

## **TGCCS: what does it mean and what does it do?**

[Ji Wu (NSSC, China), Dan Baker (University of Colorado, USA), Jean-Claude Worms (COSPAR Executive Director), and the TGCCS Members]

After its establishment, the Task Group on establishing a Constellation of Small Satellites (TGCCS), undertook a series of actions to fulfil its mandate, including starting an assessment of the scientific areas that could be best served by a constellation of small satellites. The COSPAR Secretariat wrote to all its national representatives to inquire about potential interest to participate in, and contribute to, such a constellation, gathering many expressions of interest world-wide.

To better gauge the interest in various parts of the world, and also taking stock of multiple time zones as well as today's constraints in terms of travel, TGCCS has organized two virtual town hall meetings so far, one for the American region on 2 September and one for the Asia-Oceania region on 29 September, attracting over 120 participants.

A compendium of the questions asked by the audience on these two occasions is posted below, as well as the replies prepared by the Task Group and by COSPAR, organized by broad topic.

- Q1. Is the constellation supposed to be built by combining satellites from different countries or is it supposed to originate from a single country?
- Q2. How many agencies or research organizations have expressed a genuine interest in contributing resources?
- Q3. How do you propose that industry should participate and what is the funding mechanism to support both academia and industry?

Answer: The COSPAR Constellation for Small Satellites will be an international program. The satellites will be provided by interested institutions, universities and industries from different countries and regions, and not from a single country. Currently, there are more than 50 such entities that have shown an interest in participating. COSPAR will not fund any of these satellites' development. However, it will coordinate the launch, operation and data distribution aspects. Satellite providers (institutions, universities or industries) will then look for their own funding sources in their own country.

- Q4. How do you foresee industry, especially the large nano-satellite constellation operators, possibly participating in this initiative?

Answer: One could imagine that some constellation operators might have some excess capacity where a small instrument might be able to fly, so there could be cooperation in that sense. New kinds of measurements could prove to be so valuable that a new constellation could be put together to generate a new set of measurements that would be advantageous,

whether it's for space weather or other Earth observations. The task group would really be interested in talking to the constellation operators and to others in industry to see how this science work may eventually be applied for business or operational needs. In addition, partnering with industry can teach us how to build things more cheaply, as we are doing with CubeSats, and also about the manufacturing process. There is hopefully a benefit for industry as well, as their workforce presumably comes from universities and research laboratories, where we are training the next generation of engineers who will work in industry. And so one hopes that industry would be amenable to working with us, e.g. through internships.

Q5. What is or might be the connection between this COSPAR initiative and other similar initiatives such as UN OOSA Space Access for All?

Answer: This is a new activity for COSPAR and we have not yet engaged in anything other than probing the interest of a number of countries and entities, discussing the science that could be done, and the possible modalities of implementation. COSPAR does have a memorandum of understanding with COPUOS, especially on the issue of planetary protection. This constellation will be one of the topics that we will continue discussing and coordinating with COPUOS, another one being the related space debris aspects (cf. Q18). Overall, COSPAR will use its institutional and private sector network to work with all interested entities and partners and organizations, seeking to fill the niches and gaps there might be in order to make it more possible for the world to have a more effective small satellite effort.

Q6. How can institutions participate in mission design?

Q7. What is the forum for mission-design related discussions?

Q8. Should there be a TGCSS subgroup to look at the subject of small satellite missions and constellations in deep space?

Q9. Any comments on the possibility of having an ionospheric and a magnetospheric constellation simultaneously? Will it be scientifically more rewarding?

Q10. Are there possibilities of nanosat-based ionospheric tomography and topside sounding?

Q11. How many small satellites does TGCSS estimate will be sent into space, starting from 2021 and then yearly after that?

Answer: The next step of the TGCSS is to establish a subgroup to discuss the scientific objectives of a small satellite constellation. The main theme of this first phase will be space weather. Therefore, any ideas on the measurement, monitoring and understanding of the ionosphere, magnetosphere and their responses to the solar storms will be welcome.

We will make our best effort to include interested scientists into this subgroup, although the number of members of this subgroup should naturally be limited in order to conduct fruitful discussions. So please recommend your representative scientist through your COSPAR National Committee, and inform the COSPAR Secretariat accordingly. The output of the subgroup will be general requirements for this mission, for example, the number of small satellites required, the type of constellation, its orbit and, most importantly, the key science payloads required. Defining the complete development plan will only be possible once a second subgroup dealing with engineering aspects is established and provides clear conclusions, to be further discussed and agreed by the Task Group and by COSPAR governance.

Q12. How do you plan on involving countries that are interested in space weather science but do not have the required capacity or experience?

Answer: COSPAR has always been very keen to actively support capacity building in developing countries and space educational programs. The COSPAR Panel on Capacity Building (PCB), which organizes several capacity building workshops each year, is already aware of the TGCSS activity. This is coordinated internally so as to make it possible to benefit from the possibility offered by the CB workshops to further develop the small satellite constellation concept with countries that wish to develop their competencies in space. Please watch our website and follow corresponding announcements for TGCSS and PCB.

Q13. Will this task group coordinate the development of a common instrument suite or package that would be deployed to make multi-vantage measurements of space weather, or is the goal to only encourage individual space agencies to develop independent instruments around the common theme of space weather? Or are both possibilities under consideration?

Q14. All space agencies or groups are likely to have different objectives and thus different payloads. Are there any plans by TGCSS to have a common payload for a particular scientific objective, which can work with different types of small satellite buses? Or is there any thinking of prescribing common small satellite bus architecture for such science activities?

Q15. What is the role of academics? Private industries would like to have monopolies, and sharing of resources would be difficult with them. However, we need space capacity to be built through academic sharing of resources.

Answer: Once the first subgroup finishes its job, i.e. defining the scientific objectives and general requirements of the constellation, as well as key payloads and instruments, TGCSS will ask all contributing institutes, universities and industries to follow the same instrument specifications to design and manufacture them. TGCSS may also organize cross calibrations of those instruments and define standard data format in

order to get maximum science from them. However, the payload and instrument developers will need to find their own satellite platform partners to get on board. In order to encourage different participants (including industries) to join this constellation, it is better to not require a uniform satellite platform to carry those defined key science payloads and instruments. It is also cost-free for any of the satellite providers to get their own secondary small payloads on board, as long as they ensure the required science payloads and instruments have priority.

Q16. It would be interesting to have more discussions of a QB50-like approach to organizing a joint constellation, in which (a) a group develops with shared goals, (b) nations and/or institutions offer payloads (or testing or launch or other capabilities) to others and (c) individual nations and/or institutions develop their own small satellites for the group and use a mix of their own payload hardware and payload hardware provided by others. What effort is TGCSS making along these lines?

Q17. SNIPE is an existing mission. How does this advance the objectives of the Task Group?

Answer: TGCSS will work along a similar approach to QB50 and also learn from the educational program developed by INSPIRE. It is to be noted that there is already an ongoing action between the COSPAR capacity building program and INSPIRE, to build international cooperation for addressing targeted science goals to deal with existing gaps in space weather monitoring or climate change studies. This collaborative PCB-INSPIRE program will provide funding and enable COSPAR-selected students to take part in an annual summer program in LASP, Colorado.

Q18. Are there any active space debris removal initiatives underway from the small satellite constellations (CSS) allies working alongside the industry partners?

Answer: Yes. COSPAR is a strong supporter of keeping our space continuously accessible. Therefore, the constellation will follow the rules on space debris mitigation and ask all the small satellite manufacturers to comply as well with those rules.

Q19. For Space Weather application in reality, coordinating ground network for earliest data reception might be included in the Task Group's future work.

Q20. Is it right to suppose that there will be a free and open data policy for the community?

Answer: COSPAR will coordinate the ground data network to join this measurement campaign for space weather. COSPAR will also coordinate globalized ground stations for data acquisition, also on a No Exchange of Funds basis. On data access, the baseline is to have free and open access to data, but recognizing that many of the small satellite programs are done on a shoestring budget. COSPAR can help with the

sharing and the aggregation of data from different spacecraft. COSPAR also could coordinate some of the infrastructure development in order to centralize the data.

Q21. What could be the timeline of any satellite constellation stemming from the work of this task group (how many years)? Because science objectives keep improving dynamically.

Answer: There is no definite timeline yet. This is work in progress, with a Task Group that was established in March 2020. The timeline will be defined progressively, as we continue receiving expressions of interest from stakeholders world-wide, and also when the second sub-group is established and comes up with a clear definition of the engineering constraints linked to the science objectives.

---

You may have other questions that have not yet been addressed. If this is the case, and if you are interested in joining the activity and the group, or if you would like to suggest an entity that could contribute to this effort, please contact us at [cospar@cosparhq.cnes.fr](mailto:cospar@cosparhq.cnes.fr)