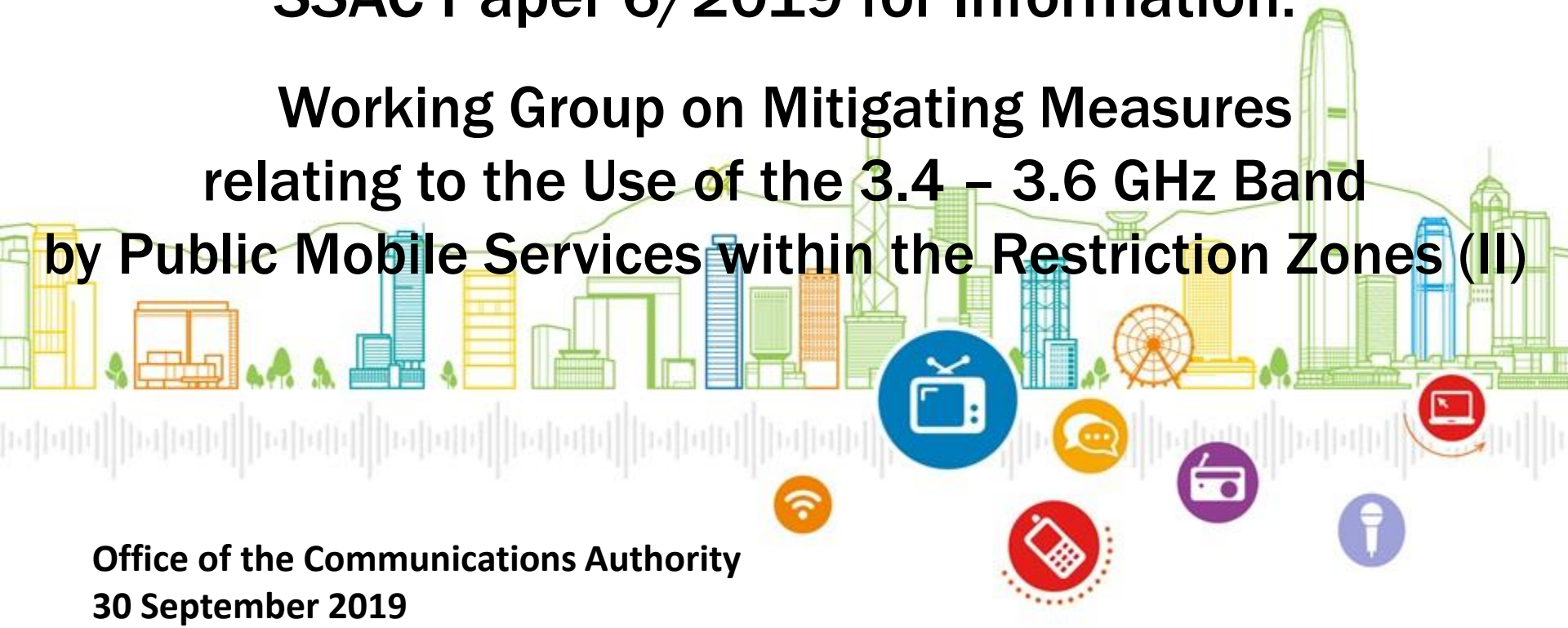
Radio Spectrum and Technical Standards Advisory Committee

SSAC Paper 6/2019 for Information:

Working Group on Mitigating Measures relating to the Use of the 3.4 – 3.6 GHz Band by Public Mobile Services within the Restriction Zones (II)



Office of the Communications Authority
30 September 2019

OFCA 通訊事務管理局辦公室 OFFICE OF THE COMMUNICATIONS AUTHORITY

Introduction

- At the 18th meeting of the Radio Spectrum and Technical Standards Advisory Committee ("SSAC") held in August 2018
  - SSAC members were briefed via SSAC Paper 5/2018 about the formation of a Working Group to consider the feasible technical arrangements for deployment of radio base stations operating in the 3.4 – 3.6 GHz ("RBS") band within the restriction zones delineated by the Communications Authority ("CA")
  - The Office of the Communications Authority ("OFCA") promised to update SSAC members on the deliverables of the Working Group in due course

Conduction of the Working Group

- Thanks to the valuable information and assistance offered by Working Group members conducive to the successful completion of the study
- A total of nine Working Group meetings have been conducted between June 2018 and June 2019

Deliverables of the Working Group

The Working Group

- a. Conducted theoretical assessments
- b. Undertook a field trial for verification
- c. Contributed comments on draft guidelines for installation of RBSs within the restriction zones (the "Guidelines") for CA's consideration

a. Theoretical Assessment

- Assume that a RBS is installed at Photonics Centre of the Hong Kong Science Park
- To calculate interference signal power receivable at the earth stations for telemetry, tracking and control ("TT&C") of satellites at Tai Po,

  $I_{Rx} = e.i.r.p._{RBS} - P_{Loss}(d) + G_{fss}(\phi) - R$, where

  - $e.i.r.p._{RBS}$
    - peak equivalent isotropically radiated power ("eirp") of panel antenna: 44.1 dBm
    - peak eirp of massive multiple-input-multiple-output ("MIMO") antenna: 77 dBm
  - $P_{Loss}(d)$, free space path loss of 4.1 km at 3.5 GHz: 116 dB
  - $G_{fss}(\phi)$, antenna gain of satellite dish: 50 dBi at beam centre
  - R, additional isolation due to clutter loss and shielding by metallic mesh sheet etc.: 25 dB
- As per ITU-R Recommendation S.1432-1, the maximum allowable co-frequency interference level at input of low noise amplifier of TT&C stations is -130.8 dBm/MHz, the **interference threshold**
- Effectiveness/Feasibility of the respective scenarios were assessed

a. Theoretical Assessment (2)

Cases	5G RBS	Transmitting Antenna Pointing Direction	Transmitting Beam Setting
(a)	Panel Antenna, peak eirp	Pointing directly to the TT&C station	Single Beam
(b)		Pointing 90° away from the TT&C station	
(c)		Pointing 180° away from the TT&C station	
(d)	Massive MIMO Antenna, peak eirp	Pointing directly to the TT&C station	Single beam
(e)		Pointing 90° away from the TT&C station	Single beam
(f)		Pointing 180° away from the TT&C station	Single Beam
(g)			Multi-beams
(h)	Massive MIMO Antenna, peak eirp	Pointing 180° away from the TT&C station, shielded by a metallic mesh	Multi-beams

a. Theoretical Assessment (3)

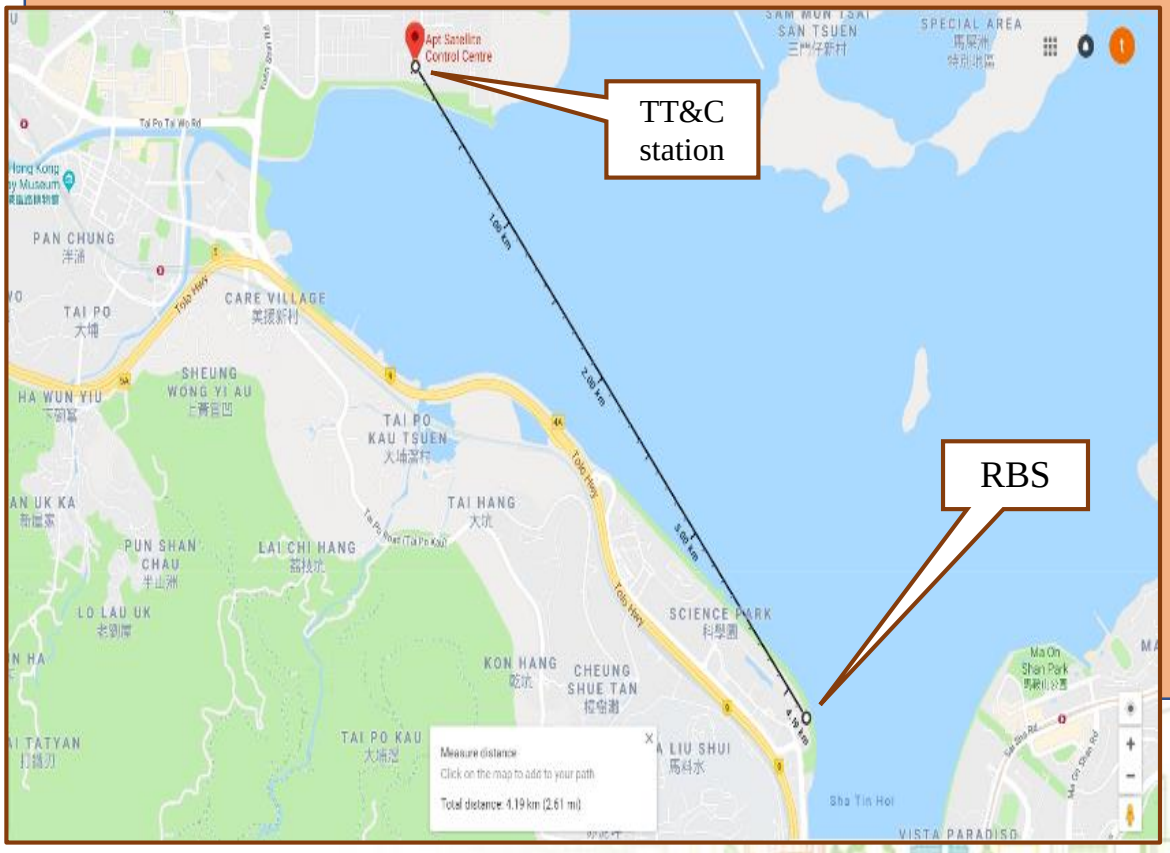
- The calculated interference signal power receivable at TT&C station for cases (a) to (h) ranges from -79 dBm/MHz to -6 dBm/MHz, if RBS antenna points to the TT&C station transmitting at peak power
  - Taking into account the 60 dB antenna gain difference (i.e. beam centre vs sidelobe) of a TT&C antenna, for case (c), the calculated interference level is below the interference threshold if RBS antenna points away from the main beam
    - ► the calculated interference level is -139 dBm/MHz
- For some other cases, the calculated interference level may also be controlled to below the interference threshold with RBS transmitting at reduced power level and with proper control of antenna pointing directions

a. Theoretical Assessment (4)

- Co-existence of RBS with TT&C stations may be possible only if the RBS antenna points away from the main beam (i.e. outside the "-48 to +48 degrees" axial angle of TT&C antenna)
  - generally achievable on consideration of the practical elevation angles of TT&C antenna deployed in Hong Kong
- A field trial was conducted to verify the situation under practical environment

b. Field Trial

- The field trial was conducted in November 2018
  - 5G signals were transmitted at the Hong Kong Science Park
  - Measurements were taken at TT&C stations at Tai Po



- Locations of RBS and dedicated monitoring station at TT&C station

b. Field Trial (2)

A 5G massive MIMO antenna was set to transmit a scanning beam covering a wide spherical sector with adjustable power setting under various trial scenarios

Trial Scenarios

1. RBS antenna pointing at 180° (i.e. facing opposite) to TT&C station with downtilt of 0° and 12°

2. RBS antenna pointing at 270° and 90° (i.e. facing perpendicular) to TT&C station with downtilt of 0° and 12°

3. **Similar to Scenario 1**, but with downtilt of 0° only and addition of a mesh installed at the back of RBS antenna (i.e. between RBS and TT&C station)

4. **Similar to Scenario 2**, but with downtilt of 0° only and addition of a mesh installed at the back lobe of RBS antenna (i.e. between RBS and TT&C station)

b. Field Trial (3)

Findings of the field trial

- RBS transmitting at reduced power level could control interference signal level to TT&C station to below -130.8 dBm/MHz* (co-frequency operation)
- Clutter loss, signal reflection and signal shielding, highly dependent on site environment, were critical to the maximum allowable RBS transmitting power to avoid interference
- Installed metallic meshed sheet at back of RBS antenna (i.e. between RBS and TT&C station) for additional shielding was not an effective measure

Note: * adjusted to -118 dBm/MHz if only blocking is concerned

c. Issue of Guidelines by the CA

- Having considered
  - the **established procedure** for processing applications for use of RBS by mobile network operators ("MNOs");
  - the **relevant special conditions of Unified Carrier Licence ("UCL")** relating to RBS deployment; and
  - the **Working Group recommendations**

  the CA issued the *"Guidelines for Installation of Radio Base Stations Operating in the 3.4 – 3.6 GHz Band within the Restriction Zones Delineated by the Communications Authority"* with the information memorandum for the spectrum auction of the 3.4 – 3.6 GHz band on 19 July 2019

Brief on the Guidelines

- In addition to the established "One-stop Application Procedure for Installation of RBSs by MNOs", the following additional telecommunications requirements will apply –
  - *unless with the TT&C station operators' consent, the signal level of RBS as receivable at the input of the low noise amplifier of the satellite receiving system of the TT&C stations should not exceed the Protection Criteria, i.e.*
    - *-130.8 dBm/MHz for the 3400 – 3405 MHz band; and*
    - *-118 dBm/MHz for the 3405 – 3600 MHz band*
  - *As required under UCL, "the licensee shall ensure that the operation of customer equipment connected to the licensee's network or having access to services provided under [the] licence does not cause harmful interference to any licensed TT&C Stations within the restriction zones..."*

Brief on the Guidelines (2)

- MNOs should submit an analysis report for each application demonstrating compliance with the additional telecommunications requirements
  - Proved to the satisfaction to OFCA that no harmful interference will be caused to the TT&C stations
  - In particular those proposed to be installed within 2 km from the TT&C stations where the TT&C antennae characteristics could not be well defined for the analysis
- Before granting approval, OFCA may conduct on-site measurement jointly with the MNO concerned and the TT&C station operators in order to verify the assessment given in the analysis report submitted by the MNO

Brief on the Guidelines (3)

- TT&C station operators should closely monitor the interference level caused by RBS
  - If any interference level reaches the limit of the Protection Criteria as measured in per MHz basis in a particular sub-band, or if there is any indication that the interference level is about to exceed the limit of the Protection Criteria in that particular sub-band, the TT&C station operator concerned should report its observation to OFCA
- In the event of harmful interference, the concerned TT&C station operator should promptly report the incident to OFCA for interference investigation

THANK YOU

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