

WP 7: Arctic Communication Technologies



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WP 7 – Objectives

- Extending coverage and range at sea for both in-use and novel terrestrial wireless systems/technologies, e.g.:
 - Cellular: GSM/GPRS/EDGE, 3G/UMTS/Turbo-3G (LTE)
 - Wireless broadband (WBB): WiFi/WLAN, WiMAX, CDMA 450 (ref. Ice)
 - Wireless narrowband (WNB): Digital VHF (D-VHF, VHF Data, VDL...), AIS, LRIT, Reclaimed VHF/UHF TV-bands (?)
- Finding appropriate SatCom solutions to complement the terrestrial ones, mainly beyond their coverage, e.g.: Inmarsat (BGAN), VSAT; DVD-RCS, DVD(/S2)-RCS(2), Molniya orbits (?)
- Obtaining seamless and continuous handover and roaming within and between the pertinent systems

WP7 – Work Structure

Literature studies
Other projects
Field tests

Workshops
Meetings

State-of-the-
Art study

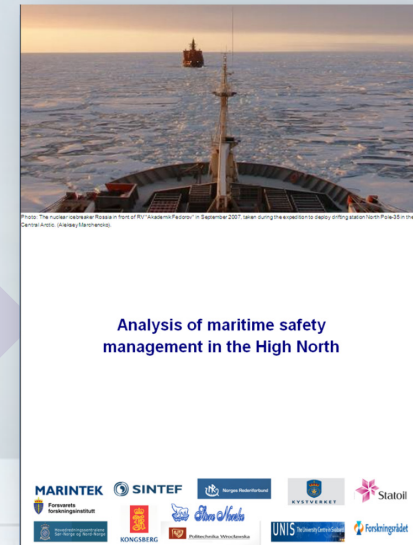
Today's user
requirements

Workshops
Meetings
Scenario studies

Literature studies
Other projects

Future user
requirements

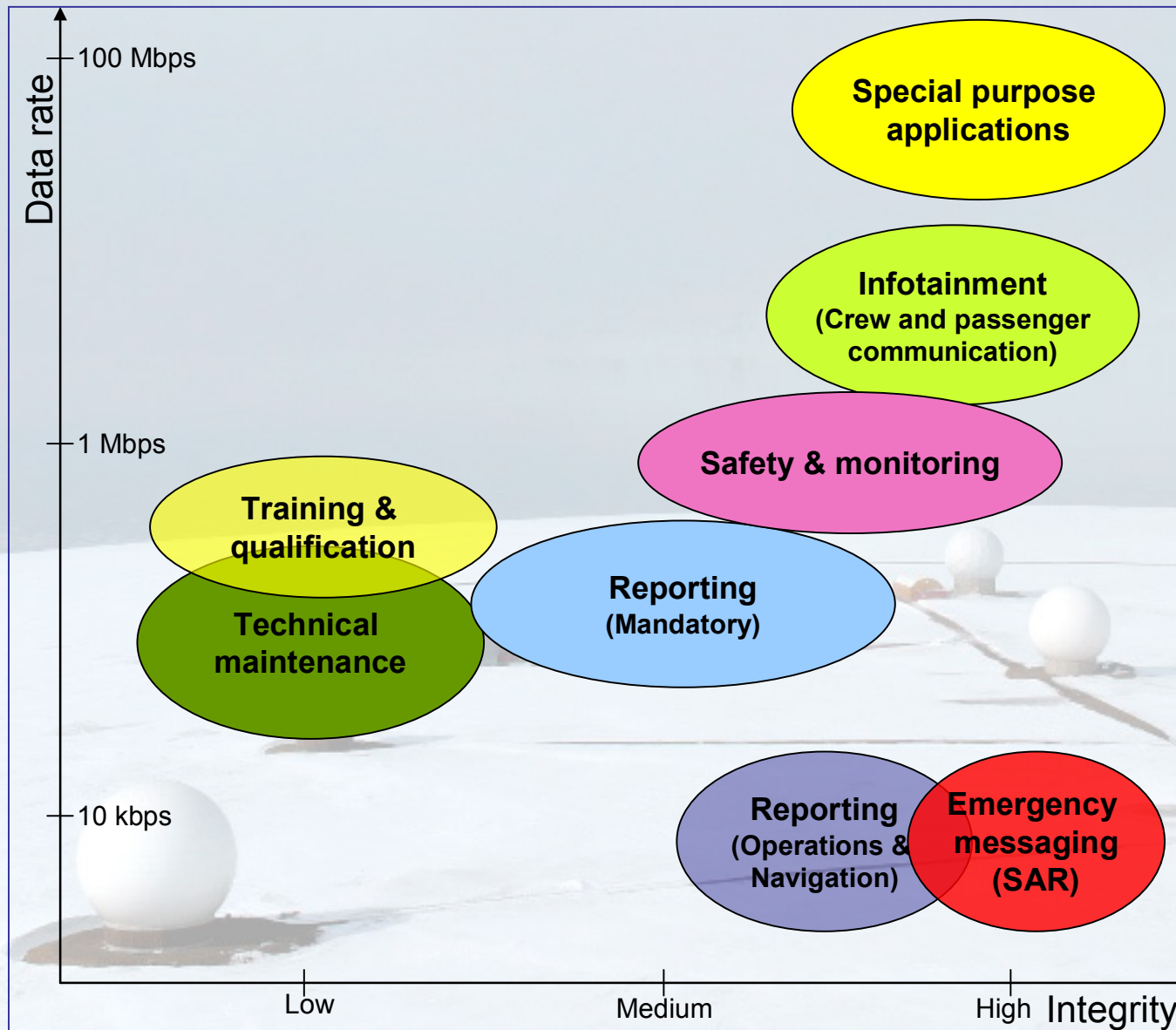
Technical
requirements



Future emergency operations – Shared situational awareness?



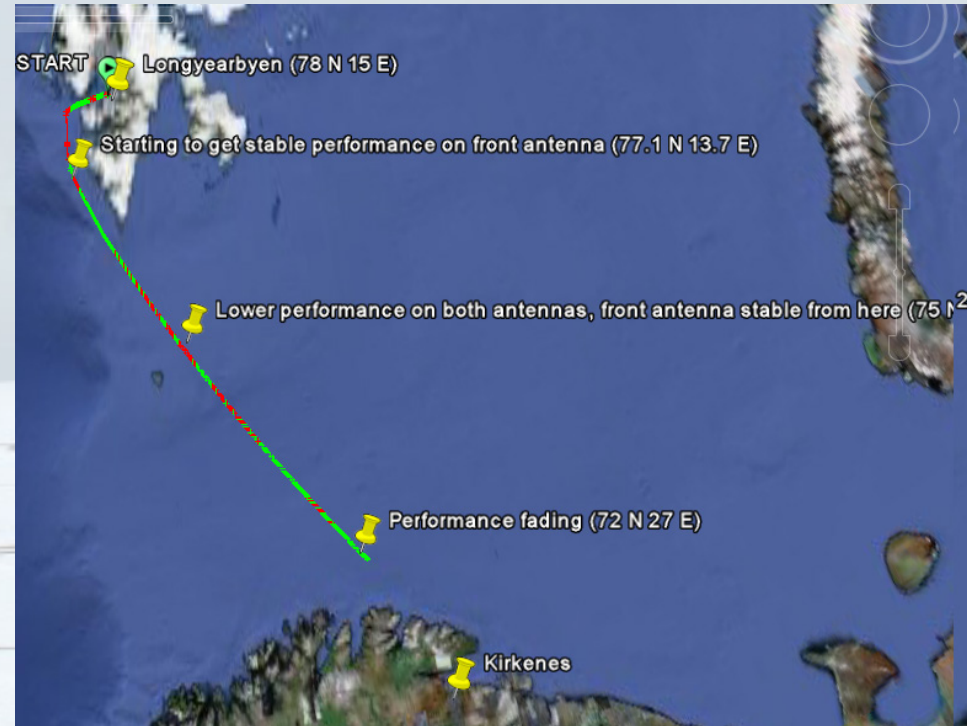
Compiled user requirements



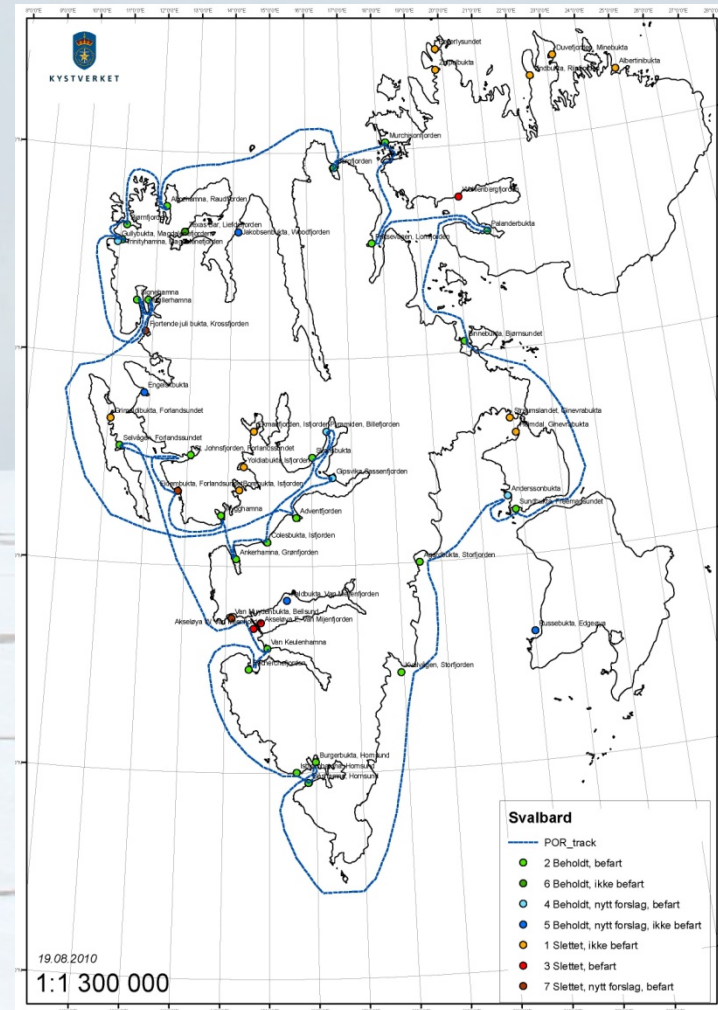
Trends for information exchange

- Higher safety and efficiency requirements requires more reporting and monitoring
- More use of video and tools for remote monitoring, training and shared situational awareness
- Increased transparency in information management (data gathering, storage, broadcasting and exchange)
- Higher quality and integrity on information
- **REQUIRES COMMUNICATION SYSTEMS WITH SUFFICIENT QoS AND COVERAGE**

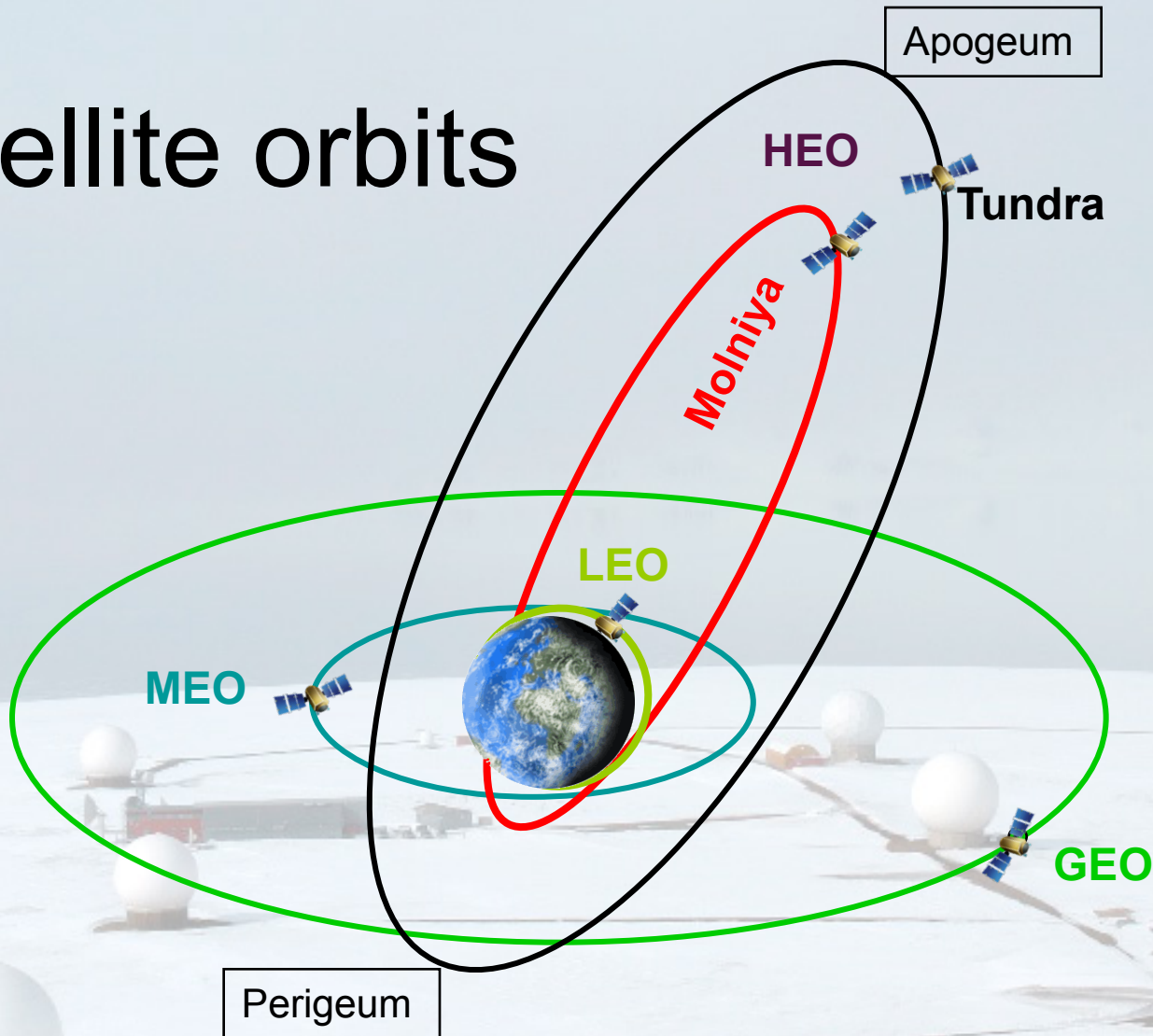
Field test at KNM Otto Sverdrup



Field test at KV Svalbard



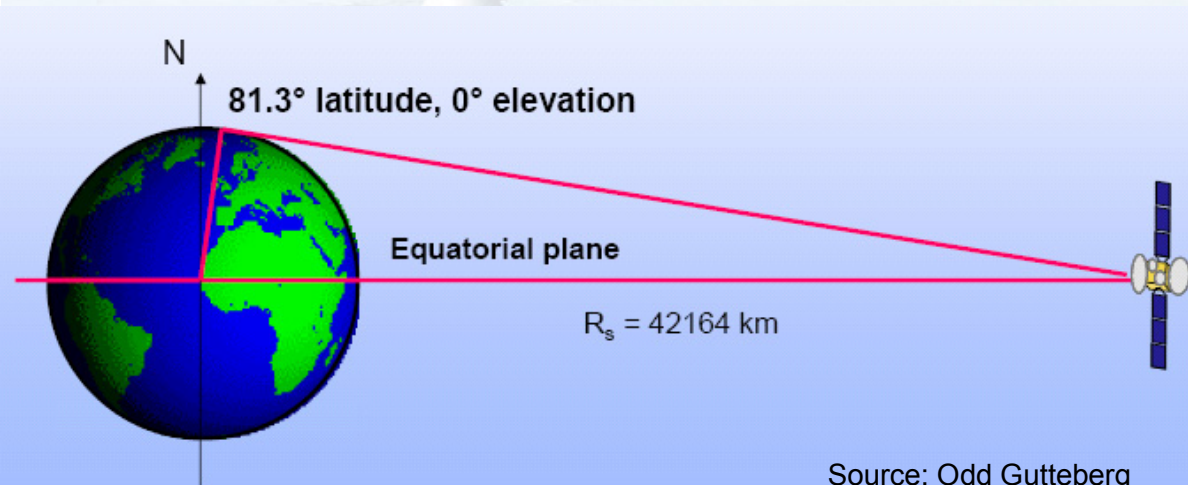
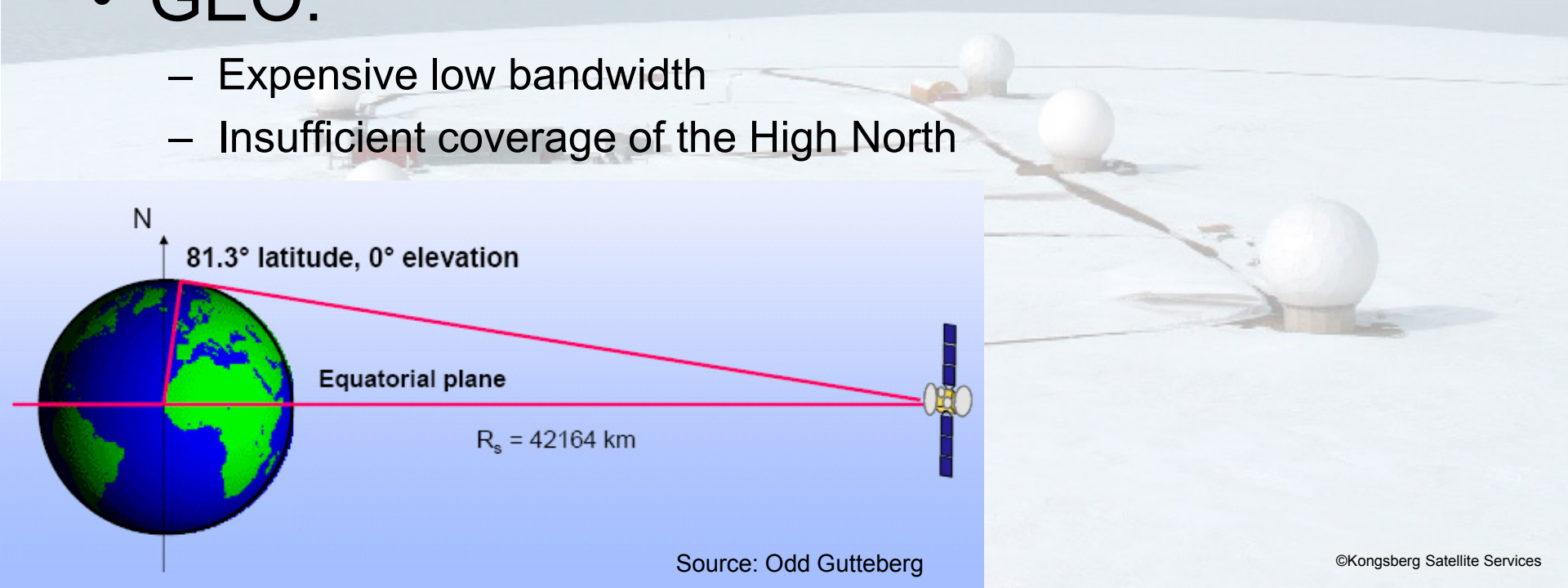
Satellite orbits



- **LEO: Low Earth Orbit** (Height: 200 - 2000 km)
- **MEO: Medium Elliptical Orbit** (Height: 2.000-GEO, normally: 10.000-20.000 km)
- **GEO: Geostationary Orbit** (Height: 35.786 km)
- **HEO: High Elliptical Orbit** (Height: 500-50.000 km)

SatCom limitations

- LEO:
 - Satellite → Gateway → Satellite transmission
 - Low bandwidth (\sim GSM \Rightarrow GPRS)
 - High and unpredictable latency
 - Uncertain performance in the High North
- GEO:
 - Expensive low bandwidth
 - Insufficient coverage of the High North



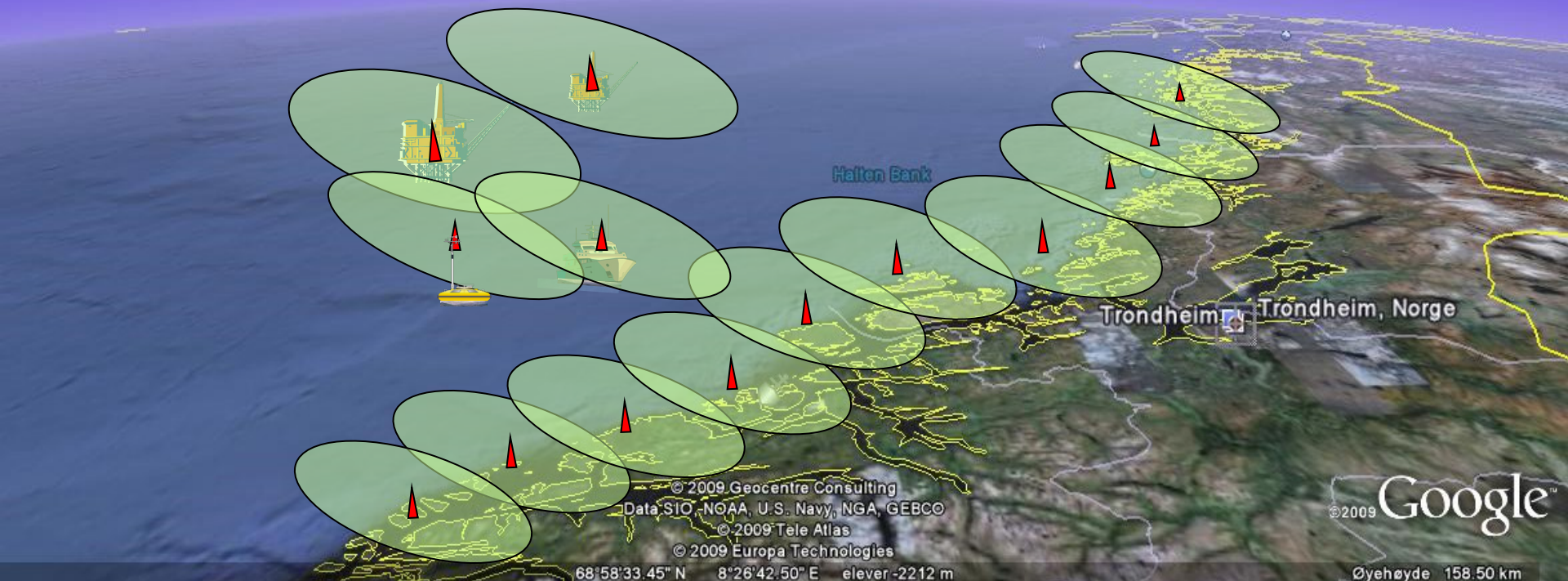
Source: Odd Gutteberg

Available communication technologies

	System	Characteristics	Polar ($>80^{\circ}\text{N}$)	Sub-Polar ($70^{\circ}\text{N} - 80^{\circ}\text{N}$)	Other ($<70^{\circ}\text{N}$)
Terrestrial systems	HF, MF	Safety related messages and voice communications	OK, but unsuitable for digital communications	OK, but unsuitable for digital communications	OK, but unsuitable for digital communications
	VHF, digital VHF, GSM, 3G	Line-of-sight, voice and low data rate communications	No base stations, ship-to-ship OK	Few base stations, ship-to-ship OK	VHF is OK close to the coast, GSM/3G limited coastal coverage
Satellite systems	GEO satellites, including Inmarsat.	Medium capacity. Low to medium latency.	Not available	Potential problems with quality and availability	OK (except in fjords and similar special areas)
	LEO satellites; Iridium <u>OpenPort</u>	Currently max. 128 kbps. High and variable latency.	Potential problems with quality	Potential problems with quality	OK, except for areas around equator
	HEO satellites	Properties comparable to GEO. Currently unavailable.	Expected to provide good coverage, capacity and quality in the Polar and Sub-Polar areas. Spare capacity can be used in other sea areas. Not yet implemented.		

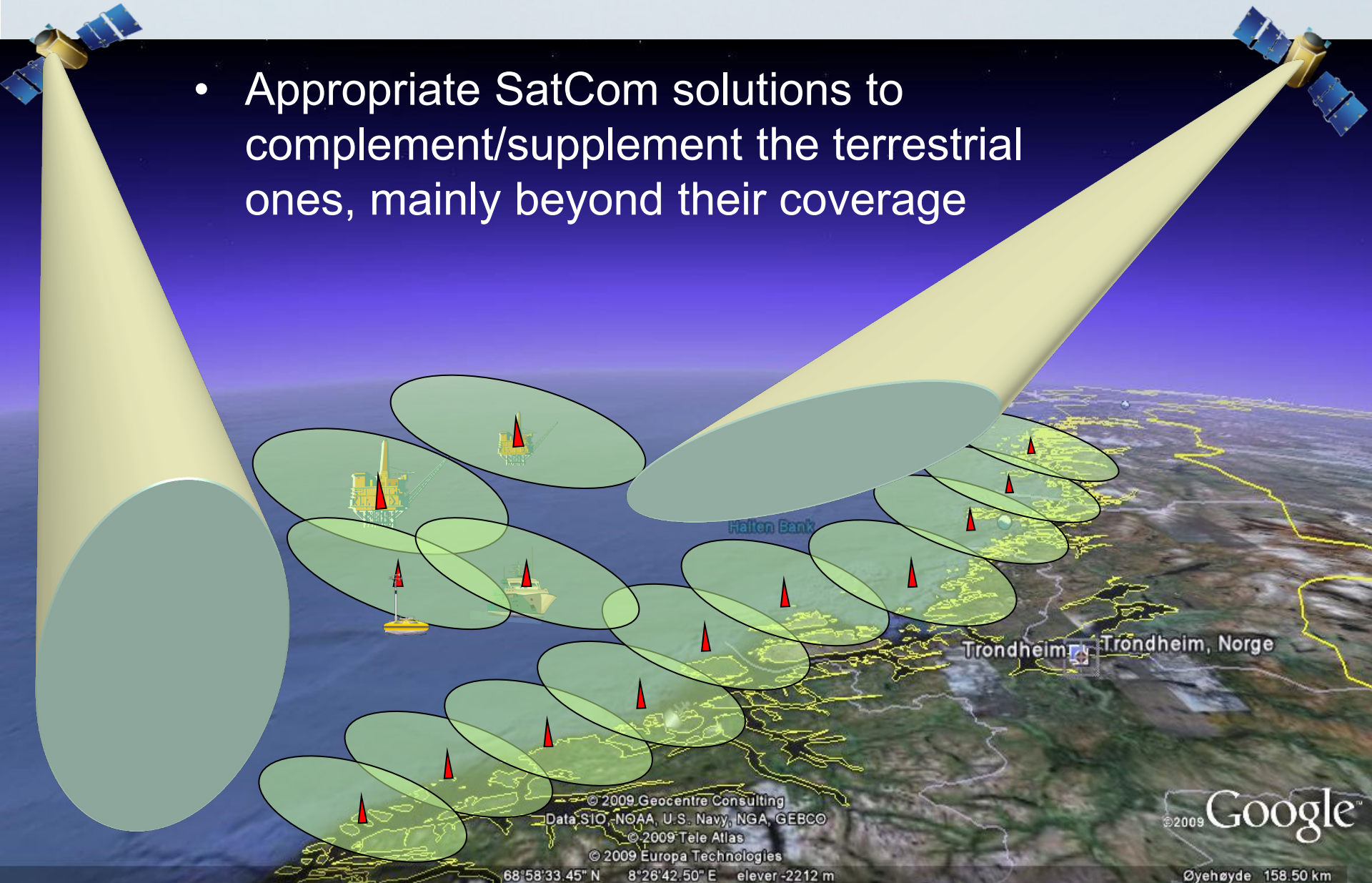
WiCAN terrestrial

- Extending the coverage and range at sea for both in-use and novel terrestrial wireless systems/technologies, utilizing:
 - *Coastal Base Station Chain*
 - *Offshore Platform Base Stations*
 - *Mobile Multi-hop Relay (MMR) & Mesh Networking*



WiCAN satellites

- Appropriate SatCom solutions to complement/supplement the terrestrial ones, mainly beyond their coverage



Other technological solutions

- **Satellite**
 - New HEO communication satellite system (PWC, PolarStar, Cascade)
 - Iridium NEXT
 - Combined HEO – Inmarsat solution?
- **Using UAV's or drones for extended coverage**



Conclusions

- **Communication is an important premise for safe and efficient maritime operations**
- **However, the market is limited, and developing communication infrastructure in the High North will probably be a private-public business**

Further work



- **Increase competence on navigation- and communication system performance versus degradation factors such as ionosphere and icing of antennas (MARENOR)**
- **Modeling communication performance (MARENOR)**
- **Improved on-site and terrestrial communication (DiMaRe)**