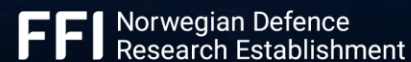


Welcome to Jammertest 2024

Information meeting August 8th 2024





Tomas Levin
Senior principal engineer,
Norwegian Public Roads
Administration



Nicolai Gerrard
Senior engineer,
Norwegian Communications Authority



Christian Berg Skjetne,
Senior engineer,
Norwegian Public Roads
Administration



Anders Rødningsby
Principal scientist
Norwegian Defence
Research Establishment



Harald Hauglin
Chief engineer,
Norwegian Metrology Service



Anders Martin Solberg
Senior engineer,
Norwegian Mapping Authority



Ingrid Dahl Skarstein
Project leader,
Testnor



Agenda

- Jammertest 2024
- Safety
- Program overview
- Test locations
- Technical program
- Communication
- Practical information

An aerial photograph of a coastal town and a rocky island in the ocean. The town is situated on a green, hilly landscape with a white sandy beach and a blue bay. A road winds through the town. In the foreground, scientific equipment is mounted on a rocky outcrop, including several white cylindrical sensors and yellow brackets. The text "This is your home for week 37" is overlaid in white on the right side of the image.

This is your home for week 37

Jammertest 2024: Record high interest with more than 250 participants from all over the world registered



Industry

Research

Government

KONGSBERG **TELEDYNE FLIR** **LOCKHEED MARTIN**

Andøya Space **BOSCH** **ERICSSON** **NOKIA**

Telia **telenor** **NRK** **TRG**

septentrio **SAFRAN** **LEONARDO**

MEINBERG **Trimble** **ROHDE & SCHWARZ** **RS**

u-blox **MICROCHIP** **RACELOGIC** **exail**

FURUNO **Honeywell** **Q-FREE** **CALIAN**

isar aerospace **SAAB** **EUTELSAT** **ospirent**

FUGRO **HEXAGON** **NovAtel** **VECTORNAV** **helix GEOSPACE**

Leica Geosystems **ANavs** **InfiniDome** **TESTNOR**

ni **VOLVO** **ASCOM** **AD NAVIGATION**

Elvia **radonor** **SentiSystems** **roketSan**

Adtran **COMBITECH** **provinn.** **HawkEye³⁶⁰** **GUIDE**

FFI Forsvarets forskningsinstitutt

RI SE Research Institutes of Sweden

Stanford University

ntr

KTH VETENSKAP OCH KONST
Royal Institute of Technology

DTU Technical University of Denmark

UNIVERSITY OF VIRGINIA

Vaasa yliopisto UNIVERSITY OF VAASA

NLS FINNISH GEOSPATIAL RESEARCH INSTITUTE FGI

NOKM Nasjonal kommunikasjonsmyndighet

FOI

POLITIET

NORWEGIAN ARMED FORCES

Statens vegvesen

FMV

Justervesenet

Statnett

dsb Norwegian Directorate for Civil Protection

Norsk Romsenter Norwegian Space Agency

esa European Space Agency

cnes CENTRE NATIONAL D'ETUDES SPATIALES

Luftfartstilsynet **AVINOR**

EUROCONTROL

KYSTVERKET

Kartverket

330 SKY **UTREDDER LUKK**

Federal Agency for Cartography and Geodesy

Ministry of Defence

PTS

Styrelsen for Dataforsyning og Infrastruktur

DGA DIRECTION GENERALE DE L'ARMEMENT

Erillisverkot

What to expect from the test week



Photo: Duus Media

Health, safety and environment (HSE)

Testing under real world conditions on open public roads can be dangerous!

In order to make Jammertest 2024 as safe as possible a few simple requirements are laid down:

- **High visibility clothing**
- Only registered participants are allowed on site - name badge is required
- Zero tolerance for driving under the influence of alcohol and drugs
- Existing speed limits are in force during test
- Listen and conform to the organizer's requests
- Photography is allowed if you ask first
- Respect of the environment and the local community



Safety

High visibility clothing



High visibility clothing is **MANDATORY** and shall be used at all times when outside!

We recommend full jacket with logo, helps the organizer

You are at 69 degrees north - weather matters. We also recommend that you bring warm clothes, a scarf, cap, robust shoes (some gravel and grass areas) and gloves.



Test equipment

*Find what you need,
find spares and finish
off with gathering
even more cables
and connectors!*

*(You are going to the top of the
globe)*

Andøya is a remote location, bring the equipment you need.

There is power at Bleik samfunnshus (230 Volt), but you may need extension cords.

Network

- normal mobile 4G coverage network is good
- There is WiFi and Ethernet available in Bleik samfunnshus (Base camp) but this is shared so your milage may vary.
- Timing – have their own setup – more on that later

GNSS antenna cables can be stretched from the outside to inside

Batteries, power generators can be sourced locally, but you must contact Erik at Testnor in advance:
erik@testnor.com

We have to help each other, don't be afraid to ask for help and plead lend a hand to those in need



Logistics

Logistics assistance

- If you are in need of assistance regarding storage, shipping or other logistical questions, please contact Testnor: erik@testnor.com
- Storage capacity is available close to the testing area.
- Be aware that this is a paid service upon request and availability – more information on <https://jammertest.no/logistics/>

Other important links

- Customs: <https://www.toll.no/en/corporate/>
- Export controlled goods: <https://www.regjeringen.no/en/topics/foreign-affairs/export-control/id754301/>

Deadline for booking of logistics assistance: August 15th 2024



Program overview

Time Schedule

Monday

- ❑ 09.00 – 11.00 Arrival, registration and equipment deployment
- ❑ 11.00 – 13.00 Welcome and safety brief
- ❑ 13.00 – 14.00 Lunch at HQ (Bleik)
- ❑ 14.00 – 18.00 Afternoon test block
- ❑ 18.10 – 18.30 Evening debrief; safety and potentially sharing results
- ❑ 20.00 – 22.00 Networking dinner

Tuesday, Wednesday, Thursday

- ❑ 08.00 – 08.30 Morning safety brief
- ❑ 09.00 – 13.00 Morning test block
- ❑ 13.00 – 14.00 Lunch at HQ (Bleik) and Stave
- ❑ 14.00 – 18.00 Afternoon test block
- ❑ 18.10 – 18.30 Evening debrief; safety and potentially sharing results

Friday

- ❑ 08.00 – 08.30 Morning safety brief
- ❑ 09.00 – 13.00 Morning test block
- ❑ 13.00 – 14.00 Lunch at HQ (Bleik) and potentially sharing results
- ❑ 14.00 – 16.00 Down rig of equipment, goodbyes and departure

Social gatherings

Networking event, Monday September 9th at 20.00, Fyrvika, Andenes

Pizza buffet NOK 300 (approx. €25) per person, pay at the door.

**Tapas evening & sharing of results, Thursday September 12th at 18.30,
Bleik communal house**

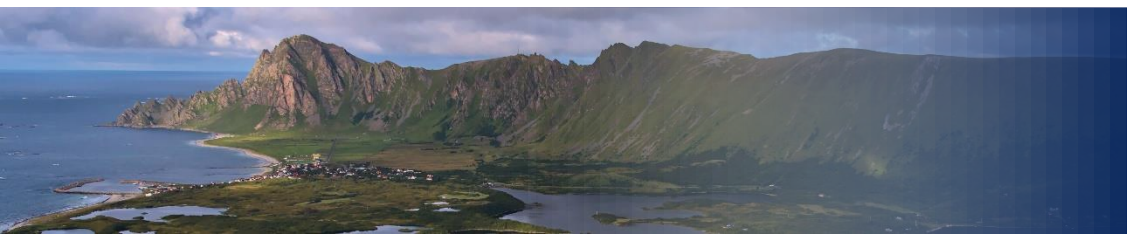


Program overview

Test block view of transmission plan

Day	Test area 1	Test area 2	Test area 3
Monday	High power stationary jamming	Low power stationary jamming	Book time slots on hourly basis
Tuesday	Meaconing High power unintentional RFI Long-time high-power jamming (evening)	Circular multi-jammer scenarios Drone scenarios	Book time slots on hourly basis Motorcade (with low-power jammers)
Wednesday	Stationary spoofing (mainly position, navigation) SBAS spoofing	Book time slots on hourly basis	Motorcade (with low-power jammers)
Thursday*	Stationary spoofing (mainly timing)	TBD Circular multi-jammer scenarios (repetition)	Mobile spoofing (SDR) (mainly position, navigation) TBD
Friday	Repetitions, variations of previous tests, special attacks	Low power stationary jamming Repetitions	Book time slots on hourly basis

**Thursday's morning test block also has airport jamming transmissions*



Test areas

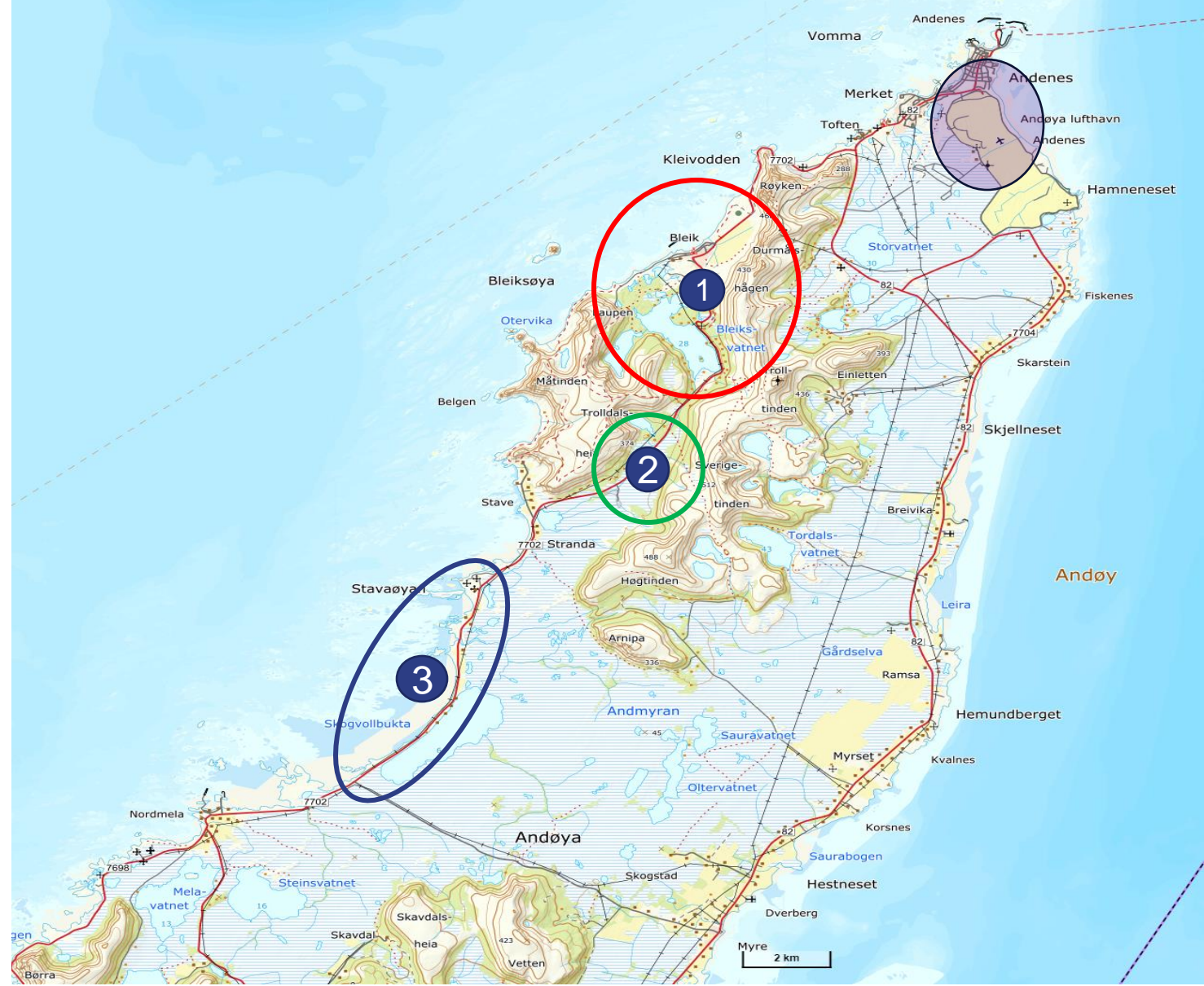
Three locations, where we can work in parallel:

Test area 1: Main test area

Test area 2: Sand box

Test area 3: Motorcade

Additional transmissions done at airport, DUTs must be helicopter, ship or airplane



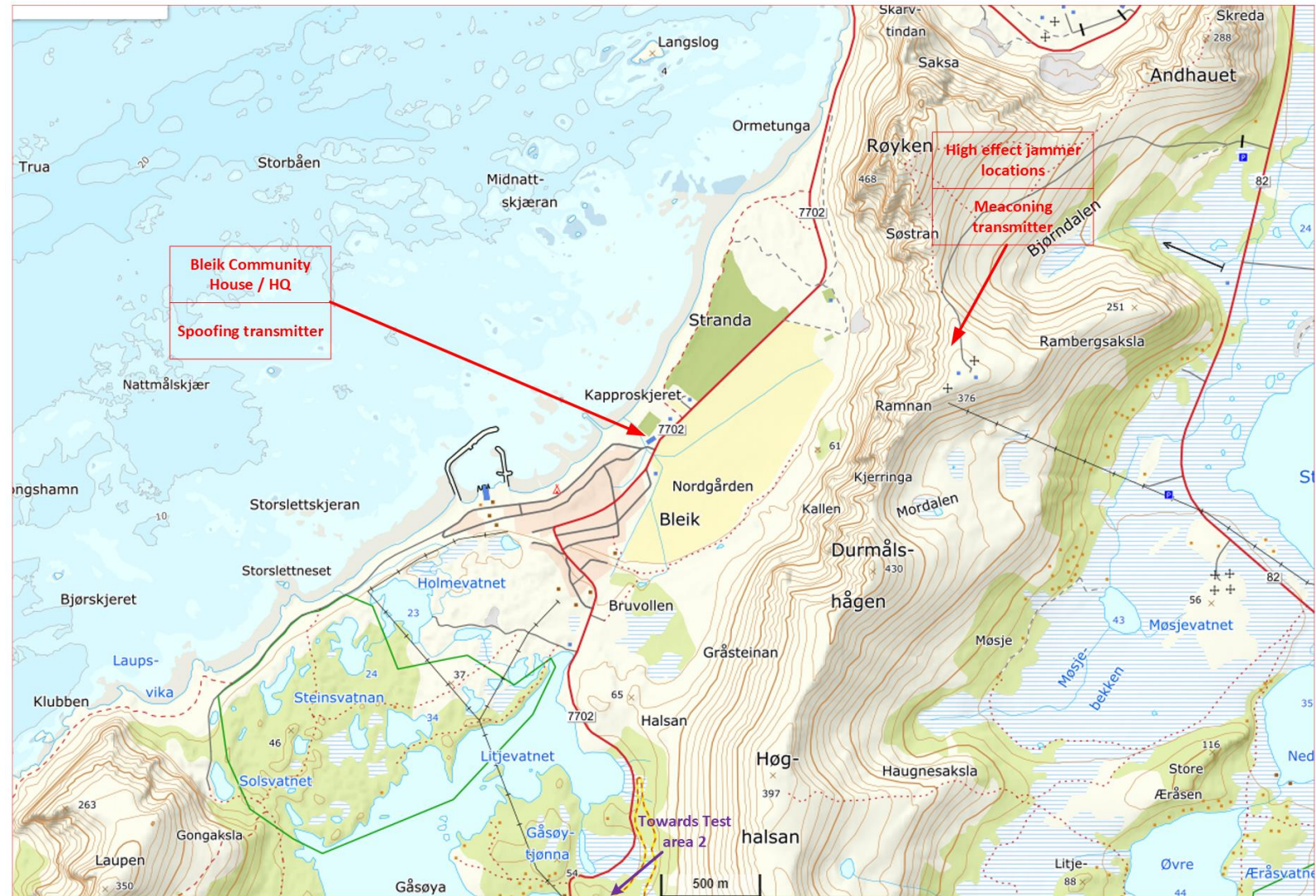
Test area 1: Main test area

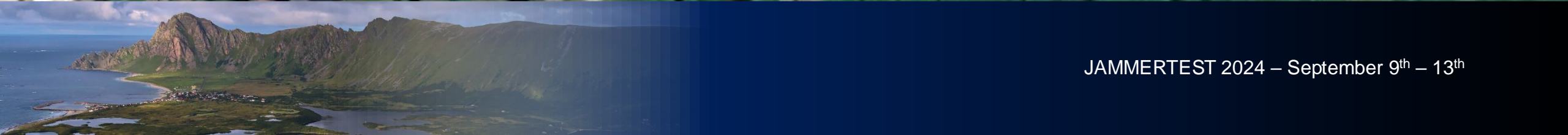


Photo: David Jensen

Test area 1: Main test area

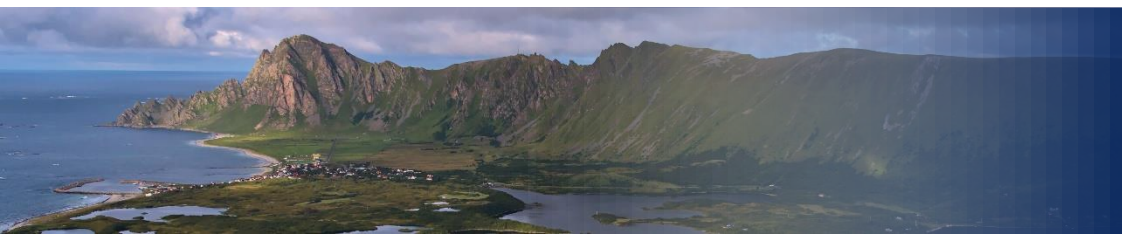
Test area 1





JAMMERTEST 2024 – September 9th – 13th

HQ antennas



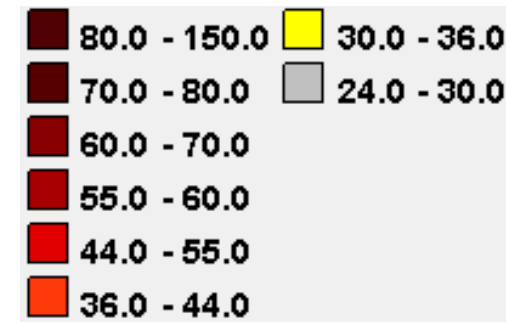
High power jammer

- Signal modulation:
 - CW – Continuous Wave (unmodulated signal)
 - PRN – Pseudo Random Noise
 - Chirp (frequency sweep)
- Power ramping
- Different combinations of frequency bands
 - Up to 8 channels
- Max 200 W EIRP at each channel with directional RHCP-antennas

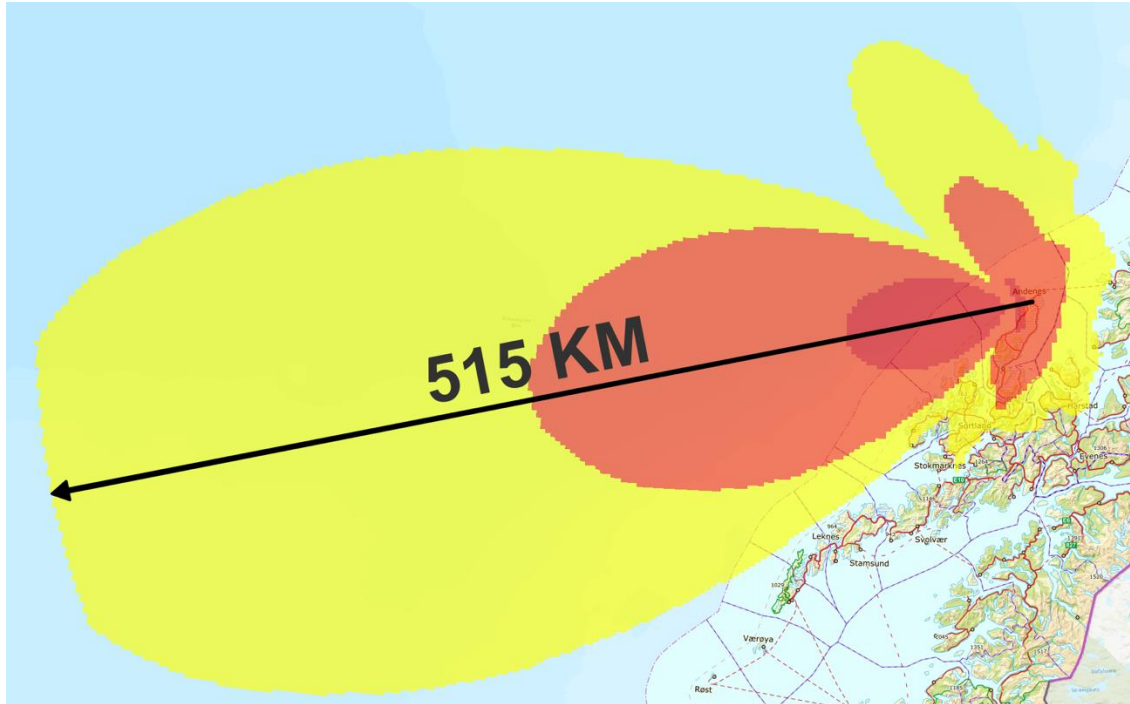


Photo: David Jensen

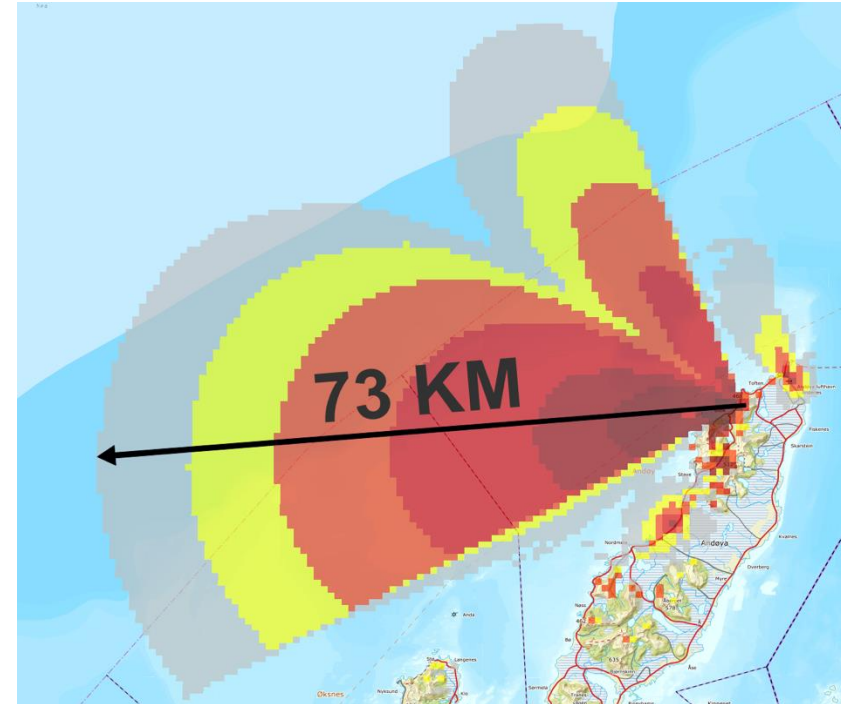
High power jammer – Range



Jamming-to-Signal-ratio (J/S) considerations with a 200 W source at Ramnan at 40 000 ft above mean sea level (MSL)

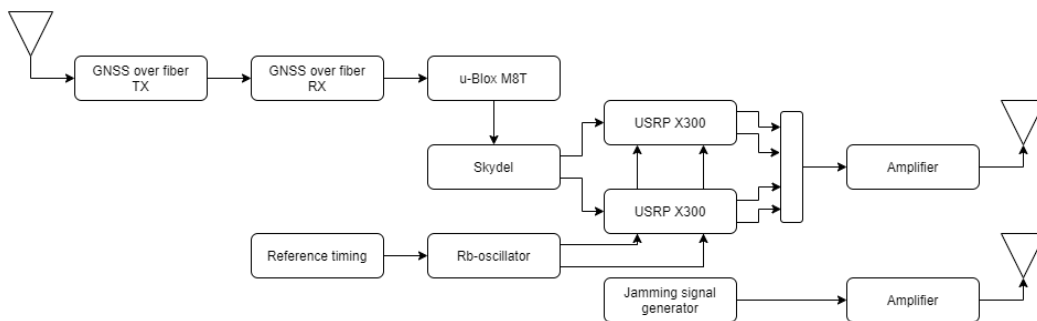


Jamming-to-Signal-ratio (J/S) considerations with a 200 W source at Ramnan at 5 ft above ground level (AGL)



Spoofing

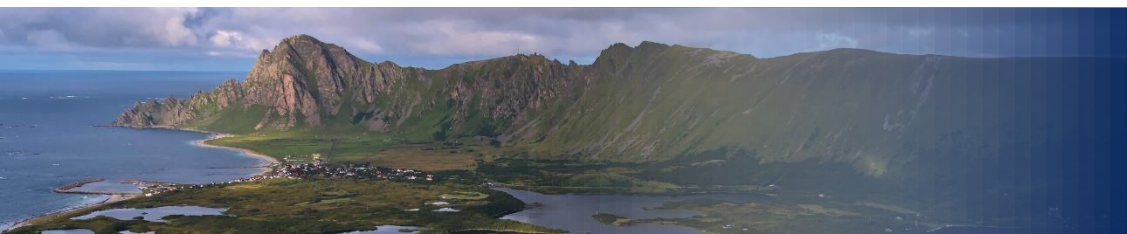
- Spoofing different combinations of frequency bands
- Jamming different combinations of frequency bands (before and/or during spoofing transmission)
- Power ramping
- Range: several hundred metres



Test area 2: Sand box



Photo: David Jensen



Test area 2

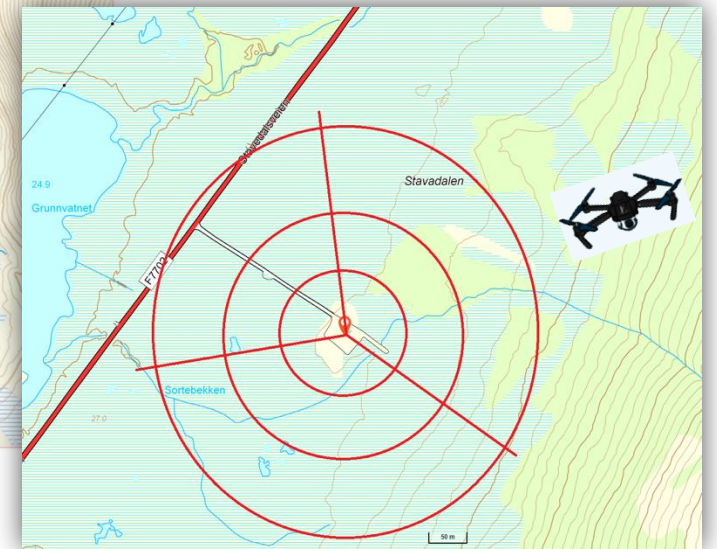
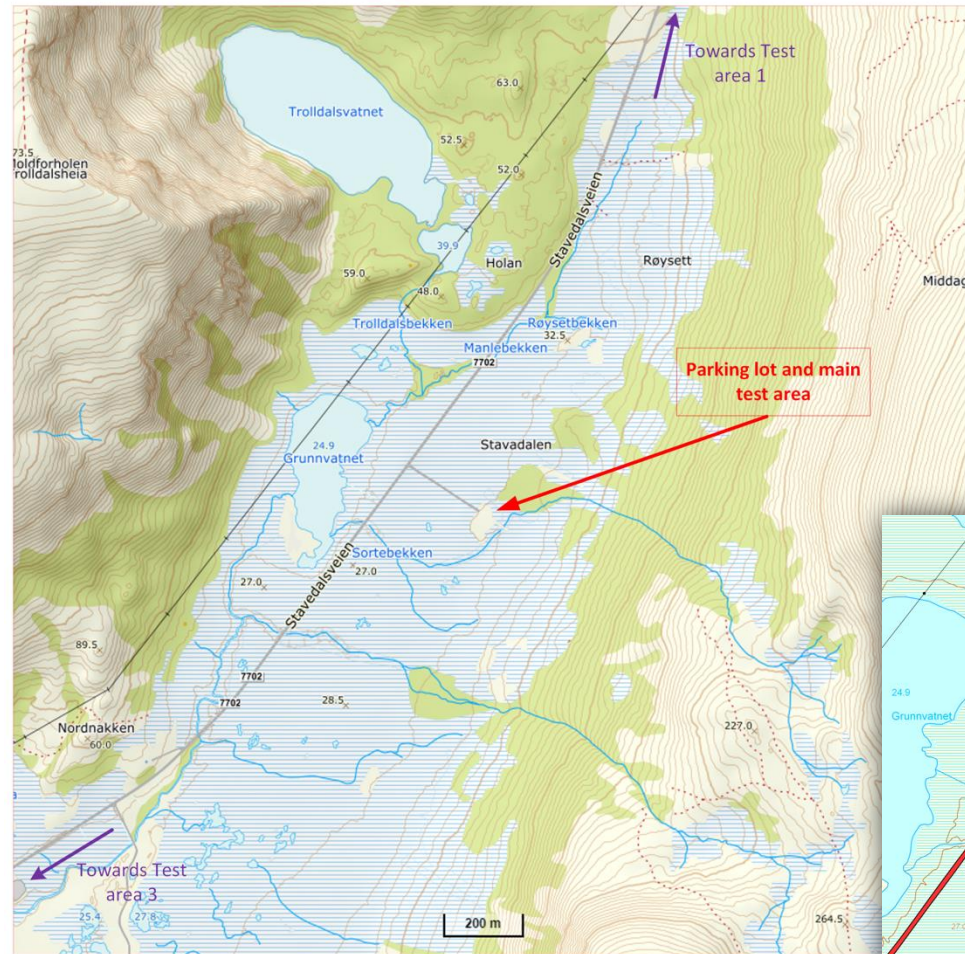
Test area 2:

Will use low power jammers

Sand box bookings

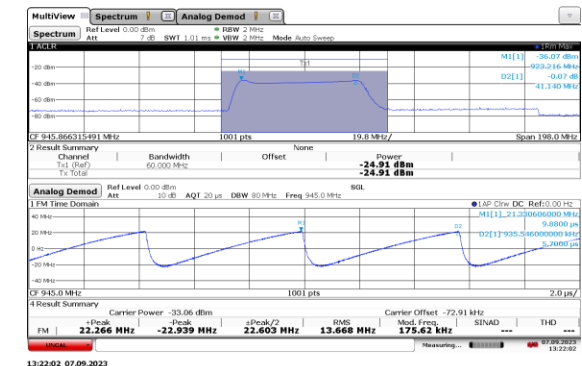
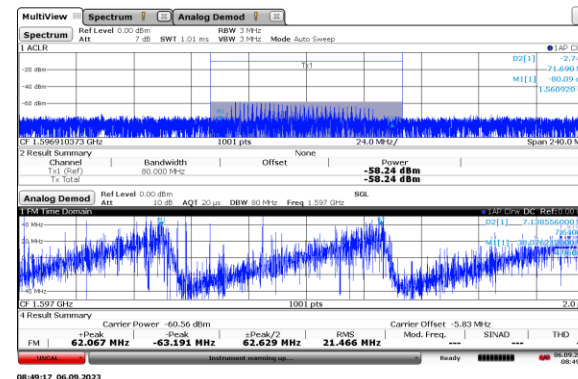
+

Centrally planned tests



Small handheld jammers (Nkom and FFI)

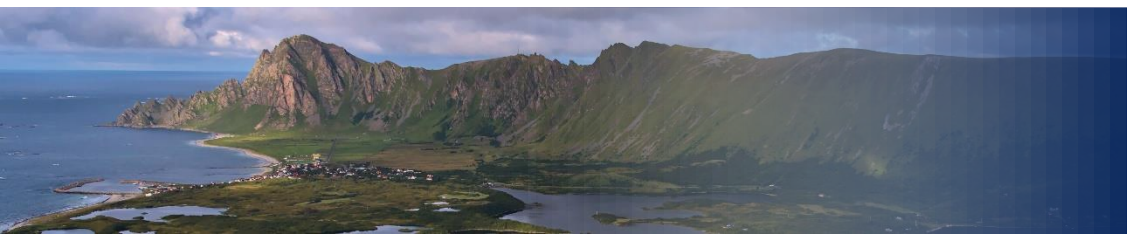
- Small, handheld jammers with 1 – 6 channels
- Up to about 1 W output power
- Mainly produced in China
- Cover GNSS bands and other frequency bands
- Modulation mostly sawtooth chirp
- Advanced jammer (with buttons) from NovAtel (Canada)



Test area 3: Motorcade



Photo: David Jensen



Test area 3:
Centrally planned
motorcade tests
+
Sand box bookings

Exact details on motorcade tests will be given in the startup brief on Monday

Test area 3



Test catalogue

V.S.

Transmission plan

Two documents are very important for participants at Jammertest 2024: a **test catalogue** and a **transmission plan**.

Test catalogue

- A catalogue of tests (grouped together into test groups) with technical descriptions of transmissions, ideas for set up and rationale for tests.
- Annexes with technical details on for example all the jammers .

Transmission plan

- Specific test groups or tests are picked from the test catalogue and used to build a plan for the Jammertest week.
- The transmission plan tells one what test is done at what time and at which test location.

After the Jammertest week, a detailed time log will be distributed to all participants. Logging will be best practice

Test catalogue

v.s.

Transmission plan

Example of how specific tests are used to build the transmission plan

- 4 Continuous stationary high-power jamming with PRN 21 ← *Example of test group*
- 4.1 Preconditions and setup..... 21
- 4.1.1 Test: 20 W PRN: L1 21
- 4.1.2 Test: 20 W PRN: L1, G1..... 21
- 4.1.3 Test: 20 W PRN: L1, G1, L2 21
- 4.1.4 Test: 20 W PRN: L1, G1, L2, L5..... 21
- 4.1.5 Test: 20 W PRN: 30-minute jamming of L1, G1, L2, L5..... 21 ← *Example of specific test*

Day	Time (location 1)	Location 1 (Bleik)	Time (location 2)	Location 2 (Grunvatn)	Time (location 3)	Location 3 (Stave)
Monday (18.09.23)		High power stationary jamming (jammer located at point A)		Book time slots on hourly basis		Book time slots on hourly basis
	13:00	2.1.1	13:00	Grunvatn - Slot 2.1	13:00	Stave - Slot 3.1
	13:20	2.1.4	14:00	Grunvatn - Slot 2.2	14:00	Stave - Slot 3.2
	13:40	3.1.1	15:00	Grunvatn - Slot 2.3	15:00	Stave - Slot 3.3
	14:00	3.1.4	16:00	Grunvatn - Slot 2.4	16:00	Stave - Slot 3.4
	14:20	4.1.1	17:00	Grunvatn - Slot 2.5	17:00	Stave - Slot 3.5
	14:40	4.1.4	18:00	Finished	18:00	Finished
	15:00	4.1.5				
	15:40	5.1.1				
	16:00	5.1.2				
	16:20	6.1.1				
	16:50	6.1.4				
	17:20	25 (all tests)				
	18:00	Finished				

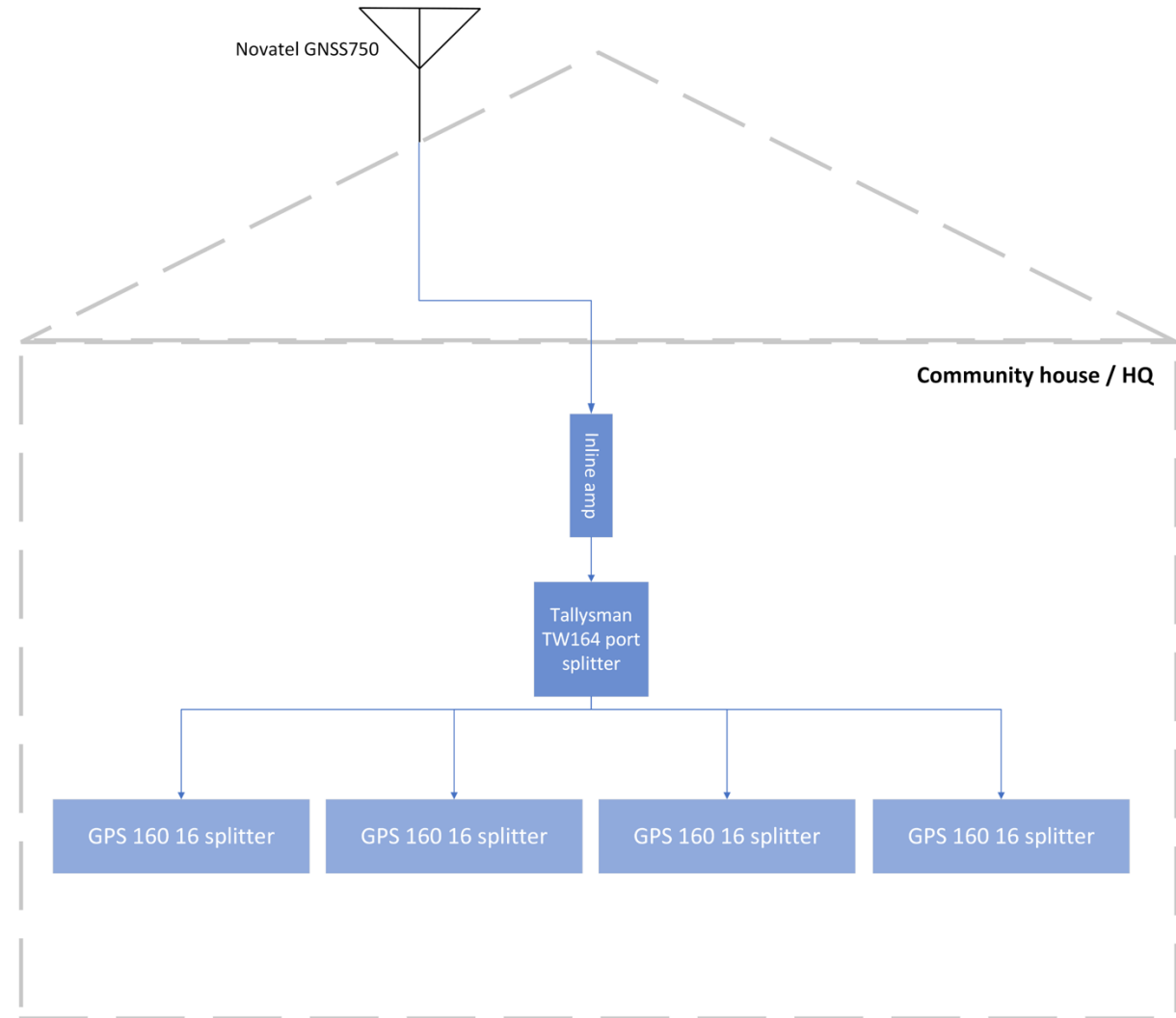


RF feed

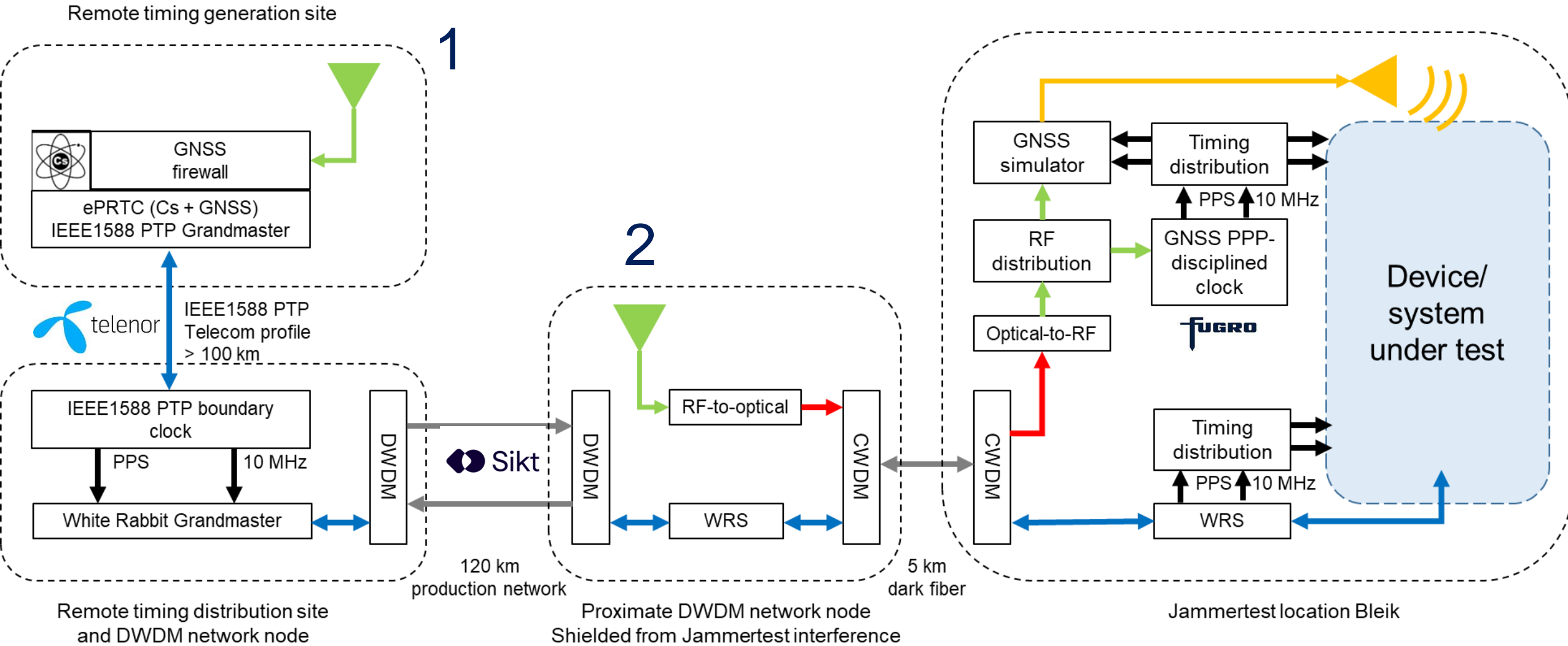
A RF feed from a GNSS antenna will be set up to distribute signals to participants (who doesn't necessarily need their own antenna).

Amplifier will be applied to ensure that the signal strength at the splitters are approximately the same as received signal at the antenna

Splitter connectors will be N female.

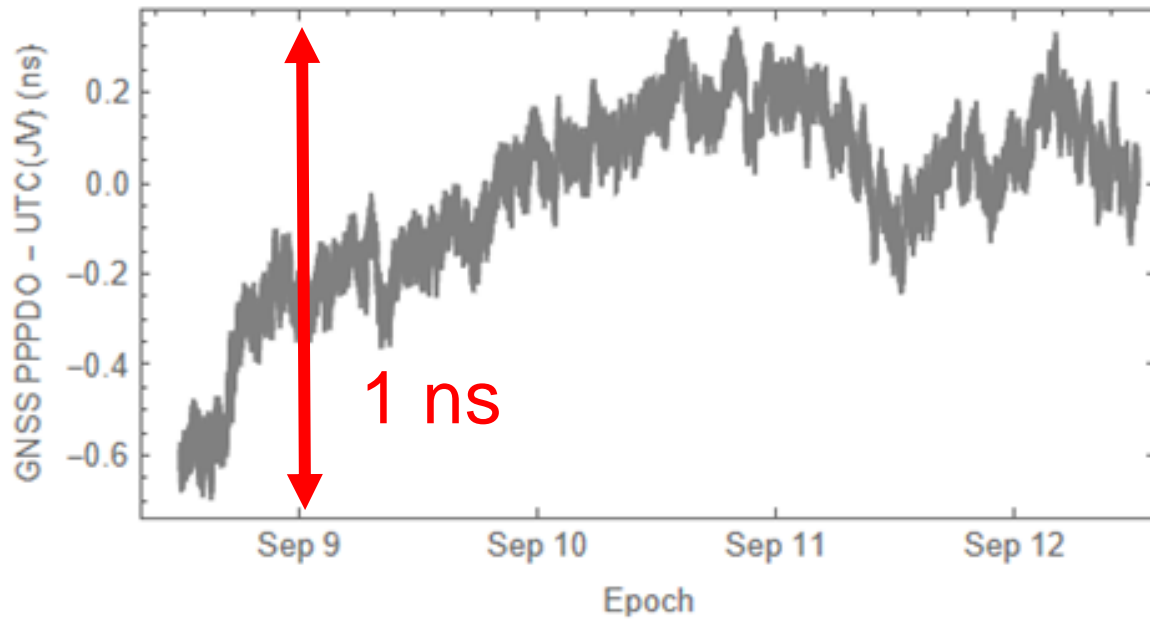


Jammertest reference timing setup: Two sources

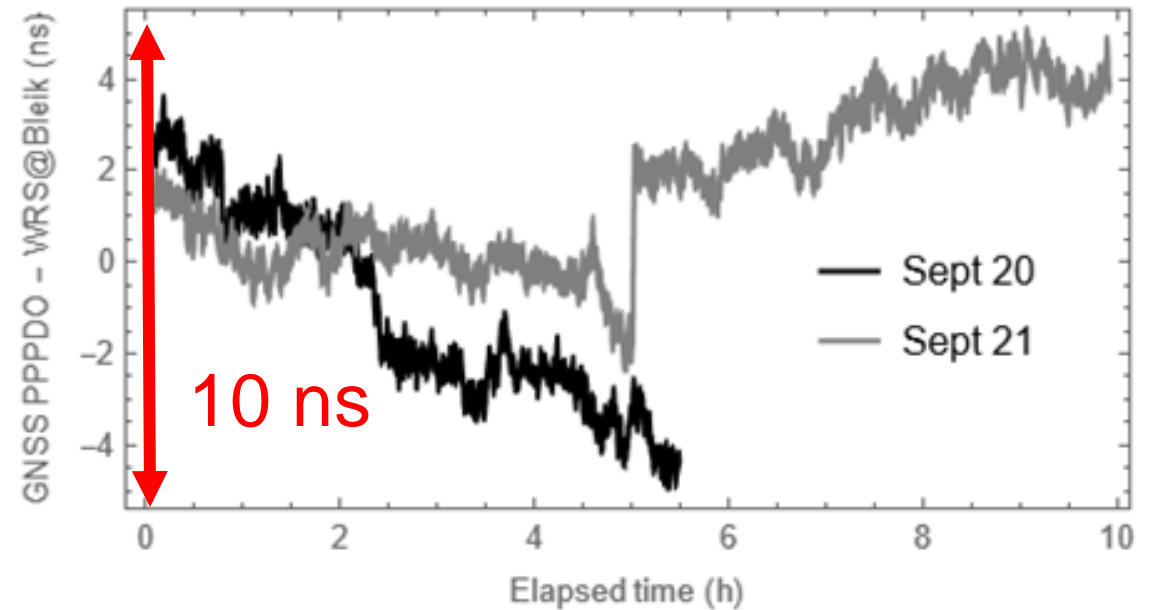


Jammertest 2023 reference timing performance

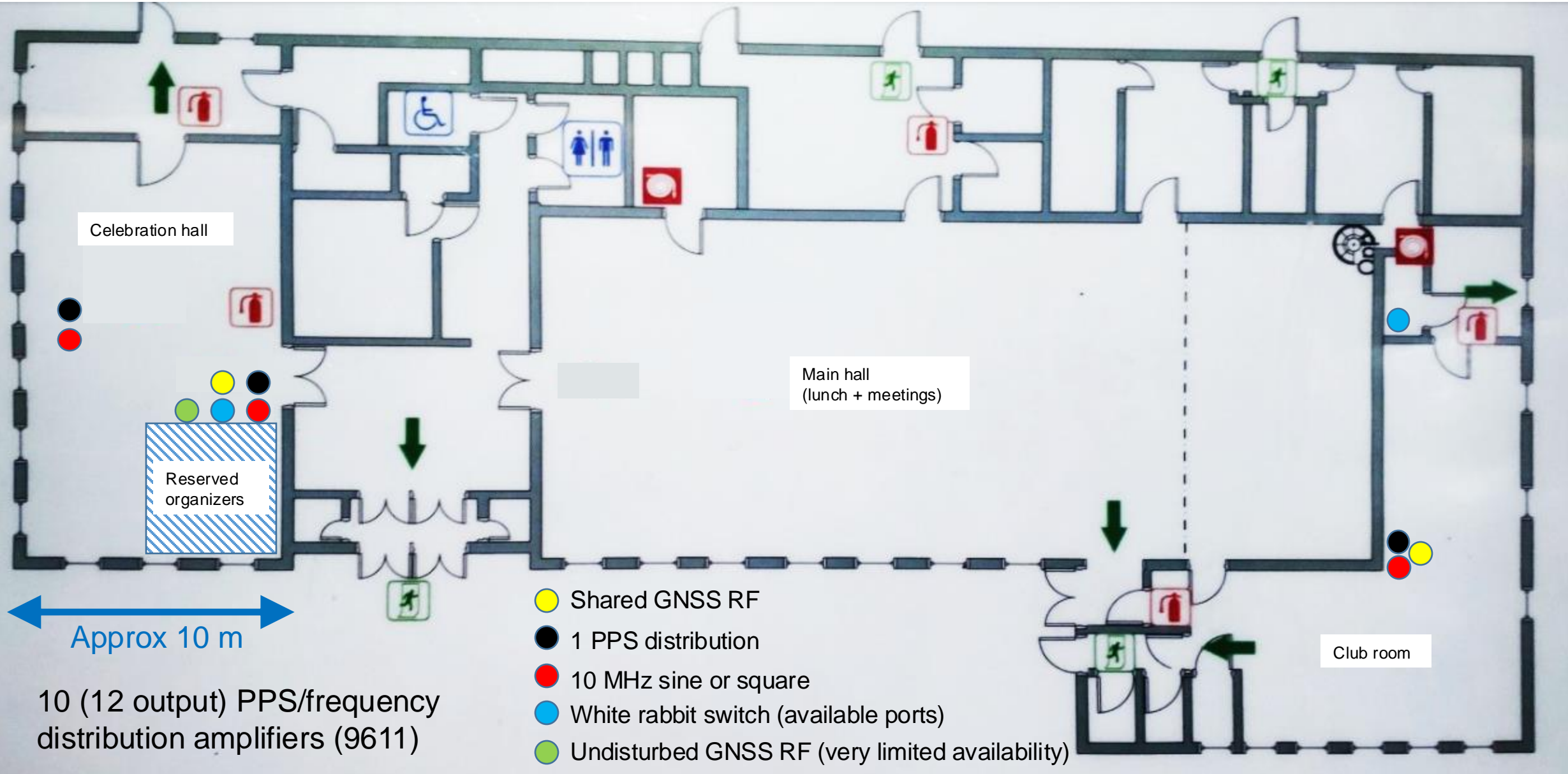
GNSS PPP (Atomichron) disciplined OCXO vs UTC(JV) in lab at Justervesenet



GNSS PPP (Atomichron) disciplined OCXO vs PTP network timing at Jammertest



Jammertest reference signal distribution at Bleik community house



GNSS correction data

The Norwegian Mapping Authority (NMA / Kartverket) provides GNSS reference (correction) data free of charge during the Jammertest week.

3 options (2 for real-time data, 1 for stored data):

- CPOS (Network RTK service). Requires NMEA input from user equipment.
- RTCM data streams from individual GNSS reference stations nearby the test areas (distances ~ 10 - 60 km). Does not require NMEA input from user equipment.
- RINEX data for post processing

More information and access details is published at (participant login needed)

<https://jammertest.no> > Jammertest 2024 > Program > GNSS reference data

We plan to open the gates on ~August 27th (exact day to be announced), and the free access of real-time data will then be available until the end of Jammertest 2024. RINEX data will remain available several weeks after the event.

See also:

<https://www.kartverket.no/en/on-land/posisjon/user-guide-positioning-services>

<https://www.kartverket.no/en/on-land/posisjon/guide-to-cpos>



FM radio:
Radio Noise
99.0MHz



Communication channels

FM radio: *Radio Noise 99.0MHz* – will transmit test number that is running. Receivers with RDS will display test number. Health and safety messages will also be broadcast here. We encourage you to bring your own radio with RDS capabilities.

Site 3 has own radio channel: 95.0 MHz used to coordinate driving (no RDS, voice only)

MQTT broker: topics with test running and start and end of tests will be published on Jammertest.no

Chat: we will try to use Synologys chat application to enable chat between participants: <http://jammertest.synology.me:5000/> - login details will be shared with you from mail@jammertest.no

Two-way radios: All NPRA personnel carry VHF radios that link them with test-leaders, safety officer and organizers. Grab a hold of an NPRA (Statens vegvesen) official for any questions

Airspace management

Civil Aviation Authority Norway's guide for flying drones in Norway

In Norway, you are generally allowed to fly in the open category if you are registered as an operator. This does not apply to Russian citizens, as there is a national ban on all Russian flights. For more information and guide for flying drones in Norway: <https://luftfartstilsynet.no/en/drones/flying-in-norway/>

Joint coordination meeting for all airborne activities on Wednesday August 21st at 14:00 on Teams.

You will receive a Teams meeting invitation.



Registration

- All participants needs to be registered and wear a visible name badge
- Registration takes place on Monday at Bleik Communal house
- Bring valid ID to register (passport or national identity card)
- In case of replacement of personnel this needs to be agreed before you arrive

Test vehicles to
be registered
on-site upon
arrival



Follow us

Official website: <https://jammertest.no/>

Official Jammertest LinkedIn account: Jammertest

Share your #jammertest experience on LinkedIn



Q&A

- Questions
- Feedback
- Inputs

Contact points:

Technical questions: Nicolai Gerrard, nge@nkom.no

Practical information: ingrid@testnor.com

Logistics: erik@testnor.com

Thank you for attending
and see you soon!