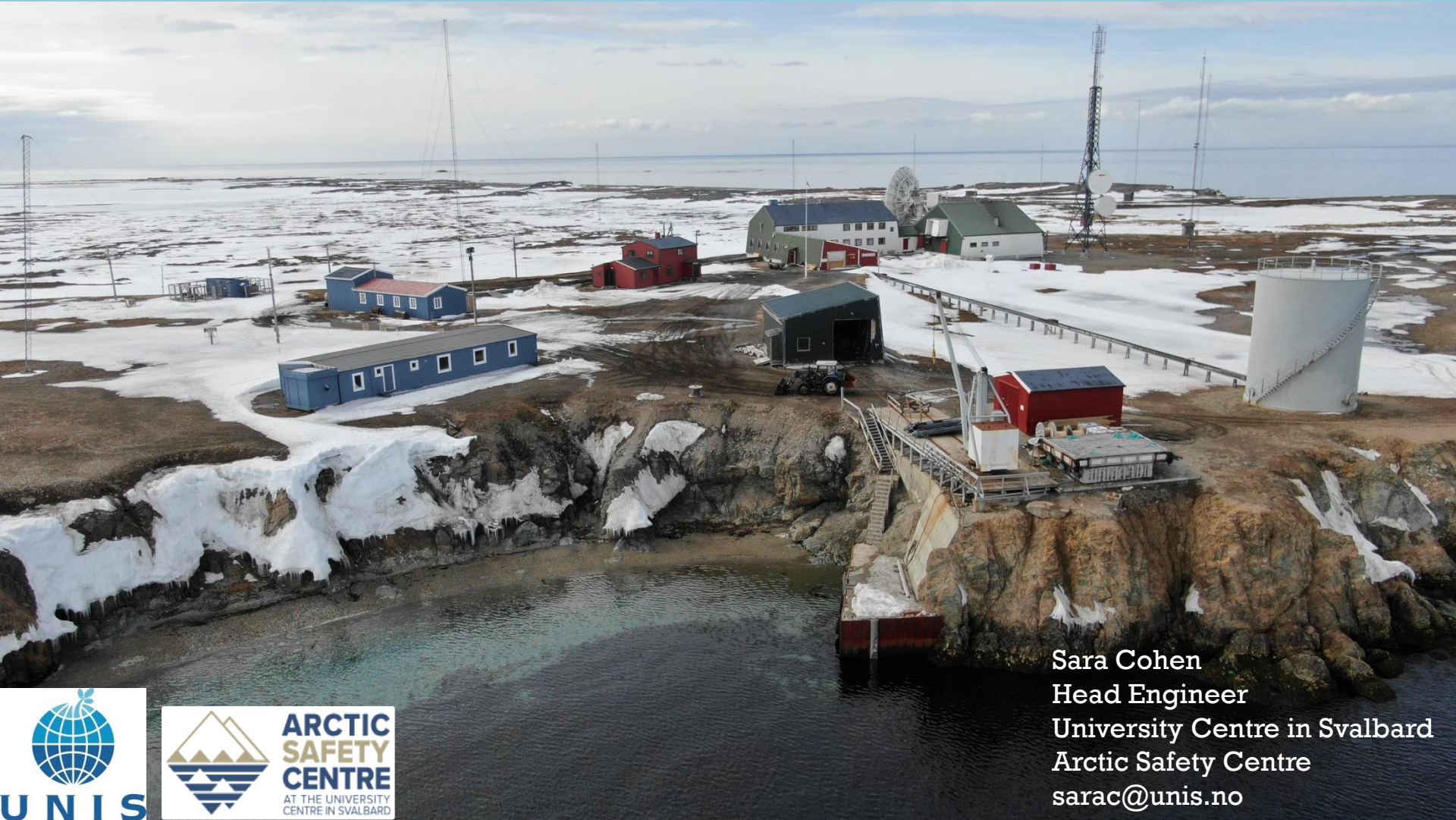


Means of Communication and Positioning Systems in the Field

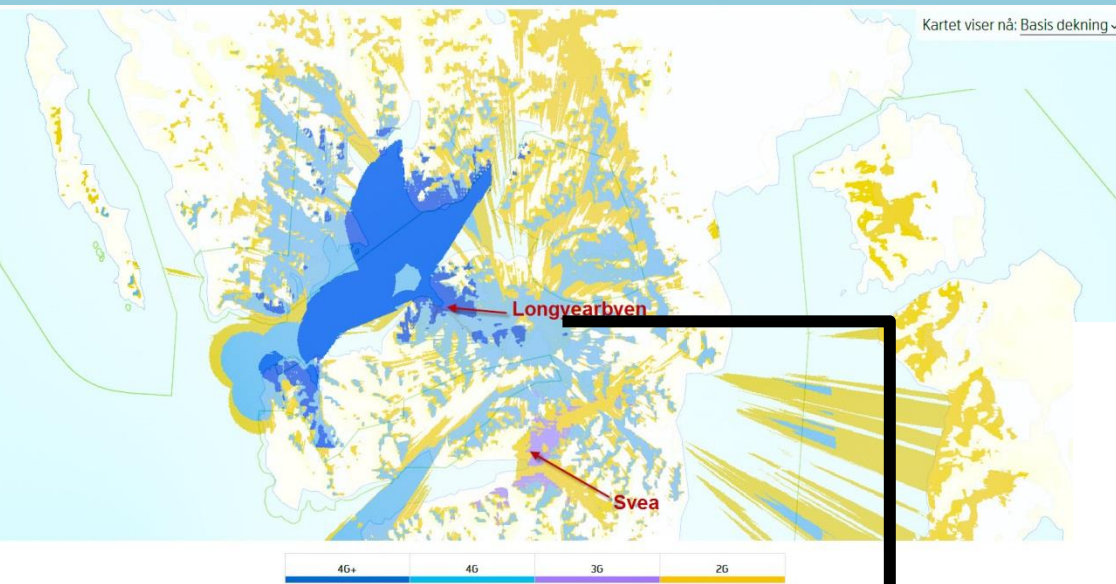


Sara Cohen
Head Engineer
University Centre in Svalbard
Arctic Safety Centre
sarac@unis.no

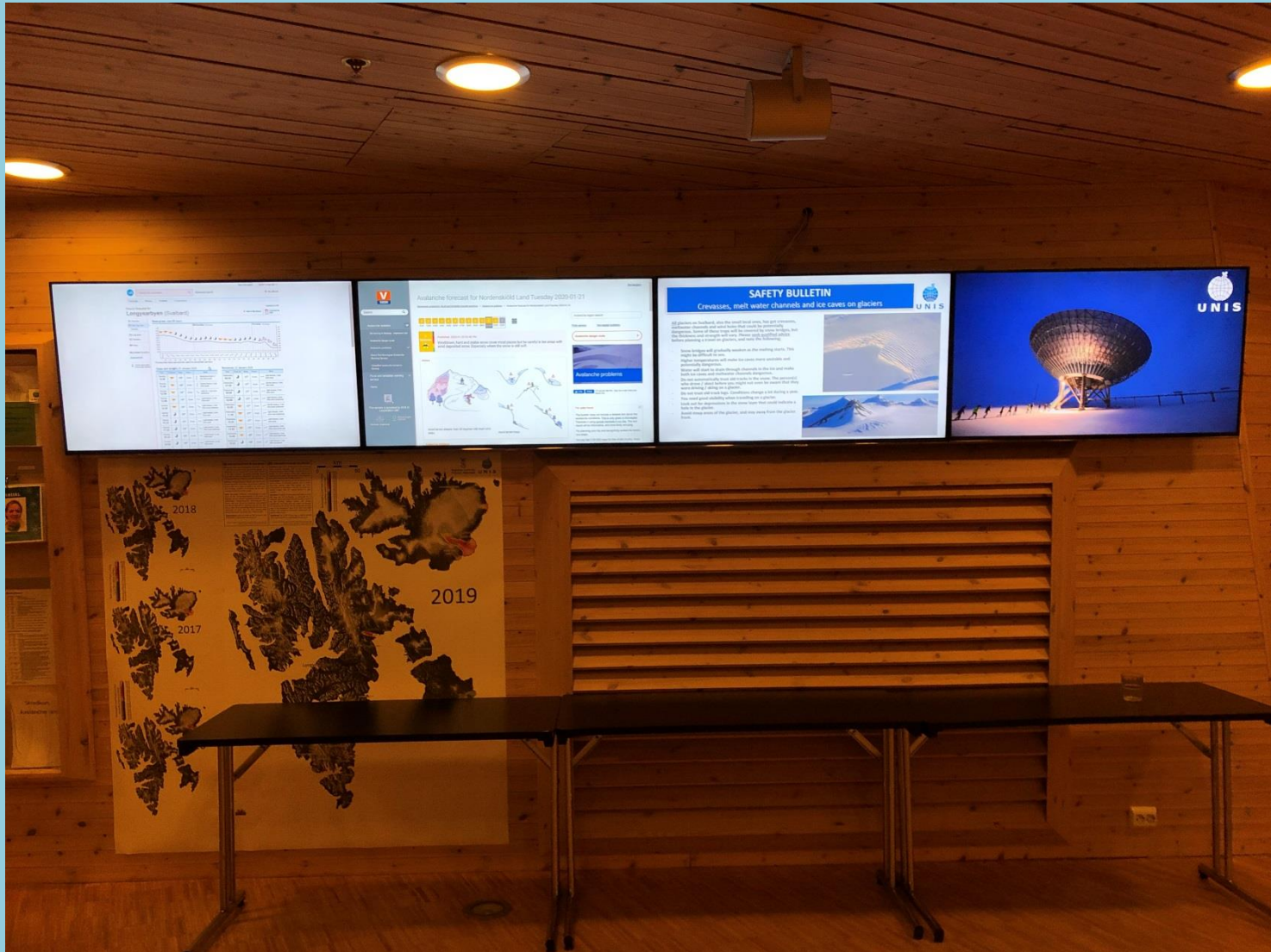


- Born and raised in Juneau, Alaska
- BSc in Physical Geography, University of Oregon 2011
- MSc in Geosciences, University of Oslo 2013
- Physical Sciences Technician at Klondike Goldrush National Historical Park, Skagway Alaska, 2011
- Scientific Technician at Summit Station, Greenland, 2014
- Head Engineer in the departments of Arctic Geology and Operations & Field Safety, University Centre in Svalbard, 2015-Present

Why do we care?



Base Information Center



Base Information Center



"HSE" documentation for fieldwork at UNIS.

Fieldwork/ excursion supervisor		
Topic / project name / Code		
Location:		
Time period:		
Object of work:		
Means of transportation:		
Communication, call signals and numbers:		
Satellite phone	Telephone number:	
VHF Radio	Call signal:	Channel:
Cell – phone (s)	Telephone number(s):	
Emergency beacon	LC number:	
In reach	UNIS number:	

Agreements on time of daily contact with UNIS, if out over several days. (+ 47 95 28 35 11)

On weekdays:	On Saturday, Sunday or holidays:
--------------	----------------------------------

Action to be taken from UNIS and the field-party if communication fails:

Latest time of arrival / return (date and time):

"Person on duty" at UNIS in this period:

Routines when returning from fieldwork:	1)	Call "Contact person at UNIS" at: +47 95 28 35 11.
	2)	Put this form in the "returned" shelter.
Governors Police department. (Emergency, search and rescue)	Telephone (weekdays 08:30 AM to 03:30 PM)	+47 79 02 43 00
	Police officer on duty (after working hours)	+ 47 79 02 12 22
	Telephone emergency line	112

Daily excursion plan (time, place and alternative routes). Use more paper, or attach a map image, if necessary:

The following "HSE issues" has been discussed and agreed on with the field party:

✓	Health issues	✓	Environmental issues
	Self declaration on health condition filled out by everyone		Disturbance of wildlife special to the area and time period.
	Appropriate clothing and personal equipment		Waste disposal
	Nutrition, food and drinks		Protected areas
	List of "next of kin"		Cultural heritage
	Alcohol / drugs / medication		Location of camp sites
	Rabies		Flora
	Parasite; " <u>Echinococcus multilocularis</u> "		Need for special applications?
	Sanitation, hygiene and risk of contagion.		
	Insurance		
	Life assurance, is everyone covered?		
	Insurance of field equipment and personal equipment		
			Field camp
			Tents
	Safety issues in general		Small cabins
	The field parties route		Fire protection
	Weather forecast for the period		CO poisoning
	How to handle bad weather situations		Polar bear protection
	Travelling over / movement on sea ice		Location of the field camp, safety issues.
	Travelling over / movement on glaciers		Communications from the field camp
	Travelling / movement in mountain sides		Garbage / waste, routines and handling
	Travelling / moving in areas exposed to avalanches		
	The Polar bear		Organisation, planning and responsibilities
	Routines regarding fire arms and pyrotechnics		Leadership and responsibilities
	Travelling / movement on melted Tundra		When to report back to UNIS.
	Crossing over rivers		Report when driving to and from destination
	Means of communication		Emergency equipment where?
	Communication routines		Preparing equipment before fieldwork
	Distribution of safety equipment in the field party		Termination of field work.
	Working on large vessels.		Has everyone paid cost money (cruises only)?
	Use of drones (UAV, UUV / AUS)		
	Permits in place?		Mandatory check in / de-brief / evaluation
	Competence and certificates for pilots		Register incidents, accidents or deviations
	Risk analyses		Restore / cleaning equipment after fieldwork
			Need of debrief / evaluation
			Register polar bear sightings / incidents
	Transportation		
	Snow scooters NB; Drivers licence needed.		
	Snow scooter; organization and driving procedures.		Special operations
	Small boats. SJA & mandatory safety briefing		Diving (see "diving instructions at UNIS")
	Large vessels		Handling heavy equipment
	Helicopter NB; Mandatory safety briefing.		Handling heavy or dangerous machinery
	Band wagon NB; Mandatory safety briefing.		Use of winch or similar.
	Car		Handling chemicals
	On foot / ski		Use of toxic material
	By local plane		Need for special safety analyses / HSE analyses?
	Information / announcing of field activities		
	Activities that might create public concern, or be of danger to the public, must be announced.		

Emergency equipment following the field party:

√	Equipment	Number	Remarks
	Rifle, cal. 30-06		Front and back of the group
	Ammunition cal. 30-06		
	Signal pistol		Front and back of the group
	Red signal ammunition		
	Brown signal ammunition (Blitz / knall)		
	Fire crackers (knallskudd)		
	Satellite telephone		Front or back of group
	Emergency beacon		Front or back of group
	VHF radio		Front and back of the group
	Spare battery pack for radio		
	Battery charger for VHF radio		
	Avalanche search beacon		Everyone
	Glacier rescue kit		Front and back of the group
	Emergency box 7 pax (winter)		Front and back of the group
	Emergency backpack 2 pax. (Summer)		
	Scooter rep set		At the back of the group
	Ice rescue spike		Everyone
	Ice rescue "throwrope bag"		Second scooter and last scooter in the column.
	Survival suite		Everyone
	Map		
	Compass		
	GPS		
	First aid kit		
	Windproof bag (lerven duk), shovel, search probe, sitting pad and candle.		In every snow scooter

Responsible individuals and registration number on rifles following the field party

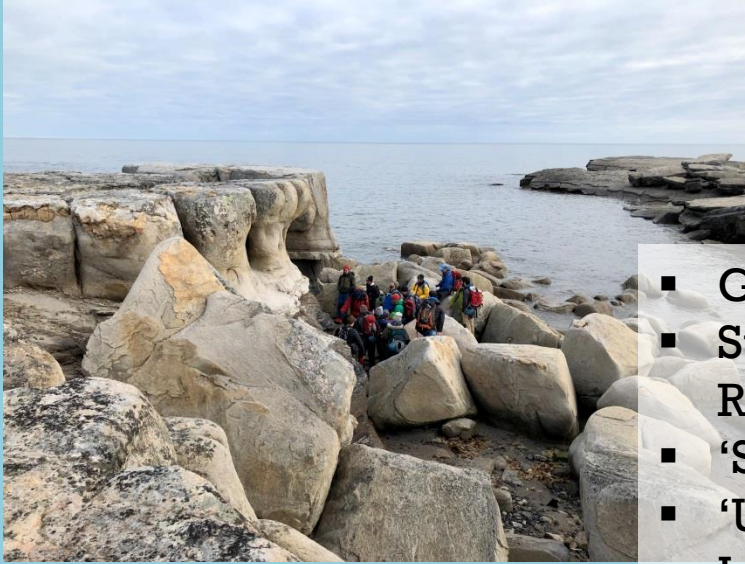
Responsible student / staff	Rifle registration number

.....
(Date and signature) Excursion supervisor.....
(Date and signature) Section for field safety**Mandatory immediate check in / de-brief / evaluation**

Topic	Y	N	Comment
Polar bear sightings / incidents?			
Accidents / incidents / close accidents?			
Equipment failure or damage?			
Cleaning and restoring of equipment done?			
Need for more thorough evaluation?			

.....
(Date and signature) Excursion supervisor.....
(Date and signature) Section for field safety

Who is our target user group?



- Group Size
- Students & Researchers
- 'Supervised'
- 'Unsupervised'
- Isolation & Field Period



Who is our target user group?

- Large Groups →
 - Multiple devices
 - Spread out within the group
 - Group-to-group, group-to-base
 - Responsibilities within the group
- Small Groups →
 - Limited space
 - Group-to-group, group-to-base
 - Backups
- Students & Researchers →
 - Clear instruction on expectations for communication
 - Instructions for use and procedure available 'in-the-field'
- 'Supervised' vs 'Unsupervised'
 - Is there a technician or staff from the field station joining?
- Isolation & Field Period
 - Can the group access cellular network?
 - How far away is help if something happens
 - How long will the group be in the field
 - Battery Capacity

What means of communication are appropriate for our situation?



- Winter
- Summer
- Snowmobile
- Boat
- Hiking
- Camping
- Group Size



Satellite Phones

- When do we use them?
 - We take them anytime we travel or work outside of network coverage, we use them for regular or emergency communication
- User Group?
 - Appropriate for any usergroup
- Different Networks
 - In polar regions we use Iridium satellite phones due to satellite coverage. It's important to assess the area you are working in when deciding what satellite phone you should use. You can decide between satellite phones which use geostationary satellites and low earth orbit satellites.
- How they work
 - Connect to a satellite 'constellation' or geostationary satellite
 - Need sky view
 - Make sure you know how to call other phones. When on the iridium network you dial: 00, country code, phone number
 - Make sure you have an active subscription service or voucher to make calls
- Pros
 - Works 99% of the time with working antenna and charged battery → sometimes patience is necessary for a connection!
 - Intuitive for anyone who has used a cell phone
 - Fairly durable, especially with pelican case
 - Battery will last for several calls
- Cons
 - Satellite phones are costly! The satellite phone can cost over \$1000 USD alone, and calls can cost 15 cents to 15 dollars per minute depending on the plan you have
 - Poor connection with satellites can lead to repeat or dropped calls, you may need several attempts to make a call
 - Need to be outside, unless you are on a ship or building which has put a fixed installation outside

Waterproof Pelican Case

Relevant Emergency Numbers

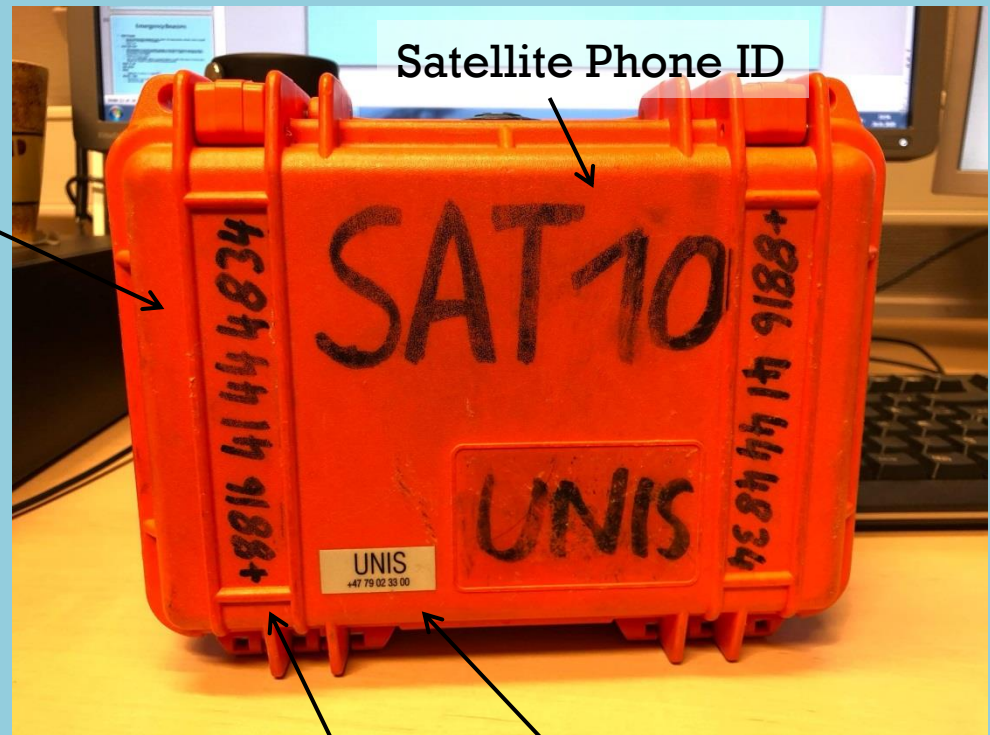


Emergency Procedures

Insulating Foam

Extra Battery

Satellite Phone ID

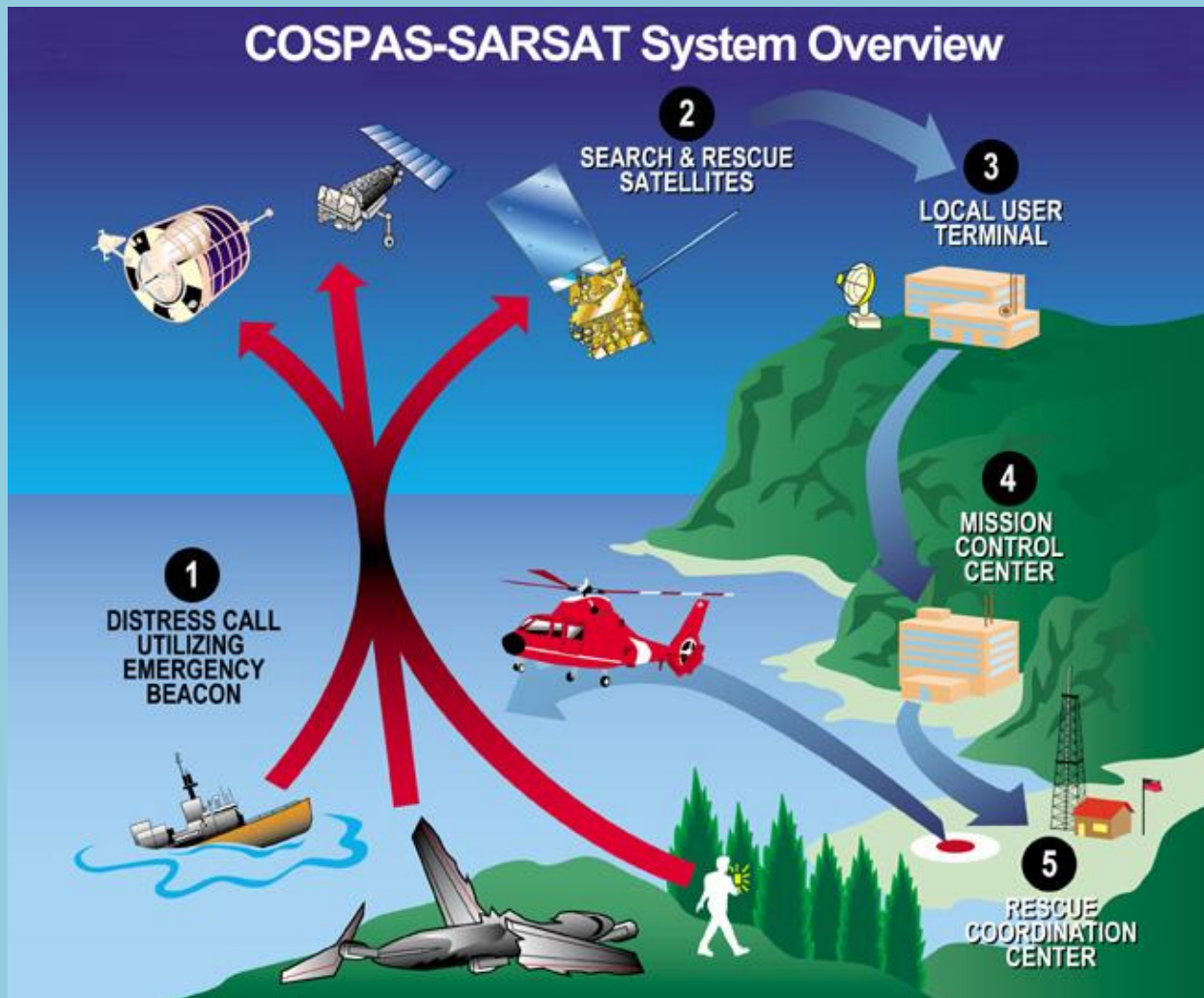


Organization

Phone Number of Satellite Phone

Always know how your device works and test it before using in the field!!

Emergency Beacons



Personal Locator Beacon (PLB)

- When do we use them?
 - We take them anytime we travel in the field, used only in an emergency
- User Group?
 - Appropriate for any user group
- How they work
 - Personal safety device designed to alert search and rescue services and allow them to quickly locate you in the event of an emergency
 - When activated it transmits a coded message on the 406 MHz distress frequency which is monitored by the Cospas-Sarsat satellite system. The alert is relayed to the nearest Rescue Coordination Centre (RCC)
 - Uses internal GPS/GNSS receiver to pinpoint location to within 62m. Once in the area, rescue services can pinpoint using 121.5Mhz homing transmitter
- Setup
 - Registered to a person or organization
- Brands / Costs
 - McMurdo Fast Find 220 USD, typically between 200-300 USD
 - Different brands cater to land/water, so pick out one appropriate for your use
- Pros
 - Cheaper than a satellite phone
 - Works anywhere on earth
 - No cost of ownership after purchase
 - Battery life is up to five years
 - Relatively small and lightweight
 - Durable
- Cons
 - Can only transmit an SOS message
 - Some models can be manually deactivated, some cannot

Floating Cover with ID & Organization



Strap to attach



Diagram for 'how to activate'



Serial Number & Call Sign

Battery Life

Always know how your device works and test it before using in the field!!

Emergency Position-Indicating Radio Beacon (EPIRB)

- When do we use them?
 - We have them on a vessel, we use them only in an emergency
- User Group?
 - Anyone working on a vessel at sea
- How they work
 - EPIRBs are registered to a specific vessel
 - Automatically deploy underwater or manually deployed
 - Utilizes the COSPAS-SARSAT system
 - Transmits for 24-48 hours
- Setup
 - Mounted on the vessel the EPRIB is registered to
- Pros
 - Battery life lasts for six years
 - Reliable for incidents at sea
 - Can be turned off if accidentally deployed
- Cons
 - Only for delivering SOS message, can be accidentally deployed

Manual Deployment

Antenna

Vessel Information

Vessel Name

Battery Life



Always know how your device works and test it before using in the field!!

Marine Very High Frequency (VHF) Radios

- When do we use them?
 - We use them on vessels and on land. Ship-to-ship, ship-to-shore, shore-to-shore. We take them when we will split into smaller groups in the field
 - We can also use them as primary communication means for a station where cellular network is not available.
- User Group?
 - Appropriate for most user groups. It is important that persons responsible for using a VHF radio are trained on proper use. If you use a VHF radio on a vessel, you should have a course
- How They Work
 - Worldwide system of two way radio transceivers on vessels
 - Line-of-sight, does not require satellite, uses antenna towers
 - All frequencies from 30-300MHz, marine is 156-174
- Setup
 - Fixed or portable, depending on use
 - Marine or other, depending on use
 - Possible to setup a mobile relay station with base station and repeaters, to use in an area with no cellular coverage
- Pros
 - Easy to use
 - Works without cellular network
 - Can use for both normal communications and emergency communications
- Cons
 - Limited Range
 - Need to 'follow the rules'
 - Can interfere with scientific equipment



Antenna

Volume Control

On/Off Knob

'Talk Button'

Comms Light

Battery Voltage

Lock Button

Channel

Always know how your device works and test it before using in the field!!

InReach

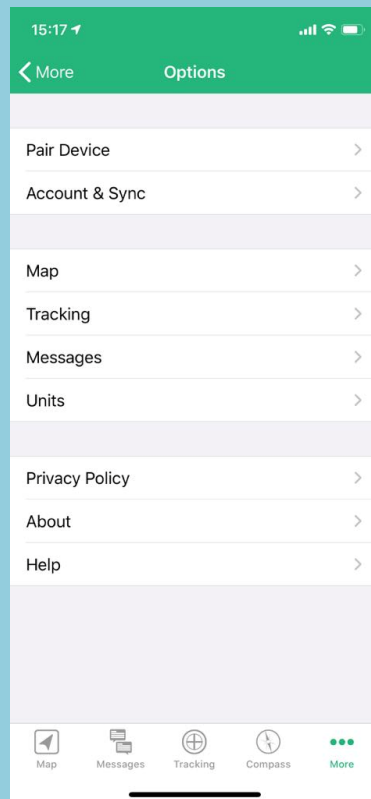
- When do we use them?
 - We use them whenever we go into the field and are out of cellular coverage
- User Group?
 - Appropriate for any usergroup
- How they work
 - InReach uses the Iridium satellite network. They are mainly used as a tracking device and for communication
 - InReach can also be used to alert an emergency situation
 - Emergency or SOS button triggers a private company (GEOS) which will then notify the appropriate rescue service
- Setup
 - The owner purchases a subscription service which allows the user to send tracking information, text messages and emergency notifications
 - Setup preferences before leaving on your trip and use the APP and bluetooth connection to use interface on cellular device
- Pros
 - Cheaper option than satellite phone. 300-400 USD, subscription 20USD/month +
 - Access to weather data
 - Track from 'base station'
 - Ability to 'communicate' in an emergency
 - Battery can last up to 5 days, even when turned on constantly
- Cons
 - Can interfere with other equipment



inReach MINI

SOS Button

Controls



Always know how your device works and test it before using in the field!!



inReach SE
(also inReach Explorer +)

App for using
Bluetooth Connection
to Cellphone



▼ Kartfiltre (På)

[Velg et bokmerke] ▼



Meldingstyper ▼

Dato og tidsrom:

Tilpasset datoområde ▼

Fra: 1. jan 2010 kl. 16.06

Til: 19. okt 2019 kl. 16.06

Rediger

Tøm filtre

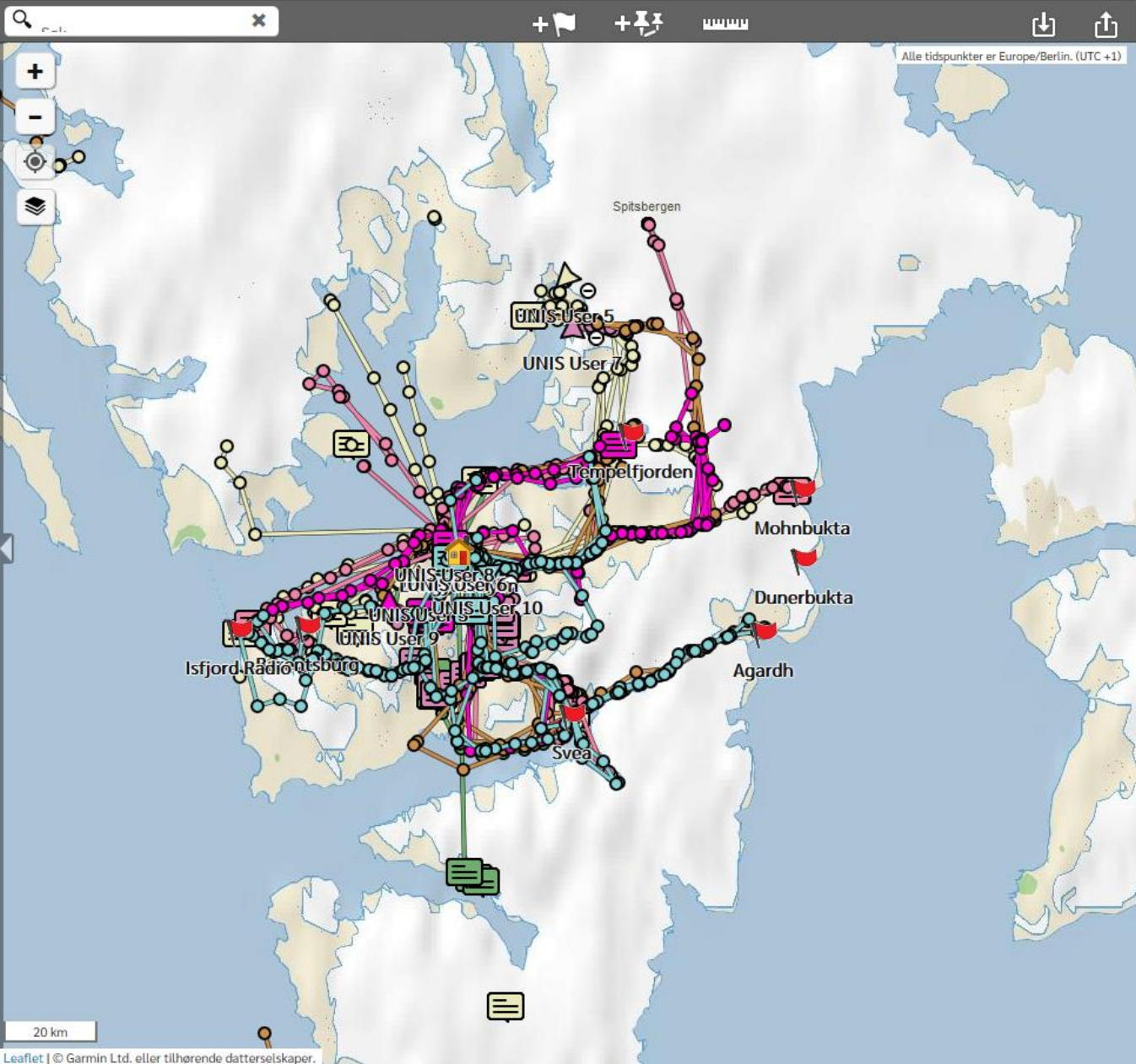
Filtrer brukere

○ ★ ⓘ 📍 ⊕
Spør Lokaliser Melding Send Sentrer

👁 ID Navn ⚙

- | | | |
|---|-------------------------------|-----|
| 👁 | UNIS User 3 | ➔ |
| ⊕ | Siste: 24. sep 2019 kl. 17.16 | |
| 👁 | UNIS User 4 | ➔ |
| ⊕ | Siste: 23. sep 2019 kl. 16.16 | |
| 👁 | UNIS User 2 | ➔ |
| ⊕ | Siste: 23. sep 2019 kl. 16.14 | |
| 👁 | UNIS User 5 | ➔ |
| ⊖ | Siste: 23. sep 2019 kl. 16.12 | |
| 👁 | UNIS User 1 | ✓ ➔ |
| ⊖ | Siste: 23. sep 2019 kl. 16.12 | |
| 👁 | UNIS User 8 | ➔ |
| ⊖ | Siste: 4. sep 2019 kl. 19.33 | |
| 👁 | UNIS User 7 | ➔ |
| ⊖ | Siste: 22. aug 2019 kl. 23.36 | |
| 👁 | UNIS User 9 | ➔ |
| ⊖ | Siste: 31. jul 2019 kl. 15.20 | |
| 👁 | UNIS User 10 | ➔ |

<https://inreach.garmin.com/Admin>

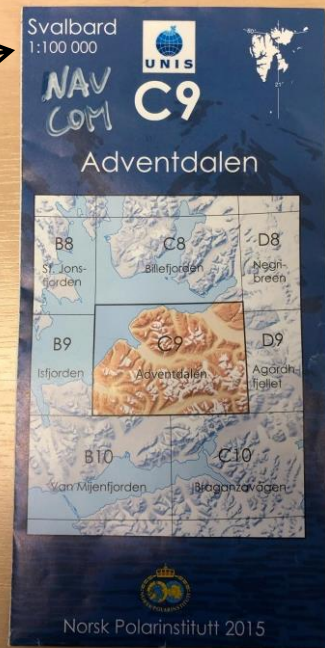


Map & Compass

- Paper Maps & Compass
 - Scale is important! For navigation, use 1:100.000 or smaller
 - Durability: most maps are not waterproof, bring plastic shield or laminate to protect
 - If not primary navigational source, at least bring as a backup
 - Always study beforehand to look at landmarks, obstacles, etc. In Svalbard we often use toposvalbard as a supplement, can also download app on the phone which works offline
 - If you use a compass, make sure to compensate for the magnetic declination!
- Reference Systems
 - Am I working in Latitude and Longitude or UTM? Lat Long is always used at sea, and for rescue purposes. UTM is used on land, and for mapping purposes (ArcGIS)
 - Lat Long can be written in three different formats:
 - Degrees Minutes Seconds 00°00'00"
 - Decimal Degrees 00.0000°
 - Degrees Decimal Minutes 00°00.00'
 - UTM is written in the following format: Zone, Easting, Northing

Map Scale!

Correct for magnetic declination

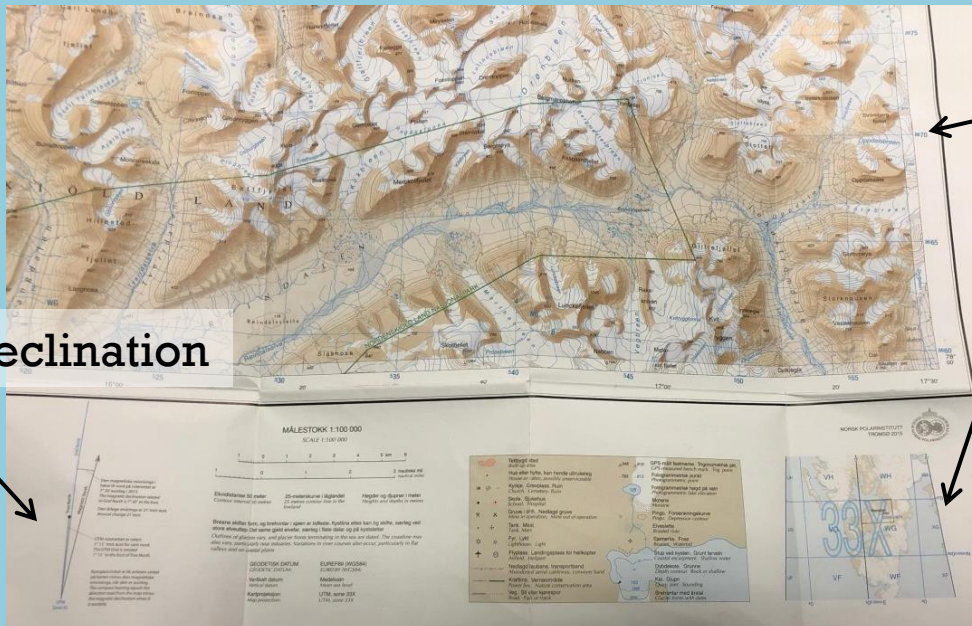


Map Grid

UTM Zone

Magnetic Declination

Always know how your device works and test it before using in the field!!



GPS

- When do we use them?
 - We take a GPS anytime we go into the field
- User Group?
 - All usergroups
- How they work
 - GPS is based on the time and known position of GPS satellites. Each satellite transmits a radio signal with the time and position, 31 satellites in total
- Setup
 - Setup the GPS unit before you go into the field with the correct units and positioning system for your use
 - Use a program (Ozi Explorer, Garmin Basecamp, MapSource, ArcGIS, etc) to download and upload tracks, routes, waypoints
 - For use with snowmobiles, install charging mount which charges the gps off of the battery
- Pros
 - Very reliable source of navigation in the field
 - Plenty of models, suited to every need
 - User friendly
- Cons
 - Dependent on battery life
 - Can be difficult to operate in the cold
 - It's Technology, so it can break down!
- Different brands
 - We use Garmin at UNIS
 - Cost 100-600 USD

Garmin E-trex
Good for waypoints



Garmin Montana
Good for driving snowmobile, hiking



Garmin 64 series
Good for hiking

Always know how your
device works and test it
before using in the
field!!



Garmin 276Cx
Good for snowmobiles, boats

Storage Space



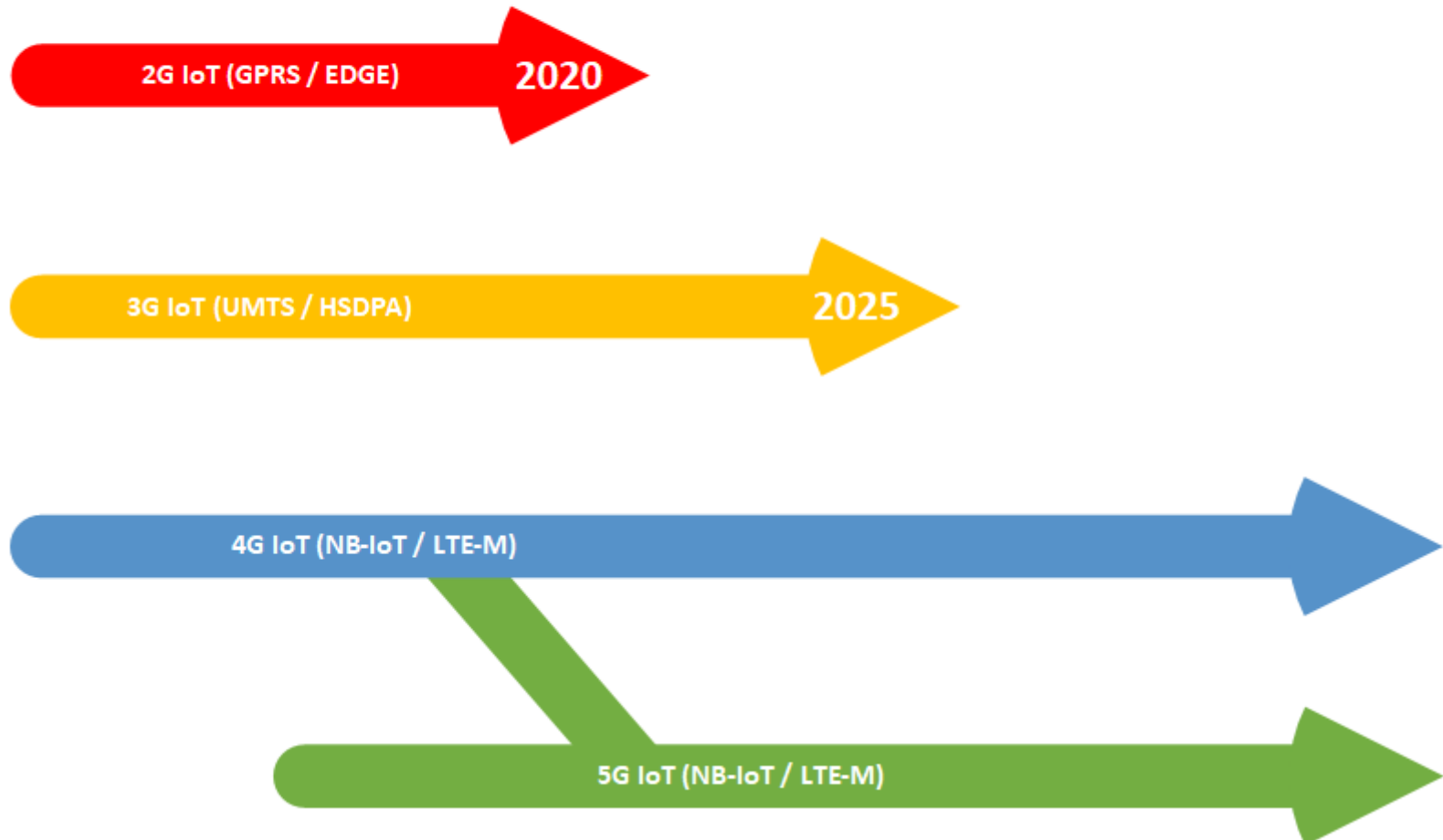
Most Important!

- 'Double Up' Principle
- Always bring two forms of communication
 - Those two forms should be different
- Always prepare for dead batteries
 - Extra batteries
 - Battery Bank
 - Solar Panel Charger
 - Generator
 - Connection to snow mobile

What Can We Expect?

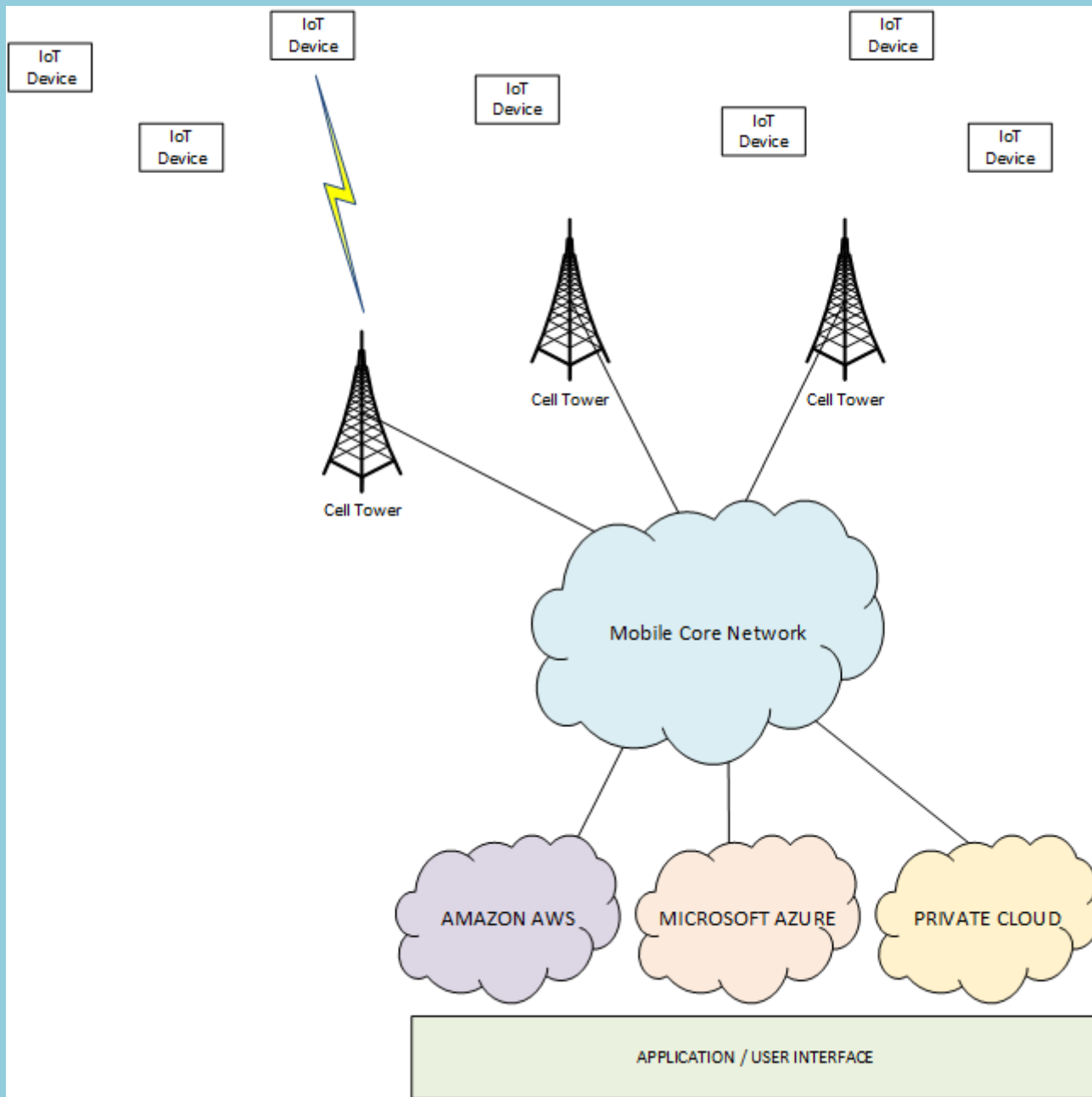
- OneWeb/Starlink
 - Will offer worldwide satellite based broadband coverage
 - Services will team up with local service providers who you can purchase the product through
 - Purchase a terminal to distribute broadband and then set up network either with WIFI or 4G/5G
 - After terminal is setup, any kind of device is usable over the network
 - Orbits run on different inclinations so choose what is viable for your location
 - OneWeb is launching 34 satellites today!
 - Service can be available in the next 5 years

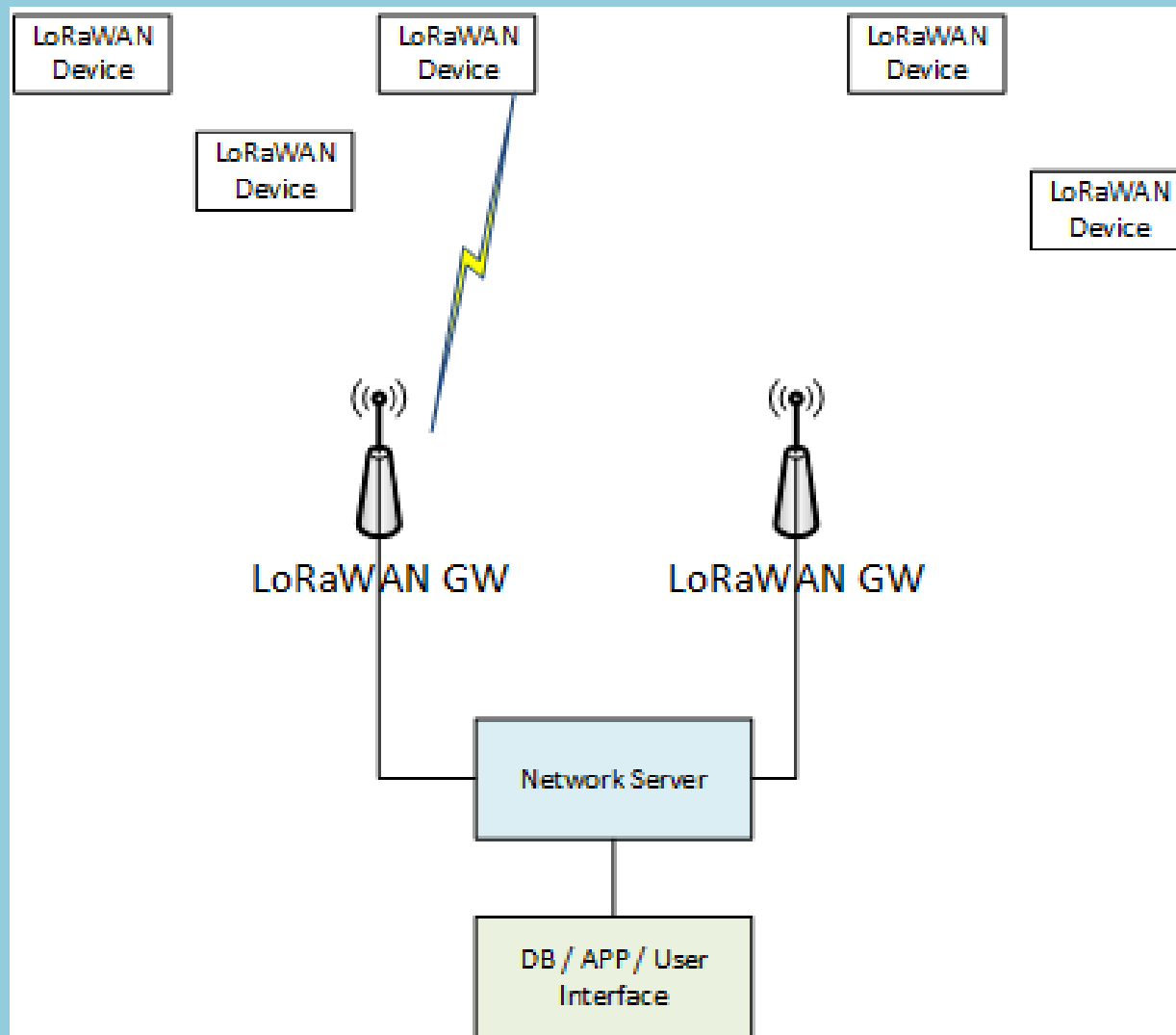
Expected mobile network availability in Norway



IoT, Narrowband, LPWAN – What is it?

- Narrow Bandwidth, Low Power Wide Area Networks
- Technologies available
 - LoRa / LoRaWAN / Sigfox
 - Non global standardization
 - Open spectrum
 - Can be set up as stand alone networks
 - NB-IoT / LTE-M (Mobile Networks)
 - Global standardization (3GPP / GSMA)
 - Licensed spectrum
 - Can only be used inside the coverage of a network provider (up to 100km)
 - SIM card based authentication for strong security
- Narrow bandwidths allows for long range communications with a minimum use of transmission power. LoRaWAN has the record of 766km using just 25mW of transmission power.
- With the use of low power sensors, it allows for devices to be operated on small batteries for a very long time.
- Example: The DRIVA snow sensor uses a first generation NB-IoT chipset which allows for up to 7 years of operation. It uses $<20\mu\text{A}$ when it sleeps – and only $622\mu\text{Wh}$ every time it sends the sensor data over the cellular network (every 10 minutes). Next generation NB-IoT chipsets will half the power consumption.
- All these technologies are based on simple chipset designs which allows for low cost devices compared to legacy 2G/3G-modems widely used today.





Thank You!

Questions

