Science Fund
of the Republic of Serbia

Quarterly Administrative Report

1. Program and Project information	
Name of the Program:	IDEAS - Engineering and Technological Sciences
Name of the Project:	Hybrid Integrated Satellite and Terrestrial Access Network
The Project acronym:	hi-STAR
Project realization period (from dd/mm/yyyy to dd/mm/yyyy):	Start date:01/07/2024 - End date:30/09/2024
Reporting period (insert Q1, Q2, Q3, Q4, …, Q8):	Q11

2. Project participants information	
2.1. Principal Investigator (PI) and Lead Science and Research Organization (SRO)	
Name and last name of the PI:	Predrag Ivaniš
Academic and research title of the PI:	Full professor
SRO name:	School of Electrical Engineering, University of Belgrade (SEE)
SRO authorized person (legal representative) name and last name:	dr. Dejan Gvozdić

2.2.* Project Partners - Science and Research Organizations (SRO)	
SRO name:	**Faculty of Electronic Engineering, University of Niš (FEE-UNI)**
SRO authorized person (legal representative) name and last name:	**Prof. dr Dragan Mančić, dean**
SRO name:	**Innovation Center, School of Electrical Engineering, University of Belgrade (ICEF)**
SRO authorized person (legal representative) name and last name:	**Ilija Radovanović, vice director**

*Copy this table as needed to provide information about all Partner SROs.

2.3. Members of the project team

Name, last name	Academic and research title*	Science and Research Organization (SRO) Acronym
PI: Predrag Ivaniš	Full professor	SEE
P1: Goran Đorđević	Full professor	FEE-UNI
P2: Lazar Saranovac	Full professor	SEE
P3: Zoran Čiča	Full professor	SEE
P4: Dejan Drajić	Senior research associate	ICEF
P5: Srđan Brkić	Assistant professor	SEE
P6: Dragomir El Mezeni	Assistant professor	SEE
P7: Vesna Blagojević	Associate professor	SEE
P8: Vladimir Petrović	Assistant professor	SEE
P9: Haris Turkmanović	Teaching assistant	SEE
P10: Đorđe Sarač	Junior research assistant	SEE

P11: Ivan Vajs	Research assistant	ICEF
P12: Goran Marković	Associate professor	SEE

*In case of any changes in the status of academic and research titles of team members, submit the appropriate decision on acquiring academic and research title of the team member(s) in question, justifying the change of the status.

2.4. Project team performance

Are the project team members performing their roles and tasks in line with the approved Project Proposal (as presented in the Project Description A, Gantt Chart, Budget and other project documentation)? Is the cooperation between team members adequate? If NO, elaborate.

Project team members perform roles and tasks fully per the approved Project Proposal. The cooperation between team members is adequate, and the obtained results represent a good starting point for the synergy of the project team in the next quarter.

In the eleventh quarter, our focus was on WP4, WP5, WP6, and WP7.

In this reporting period, we have proposed a novel strategy for adaptive coding and modulation employment in land mobile satellite networks. The proposed solution incorporates machine learning techniques to predict channel state information and subsequently increase the overall spectral efficiency of the network. Majority of efforts in the previous quarter were on completion of the HUT framework that can support steering of data streams through satellite or terrestrial paths. Simple quality of service mechanism and channel model are implemented to get initial performance results. HUT framework is currently able to track percentage of lost packets on both data channels and have simple hysteresis threshold logic for switching data stream from one to another channel.

One paper was published in the international journal from the JCR list, in the journal Electronics (published in September 2024), two papers were presented at international conferences CSNDSP 2024 and IcETRAN 2024, and four papers were submitted to the international conference TELFOR 2024.

During the reporting period, were there any unforeseen circumstances requiring a change in any of the team members, including the PI? (This includes a change of job or contract of a team member, or a change in the research or academic title, longer-term absence like parental leave, inability to work or any other relevant change.) If YES, elaborate.

No.

3. Progress on implementation and results achieved

3.1. Milestones - Short description of milestones achieved during the reporting period, with reference to the Project Description and Gantt Chart.

	Milestones title – insert milestone name*	**Delivery month (Mx)** from Gantt Chart	**Milestone reached**	**If not reached, enter estimated month (Mx)**
1	M4.2. HUT implementation and verification	M33	No	M35

*Based on milestones planned in Table 3.2d in the Project Description A (Approved Project Proposal - Project Description, in accordance with the Decision of the Managing Board) and Gantt Chart (Annex 3 of the Contract on the Project financing).

3.2. If a milestone is not reached, please explain – based on milestones planned in Table 3.2d in the Project Description A (Approved Project Proposal - Project Description, in accordance with the Decision of the Managing Board) and Gantt Chart (Annex 3 of the Contract on the Project financing). If a milestone is reached, enter N/A.

M4.2. HUT implementation and verification: There is a delay as the initial WP4 leader (Srđan Brkić) left the project team, and we had problems with the desktop computer used in the activities in WP4 (hard disc was replaced in Q10, the processor will be replaced in Q12).

3.3. Deliverables - Short description of deliverables achieved during the reporting period, with reference to the Project Description A and Gantt Chart.					
	Tasks/activities*	**Deliverable name****	**Delivery month (Mx)** from Gantt Chart	**Achieved Deliverable**	**If not achieved, enter estimated delivery month (Mx)**
1	WP6, Subactivity 6.1	D6.1 Channel emulator for 5G/satcom signals	M30	No	M34
2	WP4, Subactivity 4.3	D4.3 Evaluated of integrated HUT module	M33	No	M35
3	WP1, Subactivity 1.2	D 1.3 - Quarterly progress reports	M33	Yes	

*Based on tasks presented in Table 3.2c in the Project Description A (Approved Project Proposal - Project Description, in accordance with the Decision of the Managing Board) and Gantt Chart (Annex 3 of the Contract on the Project financing).
**Based on deliverables presented in Table 3.2c in the Project Description A (Approved Project Proposal - Project Description, in accordance with the Decision of the Managing Board) and Gantt Chart (Annex 3 of the Contract on the Project financing).

3.4. If a deliverable is not reached, please explain – based on deliverables presented in Table 3.2c in the Project Description A (Approved Project Proposal - Project Description, in accordance with the Decision of the Managing Board) and Gantt Chart (Annex 3 of the Contract on the Project financing). If a deliverable is reached, enter N/A.

D4.3 Evaluated of integrated HUT module: There was a delay as the initial WP4 leader (Srđan Brkić) left the project team, and we had problems with the desktop computer used in the activities in WP4 (the hard disc was replaced in Q10, the processor will be replaced in Q12).
D6.1 Channel emulator for 5G/satcom signals: This deliverable is mostly finished, and a final phase will be done in the next month. There was a delay with the input from WP4, as the corresponding leader (Srđan Brkić) left the project team.

3.5. Project results (recommended up to 250 words) – brief summary of the Project progress (briefly describe performed project tasks, activities and results relevant for the current reporting period).

The project progresses as scheduled.

In Q11, WP1, WP4, WP5, WP6, and WP7 were active.

WP1 - Subactivity 1.1: The tenth quarterly progress report was submitted, the signed documents were uploaded, and the hard copy of the report was sent to the Science Fund.
The reports were accepted, and the administrative part of the report was published on the project website.

WP4 - Subactivity 4.3: We have proposed a novel strategy for adaptive coding and modulation (ACM) employment in land mobile satellite networks. The proposed solution incorporates machine learning techniques to predict channel state information and subsequently increase the overall spectral efficiency of the network. The Digital Video Broadcasting Satellite Second Generation (DVB-S2X) satellite protocol is considered as the use case, and by using the developed channel simulator, we performed an evaluation of the proposed machine learning solutions for channels with various characteristics, with a total of 90 different observed channels.
WP5 - Subactivity 5.3: Major activity was work on preparation of D5.3 deliverable, based on the results of previous activities conducted in the Subactivity 5.3.

WP6 - Subactivity 6.1: Channel models for both terrestrial and satellite communications can be realized in similar fashion using two-step approach. First uncorrelated samples are generated and then ARMA block is used for final fading.

WP6 - Subactivity 6.2: Simple channel model for packet drop off is currently implemented in the HUT framework. Next step is implementation of more complex models using available ARM processors.

WP6 - Subactivity 6.3: Integration of the channel emulator has not yet started since most efforts were directed towards HUT framework completion.

WP7 – Subactivity 7.1: The project website is regularly updated. Website, google analytics, and social networks KPIs are monitored regularly.

WP7 – Subactivity 7.2: One paper is published in the international journal from the JCR list, in the journal Electronics (published in September 2024).

WP7 - Subactivity 7.3: Preparation of Special Session on 32st Telecommunications forum Telfor 2024, Serbia, Belgrade, November 26-27, 2024. Preparation of a workshop with a focused group (industrial companies) that will be held in November or December 2024.

3.6. Project deviations (recommended up to 250 words) – In case of any deviation/discrepancy from the Project Description A, briefly describe reasons for its occurrence and appropriate further steps. In case of no deviations/discrepancies, enter N/A.

Project activities have been executed according to the Project proposal (Annex 1 of the Contract on the Project financing).
The realization of the planned activities in WP4 has been delayed by a few months due to changes in the project team and equipment failures.
According to a general payment schedule, personnel costs for all researchers in M33 will be paid in the first half of October 2024. Additionally, personnel costs for researchers engaged in ICEF in M32 will also be paid in the first half of October 2024.

3.7. Project risks

3.7.1.a. Foreseen risks - the risks identified in Table 3.3 in the Project Description A – for the current reporting period.

Risk No.	**Risk title**	**Description of risk**	**Work Packages/Tasks concerned**	**Risk-mitigation measures** (as in Project Description A)
1	Members of the project team and SROs - Project team member leaves the Project	Project team member P5 (also the coordinator of WP4) leaved the Project in Q10, and the corresponding reorganization was performed in Q11	WP4	Reorganize the assignments to cover the missing member - this can lead to delay in completion of some subactivities.

3.7.1.b. Status of risk mitigation measures

Risk No.	**Risk Title**	**Did the risk occur?**	**Did you apply risk mitigation measures?**	**If the risk still applies, describe the next steps for risk mitigation.**
1	Members of the project team and SROs - Project team member leaves the Project	Yes	Yes	We have found the adequate replacement for the team member P5, and PI is now also the coordinator of WP4..

3.7.2.a. Unforeseen Risks - describe all the additional risks that were NOT initially identified in Table 3.3 in the Project Description A.

Risk No.	**Risk title**	**Description of risk**	**Work Packages/Tasks concerned**	**Proposed risk-mitigation measures**
1	The failures in the equipment	WP4	The failures appeared in the main desktop computer used in the activities in WP4 (hard disc was replaced in Q10, processor will be replaced in Q12).	The hard disc was replaced in Q10, and the processor will be purchased in Q12. While the computer is inoperable, the weaker desktop computer with less processing power will be used. This can lead to delay in completion of some tasks in WP4.

3.7.1.b. Status of risk mitigation measures (for unforeseen risks)				
Risk No.	**Risk Title**	**Did the risk occur?**	**Did you apply risk mitigation measures?**	**If the risk still applies, describe the next steps for risk mitigation.**
1	The failures in the equipment	Yes	Yes	While the computer is inoperable, the weaker desktop computer with less processing power will be used. This can lead to delay in completion of some tasks in WP4.

3.8. Publishable summary* – description (up to 250 words) of the activities and significant results achieved by the project in the reporting period in both English and Serbian.

English (up to 250 words)

We have proposed a novel strategy for adaptive coding and modulation employment in land mobile satellite networks. The proposed solution incorporates machine learning techniques to predict channel state information and subsequently increase the overall spectral efficiency of the network. The major activity was work on the completion of the D5.3 deliverable (which will be finished in the next month). The majority of efforts in the previous quarter were on the completion of the HUT framework that can support the steering of data streams through satellite or terrestrial paths. A simple quality of service mechanism and channel model are implemented to get initial performance results. HUT framework is currently able to track the percentage of lost packets on both data channels and has simple hysteresis threshold logic for switching data streams from one to another channel. The project website https://hi-star.etf.bg.ac.rs/ has been updated. Website Google Analytics and social networks KPIs are followed regularly.
One paper was published in the international journal from the JCR list, in the journal Electronics, two papers were presented at international conferences CSNDSP 2024 and IcETRAN 2024, and four papers were submitted to the international conference TELFOR 2024. We have started activities in preparation of the Special Session on 32nd Telecommunications Forum TELFOR 2024, Serbia, Belgrade, November 26-27, 2024.

Serbian (up to 250 words)

U ovom kvartalu smo predložili novu strategiju za primenu adaptivne modulacije i kodovanja u satelitskim mrežama sa mobilnim zemaljskim korisnikom. Predloženo rešenje koristi tehnike mašinskog učenja da predvidi informaciju o stanju u kanalu, čime se obezbeđuje povećanje spektralne efikasnosti čitave mreže. Značajan napor uložen je u kompletiranje izveštaja D5.3, koji će biti završen u toku narednog meseca. Najviše angažovanja u prethodnom kvartalu je bilo na kompletiranju HUT sistema koji podržava preusmeravanje toka podataka kroz satelitski ili zemaljski komunikacioni kanal. Implementrani su jednostavni mehanizmi kontrole kvaliteta protoka kao i model kanala kako bi se procenile inicijalne performanse sistema. HUT sistem trenutno ima mogućnost praćenja procenta izgubljenih paketa na oba komunikaciona kanala, i jednostavno histerezisno odlučivanje za prelazak sa jednog na drugi komunikacioni kanal. Web sajt projekta https://hi-star.etf.bg.ac.rs/ se redovno ažurira, a KPIevi Google analitike veb-sajta i društvenih mreža se redovno prate. Objavljen je rad u časopisu Electronics, dva rada su prezentovana na međunarodnim konferencijama CSNDSP 2024 i IcETRAN 2024, a poslata su četiri rada na konferenciju TELFOR 2024. Započeli smo aktivnosti vezane za organizaciju specijalne sesije u okviru 32. Telekomunikacionog foruma TELFOR 2024, koji će biti održan u Beogradu od 26-27. novembra 2024. godine.

*This summary should clearly explain the key features of the Project to a non-scientific audience. The Publishable summary for the current reporting period should not consist of more than 250 words. It should focus on achievements to date and how these will generate impact. The Publishable summary can be used by the Science Fund of the Republic of Serbia for promoting and demonstrating the value and impact of the Project.

4. Dissemination*

4.1. Scientific publications – Insert the full reference with the link of the publication: article in journal, publication in conference/workshop, book/monograph, book chapter etc.

In Q11, one paper was published in the international journal from the JCR list:

1. Ivan Vajs, Srdjan Brkić, Predrag Ivaniš, Dejan Drajić, "Neural network SNR prediction for improved spectral efficiency in land mobile satellite networks". Special Issue: 5G Mobile Telecommunication Systems and Recent Advances, Electronics 2024, volume 13, issue 18, paper no. 3659; September 2024, *ISSN*: 2079-9292, DOI: https://doi.org/10.3390/electronics13183659, (IF=2.9, M22)

Also, two papers are presented at international conferences:

1. G. T. Djordjevic, P. Ivanis, J. Makal, D. Milic, V. Kafedziski, "A Method for Generating Random Process Having Given First - and Second-Order Statistics Over FSO Channel", 2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP 2024), pp. 7-11, Rome, Italy, July 2024. DOI: 10.1109/CSNDSP60683.2024
2. G. T. Djordjevic, N. Milosevic, M. Petkovic, B. Vasic, D. Milic, B. Vasic, "A Numerical Method for Estimating Error Rate Performance of MPSK System influenced by Fisher-Snedecor Fading", 2024 11th International Conference on Electrical, Electronic and Computing Engineering (IcETRAN 2024), pp. 1-5, Nis, Serbia, June 3-6, 2024.

In Q11, the following papers were submitted for the conference TELFOR 2024:

1. I. Vajs, P. Ivaniš, D. Drajić, Z. Čiča, "CNN and LSTM Neural Networks for spectral efficiency improvements in LEO Satellite networks"
2. A. Stoimenov, Z. Cica, "Performance Measurement Testbed for Hybrid Access Based on Multipath Transport Layer Protocol"
3. B.Zivkovic, Z. Cica, "Multi-Connectivity Framework Based on Open-Source 5G Network Core"
4. H.Turkmanović, D. El Mezeni, Z. Čiča, L. Saranovac, "Distributed Simulation Framework for Assesing Multipath Transport Protocols"

*Please keep in mind that only activities that are properly labelled according to promotion, publicity and visibility rules as stated in the Contract of the Project financing will be accepted as Project results. As additional documentation, please submit a copy of the main pages of all publications.

4.2. Type of dissemination and communication activities*

Preparation of Special Session on 32st Telecommunications forum TELFOR 2024, Serbia, Belgrade, November 26-27, 2024. Preparation of a workshop with a focused group (industrial companies) that will be held in December 2024.
One paper is published in the international journal from the JCR list, in the journal Electronics, and four papers was submitted to the international conference TELFOR 2024.

*List only activities directly linked to the Project like organization of a conference, workshop, press release, website, social media, training etc. Provide the website/social media link for this reporting period. As additional documentation, please submit visibility activities supporting documentation (e.g. workshop materials, pictures, promotion materials etc.).

5. Ethical approvals (if applicable)

No.	Ethical approval*	Period covered by the ethical approval	Issuing authority	State which SRO is covered by the ethical approval	State which work package/task is covered by the ethical approval

*List all documentation (approvals, decisions etc.) required by relevant laws.

5.1. If the ethical approval has not been obtained, please elaborate.

6.1 Environment - Please indicate if your research involves use of potentially hazardous or harmful elements for the environment (such as chemicals, polluting substances etc.). In case your answer is yes, please elaborate how do you ensure environment protection in compliance with the official standards in Serbia. Please list official protocols or permissions obtained by the public authorities you follow, if any.

6.2 Health and Safety - Please indicate if your research involves activities potentially hazardous for the workers' health (e.g. field work in dangerous terrain, laboratory work etc.). In case your answer is yes, please elaborate safety measures you undertake prior to, and during those activities in compliance with the official standards in Serbia. Please list official protocols you follow, if any.

7. Additional information relevant for Project implementation (if needed)

8. Date and signature
We hereby confirm that all information in the Quarterly Administrative Report is accurate.

Name and last name of the authorized person

1. _____ **22.10.2024.**
Leading SRO (stamp) **date**
dr. Dejan Gvozdić

2. _____ **22.10.2024.**
Project PI **date**
Predrag Ivaniš

3. _____ **22.10.2024.**
SRO 1 (stamp) **date**
Prof. dr Dragan Mančić, dean

4. _____ **22.10.2024.**
SRO 2 (stamp) **date**
Ilija Radovanović, vice director