ATM-ASDE System Cassiopeia-5

Casseopeia-5 consists of the following componeents:
- Multi-Sensor Data Processor (MSDP)
- Controller Working Position (CWP)
- Maintenance Workstation

The ASDE is able to accept the following **input data**:
- **Sensor data in ASTERIX Cat010 format from**
  ◦ Surface movement radar (SMR)
  ◦ Multi-lateration system (MLAT)
  ◦ ADS-B/Mode S Ground Receiver Station
  ◦ Magnetic loop sensor system
- **System data**
  ◦ Track and FlightPlan data from Approach ATM system (in ASTERIX format)
  ◦ Meteo information (METAR/TAF reports)
- **Video surveillance data**

The system is able to produce the following **output** data:
- A-SMGCS surveillance and alerting information (in ASTERIX Cat011 format)
- Lighting system control commands
- Surveillance video server commands

The Multi-Sensor Data Processor performs:
- Data fusion from different surveillance sensor systems
- Receiving data from Approach RDPS and FDPS
- Image extraction, track data post-processing (if necessary)
- Conflict detection and safety alerting
- Data recording and replay
- Output data preparation
- Report generation

The general specification of the **required SMR** is:
- X-Band Solid-state technology
- Data output in Eurocontrol ASTERIX format
- Data/Signal processing – clutter, multipath rejection, rain effects mitigation
- Multichannel transceiver
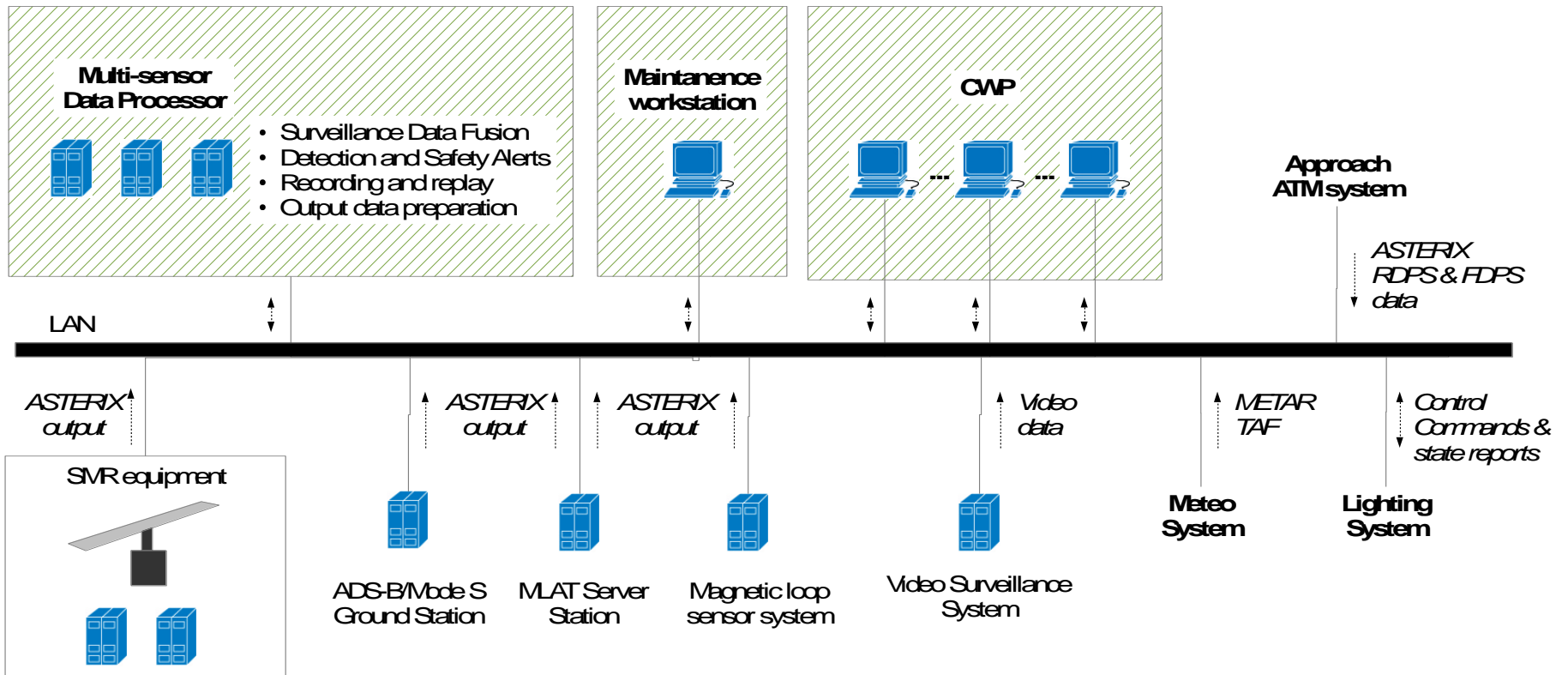
System diagram

*Blocks filled with green represent Casseopeia-5 hardware

The Human-Machine Interface of the CWP component provides:
- Ground View Display
- Airspace View Display
- ILS View Display (optional)
- Runway View Display (optional)
- Lighting equipment control display
- Video Surveillance Display (single or multiple)

Airport map features
- detailed map (runway limits and thresholds, taxiways, holding positions, stop bars, runway exits, intersections, parking positions, gates)
- range scale change (zoom in/out)
- off-centering
- polar grid
- adding user-defined zones
- adding user-defined text
- getting map context information
- configurable color and transparency scheme (switchable presets)
- graphical layer management

Track displaying features
- track marks according to current status and priority
- configurable labels (identification, velocity, etc)
- label offsetting (automatic and manual)
- speed vector
- history dots
- track filtering (by altitude, zone, priority, status, inbound/outbound)

ASDE controller functions
- system flight plan and airport schedule browsing
- arrival sequencing
- departure sequencing
- distance and bearing tool (between moving and static objects)
- taxi route assignment with automatic proposal
- indication of the taxi route to be followed
- target trajectory prediction
- short-term conflict detection and alerting (STCA)
  - between ground moving objects
  - between ground moving objects and static obstacles
  - between aircraft in flight
- medium-term conflict detection and alerting (MTCD)
  - between ground moving objects
  - between aircraft in flight
- conflict resolution advisory tool
- ground area penetration detection and alerting
  - runway/taxiway/apron incursion and excursion
  - entering prohibited/restricted/sensitive areas

- airspace proximity (APW) detection and alerting
- route deviation detection and alerting
- speed limit and wrong direction detection and alerting
- runway occupancy automated setting and indication (landing, take-off, maintenance work, runway closed)
- surveillance video integration
- lighting system control
- weather information
- coordination tools with Approach controllers

The Maintenance workstation provides a special HMI to monitor and control the state of the system and its components.

Current state of implementation

It is proposed to build the required ASDE system with use of extended versions of currently available simulation platform components. Below is the description of the available components.

1.1. Controller Working Position (CWP).
The CWP is designed to provide the operator with two-display interface consisting of:
–   Main Surveillance Display
–   Lighting equipment control display
The whole HMI is a multi-window application with window transparency and roll-up/roll-down functions supported.

1.1.1. The Main Surveillance Display comprises two views showing current traffic situation:
–   Ground 2D View - shows the airport map including runways, taxiways, apron area with the ground traffic (aircraft and service vehicles);
–   Airspace 2D View shows the airspace structure (including CTA, TMA. RA/PA, FIR boundaries, NAVAIDs, routes, runway axes) and all aircraft in flight (en-route, approach, landing/taking-off)
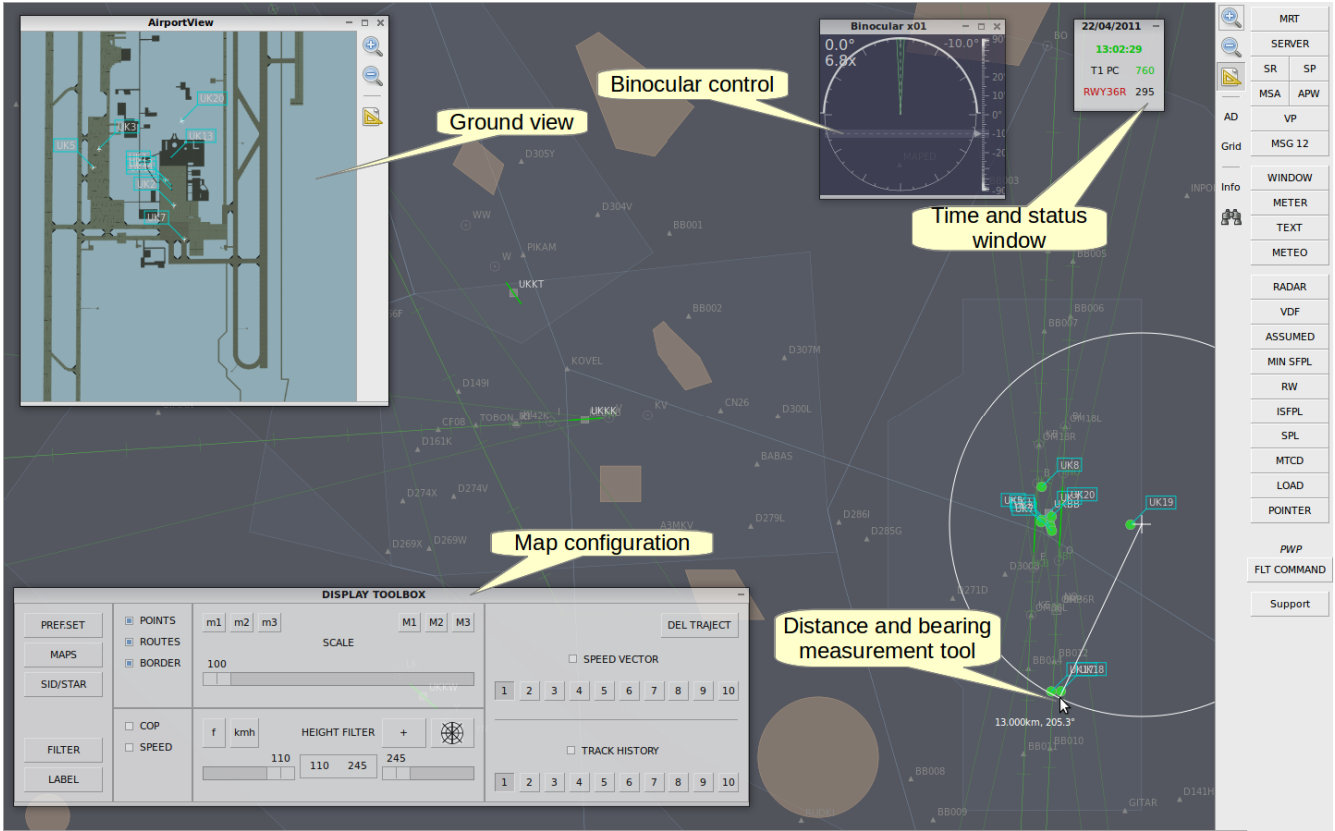
The following graphical map features are implemented for the both views:
–   cursor-selectable tracks
–   map off-centering
–   range scale selection, zoom in/out tool
–   distance and bearing measurement tool (between 2 points on the map)
–   polar or latitude-longitude grid displaying (enabled for the Airspace view only)
–   map object context information
–   graphical layer hiding/showing (every map object type has its own separate layer)
–   color and transparency scheme can be configured per layer
–   map object data is imported from standard ARINC-424 files

Additional available panels and windows:
–   main tool panel
–   time and status window (date/time, QNH, runway in use, controller role, controller id)
–   map configuration window (scale, visual layer management)
–   map context information window
–   virtual pilot flight command window (for simulation purposes only)
–   standard phraseology reference window (for training purposes only)
–   virtual binocular control window (is used to adjust orientation and zoom of the binocular view frame displayed on a simulator projection screen as well as to capture the target aircraft to be followed)
–   weather report window

The following screenshots show the current look of the CWP graphical interface

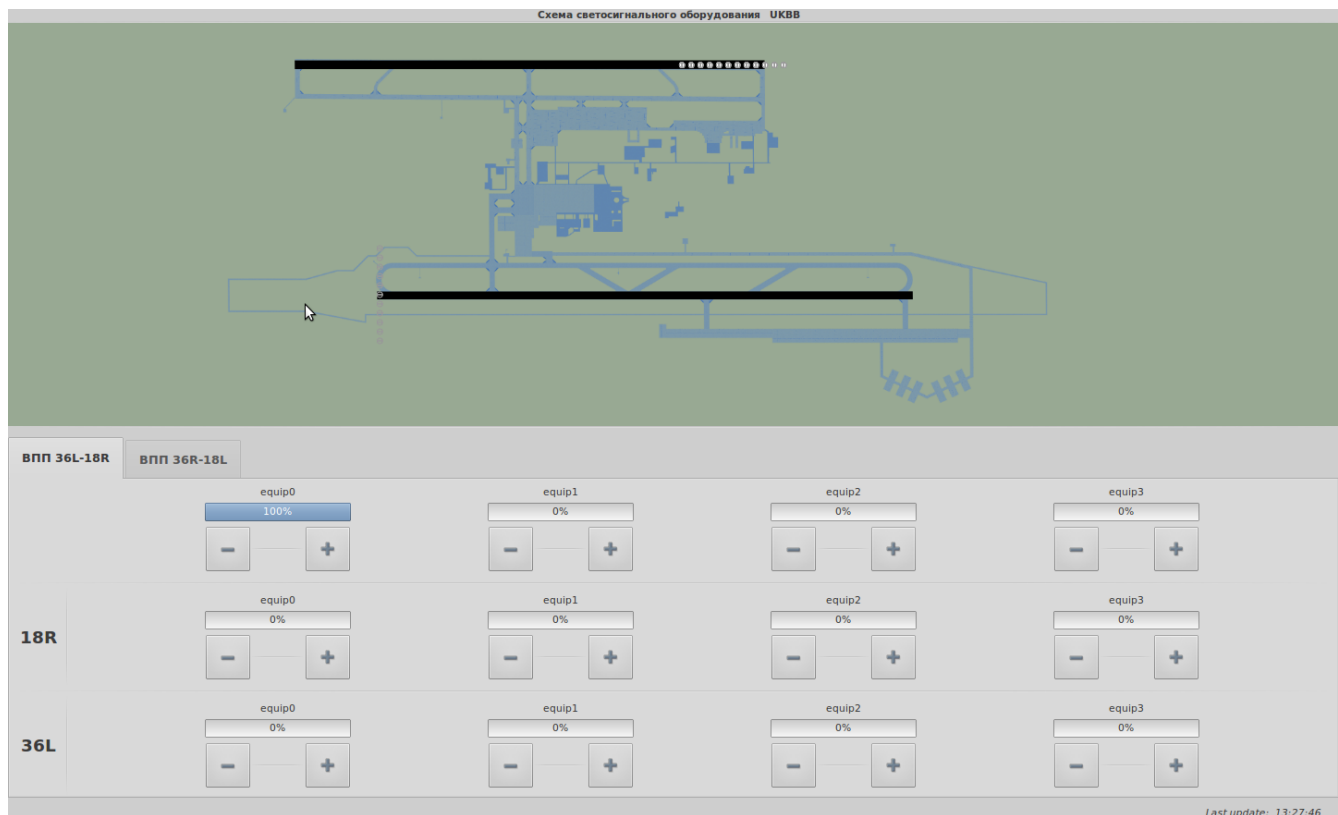Picture 1 – Main Surveillance Display: Ground and Airspace views

Callouts in Picture 1:
- Binocular control
- Ground view
- Time and status window
- Map configuration
- Distance and bearing measurement tool

AirportView

Binocular x01

22/04/2011
13:02:29
T1 PC   760
RWY36R   295

DISPLAY TOOLBOX

PREF.SET	POINTS	m1 m2 m3	M1 M2 M3	DEL TRAJECT
MAPS	ROUTES	SCALE		
SID/STAR	BORDER	100	SPEED VECTOR	
			1 2 3 4 5 6 7 8 9 10	
FILTER	COP	f kmh HEIGHT FILTER +		
LABEL	SPEED	110 110 245 245	TRACK HISTORY	
			1 2 3 4 5 6 7 8 9 10	

13.000km, 205.3°

Right toolbar (Picture 1): MRT, SERVER, SR, SP, MSA, APW, AD, VP, Grid, MSG 12, Info, WINDOW, METER, TEXT, METEO, RADAR, VDF, ASSUMED, MIN SFPL, RW, ISFPL, SPL, MTCD, LOAD, POINTER, PWP, FLT COMMAND, Support

Picture 2 – Main Surveillance Display: auxiliary information windows

Callouts in Picture 2:
- Map context info window
- Weather info window
- Phraseology reference

AirportView

DISPLAY TOOLBOX

Binocular x01

22/04/2011
13:47:07
T1 PC   760
RWY36R   295

Map object static info   Object 1 of 7

.ID	115
.class	Airport
.code	UKKK
.name	KYIV/ZHULIANY INTL
airport.runways.IDs	RW08, RW26
airport.runways.count	1
area.ICAO.airport	UKKK
area.ICAO.country	UK
area.terminal_zone	Yes
position.elevation.ft	587
position.elevation.m	178.9
position.latitude	30.452075
position.longitude	50.401811
position.mag_var	5.00

Phraseology

Situation Classes > Clearances > Airspace

Cleared to {destination} via {routing} at {level}

Meteo

UKBB 00:00
Wind 020   003   ---
WindSide ---
Visibility --- HDL ---
HHH --- N --- Nh ---
QNh 762   1016
QFE 751   1002
Humidity 088 t = 21
Occasion ---

Runway 36R
Depth --- mm
K sz. ---

EDIT   METAR

Right toolbar (Picture 2): MRT, SERVER, SR, SP, MSA, APW, AD, VP, Grid, MSG 12, Info, WINDOW, METER, TEXT, METEO, RADAR, VDF, ASSUMED, MIN SFPL, RW, ISFPL, SPL, MTCD, LOAD, POINTER, PWP, FLT COMMAND, Support

Picture 3 – Ground 2D View

1.1.2. The Lighting Equipment Control Display combines the visual tools to control the intensity level for every group of lighting equipment or for the whole airport and/or per runway. This display also shows the airport scheme with the lighting equipment highlighted according to their selected intensity levels. The Lighting Equipment Control Display is designed to be used with touch screen monitors.

The color and transparency scheme is configurable the same way as it is done for the views on the Main Surveillance Display.

Схема светосигнального оборудования UKBB

ВПП 36L-18R ВПП 36R-18L

equip0	equip1	equip2	equip3
100%	0%	0%	0%
− +	− +	− +	− +

18R

equip0	equip1	equip2	equip3
0%	0%	0%	0%
− +	− +	− +	− +

36L

equip0	equip1	equip2	equip3
0%	0%	0%	0%
− +	− +	− +	− +

Last update: 13:27:46

Picture 4 – Lighting Equipment Control Display

Visual System:

– image generation servers
– projection system (tower view + virtual binocular)

System core components:

– internal network exchange subsystem
– flight dynamics server
– airspace data server
– weather server
– terrain server

Picture 5 – Projection System
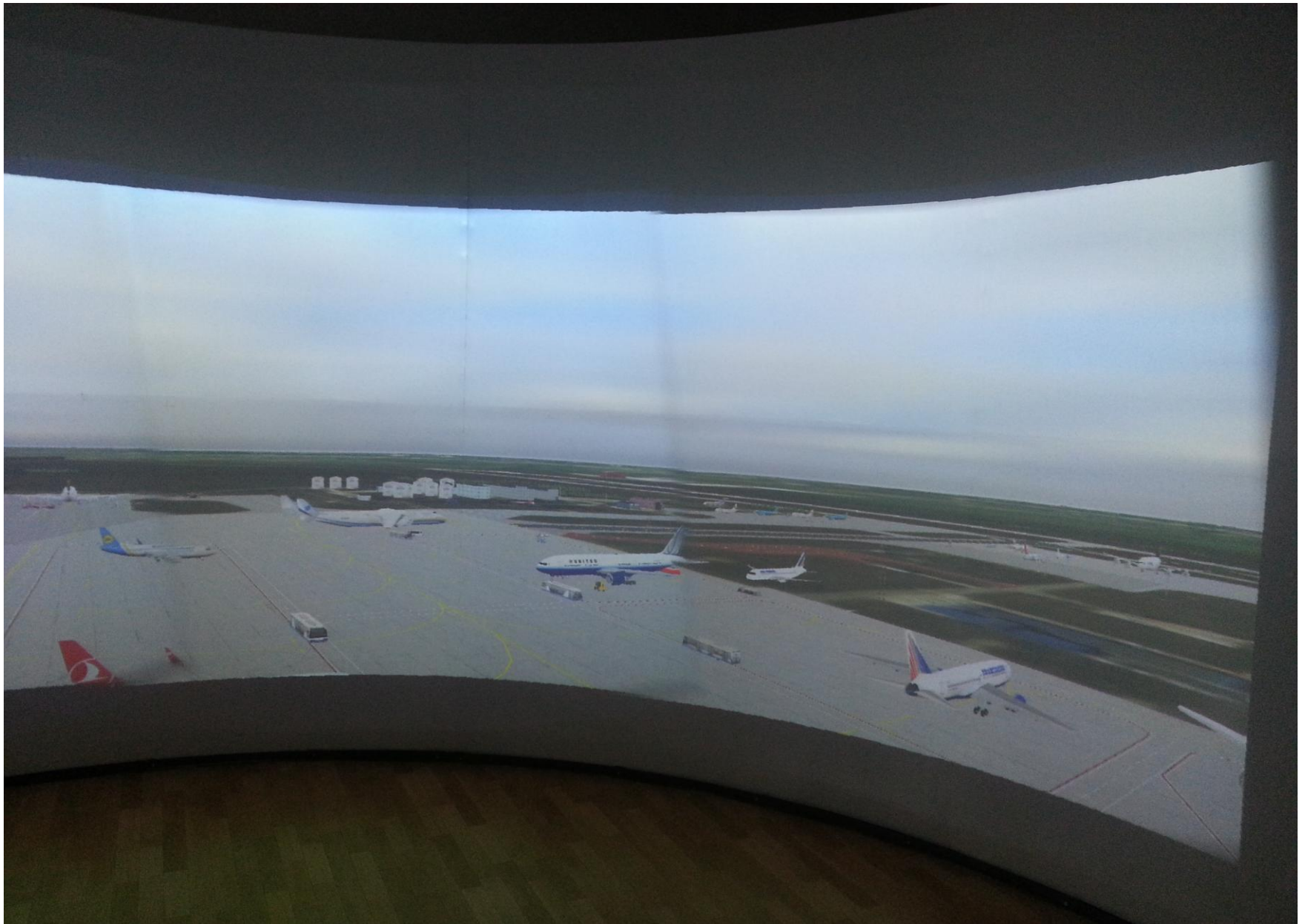
Picture 6 – Projection System

2. Additional Functionality

Function

1 CWP graphical interface features
Interactive map:
1.1   Displaying of additional aerodrome markings: stop bars, taxiway center lines and intersections, parking areas, apron restricted areas, terminal gates
1.2   History dots of target tracks
1.3   Configurable track labels (the text field contents and their order)
1.4   Automatic track label offsetting and label dragging functions
1.5   Track marks indicating aircraft weight category or dimensions
1.6   Track filtering (altitude, zone, priority, status, inbound/outbound)
1.7   Track status/priority assignment and color highlighting
1.8   Distance and bearing measurement tool snapping to moving objects
1.9   Predefined taxi routes proposal
1.10   Manual taxi route assignment (using pointer or typing taxiway IDs)
1.11   Indication of the assigned taxi route to be followed

Alerting and trajectory:
1.12   Aircraft/vehicle trajectory prediction (check-point times)
1.13   Short-term conflict visual alerting (STCA):
1.1.1   between ground moving objects
1.1.2   between ground moving objects and static obstacles
1.1.3   between aircraft in flight
1.14   Medium-term conflict visual alerting (MTCD):
1.1.1   between ground moving objects
1.1.2   between aircraft in flight
1.15   Airspace proximity warning (for aircraft in air)
1.16   Conflict resolution advisory tool
1.17   Ground area penetration alerting (runway/taxiway/apron incursion and excursion alerts, entering prohibited/restricted/sensitive areas, crossing stop bars)
1.18   Route deviation alerting
1.19   Speed limit and wrong direction alerting for air and ground traffic (aircraft and vehicles)
1.20   Runway occupancy setting and indication (landing, take-off, maintenance work, runway closed)

User-defined customization
1.21   User text-labeling (adding text on the map)
1.22   User-defined zones (adding zones on the map)
1.23   Switchable predefined color schemes (day/night)
1.24   User-defined hotkeys support
1.25   Keeping user-defined window layout
1.26   Keeping user-defined GUI and system settings

Additional windows/views:
1.25   Runway view
1.26   ILS view
1.27   Flight strip window
1.28   System flight plan window
1.29   Airport flight schedule window
1.30   Arrival sequence window
1.31   Departure sequence window
1.32   Surveillance video integration (separate window or display)
1.33   System status window

2   **System core functions**
2.1   Flight plan data input support (ADEXP, OLDI format or others) – needs to be specified
2.2   ASTERIX-input support (from all available surveillance systems – ASDE, MLAT, ADS-B etc.)
2.3   Sensor data fusion server (Multi Sensor Data Processor)
2.4   Surveillance video support (input data and output control commands from/to surveillance video server)
2.5   Real-time weather-input support (METAR/TAF)
2.6   Lighting control system protocol support (input state and output control commands)
2.7   Data recording and archiving, system logging (operational, technical)
2.8   Replay of recorded data
2.9   Report generation (customer reports)
2.10   User access and session management
2.11   System administration and diagnosis graphical tool
2.12   General simulation scenario management (preparation and execution)
2.13   Motion simulation based on scenarios