

Call: 2022

Project acronym: CERN-CONNECT

CERN Research Programme / Experiment: ALICE, ATLAS, LHCb, LCG, ISOLDE, n_TOF, NA62, MoEDAL, WA105, NA65, RD50

Annual Summary Document*

Year: 2024

Project Title: Improving the reliability and resilience of the data network for supporting the national contribution to the CERN's scientific program / CERN-CONNECT

Project Work Plan (according to the contract)

Stage:

II. Improving the resilience of the connection to the NREN for the CERN-RO experiments

Activities:

II. 1. Procurement, installation, configuration and putting into service of the routing equipment for PoP Magurele

II. 2. Procurement and installation of local networking equipment necessary for the IT support of the ATLAS experiment at P2

II. 3. Implementation and testing of a centralized system for monitoring the availability of the RO-CERN.net nodes

Allocated budget: 750.000 lei

Realized budget: 750.000 lei

* Please fill in all the required items and do not alter the template

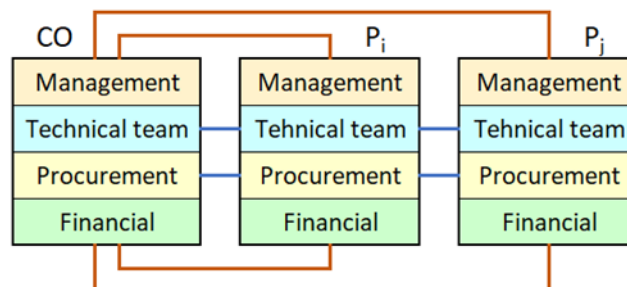
Annual Summary Document 2024

1. Cover Page

- Team description (organization, coordination, personnel, members' roles)

1.1 Organization and coordination

Each participant's team consists of 4 work groups, as in figure. Coordination is carried out: 1) horizontally [a) CO's project/financial managers coordinate each partner's management /financial reporting; b) between the technical / procurement teams of all participants]; 2) vertically, within each participant's team, coordinated by the local project management.



1.2 Personnel and member's roles

COORDINATOR (CO): Horia Hulubei NIRD for Physics and Nuclear Engineering (IFIN-HH)

Nr.	Name	Role in project	Position
1	Mihnea DULEA	Project director	Senior researcher I
2	Mihai Liviu CIUBANCAN	Technical manager of the project	Network administrator
3	Eduard Andrei CSAVAR	Procurement manager	IT Specialist
4	Gheorghe ANDREI	Financial manager of the project	Economist

PARTNER 1 (P₁): NIRD of Isotopic and Molecular Technologies Cluj-Napoca (INCDTIM)

Nr.	Name	Role in project	Position
5	M. Radu C. TRUSCA	Project manager @P1	Technological devel. eng. I
6	Felix FARCAS	Technical management	Technological devel. eng. I
7	Jefta NAGY	Network specialist	Technological devel. eng. III
8	Victor ZARBO	Procurement management	Technological devel. eng. III
9	Cristian Andrei LUPSE	Team member	Technological devel. eng. III

PARTNER 2 (P₂): 'Alexanru Ioan Cuza' University of Iasi (UAIC)

Nr.	Name	Role in project	Position
10	Octavian RUSU	Project manager @P2	Senior researcher III
11	Ciprian PANZARU	Technical management	Senior researcher III
12	Paul GASNER	Procurement & financial management	Senior researcher III
13	Valeriu VRACIU	Network specialist	Scientific research assistant

PARTNER 3: National Univ. of Science and Technology POLITEHNICA Bucharest (UNSTPB)

Nr.	Name	Role in project	Position
14	Voichita IANCU	Project manager @P3	Head of works dr. eng.
15	Mihai CARABAS	Technical management	Prof. dr. eng.
16	Aurelia GHEORGHE	Procurement management	Economist
17	Nicolae TAPUS	Team member	Prof. dr. eng.
18	Valerica MUSAT	Financial management	Economist

2. Project objectives (1 page max)

- Scientific motivation for the local team in the context of the experiment

Romanian scientists are currently involved in 11 experiments performed at CERN: ALICE, ATLAS, LHCb, LCG, ISOLDE, n_TOF, NA62, MoEDAL, WA105, NA65, RD50. The success of these CERN-RO collaborations depends significantly on the reliability of the communication of scientific data with CERN through the National Research and Education Network (RoEduNet), to which the institution's local networks are linked.

The general objective of the CERN-CONNECT project is the strengthening of the national participation in the above-said experiments by investments in high-tech networking equipment to be used in common by the CERN-RO research teams. These investments are mainly motivated by the need to improve the performance and resilience of the connection at CERN, by renewing and upgrading the network equipment currently in use. Thus, the aim is to fix the following current communication deficiencies: a) the advanced degradation of the equipment at the Magurele Point of Presence (PoP), that prevents the balance and backup of the internet services; b) the insufficient and/or unreliable access of some teams to the bandwidth provided by the local RoEduNet PoPs; c) the physical vulnerability of a segment of the Magurele-RoEduNet link, which is used in common by all CERN-RO experiments and is exposed to accidental damage.

The specific objectives of the project are:

O1. Improving the resilience of the connection to RoEduNet for the CERN-RO experiments

This objective is achieved through the purchase, installation, configuration and putting into service of networking equipment required for connecting all the CERN-RO teams from Magurele to the RoEduNet backbone. These actions, to be performed in 2024, will eliminate vulnerability a) above.

O2. Improving the local networks' connections to the RoEduNet backbone.

This involves the purchase, installation, configuration and putting into service of the networking equipment for upgrading the connection of the participants to RoEduNet, in order to solve problem b) above. The activities are planned to be carried out in 2023-2024.

O3. Improving network's physical safety at the border of the Magurele Platform domain.

A safer physical path will be realized for the connection to RoEduNet of the CERN-RO teams located in Magurele. This will eliminate the vulnerability described at point c) above.

O4. Implementation and testing of a centralized system for monitoring the availability of the RO-CERN network nodes.

The monitoring system, to be completed in 2024, will provide statistics that will measure the quality-of-service improvements resulting from the project's activities.

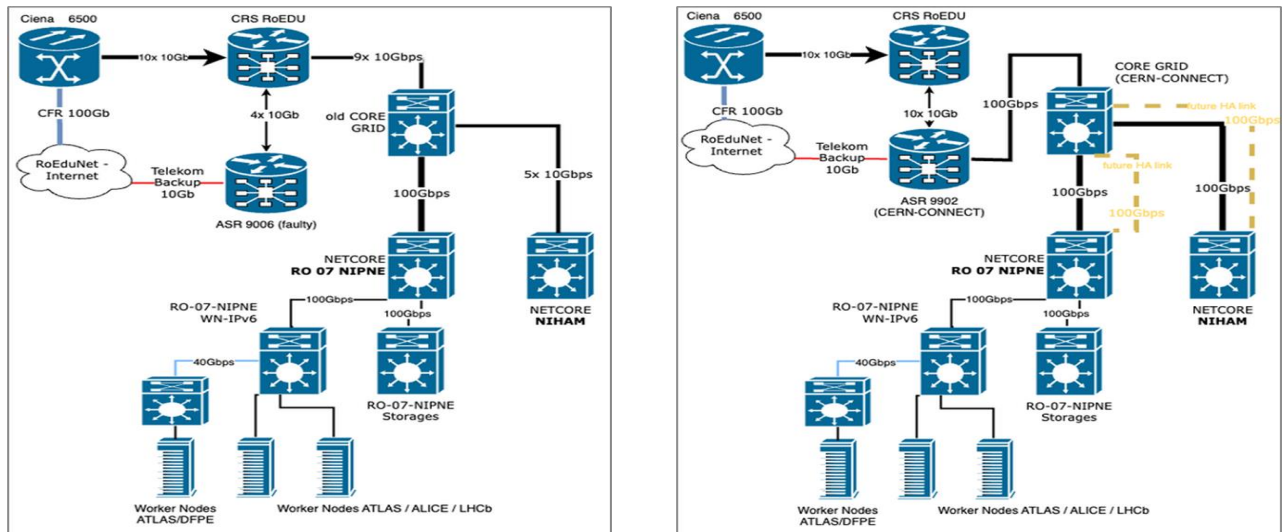
3. Project Status (2 pages max)

- Describe the progress in achieving the project scientific goals

1. Upgrading the routing equipment for PoP Magurele (Activity II.1, objective O1)

For improving the resilience of the data connection between Magurele PoP and RoEduNet, CO purchased a Cisco ASR 9902 router from CERN-CONNECT budget, together with 100G optical modules from other sources. The router has 48 ports: 2x QSFP-DD 10/40/100GbE, 6x QSFP28 10/40/100GbE, 16x SFP28 dual-rate 25/10Gb, 24x SFP+ 10Gb. The purpose of this investment is to provide a reliable connection to CERN for the Grid sites and for 11 CERN-RO experimental groups located in Magurele, together with an upgrade from 20 to 100 Gbps of the uplink for ALICE ISS. After the configuration by the NREN and testing, the router was commissioned.

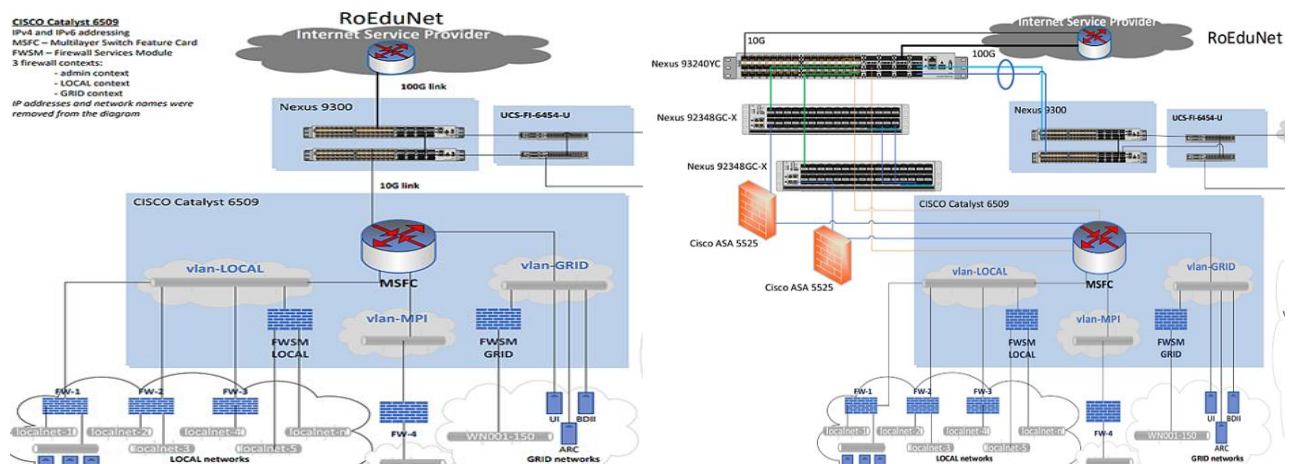
Magurele node of communications before and after the upgrade made with funding from the CERN-CONNECT project is represented below.



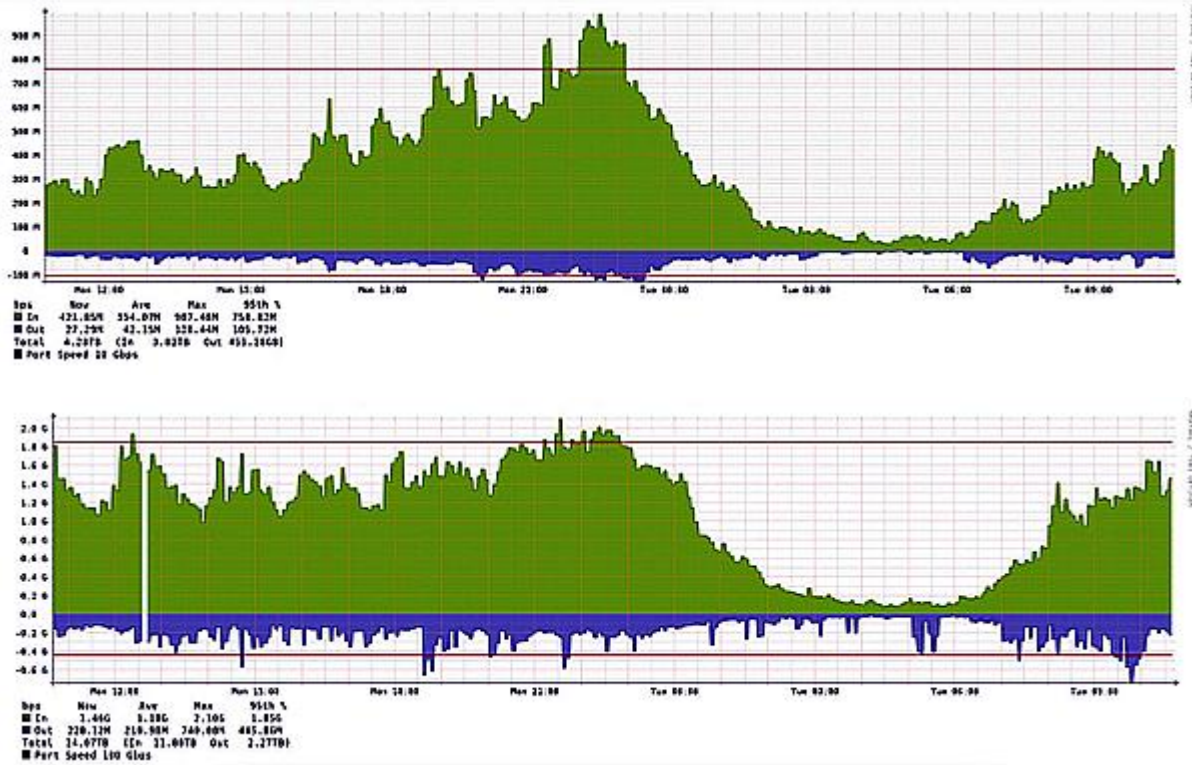
2. Upgrading the network support for the ATLAS experiment (Activity II.2, objective O2)

Partners P1 and P2 performed this year uplink upgrades from 10 to 100 Gbps.

Partner **ITIM** (P1) installed and commissioned the equipment purchased in the first stage of the project (1x CISCO NEXUS 93240YC L3 switch with 48x 1/10/25-GbE SFP28, 12x 40/100-GbE QSFP28; 2x CISCO NEXUS 92348GC-X L3 switch with 48x 1GBASE-T 100 Mbps/1 Gbps, 4x p. SFP28 1/10/25 Gbps, 2x p. QSFP28 40/100 Gbps; optical modules for switches). The local network configuration before and after the upgrade is represented below.



Partner **UAIC** (P2) upgraded the data link of the site RO-16-UAIC to RoEduNet from 10 to 100 Gbps. This operation involved the network equipment of the university, through which the RO-16-UAIC site is connected to RoEduNet, as the Grid site does not have its own dedicated connection. UAIC expanded the institution's connection capabilities, including the Grid site, by raising the bandwidth capacity towards RoEduNet from 10 Gbps to 100 Gbps. The data traffic before and after the upgrade over a 24-hour timeframe is depicted in the figures below. Both the volume of transferred data and the bandwidth got an increase of about 3.5 times.



Also, the quality of the optical connections had to be improved in order to take advantage of the enhanced bandwidth capacity, so it was necessary to review and redo all patching and splices used for RO-16-UAIC site connection. As a result, the RO-16-UAIC node's downtime, as well as the optical fiber's attenuation and reflection coefficients, dropped as the new optical fibre splicer was used to improve splices quality.

3. Rehabilitation of the Magurele uplink (Objective O3)

According to the intervention plan devised in the previous stage of the project, the data link segment located at the Magurele bridge had to be buried for improving its physical safety. While the necessary materials (conduit, wire, connection plugs and FO junctions) were purchased last year from project budget, this year's excavation service was paid from IFIN-HH's funds, whose personnel also pulled the fiber optic wire through the 294 m protective conduit. Under the coordination of the project's staff, DFCTI's personnel carried out the bonding of the three pairs of FO at both end junctions.

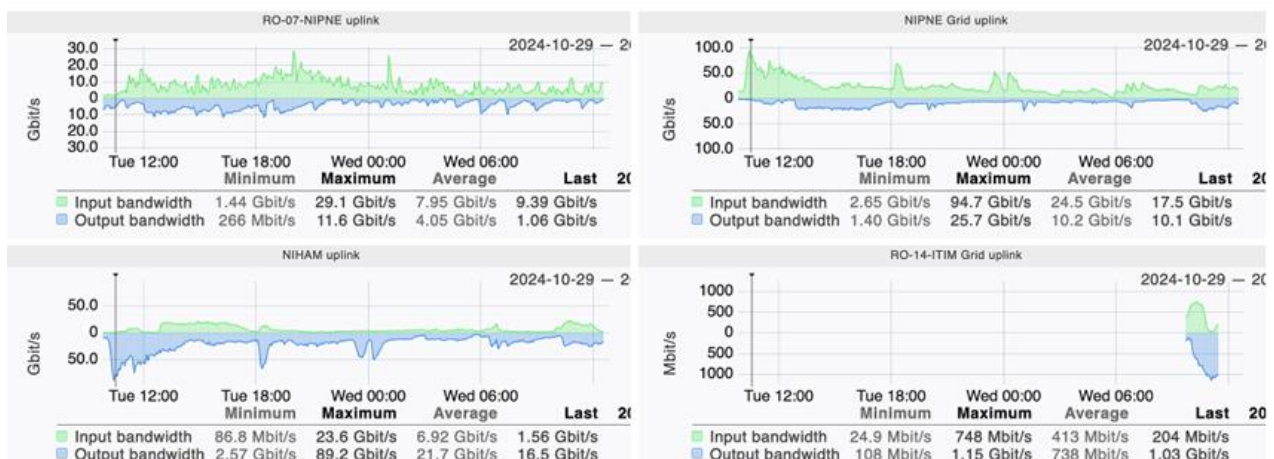
By carrying out these operations, objective O3 (improving network's physical safety) is achieved, eliminating the vulnerability of the data connection between CERN and the institutions that host the research tems of the 11 CERN-RO experiments.

4. Centralized monitoring system for RO-CERN.net (Activity II.3, objective O4)

The implementation of the monitoring system of RO-CERN.net terminal nodes has started after commissioning the local networking equipment purchased during the first stage of the project.

The nearby figures present screenshots of CheckMK display showing the traffic performance of four nodes upgraded by CERN-CONNECT. The aggregated traffic at the Core Grid shows a maximum throughput of 94.7 Gbps. Testing of the monitoring system will continue, together with its extension to other network nodes.

IFIN / GRID / CERN_Connect					
State	Host	Icons	OK	Wa	Un
UP	CERN-Connect-Cluj	☰	41	1	0
UP	CERN-Connect-Iasi	☰	1	0	0
UP	CERN-Connect-NIHAM	☰	45	0	0
UP	CERN-Connect-RO-07-NIPNE	☰	63	0	0



- Describe the technological output and its role in creating a more unified approach of the Romanian teams to the CERN experiments

The equipment purchased within the project implements identical high-quality standards for the internet services delivered to all the CERN-RO teams. Thus, in IFIN-HH: ISOLDE and n_TOF teams benefit of the 100 Gbps upgrade of Nuclear Physics Dept.’s uplink, while ALICE (DFH) upgraded its uplink from 50 to 100 Gbps. The new ASR provides 100 Gbps for all CERN-RO teams located at the Magurele campus: ATLAS and NA62 from IFIN-HH, RD50 from INCDFM, NA65, ALICE and MoEDAL from ISS, WA105 from the Physycs Faculty. Moreover, upgrades for ATLAS were performed at ITIM and UAIC. Thus, the new infrastructure offers to the CERN-RO teams similar bandwidth, speed and availability conditions for transferring large amounts of data from the international CERN community for backup, processing and analysis, and for sending their own simulation results.

Moreover, starting with 2025 the network nodes will be monitored in a centralised manner contributing to the keeping of these standards and of high service reliability of service, which will become the defining features of CERN-RO.net.

Due to the project’s results the upgraded RO-CERN.net becomes an irreplaceable technological tool for sustaining the unified participation of the national research community in the CERN experiments.

Benefits of the CERN-CONNECT project for the CERN-RO scientific community

In addition to the obvious benefits to worldwide scientific users of the LHC Grid sites hosted by IFIN-HH, ISS, ITIM, UAIC, UNSTPB, the CERN-RO research groups benefit from the improved bandwidth and reliability of the data network, as follows:

1) Groups that benefit from local data network upgrades

ATLAS group @UAIC (4 persons)

As members of the Data Quality Group, we have seen a significant reduction in reaction time, which has led to an increase in action efficiency. On the other hand, our group uses local machines and a lot of CERN data, both real and MonteCarlo simulated, to work on Machine Learning and IMC (international Masterclasses) approaches; the better performance of this activity that was ascertained recently is due to the increased speed of the data connection.

ATLAS group @ITIM (13 persons)

After the upgrade, the R&D team that contributes to the realization of mechanical component for ATLAS detector observed better stability and connection speed during online conferences with CERN/ATLAS and when exchanging messages with the collaboration.

ISOLDE group @IFIN-HH (40 persons)

The Romanian ISOLDE team actively involved in data analysis following experiments performed at the ISOLDE Decay Station has benefited from the connection upgrade through a much faster data transfer rate between remote and local servers. Another advantage is that most graphical applications can now be accessed directly through servers at CERN, which is a valuable possibility especially during online data taking. The local experiments running at the 9MV Tandem Accelerator share the same upgraded network connection and also benefit from the high data transfer rate. They no longer interfere, by slowing down the network speed, with parallel data transfers from the CERN servers.

n_TOF group @IFIN-HH (10 persons)

During the last period the Romanian n_TOF team was involved in several tests of LaBr3 and HPGe detectors using the neutron beam at n_TOF. The data were analyzed on the CERN computing system using the remote connection from Bucharest and took advantage of the improved Internet connection of the Nuclear Physics Department (DFN), in particular when graphical options were required. Also, data acquired at n_TOF were partially copied to the local computers for further analysis and this process implied the transfer of large data files. Finally, the improved connection will be essential in the near future as the Romanian n_TOF team proposed two experiments that were approved by the INTC. Data analysis of these measurements will fully use the upgraded capabilities installed locally.

ALICE group @UNSTPB

Even if the UNSTPB partner is not performing physics research, it became a full member of the ALICE Collaboration, which it supports through computing infrastructure, software development, together with shifts and internships at CERN. The upgrade of UNSTPB's network uplink improved the interaction with CERN, contributing to the speedup and completion of the PhD work on ALICE Computing topics for three students (Elena Mihailescu, Sergiu Weisz, Darius Mihai).

2) Research groups benefiting from upgrading the routing equipment from Magurele

As result of the completion of Activity II.1, the reliability of the connection to CERN was enhanced for: ALICE, NA65, MoEDAL groups from ISS, whose bandwidth increases by 5 times; ALICE, ATLAS, LHCb, NA62 groups from IFIN-HH; RD50 group from NIMP; RO-DUNE group from the Faculty of Physics of the University of Bucharest.

- Highlight the gain in expertise (scientific and technological) in the past year

Configuring and operating the purchased equipment, which is based on state of the art technology for providing uplinks with 100Gbps bandwidth and offering high-availability services, increased the data communications know-how and expertise of the technical staff. Also, technological expertise was gained in centralised monitoring of systems of network nodes distributed in different domains.

4. Deliverables (in a concise form)

- Highlight the team achievements in the past year
 - a. concrete facts such as
 - i. product/device deliveries
 - ii. paper publications, talks in conferences
 - iii. outreach activities
 - iv. other deliverables (patents, books etc)
 - b. explain why they are important in the context of the scientific goals, give qualitative/quantitative indicators (no more than 2-3 phrases/item)

The main quantifiable results obtained by the CERN-CONNECT team during the second stage of the project are as follows:

- 1x task book for CO's procedure of router purchase;
- 1x Cisco ASR 9902 router purchased, for improving the resilience of the data connection between Magurele PoP and the NREN.
- 2x network uplinks upgraded to 100 Gbps due to the project, at P1 and P2
- 1x underground 294 m network segment, for improving physical security of the connection to the NREN.
- 1x centralised monitoring system of the data traffic volumes at the nodes of RO-CERN.net.
- 3 talks on topics that includes CERN-CONNECT's achievements, given at the International Conference on Advanced Scientific Computing ICASC 2024, October 23 – 25, 2024, Cluj-Napoca: "RO-LCG current status and strategy", by M. Dulea; "Sharing grid support for ALICE, ATLAS and LHCb at RO-07-NIPNE", by M. Ciubancan; "Software improvements at site RO-14-ITIM", by F. Farcas.

6 Future group activities and plans for the next year and a longer perspective (1 page)

- a. List the goals, the timelines, the key opportunities
- b. Mention potential new collaborations, local synergies, education, outreach etc.

During 2025 new nodes of the RO-CERN.net will be integrated in the monitoring system and tested in production regime.

Long-term collaboration with the RoEduNet NREN and with other WLCG will continue for upgrading the network services, as stipulated in the RO-LCG Strategy.

New collaborations will unfold with the research and education entities on the Magurele Platform that will use the same ASR and PoP, such as the Faculty of Physics – University of Bucharest, and the National R&D Institute for Materials Physics, partners in the CERN-RO DRD3 RADASS proposal.

CERN-CONNECT acts in synergy with the project *National contribution to the development of the LCG computing grid for elementary particle physics / CONDEGRID* and with the other CERN-RO projects, for the support of the Romanian collaborations with CERN.

Students from the faculties of Physics and Informatics of the Bucharest University will benefit from training and employment prospects provided by CO on advanced ITC topics related to CERN-RO.net.

P1 group will hold lectures at the Technical Univ. of Cluj-Napoca and highschoools, together with outreach, regarding networking for Grid and Cloud computing.

P3 will present CERN-RO.net as a case study within the networking lectures provided to its students.