PROJECT REPORT

CROSS-BORDER FLIGHT BETWEEN NORWAY AND SWEDEN

GREEN FLYWAY
INTERNATIONAL TEST ARENA

Interreg
Sverige-Norge
Europeiska regionala utvecklingsfonden

EUROPEISKA UNIONEN

Trøndelag fylkeskommune
Tröndelagen fylkentjielte

Rørosregionen
NÆRINGSHAGE®

REGION
JÄMTLAND
HÄRJEDALEN

Introduction

Cross-border operations with drones have, to our knowledge, never been made between a non-EU state and an EU-state, hence the flight was the first of its kind in Scandinavia. Loss of communication caused by the “switchover” from Swedish to Norwegian network providers is one of the major factors that is investigated in this project. Likewise, customs regulations are not established for drones, as we do not operate under IFR or VFR regulations. Drone operations fall into a “gray zone” in Norwegian and Swedish custom laws, which generates a lot of questions to be answered in this project between Aviant and Green Flyway.

EASA has established drone laws in *Rules for Unmanned Aircraft Systems (Regulation (EU) 2019/947 and Regulation (EU) 2019/945).* Each EASA member state has room for national interpretations and variations, which causes regulation differences between the two states. In Norway, BVLOS can be operated in uncontrolled airspace when a NOTAM has been issued. However, Sweden requires BVLOS operations to be operated in segregated airspaces. This means that BVLOS operations in Norway can be operated more freely in uncontrolled airspace compared to Sweden where this kind of operation needs to be performed in a segregated airspace or controlled airspace to obtain separation from other airborne traffic.

As the regulations are different, communication with e.g.air ambulances is different in each state, so routines change when crossing the border. This project report will cover solutions and different routines adapted to both Norway and Sweden.

Swedish restriction area

The Swedish Transportation Agency “Transportstyrelsen", as compared to the Norwegian CAA “Luftfartstilsynet”, requires a segregated airspace for drone operations within Swedish airspace. Aviant has earlier flown in restricted airspace in Sweden. To not risk any delay in the application time of an airspace with lower restrictions, called a danger area, a restriction area was applied for. The restriction area was designed to not include the area of normal operations for the ambulance helicopters, called Ljusnedal, as shown in image 1. This was to enable simultaneous operations when the restriction area is active and the ambulance does not need to enter the restriction zone. However, if they do have to enter, then simultaneous operations are not possible within the restriction area. In such cases, the ambulance, police and military would have first priority to utilize the area.

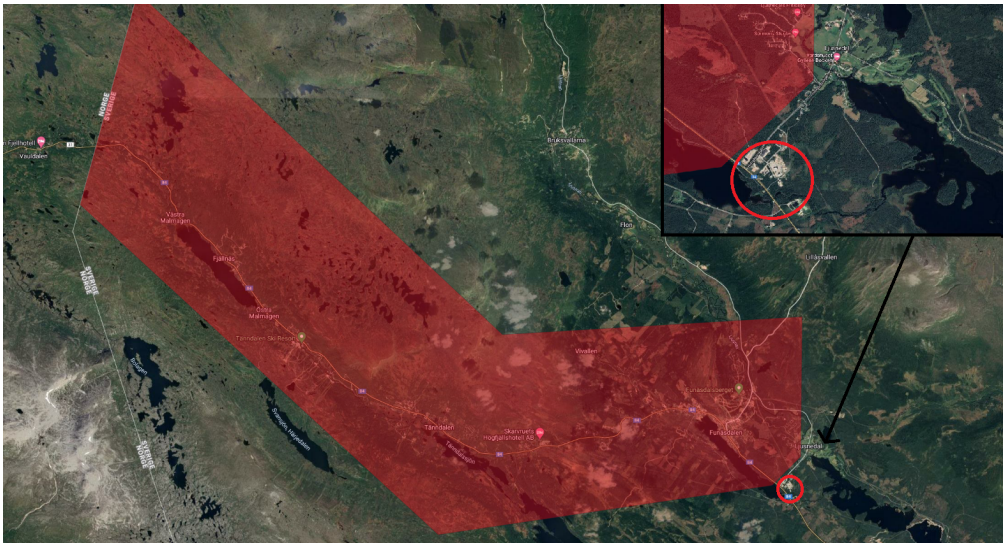


Image 1

Image 1 shows the boundaries of the restriction area (RA) applied for. The westerly end of the RA is joined with the Norwegian border and this is where the drone leaves/enters the RA from Norwegian airspace.

The lateral restriction area buffer zone used is 1 nautical mile, as seen in image 2. Within the yellow area we are able to utilize as Flight Geography (FG, i.e. the area of normal operations) after deducting the 1 nautical mile buffer zone. However, risks within the FG are to be analyzed and avoided if needed.

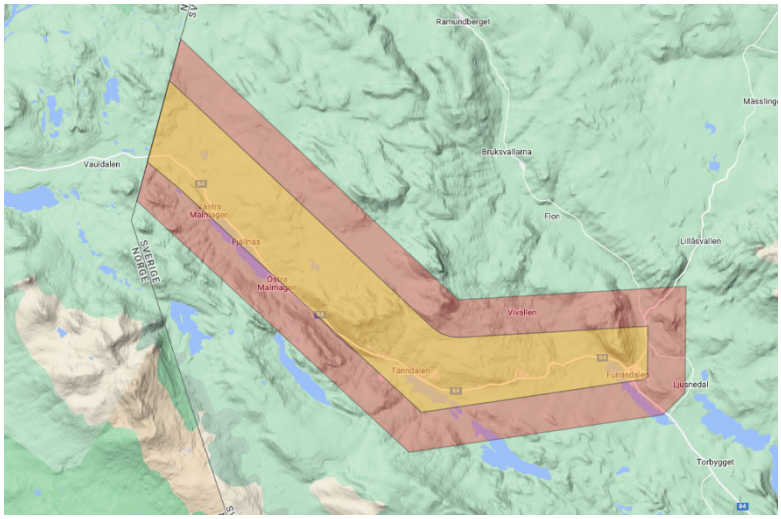


Image 2

The vertical boundary of the restriction area is 4 500ft (= 1 371m) AMSL. A buffer zone of 500ft (= 152m) also applies to the vertical perspective. Therefore, the ceiling of the flight geography equals 4 000ft (= 1 219 m) AMSL.

Looking at image 3 we can see the planned vertical profile inside the RA. Taking into account the terrain where the peak flight altitude is 1 150m AMSL, we see that we will stay within the vertical flight geography.

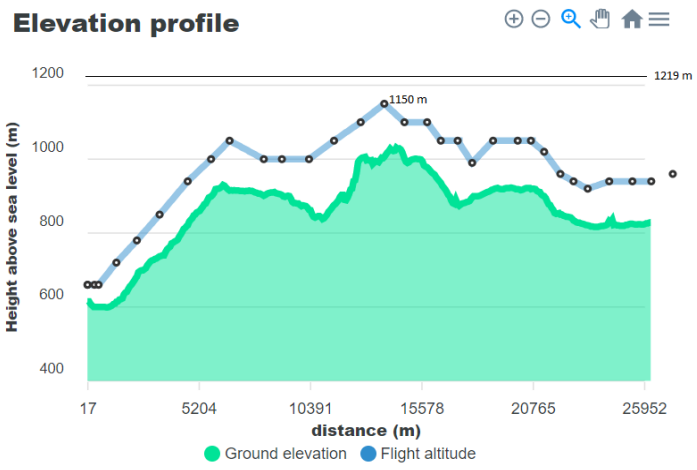


Image 3

To determine the flight path “hard ground risks”, i.e. areas to avoid, they have to be plotted and buffer zones added to avoid these areas. Image 4 shows hard risks with the corresponding lateral buffer zones. Both nature conservancies and prohibitions have been accounted for. Added in green is the geographical fence programmed in the drone.

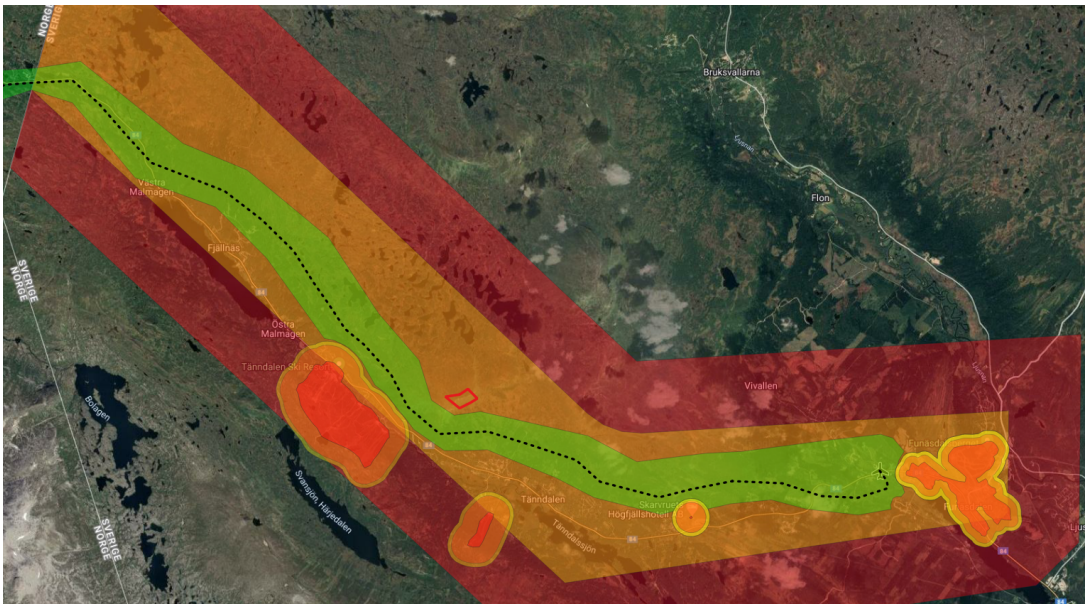


Image 4

In Norway, segregated airspace is not required. Image 5 shows the geographical fence and the hard risks accounted for, to determine the safe path of the routing towards Røros.

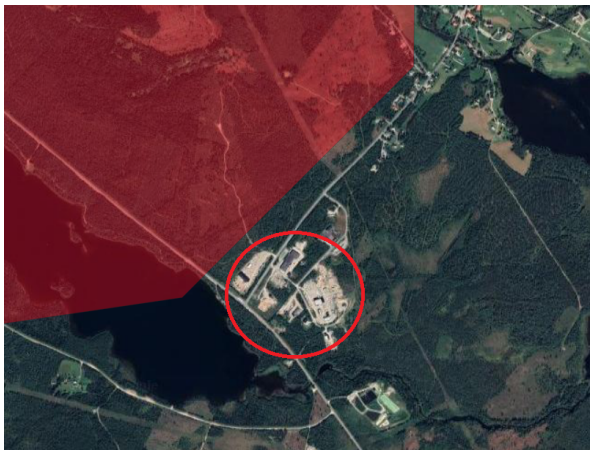
Image 5

Routines of flight

Customs authorities were initially the most problematic issues to handle. Mostly, Swedish laws related to drones involve taxation of the actual drone and the Swedish authorities claimed that the drone needed to be taxed in Sweden. However, as the drones are CAA registered in Norway this could not be the case. The final procedure was that the custom station was sent the flight plan for awareness of the operations between the two states.

Both Swedish and Norwegian reindeer husbandry were fine with Aviant's flights crossing over their pasture. They all raised concern about their need for helicopters as a tool for moving the reindeers, but in May, none of them had any need to do so.

As described in earlier, we made a RA boundary cut to allow for the ambulance helicopter to have simultaneous operation when the RA was active. Note that it did not allow for simultaneous operation *within* the RA and the ambulance had priority to utilize the area.



Both Aviant and Babcock International claim that routines from the last project were satisfactory, hence communications were unchanged for this project. These communications are to send an SMS to the helicopter pilot phone and ATCC Stockholm has the communication responsibility when the RA is active.

The same applies to Storm Heliworks as the air ambulance. The air ambulance utilizes their hangar to load patients. We have had communications with them to inform them about Aviant's operations in the area a few days before flight. The helicopter companies in Norway are informed through phone communications, at the day of flight.

Air ambulance routines in Norway are already established due to Aviants present operations in Norway. All communications here are held through phone between Aviant and AMK in Norway.

General aviation is restricted from flying in the Swedish RA. In Norwegian airspace, GA will be informed by NOTAM. Aviant already operates around Røros and so the GA was aware of drone operations.

Commercial aviation is present close to Røros airport. This routine was already established as Aviant operates to Røros from Trondheim since last year. ENRO TIZ is informed of the operations to inform any proximities. In addition, NOTAM will notify commercial aviation.

Network test data

We performed tests in order to determine our cellular network connection during a border crossing. The tests were performed by querying the cellular modem every second for which network and band it is connected to.

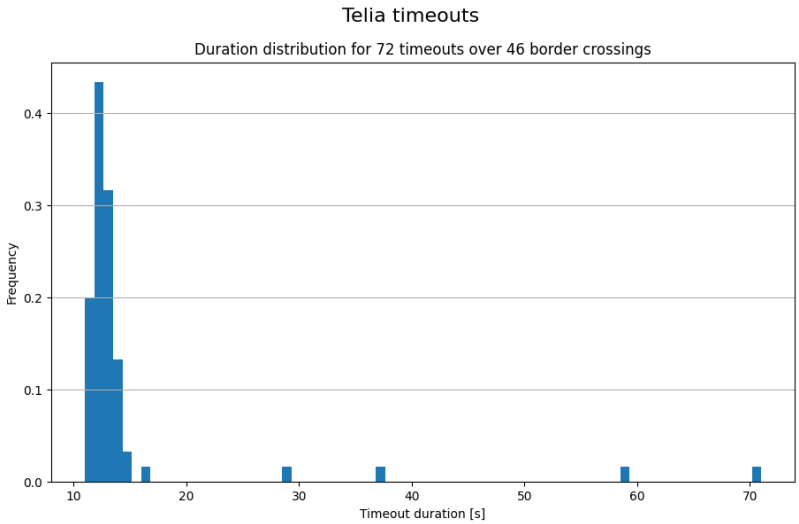


Image 6

Timeout durations for border crossings were tested with SIM cards from both Telenor and Telia. Because of equipment availability, more tests were performed using a Telia SIM. We count a dropout every time the drone is not connected to a network band for more than 5 seconds. The resulting graph can be seen in image 6, which represents combined data from car testing and actual border crossing flights.

With both network providers, we can see that there are more dropouts than border crossings. Since we do not usually see dropouts like these, we believe the dropouts to be a result of operating close to the border. The mean timeout duration of all our tests was 14.5 seconds, with a standard deviation of 8.8 seconds.

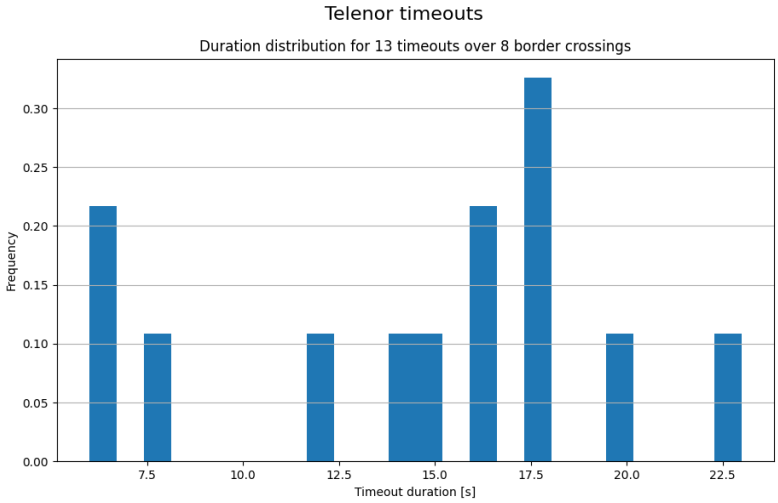


Image 7

Image 8 and 9 shows actual timeouts experienced when flying into Norway from Sweden. Timeouts are recognized as the time period where our modem is not connected to a band, which are shown as red bands labeled “N/A”.

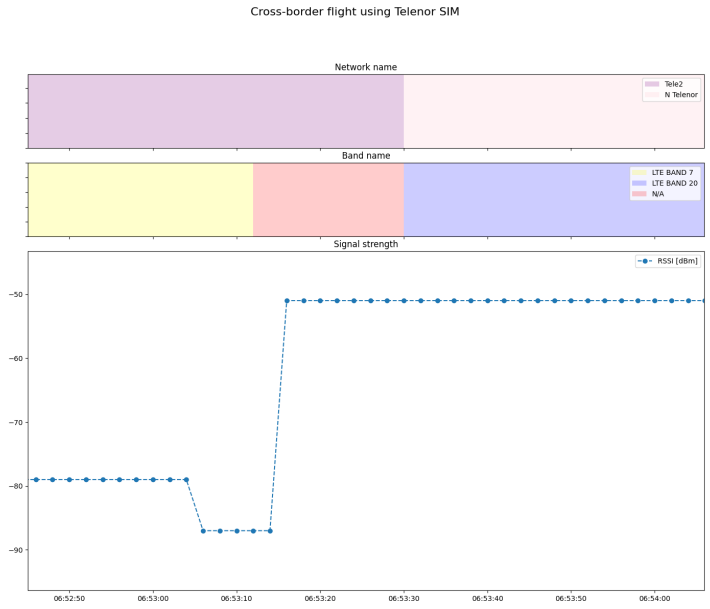


Image 8

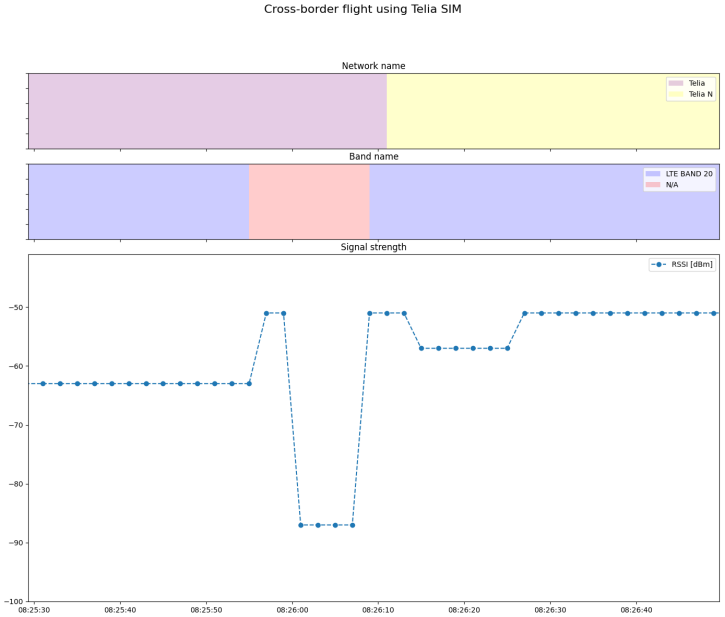


Image 9

Flight data 13.05.2022

Flight	Røros to Funäsdalen
Distance	72.56 KM
Time	48 min
Timeout at border	46s
Network	Telia

Flight	Funäsdalen Røros
Distance	72.68 KM
Time	59 min
Timeout at border	10s
Network	Telia

Flight data 19.05.2022

Flight	Funäsdalen, flying into Norway and return
Distance	60.37 km
Time	44 min
Timeout into NO	24s
Timeout into SE	16s
Network	Telenor

Flight data 20.05.2022

Flight	Funäsdalen to Vauldalen
Distance	32.14 km
Time	23 min
Timeout into NO	16s
Network	Telia

Conclusion

Routines have worked well for testing cross-border between Sweden and Norway. However, more regular operations require that permanent customs procedures are established. Sweden requires a flight plan to be filed and later to be sent to customs, but the Norwegian CAA does not accept the flight plan from their side and claims that a flight plan is not required according to EASA regulations. Transportstyrelsen, Sweden, has included EASA to conclude that flight plan shall be filed. This means that the way of informing customs is not equal in Norway and Sweden. As Vauldalen is a so-called Norwegian/Swedish customs office, the discrepancy was not an issue for this specific operation, but Aviant recommends that Green Flyway continues working with national authorities to smoothen the process for future operators.

The fact that the flights were flown without cargo made customs problems easier. Flying with any form of cargo, e.g. biological or medical, between the two states would challenge the regulations even further. Aviant suggests that Green Flyway continues investigation for cargo to be shipped between the two states. This would, in a more realistic way, simulate commercial transportation in between the two states.

During the network testing phase the border was crossed 54 times, and we experienced 85 timeouts. The timeout duration varied from 6 to 71 seconds. Aviant decided to have an accepted disconnection of 90 seconds. This means that the drone will operate according to plan, but if connection is not regained within 90 seconds the drone would land at the closest spot. As the worst case scenario recorded in flight was 46 seconds, this means that 90 seconds limit is sufficient for cross-border operations. This is longer than what Aviant usually operates with: 15 seconds. This means that cross-border operations have a higher inherent risk, as the time spent flying “blind” is higher than normal. For this reason, Aviant suggests that Green Flyway continues with further work on reducing such switchover times – for instance, a dual SIM configuration has been suggested.

This project has also highlighted the possibility of establishing a drone network between Trondheim and Östersund, which could aid healthcare logistics and give cross-border exchange of material or biological samples. The success of this cross-border flight is vital for such a network to be possible, and we recommend further work to make it a reality.