

A SYSTEM SIMULATOR FOR BROADBAND GLOBAL AREA NETWORK (BGAN)

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1. Abstract

Broadband Global Area Network (BGAN) is a mobile satellite communications service by Inmarsat, which is providing reliable, cost-effective global broadband data and voice using compact, lightweight portable terminals. BGAN provides almost global coverage with three geostationary satellites for maritime, enterprise, aviation, and governmental customers.

BGAN uses a proprietary Inmarsat Air Interface-2 (IAI-2) protocol stack, which is also the basis of the technical specification of the SL (Satellite Link) family of the Satellite Universal Mobile Telecommunications System (S-UMTS) standard, proposed by Inmarsat and published by ETSI as TS 102 744 [1]. Unlike IAI-2, S-UMTS Family SL is an open standard.

The authors are unaware of any software simulators implementing S-UMTS/BGAN air interface and appropriate (geostationary) satellite scenario. A suitable simulator could be used to estimate the suitability of S-UMTS/BGAN for different SatCom and service use cases. In this abstract, we present a system simulator which models the S-UMTS Family SL protocol stack and related geostationary satellite scenario. The simulator is implemented on top of an open-source Network Simulator 3 (ns-3) [2] and reuses the Satellite Network Simulator 3 (SNS3) [3] architecture.

2. S-UMTS/BGAN system simulator

Satellite Network Simulator 3 (SNS3) is a satellite network extension to the Network Simulator (ns-3) platform. ns-3 is a discrete event simulator for networking research licensed under General Public License v2 (GPLv2). This platform has been initially developed by Magister Solutions Ltd in the frame of ESA ARTES projects. SNS3 models a full interactive multi-spot beam satellite network with a geostationary satellite and transparent star (bent-pipe) payload. SNS3 implements DVB-S2 and DVB-RCS2 air interfaces on the forward (FWD) and return (RTN) links, respectively, in a GEO satellite network.

S-UMTS simulator reuses the SNS3 architecture but is not backwards compatible with it. The generic S-UMTS/BGAN simulator architecture presented in Figure 1 consists of three types of nodes: the ground station, a satellite, and User Equipment (UE). The ground station acts in the role of Radio Network Controller (RNC) that allocates bandwidth resources for the UEs. The satellite is assumed to model a bent pipe transponder that relays the forward and return link data.

The simulator modelling focuses on Bearer Control (BCt) and Bearer Connection (BCn) layers, but the ns-3 underneath also provides the higher layer protocols from network layer up to application layer. Physical layer is abstracted and is using bearer type specific Energy per Symbol to Spectral Noise Density (E_s/N_0) thresholds for a target Block Error Rate (BLER). Main simulator features can be listed as: 1) Status SDU creation, 2) Return link scheduling, 3) Acknowledged mode (AM) operation, Contention based access and Dynamic channel/bandwidth assignment, but for sure this is not a complete list.

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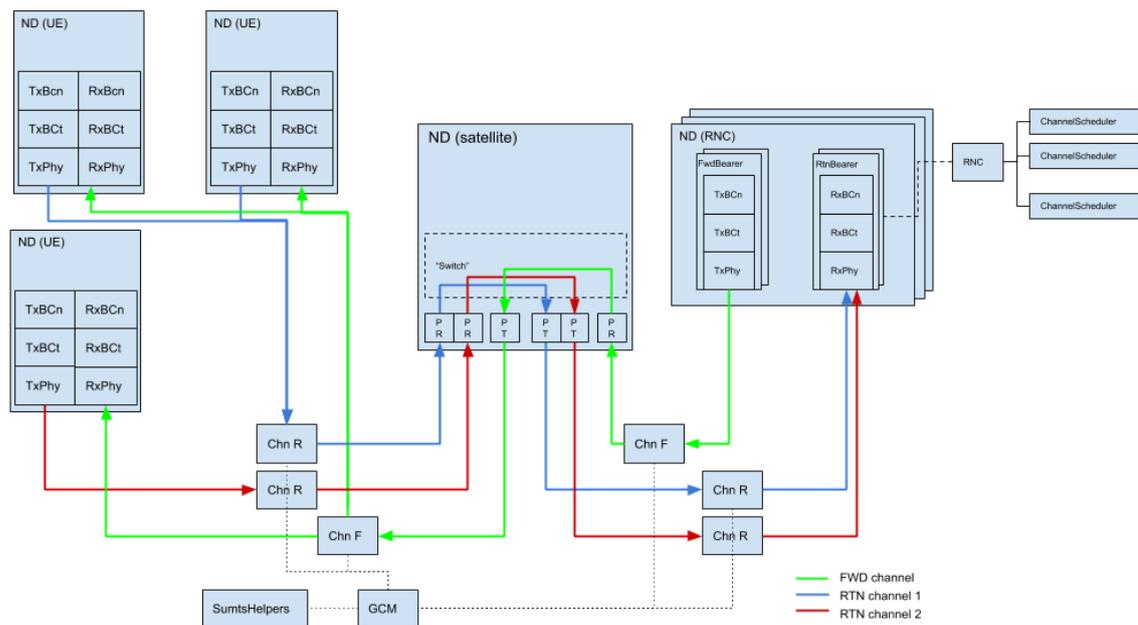


Figure 1. Generic architecture of the S-UMTS simulator.

3. Conclusion

In this abstract, we have presented an overview of a packet-level S-UMTS/BGAN system simulator based on Network Simulator 3 (ns-3) and Satellite Network Simulator 3 (SNS3). The development project is still on-going but scheduled to be finalized by the end of 3Q/2020. Thus, the final article is expected to include more detailed simulator description and simulation results for verification and demonstration purposes.

The developed S-UMTS/BGAN simulator may be used in Iris satellite-based air-ground communication system for Air Traffic Management (ATM) and satellite-based railway control communications performance analysis. In addition, the S-UMTS/BGAN simulator shall be used as one of the first simulator use cases within Magister Solutions' Simulation Service presented also previously at KaConf [4].

4. References

- [1] ETSI TS 102 744, Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface, Parts 1-4.
- [2] NS-3 Consortium, "Network Simulator 3", <http://www.nsnam.org>, referenced 2.5.2018.
- [3] J. Puttonen et al., "Satellite Model for Network Simulator 3," in International Conference on Simulation Tools and Techniques (SIMUTools), Lisbon, Portugal, 2014.
- [4] J. Puttonen, T. Nihtilä, M. Innanen, R. Järvinen, J. Kurjenniemi, V. Hytönen and T. Flink, "Cloud Simulation Platform for Satellite and Terrestrial Network Simulations", Ka and Broadband Communications Conference, Sorrento, Italy, September 30 – October 2, 2019.