avec les autres services déjà présents dans la bande imaginez-vous ?

ERICSSON

Studies are on-going in CEPT and we suggest ARCEP to follow the developments.

Question 75. Une fois la bande normalisée, souhaiteriez-vous la voir attribuée en France ? Si oui, selon quelles modalités ?

ERICSSON

This band is critical for 5G and we would like to see it allocated when harmonized by CEPT. Ericsson would also like to request ARCEP to consider how much spectrum is necessary to address the French vertical needs (in particular considering the geographical reuse of the licenses) and to study the technical conditions that will address all expected use cases in the nation. Should not all spectrum be necessary for verticals, Ericsson would suggest to consider an split of the band between local licensed (starting at the top of the band, i.e. 4.2 GHz and moving downwards) and wide-are licensing (adjacent to the 3.4-3.8 GHz band)

Question 76. Pensez-vous nécessaire d'imposer une trame de synchronisation dans cette bande ? Si non, quel autre mode de coordination estimez-vous pertinent ?

ERICSSON

Ericsson is of the view that regulations should allow for unsynchronized operation among carefully planned Local networks, allowing for bi-lateral agreements among networks. Note that carefully planned Local networks may be with regards to frequency and/or space separation, antenna directions, etc.

Should ARCEP decide on a frequency split approach among wide-area and local-area networks, as mentioned in Question 75 by Ericsson, bi-lateral agreements between the Macro and the Local operators to agree on interference coordination and acceptable interference levels should be allowed.

Question 77. Voyez-vous un intérêt à utiliser la bande 738 – 753 MHz en canalisation SDL pour de la 5G ou une autre technologie ? À quel horizon ? Quelle largeur de bande vous semble pertinent pour l'utilisation de cette bande ?

ERICSSON

At the moment, there is interest for 5G although the device ecosystem is missing due to the lack of harmonization at a global level.

Question 78. Quels usages envisagez-vous dans cette bande, dans ce cadre d'autorisation générale ? L'introduction de la 5G vous semble-t-elle pertinente ? A quel horizon ?

ERICSSON

The introduction of 5G NR is not relevant in Europe under the current regulations under Decision 2006/771/EC. However, use cases delivered by 5G NR-U (license-exempt usage) are still relevant, as regulations are technology neutral. Note that 5G NR-U is a best effort technology (similarly to WiFi yet with better performances)

We expect this band to be used in the upcoming years by license-exempt technologies (e.g. WiFi) to address very high capacity needs at small range (as example connection of AR/VR glasses with smart phones), which will help offloading the needs for very large bandwidths in the mid-bands range. We believe that this would be the most efficient use of spectrum, just like mobile uses (or plans to use) mmWave for high-capacity shorter range use cases or very high traffic scenarios.

Question 79. Quels seraient, selon vous, les usages mobiles possibles dans cette bande ? Quels sont les usages satellites prévisibles dans la bande ?

ERICSSON

A gradual introduction of 5G services in the band 40.5-43.5 GHz is foreseen in Europe. This band is intended to support mostly mobile high capacity urban and suburban areas, both indoors and outdoors. Contiguous wide coverage is not expected due to propagation characteristics of this band (i.e., high attenuation).

The band 40.5-42.5 GHz is allocated to the fixed satellite service (FSS) in the space-to-Earth direction. The band 42.5-43.5 GHz is allocated to the FSS in the Earth-to-space direction. In Europe, this band is mostly intended for receiving gateway FSS earth stations (ESs) and for transmitting gateway FSS ESs, respectively, where a limited number of stations is needed. In both cases, sharing is possible with terrestrial services. There are also satellite space station receivers planned, for which studies have shown that sharing is feasible. ESs operating with GSO and non-GSO satellites are planned for these bands.

Question 80. Quelle est la prévision de disponibilité de matériel pour le service mobile dans la bande ?

ERICSSON

The band n259 (39.5-43.5 GHz), which includes the band identified for IMT 40.5-43.5 GHz, has been standardized by 3GPP and we expect equipment to be ready shortly after allocations/auctions start happening. The more countries allocating the band, the faster the ecosystem will grow both for BS and devices.

Question 81. Quelles conditions techniques de coexistence pourraient être mises en œuvre dans cette bande ? Quel cadre d'utilisation pourrait être mis en œuvre (par exemple, des autorisations générales) ?

ERICSSON

WRC-19 sharing studies between mobile service and FSS (space-to-Earth) showed that coexistence issues ~~in~~ can be managed at national level where coordination distances can be done on a case-by-case basis since the use of the band by FSS is limited to coordinated earth stations (i.e. known location).

Regarding FSS (Earth-to-space), all WRC-19 sharing studies (GSO and non-GSO) showed a positive margin when compared with the protection criterion.

Regarding the adjacent band (i.e., FSS/MSS below 40.5 GHz), studies showed that measures may be considered by administrations, as necessary, to ensure the protection of the receiving FSS/MSS earth

stations below 40.5 GHz. In the case of coordinated FSS/MSS earth stations, the same measures as those considered for in-band can be used. For uncoordinated FSS/MSS earth stations (i.e., unknown location), further measures may need to be considered on a national basis (e.g., guidelines on installation of mobile or FSS earth stations).

It should be noted that sharing and compatibility above 40 GHz may be easier due to: high transmitting directivity (i.e., narrow beams) can be easily achieved with antennas of practical size; atmospheric attenuation is higher at these frequencies, and diffraction is weaker (leading to stronger shielding by clutter).

Question 82. Confirmez-vous la nécessité d'introduire la technologie LTE dans la bande 450 MHz ? Pour quels besoins ? Sur quelles empreintes géographiques ?

ERICSSON

Ericsson confirms and emphasizes that LTE technology can address different use cases broadband, IoT or PPDR

We also recommend to align with LTE B31 band plan 452.5 - 457.5 / 462.5 - 467.5 MHz. Ericsson also recommends nationwide licensing for this band to make best use of its properties.

Question 83. A partir de quelles largeurs de bandes (1,4 MHz, 3 MHz ou 5 MHz) peut-on considérer la bande utilisable pour la technologie LTE ? Sous quel calendrier ?

ERICSSON

3GPP standards support 1.4 MHz, 3 MHz and 5 MHz for LTE B31. However, not all combinations of features/configurations may be supported by all manufacturers. Furthermore, we recommend the usage of 5 MHz for efficient use of spectrum due to the signaling overhead on 1.4 MHz and 3 MHz channel bandwidth.

Question 84. Dans quelle mesure les équipements à bande étroite utilisant actuellement la bande 450 MHz pourraient-ils cohabiter avec les équipements LTE ? Avec quelle bande de garde et quelles distances de protection ?

ERICSSON

CEPT concluded that narrowband equipment and LTE equipment (both for MBB, IoT as well as BB-PPDR) can co-exist, see ECC Report 283 on « Compatibility and sharing studies related to the introduction of broadband and narrowband systems in the bands 410-430 MHz and 450-470 MHz » and ECC Report 240 on « Compatibility studies regarding Broadband PPDR and other radio applications in 410-430 and 450-470 MHz and adjacent bands », assuming that the same band plan is followed for both systems (i.e. UL and DL are not right adjacent to each other)

Question 85. Comment pensez- vous possible d'assurer la transition des équipements actuels vers la technologie LTE ? Vous semble-t-il indispensable de réaménager les systèmes actuels de la bande 450 MHz ? Si oui, dans quelle(s) bande(s) de fréquences ?

ERICSSON

The current Narrow Band systems are not able to support the introduction of massive critical IoT solutions in an effective and reliable way. For this reason, we see that migrating to broadband systems is necessary.

Question 86. Quelle est votre vision de la maturité de l'écosystème industriel en technologie LTE dans la bande 450 MHz ?

ERICSSON

This ecosystem is mature, with a variety of vendors and types for components (chipsets and modules), devices (routers, modems, handsets), antennas and network equipment.

Question 87. D'autres usages que des réseaux s'appuyant sur la technologie LTE sont-ils envisageables ?

ERICSSON

We don't see any other technology than mobile broadband technologies are necessary to deliver the use cases envisioned in this band (broadband, IoT, PPDR) and a global ecosystem brough by 3GPP is necessary.

Question 88. Quelles sont vos prévisions de croissance du trafic mobile et de l'usage qui appuieraient un besoin en fréquences basses ? A quel horizon ? Quelle quantité de bande serait nécessaire ?

ERICSSON

Traffic is growing across the world, see our Ericsson Mobility Report. In fact, by year 2025-2030 as we predict that additional spectrum will be needed in the city areas (see response to Question 3), we also see the risk of the digital divide becoming larger, bringing greater digital inequality to those in rural or hard to reach areas. This spectrum is key to keep society in both cities and deep rural areas as equal as possible.

GSMA estimates an improvements in rural and deep-indoors download speeds of 37-42 % in Region 1 for an additional 2x35-2x40 MHz of additional sub 1 GHz spectrum and a reduction in the cost of extending 5G to rural populations of 30%, GSMA | Vision 2030: Low-Band Spectrum for 5G - Spectrum.

We understand that sub 1 GHz spectrum is not straight forward and that the only available possibility, sub 700 MHz or 600 MHz, is today being used by DTT. Ericsson also recognizes the EU binding decision to secure this spectrum for digital TV up to 2030 (to which deadline France is aligned). Thus, we foresee the closest horizon for the availability of this band around 2030 or even further. Looking at the trends of DTT usage, we see a steady decline, however, the speed of the decline is still unclear.

WRC-23 considers primary allocation for mobile in the range 470-694 MHz in Region 1, which will imply co-primary allocation of DTT and mobile, opening opportunities for France to decide after 2030 what is most beneficial for French citizens, depending on DTT and mobile trends.

Question 89. Pourquoi les besoins auxquels pourraient répondre cette bande ne pourraient-ils pas l'être par d'autres moyens (par exemple, l'extinction des technologies 2G/3G dans la bande 900 MHz en vue d'une utilisation par les technologies 4G/5G, la mobilisation de bandes parmi celles décrites en partie 4.2 de la présente consultation, l'agrégation de porteuses des bandes déjà exploitées) ? Ces besoins appelleraient-ils un périmètre d'attribution national ou local ?

ERICSSON

Ericsson envisions this band as additional capacity in hard-to-reach areas, as explained in Questoin 88. Upgrade from 2G/3G to 5G will help as 2G used Time Division Multiple Access (TDMA) and 3G used Code Division Multiple Access (CDMA), while 4G/5G use Orthogonal Frequency-Division Multiplexing (OFDM), being the latter much more efficient when scheduling users. Additionally, performance improvement will be seen if the 4G/5G radios have enhanced capabilities compared to the 2G/3G sites (e.g. more TX/RX antennas).

However, the amount of available bandwidth remains the same and thus the capacity needs cannot be fully addressed by upgrading legacy spectrum to 4G/5G.

This band is of particular interest for rural areas and deep indoors penetration in the urban areas, thus aggregation with mid-bands is not an option, due to the propagation characteristics. Inter-band CA among existing low bands is technically feasible. For CA in general, the user performance (user data rate) can increase due to a larger channel bandwidth for that specific user, given that the user supports CA among the two specific low bands that needs to be aggregated, but the overall system bandwidth would not increase unless more spectrum is added to the network. However, aggregation of two adjacent low bands are notoriously difficult for overlapping low bands and UE antenna matching is also difficult for 700 + 900 MHz.

Due to the propagation characteristics of this band (in particular its achievable large coverage), we believe that this band requires nationwide allocation to allow operators to expand capacity across the country, targeting to bridge the digital divide among urban and deep rural areas.

Question 90. Est-ce que certaines technologies mobiles pourraient répondre aux besoins de la diffusion audiovisuelle ? Quel est votre avis sur l'intérêt de la 5G *broadcast* sur cette bande ou sur d'autres bandes ?

ERICSSON

3GPP has specified NR-based 5G multicast-broadcast and LTE-based 5G broadcast. Both of these 3GPP families aim to address audiovisual needs. However, while LTE-based 5G broadcast address high-tower/high-power deployments, requiring a~~n~~ specific band and the addition of certain subcarrier spacings and channel bandwidth, which today are not supported by 3GPP standard devices, NR~~LTE~~-based 5G multicast-broadcast can be deployed already today, in existing 3GPP mobile bands and networks with minimum additions, possibly limited to software updates. Thus, we support NR~~LTE~~-based 5G multicast-broadcasting moving forward as it would allow citizens to benefit both from a mobile and audiovisual

perspective going foward.

Question 92. Comment appréciez-vous les perspectives de développement de ces usages (Wifi, IMT[17]) ? Identifiez-vous d'autres usages appelés à se développer dans cette bande ?

ERICSSON

It is Ericsson expectation that globally we will see countries using the band for licensed or licensed-exempt. Additionally, we also expect FS to continue in the band in rural areas in those countries allocating the band for IMT while we expect investments to decline largely if license-exempt is decided due to the uncertainty on the vailability of spectrum and interference environment.

Products including WiFi6E already exist in the market, while we see large amount of devices supporting the lower 6 GHz, support for upper 6 GHz seems largely more limited.

Ericsson notes that globally, region 1 is considering IMT identification of this band (and conséquent licensing of the band) under AI1.2. In particular, we note that decisions have not been taken accross the region broadly speaking.

Ericsson invites ARCEP to read the white paper on 6 GHz opportunity: license spectrum for mobile networks

Additionally, the interest on this band for IMT goes well beyond Region 1, including Region 2 and Region 3. As example, Colombia, which previously considered RLAN indoors in the band 6425-7125 MHz, launched a new consultation inviting industry to share its views on a tentative allocation of the upper 6 GHz band (6425-7125 MHz) to IMT, after considering the latest ITU global context and the recent standardization work by 3GPP with its n104 band in Release 17 (www.mintic.gov.co). Chile has recently changed their decision to allocate the band 5925-7125 MHz for license-exempt and decided to limit the band to as 5925-6425 MHz (*Resolution 2844)*. Another example is Australia, which considered the band 5925–7125 MHz for RLAN in 2021, later limited the consultation to RLAN Low Interference Potential Devices within 5925-6425 MHz and additionally sought for comments on potential future uses of the upper part of the band (6425–7125 MHz), and decided that the future use of the upper 6 GHz band (6425–7125 MHz) further needs to be considered (Radio local area networks (RLANs) in the 6 GHz band - consultation 37/2021 | ACMA)

We invite ARCEP to follow the latest news on 6GHz here

Question 93. Quelles modalités de cohabitation avec les usages existants (faisceaux hertziens, services satellitaires) dans cette bande seraient nécessaires ?

ERICSSON

- Studies are on-going in ITU WP 5D towards WRC-23. IMT-FSS UL : the vast majority of technical sharing studies submitted by both administrations and industry to WP 5D indicate that compatibility of IMT-2020 (including macro BS) and satellite uplink is feasible.

- IMT-FSS DL : sharing is feasible by coordination by means of physical separatioin distance.

- IMT-FS: sharing is feasible by coordination by means of physical separatioin distance.

Additionally, we would like to note that tools exist to reduce the separation distances needed, as example, to coordinate geographycally or to coordinate the deployments (i.e. avoid pointing IMT BS to the main beam of the FS)

Question 94. Pensez-vous que la bande soit appropriée pour mettre en place un partage dynamique du spectre afin de concilier les usages envisagés ?

ERICSSON

Dynamic spectrum sharing is not a good solution in this band. In particular, as this is the last mid-band resource available in Europe and France. Mid-band spectrum provides the sweet spot in terms of coverage and capacity and thus would not be a good decision to allocate the band for dynamic usage or license-exempt usage.

The 6 GHz band is needed to address the capacity needs in France across wide areas (i.e. cities) for the timeframe 2025-2030 (see response including spectrum needs). Thus in these areas, dynamic spectrum access will not work due to the investment required.

Outside the cities there is typically a lack of fiber and the need to bring FWA to ensure that people do not stay behind digitally, bringing equality across the country. This band is key for this use case and cannot be delivered by Dynamic spectrum access.

Question 95. Des usages mobiles sont-ils envisageables dans ces bandes de fréquences ? Le cas échéant, quels usages mobiles sont envisagés ? Avec quelles perspectives commerciales et à quelle échéance ?

ERICSSON

Mobile usage is envisioned in this range. However, Ericsson is of the view that this frequency band will be complementary to the centimetric range (7-15 GHz) for 6G, in particular subTHz will address niche use cases which require extreme bandwidth and/or low latency in a more localized area.

Question 96. Le cas échéant, à quel horizon estimez-vous que la technologie mobile sera disponible pour ces bandes ?

ERICSSON

Equipment is expected to be available depending on auctions. Initial deployments for 6G are expected around 2030.

Question 97. Voyez-vous un intérêt à des expérimentations mobiles utilisant ces fréquences ? A quel horizon ? Avez-vous identifié des bandes de fréquences spécifiques ?

ERICSSON

Research in these frequencies is on-going as it implies a further step from mmWave. As indicated in question 3, we are originally focusing on W band. D band is another band of focus pending on co-existence analysis with FS. Ericsson notes that these are early days and that further analysis and discussions with both indstry and regulators are required.

Question 98. Au-delà de tous les sujets abordés dans les sections précédentes de cette consultation, quels autres enjeux relatifs à l'attribution de nouvelles fréquences pour les réseaux mobiles mériteraient d'être portés à l'attention de l'Arcep ?

ERICSSON

Ericsson would like to bring to ARCEP's attention the imminent need to consider the essential centimetric frequency range 7-15 GHz in the 6G timeframe and to consider subTHz (above 90 GHz) as a complement to deliver 6G niche use cases. See response to Question 3 including specific bands for initial focus.

FIN