AIR NAVIGATION SERVICES OF SWEDEN

SPARA2020

ACDM Lite Hemavan

Processes, Actors and Use Cases

Smart Peripheral And Remote Airports
SPARA 2020
Northern Periphery and Arctic Programme 2014–2020
EUROPEAN UNION
Investing in your future
European Regional Development Fund

REVISION

VERSION	DATUM	UPPRÄTTAD AV	KOMMENTAR
00.01	2017-01-26	Åke Wall	Description of Hemavan Airport, AFIS, A-CDM, Network and ATC at Stockholm-Arlanda
00.02	2017-02-10	Åke Wall	Update of Use Cases
00.03	2017-02-24	Åke Wall	Update after review of text and pictures for Airport, En-route and Use Cases
00.04	2017-03-29	Åke Wall	Update including additional maps
00.05	2017-07-17	Åke Wall	Update of Process
00.06	2017-12-18	Åke Wall	Update after Validation and Verification

CONTENT

1 INTRODUCTION

Description of work and processes at Hemavan Airport with focus on arrival process and departure process when introducing a set of elements from the European Airport CDM concept. Digital air traffic solution is also addressed with links to Stockholm-Arlanda Airport (Control Tower), Air Traffic Control Center in Stockholm (ATCC Stockholm) and Network Management Operations Center (NMOC) in Brussels.

This document will mainly focus to describe Processes, Actors and Use Cases related to a flight from Stockholm-Arlanda Airport to Hemavan Airport and also the return flight. To support coordination with EUROCONTROL and SPARA2020 project partners these descriptions are in English.

2 HEMAVAN AIRPORT

Hemavan Airport provide Aerodrome Flight Information Service (AFIS). AFIS as a part of the Flight Information Service, provides pilots of aircraft with details of other known traffic taking off, landing and flying in the vicinity of the airfield. This service is often applied when the airport is not being busy enough for full air traffic control. In this way, by applying AFIS Hemavan can maintain flight connections to Stockholm, supporting business and tourism in the region.

Overview of the northern region of Sweden with airports, Hemavan-Tärnaby and Vilhelmina have a linked flight connection from Stockholm-Arlanda.

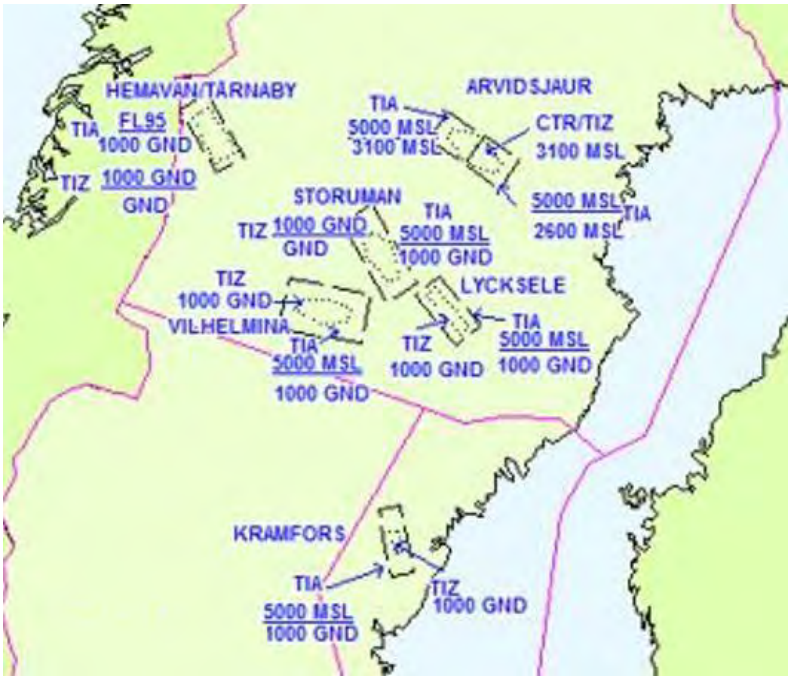

Figure 1: Airports in Swedish northern region

The aerodrome is surrounded by high ground, severe turbulence and down draft may occur in the vicinity of the aerodrome at wind speeds above 20 kt.

Figure 2: NextJet ATP at Hemavan Airport

The aerodrome is surrounded by high ground, severe turbulence and down draft may occur in the vicinity of the aerodrome at wind speeds above 20 kt.
Hemavan Traffic Information Zone (TIZ) from GND to 1000 FT GND.

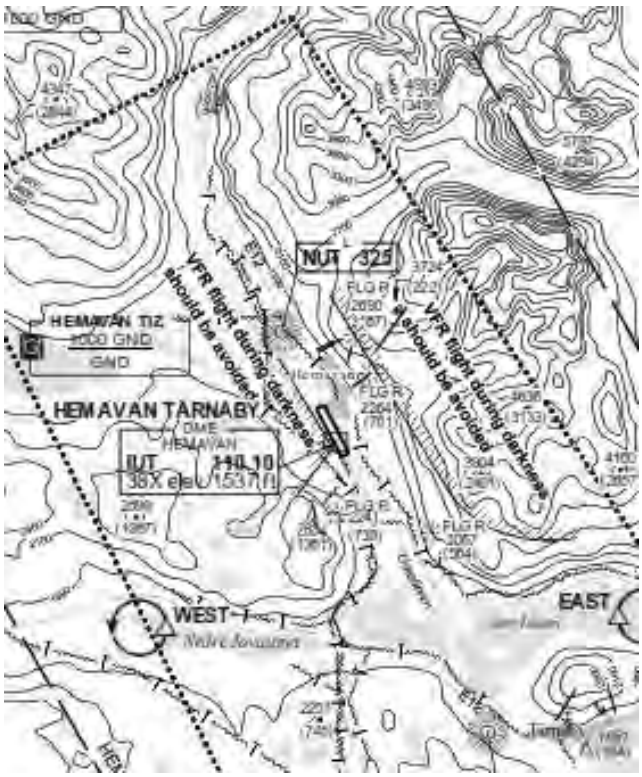

Figure 3: TIZ at Hemavan Airport

Hemavan AFIS also have a Traffic Information Area (TIA) from 1000 FT GND to FL 95.

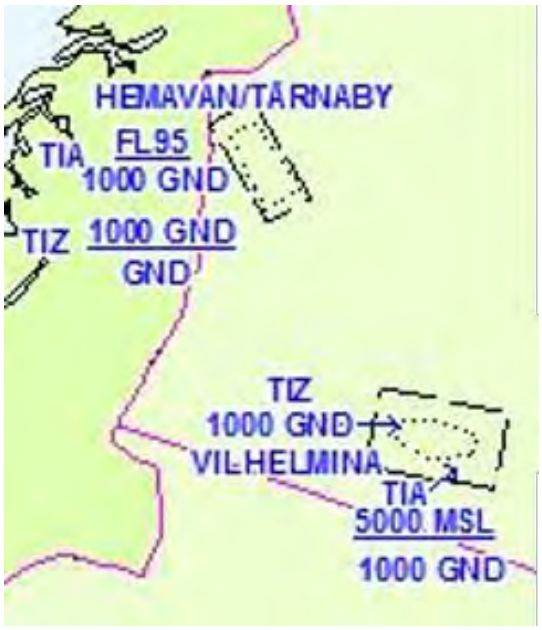

Figure 4: TIA at Hemavan Airport

Runway directions are 15/33 1444 m x 30 m (LDA 1444 m, ASDA 1744m. TORA and TODA are both 1594m). The airport is located between Umeälven (river) and the main road in Hemavan.

- Runway 33 is the main direction for landing with NDB+DME+ILS
- Runway 15 have a LLZ is installed (not certified)

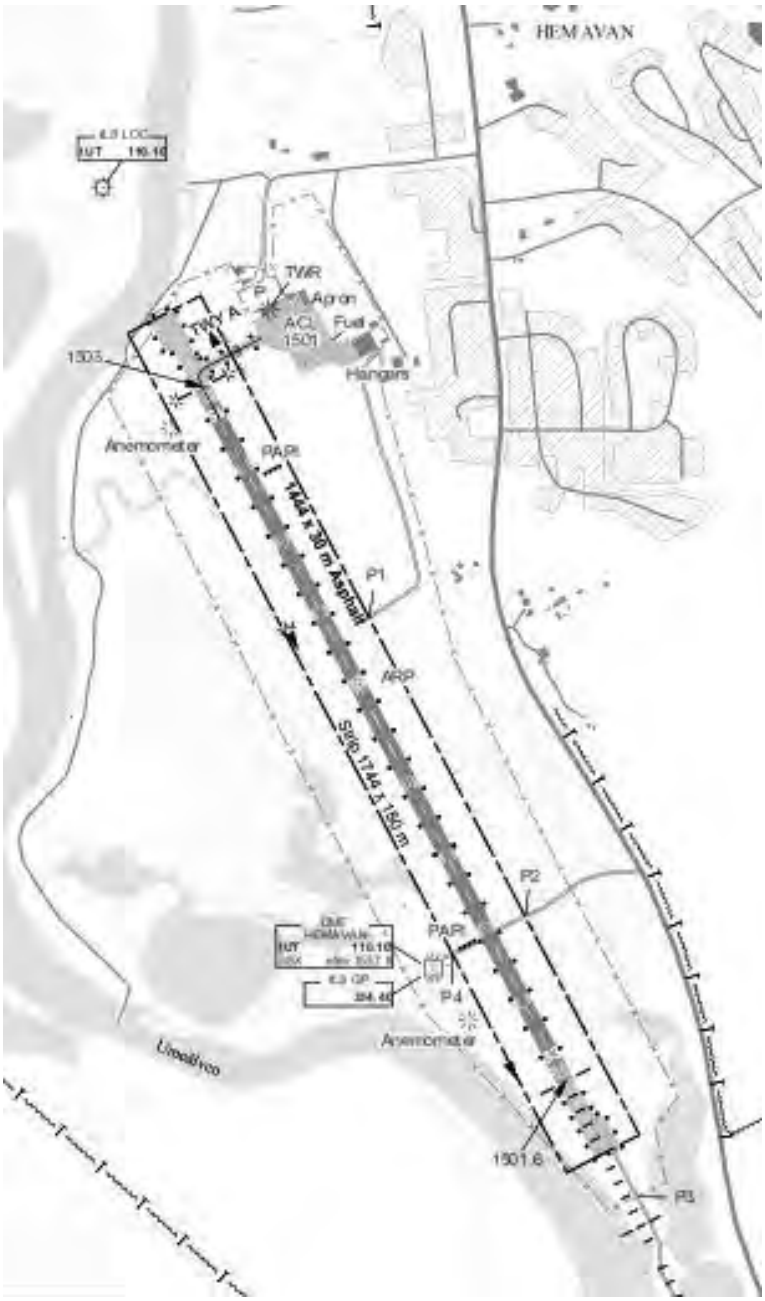

Figure 5: Runway at Hemavan Airport

2.1 Flights Arlanda - Hemavan – Arlanda

Flying time between Hemavan – Stockholm is 2:30 h. Airline Operator is NexJet with aircraft types:

- SAAB 340 (33 passengers)
- BAE ATP (68 passengers)

Figure 6: Apron at Hemavan Airport

In winter season there are normally two flights between Hemavan and Stockholm every day, during the weekends additional flights can be added. During the summer NextJet operate with one flight per day.

A flight between Stockholm-Arlanda (ARN) to Hemavan/Tärnaby (HMV) will normally make a stop in Vilhelmina (VHM). See route example;

- Morning flight from Arlanda to Hemavan with a SAAB 340;
  - Departure ARN at 09:15 with first stop at VHM 10:45 (1h 30min). Departure VHM at 11:00 to HMV arriving at 11:35 (35min).

- Afternoon flight from Hemavan to Arlanda with a SAAB 340;
  - Departure HMV at 15:45 with stop at VHM 16:20 (35min). Departure VHM at 16:35 to ARN arriving at 18:05 (1h 30min).

2.2 Hemavan Tower

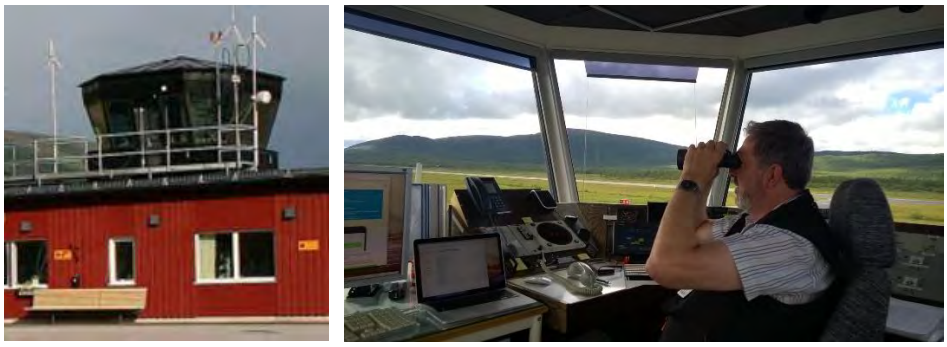

Figure 7: AFIS Tower at Hemavan Airport

Hemavan Airport open the tower with Aerodrome Flight Information Service (AFIS) to support regular flights. During open hours Hemavan TIZ (Traffic Information Zone) is established with vertical limits between 1000 feet and Ground, with linked TIA (Traffic Information Areas) between 1000 feet GND to FL 95. Transition altitude is 9000ft AMSL.

AFIS in Hemavan tower is open 60 minutes before planned arrival and 30-45 minutes before planned departure. After departing flight is airborne AFIS normally close 15-30 minutes later.

Overview of working position for Hemavan AFIS;

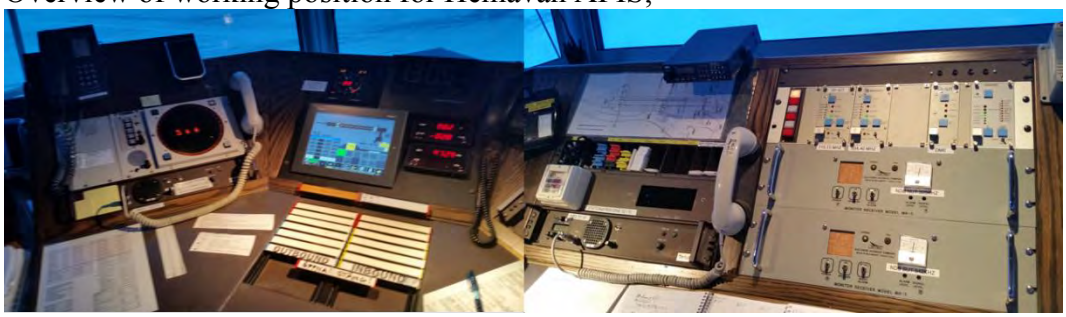

Figure 8: Tower equipment

AFTN for incoming messages (Flight Plans and CTOT) is provided by a computer software system called *Airport 2011*.

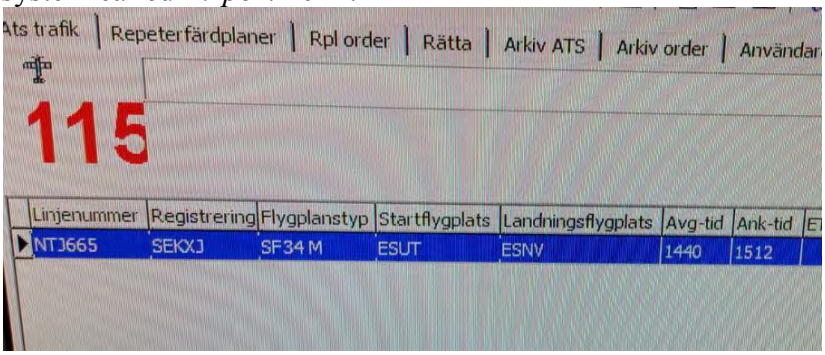

Figure 9: Airport 2011 for AFTN

Weather observations made by AFIS and supported by an AWOS 7 system.

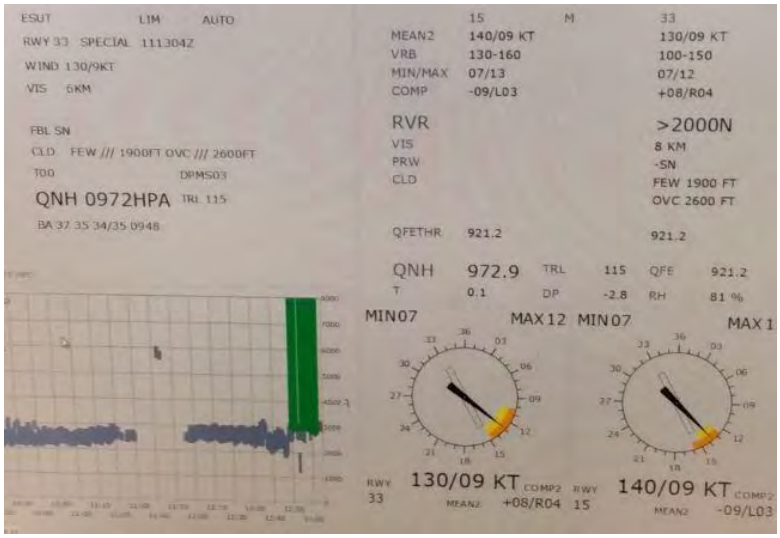

Figure 10: AWOS weather system

AFIS provide monthly data on traffic and passenger figures to the ANS Regulator (Transportstyrelsen). To support daily operations it would be of value to have a dynamic update of the number of passengers (today only on paper).

Maximum tailwind accepted is 10 knots. There can be situations when passengers have to go by buss to Vilhelmina for the flight to Stockholm.

Regular flights operating at Hemavan have to handle a Prior Permission Required (PPR). Hemavan Airport have a Runway classified in Category 2C, there is an ongoing dialogue for upgrade to Category 3C. Upgrade to 3C will require to move Terminal and Tower.

Arriving flights
Hemavan airport need a good estimate of arriving flights 60 minutes before landing to plan snow sweeping and runway friction test. In winter operations the timing of snow removal is important to ensure good braking action figures for a safe landing. The option to use Flight Radar24 to get awareness on arrivals is not always reliable, due to some aircraft transponder types not providing data.

Departing flights
AFIS in Hemavan tower will when coordinating departures with Sweden Control deliver the following data;

[1] Callsign (C/S)
[2] Estimated Time of Departure (ETD)
[3] Runway in Use (RWY)
[4] Aircraft Type (TYPE)

Sweden Control respond with SSR-code and initial clearance to FL130 or an intermediate level (can be FL90).

3 AIRPORT COLLABORATIVE DECISION MAKING (A-CDM)

A-CDM is a concept designed by EUROCONTROL and additional partners with the intent to enhance the overall efficiency of the inbound-turnaround-outbound process at an airport as well as to improve the En-route capacity management.

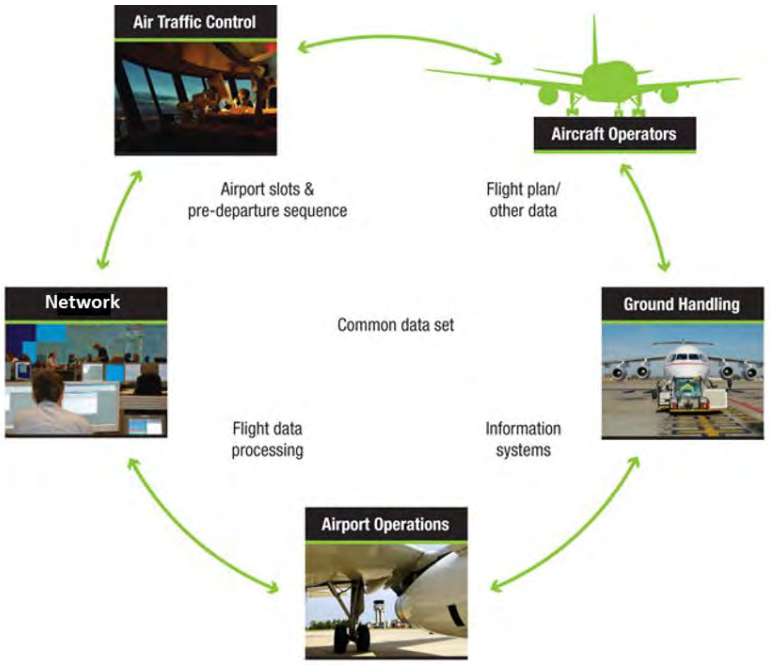

Figure 11: Airport Collaborative Decision Making

A-CDM aims to improve the operational efficiency of all airport operators by reducing delays, increasing the predictability of events during the progress of a flight and optimizing the utilization of resources. In addition, this will increase capacity at participating airports. This aim is to be achieved via improved real time information sharing between airport operators, aircraft operators, ground handlers and air traffic control. The concept involves the implementation of a set of operational procedures and automated processes.

European A-CDM has the following main objectives:

- Improve predictability
- Improve on-time performance
- Reduce ground movement costs
- Optimize/enhance use of ground handling resources
- Optimize/enhance use of stands, gates and terminals
- Optimize the use of airport infrastructure and reduce congestion
- Flexible pre-departure planning
- Reduce apron and taxiway congestion

Airport CDM started to support the larger airports were complexity is high and many aviation actors collaborate. To organise A-CDM a number of milestones are defined. For a larger airport most of these milestones will be applied.

Table of milestones used at larger airports were departure (blue), turnaround (green) and arrivals (yellow) are marked;

NUMBER	MILESTONE	TIME REFERENCE
MST1	ATC Flight Plan Activation	3 hours before EOBT
MST2	EOBT-2hrs	2 hours before EOBT
MST3	Take off from outstation	ATOT from outstation
MST4	Local Radar Update	Varies according to airport
MST5	Final approach	Varies according to airport
MST6	Landing	ALDT
MST7	In-block	AIBT
MST8	Ground handling starts	AGHT
MST9	TOBT update prior to TSAT issue	Varies according to airport
MST10	TSAT Issue	Varies according to airport
MST11	Boarding starts	Varies according to airport
MST12	Aircraft ready	ARDT
MST13	Start up request	ASRT
MST14	Start up approved	ASAT
MST15	Off-block	AOBT
MST16	Take Off	ATOT

Table 1: A-CDM Milestones

For implementation of A-CDM procedures a number of support systems is needed to enhance the planning and exchange of progress data on arriving and departing flights. At Stockholm-Arlanda the sequence planning off arriving flights is supported by an Arrival Management system (AMAN). For departing flights there is also a planning tool for Departure Management (DMAN) to support the A-CDM process.

3.1 A-CDM at Stockholm-Arlanda

Overview of process of A-CDM at Stockholm-Arlanda Airport;

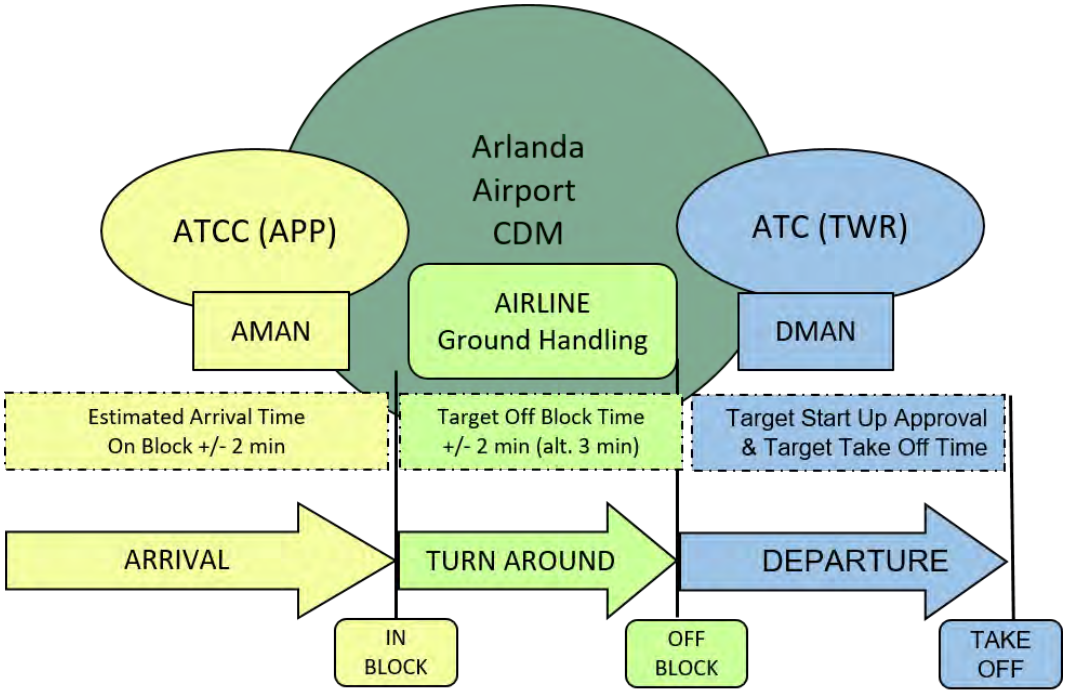

Figure 12: Stockholm-Arlanda A-CDM elements

For an airport like Hemavan a limited set of A-CDM elements can be defined and applied to enhance awareness of arriving/departing flights and also to support the Network.

4 EUROPEAN NETWORK MANAGEMENT

European Network have defined three types of airports with different links to the Network.

- **CDM Airports,** are airports that have implemented the A-CDM process and provide the full set of DPI messages to Network.
- **Advanced ATC TWR Airports,** are airports that have not implemented or not fully implemented the CDM process but still would like to integrate into the ATM Network using a limited set of DPI messages.
    - Note: An Advanced ATC TWR Airport provides;
        - Target Take-Off Time (TTOT) estimations as well as
        - Variable Taxi-Times (VTTs) and
        - Standard Instrument Departure (SID) to the NMOC.

      These are provided from the moment that the aircraft leaves the blocks.

- **Standard Airports,** are not integrated into the network via the transmission of DPI messages.

Stockholm-Arlanda Airport is a *CDM Airport* providing a full set of DPI messages and is directly linked to the Network.

Hemavan Airport presently providing *Aerodrome Flight Information Service (AFIS)* and can if linked to the Network be seen as an additional new airport category type. This new type of airport linked to Network could be defined as an *"Advanced AFIS Airport" (TBD)* and providing only a limited set of DPI.

Overview of ongoing activities regarding DPI and FUM implementation;

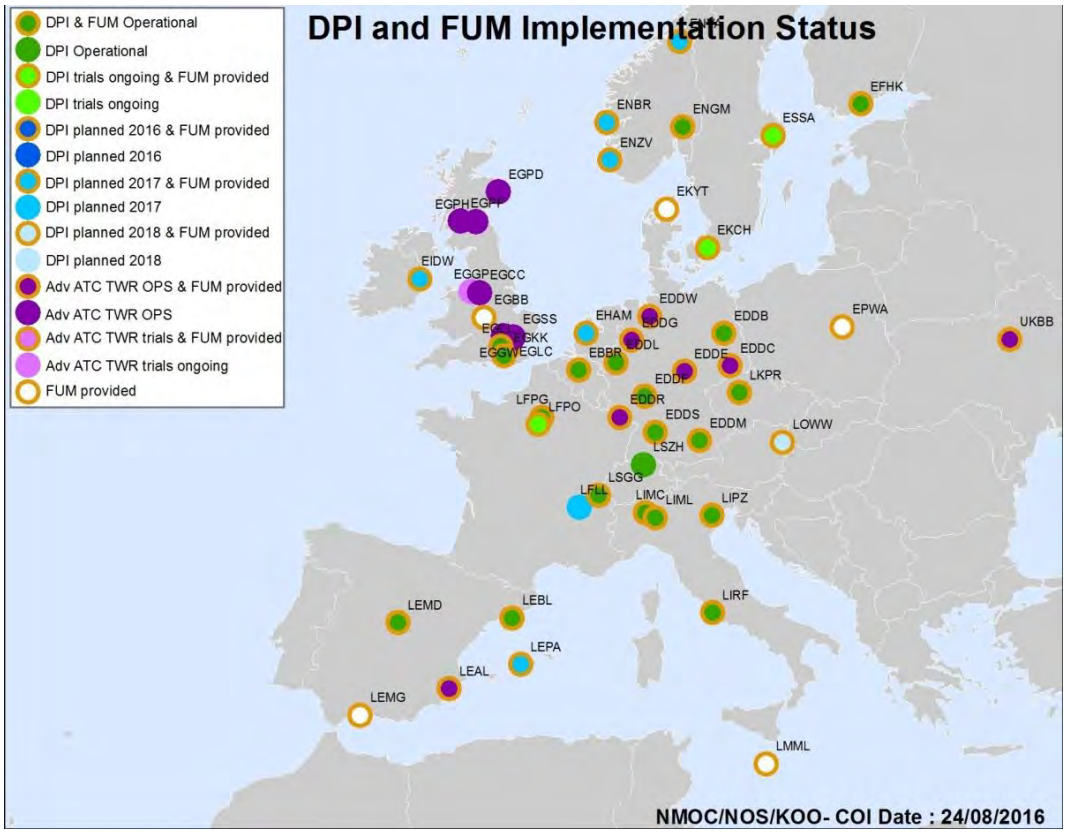

Figure 13: DPI and FUM implementation

4.1 Departure Planning Information and Flight Update Messages

Departure Planning Information (DPI) with improved accuracy of flight information, serves to improve Network traffic predictions and consequently, the effectiveness of the measures to be taken.

Airport situational information is in general collected from the TWR system in order to update the real-time flight situation, prior to take-off, in the Network Operations systems.

The main benefits for the ATM Network with increased use of DPI messages prior Take-off are improved;

- Traffic predictability for Flow Management Positions in En-route Area Control Center.
- Flight plan consistency

The objective of the Flight Update Message (FUM) is to provide the airport with an accurate estimated landing time of arriving flights for improved predictability and efficient planning of airport services.

- The Network Management Operations Center (NMOC) send Flight Update Messages (FUM) to the airports concerned, providing information of the flight status, the estimated landing times, etc.
- Situational awareness for Airline Operators when landing time estimates for Airports of Destination via the Network service for airports (Flight Update Message-FUM).

Overview of DPI and FUM messages link to the Network;

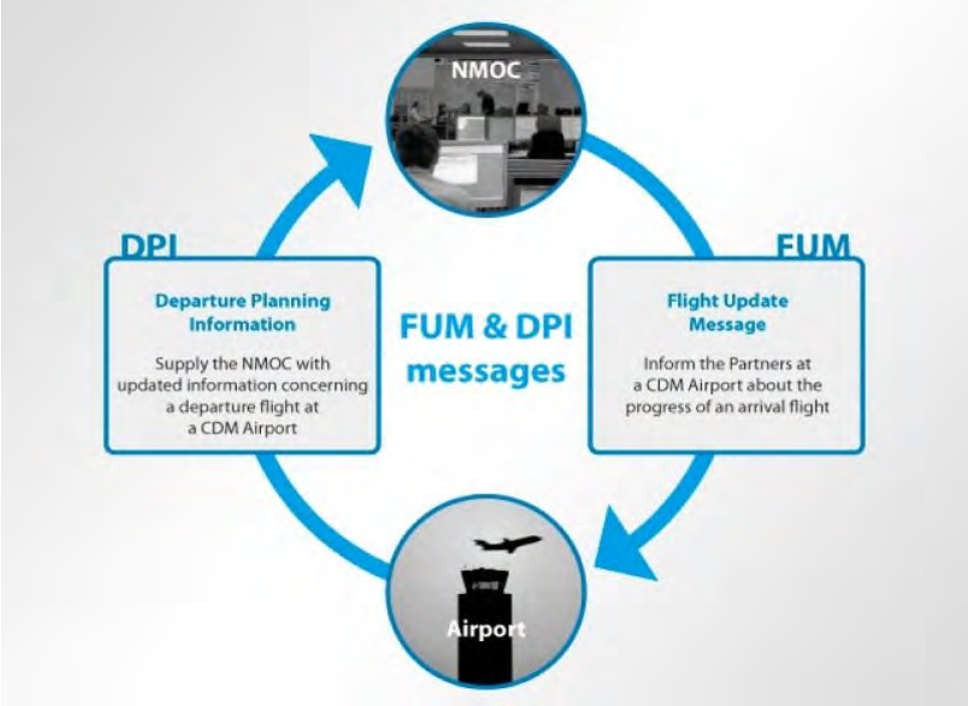

Figure 14: DPI and FUM process

5 AIR TRAFFIC CONTROL AT STOCKHOLM-ARLANDA

Description of process and systems for ATC Control Tower at Arlanda (SA TWR) and Air Traffic Control Center (ATCC Stockholm).

5.1 Arlanda TWR

The environment Stockholm-Arlanda airport (ARN) is a complex category airport with the following factors contribute to the complexity:

- Three runways, two of which are normally used simultaneously
- A very large manoeuvring area makes orientation and navigation on taxiways and aprons in low visibility conditions demanding.
- After landing, flights frequently have to cross the taxiway used by departing flights to reach the parking.

The general airport layout is described in this paragraph and illustrated in **Fel! Hittar inte referenskälla.** below. There are two parallel runways 01L-19R (3,301 m) and 01R-19L (2,500 m). The distance between these runways is 2,300 m and threshold of runway 01R is displaced 800 m to the south. A converging runway 08-26 (2,500 m) is located north of runway 01R.

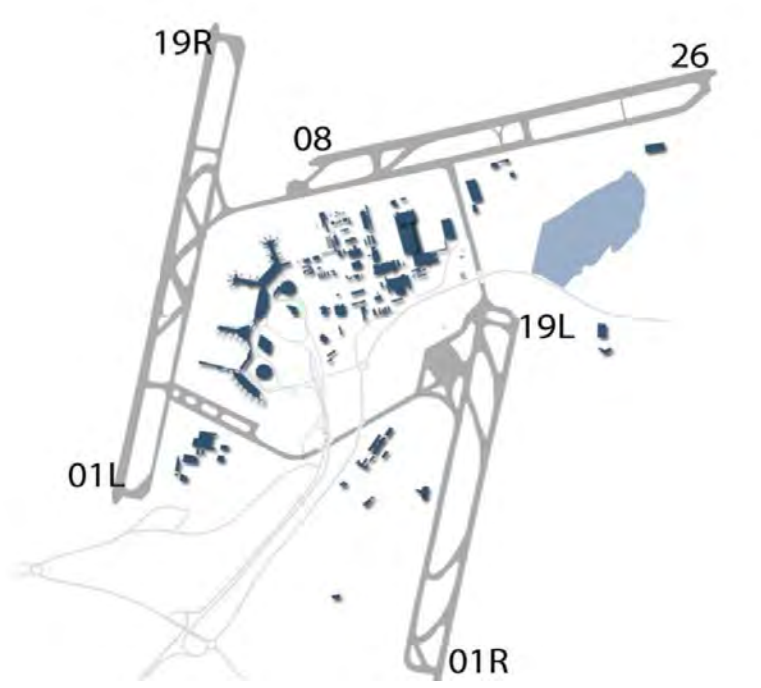

Figure 15: Stockholm-Arlanda airport layout

Stockholm-Arlanda Tower Runway Controllers' areas of responsibility.

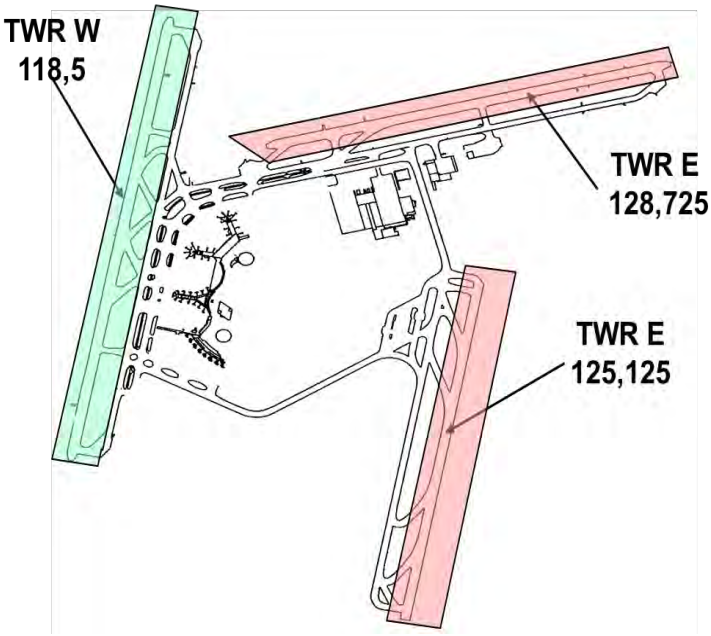

Figure 16: Stockholm-Arlanda runway layout

Stockholm-Arlanda Tower Ground Controllers' areas of responsibility.

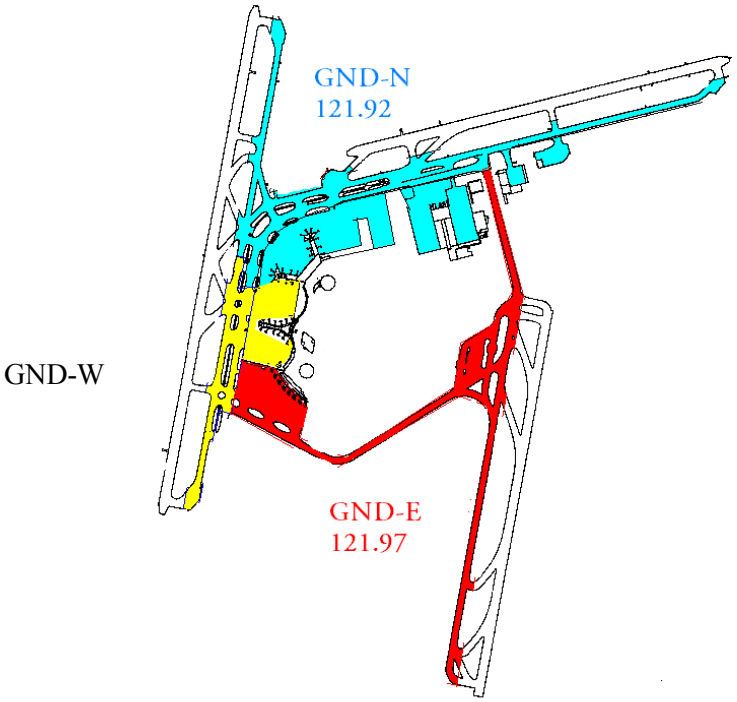

Figure 17: Stockholm-Arlanda taxiway layout

Picture of Ground Controller workingposition in Arlanda TWR;

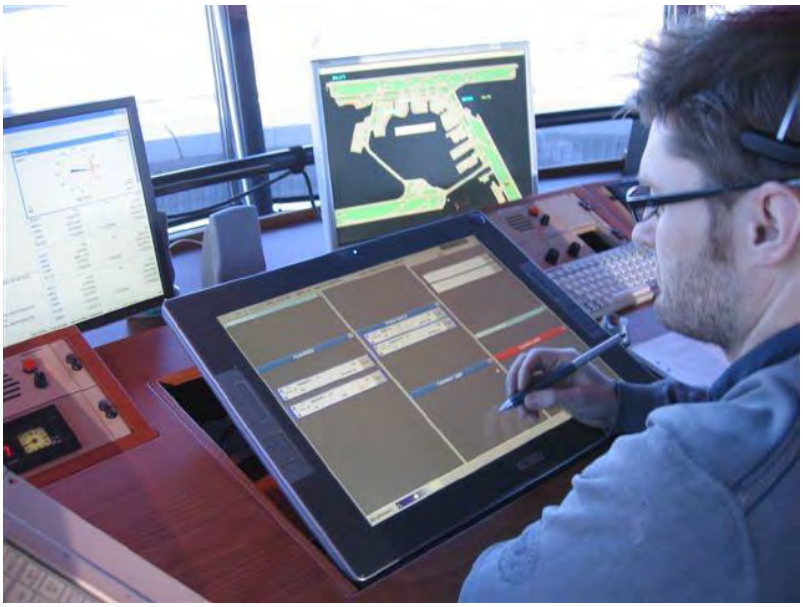

Figure 18: Stockholm-Arlanda Ground Controller

At Stockholm-Arlanda an e-Strip system is used in the Tower for presentation of flight information and used for progressive clearances. See example with departing flights, with TSAT and TTOT;

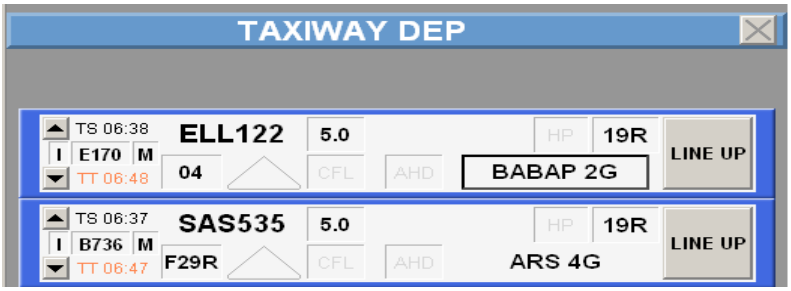

Figure 19: TWR Electronic Flight Strips

5.2 ATCC Stockholm

The airspace in Sweden is large and traffic density is low in general. Summary of specifics:

- Stockholm-Arlanda is the only hub airport in a wide area. The Departure/Arrival routings are expected to be close to the optimal routings, regarding flight-efficiency and environment. The most likely direct

constraints are the possible interaction of arriving and departing flights to/from Bromma, the city airport of Stockholm.

- The Sweden Flight Information Region (FIR) is controlled by LFV/NUAC and covers the national territory of Sweden.
    - En-route sectors in Airspace Sweden (SUECIA CTA/UTA)
        - Sector K manage the northern part of Sweden

In the northern part of Swedish airspace there is a large mix of traffic and activities. Occasions with dense military activity with Swedish Airforce and exercises with neighbouring countries. Crossing intercontinental flights mixed with flights from the northern regions to/from Arlanda.

Map of Sweden FIR with northern En-route sectors;

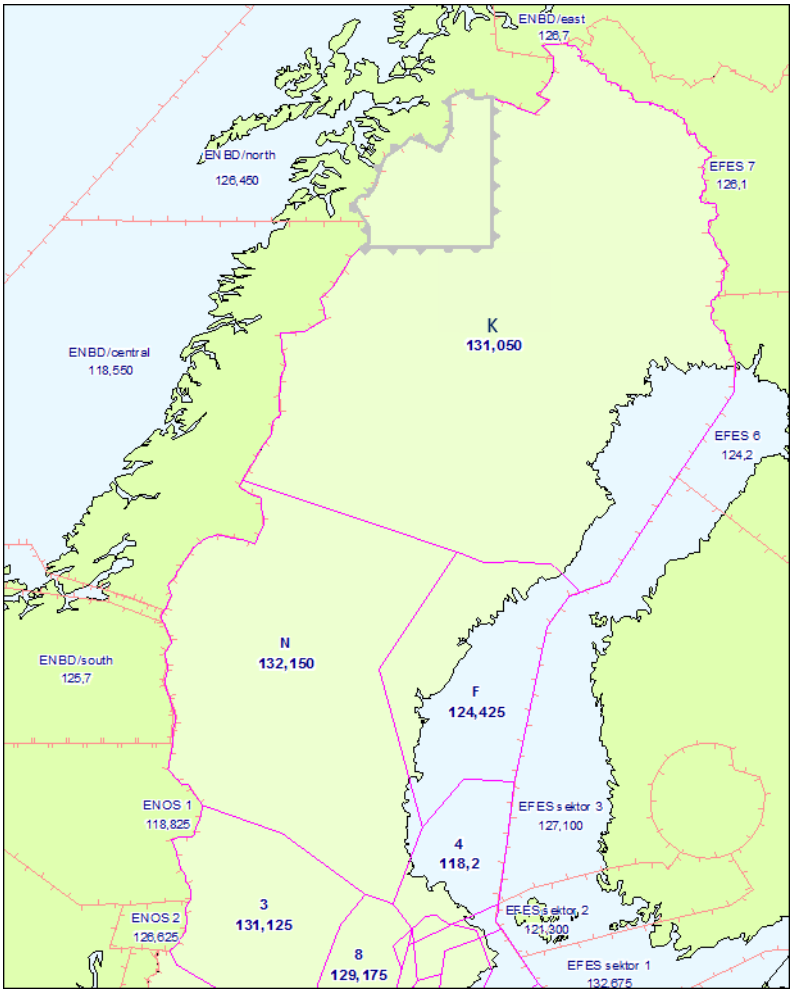

Figure 20: Stockholm ATCC En-route sectors northern Sweden

The Stockholm Area Control "En-route sector K" manage airspace in the area over Hemavan Airport. Estimated landing times are told by telephone to Hemavan AFIS. Departing traffic is coordinated before Take-off were Hemavan TWR calls Sector K and receive clearance with SSR-code. Radar coverage in this region is down to FL 120, during summer 2017 LFV plan to implement Wide Area Multilateration (WAM) with improved coverage down to 8 000 feet.

Picture of the Air traffic controller's position in Stockholm ATCC;

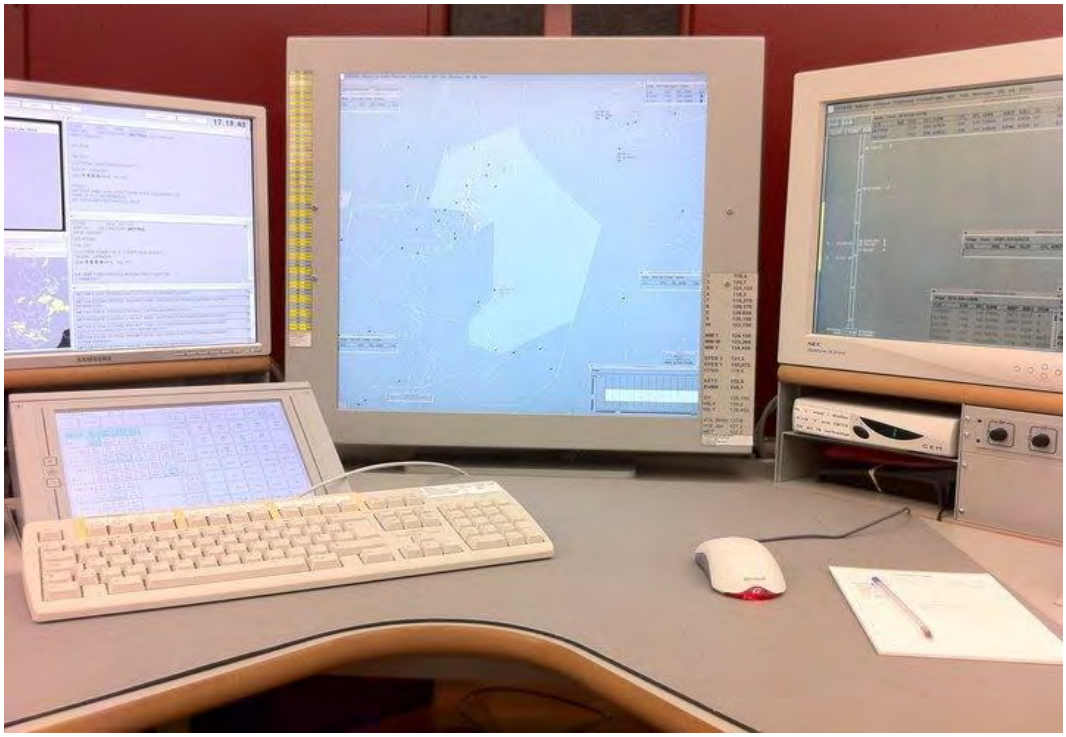

Figure 21: Stockholm ATCC En-route and Approach Working Position

6 USE CASES FOR HEMAVAN AIRPORT

Actors with a link to Hemavan Airport;

- AFIS Operator
- Airport Operator, Ground Handler, Security
- Aircraft Operator, Flight Crew
- Air Traffic Control, Stockholm
  - ATC Tower Controller
  - ACC En-route Controller
- Network, Brussels
- Landside actors (Taxi, Buses, Hotel etc.)

Following sections will mainly address the Use Cases for main Operator Roles involved.

6.1 Use Case 1- Arriving Flight to Hemavan

Scope and Summary

- This Use Case the **nominal case** for an Arriving Flight to Hemavan from Stockholm-Arlanda including how the actors shall act based on the provided information. It also includes how the system acts on the provided information.

Pre-Conditions

- There is a Flight Plan for a flight from Stockholm-Arlanda Airport to Hemavan Airport. Flight is parked at Stockholm-Arlanda Airport.

Post-Conditions

- Flight has landed at Hemavan Airport and is parked at the apron.

Actors

- Stockholm-Arlanda Tower Controller (GROUND and TOWER)
- Flight Crew (PILOT)
- Stockholm Approach Controller (APPROACH)
- Stockholm ACC En-route Controller (EN-ROUTE)
- Hemavan AFIS Operator (AFIS)

Main Flow

[1] Stockholm-Arlanda Tower DMAN system calculate Target Take-Off Time base on Flight Plan EOBT and (or Airline Target Off Block Time (TOBT). Based on TTOT a Target Start-up Approval Time (TSAT) is set and distributed to Ground Handling/Flight Crew.

[2] PILOT will request Start-up according to available TSAT time. GROUND will approve start-up and also push-back if applicable.

[3] PILOT will request Taxi clearance. GROUND will provide Taxi clearance to Runway in Use. When approaching the Runway transfer is made between GROUND and TOWER

[4] TOWER will give line-up clearance to the runway and a Take-off clearance. PILOT will commence Take-Off

[5] Flight is airborne and identified on ATC radar screen.

[6] TOWER will transfer flight to APPROACH Controller, later the flight will be transferred to EN-ROUTE Controller.

[7] EN-ROUTE Controller will coordinate arriving flight (arrival estimate) with AFIS Hemavan and later transfer flight to AFIS.

[8] EN-ROUTE Controller will provide PILOT with descend clearance to Hemavan Airport.

[9] PILOT contact AFIS and will receive actual information on runway status.

[10] AFIS provide Traffic information and inform PILOT when the Runway is free.

[11] PILOT perform landing, taxi in to the apron and is parking (engines off). Landing time is noted and registered by AFIS.

[12] The **Use Case ends**

6.2 Use Case 2- Departing Flight from Hemavan

Scope and Summary

- This Use Case the **nominal case** for a Departing Flight from Hemavan including how the actors shall act based on the provided information. It also includes how the system acts on the provided information.

Pre-Conditions

- There is a Flight Plan for a flight from Hemavan Airport to Stockholm-Arlanda Airport. Flight is parked at Hemavan Airport on the apron.

Post-Conditions

- Flight is in contact with EN-ROUTE and have received clearance to requested flight level (according to Flight Plan).

Actors

- Flight Crew (PILOT)
- Hemavan AFIS Operator (AFIS)
- Stockholm ACC En-route Controller (EN-ROUTE)

Main Flow

[1] PILOT will request Start-up according to time in the Flight plan. AFIS will approve start-up and give additional information on weather and runway status.

[2] AFIS will contact EN-ROUTE by voice with following information; Callsign (C/S), Estimated Time of Departure (ETD), Runway in Use (RWY) and Aircraft Type (TYPE)

[3] EN-ROUTE will provide an initial clearance to AFIS by voice (normally to Requested Flight Level).

[4] AFIS will forward clearance from En-route.

[5] AFIS inform the PILOT on latest runway status, traffic information and inform the PILOT the runway is free.

[6] PILOT will commence Take-Off and later the flight is airborne.

[7] AFIS will transfer flight to EN-ROUTE Controller.

[8] EN-ROUTE Controller will give PILOT clearance to requested flight level (according to Flight Plan).

The **Use Case ends**

6.3 Use Case 3- Arriving Flight from Vilhelmina to Hemavan

Scope and Summary

- This Use Case the **non-nominal case** for a Arriving Flight to Hemavan from Vilhelmina Airport including how the actors shall act based on the provided information. It also includes how the system acts on the provided information.
    - Note: this is almost a “nominal case” due to many arriving flights from Stockholm make a quick turn-around at Vilhelmina Airport.

Pre-Conditions

- Flight is parked at the apron at Vilhelmina Airport.

Post-Conditions

- Flight has landed at Hemavan Airport and is parked at the apron.

Actors

- Flight Crew (PILOT)
- Vilhelmina AFIS Operator (AFIS-VHM)
- Stockholm ACC En-route Controller (EN-ROUTE)
- Hemavan AFIS Operator (AFIS-HMV)

Main Flow

[1] PILOT will request Start-up according to time in the Flight plan. AFIS-VHM will approve start-up and give additional information on weather and runway status.

[2] AFIS-VHM will contact AFIS-HMV to get latest weather and details on runway status in Hemavan. Information will be provided to PILOT.

[3] AFIS-VHM will contact EN-ROUTE by voice with following information; Callsign (C/S), Estimated Time of Departure (ETD), Runway in Use (RWY) and Aircraft Type (TYPE)

[4] EN-ROUTE will provide an initial clearance to AFIS-VHM by voice.

[5] AFIS-VHM will forward clearance from En-route.

[6] AFIS-VHM inform the PILOT on latest runway status, traffic information and inform the PILOT the runway is free.

[7] PILOT will commence Take-Off and later the flight is airborne.

[8] AFIS-VHM will transfer flight to EN-ROUTE Controller.

[9] EN-ROUTE Controller will give PILOT clearance to requested flight level (according to Flight Plan). EN-ROUTE Controller will provide PILOT with descend to Hemavan Airport.

[10] EN-ROUTE Controller will coordinate arriving flight with AFIS-HMV and later transfer flight to AFIS.

[11] PILOT contact AFIS and will receive actual information on runway status.

[12] AFIS-HMV provide Traffic information and inform PILOT when the Runway is free.

[13] PILOT perform landing, taxi in to the apron and is parking (engines off). Landing time is noted and registered by AFIS.

[14] The **Use Case ends**

6.4 Use Case 4 - Departing Flight from Hemavan to Vilhelmina

Scope and Summary

- This Use Case the **non-nominal case** for a Departing Flight from Hemavan to Vilhelmina Airport including how the actors shall act based on the provided information. It also includes how the system acts on the provided information.
    - Note: almost a “nominal case” when many departing flights from Hemavan make a quick turn-around at Vilhelmina Airport on its way to Stockholm-Arlanda.

Actors

- Flight Crew (PILOT)
- Hemavan AFIS Operator (AFIS-HMV)
- Vilhelmina AFIS Operator (AFIS-VHM)

Main Flow

[1] PILOT will request Start-up according to time in the Flight plan. AFIS-HMV will approve start-up and give additional information on weather and runway status.

[2] AFIS-HMV will contact AFIS-VHM to get latest weather and details on runway status. Information will be provided to PILOT.

Following actions will be similar to Use case 3 in Section 6.3 from [2] to [8]

[9] The **Use Case ends**

7 AFIS HEMAVAN NEW OPERATIONAL PROCEDURES AT

This section provide an example of developed coordination procedures with use of digital exchange of Flight data.

7.1 A-CDM elements for AFIS Hemavan

One way to address links to ATCC Stockholm and Network is to provide minimum information on progress of departure before Take-off.

Table of A-CDM milestones proposed to be used at smaller airports were departure (blue), turnaround (green) and arrivals (yellow) are marked;

NUMBER	MILESTONE	TIME REFERENCE
MST3	Take off from outstation	ATOT from outstation
	Estimated Landing Time	ELDT
MST6	Landing	ALDT
MST9	TOBT update prior to issue of TTOT	Varies according to airport
	Issue of Target Take Off Time	TTOT
MST16	Actual Take Off Time	ATOT

Table 2: A-CDM Milestones for Hemavan Airport

For implementation of A-CDM procedures at smaller airports like Hemavan there is a need to follow a basic procedure and to minimise the number of updates. Information on arriving flights will not be included for A-CDM at Hemavan (will be addressed by the procedures for setup of the Beta test)

Main focus will be on;

- Pilot issue of TOBT
- AFIS issue of TTOT
- AFIS update of ATOT

7.2 New operational procedures

There are options to enhance information exchange on arriving flights to Hemavan Airport and also the dialogue between AFIS Hemavan and the En-route Controller at ATCC Stockholm.

7.2.1 Arriving flights to Hemavan Airport

Stockholm-Arlanda Airport have implemented A-CDM procedures and are linked to the Network in Brussels. The awareness on progress of pre-departing flights is high were TTOT will be set latest 20 minutes before Take-off.

Both TTOT and ATOT can together with Flight Trajectory information be input for calculation of estimated landing time at Hemavan.

Additionally, update of flight progress can be provided by access to a radar image displaying relevant flights for Hemavan and Vilhelmina. By use of LFV radar network and a web based display (the Beta version). The radar coverage is planned to be improved at remote areas and medium flight levels when Wide Area Multilateration (WAM) is operational from summer 2017.

For flights from Stockholm-Arlanda making a turn-around in Vilhelmina before final leg to Hemavan a procedure with progress information prior Take-off can enhance awareness for AFIS Hemavan (based on procedures with the Beta version for departures).

- Note: These procedures/systems can show a way to provide information on estimated arrival times at Hemavan Airport also to Landside actors (Taxi, Buses, Hotel etc.)

7.2.2 Departing flights from Hemavan Airport

Hemavan Airport can by implementing a limited set of A-CDM elements provide accurate information on departing flight progress before Take-off. By receiving TOBT from Pilot and then AFIS calculate a TTOT, information can be sent to both En-route Controller and Network (with the Beta version for departures).

- AFIS Hemavan and En-route Controller at Stockholm ACC can in this way exchange information by silent coordination.
  - AFIS Hemavan need to receive SSR-code for departure flights

- AFIS Hemavan can update Network before Take-off to improve air traffic flow management.

There is an option to introduce similar procedures/system support for AFIS at Vilhelmina Airport to improve efficiency when coordination progress of departing flights with En-route Controller in Stockholm and AFIS at Hemavan Airport.

8 VIEW ON DIGITAL AIR TRAFFIC SOLUTION FOR HEMAVAN

Description of technical options for communication between stakeholders will be provided in a separate document. In this chapter experience from other research activities will be presented to show example of ways for development of digital solution for Hemavan Airport.

8.1 Departure from Hemavan Airport

Overview example of a departing flight from Hemavan Airport planned into Network and ATCC Stockholm before Take-off;

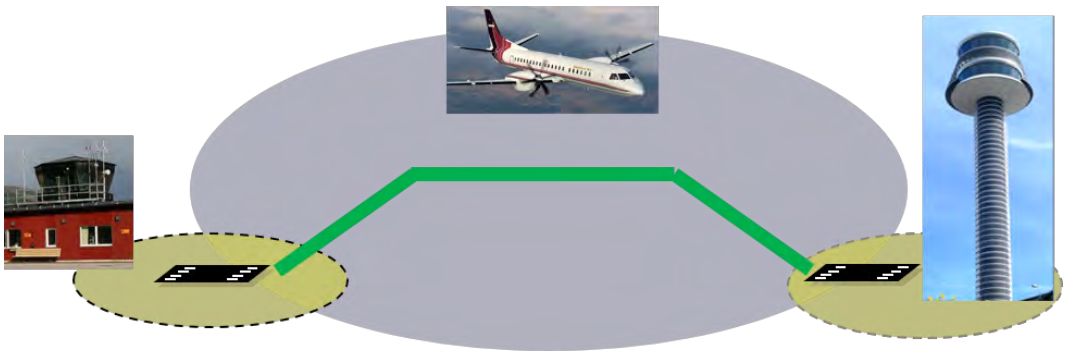

Figure 22: Departure from Hemavan Airport

1. **AFIS** get ready time (from Airline/Flight Crew) for Start-Up from Airline (TOBT)
2. **AFIS** set **TTOT** (Target Take-off Time) in system (sent to NETWORK and ATCC)
    - AFIS to receive SSR-code
3. When (if) **AFIS** receive **CTOT** from Network, TWR will **update TTOT**

8.2 Arrival to Hemavan Airport

Overview example of a flight from Stockholm-Arlanda arriving to Hemavan Airport;

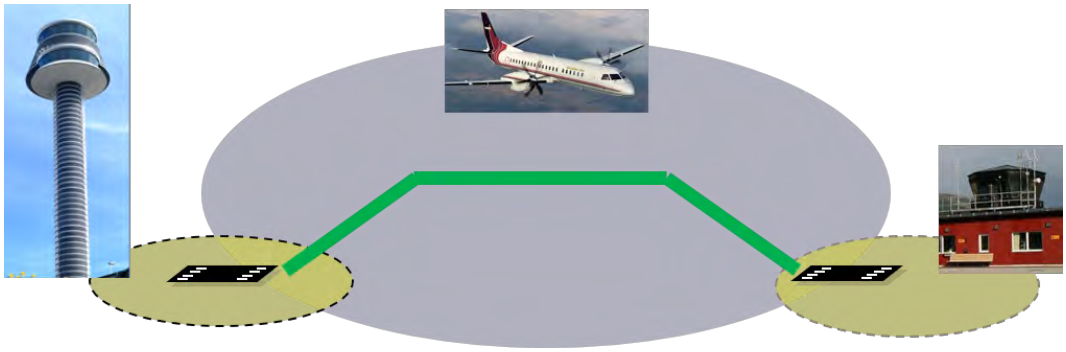

Figure 23: Arrival to Hemavan Airport

1. **Arlanda TWR** provide TTOT (Target Take-off Time) as base for calculation of Estimated Landing Time ELDT at Hemavan
2. **Arlanda TWR** provide ATOT (Actual Take-off Time) as base for updated calculation of Estimated Landing Time (ELDT)
3. Calculation of Estimated Landing Time (ELDT) can be based on Flight Plan and/or Trajectory Prediction

8.3 Regional Tower Electronic Flight Strips

In SESAR projects validation of procedures and systems for information exchange between regional tower and Area Control Center have been validated.

Example design of TWR Electronic Flight Strip system for coordination of flights (departures before Take-off) with ability for a web based application.

- EFS with "network connection"
- Early coordination between Hemavan TWR and ATCC Stockholm
- Increased predictability and information exchange for
  - Arrival flights
  - Departure flights

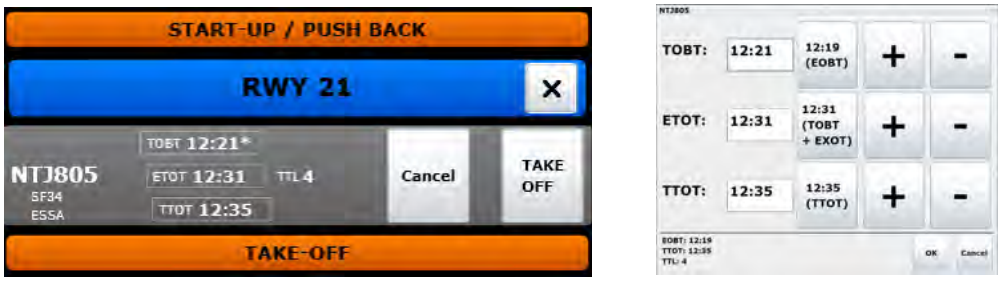

Figure 24: Tower Electronic Flight Strips example

8.4 AFIS Tower Digital Flight Information

Digital information sharing of flight progress information for improved collaboration and increased awareness.

ACDM Lite Beta tool, with web interface for coordination of arrival and departure flights (departures before Take-off).

Overview of the main display elements;

- Arrival list
  - Display of Flight progress
    - NTJ772A with an ELDT at Vilhelmina
    - NTJ662 with information on Arlanda TTOT
    - NTJ772B with flight plan data Vilhelmina to Hemmavan

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CALLSIGN	ACTYPE	REG	SSR	ADEP	ADES	TTOT	ATOT	ELDT
NTJ772A	SF34	SELJS	2001	ESSA	ESNV	09:05	09:06	10:18
NTJ662	ATP	SEMEX	2002	ESSA	ESUT	09:14		
NTJ772B	SF34	SELJS	2004	ESNV	ESUT			

Figure 25: Beta tool – Arrival list

- Air situation display (radar)
  - Display of flights for selected airports
    - NTJ662 from Arlanda to Hemavan

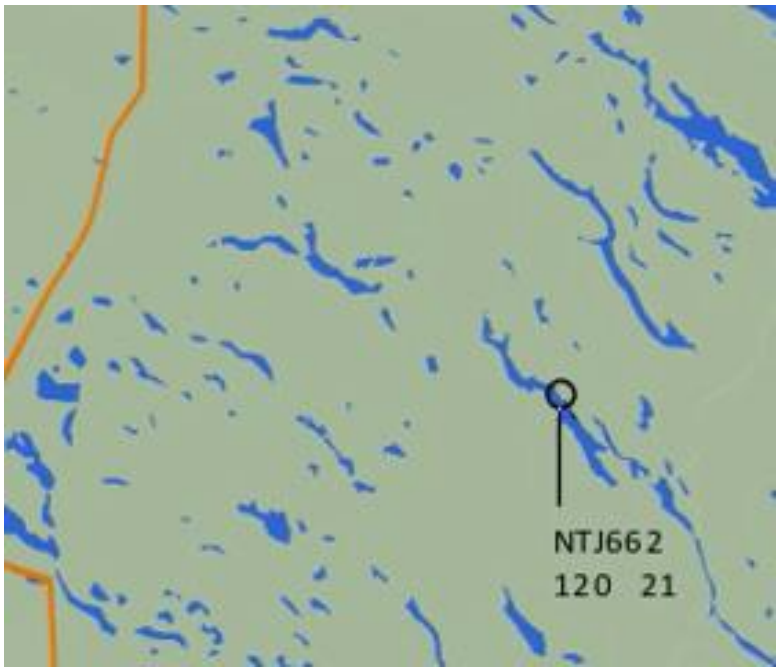

Figure 26: Beta tool – Radar display

- Departure list
  - Sequence of events for flight NTJ665 departing from Hemavan
    - Setting of TOBT
    - Setting of TTOT
    - Flight airborne

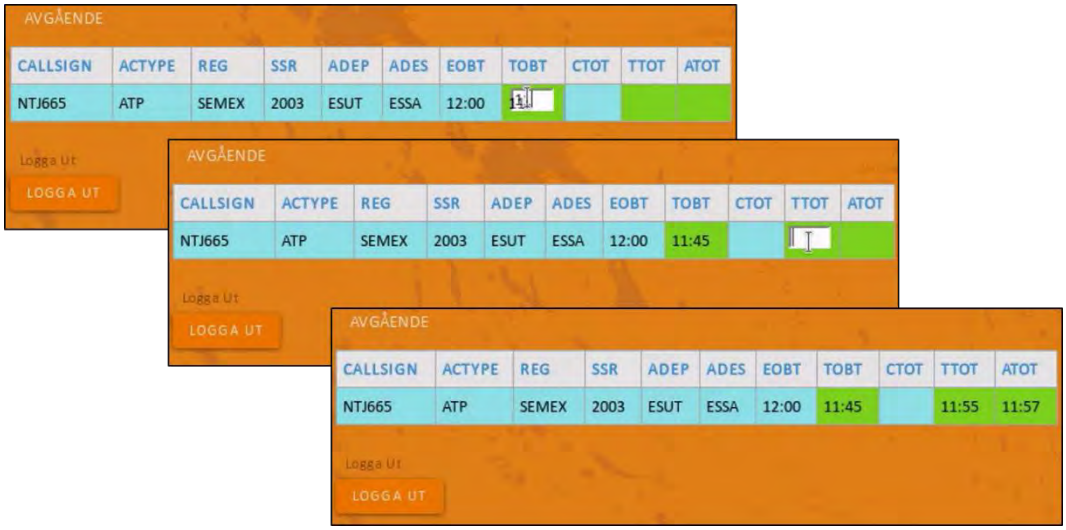

Figure 27: Beta tool – Departure list

8.5 Technical interface options

For enhanced information exchange of estimated arrival and departure times at Hemavan Airport can support both AFIS, Airside users (Airport Operator, Ground Handler, Security) and Landside users (Taxi, Buses, Hotel etc.).

By development of a web based solution a large number of stakeholders can be given access to relevant information. In this way the variation of user equipment (mobile, tablet, computer) can be supported by the same web interface.

In a separate *ACDM Lite* document the options of technical solution and interfaces will be described.

9 GLOSSARY OF TERMS

A definition of terms used in this document is given below;

Term	Definition
AOBT	Actual Off-Block Time is the actual date and time the aircraft has vacated the parking position (pushed back or on its own power).
ATOT	Actual Take off Time is the time that an aircraft takes off from the runway (Equivalent to ATC ATD–Actual Time of Departure, ACARS = OFF).
CTOT	The Calculated Take Off Time (CTOT) is a time calculated and issued by the Central Flow Management unit, as a result of tactical slot allocation, at which a flight is expected to become airborne. (ICAO Doc 7030/4 – EUR, Table 7).
ELDT	Estimated Landing Time is the estimated time that an aircraft will touchdown on the runway. (Equivalent to ATC ETA – Estimated Time of Arrival = landing).
EOBT	The Estimated Off-Block Time (EOBT) is the estimated time at which the aircraft will start movement associated with departure (ICAO).
ETOT	Estimated Take-Off Time is the forecast of time when aircraft will become airborne taking into account the EOBT plus EXOT.
TLDT	The Target Landing Time is the targeted time from the Arrival management process at the threshold, taking runway sequence and constraints into account. It is not a constraint but a progressively refined planning time used to coordinate between arrival and departure management processes.
TOBT	The Target Off-Block Time is the time that an aircraft operator / handling agent estimates that an aircraft will be ready, all doors closed, boarding bridge removed, push back vehicle present, ready to start up / push back immediately upon reception of clearance from the TWR.
TSAT	The Target Start Up Approval Time is the time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect to receive start-up / push back approval.
TTOT	The Target Take-Off Time is the time taking into account the Target Start Up Approval Time (TSAT) plus the Estimated Taxi-Out Time (EXOT).

10 ACRONYMS AND TERMINOLOGY

Term	Definition
A-CDM	Airport Collaborative Decision Making
AFIS	Aerodrome Flight Information Service
AMAN	Arrival Manager
AOBT	Actual Off-Block Time
ASAT	Actual Start Up Approval Time
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATOT	Actual Take Off Time
CD	Tower Clearance Delivery Controller
CWP	Controller Working Position
DMAN	Departure Manager
EFS	Electronic Flight Strip
EOBT	Estimated Off-Block Time
EXOT	Estimated Taxi-Out Time
FMS	Flight Management System
GND	Tower Ground Controller
HMV	Hemavan Airport
HMI	Human-Machine Interface
Network	European ATM Network
NMOC	Network Manager Operations Centre (evolved from CFMU Central Flow Management Unit)
RWY	Runway
SESAR	Single European Sky ATM Research Programme
SESAR Program	The programme which defines the Research and Development activities and Projects for the SJU.
SID	Standard Instrument Departure
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SSR	Secondary Surveillance Radar
STAR	Standard Arrival Route
TIA	Traffic Information Area
TIZ	Traffic Information Zone
TLDT	Target Landing Time

Term	Definition
TMA	Terminal Control Area
TOBT	Target Off-Block Time
TSAT	Target Start Up Approval Time
TTOT	Target Take Off Time
TWR	Tower Control Unit (Aerodrome Control Tower)
WS	Airport Tower Watch Supervisor
VHM	Vilhelmina Airport

11 REFERENCE DOCUMENTS

Doc Ref 1: EUROCONTROL Advanced ATC TWR Implementation Guide Edition 1.300, author Hans Koolen, dated 25/11/2016

Doc Ref 2: DPI Implementation Guide, URB/USD/DPI_Impl_Guide, edition 2.000, author Hans Koolen, dated 25/11/2016

Doc Ref 3: DPI and FUM Implementation RoadMap URB/USD/DPI_FUM_Impl_RM, Edition 1.800, author Hans Koolen, dated 25/11/2016.

Doc Ref 4: European A-CDM Manual 2012 edition v4