# Application for Thesis Contract – Department of Electronic Systems

Type of thesis: Master’s Thesis

## Student

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Programme: Electronic Systems

## Project Supervisor(s)

Name: Petar Popovski Signature:  
  
Name: Jens Dalsgaard Nielsen Signature:  
  
Name: Israel Leyva-Mayorga Signature:

Collaboration with a Company (YES or NO):NO

## Thesis

Project Title: Designing an Efficient Downlink through Mega Constellations  
Starting: 1/9 - 2024  
Deadline:30/5-2025  
ECTS: 50  
If long master’s thesis please indicate courses:

Quantum Information and Computing 5 ECTS

Advances in Electronic Systems 5 ECTS

## Project Description**:**

The recent swift developments in satellite technologies, in particular satellite and component miniaturization and reusable rocket carrying multiple small satellites in one launch, have facilitated space accessibility through relatively inexpensive means. As space technologies are becoming cheaper, closer, and smaller, space industry is reviving and offering various applications spanning a wide range of services, e.g. earth and space observations, spectrum monitoring, asset tracking, remote sensing, space-based cloud computing, and Internet of Things (IoT) data collection. Along with the opportunities that are foreseen in this transformation, several important communication challenges require research and innovation to bring the collected data back to Earth over a downlink with high throughput and flexibility.

Currently, space mission operators heavily depend on a network of ground stations distributed across the globe for downlinking the small satellites or for controlling them through telemetry and tele-command, which will soon require a massive network of ground stations to connect the growing number of satellites. But the number and duration of ground access sessions are, most of the times, limited, and thus, preventing real-time mission operation and continuous high-throughput downstreaming of data. Therefore, novel downstreaming techniques are required to respond to the complexity of application requirements and the dynamism of the communication environment.

The objective of this project is to devise a solution that utilizes the existing mega constellations to send data from separate missions in the downlink to the Earth. This should enable:

* enable shorter response time in peer to peer
* enable efficient multicast
* provide a framework for virtual constellations
* less resources spent on building ground stations

The last point enables a lower barrier of entry for new satellite businesses. Some of the problems to tackle could include connection establishment, beamforming, data aggregation and packet scheduling policy.

## Plan for Thesis Supervision and Lab Work:

We plan to meet roughly every two weeks, where the students will present the work done during that time.

For lab work the plan is to do an extensive simulation environment, where the findings of the project can be tested in real time.

The real time simulation enables evaluation of pure implementation but could also include hardware in the loop evaluations.

Approved by Head of Studies:

Date: Signature:

Please return the signed contract to the study board for approval by e-mail: [inst.es.sdnvn.eit@es.aau.dk](mailto:inst.es.sdnvn.eit@es.aau.dk)