COMMUNICATIONS ALLIANCE LTD

Ku-Band GSO ESIM, Future of Australian Satellite Services

A Communications Alliance Satellite Services Working Group Paper

24 March 2022

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Purpose of this paper

This paper is to brief Australia's radiocommunications regulatory decision makers (Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) and the ACMA) and other stakeholders on the progress of ITU-R technical studies on Ku-band GSO Earth Stations In Motion (ESIM) and the benefits for Australia in supporting the ITU-R studies and their consequent regulatory introduction into Australia.

Executive summary

Today, Earth Stations In Motion (ESIM) are being used around the world by airlines on thousands of planes, by the maritime sector on cargo, tanker, ferry and passenger vessels, and for public and private transportation on trains, buses, emergency response vehicles and other motor vehicles. The increasing demand from airline and cruise passengers, government and enterprise sectors are resulting in a rapid growth in the demand for flight and cruise ship broadband internet.

The ITU WRC-19 adopted agenda item 1.15, that calls for ITU-R studies on the possible operation of earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75 – 13.25 GHz (Earth-to-space).

The development of an ITU-R technical and regulatory framework for the use of earth stations on aircraft and vessels communicating with GSO space stations in the FSS in the Ku-band will continue to support the growing need for affordable ubiquitous broadband connectivity on the move, while protecting existing services in the relevant frequency bands. Studies on Ku Band GSO ESIM are in progress within the ITU-R to ensure protection of the other primary services in the band and in adjacent band.

Based on the applications and forecasts provided in this paper, Australia will also be able to derive economic benefits from the deployment of ESIM operations in Australia; in particular the introduction of 13 GHz band for the possible use of Aeronautical ESIM and Maritime ESIM. Aeronautical ESIM installed in the Australian domestic airlines such as Virgin Australia, Qantas, Jetstar and Rex and commercial international airlines flying into and out of Australia will be able to provide value-added services that meet the expectations of airline end-users, including passengers and flight crew, by providing broadband in-flight connectivity services.

Australia's radiocommunications regulator is encouraged to support the introduction of these services by supporting the ITU-R studies on Ku Band GSO ESIM. Australia could play an important role in the development of ITU-R studies on Ku Band GSO ESIM in WP 4A, APG23, CPM23, and WRC-23, noting that Australia was one of the proponents for Ka Band GSO ESIM studies from the previous ITU-R study cycle (i.e. WRC-19).

About Communications Alliance

Communications Alliance is the primary communications industry body in Australia. Its membership is drawn from a wide cross-section of the communications industry, including carriers, carriage and internet service providers, content providers, platform providers, equipment vendors, IT companies, consultants and business groups.

Its vision is to be the most influential association in Australian communications, co-operatively initiating programs that promote sustainable industry development, innovation and growth, while generating positive outcomes for customers and society.

The prime mission of Communications Alliance is to create a co-operative stakeholder environment that allows the industry to take the lead on initiatives which grow the Australian communications industry, enhance the connectivity of all Australians and foster the highest standards of business behaviour.

For more details about Communications Alliance, see http://www.commsalliance.com.au.

Introduction

The increasing demand from airline and cruise passengers (mainly millennials and business travellers), government and enterprise sectors are resulting in rapid growth in the demand for flight and cruise ship broadband internet. For example, market research[1] indicates that the global connected aircraft market size was USD 4.18 billion in 2019. The global impact of COVID-19 produced a decline of –39.9% in 2020. However, the market is projected to grow from USD 2.51 billion in 2020 to USD 10.49 billion in 2027, as the market demand is expected to return to pre-pandemic levels.

As indicated in Table 1 below, airline passengers increasingly expect to be able to have broadband connectivity during their flight. Market research[2] indicates that passengers are requiring on-demand on-line audio-video services such as movie streaming, live telecast of news and sports, rather than pre-recorded programmes.

TABLE 1

Expected annual growth of connected aircraft

Region	Connected aircraft in 2015	Connected aircraft in 2025	Annual growth (%)
North America	3 940	7 710	6.9
Latin America	44	1 529	42.6
Europe	455	5 465	28.2
Middle East	491	2 131	15.8
Asia & Oceania	356	6 256	33.2

The World Radiocommunication Conference 2019 (WRC-19) adopted agenda item 1.15, that calls for ITU-R studies on the possible operation of earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75 – 13.25 GHz (Earth-to-space), in accordance with Resolution 172 (WRC-19). The intention of these ITU-R studies on Ku band GSO Earth Stations in Motion (ESIM) is to respond to the consequent increased need for broadband in-flight and maritime connectivity where no broadband infrastructure other than satellite exists. Taking into account Australia's geography, space and satellite communications in Australia and the region can improve broadband connectivity for Australia's long haul flight paths to the region and to deliver broadband connectivity to users while they are mobile both in air and at sea.

The development of an ITU-R technical and regulatory framework for the use of earth stations on aircraft and vessels communicating with GSO space stations in the FSS in the Ku-band will continue to support the growing need for affordable ubiquitous broadband connectivity on the move, while protecting existing services in the relevant frequency bands.

In addition, currently, there is 2.5 GHz of spectrum in the uplink direction, available to be used globally by Ka-band ESIM operators, while there is only 500 MHz of Ku-band spectrum

[1] https://www.fortunebusinessinsights.com/industry-reports/connected-aircraft-market-101954

[2] https://www.marketwatch.com/press-release/connected-aircraft-market-research-report-by-growth-size-key-segmentation-and-competitive-landscape-to-2026-2021-11-29?tesla=y

available globally to be used by Ku-band ESIM operators (14 – 14.5 GHz). The additional 500 MHz of Ku-band spectrum in the uplink direction is already an FSS identified band under the ITU and Australia radio frequency allocation table and will create a fair and good business competition environment between Ku-band ESIM operators and Ka-band ESIM operators. A strong competitive environment between Ku-band ESIM operators and Ka-band ESIM operators will act to bring down the broadband connectivity price being offered to the end users.

ITU-R technical studies on Ku-band GSO ESIM

Studies on Ku Band GSO ESIM are in progress within the ITU-R to ensure protection of the other primary services in the band and in adjacent band. These services are the Fixed Service (FS) and Mobile Service (MS), as well as the Earth exploration-satellite service (EESS) (active) and Aeronautical Radionavigation Service (ARNS) operating in the adjacent 13.25 – 13.4 GHz band.

The main group responsible for conducting studies for Ku band GSO ESIM is ITU-R Working Party 4A (WP 4A). ITU-R WP 4A has already progressed its work, with several input contributions being incorporated into the working documents under Agenda Item 1.15. These input contributions have not yet been reviewed and agreed in this WRC cycle (partly due to the virtual nature of meetings during the pandemic) , but are, nonetheless, in 'good shape'. Several working documents, not yet agreed, but already discussed in CG and WP4A have been developed:

a. a compilation of input contributions received including systems overview and identification of in band and adjacent band services with which sharing studies may be required

b. Draft CPM Text, with Draft New Resolution for WRC-23 Agenda Item 1.15 as Attachment 1

The updated working document under Agenda Item 1.15 is contained in the Oct/Nov 2021 WP 4A Chairman's report Annex-15 to Document 4A/522[3] (user account required) which consists of the following items:

a. Systems overview

b. Sharing and compatibility studies with FS

c. Sharing and compatibility studies with MS

d. Adjacent band sharing and compatibility studies with ARNS

e. Sharing and compatibility studies with NGSO systems

f. Adjacent band sharing and compatibility with EESS (active)

Figure 1 on the next page gives the Ku Band GSO ESIM systems configurations. The band under study, 12.75 – 13.25 GHz, is shown as Link 3, return uplink from aeronautical or maritime ESIM to a fixed earth station. Further details of the Ku band GSO ESIM can be found in the systems overview in Annex-22 to Document 4A/522[4].

The updated preliminary draft CPM text on Agenda Item 1.15 is contained in Annex-25 to Document 4A/522[5].

[3] ITU User Account required.
[4] Ibid.
[5] Ibid.

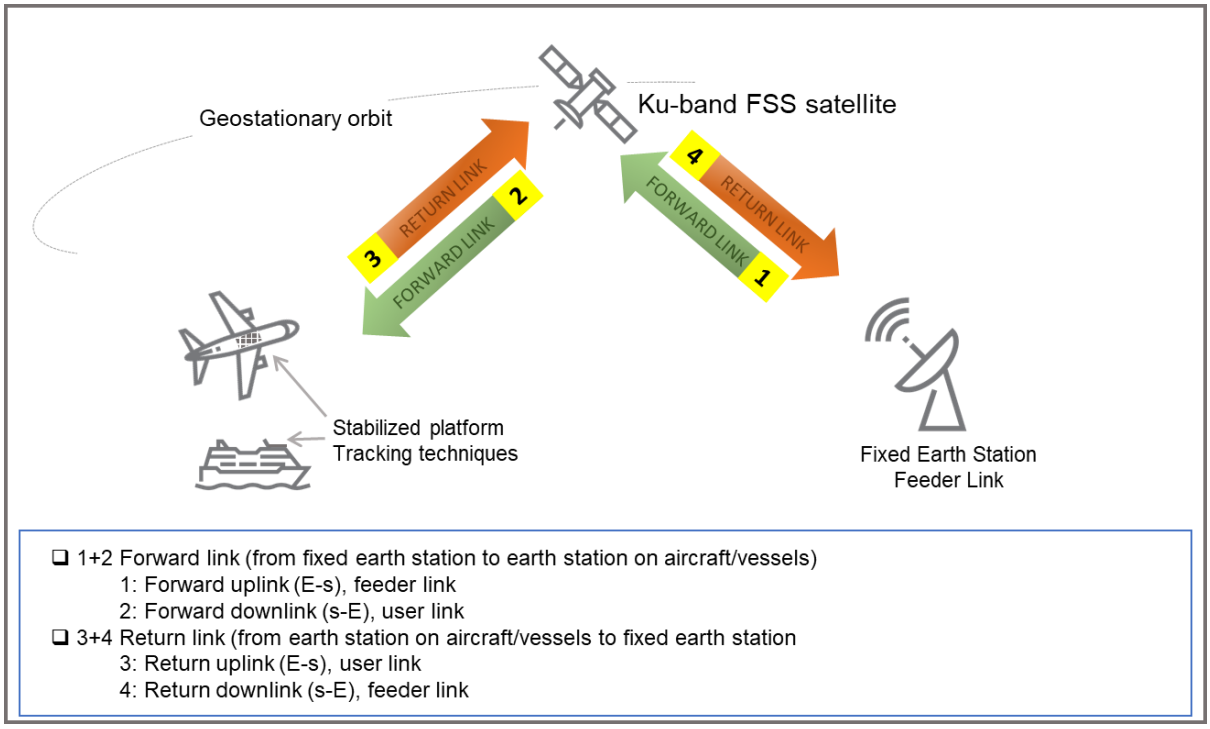

Figure 1: Transmission configuration environment of ESIMs[6]

The last Correspondences Group (CG) of WP 4A meeting was held virtually on 3rd September 2021. The CG meeting considered a comprehensive input on the procedures/examinations for ESIM filings in the context of RR Appendix 30B that was produced by the BR staff. Based on this input the CG was able to have a fuller understanding of the unique procedures involved in the RR Appendix 30B planned bands, and to generally agree to the approach provided. The CG, presented the following items to WP4A:

a. Protection of allotments in the plan and assignments in the list submitted under Articles 6 & 7 of Appendix **30B** as well as under Resolution **170 (WRC-19)**

b. Examination and protection of one ESIM with respect to the other ESIMs

The output of the CG meeting was provided to the Oct/Nov 2021 WP4A meeting (4A/398[7]) and included in the drafting of the CPM text and Draft New Resolution (Annex-25 to Document 4A/522[8]). The meeting contributions covered both regulatory matters and additional technical studies on sharing with other services. The meeting produced two Liaison Statements (LSs) to WP 7C and WP 5A regarding compatibility studies, two main documents (a compilation WD and draft CPM text with accompanying draft new WRC-23 Resolution), a revised Terms of Reference for the CG that was agreed to continue, and an updated Work Plan.

Overall, progress is being made in the virtual meeting environment with additional sharing studies being submitted in future ITU meetings.

[6] ITU-R Annex 15 to Working Party 4A Chairman's Report (9 Nov 2021), Doc 4A/522-E
[7] ITU-R TIES access required.
[8] ITU User Account required.

Benefits for Australia

Today, Earth Stations In Motion (ESIM) are being used around the world by airlines on thousands of planes (Table 1), by the maritime sector on cargo, tanker, ferry and passenger vessels, and for public and private transportation on trains, buses, emergency response vehicles and other motor vehicles. ESIM have provided broadband service to aircraft, ships, and vehicles travelling millions of kilometres in the air, at sea and on land. Aircraft passengers and crew today demand gate-to-gate, high-speed broadband for communications and entertainment, cabin support, and fleet digitization and maintenance. The size of the marketplace for broadband connectivity (pre-COVID) on aircraft is described in a report by the London School of Economics (LSE) that forecasts ubiquitous global broadband connectivity on aircraft by 2035, reaching 7.2 billion passengers, and creating a $130 Billion economic ecosystem for the benefit of airlines, content providers, retail goods suppliers, hotel and car suppliers, and advertisers.[9] LSE also explains that the digital transformation of the airline industry is giving rise to the 'connected aircraft' facilitated by satellite connectivity to create an Internet of Things (IOT) environment delivering significant commercial efficiencies for airline operations.[10]

Global shipping and passenger vessels rely on ESIM technology for broadband communications, benefiting passengers and crew and facilitating the transportation of cargo. The global maritime broadband connectivity market is expected to double in the next decade requiring 620 Gbit/s of global satellite capacity. Merchant shipping vessels (container ships, bulk carriers, freighters, tankers, etc.) today are the largest consumers of maritime satellite services.[11] The demand on passenger vessels is expected to increase. Trains, buses, emergency response vehicles and other land-based vehicles rely on satellite broadband services for passenger and crew connectivity, operations and maintenance support, and fleet tracking.

Based on the above applications and forecasts, Australia will also be able to derive economic benefits from the deployment of ESIM operations in Australia, in particular the introduction of 13 GHz band for the possible use of Aeronautical ESIM and Maritime ESIM. Aeronautical ESIM installed in the Australian domestic airlines such as Virgin Australia, Qantas, Jetstar and Rex and commercial international airlines flying into and out of Australia will be able to provide value added services that meet the expectations of airline end users including passengers and flight crew by providing broadband in flight connectivity services. Australia's international and even domestic route lengths are such that pleasure and business passengers will benefit. Such internet broadband connectivity is also expected by passengers and ship crew in Australian and international commercial maritime vessels include cruise ships, since it has become an expectation for passengers to be well connected everywhere and whenever they are. Installation of maritime ESIM in vessels would be able to fulfill the broadband connectivity needs of ship passengers and crew.

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[9] See London School of Economics, Sky High Economics – Chapter One: Quantifying the commercial opportunities of passenger connectivity for the global airline industry (September 2017) available at: https://www.lse.ac.uk/business-and[1]consultancy/consulting/consulting-reports/sky-high-economics

[10] See London School of Economics, Sky High Economics – Chapter Two: Evaluating the Economic Benefits of Connected Airline Operations (June 2018) available at: https://www.lse.ac.uk/business-and-consultancy/consulting/consulting-reports/sky[1]high-economics-chapter-two.

[11] See Northern Sky Research (NSR) Maritime Satcom Market Study, 6th edition (2018): https://www.nsr.com/nsr-report-full-steam-ahead-for-broadband-maritime-connectivity/

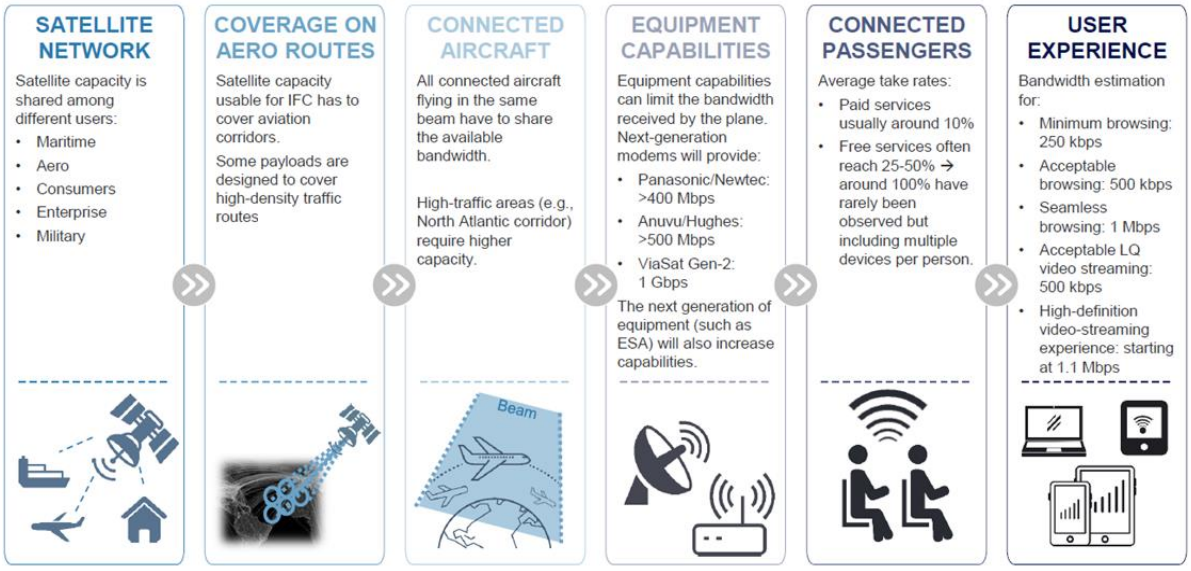

Figure 2: Satellite Ku band Capacity supply to IFC

The flying and cruising passengers are increasingly expecting internet broadband connectivity while travelling. According to a global survey conducted by Panasonic Avionics in 2019, ***'76% of passengers would choose an airline specifically because of the connectivity services they offer.'***[7]

In addition, Intelsat have conducted an Inflight Connectivity (IFC) survey[8] asking airlines and service providers what they believe the future of IFC will look like and found that:

- ***65% predict an increase in inflight passengers who expect to be connected,***
- ***72% predict an increased demand for remote, work-based applications, and***
- ***85% anticipate an increased appetite for cabin crew applications for passenger engagement.***

Based on the above facts, the demand for inflight and on-cruise broadband connectivity services is expected to increase. Australia therefore needs to capitalise on this expected increase in inflight and on-cruise broadband connectivity demand since it will support Australian economy growth. Therefore, these factors justify the need for additional 500 MHz of Ku band spectrum for the use of Aeronautical ESIM and Maritime ESIM in the 12.75 – 13.25 GHz band.

Recommended actions

Australia's radiocommunications' regulator is encouraged to support the introduction of these services by supporting the ITU-R studies on Ku Band GSO ESIM. Australia could play an important role for the development of ITU-R studies on Ku Band GSO ESIM in WP 4A, APG23, CPM23, and WRC-23, noting that Australia was one of the proponents for Ka Band GSO ESIM studies from the previous ITU-R study cycle (i.e. WRC-19).

[7] https://www.panasonic.aero/blog-post/heres-how-airlines-can-drive-connectivity-services-take-up/
[8] https://intelsat.com/solutions/aviation/

Published by:
COMMUNICATIONS
ALLIANCE LTD

Level 12
75 Miller Street
North Sydney
NSW 2060 Australia

PO Box 444
Milsons Point
NSW 1565

T 61 2 9959 9111
F 61 2 9954 6136
E info@commsalliance.com.au
www.commsalliance.com.au
ABN 56 078 026 507