



KONGSBERG

KONGSBERG REMOTE TOWERS



Worldwide Operations

For more than 200 years, KONGSBERG has been an industry leader developing world class products, always adapting in order to shape the future.

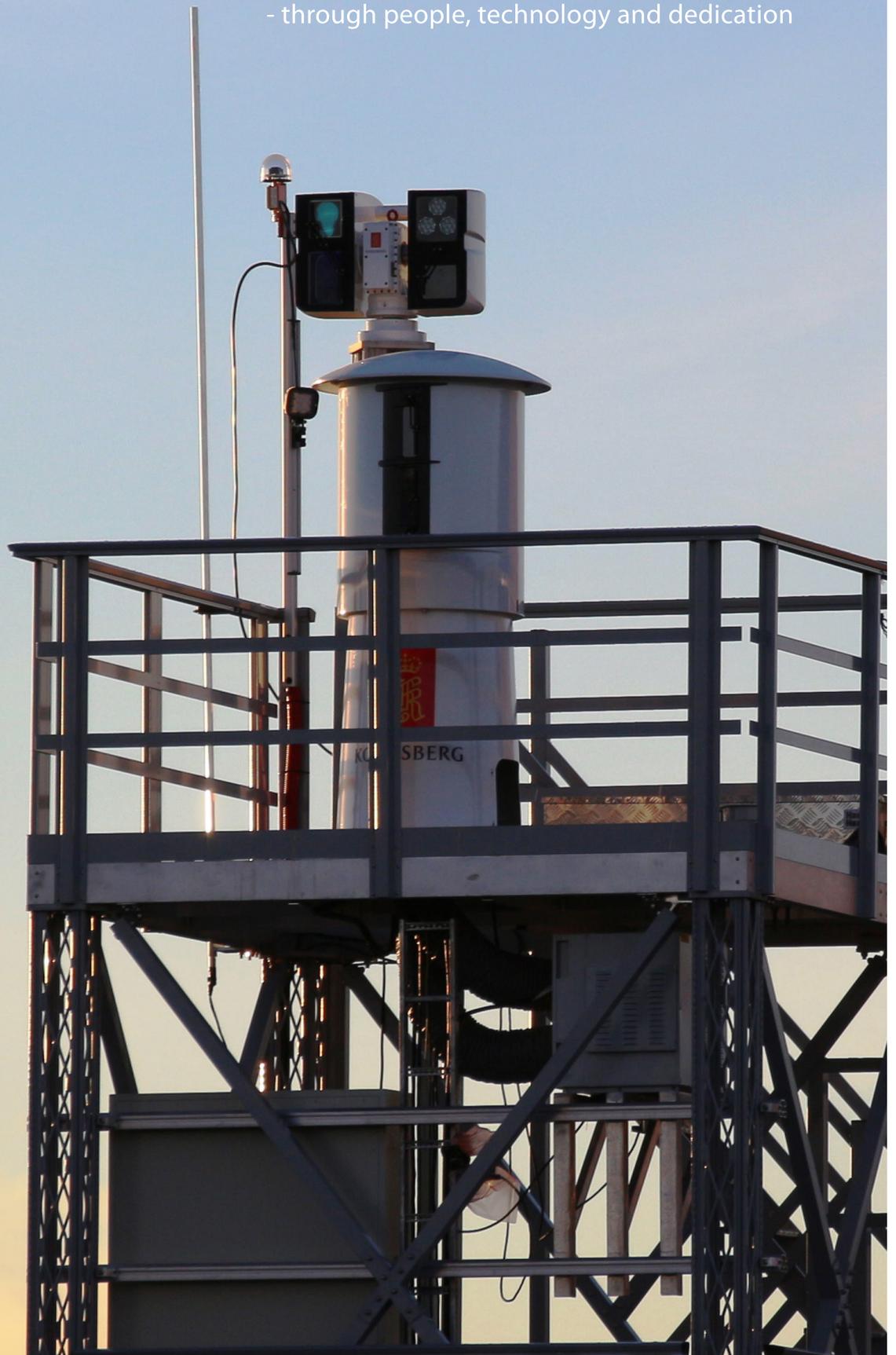
Based on our proud history and centuries of innovation, KONGSBERG has delivered strategic competence and products to our partners. Collaboration with our global customers, partners and suppliers is essential in our success as is developing a clear understanding of our end users and the operational environment where they use our technologies. These factors are driving forces behind the corporation's international success.

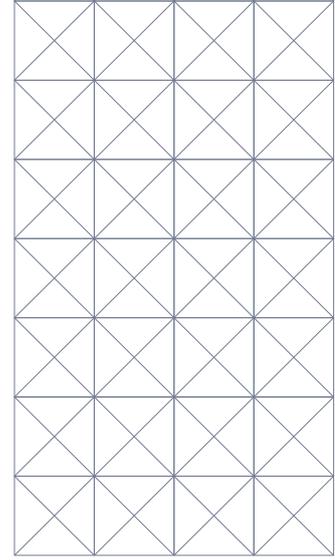
Support in the Extreme

KONGSBERG contributes to improved safety, security and performance in demanding and complex missions. We achieve this through an in-depth knowledge of our customer's objectives and the needs of the operator, and by meeting their challenges with the right systems, services and technological solutions.

WORLD CLASS

- through people, technology and dedication

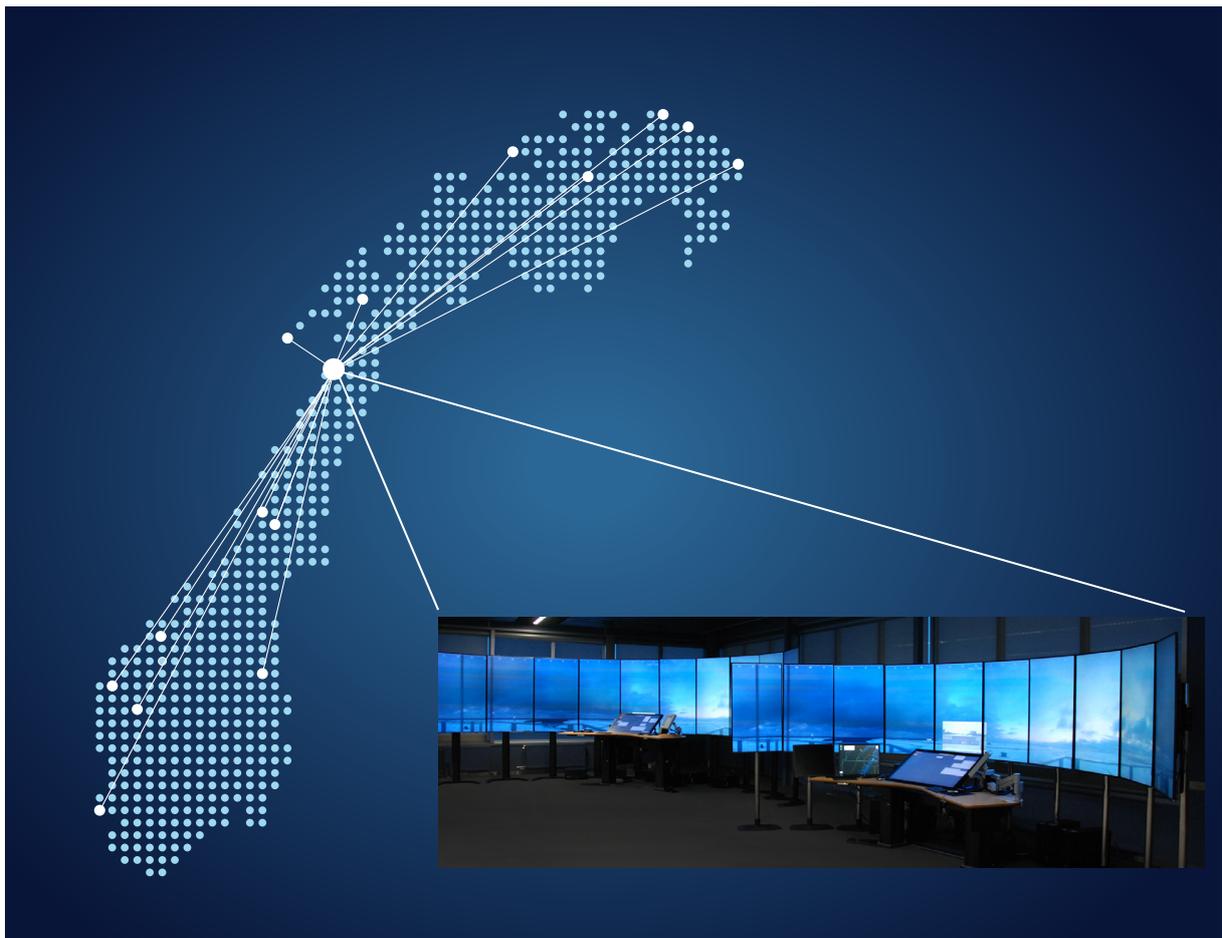




KONGSBERG Remote Towers - the unique solution

The KONGSBERG Remote Towers (RT) is the solution for all future remote tower related operations; virtual, contingency and remotely controlled towers.

The KONGSBERG Remote Towers contributes to Avinor's NINOX program - the world's largest RTS program. More than 36 sites in Norway is designated for Remote Tower Systems, starting implementing 15 airports in one control center. NINOX is a partnership between Avinor, Indra Navia and Kongsberg Defence Systems.



Total Cost of Ownership - a system lifetime

Maintenance and technical footprint

The KONGSBERG Remote Towers has well-proven technical equipment with a low technical footprint, included HW redundancy, which contributes to low maintenance cost.

Bandwidth and media hiring cost

The cost of redundant networks with the required quality of service and latency can be very high. The KONGSBERG Remote Towers has low network bandwidth requirements, without compromising image quality. Network bandwidth is a concern to many users.

Scalability

The KONGSBERG Remote Towers is scalable to support at least, but not limited to, 15 airports in Avinor's Program from one Remote Tower Centre.

The KONGSBERG Remote Towers is designed with an infrastructure supporting both single- and multi-mode capabilities. This gives the cost benefit of running several airports from one controller position, either sequential or simultaneously.

When operating low-traffic aerodromes, it may be a considerable advantage to be able to operate multiple aerodromes at the same time from the same RTM. The system supports the allocation of one, two or three aerodromes to the same RTM simultaneously.

The operator may add and remove aerodromes from the RTM at his discretion without disturbing the operation of the other aerodromes being operating, or other RTMs in the RTC.

Team expertise – Implementing remote towers

By using the team expertise, the customer will save time and cost running and implementing Remote Towers. Through our large-scale program delivered in Norway, we have gained valuable experience in the design, construction and preparation of Remote Tower control facilities.

As a customer, you will most likely have a wide range of questions. With our documentation, experience and expertise, we will provide the answers and come forward with a design proposal for your Remote Tower facility to identify a cost effective and functional solution, specifically tailored to your needs and requirements. We work closely with the ANSPs to design the most optimal solution needed.



Day cameras and infrared sensors - extreme performance

The KONGSBERG Remote Towers camera sensors provide extreme high resolution, capable of capturing details at the accuracy of the human eye, and sometimes even better with use of its advanced features such as the optional IR camera add-on. The Electro-Optical Sensor Suite (EOSS) consists of a 360° Camera System and a Pan Tilt Platform.

360° Camera System

The KONGSBERG 360° Camera System has a design that enables necessary decisions for separating aircraft and objects, without any additional surveillance systems – as for an operator in a traditional ATC Tower.

The KONGSBERG 360° Camera system:

- VIS 360 - 60° vertical FoV (- 10° to +50°)
- IR 360 - 18° vertical FoV, steerable in elevation



The performance and visual acuity of the VIS 360° camera are equivalent to 20/20 vision. Camera's resolution is 0.28 mrad meaning that an object of 28 cm in size is visible for the operator when it is at a range of 1 km from the camera sensor.

VIS and IR camera fusion has a perfect alignment of both IR and VIS image and gives the controller a higher possibility to detect unwanted objects during day-time.

5 Hz rotation attracts the ATCOs attention easier, the ability detect if an object is moving or is stopped, e.g. at stopbars and holding positions. It prevents any snow, rain or other debris sticking to the glass.

No studies have discovered any negative results for 5Hz rotation, neither on visual detection performance or physiological stress

Pan Tilt Platform (PTP)

The integrated display of the PTP gives controllers an exceptionally clear picture of airport operations: aircraft markings and landing gear are clearly visible – even in low light and bad weather conditions.

The KONGSBERG Pan Tilt Platform:

- Pan Tilt Zoom camera (PTZ)
- Pan Tilt Infrared camera (PTIR)
- Laser Range Finder (LRF)
- Signal Light Gun (SLG)



The PTP enables:

- Video tracking
- Automatically follow an ARTAS/radar track
- Automatically follow a selected MTI
- Manually follow any object by using a joystick



Full Eye Resolution

- what do you need to see?

Situational awareness of moving targets is a function of target detection capability and framerate, i.e. understanding where the target is and what it is going to do with a certain degree of confidence.

In the development of the visual sensor, KONGSBERG has taken a strategic choice regarding the resolution; ICAO DOC 8984 states requirement for eyesight of an Air Traffic Control Officer (ATCO):

“Visual acuity shall be 6/6 or better” – which is the same as “20/20 vision”.

The camera sensor, as well as the presentation monitors have the same resolution as the human eye - to maintain the out-of-the-window view.

Choosing a lower resolution value could result in the need for surveillance and/or other mitigating means for the operator. Will additional mitigating means be as good as the human eye to discover hazards, e.g. non-cooperative traffic/objects?

Color depth is essential for general situational awareness and specific understanding of navigation light position/ aircraft orientation, and color information would need to be above a certain threshold. The KONGSBERG Remote Towers has color depth of 12 bit/pixel. The compression and decompression process shall not reduce visual acuity below 1.0.



How early do you detect an approaching aircraft or how to see an aircraft leaving the aerodrome longer?

How well do you discover a flock of birds or drones over the runway?

Visual overlays and augmentation

To ensure that the ATC operator has complete overview of the remotely operated airspace, the KONGSBERG Remote Towers provides several means of situational awareness aids.

With the need to present out the window view electronically, there is also a great opportunity to embed augmented information that even further enhances the flight controller's situational awareness. This addition enhances the Operator's ability to identify these objects in harsh weather condition and poor light scenarios.

Meteorological Data

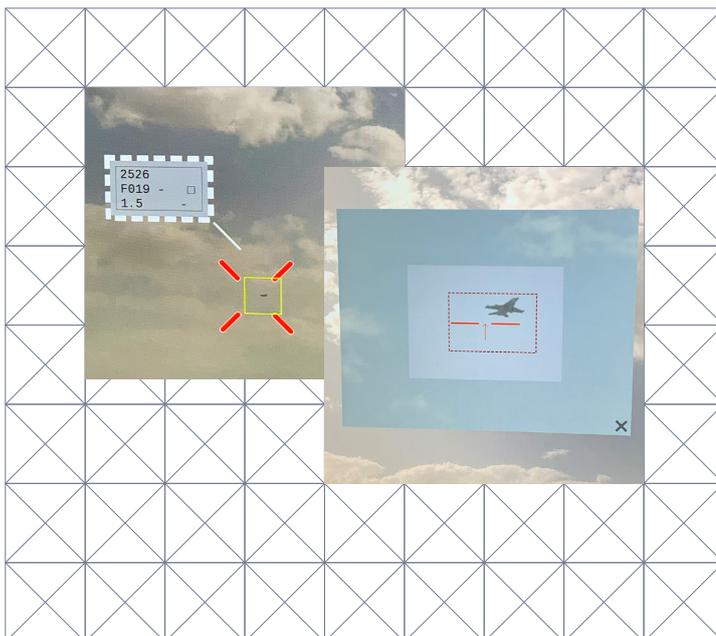
Weather elements such as wind directions, cloud information or other customizations requested by the customer. This information can be presented at any place on the HUD screens.

Masking of areas

It is possible to mask out areas that either act as a disturbance to the operator or for other reasons not interested for the controller.

Alerts

To enable the operator even greater control of the aerodrome, the system can be enhanced to visually or audibly alert the controller of any changes regarding movements at the aerodrome.



PTZ View

A small picture-in-picture window is displayed when using the Pan- Tilt-Zoom and Laser Range Finder functionalities. This window can be displayed on a fixed place on HUD, or moving automatically when tracking an object.

Track Labels

Relevant surveillance and flight information data from the HDD/ATM system are integrated, if available. These track data can be displayed at the corresponding visual objects, even when the object may not be visible due to natural conditions (out of range, behind objects etc.)

Moving Target Indicators (MTI)

To assist the operator in the tasks of identifying relevant movements, MTIs may be added to objects that the system detects as moving. These MTIs reduce the operator's mental strain in detecting and following which object are moving/and/or when they start to move.



IR Hot Spot Detection

It is possible to detect thermal hot-spots using the IR-360 camera. Objects with a higher intensity than a defined threshold will be reported as hot-spots. The level of the threshold will be adjustable by the user. The hot-spots will only be reported for a region of interest at ground level. The region of interest must be defined for each airport as part of the setup procedure

3D Overlays

To increase visual orientation in certain situations like low visibility, odd light conditions or simply user preferences. 3D overlays like compass rose, terrain contours, approach funnel, runway and specific points of interest e.g. altitude and distance.



Electronic Curtain

A built-in electronic curtain, i.e. an area surrounding the sun - adjustable in size, position and transparency. The adjustable area can automatically follow the position of the sun.

The system has an inherent mitigation to deal with counter light. In cases of direct sunlight into the camera, the sensors are only affected in the small azimuth sector covered by the sun. This is opposed to conventional standard HD camera systems, where the complete image from the camera covering the sun is usually saturated or blurred.

Airport Sound

In order to increase situational awareness the environmental sound from the airport is provided to the air traffic controller via a loudspeaker. The user will have the ability to turn the sound off or adjust the volume.

Flexibility – a key capability

The KONGSBERG Remote Towers offers a unique flexibility through scalability and Service oriented Architecture (SoA) and DDS.

Scalability

– from small to large airports

The KONGSBERG Remote Towers has a design being able to tailor the user interfaces and work with local suppliers to ensure full compatibility with systems already in place.

The KONGSBERG Remote Towers has a Heads-Down Display (HDD), may include the integration and control of airport lighting, airport environmental conditions, electronic flight strips system, airport and terminal sensors and radars and other components very easy.

The customer may keep existing systems in our solution, e.g. such as existing flight strip system or radar display systems. This integration may be a full integration into one heads down display, or as separate displays.

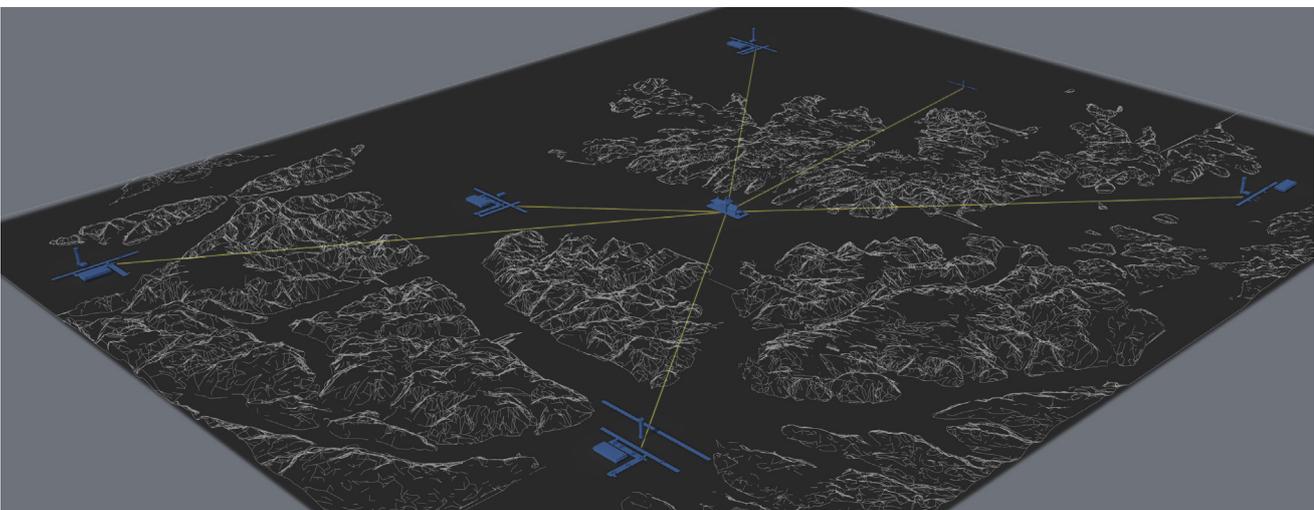
Service Oriented Architecture (SoA) and DDS

– prepared for SWIM

The KONGSBERG Remote Towers has an open architecture that is flexible and adaptable to future needs and enhancements.

To ensure a well-structured and loosely coupled architecture allowing for future development, the RTS software has a Service Oriented Architecture (SOA) with the open international Data Distribution Service (DDS) standard from the Object Management Group (OMG). DDS is specifically designed for use in mission critical real-time systems such as the RTS. This includes the integration of new systems within RTS and for an integration of systems external to RTS.

SOA and DDS are keywords in the future Eurocontrol ATM Interoperability Infrastructure SWIM (System Wide Information Management).



KONGSBERG Remote Towers facilitates addition of new systems, airports and data exchange through SoA and DDS.

KONGSBERG Remote Towers

- values

Total Cost of Ownership through:

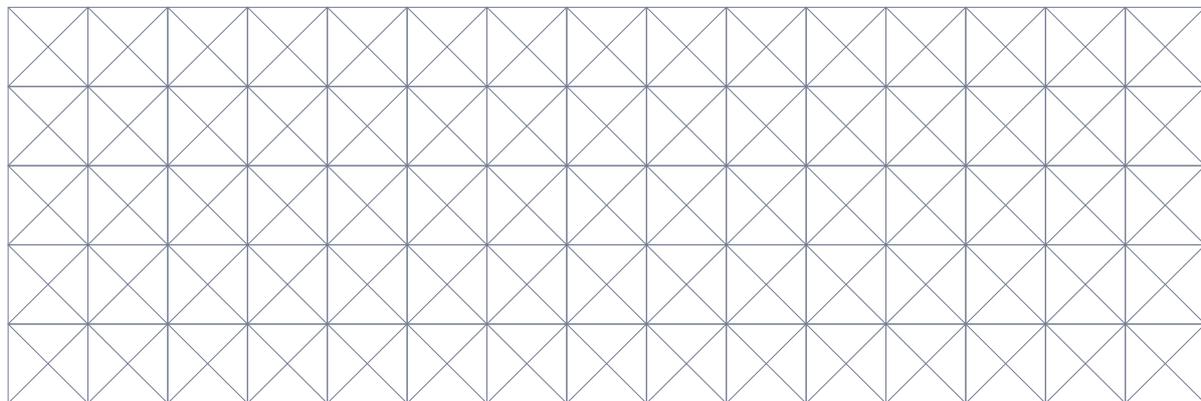
- Low bandwidth requirements and media hiring cost
- Low technical footprint and maintenance cost
- Scalability (#RTMs and Multimode capability)
- Team Expertise (ATM, System Integration, Project planning, Implementation and Safety)

Increased safety and situational awareness through:

- Full Eye Resolution (Visual Acuity 1.0) and 5 fps
- Day cameras and Infrared Sensors
- IR fusion with day camera image
- Seamless panoramic image (Field of View: 360° horizontal and 60° vertical)
- Augmented Reality

Flexibility through:

- Scalability (from small to large airports)
- Service Oriented Architecture (SoA) and DDS. The system architecture is modular and scalable, thereby permitting additional functionality to be provided by adding hardware and/or software modules to a basic system, at the same time as providing excellent availability .





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