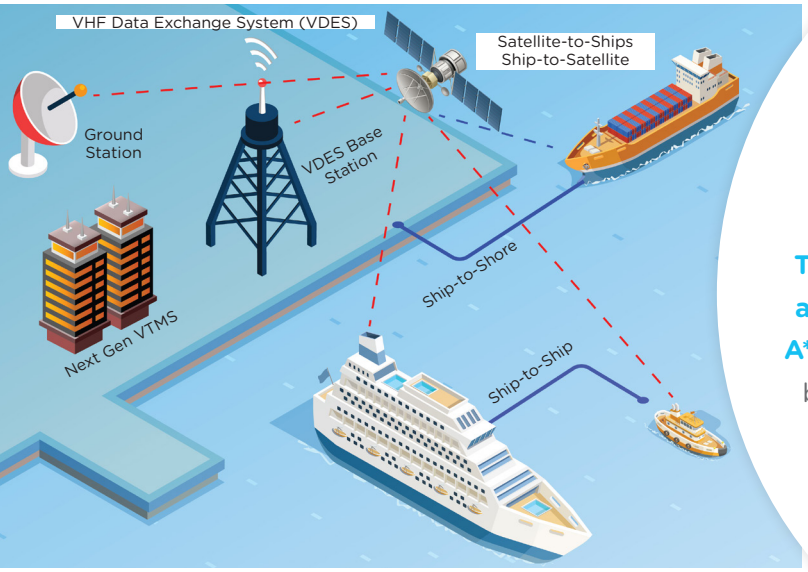
Advanced Remanufacturing and Technology Centre
ARTC

In partnership with

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

INSPIRING TRANSFORMATION IN THE REALM OF SPACE ENGINEERING THROUGH DESIGN-TO-MANUFACTURE SOLUTIONS

The successful collaboration between NUS and A*STAR's I2R and ARTC to launch the Lumelite-4 Satellite



On 22nd April 2023 at 16:50(GMT+8), the Lumelite-4 satellite was successfully launched on the PSLV-C55 launch vehicle from the Satish Dhawan Space Centre in Sriharikotta, India operated by the Indian Space Research Organisation (ISRO).

The Lumelite-4 satellite represents a groundbreaking achievement by Singapore researchers from NUS and A*STAR. The development of Lumelite-4 with a satellite-based high-performance VHF Data Exchange System (VDES), will revolutionise maritime communications, traffic management and analytics. **This technology will allow Singapore to take the lead in providing cutting edge VDES solutions to support e-Navigation for the global market**

BENEFITS OF VDES

- Extending VDES to the Automated Identification System (AIS) used by ships and Vessel Traffic Services (VTS), significantly enhances maritime communication between ships, shores, and satellites.
- Provides a 2-way higher data transfer rate of up to 32 times.
- Enables real-time extended area maritime traffic and asset tracking, leading to better predictive analysis for enhanced navigational safety and port efficiencies.
- Forms a core element of future maritime safety communications to meet the growing demands of data exchange and new applications.

This satellite marks the first demonstration of satellite VDES for maritime applications in Southeast Asia. It was designed and constructed by NUS' STAR, utilizing the university's patented modular and scalable satellite bus system with fault-tolerant features while A*STAR's I2R and ARTC developed the experimental satellite-based communication hardware and deployable antenna, respectively.

The I2R team focused on designing and developing the satellite-based communication hardware, while the Additive Manufacturing Industrialisation (AMI) Team from ARTC handled the design of the deployable antenna and its mechanism—from ideation, prototyping, proof of concept, testing, qualification, to final delivery and integration to the satellite bus. Additionally, the ARTC team performed modal analysis on the antenna to ensure there would be no interference with the satellite's altitude control system.

The integration of the various hardware components and mechanisms was a collaborative effort between the two research institutes of A*STAR before the final delivery to NUS for system-level assembly.

To meet the stringent weight and size requirements while ensuring optimal antenna radiation performance, the team designed an antenna with the following features:

- **Four turnstile arms divided into two pairs, excited with the same amplitude but a 90-degree phase difference producing a circularly polarised radiation, which enhance the signal reception and transmission.**
- **The turnstile antenna design is foldable and can be arranged in a parallel configuration for stowing, this results in a system which is compact and able to fit in a small envelope within the satellite bus.**

FUTURE OUTLOOK

Building upon the success, the AMI team remains committed to pushing the boundaries of innovation. A pivotal aspect of their endeavor involves the integration of additive manufacturing into their design process, allowing for a remarkable reduction in structure weight. This approach transcends conventional methods, empowering the team to conquer design obstacles that were once deemed insurmountable.

By harnessing the power of additive manufactured parts, the team unlocks unparalleled design flexibility, paves the way for the optimal utilisation of space within the satellite launcher for the integration of additional vital components.

These new efforts will soon take centre stage in the upcoming space project the team participated in, scheduled for launch in July 2023. With their expertise and cutting-edge technologies, the AMI team is poised to redefine the boundaries of possibility in the realm of space exploration and engineering.