

Brief information about the project

Name of the project	Study of LoRaWAN Base Station Application Capabilities on a Nanosatellite
Relevance	In the past decade, nanosatellites have become an essential element of modern space technologies. They offer a wide range of applications in various fields such as environmental monitoring, telecommunications, navigation, and scientific research. One of the promising technologies for ensuring communication in space is LoRaWAN, which is characterized by low power consumption and the ability to maintain communication over long distances. This project is aimed at studying the technical and operational capabilities of a LoRaWAN base station installed on a nanosatellite. Special attention is given to the system's performance in space conditions, including the impact of radiation, temperature, microgravity, and other factors that may affect the equipment's functionality. The project also explores methods for optimizing energy efficiency in communication systems, which is especially important for low-power nanosatellites, where energy resources are limited.
Purpose	Study of technical and operational capabilities of LoRaWAN base station on board nanosatellite, as well as development of recommendations for creation of energy-efficient communication system using nanosatellites.
Objectives	1. Study the applicability of LoRaWAN technology in low earth orbit (LEO). 2. Develop a concept for an on-board communication system based on LoRaWAN technology. 3. Development and assembly of a pilot model of the on-board base station 4. Conducting laboratory tests of the communication system model.
Expected and achieved results	The expected results of the project include confirmation of the applicability of LoRaWAN technology in low-Earth orbit (LEO) for energy-efficient data transmission, development of the concept and creation of an experimental model of an on-board base station, as well as obtaining practical data on its characteristics and behavior in conditions simulating the space environment. The study will make it possible to formulate recommendations for the design and operation of LoRaWAN base stations in space conditions, which will create the basis for integrating this technology into IoT systems using nanosatellites.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	1. A.A. Temirbayev – Project Leader (WOS Researcher ID: HZJ-7882-2023, ORCID: 0000-0001-6759-2774, Scopus Author ID: 54956606000) 2. N. Meirambekuly (WOS Researcher ID: FLK-8611-2022, ORCID: 0000-0003-2250-4763, Scopus Author

	ID: 57237479500) 3. N.Sh. Uzbekov (ORCID: 0009-0007-9956-0102) 4. B.A. Khaniyev (ResearcherID: JRX-4395-2023, ORCID: 0000-0002-0103-9201, Scopus Author ID: 57218681308) 5. S.O. Orynassar (Scopus ID: 59498844800) 6. B.A. Karibayev (WOS Researcher ID: FYZ-7255-2022, ORCID: 0000-0003-1057-0296, Scopus Author ID: 57199864901) 7. A.N. Beisen 8. L.B. Abdizhalilova (WOS Researcher ID: LQK-6642-2024, ORCID: 0009-0000-5965-7195) 9. D.O. Tokmyrzayev (Scopus ID: 59412363600, ORCID: 0009-0007-6935-2230) 10. G. Kudaibergenova (ORCID: 0009-0003-4880-3734, Scopus ID: 59730661100) 11. A.I. Samsonenko
Usage	The project results can be applied in satellite communication and Internet of Things (IoT) systems to ensure reliable and energy-efficient data transmission in remote and hard-to-reach areas. The developed technology enables the use of nanosatellites for agricultural monitoring, environmental control, infrastructure management, logistics, and communication in regions with limited or отсутствующей terrestrial infrastructure.
Priority compared to real-world alternatives	The proposed project has a priority over existing analogues due to the use of the open LoRaWAN standard instead of proprietary solutions, ensuring easy integration with existing IoT infrastructure and reducing implementation costs. Unlike many international developments limited to theoretical studies, this project includes the development and experimental validation of an onboard base station prototype, increasing the technology readiness level. Additionally, the project offers advantages in energy efficiency, scalability, and practical applicability under the resource constraints of nanosatellites.
List of publications with links to them	1. Abdizhalilova L., Temirbayev A.A., Peng L., Uzbekov N., Orynassar S., Beisen A., Geroyeva Z., Tokmyrzayev D., Meirambekuly N. The Evaluation of Nanosatellite Missions: Statistical Analysis of Missions for Payloads // IEEE Access, 2025, 13, 160536 – 160548. https://doi.org/10.1109/ACCESS.2025.3607970 2. Temirbayev A.A., Meirambekuly N., Karibayev B. A COMPARATIVE STUDY OF APRS AND LORAWAN FOR LOW-EARTHORBIT AND IOT TELEMETRY APPLICATIONS // Bulletin of the Almaty University of Power Engineering and Telecommunications, 2025, 3, 70, 191. https://doi.org/10.51775/2790-0886_2025_70_3_191 3. Temirbayev A. Phase-based interferometric method for precise displacement estimation: theory and computational potential // Journal of Problems in Computer Science and Information Technologies, 2025, 3, 3, 37-43. https://doi.org/10.26577/jpcsit2025334

	4. Temirbayev A., Meirambekuly N., Uzbekov N., Beisen A., Abdizhalilova L. Cubesat-based APRS digipeater: design, feasibility and mission concept // Academic Scientific Journal of Computer Science, 2025, 3, 355, 243-257. https://doi.org/10.32014/2025.2518-1726.375
Patents	-