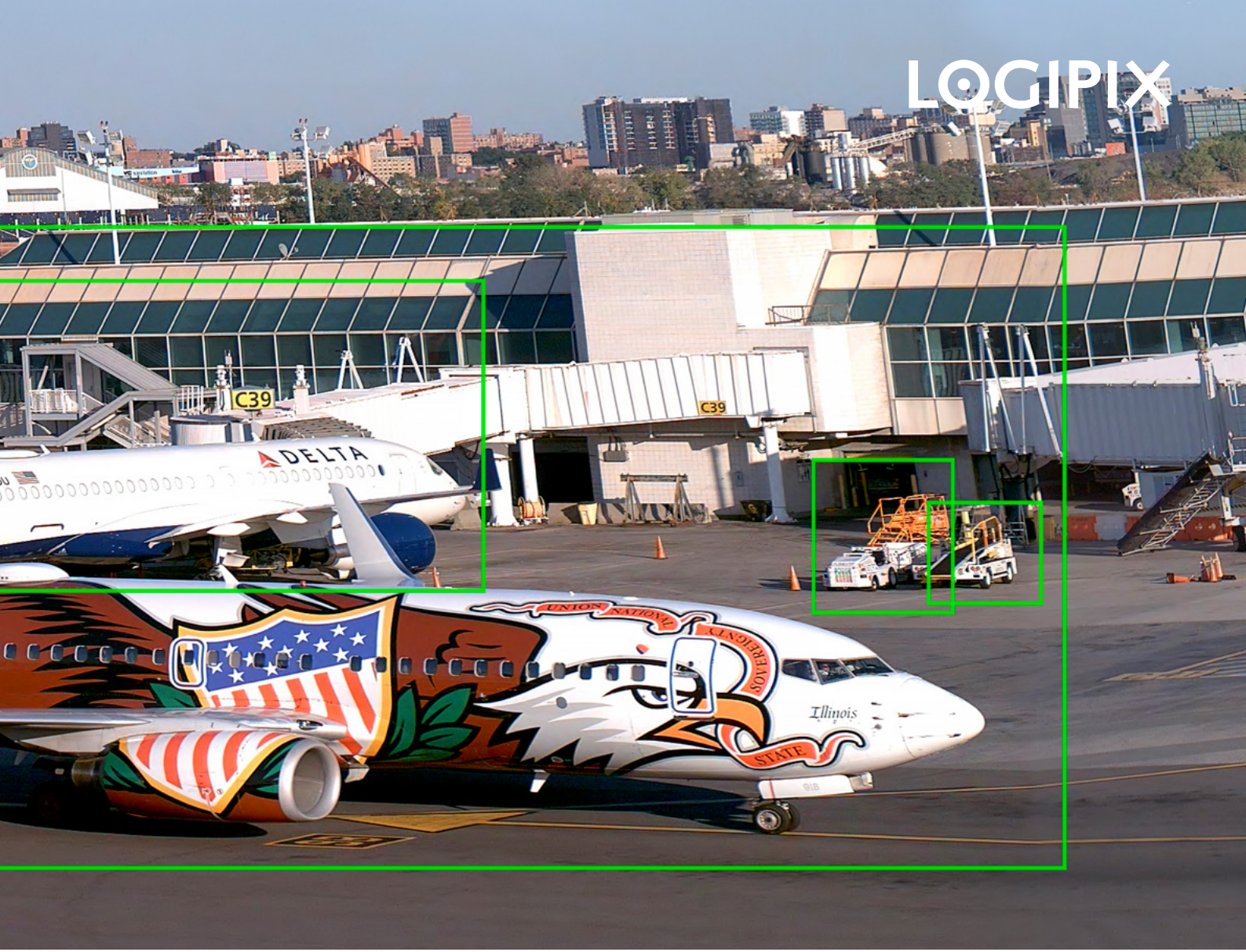
LOGIPIX



AIRSIDE AUGMENTED REALITY SOLUTION

ALL IMAGES IN THIS BROCHURE WERE TAKEN BY LOGIPIX CAMERAS

www.logipix.com

AIRSIDE OPERATIONAL CHALLENGES

The new decade brought many changes in aviation's routines and processes. The forced shutdown caused the most difficult times for airports in history and the restart wasn't an easy takeoff either. Now the industry faces pressing new requirements to preserve health and safety, which directly impact efficiency.

Airports operate just like complex ecosystems. Even if one part changes, it affects the whole. To avoid costly delays, in addition to protecting people and assets, it has been never more important to maintain a smooth operation across the airport – including the airside. Airports need to get ready for smart operations and prepare to maintain efficient control under difficult circumstances, even with less employees.

In order to help rebuild airports in this new era, Logipix created LAARS. The system is an intelligent video monitoring solution specifically developed for the airside. It can greatly enhance security and improve efficiencies across all ground operation functions. The system helps improve operational capabilities and capacities, which includes optimizing ground operation efficiency, improving safety parameters and enhancing vision for overall observation.

AIRSIDE AUGMENTED REALITY SOLUTION

LAARS fuses various technologies. The solution is a high-end video monitoring system with AI-based computer vision and augmented reality functions and it also integrates existing airport information sources.

It monitors the entire airside with enormous resolution. LAARS automatically detects, classifies and tracks both cooperative and non-cooperative objects and guides the attention of operators to handle ground processes more efficiently. It augments the high-resolution video streams with informative graphical and textual elements, which help faster and better understand the view. The solution also helps prevent incidents by predicting certain proximity situations and automatically detecting various operational irregularities and FOD.

YOU NEED OUR SYSTEM, IF YOU WOULD LIKE TO...

- improve overall airside efficiency by monitoring and automatically analyzing object movements and ground processes
- enhance airside visibility for ground controllers, airfield controllers, security operators and for any airside operation department
- optimize ground process management and explore operational bottlenecks by bringing Artificial Intelligence and Computer Vision Technologies into airside monitoring
- increase safety of passengers, employees and assets at the airside
- enforce airside traffic rules without extra burden on operators
- realize access control for different types of objects at designated airside zones, using image sensors and Video Content Analysis
- create airside statistics on area occupancy based on automatically collected data
- make billing procedures fast, easy and accurate by automatically calculating the time that airplanes spend on the airport
- increase situational awareness to reduce the number of incidents on the airside
- significantly reduce the risk of incidents caused by FOD, using automatic detection methods
- facilitate incident investigation and get irrefutable visual evidence in already occurred cases
- optimize turnaround times and create useful statistics on ground handling efficiency

FINANCIAL BENEFITS

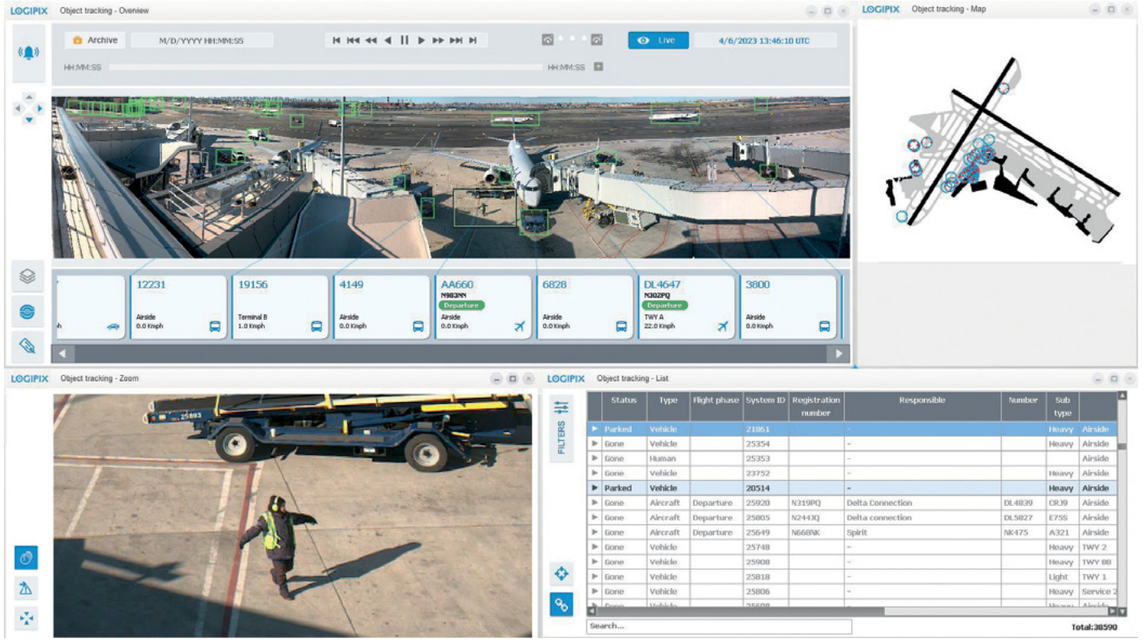
- **Supporting strategical decisions**
  The system supports both short-term and long-term strategical decisions by providing information on aircraft movements and turnaround processes.
- **Optimizing area occupancy**
  Utilizing the VCA, various airside statistics and calculations can be created on area occupancy, which helps realize explicit business benefits.
- **Avoiding financial loss by preventing accidents**
  LAARS provides computer vision technologies to prevent various incidents, which helps avoid significant financial loss.
- **Undoubted visual evidence of all recorded situations**
  Using the high-resolution footage, any situation can be investigated to details. Hundreds of megapixels and fine details provide an undoubted evidence on demand.
- **Significantly less cameras are needed**
  Logipix is a cost effective system. As only a few cameras are needed to cover an entire airport, installation and maintenance costs can be kept strikingly low.
- **No need for frequent maintenance using human resources**
  Logipix hardware components are capable of self-maintenance, thanks to their built-in self-cleaning and deicing systems.
- **Adaptable system structure**
  We always consider the specific structure and characteristics of airports to best adapt the system for the current project. Moreover, LAARS has a flexible hardware structure that can be easily rearranged in case of future airside developments.
- **Designed for long long-term**
  Our engineers developed leading-edge technologies that ensure the system avoids both physical and technological obsolescence for a long time.
- **Maximized system uptime**
  Logipix provides uninterrupted system availability as all their components are developed to operate with high MTBF.

SAFETY AND OPERATIONAL EFFICIENCY BENEFITS

- **Increased safety by providing vision far beyond human eye capabilities**
  Logipix provides the full coverage of the airside. 200, 300 and 320 MP panoramic video streams create a solid visual base for controllers to ensure operational safety of aircraft, ground vehicles and also ensure the security of employees and passengers.
- **Increased operational efficiency**
  The solution makes it possible to manage ground processes at a higher, Video Content Analysis (VCA) assisted level and therefore increase safety and overall operational efficiency at the airside.
- **Real-time Decision Making Support**
  LAARS is an RTDMS system that always highlights the most relevant information on screen.
- **Less FODs in the AOA area**
  The system automatically detects FOD and manages the entire securing and removal procedure.
- **Increased situational awareness**
  LAARS helps prevent incidents and unauthorized access into restricted areas.
- **Customizable traffic enforcement**
  LAARS has the potential to decrease the number of traffic violations and this way it can ensure health and safety of air crews, employees and passengers.
- **Automatic LND and TOF registration**
  LAARS automatically registers landings and take-offs and also the time that airplanes spend on the airside.
- **Secured perimeter area**
  The system provides advanced, VCA based perimeter monitoring, and it is also able to integrate third-party PIDS and use its alerts as triggers for automatic zoom functions.

WHAT DIFFERS US FROM OTHERS

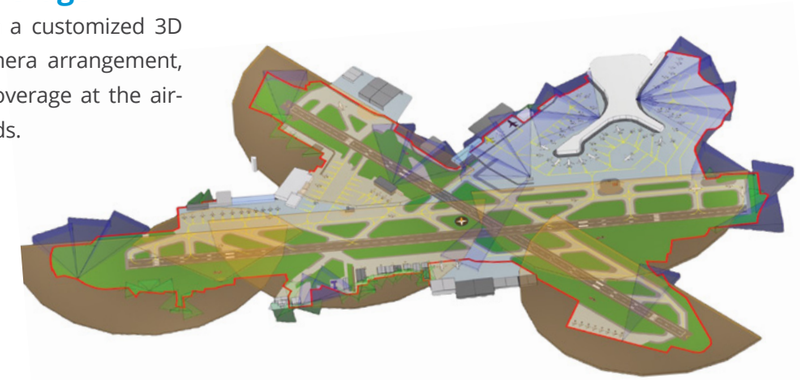
- Logipix developed a complex system focusing on the tasks that should be processed at the airside.
- Our system provides Video Content Analysis specially developed to track and register object movements, and prevent incidents that may occur at the airside.
- The software of the system have been developed specifically for the airside application area.
- LAARS is a Real-time Decision Making Support system. It helps operators and controllers better understand situations on the airside and faster react to them.
- Operators and controllers get various coherent visual and text information on aircraft, vehicles and ground processes watching a single user interface.
- Our end-to-end solution provides Artificial Intelligence assisted video monitoring, Augmented Reality supplemented visualization and also advanced Turnaround Management.
- Our system can be used by multiple airport departments simultaneously.
- Logipix is able to integrate existent Airport Systems, like Airport Operational Database, Radar Systems, Range Finders and positioning systems like ADS-B, MLAT and A-SMGCS. Using specially developed sensor fusion technology, it merges the data of Logipix visual and external sensors.
- LAARS is able to cover even the largest airside in high-resolution with only a few multi-sensor camera. It significantly reduces installation and maintenance costs and it also provides better spatial transparency in the displayed camera images.
- We developed a special technology to handle large visual data and utilize the full resolution during monitoring.
- Our intelligent Video Content Analysis runs on full resolution JPEG2000 image streams. Logipix VCA functions are developed for detecting and analyzing airside specific situations.
- LAARS provides long storage periods, thanks to its intelligent storage management technology.



DESIGNING YOUR PROJECT

3D model of visual coverage

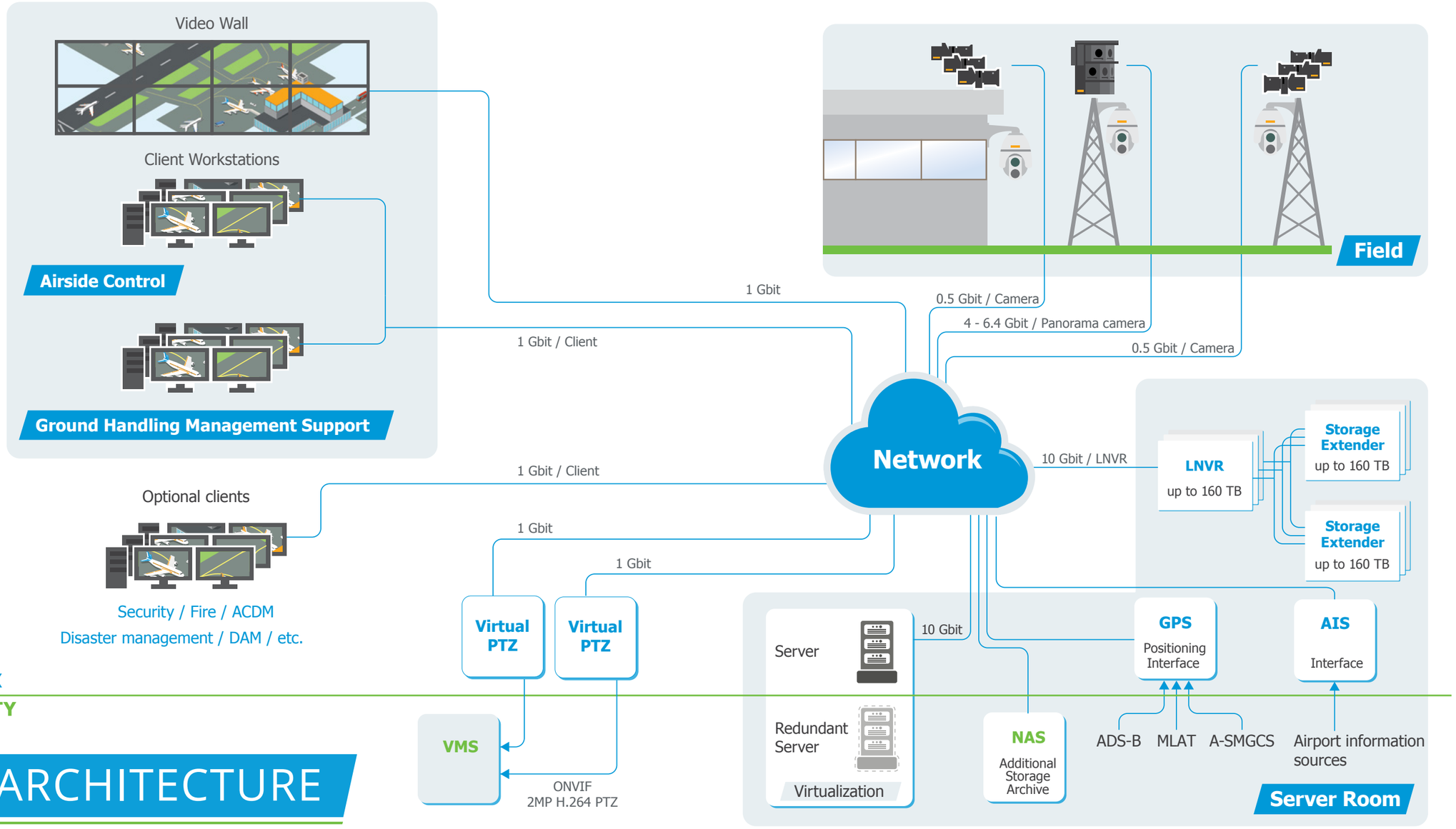
Logipix starts each project with a customized 3D plan, which helps optimize camera arrangement, the necessary resolution and coverage at the airside, according to customer needs.



System extension

Logipix solution is designed to be flexible for future developments. Both the covered areas and also system functionality can be extended easily on demand.

SYSTEM ARCHITECTURE



TECHNOLOGICAL DESCRIPTION

AIRSIDE COVERAGE AND VISUAL ENHANCEMENT

LAARS provides video monitoring with extreme high-resolution to observe everyday operations at the airside. These images can effectively supplement normal observation. Logipix image sensors, the panorama cameras provide vision at a much higher performance, than the human eye is capable of. These sensors constantly take images of the entire airside area with enormous resolution and the embedded intelligence continuously analyzes the view.

The entire airside can be covered using only a few panorama cameras. These cameras are interconnected and provide a comprehensive coverage. Within the covered area objects are tracked uninterruptedly, even when they move across multiple camera images.

Logipix Panorama Cameras deliver 200-320 MP video streams at up to 20 fps, which forms a revolutionary quality improvement in video monitoring. It means users can watch a continuous live stream and they can zoom in on any area of interest any time and get fine details even at far distances. In areas without artificial lighting, Logipix thermal image sensors deliver useful visual information.

Monitoring with Logipix Panorama Cameras

Even a single Logipix Panorama Camera is able to monitor a vast area. Watching large panoramic images, users have better spatial orientation within the observed area, as the space is not split by individual images on a confusing monitor profile.

The act of monitoring with high-resolution panoramic images in itself accelerates the process of getting relevant visual information. It is much faster to zoom in on the panoramic images than picking binoculars up and scanning the airside.

LAARS provides efficient monitoring under all occurring lighting conditions at the airport. Users can easily track airplane and ground vehicle movements throughout the airside even in bad weather conditions and also at night.

In areas that are not lit by artificial light, the Logipix Dual Vision Panorama Camera and the thermal panorama can be used, which has a thermal panorama extension with 6 MP resolution. The visible light and thermal sensor cluster observe the very same area, but they utilize different electromagnetic radiations to provide informative visual data in all circumstances.

Recording

The system continuously records the images and stores them in a fail-safe file system, distributed among many HDDs. In case of any negligence or accident the situation can be investigated by watching the footage in full resolution. As the video stream consists only intra-frame coded JPEG2000 images, any frame can serve as irrefutable visual evidence in critical situations.

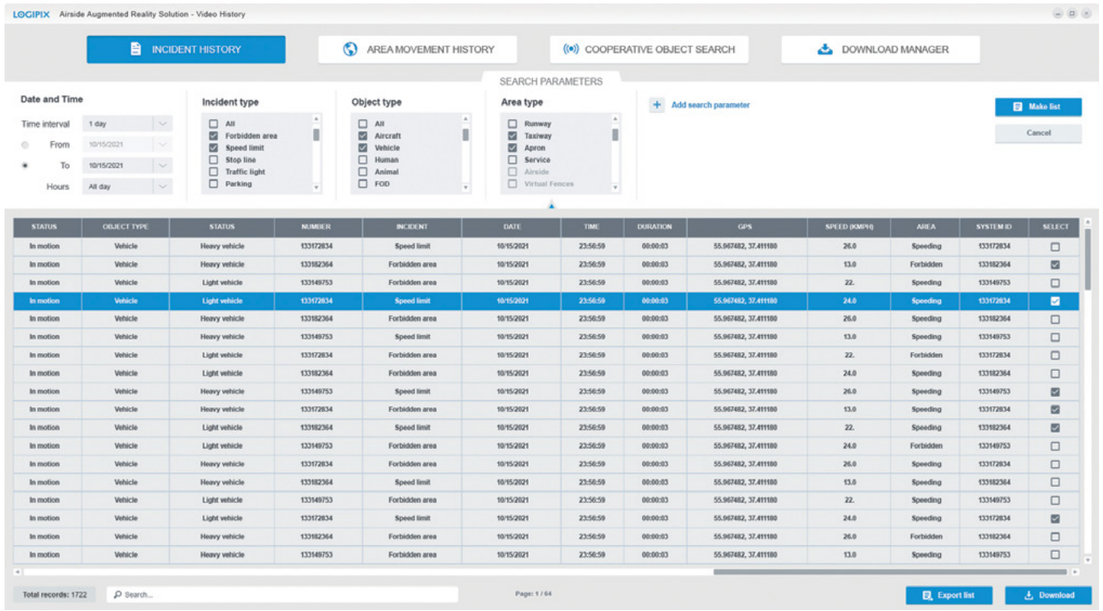
Online archive

In the LAARS software operators can search the archive during real-time monitoring if necessary. The archive search is not time based, instead operators search for objects and their registered movements and statuses to load the footage of interest.

Video history

LAARS provides fast archive search, based on the in-memory airside history database. The function allows to search for specific incidents, designated area movements and also for particular objects. In order to search effectively within this huge amount of information, multi-level filtering is available.
For instance, operators can filter for a specific violation type committed by a certain object class within a desired time period. They can also list certain object statuses concerning for specific areas, which contributes to create useful analyses.

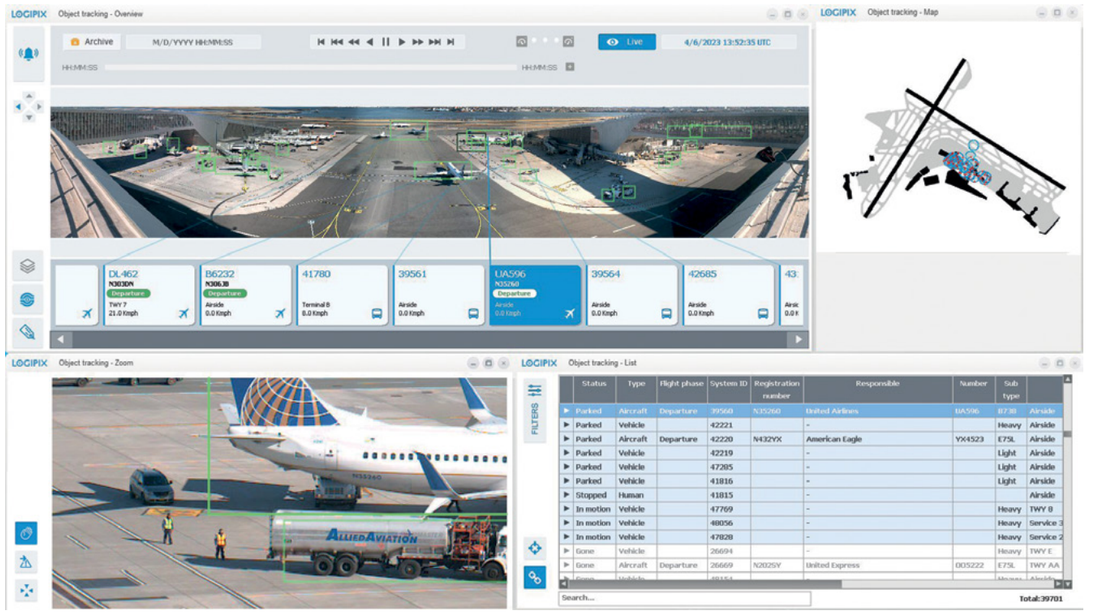
To provide an even more targeted example, operators can check all registered airplanes that moved on a selected taxiway within the time frame of interest. They get the exact number in no time, and they can get the visual confirmation on demand.
High-resolution videos are available for each list items, even from multiple camera angles. Selecting a list item, the program displays thumbnail images from all relevant cameras, therefore operators can download those videos that best fit their needs.



INTELLIGENT AIRSIDE CONTROL WITH AUGMENTED REALITY

Beyond recording and displaying video streams with enormous resolution, Logipix increases the efficiency of monitoring by providing numerous intelligent functions based on Video Content Analysis (VCA).
These functions can effectively aid operations at the airside, as they are able to automatically detect and even predict several incidents, furthermore they help optimize airside processes.

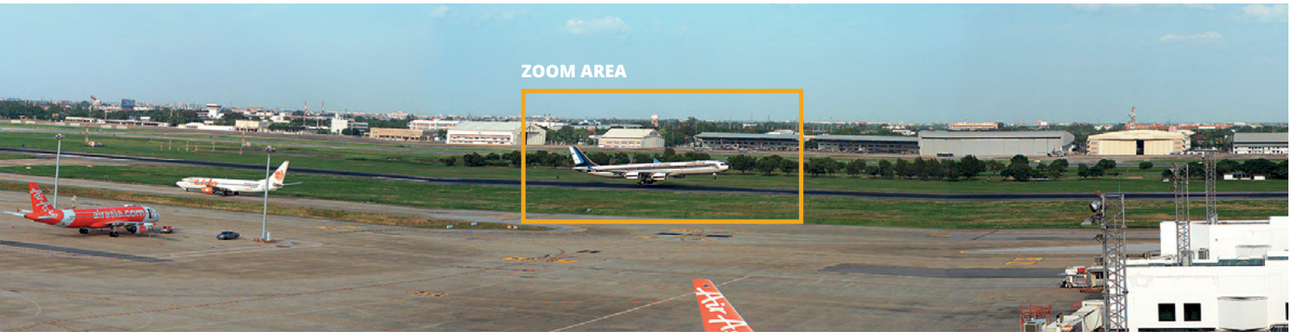
Automatically generated warnings and alerts guide the attention of operators and controllers. Real-time Decision Making Support (RTDMS) intelligently optimizes the front end visualization of all signals generated in the system. Based on operator intentions, it filters the large number of situations and highlights only the relevant ones.
This way operators and controllers can always focus on the most important situations occurring at the airside. This function results in better situational awareness during airside operations and it also helps prevent incidents.



Landing and take-off

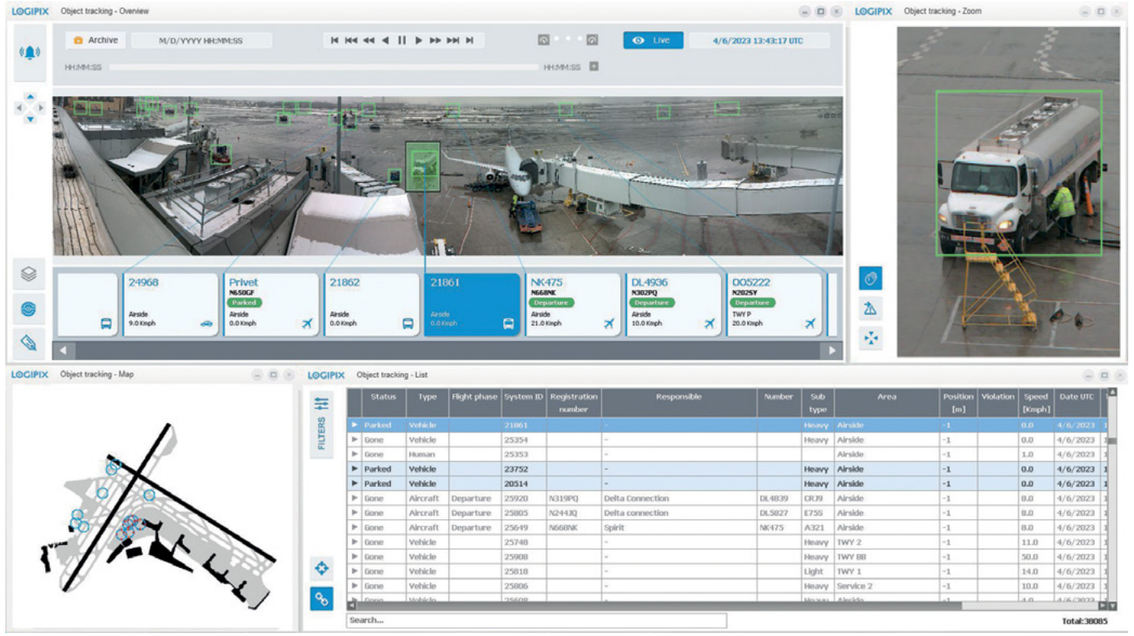
The solution detects the moment of landings and take-offs with great precision. The module automatically detects and registers the very moment when aircraft wheels touch or leave the runway. It also saves evidence images with time codes in the image header. It compiles detailed reports, which can be later reviewed fast and easy.

In case Logipix receives transponder data, the system automatically calculates the exact time that airplanes spend at the airport. This function significantly simplifies billing procedures.



Object tracking

Logipix VCA algorithms are developed to accurately detect, track and classify objects under various visibility conditions. Both cooperative and non-cooperative objects can be classified and tracked. The VCA differentiates five basic type of objects (aircraft, heavy and light vehicle, human, FOD). Filtering is available for these objects on the monitoring interface. Beyond tracking objects on the airside, Logipix gives information on their position. The solution provides real-time GPS coordinates for both cooperative and non-cooperative objects. Additionally the system is able to receive position information of cooperative objects from integrated airport systems, like ADS-B and MLAT. Utilizing this feature the system is able to provide more accurate geopositioning.



Geofencing

The Logipix Geofencing function allows to virtually map existing airside zones on camera images. These configured zones facilitate orientation and accelerate object search for operators. They can easily find objects during live monitoring or archive search, as the objects always carry their current zone IDs. Operators can also filter for zones to list all their current objects.

Geofencing function also allows to virtually assign various object and/or time-based airside rules to the designated zones.

For instance these rules can specify the speed limit for various object types within the zones and also define access rules. LAARS uses these configured rules for automatic detection functions.

Virtual fence

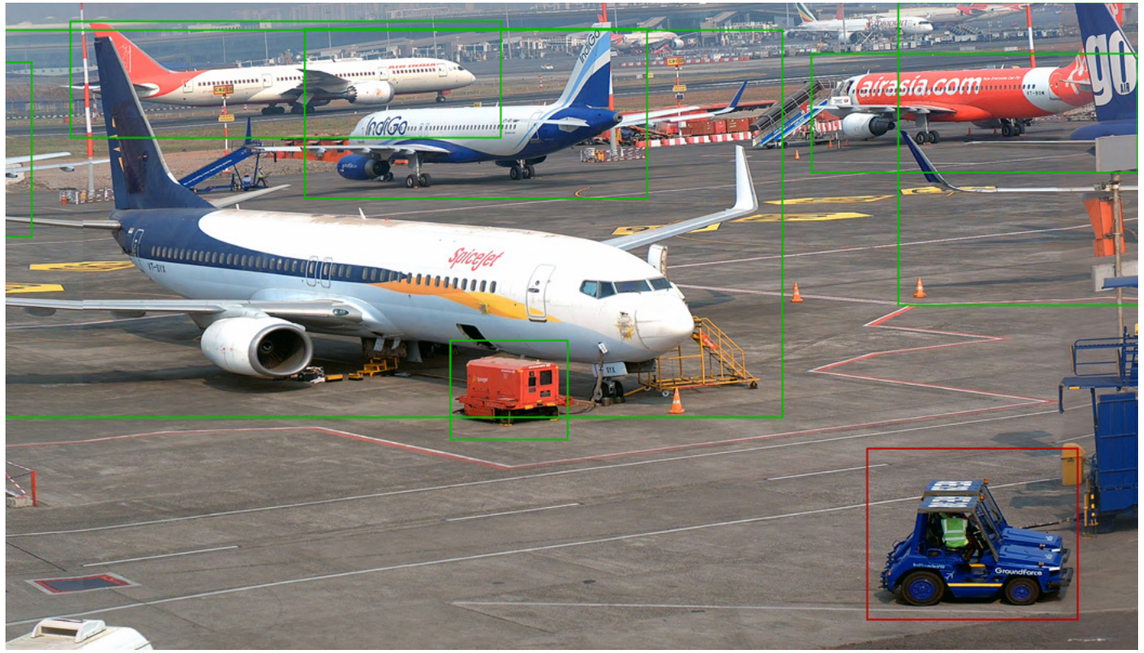
Operators and controllers can designate temporary zones and they can define various rules to these areas. They can simply draw around a static object or a desired area and apply relevant rules. The activated rules take effect on this area and trigger different warnings or alerts.

Situational awareness

With the help of computer vision technologies Logipix is able to enhance situational awareness at the airside. VCA-based features help prevent incidents by tracking real-time position of objects, predicting their future status and alerting users in time.

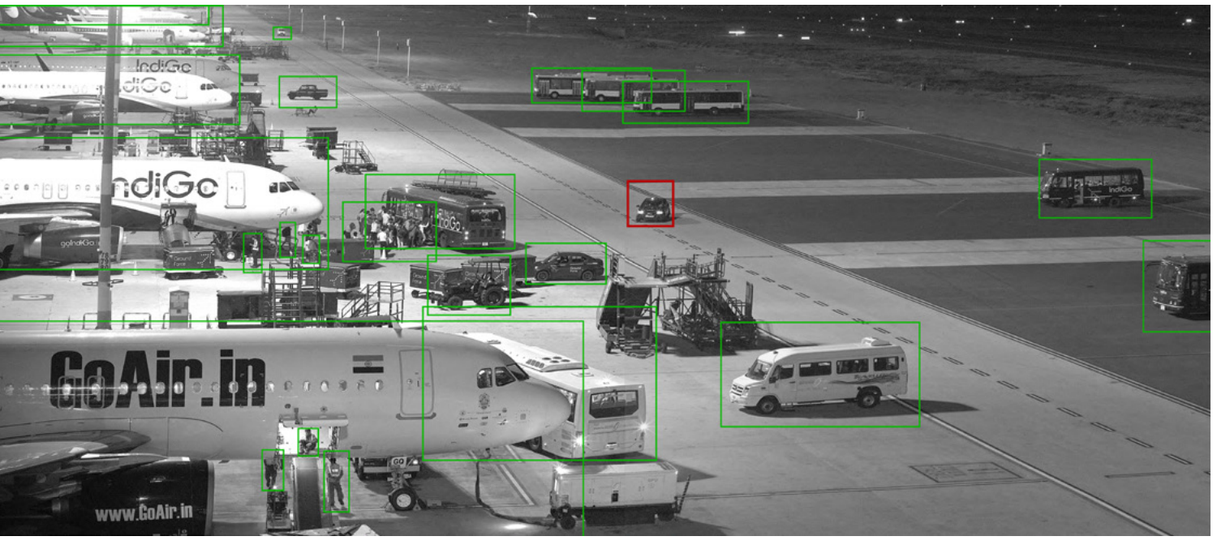
Proximity alert function uses dynamic proximity areas around objects. The size of these areas vary based on object type, speed and airside zone. In case the proximity areas of objects are overlapping, the system immediately alerts the user. This function mostly protects parking aircraft and vehicles from dangerously moving objects.

Collision prediction function helps prevent collisions among moving objects by applying Motion Behavior Analysis and Motion Path Estimation. The system analyzes the motion dynamics of the moving objects and calculates their motion vectors. In case the motion vector of an object is pointing to another one, the system predicts a possible collision area and alert the controller instantly who can react in time and warn the pilots or drivers. If the objects seem to miss collision the warning or alert signal ceases immediately.



Automatic traffic enforcement

Logipix VCA provides several traffic violation detection at the airside for both cooperative and non-cooperative vehicles. Different rules can be specified for different type of vehicles in different areas. The system effectively detect overspeed, line, traffic light and parking violations within the monitored areas. In case a vehicle is violating a traffic rule, the system generates a warning immediately and signs it on the monitoring interface. The function does not just detect traffic violations, but also registers them and save an evidence image.



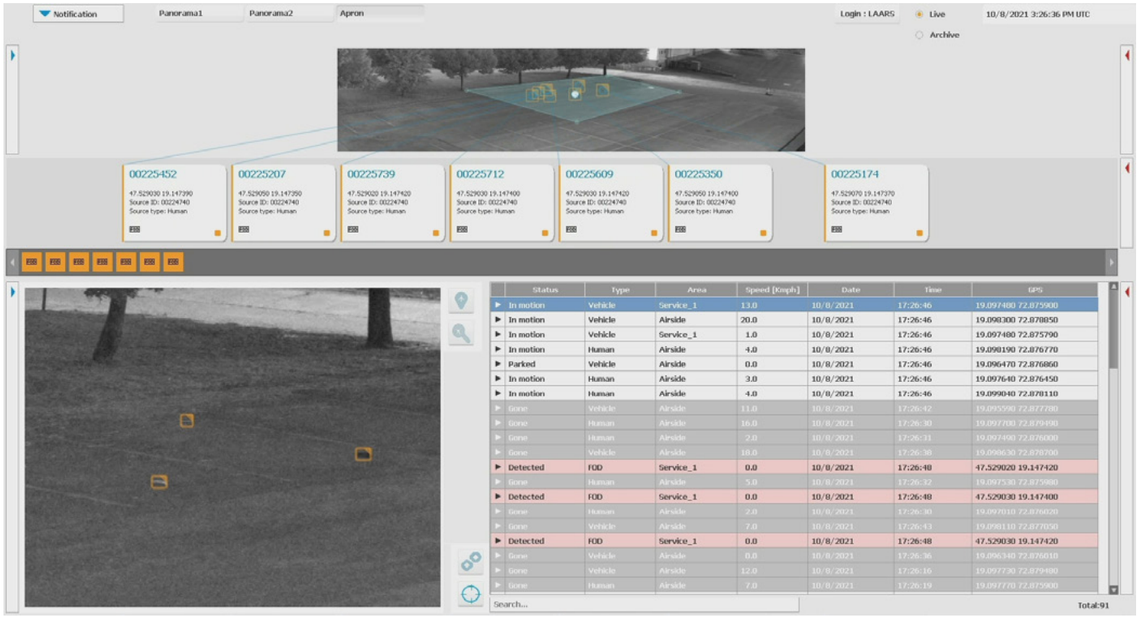
FOD detection

Foreign Object Debris can cause serious damage to airplanes and severely injure personnel, therefore it is essential to clean all AOA areas from them. Despite preventive FOD awareness, FODs constantly form on the runways, taxiways and on the apron.

It is very difficult to explore the entire airside area by general FOD inspection and FOD walks. To help collect FOD, LAARS provides an automatic FOD detection function. Beside inorganic FODs (stones, plastic foils, tools, aircraft parts, dolly wheels or bolts, screws, etc), LAARS is able to detect and classify animals on the airside. The size of the detectable FOD only depends on the applied resolution, which is always customizable.

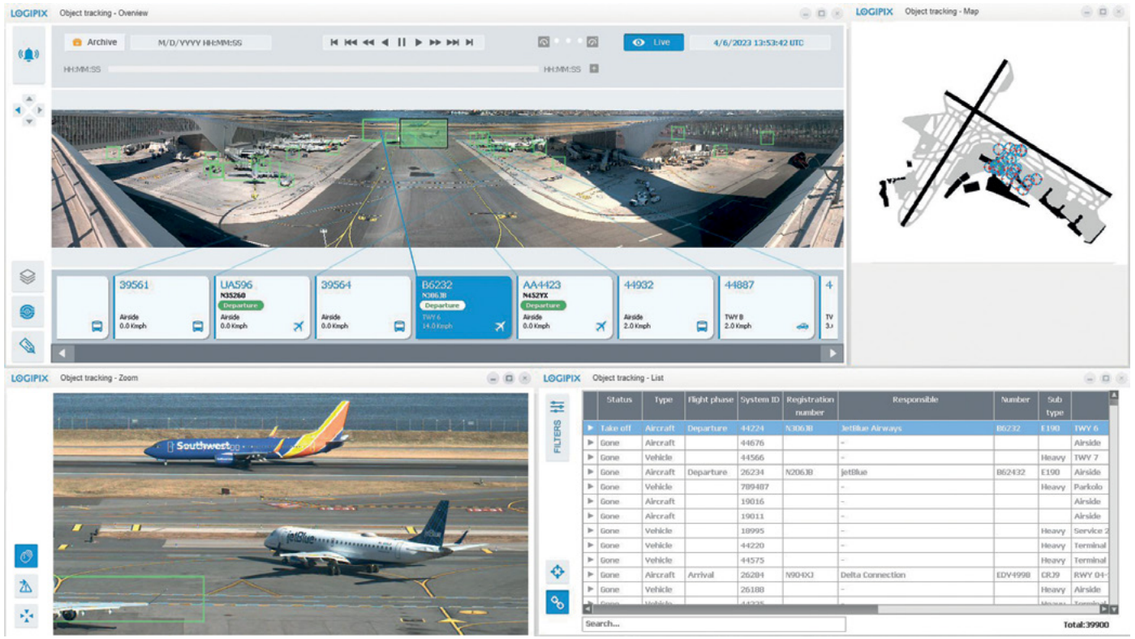
The function does not just recognize FODs, but it also supports the entire FOD management operation and helps investigate FOD formation. The function registers the source object which the FOD comes from (human, aircraft, dolly, etc.). It also provides information on exact FOD geoposition.

To handle the situation, operators first virtually fence the FOD area. They send inspectors to collect the FOD and when it has done, they acknowledge the process. All actions are recorded automatically which can be later reviewed if necessary.



RTDMS – FRONT END VISUALIZATION

LAARS was developed with the intention to facilitate general monitoring and make airside ground processes more efficient. LAARS transforms complex monitoring tasks into intuitive operations on a single platform. It provides faster decision making as it fuses multiple high-resolution video streams together with helpful object information generated by Video Content Analysis and integrated airport data feeds. This way operators and controllers get extra visual and text information on the user interface, which helps guide their focus on the most important situations.



User Interface

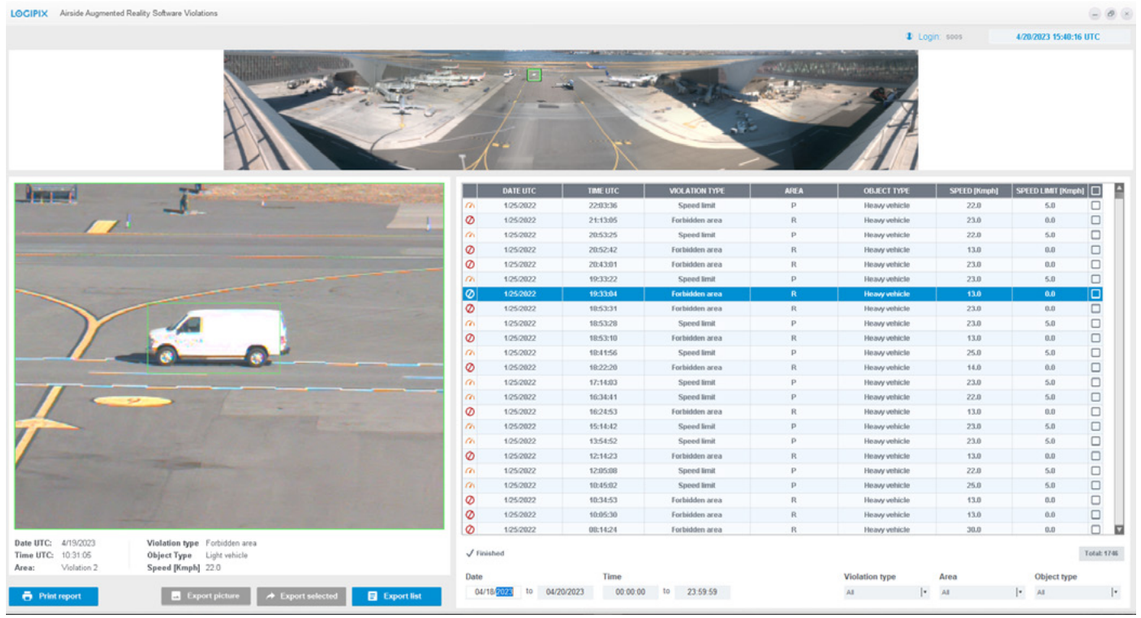
The front end interface is responsible to display and structure the information generated by all LAARS functions.

Operators use different forms for real-time monitoring, searching in video history, investigating violations and reviewing registered landings and take-offs. Ground handling operators perform their work in the Turnaround Management form.

The real-time monitoring form displays the most versatile functions but it still delivers clarity and usability. Its modular design ensures flexible interface customization even on multiple screens. All interface modules are interconnected with each other, all information are displayed in a synchronized fashion.

The interface contains a large overview video stream with informative AR visualization. Separate zoom windows provide detailed close-ups of the area of interest. An interactive map provides additional information on object positions. A detailed object list contains all detected objects with all their current and previous statuses, which are recorded in an in-memory database. Operators can load previous object statuses in no time and watch archive on the fly if needed.

LAARS generates informational labels with collected data and associates these with the detected objects. Clicking on the desired label, the related object is highlighted in the panoramic video. Operators can select an object on the displayed image and in the object list as well. This way they get information on airplanes quickly and they can easily track all their movements throughout the airside. Also non-cooperative objects get labels but with moderate information. The zoom window can be locked to automatically track any selected object.



TURNAROUND MANAGEMENT

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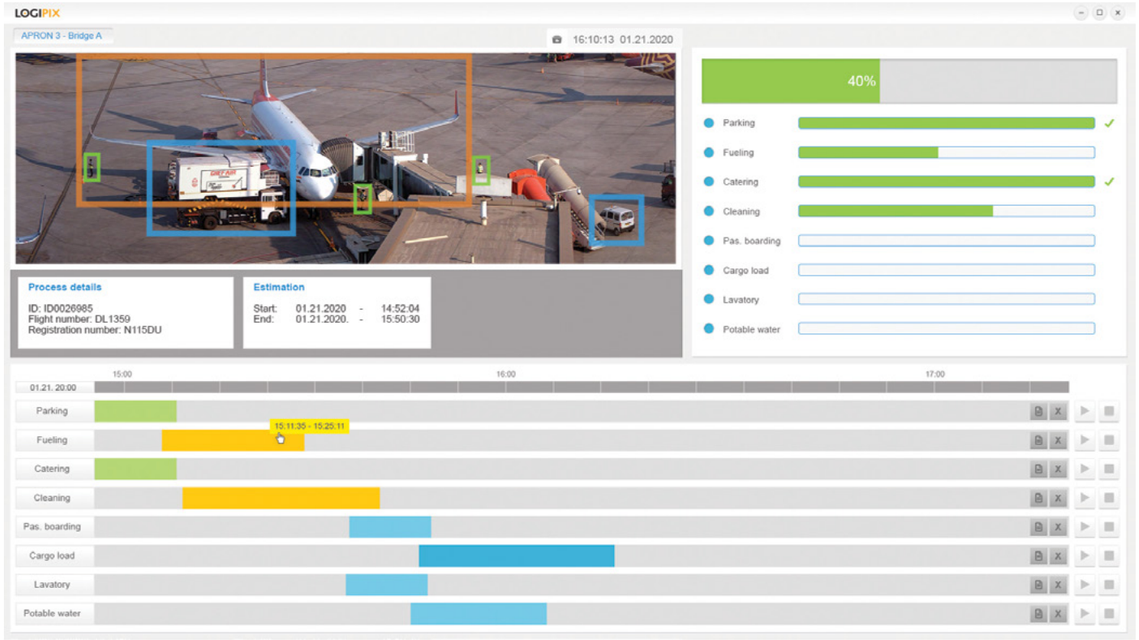


*detailed information can be found of this LAARS module in the Turnaround Management brochure

PERIMETER SECURITY

The Logipix VCA detects perimeter intrusions. Existing PIDS can be integrated in the system. The generated alarm signals trigger the Logipix Visible light and Thermal Panorama and also the PTZ to automatically zoom in on the alarmed area. The system is able to precisely track the motion of the detected intruder, thus operators can easily follow the situation and react quickly. The system effectively avoids false alarms.

TECHNOLOGIES BEHIND LOGIPIX FUNCTIONS

Logipix Video Content Analysis

Logipix provides the most reliable VCA possible, as the algorithms run on full resolution, uncompressed image streams. This approach ensures accurate detection and tracking even at far distances. The VCA relies on several advanced methods. One of them is the Multidimensional Gaussian Background Model that always adapts to the background and differentiates every moving object from the learnt environment. Our built-in neural network ensures that the system does not loose the relevant non-moving objects. The VCA also applies Object Feature Extraction, Motion Behavior Analysis and Motion Path Estimation algorithms in order to realize an intelligent, self-learning virtual environment.

Sensor Fusion Technology

Logipix developed specific raw data level and GPS level sensor fusion technologies. Raw data analysis works with uncompressed data, therefore it provides the highest level of accuracy. It was developed for Logipix sensors, but the system is able to fuse the data of external sensors as well. Complex data analysis means, the algorithms fuse the data of different sensors, which results in more accurate object detection and geopositioning.

Logipix Panoramic Technology

Logipix panoramic technology makes it possible to geometrically stitch images of Logipix visible light and thermal sensors. The images are taken in a synchronized fashion which precludes the possibility of duplicated or hidden objects at the stitching borders. White balance and tone correction algorithms smoothen the color gradient between the images.

Logipix PTZ cameras in the system

High-end PTZ cameras efficiently complement the system. A special function allows the PTZ cameras to be assigned with the Logipix Panoramas by registering common spatial points that are visible to both cameras. This function allows operators to control the PTZ cameras by selecting the area of interest in the panoramic image.

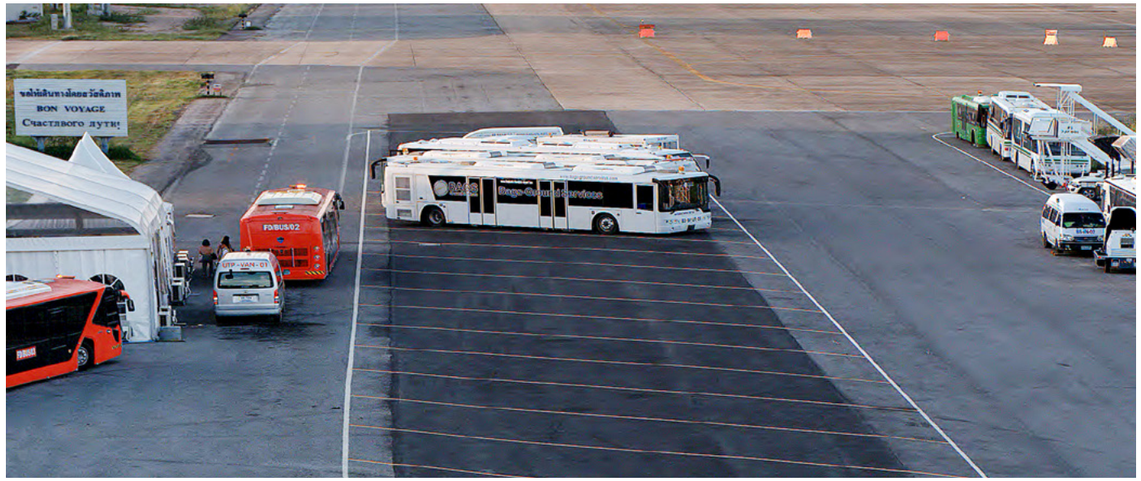
Logipix Intelligent Storage Management Technology

The system continuously records the videos. Thanks to the Logipix Ageing Technology, storage period of video streams can be greatly prolonged. The system intelligently drops frames from the video stream according to a configured period. As the JPEG2000 stream consists only intra-frame images, the footage will be still available after video stream ageing, but with reduced fps.

Monitoring in Full Resolution

Displaying 320-200 MP panoramic images during live monitoring or archive playback is not an easy task. This amount of data can impose excessive burdens on the network infrastructure and also on client computers.

Logipix developed a special technology to overcome this issue. The system stores the panoramic images in full resolution on the NVR, but always transmits and displays only relevant pixels. When a panoramic overview is on screen, its horizontal resolution is equal to the screen resolution. When an operator zooms in, the system sends the cropped image in higher resolution. As the zoom value increases, so does the transmitted image resolution.



MAIN FEATURES AND FUNCTIONS

Monitoring

- 320-200 MP panoramic video stream with 20 fps / cam
- 6 MP thermal monitoring / cam
- Real-time monitoring in full resolution
- PTZ control on panoramic images
- Interactive map
- Interactive object list
- In-memory object database
- Video History

AI-powered Video Content Analysis

- Registering Landings and Take-offs
- VCA-based object tracking
  - Detection
  - Classification
  - Merging motion information with images
    - Object frames, Path history, Heading
  - Object labeling
- Geofencing
- Virtual fence
- Situational awareness
  - Proximity alert
  - Collision prediction
- Automatic traffic enforcement
  - Overspeed
  - Line violation
  - Traffic light
- Automatic FOD detection

Turnaround Management

- Overview of all aircraft stands
- Automatic and manual registration of ground services
- Interactive ground service timeline and list
- Turnaround History
- Summarized turnaround data

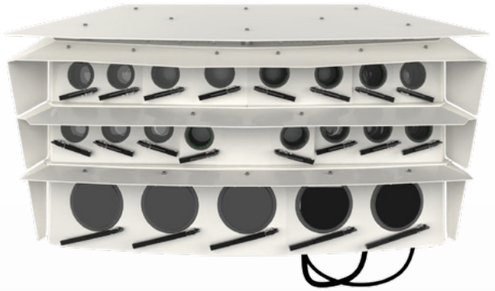
Perimeter security

- PIDS triggered intrusion detection
- VCA-based intrusion detection
- Highest detection accuracy possible
- Automatic zoom in on alarmed area
  - ePTZ (automatic zoom on panoramic images)
  - Automatic PTZ zoom

Integration

- Positioning systems: ADS-B, MLAT, A-SMGCS
- Radar systems and rangefinders
- Airport information sources

KEY SYSTEM COMPONENTS



Logipix 320 MP
Visible & Thermal Panorama Camera

Logipix 200 MP Panorama Camera

Logipix 320 MP Panorama Camera

Logipix 6 MP PTZ Camera

Logipix 300 MP Panorama Camera

LAARS and Server components

Logipix Network Video Recorder 4th gen

TECHNOLOGICAL STRENGTHS OF THE SOLUTION

- The Logipix visible-light and thermal cameras provide high-resolution panoramic images that ensures users an enhanced vision throughout the airside.
- The solution uses the scalable JPEG2000 image compression, which is the only standard that allows for real-time monitoring with hundreds of megapixels in a bandwidth effective manner.
- Logipix Video Content Analysis is embedded in the cameras and Network Video Recorders. It works with full resolution JPEG2000 images.
- Based on advanced Video Content Analysis the solution detects, tracks and classifies both cooperative and non-cooperative objects at the airside.
- A special software function provides informative, moving labels that tied to both cooperative and non-cooperative objects. This way among others, aircraft types, registration numbers and flight numbers can be displayed along with the detected objects.
- Logipix makes it possible to cover the monitored area with virtual layers both temporary and permanent and assign specific rules to them.
- Logipix automatically detects traffic related violations, proximity situations, predicts possible collisions and detects FOD throughout the movement area and the apron.
- Using Real-time Decision Making Support, operators can effectively filter numerous objects, incidents and situations and highlights only the most relevant ones on screen.
- The solution integrates Airport Systems like Airport Operational Database, Radar Systems, Range Finders, ADS-B, MLAT and A-SMGCS and fuse these data with the VCA data flow.
- Logipix system is able to ensure redundancy for all types of hardware elements.
- Our system ensures to monitor the status and manage the progress of ground handling services during turnarounds, record and summarize all data and prepare them for post-analysis. This module of the system can also be aided by Video Content Analysis, further expanding system automatism.

CONCLUSION

Logipix engineers developed the best-in-class airside video monitoring solution that comprises high-end visual sensors, intelligent data processing units and a complete software package. It aids airside services by Computer Vision Technologies and supplement the scene for operators with informational augmented reality elements.

The solution facilitates airside operations and prepares airports to conveniently face pressing new directives. It ensures smooth and secure ground processes and turnarounds, and plays a key role in preventing incidents and also in investigation. As a result, it enhances airport efficiency, reduces the number of costly delays, and even shortens the system's payback period.

LAARS is a trusted system that has been chosen already by some of the largest airports around the globe, preparing their airsides for the difficulties of our new challenging era.

ABOUT LOGIPIX

Logipix Technical Development Ltd. is a privately held company established in 1996 in Budapest, Hungary. Since then, Logipix has grown into the international company that it is today – one of the most innovative, end-to-end video surveillance solution developers and manufacturers. Today the main profile of the company is to provide specially designed, high-end video surveillance solutions considering the various characteristics of different application areas.

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