Nokia response to the Discussion Document on re-planning options for frequency bands within 1710-2300 MHz, March 2020

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Disclaimer: This response is based on Nokia's current understanding of the market dynamics and various standards bodies; these dynamics are changing and hence our views may update with these changes

1 About Nokia

We create the technology to connect the world. We develop and deliver the industry's only end-to-end portfolio of network equipment, software, services and licensing that is available globally. Our customers include communications service providers whose combined networks support 6.1 billion subscriptions, as well as enterprises in the private and public sector that use our network portfolio to increase productivity and enrich lives.

With an end-to-end portfolio that is unique in the industry, Nokia can work in partnership with operators to deliver "real 5G". Nokia's in house 5G mmWave Small Cells and AirScale BTS provide in-building and outdoor coverage, while our Microwave Anyhaul, Cloud native RAN, antennas, and 5G cloud-native core are part of approximately half of our agreements to date. Beyond our mobile networks portfolio, Nokia has excellent FP4 network processor-based IP routers and PSE- 3 chipset powered optical networking - our customers can use the Nokia Network Services Platform to make this into full-5G-strength software defined connectivity 'smart network fabric' secured by Nokia Security Orchestration, Analytics and Response (Nokia SOAR) to ensure resilient 5G.

As of April 2020, Nokia confirms its 5G leadership position with more than 60 commercial 5G deals in place with operators around the world. Including these agreements, Nokia's 5G deals, trials and demos total over 100 5G customer engagements to date.

Through our research teams, including the world-renowned Nokia Bell Labs, we are leading the world to adopt end-to-end 5G networks that are faster, more secure and capable of revolutionizing lives, economies and societies. Nokia adheres to the highest ethical business standards as we create technology with social purpose, quality and integrity.

For more information: https://www.nokia.com/networks/5g/

2 Nokia View

Nokia welcomes the opportunity to comment the discussion paper related to planning options for bands between 1710MHz and 2300MHz. Nokia would specifically like to comment on the Paired 2100MHz band expansion and answer the related **question number 12** in the document.

Some countries (such as Korea) have started to investigate a potential use of this band for mobile services and Nokia is closely monitoring the evolution of the demand of this spectrum. We support RSM in further assessing the potential for new services such as mobile services while ensuring that co-existence with adjacent services is possible.

Nokia recommends allocating part of the Paired 2100MHz band expansion spectrum to Direct air-to-ground (DA2G) services while the rest of the band could be allocated e.g. for terrestrial mobile.

Nokia notes that the ACMA in Australia has recently held a similar consultation on the utilisation of the 2GHz band, and Nokia has made the same recommendation in its submission.

Please see below for more detailed information related to the DA2G systems and services.

2.1 Applicable services & applications

Air passengers increasingly expect and require fast, reliable broadband services while in flight. This demand is growing, mainly driven by competition among airlines to provide best-in-class in-flight connectivity services, and by passengers using smartphones, tablets and laptops. Others who would greatly benefit from inflight broadband are, as an example, critical services, such as flying doctors.

In the future, airline applications further fuel the demand for broadband aircraft connectivity. In return, airline operations will become more efficient and will also lead to reductions in fuel consumption and CO_2 emissions by utilizing such connectivity.

With such an importance of the aviation industry on domestic transport, it is imperative to provide “economical and fast connectivity” on board of the aircraft, but it also needs to be understood that the domestic air traffic market is highly competitive and cost sensitive.

Currently, most in-flight connectivity uses satellite backhaul, with vendors operating a satellite/ground internet system. Especially for short-haul and medium-haul continental flights, these systems tend to be bulky and expensive. Additionally, current capacity is limited and exhibits high latency, especially when serving many continental aircraft in a limited geographic area.

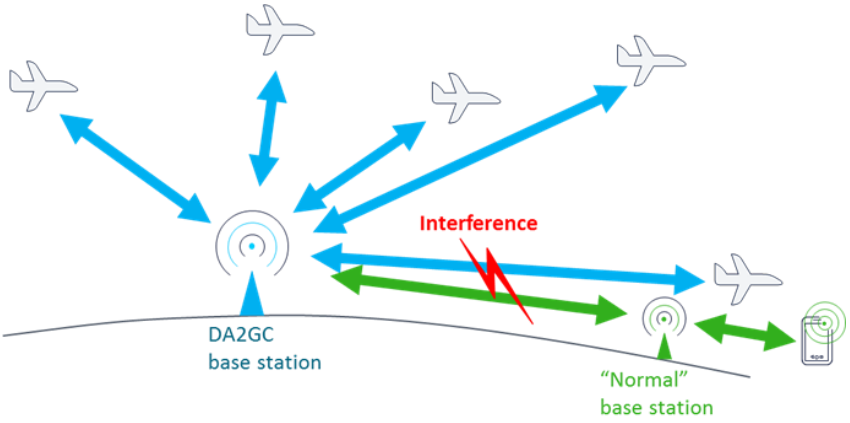
DA2G utilizes a ground-based cellular system to create a direct link between the aircraft and the ground for broadband IP connectivity without the delay introduced by satellite hops. With a highly efficient air interface and a flat IP network architecture, to date, LTE is an ideal platform on which

to deploy an A2G network. Moreover, the 3GPP-based DA2G has several compelling advantages over existing satellite-based systems:

- Capacity and throughput: DA2G offers the world's fastest in-flight broadband connectivity service with speeds up to about 100 Mbit/s at a bandwidth of 15MHz. The DA2G solution outperforms existing L-band, Ka-band and Ku-band satellite solutions in bit rates per aircraft.
- Weight and drag: DA2G benefits much simpler, lighter and less-expensive aircraft equipment, especially compared to the Ku-band equipment leading to lower fuel consumption. DA2G is better solution not only for commercial aircrafts but also for general aviation and critical services such as flying doctors.
- Scalability: Unlike satellites, the DA2G solution allows roll out and expansion of network capacity exactly where it is needed by adapting the cell sizes or increasing the number of cells.
- Ease of installation: This solution can be installed in aircraft in one overnight stop, compared to up to five full maintenance days for satellite-based systems. Contrary to satellite installations, no structural changes to the aircrafts are required.
- Future proof: 3GPP-based DA2G is based on fully standardized, future-proof technology that will allow DA2G system evolution along the evolution of mobile communication standards.

2.2 Frequency range for DA2G services

To enable a terrestrial-based connection, the DA2G 3GPP network requires a dedicated radio infrastructure decoupled from established cellular networks designed for "normal" terrestrial mobile broadband applications. Therefore, it is a precondition that DA2G operates in a dedicated frequency band.



Commercially viable DA2G services depend on the availability of sufficient spectrum resources to ensure high-speed broadband services to users. Too little spectrum allocated to more than one

A2G LTE operator could negatively impact the quality of the service, and thus limit the benefits versus satellite based broadband access.

The existing inflight communication system in Europe (“European Aviation Network”, EAN), which utilizes DA2G technology, is using 2 x 15 MHz FDD per network operator as follows:

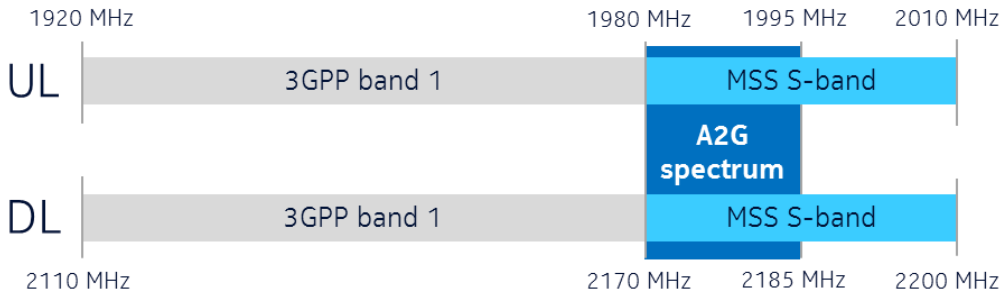


Figure 1 - European Aviation Network spectrum allocation

This allows to achieve data throughput in downlink of up to 100 Mbps which could be considered sufficient for this use case. This also represents only half of the spectrum under consideration by the NZ Radio Spectrum Management, the remaining half of the spectrum (1995-2010 / 2185-2200 MHz) can be used for other purposes such as terrestrial mobile.

2.3 Equipment availability

Equipment is available off-the-shelf and in commercial operation in Europe across 36 countries so far, rollout to further countries in Europe and Middle East is planned. The equipment installed into aircraft is air-worthiness-certified.

2.4 Access to spectrum

Access to the DA2G spectrum 1980-1995 / 2170-2185 MHz should be granted on an exclusive basis, in a coordinated manner.

A mandatory satellite component (satellite services with Ancillary Terrestrial Component/ Complementary Ground Component) should be avoided, as major advantages of DA2G, such as low cost, easy aircraft installation and low weight/drag would be lost for the airlines. Equally, the application to general aviation and flying doctors would hardly be possible.

Access to the remaining part of the spectrum e.g 1995-2010 / 2185-2200 MHz can be managed independently, depending on the application chosen.

2.5 Adjacent band considerations

DA2G implication to other bands was studied by CEPT ECC and summarized in the ECC Report 233 “Compatibility studies for aeronautical CGC systems operating in the bands 1980-2010 MHz and 2170-2200 MHz”.

Based on these findings, a detailed specification for DA2G and Hybrid systems was compiled and published as Harmonized European Standards ETSI EN 302 574-1 and ETSI EN 302 574-2. These cover, amongst others, adjacent band considerations.