3GPP TSG RAN1#103-e
26th October - 13th November 2020

R1-2007882
Agenda Item 8.15

NB-IoT Waveform Tests over LEO Satellite

OQ Technology, Luxembourg

TIGER – 1 Mission

- First experiment for NB-IoT over LEO satellites
- Validation of NB-IoT waveform over LEO Orbit
- First step towards a vision for 4G/5G IoT for over Non-Terrestrial Networks

- https://space-agency.public.lu/en/news-media/news/2019/oq-technology-and-gomspace-sign-for-tiger-mission.html
- https://www.oqtec.space/?p=2046

Setup

3rd Party Nanosatellite

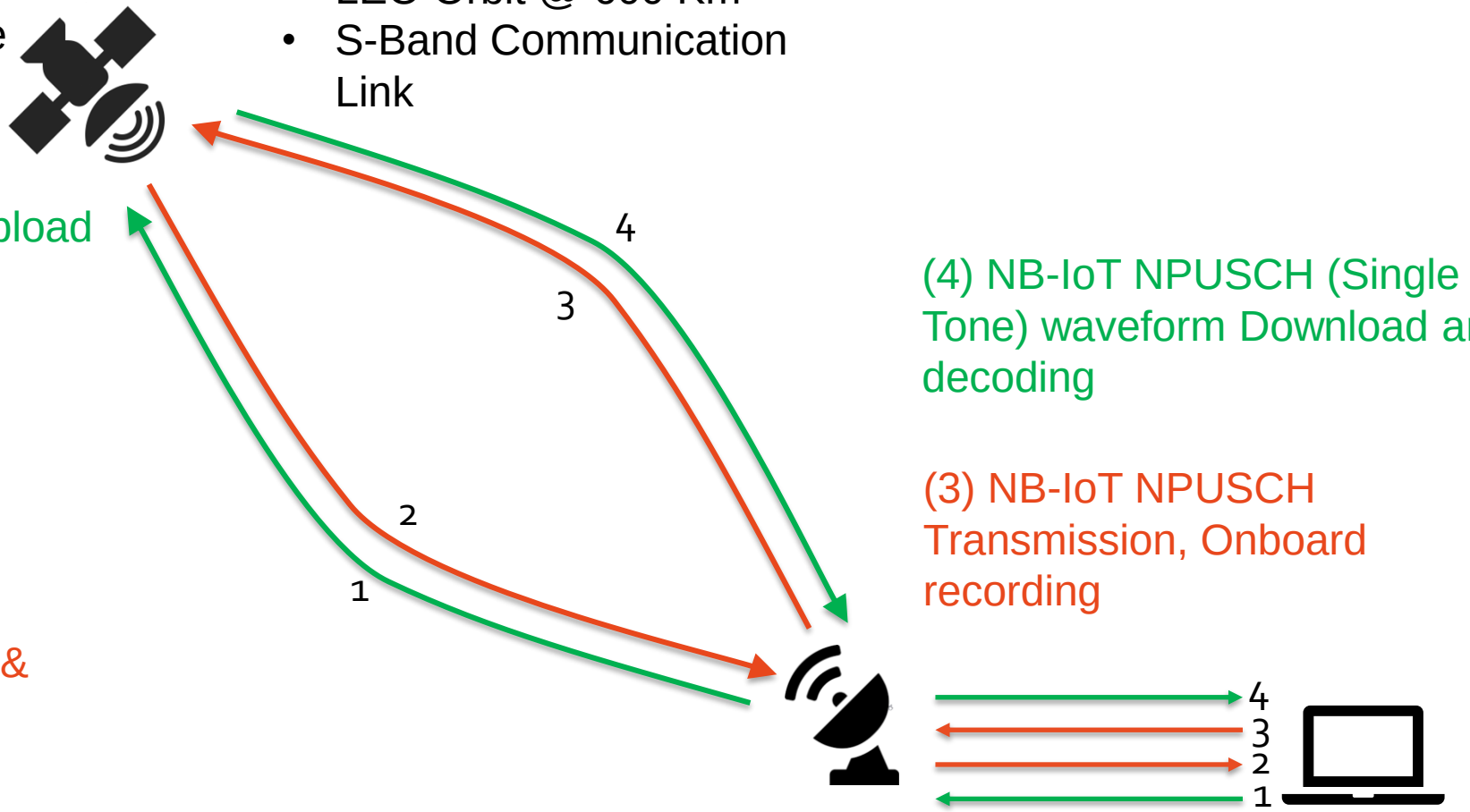
- LEO Orbit @ 600 Km
- S-Band Communication Link

(1) NB-IoT DL waveform upload
- NPSS
- NSSS
- NPBCH

(2) NB-IoT DL waveform playback, Synchronization & NPBCH (MIB) Decoding

(3) NB-IoT NPUSCH Transmission, Onboard recording

(4) NB-IoT NPUSCH (Single Tone) waveform Download and decoding



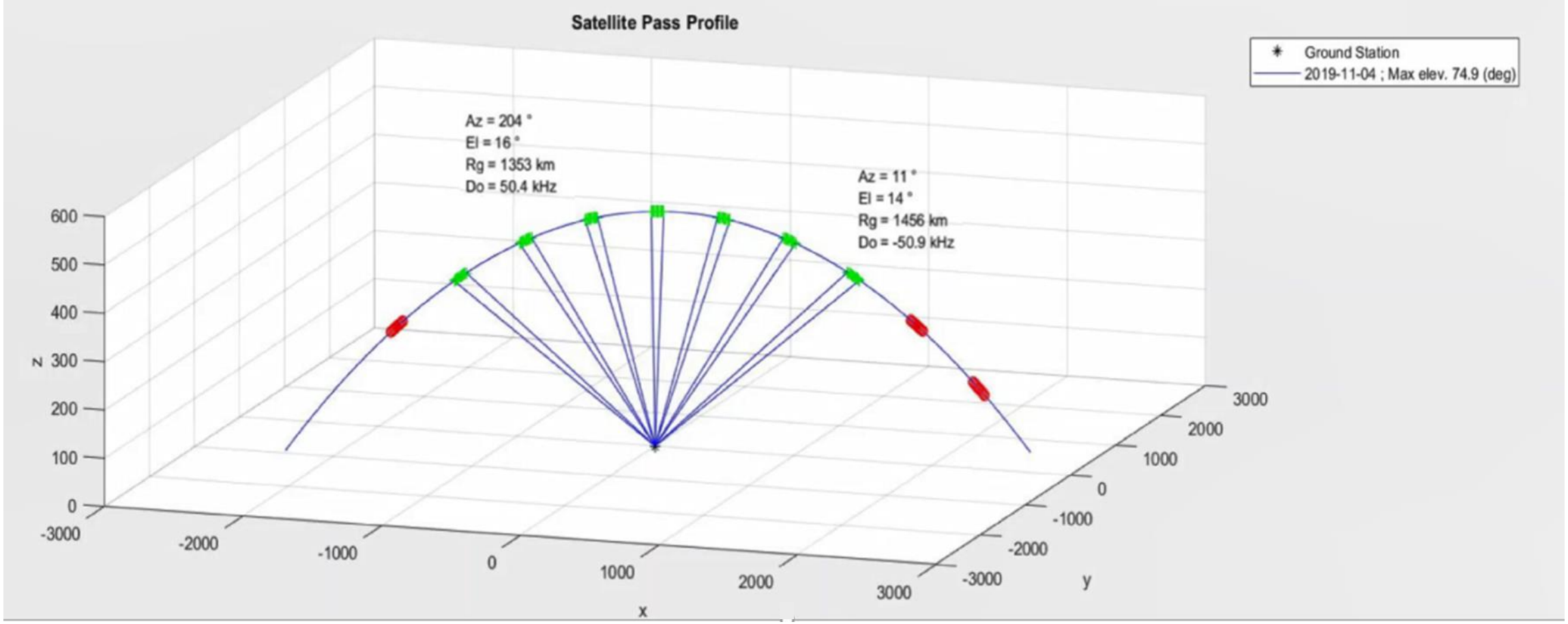
Waveform playback Transmission

Recorded IQ Data upload/download in feeder link

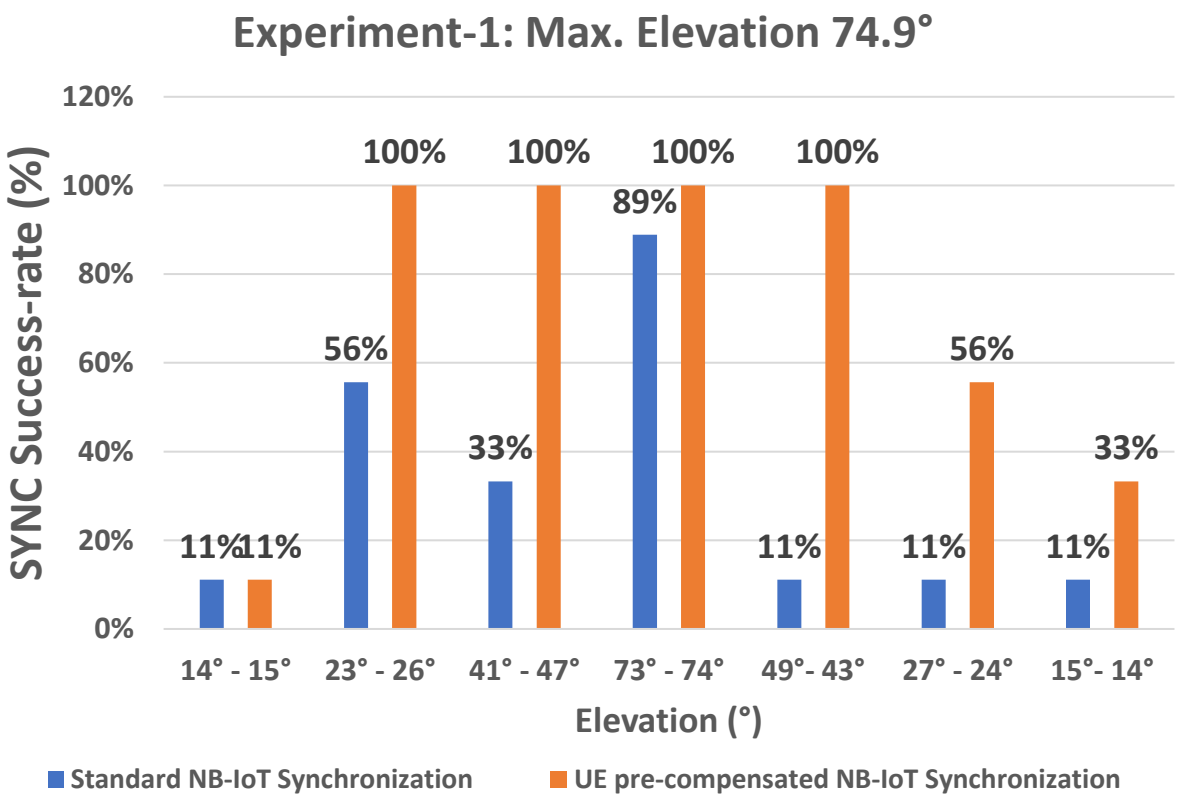
Parameters

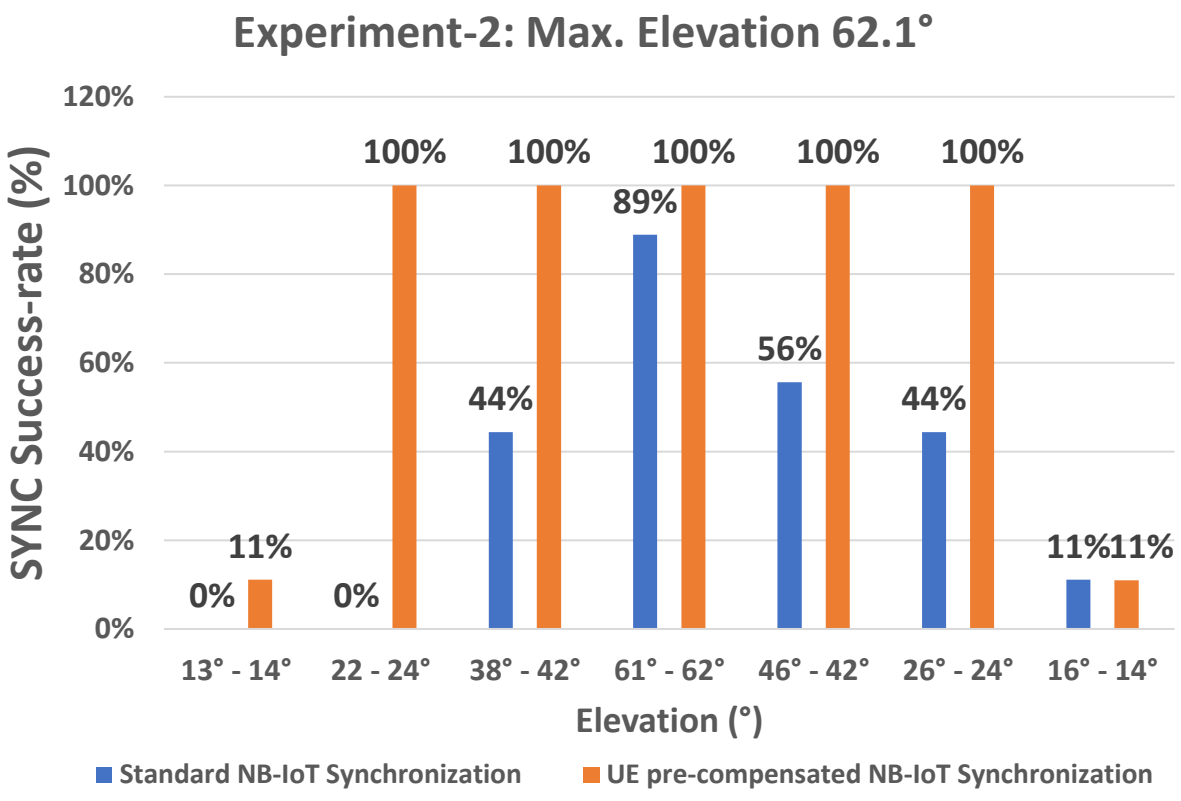
- Satellite
  - EIRP: 32.5dBm
  - Payload: SDR
- Gateway
  - S-Band Gateway
  - UE pre-compensation for time and frequency using satellite TLE & UE location (relative position information between UE and Satellite)
  - S-band Channel for LEO Orbit
- Experiments:
  - 26 Experiment Trials between November 2019 to April 2020

Example Satellite pass profile



SYNC success-rate





Results

- Elevation angle:
  - 99.99% SYNC success rate for DL SYNC at 23° elevation & MIB Decoding
  - 99.99% of decoding success rate for over 40 single tone NPUSCH transmission (No Repetition) over 43° elevation angle as a validation example
- Link Budget normalized to Power Class PC3 (23dBm) with achievable SNR > 3 dB for both Downlink & Uplink