The Competitive Carriers Association

Rural Cellular Association
805 15th Street NW, Suite 401
Washington, DC 20005
Office: (202) 449 -9866 • Fax: (866) 436 -1080

December 13, 2011

Via ECFS

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: ***WT Docket No. 11-18; RM-11592***

Dear Ms. Dortch:

On December 9, 2011, Hu Meena and Ben Moncrief from C Spire Wireless, Doug Minster from ATN, Steve Berry from RCA and I met with Chairman Genachowski, Rick Kaplan, and Amy Levine to request that the Commission approve AT&T's purchase of the Qualcomm spectrum on the condition that AT&T utilize the original band class (3GPP Band Class 12) for all paired-spectrum deployments within the Lower 700 MHz.

We discussed that since the Thanksgiving holiday, Lower 700 MHz licensees have made several significant submissions in the above-referenced proceedings. These submissions conclusively demonstrate (1) the lack of any technical justification for AT&T's use of Band Class 17 in the Lower 700 MHz spectrum and (2) a direct relationship between the subject-matter of this transaction and Band Class 12.

The Atlanta Study[1]

Earlier this month, several 700 MHz Lower A Block licensees presented the Commission with results of a recently-concluded engineering study (the "Study"). The Study's results prove that AT&T's claimed justifications for its use of a boutique band class in the Lower 700 cannot be substantiated.

The Study tested, in a real world setting, the underlying assumptions originally put forth regarding the need for a separate Band Class 17 in the Lower 700 MHz band class. The Study also set out to test a series of unsubstantiated claims put forth by AT&T and Qualcomm regarding the technical feasibility and cost impact of the utilization of a single band class (3GPP Band Class 12) for all deployments on paired spectrum in the Lower 700 MHz.

The Study found that the alleged interference circumstances were unfounded and the underlying assumptions put forth for a separate Lower 700 MHz Band Class 17 were overstated.

[1] *See, e.g.*, Vulcan Wireless *ex parte* Notice, filed November 30, 2011 in RM-11592 and WT Docket 11-18.

The data confirms that the use of Band Class 12 would not lead to degraded service for Lower 700 MHz B and C Block users. Further, device testing demonstrated that unsubstantiated claims regarding the potential increase in cost or size of devices are inaccurate and misstated, as the current bill of materials costs will remain virtually unchanged.

The Study's results support the Commission's approval of the AT&T-Qualcomm transaction with a condition that would restore a unified Lower 700 MHz band plan. Accordingly, the Commission should approve AT&T's purchase of the Qualcomm spectrum on the condition that AT&T utilize 3GPP Band Class 12 for all paired-spectrum deployments within the Lower 700 MHz.[2]

Direct Relationship Between Transaction and Band Class 12

AT&T's planned deployment on the spectrum licenses it seeks to acquire from Qualcomm has a direct and potentially detrimental relationship to Band Class 12. During the meeting, we discussed that recent actions at 3GPP, the international standards setting body for LTE, demonstrate a direct and specific nexus between the subject matter of the AT&T-Qualcomm transaction (Lower D and E Block of the 700 MHz spectrum) and Band Class 12 (the Lower A, B, and C Blocks of 700 MHz spectrum).

Just last month, Ericsson submitted a proposal to 3GPP regarding the specifications for use of the Lower D and E blocks of 700 MHz (the "Qualcomm spectrum") in the manner proposed by AT&T. That proposal, a copy of which is attached, assumes that Band Class 12 operators will sacrifice over 5% of the uplink portion of the band class (or over 16% of the uplink of the Lower C block) to enable AT&T's proposed deployment on the Qualcomm spectrum. Specifically, the Ericsson proposal requires a deployment in which "carriers in Band 12 UL [uplink] are allocated below 715 MHz and above 717 MHz in LTE DL FDD 716-728 MHz [the Qualcomm spectrum]." In other words, Ericsson's proposal concludes that Band Class 12 licensees must sacrifice a 1 MHz "guard band" to facilitate AT&T's proposed deployment for the Lower D and E blocks.

As seen in the attached 3GPP submission from Alcatel Lucent (presented in August of 2011), Ericsson is not unique in its view that a 1 MHz guard band from 715 – 716 MHz is necessary to accommodate AT&T's proposed use of the Lower 700 MHz D Block.

While one Band Class 12 licensee, C Spire Wireless, has raised an objection to these submissions, 3GPP procedures allow adoption of proposals like Ericsson's over the objection of a minority. 3GPP's Working Procedures make an express accommodation for "working agreements," which "are tentative decisions reached by 3GPP groups in order to make progress on matters where consensus . . . cannot be reached" and are "intended to be used in situations where there is a clear majority in favour of one approach, but a small minority has sustained opposition to that approach."[3]

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[2] This condition is far narrower than the full 700 MHz relief C Spire Wireless has and continues to advocate for in RM-11592. That relief – full interoperability across the 700 MHz band – should remain a policy goal of the Commission and we continue to urge the issuance of an NPRM in response to the Good Faith Purchasers Alliance's 26-month-old Petition for Rulemaking.

[3] *See*, Annex G of the April 2010 3GPP Working Procedures at p. 33 (link here).

In short, the Ericsson and ALU submissions to 3GPP evidence the direct relationship and potential negative impact AT&T's planned use of the spectrum at issue in this transaction can have on Band Class 12 licensees. This negative impact results from the continued, but technically unsupported, existence of AT&T's boutique band class in the Lower 700 MHz.

Additionally, the AT&T-Qualcomm transaction would increase AT&T's dominance in the Lower 700 MHz band, giving it further influence over the vendor community and competitors' ability to deploy 4G LTE services. So long as AT&T continues to utilize Band Class 17, rather than Band Class 12, for its Lower 700 MHz deployments, the vendor community will continue to cater to AT&T's unnecessarily unique specifications. This has slowed or prevented the deployment of 4G LTE services by other Lower 700 MHz licensees, and, therefore, is limiting the access of American consumers to mobile broadband, harming competition, and causing at least 12 MHz of the American tax-payers' spectrum to go underutilized and deteriorate in value.

The Sooner, the Better

In addition to the above, we also discussed that AT&T's transition to Band Class 12 could be done quickly because (1) AT&T's LTE deployment is limited currently to approximately 15 markets[4] and (2) Band Class 12 is formally established and approved by 3GPP.

By unifying the market for devices and equipment in the Lower 700 MHz spectrum, the proposed condition could allow 12 MHz of currently unused Lower 700 MHz spectrum (the Lower A Block) to almost immediately be put to use for the deployment of 4G LTE services—speeding deployment of wireless broadband services throughout the country and increasing the availability of 4G LTE devices and services to American consumers. Deployments across these additional 12 MHz of spectrum would unleash hundreds of millions of dollars in private capital as licensees, which are currently unable to access devices necessary to facilitate a feasible deployment of Band Class 12, build towers and retail locations to provide expanded services, service growing networks, and serve additional customers.

Public Interest

For over two years, competitive carriers have requested that the Commission resolve the harms created by the presence of multiple band classes within the Lower 700 MHz spectrum. Since 2008, this problem has emerged, been argued before the Commission, and resulted in actual harm (the inability to deploy 4G LTE services) to consumers and spectrum licensees.

During that period, competitive licensees have sought to resolve the issue via negotiations with chipset makers and device and equipment vendors. Since those efforts have been unsuccessful and since AT&T desires to accumulate even more spectrum in the Lower 700 MHz through the present transaction, the Commission now has the ability to fix this competitive and consumer harm in a limited but critical way. By adopting the proposed condition, the Commission will free the marketplace to develop devices capable of deployment and roaming on multiple carriers' 4G LTE networks across the entire Lower 700 MHz paired spectrum. The market's development of these devices on a timeline equal to those of other 700 MHz LTE bands is in the public interest as it will

[4] Brad Molen, *AT&T Expanding LTE to 15 Markets on November 20th*, Engadget, Nov. 14, 2011 (link here).

result in increased market competition, increased access to spectrum, and faster deployment of next generation wireless services to more Americans.[5]

Pursuant to Section 1.1206(b) of the Commission's rules, I am filing this notice electronically in the above-referenced docket.

Sincerely,

/s/

Rebecca Murphy Thompson
General Counsel

cc: Rick Kaplan
Amy Levine

Enclosures

[5] RCA members alone have spent over $1.7 billion dollars on paired Lower 700 MHz spectrum. An RCA–commissioned study found that full deployment of wireless broadband in rural America with a fully interoperable 700 MHz band would result in the creation/retention of 117,000 jobs over four years in the nineteen states that have the lowest broadband availability and penetration. Of the 117,000 jobs, almost 40,000 are new jobs. Raul L. Katz et al., RCA, Economic Impact of Wireless Broadband in Rural America (2011) at 5.

3GPP TSG-RAN WG4 meeting #61 **R4-115759**
San Francisco, California, USA, 14-18 November, 2011

Source: Ericsson, ST-Ericsson

Title: Co-existence/co-location between LTE Downlink FDD 716-728 MHz and Band 17, 12

Agenda item: 8.3.1

Document for: Approval

1 Introduction

LTE downlink FDD 716-728 MHz was approved in [1]. LTE downlink FDD 716-728 MHz is allocated at 0 MHz distance from Band 12/17 UL. Co-existence/co-location between these bands needs to be considered.

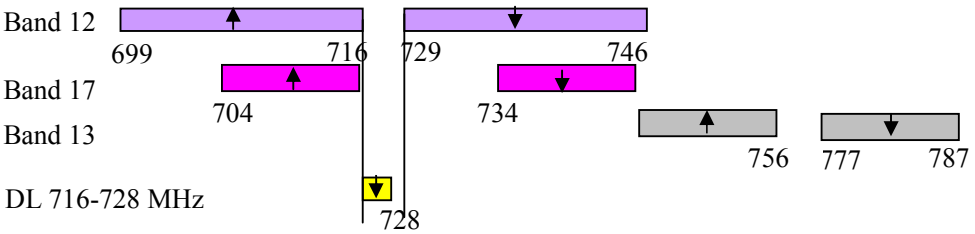

Figure 1. 3GPP spectrum allocation in together with DL 716-728 MHz

2 Discussion

2.1. BS co-existence/co-location

The same operator is expected to deploy in both LTE DL FDD 716-728 MHz and Band 12/17. Therefore BS co-location (instead of co-existence) can be considered the most realistic scenario.

To be able to protect Band 12/17 UL against a LTE DL 716-728 MHz BS with 46 dBm transmit power, an attenuation of about 80 dB is needed in case of co-located BSs, considering that ACS is the applicable requirement for Band 12/17 at 716 MHz, which defines a blocker of -52dBm for 6dB degradation. Here, we assume 1 dB degradation at the receiver band of Band 12/17. Such rejection level will require certain frequency separation between the bands or performance degradation at Band 12/17 UL highest edge. Band 12/17 is 17/12 MHz wide, which means that the largest LTE carrier which can be fit is 15/10 MHz. Assuming that this carrier is allocated in the middle of Band 12/17, degradation could be allowed at Band 12/17 UL highest edge.

LTE DL FDD 716-728 MHz needs to protect Band 12/17 UL according to the co-location spurious emission requirements stated in TS 36.104, -96 dBm/100kHz at 716 MHz, if co-location is declared. The filter needs to attenuate the signal by 80 dB considering ACLR=45dB at the adjacent channel. LTE DL FDD is composed by two blocks, Block D (716-722 MHz) and E (722-728 MHz), which are 6 MHz wide each. It is then possible to allocate 2x5 MHz LTE carriers as well as 1x10 MHz carriers. In those regions on which just Block D has been allocated for mobile communications, the carrier could be put at the highest edge, i.e. 717-722 MHz. In case of regions, where both block D+E are allocated, the carrier could occupy 718-728 MHz, increasing the frequency separation towards Band 12/17 UL.

Figure 2 shows simulations for LTE DL FDD 716-728 MHz assuming co-location with Band 12 and allowing less protection at the highest edge of Band 12 UL. 20 dB rejection is also considered at 10 MHz from the highest operating band edge of LTE DL FDD to be able to decrease emissions on the spurious emissions domain according to TS 36.104. LTE DL FDD arrangement is defined as 716-728 MHz, while real deployment scenarios allow an increase of the guard between Band 12 UL and LTE DL FDD by at least 1 MHz. Thus, filter simulations are shown with a 716-728 MHz and 717-728 MHz passband. Simulations are not optimized since they intend to show the effect of the frequency separation between Band 12 UL and LTE DL FDD 716-728 MHz. We can observe that the number of poles needed for LTE DL FDD 716-728 MHz with 716-728 MHz passband is 12 and 10 for a 716-728 MHz and 717-728 MHz

passband, respectively. The Q value is in case of 716-728 MHz passband (Q=17000) is about 2.4 times the one for 717-728 MHz passband (Q=7000)

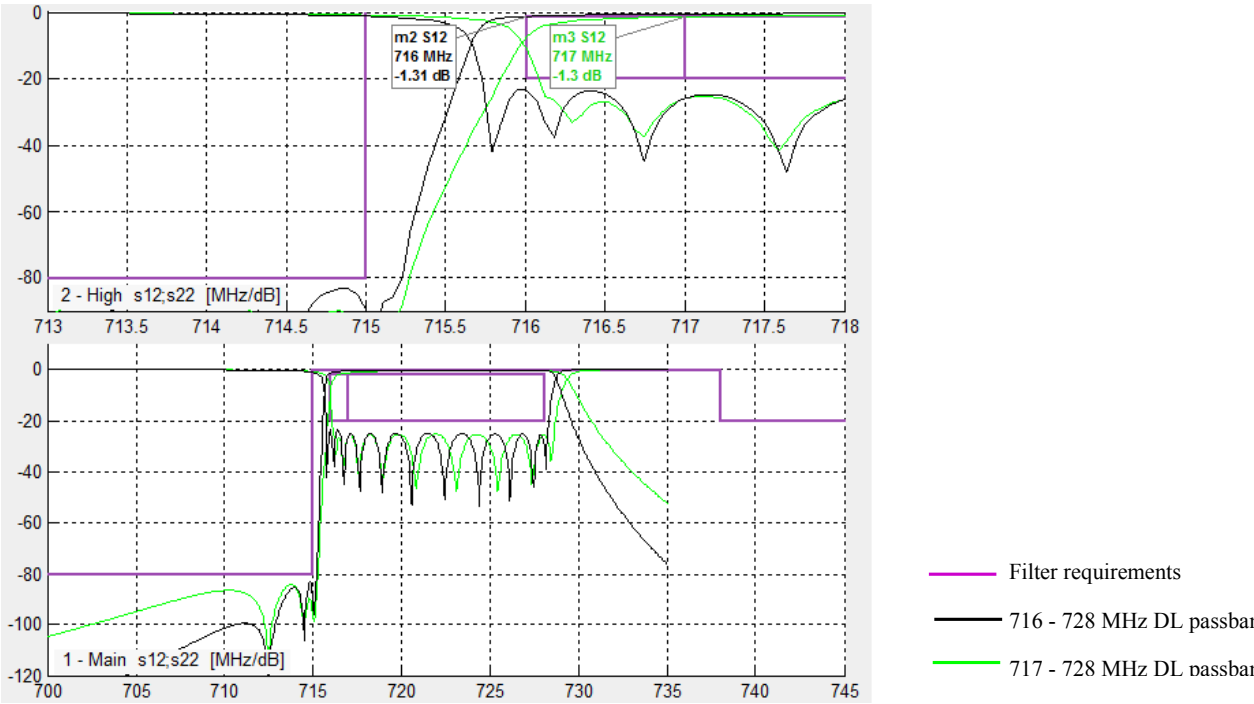

Figure 2. LTE DL FDD 716-728 MHz

Band 12 is 17 MHz wide while LTE DL FDD 716-728 MHz is 12 MHz. Due to the larger passband, the filter will be more challenging for a co-location scenario which requires 80 dB attenuation at 716 MHz or alternatively 717 MHz, if a real deployment case is considered. Certain IL degradation can also be allowed at the highest edge of band 12 UL, i.e. 699-715 MHz passband, taking into account the current deployment scenario.

2.1. UE co-existence

The coexistence between LTE Downlink FDD 716-728 MHz and Band 12 DL has been considered earlier but in a different context with a MediaFLO broadcast interferer in Block D and possibly also Block E. To facilitate UE coexistence, a 1 MHz guard and an additional in-band blocking requirements were introduced to protect Band 12 DL against broadcast interferers.

For the LTE Downlink FDD 716-728 MHz, coexistence with Band 12 is an UL-DL and the 1 MHz guard has only marginal effect on protected adjacent band. However, the DL-only band is used for carrier aggregation and supporting a Secondary CC. The Primary CC with the associated uplink is assigned in an operating band well separated from Band 12 in frequency, e.g. Band 2 or Band 4. Hence, if the Secondary CC is harmfully interfered by a close-by Band 12 UE, the Primary CC will still supply throughput. The CQI reported on the Primary CC will then show low values for the interfered Secondary CC and data (or higher-layer retransmissions) can be scheduled on the primary CC.

3 Conclusion

BS-BS co-location between LTE DL FDD 716-728 MHz and Band 12 requires challenging filters. However, this can be facilitated by considering a real deployment scenario on which carriers in Band 12 UL are allocated below 715 MHz and above 717 MHz in LTE DL FDD 716-728 MHz. In this way, guard band between UL and DL is increased.

3 Proposal

It is proposed to study the possibility of considering LTE Downlink FDD 76-728 MHz frequency arrangement as 717-728 MHz to improve BS-BS co-location/co-existence while not impacting real deployment scenarios. It is also proposed to add the following TP into the TR for LTE Downlink FDD 716-728 MHz [2]

References

[1] RP-110710, “Revised WID for New Band LTE Downlink FDD 716-728 MHz”, AT&T

[2] R4-113902, “New TR new Band 716-728MHz v0.0.1”, AT&T

TEXT PROPOSAL:

<start of text proposal >

6 List of band specific issues for <Work item name>

- General issues

  - Co-existence/co-location between LTE DL 716-728 MHz and Band 12/17

- <UTRA issues>

  - <Issue 2>

  - ...

- <E-UTRA issues>

  - <Issue 3>

  - ...

- <MSR issues>

  - <Issue 4>

  - ...

List of general issues, UTRA, E-UTRA and/or MSR issues (if there is not any issue for a specific requirement, the same requirement as for the existing bands in the current 3GPP specifications will apply to the new band). The list serves as a summary of issues and should not contain any discussion of the solution to the issues. Further details, analysis, solutions and resulting requirements should be documented in the respective clause (7, 8, 9 and/or 10).

This chapter should consider for example co-existence studies with other 3GPP bands and other adjacent services, UE REFSENS and A-MPR.

This chapter should be filled in first place in order to have a clear picture of all issues which need further study and should be updated when new issues are found

7 General issues

This chapter is needed if is there is any general issue to solve (e.g. co-existence). Otherwise, it can be omitted. BS and UE issues should be treated separately.

General issues refer to common issues between E-UTRA, UTRA and/or MSR.

<next section changed >

7.1 Co-existence/co-location between LTE DL 716-728 MHz and Band 12/17

7.1.1. BS-BS co-existence/co-location

The same operator is expected to deploy in both LTE DL FDD 716-728 MHz and Band 12/17. Therefore BS co-location (instead of co-existence) can be considered the most realistic scenario.

To be able to protect Band 12/17 UL against a LTE DL 716-728 MHz when the BS are co-located requires an attenuation of about 80 dB, assuming a BS with 46 dBm transmit power. Band 12/17 is 17/12 MHz wide, which means that the largest LTE carrier which can be fit is 15/10 MHz. Assuming that this carrier is allocated in the middle of Band 12/17, degradation could be allowed at Band 12/17 UL highest edge.

LTE DL FDD 716-728 MHz needs to protect Band 12/17 UL according to the co-location spurious emission requirement in TS 36.104, for which 80 dB attenuation is needed at the RF filter, assuming ACLR=45dB at the adjacent channel. LTE DL FDD is composed by two blocks, Block D (716-721 MHz) and E (722-728 MHz), which are 6 MHz wide each. It is then possible to allocate 2x5 MHz LTE carriers as well as 1x10 MHz carriers. In those regions on which just Block D has been allocated for mobile communications, the carrier could be put at the highest edge, i.e. 717-722 MHz. In case of regions, where both block D+E are allocated, the carrier could occupy 718-728 MHz, increasing the frequency separation towards Band 12/17 UL.

Figure 7.1-1 shows simulations for LTE DL FDD 716-728 MHz assuming co-location with Band 12 and allowing less protection at the highest edge of Band 12 UL. 20 dB rejection is also considered at 10 MHz from the highest operating band edge of LTE DL FDD to be able to decrease emissions in the spurious emissions domain according to TS 36.104. The filter simulations are shown with a 716-728 MHz and 717-728 MHz passband based on the LTE DL FDD 716-728 MHz arrangement and real deployment scenario, respectively. Simulations are not optimized since they intend to show the effect of the frequency. We can observe that the number of poles needed for LTE DL FDD 716-728 MHz with 716-728 MHz passband is 12and 10 for a 716-728 MHz and 717-728 MHz passband, respectively. The Q value is in case of 716-728 MHz passband (Q=17000) is about 2.4 times the one for 717-728 MHz passband (Q=7000)

Figure 7.1-1. LTE DL FDD 716-728 MHz

Band 12 has a wider passband than LTE DL FDD 716-728 MHz, thus the filter will be more challenging for this co-location scenario which requires 80 dB attenuation at 716 MHz or alternatively 717 MHz, if a real deployment case is considered. Certain IL degradation can also be allowed at the highest edge of band 12 UL, i.e. 699-715 MHz passband, taking into account the current deployment scenario.

7.1.2. UE-UE co-existence

UE co-existence between LTE FDD DL 716-728 MHz and Band 12 is an UL-DL and the 1 MHz guard has only marginal effect on protected adjacent band. However, the DL-only band is used for carrier aggregation and supporting a Secondary CC. The Primary CC with the associated uplink is assigned in an operating band well separated from Band 12 in frequency, e.g. Band 2 or Band 4. Hence, if the Secondary CC is harmfully interfered by a close-by Band 12 UE, the Primary CC will still supply throughput. The CQI reported on the Primary CC will then show low values for the interfered Secondary CC and data (or higher-layer retransmissions) can be scheduled on the primary CC.

7.1.3. Conclusion

Conclusion: study the possibility of LTE Downlink FDD 716-728 MHz frequency arrangement as 717-728 MHz to improve BS-BS co-location/co-existence while not impacting real deployment scenarios.

7.2 …

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3GPP TSG-RAN WG4 (Radio) Meeting #60 R4-113985
Athens, Greece, 22 – 26 August 2011

Agenda Item: 9.7.3
Source: Alcatel-Lucent
Title: BS to BS coexistence between Band 12/17 and additional new 716-728 downlink
Document for: Discussion

1. Introduction

The WI proposal to support the New Band LTE Downlink FDD 716-728 MHz was approved in RAN#50 [1]. And the revised WID was approved in RAN#51 [2]. One objective of the WIs is to specify the band-combinations specific Radio Frequency (RF) requirements for inter-band CA of Band 2, 4 or 5 plus additional new 716-728 downlink. Note that we will denote the additional new 716-728 downlink as Band A for convenience.

In this paper, we investigate the coexistence issue between Band 12/17 Base Station (BS) and Band A BS from the 3GPP requirements perspectives.

2. Discussion

The frequency ranges of the current Bands 12 and 17 uplink (UL) and downlink (DL) defined in the 3GPP standards [3] as well as the proposed DL-only Band A are shown in Figure 1 below.

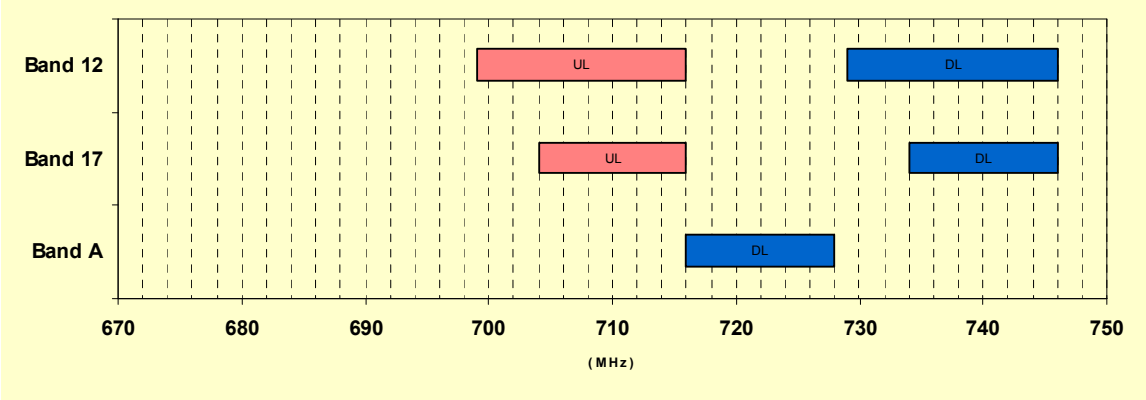

Figure 1: Frequency ranges of Bands 12, 17 and A

It can be seen from Figure 1 that the most challenging BS to BS coexistence issue is at 716 MHz where Band 12/17 UL is adjacent to Band A DL. To allow Band 12/17 BS to coexist (in the same geographical area) or co-locate with Band A BS, the operators should ensure the following:

- The Band A BS transmitter unwanted emissions received by the Band 12/17 BS do not cause unacceptable Band 12/17 BS receiver desensitization.
- The total Band A BS carrier power attenuated by the Band 12/17 BS receiver RF, IF and baseband filters do not result in the Band 12/17 BS receiver blocking.

2.1 Transmitter unwanted emissions

Currently, the BS spurious emissions limits for co-existence (in the same geographical area) with BS operating in other frequency bands is specified as -49 dBm/MHz in the UL frequency range of the operating band of the coexisted BS [3]. This requirement value is obtained assuming a 67 dB BS to BS minimum coupling loss (MCL) and a 0.8 dB victim BS receiver desensitization [4]. The calculation for 5 MHz and 10 MHz channel bandwidths is shown in Table 1 below.

Table 1: Calculation of spurious emission limits for BS coexistence

Thermal Noise power spectral density	dBm/Hz	-174	
BS noise figure	dB	5	
Channel bandwidth	MHz	5	10
Noise bandwidth	MHz	4.5	9
Receiver noise floor	dBm	-102.47	-99.46
BS Spurious emissions limits (co-existence)	dBm/MHz	-49	
BS-BS MCL (co-existence)	dB	67	
Receiver interference (co-existence)	dBm	-109.47	-106.46
Receiver interference + noise floor (co-existence)	dBm	-101.68	-98.67
Receiver sensitivity degradation (co-existence)	dBm	0.79	0.79

If we assume the out-of-band (OOB) emission from the power amplifier (PA) is designed to meet the -13 dBm/MHz specified in the Multi-Standard Radio (MSR) specification [4] so that the BS can also be used for UTRA operation, then the required rejection by the BS RF transmit (TX) filter to meet the -67 dBm/MHz emission limit will be (67 – 13 =) 54 dB.

Moreover, the BS spurious emissions limits for co-location with BS operating in other frequency bands is specified as -96 dBm/100 kHz in the UL frequency range of the operating band of the co-located BS [3]. This requirement value is obtained assuming a 30 dB BS to BS MCL and a 0.8 dB victim BS receiver desensitization [5]. The calculation for 5 MHz and 10 MHz channel bandwidths is shown in Table 2 below.

Table 2: Calculation of spurious emission limits for BS co-location

Thermal Noise power spectral density	dBm/Hz	-174	
BS noise figure	dB	5	
Channel bandwidth	MHz	5	10
Noise bandwidth	MHz	4.5	9
Receiver noise floor	dBm	-102.47	-99.46
BS Spurious emissions limits (co-location)	dBm/100kHz	-96	
BS-BS MCL (co-location)	dB	30	
Receiver interference (co-location)	dBm	-109.47	-106.46
Receiver interference + noise floor (co-location)	dBm	-101.68	-98.67
Receiver sensitivity degradation (co-location)	dBm	0.79	0.79

Again if we assume the OOB emission from the PA is designed to meet the -13 dBm/MHz specified in the MSR specification [4] so that the BS can also be used for UTRA operation, then the required rejection by the BS RF TX filter to meet the -96 dBm/100 kHz emission limit will be (96 – 10 – 13 =) 73 dB.

From the above discussion, it can be seen if the OOB emission from the PA is -13 dBm/MHz, then the Band A BS RF TX filter must provide 54 dB and 73 dB, respectively, to coexist (with 67 dB MCL) and co-locate (with 30 dB MCL) with Band 12/17 BS receiver. It is impractical to achieve these levels of rejection without any gap between the Band A DL and Band 12/17 UL. However, up to 4 MHz gap between the Band A DL and Band 12/17 UL could be obtained by putting the

UL carrier at the lower edge of the allocated frequency block and the DL carrier at the higher edge of the allocated frequency block. The carrier arrangement is shown in Table 3 below. Note that the unused frequency range at each edge inside the channel bandwidth (0.25 MHz and 0.5 MHz, respectively, for 5 MHz and 10 MHz channel bandwidth) are not included in Table 3.

Table 3: Possible gap between Band 12/17 UL and Band A DL

Band 12/17 frequency block (FCC allocation)	Band A frequency block (FCC allocation)	Band 12/17 UL carrier (MHz)	Band A carrier (MHz)	DL<->UL Gap (MHz)
C	D	710 – 715	717 – 722	2
C	D+E	710 – 715	718 – 728	3
B+C	D	704 – 714	717 – 722	3
B+C	D+E	704 – 714	718 – 728	4

With the at least 2 MHz (2.5 MHz including unused frequency inside the channel bandwidth) gap available by carrier arrangement as shown in Table 3 above, it could be feasible for the Band A BS RF TX filter to provide the required rejection to coexist or co-locate with Band 12/17 BS receiver, with small degradation in other aspects of the filter performance (e.g. insertion loss and modulation accuracy). However, the increase in cost, size, weight, and complexity of the filter still need to be considered. Other alternatives to achieve the same Band 12/17 BS receiver desensitization of 0.8 dB include reducing the OOB emission from the Band A PA and increasing the coupling loss (i.e. antenna isolation) from Band A BS TX antenna connector to Band 12/17 BS receive (RX) antenna connector.

2.2 Receiver blocking

Now we look at the Band 12/17 BS receiver blocking requirements in order to avoid receiver blocking by the Band A DL carrier power. Currently, the interfering signal power for the BS adjacent channel selectivity (ACS) requirement is specified as -52 dBm for a 6 dB victim BS receiver desensitization [3]. These requirement values mean that the minimum rejection by the Band 12/17 BS receiver IF and baseband filters on the adjacent channel interferer is 45.72 dB for 5 MHz channel bandwidth, as the BS RF filter cannot provide any rejection in the in-band frequency range. The calculation for 5 MHz channel bandwidth is shown in Table 4 below. Note that the calculation in Table 4 is also valid for 10 MHz channel bandwidth because the same reference measurement channel as for 5 MHz channel bandwidth is specified for the ACS requirement.

Table 4: Calculation of BS ACS requirement

Thermal Noise power spectral density	dBm/Hz	-174
BS noise figure	dB	5
Channel bandwidth	MHz	5
Noise bandwidth	MHz	4.5
Receiver noise floor	dBm	-102.47
Interfering signal power (ACS)	dBm	-52
Receiver sensitivity degradation (ACS)	dB	6
Allowed receiver interference (ACS)	dBm	-97.72
Required receiver filter rejection (ACS)	dBm	45.72

Moreover, the interfering signal power for the BS in-band general blocking requirement is specified as -43 dBm for a 6 dB victim BS receiver desensitization [3]. This interfering signal level is applied from the lower frequency of the BS receive band minus 20 MHz to the upper frequency of the BS receive band plus 20 MHz. These requirement values mean that the minimum rejection by the Band 12/17 BS receiver IF and baseband filters on the in-band interferer is 54.72 dB for 5 MHz

channel bandwidth, as the BS RF filter cannot provide any rejection in this in-band frequency range. The calculation for 5 MHz channel bandwidth is shown in Table 5 below. Again the calculation in Table 5 is also valid for 10 MHz channel bandwidth because the same reference measurement channel as for 5 MHz channel bandwidth is specified for the in-band general blocking requirement.

Table 5: Calculation of BS in-band general blocking requirement

Thermal Noise power spectral density	dBm/Hz	-174
BS noise figure	dB	5
Channel bandwidth	MHz	5
Noise bandwidth	MHz	9.00
Receiver noise floor	dBm	-102.47
Interfering signal power (general blocking)	dBm	-43
Receiver sensitivity degradation (general blocking)	dB	6
Allowed receiver interference (general blocking)	dBm	-97.72
Required receiver filter rejection (general blocking)	dBm	54.72

Comparing the required receiver filter rejection levels in Tables 4 and 5, it can be seen that the BS receiver IF and baseband filters could provide (54.72 – 45.72 =) 9 dB more rejection when the interfering signal is 5 MHz further away from the wanted signal. This will mean 1.8 dB/MHz more rejection if we assume a constant slope in the filter transfer function within this frequency range.

On the other hand, the interfering signal power for BS blocking performance requirement when co-located with BS in other frequency bands is specified as 16 dBm for a 6 dB victim BS receiver desensitization [3]. Again this requirement value is obtained assuming a BS output power of 46 dBm and a 30 dB BS to BS MCL [5]. These requirement values mean that the minimum rejection by the BS receiver RF, IF and baseband filters on the co-located BS DL signal is 113.72 dB for 5 MHz channel bandwidth. The calculation for 5 MHz channel bandwidth is shown in Table 6 below. Again the calculation in Table 6 is also valid for 10 MHz channel bandwidth because the same reference measurement channel as for 5 MHz channel bandwidth is specified for co-location blocking requirement.

Table 6: Calculation of BS co-location blocking requirement

Thermal Noise power spectral density	dBm/Hz	-174
BS noise figure	dB	5
Channel bandwidth	MHz	5
Noise bandwidth	MHz	4.5
Receiver noise floor	dBm	-102.47
Interfering signal power (co-location blocking)	dBm	16
Receiver sensitivity degradation (co-location blocking)	dB	6
Allowed receiver interference (co-location blocking)	dBm	-97.72
Required receiver filter rejection (co-location blocking)	dBm	113.72

Now if we use the more conservative ACS rejection by the Band 12/17 BS receiver IF and baseband filters on the co-located BS A DL signal, then the required rejection by the Band 12/17 BS RF RX filter to meet the co-location blocking requirement will be (113.72 – 45.72 =) 68 dB. It is impractical to achieve this level of rejection without any gap between the Band 12/17 UL and Band A DL. However, as discussed above and shown in Table 3, up to 4 MHz gap between the Band 12/17 UL and Band A DL could be obtained by putting the UL carrier at the lower edge of the allocated frequency block and the DL carrier at the higher edge of the allocated frequency block.

With the at least 2 MHz (2.5 MHz including unused frequency inside the channel bandwidth) gap available by carrier arrangement as shown in Table 3 above, the Band 12/17 BS receiver IF and baseband filters should provide more rejection than ACS, and it could be feasible for the Band 12/17 BS RF RX filter to provide the required rejection to co-locate with Band A BS transmitter, with small degradation in other aspects of the filter performance (e.g. insertion loss). However, the increase in cost, size, weight, and complexity of the filter still need to be considered. Other alternatives to achieve the same Band 12/17 BS receiver desensitization of 6 dB include increasing the IF and baseband filter rejection of the Band 12/17 receiver and increasing the coupling loss (i.e. antenna isolation) from Band A BS TX antenna connector to Band 12/17 BS RX antenna connector. In order to maintain same Band 12/17 BS receiver desensitization of 0.8 dB based on Band A BS transmitter emissions, the 30 dB MCL derived from Band 12/17 BS RX co-location blocking requirement should be increased to 42 dB.

3. Conclusions

In this paper, we have investigated the coexistence issue between Band 12/17 BS and Band A BS from the 3GPP requirements perspectives. We have shown that with the at least 2 MHz (2.5 MHz including unused frequency inside the channel bandwidth) gap available by carrier arrangement, it could be feasible for the Band 12/17 BS RX RF filters and the Band A BS TX RF filters to provide the required rejection to co-exist/co-locate with each other, with small degradation in other aspects of the filter performance (e.g. insertion loss and modulation accuracy). However, the increase in cost, size, weight, and complexity of the filters still need to be considered. Other alternatives to achieve the Band 12/17 receiver desensitization of 0.8 dB include reducing the OOB emission from the Band A PA, increasing the IF and baseband filter rejection of the Band 12/17 receiver, and increasing the coupling loss (i.e. antenna isolation) from Band A BS TX antenna connector to Band 12/17 BS RX antenna connector. Therefore, if at least 2 MHz gap will be available by channel arrangement of the Band 12/17 UL and/or Band A DL carriers, then we can reuse the same coexistence / co-location requirements for Band A as the other frequency bands specified in the 3GPP standards.

References

[1] RP-110435, “Work Item Proposal: New Band LTE Downlink FDD 716-728 MHz”, AT&T.

[2] RP-110432, “Revised WID for New Band LTE Downlink FDD 716-728 MHz”, AT&T.

[3] 3GPP TS 36.104 v10.3.0, “Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception”.

[4] 3GPP TS 37.104 v10.3.0, “E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception”.

[5] 3GPP TS 25.942 v10.0.0, “Radio Frequency (RF) system scenarios”.