



Remote towers at your service

First validation of remote tower for multiple airports (PJ05)





DLR (AT-One)

...the research perspective



Remote Tower Operations – from Vision to Reality

First Prototype

@DLR, 2005



The Vision

Virtual Tower, 2002



2002

Technical Tests

Since 2005



First RTC trials
@DLR, 2010

Proof of Concept

Since 2008



2018



First
Operational
Installation
@LFV, 2015

Proof of Concept Multiple Towers

SESAR2020

PJ05 2016-2022



Standardisation

EUROCAE WG100
ED-240 in 2016



Partners / Tasks



FOR A SAFER WORLD

- Provider field test platform
- Planning tool



- Provider Simulation Platform
- Validation



Hungarian Air Navigation Services

- Operational Concept
- Validation



- Leonardo
- Prototyping MET Processing and Display

Schedule & Set Up

V2 Simulation in Braunschweig (HC, DLR, FRQ, SELEX)

Nov 2017 ✓

V2 Simulation in Braunschweig (ON, DLR, FRQ)

March 2018

V3 Simulation in Braunschweig HC (DLR, FRQ, SELEX)

Nov 2018

V3 Shadow Mode at RTC Budapest (HC, FRQ)

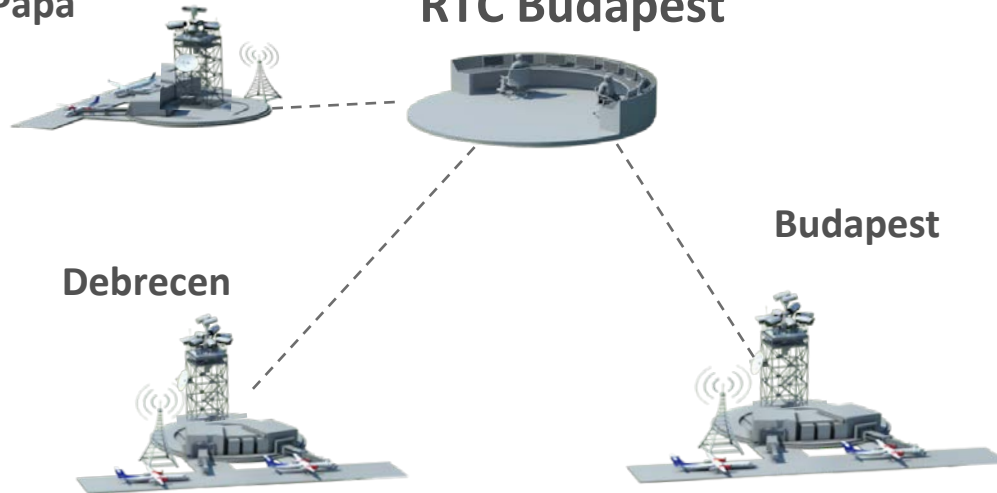
Mar 2019

Papa

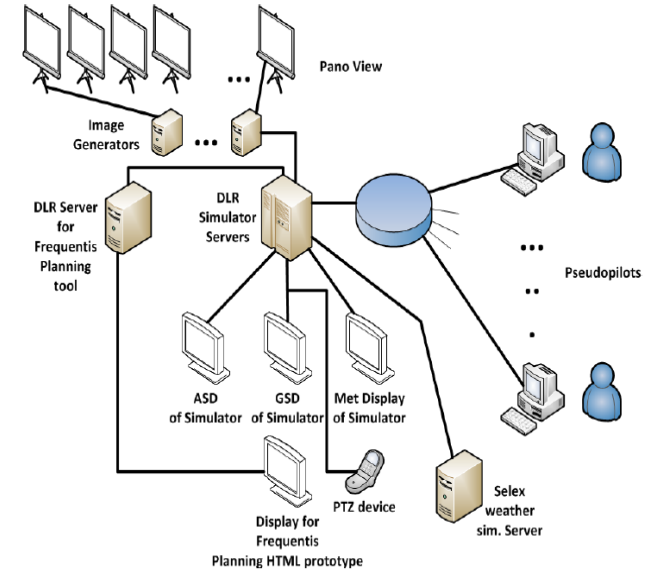
RTC Budapest

Debrecen

Budapest



Overview



V2 Simulation at DLR/Braunschweig – SET UP

3x Panorama views
with augmentation

3x Approach
Radar

Planning Tool

Flight Strips

3x PTZ View for
each airport

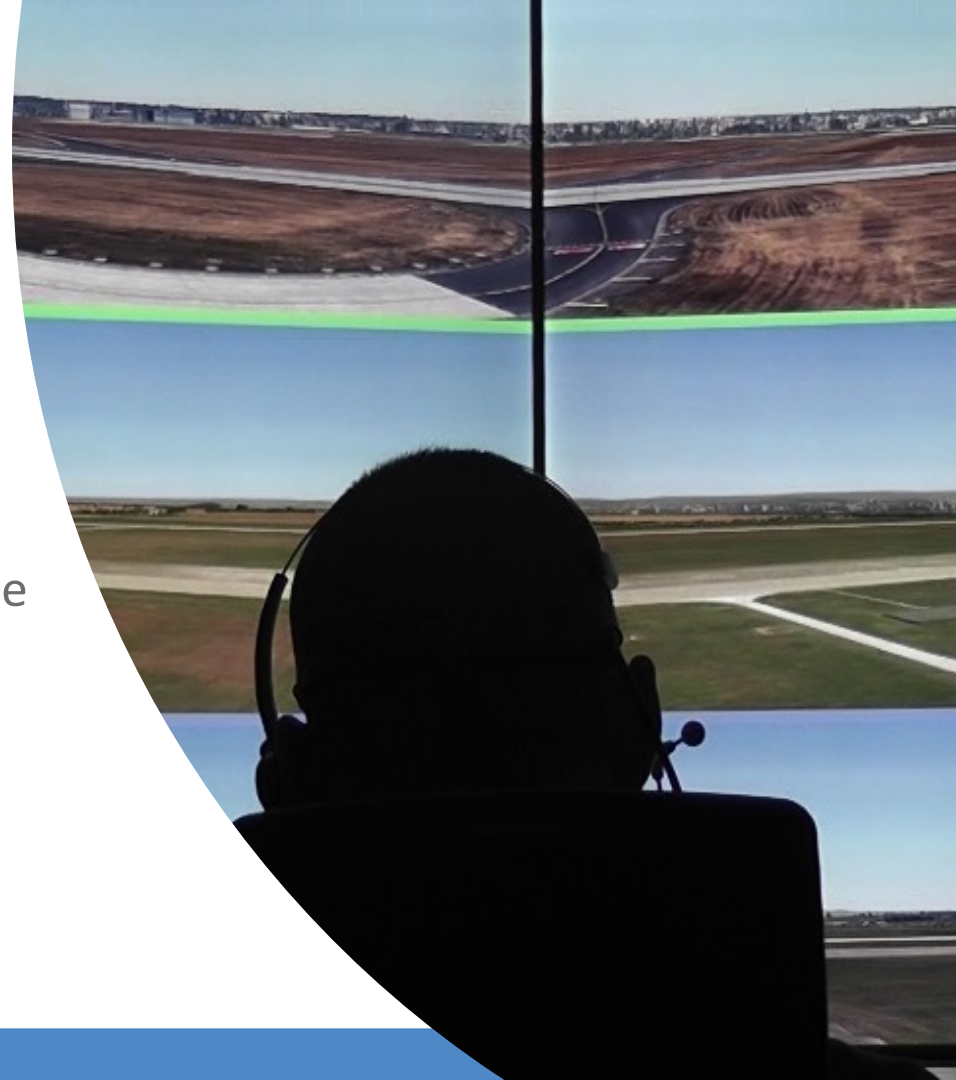
Support Information
& Control Functions

Voice Communication



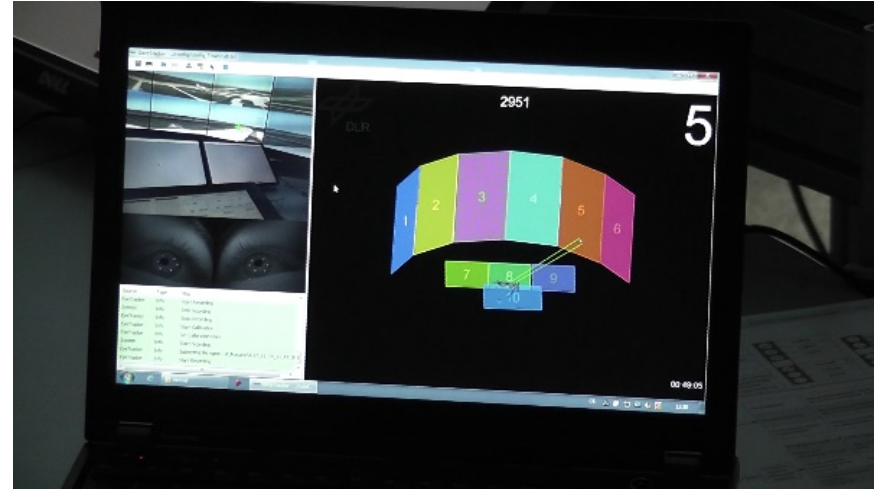
Validation Scope (V2) - “Concept Validation through Simulation”

- Proof of operational feasibility & safety for 1:3 multiple setting
- Prototyping: Planning tool assistance



Exerimental Design

Scenario ID	IV1 Mixture VFR/IFR %	IV2 mvmt/hr	<i>Number of airports</i>	<i>Duration</i>	<i>lighting</i>	<i>Traffic distribution</i>
Training	20/80	20	2	40 min	daylight	even
Scenario 1	10/90	20	3	50 min	daylight	even
Scenario 2	20/80	20	3	50 min	daylight	even
Scenario 3	10/90	30	3	50 min	daylight	even
Scenario 4	20/80	30	3	50 min	daylight	even



Validation Objectives & Results

Validation Objectives

Validation Objectives	Number of Success Criteria
HUMAN PERFORMANCE – SITUATION AWARENESS	4
HUMAN PERFORMANCE – WORKLOAD	1
HUMAN PERFORMANCE – ACCEPTANCE OF OPERATING METHODS / ROLES	3
HUMAN PERFORMANCE – USABILITY and UTILITY	3
SAFETY - GENERAL	2
SAFETY	3
CAPACITY	1
COST EFFICIENCY	1

- Each **Success Criteria** has to be measured with a **Metric**
- All **18 Success Criteria** were passed ✓

Metrics

Mid - Run

- ISA – Scale
- Modified Cooper Harper Scale

Post – Run

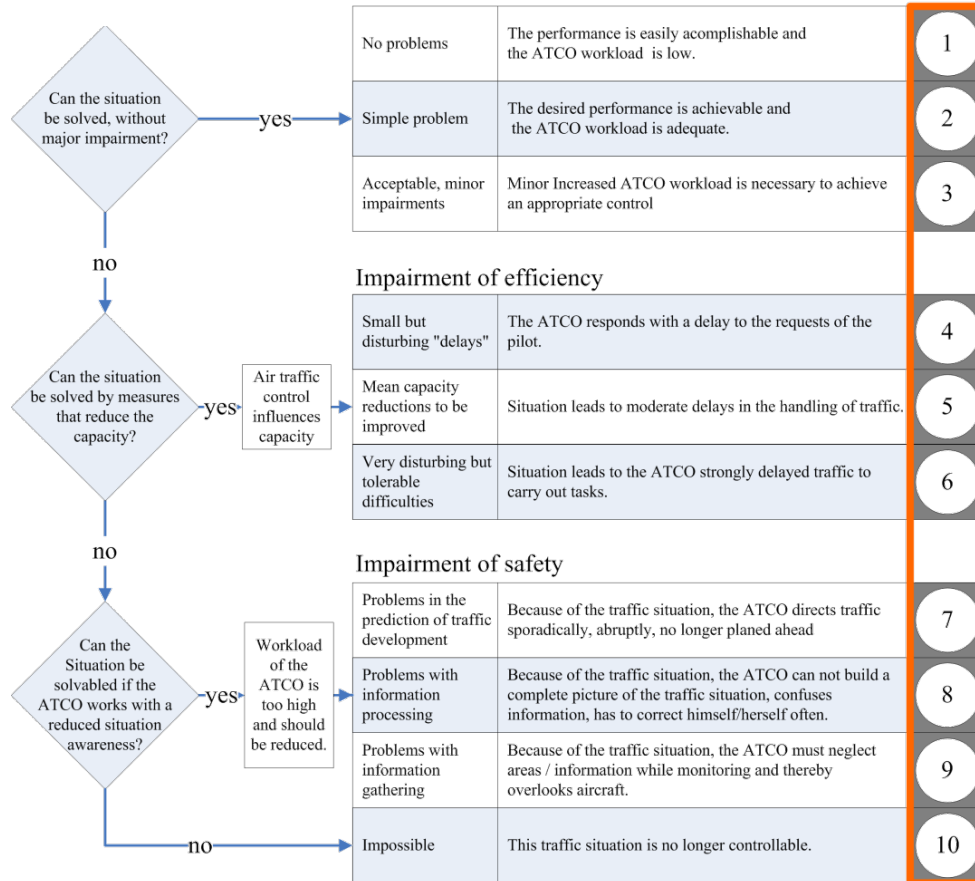
- NASA-TLX
- SASHA
- AIM
- 26 closed questions

Debriefing

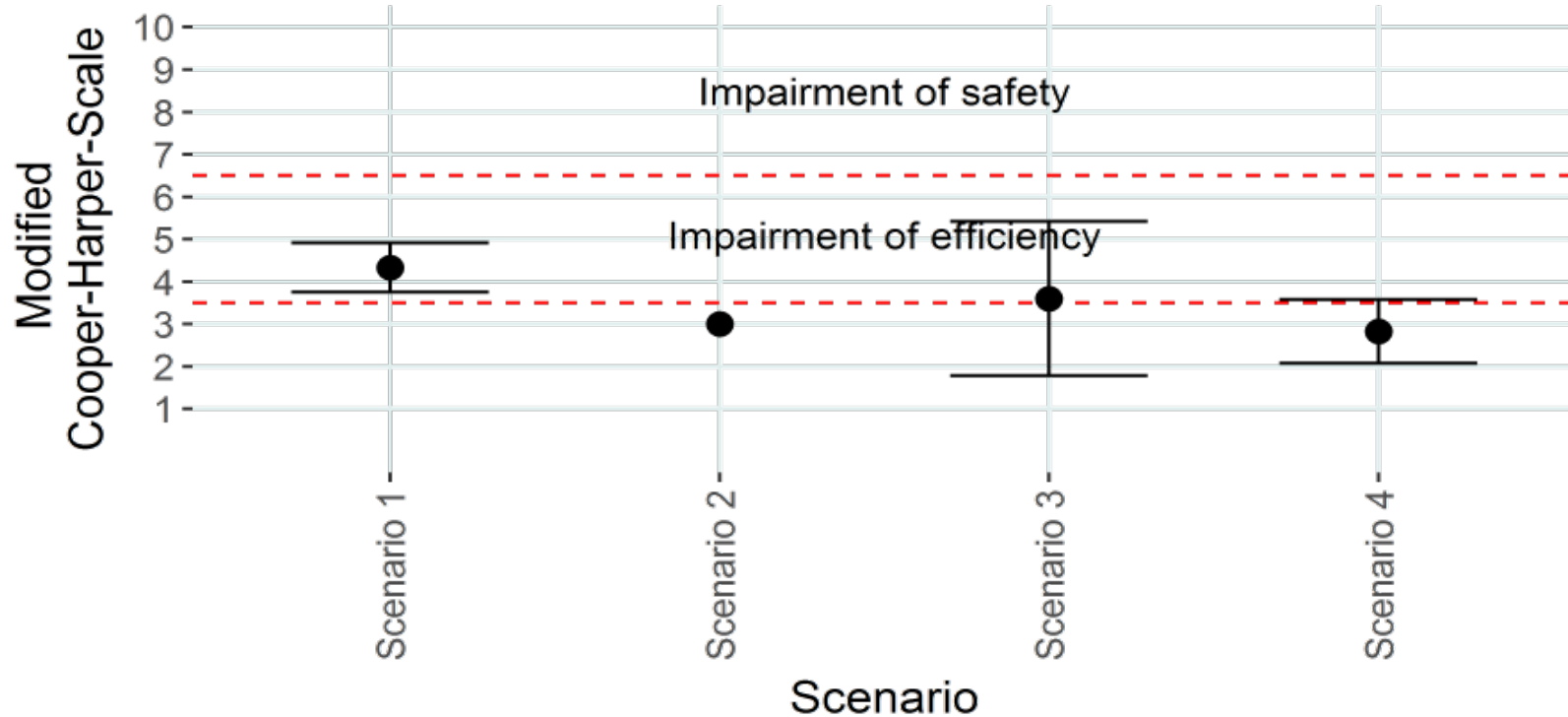
- 33 closed questions
- 24 open questions
- System Usability Scale (SUS)



Safety & Efficiency Metrics



Safety & Efficiency Results





Open Day



HungaroControl *...the ANSP perspective*



HungaroControl multi remote tower animation



What are the benefits of a rTWR?

1

Operational benefits

- Increased situational awareness
- More convenient workplace & working position
- Increased capacity (e.g. LVP/normal)
- To have a chance for real solutions 100% tailored to your needs
- To exploit the advantages of augmented reality

2

Financial benefits

- Less capital expenditure considering normal office building
- Less operational expenditure considering camera and data connection infrastructure
- Optional: decreased number of ATCOs
- Less cost related to the ATCO's training

3

Safety benefits

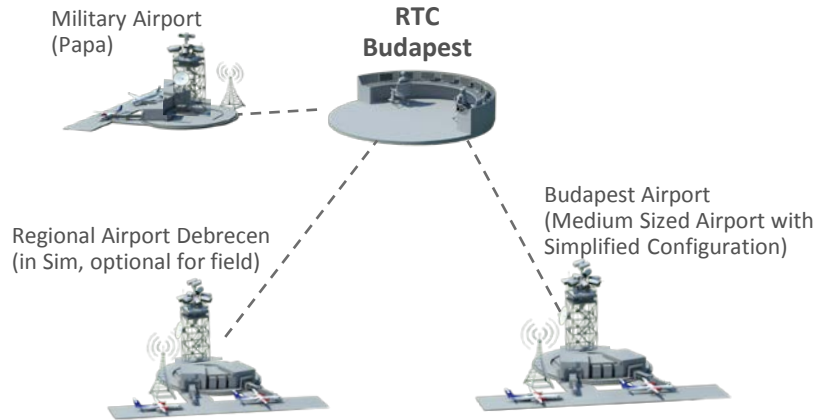
- Enhanced safety
- Increased situational awareness
- Increased capacity (e.g. LVP/normal)
- High definition cameras technology to safely and securely manage air traffic

Planned setup for validation

Simulation in Braunschweig (DLR)



Shadow Mode Validation in Budapest (HC) 2018/19



	Airport A	Airport B	Airport C
Airport name	Pápa (military)	Debrecen (civil)	RWY 1 – Budapest
IFR flights / VFR flights	100 % / 0 %	70 % / 30 %	50 % / 50 %
Ground movements per hour	1	2	16

Operational challenges and objective

Challenge

Attention divided between **three aerodromes** - first time



Mixing-up which aircraft belongs to which aerodrome



Challenge

ATCOs are familiar with one of the aerodromes, but two of them are **completely new** to them



Challenge

Determine the **maximum number of movements** that ATCOs are able to handle safely while maintaining situational awareness



Objective



Initial operational findings



No mixing up airports

Advanced HMI and the usage of the tower designator in the phraseology helped maintaining situational awareness



Operational procedures

Harmonised procedures could help improve situational awareness and lower workload



Traffic complexity

Based on ATCO feedback traffic complexity is key factor contributing to workload



Frequency congestion

Frequency congestion is a key factor when handling such amount of traffic



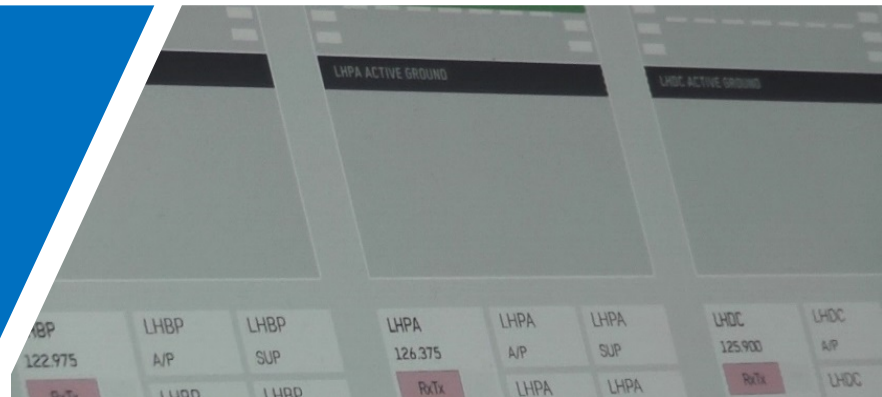
FREQUENTIS AG

...the industry perspective



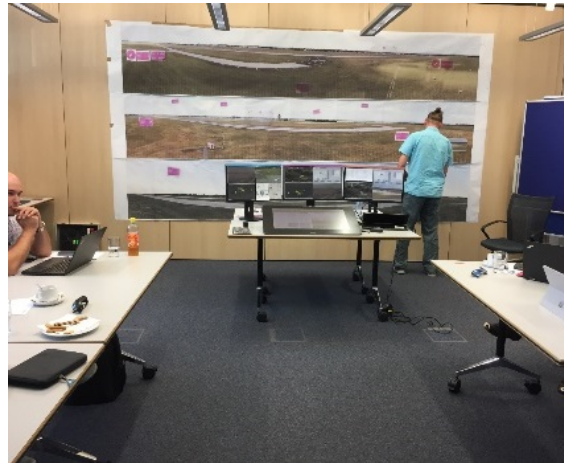
Key Topics addressed in the validation

- Integrated Multi Tower CWP
- Planning and workflow tools
- Integration of
 - Enhanced Voice Services
 - Met Warnings
 - Surveillance / Safety Net



Multi CWP Design Workshop in Vienna

- Workshop with ATCOs
- Paper Prototyping to get initial working position design
- Setup of simulation environment in Braunschweig
- Technical Integration
- Pre Validation Phase with ATCOs



Simulation Setup in Braunschweig (3 Airports)

Panorama Views
with
augmentation

Situation Display
for each airport

Planning Tool

Flight Strips



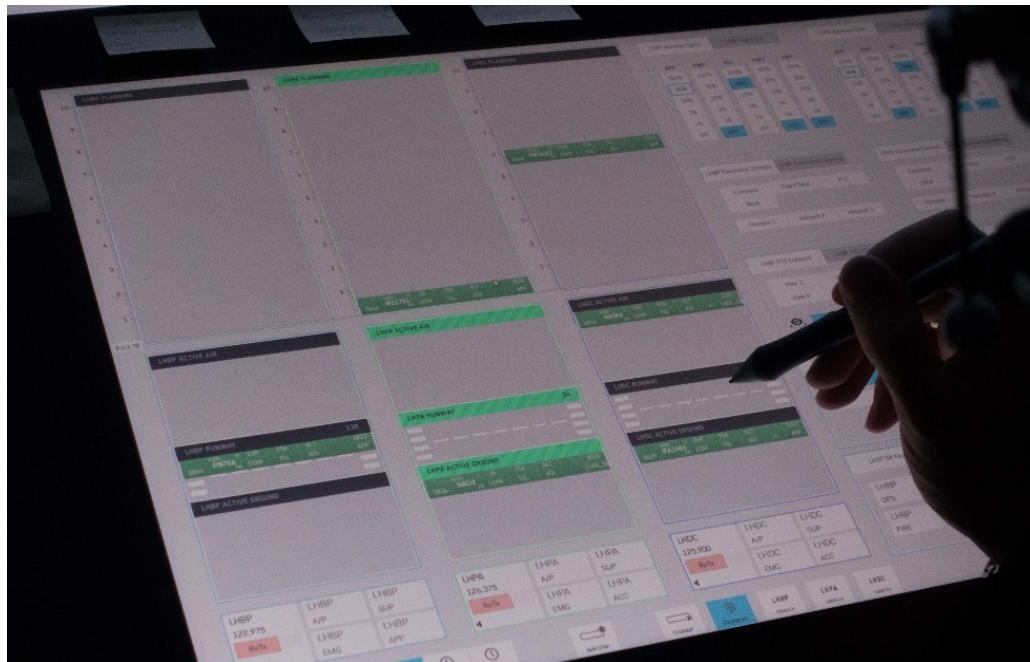
PTZ View for each
airport

Support Information
& Control Functions

Voice Communication

Integrated Control Panel

- Timeline based traffic display for multiple airports & parallel traffic indication
- Planning of upcoming traffic situation
- Replanning function
- Integrated flight strips functions
- Clearance assignment
- Integrated VCS functionality (PTT / Squelch)



Surveillance & Situation Display

- Multi Airport Situation Display (combined Ground and Air View)
- Support of multiple surveillance sources (SSR, MLAT, ADS-B)
- Integration of camera control functions





Overview of Validation Plan & Objectives in SESAR 2020

Thank you very much
for your attention!



founding members

