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Communications Regulatory Authority State of Qatar

هيئة تنظيم الاتصالات دولة قطر

Name

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Presentation Title

Regulatory Challenges and Measurements in D2C Satellite Networks

Abstract

With the NTN technology to access mobile phones directly from satellite a novel range of connectivity opens up. With this opportunity the question of how a regulation of this technology is fit for purpose is a key topic. This talk will address the challenges and gives a first inside into measurements of direct to cell connectivity.

Bio data

Uwe Baeder studied physics and electrical engineering and holds a physics diploma from the University of Kaiserslautern. He joined Rohde & Schwarz in 2000 as standards engineer for radio communication tester. He represented Rohde & Schwarz in various international standardization groups for wireless communications and oversaw the company's presence on these committees. His interest was especially focused on the standardization of IMT systems within the 3rd Generation Partnership Project (3GPP). Here he contributed to the development of the test specifications, which are used as basis for radio regulation of wireless communication devices. At the same time, he was leading an international team for the development of certification tests for WCDMA/HSDPA, eCall, EWTS, LTE radio protocols including IMS and IoT standards like eMTC and NB-IoT. He is now director public affairs where he is responsible for digital policy and frequency regulation.

Regulatory Challenges and Measurements in D2C Satellite Networks

Uwe Baeder
ISRMM-25, September 2024, Doha, Qatar

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Make ideas real

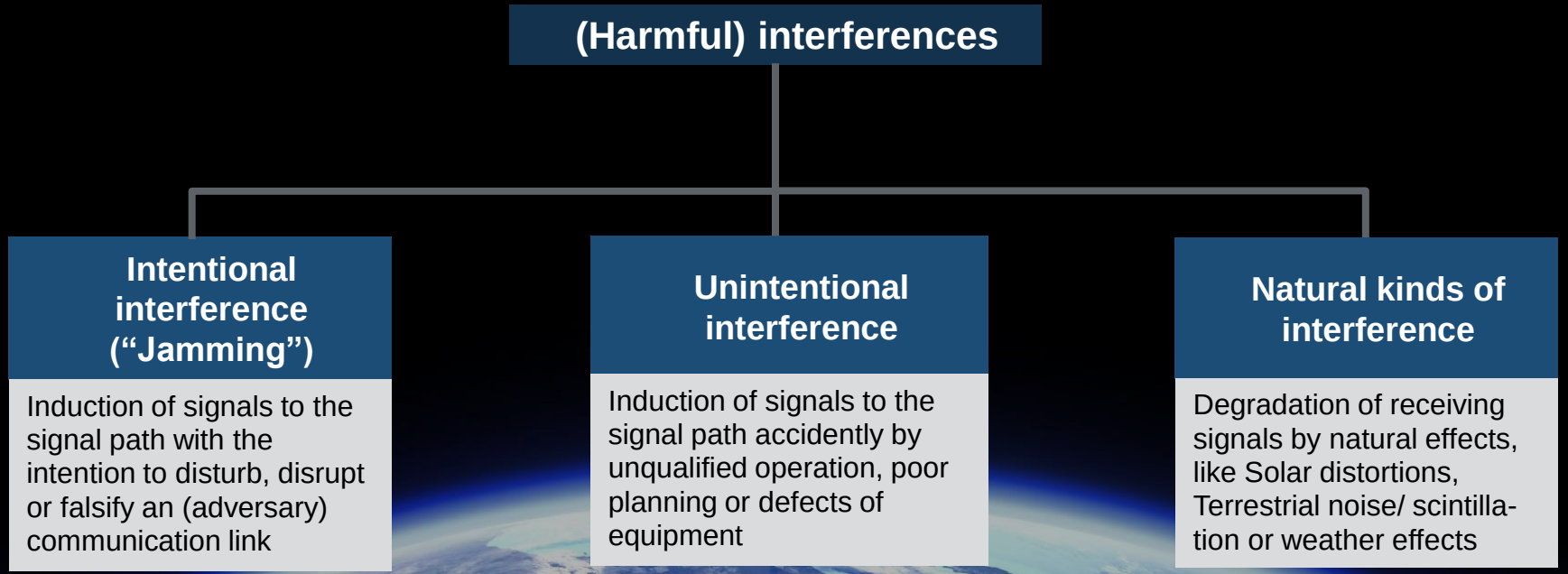
SPM Motivation

- RF emissions from satellites could interfere with radio services on the ground
- License parameters of RF emissions from satellites need to be validated
- The spectrum occupancy in frequency bands used by satellites needs to be measured
- Satellite positions need to be validated
- Interference Hunting to guarantee efficient spectrum usage for Satellite Services

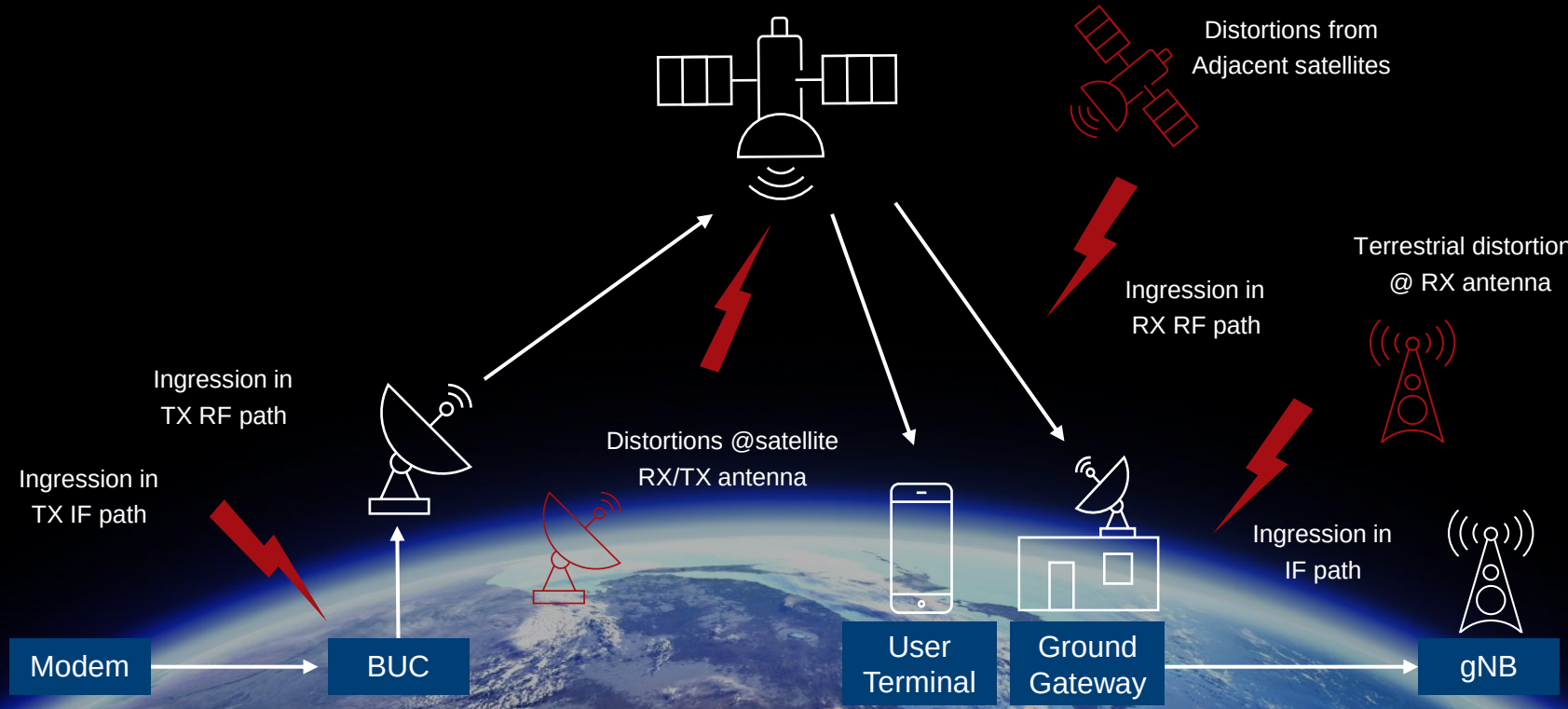
SPM Solution

- Fixed, mobile and transportable monitoring stations
- Mobile monitoring stations with magnet mount direction-finding antenna
- Automatic running-fix software for quick and easy radiolocation of RF interferers
- Signal measurements in line with ITU-R Recommendations
- Handheld monitoring receivers with handheld directional antennas

INTERFERENCE IN SATELLITE COMMUNICATIONS



SATELLITE COMMUNICATION LINK PENETRATION POINTS FOR INTERFERENCES



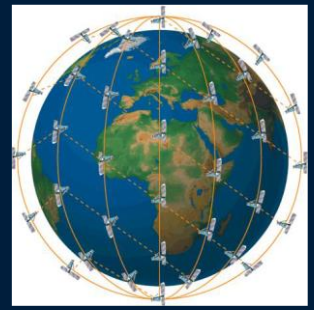
CASE STUDY: SATELLITE INTERFERENCE HUNTING

- Source for interference might be
  - other satellite signal
  - terrestrial signal
- Comparison of SNR and C/N
- Demodulation and display of interfering signal

Focus - Non-Terrestrial Networks (NTN)

- Mobile communication via satellites to close white spots of terrestrial networks

Type of satellite Typical dimensions	**Altitude range**	**Typical beam footprint**
LEO (Low-Earth Orbit)	300 – 1500 km	100 – 1000 km
MEO (Medium-Earth Orbit)	7000 – 25000 km	100 – 1000 km
GEO (Geostationary Earth Orbit)	35 786 km	200 – 3500 km



- LEO in 1000 km altitude takes ~ 90 minutes to circle Earth
  - Beam footprint: LEO visible for 1-2 min every 90 minutes (fixed beams, longer for steerable beams) → LEO network
- Direct-to-Cell (D2C) uses terrestrial IMT spectrum that is allocated per country!

Example - FCC SCS - Supplemental Coverage from Space

- **SCS operator must have a spectrum lease arrangement (from terrestrial licensee(s))**
- **SCS Bands - Implemented as bi-directional, secondary MSS (Mobile Satellite Service)**
  - 600 MHz: 614 - 652 MHz and 663 - 698 MHz
  - 700 MHz: 698 - 769 MHz, 775 - 799 MHz, and 805 - 806 MHz
  - 800 MHz: 824 - 849 MHz and 869 - 894 MHz
  - Broadband PCS: 1850 - 1915 MHz and 1930 - 1995 MHz
  - AWS-H Block: 1915 - 1920 MHz and 1995 - 2000 MHz
- **Power flux-density and in-band field strength**
  - 40 dBµV/m for the 600 MHz, 700 MHz, and 800 MHz bands
  - 47 dBµV/m for the AWS and PCS bands
  - aggregate field strength (earth's surface) by all visible beams and satellites providing service
- **Certification of terrestrial devices: license by rule!**
- the terrestrial licensee's license parameters apply
- **Interim 911 text and call routing requirements**
  - Dedicated/appropriate SCS PSAP

Example: Coverage measurement of NTN LTE signal

► Scanner measurements of a LEO satellite network transmitting a standard LTE signal

LTE Coverage per Carrier | LTE Coverage Statistics per Ca... | LTE Serving Cell | LTE Availability per PCI

LTE Serving Cell

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Coverage per: RSRP | Operator | Band Name | EARFCN: (All) | Date: March 21, 2024

Timeline coverage by PCI

March 21, 2024

-100
-110
-120
-130
-140

-120 dBm RSRP limit for smartphones

~ 90 minutes

11:01:00 AM 11:11:00 AM 11:21:00 AM 11:31:00 AM 11:41:00 AM 11:51:00 AM 12:01:00 PM 12:11:00 PM 12:21:00 PM 12:31:00 PM 12:41:00 PM 12:51:00 PM 1:01:00 PM 1:11:00 PM

72 75 76 77 78 79 100

Regulatory challenges / questions

- Many technical topics (KPIs) can be measured with passive and active testing solutions already now.
- But what about regulatory questions?

Examples:

- Spectrum Utilization in Direct-to-cell mode:
  - What will the regulators require to measure?
- Monitoring of NTN Band blocks:
  - What happens at country borders?
- Roaming issues:
  - various satellite constellations, various operator cooperations, various SIM/eSIM in unmodified devices, what interworks?

Related ITU WRC-27 Agenda Item

- *AI 1.5: t*o consider regulatory measures, and implementability thereof, to limit the unauthorized operations of non-geostationary-satellite orbit earth stations in the fixed-satellite and mobile-satellite services and associated issues related to the service area of non-geostationary-satellite orbit satellite systems in the fixed-satellite and mobile-satellite services, in accordance with Resolution **14 (WRC-23)**;

- *AI 1.13:* to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution **253 (WRC-23)**;

Thank you!