Open Day

Remote Tower Center with a Highly Flexible Allocation of Aerodromes

PJ05-W2 DTT sol35 - EXE-2.1

Jörn Jakobi, PJ.05 Project Manager, DLR (AT-One)
DLR, FRQ, PANSA, ON

Braunschweig, Germany - 01/12/2021

SESAR JOINT UNDERTAKING

Founding Members

EUROPEAN UNION EUROCONTROL

Agenda

10:00 Welcome & Introduction	
10:15 Experimental Set Up	Jörn Jakobi (DLR)
10:30 Technical Set Up	Regina Bruzek, Ibrahim Karaca (FRQ)
10:45 ATCO Feedback on Exercise (1)	Jan Rękowicz (PANSA)
11:00 ATCO Feedback on Exercise (2)	Tomas Pagirys (ON)
11:15 Q&A Session (1)	

11:30 Live-Demo at DLR Remote Tower Lab (lunch in between)

in a HITL Simulation with 2 ATCOs at 2 RTMs and a Supervisor controlling 15 Airports with splitting and merging of Aerodromes and supervisor planning

13:45 Q&A Session (2)

15:00 End of Meeting


Welcome to
DLR Braunschweig
DLR

The DLR Institute of Flight Guidance in Braunschweig



Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center







- Research Institution
- Space Agency
- Project Management Agency

DLR Fields of Activity

Research: ~ 1 billion euros

Aeronautics	Space	Energy	Transportation
			

(approx. 80% of the activities, resources)

(approx. 20%)

Locations and Personnel

10,000 employees work in 55 institutes and facilities.
Offices in Brussels, Paris, Tokyo and Washington D.C.

Braunschweig Location

Employees: around 1200

Institutes and installations for:

- Aerodynamics and flow technologies,
- Composite structures and adaptive systems
- **Flight guidance**
- Flight systems
- Transportation systems
- Air transport and airport research
- Flight experiments and design organisation



Structure of the Institute

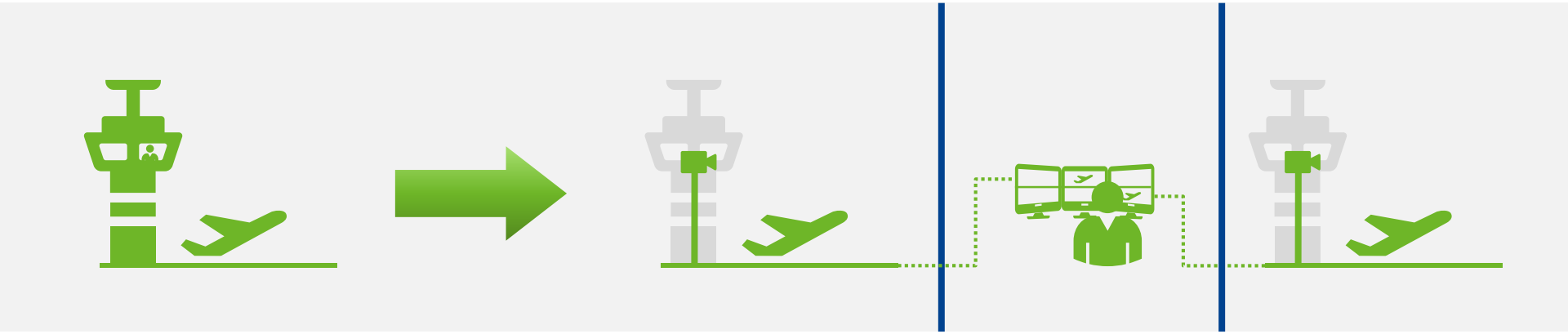
Head of the Institute
Prof. Dr.-Ing. D. Kügler

142*

Controller Assistance	Pilot Assistance	Unmanned Aircraft Systems Group	ATM Simulation	Human Factors	Management Services and AT-One
Dipl.-Ing. J. Rataj	Dr.-Ing. B. Korn	Dr. rer. nat. D. Geister	Dipl.-Ing. S. Kaltenhäuser	Dr.rer.nat. N. Carstengerdes	Dr.-Ing. H. Többen
					
Bodenverkehrs-management	ATM-Leistungsbewertung		Aviation Security	Systembewertung und soziale Akzeptanz	AT-One

* 12/2020

DLR Research and Development of Remote Tower Concept



2002 **Invention** in the Competition of Visions

2005 First DLR **Prototype** in Braunschweig

2006 RTO **Patent**

2010 Operational tests **Single RTO**

ab 2010 Operational tests **Multi RTO**

2014 **Licensed** to FREQUENTIS

2015 **RTO First Operation** in Sweden

2016 **Standardisation** on EU Level

2019 **SESAR2020** tests for Multi RTO

Today

SESAR2020
PJ05-W2 Digital Technologies for Tower

PJ05-W2 DTT

WP2 Solution 35

Multiple Remote Tower and Remote Tower Centre

EXE-2.1-V3-DLR /FRQ/B4 - Braunschweig

EXE-2.2-V3-COOPANS - Malmö

EXE-2.3-V3-INDRA - Asker

EXE-2.4-V3-ENAV

EXE-2.5-V3-DFS - Langen

WP3 Solution 97.1 & 97.2

HMI Interaction modes for Airport Tower

EXE-0.1 New supporting HMI tools - Amsterdam

EXE-0.2 Virtual/Augmented Reality Tower Tools - Bologna

EXE-0.3 AI & Machine Learning – EEC Bretigny

EXE-0.4 Hungary Remote Tower - Budapest

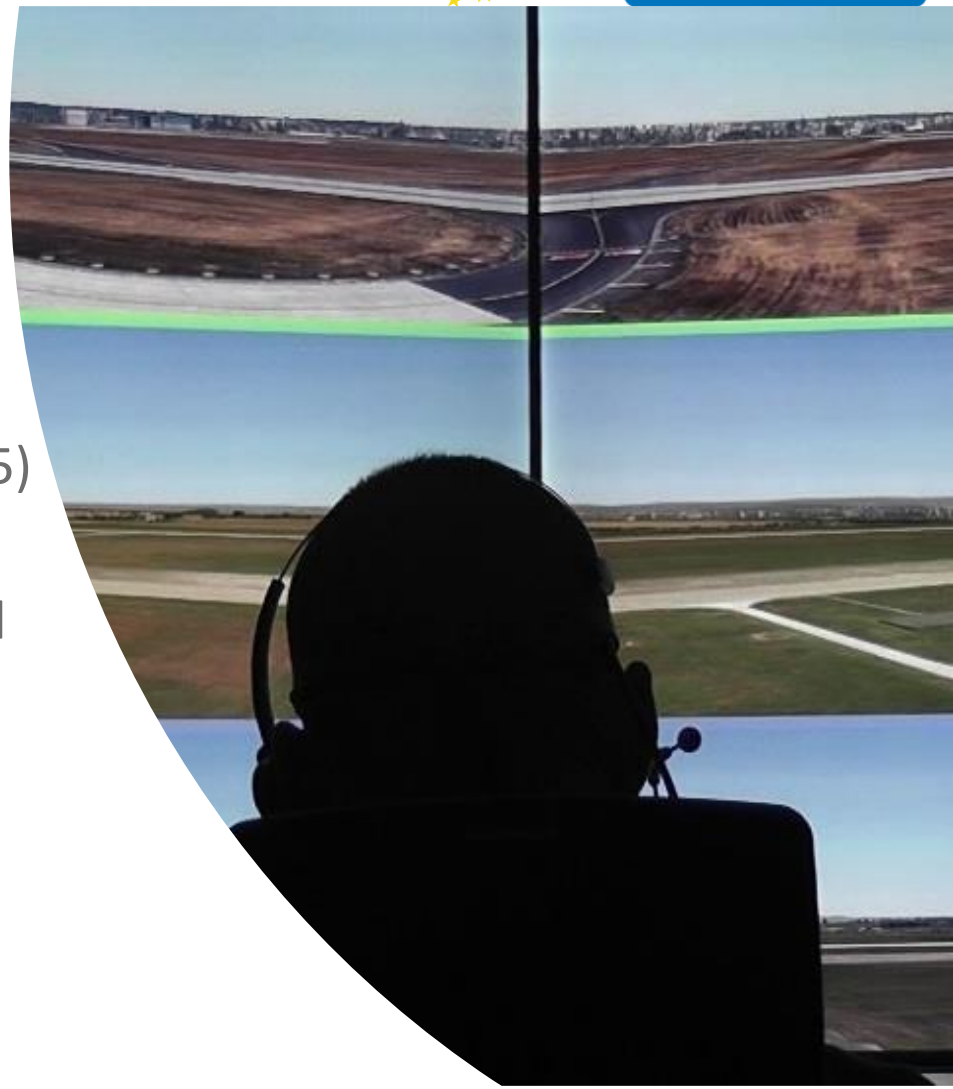
EXE-0.5 Virtual and augmented reality + Tracking Label and Air Gestures - Spain

EXE-0.6 TRL4 ASR in Tower - Braunschweig

Validation Scope EXE-2.1

Proof of a

- Remote Tower Center with a Highly Flexible Allocation of Aerodromes (15)
  with focus on the
- supervisor position and planning tool



SU Planning Tool

- Input Parameter

- ATCO AD endorsements / ATCO roles [TWR, APP, AFIS]
- Shift hours / break agreements
- Required Training times
- ATCO experience
- Traffic Plans [6 months, 24hours, 2hours, 30min]
- Weather forecasts
- Briefing / Debriefing requests

SU Planning Tool

- Parameter for an optimal allocation

- Balanced ATCO workload
- Balance airport working hours for ATCO licences to keep the proficiency level
- Handover: as little as possible, but as many as necessary
- Amount of ATCOs: as little as possible, but as many as necessary
- Redundancy in case of not foreseeable situations [emergencies]
- Plan for airports as alternates

ATCO – Airport Matrix

	15 airports														
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	A13	A14	A15
ATCO-01															
ATCO-02															
ATCO-03															
ATCO-04															
ATCO-05															
ATCO-06															
ATCO-07															
ATCO-08															
ATCO-09															
ATCO-10															
ATCO-11															
ATCO-12															
ATCO-13															
ATCO-14															
ATCO-15															

ATCO – Airport Matrix

	15 airports														
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	A13	A14	A15
ATCO-R01	E	E	E												
ATCO-R02		E	E	E											
ATCO-V03			E	E	E										
ATCO-V04				E	E	E									
ATCO-V05					E	E	E								
ATCO-V06						E	E	E							
ATCO-V07							E	E	E						
ATCO-V08								E	E	E					
ATCO-V09									E	E	E				
ATCO-V10										E	E	E			
ATCO-V11											E	E	E		
ATCO-V12												E	E	E	
ATCO-V13													E	E	E
ATCO-V14	E													E	E
ATCO-V15	E	E													E

ATCO – Airport Matrix

	15 airports														
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	A13	A14	A15
ATCO-R01	E	**E**	**E**												
ATCO-R02		**E**	**E**	E											
ATCO-V03			E	E	E										
ATCO-V04				E	E	E									
ATCO-V05					E	E	E								
ATCO-V06						E	E	E							
ATCO-V07							E	E	E						
ATCO-V08								E	E	E					
ATCO-V09									E	E	E				
ATCO-V10										E	E	E			
ATCO-V11											E	E	E		
ATCO-V12												E	E	E	
ATCO-V13													E	E	E
ATCO-V14	E													E	E
ATCO-V15	E	E													E

ATCO – Airport Matrix

	6 simulated airports						9 virtual airports								
	A01	**A02**	**A03**	**A04**	**A05**	**A06**	A07	A08	A09	A10	A11	A12	A13	A14	A15
ATCO-R01	E	**E**	**E**		E										
ATCO-R02		**E**	**E**	E		E									
ATCO-V03			E	E	E										
ATCO-V04				E	E	E									
ATCO-V05					E	E	E								
ATCO-V06						E	E	E							
ATCO-V07							E	E	E						
ATCO-V08								E	E	E					
ATCO-V09									E	E	E				
ATCO-V10										E	E	E			
ATCO-V11											E	E	E		
ATCO-V12												E	E	E	
ATCO-V13													E	E	E
ATCO-V14	E													E	E
ATCO-V15	E	E													E

ATCO – Airport Matrix [1:1]

	6 simulated airports						9 virtual airports									
	A01	**A02**	**A03**	**A04**	**A05**	**A06**	A07	A08	A09	A10	A11	A12	A13	A14	A15	
ATCO-R01	✓	E	E		E											**1**
ATCO-R02		✓	E	E		E										**1**
ATCO-V03			✓	E	E											**1**
ATCO-V04				✓	E	E										**1**
ATCO-V05					✓	E	E									**1**
ATCO-V06						✓	E	E								**1**
ATCO-V07							✓	E	E							**1**
ATCO-V08								✓	E	E						**1**
ATCO-V09									✓	E	E					**1**
ATCO-V10										✓	E	E				**1**
ATCO-V11											✓	E	E			**1**
ATCO-V12												✓	E	E		**1**
ATCO-V13													✓	E	E	**1**
ATCO-V14	E													✓	E	**1**
ATCO-V15	E	E													✓	**1**
	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	

ATCO – Airport Matrix [1:3]

	6 simulated airports						9 virtual airports									
	A01	**A02**	**A03**	**A04**	**A05**	**A06**	A07	A08	A09	A10	A11	A12	A13	A14	A15	
ATCO-R01	✓	✓	E		✓											**3**
ATCO-R02		E	✓	✓		✓										**3**
ATCO-V03			E	E	E											**0**
ATCO-V04				E	E	E										**0**
ATCO-V05					E	E	E									**0**
ATCO-V06						E	E	E								**0**
ATCO-V07							✓	✓	✓							**3**
ATCO-V08								E	E	E						**0**
ATCO-V09									E	E	E					**0**
ATCO-V10										✓	✓	✓				**3**
ATCO-V11											E	E	E			**0**
ATCO-V12												E	E	E		**0**
ATCO-V13													✓	✓	✓	**3**
ATCO-V14	E													E	E	**0**
ATCO-V15	E	E													E	**0**
	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	

ATCO – Airport Matrix [example]

	15 airports															
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	A13	A14	A15	
ATCO-R01	E	✓	E		E											**1**
ATCO-R02		E	✓	E		E										**1**
ATCO-V03			E	E	E											**0**
ATCO-V04				E	E	E										**0**
ATCO-V05					E	E	E									**0**
ATCO-V06						E	E	E								**0**
ATCO-V07							E	E	E							**0**
ATCO-V08								✓	✓	✓						**3**
ATCO-V09									E	E	E					**0**
ATCO-V10										E	E	E				**0**
ATCO-V11											E	E	E			**0**
ATCO-V12												✓	E	E		**1**
ATCO-V13													E	E	E	**0**
ATCO-V14	E													E	E	**0**
ATCO-V15	E	E													E	**0**
	0	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	

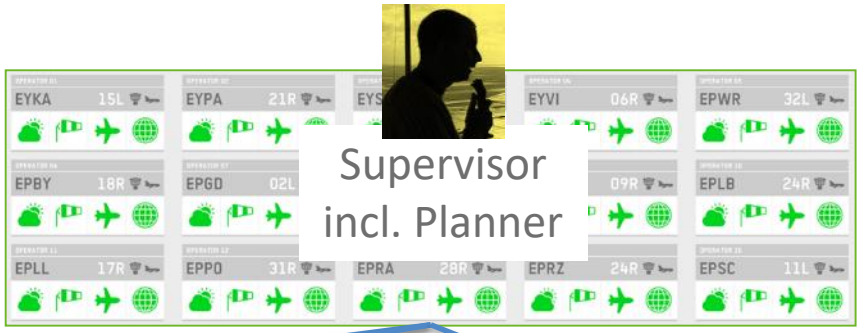
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ATCO-R01	E	✓	E		E											**1**
ATCO-R02		E	✓	E		E										**1**
ATCO-V03			E	E	E											**0**
ATCO-V04				E	E	E										**0**
ATCO-V05					E	E	E									**0**
ATCO-V06						E	E	E								**0**
ATCO-V07							E	E	E							**0**
ATCO-V08								✓	✓	E						**2**
ATCO-V09									E	E	E					**0**
ATCO-V10										✓	E	✓				**2**
ATCO-V11											E	E	E			**0**
ATCO-V12												E	E	E		**0**
ATCO-V13													E	E	E	**0**
ATCO-V14	E													E	E	**0**
ATCO-V15	E	E													E	**0**
	0	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	

ATCO – Airport Matrix [example]

	15 airports															
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	A13	A14	A15	
ATCO-R01	E	✓	E		E											**1**
ATCO-R02		✓	E	E		E										**1**
ATCO-V03			✓	E	E											**1**
ATCO-V04				E	E	E										**0**
ATCO-V05					E	E	E									**0**
ATCO-V06						E	E	E								**0**
ATCO-V07							E	E	E							**0**
ATCO-V08								✓	✓	E						**2**
ATCO-V09									E	E	E					**0**
ATCO-V10										✓	E	✓				**2**
ATCO-V11											E	E	E			**0**
ATCO-V12												E	E	E		**0**
ATCO-V13													E	E	E	**0**
ATCO-V14	E													E	E	**0**
ATCO-V15	E	E													E	**0**
	0	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	

1:1 setting = per Airport 1 ATCO via 1 MRTM



Supervisor incl. Planner

ATCO R1



ATCO R2

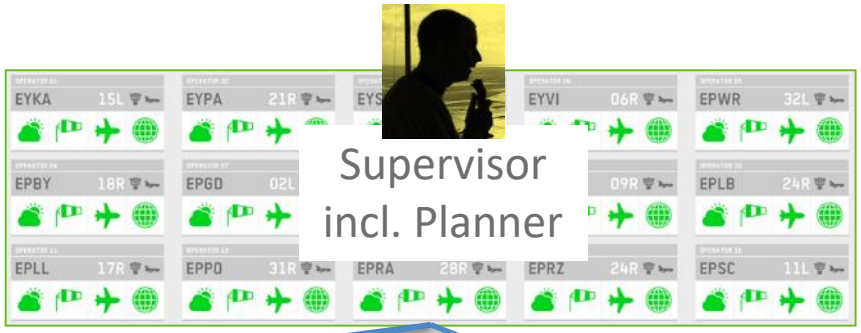


13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O

1 2 3 4 5 6 7 8 9 10 ## 15

Flexible Allocation



Supervisor incl. Planner

ATCO R1



ATCO R2

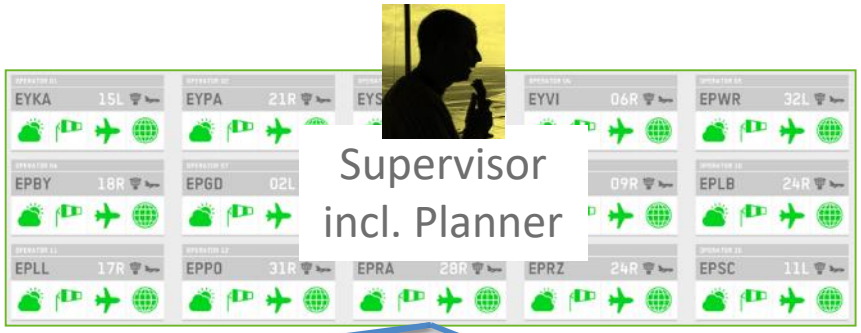


13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O



Flexible Allocation 2:1



Supervisor incl. Planner

ATCO R1



ATCO R2

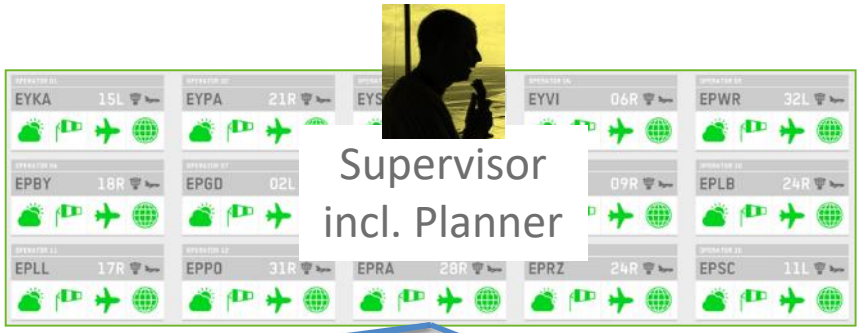


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Flexible Allocation



Supervisor incl. Planner

ATCO R1

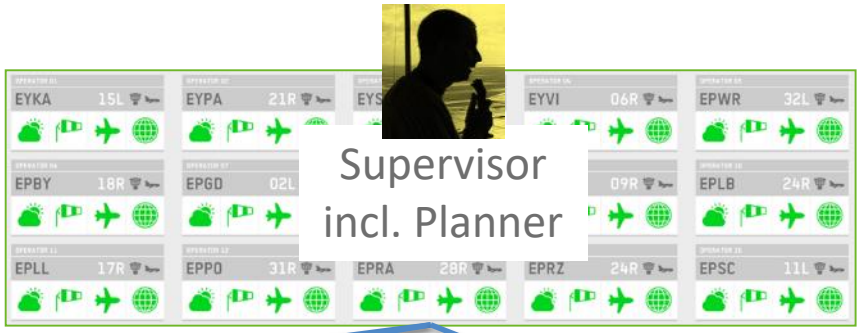
ATCO R2

13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O

1 2 3 4 5 6 7 8 9 10 ## 15

Flexible Allocation



Supervisor incl. Planner

ATCO R1

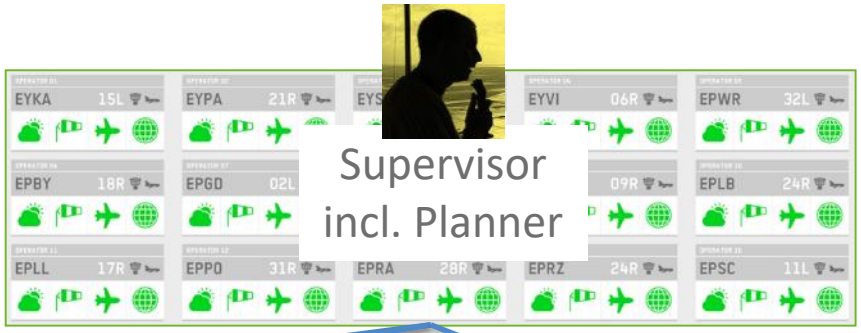
ATCO R2

13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O

1 2 3 4 5 6 7 8 9 10 ## 15

Flexible Allocation 1:3



Supervisor incl. Planner

ATCO R1

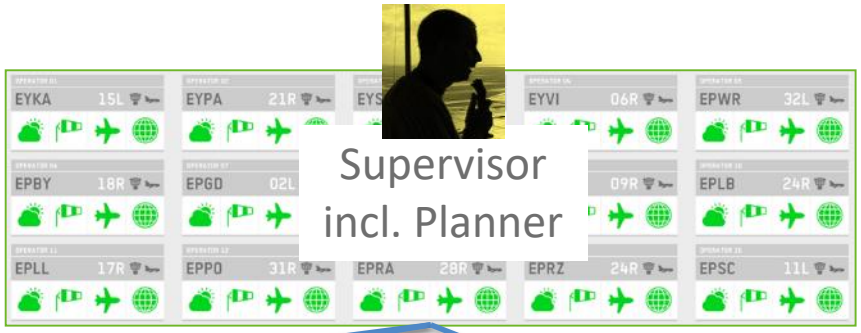
ATCO R2

13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O

1 2 3 4 5 6 7 8 9 10 ## 15

Handover from real to virtual ATCO



Supervisor incl. Planner

ATCO R1



ATCO R2

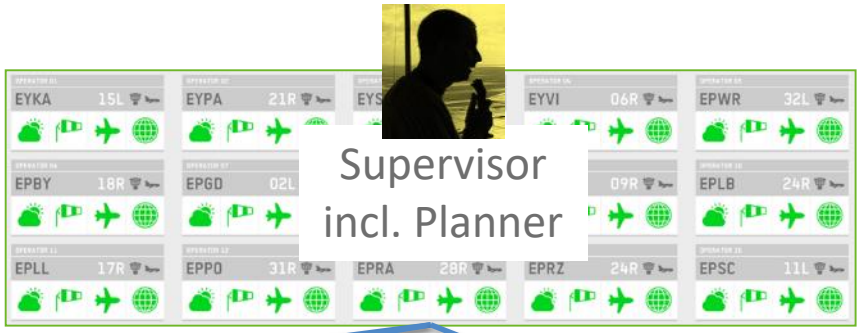


13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O

1 2 3 4 5 6 7 8 9 10 ## 15

Handover between real ATCOs



Supervisor incl. Planner

ATCO R1

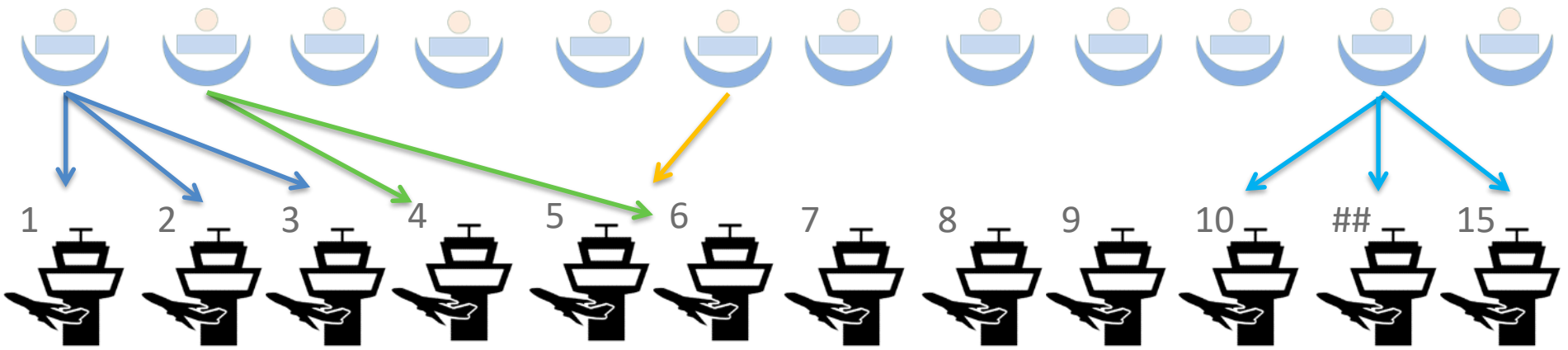


ATCO R2

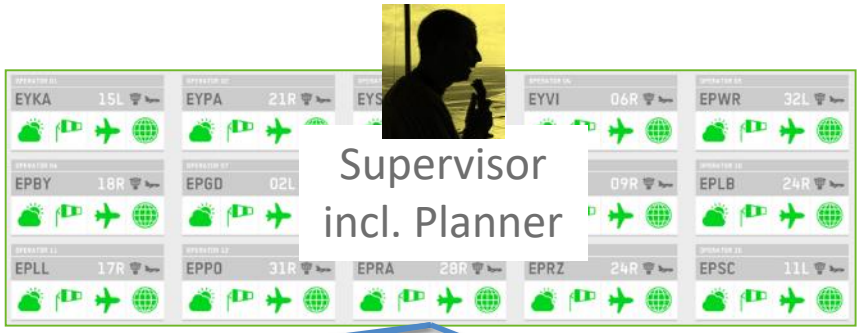


13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O



Emergency on Airport 4 – Handover of Airport 2 & 3 to ATCO1



Supervisor incl. Planner

ATCO 1

ATCO 2

13 Virtual MRTMs + 13 virtual ATCOs

MRTM A **MRTM B** MRTM C MRTM D MRTM E MRTM F MRTM G MRTM H MRTM I MRTM K MRTM X MRTM O

1 2 3 4 5 6 7 8 9 10 ## 15

Basic Set-Up



Supervisor incl. Planner

6 Pseudo-Pilots
1 Pseudo-ATCOs

2 real ATCOs

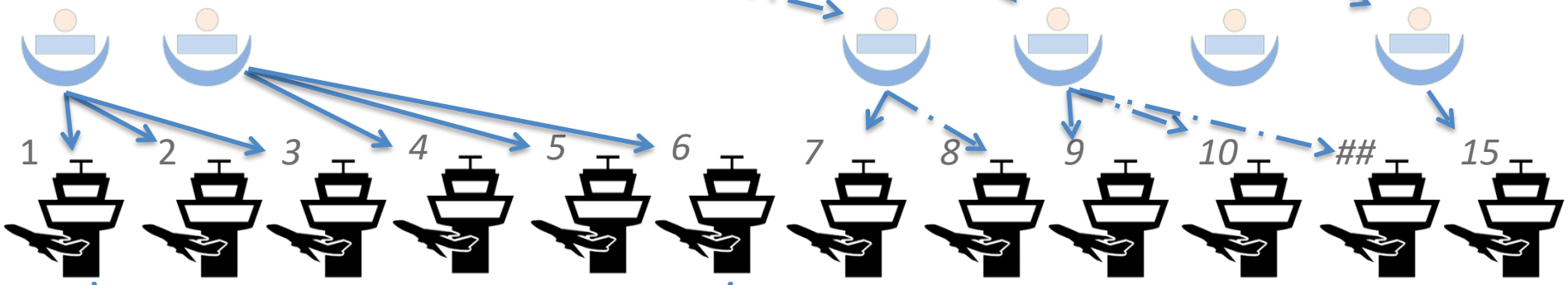
8 virtual ATCOs

ATCO ATCO





MRTM A **MRTM B** *MRTM C* *MRTM D* *MRTM E* *MRTM F*



6 real airports

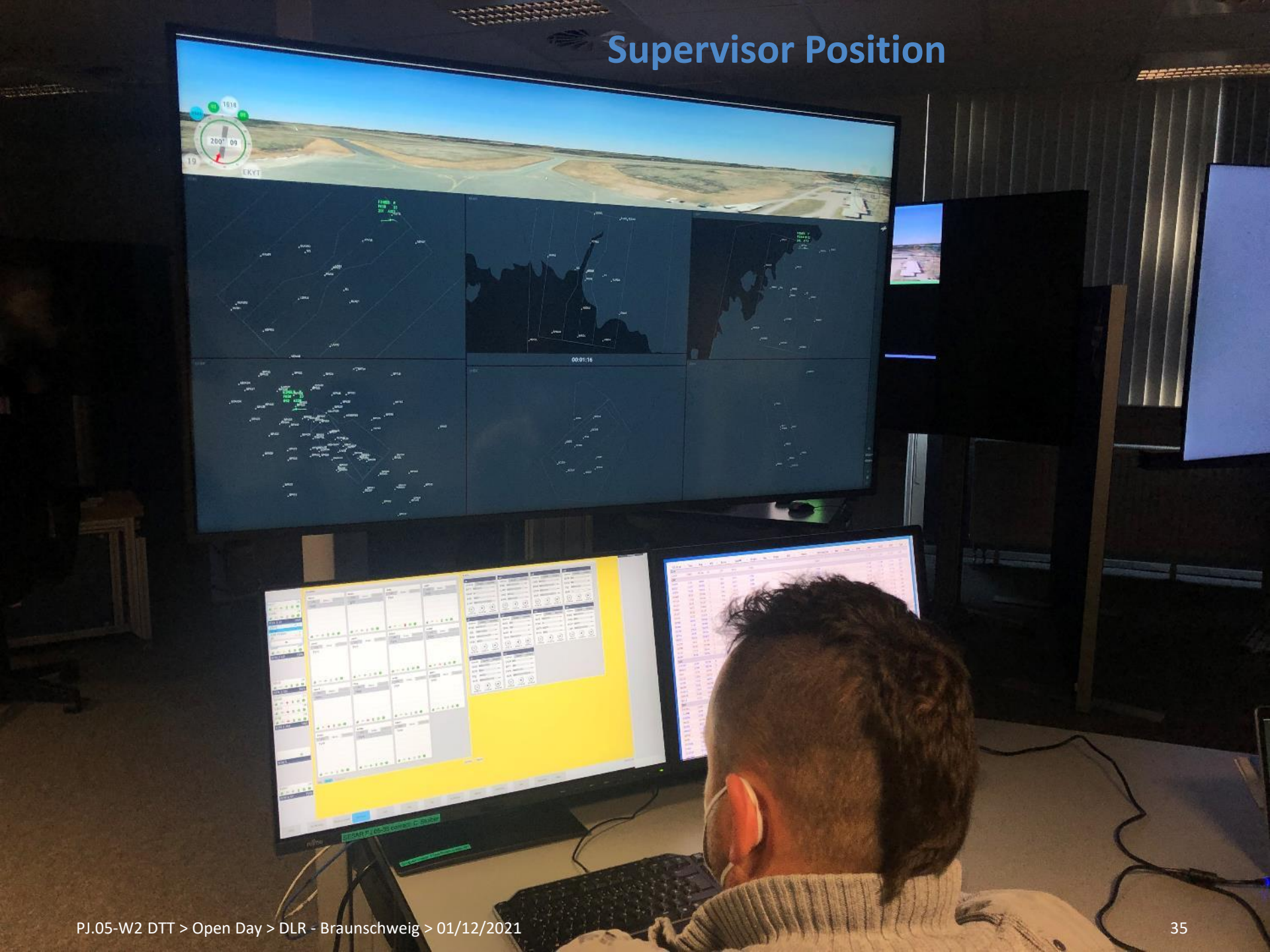
9 virtual airports


DLR

ATCO 1



Supervisor Position



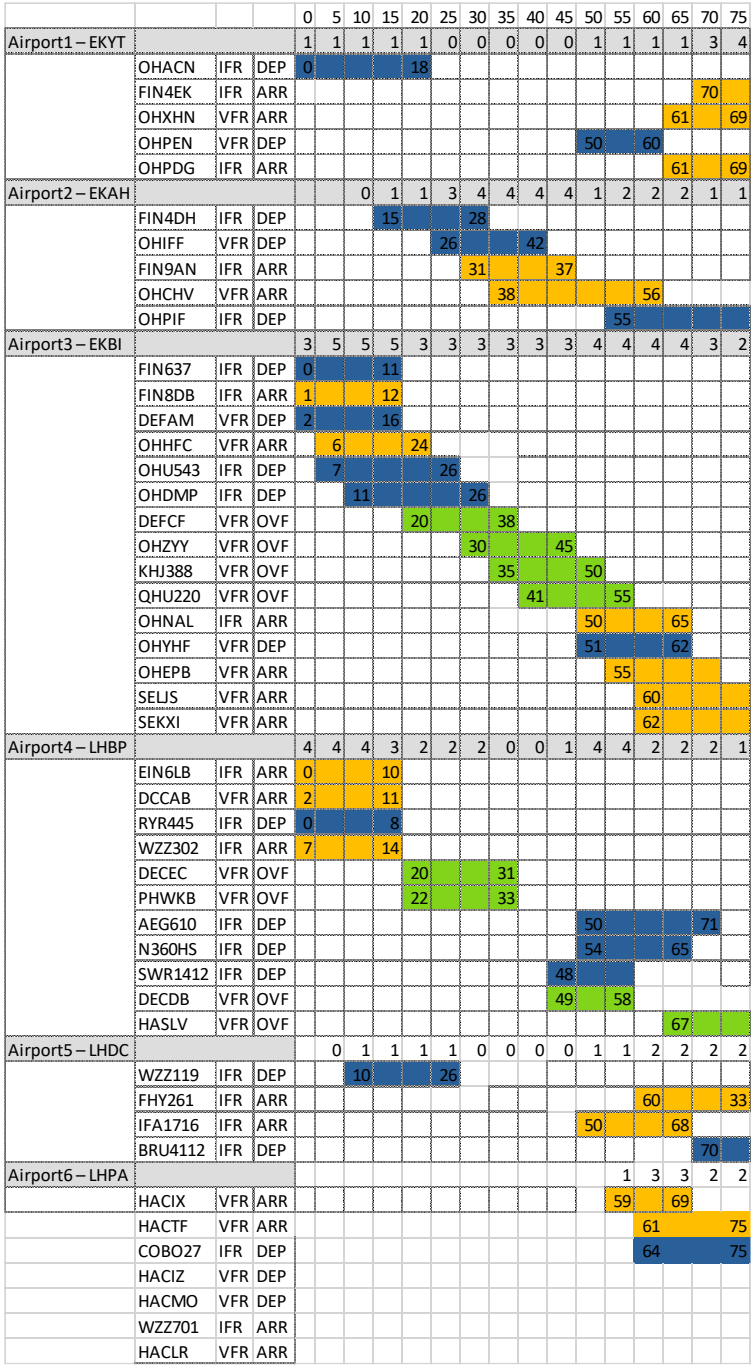
Airports

- All airports are small generic airports
- All unknown to the ATCOs
- Low to medium traffic
- Mixed traffic (50/50% IFR/VFR)
- Basic layout (1 RWY, 1 to 4 entry points, 1 apron)
- Ground surveillance at two of them
- Phraseology
  - in every **new** radio call identify with airport name (call sign – airport name)
  - pilots will do the same but vice versa (airport name - call sign)

Participants

- 15 ATCOs in total (8 ON & 7 PANSA)
- 5 groups of 3 ATCOs (2 real ATCOs + 1 Supervisor)
- 4 aerodrome endorsements each
- TWR/APP ratings

Traffic



				0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
Airport1 – EKYT				1	1	1	1	1	0	0	0	0	0	1	1	1	1	3	4
	OHACN	IFR	DEP	0				18											
	FIN4EK	IFR	ARR															70	
	OHXHN	VFR	ARR														61		69
	OHPEN	VFR	DEP											50		60			
	OHPDG	IFR	ARR														61		69
Airport2 – EKAH						0	1	1	3	4	4	4	4	1	2	2	2	1	1
	FIN4DH	IFR	DEP				15			28									
	OHIFF	VFR	DEP						26			42							
	FIN9AN	IFR	ARR							31			37						
	OHCHV	VFR	ARR								38					56			
	OHPIF	IFR	DEP												55				
Airport3 – EKBI				3	5	5	5	3	3	3	3	3	3	4	4	4	4	3	2
	FIN637	IFR	DEP	0			11												
	FIN8DB	IFR	ARR	1			12												
	DEFAM	VFR	DEP	2			16												
	OHHFC	VFR	ARR		6			24											
	OHU543	IFR	DEP		7				26										
	OHDMP	IFR	DEP			11				26									
	DEFCF	VFR	OVF					20			38								
	OHZYY	VFR	OVF							30			45						
	KHJ388	VFR	OVF								35			50					
	QHU220	VFR	OVF									41			55				
	OHNAL	IFR	ARR											50			65		
	OHYHF	VFR	DEP											51			62		
	OHEPB	VFR	ARR												55				
	SELJS	VFR	ARR													60			
	SEKXI	VFR	ARR													62			
Airport4 – LHBP				4	4	4	3	2	2	2	0	0	1	4	4	2	2	2	1
	EIN6LB	IFR	ARR	0			10												
	DCCAB	VFR	ARR	2			11												
	RYR445	IFR	DEP	0			8												
	WZZ302	IFR	ARR	7			14												
	DECEC	VFR	OVF					20			31								
	PHWKB	VFR	OVF					22			33								
	AEG610	IFR	DEP											50				71	
	N360HS	IFR	DEP											54			65		
	SWR1412	IFR	DEP										48						
	DECDB	VFR	OVF										49		58				
	HASLV	VFR	OVF														67		
Airport5 – LHDC					0	1	1	1	1	0	0	0	0	1	1	2	2	2	2
	WZZ119	IFR	DEP			10			26										
	FHY261	IFR	ARR													60			33
	IFA1716	IFR	ARR											50			68		
	BRU4112	IFR	DEP															70	
Airport6 – LHPA															1	3	3	2	2
	HACIX	VFR	ARR												59		69		
	HACTF	VFR	ARR													61			75
	COBO27	IFR	DEP													64			75
	HACIZ	VFR	DEP																
	HACMO	VFR	DEP																
	WZZ701	IFR	ARR																
	HACLR	VFR	ARR																

Traffic volume

- 46 mov. via 6 airports
- 17/21/8 DEP/ARR/OVF
- 50/50% IFR/VFR

Operational modes

- normal operations
- Emergency situation
- Wind calm
- Daylight

Use Cases

1 Opening of an airport
2 Emergency opening of an airport
3 Closing of an airport due to closing times
4 Closing of an airport due to weather
5 Closing of an airport due to emergency situations
6 Splitting airports from a specific MRTM
7 Merging airports to a specific MRTM
8 Reschedule of an ATCO within his shift
9 Handover of a MRTM between two ATCOs
10 Increase Workload of a single airport
11 Reschedule of an ATCO within his position due to health issues

Traffic

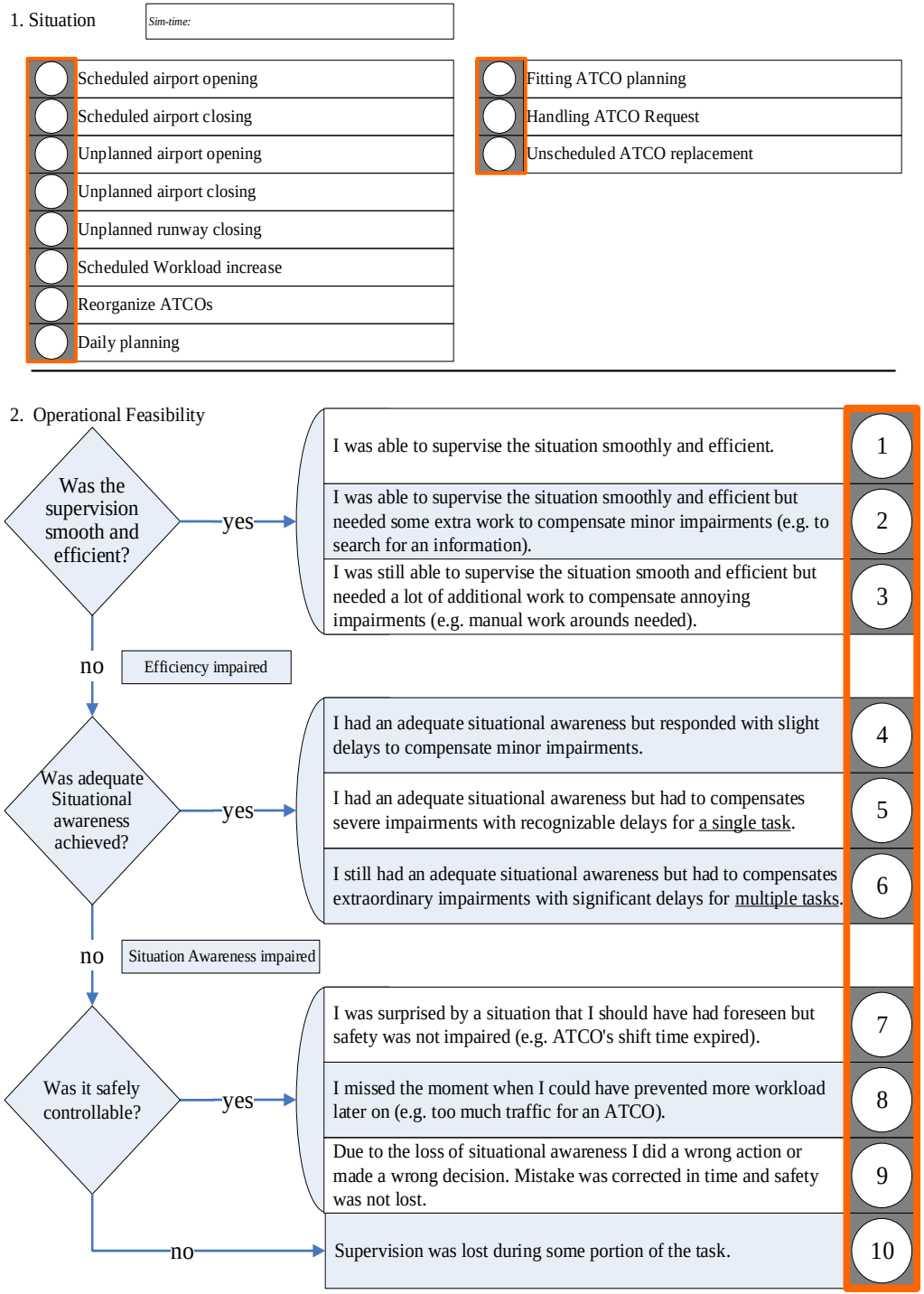
	MRTM 1 - ATCO 1						
	Airports				Traffic		
Time	EKYT	EKAH	EKBI	LHBP	simulta	ID	Use Case
00:00	1			4	5		
00:05	1			4	5	1	Opening EKAH
00:10	1	0		4	5		
00:15	1	1		3	5	6	LHBP to MRTM 2
00:20	1	1			2		
00:25	0	3			3		
00:30	0	4			4		
00:35	0	4			4		
00:40	0	4			4		
00:45	0	4			4	7	Merging EKBI
00:50	1	1	4		6		
00:55	1	2	4		7		
01:00	1	2	4		7		
01:05	1	2	4		7	3	Closing EKYT
01:10		1	3		4		
01:15		1	2		3		
Total	2	5	7	4	18		

	MRTM 2 - ATCO 2						
	Airports				Traffic		
Time	LHDC	LHPA	EKBI	LHBP	simulta	ID	Use Case
00:00			3		3	1	Opening of LHDC
00:05	0		5		5		
00:10	1		5		6		
00:15	1		5		6		
00:20	1		3	2	6	7	Merging LHBP
00:25	1		3	2	6		
00:30	0		3	2	5		
00:35	0		3	0	3		
00:40	0		3	0	3		
00:45	0		3	1	4	9	Hand-over of EKBI
00:50	1			4	5	1	Opening of LHPA
00:55	1	1		4	6		
01:00	2	3		2	7		
01:05	2	3		2	7		
01:10	2	2		2	6		
01:15	2	2		1	5		
Total	4	7	8	7	26		

Measurements

- Mid,- Post Run & Post Exercise
- ATCO & SUP
  - Workload (NASA TLX, AIM, China Lake, Bedford)
  - Situation Awareness (SASHA, China Lake
  - Usability (SATI, SUS)
  - Safety (Adapted Cooper Harper Scale)
  - Tailored Post Run & Post Exercise Question
  - Debriefing

Adapted Cooper Harper (SUP)



Remote Tower



Home

www.remote-tower.eu

The modernisation of air traffic management is one of the main challenges of current aeronautics research.The Single European Sky ATM Research (SESAR) project defines, develops and deploys what is needed to increase ATM performance and build Europe's intelligent air transport system.

Part of SESAR are the projects **PJ05 "Remote Tower for Multiple Airports"** and **PJ05-W2 "Digital Technologies for Tower"**, which focus on the safe and efficient airport of the future. By bringing the concept of remotely controlling multiple airports as well as HMI interaction modes for airport towers to higher maturity levels, the SESAR projects aim at providing small and medium sized airports with more cost-efficient and service tailored air traffic services.

The current programme is SESAR 2020 supports projects to deliver solutions in four key areas, namely airport operations, network operations, air traffic services and technology enablers. It is running from 2016 to 2024 with a budget of 1.6 billion Euro.

Recent News



SESAR PJ05-W2-35 Multi Remote Tower Online Open Day on 6 December
15. November 2021



EUROCAE WG-100 Remote and Virtual Towers Finalises a New Deliverable
3. November 2021

These projects have received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 730195 and No 874470.

SUPPORTED BY SESAR JOINT UNDERTAKING

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SESAR PJ05-35 V3
December 1, 2021

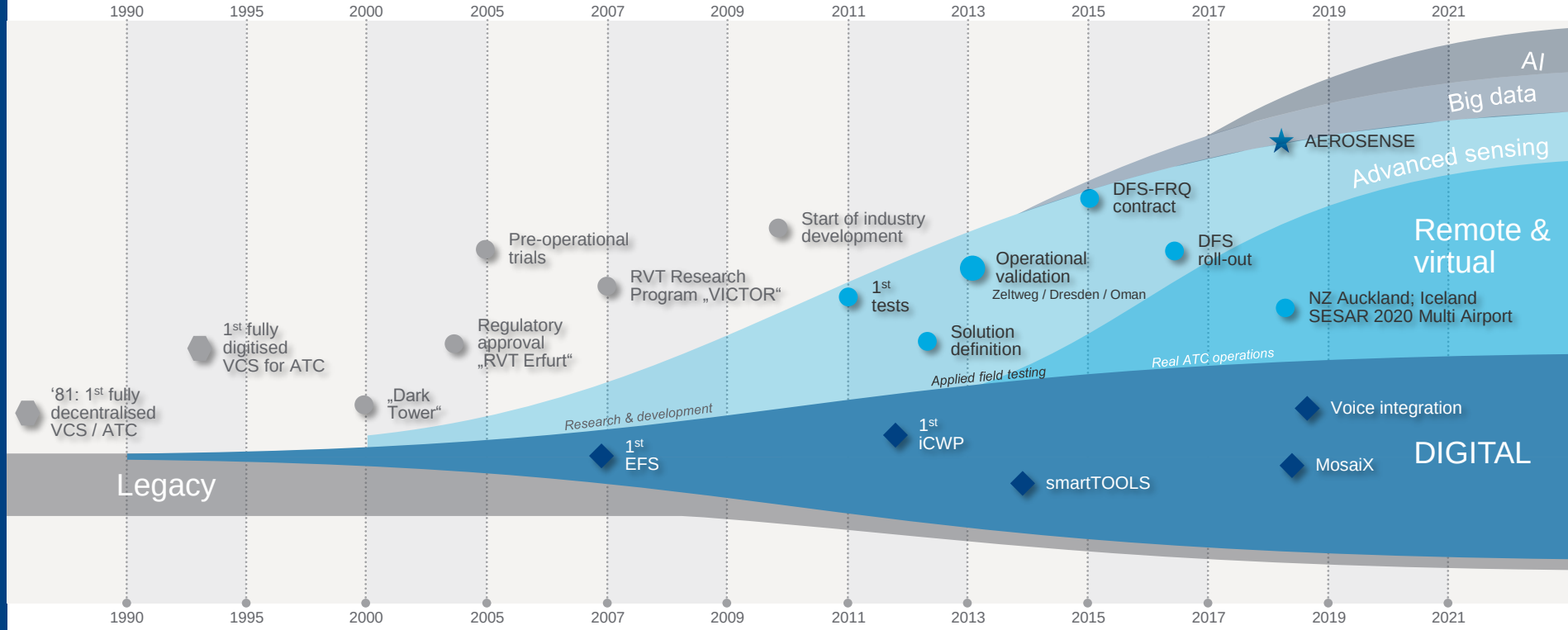
EXE 2.1.1., EXE 2.1.2.

Operational & Technical Set-up

Regina Bruzek & Ibrahim Karaca

Long history in integrated towers & remote digital tower solution

Benefit from 18 years of experience



© Frequentis AG 2021

Remote Digital Tower Capabilities

Efficient and safe operation by enhanced visualisation and smart augmentation



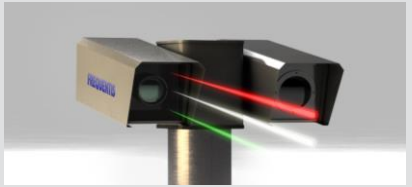
Efficient working position concept with small footprint



Enhanced high quality 360 degree visual & IR view



Automatic detection of multiple objects in panorama view



PTZ with Light Gun & IR including tracking capabilities



Advance augmentation & surveillance integration



Flexible HMI concept multi-touch and multi-button mouse interaction concept



Inter-product functions with VCS, electronic strips, met system & surveillance displays



Multi-remote tower ready

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Our experience – Deployed solutions in operation around the world

DFS
Advanced Remote Tower



Jersey
Contingency Solution



VIE
Apron Management



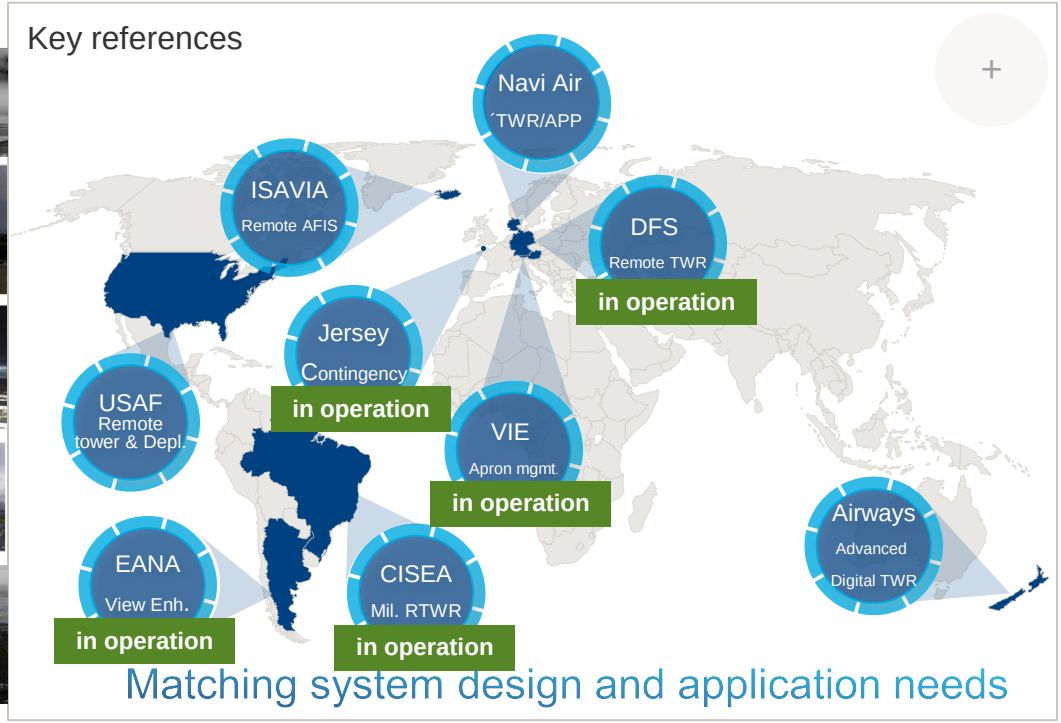
Iceland
Basic Remote Tower



NZ
Demonstrator



Key references



Matching system design and application needs

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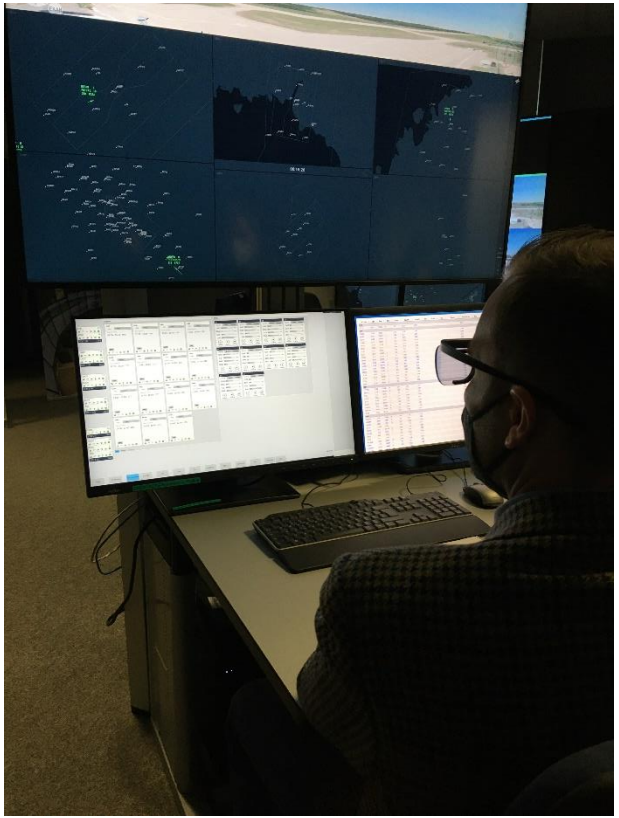
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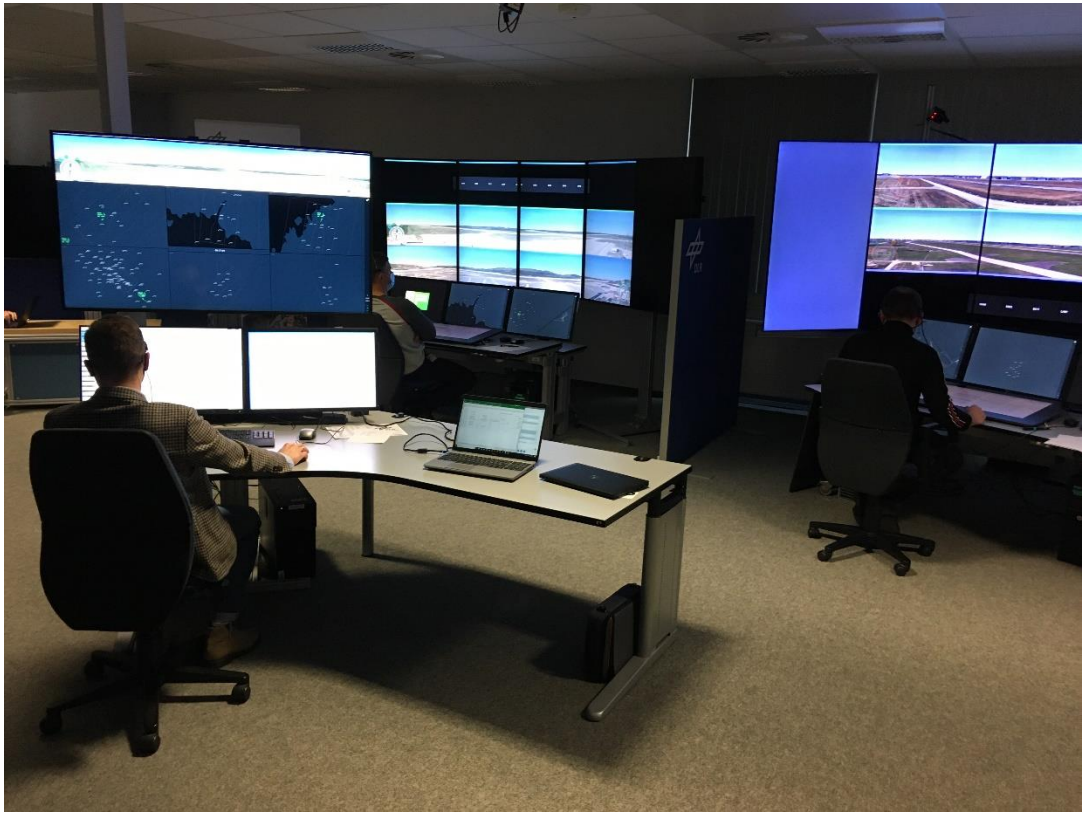
FOR A SAFER WORLD

EXE 2.1.1.

SUPERVISOR tool for flexible allocation of roles to working positions

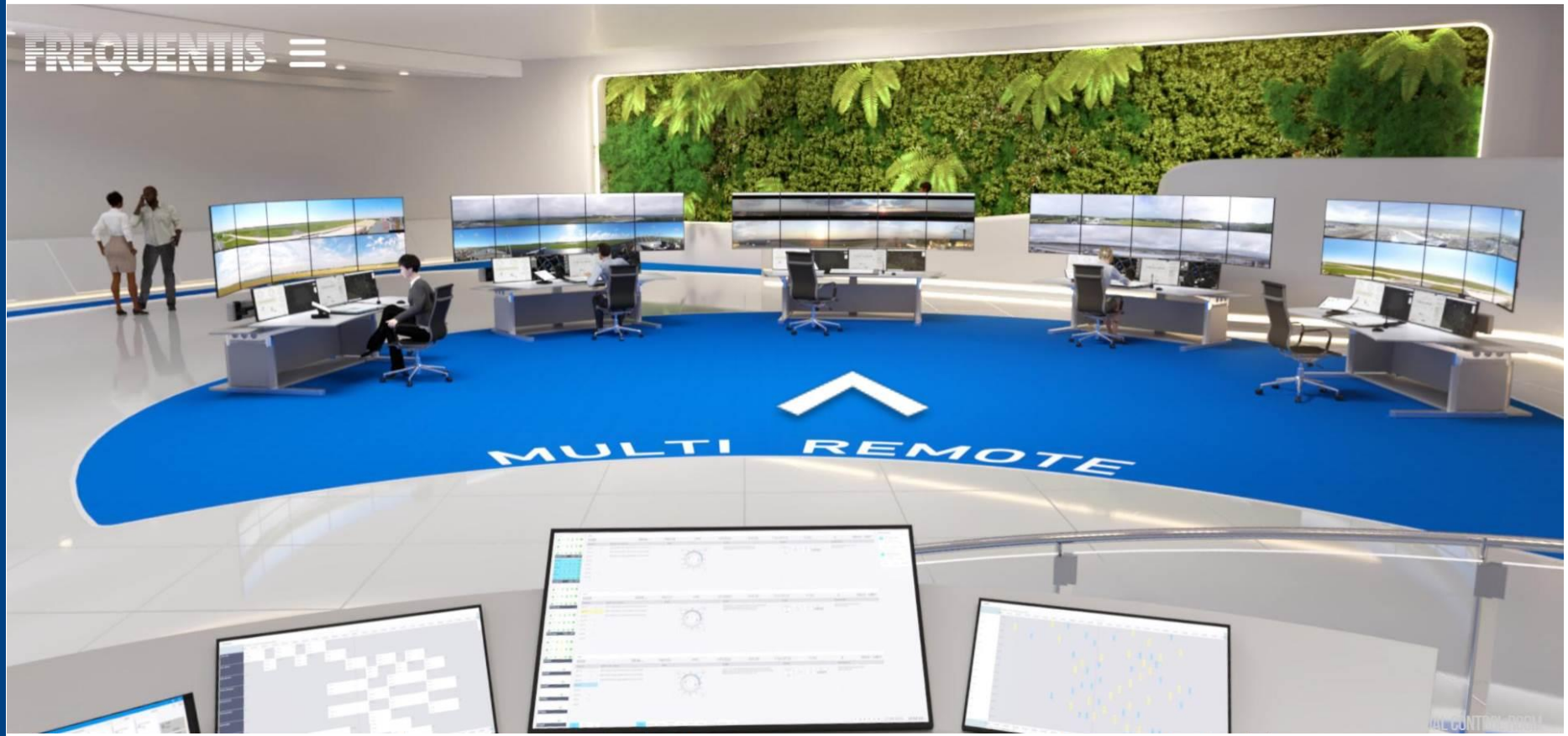
Supervisor Tool





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Center Supervisor‘s daily business



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Highly Flexible Allocation Of Aerodromes to Remote Tower Modules

Our approach

- Iterative workshops with ON & PANSA ATCOs - shaping ideas
- Use Cases Identification
- Focus on main tasks: role allocation, ATCO allocation, event logging
- Additional tasks for an authentic experience
- ATCO and Supervisor feedback and review cycles
- Software development
- Integration with existing Multiple Remote Tower working positions successfully validated in WAVE 1 – using one common MosaiX platform

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Supervisor tasks

Conclusions

Planning & management tasks

	Long term	Mid term	Short term
Centre Manager	Rostering Endorsement Management		
Supervisor		Global Airport Monitoring Shift Management Traffic Forecast Monitoring Endorsement Monitoring	Role Management
ATCO			SUP <> ATCO Coordination Briefing Traffic Planning
Technical staff	Maintenance Planning	Reconfiguration	Technical Supervision

Planning & Optimization Tools



Briefing
Rostering
Shift planning



Technical supervision
Operational supervision



Traffic forecasting
Traffic planning

Systems

Testing – Development - Data preparation

Training - Simulation

Contingency

Operations

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Previously on PJ05 – WAVE 1







Multiple Remote Tower Operation Validations at level V2 & V3

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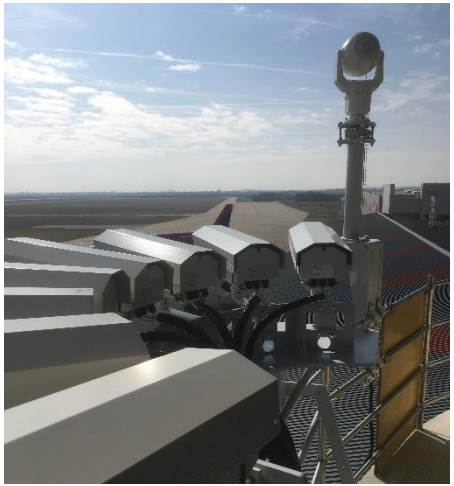
Multi Remote Tower Simulator set-up

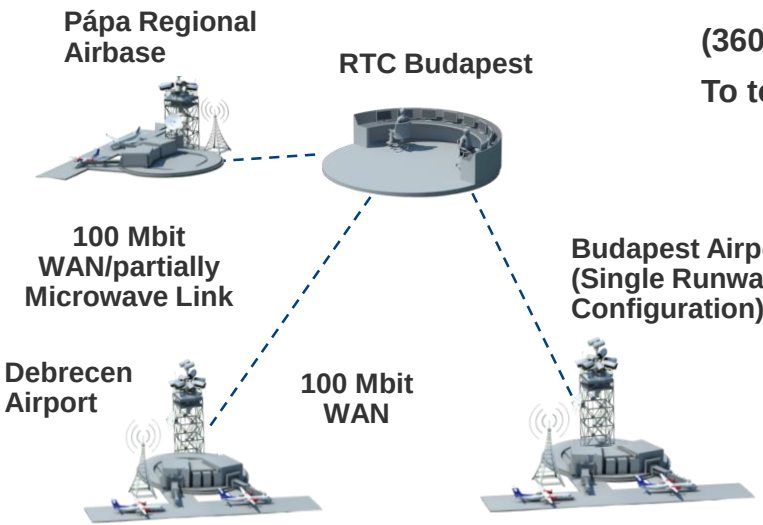


Multiple Remote Tower Module in the field

Temporary installation on existing towers / buildings







1 PTZ per Airport

(360° coverage, restriction due To tower and construction)

8 HD Cameras

(180° horizontal coverage, >40° vertical coverage)



3 HD Cameras

(180° horizontal coverage, >40° vertical coverage)

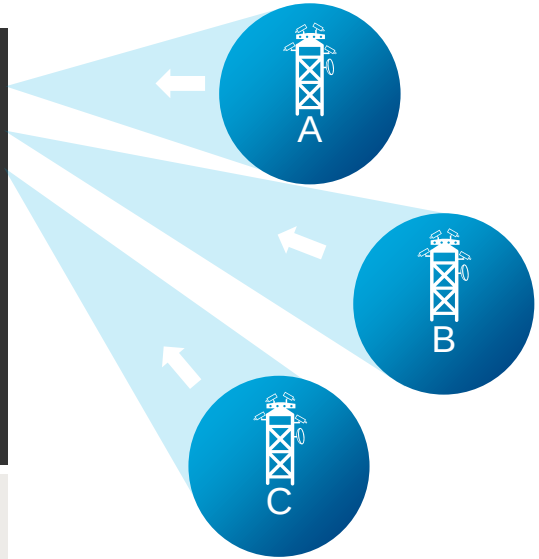
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RTM structure

Controller Working Position



Full integration of enhanced voice services	Multi-airport planning tool for efficient and safe traffic handling	Surveillance Integration & Augmentation	Combined Civil / Military operations	Validations with DFS, Hungaro Control and Oro Navigacija



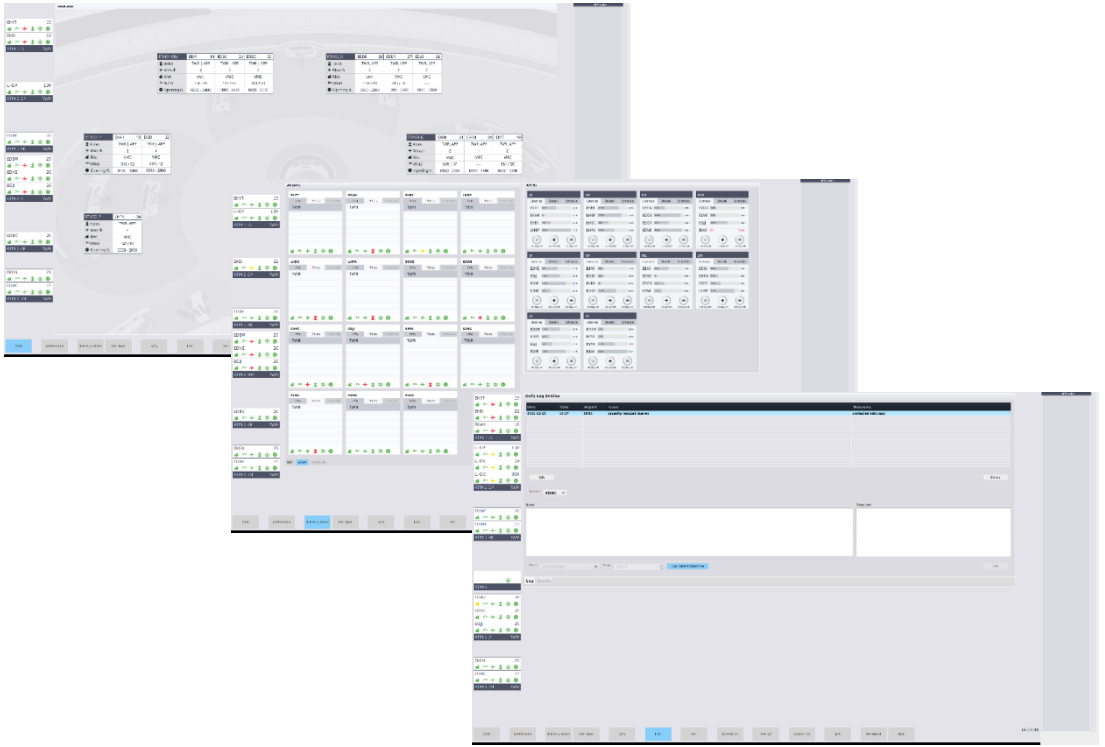
Control of up to 3 airports by one Air Traffic Controller

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PJ 05 - WAVE 2

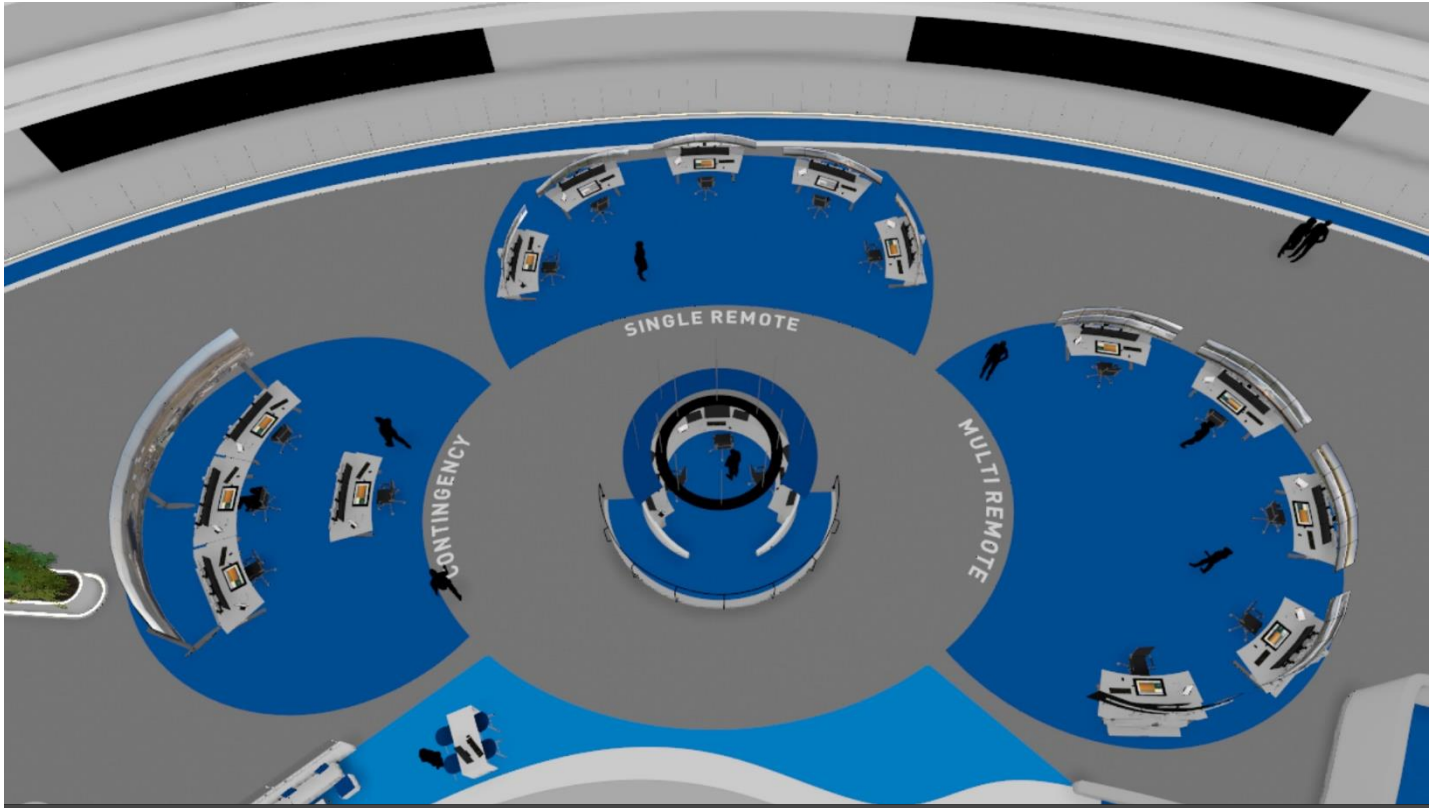
Results: validation of center software to support a supervisor in accomplishing his tasks:

- Dashboard view
- Airport details
- **Role allocation**
- **Staff allocation**
- **Upfront traffic peak warnings**
- Voice Communication
- **Event logging**
- Flight Plan Information
- Shift schedule
- Replay function
- Statistics
- Emergency procedures
- Browser & Mail
- **Notification board**



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15 airports in one control center

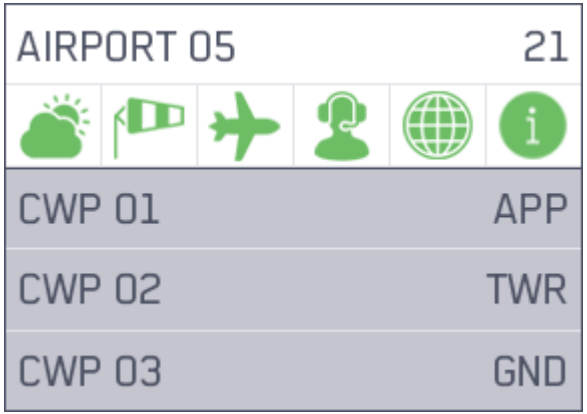


Scalable center design supporting different use cases

© Frequentis AG 2021

Flexible Allocation





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Single Remote
Contin gency
Super- visor
Multi remote

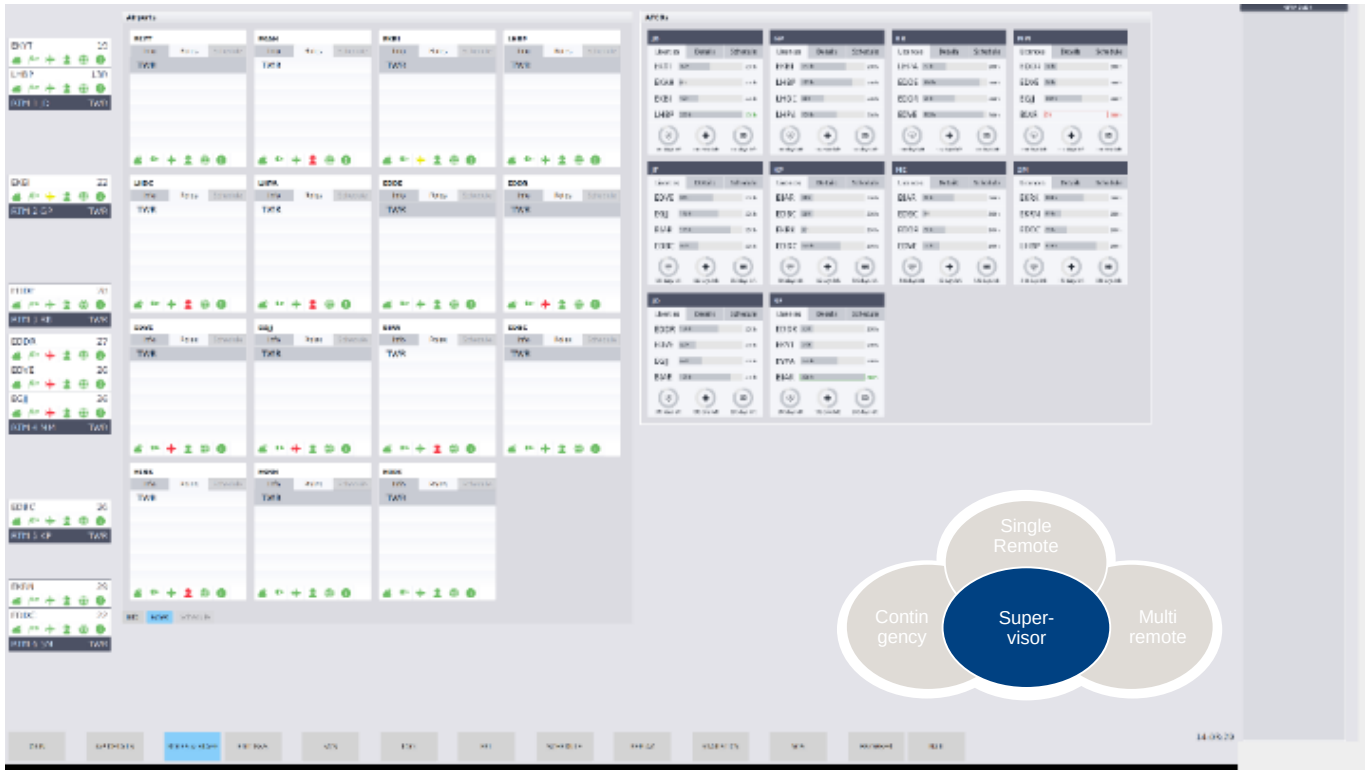

MULTI REMOTE
Single Remote
Contin gency
Super- visor
Multi remote


CONTINGENCY
Single Remote
Contin gency
Super- visor
Multi remote

Flexible Allocation







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Way to go!

- Solid baseline
- Valuable insight into Supervisor operation at a center for multiple airports
- Better understanding of role management requirements in a multiple set-up
- Continue usability & efficiency improvements
- Strengthen automation
- Emphasize interoperability

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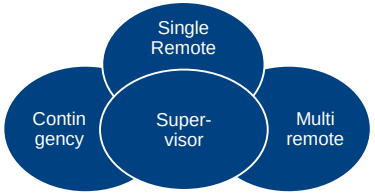
Responses

„All necessary information in one place.”

„Easy to operate, you don’t need a lot of time to learn it. ”

„Plenty of information that you need as a supervisor.”

We look forward to the first flexible multiple remote tower module center in operation.



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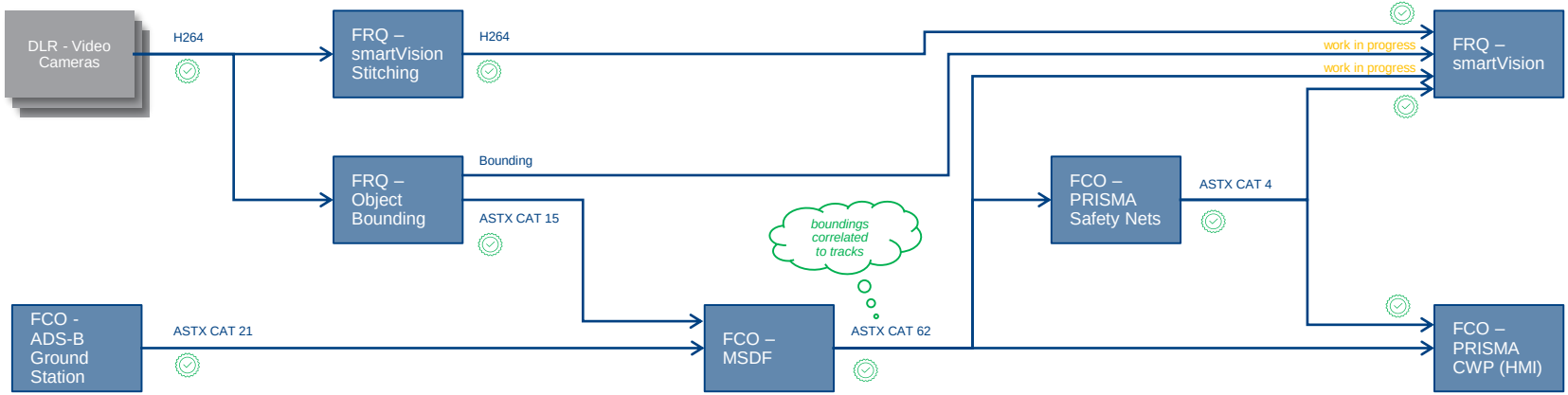
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EXE 2.1.2.

Tracker & Safety Net

EXE-PJ05-W2-35-V3-2.1.2

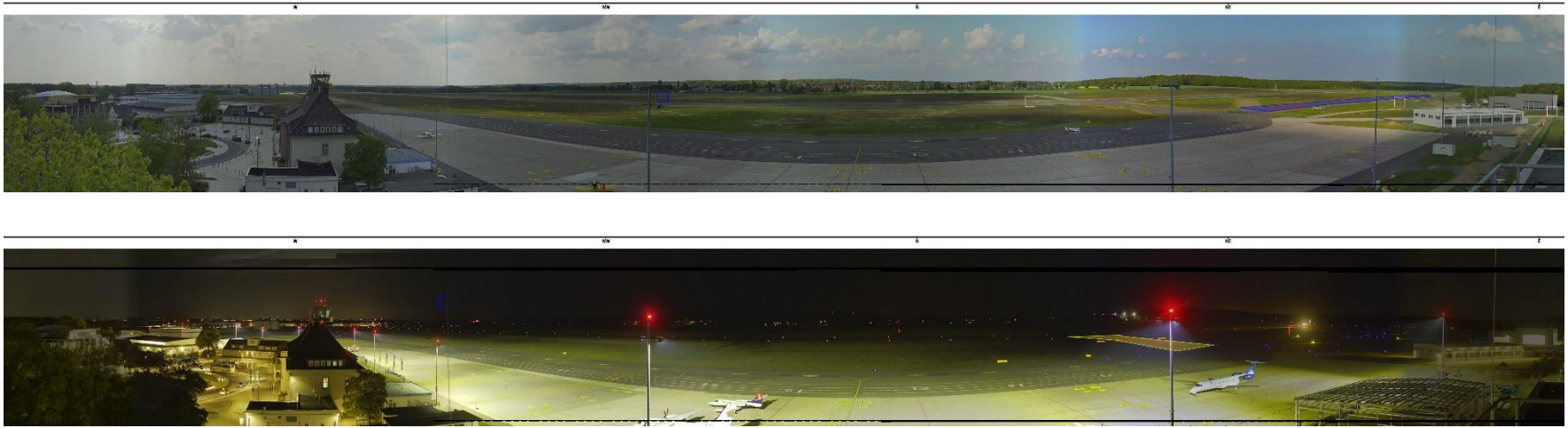


- Objective: Evaluate how correlation and fusion of electro-optical and ADS-B/MLAT detections enable Safety Net improvements that enhance the situational awareness
- DLR video cameras together with FRQ Object Bounding form electro-optical sensors that provide detection reports in CAT15 (partial measurements incl. azimuth and elevation, with high update rate of e.g. 10 Hz))
- FCO MSDF tracker correlates and tracks CAT15 detections together with classical surveillance, and provides track services with an equally high update rate (e.g. 10 Hz)
- FCO PRISMA Safety Net (achieved), PRISMA CWP (achieved) and smartVision (work in progress) make use of the high update rate track service to enhance situational awareness

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Visualization of the Safety Nets APW Alerts on the Panorama Screen

- Improves the SA of the ATCOs
- Provides time to ATCO to take an action.
- Prevents incidents in the apron.
- Does not depend on the weather
- Dynamically configurable APW Volumes



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Surveillance Input with High Update Rate (0.1s, 10 Hz)

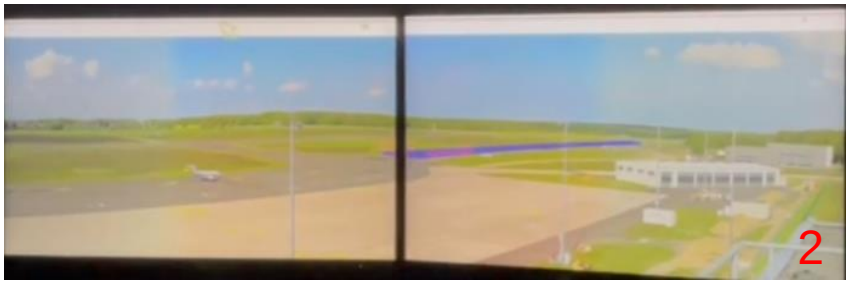
- Less Nuisance Alerts
- Better Prediction

4s update rate

vs

0.1s update rate









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Open Day

Remote Tower Center with a Highly Flexible Allocation of Aerodromes

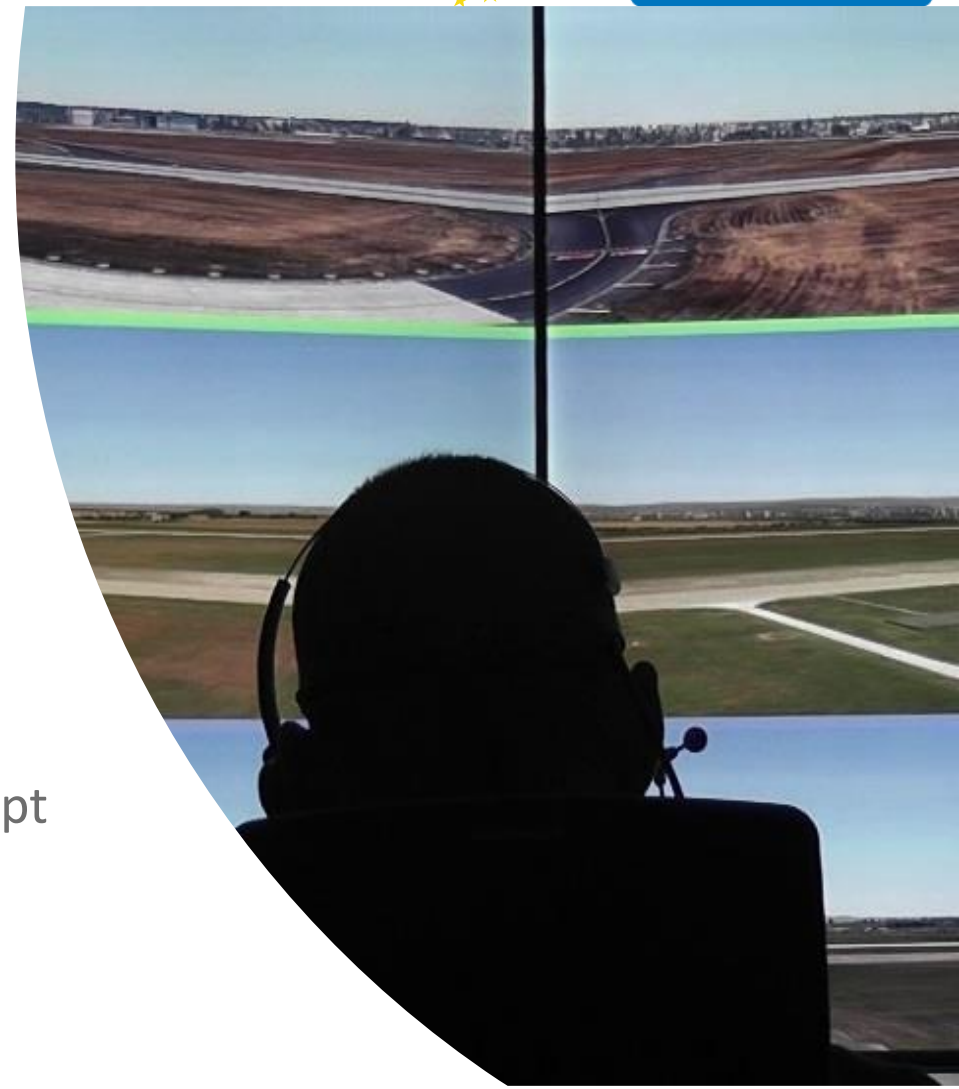
PJ05-W2 DTT sol35 - EXE-2.1
Jan Rękowicz – ATCO TWR/APP, PANSA
DLR, FRQ, PANSA, ON
Braunschweig, Germany - 01/12/2021

SESAR JOINT UNDERTAKING

Founding Members
EUROPEAN UNION EUROCONTROL

ATCOs background

- 7 ATCOs
- All are TWR/APP rated
- Mixture of ATCOs familiar and unfamiliar with Remote Tower concept



Multiple Remote Tower
- General view

- Radio coupling is a must due to double transmissions
- Maximum of three airports in one hands
- Traffic complexity (training flights, etc.)
- Extensive training process
- Radar view and/or A-SMGCS – „nice to have” feature
- „Delivery” position for multiple airports (even more than three)
- Airport layout – location of the camera mast is important
- As unified as possible

Multiple Remote Tower
- Benefits

- Reduction of costs (personal and facility)
- More flexible allocation of resources
- Reasonable allocation – improved work/break balance
- Easier to maintain the endorsements for multiple airports
- Entire equipment under one roof
- Small and medium size airports with low complexity traffic

Multiple Remote Tower
- Risks

- Possible mistakes due to complexity of airports
- Loss of situational awareness
- „Heads-down” work
- Equipment failure affecting multiple airports
- Fast changing environment – traffic peaks
- Maintain accurate balance between workload and breaks

Supervisor Tool
- Benefits

- Multiple Remote Tower Centre management tool
- Stores all the information needed in one place
- Supervisor's „best friend"
- Simple to use
- Reduces the amount of equipment needed on Supervisor's position
- Compatible with electronic flight strips system
- Almost limitless features in the future

Supervisor Tool
- Fields to improve

- Filtering options to see suitable ATCOs for the position
- Field for „transition” mode, e.x. handover/takeover
- Traffic volume presentation
- „Flight score” mode
- Algorithms to simplify the allocation
- Drag-and-drop operation mode
- Alerting (end of ATCO’s shift, airport closing time, etc.)
- Layout of the tool to be configured

Remarks

- More realistic environment to assess the real workload on ATCOs and Supervisor positions
- Improve the CWPs design
- Research on ATCOs' ability to maintain high level of service
- Reasonable mixture of up-to-date technology
- „Safety First" even at higher costs

Questions?

ON experts on initial SUP tool

SESAR JOINT UNDERTAKING

Founding Members

EUROPEAN UNION EUROCONTROL

ON experts approach to the Supervisor role

The main task of Supervisor:

- *„To ensure continuous, **safe** traffic flow and high quality of ATS provided in the APP/TWR center“*

The responsibilities to assure the Supervisor‘s main task:

- Shift planning and control
- Traffic load monitoring
- Communication with ATCOs, internal/external units
- Briefing/de-briefing and reporting
- Operational support for ATCO (contingency function)

ON initial requirements for the Supervisor position

Equip working place by innovative digital tool to ensure the Supervisor role in the MRTWR center

ON trial results and insights on SUP tool and position (1)

Shift planning and control

- All the essential information is included in the SUP tool
- **Needs more automation**
- The order of tabs and architecture of views could be improved or reorganised
- Overall – the SUP tool ensures one of the most crucial supervisor‘s responsibility

Traffic load monitoring

- The essential information included in the SUP tool but needs to be expanded
- **Needs more automation**
- Needs more studies of how to monitor the traffic load and combine the different rTWRs into MRTWRs accordingly (as the process of combining the various airports is time demanding)
- Overall – the SUP tool helps to ensure the monitoring of traffic at various airports but it needs to be expanded by some additional automatic functions to decrease the workload of supervisor

ON trial results and insights on SUP tool and position (2)

Communication with ATCOs and internal/external units

- SUP tool provides basic functions for communicating and indicating between MRTWR CWPs (basic indications about NAVAIDS issues, emergencies or „request for support“)
- Would be helpful to expand two-way communication between supervisor and MRTWR positions by more indications, freetext or standart messages (reduce voice communication need)
- Same could be done for communiction between internal/external units
- Overall – SUP tool has the potential to ensure these functions as their relevance is undisputed

Briefing/de-briefing and reports

- The daily log functionality is enabled by SUP tool and it worked fine as a notebook
- We see the potential to expand SUP tool with more functionalities including briefing/de-briefing reporting system connected to other systems
- Overall – this functionality could be expanded and would be very useful

ON trial results and insights on SUP tool and position (3)

Operational support for ATCO (contingency function)

- **Traditional concept of supervisor role changes significantly** as supervisor is not able to act as an ATCO who assures contingency – supervisor is not able to have so many endorsements
- More operational responsibilities for acting ATCOs at CWP is expected
- Overall – Supervisor shouldn‘t be considered as a contingency ATCO. It takes the role of planner or manager, but not the operational decision maker

ON trial results and insights on SUP tool. Future development

Safety concern

- Trials proved that supervisor‘s operational awareness of the actual traffic situation at different airports decreases significantly and supervisor is hardly able to monitor it
- Various safety nets should be added into SUP tool (automatic emergency indications from traffic situation)
- Improved interconnection between SUP tool and CWPs (better indications about handovers, data validation and etc.)