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RP-220545

Regulatory Issues with wide global bands

T-Mobile USA, 10 March, 2022

Overview

- The Issue
- The solution for 3450-3550 in the USA
- The situation in Canada
- Why a general solution is needed
- Potential solutions
- Solution comparison
- Additional details on Option 3
- Proposed Way forward

The Issue

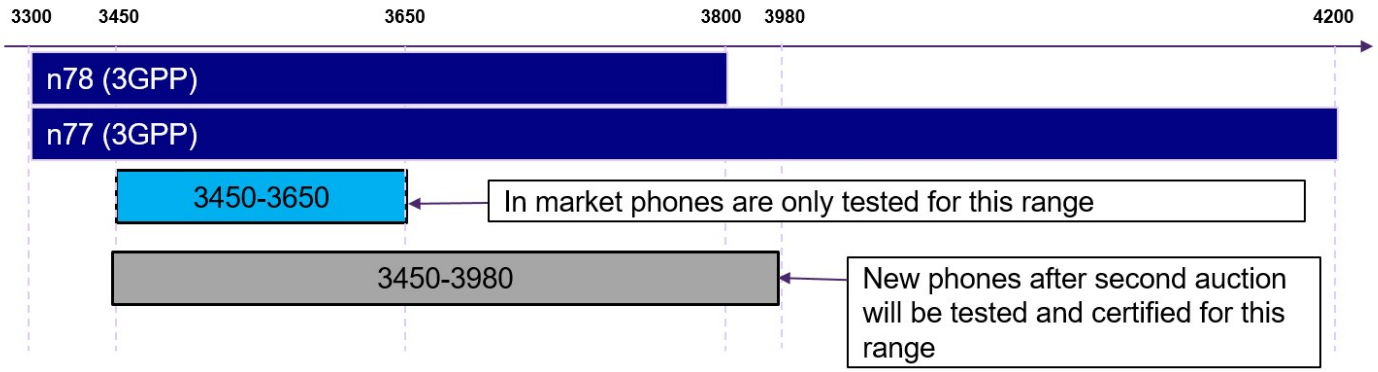
- In the past most 3GPP bands were relatively narrow, with regulations in the entire band in most countries
- With the introduction of new, wider channel bandwidths, like 900 MHz wide n77, there is an issue in some countries where only part of the band has regulations at a given time, and regulators will only certify devices to operate in the part of the band where there are regulations at the time of regulatory certification.
- This led to “Note 12” in 38.101-1 Table 5.2-1 for n77 with initially restricted operation to 3700-3980 MHz in the USA.
- When 3450-3550 MHz became available in the USA, a change was needed to allow operation in that part of the band.
- Now, there is a similar situation in Canada, where initially certified to operate in 3450-3650 MHz, and now 3650-3980 MHz is being planned for auction

The solution adopted for 3450-3550 MHz in the USA

- Note 12 in 38.101-1 Table 5.2-1 was modified as follows "NOTE 12: In the USA this band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz"
- A new UE capability IE extendedBand-n77-r16 was added to indicate support for 3450-3550 MHz in the USA
- NS_55 was added, to bar UEs that don't report *extendedBand-n77-r16* from attempting to access 3450-3550 MHz in the USA, to avoid a situation where a roaming UE repeatedly attempts to access 3450-3550 MHz and is rejected repeatedly.

The situation in Canada

- Initially 3450-3650 was auctioned in Canada
- Devices there were certified by the regulator to operated in 3450-3650 MHz, and such UEs are not allowed to operate outside of 3450-3650 MHz
- Canada is planning to auction 3650-3980 MHz, so there is a situation similar to the one in the USA, except there was not an equivalent Note 12.



Why a general solution is needed

- The solution for the problem in the US resulted in new capability signalling and new NS value that only has meaning defined for the USA
- In the future, there may be additional parts of n77 available; 3300-3450 MHz and 3980-4200 MHz are currently not available in the USA
- It is now clear that there is a similar situation in Canada, and there will be additional similar issues when additional spectrum becomes available in those countries
- There may be similar issues in other countries

Potential solutions

- **Custom solutions, similar to the approach taken for 3450-3550 MHz in the USA**
- **New country specific band numbers for sub-bands (Not really new bands, just new sub-band band numbers)**
- **A new IE to indicate which part of large band the UE is certified to operate in in the country**
  - Could indicate support for country specific frequency ranges, documented in 38.101-1, like 3450-3550 MHz in the US or 3650-3980 MHz in Canada
  - Could be a bitmap to indicate support for the band in 50 MHz increments, so 18 bits total for n77 (support for 3950-4000 MHz would be interpreted as 3950-3980 MHz in the US)

Solution comparison

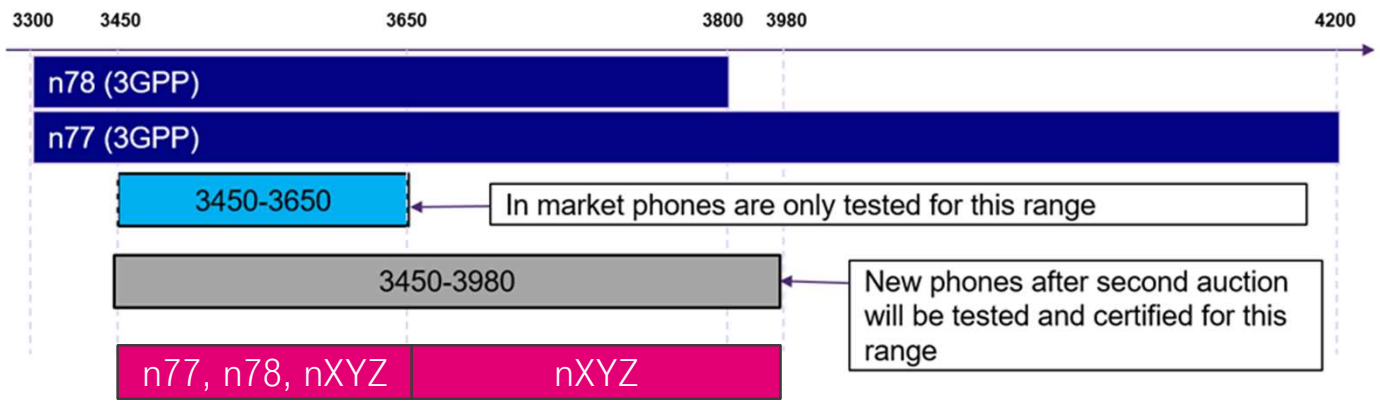
Option	Pros	Cons
1) Custom solutions similar to Note12/NS_55 for the USA	Has a precedent	Requires new signaling and new NS values every time the situation changes in an affected country
2) New country specific band numbers for sub-bands	No new signaling required Rel-independent to Rel-15 Not really a new band, just a new band number	Challenges for chip/UE vendors?
3) New per-band bitmap to indicate which (new) frequency ranges of the band the UE is certified to operate in in the country Bit 0 = 3650-3980 MHz in Canada Bit 1 through n: reserved for future use (Additional details on the next slide)	One-time change to RAN2 signaling to allocate a bitmap, where the meaning of the bits is defined in 38.101-1 Also, a single new NS value probably needed to bar UEs that don't report the new bitmap Should be fewer bits than Option 4 (Maybe 8 bits?) No country specific UE capability signaling required	New signaling required, but could be a one-time change with bits reserved for future use NS_55 issue for UL CA described in R2-2203706 needs to be solved.
4) New per-band bitmap to indicate which 50 MHz blocks of the band the UE supports in the given country	One-time change to RAN2 signaling to allocate a bitmap, where the meaning of the bits is defined in 38.101-1 (and 38.101-2 if needed) Also, a single new NS value probably needed to bar UEs that don't' report the new bitmap If signaled per band, could be used for other bands like n78 and n79.	New signaling needed, but could be a one-time change Country specific UE capability signaling, although all bits could be set to 1 for countries with no restrictions 18 bits for n77 might be a too much signaling overhead
5) re-use of ModifiedMPR-Behavior (Originally proposed in R4-2109442)	Re-uses existing signaling	May need NS signaling similar to Option 1

Additional details on Option 2

- **Not really new bands, just new band numbers, similar to n90**
  - n90 is the same as n41 except it includes the 100 kHz raster and 7.5 kHz UL shift (for DSS)
  - n90 UEs must also support n41
  - All of the n41 band combinations apply to n90. No n90 specific band combinations.
- **New band numbers for subsets of n77**
  - nXYZ would be a subset of n77
  - nXYZ UEs would have to also support n77
  - There will be no band combinations with nXYZ. Band combinations with n77 would apply to nXYZ
  - In Canada, the gNB would indicate both n77 and nXYZ in 3450-3650 MHz, and nXYZ in 3650-3980 MHz
  - In the future, if 3300-3450 MHz becomes available in Canada, then nABC would be defined.
  - There would be no special UE RF requirements associated with the new band numbers; n77 requirements would apply

Additional details on Option 2 (Cont.)

- gNB indicates n77, n78 and nXYX in 3450-3650 MHz in Canada
- gNB indicates only nXYZ in 3650-3980 MHz in Canada
- If/when new spectrum becomes available in Canada, a new band number could be allocated, with no signaling changes required
- Draft CR submitted as RP-220546 to show how a new band number could be implemented in 38.101-1.



Additional details on Option 3

- Similar to Option 1, except a bitmap instead of a single bit
- New per-band bitmap to indicate which (new) frequency ranges of the band the UE is certified to operate in in the country
- Could be used for other bands like n78 if needed
- For n77, Default: UE supports 3700-3980 MHz in the US, 3450-3650 MHz in Canada
- extendedBand-n77-r16 still indicates support for 3450-3550 MHz in the US (alternatively, extendedBand-n77-r16 could be deprecated in favor of a bit in the new bitmap IE)
- New IE extendedBandBitmap-r16 (8 bits)
- Bit 0 = 3650-3980 MHz in Canada
- Bit 1 through n: reserved for future use
- New NS_XY to bar UEs that don't support the new IE (similar to NS_55)

NS Signalling issue for the US solution and Option 3

- **In RAN2 Ericsson raised concern about the use of NS_55 signalling in R2-2203706:**
  - For intra-band uplink CA in n77, the same NS value needs to be indicated for both CCs
  - If one CC is in 3450-3550 MHz and the other in 3700-3980 MHz, the issue is that NS_55 is only defined for 3450-3550 MHz
  - Also, 38.331 says that the same NS value needs to be indicated for CA as in the SIB
- **There are at least two possible solutions to this issue, and similar issues that may arise with a new IE and new NS signaling. A solution is needed for the US, and the same solution would apply if NS signaling is needed for Canada**
  - 1) Since there are no special emissions requirements associated with NS_55 (or a new similar NS), there should be no need to signal NS_55 in the CA configuration. There could be an exception defined that NS_01 can be signaled for CA configuration when NS_55 (and a new similar NS) is signaled in the SIB
  - 2) NS_55 (and a new NS)could be signaled in 3700-3980MHz (or other parts of the band) in addition to NS_01, and then NS_55 signaled for UL CA in both CCs. RAN4 specs would need to document that NS_55 has no meaning for CA.

Proposed Way Forward

- RAN Plenary should instruct RAN2 and RAN4 to work on a general solution for regulatory compliance issues for regional frequency ranges for large global bands

Let’s talk

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