

Ka-band Time Diversity Statistics Evaluation in Attica Greece using ALPHASAT

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It is known that satellite links operating at Ka-band and above are notoriously prone to propagation phenomena and more particularly to rain precipitation. Such impairments constitute a serious design limitation and have to be compensated for using appropriate Fading Mitigation Techniques (FMTs) [1] in order to reduce downtime and outages. One of the proposed FMTs is the time diversity technique: a link affected by a propagation impairment leading to outage merely retransmits the signal after a scheduled time delay; this technique is therefore appropriate to time-delay tolerant applications (i.e. non-real-time) such as data transfer. A significant advantage of time diversity over other FMTs is that it makes use of only a single link, i.e. the same propagation channel but delayed in time. [2]

Making use of the Ka-band beacon transmitted by ALPHASAT at 19.701 GHz, the attenuation time series collected at the National Technical University of Athens (NTUA) stations [3] are used to evaluate the performance of a time diversity scheme. The data have been collected by two ground stations, one at NTUA campus in Athens and one in Lavrion (approximately 36.5 apart) for the period of 2 years.

The time diversity statistics for a time delay TD are derived from the measured excess attenuation statistics based on the definition:

$$P(A(t) \geq a, A(t + TD) \geq a) \quad (1)$$

where $P(\cdot)$ is the probability that both attenuation values $A(t)$ and $A(t+TD)$ at the instant t and $t+TD$ accordingly exceed the attenuation threshold a . The time diversity statistics presented are obtained after harmonizing all the data to 1 sec time resolution for the time delay and TD values: 1s, 5s, 10s, 1min, 3 min, 5min, 10min, 30min, 1h, 3h, 6h, 12h and 18 h.

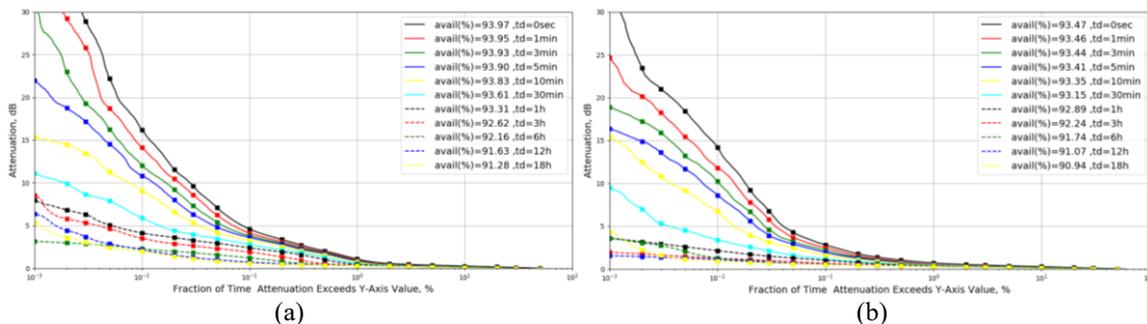


Figure 1. Annual Time Diversity Statistics at 19.701 GHz measured in (a) Athens and (b) Lavrion for different time delay values in comparison with the statistics with time delay 0 sec. Observation period: 1st of July 2016 to 30th of June 2017.

References

- [1] A. D. Panagopoulos, P.-D. M. Arapoglou and P. G. Cottis, "Satellite Communications at Ku, Ka and V Bands: Propagation Impairments and Mitigation Techniques." *IEEE Communication Surveys and Tutorials*, 2004.
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