3GPP TSG RAN#89E
September 2020

RP-201702
Agenda Item 10.6.1

Demonstrating NB-IoT viability for Satellite use

Live trial set-up, parameters and key results

Inmarsat, MediaTek Inc., Institute for Information Industry

Trial set-up

Objective

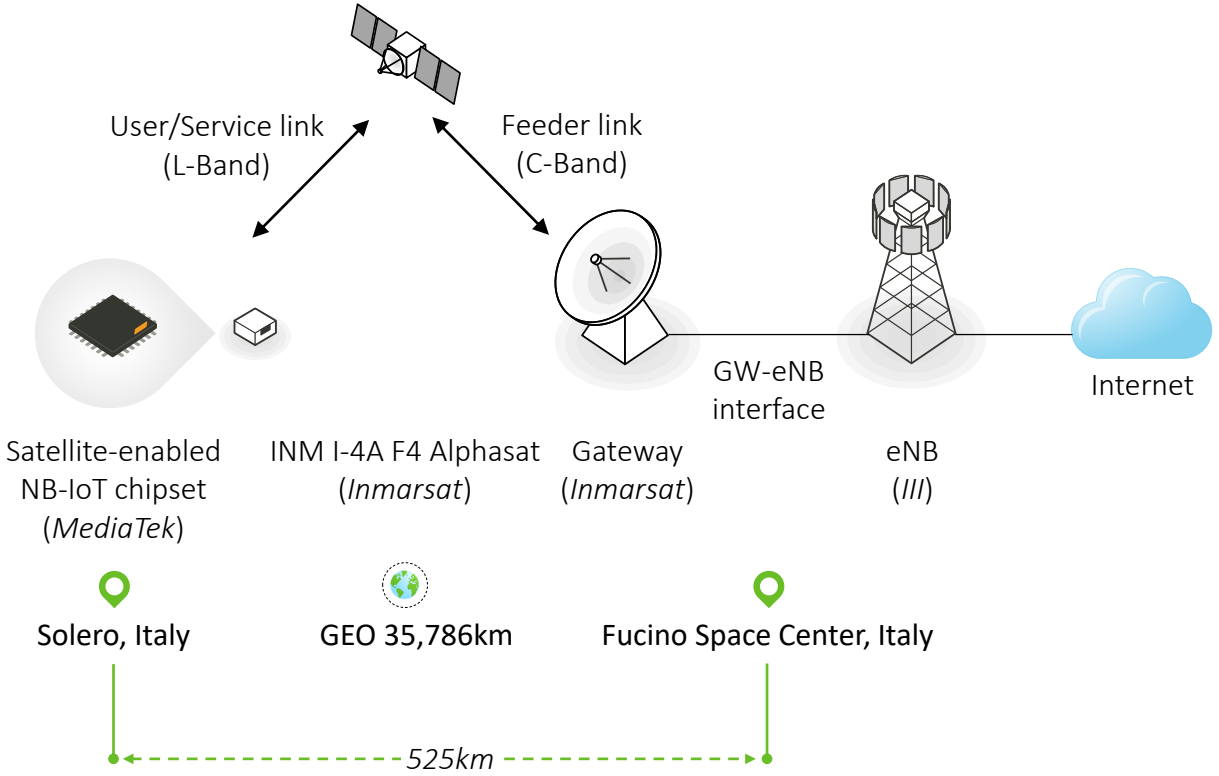
- Demonstrate NB-IoT viability for Satellite use

Set-up

- UE: MediaTek satellite-enabled NB-IoT chipset
- Satellite: Inmarsat Alphasat L-band, GEO orbit
- eNB: Institute for Information Industry (III)
- UE and eNB 525km apart

Result

- Bi-directional link successfully established (Aug 19, 2020)



https://www.inmarsat.com/news/successful-trial-advances-global-5g-iot-communications/

Trial Parameters

- UE
  - Power Class PC3 (23dBm)
  - Linearly polarized antenna (-3dB polarization loss)
  - Tx / Rx antenna gain: 0 dBi
- eNB
  - Local connection to Satellite Gateway via proprietary interface
  - Internet connection
- Gateway
  - Feeder link with circular polarisation on C-band

- Satellite INM I-4A F4 Alphasat (EMEA)
  - User / Service link with circular polarisation on L band
  - Transparent payload
  - EIRP: 71.5 dBm
  - Elevation angle: 40° service link, 36° feeder link

- Real-time Trial successfully demonstrated
  - Initial cell access (RACH, RAR, CR)
  - Bi-directional Data transfer

RACH: Random Access Channel
RAR: Random Access Response
CR: Contention Resolution

Key Results

- Link budget closed: Rel-13 NB-IoT
  - CP-OFDM on forward and return links
  - Repetition on DL and UL
  - DL: NPSS/NSSS, PDSCH, PDCCH
  - UL: PRACH, PUSCH (Single Tone)
- UL scheduling and MAC timers with full TA (1)
  - Max full TA in cell used for MSG3 scheduling delay and HARQ scheduling delay
  - MAC timers on RAR window offset and CR timer offset *extended* by UE-autonomous full TA
- UE transmission met specified legacy UL synchronization requirements
  - UE pre-compensation using real-time satellite assisted system information and GNSS-acquired UE location
  - Projections used for real-time satellite position and velocity in UE and eNB
  - UE pre-compensation of satellite delay and frequency offset before UL transmission (2)
- ACLR/OOB emission on eNB forward link
  - Lower OOB emission required

NOTE1: Full TA including access link RTD and feeder link RTD
NOTE2: Satellite delay and frequency offset can be predicted from real-time satellite position and velocity via simple processing in the device

ACLR: Adjacent Channel Leakage Ratio
OOB: Out-Of-Band
TA: Timing Advance