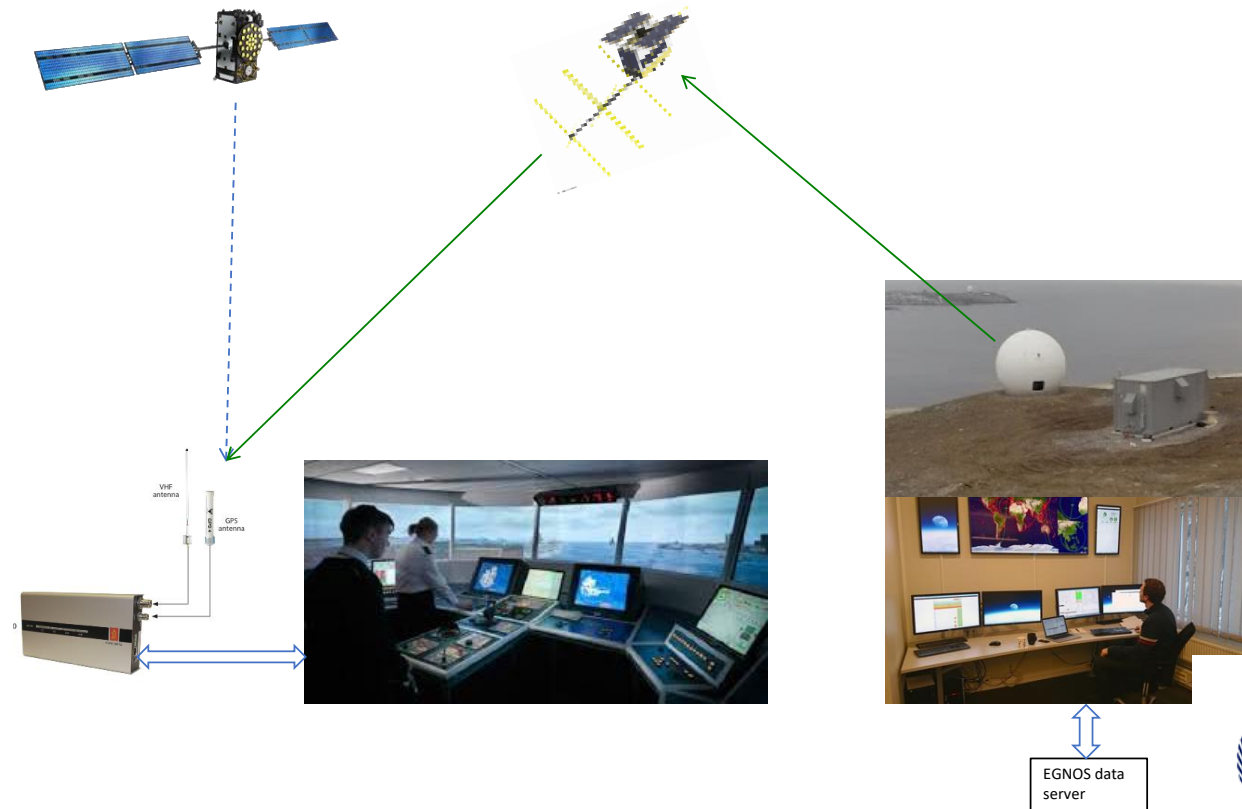
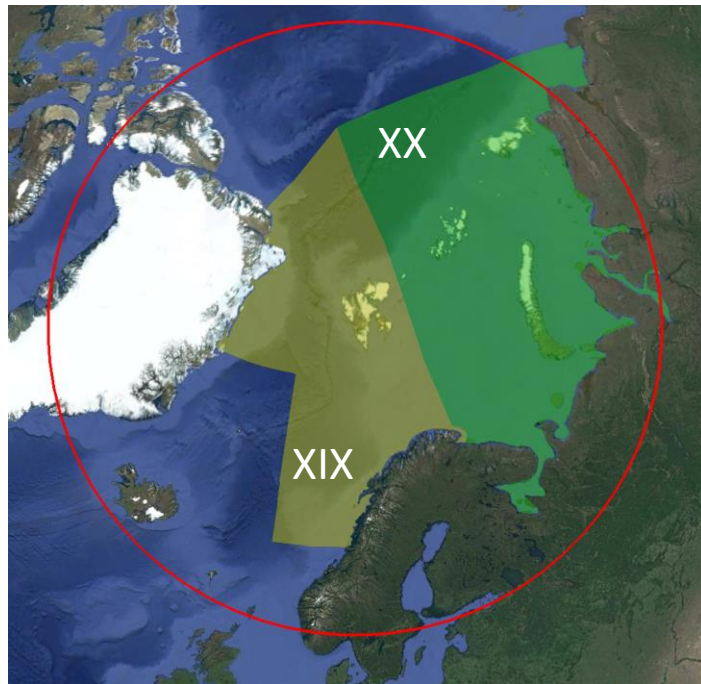


GNSS AUGMENTATION USING VDE-SAT

IALA ENAV22 v2
Paris 11 October 2018

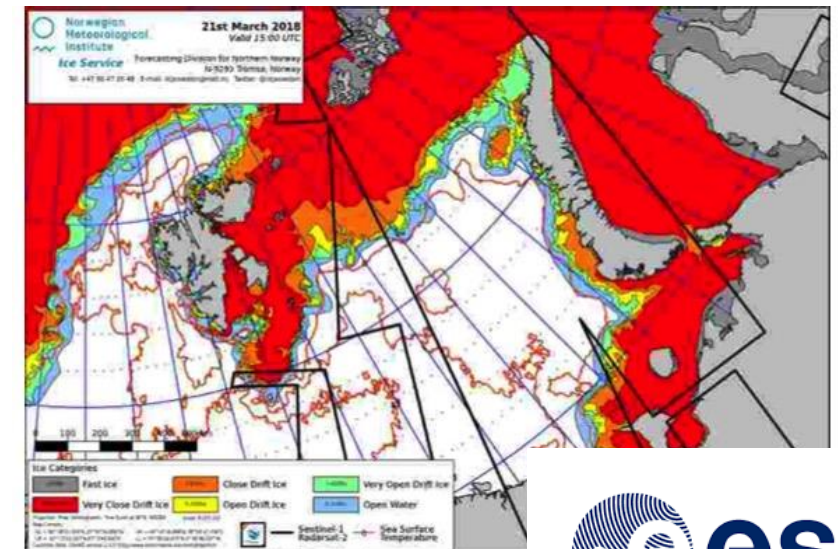
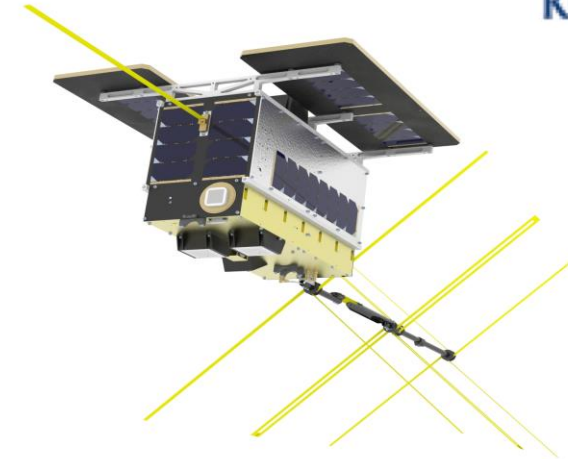


AMNAS Study - Summary



KONGSBERG

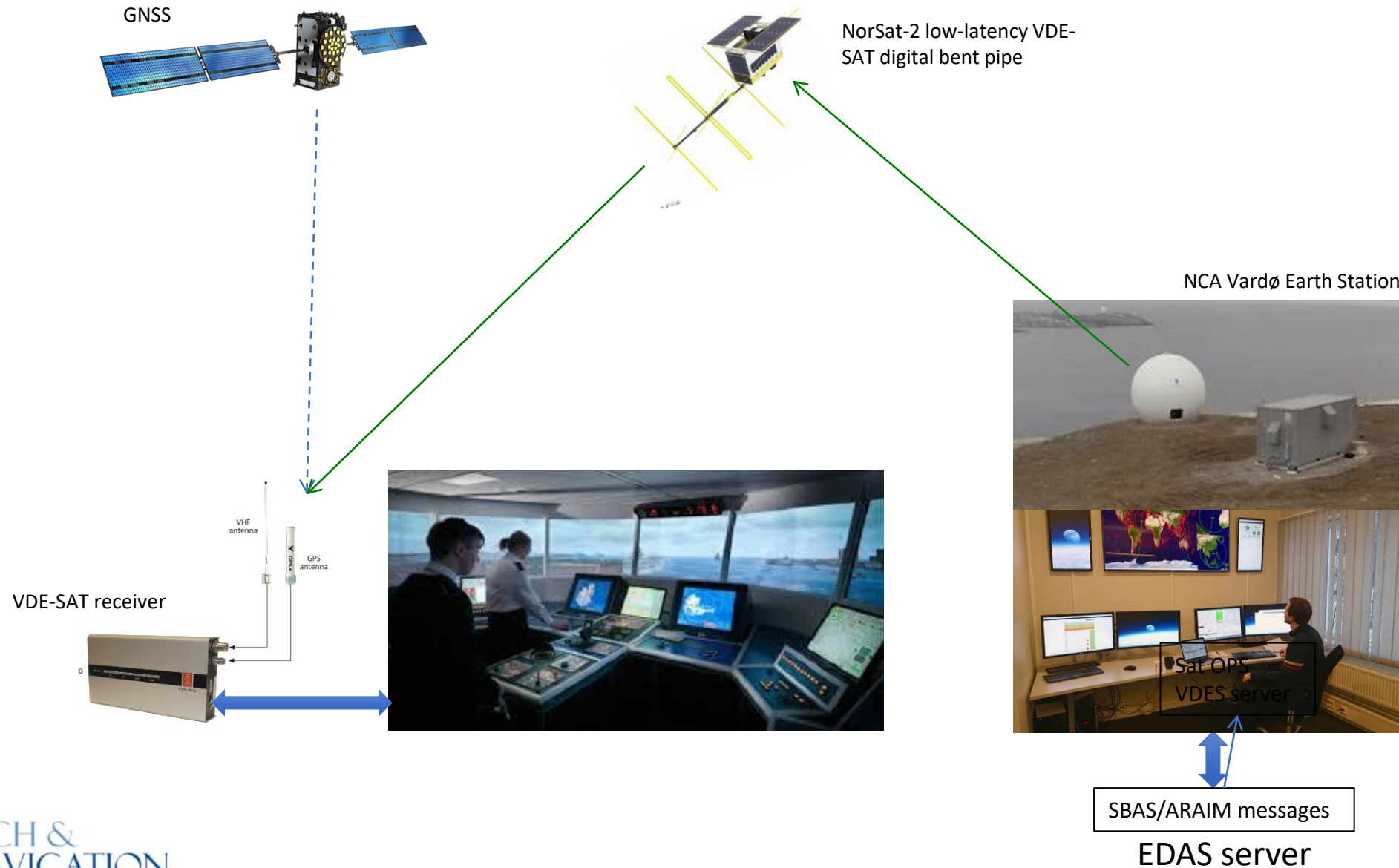
- VDE-SAT can provide wide area coverage in the Arctic and elsewhere
- The NCA NorSat-2 has already broadcasted icecharts over the Barents sea
- An ESA study by Kongsberg Seatex, General Lighthouse Authorities of the UK & Ireland and Space Norway has concluded that low latency satellite-based augmentation (SBAS) messages and Advanced RAIM integrity support messages can be provided by VDE-SAT
- These satellites can be very small (4 litres) and the number varies with latency and coverage requirements from 3 to roughly 25



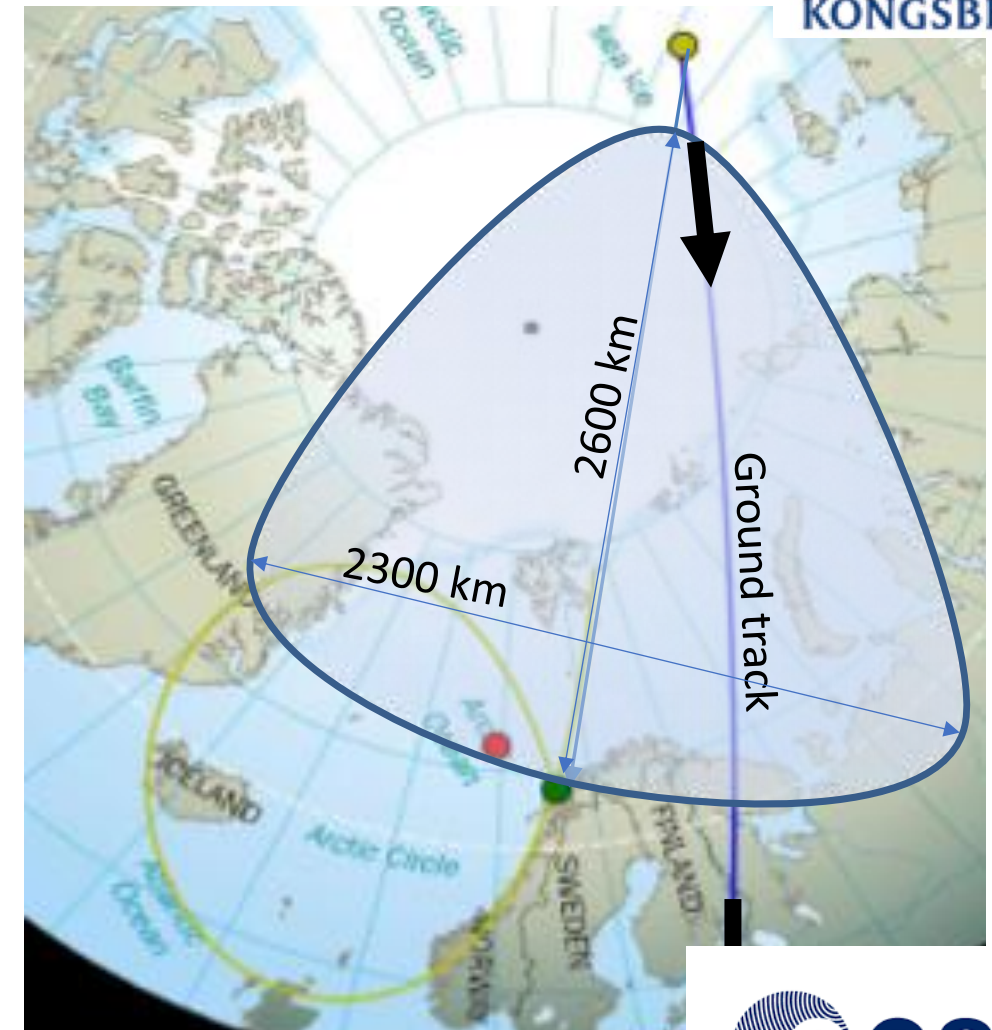
Arctic EGNOS demo system (VNADS)



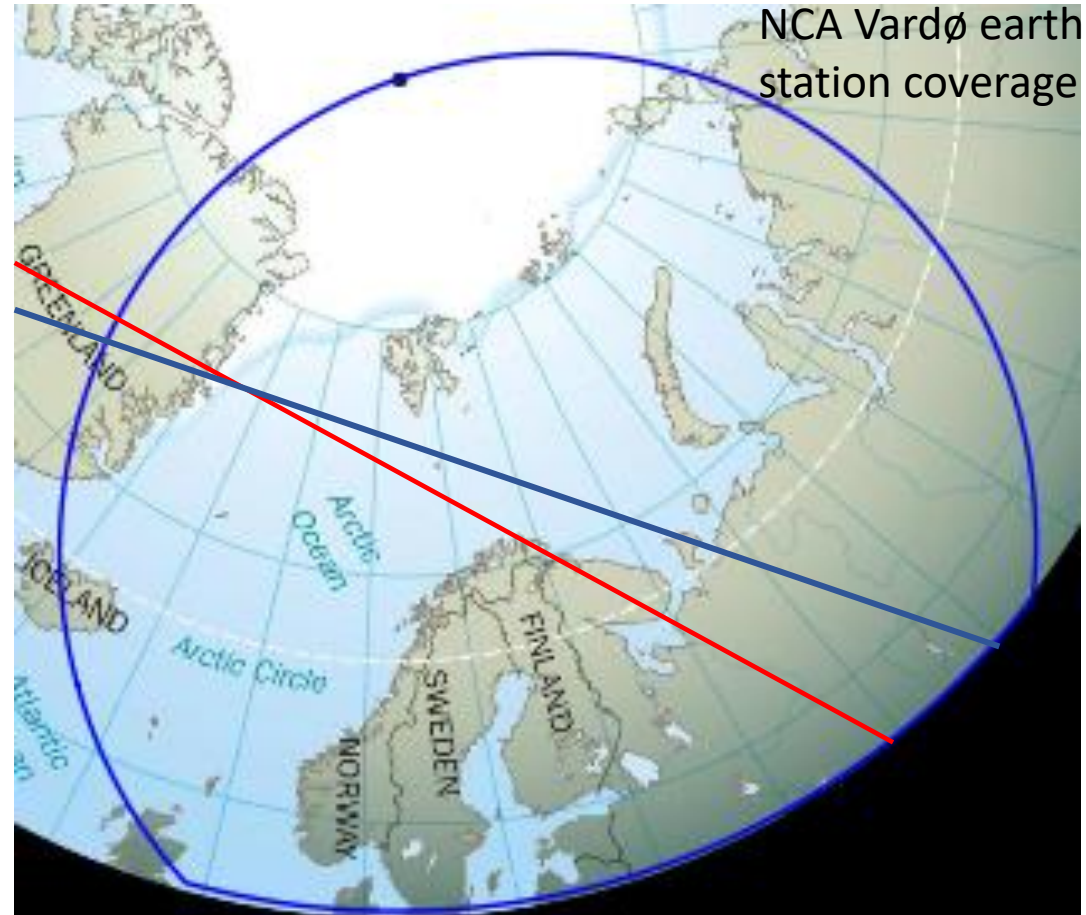
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- SBAS
 - > 250 bps throughput:
One VDE-SAT channel
 - < 1 s latency:
New 15-slot format updated every 0.8 s
 - < 10 s end to end latency:
20-25 cubesats w/propulsion for orbit phasing
- Online ARAIM
 - < 15 minutes latency:
6-7 cubesats for services above 70N
 - > 7 kbits/minute:
117 bps average



- NorSat-2 programmed as a digital bent pipe can keep latency below 1 s within coverage area
- The service concept will be tested and demonstrated next year under an ESA contract using the NCA Vardø earth station and vessels in Northern Norway (70N) and Svalbard (80N)



- VDE-SAT can complement current SBAS coverage to the Arctic regions, however validity of the corrections must be verified
- The concept can be applied to any region using inclined orbit satellites
- ARAIM services can be delivered with a handful low cost satellites
- VDE-SAT would operate as low-latency digital bent pipes
- Demonstrations planned in Northern Norway and Svalbard before WRC-19
- Requires support for VDE-SAT frequencies at WRC-19 by all IALA member states

