Remote Tower Operations

The Remote Tower Operational Concept

SESAR Solution Development

Operational Experiences

Hosted by:

daa

#SESAR

Programme – First Session

13:50   Remote Tower Operational Concept

Including an introduction to SESAR

(Robin Garrity, SESAR JU)

14:10   SESAR Solution Development

(Olivier Mongenie, SESAR JU)

14:40   Operational experiences

(Mikael Henriksson, LfV)

15:10   Questions and Answers

15:40   Coffee

FROM INNOVATION TO SOLUTION

The SESAR Operational Concept

Network Management

30

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System Wide Information Management

Air Traffic Control Centre
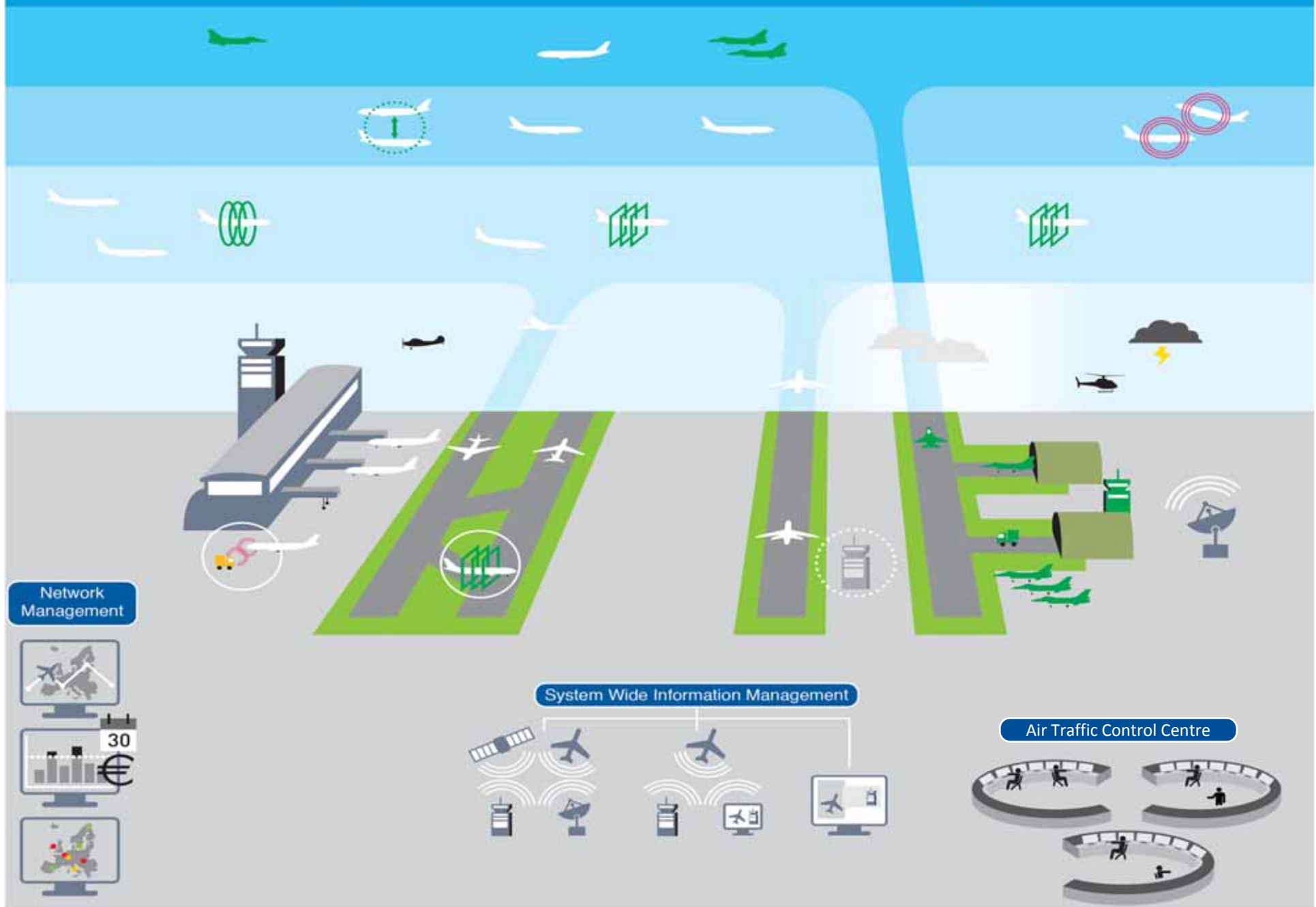
Priority Strategic Business Needs

Moving from Airspace to 4D Trajectory Management

Network Collaborative Management and Demand and Capacity Balancing

Conflict Management and Automation

Traffic Synchronisation

Airport Integration and Throughput

FROM INNOVATION TO SOLUTION

SESAR Operational Concept

Moving from Airspace to 4D Trajectory Management

4D Trajectory Management creates an environment where air and ground stakeholders share a common view of the aircraft's trajectory, so that the flight can be managed as closely as possible to the Airspace User's ideal profile, while optimising the flow of air traffic.

FROM INNOVATION TO SOLUTION

Moving from Airspace to 4D Trajectory Management

Network Collaborative Management and Dynamic Demand and Capacity Balancing

Network capacity is sufficient to meet demand and all parties work collaboratively to allow the flight to progress as agreed and updated through the Reference Business Trajectory (RBT)

FROM INNOVATION TO SOLUTION

SESAR Operational Concept

Moving from Airspace to 4D Trajectory Management

NCM and dDCB

Conflict Management and Automation

The SESAR conflict management process is enhanced by advanced controller tools, compatible with the new controller sector team organizations, in order to enable earlier identification and resolution of conflicts.

FROM INNOVATION TO SOLUTION

SESAR Operational Concept

Moving from Airspace to 4D Trajectory Management

NCM and dDCB

Conflict Management and Automation

Traffic Synchronisation

Airport Integration and Throughput

At the SESAR airport air traffic controllers, supported by advanced technologies, collaborate with all airport stakeholders to provide optimised services to airspace users as a fully-integrated part of the ATM network.
Remote Tower Operations are enabled

FROM INNOVATION TO SOLUTION

SESAR Operational Concept

Moving from Airspace to 4D Trajectory Management

NCM and dDCB

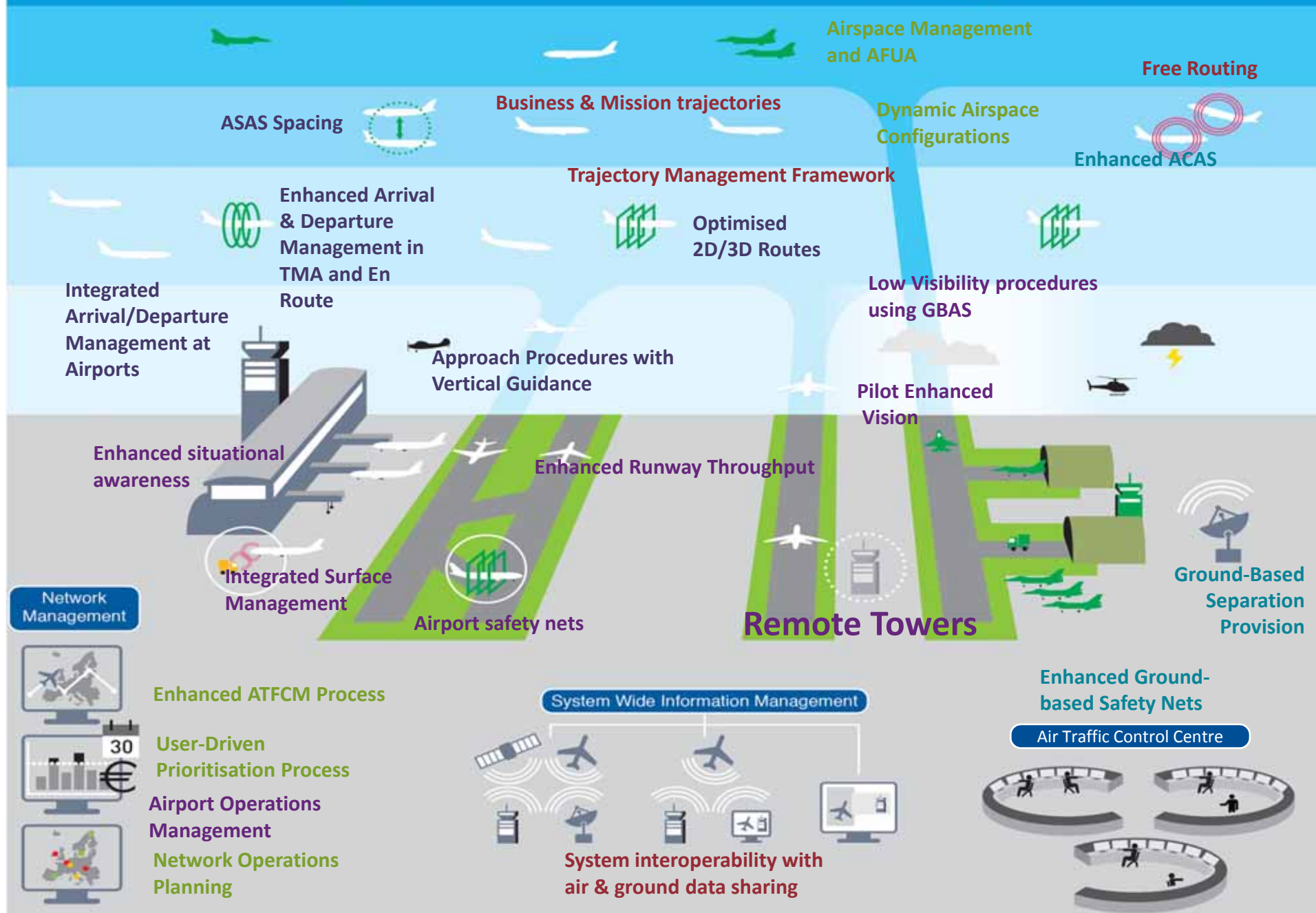**Conflict Management and Automation**

Traffic Synchronisation

Airport Integration and Throughput

SESAR
RESEARCH & INNOVATION

FROM INNOVATION TO SOLUTION

The SESAR Operational Concept

Airspace Management and AFUA

Free Routing

Business & Mission trajectories

ASAS Spacing

Dynamic Airspace Configurations

Enhanced ACAS

Trajectory Management Framework

Enhanced Arrival & Departure Management in TMA and En Route

Optimised 2D/3D Routes

Low Visibility procedures using GBAS

Integrated Arrival/Departure Management at Airports

Approach Procedures with Vertical Guidance

Pilot Enhanced Vision

Enhanced situational awareness

Enhanced Runway Throughput

Integrated Surface Management

Airport safety nets

Remote Towers

Ground-Based Separation Provision

Network Management

Enhanced Ground-based Safety Nets

Enhanced ATFCM Process

System Wide Information Management

Air Traffic Control Centre

30

User-Driven Prioritisation Process

Airport Operations Management

Network Operations Planning

System interoperability with air & ground data sharing

UNPACKING SESAR SOLUTIONS
REMOTE TOWER SERVICES
12-13 JUNE 2014, DUBLIN AIRPORT

SESAR
JOINT UNDERTAKING

Remote Tower operations

An introduction to SESAR activities
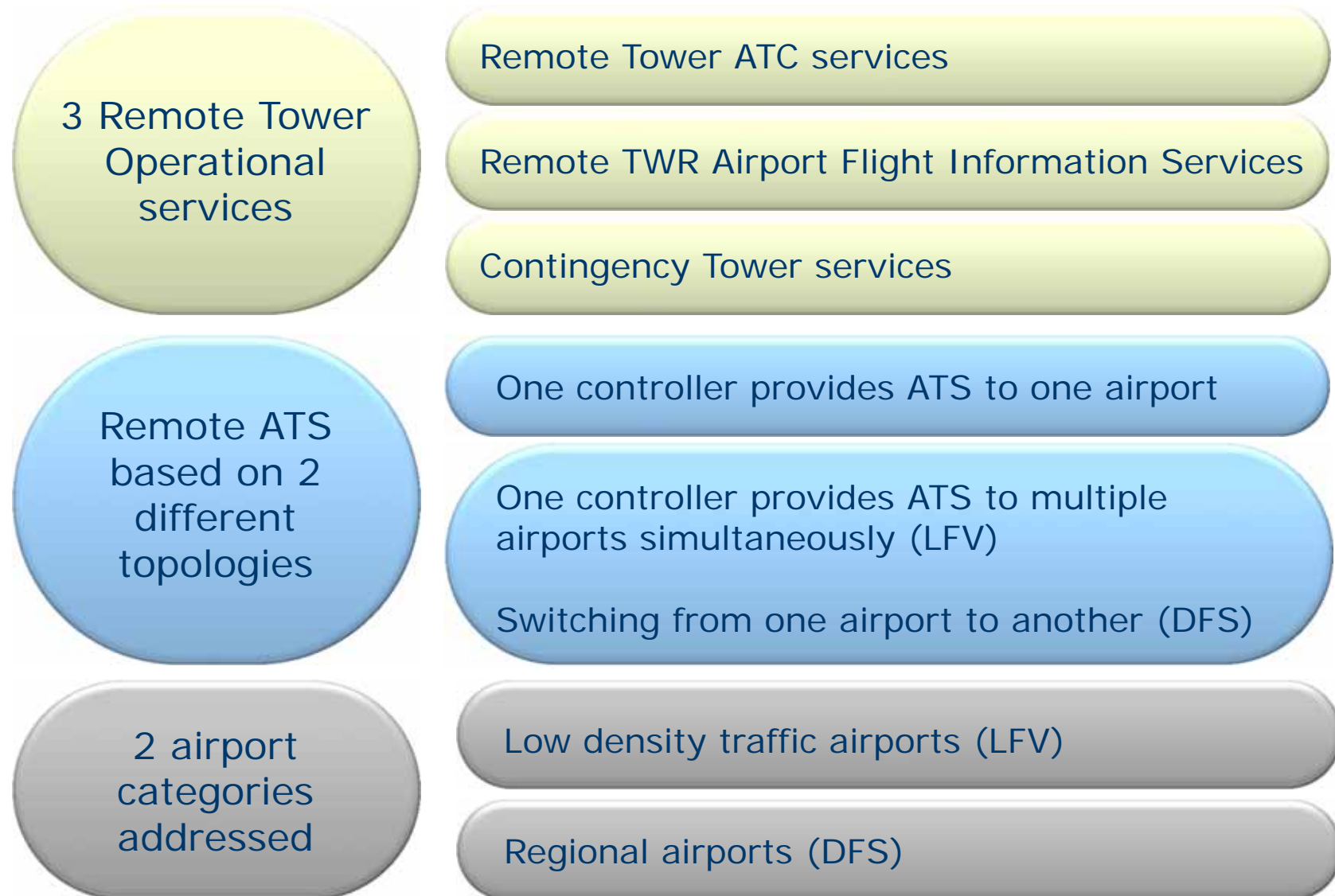
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What is a "Remote Tower"?

- Aim of Remote Tower OFA (06.03.01):

    - Development and assessment of an operational concept that enables the cost effective provision of Air Traffic Services (ATS) at one or more airports from a control facility that is not located in the local ATS Tower.

- Validation Targets:

    - It is feasible to provide ATS from a remote facility;

    - Human Performance is not negatively impacted and is at least as good as with current operations (from a local Tower). Any instances of Human Performance degradation are either mitigated or acceptably offset by improvements in other areas;

    - Safety levels are maintained; and

    - The airspace and runway capacity for the target candidate environments is not negatively impacted by the Remote Provision of ATS under normal conditions, and may be positively impacted.

FROM INNOVATION TO SOLUTION

Remote Tower Operations in SESAR

3 Remote Tower Operational services

- Remote Tower ATC services
- Remote TWR Airport Flight Information Services
- Contingency Tower services

Remote ATS based on 2 different topologies

- One controller provides ATS to one airport
- One controller provides ATS to multiple airports simultaneously (LFV)
- Switching from one airport to another (DFS)

2 airport categories addressed

- Low density traffic airports (LFV)
- Regional airports (DFS)

SESAR Solution

- The scope of the *current* SESAR Solution covers:
    - Remote Tower for Single Airport;
    - ATC services and AFIS;

- Other aspects of Remote Tower Operations will be covered in the ongoing research programme:
    - Multiple airports from a single location;
    - Contingency operations; and
    - Higher-density operations.

- SESAR also supports safety, deployment and standardisation activities through:
    - Publication of project material in 'Solution Packs';
    - Support to EUROCAE (WG 100); and
    - Feeding back external analyses and comments (*e.g.* from regulators and Users) into continuing research.

FROM INNOVATION TO SOLUTION

Thank you for your attention

FROM INNOVATION TO SOLUTION

SESAR Solution Development

Olivier Mongenie, SESAR JU

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SESAR Development Methodology

European Operational Concept Validation Methodology (E-OCVM)

SESAR Scope

ATM needs	Scope	Feasibility	Pre-industrial development & integration	Industrialisation
V0	V1	V2	V3	V4
Gather and access ATM performance needs	Scope operational concept and develop validation plans	Iteratively develop and evaluate concept	Build, consolidate and test	Industrialisation and approval

Concept validation

Requirements development

Concept development

Technical development and verification

Integration

FROM INNOVATION TO SOLUTION

- ## Remotely Operated Tower (ROT) Project
  - Partners: SAAB and LFV
  - 2006 – 2009
  - 1st concept definition and live demonstration

Courtesy of SAAB

FROM INNOVATION TO SOLUTION

- ## Advanced Remote Tower (ART) Project
  - Partners: SAAB, LFV, LYYN AB, NLR, Equipe Electronics Limited
  - Co-funded by the European Commission (FP6)
  - 11/2006 – 10/2009
  - Concept and system refinement, operational requirements identification

FROM INNOVATION TO SOLUTION

Remote Tower Operations in SESAR

- One dedicated Operational Focus Area (OFA)
  - 2 Operational Projects
  - 4 System Projects
- 8 SESAR Members involved

Remote Tower Operations in SESAR

EXE-06.09.03-VP-056
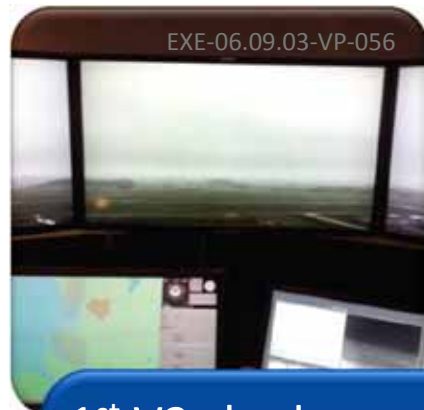
1st V3 shadow mode trial of a 'Single Remote Tower'

- Ängelholm airport TWR ATS from Malmö airport, Sweden
- Q4 2011 – Release 1

EXE-06.09.03-VP-057

2nd V3 shadow mode trial of a 'Single Remote Tower'

- Ängelholm airport TWR ATS from Malmö airport, Sweden
- Q2-Q3 2012 – Release 2

EXE-06.09.03-VP-058

V3 shadow mode trial of a 'Single Remote AFIS'

- Værøy airport AIFS from Bodø airport, Norway
- Q4 2012 / Q1 2013 – Release 3

FROM INNOVATION TO SOLUTION

1st V3 trial of a 'Single Remote Tower'

- Objective: assess the technical and operational capability of an initial prototype for the **provision of ATS to a single aerodrome, from a remote control site**, located at a distance of approximately 100 kilometers away, in an operational environment

- Date: Q4 2011

- Exercise coordinator:

FROM INNOVATION TO SOLUTION

1st V3 trial of a 'Single Remote Tower'

- Exercise context: V3 shadow mode trials @ Ängelholm airport, Sweden from Malmö ACC (~ 100 km away)
  - 1 RWY
  - 12.500 mvts / 376.000 pax in 2010

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© LFV   SOLUTION
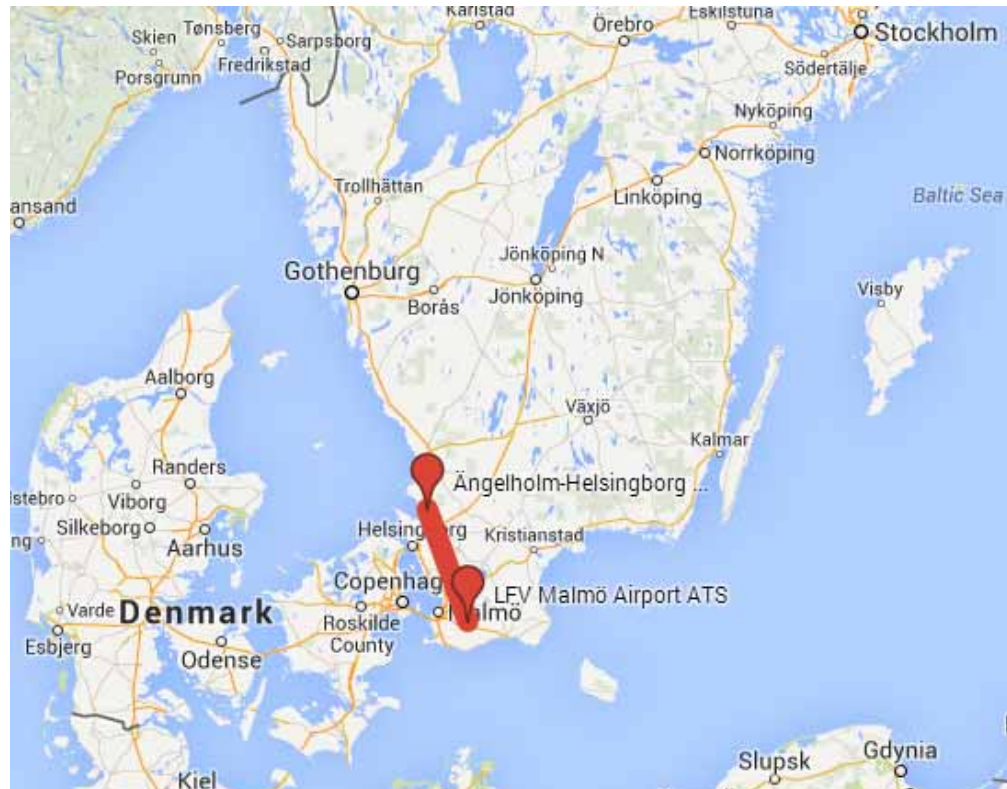
EXE-06.09.03-VP-056

1st V3 trial of a 'Single Remote Tower'

- System under test: SAAB
  - 9 50'' LCD screens
  - 9 cameras covering 360 degrees
  - IR camera / independant screen
  - PTZ camera
  - No tracking

FROM INNOVATION TO SOLUTION

EXE-06.09.03-VP-056

1st V3 trial of a 'Single Remote Tower'

- Main outcome
  - Acceptance by ATCOs of operational procedures and system
  - ATCOs considered IFR traffic could be accommodated with no negative impact on capacity
  - Issues with the quality of image (frame rate, contrast, etc.) but system continuously improved by NATMIG during trials
  - Positive initial safety feedback from ATCOs in normal conditions

2012

SESAR Release 1 Results

SESAR

FROM INNOVATION TO SOLUTION

EXE-06.09.03-VP-056

2nd V3 trial of a 'Single Remote Tower'

- Objective: assess the technical and operational capability of an initial prototype for the **provision of ATS to a single aerodrome, from a remote control site**, located at a distance of approximately 100 kilometers away, in an operational environment

- Built upon and complemented Release 1 exercise
  - Safety assessment
  - Human performance assessment
  - Operational service levels

- Date: Q2-Q3 2012

- Exercise coordinator:

LFV

FROM INNOVATION TO SOLUTION

2nd V3 trial of a 'Single Remote Tower'

- Exercise context: V3 shadow mode trials @ Ängelholm airport, Sweden from Malmö ACC (~ 100 km away)
  - 1 RWY
  - 12.500 mvts / 376.000 pax in 2010

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SOLUTION
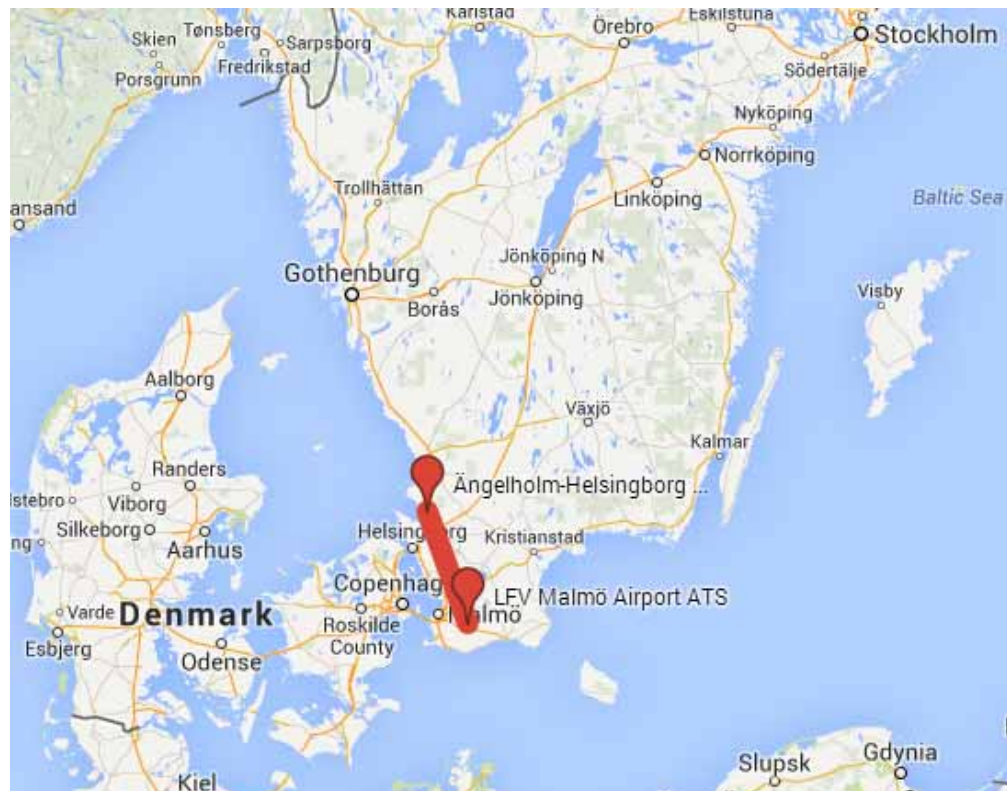
2nd V3 trial of a 'Single Remote Tower'

- System under test: **SAAB**
  - 9 42″ LCD screens
  - 9 cameras covering 360 degrees (improved frame rate) *Improved!*
  - IR camera / Picture-in-picture display (following recommendation from VP-056) *Improved!*
  - New HD PTZ camera *Improved!*
  - Image enhancement *New!*
  - Visual tracking *New!*
  - Label overlays + flight label *New!*
  - 5 additional cameras for hotspot monitoring / picture-in-picture display *New!*

FROM INNOVATION TO SOLUTION

INTEGRATED CWP

AIRPORT CAMERAS & PTZ

INFRA-RED IMAGE

RADAR TRACKING LABEL

ADDITIONAL CAMERA VIEWS

VIDEO TRACKING

INNOVATION TO SOLUTION

EXE-06.09.03-VP-057

2ⁿᵈ V3 trial of a 'Single Remote Tower'

- Main outcome
  - ATCOs considered the concept feasible
  - The concept provides a level of service equal to when the ATS are provided from a local tower
  - Human performance and safety were not negatively impacted
  - Insight into the potential levels of service (and corresponding safety and human performance levels) provided by the system and operational procedures

RESULTS

SESAR Release 2

SESAR

funding members

FROM INNOVATION TO SOLUTION

EXE-06.09.03-VP-057

V3 trial of a 'Single Remote AFIS'

- Objective: assess the technical and operational capability of an initial prototype for the **provision of AFIS to a single aerodrome, from a remote control site**, located at a distance of approximately 90 kilometers away, in an operational environment

- Built upon and complemented Release 2 exercise

- Date: Q4 2012 / Q1 2013

- Exercise coordinator: AVINOR

FROM INNOVATION TO SOLUTION

V3 trial of a 'Single Remote AFIS'

- Exercise context: V3 shadow mode trials @ Værøy airport, Norway from Bodø airport (~ 90 km away)
  - 1 helipad
  - 1 RWY (closed)
  - 1.388 mvts / 10.261 pax in 2011

Photo: Bernt Olsen-Hagen

Photo: Carlos Delgado

FROM INNOVATION TO SOLUTION

V3 trial of a 'Single Remote AFIS'

- System under test: SAAB
  - 14 55" screens
  - 14 HD cameras on top of a mast
  - Off-set rear screens showing view "behind" tower
  - PTZ camera with better operability
  - IR Camera
  - Visual Tracking, radar tracking plus combined tracking

Photo: SAAB

Photo: AVINOR

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V3 trial of a 'Single Remote AFIS'

- Main outcome
  - AFISOs considered the concept as viable and acceptable
  - The concept provides a level of service equal to when AFIS is provided locally
  - Excellent situational awareness
  - System in general and image quality in particular improved compared to previous validations
  - System must be optimised to be fully operable in severe weather and environment

FROM INNOVATION TO SOLUTION

EXE-06.09.03-VP-058

Safety Issues

- Analysis of the Safety Assessment Report of the SESAR single aerodrome remote tower services done after having gone through the SESAR R&D results

- Several important safety issues are of concern, which will require further clarifications in the implementation safety case for the particular implementation environment, e.g.:
  - Mitigation against loss of data connections and communications
  - Visual signalling
  - Controller responsibility and operational procedures for pilots and controllers
  - Cross-border operations

- SESAR will incorporate lessons learned from the implementations for the benefit of the future SESAR research programme – this process is already under way

FROM INNOVATION TO SOLUTION

Future Remote Tower Activities

Remote ATS for Single Airport

V3 shadow mode trial – EXE-06.08.04-VP-639

- Saarbrücken airport, Germany
- Q4 2014 – Release 4
- System under test: TBD

V3 shadow mode trial – EXE-06.08.04-VP-640

- Erfurt airport, Germany
- Q2 / Q3 2015
- System under test: TBD

Future Remote Tower Activities

Remote TWR ATS & AFIS for Multiple Airport

V2 shadow mode trial – EXE-06.09.03-VP-061

- Remote TWR ATS for Örnsköldsvik and Sundsvall airports from Sundsvall airport, Sweden
- Q3 2014

V2 real-time simulation – EXE-06.08.04-VP-750

- Remote TWR ATS
- 2016

V3 shadow mode trial – EXE-06.09.03-VP-063

- Remote AFIS for Röst airport (Sweden) and Værøy heliport (Norway) from Bodö airport (Sweden)
- Q3 / Q4 2014 – Release 4

Future Remote Tower Activities

Remote ATS for Contingency Situations

V3 shadow mode trial – EXE-06.09.03-VP-062

- Göteborg airport, Sweden
- Q4 2014

V2 shadow mode trial – EXE-06.08.04-VP-751

- Girona airport, Spain
- Q4 2014

V3 shadow mode trial – EXE-06.08.04-VP-752

- Spain
- Q4 2015

3D Modelling for Remote Tower

- Integration of 3D model of the airport and its surroundings in the remote tower video
  - Calibrate 2D cameras with the 3D model
  - 3D pixel analysis algorithms to support advanced visual tracking unit functions: runway incursion alerts, distinguish a bird from an aircraft, etc.
  - Integration of distributed 2D cameras and multiple vantage points to simulate another location of the tower
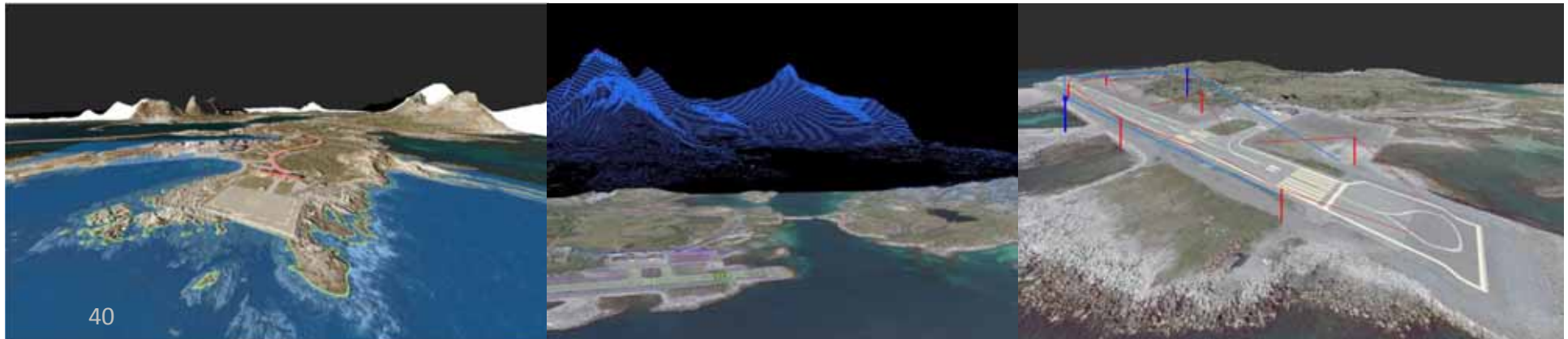
Thank you for your attention!

Olivier Mongénie

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FROM INNOVATION TO SOLUTION

Remote Tower Services – RTS

Operational experience RTC 1.0

Mikael Henriksson, RTC Operational Project Manager

mikael.henriksson@lfv.se

Product development based on operational demands 2009-2012

> **Adapting to existing rules and regulation**

> Number of cameras and orientation

> Pan Tilt Zoom camera function(PTZ)incl. S

> Image quality and performance

> Redundancy, fall back procedures

> Some predicted operational challenges mitigated (SESAR)

> **Controllers working position - CWP**

> Integrated CWP – one provider of all operational systems

> Integrated systems. Decreased ATCO interaction and reduced workload

> HF experts involved from the start

> Easy to use, ATCO can put all attention on the operational work

D 2014-

A new way of performing air traffic service
- from propeller to jet
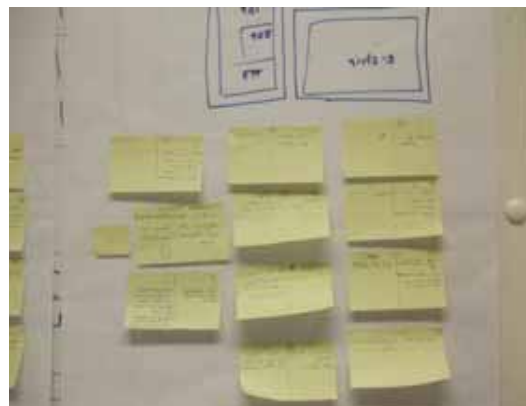
Workshops January 2011

D 2014-

Camera tower established at airports.
Operational demands choses the position.

14	Cameras
2	Zoom cameras
2	Signal lights
2	Microphones

5 March 2014

D 2014-

Product development, verifications and validations activities

› Validation (Situation awareness, Functional requirements, Safety, Scenario Based Observations, Trust, HMI, CWP, Roles and Responsibilities, Risks (EURO CONTROL METHODOLOGY))

› Passive validation ; Performed for 10 weeks, 30 ATCO from other LFV units

› Access to operational system, not connected to outside world.

› Validation report , updated Human Performance case, more safety docs.

› Information and visits from trade unions, aviation associations, airports, airlines and stakeholders.

› Advanced validation; ATCO with local rating for validated airport. Performed for 8 weeks-positive results.

› Validation report updated, Human performance case updated , more safety docs.

› More than 100 ATCO´s has seen the facility and worked with technique.

D 2014-

RTC Operational experiences

> Important mindset; We shall provide the same service from an center with new technical tools. Move the mind from TWR.

> Presenting 360⁰ in 225⁰ RTM opening, ATCO adapted it easily and saw some benefits. They felt an better overview.

> Reduction of separation minima can bee used according to doc 4444 after experience, compare with new ATCO´s in today TWR.

> Moving between airports minor problem because of same CWP and interaction.

> "TWR" position was placed at different side of runway, you adapt easily and have technical support by overlays.

> Backlight and operational room lightning is important.

> Depth sight is not an issue, human eye doesn't do it - it is an mental process that ATCO´s learn in the new operational environment.

RTC Operational experiences

› We can use most of our operational manuals. (design decision 2010).

› New modern integrated alarm system needed to be developed.(Integrated Airport and ATM system)

› Cameras and filters present "longer" days and visual positive effects in mist.

› Filters give improvements in cloud type detection.

› You can use binoculars in RTM!

› Every OTW screen present an exact angel of the visual presentation regardless line of sight (compare TWR). Can maybe be use for geographical separation and communication with VFR pilots.

› And more will come, trust me..

RTC
APPROVAL PROCESS

RTS Sweden approval process

> According to LFV Safety Management System (SMS).

> Long process with the Swedish regulator; first meeting mars 2011 and ongoing.

> Deliver of more than 200 documents of various volume. Questions & answers, 485 until today-more will come.

> Several visits of the Swedish regulator at site and follow up meetings.

> Approval for advance validation October 2013; ATS performed from RTC with safeguard in TWR. Validation finished Dec 2013.

> Application for full ATS/RTS is send to the Swedish regulator, goal is Q2 2014.

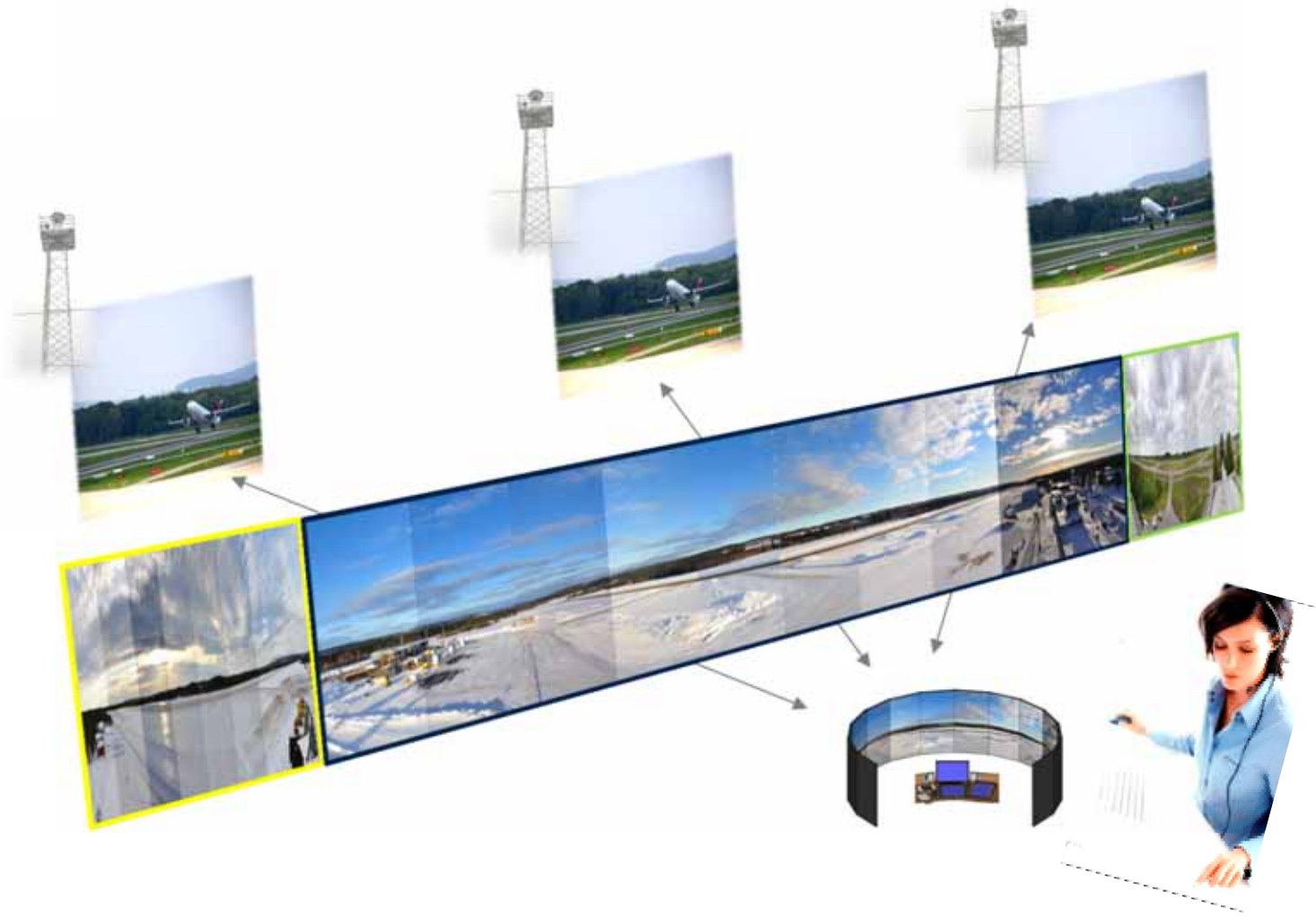# RTC facility in Sundsvall – serving two airports

Further development planned - RTC 2.0

D 2014-

5 March 2014

Multiple airports RTC 3.0

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5 March 2014

D 2014-

Summary

> Remote Tower Service in Sweden is close to an operational approval.

> The approval process has been complex and cumbersome which has resulted in extensive experience and know-how. The involvement of the national regulator is crucial.

> The experience of both the operational and technical aspects is growing exponentially.

> There are "hidden" growth potential in RTS to embrace new services.

> LFV offer RTS as an alternative for our costumers from Q3 2014 and onwards.

D 2014-

THANKS FOR LISTENING.

LFV

AIR NAVIGATION SERVICES OF SWEDEN