D7.1 Exploitation strategy

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1 Executive summary

The SpaceWire-RT research programme aims to conceive and create communications network technology, suitable for a wide range of demanding space applications where responsiveness, determinism, robustness and durability are fundamental requirements. This is a critical component technology for future spacecraft avionics and payloads. SpaceWire-RT implements quality of service (QoS) layer, which is needed for SpaceWire to support mixed avionics and data-handling applications. SpaceWire-RT will: use virtual channels to provide a variety of QoS; provide broadcast and multicast capability; support extremely low latency time and out-of band signalling; and incorporate novel fault detection, isolation and recovery methods. The network will be fully responsible for information transfer, decoupling application and data transfer. Creation of this technology will substantially strengthen collaborative bonds between the Russian and European organisations involved in the research, and lead to technology of vital importance for future space mission.

This document describes the proposed measures for dissemination and exploitation of SpaceWire-RT project results and the management of knowledge and intellectual property.

The exploitation plan covers the post-development in the industrial and consumer application domains that will lead to more advanced European and Russian space products. The results of the SpaceWire-RT project will be an important input for the future of the spacecraft.

The SpaceWire-RT project develops the prospective technology for onboard networking that will be exploited by the consortium industrial participants - SMIC, ASTRIUM ST, ELVEES - in their products developments and future production. The SpaceWire-RT as an open technology is foreseen to be exploited widely by the European and Russian space industry. To promote its exploitation the consortium will actively work with the Industry Advisory Board companies and with industry represented in the international SpaceWire WG that was organized and governed by the ESTEC.

Russian Space industry will be involved in the SpaceWire-RT project results exploitation also through the Russian National SpaceWire WG that has been organized by Roscosmos. Following SpaceWire-RT project evolution and analyzing its results for exploitation has been included by SUAI, Submicron and ELVEES in the work program of the WG.

Furthermore, it is anticipated that the SpW-RT project will be the catalyst for ongoing collaborations between EU and Russian space technology companies and academics. The project will sow the seeds for ongoing collaboration; it is hoped under future FP7 SPACE call topics.

2 Dissemination plan

2.1 Participation in Conferences/Seminars/Workshops

Members of the consortium plan to participate in different conferences, seminars and workshops related to the space technologies and avionics. This would be one of the major ways for dissemination of the project results. Also the results will be periodically presented to the SpaceWire Working Group to ensure engagement with the broader SpaceWire community. Different papers would to be presented in leading international aerospace conferences like the International Astronautical Congress and IEEE Aerospace, in conferences related to embedded systems development.

2.2 Publications

Conferences and journals are an important way to disseminate scientific knowledge and the results of researches based on developed protocol. SpaceWire-RT consortium will also follow this approach by publishing its results. All partners are planning to present papers on different conferences and publish it in journals.

The proposed activities will give a good base for scientific researches in field of the embedded systems development. For instance, a good SpaceWire-RT mechanisms analysis could be done by the simulation and validation of the SpaceWire-RT protocol with SystemC and SDL models. Simulation could give a number of interesting results that surely could be the good reason for the publications.

The publications would be given on both Russian and English languages and consequently would be presented on Russian and English conferences.

2.3 Public Web-site

The project web site has been set up and can be found at the web address:

http://spacewire-rt.org/

The web site will be updated throughout the project and currently contains general information about the project objectives and the work to be performed in SpaceWire-RT project, as well as details of the project sites and project partners. All public deliverables will be available for downloading from the web site. It is intended to use the web site to inform members of the consortium of progress in the project. The web site will remain active for at least one year after the end of the project.

The website is structured into a number of pages, showing the main project information:

- Home – gives a brief overview and motivation of the project.

- Project – shows the workplan and gives details of each work package.
- Partners – gives a list of project partners with links to the web-pages.
- Links - contains links to the Seventh Framework Programme (FP7) and European Commission Space sites.
- Publications – will include details of scientific papers published as a result of this project and conference presentations about the project
- News – will contain major key-points of the project.

The main page of the SpaceWire-RT project web site is shown in figure 1.

Figure 1. SpaceWire-RT project web-site

2.4 Newsletters

Regular newsletters are planned to be sent quarterly, presenting the project's progress to the partners and "outside" companies that are interested in the project results. For this purpose the members of consortium will collect the contact information to the Contact Information database.

Also for this purpose the SpaceWire-RT mail list has been set up. The mail list address is spacewirert@spacewire.guap.ru.

Newsletters will contain several sections: News, Current state of the project, Next steps. The "News" part will contain everything that has happened during the last period. "Current state" will provide reader with the current status of the project (what is in progress). "Next steps" section would provide the next steps for the next quarter. The design of the Newsletter is to be done.

2.5 Demonstration Events

If there is an interest from a number of companies from EU or Russian Federation it is possible to organize a demonstration event. At this event a number of presentations and demonstration of prototypes could be done. The date and location of this event could be defined depending of the number and location of participants.

3 Exploitation Plan

The Exploitation plan includes the number of steps, which would be made during the SpaceWire-RT VLSI and SoC hardware implementation.

3.1 Joint SpaceWire-RT and SpaceWire boards operation testing

Joint SpaceWire-RT and SpaceWire boards operation testing will give the ability to make researches that would give important information of what should be done to make the hardware, based on SpaceWire-RT standards, operate within the bounds of one system. For this purposes the special adapters are to be implemented. The SpaceWire-RT board could be used as a reference implementation for future SpaceWire-RT products design.

3.2 SpaceWire-RT specific applications and drivers development

Development of drivers for the SpaceWire-RT chips is one of the highest priority tasks for the exploitation process. This could be done in two ways. The first one is the development of the drivers from scratch. And the second one is upgrading of drivers which were implemented for the SpaceWire chips. Both these ways are implementable, but the SpaceWire drivers upgrade looks much easier.

3.3 Joint testing of the Russian and European devices

Joint testing of the Russian and European devices within the bounds of one network could give interesting results for the VLSI and SoC developers. This will help to test the devices itself on the conformity to the SpaceWire-RT standard. Also it would be useful for the Russian and European companies' cooperation in space research programs.

3.4 Simulation and validation

Simulation and validation of the developed standard will help to check the specification for the inconsistencies and vulnerabilities. It would be useful for the developers to include needed changes to the new revisions if the specification. Moreover these results could be taken into account for the future specifications development processes in new projects.

Also the implemented models could be used as the obvious examples of the SpaceWire-RT nodes and network operation. The virtual network could be configured in one model and tested.

SpaceWire-RT models could be a powerful tool for testing of the real board prototypes. It is done by connection of the standard reference model with a real board via the special application. This could help to test the prototype and to get important information for the developers.

3.5 SpaceWire-RT research in the educational process

Research in the educational process will be done depending on the simulation and validation of the standard results. The implemented models could provide researchers with particular numbers (e.g. number of lost packets, the bandwidth etc.), which could be taken for mathematical calculation of different parameters.

Different SpaceWire-RT concepts, which are listed in the specification, will be taken as one of the many theoretical approaches for the real-time systems implementation for the corresponding training courses and lectures.

4 Exploitation and dissemination plan per partner

Participant	Brief exploitation and dissemination plan participation	Exploitable product	Sector
UNIVDUN	Plans to directly exploit the SpW-RT technology through its spin-out company STAR-Dundee. Will develop different types of devices which work using the SpaceWire-RT. Testing a SpaceWire-RT network operation using new implemented devices.	Prototype VHDL IP core	Space data systems and spacecraft avionics
	The work will also include education in computer engineering, development of new educational programs and further training of space industry engineering staff.	SpaceWire-RT Specification	Education and further training
	Research and design of distributed onboard space systems based on a SpaceWire-RT standard.	SpaceWire-RT Specification	R&D, engineering. (Space data systems, instruments, EGSE)
	Publication of the project results and results of the related research.	SpaceWire-RT Specification	Publications
	Organization of demonstration events for European companies	SpaceWire-RT Specification, Models and Prototypes	Training and dissemination in EU
	Collection of the contact information from EU companies those are interested in the project results.	SpaceWire-RT project results	Newsletters dissemination in Europe
	Participation in conferences, seminars and workshops	SpaceWire-RT project results	Dissemination of project results
	SpaceWire-RT specific applications and drivers development	SoC prototypes	SpaceWire-RT testing and maintenance
	Joint testing of the Russian and European devices	SoC Prototypes	Testing
SUAI	Will make use of the SpW-RT on-board networking technology in its education	SpaceWire-RT Specification	Education and further training

	dedicated to aerospace technologies, in and space data systems and instruments engineering. It will ensure familiarity of graduates and post-doctoral researchers with the SpW-RT technology and its applications in the space industry.	and Models	
	Research and design of distributed onboard space systems based on a SpaceWire-RT standard. Exploitation of SpaceWire-RT Models as the reference model in its HW/SW implementations	SpaceWire-RT Specification and Models	R&D, engineering. (Space data systems, EGSE, instruments)
	Publication of the project results and results of the related research.	SpaceWire-RT Specification	Publications
	SpaceWire-RT Simulation and Validation	SpaceWire-RT Specification	Research
	Training and maintenance during the uptake of the SpaceWire-RT technology of Russian space industry engineering staff. Organization of demonstration events for Russian companies	SpaceWire-RT Specification, Models and Prototypes	Training and dissemination in RU
	Development and maintenance of the SpaceWire-RT project WEB-site	SpaceWire-RT project results	WEB dissemination
	Collection of the contact information from RU companies those are interested in the project results and sending of the quarterly project newsletters via the SpaceWire-RT reflector.	SpaceWire-RT project results	Newsletters dissemination in Russia
	Participation in conferences, seminars and workshops	SpaceWire-RT project results	Dissemination of project results
	SpaceWire-RT specific applications and drivers development	SoC prototypes	SpaceWire-RT testing and maintenance
	Joint testing of the Russian and European devices	SoC Prototypes	Testing
SMIC	Plans to integrate the results of SpaceWire-RT into: • failure-tolerant structure of onboard computing systems of prospective satellites and piloted transport spacecraft with high-speed information interfaces; • Design of onboard data systems	SpaceWire-RT Specification and Models	Space data systems and spacecraft avionics

	and control equipment for space systems		
	Participation in conferences, seminars and workshops	SpaceWire-RT project results	Dissemination of project results
ASTRIUM ST	Will use the learning, system and product outputs of SpW-RT to continue to offer customers the best possible solutions with leading levels of quality and cost-efficiency. Exploitation of SpaceWire-RT Models as the reference model in its HW/SW implementations design and in onboard system integration in prospective missions	SpaceWire-RT Specification	Space data systems and spacecraft avionics. Satellites.
	Training and maintenance during the uptake of the SpaceWire-RT technology in European companies.	SpaceWire-RT Specification, Models and Prototypes	Training and dissemination in EU
	Participation in conferences, seminars and workshops	SpaceWire-RT project results	Dissemination of project results
	Joint testing of the Russian and European devices	SoC Prototypes	Testing
	Joint SpaceWire-RT and SpaceWire boards operation testing	SoC Prototypes	Testing
ELVEES	Will utilize the SpaceWire-RT Specification and the developed prototype ASIC IP core in design and production of the space graded chipsets for spacecraft avionics for the Russian and international market, in collaboration with European electronic industry. Development of the VLSI and SoC which operate using SpaceWire-RT, promoting of the developed SpaceWire-RT devices among the Russian companies to uptake of the new standard.	Prototype ASIC IP core	Electronic industry
	Participation in conferences, seminars and workshops	SpaceWire-RT project results	Dissemination of project results