Regional, local and non-national 5 G in 3 300 – 3 400 MHz

A feasibility study / review

Introduction

We have looked at having regional users (i.e. WISPs) who have some existing rights in the 3 410 – 3 600 MHz band, having some access at or near the bottom of the 3 410 – 3 800 MHz band (the 3.5 GHz band) after 1 November 2022, when long term rights are available for new allocation. The discussions we have had internally is that they would have 10 years in the 3.5 GHz band and then we would look at moving them below 3 410 MHz into the 3 300 – 3 410 MHz band. However this would trigger a two stage move with both regional users and national rights holders (ie potentially the MNOs and IMSC) in the 2032 period. As national rights holders would or could be restacked down to 3 410 MHz when the regional players move below 3.410 MHz.

So why could not regional players move below 3 410 MHz in November 2022, and not November 2032?

Current users

The table below shows an extract of PIB 21 regarding allocation and use of 3 300 – 3 410 MHz. In the ITU-R Radio regulations New Zealand was added to footnote 5.429 in WRC-19 which provides an additional allocation to the mobile services through for the 3 300 – 3 400 MHz band. Within this footnote New Zealand and countries bordering the Mediterranean can not claim protection from the radio location service[1]. New Zealand is not included in a footnote that identifies this band for IMT but this not going to impact on usability. We would need to ensure our allocation is updated in PIB 21 to reflect our additional mobile allocation in footnote 5.429.

2.3.6. SHF Band (3 - 30 GHz)

Frequency Range	International Region 3 Allocation	New Zealand Allocation	Summary of Usage	References and Policies
2 900-3 100 MHz	RADIOLOCATION 5.424A RADIONAVIGATION 5.426 5.425 5.427	RADIONAVIGATION RADIOLOCATION	2 900-3 100 MHz Maritime radar 2 900-3 400 MHz Short Range Devices – limited to radiolocation usage 3 300-3 410 MHz Amateur usage	General User Radio Licence for Maritime Purposes General User Radio Licence for Short Range Devices General User Radio Licence for Amateur Radio Operators PIB 58: Radio Licence Policy Rules
3 100-3 300 MHz	RADIOLOCATION Earth exploration-satellite (active) Space research (active) 5.149 5.428	RADIOLOCATION		
3 300-3 400 MHz	RADIOLOCATION Amateur 5.149 5.429 5.429E 5.429F	RADIOLOCATION Amateur		
3 400-3 500 MHz	FIXED FIXED-SATELLITE (space-to-Earth) Amateur Mobile 5.432 5.432B Radiolocation 5.433 5.282 5.432A	3 400–3 410 MHz FIXED MOBILE 5.432B Radiolocation Amateur Amateur Satellite	3 300-3 410 MHz Amateur usage	General User Radio Licence for Amateur Radio Operators PIB 58: Radio Licence Policy Rules
		3 410–3 500 MHz	3 410-3 417 MHz Spectrum	Radio Spectrum Auctions

[1] s6(a)

Amateur

The longest user of this band is the amateur service. Radio Amateurs refer to this as the 9 cm band and use this for high power narrowband communication, including "moon bounce". Amateur Radio Emergency Communications may expand the use of this band for low cost fixed and itinerant links, however that appears to not be the case in New Zealand, as we believe there are "internet" connections to some amateur repeater sites. Radio Amateurs also claim that the 3 400 -3 410 MHz band may be considered for Amateur satellite (likely earth to space) but there is currently no allocation or footnote for this use[2]. Radio Amateur operators are permitted to use the 3 300 – 3 410 MHz band anywhere within New Zealand at 30 dBW. As of December 2020, there is one fixed amateur radio beacon located at Colonial knob noted in the RRF[3]. This band has been in use by the amateur service for a significant period of time.

The Amateur allocation in the 3 300 – 3 410 MHz band is on a secondary basis and special condition 1 in the General User Radio Licence for Amateur Radio Operators specifies *"These frequencies are, or may be, allocated for use by other services. Amateur operators must accept interference from, and must not cause interference to, such other services."*

The IARU[4] and the NZART call book (embedded below) shows limited information for this band, with no specific channelling outlined by either organisation for the band.

Call Book 2020LR.PDF

Attachment outside scope of request

GUL for UWB use

A recent additional to the band is the GUL for ultra wide band applications. Typically these transmissions are used for communications, measurement, imaging, location tracking and applications in ground based vehicles (e.g. ground penetrating radar and object detection). UWB has a very low power spectral density over a wide frequency range (over 1 GHz wide at times). UWB is typically a pulse base radio system utilising pulse position modulation. UWB can be used as a high resolution radar utilising reflections from objects to determine if the makeup of an object e.g. where pipes might be inside a wall.

UWB operates as an "underlay application" where the power spectral density limits have been set (as a result of international studies) to minimise the impact on existing radio systems and ensure co-existence.

Radio Astronomy

[2] https://www.rsm.govt.nz/assets/Uploads/documents/consultations/2019-technical-arrangements-of-the-3-5-ghz-band/44e2564d87/nzart-submission-technical-arrangements-3-5-ghz-band.pdf
[3] https://rrf.rsm.govt.nz/rrf/licence/id/179457
[4] https://www.iaru.org/wp-content/uploads/2020/01/R3-004-IARU-Region-3-Bandplan-rev.2.pdf

The 3 332-3 339 MHz and 3 345.8-3 352.5 MHz can be used for radio astronomy and through the ITU Radio Regulations, footnote 5.149, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. It is understood that this frequency range is used for observations on carbon-hydrogen CH ions. It is not clear how much this is used in New Zealand but there is a suggestion that it is used at Warkworth Radio Astronomical Observatory operated by the Institute for Radio Astronomy and Space Research, Auckland University of Technology. There are not receive protection licences in the RRF

Radiolocation

Internationally the 3 100 – 3 400 MHz band is used for airborne, land and maritime based military radars systems.

This band is used by allied militaries including Australian long range maritime radar systems. Although this is not a direct concern to New Zealand, however for visiting naval vessels equipped with radars in these frequency range, we need to understand the impact and potential sharing or exclusions zones.

Future users

Potential new users – Fixed Wireless Access (FWA) and industry verticals

Impacts on other users

In band, the biggest impact on amateur users – if we have to split / make smaller their current operation. Also managing the expectation / relationship with other regional / local users of the allocation.

Technical constraints

How prescriptive are we? How do we manage sharing? The border issues between different operators of any allocation?

Timing

It would be ideal to align the commencement date with the 1 November 2022 start of the 3.5 GHz band. This would allow for current regional users in the crown MRs to be migrated out. We could even consider short-term radio licences to allow a transition period into the new band(s).

Sharing and compatibility considerations

There are a number of sharing and compatibility considerations for both in band and adjacent bands. An overview is are given in table 1 below. Normally interference to the newcomer to the band (5G in this case) is not fully analysed but it is include in the table to give a complete picture.

Table 1 –Sharing and compatibility considerations

Interferer	Victim	Description	Options / Action
3 300 – 3 410 MHz 5G	3 100 -3 300 MHz Radiolocation (Radar)	If there are any use of these radars they will be at specific locations / areas which could be managed through co-ordination zones. If these	If radars are used, manage through coordination zones

3 100 -3 300 MHz Radiolocation (Radar)	3 300 – 3 410 MHz 5G	are used on naval vessels then this could be more challenging, particularly for visiting naval vessels. For an adjacent band case, the types of radar systems that operate in these bands have sensitive receivers with little filtering (likely to be designed to work up to 3400 MHz). The receiver performance of the radars will likely dominate the adjacent interference scenarios determining the size of coordination zone. However, unwanted emissions may need to be considered. For an in band case the interference scenario will be driven by the 5G transmit power and the thermal noise floor of the radar receiver. Coordination zones for the in-band case will be much larger than the adjacent band case.	around specific locations / areas
3 300 – 3410 MHz 5G	3 300 – 3 410 MHz Amateur	There is a risk that 5G will cause interference to amateurs radio within a certain separation distance (depending on terrain, clutter etc). Amateur radio must accept interference from other services, and it is likely that spectrum will still be available in certain geographic areas in the medium term There is a risk that Amateur radio may cause interference to 5G. Amateurs are not allowed to cause interference (special condition 1 of the GURL) to other services and it is expected that they will listen before transmitting. However, due to the high power permitted they may not hear 5G and cause interference. There may also be some cases where amateur radio operators transmit anyway (either because they forgot to listen first or heard it and transmitted anyway).	To manage interference to Amateur radio, they can either accept interference or clear the band To manage interference to 5G the power in the GURL could be lowered with education on listen before transmit, we could monitor the situation to see if problems occur or we can clear the band
3 300 – 3 410 MHz Amateur	3 300 – 3 410 MHz 5G		
3 300 – 3 410 MHz 5G	2 700 -3 400 MHz UWB	UWB is designed to be robust to interference and must accept interference from other spectrum users. UWB also underlays 5G in 3400	No action needed.
2 700 -3 400 MHz UWB	3 300 – 3 410 MHz 5G		

		-3800 MHz and there are no known issues. However, there could be a possibly of degradation to UWB performance in certain areas. UWB is unlikely to cause interference to 5G. The power spectral density limits are designed to co-exist with other primary radio systems	
3 300 – 3 410 MHz 5G	3 332-3 339 MHz 3 345.8-3 352.5 MHz Radio Astronomy	If Radio Astronomy has very sensitive receivers and would be susceptible to in band and unwanted emissions. Radio Astronomy is usually at very few specific locations. Interference to Radio Astronomy can be managed through co-ordination zones around those sites. New Zealand does not have any receive protection licences for Radio Astronomy.	If Radio Astronomy is being used then this could be managed through co-ordination zones / receive protection licences. We should avoid allowing these zones / licence in urban or suburban areas.
3 300 – 3 410 MHz 5G	3 300 – 3 410 MHz 5G	If there are going to be different network operators sharing the same frequency ranges technical rules will be needed to manage interference between networks. A more spectrally efficient approach will be to base this in a metric such as degradation of throughput rather than interference to noise. If networks are operating adjacent to each other this will need the same considerations as 3400 – 3800 MHz (below).	TBD
3 300 – 3 410 MHz 5G	3 410 – 3 800 MHz 5G	As noted we have previously considered regional and national using the 3.5 GHz band together. One of the proposals for allowing this to happen to allow regional and national operators was a 40 MHz of guard band. A second option would be to mandate synchronisation would be mandated for all the users in the band, which would allow a 0 MHz guard band Therefore, the starting positions for protecting the 3.5 GHz would be one of these two scenarios. Obviously, synchronisation is only possible with	TBD

		equipment that regional operators could access at a lower price point. If we allow non-3GPP compliant equipment s9(2)(g)(i) this may have poorer adjacent channel leakage ratio and adjacent channel selectivity. This could result in some compatibility issues with adjacent 5G. This could possibly be managed with frequency or geographic separation.	

Neighbouring bands

How / what would sharing with incumbent users and new neighbours (the 3.5 GHz band) beyond October 2022 look like? e.g. interference management, guard bands, tuning ranges, locations.

Equipment availability

At least two manufactures who are producing equipment for CBRS use in the United States, have equipment that is available to operate between 3.3 GHz. These are New Zealand based agents for these products. Furthermore, an industry consultant has told us that SCADA equipment is coming to market which is enabled for C band use, being the 3 300 – 3 800 MHz range as default, with overseas vendors seeking to provide in band flexibility.

The frequency range is specified by 3GPP band N77 and covers the 3 300 – 4 200 MHz frequency range. In theory base stations and mobile user equipment should support this entire band. However, it is currently unclear on if all base stations and user equipment support the entire frequency range in practice given the piecemeal availability of 3 300 -3 400 MHz and 3 800 – 4 200 MHz equipment.

How will the band be allocated?

The definitive allocation is still to be decided and the policy work will progress this. However so we can consider from unlikely to likely scenarios based on what has worked to date / current thinking

Most Unlikely

Regional / local Management Rights – there is no legislation in place for this to happen at this time and none is expected to be in place by November 2022, however a regional rights construct could be enabled with the right mix of nationwide Crown Management Right (MR) and spectrum licencing rules for this MR.

GUL – there are other bands for GUL use. We want some form of overt management, a GUL does not provide any kind of exclusivity in the band. However,

indoor GUL use could be undertaken with some appropriate rules and power limits in place.

Managed Spectrum Park – We currently have 40 MHz in the 2.5 GHz band under a crown MR, which is allocated on a contestable basis, with some sharing permitted in a geographic area based on local authority boundaries. Park users can only have a certain amount of geographic areas , as it's for regional and not national use. Incumbent users like the park, however in its current form, there is currently a high administrative burden on the crown. Improvements could be made – see here for suggestions. It would be likely that some more technical prescriptive measures could be implemented, along with higher resource charging to provide more uniform use within a MSP style allocation.

Radio licencing – First in, first served licences has some issues with people potentially speculating and scarcity occurring in the band. However if appropriate in band sharing rules are in place, along with common technical rules, then radio licencing could be an option for all or part of these regional / local uses.

Most likely

Use cases

There are a number of use cases that could be used in this band. Networks could be deployed by many different kinds of users for a wide range of purposes, including IoT devices. Larger bandwidths, would support systems that needs to quickly transfer large amounts of data. 5G technology can support ultra-reliable, low latency communications, which may be desired in a number of applications. Outlined below are some different deployment / licencing scenarios that should be considered:

Regional broadband. There are existing regional broadband providers in the paired Crown MRs just above this band (3 410 – 3 424 and 3 510 – 3 524 MHz). Their rights will expire in Oct 2022, along with those national rights holders. As all the licences in the 3.5 GHz band (baring some satellite receive licences in Warkworth) are not being renewed.

Campus / local use. Single site locations e.g. manufacturing at a single location, or SCADA in a specific area or geographic spread eg electricity switchyard or defined geographic area for SCADA control of a utility networks assets.

Industry Verticals. Agriculture, mining, oil & gas, wide scale utilities, enterprises, industrial IoT manufacturing, logistics and multi-site orgs that would like spectrum at specific locations e.g. Fonterra or Fletchers who would like to have access to a dedicated network across the country at their sites.

General access. Allow for very low power use, with some technical parameters to allow general access with no individual licences required to be issued.

Policy stages

Complete

Stage 1: main BIM, and Second tier BIM introduces the opportunity regarding wider 5G spectrum issues; secure initial direction from Minister at initial high level briefings

To do in Feb 2021 with the Minister

Stage 2: Figure out policy details including IMSC role in the work.

Beyond Feb 2021

There are further stages in the policy process, but not required to be detailed here.

[How / what would sharing with incumbent users and new neighbours (above 3 410 MHz) beyond October 2022 look like? e.g. interference management, guard bands, tuning ranges, locations]

Out of scope

From: Peter Gent
Sent: Tuesday, 30 March 2021 12:00 PM
To: Xin Tang; Craig Scott
Subject: Cambium equipment performance [UNCLASSIFIED]
Attachments: PMP450m 3 GHz RF test reports.zip

Attachments withheld in full under sections 9(2)(ba)(i) and 9(2)(b)(ii)

Importance: Low

Hi,

Cambium has sent over the FCC/ ETSI / IC reports for some of their 3 GHz products. Could one of you have a quick read through and see if there is enough information for various sharing and compatibility considerations we might undertake between cambium and 3GPP kit?

Thanks

Pete

From: s9(2)(a) @cambiumnetworks.com>
Sent: Tuesday, 30 March 2021 8:30 AM
To: Peter Gent <Peter.Gent@mbie.govt.nz>; s9(2)(a) @cambiumnetworks.com>
Subject: RE: [External] Equipment performance request [UNCLASSIFIED]

Hi Peter,

I am not sure if we use ACLR and spurious emission terms for PMP products , but from FCC and ETSI report there should be similar test items. You can download the FCC/ETSI RF test report for the PMP450m here.

In LTE (cnRanger), we do have ACLR and spurious emission data, due to the fact we follow 3GPP standards which specifically list them.

Please let me know if these reports suit. I'm still waiting for confirmation on the existence of ACLR for the 450 equipment.

Regards,

s9(2)(a)

Cambium Networks™

s9(2)(a)

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Wednesday, 24 March 2021 11:04 AM
To: s9(2)(a) @cambiumnetworks.com>; s9(2)(a) s9(2)(a) @cambiumnetworks.com>
Subject: Re: [External] Equipment performance request [UNCLASSIFIED]

Hi s9(2)(a)

thanks very much.

Regarding your 5.1 / 5.2 / 5/4 GHz questions via separate emails, I'll aim to look at them tomorrow or Friday, to get some answers for you.

Kind regards

Peter

From: s9(2)(a) @cambiumnetworks.com>
Sent: Wednesday, 24 March 2021 12:43 PM
To: Peter Gent <Peter.Gent@mbie.govt.nz>; s9(2)(a) @cambiumnetworks.com>
Subject: RE: [External] Equipment performance request [UNCLASSIFIED]

Thanks, Peter.

I'm chasing the relevant reports for you.

s9(2)(a)

Cambium Networks™

s9(2)(a)

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Wednesday, 24 March 2021 9:34 AM
To: s9(2)(a) @cambiumnetworks.com>; s9(2)(a) @cambiumnetworks.com>
Subject: Re: [External] Equipment performance request [UNCLASSIFIED]

Hi s9(2)(a)

apologies, keyboard error - its ACLR, not the neighbouring "E"

Thanks

Peter

From: s9(2)(a) @cambiumnetworks.com>
Sent: Wednesday, 24 March 2021 11:18 AM
To: s9(2)(a) @cambiumnetworks.com>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: [External] Equipment performance request [UNCLASSIFIED]

Hi Peter – sorry but I'm not familiar with ACLE. Could you please tell me what this is?

s9(2)(a)

Cambium Networks™

s9(2)(a)

From: s9(2)(a) @cambiumnetworks.com>
Sent: Monday, 22 March 2021 1:29 PM
To: Peter Gent <Peter.Gent@mbie.govt.nz>; s9(2)(a) @cambiumnetworks.com>
Subject: RE: [External] Equipment performance request [UNCLASSIFIED]

Hi Peter

Thanks for reaching out.

We have two solutions that will fit in this band. Both to 3.3GHz to 3.9GHz

1. PMP450i
2. PMP450m

Note, we also have a Fixed LTE product (standards based, but that operates from 3.4-3.8GHz).

Eddie see below, performance metric required… " On the transmitter side, we interested in at a minimum of the ACLE and spurious emission performance, and on the receiver side, ACS and receiver blocking."

Regards
s9(2)(a)

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Monday, 22 March 2021 1:10 PM
To: s9(2)(a) @cambiumnetworks.com>
Subject: [External] Equipment performance request [UNCLASSIFIED]

Hi s9(2)(a)

As I noted to Eddie last month, we are looking at 3.3 – 3.4 GHz for non-national and regional use, which we aim to compliment the 3.4 – 3. 8 GHz work aimed at national use.

As part of this work, we are undertaking some scenario analysis between national and regional use, and I was therefore wondering if it's possible to access some detailed equipment performance metrics for Cambium products? On the transmitter side, we interested in at a minimum of the ACLE and spurious emission performance, and on the receiver side, ACS and receiver blocking.

If it's possible to get access to this data for one of the cambium products for the 3.3 – 3.4 GHz band (e.g. a PMP 450m access point), it would be incredibly useful to our work on this band.

Thank you in advance

Peter

Peter Gent
SENIOR PLANNER

Radio Spectrum Management

Commerce, Consumers and Communications Branch, Building, Resources and Markets Group
Ministry of Business, Innovation & Employment

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RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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Out of scope

From: Craig Scott
Sent: Tuesday, 14 September 2021 11:24 AM
To: Len Starling
Subject: FW: September 2021 TWG presentation and call for proposals [UNCLASSIFIED]
Attachments: 3.5 GHz Technical Working Group 2021 09.pdf

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Monday, 13 September 2021 17:59
Subject: RE: September 2021 TWG presentation and call for proposals [UNCLASSIFIED]

Good afternoon,

Please find attached a copy of the updated slide pack for Wednesday afternoon's TWG meeting.

Regards

RSM

From: Peter Gent
Sent: Wednesday, 8 September 2021 1:49 PM
Subject: September 2021 TWG presentation and call for proposals [UNCLASSIFIED]

Good afternoon,

In light of the current Covid-19 lockdown in Auckland, as well as the limited indoor gathering restrictions in Wellington, the Ministry has decided to move the TWG meeting entirely online. Please use the MS Teams (below) to join the meeting next Wednesday at 14:00 Hrs.
A copy of the updated slide pack will be distributed to all participants before the meeting, either later this week or early next week.

We look forward to seeing you then

Regards

RSM

-----Original Appointment-----
From: Peter Gent
Sent: Wednesday, 1 September 2021 11:32 AM
To: Peter Gent
Cc: s9(2)(a)@ansconsult.net; s9(2)(a)
Su eptember 2021 TWG presentation and call for proposals
When: Wednesday, 15 September 2021 2:00 PM-4:00 PM (UTC+12:00) Auckland, Wellington.
Where: MBIE 25 The Terrace Wellington and MS Teams

Dear TWG Participant,

Further to the invitation sent to you last week to attend the September 2021 TWG meeting, please find attached the draft slides from the Ministry which will be used for the basis of our discussions on September 15. These slides also contain a draft agenda and a list of technical topics for the meeting as given below:

1. Introduction and Background
2. Technical discussion
    a. Technology choices and standards
    b. Synchronisation and frame structure
    c. Unwanted emission limits
    d. Other technical issues
3. Any other business
4. Summary and next steps

In advance of the meeting we are calling for proposals and technical input from attendees on the technical subjects listed for providing stakeholder technical input to the meeting in addition to the Ministry's material in the slide. Material from attendees should be in the form of power point slide(s) against each technical topic that can be inserted into placeholders in the attached slides. The material will be talked through in the meeting but please keep in mind that there is a limited amount of time so please focus on the main topics and keep your material concise and with no more than a couple of slides on each topic. We anticipate that there will be further technical working group meetings to discuss issues in more details and cover other topics if needs be.

In order to allow us time to consider the proposals and incorporate these into the presentation for distribution to all participants before the meeting, please submit any proposals by COB on September 8 to radio.spectrum@mbie.govt.nz

Finally for those joining us online, and if we unable to host a physical meeting in Wellington, the MS Teams link is below for the meeting

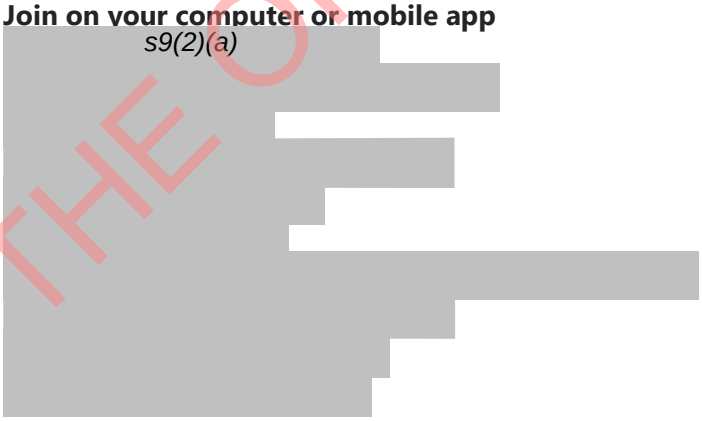
Regards

RSM

Microsoft Teams meeting

Join on your computer or mobile app

s9(2)(a)



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RADIO SPECTRUM MANAGEMENT

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RADIO SPECTRUM MANAGEMENT

Technical Working Group on 3.3-3.8 GHz

September 15 2021

TWG Meeting Agenda

1. Introduction and Background (15 min)
2. Technical discussion (75 min)
    a. Technology choices and standards
        - Presentation or information from stakeholders
    b. Synchronisation and frame structure
        - Presentation or information from stakeholders
    c. Unwanted emission limits
        - Presentation or information from stakeholders
    d. Other technical issues
        - Presentation or information from stakeholders
3. Any other business (10 min)
4. Summary and next steps (15 min)

1. Introduction and Background

- Introduction
- Background and brief summary
  - What has happened to date and previous work
  - Short-term 5G rights
  - National and non national uses
- Aim of meeting
  - Share information between stakeholders to inform technical options for decision-making
  - First in a new series of TWG meetings
  - In this meeting we won't be directly discussing allocation or policy

2. Technical subjects for discussion

- Technology choices and standards
- Synchronisation and frame structure options
- Unwanted emission limits
  - How these translate into Adjacent Frequency Emission Limits (AFELs)
  - EIRP vs TRP
- Other technical issues

2a Technology choices and standards

- Current rules for the 3.5 GHz Early Access Allocation
  - Based on 3GPP standards TS 38.104 (Base stations - Release 15).
  - Developed after previous TWG discussions
  - Have now been in use for over 12 months
- Rules going forward
  - Our objective is to be technology flexible while managing compatibility issues

2a Technology choices and standards

- Presentations or information from stakeholders
  - None

2b Synchronisation and frame structure

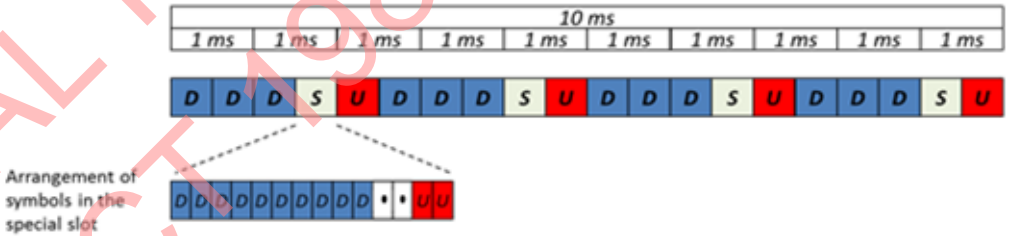
- Issues to consider in frame structure selection:
  - Down Link to Uplink (DL/UL) traffic ratio;
  - Spectrum utilisation efficiency;
  - Round-trip time (RTT) latency;
  - Coverage (DL synch. coverage and UL coverage).

2b Synchronisation and frame structure

- Early access 3.5GHz frame structure

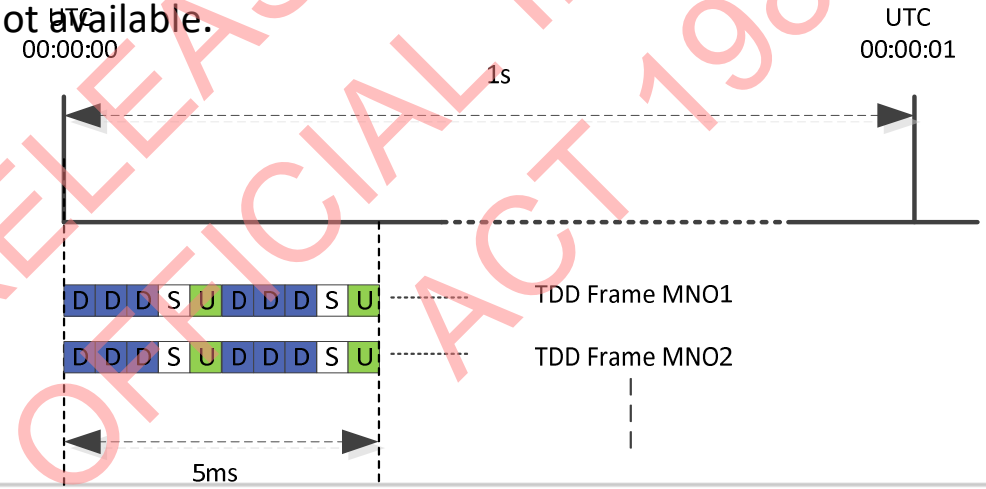
Duration of a frame	10 ms
Reference Subcarrier Spacing	30 kHz (20 slots in one frame)
Periodicity of the DL-UL pattern	2.5ms
DL/UL traffic ratio	3:1
Number of consecutive full DL slots at the beginning of each pattern	3
Number of consecutive DL symbols in the beginning of the slot following the last full DL slot	10
Number of consecutive full UL slots at the end of each pattern	1
Number of consecutive UL symbols in the end of the slot preceding the first full UL slot	2
Number of guard period symbols	2

One uplink slot in every 2.5ms
Low latency communication frame structure



2b Synchronisation and frame structure

- Phase clock reference and accuracy requirement
  - Tranmitters needs to synchronise their frame on a UTC primary reference time clock (PRTC).
  - The start point of the first timeslot needs to align with UTC second with a time offset T_offset = 0 and an accuracy of ≤±1.5µs.
  - A distributed PRTC approach, implementing on (GNSS) receiver. At the base station, the transmitted radio frame shall be time-aligned with the 1pps timing pulse.
  - Packet-based methods (IEEE1588) with timing support of intermediate nodes where GNSS coverage is not available.



2b Synchronisation and frame structure

- Dealing with concurrent LTE and 5G use:
  - Options to synchronise with TDD-LTE and 5G NR
  - Different stakeholder technology roadmaps and 5G Stand Alone still some time away

Benefit: equipment availability and cost for deploying
Trade-off: a higher RTT and user plane latency

Slot / non-slot based scheduling	Latency		Frame structure (GP: 2 OFDM symbols)	
			DDDSU (early access 5G)	DDDDDDDSUU
Non-slot based scheduling	User plane latency (ms)	p=0	1.22	2.01
		p=0.1	1.39	2.30
	RTT (ms)		1.71	2.95
Slot-based scheduling	User plane latency (ms)	p=0	1.61	2.40
		p=0.1	1.80	2.72
	RTT (ms)		1.90	3.14

2b Synchronisation and frame structure

- Presentations or information from stakeholders
  - Spark NZ

Frame Structures

Spark Position – *Retain current C-Band frame structure, however, leave open possibility for future reconsiderations, based on industry and regulatory consensus.*

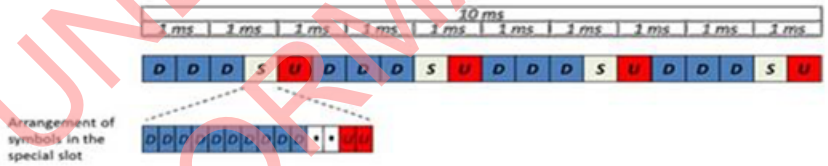
Rationale –

Current frame structure arrangement [DDDSU] for C-Band algins with most global C-Band deployments, from information shared by other operators and our infrastructure vendors.

Coverage of current C-Band infrastructure including massive MIMO capabilities doesn't appear to be limiting access to C-Band NR cells. We expect optimisation of PRACH frame formats (operator specific) and RS planning (operator specific) should provide sufficient flexibility.

Downlink vs Uplink imbalance is still in line with expected broadband split of traffic between DL and UL. This is subject to change over time as 5G use-cases evolve, however we expect UL enhancements for NR will help to close the gap [higher order modulation, joint recievers, CA / DC enhancements] which should be explored first before considering rebalancing of resources.

Figure 1 Frame structure for Early Access Spectrum



(b) Common phase clock reference and accuracy requirement

Right holders must synchronise their frame structure on a UTC primary reference time clock. The start point of the first timeslot in the frame must align with the UTC second with a time offset T_{offset} = 0 and an accuracy of ≤±1.5μs. The frequency accuracy must be within ±50ppb. Figure 2 shows the concept of time alignment between two different Mobile Network Operators (MNO).

Synchronisation

C-Band as a TDD system requires strict adherence to synchronisation.

The requirements outlined previously for C-Band can be satisfied by current RAN infrastructure vendor implementations, providing they have a suitable PRC input [National synchronisation to maintain 1.5us accuracy and frequency accuracy of 50ppb].

Options include GPS and Network based timing. Implementation needs to cater for both Phase and Frequency based synchronisation.

For any timing solution it's important that operators implement appropriate alarming and monitoring to ensure compliance, and where required measurement of drift or variation.

What needs to be agreed is how failure scenarios are handled :-

- Limits of system holdover (when PRC input goes offline or is unavailable)
- What happens after expiry of holdover.

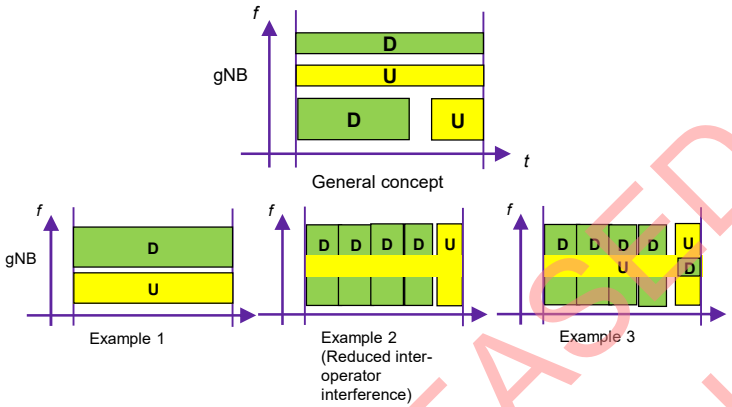
Other users [3.3 – 3.4GHz]

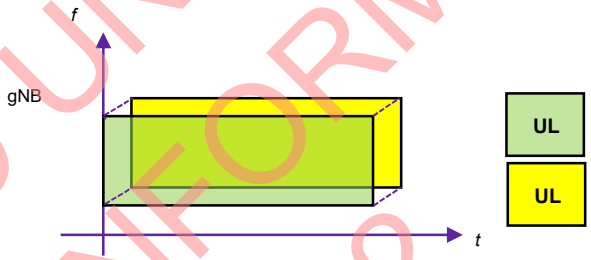
It's noted that 3.3GHz to 3.4 GHz falls under spectrum blocks /bands n78 and n77. As adjacent rights holders in the same 3gpp band as mobile operators, the same synchronisation requirements, and framing should be adhered too in order to adopted to minimise the risk of interference.

Future Synchronisation Requirements

3gpp is actively looking at more advanced synchronisation techniques to support additional use cases such and more accurate UE positioning etc. This requirements are likely to exceed system level requirements required to adhere to a national standard.

Full Duplex Operations – Impacts to TDD- Rel 18 workshop (ref CMCC)





Type-1 FD (Sub-band wise full duplex)

gNB: Simultaneous Tx and Rx in difference sub-bands

UE: may not support simultaneous Tx and Rx

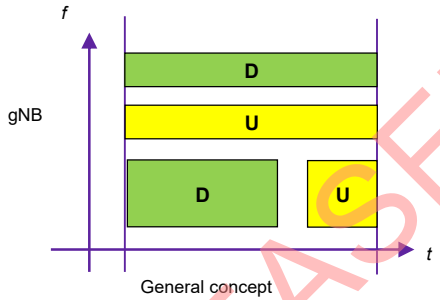
UL-only/DL-only/TDD sub-bands can be configured in the TDD carrier

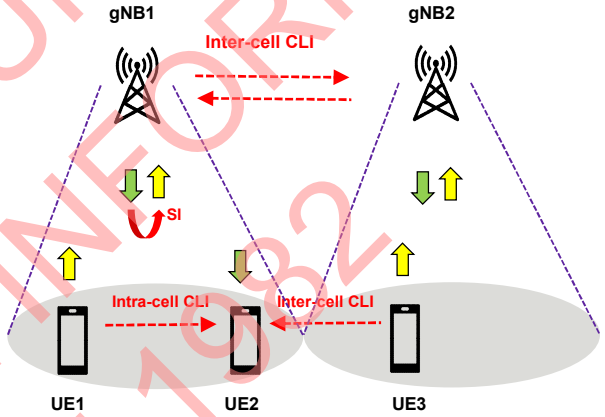
Type-2 FD (Frequency fully overlapped full duplex)

gNB: Simultaneous Tx and Rx in the same frequency resources

UE: may not support simultaneous Tx and Rx

Type-1 FD Operation – 3GPP Rel 18 workshop (Ref CMCC)

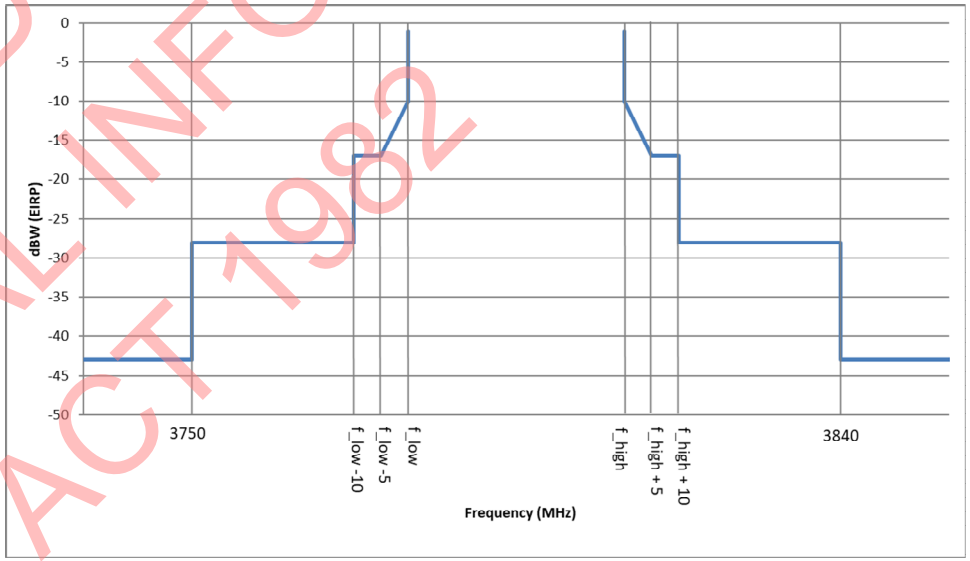




Mitigation of interference requires 120- 150 dB isolation

2c Unwanted emission limits

- Unwanted emission limits in 3.5 GHz early access
  - In the form of a AFEL
  - Based on 3GPP TS38.104 (Release 15)
  - Prescribed in EIRP
  - AFEL=Base Limit (Cat B)+ 17dBi (passive antenna)
  - Operate band 3590 – 3800 MHz (non-standard)
  - Down Link to Uplink (DL/UL) traffic ratio;
  - Spectrum utilisation efficiency
  - Statutory declaration for AAS 5G
  - Round-trip time (RTT) latency
  - Coverage (DL synch. coverage and UL coverage).
  - OBUE (< ±40MHz) + Spurious Emissions



2c Unwanted emission limits

- Unwanted emission limits for long term use:
  - Operating band expands to 3300 – 3800 MHz (Standard N78)
  - OBUE (< ±40MHz) + Spurious Emissions
  - Unwanted Emission format:
    - Option 1: TRP based fully align with 3GPP (Note: this requires regulation change)
    - Option 2: AFEL(EIRP)=Base Limit + 10dBi + (X scaling factor)+ MIMO gain

64TRX 192 Antenna Elements	Sub-array (dBi)	Scaling factor (dB)	MIMO layers	Total gain (dBi)	16TRX 96 Antenna Elements	Sub-array (dBi)	Scaling factor (dB)	MIMO layers	Total gain
	10	9	2	22		10	9	2	22
	10	9	4	25		10	9	4	25
	10	9	8	28		10	6	8	25
	10	6	16	28		10	0	16	22
32TRX 96 Antenna Elements	**Sub-array (dBi)**	**Scaling factor (dB)**	**MIMO layers**	**Total gain**	**8TRX 48 Antenna Elements**	**Sub-array (dBi)**	**Scaling factor (dB)**	**MIMO layers**	**Total gain**
	10	9	2	22		10	6	2	19
	10	9	4	25		10	3	4	19
	10	6	8	25		10	0	8	19

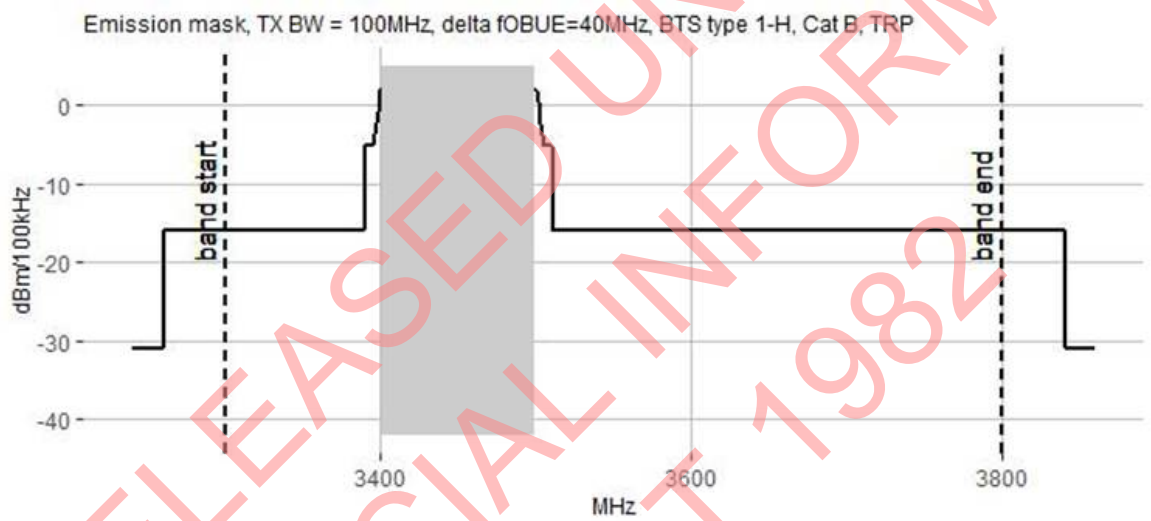
The highest antenna gain happens during single user MIMO, which antenna array forms one beam to user

The maximum number of transmitters counted per cell is 8 by 3GPP

2c Unwanted emission limits

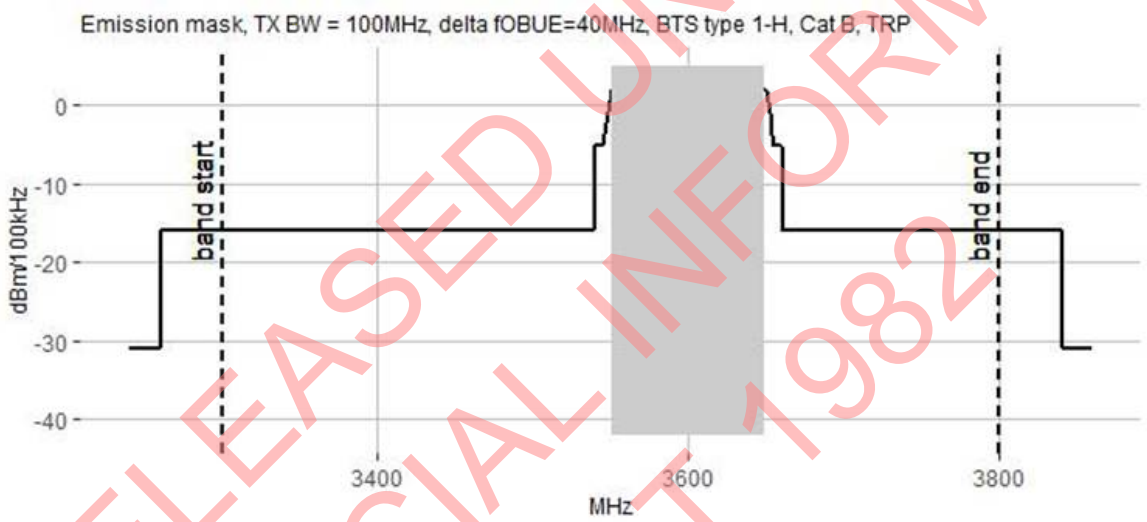
- Presentations or information from stakeholders
  - Spark NZ

OOBE Plot – 100MHz Carrier, Low



- **Assumptions**
- for type 1-H category B BTS
- 3GPP band n78 which is 3300MHz-3800MHz
- Centre frequency 3450MHz
- **References**
- TS38.104 Table 6.6.1-1: Maximum offset of OBUE outside the downlink operating band (as BW = 100MHz, delta f OBUE = 40MHz)
- Table 6.6.4.2.2.1-2: Wide Area BS operating band unwanted emission limits (NR bands above 1 GHz) for Category B
- Table 6.6.5.2.1-2: General BS transmitter spurious emission limits in FR1, Category B

OOBE Plot – 100MHz Carrier, Mid



- **Assumptions**
- for type 1-H category B BTS
- 3GPP band n78 which is 3300MHz-3800MHz
- Centre frequency 3600MHz
- **References**
- TS38.104 Table 6.6.1-1: Maximum offset of OBUE outside the downlink operating band (as BW = 100MHz, delta f OBUE = 40MHz)
- Table 6.6.4.2.2.1-2: Wide Area BS operating band unwanted emission limits (NR bands above 1 GHz) for Category B
- Table 6.6.5.2.1-2: General BS transmitter spurious emission limits in FR1, Category B

OOBE Plot – 100MHz Carrier, High

- **Assumptions**
- for type 1-H category B BTS
- 3GPP band n78 which is 3300MHz-3800MHz
- Centre frequency 3750MHz
- **References**
- TS38.104 Table 6.6.1-1: Maximum offset of OBUE outside the downlink operating band (as BW = 100MHz, delta f OBUE = 40MHz)
- Table 6.6.4.2.2.1-2: Wide Area BS operating band unwanted emission limits (NR bands above 1 GHz) for Category B
- Table 6.6.5.2.1-2: General BS transmitter spurious emission limits in FR1, Category B

2d Other technical issues

- Presentations or information from stakeholders
  - None

3 Any other business

4 Summary and next steps

3.3 – 3.8 GHz Technical Working Group meeting

Summary of discussion

15 Sept 2021

ATTENDEES - SEE ANNEX 1

SLIDES – SEE ANNEX 2

Peter Gent (RSM), Chair of the TWG opened the meeting at 1400 Hrs, welcoming everyone to the meeting

1 Introduction – Slide 3

Len Starling (RSM) gave an overview of the broader context of the 3.3 – 3.8 GHz band and the need to re-establishment of the TWG. RSM last held a meeting of the TWG in September 2019. Since then RSM undertook the early access spectrum allocation. It was noted that all the rights expire in October 2022 and going forward there may need to be to a re-stack in band.

It was noted that at this stage, information on allocation issues is not ready to be shared. The focus of this TWG meeting is technical matters only, no policy or allocation issues are up for discussion. Furthermore, it was explained that there is ongoing work with MSWG and that these stakeholders on the call. There was no update for this meeting either.

Peter Gent (RSM) gave an overview of how the TWG meeting would be be run and explained the items on the agenda for discussion as well as the inputs from stakeholders.

2A Technology choices and standards – slides 5 & 6

Craig Scott (RSM) noted that for the early access allocation, the technical conditions have based technology on 3GPP TS 38.104 for Base Stations and TS 38.101 for User Equipment, as per 3GPP Release 15 (5G NR), as a result of previous TWG meetings. Crag noted that releases since setting these technical conditions Release 16 has been finalised and Release 17 will be finalised in early 2022. However, these later releases are comparable from an spectrum management perspective. The idea is to aim to implement least restrictive conditions possible, with technology flexible, light rules while achieving the most technically efficient use of spectrum (e.g. minimising frequency separations or distance separations between users or interference issues). There is a balance to be struck between being fully flexibile versus having detailed conditions versus ensuring the most efficient use of spectrum to maximise utility.

Craig noted that there are quite a few aspects to the technology choices and standards. This includes issues around appropriate RF performance both for transmitters and receivers (for example comparable adjacent channel leakage ratios (ACLR) and adjacent channel selectivity (ACS)). Another important aspect in this band is synchronisation which is covered in more detail under section 2B

s9(2)(a) (WISPA) noted that for 3.3 – 3.4 GHz, his members were looking at rural connectivity, with large cell radius of 32 km and 4G LTE (or technologies with a comparable frame structure) could

achieve this. Peter considered that the technical conditions set for the early rights 5G NR could only achieve a radius of 11km, that's 1/9 of the coverage compared with technologies WISPA are using today. 4G LTE configuration 2 is ideal for WISPA. It was also proposed that a 30 MHz guard band or frequency separation between 4G LTE operating in 3.3 -3.38 and up 5G NR to 3.8 -3.41 GHz would be sufficient to manage interference issues. s9(2)(a) (WISPA) added that in rural areas, no guard band frequency separation is needed, as 5G NR exists in those areas meaning that distance separation would achieve the appropriate isolation. It was also highlighted that ECC report 296 provides information on coordination of 4G LTE and 5G NR

s9(2)(a) (Spark) questioned how coexistence issues between LTE structure 2 and 5G NR could be managed.

s9(2)(a) (Vodafone) noted that New Zealand never had 4G LTE in the 3.3-3.8 before, considered that this technology will become obsoleteand was potentially a backwards step. It was suggested that the 3.3 – 3.4 GHz band be used for local and regional use, but to use 5G only in the band. It was highlighted that Vodafone intend to deploy 5G in the C band nationwide, including in rural areas, not just urban areas.

s9(2)(a) (Cisco) noted that there are a number of administrations (including Taiwan & Japan) that are employing local licences for enabling industry verticals to operate where they do not need to fully synchronised.

s9(2)(a) (WISPA) considered that 4G LTE and 5G NR can coexist, and that it is just a matter of timing or frame structure. It was highlighted that CBRS in the US (US 3.55 -3.7 GHz) allows this to happen. However, using LTE configuration 1, limits the cell size to ~10-14km and that for WISPA the frame structure needs to allow larger rural coverage.

Craig Scott (RSM) noted that that the current technical rules are based on Release 15 which was the first release got 5G NR. Previous 3GPP releases (e.g. Releases 10 – 14) cover 4G LTE. It was also noted that many elements of the discussion have been around was trade-off between technology choice versus frequency separation versus distance separation. It has also been highlighted that some users need a larger coverage radius for which they consider only 4G LTE can achieve.

2B Synchronisation and frame structure options – Slides 7 - 16

Xin Tang (RSM) introduced the RSM slides on the current technical conditions for synchronisation and frame structure. It was noted that the early access rules that have been successfully in place over the past 12 months.

s9(2)(a) (Spark) presented their pre-shared slides to the meeting. He noted that there has been global testing of this configuration, with cell range not an issue, ?? can study extended cell range. The current UL/DL ratio is in line with most use cases they are seeing. They would like the whole 3.3-3.8 GHz to have a common synchronisation regime. s9(2)(a) (Spark) noted that Relase 18 information is looking at full duplex configurations and that these may require different frame structures. It was It was explained that 3GPP has been undertaking workshops on this topic and there is ongoing work on Uplink to Downlink ratios. This issue highlights that it is very likely that frame structures will evolve every few years and more frequently than before.

.

s9(2)(a) (Cambium) noted that from a Fixed wireless Access (FWA) viewpoint, Cambium can synchronise with standards-based technologies, which allows a mix of technologies that can be accommodated. RSM do not need to only define rules just from a 4G LTE or 5G NR perspective. FWA should not be lost, just to enable cellular. s9(2)(a) (Cambium) noted that FWA can synchronise at 2.5 or 5ms, though not to frames marked as special. It was also noted that Cambium will continue to update their technologies. For example, they noted that a 28 GHz 5G NR solution is coming on-stream soon. Not looking at 5G NR C band products yet.

Len Starling (RSM) highlighted that the 2020 short-term rights are based on reasonable industry consensus, from previous TWG work. In the early access regime, users can operate on a non – synchronised basis, but cannot claim protection from synchronised services.

s9(2)(a) Vodafone) noted they Vodafone has a long-term roadmap on technology. It was questioned if the the regional equipment keep pace to stay compatible with the use of 5G NR over time.

s9(2)(a) (Spark) noted that Spark has TDD 4G frame structure in other bands already. This is synchronised to other users.

s9(2)(a) (Huawei) notated that the fourth point re coverage, was not covered in presentation.

Xin Tang (RSM) replied to s9(2)(a) comments on coverage. He noted that the UE max Tx power will limit coverage with FWA removing some of those limitations.

Craig Scott (RSM) noted that as per Len's comments users can do something different as long as they don't cause interference. What this means in practice is that if users wish to use a different frame structure (unsynchronised) then either frequency or distance separation will be needed to achieve compatibility. If use becomes ubiquitous (e.g. all users trying to operate in the same area) and want to use different frame structures (unsynchronised) this could mean frequency separation or guard bands will be needed and there is the danger of unused spectrum within the band (inefficient use of spectrum).

2C Unwanted emission limits – Slides 17 – 23

Xin Tang (RSM) introduced the UEL topic talking to the pre-shared slides and explained the current technical conditions unwanted emission limits (implemented as Adjacent Frequency Emission Limits).

s9(2)(a) (Spark) presented three examples of Unwanted Emission Limit masks in the band. There is still deliberation on how to convert TRP to EIRP, however no answer yet and consensus across industry will be needed.

s9(2)(a) (Nokia) noted that there will likely be 512 and 1024 antenna within the next 10 years over many bands and studies are underway, noting that some of the larger arrays may only be implemented in mmWave due to wavelength. It was noted the 32 TX assumptions could be too low for future antennas.

s9(2)(a) (Spark) noted that the emission masks is not one size fits all, and there are hardware filter constraints. There needs to be consideration of UEs,and there's not just TS 38.104 to look at.

s9(2)(a) Vodafone) asked how RSM will enforce compliance with the emission masks if complaints are received noting the use of active antennas and potentially the TRP metric. Eric also questioned what level of compliance will be undertaken.

s9(2)(a) (Huawei) questioned if emission limits will apply across the the entire 3.3-3.4 band GHz noting that the operating band for 3GPP n78 is 3.3 - 3.8 GHz

Xin Tang (RSM) explained that there are various international activities underway on the measurement of Active Antenna Systems and TRP in the field. It was noted that measurements in a lab are well defined. It was explained that field measurement methods in EIRP are well defined while TRP methods are under development. It was noted that this is a matter for the enforcement team. Regarding the frequency range that the emission limits would apply to it noted that the whole 3.3 – 3.8 GHz band would be considered as the b78 or n78 operating band. The 1 November 2022 commencement of rights provides a changce to fully reset the parameters of the band.

2D Other technical issues – Slide 24

Periodic review of technical conditions

Craig Scott (RSM) opened a discussion around the proposal from Spark around review of technical parameters and how often these should be reviewed and the mechanism to review them. It was note in the past many of our rules have been set and not changed for 20+ years, this is due to the conditions being relatively light. Some of the TWG discussion has been about more specific conditions while noting that the rate of technology change is increasing. One approach is to leave it to stakeholders to initiate discussions about a change in technical conditions which they can discuss amongst themselves but agreement would neededfrom all parties. Another approach is to set mandatory review junctures, so as to cope with technology change (e.g. every 5 years)?

s9(2)(a) Vodafone) supported a mechanism for stakeholders to reconsider the technical parameters. Either a rights holder initiated process for RSM to review the band, or a mandatory review junctures.

s9(2)(a) (WISPA) supported the use of a common frame structure and synchronisation. Otherwise, it will affect investment in rural connectivity.

Time source to ensure synchronisation

Xin Tang (RSM) asked the meeting about how could operators meet the challenges of building in timing solutions (e.g. 1 ppps accuracy) for synchronisation, for timing, and for the start of frame when GNSS is not available.

s9(2)(a) (WISPA) noted that for indoor use, there are a number of solutions for timing including the Facebook backed Telecom Infra Project atomic clock on chip https://engineering.fb.com/2021/08/11/open-source/time-appliance/

s9(2)(a) (Nokia) noted that timing solutions needed esp. for indoor use are crucial for deployment and that there are options.

Harmonisation with major markets

s9(2)(a) (Ericsson) supported using 3GPP based limits for emissions limits, masks and technical conditions. If alternative limits were used this would not be aligned with other major markets and

will require customised filtering, which turns into bespoke solutions, and which are less viable as stepping outside of 3GPP is expensive and has long development times.

Other business, summary and next steps

There was no other business raised from the floor

Peter Gent (RSM)outlined the next steps and thanked participants for their active contributions to the TWG. Peter closed the meeting at 1545 hrs

Annex 1 - Attendees

Name	Organisation
s9(2)(a)	Kordia
	Nokia
	Huawei
	Cisco
	IMSC
	Chorus
Cam Scott	RSM
s9(2)(a)	Two Degrees
	Nokia
Craig Scott	RSM
s9(2)(a)	Go Wireless
	Broadtech
	Cambium
	Vodafone
	Spark
	Spark
	Ericsson
	Samsung
	Ericsson

Name	Organisation
s9(2)(a)	WISPA
	Broadtech
Len Starling	RSM
s9(2)(a)	Spark
	Ericsson
	Dense Air
	Spark
Peter Gent	RSM
s9(2)(a)	WISPA
	NZART
	Nokia
	Vodafone
	Cambium
	Samsung
	IMSC
	Nokia
	Cambium
	Two Degrees
Xin Tang	RSM

Annex 2 – Presentation slides

Attachment duplicated in release at pp 685 - 707

3.5 GHz Technical Working Group 202

Out of scope

From: Peter Gent
Sent: Wednesday, 22 September 2021 3:05 PM
To: Xin Tang; Craig Scott
Cc: Cam Scott
Subject: RE: TWG meeting notes Classification removed

Len has asked me to set up a TWG review / scoping for meeting 2 meeting for next week. Will fire an invite through hopefully in the next few hours, so we can thrash out some of these matters together shortly

---

From: Xin Tang <Xin.Tang@mbie.govt.nz>
Sent: Wednesday, 22 September 2021 3:03 PM
To: Craig Scott <Craig.Scott2@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Cc: Cam Scott <Cam.Scott@mbie.govt.nz>
Subject: RE: TWG meeting notes Classification removed

Just for your information.
Following up the discussion on the first TWS, I think there is a need for us to think about including 4G system which may be favoured by some stakeholders.
So I am currently looking for opportunity of implementing unsynchronised or semi-synchronised solutions. Maybe something we can put on the table for the second TWS?

Regards

T.X.

From: Craig Scott <Craig.Scott2@mbie.govt.nz>
Sent: Wednesday, 22 September 2021 2:50 PM
To: Peter Gent <Peter.Gent@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>
Cc: Cam Scott <Cam.Scott@mbie.govt.nz>
Subject: RE: TWG meeting notes Classification removed

Hi Peter,

Thanks for putting this together, I have had a first go through it. I think we should look to provide this to participants so all the points are understood, I think we said we would provide something. While it is really useful from our point of view to know who said what we will want to try keep this narrative neutralised so we don't have people coming back trying to rewrite what they said. I have made some edits to address some of this.

On the points for us outside the minutes / summary. I think these are the following:

1. Get a clearer picture of the radius different frame structures in 4G LTE and 5G NR can achieve. This should be a topic for the next meeting to bottom this issue out (helps us understand if this is a pure technical issue or if it is about cost of equipment and in turn frequency separation is needed)
2. Get a clear picture of where this 30 MHz guard band has come from and if there is any analysis to support it (probably ask JB)
3. Get a better understanding of ECC Report 296 and probably CBRS and the frequency, distance, synchronisation trade off
4. Get a better understanding of what Cambian was talking about and what they can do with synchronisation

Anything else?

Craig

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Tuesday, 21 September 2021 18:41
To: Xin Tang <Xin.Tang@mbie.govt.nz>; Craig Scott <Craig.Scott2@mbie.govt.nz>
Cc: Cam Scott <Cam.Scott@mbie.govt.nz>
Subject: TWG meeting notes [*Classification removed*
Importance: Low

Hi,

Thanks to cam for starting this, I've developed the text into a summary of discussion set of notes from last week's TWG. It could do with a second and third pair of eyes to refine it to make it useful however.
Happy to discuss who our audience is for this – is it internal, or will we circulate this around attendees?

Cheers

Pete

Peter Gent
SENIOR PLANNER

Radio Spectrum Management
Digital, Communication & Transformation Branch, Building, Resources and Markets Group
Ministry of Business, Innovation & Employment

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RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Out of scope

From: Craig Scott
Sent: Monday, 4 October 2021 1:17 PM
To: Peter Gent; Xin Tang
Subject: RE: 3.3 GHz guard band question [UNCLASSIFIED]

Thanks for following up on this, very good to get a understanding on the basis.

It does not look like there is much of a technical basis or analysis for 30 MHz and it is more of a technical guess, also the receiver performance (probably the weakest link) has not been considered. That said, I do agree with some of s9(2)(a) general points and the guard band might be able to be less than 40 MHz depending on the circumstances.

Craig

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Monday, 4 October 2021 12:21
To: Xin Tang <Xin.Tang@mbie.govt.nz>; Craig Scott <Craig.Scott2@mbie.govt.nz>
Subject: FW: 3.3 GHz guard band question [UNCLASSIFIED]
Importance: Low

For your information – s9(2)(a) 's 30 MHz answer

From: s9(2)(a)
Sent: Friday, 1 October 2021 9:21 PM
To: Peter Gent <Peter.Gent@mbie.govt.nz>
Cc: Len Starling <Len.Starling@mbie.govt.nz>
Subject: Re: 3.3 GHz guard band question [UNCLASSIFIED]

Hi Peter,

In my 3.3 GHz submission, I preferred that the entire band from 3.3-3.8 GHz be set to a frame structure compatible with both 5G nr and 4G LTE. Such a frame structure would allow for a large cell radius appropriate for rural use. It would not meet the 5G latency requirements for URLLC but it also would not be incompatible with equipment available on the market.

As an acceptable compromise I suggested that the part of the shared band adjacent to the MNOs be set to their synchronisation, then a 10 MHz guard implemented in the middle of the band, breaking the band into 5G and 4G sections. I considered this acceptable and believe that interference could be managed this way within the shared band - especially given the intended use of the band for fixed wireless, and the generally higher tolerance for interference most smaller carriers have.

I submitted that a configuration with a guard band in between the regional/rural allocation and the MNOs was the most restrictive option.

Subsequent to that submission I spoke in depth with an engineer working for one of the MNOs. I've since changed my position to endorse a guard band between the blocks because the carriers will not consider changing their TDD pattern to match rural users, and rural users cannot use their pattern to provide the cell sizes they need to serve their customers. So some points about the guard band:

- MNOs are looking for 40 MHz for a guard band, I believe based on the OoB domain from ITU-R SM.1541-6.
- A guard band should be "as required" when unsynchronised or semi-synchronised use in the rural/regional block would have an impact on an active license. If the owner of an adjacent band isn't using that band in a particular region, there shouldn't be any requirement for a user of the regional band to implement a guard band - if they won't be causing interference, they should be able to operate to the band edge.

Where a guard band is required, I've suggested 30 MHz as appropriate because:

- the equipment being manufactured today provides UEL performance that exceeds the ITU standards developed some years ago
- in the cases of equipment with worse UEL, transmit power can be reduced to compensate
- 30 MHz would be sufficient separation from the MNO OoB domain for fixed wireless users who are operating with high gain fixed antennas & unlikely to encounter interference from the MNOs

I'd also like to add that given further study of the market, any regional block should be moved to the top of the band: 3690-3800. n78 supports 3300-3800, but common LTE bands B37 & B38 only support 3400-3600 and 3600-3800 respectively. They're both well established bands and we should expect new hardware support for them to persist through 2030. There is little equipment available for 3300-3400 and changes in China mean it will probably go out of use soon. So shifting the regional/rural block up to the top of the range has no negative impact on providers who plan to deploy 5G, but a large positive impact on users who want to deploy 4G now.

Thank You,

s9(2)(a)

On Fri, 1 Oct 2021 at 06:57, Peter Gent <Peter.Gent@mbie.govt.nz> wrote:

> Hi s9(2)(a)
>
> During our internal preparation for the next TWG, we have been wondering about the 30 MHz guard band figure noted in your 3.3 GHz submission as well as made orally at the 1st TWG meeting a couple of weeks ago.
>
> Could you possibly provide us with some background on that figure and how you developed it? In the 2019 TWG meetings, RSM noted a 40 MHz figure and we are interested in your thinking for a 30 MHz guard band.
>
> Thank you in advance
>
> Peter

Peter Gent
SENIOR PLANNER

Radio Spectrum Management

Digital, Communication & Transformation Branch, Building, Resources and Markets Group

Ministry of Business, Innovation & Employment

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Out of scope

From: Peter Gent
Sent: Thursday, 7 October 2021 3:39 PM
To: Xin Tang; Len Starling
Cc: Craig Scott
Subject: RE: 3.3GHZ CONSULATION Classification removed

Just adding into this discussion something we just noted offline. We may need to understand the existing MNOs equipment tuning ranges sooner rather than later. Craig has had some very informal updates from one MNO already and we might need some direct engagement with MNOs on what they can and cannot do with existing or ordered equipment.

Secondly, the WISPA paper is directly focused on LTE equipment. Noting that Cambium is proprietary, it might be an indirect move to stay away from Cambium (as a sole equipment supplier?)

From: Xin Tang <Xin.Tang@mbie.govt.nz>
Sent: Thursday, 7 October 2021 3:31 PM
To: Len Starling <Len.Starling@mbie.govt.nz>
Cc: Craig Scott <Craig.Scott2@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3GHZ CONSULATION

Yes, we can definitely have some informal discussions with major equipment providers.
I believe this will feed into our preparation for the second TWG meeting.

Regards

T.X.

From: Len Starling <Len.Starling@mbie.govt.nz>
Sent: Thursday, 7 October 2021 3:27 PM
To: Xin Tang <Xin.Tang@mbie.govt.nz>
Cc: Craig Scott <Craig.Scott2@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3GHZ CONSULATION

Thanks Xin

I can see that top-of-the-band for WISPs might solve some other problems for us. At the lower end … do we know about 5G equipment availability down to 3.3 GHz? Worth checking with s9(2)(a)

From: Xin Tang <Xin.Tang@mbie.govt.nz>
Sent: Thursday, 7 October 2021 3:19 pm
To: Len Starling <Len.Starling@mbie.govt.nz>; Craig Scott <Craig.Scott2@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3GHZ CONSULATION

Thanks for the information, Len.
They have made two good points which also resonate our earlier thinking on synchronisation and equipment availability.

There are some initial thoughts through our synchronisation and interference management research.

1. There is very small performance sacrifice (around 2ms additional network latency) if we change the frame structure from the current early access one to LTE compatible.
2. However, the LTE compatible frame structure allows a larger cell size when we combine a high antenna outdoor CPE.
3. The only large use of 3.3-3.4GHz is China, but for indoor 5G only. I didn't find any commercial LTE network operating in this frequency range. If we lock WISP into the band, they may end up choosing non 3GPP compliant equipment (the implication is poorer performance and higher risk of interference).
4. Satellite above 3.8GHz is a risk on spectrum allocation. As Craig summarised, there may be some 5G denial areas near their Earth station. Whoever pick the top band within 3.3-3.8GHz should be aware of the risk. This implies the spectrum value for the top band is not as good as lower and middle band.

Happy to have further discussion, maybe it is worth for us to think about the allocation again.

Regards

T.X.

From: Len Starling <Len.Starling@mbie.govt.nz>
Sent: Thursday, 7 October 2021 1:24 PM
To: Craig Scott <Craig.Scott2@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: FW: 3.3GHZ CONSULATION
Importance: High

For discussion. I'll acknowledge receipt.

From: s9(2)(a) @wispa.nz s9(2)(a)
Sent: Thursday, 7 October 2021 12:49 pm
To: Len Starling <Len.Starling@mbie.govt.nz>
Cc: s9(2)(a) @connecta.co.nz>
Subject: 3.3GHZ CONSULATION
Importance: High

Hi Len

Please see attached letter in regards to the 3.3-3.4Ghz band proposition for regional spectrum.

s9(2)(a) our spectrum committee Chair attended the technical working group recently held and this letter forms WISPA NZ's views on the planned regional allocation of the spectrum.

It would be good to catch up you and your team on this and other spectrum matters before the end of the year. I am intending on heading to Wellington later this month / early November and can have Peter who is in Auckland join on a teams call etc. if he has not made it out of lockdown.

Let me know if you have any questions and if a meeting would work for you later in October, early November.

Ngā mihi

s9(2)(a)

Wireless Internet Service Providers Association of New Zealand (WISPA.NZ)
s9(2)(a)
wispa.nz

Out of scope

From: Craig Scott
Sent: Monday, 11 October 2021 2:26 PM
To: Peter Gent; Xin Tang
Subject: RE: Cambian pre chat [UNCLASSIFIED]

Hi, just to jot down a few thoughts for the meeting:

1. Types of technology / products they offer and technology roadmap
2. Frame structures and compatibility with 4G and 5G frame structures
    a. Can they sync (mostly with 4G and 5G)
    b. What configurations / frames they support (i.e. what LTE frames and what NR frames)
    c. Is there any particular disadvantages to certain frames
    d. What distance / range do they achieve / want to achieve
    e. Can frame structure be updated over the air or is it a site visit
3. Frequency ranges they support (especially the 3.3 – 3.4 GHz band)
    a. Price difference and availability of the 3.3 – 3.4 GHz band equipment
    b. Flexibility of the equipment (how wide can it tune)
4. Base station and CPE characteristics
    a. TX and RX parameters (transmit power, sensitivity, unwanted emissions, blocking)
    b. Filtering options

-----Original Appointment-----
From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Friday, 8 October 2021 17:16
To: Peter Gent; Craig Scott; Xin Tang
Subject: Cambian pre chat [UNCLASSIFIED]
When: Monday, 11 October 2021 15:45-16:00 (UTC+12:00) Auckland, Wellington.
Where: Microsoft Teams Meeting

Microsoft Teams meeting

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s9(2)(a)

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Out of scope

From: s9(2)(a) (Nokia - NZ/Wellington) s9(2)(a)
Sent: Monday, 11 October 2021 7:55 PM
To: Craig Scott; s9(2)(a) (Nokia - NZ/Auckland)
Cc: Xin Tang; Peter Gent
Subject: RE: 3.3 - 3.4 GHz questions and chat [UNCLASSIFIED]

Hi Craig

I had a chat with s9(2)(a) and we can both do an hour between 1 and 4pm on Wednesday or Friday afternoon this week.

Hopefully within this 6 hour window, there is a time that will suit the three of you.

Please let us know.

Thanks

s9(2)(a)
Level 6, 1 Grey St
PO Box 2810, Wellington, NEW ZEALAND
NOKIA
s9(2)(a)

From: Craig Scott <Craig.Scott2@mbie.govt.nz>
Sent: Monday, October 11, 2021 10:32 AM
To: s9(2)(a) (Nokia - NZ/Wellington) s9(2)(a) s9(2)(a) (Nokia - NZ/Auckland) s9(2)(a)
Cc: Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3 - 3.4 GHz questions and chat [UNCLASSIFIED]

Hi s9(2)(a)

Thank you, that would be great, please let us know what time suits.

Craig

From: s9(2)(a) (Nokia - NZ/Wellington) s9(2)(a)
Sent: Friday, 8 October 2021 17:12
To: Craig Scott <Craig.Scott2@mbie.govt.nz>; s9(2)(a) (Nokia - NZ/Auckland) s9(2)(a) >
Cc: Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3 - 3.4 GHz questions and chat

Hi Craig

Thanks for your email. Yes, I am certainly happy to have an informal chat with you on this. I'll check with Riku on his availability and get back to you.

Thanks

s9(2)(a)

Level 6, 1 Grey St
PO Box 2810, Wellington, NEW ZEALAND

NOKIA

s9(2)(a)

From: Craig Scott <Craig.Scott2@mbie.govt.nz>
Sent: Friday, October 8, 2021 4:55 PM
To: s9(2)(a) (Nokia - NZ/Wellington) s9(2)(a) ; s9(2)(a) (Nokia - NZ/Auckland) s9(2)(a)
Cc: Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: 3.3 - 3.4 GHz questions and chat

Hi s9(2)(a)

We and looking into a couple of technical issues on C band at the moment and would be interested in getting some thoughts and information from you. Some of these things we have touched on before but we are interested in:

1. **Equipment ecosystems that support the 3.3 – 3.4 GHz band:** While we are aware is part of band n77 and n78 and equipment should be available we are also aware that the 3.3 – 3.4 GHz band is not widely adopted globally. We also understand that in places it has been adopted it is normally for indoor small cells. A couple of questions spring to mind:
    a. What is the availability of different base station types in the 3.3 – 3.4 GHz, including macro cells. Is this a standard product (e.g. same availably as a base station in the 3.4 – 3.8 GHz band) or is it a more restricted / special product?
    b. Is there cost difference between a base stations in 3.3 – 3.4 GHz and 3.4 – 3.8 GHz band?
    c. What is the availably of LTE base stations in the 3.3-3.4 GHz band (e.g. band 52)?
2. **Equipment flexibility within the 3.3 – 3.8 GHz band:** While we understand that it is possible to have base station equipment that can be flexible across the whole band (or much of the band), this comes at a cost and performance trade off. We understand that generally much of the equipment is for a particular portion of the band. We would be interested in understanding how flexible this equipment is (e.g. can only work on a single frequency range or is flexible within X MHz)?

Any information you can provide would be much appreciated, It could be good to have a informal chat on this and am wondering if we can set up a time in the next week or two?

Best regards,

Craig Scott
Principal Spectrum Planner

Radio Spectrum Management
Ministry of Business, Innovation & Employment

Phone: +64 4901 1448
Email: Craig.Scott2@mbie.govt.nz

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Out of scope

From: s9(2)(a) @huawei.com>
Sent: Tuesday, 12 October 2021 10:35 AM
To: Craig Scott
Subject: RE: 3.3 - 3.4 GHz questions and chat

Hi Craig,

Would you please drop me a call at s9(2)(a)

Wed 13th Oct is fine. I have accepted the meeting inivite. Sorry for causing some confusions ☺

Regards,
s9(2)(a)

From: Craig Scott [mailto:Craig.Scott2@mbie.govt.nz]
Sent: Monday, October 11, 2021 8:15 PM
To: s9(2)(a) @huawei.com>
Cc: Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3 - 3.4 GHz questions and chat

Hi s9(2)(a)

Thanks for getting back to me and sorry to hear about your family member, it is good to hear that they are out of hospital.

I have pencilled something in your diary for Wednesday but we are flexible. I note that you said the 14th of October which is Thursday, thought I would check on if you did mean Thursday rather than Wednesday?

Craig

From: s9(2)(a) @huawei.com>
Sent: Monday, 11 October 2021 10:40
To: Craig Scott <Craig.Scott2@mbie.govt.nz>
Cc: Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: 3.3 - 3.4 GHz questions and chat

Hi Craig,

Thank you for your enquires. Can I suggest to pencil the meeting on Wed 14th Oct? I will prepare some info and send them back prior to the meeting.

If there is any change I will send out notice ahead. I have been looking after a family member in-and-out of hospital a few times in the past three weeks. He got discharged yesterday, and hopefully his condition becomes stable …

Regards,
s9(2)(a)

From: Craig Scott [mailto:Craig.Scott2@mbie.govt.nz]
Sent: Friday, October 8, 2021 4:59 PM
To: s9(2)(a) @huawei.com>

Cc: Xin Tang <Xin.Tang@mbie.govt.nz>; Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: 3.3 - 3.4 GHz questions and chat

Hi s9(2)(a)

We and looking into a couple of technical issues on C band at the moment and would be interested in getting some thoughts and information from you. The areas of interest are:

1. **Equipment ecosystems that support the 3.3 – 3.4 GHz band:** While we are aware is part of band n77 and n78 and equipment should be available we are also aware that the 3.3 – 3.4 GHz band is not widely adopted globally. We also understand that in places it has been adopted it is normally for indoor small cells. A couple of questions spring to mind:
    a. What is the availability of different base station types and user equipment in the 3.3 – 3.4 GHz, including macro cells. Is this a standard product (e.g. same availably as a base station in the ?3.4 – 3.8 GHz band) or is it a more restricted / special product? We are also interested in user equipment support for the 3.3 -3.4 GHz band?
    b. Is there cost difference between a base stations in 3.3 – 3.4 GHz and 3.4 – 3.8 GHz band?
    c. What is the availably of LTE base stations and user equipment in the 3.3-3.4 GHz band (e.g. band 52)?

2. **Equipment flexibility within the 3.3 – 3.8 GHz band:** While we understand that it is possible to have base station equipment that can be flexible across the whole band (or much of the band), this comes at a cost and performance trade off. We understand that generally much of the equipment is for a particular portion of the band. We would be interested in understanding how flexible this equipment is (e.g. can only work on a single frequency range or is flexible within X MHz)?

Any information you can provide would be much appreciated, It could be good to have a informal chat on this and am wondering if we can set up a time in the next week or two?

Best regards,

Craig Scott
Principal Spectrum Planner

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Ministry of Business, Innovation & Employment

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Email: Craig.Scott2@mbie.govt.nz

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Out of scope

From: Craig Scott
Sent: Thursday, 4 November 2021 1:51 PM
To: s9(2)(a)
Cc: Peter Gent
Subject: RE: C band equipment ecosystem questions [UNCLASSIFIED]

Hi s9(2)(a)

Peter is currently away but I am more than happy to cover the discussion tomorrow in the 10am – 11am NZL time (or any other time except 11 – 12 am NZL time) and pass on the information.

If you would like to chat with us both, we can also do Monday, 11 – 12 NZL time.

Many thanks in advance for being able to take the time to have a chat with us.

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Principal Spectrum Planner

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Phone: +64 4901 1448
Email: Craig.Scott2@mbie.govt.nz

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From: s9(2)(a)@ericsson.com>
Sent: Thursday, 4 November 2021 11:35
To: Peter Gent <Peter.Gent@mbie.govt.nz>
Cc: Craig Scott <Craig.Scott2@mbie.govt.nz>
Subject: RE: C band equipment ecosystem questions [UNCLASSIFIED]

Hi Peter

I can do Monday, 11 – 12 or 3 – 4pm NZ time, if that works better

s9(2)(a)

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Wednesday, November 3, 2021 2:28 PM
To: s9(2)(a) @ericsson.com>
Cc: Craig Scott <Craig.Scott2@mbie.govt.nz>
Subject: RE: C band equipment ecosystem questions [UNCLASSIFIED]

Hi s9(2)(a)

Thank you for your reply.

I'm not available on Friday due to a prior commitment, however Craig Scott my colleague is for most of the morning excluding 10am – 11am NZL time.
So if you happen to have some time slightly later on in the day that suits you, that would be excellent.

Kind regards

Peter

From: s9(2)(a) @ericsson.com>
Sent: Wednesday, 3 November 2021 11:45 AM
To: Peter Gent <Peter.Gent@mbie.govt.nz>
Subject: RE: C band equipment ecosystem questions [UNCLASSIFIED]

Hi Peter

Apologies for the delay in replying. I have some insight into the support of the 3.3 – 3.4GHz bands, does 10:30am NZ time Friday (8:30am Aus) suit for a discussion?

Regards
s9(2)(a)

From: Peter Gent <Peter.Gent@mbie.govt.nz>
Sent: Thursday, October 14, 2021 2:50 PM
To: s9(2)(a) @ericsson.com>
Cc: s9(2)(a) @ericsson.com>; s9(2)(a) @ericsson.com>; Craig Scott <Craig.Scott2@mbie.govt.nz>
Subject: C band equipment ecosystem questions [UNCLASSIFIED]

Hi s9(2)(a)

We are looking into a couple of technical issues on C band at the moment in the follow up to the New Zealand C band 5G technical working group a few weeks ago and would be interested in getting some thoughts and information from Ericsson. Some of these things we are interested in:

1. **Equipment ecosystems that support the 3.3 – 3.4 GHz band:** While we are aware is part of band n77 and n78 and equipment should be available we are also aware that the 3.3 – 3.4 GHz band is not widely adopted globally. We also understand that in places it has been adopted it is normally for indoor small cells. A couple of questions spring to mind:
    a. What is the availability of different base station types in the 3.3 – 3.4 GHz, including macro cells. Is this a standard product (e.g. same availably as a base station in the 3.4 – 3.8 GHz band) or is it a more restricted / special product?
    b. Is there cost difference between a base stations in 3.3 – 3.4 GHz and 3.4 – 3.8 GHz band?
    c. What is the availably of LTE base stations in the 3.3-3.4 GHz band (e.g. band 52)?

2. **Equipment flexibility within the 3.3 – 3.8 GHz band:** While we understand that it is possible to have base station equipment that can be flexible across the whole band (or much of the band), this comes at a cost and performance trade off. We understand that generally much of the equipment is for a particular portion of the band. We would be interested in understanding how flexible this equipment is (e.g. can only work on a single frequency range or is flexible within X MHz)?

Any information you can provide would be much appreciated, It could be good to have an informal chat on this and am wondering if we can set up a time in the next week or so?

Best regards

Peter Gent

Peter Gent
SENIOR PLANNER

Radio Spectrum Management
Digital, Communication & Transformation Branch, Building, Resources and Markets Group
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peter.gent@mbie.govt.nz | Waea/DDI: +64 4 978 3279 Free Phone: 0508 RSM INFO (776 463) | Website: www.rsm.govt.nz
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Out of scope

From: s9(2)(a)@4rf.com>
Sent: Monday, 13 December 2021 11:23 AM
To: Craig Scott; Peter Gent; Xin Tang; Len Starling
Cc: s9(2)(a)@spark.co.nz
Subject: RE: December TWG on the 3.5 GHz band [UNCLASSIFIED]
Attachments: OnGo-TS-2001 v4.1.0 CBRS Coexistence Specification_Ready for IPR Review.pdf

Dear RSM team,

Attachment refused under section 18(d). Available online from the OnGo website

Thank you for the invitation to the meeting this week, I'm afraid I will not be able to attend.

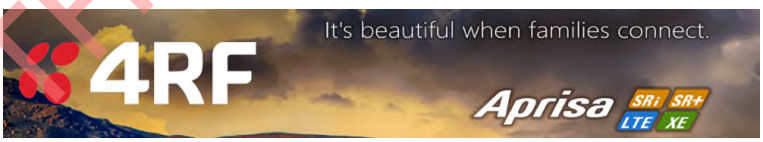
I do want to pick up on the synchronisation discussion covered in the draft slide deck circulated. You may remember that following the September 2019 meeting I commented on the importance of burst timing synchronisation with respect to the epoch, or reference point in time, in addition to frequency and pahse. This was a follow up to the point made by Dr Shafi at the meeting itself.

4RF is an advisory member of the OnGo CBRS alliance in the US, an industry group focused on cooperation between vendors of products for the US 3.65 GHz CBRS band. The attached document, *OnGo-TS-2001 v4.1.0 CBRS Coexistence Specification,* released for IPR (intellectual property rights) review contains in section 5. Coexistence Requirements for CBSDs a specification for Cell Phase Synchronization and TDD Configuration that may be of interest to TWG members. The document is not confidential and may be shared.

I hope the meeting goes well.

Regards, s9(2)(a)

s9(2)(a)
Directory Regulatory Affairs
4RF Limited
s9(2)(a)



From: Craig Scott <Craig.Scott2@mbie.govt.nz>
Sent: Wednesday, 8 December 2021 16:29
To: Peter Gent <Peter.Gent@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>; Len Starling <Len.Starling@mbie.govt.nz>
Subject: RE: December TWG on the 3.5 GHz band [UNCLASSIFIED]

Dear TWG Participants,

Please find attached the draft slide pack which will be used for the basis of our discussions on Wednesday 15 December between 14:00 – 16:00. This slide pack contains and agenda, approximate timings, technical topics and proposed technical parameters for the 3.5 GHz band. The technical topics for discussion are the following:

- Technology choices and standards
- Common phase clock reference and accuracy
- Default synchronisation and frame structure
- Unwanted Emission Limits
- Technical review period
- Coexistence with Users above 3.8 GHz
- Other technical issues

As with the last TWG, there is a placeholder under each technical topic for attendees / stakeholders to provide technical input in the form of power point slide(s). The material will be talked through in the meeting but please keep in mind that there is a limited amount of time so please focus on the main topics and keep your material concise and with no more than a couple of slides on each topic. Could we please ask that you provide your material by **COB Monday 13 December** so we have enough time to compile the final slides.

We look forward to seeing you on the meeting next week.

Craig Scott
Principal Spectrum Planner

Radio Spectrum Management
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Phone: +64 4901 1448
Email: Craig.Scott2@mbie.govt.nz

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-----Original Appointment-----
From: Craig Scott
Sent: Tuesday, 7 December 2021 12:19
To: Craig Scott; Peter Gent; Xin Tang; Len Starling
Cc: s9(2)(a)
Subject: December TWG on the 3.5 GHz band
When: Wednesday, 15 December 2021 14:00-16:00 (UTC+12:00) Auckland, Wellington.
Where: Microsoft Teams Meeting

Dear TWG participants,

Following on from the Technical Working Group (TWG) meeting on the 3.5 GHz band on 15 September 2021 we would like to invite you to a follow-up discussion on Wednesday 15 December between 14:00 – 16:00. Apologies for the short notice on this meeting but we are keen to have this follow up discussion before the Christmas break.

The invitee list is based off the attendees from the last meeting. This meeting will again be a focused technical discussion on the 3300 – 3800 MHz band where we are seeking your feedback and input.

This is a placeholder for your calendar and will be held as a virtual meeting (on MS Teams – link below). We will follow up with a slide pack for the meeting shortly.

Microsoft Teams meeting

Join on your computer or mobile app

s9(2)(a)

s9(2)(a)

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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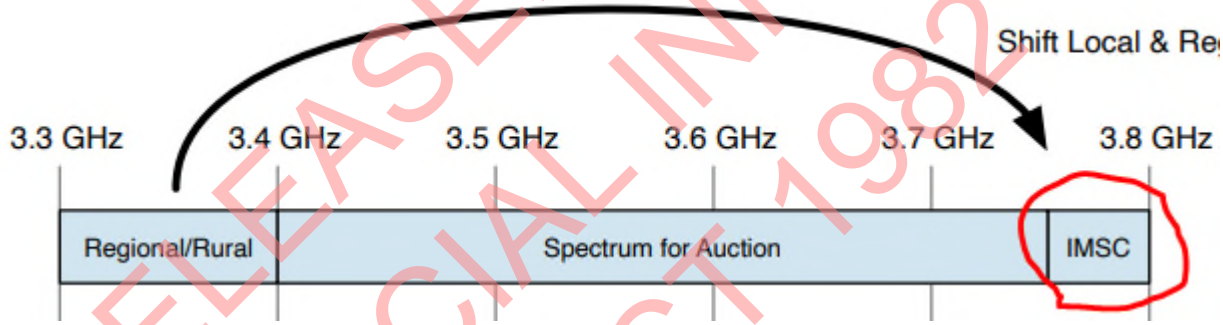
Out of scope

From: Craig Scott
Sent: Monday, 13 December 2021 2:23 PM
To: Len Starling; David Stimpson
Cc: Peter Gent
Subject: FW: December TWG on the 3.5 GHz band [UNCLASSIFIED]
Attachments: c-band-layout-and-equip-availability.graffle.pdf

Hi both

s9(2)(a) has provided a slide to the TWG which makes an assumption on where the IMSC might be placed in a future spectrum allocation. While IMSC is at the top of the band at the moment in the early access this is not necessarily the case long term s9(2)(g)(i) We will include the slide but will point out the inaccuracy verbally. As you know the entire 3.4 (3.41 GHz) – 3.8 GHz is for allocation and there are no decisions on placement so far

Len is it worth giving s9(2)(a) a heads up on this in your meeting tomorrow?



From: Craig Scott
Sent: Monday, 13 December 2021 13:50
To: s9(2)(a)
Cc: Peter Gent <Peter.Gent@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>; Len Starling <Len.Starling@mbie.govt.nz>
Subject: RE: December TWG on the 3.5 GHz band [UNCLASSIFIED]

Hi s9(2)(a)

Thank you very much for your slide, we will incorporate this into the slide pack. Before we do a couple of questions:

1. This is from Telco2 not WISPA? I can see Telco2 on the slide but just double checking.
2. Could you please provide the PPT so we can easily put this into the slide pack?
3. What technical topic do you want to include this under:
    a. 2a Technology choices and standards
    b. 2b Common phase clock reference and accuracy
    c. 2c Default synchronisation and frame structure
    d. 2d Unwanted Emission Limits

e. 2e Technical review period
f. 2f Coexistence with Users above 3.8 GHz
g. 2g Other technical issues

Craig

From: s9(2)(a)
Sent: Monday, 13 December 2021 13:34
To: Craig Scott <Craig.Scott2@mbie.govt.nz>
Cc: Peter Gent <Peter.Gent@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>; Len Starling <Len.Starling@mbie.govt.nz>
Subject: Re: December TWG on the 3.5 GHz band [UNCLASSIFIED]

Hi Craig,

Slide from me on behalf of my regional and rural customers.

Thanks,

s9(2)(a)

On Wed, 8 Dec 2021 at 16:30, Craig Scott <Craig.Scott2@mbie.govt.nz> wrote:

> Dear TWG Participants,
>
> Please find attached the draft slide pack which will be used for the basis of our discussions on Wednesday 15 December between 14:00 – 16:00. This slide pack contains and agenda, approximate timings, technical topics and proposed technical parameters for the 3.5 GHz band. The technical topics for discussion are the following:
>
> - Technology choices and standards
> - Common phase clock reference and accuracy
> - Default synchronisation and frame structure
> - Unwanted Emission Limits
> - Technical review period
> - Coexistence with Users above 3.8 GHz
> - Other technical issues
>
> As with the last TWG, there is a placeholder under each technical topic for attendees / stakeholders to provide technical input in the form of power point slide(s). The material will be talked through in the meeting but please keep in mind that there is a limited amount of time so please focus on the main topics

and keep your material concise and with no more than a couple of slides on each topic. Could we please ask that you provide your material by **COB Monday 13 December** so we have enough time to compile the final slides.

We look forward to seeing you on the meeting next week.

Craig Scott
Principal Spectrum Planner

Radio Spectrum Management
Ministry of Business, Innovation & Employment

Phone: +64 4901 1448
Email: Craig.Scott2@mbie.govt.nz

RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

-----Original Appointment-----
From: Craig Scott
Sent: Tuesday, 7 December 2021 12:19
To: Craig Scott; Peter Gent; Xin Tang; Len Starling
Cc: s9(2)(a)
Subject: December TWG on the 3.5 GHz band
When: Wednesday, 15 December 2021 14:00-16:00 (UTC+12:00) Auckland, Wellington.
Where: Microsoft Teams Meeting

Dear TWG participants,

Following on from the Technical Working Group (TWG) meeting on the 3.5 GHz band on 15 September 2021 we would like to invite you to a follow-up discussion on Wednesday 15 December between 14:00 –

16:00. Apologies for the short notice on this meeting but we are keen to have this follow up discussion before the Christmas break.

The invitee list is based off the attendees from the last meeting. This meeting will again be a focused technical discussion on the 3300 – 3800 MHz band where we are seeking your feedback and input.

This is a placeholder for your calendar and will be held as a virtual meeting (on MS Teams – link below). We will follow up with a slide pack for the meeting shortly.

Microsoft Teams meeting

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s9(2)(a)

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intended recipient, be advised that you have received this message in error and that any use is strictly prohibited. Please contact the sender and delete the message and any attachment from your computer.

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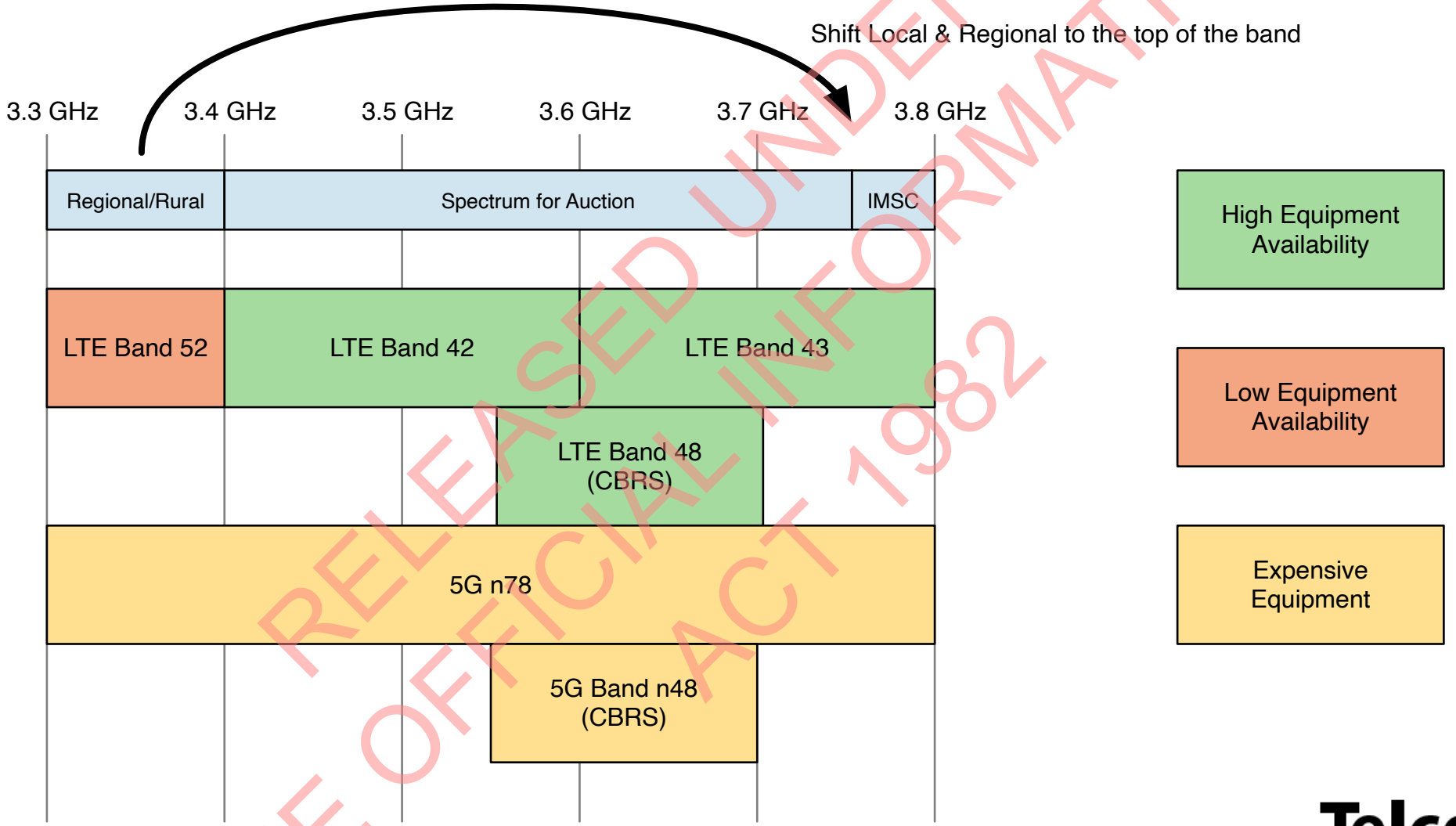
s9(2)(a)

C Band Spectrum Layout



Telco2

Out of scope

From: Craig Scott
Sent: Tuesday, 14 December 2021 1:55 PM
To: Peter Gent; Xin Tang; Len Starling
Subject: Final slide pack for December TWG on the 3.5 GHz band [UNCLASSIFIED]
Attachments: Final slides - 3.5 GHz Technical Working Group December 2021.pdf; Attendee list for the 3.5 GHz Technical Working Group.pdf

Dear 3.5 GHz TWG participants,

Please find attached the final slide pack for the 3.5 GHz Technical Working Group (TWG). The changes from the earlier slide pack include received stakeholder contributions along with a couple of minor adjustments. We will use this slide pack for the basis of discussion tomorrow (Wednesday) afternoon.

We have also attached a list of attendees and representation based off the RSVPs received. This attendee list is provided to you ahead of the meeting to replace of a round of verbal introductions to save time. Please let us know if any adjustments are needed to this list ahead of the meeting.

Craig Scott
Principal Spectrum Planner

Radio Spectrum Management
Ministry of Business, Innovation & Employment

Phone: +64 4901 1448
Email: Craig.Scott2@mbie.govt.nz

RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

From: Craig Scott
Sent: Wednesday, 8 December 2021 16:29

To: Peter Gent <Peter.Gent@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>; Len Starling <Len.Starling@mbie.govt.nz>
Subject: RE: December TWG on the 3.5 GHz band [UNCLASSIFIED]

Dear TWG Participants,

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- Technology choices and standards
- Common phase clock reference and accuracy
- Default synchronisation and frame structure
- Unwanted Emission Limits
- Technical review period
- Coexistence with Users above 3.8 GHz
- Other technical issues

As with the last TWG, there is a placeholder under each technical topic for attendees / stakeholders to provide technical input in the form of power point slide(s). The material will be talked through in the meeting but please keep in mind that there is a limited amount of time so please focus on the main topics and keep your material concise and with no more than a couple of slides on each topic. Could we please ask that you provide your material by **COB Monday 13 December** so we have enough time to compile the final slides.

We look forward to seeing you on the meeting next week.

Craig Scott
Principal Spectrum Planner

Radio Spectrum Management
Ministry of Business, Innovation & Employment

Phone: +64 4901 1448
Email: Craig.Scott2@mbie.govt.nz

RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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The invitee list is based off the attendees from the last meeting. This meeting will again be a focused technical discussion on the 3300 – 3800 MHz band where we are seeking your feedback and input.

This is a placeholder for your calendar and will be held as a virtual meeting (on MS Teams – link below). We will follow up with a slide pack for the meeting shortly.

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s9(2)(a)

[redacted]

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RADIO SPECTRUM MANAGEMENT

Technical Working Group on 3.3 - 3.8 GHz

15 December 2021

TWG Meeting Agenda

1. Introductions (5 min)
2. Technical discussion (100 min)
3. Any other business (10 min)
4. Summary and next steps (5 min)

1. Introduction and Background

- Introduction
- Aim of meeting
  - Share information between stakeholders to inform technical options for next steps
  - Build on TWG held in September 2021
  - Confirm main ideas for the proposed technical parameters
    - Focus on 3.4 – 3.8 GHz
    - 3.3 – 3.4 GHz may need more detailed consideration later
  - Not discussing allocation or policy issues

2. Technical subjects for discussion

- 2a Technology choices and standards (15 min)
- 2b Common phase clock reference and accuracy (10 min)
- 2c Default synchronisation and frame structure (35 min)
- 2d Unwanted Emission Limits (10 min)
- 2e Technical review period (10 min)
- 2f Coexistence with Users above 3.8 GHz (10 min)
- 2g Other technical issues (10 min)

2a Technology choices and standards

- Current rules for the 3.5 GHz Early Access based on 5G NR 3GPP standards:
  - TS 38.104 (Base stations – Release 15)
  - TS 38.101 (User equipment - Release 15)
  - TS 38.211 (NR frame structure)
- Last TWG interest in using 4G LTE for regional broadband
  - TS 36.104 (Base stations - Release 14 or earlier)
  - TS 36.101 (User equipment - Release 14 or earlier)
  - TS 36.211 (LTE frame structure)
  - Options to achieve a larger cell radius
  - More equipment available economically
  - Don't need a LTE anchor carrier in another band (needed to support 5G NR NSA)

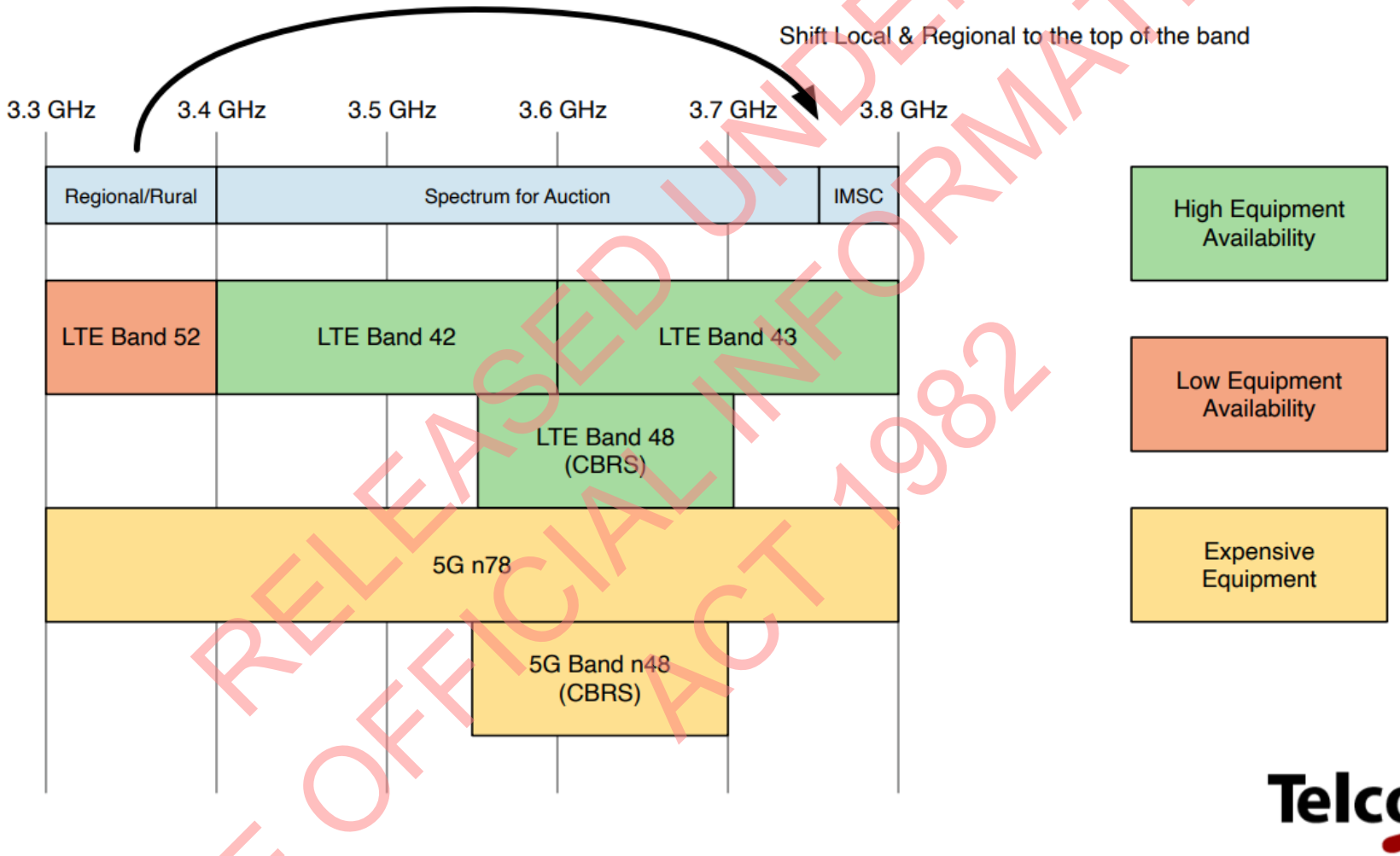
2a Technology choices and standards

- **Proposed technical parameters:**
  - To be based on 5G NR, 3GPP standard TS 38.104 / TS 38.101 / TS 38.211 Release 17
    - 4G LTE, 3GPP standard TS 36.104 / TS 36.101 / TS 36.211 Release 14 (or earlier) is possible
      - May have further technical constraints (e.g. guard bands) and be on a non interference basis
      - Dependent on default frame structure and synchronisation discussion and outcomes

2a Technology choices and standards

- Stakeholder presentations / information:
  - Telco2

C Band Spectrum Layout



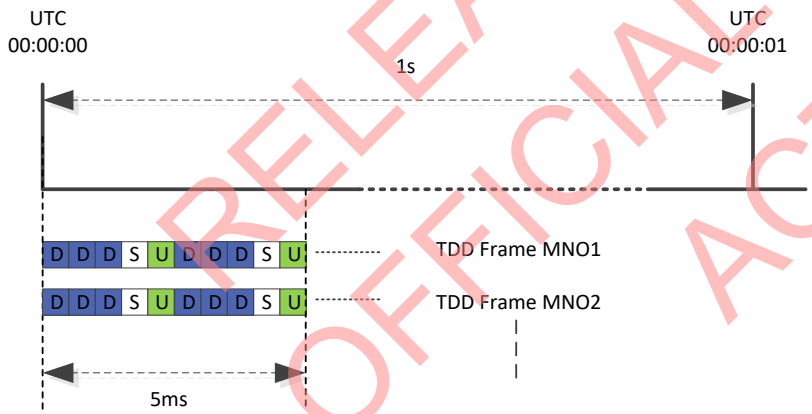
Telco2

2a Technology choices and standards

- Discussion

2b Common phase clock reference & accuracy

- Phase clock reference and accuracy requirement discussed at the last TWG
  - Conditions on Early Access
  - Few comments received, no proposal for change
- In addition, beneficial to have a recommendation on 4-12 hours holdover (in a case the timing signal is lost)



2b Common phase clock reference and accuracy

- **Proposed technical parameters:**
  - Transmitters needs to synchronise their frame on a UTC primary reference time clock (PRTC).
  - The start point of the first timeslot needs to align with UTC second with a time offset T_offset = 0 and an accuracy of ≤±1.5µs.
  - The frequency accuracy must be within plus or minus 50ppb.
  - Recommendation that base stations should maintain a holdover period in the absence of UTC PRTC. International deployment shows 4-12 hours holdover can be achieved with OCXO.

2b Common phase clock reference and accuracy

- Stakeholder presentations / information:
  - None
- Discussion

2c Default synchronisation and frame structure

- Main points of discussion at previous TWG:
  - Some participants advocated for current early access frame structure
    - Currently in use by MNOs
    - Good selection for 5G NR with low latency
  - Some participants advocated for 4G LTE frame structure (LTE configuration 2)
    - Longer maximum range. More equipment options
  - Discussion on a 5G NR and 4G LTE compatible frame structure
  - Discussion on compatibility and spectrum management issues with unsynchronised use
    - Frequency separation and geographic separation

2c Default synchronisation and frame structure

- Synchronisation options

	Synchronised	Semi-synchronised	Unsynchronised
Network value	May not suitable for some use cases	Can configure for different use cases	Can easily configure for different use cases
Change flexibility	Low, changing frame structure may require RSM to co-ordinate	Some limitations. Control signal must be allocated into certain sub-frame/slots.	Least limitations, though at a later stage users may be forced to synchronise to avoid causing interference
Interference /performance degradation	Low interference risk	Medium risk, may suffer some throughput loss if network co-located	High risk, may suffer high throughput loss if networks co-located
Cost of interference mitigation	Low, may not require additional filtering	Medium, may require additional filtering or involve operators to resolve the interference	High, may require good filtering or involve operators to resolve the interference

2c Default synchronisation and frame structure

- **Synchronised operation:**
  - A specific frame structure is set as the default
  - Basic unwanted emissions limited (standard equipment)
  - Frame structure design principle:
    - DL/UL traffic ratio should be between 2:1 to 4:1.
    - A balance between spectrum efficiency, latency, interference and cell size.
    - Try to be least restrictive and technology agnostic
  - Two options for consideration for default frame structure:
    - Option A: 5G 2020 Early access
    - Option B: 5G NR - 4G LTE compatible

2c Default synchronisation and frame structure

Examples of synchronisation and frame structure requirements globally

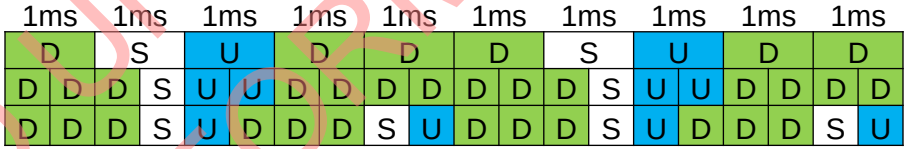
Frame structure	Countries
OPTION A DDDSU	Sweden, Germany, Finland, Korea, New Zealand (2020 early access)
OPTION B LTE (DSUDD 15KHz SCS) 5G (DDDSUUDDD 30K SCS) compatible	France, UK, Italy, Japan, USA(CBRS), Australia
DDDSUDDSUU	China, and some stakeholders proposed in early access

2c Default synchronisation and frame structure

- **Frame structures comparison**

OPTION B 4G LTE config 2
5G NR 30KHz LTE compatible

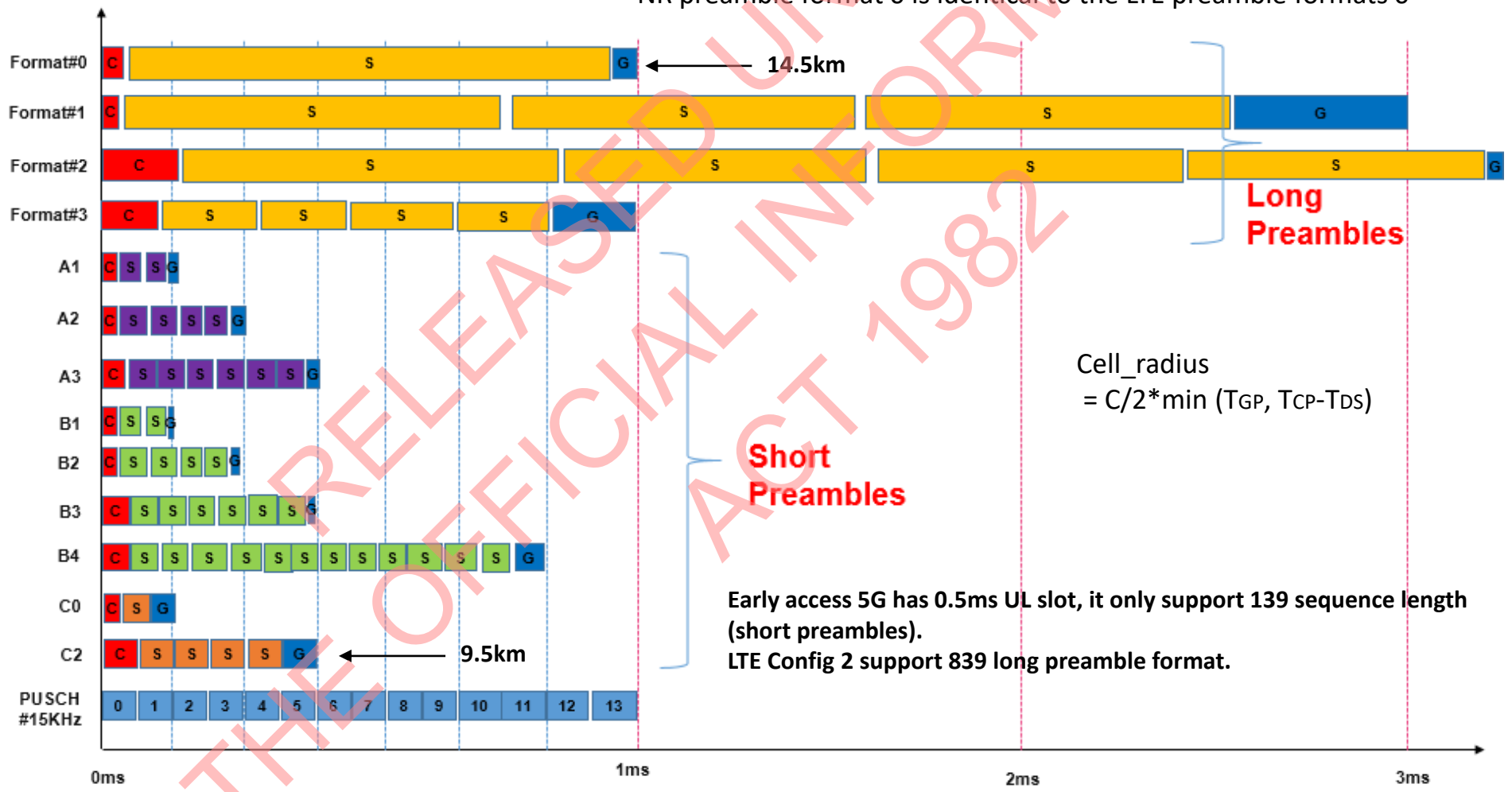
OPTION A 5G 2020 early access



Frame comparison	OPTION B 4G-5G compatible frame LTE config 2	OPTION A 5G early access frame current use
Pros	• Allow 4G and 5G co-exist without frequency separation / guard bands or restricted emission limits • Supports large cell (radius up to ~14.5km) • Allow 8 SSB set sweeping (long consecutive downlink time), useful for massive MIMO beam alignment.	• Low uplink latency due to halved Uplink periodicity (2.5ms per Uplink slot versus 5ms)
Cons	• A much higher uplink latency, requires Supplementary Uplink (SUL) to reduce it. However, in NSA mode, the anchor link can provide the SUL.	• Can't synchronise with 4G LTE • Cell size is smaller (radius up ~9 km) but still reasonable (depends on Zcs re-use)

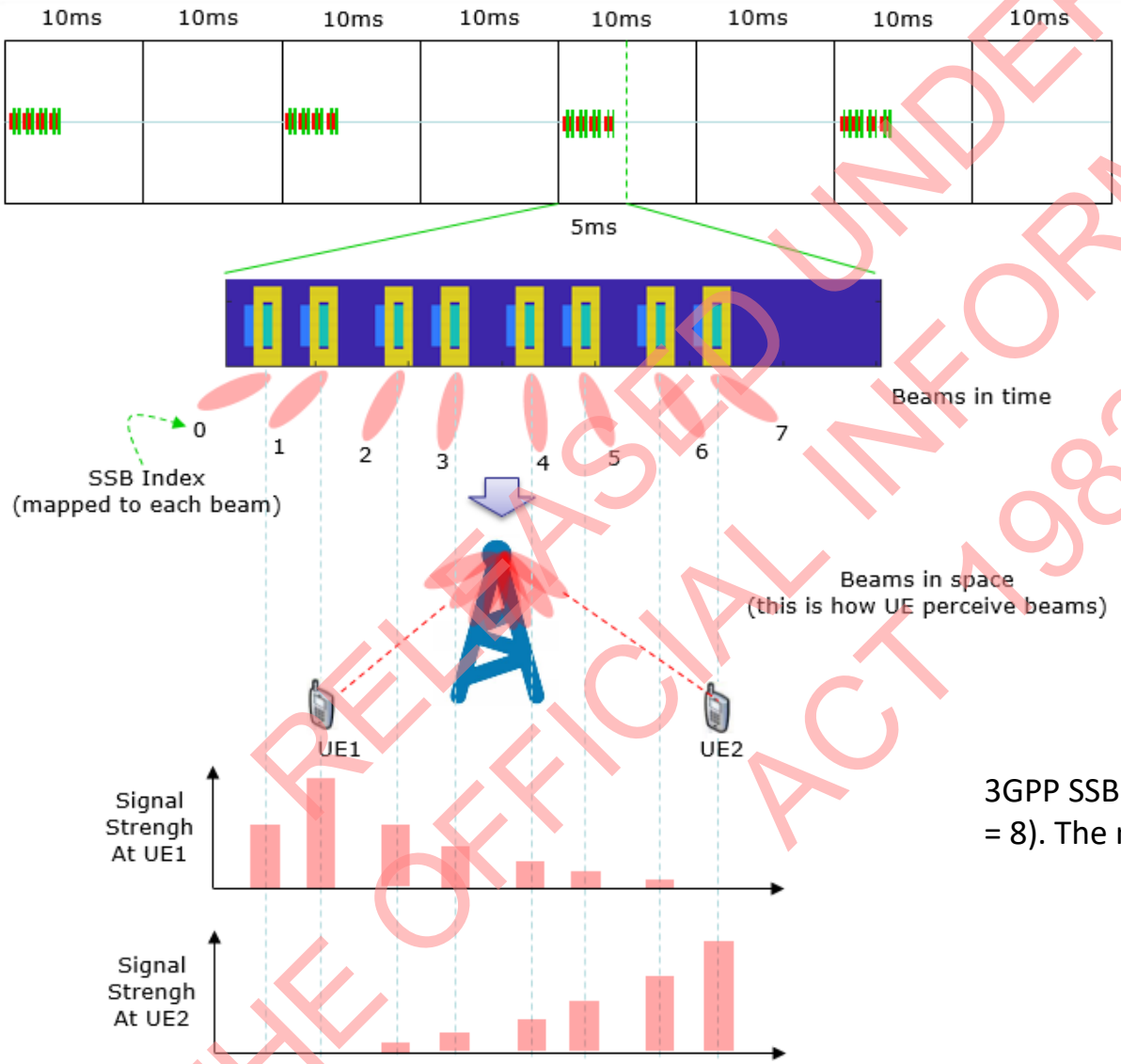
2c Default synchronisation and frame structure

NR preamble format 0 is identical to the LTE preamble formats 0



Cell_radius
= C/2*min (T_{GP}, T_{CP}-T_{DS})

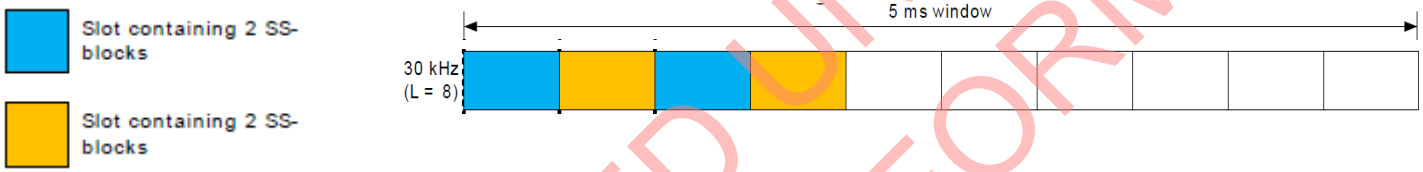
Early access 5G has 0.5ms UL slot, it only support 139 sequence length (short preambles).
LTE Config 2 support 839 long preamble format.



< Case C> 3 < f <= 6 GHz
SCS = 30 kHz

3GPP SSB Case C support a maximum of 8 SSB (L_{MAX} = 8). The more SSB set, the better beam calibration.

2c Default synchronisation and frame structure



8 SSB requires 4 consecutive DL slots, which is not supported by early access 5G

OPTION B 4G LTE config 2
5G NR 30KHz LTE compatible

OPTION A 5G 2020 early access

1ms	1ms	1ms	1ms	1ms	1ms	1ms	1ms	1ms	1ms
D	S	U	D	D	D	S	U	D	D
D D	D S	U U	D D	D D	D D	D S	U U	D D	D D
D D	D S	U D	D D	S U	D D	D S	U D	D D	S U

RADIO SPECTRUM MANAGEMENT

Latency simulation Source: ITU-R 5D 474, IMT 2020.TDD.SYNCHRONIZATION

DL latency (30 kHz SCS, TDD), Study 1

Slot/non-slot based scheduling	DL Latency (ms)		TDD pattern		
			DDSU	DDDSU	DDDSUUDDDD/ DDDDDDDSUU[Note 1]
eMBB: 14os slot-based (type A) scheduling with UE capability#1	Average user plane latency	1 transmission	1.52	1.44	1.44
		when the error probability of the first HARQ retransmission p=0.1	1.76	1.71	1.84
	RTT		2.38	2.70	3.95
URLLC: 2os non-slot based (type B) scheduling with UE capability#2	Worst-case latency	1 transmission	0.98	0.98	1.48
		2 transmissions	2.98	3.48	6.48
	Maximum RTT		2.00	2.50	5.00

DL latency (30 kHz SCS, TDD), Study 2

Slot/non-slot based scheduling	DL Latency (ms)		TDD pattern			
			DDSU	DDDSU [Note 1]	DDDSU+SUL	DDDDD DDSUU
eMBB: 14os slot-based (type A) scheduling with UE capability#1	Average user plane latency	1 transmission	1.29	1.26	1.26	1.31
		when the error probability of the first HARQ retransmission p=0.1	1.50	1.50	1.42	1.67
	RTT		2.48	2.73	1.70	3.53
URLLC: 2os non-slot based (type B) scheduling with UE capability#2	Worst-case latency	1 transmission	0.94	0.94	0.94	1.58
		2 transmissions	2.94	3.44	1.44	6.58
	Maximum RTT		2.35	2.85	1.17	5.42

UL latency (30 kHz SCS, TDD), Study 1

Slot/non-slot based scheduling	UL Latency (ms)		Frame structure		
			DDSU	DDDSU	DDDSUUDDDD/ DDDDDDDSUU[Note 1]
eMBB: 14os SR-based UL with UE capability#1	Average user plane latency	1 transmission	3.68	4.93	8.18
		when the error probability of the first HARQ retransmission p=0.1	3.88	3.18	8.68
	RTT		2.00	2.50	5.00
URLLC: 2os configured grant UL with UE capability#2	Worst-case latency	1 transmission	1.75	2.25	4.25
		2 transmissions	3.75	4.75	9.25
	Maximum RTT		2.00	2.50	5.00

UL latency (30 kHz SCS, TDD), Study 2

Slot/non-slot based scheduling	UL Latency (ms)		Frame structure Study 2			
			DDSU	DDDSU [Note 1]	DDDSU+ SUL	DDDDD DDSUU
eMBB: 14os SR-based UL with UE capability#1	Average user plane latency	1 transmission	3.95	5.41	2.80	8.45
		when the error probability of the first HARQ retransmission p=0.1	4.15	5.66	2.96	8.95
	RTT		2.00	2.50	1.60	5.00
URLLC: 2os configured grant UL with UE capability#2	Worst-case latency	1 transmission	1.78	2.28	0.35	4.20
		2 transmissions	3.78	4.78	1.53	9.20
	Maximum RTT		2.31	2.81	1.24	5.31

For Option B (4G LTE – 5G NR Compatible) Uplink latency can be reduced by Supplementary Uplink (SUL)

2c Default synchronisation and frame structure

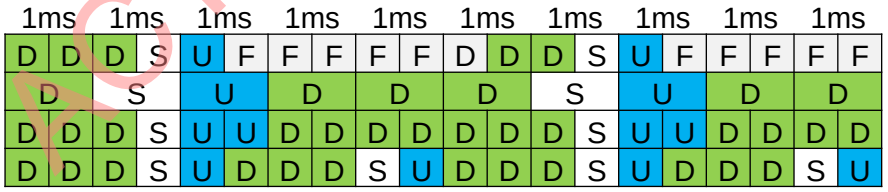
- **Semi-synchronised operation:**
  - A specific frame structure is set as the default
  - Basic unwanted emissions limited (standard equipment)
  - Frame structure design principle
  - DL/UL traffic ratio should be between 2:1 to 4:1.
  - A balance between spectrum efficiency, latency, interference and cell size.
  - Try to be least restrictive and technology agnostic

Semi-Synchonised

OPTION B **LTE config 2**

NR 30KHz LTE compatible

OPTION A **5G 2020 early access**



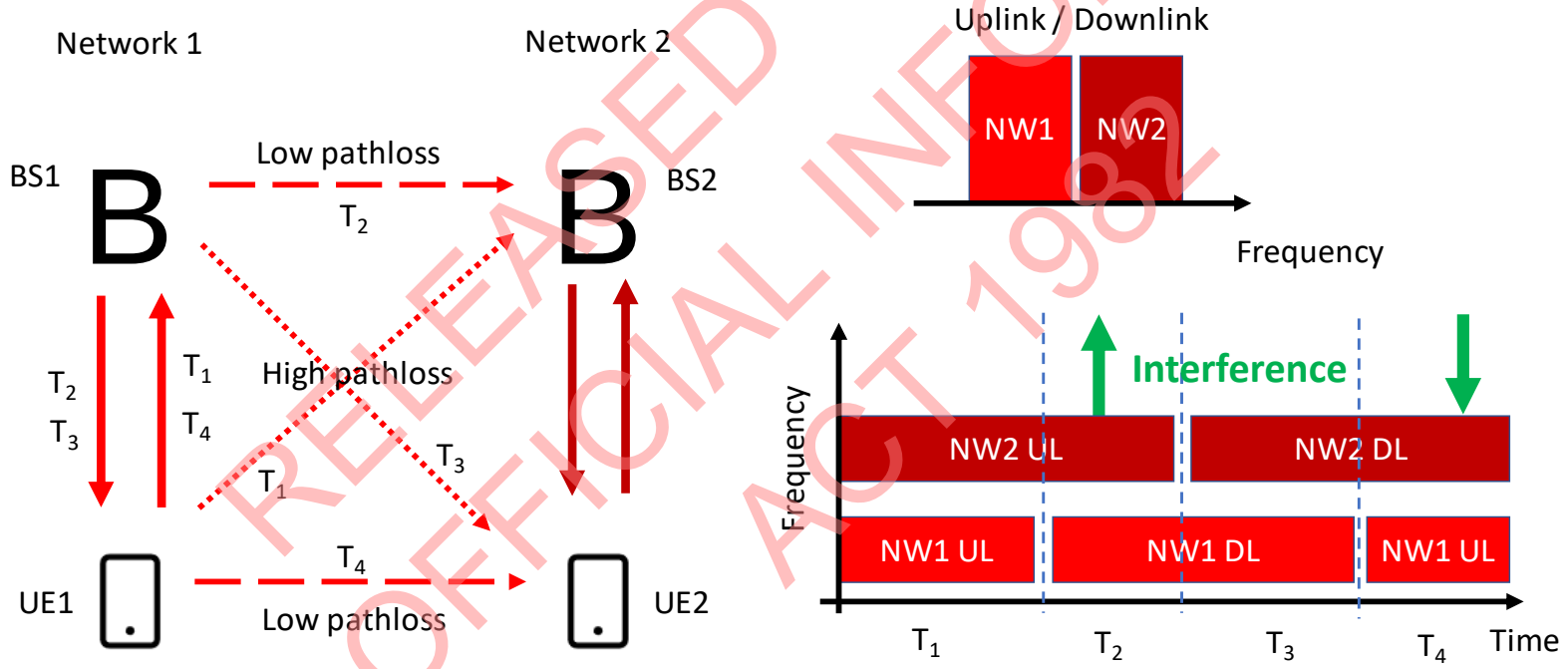
2c Default synchronisation and frame structure

- Semi-synchronised operation

Example of control signal design in synchronised slots.

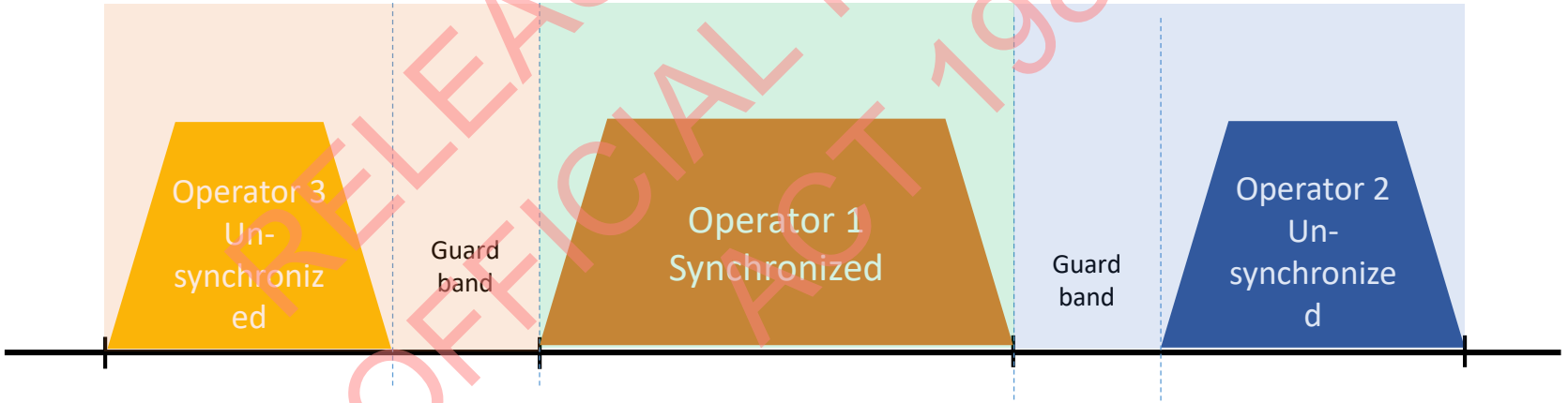
2c Default synchronisation and frame structure

- Unsynchronised operation



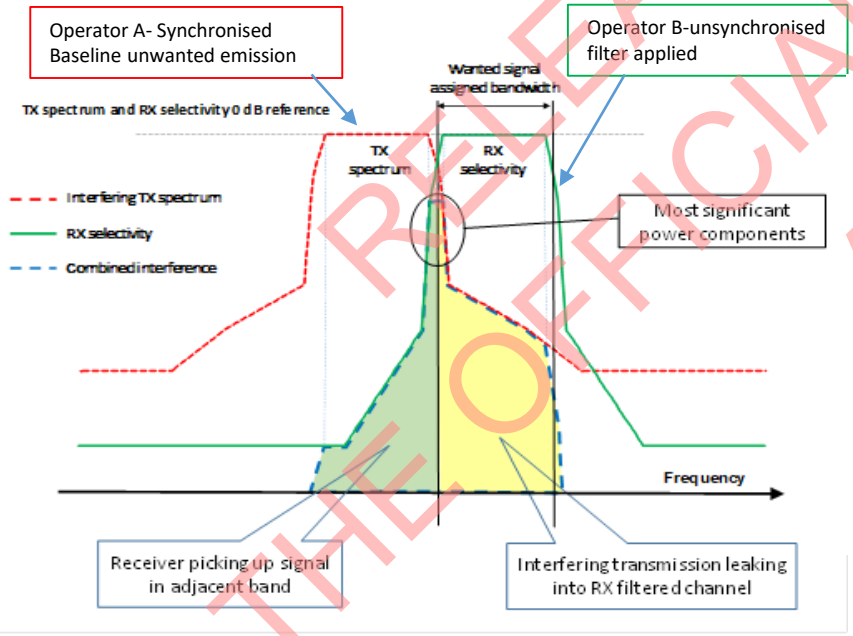
2c Default synchronisation and frame structure

- Non-synchronised operator may need frequency separation / guard band in their spectrum assignment.
  - How many MHz spectrum? We previously assessed that 40 MHz was sufficient.
- Non-synchronised operator(s) can not cause interference and must accept interference from operators on the default synchronised frame structure.

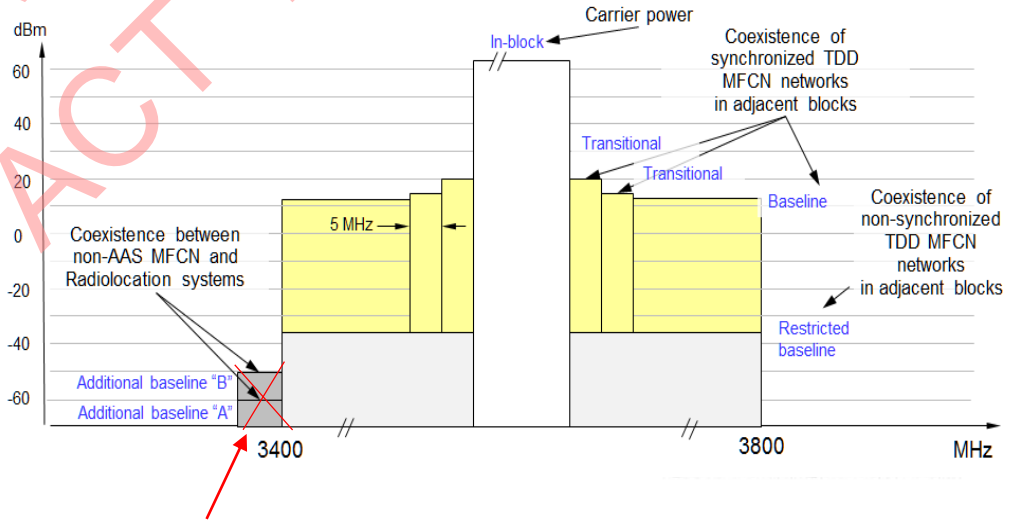


2c Default synchronisation and frame structure

- For unsynchronised operators interference mechanisms can be:
  - Receiver Adjacent Channel Selectivity / blocking
  - Unwanted emissions



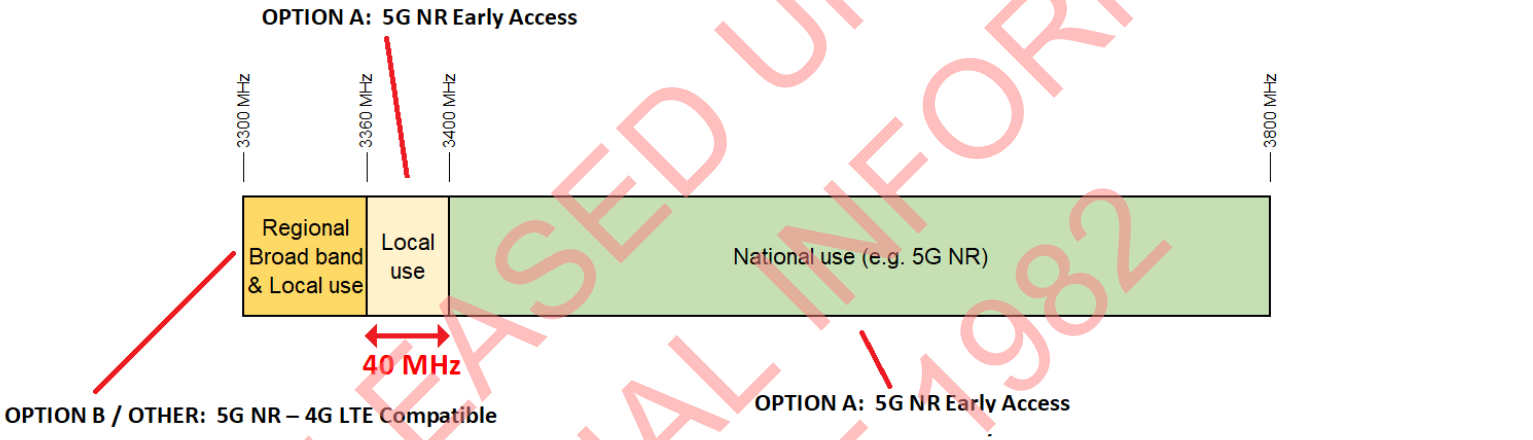
- Synchronised operators only need to meet 3GPP baseline requirement
- Unsynchronised operators could use a more stringent unwanted limits (~spurious limit)
  - Example of restricted unwanted emission limit / block emission mask (ECC Report 296)
    - ECC restricted baseline -43dBm/5MHz (AAS TRP)
    - ECC restricted baseline -34dBm/5MHz (non-AAS EIRP)



Not applicable to NZ

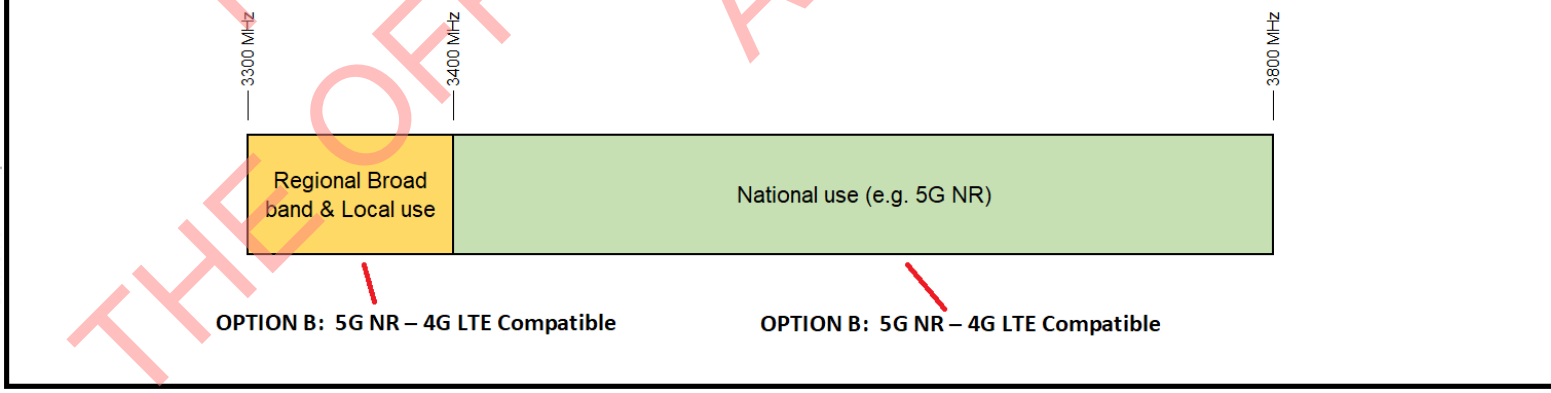
2c Default synchronisation and frame structure

ALTERNATIVE A – Different default frame structure for regional broadband and national mobile



Note: 3300 - 3400 MHz band will need detailed consideration at a later point. This shows the default frame structure options and the frequency separation between regional broadband and national mobile

ALTERNATIVE B – Same default frame structure for regional broadband and national mobile



2c Default synchronisation and frame structure

- **Proposed technical parameters for 3400 – 3800 MHz:**
  - Set the default frame structure after the TWG as Option A, Alternative A OR Option B, Alternative B
  - Allow users to operate unsynchronised but not cause interference and must accept interference. If interference occurs then the burden to mitigate it is on that user. Actions could one or more of the following:
    - Use the default frame structure
    - Apply a more stringent unwanted emission limits
    - Operate a semi-synchronisation frame structure
    - Create a guard band in their spectrum assignment
  - Provide informative guidance on semi-synchronisation frame structure and more stringent unwanted emission limits for un-synchronised users

2c Default synchronisation and frame structure

- **Proposed technical parameters for 3300 – 3400 MHz:**
  - Needs further detailed consideration at a later stage:
    - **Alternative B:** If Regional broadband is synchronised with national mobile
      - Similar conditions to 3400 – 3800 MHz
    - **Alternative A**: If Regional broadband and national mobile are not synchronised
      - Frequency separation between regional broadband and national mobile is likely (40 MHz)
      - Local use to have a default frame structure that aligns with national mobile
      - Regional broadband can have a separate default frame structure – TBD
      - Interference issues between local use and regional broadband will need further thought (different use cases, acceptance of interference and technical coordination on a case by case basis)

2c Default synchronisation and frame structure

- Stakeholder presentations / information:
  - None

- Discussion

2d Unwanted Emission Limits

- Early Access based on 3GPP bands
  - 3GPP LTE bands 42 / 43
  - Passive antenna (17 dBi gain)
  - EIRP Emission mask
- Discussion in TWG on limits being based on n78 and in TRP
  - Note that TRP would need a Regulations change

2d Unwanted Emission Limits

- Proposed technical parameters:
  - Operating Band: 3300 – 3800 MHz (n78)
  - OBUE (< ±40MHz offset) and spurious emissions (<3260 MHz and >3840 MHz)
  - AFEL (EIRP) = 3GPP base limit + 25dBi (single polarisation)
  - AFEL (TRP) = 3GPP base limit + 9dB

Table 6.6.4.2.2.1-2: Wide Area BS operating band unwanted emission limits (NR bands above 1 GHz) for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	*Basic limits* (Note 1, 2)	Measurement bandwidth
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-7dBm - \frac{7}{5}\left(\frac{f\_offset}{MHz} - 0.05\right) dB$	100 kHz
5 MHz ≤ Δf < min(10 MHz, Δf_{max})	5.05 MHz ≤ f_offset < min(10.05 MHz, f_offset_{max})	-14 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-15 dBm (Note 3)	1MHz

NOTE 1: For a BS supporting non-contiguous spectrum operation within any *operating band*, the emission limits within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block. Exception is Δf ≥ 10MHz from both adjacent sub blocks on each side of the sub-block gap, where the emission limits within sub-block gaps shall be -15 dBm/1 MHz.

NOTE 2: For a *multi-band connector* with Inter RF Bandwidth gap < $2*\Delta f_{OBUE}$ the emission limits within the Inter RF Bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks or RF Bandwidth on each side of the Inter RF Bandwidth gap, where the contribution from the far-end sub-block or RF Bandwidth shall be scaled according to the measurement bandwidth of the near-end sub-block or RF Bandwidth.

NOTE 3: The requirement is not applicable when Δf_{max} < 10 MHz.

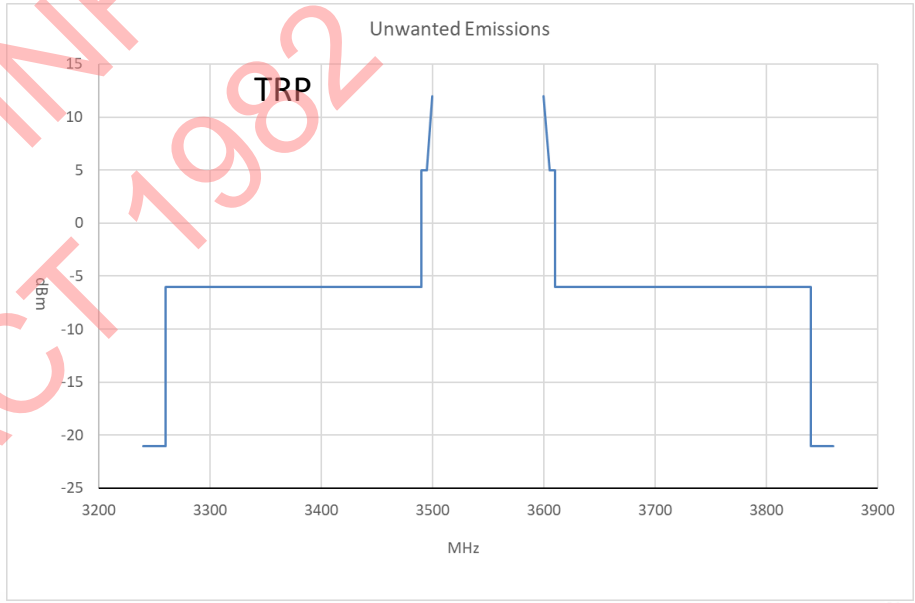
Table 6.6.5.2.1-2: General BS transmitter spurious emission limits in FR1, Category B

Spurious frequency range	*Basic limit*	Measurement bandwidth	Notes
9 kHz – 150 kHz	-36 dBm	1 kHz	Note 1, Note 4
150 kHz – 30 MHz		10 kHz	Note 1, Note 4
30 MHz – 1 GHz		100 kHz	Note 1
1 GHz – 12.75 GHz	-30 dBm	1 MHz	Note 1, Note 2
12.75 GHz – 5th harmonic of the upper frequency edge of the DL *operating band* in GHz		1 MHz	Note 1, Note 2, Note 3

NOTE 1: Measurement bandwidths as in ITU-R SM.329 [2], s4.1.
NOTE 2: Upper frequency as in ITU-R SM.329 [2], s2.5 table 1.
NOTE 3: This spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge is reaching beyond 12.75 GHz.
NOTE 4: This spurious frequency range applies only to *BS type 1-C* and *BS type 1-H*.

2d Unwanted Emission Limits

- Proposed technical parameters:
  - Proposed Unwanted Emission Limit (example):
    - Operating band n78 3300-3800 MHz
    - Carrier 3500 – 3600 MHz



2d Unwanted Emission Limits

- Stakeholder presentations / information:
  - None
- Discussion

2e Technical review

- Discussion in TWG on a regular review of technical parameters, generally agreed as a good idea

- **Proposed technical parameters:**
  - Mandatory review every 7-10 years - TBD

2e Technical review

- Stakeholder presentations / information:
  - None
- Discussion

2f Coexistence with Users above 3.8 GHz

- Coexistence issues with adjacent satellite earth stations in the 3800 – 4200 MHz band with receive protection licences:
    - Specific to the licenced earth station on a case by case basis
    - Predominantly caused by receiver filtering at the earth station (LNA/ LNB)
        - Resolved with a filter, best filters roll off in 20 MHz
    - Unwanted emissions could still be a issue close-by.
  - Managed on a case by case basis by the spectrum user and the Approve Radio Engineer

- Compatibly concerns with Aeronautical Radio Altimeters in the 4200 - 4400 MHz band:
    - Monitoring international developments
    - Being discussed with the sector

2f Coexistence with Users above 3.8 GHz

- Discussion

2g Other technical issues

- Stakeholder presentations / information:
  - None
- Discussion

3 Any other business

4 Summary and next steps

Out of scope

From: Xin Tang
Sent: Monday, 20 December 2021 11:15 AM
To: Craig Scott; Peter Gent; Cam Scott
Subject: FW: 3.5GHz TWG [UNCLASSIFIED]

FYI

Regards

T.X.

From: s9(2)(a) @ericsson.com>
Sent: Monday, 20 December 2021 11:04 AM
To: Xin Tang <Xin.Tang@mbie.govt.nz>
Subject: RE: 3.5GHz TWG [UNCLASSIFIED]

Hi Xin,

I've asked the question and we are not sure why. They will see if they can find a person who worked on LTE that would know. I was told that Ericsson only use the 3us limit for all cells.
If I hear any more I'll let you know.

Regards,
s9(2)(a)

From: Xin Tang <Xin.Tang@mbie.govt.nz>
Sent: Thursday, 16 December 2021 8:24 PM
To: s9(2)(a) @ericsson.com>
Cc: Peter Gent <Peter.Gent@mbie.govt.nz>; Cam Scott <Cam.Scott@mbie.govt.nz>; Craig Scott <Craig.Scott2@mbie.govt.nz>
Subject: RE: 3.5GHz TWG [UNCLASSIFIED]

Hi s9(2)(a)

Thanks for your question. I can confirm part 2b of the slide is from 3GPP TS 38.401. TAI should be used as reference timing.
You are right, TAI is traceable to UTC without leap second added. When it comes to frame alignment, there is no difference between these two as the requirement here is just to align the start of the frame with start time of the UTC second.

3GPP TS 38.401 version 16.3.0 Release 16 **73** **ETSI TS 138 401 V16.3.0 (20**

In case of non isolated networks, the start of the radio frame on the output shall be synchronous with the input tim reference, i.e., when an UTC traceable reference is required, the start of the radio frame shall be aligned with the s time of the UTC second.

Unless otherwise mutually agreed by the operators of the cells in non isolated networks and/or unless different SF initialization offsettings do not affect operators' networks in the same area, the common SFN initialization time sh be 1980-01-06T00:00:19 International Atomic Time (TAI).

In the meanwhile, can I ask a question about TD-LTE cell phase synchronization accuracy?

In TS36.133, the accuracy requirement for TD-LTE deployed in large cell (>3km) is 10us, but the requirement is not listed for 5G (TS38.133). In practical, can large cell TD-LTE really meet 3us requirement?
I am also curious why large LTE cell need relaxed accuracy even though the measurement point is at BS antenna. As the timing of the UE frame usually has an offset to base station for compensate propagation with base station.

7.4 Cell phase synchronization accuracy (TDD)

7.4.1 Definition

Cell phase synchronization accuracy is defined as the maximum absolute deviation in frame start timing between a pair of cells on the same frequency that have overlapping coverage areas.

7.4.2 Minimum requirements

For Wide Area BS, the cell phase synchronization accuracy measured at BS antenna connectors shall be better tha requirement specified in table 7.4.2-1. If a cell's coverage area overlaps with another cell with different cell radius the cell phase synchronization accuracy corresponding to the larger of the two cell sizes applies to the overlapping with different radii.

Table 7.4.2-1 Cell phase synchronization requirement for wide area BS (TDD)

Cell Type	Cell Radius	Requirement
Small cell	≤ 3 km	≤ 3 μs
Large cell	> 3 km	≤ 10 μs

Tang Xin
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Spectrum Planning | Radio Spectrum Management
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Level 16, 25 The Terrace, Wellington, New Zealand

RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

From: s9(2)(a) @ericsson.com>
Sent: Wednesday, 15 December 2021 4:45 pm
To: Radio Spectrum <Radio.Spectrum@mbie.govt.nz>
Cc: s9(2)(a) @ericsson.com>
Subject: 3.5GHz TWG

Hi,

Thanks for the meeting today.
In relation to part 2b of the slides presented, we refer you to 3GPP 38.401. Section 9.1 shown below.

9 Synchronization

9.1 gNB Synchronization

The gNB shall support a logical synchronization port for phase-, time- and/or frequency synchronization.
Logical synchronization port for phase- and time-synchronization shall provide:

1) accuracy that allows to meet the gNB requirements on maximum relative phase difference for all gNBs in synchronized TDD-unicast area;

2) continuous time without leap seconds traceable to common time reference for all gNBs in synchronized TDD-unicast area. In the case the TDD-unicast area is not isolated, the common time reference shall be traceable to the Coordinated Universal Time (UTC).

A logical synchronization port for phase- and time-synchronization may also be provided for e.g., all gNBs in FDD time domain inter-cell interference coordination synchronization area.
Furthermore common SFN initialization time shall be provided for all gNBs in synchronized TDD-unicast area.
In case of non isolated networks, the start of the radio frame on the output shall be synchronous with the input time reference, i.e., when an UTC traceable reference is required, the start of the radio frame shall be aligned with the start time of the UTC second.
Unless otherwise mutually agreed by the operators of the cells in non isolated networks and/or unless different SFN initialization offsettings do not affect operators' networks in the same area, the common SFN initialization time should be 1980-01-06T00:00:19 International Atomic Time (TAI).

Can you please provide comment on whether TAI could be used as this is specified in 3GPP standards. If not, can we get confirmation that 3GPP 38.401 is compatible with the proposal in part 2b presented.
Our understanding is that TAI is traceable to UTC but does not have leap seconds.

Regards,

s9(2)(a)

Ericsson MOAI NDO
8/818 Bourke St, Docklands, VIC, AUS
s9(2)(a)

Out of scope

From: Peter Gent
Sent: Thursday, 27 January 2022 11:01 AM
To: Craig Scott; Xin Tang; Cam Scott; David Stimpson
Subject: December TWG on the 3.5 GHz band - summary of discussion [UNCLASSIFIED]
Attachments: 3.5 GHz Technical Working Group 2021 12 15 TWG summary of meeting - FINAL.docx

Hi,

Thank you for the feedback on summary of discussion from the December meeting of the 3.5 GHz TWG. Please find attached a final copy of the summary.
Note that there have been a small number of editorial changes to the document.

Kind regards

Peter

Peter Gent
SENIOR PLANNER

Radio Spectrum Management
Digital, Communication & Transformation Branch, Building, Resources and Markets Group
Ministry of Business, Innovation & Employment

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RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Summary of 2nd 3.5 GHz TWG

Time: 14:00 – 16:05 hrs

Date: 15 December 2021

Place: Virtual, MS Teams

Chair: Peter Gent, RSM

Attendance: See Annex 1

1 Introduction

RSM welcomed participants to the second meeting of the TWG on the 3.3 – 3.8 GHz planning. This is the second TWG this year, following the 15 September meeting. This TWG was a further opportunity to share information. RSM noted that the key aim was to solidify the parameters for 3.4 – 3.8 GHz, and recognised that there is further, ongoing work required on 3.3 – 3.4 GHz.

2 Technical discussion

2a Technology choices and standards

RSM provided an overview of the proposed 3GPP standards that the technical parameters for the band. RSM proposed that it would be based on 5G, 3GPP release 17 (due to be frozen in early 2022). RSM outlined that 3GPP Release 14 (LTE), or earlier could be possible (i.e., it is not forbidden) but it may have to be for certain technical constraints depending on the decisions made on other technical parameters (e.g., default synchronisation and frame structure). RSM noted that it is important for the parameters to be forward looking – this could be more than 5 -10 years into the future.

Telco2 presented a slide on 4G and 5G bands, on equipment availability and on potential band placement for regional broadband (e.g. WISPA). They noted that LTE equipment has low availability in the 3.3 – 3.4 GHz band and noted that 3.7 – 3.8 GHz would be a frequency band where there is, and will continue to be, equipment available for 10+ years. Also, the coordination around satellite earth stations could be managed on a more granular basis.

Spark enquired if LTE equipment could be compatible with the frame structure used for the 5G early access program. Telco2 noted that LTE (configuration 2) would not be compatible with the 5G early access frame structure.

Cambium noted that they are comfortable with current settings. Their current product range supports 3GPP release 10 LTE in 3.4-3.8 GHz. Their roadmap has a commitment to FWA for rural, long-range access and that it can synchronise to 5G. They noted that in June 2022, an updated roadmap would be released, with FWA-LTE compatibility being at the head of that.

Spark asked Cambium what frame structure they have in mind going forward. Cambium explained that they can synchronise with many frame structures, be interoperable and compatible, and so can co-locate solutions with the equipment of other vendors. The equipment is flexible, while timing supports frame structures of 2.5 or 5ms only.

Vodafone asked if Cambium currently supports all frame structures and all available options. Cambium noted they are taking part in the TWG to understand the issues and can create frame structures that will synchronise and co-exist. Presence at the TWG provides industry awareness. The June 2022 roadmap will make this clearer. Cambium is flexible to frame structures including LTE.

RSM summarised and noted that there had been no negative feedback on the proposal to use 3GPP release 17 as a basis for the band.

2b Common phase clock reference and accuracy

RSM proposed that like the first TWG, a ±1.5µs timing signal with reference to Universal Coordinated Time (UTC) be used for timing and phase accuracy. The measurement point is at the antenna radiation plane.

RSM mentioned that 4RF provided information in an email on the CBRS radio specification (noted below).

OnGo-TS-2001 v4.1.0
CBRS Coexistence Spe

This specification notes that 10µs accuracy is used for LTE base stations deployed at large cells. RSM asked stakeholders on whether 10µs is needed for large LTE cells (>3km).

Ericsson asked why RSM had not considered international atomic time (TAI) rather than UTC as per 3GPP docs. With regard to the holdover recommendation, the feedback is that length is also on the reference side, there was a question on whether redundancy is an option. For Base Stations there can be diversity with multiple oscillators, so is there a GPS or backhaul timing requirement for a long holdover time?

RSM replied that the requirement is that the starting point of the frame align with the second, so there is no difference between UTC and TAI. Furthermore, RSM clarified with Ericsson that this requirement is from 3GPP TS 38.401 section 9.1.

2c Default synchronisation and frame structure

RSM provided information on synchronised, semi synchronised and un-synchronised options for the band noting the trade-offs between them. Currently networks are synchronised under the 5G early access. RSM presented the proposed technical parameters for default synchronisation. These had two options for frame structures and two alternatives for how these frame structures are applied. Comparisons were given on the coverage, synchronisation design and latency. Information from a recent ITU-R WP 5D study was presented to show how uplink latency can be reduced by using supplementary uplinks.

RSM explained that if the default frame structure is not used then those users shall not cause interference and must accept interference from adjacent users who are synchronised. The burden to mitigate interference is on that user.

RSM explained the design principles of semi-synchronised operations. Under the semi-synchronised operations, network operators are required to assign their control signal in the fixed slot. Flexi time slots should be used for data traffic only to minimise the packet loss.

For unsynchronised operations, RSM suggested frequency separation / guard bands and stricter unwanted emission limits (e.g. block-edge emission masks -BEM) for interference mitigations and management. The amount of spectrum needed for a guard band is determined by the user and by the neighbour's transceiver performance, co-location scenarios etc. The BEM can suppress unwanted emissions by installing operators' customized filter. RSM showed a BEM example from ECC Report 296 and explained a NZ version of Unwanted Emission Limit would need to be developed if operators want to use this solution, for it to be based on our spectrum use.

Telco2 proposed a new "Alternative C", consisting of semi-synchronised services in the entire 3.3 – 3.4 GHz band, alongside Alternative A, Option A in 3.4 – 3.8 GHz for national use (see slide 27). They noted that the usage scenarios between regional and national application are different. The interference cases would be regional into national vs national into regional if adjacent. However, with 0 – 6 dBW for regional vs 30 dBW for national use, then regional would be more likely to be interfered with rather than being the interferer. They proposed that a guard band should not be employed so that regional users can gain access to the full 100 MHz, with coordination. They noted a comparison can be made with the 2.5/2.6 GHz bands where MNOs have national rights but only deploy networks in population centres and do not generally provide rural coverage (i.e., different usage scenarios). Having a full guard band across entire country is a bad idea. This would allow 3.3 – 3.4 GHz to be semi-synched regional use, with national users (3.4 – 3.8 GHz) using use numerology 1 (i.e., the 5G early access Frame Structure)

RSM noted that there is no intention to have a guard bands free of spectrum users (i.e. have empty or unused spectrum), the intention would be to use it for local private networks (e.g. industry verticals).

Spark enquired about the filtering that would be required between the national and non-national bands. Spark noted that treating the 3.3 – 3.8 GHz as a single band makes coexistence more difficult. It was suggested that the 3.3-3.4 GHz and 3.4-3.8 GHz bands should be treated as separate bands (i.e. have more stringent unwanted emission limits applied at the 3.4 GHz boundary). It was noted that 3.3-3.8 GHz (i.e., band n78) is implemented in different ways by different vendors (e.g. Europe have additional requirements to protect radiolocation services below 3.4 GHz).

Spark also noted that there is a need to accommodate new frame structures and other rules as 3GPP continues to make rapid progress in new releases (e.g., Release 18) and MNOs will want to update them in the future. RSM noted that technical review periods will be discussed in section 2e. It was also noted there is nothing stopping parties from coordinating with each other at any time.

Vodafone reiterated elements of its submission to the 3.3 GHz consultation explaining that the upper 40 MHz (i.e. 3.36 -3.4 GHz) should be used for low-power indoor services only. It was also noted that LTE is a poor choice for the band as it is an old technology and 5G is rapidly developing and the costs of deployment are falling. Vodafone considered that 5G in the 3.5 GHz band is important for rural coverage.

Telco2 noted that MNOs are deploying new 3G networks in Africa until 2026 and that 4G will still be in active development beyond 2045. Also, 5G never will be less expensive than 4G as it is more sophisticated and that there is still a need for 4G for rural deployment.

Cambium echoed Telco2's comments and argued that RSM should consider each use case separately, as 3 GHz is effective for rural coverage and so regional broadband users should continue to have access to the band. However, Cambium noted that this band can also be used for 5G in NR NSA mode.

Cisco noted that supplementary up links are not an option and that using a semi-synchronised frame structure is best in 3.3-3.4 GHz band, as this allows for uplink-heavy applications such as streaming video and artificial intelligence analysis.

RSM summarised the discussions noting that that that there was some support for Alternative A, not much support for Alternative. B and some support for a new proposed Alternative C. RSM noted that there were different views on interference risks between unsynchronised regional and national uses. There were some views that the usages scenarios are different and that the risks are low. There were other views that frequency separation is needed and a suggestion that 3.3-3.4 GHz and 3.4-3.8 GHz be treated as separate bands (i.e. more stringent unwanted emission limits be applied at the 3.4 GHz boundary).

2d Unwanted Emission Limits

RSM outlined the proposed Unwanted Emission Limits. Currently the 5G early access limits are based on 4G bands 42/43. The limits going forward would be based on 5G band n78 for the 3.3-3.4 GHz range and will be taken from the 3GPP specifications. If possible, the limits would be based on TRP, and be adopted directly from the standards. However, using a TRP metric would require a change in the Radiocommunication Regulations 2001 and such a change may not happen for a while. RSM explained the proposed translation formula from the 3GPP base limit to TRP or EIRP.

Spark asked about the 25 dBi (for the AFEL (EIRP) with single polarisation), and asked what if BS are cross-polarised. It was asked if 3 dB needed to be added for a cross polarised installation, and what changes would be needed for a 32T/32R configuration if 64T/64R is only specified. Spark's earlier comment on treating the 3.3 – 3.4 GHz and 3.4 -3.8 GHz bands separately was also noted.

RSM noted that the analysis and subsequent figures are based on 192 antenna elements and measuring the gain for dual polarisation requires the same antenna configuration at the spectrum analyser. It is unlikely that a 3 dB MIMO gain from dual polarisation can be measured without demodulation. It was also noted that the unwanted emission limits set a maximum limit. It is assumed that if this is based on 64T/64R smaller arrays (e.g 32T/32R) then this should easily meet the limit.

Vodafone enquired as to how compliance on these new BS would be undertaken, and what process would be used to enforce these limits?

RSM noted that already there are procedures for measuring EIRP accurately in the field and internationally there is active development (e.g., ITU-R WP1C and CEPT) on how to effectively measure TRP in the field. There are already well-defined methods for accurately measuring EIRP and TRP in a laboratory.

2e Technical review period

RSM noted that following the first TWG, it proposes a mandatory technical review, with a possible 7-10 period review timeframe. It was also noted that there is nothing stopping all the users of the band voluntarily changing parameters if all parties could mutually agree.

It was suggested that a 5-year mandatory period would be appropriate as technology is continuing to evolve (e.g., 3GPP release 18 could bring new frame structures) and this this would allow unforeseen disruptive technologies to be accommodated. It was suggested that a technical review should be coordinated across an entire band (e.g. include 3.3 - 3.4 GHz).

RSM noted some care was needed to not have the review period too short as a review could start soon after the implementation of technical conditions (e.g., perpetual or ongoing reviews), noting that review periods can be quite long(e.g. 12-18 months). RSM noted that the TWG has covered the entire 3.3 - 3.8 GHz band and that future coordination for in-band and adjacent-band users would be beneficial.

2f Coexistence with Users above 3.8 GHz

RSM outlined details of two adjacent-band coexistence issues. The first being receiving satellite earth stations use of spectrum in 3.8 – 4.2 GHz; the second being the use of radio altimeters (RA) on aircraft operating in 4.2 - 4.4 GHz.

Spark sought to confirm that the burden of filtering would be required on the satellite earth station receivers rather than on MNOs transmitters at the base stations. Spark highlighted that only type 1-H base stations will be used in this band so that installing additional filters is not possible. Spark queried if there were requirements on their satellite earth stations to have filters on their receivers RSM explained that satellite earth station receivers are often the dominant issue in the coexistence scenario but under certain circumstances the unwanted emissions from base stations could also be an issue. In general, requirements on receiver filtering are not specified.

Telco2 asked that if an auction takes place, would satellite earth stations be an encumbrance in the 3.7 – 3.8 GHz band, especially in locations like central Auckland. It was suggested that regional broadband (e.g. as offered by WISPA) would be best placed in the 3.7 – 3.8 GHz band as coordination could be better managed on a case by case basis.

Vodafone noted that they had interference early on in their 5G deployment, specifically at TVNZ in Auckland, but that this had been resolved with filtering at the satellite earth station receiver side.

The IMSC asked if the broader 3.4 – 3.8 GHz band would be affected by radio altimeters and asked about the results from European studies and from flight testing.

RSM noted that this work on radio altimeters was still on-going internationally and many spectrum regulators are currently looking at the issue. The European studies are in draft form and can be found on the CEPT website. The aviation sector was still undertaking work as well and has been asked for radio altimeter parameters, preferably based on actual measurements. RSM is continuing to monitor this and will continue to engage with stakeholders as appropriate.

2g Other technical issues

No other technical issues were raised.

3 Any other business

There was none.

4 Next steps and Closing

RSM thanked everyone for their active contribution to the meeting. RSM asked participants to forward any final information on this topic to the Radio.Spectrum@mbie.govt.nz inbox by 28 January 2022, and before the technical parameters of the 3.4 – 3.8 GHz rights are formalised.

RSM wished everyone a good afternoon.

Annex 1 – Attendees

Name	Organisation	Name	Organisation
Peter Gent (Chair)	Radio Spectrum Management (RSM), MBIE	s9(2)(a)	Sensing Value
s9(2)(a)	Nokia		Spark
	Huawei		Ericsson
	CISCO		Samsung
	Interim Māori Spectrum Commission		WISPA
	Interim Māori Spectrum Commission		Broadtech
	Chorus	Len Starling	Radio Spectrum Management (RSM), MBIE
Cam Scott	Radio Spectrum Management (RSM), MBIE	s9(2)(a)	Spark
s9(2)(a)	2Degrees		Ericsson
	Nokia		Spark
Craig Scott	Radio Spectrum Management (RSM), MBIE		WISPA
s9(2)(a)	Go WiFi		Nokia
David Stimpson	Radio Spectrum Management (RSM), MBIE		Vodafone
s9(2)(a)	Broadtech		Interim Māori Spectrum Commission
	Cambium		Cambium
	Vodafone		NZART
	Spark	Xin Tang	Radio Spectrum Management (RSM), MBIE

Attendee list for the 3.5 GHz Technical Working Group (TWG) - 15 December 2021

Attendee	Representing
s9(2)(a)	2 Degrees
	2Degrees
	Broadtech
	Broadtech
	Broadtech
	Cambium
	Cambium
	Cambium
	Chorus
	CISCO
	Dense Air
	Dense Air
	Ericsson
	Ericsson
	Ericsson
	Go WiFi
	Huawei
	Interim Māori Spectrum Commission
	Interim Māori Spectrum Commission
	Interim Māori Spectrum Commission
	Nokia
	Nokia
	Nokia
	NZART
	NZART
Cam Scott	Radio Spectrum Management (RSM), MBIE
Craig Scott	Radio Spectrum Management (RSM), MBIE
David Stimpson	Radio Spectrum Management (RSM), MBIE
Len Starling	Radio Spectrum Management (RSM), MBIE
Peter Gent (Chair)	Radio Spectrum Management (RSM), MBIE
Xin Tang	Radio Spectrum Management (RSM), MBIE
s9(2)(a)	Samsung
	Samsung
	Samsung
	Sensing Value
	Spark
	Spark
	Spark

s9(2)(a)	Spark
	Spark
	Spark
	Vodafone
	Vodafone
	Vodafone
	WISPA
	WISPA

Out of scope

From: Peter Gent
Sent: Monday, 9 May 2022 1:26 PM
To: s9(2)(a)
Cc: Craig Scott; Cam Scott; David Stimpson; Daniel O'Grady
Subject: RE: December TWG on the 3.5 GHz band - summary of discussion [UNCLASSIFIED]

Hi s9(2)(a)

Thank you for your email.

We have talked with s9(2)(a) and s9(2)(a) (WISPA) on this topic before Easter. As you are aware, we have previously publicly consulted on the intention to make spectrum available in the 3.3 – 3.4 GHz band for non-national use. Cabinet has now decided to allocate the entire 3.3 – 3.8 GHz band for mobile broadband use. This decision includes non-national usage (e.g. regional broadband and private networks) in addition to national use. However, while there are still a number of details to work through. It is highly unlikely that non-national usage will be accommodated within the 3.4 -3.8 GHz band and it is likely that it will be within the 3.3 -3.4 GHz band (or portions thereof) as per our consultation.-

In terms of the design and regime for 3.3 – 3.4 GHz to accommodate regional broadband and private networks, we are working in this internally. However our first priority is on national use in 3.4 -3.8 GHz.

Kind regards

Peter

From: s9(2)(a)
Sent: Thursday, 5 May 2022 9:16 AM
To: Peter Gent <Peter.Gent@mbie.govt.nz>
Cc: Craig Scott <Craig.Scott2@mbie.govt.nz>; Xin Tang <Xin.Tang@mbie.govt.nz>; Cam Scott <Cam.Scott@mbie.govt.nz>; David Stimpson <David.Stimpson@mbie.govt.nz>
Subject: Re: December TWG on the 3.5 GHz band - summary of discussion [UNCLASSIFIED]

Kia ora Peter,

Has the ministry provided any advice to any parties about the potential layout of the spectrum blocks and location of the local/regional block?

I'm extremely concerned about a communication I just saw indicating that the local/regional block is now fixed to 3.3-3.4 GHz. Also very concerned that the communication mentioned using the block for P-P linking.

Please provide me with any information your team has provided to other stakeholders. I would also appreciate an indication of when we are likely to have decisions on the spectrum.

Thank You,

s9(2)(a)

On Thu, 27 Jan 2022 at 11:01, Peter Gent <Peter.Gent@mbie.govt.nz> wrote:

Hi,

Thank you for the feedback on summary of discussion from the December meeting of the 3.5 GHz TWG. Please find attached a final copy of the summary.

Note that there have been a small number of editorial changes to the document.

Kind regards

Peter

Peter Gent
SENIOR PLANNER

Radio Spectrum Management

Digital, Communication & Transformation Branch, Building, Resources and Markets Group

Ministry of Business, Innovation & Employment

peter.gent@mbie.govt.nz | Waea/DDI: +64 4 978 3279 Free Phone: 0508 RSM INFO (776 463) | Website: www.rsm.govt.nz

Level 14, 25 The Terrace, Te Puāwai o te Aroha – Pastoral House, PO Box 2847, Wellington, New Zealand

RADIO SPECTRUM MANAGEMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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s9(2)(a)

Some 3GHz radio complies with EN 302 326

https://www.cambiumnetworks.com/wp-content/uploads/2021/01/Cambium_Networks_data_sheet_PTP-450i.pdf

We use 40 MHz as the channel bandwidth to compare ACLR between 3GPP (TS 38.104) and Non-3GPP equipment.

3GPP ACLR requirement

Table 6.6.3.2-1: Base station ACLR limit

BS channel bandwidth **of *lowest/highest carrier*** **transmitted $BW_{Channel}$ (MHz)**	**BS adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted**	**Assumed adjacent channel carrier (informative)**	**Filter on the adjacent channel frequency and corresponding filter bandwidth**	**ACLR limit**
5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90,100	$BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	45 dB
	2 x $BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	45 dB
	$BW_{Channel}$ /2 + 2.5 MHz	5 MHz E-UTRA	Square (4.5 MHz)	45 dB (Note 3)
	$BW_{Channel}$ /2 + 7.5 MHz	5 MHz E-UTRA	Square (4.5 MHz)	45 dB (Note 3)

NOTE 1: $BW_{Channel}$ and BW_{Config} are the *BS channel bandwidth* and *transmission bandwidth configuration* of the *lowest/highest carrier* transmitted on the assigned channel frequency.
NOTE 2: With SCS that provides largest transmission bandwidth configuration (BW_{Config}).
NOTE 3: The requirements are applicable when the band is also defined for E-UTRA or UTRA.

EN 302 326 , The frequency of each turning point is expressed as F/ChS, where F is the frequency offset from the carrier centre frequency (f0) and ChS is the supplier stated Channel Separation (EqC-ChS).

EqC-PET = O								
F/ChS ⇨	0	0,5	0,5	0,71		1,06	2	2,5
EqC-EMO ⇩								
2	0 dB	0 dB	-8 dB	-25 dB		-27 dB	-50 dB	-50 dB
4	0 dB	0 dB	-8 dB	-27 dB		-32 dB	-50 dB	-50 dB
6	0 dB	0 dB	-8 dB	-32 dB		-38 dB	-50 dB	-50 dB

40 MHz scenario, Chs=40 MHz,

	0	20MHz	20MHz	28.4MHz	40.24MHz	80 MHz	100 MHz
1 bit/s/Hz	0	0	-8	-25	-27	-50	-50
2 bit/s/Hz	0	0	-8	-27	-32	-50	-50
3 bit/s/Hz	0	0	-8	-32	-38	-50	-50

A rough estimation, the first adjacent channel ACLR is -35dB, second adjacent channel is -50dB

3GPP Receiver ACS Requirement , -95dBm (sensitivity @40MHz channel) – interference level =

43dB ACS Wide area Base

48dB ACS Medium Range Base

51dB ACS Local Area Base

Base station ACS requirement

***BS channel bandwidth* of the lowest/*highest carrier* received (MHz)**	**Wanted signal mean power (dBm)**	**Interfering signal mean power (dBm)**
5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 (Note 1)	$P_{REFSENS}$ + 6 dB	Wide Area BS: -52 Medium Range BS: -47 Local Area BS: -44

NOTE 1: The SCS for the lowest/highest carrier received is the lowest SCS supported by the BS for that bandwidth.

NOTE 2: $P_{REFSENS}$ depends on the RAT. For NR, $P_{REFSENS}$ depends also on the *BS channel bandwidth* as specified in tables 7.2.2-1, 7.2.2-2, 7.2.2-3. For NB-IoT, $P_{REFSENS}$ depends also on the *sub-carrier spacing* as specified in tables 7.2.1-5, 7.2.1-5a and 7.2.1-5c of TS 36.104 [13].

EN 302 326 has 0 dB ACS rejection requirement

Table 11: Limits of adjacent channel interference rejection for BER ≤10^{-6} for equipment with Primary Equipment Types F, T, O or M

Primary Equipment Type (EqC-PET)	Frequency Range (EqC-FR)	Modulation Order (EqC-EMO) (Note 3)	Sub-type (EqC-ST)	Signal to Interference level (S/I) Threshold Degradation: For 1 dB	For 3 dB
F Note 1	< 1 GHz	2	Any	0	-4
		3	Any	0	-4
		4	Any	0	-4
	1 GHz to 11 GHz	2	FA	-15,5	-19,5
		3	FA	-13,5	-17,5
		4	FA	-6,5	-10,5
	1 GHz to 3 GHz	2	FB	-3	-7
		3	FB	-3	-7
		4	FB	-3	-7
	3 GHz to 11 GHz	2	FB	-10,5	-14,5
		3	FB	-8,5	-12,5
		4	FB	-1,5	-5,5
	26 GHz, 28 GHz and 32 GHz	2	Any	-15,5	-19,5
		3	Any	-13,5	-17,5
		4	Any	-6,5	-10,5
	26 GHz and 28 GHz	6	Any	0	-4
M Note 4	26 GHz, 28 GHz and 32 GHz	2	Any	0	-4
		4	Any	0	-4
		6	Any	0	-4
T	< 1 GHz	2	QP	11	9
		2	GM	11	9
		2	DQ	11	9
	1 GHz to 3 GHz	Any	Any	0	Note 2
	3 GHz to 11 GHz	2	HC	-10	-13
		2, 4, 6	Not HC	0	Note 2
	26 GHz and 28 GHz	2	HC	-10	-13
	26 GHz, 28 GHz and 32 GHz	2	Not HC	0	-4
		4	Any	0	-4
		6	Any	0	-4
O	≤ 11 GHz	Any	Any	0	Note 2

NOTE 1: The unwanted signal is one ChS channel away.

NOTE 2: Earlier equipment standards corresponding to the equipment types annotated by note 2 specify co-channel performance in terms of BER degradation up to 10^{-5}, rather than the more usual RSL degradation for BER≤10^{-6} which is more usual and more appropriate in the context of modern broadband systems. In these cases, the requirement of the earlier standards has been translated to a degradation of RSL threshold of 1 dB, which is considered equivalent from the point of view of the essential requirements under article 3.2 of the R&TTE Directive [2] and the figures adjusted accordingly. Equipment already assessed according to the previous requirement do not need reassessment.

NOTE 3: Mixed-mode systems may also provide EqC-EMO=1 option, among other more efficient EMOs; for this case the requirement shall be 3 dB tighter than that for EqC-EMO=2 case.

NOTE 4: For multi-carrier equipment, the limits shall be met for each sub-carrier. The requirement shall be met for an interfering signal on either side of the multi-carrier system centre frequency.

Frequency: 3605 MHz; Bandwidth: 40 MHz						
Frequency centre (MHz)	***Mod Mode***	***Data Rate (Mb/s)***	***RSSI Unit reading (dBm)***	***Adjacent Channel signal Level (dBm)***	***RSSI Unit reading with Adjacent Channel Signal (dBm)***	***Verdict***
3565	QPSK	8	N/A	-82	N/A	PASS
3605	QPSK	8	-82	N/A	-82	PASS
3645	QPSK	8	N/A	-82	N/A	PASS

Xin to look at this W/C 31/05

Basic analysis to sense check the assumptions / settings

[Indoor to local use. Building entry loses should be ok.]

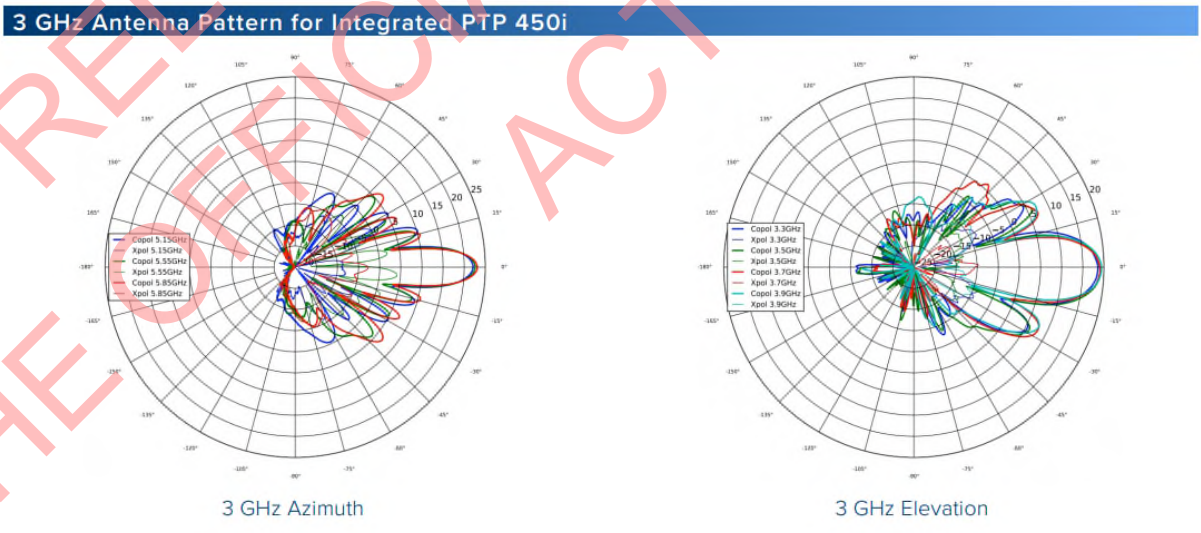
Receivers RF interference Criteria

CBRS or 3GPP power levels using CBRS values from https://www.law.cornell.edu/cfr/text/47/96.41

Devices with some antenna gain

Setting	**Gain (dBi)**
Regional	17
Local	9
Indoors	0

Antenna Pattern from Cambium P450i datasheet, maximum antenna gain is greater than 20dBi.



Link budget time

Building entry loss – P.2109 https://www.itu.int/rec/R-REC-P.2109/en

All building entry losses have 15.5 dB of attenuation as the ITU-R recommendation

Scenarios

- Regional and local
- Regional and indoors
- Local and indoors

Interferer (tx)

	Regional	**Local**	**Indoors**
Tx Power (dBm / 10 MHz)	47[1]	30[1]	23[1]
Tx Power (dBm / MHz)	37	20	13
Cable loss (dB)	3	1	0
Antenna gain (dB)	17[2]	9[3]	0

[1] https://www.law.cornell.edu/cfr/text/47/96.41
[2] E.g. 90 deg antenna https://www.arubanetworks.com/assets/og/OG_Celona-Outdoor-Antennas.pdf
[3] E.g. https://panorama-antennas.com/site/CBRS-3.6GHz-5G-LTE-Antennas/W36-CP-9

Clutter losses (dB)[4]	16.5	16.5	16.5
Building entry loss (dB)	0	0	15.5 (p=0.5)

Victim (rx)

	Regional BS	**Local BS**	**Indoors BS**	**User equipment**
Thermal noise (dBm / MHz)	**-114**	**-114**	**-114**	**-114**
RX noise figure[5] (dBm)	**5**	**10**	**13**	**9**
Receiver Noise (dBm)	**-109**	**-104**	**-101**	**-105**
Protection criteria (I/N)[6]	**-6**	**-6**	**-6**	**-6**
Rx protection level (dBm) - noise limited)	-115	-110	-107	-111
RX protection level (dBm) (interference limited)[7]	-105	-100	-97	-101
Cable loss	3	1	0	0
Antenna gain	17	9	0	0
Building entry loss	0	0	15.5	0 / 15.5 (indoor)

Calculated values with 10 dB of the RX protection level from the noise limited level, along with clutter loss for 5% at 3.3 GHz

Ie if we protect to the noise floor, then its poor spectrum management. However if you accept more interference, you can decrease the throughput ie change the Mod code and drop the data throughput. E.g if the noise floor is -105. What happens to tolerate noise floor to -95dBm.

(Another commonly used way is that 3GPP is a 5% reduction in capacity, which nominally equates to 5% coverage loss.)

Values at 3 300 MHz		**Required path loss**	**Minimum separation distance**
Scenario			
Regional and local	Regional tx and local rx	142 dB	96.94 km
	Regional tx and UE	135.5 dB	43.30 km
	Local tx and regional rx	130.5 dB	24.35 km

[4] Taken from ITU-P 2108 section 3.2, 3.3 GHz, 500 Meters and 5% scenarios are worse than this figure
[5] Taken from ITU-R M.2292-0 – Table 1, section 7.1 for LTE equipment, no NR report available so far and would expect performance to be broadly similar,
[6] Taken from This is from ITU-R M.2292-0
[7] 10 dB, potential reduction from 2.75 to 1 bits / hertz reduction in capacity – 3GPP TR 36.942

	Local tx and UE	112.5 dB	3.07 km
Regional and indoors	Regional tx and indoors rx	116 dB	4.58 km
	Regional tx and UE (indoors)	120 dB	7.27 km
	Indoors tx and regional rx	96 dB	0.458 km
	Indoors tx and UE	82 dB	0.091 km
Local and indoors	Local tx and indoors rx	93 dB	0.325 km
	Local tx and UE (indoors)	97 dB	0.515 km
	Indoors tx and local rx	89 dB	0.205 km
	Indoors tx and UE	90 dB	0.230 km

Need to calculate a link budget Look at different levels of degradation. CAS to have a look at this

Len Starling
Radio Spectrum Management
MBIE
PO Box 2847
Wellington 6140
By Email

Dear Len

Use of 3.3 – 3.41 GHz Spectrum for Regional Broadband Access

WISPA members provide broadband connections to around 75,000 households. They push boundaries when it comes to economic delivery of services to remote users. Tens of thousands of these connections are provided from small, low cost installations that are often solar powered. Their end users are frequently tens of kilometers away from their serving cells.

Having recognised the critical role WISPA members play in delivering rural and remote broadband, Crown Infrastructure Partners are in negotiation with a number of our members to assist them in increasing their networks to provide more coverage and higher speed connections.

When you announced the review of the 3.3-3.41 GHz band during our January conference we were encouraged. This band initially appeared to be a solution for the problem that most of our members have – that they do not have access to enough licenced spectrum to meet the rapidly-increasing demand for rural broadband.

Our consultations with our members when preparing our response to your recent discussion paper on this band, and also items discussed at the recent meeting of the 3.5 GHz Technical Working Group, have highlighted two issues that could have a major impact on its use for regional broadband delivery, especially in the short term.

The first issue is the lack of suitable equipment that can operate in the proposed allocation.

WISPA members require access to low-cost equipment, as thousands of WISPA sectors service fewer than twenty subscribers. Low-cost LTE equipment is available from more than ten vendors in Bands 42 and 43 (3400-3600 and 3600-3800), but no low-cost equipment is available in band 52 (3300-3400).

To resolve this issue we request that the regional/rural allocation be relocated higher in the c-band, perhaps 3690-3800 MHz.

The second issue is a requirement for synchronisation across the entire 3.3-3.8 GHz frequency range.

WISPA members understand the value of synchronisation to the coordination of radio spectrum - especially when it comes to co-channel coordination between regional allocations. WISPA members support synchronisation within the band, and propose a pattern that would allow for the use of 4G and 5G technologies simultaneously, as recommended by the CBRS alliance.

The proposed synchronization methods favoured by the mobile network operators are designed for 5G nr access with maximum cell sizes of around 10 km. It's not technically or financially practical for WISPA members to synchronise with a pattern that would limit communications to 10 km.

It is important for the advancement of rural New Zealand that these issues are addressed if a portion of this band is to be used effectively and efficiently for the provision of broadband services that is critical to the advancement of our country.

We look forward to your comments on the above proposal.

Yours faithfully

s9(2)(a)

WISPA.NZ

3.3 GHz Band Planning

RSM released a public consultation on the future of the 3.3 – 3.41 GHz band (the band) in August 2021. This consultation looked at regional, local, and indoors use (non-national) which covers a potentially wide range of use from regional internet service providers (known as WISPs) through to local (campus) use and indoor networks. A brief summary of the 20 submissions has been developed and is in Annex 1. Subsequently to this consultation, RSM received further correspondence from WISPA (see Annex 2) which provides additional information about their views of the use of the whole 3.3 – 3.8 GHz.

The 3.3 – 3.41 GHz band is adjacent to the key C band 3.5 GHz band, which is the key national 5G band, whose rights will be set to commence in November 2022 by an allocation process currently being developed.

Use cases

Despite our initial analysis showing that indoor and either regional or local uses can co-exist, the s9(2)(f)(iv). This removes some potential for incorrectly configured networks. There are neighbouring GUL bands that can be (or likely in the near future) be able to provide licence free connectivity.

Local and regional uses were supported by most submitters, so having trying to accommodate both uses in the band would be a good thing to enable.

Band plan

Building on the use case section above. s9(2)(f)(iv)

s9(2)(f)(iv)

However further discussion will take place, noting the further submission from WISPA in light of their equipment availability.

Technical parameters

Suggestion of a combined parameters across the whole 3.3 – 3.8 GHz band. s9(2)(f)(iv) [redacted]

Licencing options for consideration

New users

Regional – to be discussed further, s9(2)(f)(iv) [redacted]

Local – licencing only available

Existing users

The recommendation is to s9(2)(f)(iv) [redacted]

Annex 1 Summary of submissions

20 submission from a range stakeholders. Ranging from individuals through to national MNOs on the 3.3 GHz band (the band). Below are selected themes that came through from the submissions received.

Question 1

Do you agree that the 10 MHz between 3.40 – 3.41 GHz should be included with the 3.4 - 3.8 GHz band (the 3.5 GHz band) that will be made available for national use?

Most submitters were comfortable with an additional 10 MHz to the national 3.5 GHz band plan – with the band edge moving from 3 410 MHz down to 3 400 MHz. One submitted noted that it is "…logical to include the 3.40 – 3.41 GHz band into the segment allocated for national use".

Some disagreed, wanting this 10 MHz to either be used a as guard band, or a guard band with secondary use for the Amateur use.

Question 2

Do you agree with our assessment of current spectrum use and potential impacts?

Most submitters agreed with the proposed uses of the band.

Some submitters noted that the utilities should be among the mix for local and regional use.

One submitted wanted the band to set aside for a new entrant for national use. One submitter suggested RSM look to opening up 3.8 – 4.2 GHz for non national use, although this is out of scope of the consultation.

Question 3

What is your view on using the 3.3 - 3.4 GHz band for regional broadband and/or private networks? Are there other use cases of this band that should be considered?

Most submitters agrees that the band appeared to be underused.

Some submitters noted that the band has been used for moon bounce amateur operations.

Some submitters noted that while there were no Radio Astronomy licences in New Zealand, some work had been undertaken within the band, at Warkworth in recent times.

Question 4

Do you agree with the assessment that regional and local use will not be able to co-exist in the same geographic area on the same frequency. If not, why?

One submitter noted that with synchronisation, local and regional use could co-exist on the same frequency.

Most submitters agreed that regional and local use will not be able to co-exist in the same area however.

Question 5

Do you agree that both regional and indoor use as well as local and indoor use could be manageable in the same geographic area on the same frequency? If not, why?

Most submitters were comfortable with the proposals.

One submitted questioned the need for indoor use, with the availability of the nearby 5 GHz GURL (predominantly used by Wi-Fi).

Question 6

Do you agree that the most effective way to manage spectrum in this band is to have contiguous services with a common frame structure and timing (synchronisation)? If not, why not?

One submitter suggested defining only high level technical parameters and leaving the modulation structures not defined.

Most submitters agreed that the most effective way is to have common synchronisation.

Question 7

What are your preferred options for a band plan for the 3.3 - 3.4 GHz band, are there other options we should consider, if so please explain what these are?

There were a number of proposals for band plans for the band.

Some submitters wanted higher power users at the bottom of the band, with lower power uses (either indoor or local) providing a partial guard band or buffer to national services at 3.4 GHz.

Some other submitters wanted significant spectrum (80 -100 MHz) for regional use, with either some wanting 20 MHz (5/10 MHz channels) for local use or local use relegated to secondary use across the band.

One submitter suggested reintroducing the WiMAX FDD legacy band plan from the early 2000's.

Another submitter proposed a number of options, including allowing for LTE and 5G NR services within the band, with a guard band between the two.

One submitter suggested that there should be no differentiation between local and regional use.

Question 8

How much spectrum is required for regional and uses and how much is needed for local use?

Some submitters wanted a 80 (regional) / 20 MHz (local) spilt.

Some submitters wanted smaller local channels that could be combined to provide consolidated channels eg 5+5 = 10 MHz channels.

Question 9

What equipment options and standards should we consider for the 3.30 – 3.30 GHz band? If we adopt multiple standards how should we manage potential interference issues between the technologies while minimising inefficient use of spectrum?

Some submitters wanted 3GPP standards to be used as the basis of services within the band.

Other submitters wanted the Ministry to just set technical parameters (e.g. frame structure) and not mandate standards

One submitter noted it would likely to be inefficient if different frame structures were permitted

Question 10

Do you agree that we should seek to permit all three use cases, indoor, local and regional uses in the 3.3 GHz band? Do you agree with our mix of use? If not which cases should we permit?

Some submitters were happy with all three use cases.

Some other submitters suggested that the indoor use not be permitted, as there are neighbouring bands eg Wi-Fi at 5 GHz (and recently consulted 6 GHz) that could be used to provide this functionality.

Question 11

What authorisation mechanisms should we use for indoor, local and regional use cases non-national access in the 3.3 – 3.4 GHz band? Are there any other mechanisms that should be considered?

One submitter suggested that the Ministry would have be very hands on when managing the three uses.

One summited noted that it's practical to manage interference issues between unsynchronised TDD users without inefficient use of spectrum in the band.

Question 12

What are sort of rules should be applied to the authorisation mechanisms to ensure compatibility and fair access?

One submitter suggested a GURL be implemented across the band

One submitter suggested first-in-time licenses for indoor use, with synchronised licences.

A number of submitters suggested a CBRS or CBRS like mechanism be implemented. There were concerns about high cost [database] solutions however.

Question 13

How should we prevent spectrum denial / hoarding/ speculating of licenses? Should we adopt one of the existing models that RSM already employs or what new model should we use in the 3.3 GHz band?

One submitter suggested using a GURL with antenna performance standards, and let the band self-manage by removing resource charge barriers to entry.

Question 14

How should we prevent spectrum denial / hoarding/ speculating of licenses? Should we adopt one of the existing models that RSM already employs or what new model should we use in the 3.3 GHz band?

One submitter wanted regional licences restricted to existing radio network operators to ensure use.

Another submitter wanted tightly defined rules to prevent e.g. regional licences must be for public broadband access and local licences being limited to land / building ownership areas, with no spill over

Another submitter wanted a light licencing regime with a prescriptive GUL to allow parties to work on the same technical parameters but no individual licenses required.

Finally another submitter wanted to contract out the management of the band to a third party, to act as band manager with a regional focus.

Annex 2

WISPA submission

Letter to RSM - 3.3 GHz rev 3.pdf

Attachment duplicated in release at pp 138-139