Non-Terrestrial Networks in 5G/6G

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5G/6G Environmental Impact

- Indirect Effect (Enabling Effect)
  - Enabler for other industries to achieve their enviromental goals*

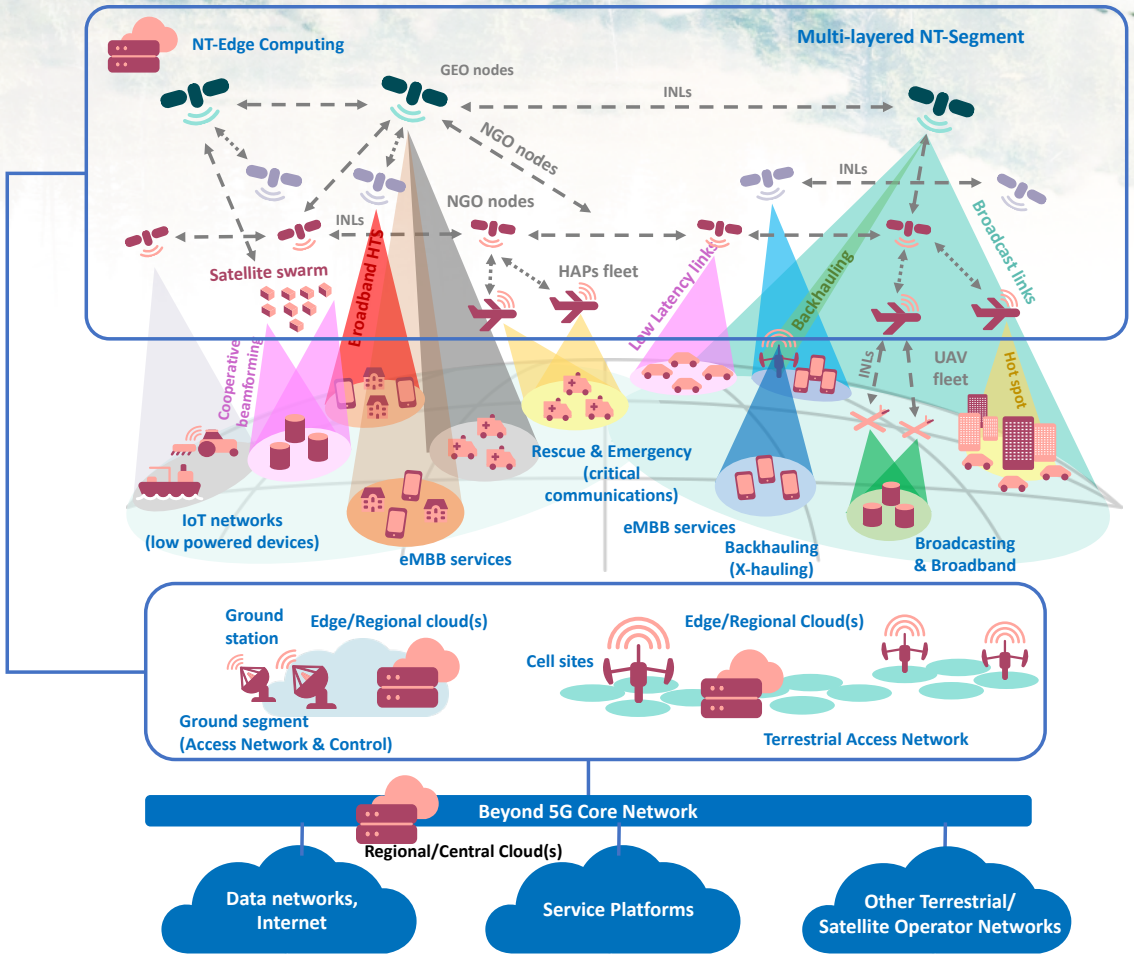
- Direct Effect (Greener 5G/6G Ecosystem):
  - Infrastructure optimization
  - Resource optimization for energy efficient traffic delivery

Which is the role of NTN in this context?

** GREEN 5G: BUILDING A SUSTAINABLE WORLD, Analysys Mason, July 2020*

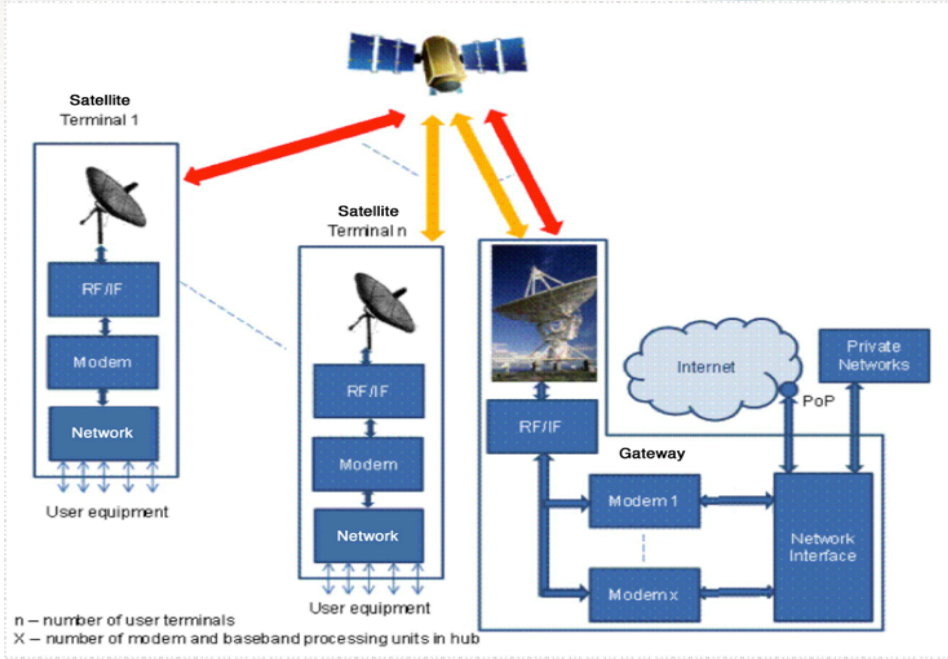
The role of Non-Terrestrial Networks in 5G/6G

- 5G/6G Vision
  - ➢ a unified Terrestrial/Non-Terrestrial architecture
- NTN Component
  - ➢ multi-layered infrastructure
    - nodes flying at different altitudes
    - inter-node links
  - ➢ flexible and reconfigurable topology for system optimization
- NTN traffic delivery
  - ➢ optimized and efficient delivery for several services (e.g., broadcasting, broadband in unserved areas, narrowband IoT, etc.)



NTN Life Cycle Assessment

- Studies not yet available on NTN LCA
- Previous analysis on Hybrid High Throughput Satellite Systems*
  - ➢ the total yearly GHG emissions of the entire system is comparable with that foreseen for a 4G/5G medium national infrastructure
  - ➢ only 3.4% of the GHG life cycle emissions of a Satellite system are due to production (~2.9%), launch (~0.56%), and end of life treatment (~0.04%)
  - ➢ 96.6 % of GHG emissions are due to operational phase and 92% of that is due to energy consumption of the satellite and user modems



** ETSI TR 103 353 Environmental impact of satellite broadband network Full LCA (2016) and FP7 BAST project*

Conclusions

- NTN will play a fundamental role in reducing the environmental impact of 5G/6G
  - Infrastructure optimization
  - traffic delivery optimization in synergy with the terrestrial component
  - Limited direct impact of the NTN component, mainly due to “traditional” contributions (modem)
- To further improve the direct and indirect impact, studies are needed to
  - reduce modem energy consumptions:
    - softwarization, virtualization, and disaggregation of the NTN access network
    - ultra low power components development
  - evaluate LCA of NTN based on multiple constellations

** ETSI TR 103 353 Environmental impact of satellite broadband network Full LCA (2016) and FP7 BAST project*

References

[1] ETSI TR 103 353 V1.1.1 (2016-07) Satellite Earth Stations and Systems (SES); Environmental impact of satellite broadband network; Full LCA (Life Cycle Assessment)

[2] Jan Bieser, Beatrice Salieri, Roland Hischier, Lorenz M. Hilty “Next generation mobile networks Problem or opportunity for climate protection?” Oct. 2020 [https://plus.empa.ch/images/5G%20climate%20protection_University%20of%20Zurich_Empa.pdf]

[3] Haut Conseil Pour Le Climat, France Government “Maitriser l’impact Carbone de la 5G” Dec. 2020, [https://www.hautconseilclimat.fr/wp-content/uploads/2020/12/rapport-5g_haut-conseil-pour-le-climat.pdf]

[4] Caroline Gabriel, Andy He, Andrew Chern “GREEN 5G: Building a Sustainable World”, Analysys Mason, July 2020, [https://www.analysysmason.com/contentassets/bb742b22fb434cf8a055291c20331dfe/analysys_mason_green_5g_sustainability_jul2020_rma18_rdns0.pdf]