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Source:	**Samsung**
Title:	**BC 13 issue analysis**
Agenda Item:	**6.1.2.2**

Document for:	**Discussion**

Contents

- BC 13 interference measurement to PS band
- Coverage analysis for UL control and traffic channels

Interferences to Public Safety

- **We assume that carrier leakage and Image reduction are 35dBc.**
- **The image and LO spurious components fall into the adjacent DL channel with current PUCCH structure which is located in the edge of system bandwidth toward PS band.**
- **The emission of Public safety is -38.46dBm in case of 1dB MPR.**
- **If we assume that the emission limit is -50dBm/100kHz (-40dBm/1MHz), we have to mitigate this spurious emission.**

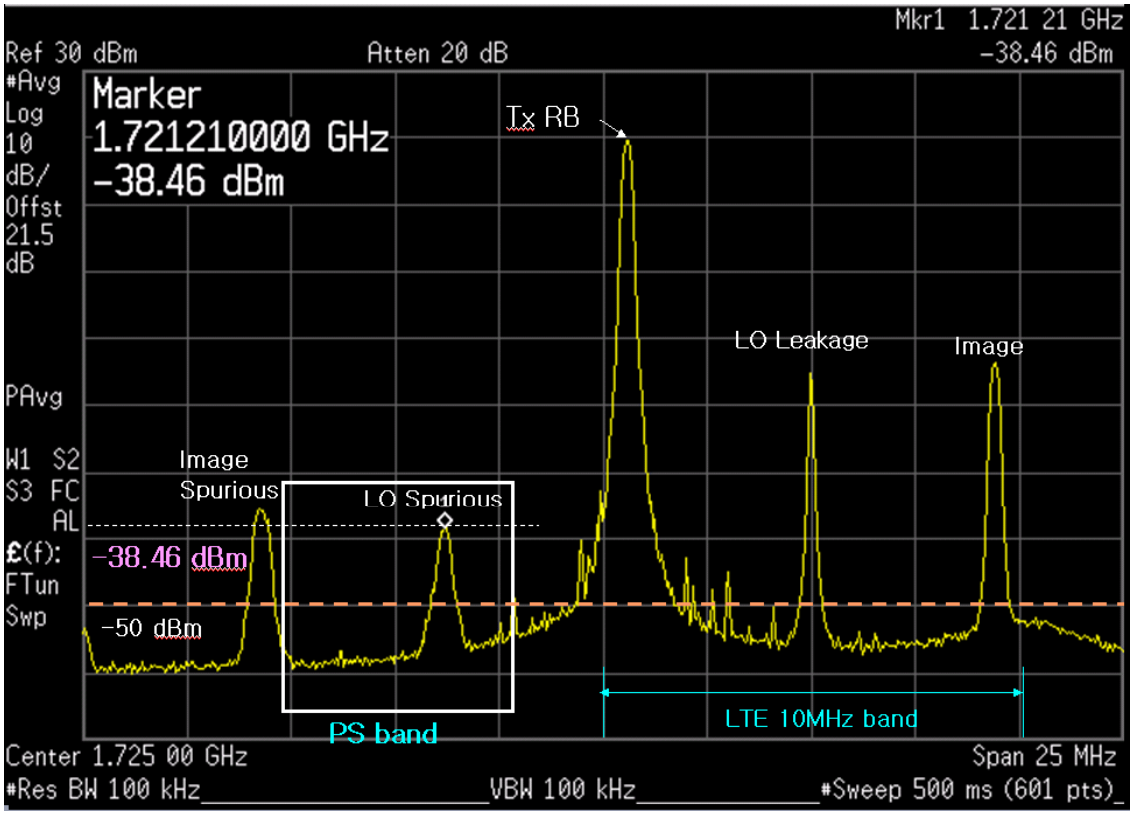


Image and LO spurious emission mitigation(1/3)

- With 10dB MPR, Spurious emission in PS band is -50.20dBm.

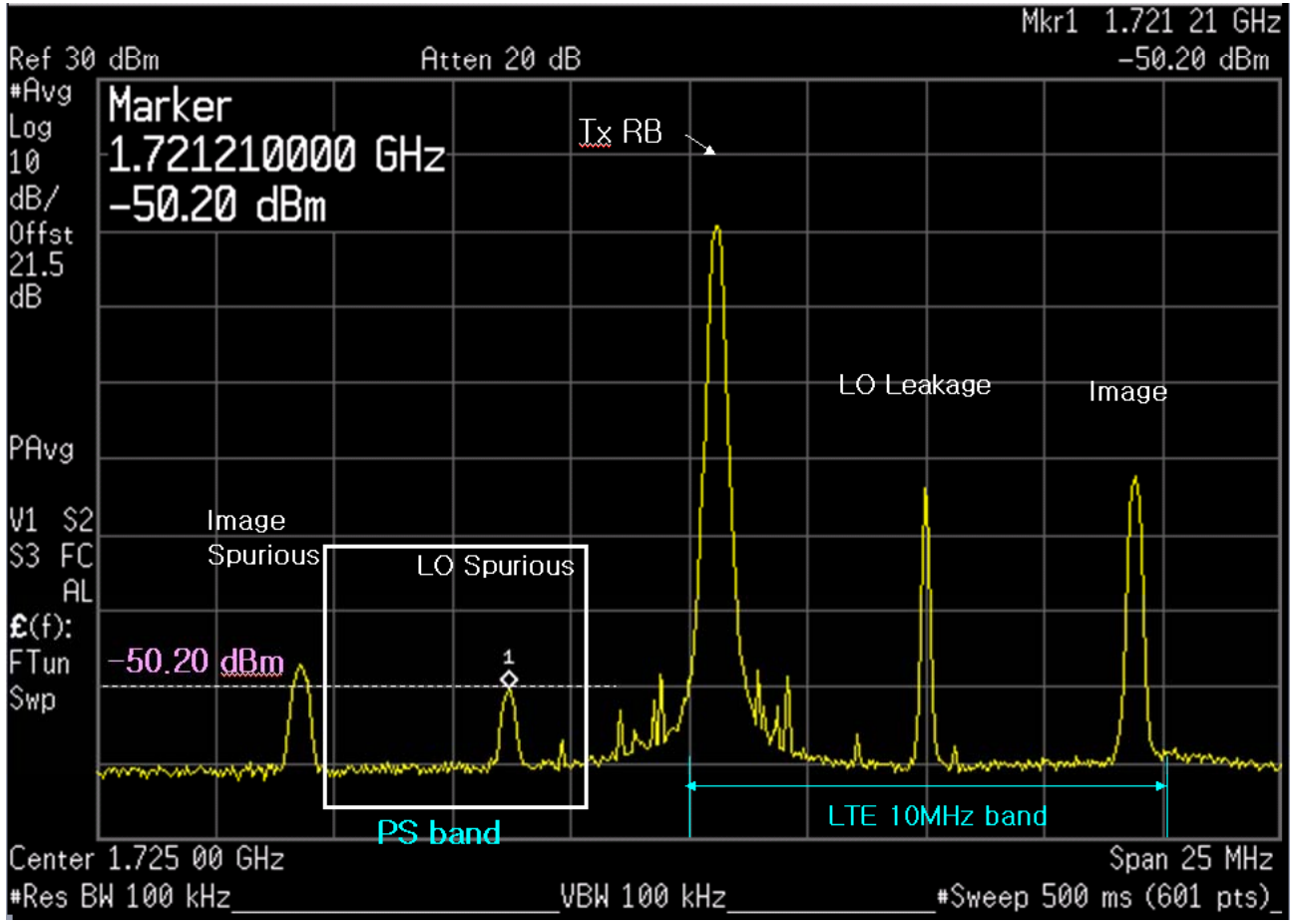


Image and LO spurious emission mitigation(2/3)

- From the coverage analysis study, around 98% A/N coverage can be achieved with 7dB MPR, for ISD =1732
- 7dB MPR and 11RB PUCCH over-dimensioning offset - Spurious emission of PS: -42.77dBm.

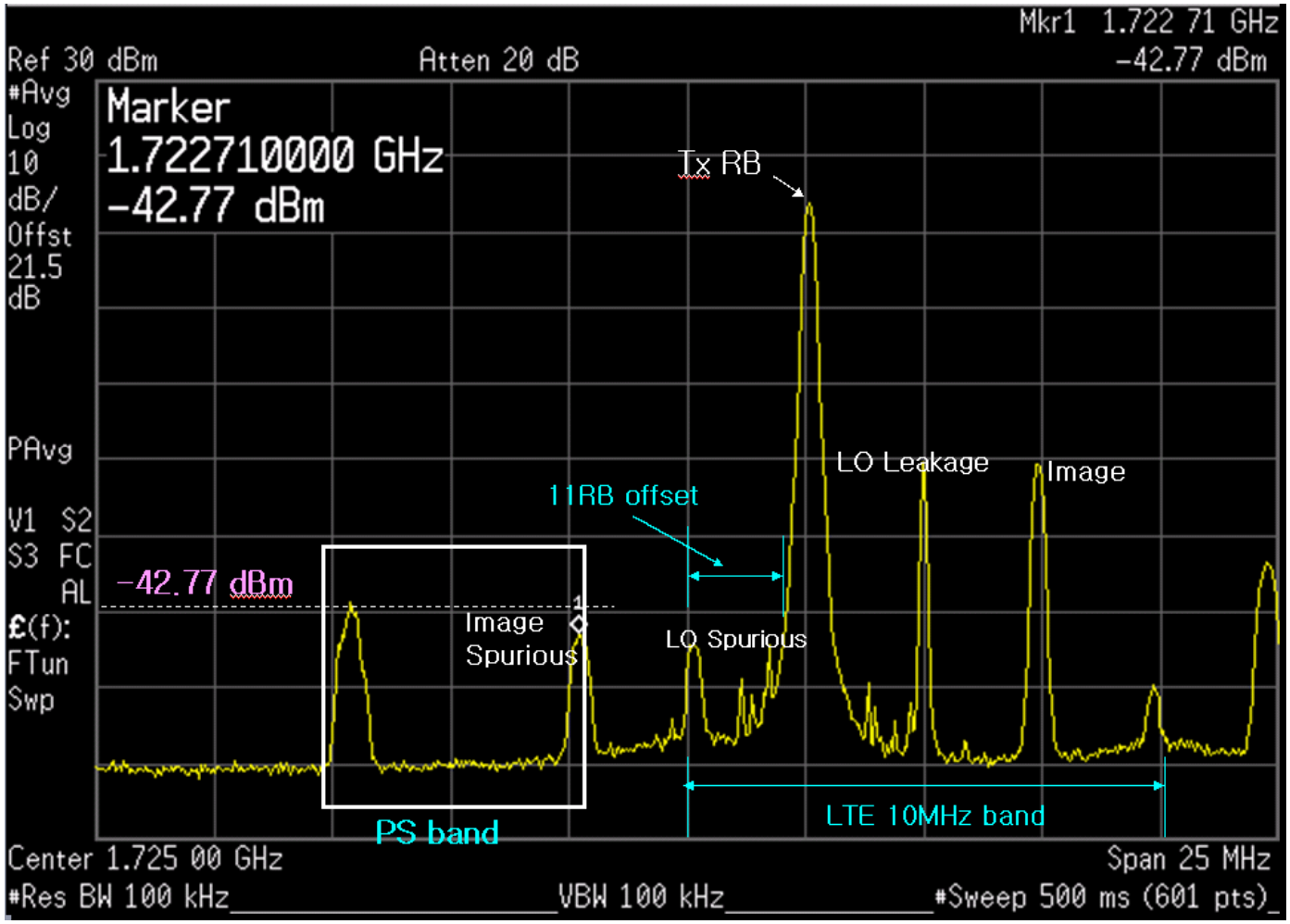
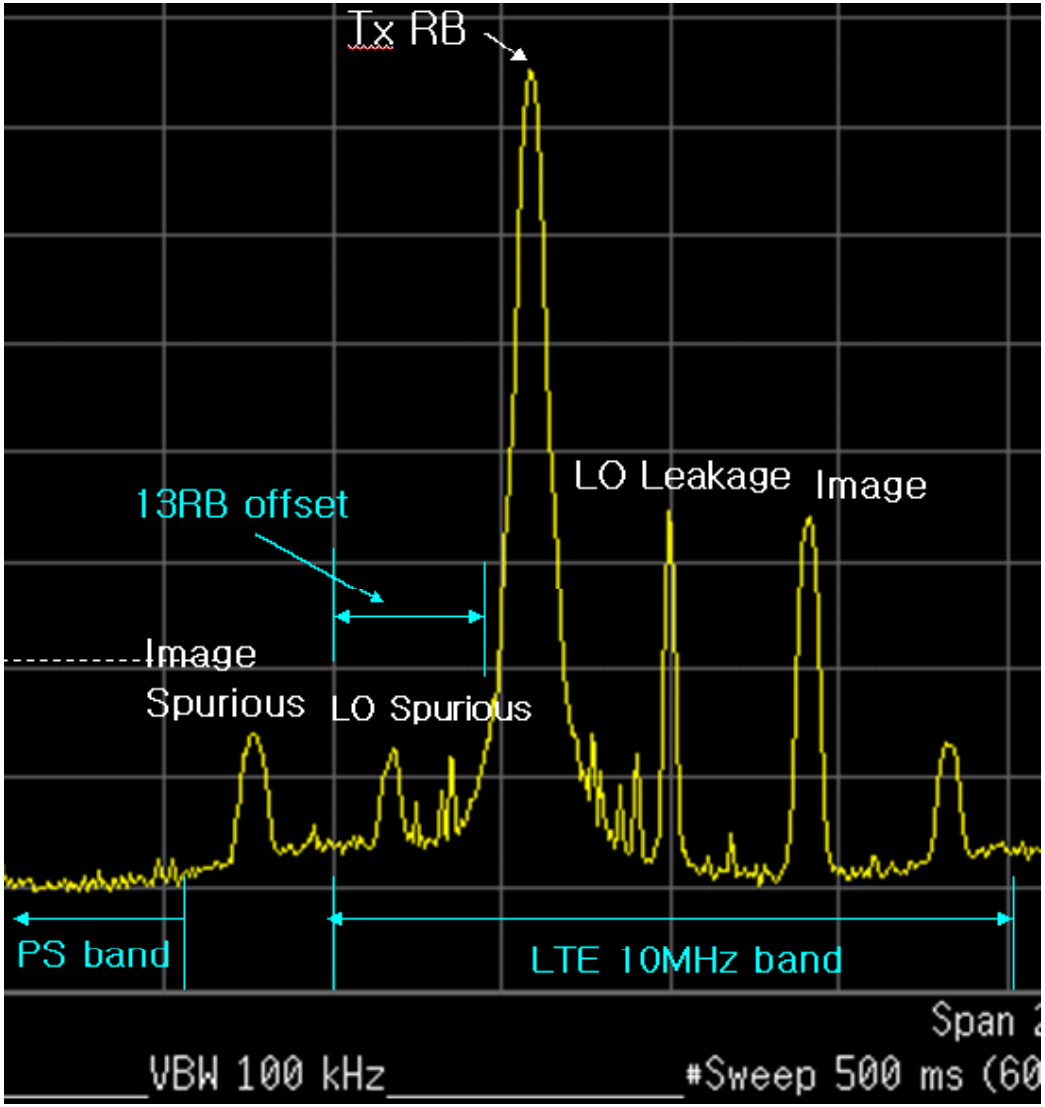


Image and LO spurious emission mitigation(3/3)

- If 12RB < PUCCH over-dimensioning offset - Spurious emission of PS: No problem



Coverage Analysis Assumptions

- Link budget assumptions
  - ISD:1732m or 3000m
  - Handoff gain: 3.5dB
  - UE Max power: 23 dBm [3GPP TS36.101]
  - IoT + Interference margin: 3dB
  - Building penetration: 13dB
  - UE antenna and body loss: 10dB
  - BS antenna gain and cable loss: 14dB
  - Shadow fading standard deviation: 8 dB
  - Urban Marco Passloss Model for 700MHz band [3GPP TR36.942]
    - 118.6+37.6Log10(d(km))

- Average SINR to meet BS demodulation performance requirement is obtained from link simulation for various UL channels:
  - 1 bit A/ N channel : -7.5 dB
  - 10 bit CQI channel: -4.5 dB
  - VoIP 12.2kbps with 4 Retransmissions: 1.3dB

UL Coverage Analysis

Assumptions: 700 MHz, ISD =1700m , 3000m

- Path loss model 118.6+37.6 log10(d) [TR 36.942 section 4.5.2 Urban Macro Model]

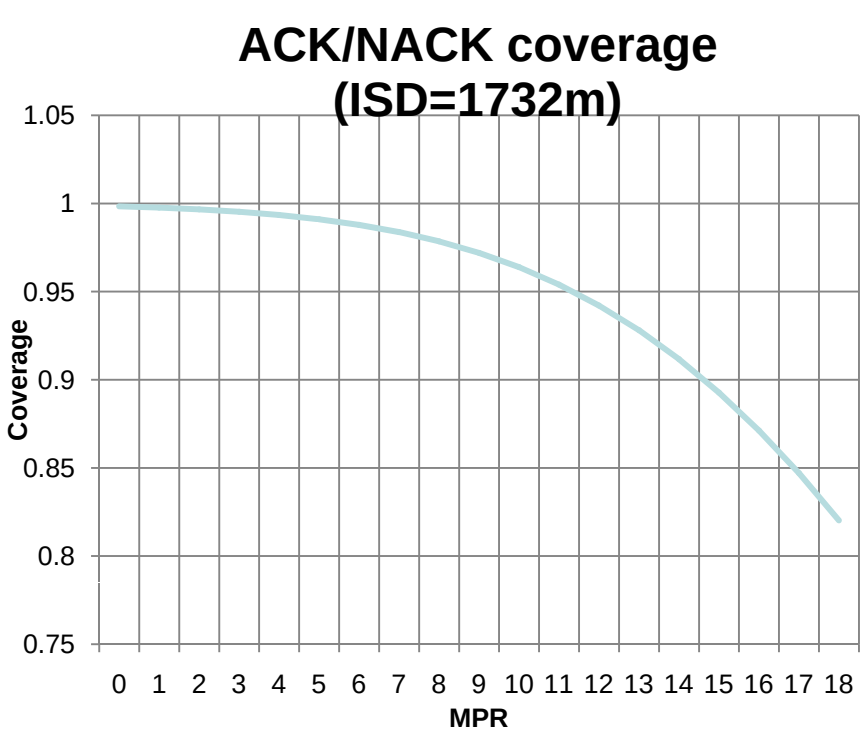
- For ISD =1700m, A/N coverage is above 98% even with MPR =7dB
  1 A/N repetition is needed with MPR =10dB for 98% coverage
- For ISD = 3000m, A/N coverage is around 97.2% with MPR =0dB;
  A/N coverage is above 98% with MPR = 7dB and 6 repetition

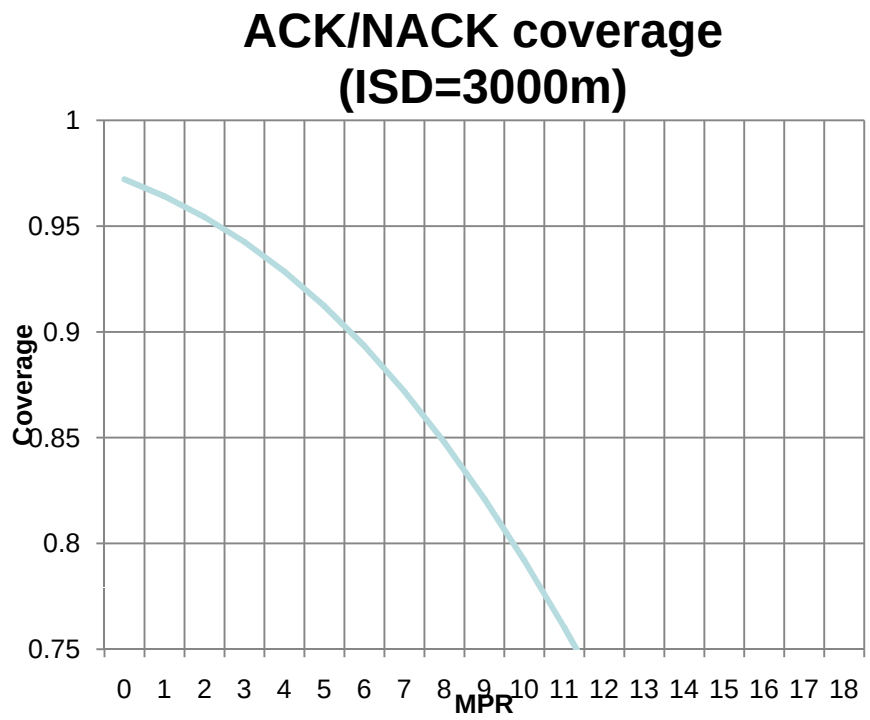
Uplink Channel Type	# Re Tx or repete	Hand off Gain (dB)	Pen Loss+ Body loss (dB)	IoT + 1dB intf margi (dB)	Tx Power (dBm)	(Io+No)W per subcarr (dBm)	SINR per subcarri --from link sims (dB)	Rx Power per Subcarr (dBm)	**LogN Margin** = TxP-ReTx-RxP-Pen/bd +G_an-PL +HO(**ISD =1732m**) (dB)	**LogN Margin** = TxP+ReTx-RxP-Pen/bd +G_an-PL+HO (**ISD =3000m**) (dB)	Covearge Area (ISD =1732m) perc(%)	Coverage Area (ISD =3000m) (perc %)
A/N 1-bit (1% P(A))	0	3.5	23	3	23.0	-124.2	-7.5	-131.7	19.8	10.8	99.8	97.2
CQI-10 bits (1% FER)	0	3.5	23	3	23.0	-124.2	-4.5	-128.7	16.8	7.8	99.5	94.2
VoIP (12.2 kpbs)	4	3.5	23	3	23.0	-124.2	1.3	-122.9	18.0	9.0	99.7	95.6
					Normal							
A/N 1-bit (1% P(A))	0	3.5	23	3	13.0	-124.2	-7.5	-131.7	9.8	0.8	96.4	79.1
A/N 1-bit (1% P(A))	0	3.5	23	3	16.0	-124.2	-7.5	-131.7	12.8	3.8	98.4	87.1
					MPR =10 or 7	**No A/N Repetition**						
A/N 1-bit (1% P(A))	1	3.5	23	3	13.0	-124.2	-7.5	-131.7	12.9	3.9	98.4	87.1
A/N 1-bit (1% P(A))	6	3.5	23	3	16.0	-124.2	-7.5	-131.7	21.3	12.3	99.9	98.1
					MPR =10 or 7	**with A/N Repetition**						

Green: Above 98% coverage

Coverage Decreases with MPR Increase

- ACK/NACK channel Coverage Analysis
  - 1 bit A/N channel of interest, 23 dBm max power
  - To achieve 98% coverage requirement
    - With ISD=1732 m, around 7dB MPR is allowed
    - With ISD= 3000 m, even transmission at 23dBm is not enough
    - A/N repetition needed for ISD =3000 m





Conclusion

- Measurement of interference to PS band is provided.
- To meet both interference limit and 98% coverage, 7dB MPR and 13RB offset are needed
- Coverage analysis is studied for ISD=1732m and 300m.
  - With 10dB MPR
    - 98% coverage is achieved with 1A/N repetition for ISD =1700m

References

- [1] Gordon L. Stuber, Principles of mobile communication, Springer
- [2] Andrea Goldsmith, Wireless Communications, Cambridge University Press

Annex:Coverage Analysis Methods

- Coverage analysis tools
  - Coverage analysis closed form from reference books[1][2]
    - From noise outage probability perspective of [1]

$$
\begin{aligned}
O_N &= \frac{1}{\pi R^2}\int_0^R O(r)2\pi r\,dr \\
&= Q(X) - \exp\left\{XY + Y^2/2\right\} Q(X+Y) \qquad (1.25)
\end{aligned}
$$

where

$$
X = \frac{M_{\text{shad}}}{\sigma_\Omega}, \qquad Y = \frac{2\sigma_\Omega}{\beta\xi} \qquad (1.26)
$$

    - From Cell coverage perspective of [2]

$$
C = \frac{2}{R^2}\int_0^R rQ\left(a + b\ln\frac{r}{R}\right)dr, \qquad (2.58)
$$

where

$$
a = \frac{P_{min} - \overline{P}_r(R)}{\sigma_{\psi_{dB}}} \qquad b = \frac{10\gamma\log_{10}(e)}{\sigma_{\psi_{dB}}}, \qquad (2.59)
$$

$$
C = Q(a) + \exp\left(\frac{2-2ab}{b^2}\right) Q\left(\frac{2-ab}{b}\right). \qquad (2.60)
$$