

SPECIAL BULLETIN SERIES 2020/21

REMOTE & DIGITAL TOWERS

PUBLISHED AND COMPILED BY ATC-NETWORK.COM



EDITORIAL

Welcome to the second edition of ATC Network's Special Bulletin Series. The focus of this edition is 'Remote & Digital Towers'.

The technology behind Remote towers is by no means a new technology but the speed at which it is now starting to be implemented into the industry is changing the way in which Air Traffic Services will be provided.

The recent opening of the largest Remote Tower centre in Bodø is a sign that remote tower services are going to be used across the industry worldwide.

Also the digitalization aspect of these technologies is providing benefits for tower controllers which enables them to work more safely and efficiently.

Thank you to all the contributors to this magazine and I hope you enjoy the publication.

Best Regards,

Chris Wade
CEO ATC Network



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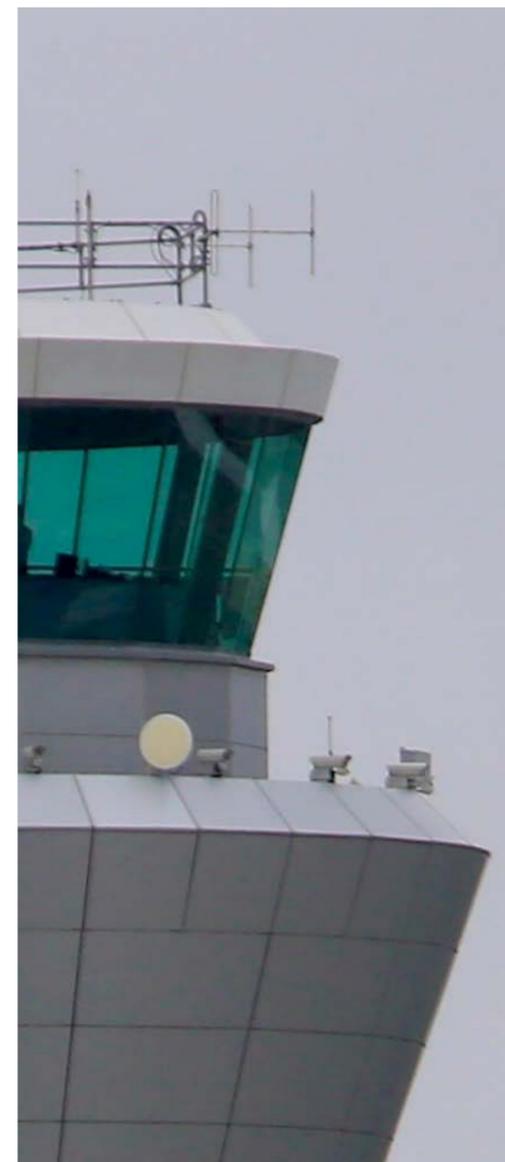
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REMOTE & DIGITAL TOWERS AND THE ROLE OF SIMULATION

Simulators can support the transition to Remote Digital Towers (RDTs) in multiple ways

Bianca Iacob, Simulation Product Manager, Micro Nav

Since the first tower went into operation 100 years ago in Croydon, UK, air traffic controllers have been traditionally situated in a physical control tower.

In the last few years, the implementation of RDTs has expanded significantly. From enhancing controller tools and providing additional safety, to offering operational contingency and significant cost reductions, the benefits of RDTs is changing the future of the ATM industry in tower environments.

The concept of providing air traffic services to one or more aerodromes, at a location away from the control tower, has raised many concerns within the industry, including security, technology, regulations, human factors and training.

Over time, it has been proven that security and technology challenges are being addressed by operational equipment manufacturers, ANSPs and working groups set up through NEXTGen and SESAR, while regulatory, human factors, and

training challenges could be addressed through the use of simulators.

The industry often sees simulators solely as training devices. A modern and market-leading simulator, such as Micro Nav's BEST (Beginning to End for Simulation and Training), can provide and support much more than just training. From a single platform, the simulation suite can also be used for research, evaluation, testing, and validation.

Supporting the Regulators

A simulator can be used to design or modify procedures for arrivals and departures to and from aerodromes, and simulate the ground movements of aircraft and vehicles.

Scenarios can be quickly created or modified, and be witnessed in the simulator within minutes, to see the results of modifications. Performing this due-diligence, and providing a body of evidence to regulators, will help with certification for RDTs.

Supporting Human Factors

One of the key challenges is the human factor when transitioning from a traditional physical tower to an RDT with dependency on camera feeds and, in some cases, a new set of augmented digital tools. This process involves controllers adapting to a different environment, along with to a mixture of old and new tools.

Using a simulator can support the controller with new system interactions, and how to deal with potential failures - for example, managing camera feed issues and the use of pan-tilt-zoom (PTZ) cameras to focus on an area.

Training for RDTs

Training is fundamental to the success of any operational system going live. By familiarising the controller with the new environment, on-the-job training can be significantly reduced, and the efficiency of the controller increased from the outset. When fully trained and confident, the controller will ensure a seamless transition from the traditional tower to an RDT, with a continuous provision of air traffic services to the airlines.

Simulators can be used to train the RDT controller in a diverse range of situations either in a system-agnostic environment that teaches the controller methods and procedures, rather than graphical user interface (GUI) operations, or on a specific operational system by being fully integrated with operational kit.

Micro Nav's BEST is continuously updated to exceed market demands for training involving single and multiple RDTs. BEST can run multiple 3D airports in a single exercise circuit, with the ability to show two or more airports on 3D displays at the same time.

Integration with Operational Equipment

The use of simulation software integrated with operational equipment provides high-fidelity training. The benefits of training on operational equipment are that the human machine interface (HMI), and associated features, are experienced by the controller, providing a high-fidelity training environment. This combination is powerful and difficult to safely replicate in other ways.

To achieve a high return on investment, a simulator can be integrated with contingency equipment, doubling up as a testing, training and research facility. By using integrated simulation capabilities and an ATC image generator, operational integrated tower working position (ITWP) displays can be stimulated with real-world data and messages, while monitors can show 3D camera views.

Supporting the move to RDTs

The current challenges have been a catalyst for the increased interest in RDTs, with the ATM industry looking for more sustainable and flexible solutions. Simulators are vital to support the transition to a complete RDT, as well as the use of digital tower elements in a traditional tower environment.

The right choice of simulator will support an organisation to fully realise the benefits of using an RDT operation, including enhancing controller tools, providing additional safety, increasing flexibility and enjoying significant cost reductions going forward.

For further information, or to request a copy of our in-depth whitepaper, please contact us at info@micronav.co.uk



DIGITIZING ATC

The evolving use cases and business benefits of the digital tower

By: Neil Bowles, Searidge Technologies

The concept that became known as remote tower originated in Europe in the early 2000s through a series of research programs. The concept was developed to address social and operational requirements to maintain air traffic services to remote communities in a more efficient and sustainable way.

Searidge Technologies was founded in Ottawa, Canada with the idea of using an emerging technology in a different way. In fact, Searidge was the first company to operationalize remote tower technology to augment aerodrome ATC by introducing "ATC grade" video into the control tower to support safe operations. In this way, remote tower technology in Canada was already being used in a broader way than the focus of the European research while adhering to the emerging technical standards that industry and ANSPs contributed to creating.

Evolution from Remote to Digital

Since then, remote towers have become operational in support of that original use case but a growing demand for digital aerodrome services has emerged, which includes a much broader range of airports and a wider range of operational and business requirements.

The term "remote tower" does not accurately reflect these evolving uses nor the greater technological and functional advances that these uses support. This is where the concept of a "digital tower" was introduced to capture the growing demand for integration of a wide range of ATM systems and data in support of advanced air traffic operations. The digital tower is also part of the broader evolution of digital air traffic services.

Contingency

One of the most widely-considered digital tower uses is to support an airport or ANSP's business continuity plan by providing a digital tower contingency facility. The benefit is clear – a large, international hub airport would be at risk of having its operational capacity

reduced for a period of time should the main control tower become disabled.

Often, an airport will have a contingency facility to revert to during a short-term outage. However, this facility is likely to only support a reduced capacity, leading to extensive delays and cancellations, and significant disruption until services are returned to full capacity.

A digital contingency tower can support a high level of capacity at a much lower cost than implementing an equivalent-capacity brick and mortar tower. The first true contingency digital tower supported by video was the Budapest rTWR system implemented by HungaroControl with the support of Searidge Technologies. Certified for operational use in 2017, Budapest is the world's largest certified digital tower and first to integrate advanced surface surveillance data into panoramic video to support situational awareness. The system has been in constant operational use, consistently demonstrating its benefits.



HungaroControl rTWR system at Budapest Airport

Expansion

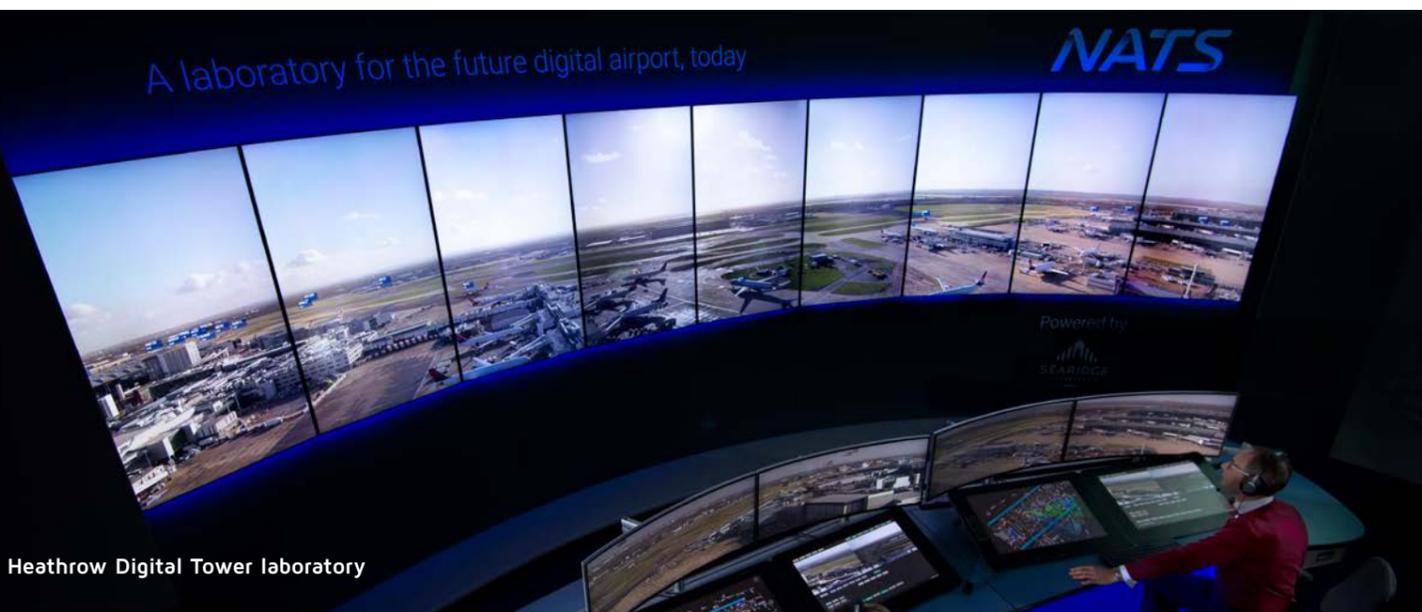
Staying with the theme of large international airports, a digital tower is being considered as a solution to airport expansion where a new tower is needed, or for airports where the existing tower is approaching end of life. The Civil Aviation Authority Singapore (CAAS) and NATS at Heathrow have both invested in digital tower systems to validate such concepts. CAAS' Smart Tower Prototype is used for periods of active shadow mode with controllers sharing digital data in real time across a network of video cameras, displaying data to controllers when and where they need it, assessing the feasibility of a digital tower for an airport like Changi.

At Heathrow, the digital tower laboratory is based in a room in the actual control tower which enables Heathrow ATCOs to assess the system and drive development towards a digital solution that can support an additional runway operation at the airport. The system has already been used to validate a concept of unlocking capacity during low visibility by utilizing Artificial Intelligence (AI) to determine, with a very high degree of accuracy, when an aircraft vacates an active runway.

Resilience

During the unprecedented challenges that confronted aviation in 2020, a new use case was introduced by HungaroControl using the Budapest rTWR system. HungaroControl were able to deliver resilient operations in the face of the pandemic by enabling ATC staff to be physically separated while maintaining safe services. By creating two operational teams, it was possible to operate day shifts from the rTWR and night shifts from the traditional tower, reducing the potential impact of the virus on operational teams and enabling each facility to be sanitised without impacting operations. This innovative approach to managing the operation demonstrated the flexibility of digital tower technology to continue safe, resilient operations in times of crisis.

These advances in the deployment of technology demonstrate to airports considering implementing a digital tower facility for contingency, airport expansion or business resilience, that a viable digital air traffic solution is here. A digital tower is the perfect environment to integrate ATM data and innovative technology to support airports as they plan for the future.



Heathrow Digital Tower laboratory

CANSO PUBLISHES GUIDANCE MATERIAL FOR REMOTE AND DIGITAL TOWERS

CANSO Guidance Material for Remote and Digital Towers provides an introduction to the remote and digital tower concept and technologies, and explores what drivers, challenges and pressures can influence operations.

The aim is to answer specific questions that ANSPs may have, including: what is a digital tower, why and when can they be implemented, and how to get started. It also touches on what's next for digital towers.

To provide an accessible learning experience, the guidance material also includes perspectives from early adopters and the lessons learned. These case studies emphasise the diversity in digital tower solutions and applications, each offering a unique insight into the drivers, challenges and lessons learnt along the way.

The key takeaway is that digital towers can provide effective and cost-efficient ATS provision in a range of scenarios. For example at low traffic airports, or newly established airports, or as replacement/interim or remote services, and in aid of the centralisation of digital tower services for airports of various sizes in one facility, referred to as a Remote Tower Centre (RTC).



CANSO Guidance Material for Remote and Digital Towers



CANSO WEBINAR SERIES

To support General Managers on their own digital towers journey, a new, three-part CANSO webinar series will provide an accessible learning experience to help ATM industry leaders understand the guidance material, gain in depth knowledge of the technological aspects, and learn more about the operational perspective from early adopters.

Part two – Technology and Enhancements: Tuesday 2 February, 13:00 CET

The second webinar will be a panel discussion with vendors and systems providers and will address the technological aspects of remote and digital towers. It will be an in-depth introduction of the technologies and systems applied in various case studies. Attendees will be able to question the panel to find out more about the technology and systems that support digital towers now and in the future.

Register Here:

<https://canso.org/event/>

Part three - Case Studies and Key Learning Points: Tuesday 16 February, 13.00 CET

The final webinar is another panel discussion with Air Navigation Service Providers (ANSPs) who will talk about the operational aspects of remote and digital towers. The session gives an in-depth introduction to the operations of specific case studies featured in the guidance. Attendees will familiarise themselves with the operational side of the concept, and will have their questions answered.

Register Here:

<https://canso.org/event/>

ENAIRE SPURS INNOVATION AT THE CONTROL TOWER OF THE MÁLAGA-COSTA DEL SOL AIRPORT

ENAIRE, in its commitment to the continuous digitisation of its services, is implementing a series of technological and operational improvements in the air control tower at the Málaga-Costa del Sol Airport in order to promote greater efficiency and safety in air traffic management.

The implementation of the Autoswitch process has consolidated communications between pilots and air controllers during take-offs from this airport. This procedure allows departing aircraft to contact the approach controllers directly when they reach 2,000 feet (almost 610 metres), thus clearing the frequency used by air controllers in and around the airport.

[More streamlined communications with the Autoswitch procedure](#)

As Spain's air control service provider, ENAIRE is working on operational procedures that facilitate the exchange of information between pilots and air traffic controllers. The implementation of Autoswitch seeks to enhance the safety of flights departing from this airport. The control tower at the Málaga-Costa del Sol Airport is the second facility in ENAIRE's network to incorporate this procedure, first implemented at the Josep Tarradellas Barcelona-El Prat Airport.

Furthermore, ENAIRE is currently installing new, larger displays at this control tower. These improved ergonomics allow air traffic controllers to make better use of the various radar tools to monitor air operations, thus increasing the efficiency and safety of our service.

[First Brief, improved work flows through digitisation](#)

The Málaga control tower has become the first facility in the ENAIRE network to implement the "First Brief" tool. This system, developed by ENAIRE, can be used to customise and optimise the information that air controllers need to provide their service. This "integrated briefing" tool streamlines the interface between airport and approach controllers.

This tool enables controllers to hold briefings from any mobile device or platform, thus helping to significantly cut down on paper use. First Brief, which is constantly evolving, will be deployed in the next few months at ENAIRE's Air Control Centre in Barcelona, and the control towers at the airports of Almería, Melilla and Federico García Lorca Granada-Jaén. It is expected to be in service throughout the ENAIRE network sometime in 2021



Credit: ENAIRE

AENA SELECTS SEARIDGE AND FERRONATS FOR REMOTE TOWER PROGRAM IN SPAIN

Searidge Technologies and FerroNATS today announced Aena, Spain's airport management company, has selected them to deliver a Remote Tower to control Vigo Airport (VGO). The Searidge and FerroNATS Remote Tower solution will replace direct vision of the aircraft movement zone and the terminal area with 360 degree ultra-high definition video for enhanced situational awareness.

In the initial phase, a virtual remote tower will be implemented at Vigo Airport, at a facility independent of the current conventional tower, to provide Air Traffic Control (ATC) services for the airport. In the next phase, the Vigo implementation will become a Remote Tower Control (RTC) centre, from which ATC will be provided for three airports: Vigo plus two other airports, to be confirmed by Aena at a later date.

"We look forward to working with Aena and Searidge to advance air traffic services in Spain with market leading technology," says Pablo Caballero Lagrú, Managing Director FerroNATS. "The Remote Tower concept offers operational and safety benefits that enable safer and more effective service compared to what a new conventional tower can offer."

"Searidge and FerroNATS entered a joint venture to support Aena's vision for a remote tower centre in Spain," says Moodie Cheikh, CEO, Searidge Technologies. "FerroNATS' operational experience and knowledge of Spain's air traffic management environment, combined with our digital tower pedigree, will enable us to deliver a robust solution that addresses both Aena's technology and operational requirements."

THE WORLD'S LARGEST REMOTE TOWERS CENTRE OPENS IN NORWAY



Credit: Avinor

Avinor, the Norwegian airport operator and air navigation service provider, opened the World's largest Remote Towers Centre in Norway on the 20th of October 2020.

Aviation is the backbone of Norwegian infrastructure and ensures connectivity across vast distances. Avinor's new Remote Towers Centre located in Bodø, north of the Arctic Circle, will play an important role in maintaining a sustainable aviation structure in the future. This is a result of the collaboration between Avinor and KONGSBERG, where the companies have utilized complementing areas of expertise in order to build a system which will strengthen the aviation sector. Digitalisation is an important part of Norway's future and we are pleased that the aviation sector leads the way in this regard, says the Norwegian Minister of Transport and Communications, Mr. Knut Arild Hareide.

-This is the beginning of a new era of aviation. Avinor ensures the connectivity of Norway domestically and internationally. Our goal is to develop a more effective and sustainable aviation infrastructure through digitalisation and new technology. Remote Towers will make aviation safer and more robust through utilizing advanced technology. We already have two towers operating from the Remote Towers Centre and will roll out a further 13 airport towers within the next two years, says the Avinor CEO, Mr. Dag Falk-Petersen.

The first tower in Norway to be run through the Remote Towers technology was rolled out in 2019, while three more towers are being implemented this year. The Remote Towers technology will be rolled out at a total of 15 airports in Norway by the end of 2022, which will be run from the World's largest centre in Bodø, Norway.

-Avinor's Remote Towers Centre will be a world-leading centre. We experience a significant interest from the global aviation industry, seeing that our Remote Towers solution is economically sustainable and utilizes cutting-edge technology, says Mr. Dag Falk-Petersen.

-Remote Towers is an impressive Norwegian innovation which will prove useful in society and emergency preparedness situations. By combining the vision, knowledge and expertise

of Avinor, and the expertise and technology of KONGSBERG and the Ninox team, I am proud to write aviation history. The remote towers solution has great potential and I look forward to be working with Avinor to develop the next generation of aviation safety, says Geir Håøy, CEO of the KONGSBERG Group.

Remote Towers is being tested by the Royal Norwegian Air Force

In 2019 The Royal Norwegian Air Force and Avinor entered a partnership for testing the Remote Towers solution for military use in Norway.

- The digitalisation with remote towers centre is exciting and will help to develop the aviation of the future. We are already working with Avinor to develop a solution that can take care of both civilian and military needs at our bases and air stations.

Remote control tower services can help ensure necessary air traffic services throughout the spectrum of conflicts from peace to war, says Major General Tonje Skinnarland, chief of the Royal Norwegian Air Force.



Credit: Avinor



Credit: Avinor



Credit: Avinor



Credit: Nav Canada

NAV CANADA LAUNCHES REMOTE AIR TRAFFIC SERVICES TRIAL WITH SEARIDGE TECHNOLOGIES

NAV CANADA has commenced a trial to provide Aerodrome Advisory Services (AAS) at Fredericton International Airport (CYFC) remotely from Saint John, New Brunswick (CYSJ) using Searidge Technologies' Enhanced Airport Vision Display (EAVD).

The trial, which integrates the EAVD platform into NAV CANADA's operational display suite, aims to demonstrate how certified video technology can increase levels of safety, efficiency and flexibility in air traffic services and aircraft operations.



Credit: Nav Canada

Flight Service Specialists will benefit from increased situational awareness with a clear and real-time view of the airfield operating areas and surrounding airspace, which will support service enhancements such as the control of vehicles on the ground.

This remote services trial builds upon past successes with Searidge Technologies, where installations in Red Deer, Kingston, Lethbridge, London, Vancouver and Winnipeg have leveraged camera technologies to enhance operations by providing air traffic services staff with the ability to see beyond line-of-sight obstacles.

The trial, which is anticipated to run until the fall, has received Transport Canada approval and will assess safety and efficiency benefits of the new service enhancements enabled through aviation-grade video capability.

"This made-in-Canada technology has the potential to become an important, adaptive service delivery solution, allowing NAV CANADA to respond cost-effectively and efficiently to changes in demand while enhancing safety through increased situational awareness," said Ben Girard, Vice President and Chief of Operations.

"Being a Canadian company, we are extremely proud to be supporting NAV CANADA and Transport Canada as they assess the benefits of our Enhanced Airport Vision Display platform for domestic operations. NAV CANADA has been a close partner of ours for many years, this is an excellent demonstration of how, together, we continue to bring innovation to air traffic management," said Moodie Cheikh, CEO, Searidge Technologies.

"ATSAC looks forward to proving this technology. With it, Flight Service Specialists will have another tool to move the flying public into and out of airports across this Country with added safety. Great collaboration between the 3 entities involved," said Elizabeth O'Hurley, President, Air Traffic Specialist Association of Canada.



Credit: Nav Canada

REMOTE TOWERS – REVOLUTION OR ILLUSION?

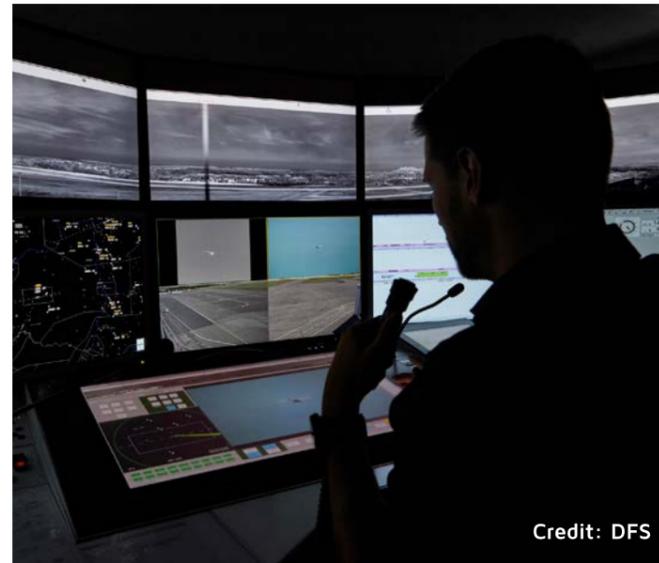
by Paul Diestelkamp, Air Navigation Solutions (ANSL)

Remote Tower Control (RTC) still feels like an innovation in its early stages but in reality, the era of Remote and Digital Towers began over 15 years ago with early research and development activities progressed in Sweden and Germany. The first airport to fully transition to remote Air Traffic Control (ATC) services was Örnköldsvik's Airport in 2015. Saarbrücken Airport in Germany followed suit in 2018. Numerous other RTC implementations have been progressed worldwide, both to deliver main ATC services remotely and for improved contingency capabilities. More than ten years collective experience of safe and successful operations suggest that today RTC is a proven concept, well explored across the globe and well-established across the Air Traffic Management (ATM) industry.



Credit: Ports of New Jersey

The popularity of remote service provision in ATC is partially at least the result of what one could refer to as a 'hype' that developed around RTC a good five years ago or so. RTC became something that was understood to add value, be ground-



Credit: DFS

breaking in the way it allowed ATC services to be delivered and that was said to save a lot of money. This claim to fame quickly catapulted RTC into becoming one of the strategic priorities of Air Navigation Services Providers (ANSPs) and RTC gained huge popularity across the industry. The urge to increase flexibility and ultimately reduce the cost of ATC services, not least in readiness for the liberalisation of ATM Markets across Europe, drove this interest, as did the new financial pressures that the European Performance Scheme for ANSPs had introduced with its first Reference Period (RP1) underway at the time. ANSPs were looking for means to structurally change their cost base, and staff cost is and remains the biggest contributor.

However, it could also be argued that this interest in Remote Operations was partially induced by a concern not to miss out on what was seen to be a trend with the potential to change the industry substantially. Remote Tower Solutions were a theme across all segments of the World ATM Exhibition in Madrid at the time: all equipment manufacturers presented their own version of RTC solutions, all consultants advertised their ability to consult on and refine RTC concepts and most ANSPs, if not directly involved in the development themselves, were keen to demonstrate their genuine interest in remote service delivery as an enabler for flexible and cost-effective ATC services. The cost of Air Navigation Services to airlines had come under scrutiny as part of the Performance Scheme and it was important to offer concepts to address this point.

Silver bullet or basket case?

The collective experience of numerous RTC operations worldwide has confirmed the concept as safe and viable. In a world where safety and compliance are a given, however, this should not come as a surprise. More interesting perhaps therefore is the question of the economic benefit that experience to date has demonstrated for Remote Tower Operations.

The key enabling element of RTC for ATC operations is the removal of the inevitable tie to the location of the airport which generates various opportunities for a more flexible service provision. This in itself does not result in lower cost though and with substantial investments required can easily be a loss-making undertaking unless applied strategically. It is when this newly won flexibility is put into action with the aim to generate synergies that efficiencies can be created. At least one additional ingredient is therefore required for an RTC implementation to become the recipe for financial success.

Combination is key

This additional ingredient can be the combination of several ATC Units in one location and the combination of staff pools across these units, an option that does not exist in a conventional Tower environment. Equally, this could be the combination of an RTC implementation with a pre-existing requirement to invest in infrastructure. In other words, implementing remote operations instead of building a new Tower building. Or, this could be the combination of remote operations with the flexibility of service hours at various airports where one staff pool can now cover limited hours of operations at a number of airports.

Equally important though is the possibility of combining the strategic decision to transition to a remote operations environment with other organisational and business-related decisions. The newly gained flexibility could be used to create increased competition. Airports could progress remote implementations to make the ATC service delivery more accessible for service providers not currently in their local market and ANSPs could utilise the technology to broaden their reach. The implementation of an RTC solution could be the trigger for an airport to outsource their ATC service and by doing so generate additional benefits. Perhaps the regulatory environment should adapt as well and enable the decoupling of the service provision from the infrastructure, making RTC infrastructure provision a business line in its own right, independent of ATC service providers.

Combination is key because the sole benefit of a more flexible utilisation of staff can well be achieved in other ways. Sometimes simplification wins over automation and 'technification'.

Understand your use-case

The view offered here is, no doubt, narrow and excludes many considerations relevant to a decision as fundamental as the implementation of RTC for an ANSP. To start with, there are other reasons to pursue remote operations than financial benefits alone. What remains though and is important for a sound and sustainable strategic decision to be made, is the ability to differentiate between RTC as the long-awaited cost-reducing innovation and RTC as a strategic enabler for a revolutionised ATM industry. The innovation lies not in RTC but

in the ability to reshape the way ATC services are delivered. If this ability is recognised and utilised, then and only then does RTC become a revolution. The technical solution deployed does not materially change this ability and, most importantly, only ever becomes relevant if RTC is implemented for the right reasons. So, ensure that you understand your use-case and the right solution will then become surprisingly obvious.

Paul has 15 years of experience in ATC. He began his career at DFS, Germany's national ANSP, where he held numerous roles initially as an ATCO before progressing into management and becoming Operational Lead for DFS's Remote Tower Control project.



Today, Paul leads ANSL's development of tailored solutions and capabilities that break new ground and reshape the way ATM is delivered.

Air Navigation Solutions (ANSL)

Air Navigation Solutions (ANSL) is a leading Air Navigation Services Provider and the Catalyst for Change in air traffic management. We deliver air traffic control and engineering services at some of the world's busiest and most complex airports and develop bespoke air traffic management solutions designed around our customers' needs.

Our solutions include technical projects, as well as operational concept development and performance improvements. We deliver training, offer advice and have a wide range of expertise in safety, quality, regulations and all other areas relevant to our industry.

ADVANCING REMOTE DIGITAL TOWER FOR AIRSPACE RECOVERY

Digital tower has the power to reduce controller workload, increase the cost efficiency of operations, and ensure business continuity in the event of a crisis. Frequentis DFS Aerosense' Peter Gridling, Remote Tower Expert and VP of Sales, and Yannick Beyer, Director of Sales, explain how.

Aviation has had one of its most challenging years for decades. Although the number of flights is slowly increasing, the revenues of airlines and air navigation service providers (ANSPs) have been hit hard and remain low. Before the pandemic pressure on the aviation industry centered around capacity and increasing passenger demand, now, as we look towards recovery, it is clear that solutions that provide contingency and resilience, as well as cost efficiency, have increased their appeal. Solutions like remote digital tower and combined tower and approach solutions that offer a way for ANSPs to more cost effectively operate the airspace in lulls as well as highs should be top of their agenda. As well as being the answer to the current traffic lows and the future ramp up they also offer air navigation service providers (ANSPs) another level of preparedness for future crises.

Multiplying efficiencies

Remote digital towers have already been implemented in many locations across the world, allowing ATC to be carried out away from the airport in bespoke facilities, instead of airport towers. However, when more airports can be managed from the same remote tower, or virtual tower, centre we will see the most significant benefits in terms of optimising air traffic controller capacity.

By geographically decoupling ATM services from a location, virtual centres increase agility, capacity and cost-efficiency, while enabling better contingency planning. For the virtual centre concept to be effective, what we need is a more harmonised concept of operations (CONOPS) to allow suitably trained controllers to manage a different sector of another airspace. On top of this there needs to be a more networked approach to the way ATM systems are connected, enabling safe and secure data exchange, even across national borders. Lastly, it requires a joint effort by ANSPs and policy makers to ensure we have the proper legislation to enable such an operational concept.

In Europe, Frequentis and its project partners in the SESAR 2020 research program have conducted numerous multiple remote tower validations since 2017, where a single air traffic controller

manages traffic at more than one airport simultaneously. The first two simulation exercises were carried out at the German Aerospace Centre (DLR) Air Traffic Validation Center in Braunschweig, Germany. In a human-in-the-loop, real-time simulation, seven Hungarian civil and military controllers managed up to 30 movements per hour at three Hungarian airports.

In 2019 Frequentis took this a step further, moving from the simulator to more advanced testing in a real airport environment. Passive shadow validation for multiple remote tower technology took place at HungaroControl's headquarters in Budapest where Air Traffic Management (ATM) experts from around the world were able to see first-hand a single air traffic controller manage three airports simultaneously, in real time. The Frequentis planning tool and the directly integrated the voice communication system enabled the controller to provide safe and reliable ATC control for all three airports. This validation proved that with the advanced support tools from Frequentis a permanent multi-remote tower operation is possible. This has not since been performed by any other vendor. It is this operation of multiple towers by single operators that will bring the most benefits when it comes to efficiency and growth.

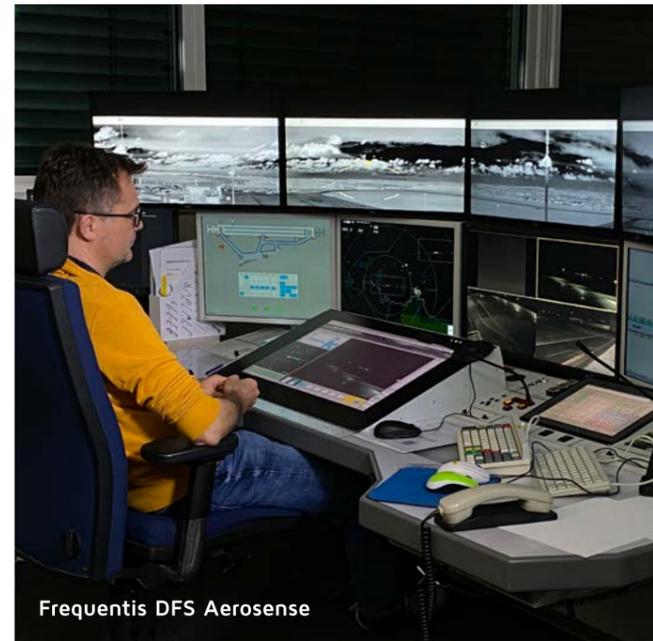


Frequentis DFS Aerosense

Reacting to changing demand

The virtual centre concept, based on IP tech, will become more important than before, because of its flexibility for contingency situations and scalability in general. The other issue from the reduced air traffic of COVID was the lack of flexibility and continued need to run fully staffed air traffic control towers, despite the lack of traffic. This is because one controller is required for tower services and another for approach. With an integrated tower and approach module in a digital tower these functions can be combined in times of low traffic volume and separated when traffic increases. This gives ANSPs the flexibility to react to changing traffic demand.

What we are looking at is a networked solution, which seamlessly integrates the air traffic flow from the airports in the upper airspace, but which is scalable and flexible in terms of resources and traffic load. This allows air navigation service



Frequentis DFS Aerosense

providers (ANSPs) to integrate remote digital tower and approach solutions, therefore adapting to traffic demands in a holistic way. The integrated, or hybrid, tower and approach centre combines digital tower technology and an approach automation solution, designed to autonomously process flight plan data and surveillance data for air traffic services (ATS). The approach function includes safety net functionality such as short-term conflict detection, area proximity warnings and minimum safe altitude warnings, all designed to assist the air traffic controller (ATCO) with optimal situational awareness. With automated controller tools it is also possible to integrate an advanced surface movement guidance and control system (A-SMGCS) into the digital tower environment, to further enhance airport surveillance and controller functionality. This concept allows controllers to provide ATC services where required.

Prepared to scale up

Digital tower and virtual centre technologies can provide ANSPs with the flexibility to support longer-term strategic goals. These include an RDT centre as a permanent back-up facility and ideal fallback solution if the main automation system is unavailable. The only requirement for contingency operations is the availability of a secure and resilient ATM-grade network at the

back-up location, able to react to changing network demands and ensure continuous connectivity. Introducing digitalisation now is the answer to the current situation as well as allowing us to fulfil the growing demand for mobility and the rise of air travel and be better prepared for future crises.

A project of this kind relies on the appropriate involvement of operational staff from the very beginning and throughout the project. A thorough change management process should consist of safety, transition and training aspects to fully prepare operators, but also to ensure a seamless approval process within the regulatory authorities.

DFS gained a lot of experience regarding regulatory approval, operational transition and stakeholder management when completing its own remote tower project and in various international assignments., which can guide many other ANSPs around the world, allowing them to avoid potential complications and save project costs. For Multi Remote projects this expertise is essential for a successful implementation. Looking ahead, we expect to see the first operational multi-remote towers in three to five years. The first tenders are already coming up.

Author Bios:

Peter Gridling, Digital Tower Expert and Vice President Sales, Frequentis DFS Aerosense
Peter graduated with an engineer's degree in computer sciences has a strong camera and image recognition technology background, including forming a start-up company for image recognition technologies. Peter joined Frequentis in 2016 to support the digital tower team and is now VP Sales for Frequentis DFS Aerosense.

Yannick Beyer, Sales Director, Frequentis DFS Aerosense
Yannick joined the DFS Group in 2012 as a Consultant for international ATM projects. With his Bachelor degree in Aviation Management and his Masters in Business Administration, he today serves customers from all over the world in ATM topics. Since 2020 Yannick is Director of Sales at Frequentis DFS Aerosense.

Company bio:

Frequentis AG and German ANSP DFS Deutsche Flugsicherung GmbH, through its wholly owned subsidiary DFS Aviation Services, formed joint venture FREQUENTIS DFS AEROSENSE in 2018, to deliver turnkey remote tower solutions worldwide. Frequentis contributes the technologies, as well as expertise in developing customised remote tower systems, and its worldwide network of locally represented subsidiaries that can implement remote towers globally. DFS Aviation Services contributes its operational air traffic management experience in consulting, validation, transition and training, as well as the deep operational experience gained through developing its own remote tower solution.

For more information, visit www.aerosense.solutions

Links to include

Pandemic explainer video

AEROSENSE Imagevideo

1st year of operation

UNDERSTANDING THE DIGITAL TOWER "PARADOX"

by Elizabet Pavlova, Think Research

In this – the year of the webinar – there has been one topic consuming more bandwidth than many others. Ironically it's a concept which itself is based on sending video down a telecoms link straight to your screens. From digital tower simulation, live tours of Remote Tower Centres, to the benefits of using Digital Tower for COVID secure operations, we have seen a huge rise in the number of Remote or Digital Tower infomercials webinars. Perhaps that rise is fitting since the concept itself has become more and more popular in the last few years. This rise in popularity is what has led us to speak about what we call the "Digital Tower Paradox".

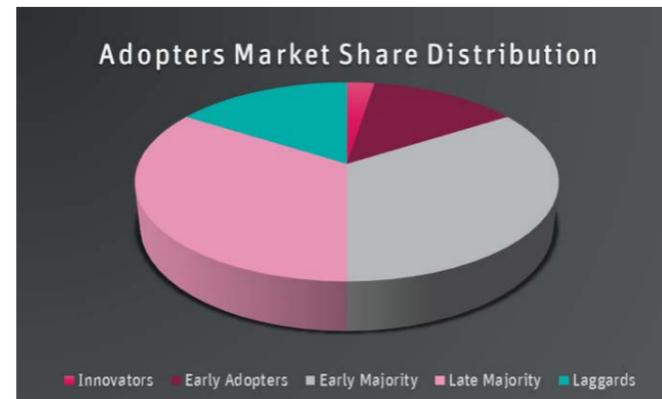
The crux of this paradox is that while it seems Digital Towers are everywhere, in fact when it comes to experiencing the technology it is a whole different story – we can still count the actual implementations on our fingers.

To help us understand the paradox we turn to semantics and mathematics. Having joined you all in watching so many webinars we are familiar with many of the common phrases associated with Digital Tower and we focus on one in particular – the one which says that "the number of Digital Tower implementations worldwide is growing exponentially". When we

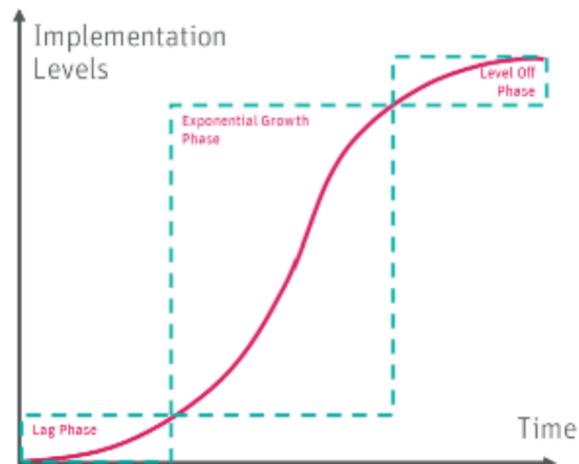
hear that phrase we naturally think of massive, fast and sudden growth. Digital Towers popping up all over the place. And yet they are not. Not yet anyway. Where are they then?

This is where mathematics comes in. The thing we often forget about exponential growth is that it actually involves a very slow take off. In the beginning there is always a phase of very, very slow growth – the so-called "lag phase". We need to get through that part before we start observing a rapid increase.

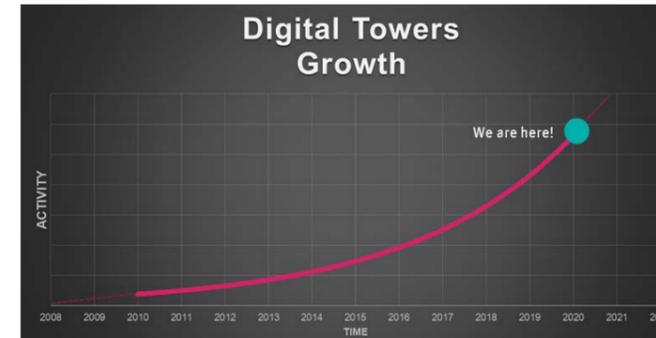
Adopting the Digital Tower concept



With every new concept, the adaptation process is more or less the same – first we have the innovators, or the so-called "technological enthusiasts", after that are the early adopters, followed by the majority, and finally the laggards. The innovators are a proactive niche group of stakeholders that usually go all in. They might be looking for the "glory" of being the first in the world or may simply be forced to **innovate** an invent out of necessity. This is positive in the case of developing solutions fully tailored to their needs, but since they're so unique, it takes a long time ... most of the time. Being a leading innovator in the world of Digital Towers is further complicated by the almost exclusive reliance upon the technology manufacturers to provide support and lead the technology innovation. This concept was not born solely from ATM or airport R&D departments but out of collaborations with manufacturers applying commonly used technologies to a novel use case. All of the early Digital Tower implementation projects required a willingness to embrace the innovation of manufacturers, which is often harder than embracing internal innovation which may have built up over years.



The **early adopters** are somewhere in the middle of "we want to be unique, but we don't want to risk it all in the process". The **majority**, well they are self-explanatory – they are the stakeholders that engage with a concept when they have seen enough of it to assume the risk of disruption is very low. And finally are the **laggards** who only adopt a technology because



"everyone else has one" or "we were told to adopt it" We wanted to better understand how the Digital Tower concept has been adopted from 2010 onwards. So, we decided to plot all Digital Tower activity together, including new projects, trials and implementations from the last decade, and we got some interesting results.

While in the beginning, the uptake on Digital Towers among the innovators was steady, today we can see that the rate of engagement with the concept is increasing. We see concept moving out of the lag phase as it grows in popularity and more ANSPs now become interested in adopting the technology.

Why now?

The main challenge of innovative technological solutions is moving past the development stage to allow concept accessibility on a large scale. Digital Towers are still exclusive when considering implementations worldwide - there isn't a "one size fits all" commercial-of-the-shelf (COTS) product. And while we know that the concept promotes cost-efficiency, the cost of entry into the market is still high. Based on feasibility studies conducted over the years, some show that in several cases return of investment can take up to 20 years. This is often the reason for ANSPs to step back and not proceed with their plans until "cheaper ATS" actually becomes cheaper. In simpler terms – lots of people think about doing it but fewer actually do it.

In the early days of implementing digital towers, the validation and approval process took longer to complete due to the lack of experience in the area. The first digital tower implementation in

Sundsvall took over 5 years of planning and testing until it was certified. Things have changed now. With the help of guidance materials (GM) and standards such as the EASA's Remote Tower GM, EUROCAE ED-240, and working groups like CANSO Digital Tower Taskforce it is becoming easier for service providers and manufacturers to better understand safety considerations and operational requirements.

With more experience in the market, the industry is more familiar with the concept which is reflected in the ability to implement the concept more quickly. This practice becomes somewhat self-fulfilling in that the more people that have done it, the more people can do it. Back to mathematics – exponentiality is where the value increases relative to itself. If trends are correct we could (dependant on traffic recovery post-2020) see as many Digital Tower implementations announced in the next two years as we did in the first 10 years.

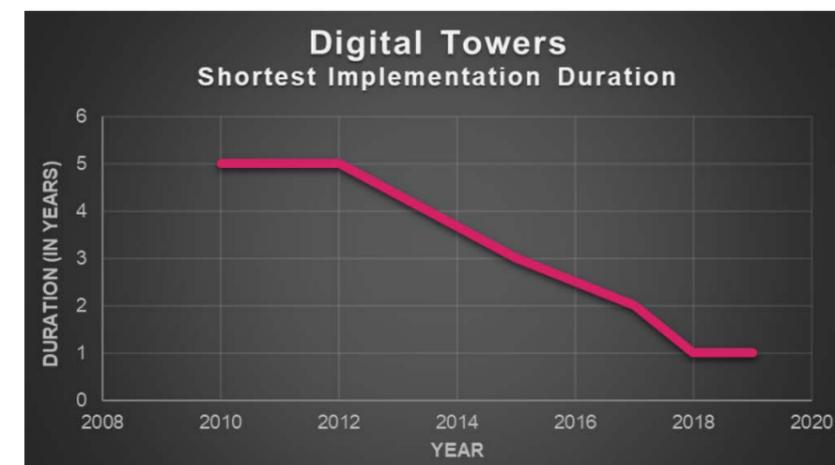
How quickly can we move?

While the rate of adoption is increasing, the time lag from idea to implementation is decreasing. It is not so much about learning how to implement digital towers anymore, it is about learning how to optimise the process. This is particularly true for single-mode applications in low traffic density airports where the process of validating and maturing the concept from feasibility to implementation has reached its optimum. The duration from idea to implementation can now be as short as 1 year, which is a 5 times reduction in the required timeframe as compared to 10 years ago. The manufacturers are experts in guiding ANSPs through this process and the industry guidance materials are sufficiently useable to support safety and other assurance activities required for such low density (and often single movement) operations.

Multiple-mode and contingency applications are a different story, however. When we consider all of the different application options, we can't expect the same rate of immediate uptake for all.

For example, Multiple-mode implementations can't be done in one year starting from today. In fact, they will require quite a long time in the beginning to reach the approval and certification stage just the way the first single-mode applications did. The concept is inherently more complicated and has more hurdles than single mode so the lag phase may be longer. But given the drivers behind multiple mode and the maturity of the market by the time it is available, we might see an even quicker growth phase one we move past early adopters.

What about Contingency mode? From a technical point of view, the potential for growth is the same as single-mode, however, as it is applied mainly for fewer larger airports which have a business case for contingency, the rate of uptake is naturally going to be slower.



UNDERSTANDING THE DIGITAL TOWER “PARADOX”

by Elizabet Pavlova, Think Research

Does size matter?

Digital towers are fit for all airport sizes, but they all have different use cases. Yes, small and remote airports are still the primary stakeholders of digital towers, but we are seeing increasing interest from busy international airports, who are intrigued by the performance and business case benefits the technology can offer. Everything from developing contingency measures to providing visual enhancements to help maintain safety during adverse conditions.

The digital tower concept is easily adaptable to serve dynamic operational needs and changes in business models, however, as we already identified, some of these concept modes are less mature and remain in the lag phase. The question is: Will uptake grow at the same rate across all sizes? The answer is “not always”.

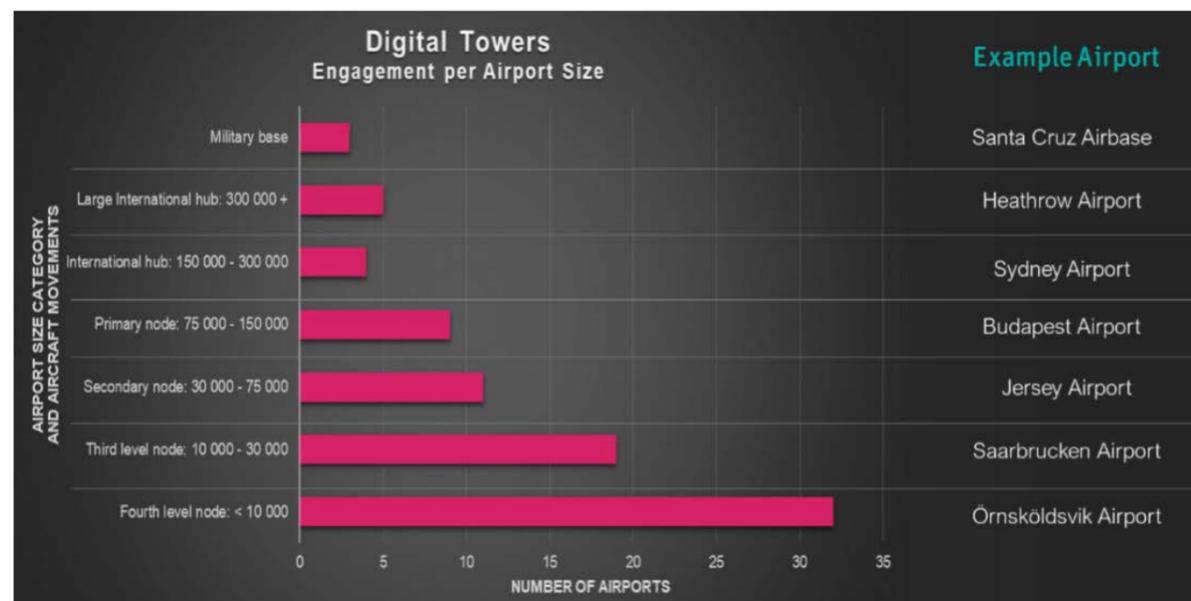
Low density airports (third and fourth level node) have accelerated further along the concept’s exponential growth curve than busier airports with more complexity and higher workload scenarios. The nature of exponential growth is like a snowball effect – with more low density airports getting in on the Digital Tower act, that rate will increase faster than it will for larger airports. Relative to previous implementations, future implementations at larger airports may be more common and take less time, but they won’t have quite the same mass to achieve the same economies of scale as the smaller airports.

Another thing to note is that civil is way ahead of military. However, it is likely the military stakeholders are just being “laggards” here and have waited for the civil Digital

Towers to really start to accelerate in terms of the implementation projects before they invested.

What is next for Digital Towers?

Over a decade after the digital tower concept was born, the industry’s knowledge of the technology and experience with it have undoubtedly progressed. In 2015, there was one implemented digital tower. In 2020, we have nearly 20! The benefits of implementing digital towers are the main drivers behind the growing demand, especially in such times where many stakeholders have taken a financial hit by the pandemic and cost-efficiency is a driving force. While multiple-mode application is yet to be matured, we can clearly see that single-mode applications have started to progress rapidly. With the maturing technologies along with the continuously growing experience with the concept, we hope to see most of the projects currently in their testing phase be successfully implemented and certified in the next two years. 2021 should finally be the year we banish the Digital Tower paradox to the history bin but we leave with one note of caution... Much like a vaccine for contagious respiratory and vascular diseases (to choose an example totally at random), the acceleration of a technology onto the market is met with joy and excitement. That’s the good news. The hard part comes when the technology has been circulating on a large scale for an extended period of time. Those benefits that we were told the technology would bring have to become obvious to everyone. They have to actually make an impact or else that final phase – the level off phase – will come quicker and lower than anyone expects or indeed wants.



RACCOON



ENAV has been involved in the Remote Tower Concept since 2015. RACCOON (Remote Airport Concept of Operation) - its first experience - was a SESAR Large Scale Demonstration project that proved, in a live operational environment, the technical and operational feasibility of the Remote Tower Concept. Milan Linate, the principal air operations area, was operated remotely through a specially developed Remote Tower Module (RTM) located at Milan Malpensa. The remote tower Controller Working Position was equipped with conventional ATS systems complemented by a reproduction of the “out-the-window” view based on high definition camera sensor systems. During the Linate live trial campaign more than 100 commercial flights were managed remotely by the RACCOON platform.

The RACCOON experience has paved the way for the implementation of the Remote Tower Service in Italy. Since completion of the project, ENAV has begun studies on the operational implementation of the Remote Control Service in some Italian airports. Following this strategy, an operational Remote Tower Test Bed was installed at Brindisi airport with the aim of fine tuning the operational concept, testing and validating various technical solutions in a real operational environment. Through various program phases that define the software functionalities, the human-machine interface and the subsidiary system for the management of the flight plans and meteorological information, ENAV will be capable of implementing its first Remote Tower in the near future.



credit ENAV



credit ENAV

QUESTIONS STILL UNANSWERED

by Katariina Syvays, IFATCA

Questions still unanswered

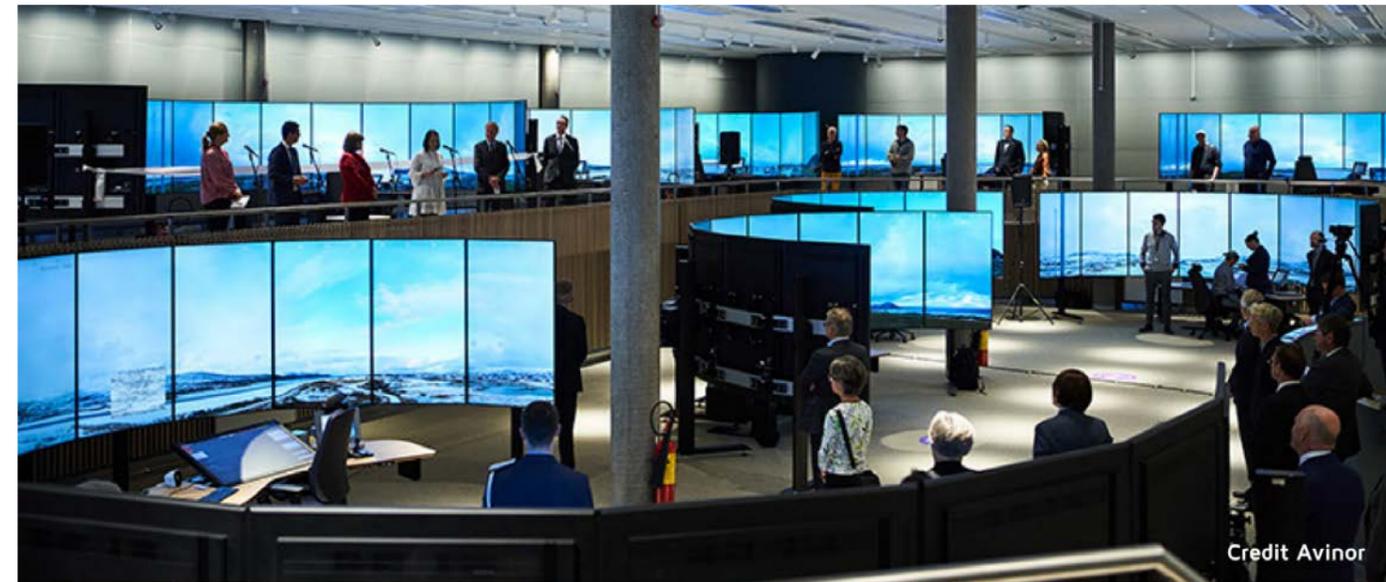
The concept of remote tower was first introduced to the international community of air traffic controllers at IFATCA Annual meeting in Kathmandu, Nepal in 2012. The audience was bewildered by a concept that at first seemed a product of a wild imagination instead of an operational method to produce air traffic control service. Only three years later, in April 2015, the world's first remote tower at Örnsköldsvik airport in Sweden went operational. The airport is controlled from LFFV's remote tower centre in Sundsvall.

The concept has evolved over the years, and new modes of operation have been introduced, although none of the new modes is yet operational. Especially the multiple mode of operation raises questions: is it simultaneous, where one air traffic controller provides service for two or three aerodromes at the same time? Or is it sequential, where one air traffic controller provides service for more than one airport in sequence, but not simultaneously? Even a simultaneous mixed mode is under consideration, where remote tower service could be provided from a conventional tower for another remote airport.

The companies building remote systems claim their technology is cheaper and better than conventional towers. But is it really cheaper and more flexible? The idea of multiple mode of operation is based on wide range of technical equipment along with camera systems: surveillance (MLAT, ASR, ADS-B,

A-SMGCS), electronic strip system, AI-solutions, machine learning, object identification tools, electronic planning and workload forecast tools, PTZ camera, IR camera, to mention a few. What about other systems? Should there be an ATIS and an automated weather observation system AWOS? Silent coordination between ATC units? VoIP radio systems? Is all this really a cost-effective solution for small or even medium sized airports when bearing in mind, that all technical aid will be needed if expected that one air traffic controller is providing service to more than one airport simultaneously.

IFATCA has several policies about remote tower systems and operation, but the one concerning multiple mode of operation is one of the very few "negative" policies amongst all IFATCA policies: ATCOs shall not be required to provide a Remote and Virtual tower service for more than one aerodrome simultaneously. The policy is in place for a reason. Multiple simultaneous mode of operation has been tested in simulators over a quite a many year. The results are interesting yet incoherent. The real world can never be simulated as it is; the simulations will inevitably be a selected sample of reality, a test kit with blind spots. How to select the traffic for simulation? Only IFR? School flights? Emergencies? Incidents? Phone calls? Weather, snowfall, rain, fog? Lightning conditions? The simulations often tend to have CAVOK and daylight. The view is restricted: the downwind behind the air traffic controllers back is not shown, because "there is no traffic on that side of the aerodrome in this simulation". Or, there are three pseudo pilots taking part in the simulation, one for each airport. Would the air



Credit Avinor

traffic controller then recognise the airport by the pilots' voice? The need for harmonisation of systems and procedures has been identified. This will increase the capacity of the systems and mitigate risks for errors. But the harmonisation of systems and procedures should be studied more in the future, because it seems that the analysis of the simulations do not consider how human brains function. The study of workload is also missing. Will the use of support tools increase the workload or will the use of such tools actually impose new tasks for the air traffic controller? Human short-term memory has approximately 4-7 memory blocks to be used simultaneously or in sequence. To support our short-term memory, we humans create routines and gather information to our long-term memory (learning). When working we use information in unconscious way and consciously using short term memory. Automation tools may hinder the memory functions, because every time the system imposes a warning or a suggestion, it occupies at least one of your short-term memory blocks for decision making period. Will automation functionalities, which for example intervene the air traffic controller's performance by suggesting to prioritise the tasks, actually interrupt the air traffic controller in a way that was not intended?

On the other hand, can the harmonisation go too far? Will it prevent the triggers we have in our brains to function? Triggers are warnings or stimulus to act, to check, to verify. Will the harmonisation lead to a false priming of brains; an air traffic controller performs a totally right action, but in a wrong environment, in this case on a wrong aerodrome?

Implementing a remote tower system will actually create unpredictable costs for an aerodrome operator. Let's imagine. If there was a multiple simultaneous remote tower centre with multiple working positions, where any aerodrome could be controlled from any work position with any combination of aerodromes, could there be for example vehicles by the same

radiotelephony call sign at different aerodromes? Could there be different working methods or procedures in place at different airports?

Will implementing of remote tower centres increase the operational costs for the airlines? If the flight is operated between to aerodromes controlled from the same remote tower centre, can the alternate aerodrome be controlled from the same centre? Or can the destination and the alternate airports be controlled from the same centre? Will this lead to a carriage of extra fuel or other arrangements with passengers and cargo? There are more questions than answers. There are bold plans and ambitious schedules to implement new remote towers around the globe. Luckily the ANSPs are responsible and are not rushing into implementation of the systems, and most importantly not rushing into operation with already implemented systems. Without a doubt there is a place for remote tower solutions. There are truly remote and secluded places where remote tower is probably a flexible and cost-efficient solution; places and aerodromes with very few movements annually, but which provide a lifeline for communities living at the outskirts. Other development is building of contingency towers using remote tower technology. The world's largest and busiest airports are looking for solutions to enable them maintaining a 100% capacity in all situations and solutions to minimise the impact weather on low visibility conditions.

The concept of remote tower control, unthinkable just a few years ago will probably be part of normality soon. A lot of work has been done already and in consequence nobody considers the remote tower control as a purely theoretical idea. Many of the doubts and questions considered in this article are in its way to being answered but reservations about the concept will persist until every detail in the operation of remote towers has been fully understood.



Credit: Nav Canada

THE MULTIPLIER EFFECT OF SESAR REMOTE TOWERS

by Florian Guillermet, SESAR JU

In a matter of years, remote tower technology has re-written the rulebook on air traffic control. With a proven return on investment, remote towers offer a possible lifeline for smaller and regional airports struggling to survive during these difficult times, says Florian Guillermet, Executive Director, SESAR Joint Undertaking.

The COVID pandemic has had and will continue to have for some time a devastating impact on air traffic. Airports of all sizes have been hit hard but smaller and regional airports are particularly vulnerable as a result of the crisis as they must maintain air service provision for next to no traffic. While there is no silver bullet, these airports can use this as an opportunity to reflect on how to build their resilience at an affordable price in the long term. Given the social and economic importance of these airports for their surrounding communities, it will be critical to have strategies to ensure their sustainability. This is where innovation has a role to play. Satellite-based navigation technologies, such as ground-based augmented system (GBAS) or low-cost surface surveillance solutions, provide airports with the means to improve accessibility and increase their resilience at a fraction of the cost. But perhaps the most promising solution for these categories of airports are remote towers, a technology that SESAR research and innovation partners have made significant progress on in the last ten years.

Zooming in on the technology

Remote tower technology works by deploying high-definition, infrared and pan-tilt-zoom cameras, complemented by a suite of supporting technologies and network links. A live video feed is securely relayed to a controller at a separate location who sits at a 'remote tower module', comprising a panoramic array of high-definition screens, which provide an 'out of the window' view of the airport.

In the controller's module, the screen is overlaid with information from additional sources, such as secondary radar and automatic dependent surveillance-broadcast (ADS-B), where it is available, which enhances the visual imagery for use in normal conditions, and improves the controller's situational awareness during low-visibility conditions. Additional features can include object tracking, image magnification, motion-based alerting, infrared vision and hotspot monitoring.

Having a single minded vision

In the first SESAR research and development (R&D) programme (2008-2016), members and partners showed the feasibility of physically separating the control tower and controllers, while still enabling the safe provision of air traffic control (ATC) services

at an airport. This R&D¹ led to the first single remote tower deployment at Sweden's Örnköldsvik Airport in 2014, which in many ways has become the template for ensuing deployments. The next logical step was to see if the single remote tower set-up could be used for regional airports with medium-sized traffic volumes. This category of airport is faced with similar challenges as their smaller counterparts in ensuring service continuity or even expansion since conventional towers can become too costly to run over time, or if the number of flights becomes insufficient. This second SESAR Solution was tested at an installation at Saarbrücken Airport in south western Germany near its border with France – that installation has now become operational with traffic controlled remotely, thanks to the work done in SESAR². Validation work³ was complemented by large-scale demonstrations in Germany⁴, Italy⁵ and Ireland⁶.

¹ SESAR R&D projects 06.09.03, 12.04.06 and 12.04.07 (EUROCONTROL, Frequentis, INDRA, LEONARDO, NATMIG, NORACON)

This R&D work and the first deployments have encouraged similar implementation plans, and not just at other small airports. For example, the smaller physical footprint of remote towers has prompted airport planners and architects to rethink how the valuable liberated space can be exploited for other operational and business purposes. This is the case at London City (LCY) Airport, which is planning remote tower installation that will feature a live feed via super-fast secure fibre connections to a new control room⁷.

SESAR members have also looked at how remote towers could serve larger airports as a contingency for outages, providing resilience and safety assurance. The need for contingency towers is, as such, not new, and facilities already operate in many places such as at London Heathrow and Brussels.

The SESAR Solution brings additional technology into play, and addresses issues including accessibility, training and security to deliver more resilience and a higher efficiency in degraded situations. Through a series of trials at Göteborg in Sweden and Girona in Spain⁸, members tested the switchover time from the primary to the contingency tower, the level of service attainable when 'out of the window' is unavailable, and the extent of

information accessible to controllers. Since these demonstration activities⁹, Sweden has gone on to adopt the technology for three more of its airports, inaugurating in 2019 the first new airport in the world with a traditional tower. Meanwhile in Spain, plans are underway to implement a virtual remote tower will be implemented at Vigo Airport, with a view to it becoming a centre, from which ATC will be provided for three airports: Vigo plus two other airports. Finally, HungaroControl has rolled out Europe's first contingency remote tower facility in Europe in Budapest.

From single to multiple towers

Haven proven the safety and efficiency of the technology, the focus turned to investigating the feasibility of allowing controllers manage more than one airport at a time. Considering the safety and human factor implications of such a research topic, development work focused on very small airports initially. The first multiple remote tower SESAR Solution, 'remote tower for two low-density aerodromes' was delivered in 2015¹⁰. With the launch of SESAR 2020 (2016-2020), the next wave of R&D, further remote tower solutions are under development. This includes the recent delivery of the multiple remote tower module, which provides advanced features necessary for controllers to maintain situational awareness for two or three airports simultaneously. The solution can be used to pair airports of different sizes, with indicative figures showing that two airports with 15,000 to 40,000 annual movements or three airports with less than 15,000 annual movements can be handled by one air traffic controller simultaneously. In cases of traffic overload, airports can be split between several modules.



Credit DLR

² <https://www.atc-network.com/atc-news/dfs-deutsche-flugsicherung-gmbh/dfs-controls-traffic-at-saarbruecken-airport-remotely>

³ SESAR Large Scale Demonstration Project RTO (DFS)

⁴ SESAR Large Scale Demonstration Project Racocon (ENAV, Air France, Deep Blue S.r.l., IDS Ingegneria Dei Sistemi S.p.A., NAV Canada ATM Inc, Societa P.a Esercizi Aeroportuali (SEA), Searidge Technologies Inc, Consorzio SICTA, Technosky S.r.L)

⁷ SESAR Large Scale Demonstration Project Remote Towers (Irish Aviation Authority (IAA), Dublin Airport Authority Plc, Comhfhorbairt Gaillimh)

⁸ NATS' control centre at Swanwick

SESAR R&D Projects 06.08.04, 06.09.03, 12.04.06 and 12.04.08 (DFS, ENAIRE, EUROCONTROL, Frequentis, INDRA, LEONARDO, NATMIG, NORACON)

Linked to this solution is the 'remote tower centre' (RTC). Currently undergoing intense work in Germany, Hungary, Italy, Lithuania, Norway, Sweden¹¹, the solution brings together in one place a number of modules to cover several different airports. At a remote tower centre, an air traffic controller can provide air traffic services to up to three low traffic volume airports at the same time¹². Thanks to the pooling of resources, controllers can assist each other in cases where the traffic at one of the airports becomes too complex to handle alone. Automatic planning tools support the remote tower centre supervisor for the most efficient allocation of airports and controllers to each working position. Such a centre is being established at Arlanda to provide remote air traffic control to airports in Malmö, Östersund, Umeå and Kiruna, with one controller assigned to one airport. A similar installation recently opened in Norway, where 15 airports will be operated by a tower centre in Bodø - The centre houses the same staff who used to sit in the individual towers.

The story does not end there...

What started as a concept to make small and regional airports more viable has extended into new and sometimes unexpected directions, transitioning into a family of solutions and blending other technologies such as virtual or augmented reality. Deployments of remote tower solutions are being planned on a broader scale across regional locations, particularly in Northern Europe. Their smaller footprint is helpful to designers of new airports and provide safety assurance in contingency roles. Remote tower centres are bringing operational efficiencies, resilience and cost effectiveness that airports need now and in the long term.

⁹ LSD project Budapest 2.0

¹⁰ SESAR R&D projects 06.09.03, 12.04.06 and 12.04.07 (EUROCONTROL, Frequentis, INDRA, LEONARDO, NATMIG, NORACON)

¹¹ ACG (COOPANS), CCL (COOPANS), DFS, DLR (AT-One), ENAV, EUROCONTROL, Frequentis, HungaroControl, Indra, Leonardo, LFV, LPS SR (B4), NLR (AT-One), ON (B4), PANS (B4) SAAB, SINTEF, SWEDAVIA, Thales

¹² PJ.05-W2-35 project: DLR (AT-One), Oro Navigacija (B4), PANS (B4), Austro Control / COOPANS, Croatia Control / COOPANS, LFV / COOPANS, Naviair / COOPANS, DFS, ENAIRE (incl. CRIDA as LTP), ENAV (incl. NAIS, Techno Sky, IDS AirNav, Bip and Deep Blue as LTPs), Frequentis (incl. Frequentis Comsoft as LTP), HungaroControl, Indra (incl. Indra Navia and Avinor as LTPs), LEONARDO, SAAB (NATMIG), SINTEF (NATMIG), Swedavia (SEAC2020) and Thales Land and Air Systems France (incl. Thales Deutschland as LTP)

REMOTE & DIGITAL TOWER INSTALLATIONS WORLDWIDE

by Chris Wade, ATC Network

Introduction

In the following pages we have collected information from ANSPs and institutes worldwide on how they have been researching, planning and implementing the technologies from Remote & Digital Towers. This is not a complete list but we hope it gives an insight into the progress of implementing these technologies. Thank you to all the organisations that took part.

Norway - Avinor

The World's largest Remote Towers Centre opened by the Avinor Group in Norway. The Norwegian air navigation service provider and airport operator Avinor Group opened the World's largest Remote Towers Centre in October this year. The centre will operate a total of 15 airport towers in Norway by the end of 2022. Four airport towers have already gone operational, and the experience so far has been positive.

The Ninox Remote Towers System technology is provided by Kongsberg Defence & Aerospace and Indra. The system is based on a single rotating camera located at airports, capturing visual and infrared 360 degrees views, which contains more details than can be detected by the human eye. The cameras can zoom in on small details and show movements in images – for example birds or drones. Every airport is connected to the Remote Towers Centre via networks with redundancy. If one network should fail, the other can be used to connect to the tower centre. These networks are high grade networks used for aviation and involve the use of both fibre cables and radio transmissions.

[Avinor 5 Credit Avinor Air Navigation Services / Catchlight Fotostudio] [Avinor 6 Credit Avinor Air Navigation Services / Catchlight Fotostudio.]

Nav Canada – Canada

In September 2020, NAV CANADA commenced a trial to provide Aerodrome Advisory Services (AAS) at Fredericton International Airport (CYFC) remotely from Saint John, New Brunswick (CYSJ) using Searidge Technologies' Enhanced Airport Vision Display (EAVD). The trial, which integrates the EAVD platform into NAV CANADA's operational display suite, aims to demonstrate how certified video technology can increase levels of safety, efficiency and flexibility in air traffic services and aircraft operations.

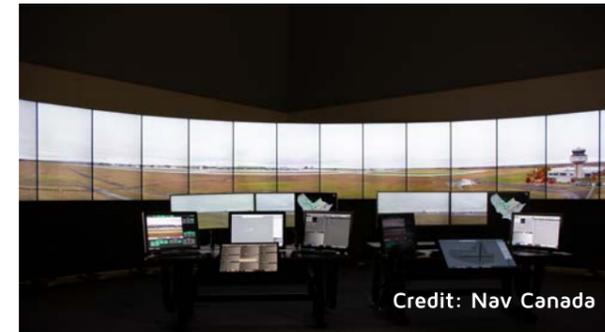
"This made-in-Canada technology has the potential to become an important, adaptive service delivery solution, allowing NAV CANADA to respond cost-effectively and efficiently to changes in demand while enhancing safety through increased situational awareness," said Ben Girard, Vice President and Chief of Operations at NAV CANADA. Flight Service Specialists will benefit from increased situational awareness with a clear and real-time view of the airfield operating areas and surrounding airspace, which will support service enhancements such as the control of vehicles on the ground. The trial, which is anticipated to run until the fall, has received Transport Canada approval and will assess safety and efficiency benefits of the new service enhancements enabled through aviation-grade video capability. Facilities across Canada benefiting by combining digital technology with existing operations include Red Deer, Kingston and Lethbridge FSS, and London, Vancouver Harbour, Vancouver International and Winnipeg Towers.



Credit: Nav Canada

"There is certainly an appetite for digital facilities. It is cost effective and it is flexible, enabling NAV CANADA to better serve our customers. The next step will be to

use the learnings from these trials to develop a national strategy of deployment. From these tests we will learn more about the resources and infrastructure needed for a wider implementation of digital facilities across Canada," said Jerome Gagnon, General Manager, Montreal Flight Information Region and Program Director, Digital Facilities at NAV CANADA.



Credit: Nav Canada

Searidge Technologies has deployed this technology at many international locations around the world as part of their digital tower platform, where digitalization provides increased safety and efficiency benefits to airport and air traffic management operations.

Hong Kong Civil Aviation Department

Digital Tower (DT) and Remote Tower (RT) technologies are ready to serve as a provision of the visual surveillance system in the context of Air Traffic Surveillance (ATS). Validation trials and implementation for DT and RT have been intensively carried out worldwide to meet the operational needs of various ANSPs. In the light of technologies for digitisation of tower operation being ready for deployment with a view to enhancing ATS safety, service levels and efficiencies, the Hong Kong Civil Aviation Department (HKCAD) conducted trials of the DT technologies at the Hong Kong International Airport (HKIA) in 2019, which demonstrated the technologies were useful in enhancing out-of-window view, especially during low visibility conditions and night time. The trials were successfully concluded, which provided good foundation for pursuing implementation at the HKIA.

France – DSNA

In France, DSNA is currently implementing various digital tower use cases :

A remote air traffic control service for a helipad is being implemented in Cannes airport, near Nice. The helipad is at a remote location in the centre of the city. Searidge was awarded the contract. Tests are expected to start in early 2021.

DSNA explores other usages of the remote tower technique, such as in the overseas islands of Saint-Pierre and Miquelon (in the East of Canada). In addition, the "Pyrénées project" is set up to enhance situational awareness of the approach air traffic controllers from Pau airport, using digital advanced tower technology. DSNA is notably building its first Remote Tower Centre (RTC). Located in an existing building at the Toulouse facility, it will first provide Air Traffic Control services for

Tours Val de Loire regional airport, located 420 km away. The RTC will manage up to 5 French regional commercial airports. The provision of the Remote Tower system is put up for tender with the objective of carrying out first tests in 2023.



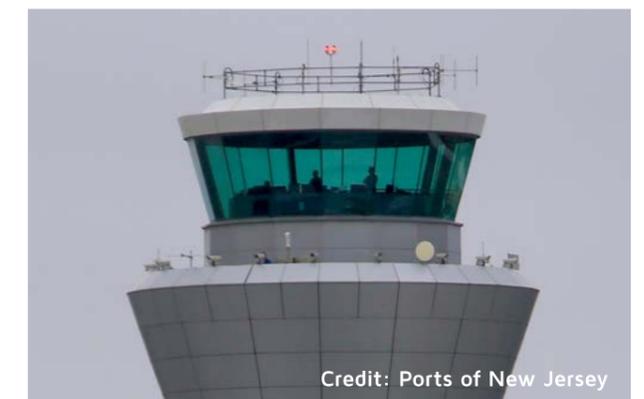
Credit: DSNA

Jersey – Ports of Jersey

Jersey Airport's digital air traffic control tower was the first operational remote tower approved in the UK. Following an extensive project which lasted nearly four years, the remote tower underwent a thorough testing period in 2018 and was finally approved for use by the European Aviation Safety Agency in May 2019. The remote tower is housed in a facility at a discrete location outside the airport perimeter. A faithful recreation of a controller's 'view' is achieved via 11 fixed cameras and two pan-tilt zoom cameras – which all combine to create a digital image that is stitched across three large screens. All other equipment in the conventional tower was replicated so that controllers would be operating in familiar surroundings and they were all required to undergo a programme of live training. While all options are being considered in the future, such as using the site as a training facility or even to operate other airports, the remote tower's main function for now and the future will be as a contingency service in the event of emergency, evacuation or equipment failure.



Credit: Ports of New Jersey



Credit: Ports of New Jersey

Spain - ENAIRE

Thinking about Air Navigation Services future, new paradigms will be on board. These new paradigms in service provision concepts will be based on digitalization and virtualization as enabler for service geographical de-location and also for service quality improvement. This is the vision that drives ENAIRE in the development of its Digital Control Tower project, together with Indra as technological partner, a project that goes well beyond the mere remote provision of Tower Control Traffic Services. This advanced solution integrates the existing ATS surveillance data, Air Traffic Control and Communications systems with a panoramic visualization system equipped with advanced information and alert functionalities, based on the application of Augmented Reality and Artificial Intelligence. This evolution of "remote concept" to a new "digital concept" is based on the objective to improve the human and ATMS system cooperation, moving from the "visual" concept of operations of the exiting Towers to a new concept of operations based on the combination of a new digitalized visual together with ATM system information.

This solution will improve airport capacity in all weather conditions, especially in low visibility, as well as the operational resilience, protecting operations from disruption. Improved situational awareness and additional safety nets will also boost operational safety. Additionally, Digital Tower will allow the provision of ATS services to several airports simultaneously from a single control location, offering greater resources flexibility and cost-efficiency in terms of personnel management and freed up space on the airfields.

However, for ENAIRE, this is only the first step on a path that will undoubtedly lead to the implementation of a Digital Intermodal Transport System in which ENAIRE's Digital Tower, as well as the entire ATM system, is called to play a key role.

Sweden - LFFV

The building for LFFV's new control centre for remote air traffic control, RTC Stockholm, situated nearby Stockholm Arlanda Airport is completed. Technology installations and other preparations for commissioning of RTS at four Swedish airports (Kiruna Airport, Umeå Airport, Åre Östersund Airport and Malmö Airport) are now underway in the world's largest control center



Credit: ENAIRE

for digital air traffic control.

At the same time we are working with operational development, education and preparations for our project Multiple which means the possibility for one ATCO to work with traffic at two or more airports simultaneously. In the future we will be looking for more airports to be established with RTS at RTC Stockholm.

Italy - ENAV

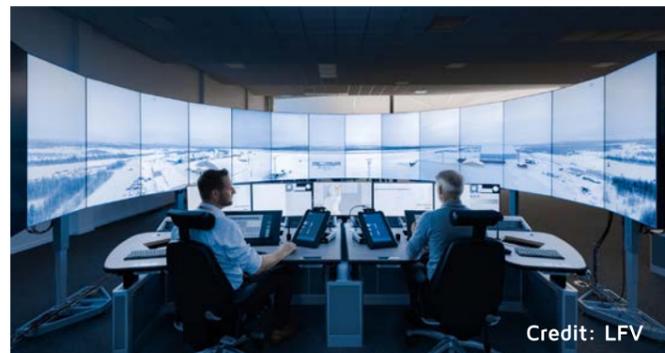
ENAV has been involved in the Remote Tower Concept since 2015. RACOON (Remote Airport Concept of Operation) - its first experience - was a SESAR Large Scale Demonstration project that proved, in a live operational environment, the technical and operational feasibility of the Remote Tower Concept. Milan Linate, the principal air operations area, was operated remotely through a specially developed Remote Tower Module (RTM) located at Milan Malpensa. The remote tower Controller Working Position was equipped with conventional ATS systems complemented by a reproduction of the "out-the-window" view based on high definition camera sensor systems. During the Linate live trial campaign more than 100 commercial flights were managed remotely by the RACOON platform.

The RACOON experience has paved the way for the implementation of the Remote Tower Service in Italy. Since completion of the project, ENAV has begun studies on the operational implementation of the Remote Control Service in some Italian airports.

Following this strategy, an operational Remote Tower Test Bed was installed at Brindisi airport with the aim of fine tuning the operational concept, testing and validating various technical solutions in a real operational environment. Through various program phases that define the software functionalities, the human-machine interface and the subsidiary system for the management of the flight plans and meteorological information, ENAV will be capable of implementing its first Remote Tower in the near future.

The Netherlands - LVNL

Starting in spring 2022, Air Traffic Control the Netherlands (LVNL) will provide air traffic control for the regional airports of Maastricht Aachen Airport and Groningen Airport Eelde from its head office at Amsterdam Airport Schiphol. Remote tower



Credit: LFFV



Credit: ENAV

technology will be used for these operations. LVNL is taking this step in order to continue providing these airports with efficient and innovative services in the years to come. The ambition is to develop a digital remote tower unit that offers room for multiple towers and digital developments. By applying this innovation, LVNL is creating added value for their service at these regional airports as well as for the national and international aviation sector.

Poland - PANSA

"Tower Digitalization Programme at PANSA aims at delivering the latest technologies to the air traffic control towers. It follows the service virtualization as well as data service provision concepts that utilize commercial products and R&D. The heart of the Programme has already been delivered: the EFES system which builds environment for tower data



Credit: Wout Peterse

processing, supporting network functions countrywide. It is followed by ongoing design and project works on the first remote tower system that shall be launched in 2021.

The remote tower system has recently been revised to grow into a wider concept that includes both delivery of rTWR for existing airport as well as delivery of back-up rTWR for Solidarity Transportation Hub.

In parallel there are ongoing works in R&D: PANSA and its Partners are actively working on camera-module-based surveillance as well as tools for multiple rTWRs (in the framework of the SESAR 2020 Programme)."

Australia - Airservices Australia

Airservices Australia worked with Searidge Technologies late in 2019 and 2020 to develop a digital aerodrome service proof of concept for Sydney's Kingsford Smith Airport.

The proof of concept system was established to demonstrate the Ultra High Definition (UHD) visual reproduction of the 'out the window view' using digital cameras, supporting engagement with controllers and other stakeholders to facilitate on the potential and benefits of digital aerodrome services.

Demonstrations were conducted Feb-March 2020 with positive feedback received from stakeholders, who were able to visualise the possibilities for greater resilience and responsiveness to service level requirements. This input aligns with Airservices direction to optimise our future service delivery and improve safety outcomes for the industry and travelling public.

Airservices is now incorporating this technology as part of its future roadmap and planning for the project in 2021 as the aviation industry recovers from COVID-19 impacts.

Iceland – ISAVIA

The Icelandic Air Navigation Service Provider (ANSP), Isavia, and Frequentis formed a technology partnership in 2017 to investigate suitable remote tower camera and casing solutions that would be effective in Icelandic weather conditions. The ongoing partnership is analysing the benefits this solution will have for isolated airports, by enabling ATS to be carried out from a centrally located facility.

Isavia and Frequentis partnership for remote tower solution provided a learning curve for both companies to better understand the challenges related to weather, infrastructure and isolated airports. The partnership focused on cost effective implementation using infrastructure on-site. The concept is a game changer in terms of how isolated airports will be controlled remotely in the future.

Remote tower tests and validations around the world have already shown the decreased cost and increased safety benefits. By mounting high definition cameras and communication technology at the airport and feeding information back to screens at a remote facility it is no longer necessary to build and maintain costly concrete towers. In regions where smaller, low traffic volume airfields are at risk of closure, the remote tower concept allows ATC operations to be located at an easily accessible site, reducing the level of onsite staffing required. Isavia manages one of the largest airspaces in the world from the North Pole almost to Scotland, and from the Greenwich Meridian in the East to west of Greenland. Iceland's glacial landscape and icy temperatures, especially in the North of the country will require camera technology and casings that will protect the equipment and its performance despite climate challenges.

The video feed from Akureyri is transported using the Isavia owned redundant core network to Egilsstaðir where the Working Position is located.

Isavia's plan was to run Shadow Mode Validation beginning of 2021 but the plan has been postponed due to COVID-19 outbreak.



Credit: Isavia

Germany – DFS

Two years ago, in December 2018, DFS started remote tower control (RTC) operations at Saarbrücken International Airport. Since then, air traffic controllers have controlled over 22,000 flights safely from the company's Remote Tower Control Centre in Leipzig, located 450 km away. Passengers have travelled safely to various destinations in Europe, ranging from Tenerife to Antalya, as well as further abroad to Egypt.

Saarbrücken Airport is currently the largest airport in the world operating in regular RTC operations. This applies to both flight movements and passenger numbers.

The usual ATC systems are complemented by the out-of-the-window view. An advanced camera system with high-definition video and infrared cameras delivers a permanent 360-degree view of the airport. The controllers can adjust the view between 190 and 360 degrees to the traffic situation and switch between full high definition (HD) and infrared views. In addition, the system can automatically detect movements and highlight up to 256 objects in parallel. Complementary pan-tilt-zoom cameras can track objects and work like automatic binoculars. High-performance sensors mean the system can deliver safe and efficient operations in both good and adverse visual meteorological conditions.

DFS is currently working on adding Erfurt Airport to the RTC Centre in Leipzig, which will be connected in 2021, followed by Dresden Airport. First functional acceptance tests were conducted in October. The site acceptance test is to follow soon. These additions will enable DFS to exploit the full potential of RTC and increase efficiency.

In addition, DFS, and technology provider Frequentis have set up a joint venture, [Frequentis DFS Aerosense -insert hyperlink to page 14 DFS Frequentis Aerosens advertorial] , to provide consulting and development of remote tower concepts and systems to other organisations.

Hungary – HungaroControl

As the world's first to deploy a fully capable remote tower for a medium sized airport in 2015, HungaroControl's remote tower services provide a cost-effective digital alternative to conventional tower operations, enabling a refocus on delivering valued services to customers.



Credit: DFS

Facing the constraints and operational service impacts of ageing tower infrastructure, HungaroControl implemented its remote tower 3 years ago to build a resilient contingency capability to safely and efficiently serve the 14 million passengers that transit Budapest every year. In partnership with its integration and technology partners, HungaroControl coupled advanced technology with a coordinated and people-focussed implementation program to successfully digitise tower operations in Budapest.

Csaba Gergely, senior ATM adviser and remote tower technology expert said: "While a conventional tower is a single point of service provision, a remote tower can offer a second full-scale solution that is independent and separated from the physical tower. This assures business continuity and resilience."

Since the first days of this COVID-19 crisis, HungaroControl – the Hungarian ANSP – has been actively working on an operational response to tackle the challenges brought on by the pandemic. The foundation of an effective response has been the innovative technologies and processes that HungaroControl has implemented over the last few years. Our operational response during the pandemic centres on the remote tower at Liszt Ferenc International Airport, which has been in operation since 2017. We have also physically separated our tower controllers who operate on 12 hour shifts. The nightshift works from our physical tower at Budapest Airport and the dayshift from our remote tower at HungaroControl's head office. After each shift, a complete decontamination is carried out and we made sure the two groups do not meet each other. This made sure that tower operations can be performed even in the harshest pandemic situations.

HungaroControl's remote tower is a precedential use-case for this technology's application beyond small airports and low complexity operating environments, demonstrating how this technology can be extended to serve medium-sized airports and some of the world's largest hubs. More importantly though, the remote tower is fulfilling its true use-case not only as a contingency facility but as a second full-capacity location for service provision as a line-of-defence against the COVID-19 pandemic.



Credit: HungaroControl



Credit: HungaroControl



Credit: HungaroControl



United Kingdom – Cranfield University
Cranfield Digital Tower project.

In summer 2017 Cranfield University, as part of the DARTeC project, embarked on an ambitious partnership with SAAB (Pre SDATS) to procure, install and commission at SAAAB Remote Tower, replacing the old pre-war Control Tower. The time line was deliberately aggressive to ensure Cranfield delivered the whole project to first operation in a year. The concept was to provide a cutting edge ATS facility which gave the global ATM market an environment of innovation in real and simulated context. Due to lack of UK regulation and policy at the time, Cranfield, SAAB and the CAA worked collaboratively on ensuring safe implementation. Physical works started February 2018 with the camera system installation May. The tower facilities including new voice switch and ancillaries were commissioned and the Tower went live, opened by Baroness Sugg December 13th 2018 on the exact day agreed in the initial project schedule.

The tower has undergone 2 years of operations and validations as the whole operation moved from convention to remote delivery. In being one of the first to engage in this innovation, Cranfield Airport was fulfilling one of its prime strategic goals, supporting the aviation community in understanding and driving change. The tower continues to operate on a day to day basis as any other 'normal' tower but has also been used for research support including proof of concept of airport UAS integration as part of the National Beyond Visual Line of Sight Corridor (NBEC), UAS Airport survey and even the first hydrogen commercial aircraft flight. Future development of further integration and exploitation of the live and simulated world to investigate AI support to airport operations, safe integration of UAS and many other opportunities, some covered in the Future Flight program, means Cranfield Digital Air Traffic Centre where the remote tower resides has an exciting future challenging norms and encouraging innovation.

United Kingdom – NATS

We have seen airports do some pioneering work introducing remote digital towers and I think we will continue to see successful examples of that. But to me the full transformative power of digital tower technology lies in using it to augment and improve an existing operation. That is what we've been working on with Searidge Technologies over the past 3 years. You can see a taste of that in the work we've been doing at Heathrow, using cameras and Artificial Intelligence (AI) to tackle specific operational constraints.

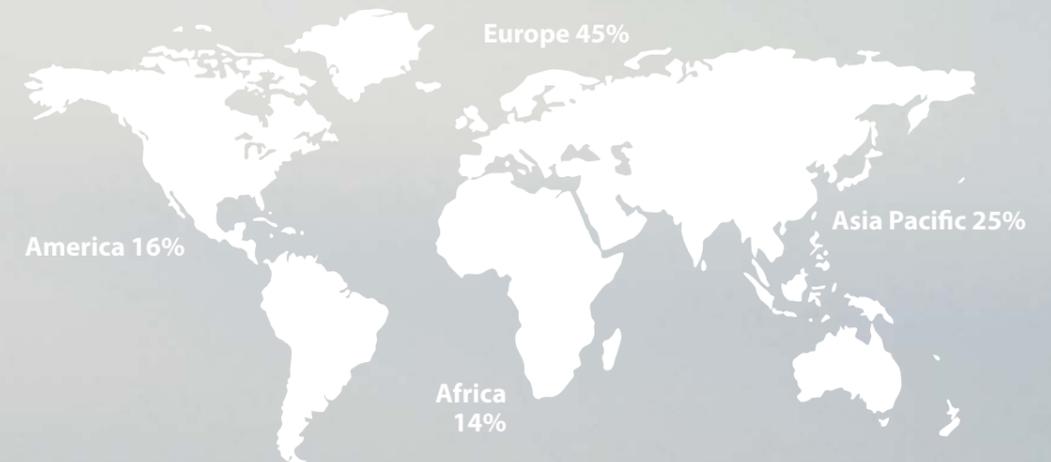
We're also working with customers who are particularly interested in deploying hybrid solutions – where an existing conventional control tower is supplied with digital tower video feed to each workstation – which provides immediate benefits of enhanced views of key parts of the operation, specific to each controller, and enables a more rapid deployment route for the additional supporting technology, including AI based applications.

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