

Blue Sky Thinking on Computer Networks in Space 12-13 July 2022 Workshop Report



Event themes

A synthesis of the main themes and issues discussed that emerged from discussions. We'll include a link to your programme brochure.

From a high-level view, the workshop had two themes. Within each theme, the speakers covered various interesting topics:

Theme 1: Low Earth Orbit (LEO) satellites applications and challenges.

This was the main theme of day one. On the first day of the workshop, we had several talks covering this theme started with a talk on the internet standards for the next generation of satellite systems (i.e. LEO) discussing IETF standardization efforts to enhance transport layer (e.g. TCP and QUIC) performance over satellite networks. The second talk of Day 1 was on LEO network topology design challenges and trade-offs discussing various design decisions and constraints that can influence LEO topology design and simulating the LEO network performance while tweaking each of these design decisions. The third and fourth talks on Day 1 focused on LEO satellites in mobile networks including challenges such as global resource management, orchestration, routing, 5G and LEO integration and trials, global mobile coverage, and challenges with mobile connectivity from space. The last talk of Day 1 discussed challenges and possible directions to achieve real-time multipath fast-converging routing and resource control in networks of fast-moving LEO satellites, to efficiently run such networks with high utilization.

Theme 2: The future space networking to be developed.

This was the main theme of day two. On the second day of the workshop, we had several talks covering this theme including a talk on the NASA LunaNet project and its architecture to provide users with three services: networking services; positioning, navigation and timing services; and science utilization services. We also had a talk on the need to rethink the spacecraft as networked systems and new methods required to enable large-scale cooperative and self-organizing satellites. The last talk of Day 2 discussed the essential need for space assets to cooperate with aerial and ground assets to optimize and coordinate the data collection. This talk also shed light on In-Space Servicing, Assembly, and Manufacturing (ISAM).

Demo. Alongside these two main themes, the University of Surrey and Virginia Tech ran a session to demonstrate their scalable and highly-realistic LEO network emulator that is built to enable both research and industry communities to design, develop and evaluate new network protocols for LEO networks before the real-world deployment.



Next steps - Outcomes

A number of teams emerged as a result of the workshop.

From the UK side, from the preparatory works for this workshop, the discussions between Virginia Tech and the University of Surrey led to the submission of a project to Next Generation Internet Atlantic scheme and the project proposal we submitted has been funded for feasibility studies for the next 5 months from July - December. We are also preparing a larger proposal to the European Space Agency, a result of interactions with ESA, one of the funding agencies we invited to the workshop.

From the US side of the workshop, two partnerships were able to form during the event. One includes students from Virginia Tech in the Wireless@VT research group learning more about the project and connecting with Space@VT and VT-NSI students and faculty. The Wireless@VT group has expertise on communication protocols and have implemented a 5G testbed using very similar hardware to this program. The workshop gave an opportunity to discuss plans to integrate 5G communications with our current internet constellation simulator and emulator.

Additionally, Virginia Tech was able to meet with and discuss a partnership with the Virginia Military Institute (VMI), a university looking to partner with us in research projects, specifically with either using the testbed in their research groups, or building up their own testbed to be interconnected with the VT and UoS testbeds. Meetings with VMI will continue into the fall semester.

Following the completion of the workshop, the Virginia Tech team submitted a NSF proposal for support to build the testbed's capabilities to enable it to be open sourced and shareable. This funding would enable the future plans of scalability and collaboration between interested partners.

Here you can view the [VT News article](#) and [Livestream recording link](#)

Acknowledgements

Sponsors, helpers, and anyone deserving particular praise.

From University of Surrey, we would like to acknowledge the support of the Department of Computer Science for the use of the department seminar room and the administrative staff for their assistance in hosting the workshop. We would also like to acknowledge the support from the Institute of Advanced Studies (IAS) and IAS administrative staff for their invaluable support in different stages before, during and post the workshop.

From Virginia Tech, thank you to the Aerospace and Ocean Engineering department for use of their facilities for the in-person US meeting. Also thank you to VT-NSI for providing morning refreshments.