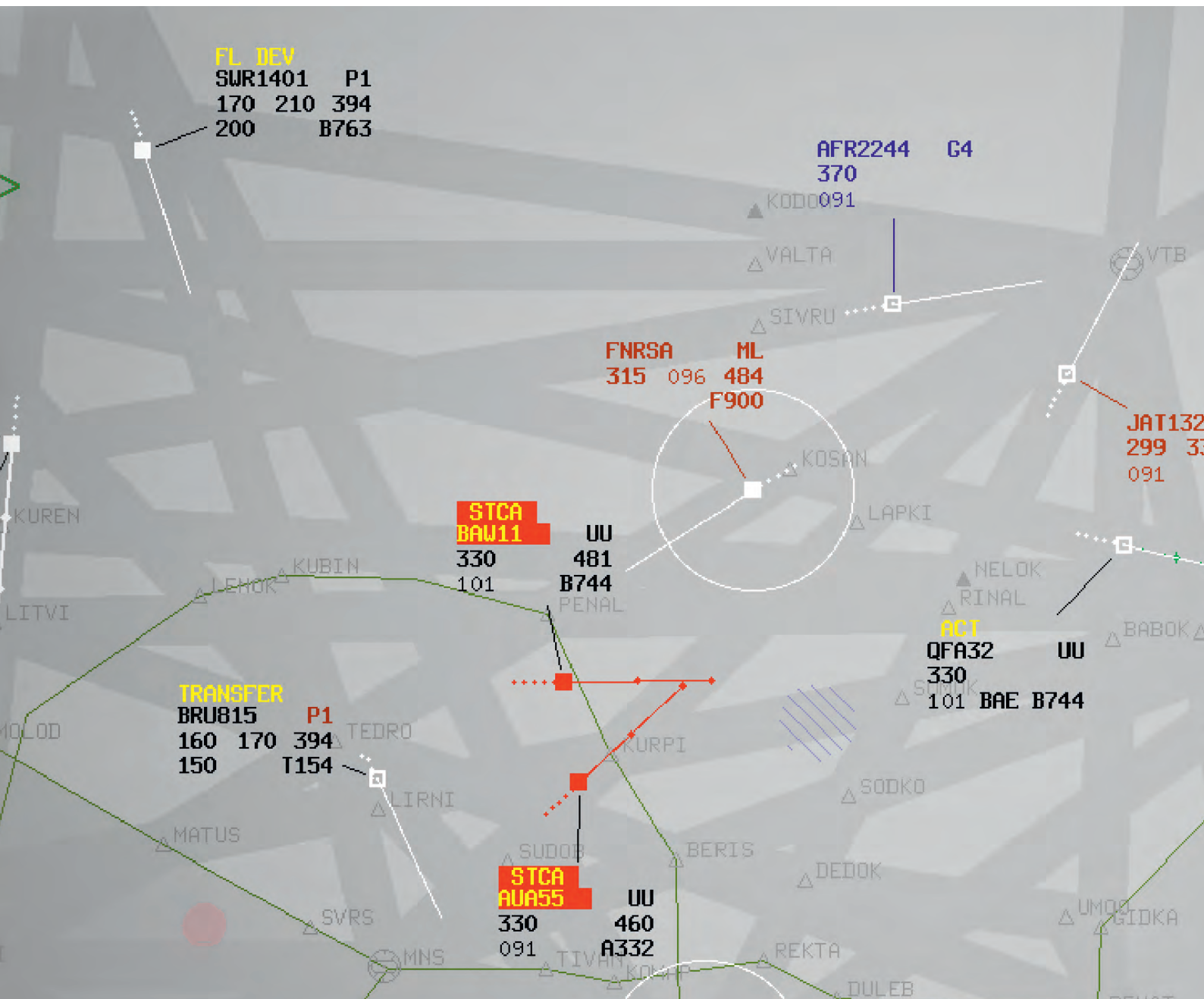




Complexes of Air Traffic Control Automation Aids

«SINTEZ» AIR TRAFFIC CONTROL AUTOMATION SYSTEM





Taurus.

ORIO

Equator

Eridanus.

Fig. QQ.

Lepus.

Longitude

Longitude



VNIIRA. AIR TRAFFIC MANAGEMENT
SYSTEMS AND AIDS

Information about the Company:

All-Russian Scientific Research Institute of Radio Equipment (JSC VNIIRA) has specialized in the development, production, commissioning and maintenance of navigation and landing systems and aids, air traffic control automation, airborne equipment and weather radars.

Areas of activities:

- | automated ATC and ATM systems and facilities for various control areas and for large regions and separate countries;
- | simulator systems for AT controllers;
- | surveillance, approach control, secondary, and weather radars;
- | ground and airborne equipment of short-range radio navigation systems and instrument landing systems;
- | airborne equipment of range measuring, aircraft (A/C) collision avoidance, and early
- | ground proximity warning systems, and transponders;
- | onboard integrated navigation and landing systems;
- | ground and airborne aids of the Automatic Dependent Surveillance-Broadcast (ADS-B).

In 1999 JSC VNIIRA has got a status of the Federal Scientific Production Center.

In 2004 JSC VNIIRA has joined JSC «Concern PVO «Almaz - Antey».

When working out a solution, VNIIRA specialists prove again and again that they are capable of achieving more, inasmuch as each follow-on development surpasses the previous one. The long experience and our Customers' acknowledgements confirm it.

VNIIRA is far more than:

- | 65 years of the successful performance for the benefit of air safety;
- | 150 prototypes of radio-technical systems and the complex of ground and airborne radio instruments;
- | 1 300 Inventor's Certificates;
- | 60 complexes of ATC automation systems and facilities for airports and regional centers of Russia and other countries;
- | 100 types of home-produced aircrafts and helicopters employ the airborne equipment, navigation and landing facilities developed by VNIIRA;
- | 1 600 employees including 11 Doctors of Engineering Science and 68 Candidates of Engineering Science.

VNIIRA is a long-standing developer of the automated air traffic control systems from 1975.

It is currently the one of the leading Russian enterprises in this industry.

VNIIRA is the only Russian Federation enterprise supplying UNIX-based ATC AS as recommended by the EUROCONTROL



The automated air traffic control system (ATC AS) is a complex of facilities providing:

- | processing and display of surveillance data and flight data and information regarding airspace management;
 - | processing of meteorological data;
 - | analysis of the air situation for safety;
 - | training of ATC controllers;
 - | information recording and playback;
- as well as solution of a variety of other key functions.

The customers of the system are the Air Navigation Service Providers (in the Russian Federation – Rosaerоnavigation and Federal State Unitary Enterprise «State ATM Corporation»).

The level of the technical facilities used and the functional tasks solved (high-precision detection of short-term and medium-term conflicts, automated interaction with interfacing ATC Centers, Controller Decision Support Tools, etc.) from VNIIRA corresponds to the level of the leading global manufacturers of ATC AS and considerably surpasses all the domestic counterparts.

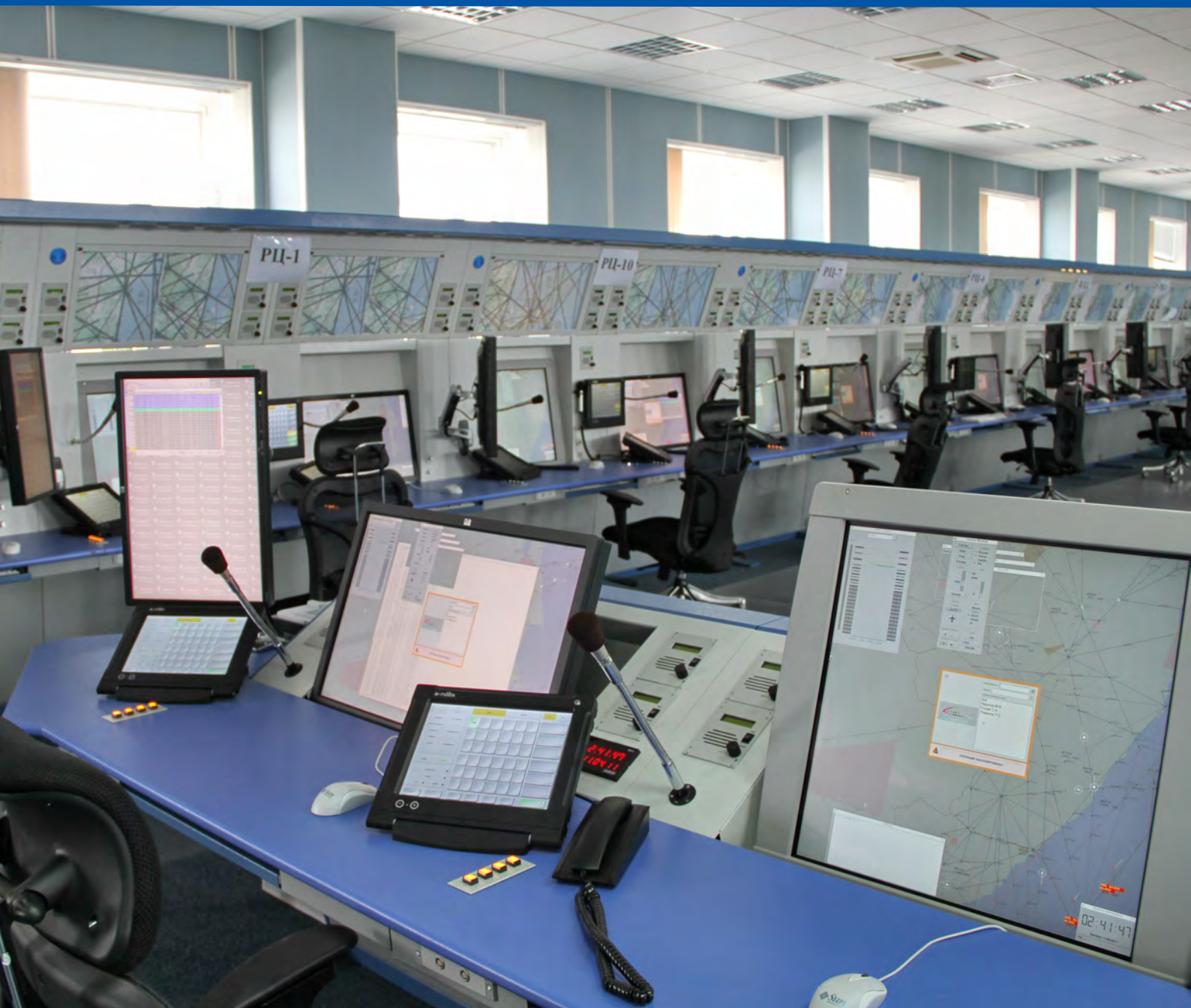
JSC VNIIRA is the only Russian Federation enterprise supplying ATC AS on the UNIX platform as recommended by the EUROCONTROL (European Organisation for the Safety of Air Navigation established in 1960)

SINTEZ ATC AS

VNIIRA is the developer of the new Moscow Automated ATM center.

VNIIRA is the largest solution provider of more than 20 ATC area and terminal and air nodal points in Russia in the

cities of Moscow, Saint-Petersburg, Khabarovsk, Sochi and other locations within the framework of the Federal Target Program of RF ATM US.



The SINTEZ ATC AS of the last generation has no analog. 10 unique

functions implemented in this system are not provided completely in any ATC AS system of Europe.

The distinctive features of ATC AS supplied by VNIIRA are as follows:

Modular open architecture for quick adapting to the real needs throughout the life cycle;

Capability of interfacing with any types of radars and other sources of information;

Human-machine interface in accordance with the recommendations of the EUROCONTROL.

VNIIRA is a long-standing developer of the automated air traffic control systems. In 1975, the first domestic START ATC AS was developed, which included SSR and PSR data processing and initial flight data handling. In 1986, the second generation SPECTR ATC AS was developed, in which not only the radar data processing was automated, but also the full flight data processing, as well as the calculation of spatiotemporal (4D) trajectories and the air situation analysis for conflict-free environment (STCA, MSAW). In the nineties and early 2000th years, the unified series of SINTEZ ATC AS was created,

implementing the state-of-the-art level of automation (SNET, MTCO, MONA, SYSCO, etc.), satisfying the EUROCONTROL's recommendations, and providing the strip-less ATC operations.

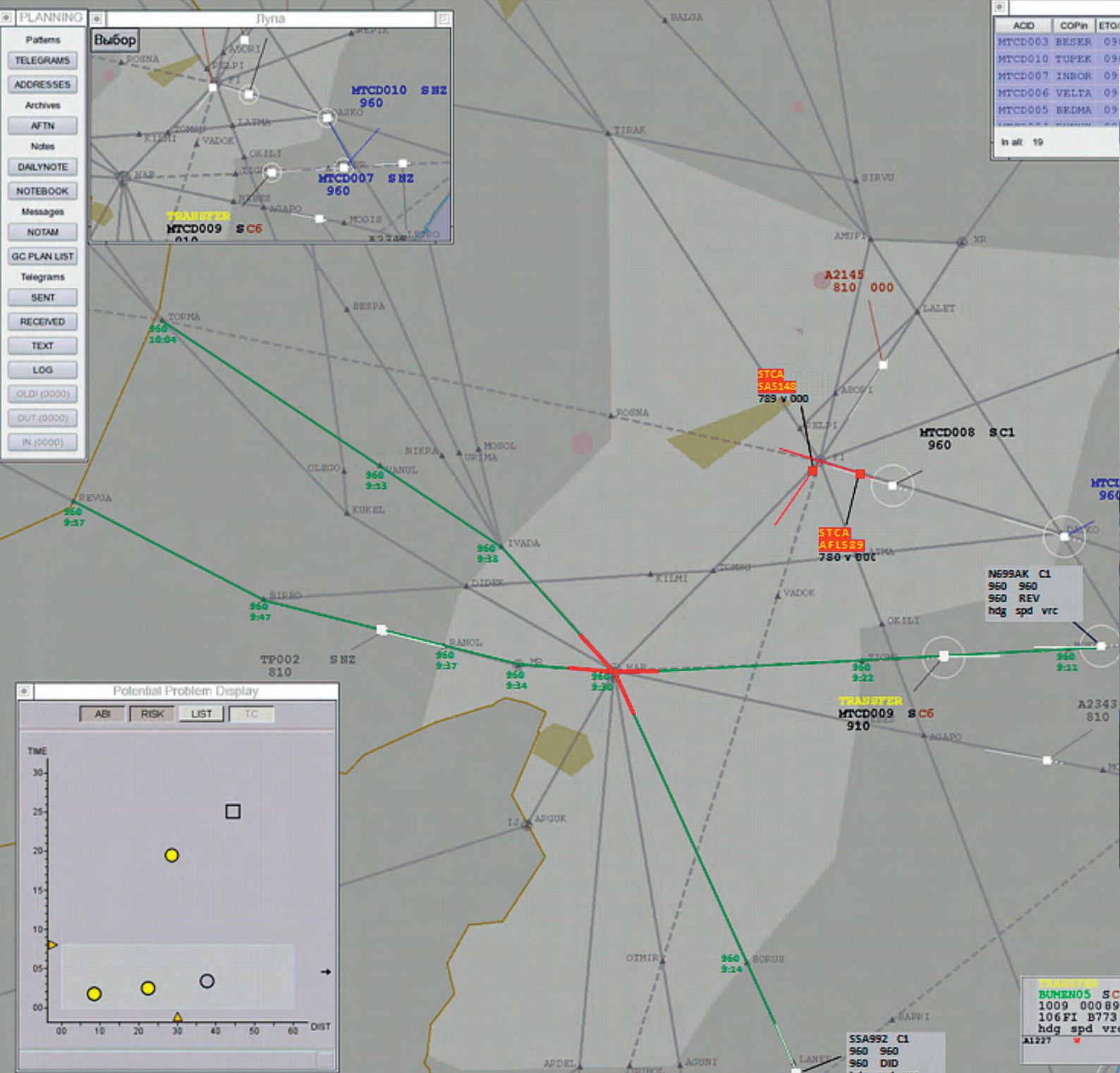
Starting from 2009, VNIIRA has operated as a solution provider of design and survey, construction and erection works, a supplier of own design equipment for the modernization of more than 20 ATC UR ER APP (E)TMA & Aerodrome ATC Centres in Russia in the cities of Sochi, Moscow, Saint-Petersburg, Khabarovsk, and others. These works are carried out in accordance with the Federal Target Program «Modernization of Unified Air Traffic Management System of the Russian Federation (2009–2015)».

Since the end of 2009, VNIIRA has been performing the development of a new ATM system for the Moscow Center of Unified ATM System.

SINTEZ from VNIIRA is a unified series of the automated air traffic control systems and facilities.

Over 40 ATC centers are currently equipped with the unified series of the SINTEZ ATC AS facilities in Russia and abroad. The SINTEZ ATC AS of the last generation has no analog.

10 unique functions implemented in this system are not provided completely in any ATC AS system of Europe.



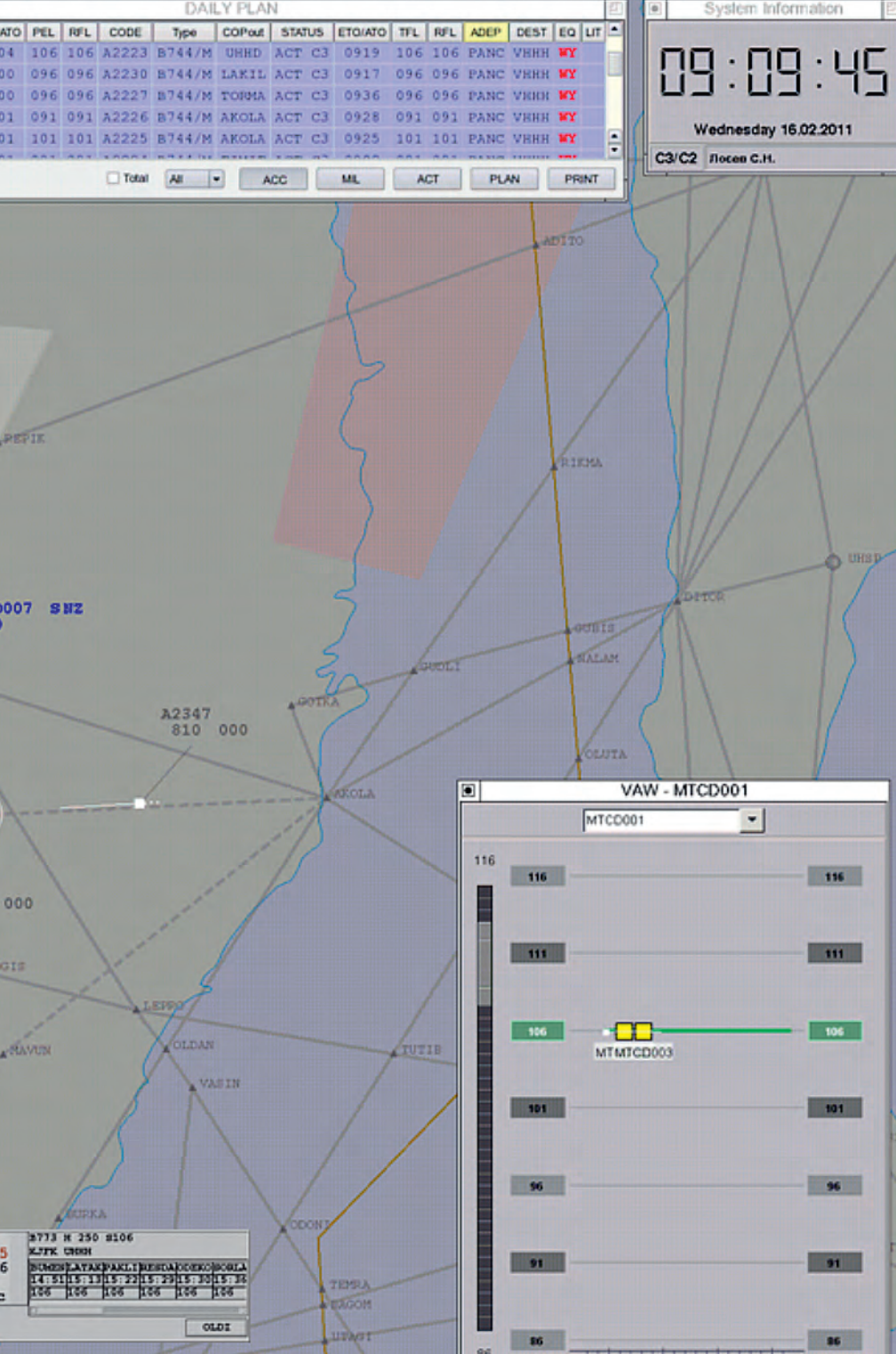
What distinguishes SINTEZ from all other systems?

Firstly, the SINTEZ system predicts to a high precision the aircraft flight path over the entire consolidating ATC area of interest, allows a Controller to detect conflicts all the forecast through. Before SINTEZ, such medium-term conflict prediction did not merely exist in Russia. Moreover, at present it is possible to determine even a probability of a medium-term conflict occurrence.

Secondly, the SINTEZ system will now help a Controller, how one or another conflict would rather be resolved. What is the result? The controller becomes less kept loaded and he/she has the time for the solution of other intricate problems. All this positively influences the flight operations safety eventually.

Thirdly, in the new ATM AS for the Moscow Automated ATM Center a controller

will be able to control the air traffic not only by means of a microphone, but also using a computer mouse. Now it will be sufficient to click a mouse button in order to uplink an instruction for data link-equipped aircraft. This system with such capabilities unknown to controllers of the previous generation/ Therefore it will have the level in line with the best European systems.



SINTEZ ATC AS – a controller becomes less loaded, as the system offers help him/her to take choice between alternate conflict solutions.

Product Advantages:

Customizing to any needs in equipping:

- ▮ Area Control Centers (ACCs), from ordinary standard ACC to enlarged Center to control aggregated areas with various traffic density,
- ▮ (E)TMA Control Centers with various traffic density
- ▮ airdrome flight control units(Towers) with with various traffic density both on

the basis of autonomous and integrated terminal and area systems.



CODE	TYPE	CFL	COPout	ETO	TFL	RFL	DEST	REM/WRN
4502	A332	330	RATIN	1042	091	091	RJBB	ABI SND
6221	B744	330	BAEVO	1032	101	101	WSSS	ACT
2601	B757	330	XX1	1033	330	330	LGAT	ABI SND
6225	B744	330	BAEVO	1040	101	101	VHHH	ACT
2701	B734	320	ALT	1023	340	340	LYBE	ABI SND
7612	B763	210	KUBIN	1034	200	270	UMMS	ACT RCV
7611	T154	170	KUBIN	1025	150	270	UMMS	ACT RCV

SINTEZ: Functional Capabilities

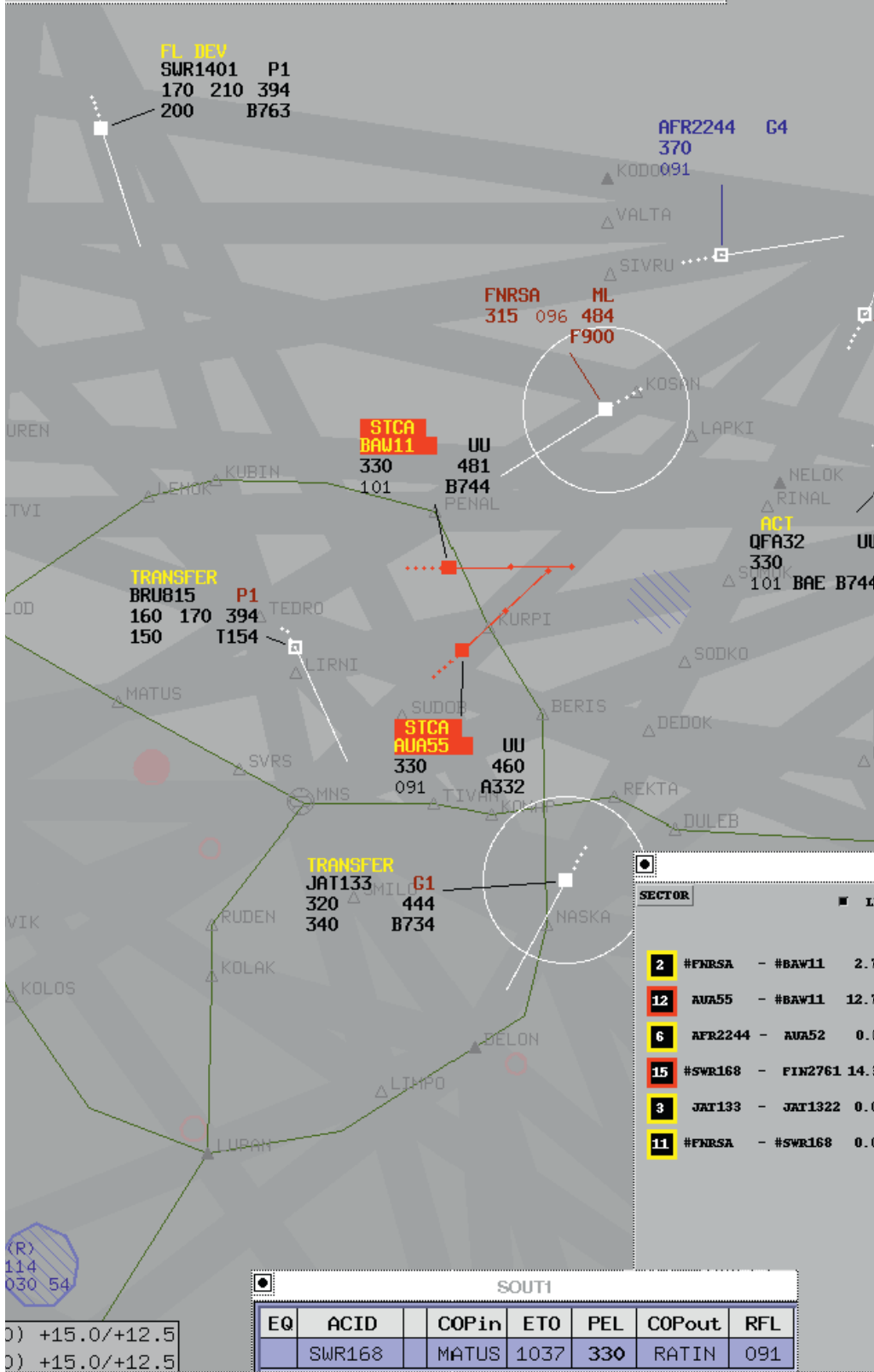
The generation of the SINTEZ ATC AS, version A3 (terminal and air nodal), A3 (area), AR3 (integrated terminal and area) for Consolidated ATM Centers and AR4 (for the Moscow Automated ATM Center) has the following functional capabilities:

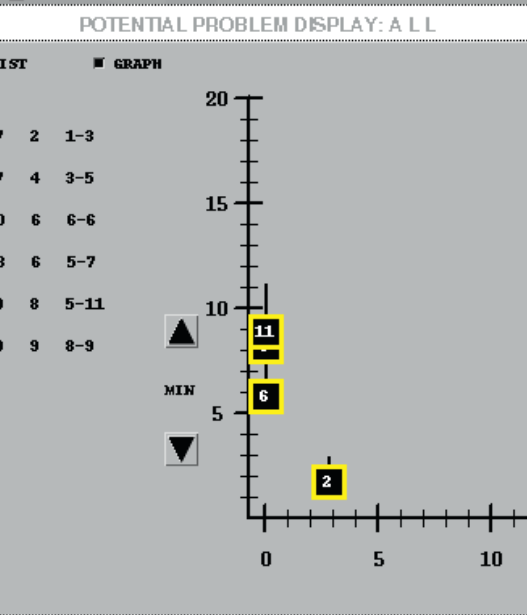
1. Safety Net – a pool of the following conflict alert functions:

▮ STCA (Short Term Conflict Alert) – a short-term conflict warning (up to 2 minutes);

▮ APW (Area Proximity Warning) – a function providing in the interval of 1 to 2 minutes the detection of A/C approaching (and penetrating) the protected airspace, in which the flight cannot be carried out, and the transmission of the respective warning to a controller;

▮ MSAW (Minimum Safe Altitude Warning) – a function providing the detection of A/C proximity to terrain/obstacles below the minimum safe flight





level (altitude, height) and the transmission of the respective warning to a controller;

1. APM (Approach Path Monitor) – a safety net. intended to warn the controller about increased risk of controlled flight into terrain accidents during final approach if the track is below the minimum altitude defined for that position on the glideslope.

2. TP (Trajectory Prediction) – calculation of the future progress of individual a/c on the basis of the current flight state, estimates of pilot and controller intent, expected environmental conditions, models of a/c performance,

3. MTCD (Medium-Term Conflict Detection) – medium-term detection of potential conflict situations at the prediction horizon of from 0 to 20–60 min on the basis of 4D trajectories taking into account a concept of separation for different flight phases. MTCD covers A/C conflicts, penetration into the air-space of special use; penetration into the holding area; proximity to terrain below the lowest flight level used.

4. TCT – Tactical Controller's Tools. They render assistance for a tactical controller in providing separation at the prediction horizon of up to 8 minutes.

5. MONA (Monitoring Aids) – flight conformance monitoring and reminders, to help a controller in monitoring all traffic under control. It allows detecting the A/C deviation from the desired 4D path with further warning a controller to this effect or starting-up the path recalculation. Moreover, it provides a controller with a reminders on the desired actions.

6. CORA (Conflict resolution assistant) – decision support in conflict resolution or in

estimation of the pilot's requests. It engages the decision support tools in the conflict resolution in the vertical/horizontal plane.

7. SYSCO (System Supported Coordination) – a system-to-system message handling method of flight transfer coordination between adjacent ATC units (implemented, e.g., by means of the OLDI protocol).

The ATM system of the Moscow ATM Center AS, including the complex of ATC automation facilities SINTEZ-AR4, currently under development of VNIIRA, performs also the following functions:

8. CPDLC (Controller Pilot Data Link Communications) – data exchange between a controller and a pilot using the ATC HMI and the digital data channel. It provides automated interaction of a crew and a controller. It is intended for reducing overload of a voice communication link between controllers and a flight crew. It is carried out via an air situation display interface at the main working position of ATC controller.

9. AMAN – Arrival Manager. The AMAN function is intended for organisation of the sequence of RWY use by arriving aircrafts taking into account departing aircrafts. AMAN sets an order of priority and forms a sequence of time moments of landing of the arriving aircrafts (arrival sequence).

10. DMAN – Departure Manager. The DMAN function is intended for organisation of the sequence of RWY use by departing aircrafts taking into account arriving aircrafts and organization of movement on the airfield. DMAN forms an optimal order of priority and a sequence of time moments of take-off of the departing aircrafts.





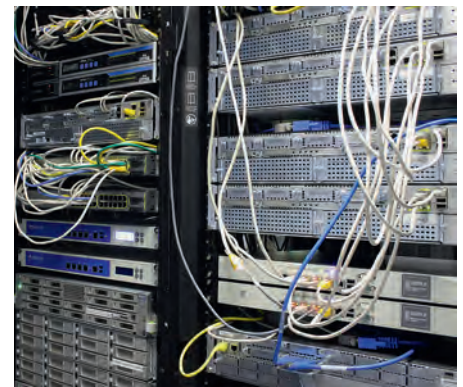
Surveillance Data Processing:

- reception and checking of radar data from any radar complexes (up to 32), data from ADS-B;
- tracking and integration of surveillance data from a number of sources including ADS-B and WAM (Wide Area Multilateration);
- correlation with the flight plan information;
- ADF data reception and processing;
- channel of direct access to radar data («by-pass») including the flight plan information elements.

Flight Data Processing:

- data reception from IFPS, flight plan database storage and management;
- processing, distribution and forwarding of plan information;
- calculation of spatiotemporal trajectories and prediction of air situation;
- correction of spatiotemporal trajectories according to radar data;
- assignment of SSR codes;
- silent cross-sectoral coordination and radar transfer of control;
- coordination with interfacing centers by the EUROCONTROL standard – OLDI (SYSCO);
- capability of RPL storage, AFTN

- message reception, and preliminary (daily) planning;
- data acquisition for calculation of air navigation services charges
- traffic load monitoring over defined sectors and other aeronautical elements in defined intervals.
- traffic analysis, preparation and issuance of statistical data on the use of airspace

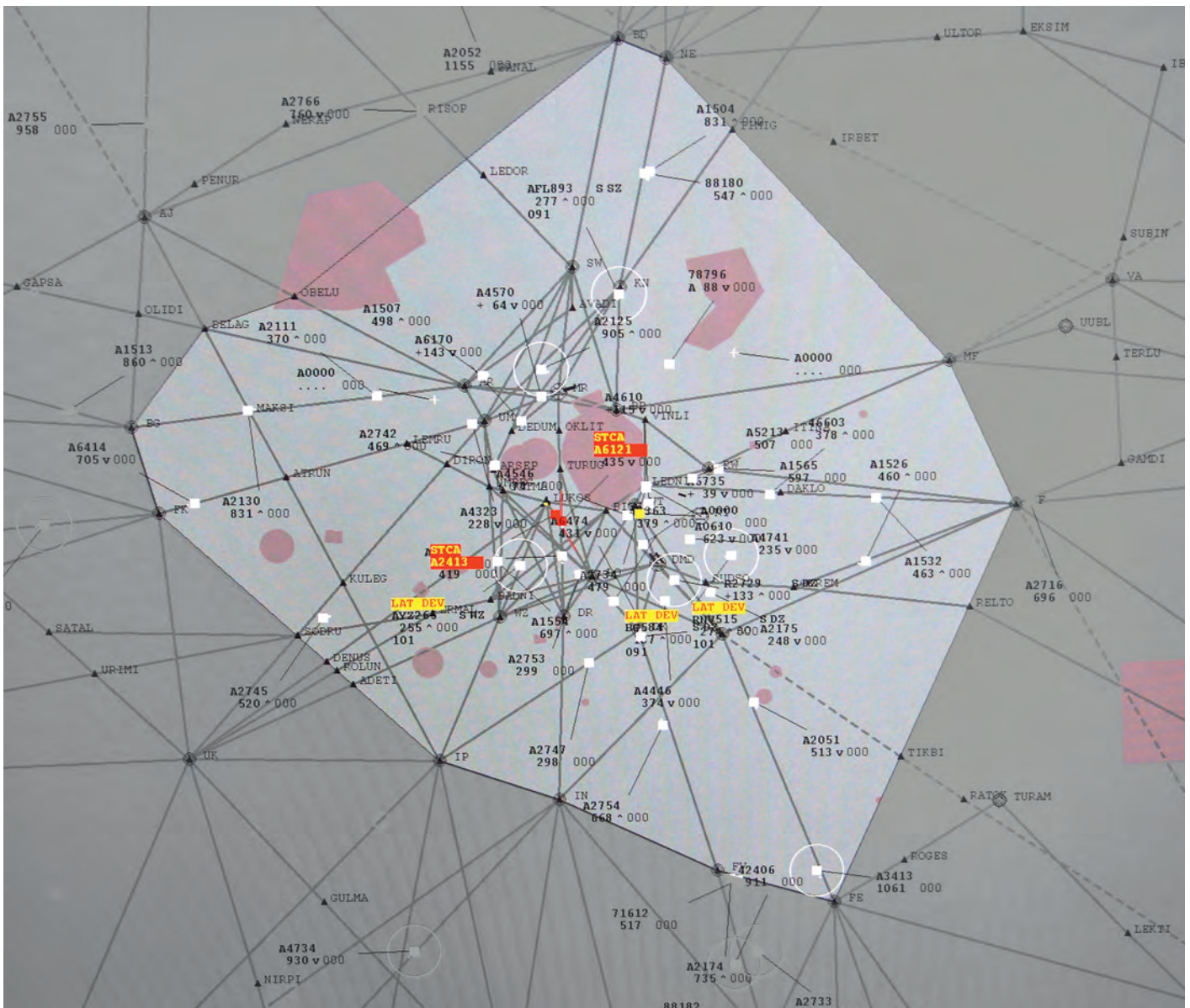


Analysis of Current and Predicted Air Situation for Absence of Conflicts and Conformity with Flight Plans:

- | medium-term potentially conflict situations (with look-ahead time of 2 - 60 minutes) on the basis of 4D trajectory prediction (MTCDD);
- | calculation and displaying of a probability of medium-term conflicts occurrence to a controller;
- | displaying of conflicting A/C and context A/C restricting maneuvering in the case of the conflict resolution implementation;
- | displaying of the air situation upright projection (Vertical Aid Window);
- | airspace use monitoring considering RVSM;
- | prediction and achievement of the boundary values of the separation norms (SSA);
- | short-term potentially hazardous close proximity (STCA);
- | descent below the safe altitude (MSAW);
- | potentially conflict situations with the airspace restrictions and hazardous weather phenomena (APW);
- | flight plan routes deviation, non-observance of the preset flight level and a reminder (MONA) and others;
- | final approach safety monitoring;
- | decision support in the conflict resolution in the vertical and horizontal planes;
- | function «what if».

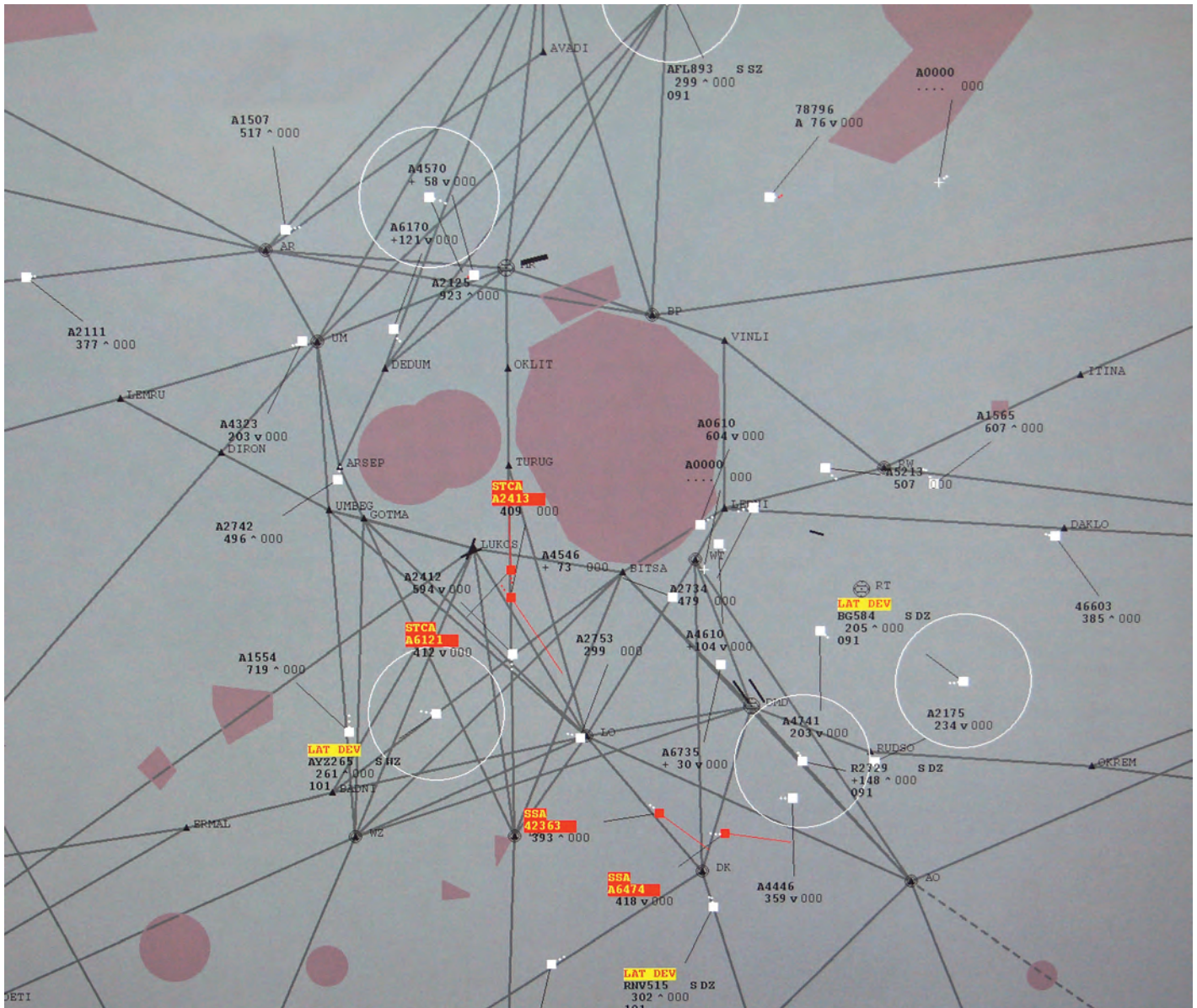
Processing of Meteorological Data

- | Processing of meteorological data, graphical and textual displaying (combined with the air situation displaying):
- actual weather on RWY,
- | hazardous weather phenomena,
- | weather and airdrome and flight route forecasts (METAR, SPACI, TAF, SIGMET),
- | constant-level balloon tracks;
- | Reception of meteorological data from the Meteoserver ADS.



Displaying of the Following Information on Integrated Air Situation and Flight Plan Data Displays:

- current air situation on the basis of multi-radar processing, including mapping, radar, bearing and meteorological data, information of ADS-B and WAM, temporary airspace restrictions, and hazardous weather phenomena;
- plan data structured in the form of planning lists and individual flight plans;
- windows of potentially conflict situations (PCS/PPD);
- attributes of PCS, information for their avoidance and plan deviations;
- various warnings and reminders;
- short-term prediction on radar state vectors extrapolation in terms of distance / minutes (both for all A/C and individually);
- medium-term conflict prediction in graphical and alphabetic-numeric form:
 - planning lists and sector inbound lists,
 - PCS window (PPD),
 - controller help window in the vertical plane (VAW),
 - predictable air situation (routes according to the plan),
 - selected and extended labels (ELW) with the information of compulsory reporting points (CRP) flyover,
- Traffic Load Monitor;
- data on interaction with adjacent ATC AS by the standard OLDI protocol;
- pseudoradar displaying of air situation information in the absence of radar data («track by plan»);
- information on the status of navigation and landing aids;
- air situation by sectors, current and anticipated traffic load (at the Area / Approach Supervisor working position).



Human-Machine Interface:

- l complies with the EUROCONTROL recommendations (Eatchip Phase III HMI Catalogue, etc.);
- l provides a stripless environment for ATC controllers' operations;
- l provides the combined display of air situation, sector planning, meteorological and reference data;
- l the graphical user-friendly HMI on the basis of the window technology minimizes a load on ATC controllers, and provides:
 - l displaying of minimum information required to a controller at the moment,
 - l easy access to additional information,
 - l lay-out of aircraft labels (ALs) depending on the A/C heading for reducing the number of ALs overlapping,
 - l automatic and manual anti label overlap settings,
 - l matching of the a/c label colour to the flight status,
 - l use of standard, selected and extended a/c labels,
 - l a graphic representation of the predicted air situation (speed vector, flight planed route), of the potential problems detected by MTCD
- l integral graphic representation of potential conflict situations (PCS) in special windows (PPD, VAW),
- l efficient graphic representation of information on particular short-term and medium-term PCSs (STCA, MTCD),
- l information input via the parameter menu by means of direct addressing to the respective elements.



Recording and Replay

- Continuous recording of information and controller's actions processed by the system;
- Storage of recorded information for the preset period of time;
- Active or passive reproduction in real or accelerated time at any prescribed working position;
- Synchronous voice and data replay;
- Statistics on the airspace use and aircraft violations of the predefined separation limits.

Technical Monitoring and Control

- Continuous monitoring of performance of all system components, including all sources of information;
- Window-based graphical interface of a System Supervisor;
- Automatic and manual reconfiguration of system components according to operational or technical need;
- Acquisition and displaying of information on the status of navigation and landing aids;
- Recording of system events and shift engineer's actions;
- Documentary and graphic representation of archive information for the following analysis;
- On-line testing of all system components.

Training of ATC Controllers

- Integrated or autonomous training simulator carrying out all system functions;
- simulation of the air situation controlled by pseudo-pilots on the basis of flight plans or combination of real and simulated air situation;
- Air situation simulation in the real or fast time scales;
- Autonomous sector-wise exercises with the simulation of interaction with adjacent sectors, and system-wide exercises;
- Recording and reproduction of exercises synchronously with voice data;
- Simulation of the visual ground situation (using the 3D graphics) for training controllers of runway and taxiing operations.



External Interfaces

- The EUROCONTROL standard ASTERIX for the radar complex, the library of CIS protocols, and any customer's protocols.
- Automatic direction finders (ADF).
- AFTN for messages on flight plans and METEO messages (METAR, SPECI, TAF, SIGMET).
- IFPS AS.
- Meteoserver ADS. AWOS, automated MPR, AFTN, and Automated Document Printing System of the State Committee on Hydrometeorology and Natural Environment Monitoring (Goscomhydromet).
- Interfacing ATC AS (OLDI).
- Extensibility of mode S, ADS-B, CPDLC and ADS-C by SSR.
- Interfacing with satellite – based data links.

Basic System Solutions

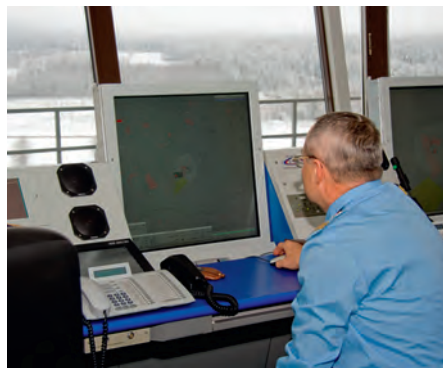
- Conformance to the standards and recommendations of the world aviation community: ICAO and EUROCONTROL (COPS/CWP, documents of programs EATCHIP (REFGHMI, HMI Catalogue), Link2000+, FASTI, SESAR, etc).
- System-level SW providing the architecture openness and the system extensibility:
 - UNIX OS (Solaris);
 - Protocols of LAN ETHERNET TCP/IP, SNMP;
 - Graphic package X-Windows X11-R6, Qt;
 - MySQL database.
- Conformance of the HMI to the EUROCONTROL recommendations: document EATCHIP PHASE III HMI Catalogue, etc.

- Standard advanced computer aids (COTS). Work stations and servers from the leading manufacturers (Oracle, Sun, HP).
- Standard state-of-the-art display facilities: LCD monitors 28» (2048 × 2048), 30» (2560 × 1600), and 24» (1920 × 1200).
- The ATC sectors consist of two independent Controller Working Positions (CWPs) in the suite providing both separate performance of the TC and PC roles and combined by one controller at one CWP.
- Backup and hot standby of the group servers, LANs, work stations, and availability of the channel of direct access to radar data, including plan data elements, ensure failure-free performance of the system.

The system of work stations for airport area AT controllers «SINTEZ-ARM-A» and ATC area «SINTEZ-ARM-R» is the simplest element offered by the unified series of «SINTEZ» ATC WSs designed to computerize air traffic control in the airport area and ATC areas showing medium and low air traffic density. The WSs are fitted in the regional centers of common air traffic control system, APPs and ATC towers, also used as «by-pass» for «bigger» systems.

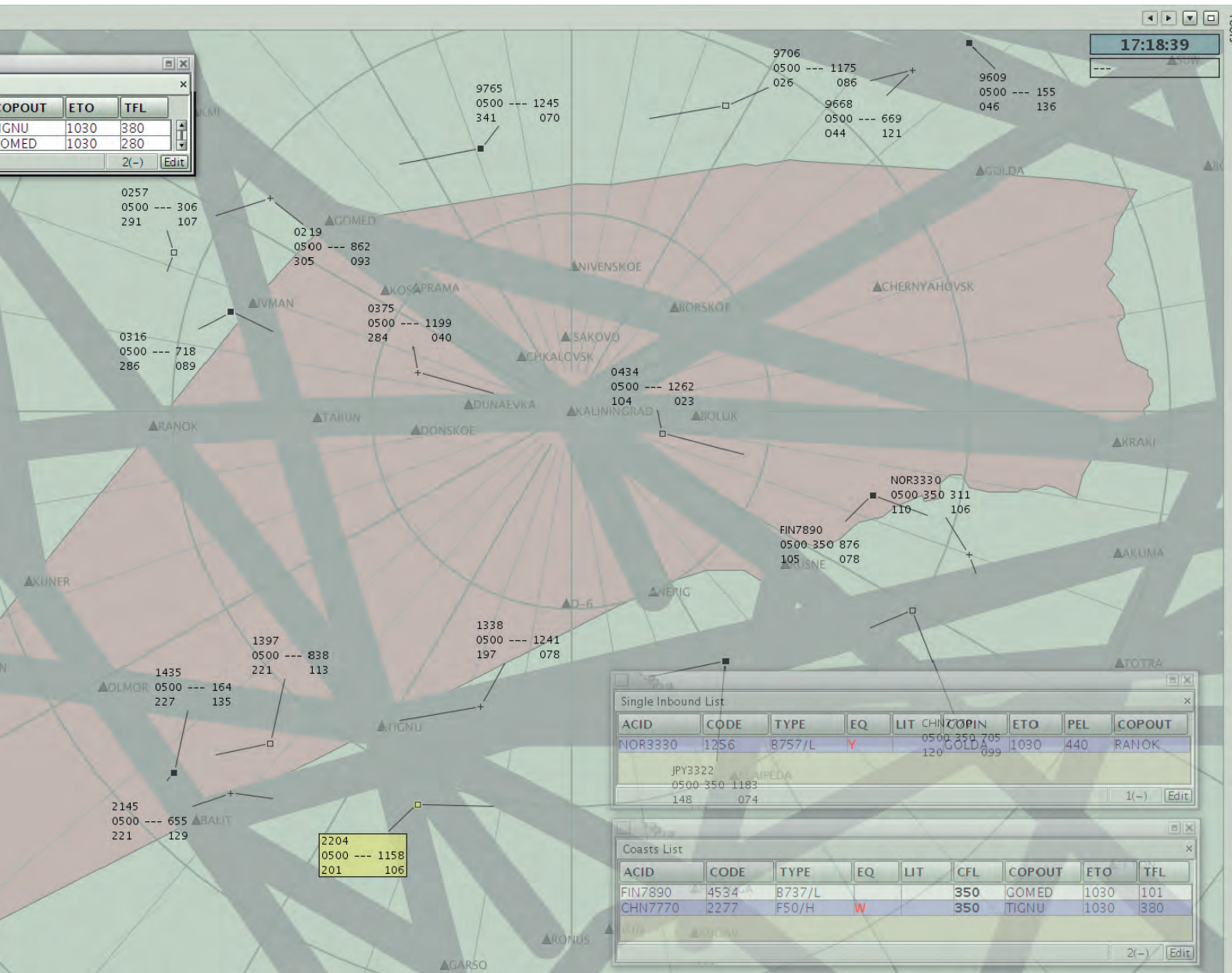
ATC WSs are compatible with:

- | Radar systems of all types both with suitable data processing & transfer equipment (DP&TE) and without it;
- | Automatic direction-finders;
- | ADS-B 1090 ES ground stations;
- | Weather data sources.



Primary computerized processes

1. Collection, processing, and capturing data which give air situation (AS), including:
 - | Radar (up to 8 radars) and ADS-B 1090 ES;
 - | Directional;
 - | Weather (AWOS, AMWR).
2. Input, processing, and capturing data which give elements of current flight plans (Callsign, COP, CFL, TFL, PEL, DEP, DST, etc.).
3. Tertiary processing of radar data provided that several radars are used.
4. Analysis of current and predicted air situation to avoid conflicts, including the following warnings:
 - | Reaching boundary values of separation norms (SSA);
 - | Short term conflict alert (STCA);
 - | Minimum safe altitude warning (MSAW).
5. Ensuring safe final approach in response to information from the airdrome secondary surveillance radar.
6. Capturing AS on indicators:
 - | Current AS, including Sector Inbound List (SIL), air space restrictions, and hazardous weather phenomena;
 - | Mapping information;
 - | UserForms to enter elements of plan information, SIL, and Coasted Tracks list;
7. Record-keeping and playback of AS data.
 - | Range and Bearing vector between two selected points, one, both or neither of which may be a track;
 - | Short-range prediction of AS based on radar data;
 - | Signs of potential short-term conflict situations (SSA, STCA, MSAW);
 - | Sign of failure to keep at Cleared Flight Level;
 - | Signs of deviations from the final approach on-course and glide slope lines.



Technical parameters

The ATCWS system consists of workstations using UNIX (Solaris) operating system according to EUROCONTROL recommendations and ensures:

- Display of information on 30 air situation indicators having a resolution of up to 2,560 × 1,600;
- Human-machine interface is implemented based on EUROCONTROL recommendations considering specific ATC in Russia;
- Operating time provided failure of external power supply network – up to 30 min (from a Local UPS);

Mean Time between failures – at least 20,000 hours.

The system consists of interconnected WSs and ensures automatic distribution of data across the WSs (elements of flight plan and other data inputs made on one WS proceed to another).

The work station system may be set up without dedicated group equipment (server mount) which reduces configuration costs. The system consists of two interconnected work stations (one work place with 100% redundancy).

Additional modifications

- If CUSTOMER so requires, analogue radar information may be displayed («raw» video).
- Complexation of WSs for TMA, APP and En-route ATC operations using LAN ensures collection and merging of radar data from the number of radars as required by CUSTOMER.
- «Sintez-T» training module may optionally be set up.

Earlier generation of «SINTEZ-ARM-A» and «SINTEZ-ARM-R» ATC WSs have been furnished and successfully operate in more than 30 Area and TMA+APP ATC units all over Russia and CIS countries.

VNIIRA.

AIR TRAFFIC MANAGEMENT
SYSTEMS AND AIDS

Complexes of Air Traffic
Control Automation Aids

Air Surveillance Aids

Navigation and
Landing Radio Systems

Weather Radar Systems

Airborne Navigation and
Landing Equipment

Antenna and Feeder
Systems and Devices

Automated Flight
Test System (ASLK)

ATC Training Systems



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SYSTEMS AND AIDS