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Conceptualization and Specification of the Machine-to-Machine Payload System on NIMPH Satellite for IoT-Based Medical Monitoring Applications

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Keywords: Satellite-based Internet of Things (IoT), Machine-to-Machine (M2M), Lightweight Machine-to-Machine (LwM2M) protocol, remote medical monitoring, Nanosatellite, Intermittent satellite system

This paper explores a novel concept that has the potential to revolutionize medical monitoring through the integration of a satellite-based Internet of Things (IoT) system. The rapid progress of IoT applications in the medical field paves the way for unprecedented developments in remote patient monitoring. [1] This revolutionary approach proposes the continuous collection and transmission of individual health data, particularly in regions without network coverage, thereby empowering healthcare professionals to provide personalized and timely care remotely.

The integration of satellite technology with IoT-based remote medical monitoring is an innovative endeavor that necessitates overcoming inherent challenges. The primary challenge lies in ensuring the operability of an IoT system, characterized by instantaneous communication, within an intermittent satellite system. [2] At the conceptualization stage, the Nanosatellite to Investigate Microwave Photonic Hardware (NIMPH) project aims to significantly expand the reach of remote medical monitoring. This project envisions the incorporation of several payloads, each contributing unique functionality to the holistic system. Specially, the Machine-to-Machine (M2M) payload serves as a conceptual proof, demonstrating the potential for a transport medium that bridges two ground-based IoT systems within a medical monitoring context. One notable attribute of the NIMPH project is its global coverage potential, which significantly broadens the scope of IoT applications.

This study examines the conceptualization, specification, and theoretical feasibility of the M2M payload system on the NIMPH satellite, envisaged to be underpinned by Lightweight Machine-to-Machine (LwM2M) technology. The proposed LwM2M technology, characterized by its lightweight nature, appears to be ideally suited for this purpose. The investigation aims to establish the theoretical viability of the system to create a dependable communication link between two ground-based IoT systems for medical monitoring.

The proposed LwM2M-based NIMPH M2M payload system theoretically holds the potential to enable bidirectional transmission of medical data packets between two ground-based IoT systems. It is expected to respond to data acquisition requests and to relay specific commands from a centralized healthcare center to remote patient monitoring devices. Additionally, it's hypothesized that the system will show robustness in managing fluctuating data traffic while preserving high data integrity.

These theoretical insights highlight the potential of satellite technology in IoT-based remote medical monitoring applications. The conceptual success of the LwM2M-based M2M payload system on the NIMPH satellite would validate the capacity to expand healthcare services to remote and underserved regions globally, thereby fostering the evolution of space-based IoT applications. As the project progresses from conceptualization to realization, future research will focus on actual implementation, performance optimization.

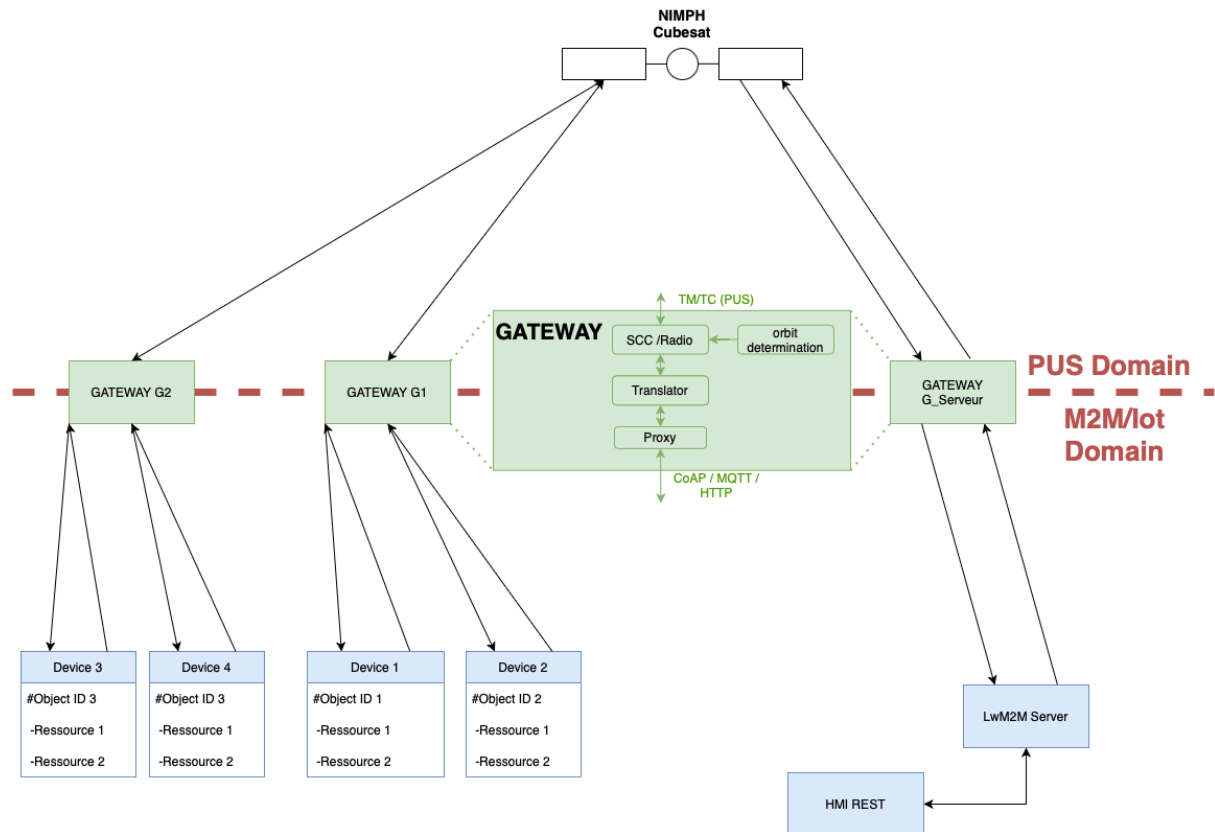


Figure 1 : Configuration of the NIMPH System for Medical Monitoring

References

- [1] Usak, M.; Kubiato, M.; Shabbir, M.S.; Dudnik, O.V.; Jermsittiparsert, K.; Rajabion, L. Health care service delivery based on the Internet of things: A systematic and comprehensive study. *Int. J. Commun. Syst.* 2020
- [2] M. Centenaro, C. E. Costa, F. Granelli, C. Sacchi and L. Vangelista, "A Survey on Technologies, Standards and Open Challenges in Satellite IoT," in *IEEE Communications Surveys & Tutorials*, vol. 23, no. 3, pp. 1693-1720, thirdquarter 2021, doi: 10.1109/COMST.2021.3078433.