



PERFORMANCE BASED NAVIGATION ON AVIATION'S MARRIAGE WITH THE SATELLITES

NORDIC INSTITUTE OF NAVIGATION
Seminar on Safety and Security Issues in
Positioning, Navigation and Timing

Wednesday 14 June 2023
Jens Gjerlev
WIDERØE'S FLYVESELSKAP AS





Widerøe - key numbers



Norway's oldest airline - established 1934
26 Dash-8-100/200 turboprop aircraft
4 Dash-8-300 turboprop aircraft
12 Dash-8-400 turboprop aircraft
3 Embraer 190-E2 jet aircraft
50 destinations
8 international
24 STOLPORTS 800m runway in Norway
450 flights per day
2.450.000 passengers
3000 employees ('FTE')
Turnover 570 MUSD in 2022
Profit -1.6 MUSD in 2022

Widerøe Dash-8 STOLPORT operation

'Shaken, not stirred'



- 24 STOLPORTS along the coast
- Short runways - 800m
- Steep approach - 4.5°
- Turbulence and frontal weather
- Winter operations and contaminated runways
- Uncontrolled airports



Flight Management System - FMS



NAV 1/3 M

FR PUFFR	18:26	HDG→
249° 8.4NM	0+01	
TO PIEKE	18:30	MNVR→
249° 39.9NM	0+05	
NX KOHOE	18:36	APPR

XTK(T) LO-02	G5	430
WND 165T/ 4	ANP	0.03
	RNP	1.00

DATA NAV VNAV DTO LIST PREV 1 2 3

FUEL FPL PERF TUNE MENU NEXT 4 5 6

A B C D E F G 7 8 9

H I J K L M N BACK 0 MSG

O P Q R S T ON/OFF DIM ±

U V W X Y Z ENTER



GPS is used in all phases of flight

ENROUTE NAVIGATION

'Basic RNAV' - RNAV-5 - RNP 5 NM (1998)

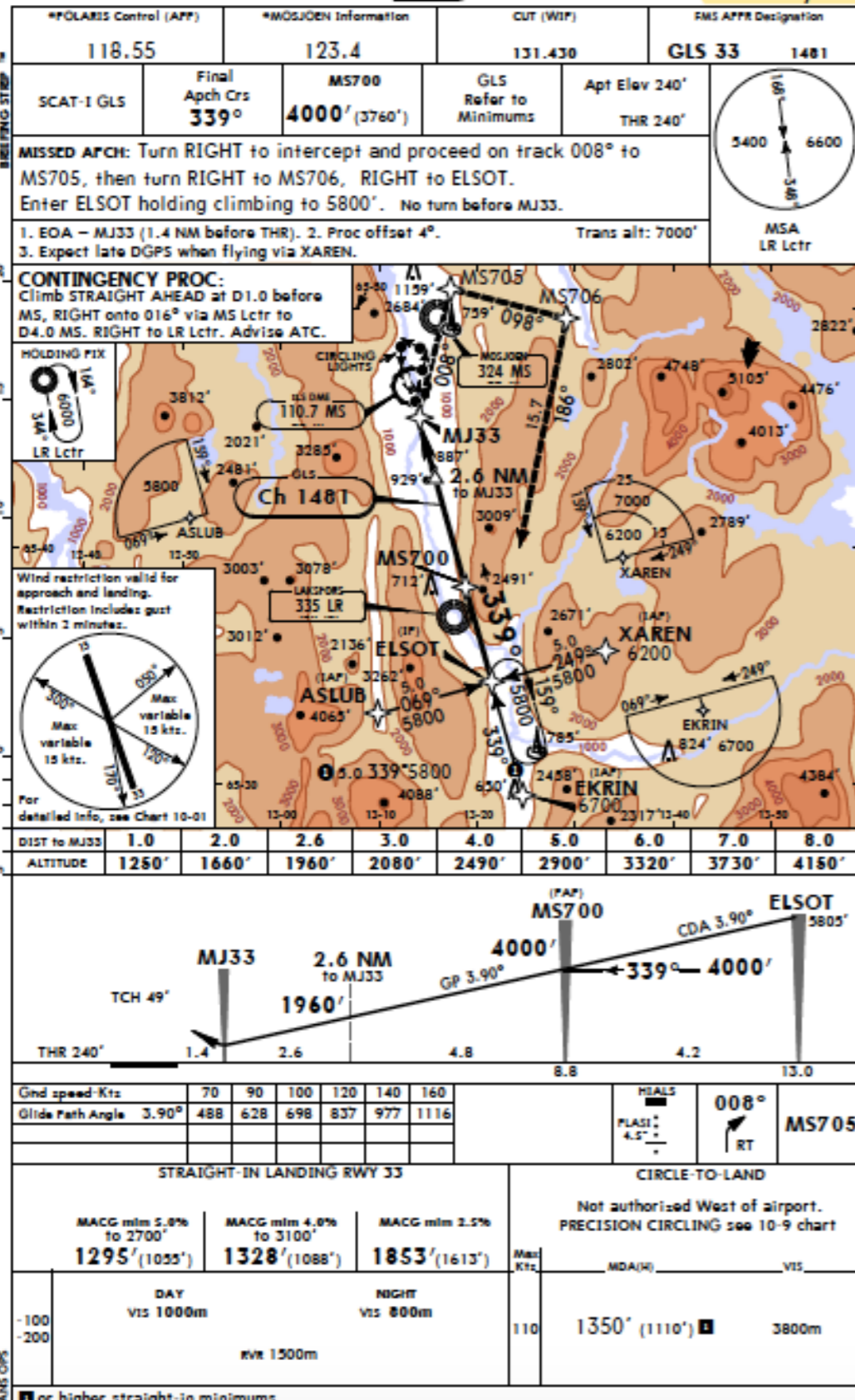
TERMINAL AREA NAVIGATION - CLOSE TO THE AIRPORT

'Precision RNAV' - RNP 1 NM (2001)

APPROACH PROCEDURES

RNP APPROACH - RNP 0.3 NM - missed approach: RNP 1 NM (2003) - new applications 0.1 NM





Widerøe's GLS story

- Following two 'CFIT' accidents, 'SCAT-I' GLS approaches were introduced from 2007
- 'Electronic glideslope'
- Full 3D control of flight path
- ILS like, but better precision
- GLS uses augmented differential GPS correction signals, sent from a ground station at the airport

GNSS will be sole means from 2030

- Performance Based Navigation (PBN) is now being rolled out
- Objective: Increased safety, efficiency and capacity
- EU Implementing Rule effective from 6 June 2030
- «Exclusive use of PBN»
- Conventional navigation facilities will be decommissioned except for a small back-up network

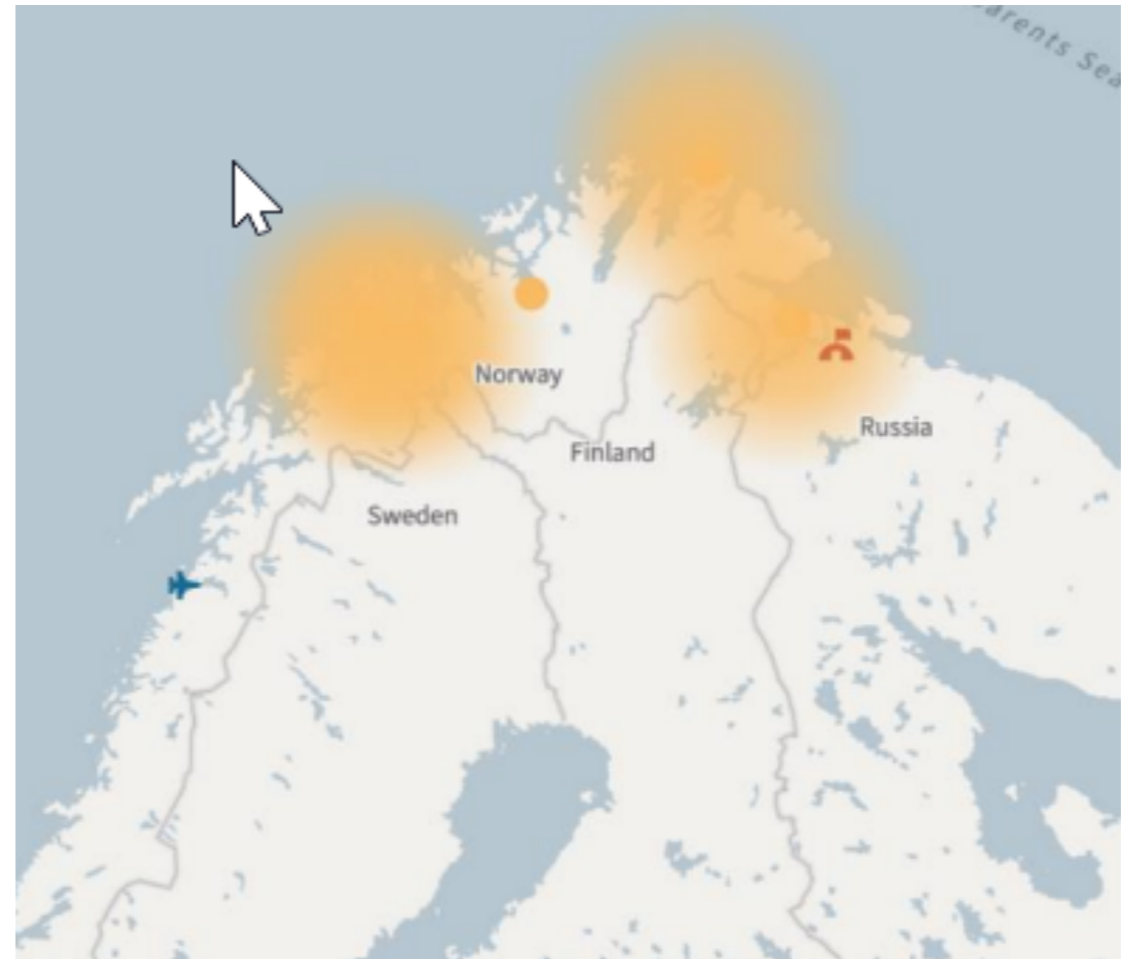
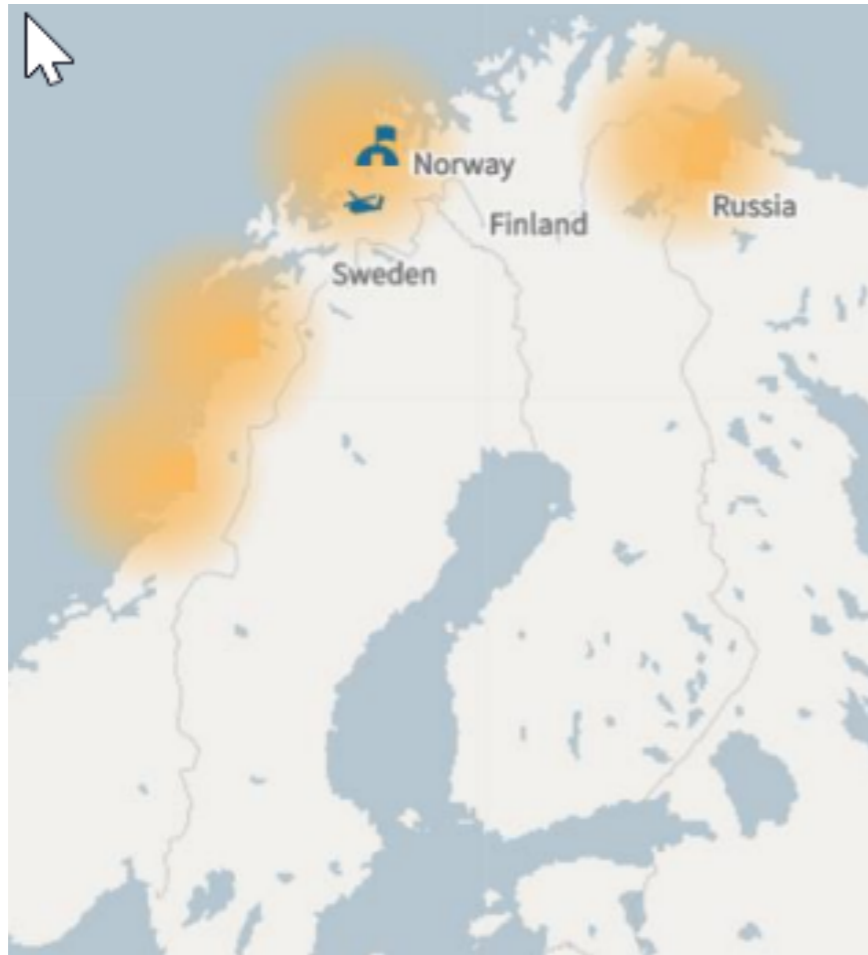


GPS jamming

- WIDERØE was first exposed to jamming in 2017
- In connection with military exercise in 2018/19 new extensive jamming for prolonged periods of time
- Following Russia's invasion of Ukraine, jamming has become a new normal situation



Jammed areas



How this is displayed in the cockpit



Mitigations

- Reversion to conventional navigation, observing minimum safe altitudes
- Request radar assistance from air traffic control
- Usually GPS is re-acquired at lower altitudes
- Equip aircraft with Inertial navigation
- Longer term: Design FMS for multi-constellation and dual frequency capability
- Dedicated anti-jamming tools for civil aviation



THANK YOU!

