About RUNES
RUNES (Reconfigurable Ubiquitous Networked Embedded Systems) is a European Integrated Project (IP) launched in Sept. 2004 for a period of 32+3 months under the 6th Framework Programme (FP6) in the field of Information Society Technology (IST). RUNES brings together world class industrial and academic partners with the objective of enabling the creation of large-scale, heterogeneous, networked embedded systems which interoperate and adapt to their environments.

Welcome to the 5th RUNES newsletter
This newsletter aims to present the members of the RUNES Interest Group as well as other interested individuals and organisations with a snapshot of our work within the project over the past months. This edition also includes updates on our activities and information on upcoming events.

Welcome to the fifth issue of the RUNES newsletter, which marks the beginning of the final phase of the project. The consortium is building on the successful demonstration of the RUNES platform at the IST2006 conference. We are very keen to speak to potential adopters of the technology and identify opportunities to apply it in different domains. The project will be officially completed with a Public Dissemination day featuring various demonstrations in Stockholm shortly after our Summer School in London, both scheduled for July 2007 (page 7).

In this issue you can read an interview with two members of the RUNES Interest Group (pages 1, 4), about the major project meetings and their outcomes (page 2) and technology news including the Secure & Scalable Re-keying Protocol, the Usability Platform and autonomous Robots (page 3). A profile of the RUNES partner CRC is presented on page 5. A number of events where the partners had the opportunity to present some of the developments are listed on page 6, while upcoming events are listed on page 7.

We hope that you find the newsletter interesting and enjoyable.

Interview with Experts from the RUNES Interest Group
Two members of the RUNES Interest Group, Stamatis Karnouskos Senior Researcher at SAP in Germany and Harold Linke Head of ICT and Software Development at HITEC Luxemburg talked to Costis Koumpis about the ways that RUNES may influence their own systems. In their mini interviews they discuss the importance of system dependability, the potential of RUNES as an alternative to bespoke embedded systems development and uses of the reconfiguration capabilities.

CK1. It is unrealistic to expect communication networks, industrial, medical or automotive control systems to be completely fault-free. One of our main aims in RUNES is to ensure that when a part or a component fails the system still continues to work safely. How would such improvements in dependability affect the way your systems operate?

SK1. There are specific sectors where high dependability and fault tolerance of mission-critical software is a must; which in turn implies the goal of realising fault-free systems. However, as the software and hardware are becoming more complex with an increasing number of interdependencies on other components and services, implementing deterministic and completely fault-free systems becomes a serious challenge. In modern business environments we are witnessing a paradigm shift towards a service-oriented infrastructure that is complex, collaborative and highly heterogeneous in software and hardware.

That in conjunction with the increasing integration of embedded devices in order to achieve real-world awareness and enhance business processes (Internet of Things vision) will require risk minimization which can be achieved also via highly dependable fault-tolerant systems. Therefore, both aspects i.e. dependable computing and fault-tolerance are expected to be more strongly pursued in the years to come at several layers ranging from device-level up to enterprise systems level.

HL1. The vision of the u-2010 project in which we participate is to provide the most capable means of communication and the most effective access to information to everybody required to act in case of accident, incident, catastrophe or crisis, while using existing or future communication infrastructure. Especially in crisis situations we are heavily dependent on reliable communication infrastructures. Depending on the scenario, several parts of the communication infrastructure can be destroyed or overloaded (i.e. in a tunnel fire the communication infrastructure in the tunnel may be destroyed, in a hurricane like Katrina, the communication infrastructure of a whole community may be not operable anymore).

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RUNES Meetings

Below is a brief summary including the major outcome of the key meetings held to date in order to co-ordinate the work within the project.

7th Project Meeting in Ottobrunn
The 7th RUNES Project Meeting was hosted by IABG during 4-6 Oct. 2006 in Ottobrunn, Germany. A central topic of the meeting was the system demonstration of the project at the IST2006 Conference (see page 6). A presentation by Venkat Kumar from Victoria University outlined radio node collaboration techniques and their application for range extension in the RUNES tunnel scenario. The project co-ordinator also presented some information on the ARTEMIS platform as part of the preparation of “Future work in FP7” session.

8th Project Meeting in London
The 8th RUNES Project Meeting was hosted by UCL during 14-16 Feb. 2007 in London, UK. Since that was practically the last meeting prior to the project’s completion, the main focus was on integration of the components produced so far and as well some outstanding technical issues. Among the topics discussed in the meeting were the exploitation plan, collaborations with other projects as well as provision of the middleware as an open source platform, interfaces and networking protocols.

The second day of the meeting featured presentations by two other EC projects: VISIONS (Vehicular System Interface for Open Network Service) and u-2010 (ubiquitous IP centric Government & Enterprise Next Generation Networks Vision 2010). Both projects have significant complementarities with RUNES and several fruitful discussions followed the presentations.

Ericsson Hungary team showed in London some of their recent work on porting the GUIs in the RUNES demonstrations (eg display events to firefighters) on a tablet that features the Linux based Internet Table OS.

Nicola Zingirian (Padova University) sharing some results of the recently completed VISIONS project with the RUNES partners in the London Meeting.

RUNES and U-2010
RUNES personnel have started to work with the consortium of the FP6 project U-2010 (www.u-2010.eu) to investigate how RUNES technology might be deployed in practice. U-2010 is researching use of existing or future telecommunication infrastructures to provide the most capable means of communication and the most effective access to information to everybody required to act in case of accident, incident, catastrophe or crisis. The project hopes to learn from the RUNES ‘Fire in a Road Tunnel’ scenario and use aspects of the technology developed in its own scenario work. At the last U-2010 project meeting Lesley Hanna, one of the RUNES work package leaders was able to give a presentation on requirements analysis, and several of the people active within RUNES were able to take part in a subsequent discussion on how RUNES outputs might be used to further the work in U-2010.

New GUIs running on tablet pc.
RUNES Technology news

This section summarises the progress that has been made within and between work packages during the recent months.

Secure & Scalable Re-keying Protocol
Partners from the University of Pisa have recently developed a Secure and Scalable Re-keying Protocol (S2RP) which is aimed for large, highly dynamic wireless sensor networks. S2RP aims at a trade-off between security and resource consumption while it guarantees an authentic distribution of keys that preserves both forward and backward security. The proposed protocol is efficient in terms of communication overhead as it reduces the number and the size of re-keying messages. It is efficient in terms of computation overhead as it guarantees the necessary level of confidentiality and authenticity of re-keying messages by only using symmetric ciphers and one-way hash functions which are several orders of magnitude more efficient than public-key cryptography. It is also scalable because it requires O(log n) messages to revoke the current group-key and distribute a new one, where n is the number of sensor nodes in the network. S2RP re-keying protocol has been recently written in Contiki-CRTK so as to become part of the RUNES middleware components. A security-related demonstration has been scheduled for the review and public dissemination day in July 2007.

Stakeholder Requirements Capture
RUNES is committed to real-world applications of the technology. As a result, the project has investigated the requirements of stakeholders, in particular tunnel operators and fire fighters. Among the organisations visited are: Centre d’Etudes des Tunnels (CETU), Tunnel du Mont Blanc, Oresund Tunnel, Elbetunnel, Channel Tunnel, London Underground, Hamburg Fire Brigade and Kent Fire Brigade. These requirements capture exercises focused on installation and maintenance of the safety equipment in tunnels, information useful to first responders gathered both in advance and after the emergency has occurred, communications issues within tunnels especially after fire has broken out as well as current internal procedures and external regulations. The information collected is being incorporated into the functionality of the project’s main demonstrator and will ultimately facilitate the commercial exploitation of the RUNES technology in this application domain.

Open source Middleware Components
Middleware in RUNES is built around component frameworks, which are re-usable and dynamically-deployable software architectures. The Middleware workpackage (WP5) has recently released as open source a Contiki implementation of the RUNES middleware, as well as two implementations of the RUNES middleware kernel (in C/Unix and Java). For more information visit http://www.ist-runes.org/middleware

Usability Assessment Platform
A platform is being designed for the usability trials in RUNES by project partner Kodak in collaboration with the Ergonomics and Safety Research Institute of Loughborough University. The platform in its current realisation at the Kodak Smart Lab in Cambridge features displays with tunnel control, fire command and fire fighter information. The idea is that the ‘fire in a road tunnel’ scenario is segmented into scenes so that the RUNES technologies can be applied and assessed on those scenes by the different stakeholders. As part of the platform development researchers have been designing visuals and physical models, evaluation materials and protocols.

Robots in the Final Demonstrator
The main aim of the Advanced Control work package has been the use of robots to re-establish radio connectivity between networks that have been partly destroyed. The tasks that need to be addressed include moving a robot to a specified position, avoid collisions with other robots and with unknown stationary obstacles. In the project’s final large demonstration site such capabilities will be shown using 2-3 robots interfacing a fixed network that combines ultrasound and regular wireless nodes. Partners from Lund Institute of Technology and the Universities of Pisa, and Patras each develop a working solution for the above problem aiming to show interoperability among different robot platforms in this setting.
**Interview**

*Interviewed by: [Interviewer's Name]*

(continued from page 1)

In our work we therefore try to integrate all existing communication networks, to allow emergency services to communicate over any channel that may be available. In case of complete infrastructure failure, a network can be hastily formed to act as communication host for the emergency site. A communication system that ensures that the system still works when a part or a component fails as it is realised in RUNES will support our vision and may become an important cornerstone in the u-2010 project. We are already in discussion with the RUNES consortium and we are working on integration of the RUNES outputs into the u-2010 concepts and solutions.

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**CK2.** The RUNES middleware component-based model can also serve as an infrastructure for multiple applications overcoming the need to develop systems from scratch. Do you see this as a real alternative to bespoke system development and testing?

**SK2.** The complexity of software and tasks in business environments is continuously increasing. Therefore in order to lead and innovate in the market, new sophisticated solutions have to be brought in a timely manner. Due to the requirements of rapid development with controlled cost and high customer satisfaction, we can not afford anymore to develop any solutions from scratch! The only viable approach to be followed is the industrialisation of the software sector. The latest implies increasingly products that can be created by customization and assembly of a large number of standard components that are built for mass markets. Therefore the significance of platforms offering dependable fault-tolerant reusable technology for system development and testing will become more eminent.

**HL2.** The RUNES middleware component based model can be used to develop new applications. The advantage we see is that components that are already available and tested can easily be integrated into our systems. Components based on the RUNES middleware can be reused in other domains, e.g. communication components designed for ensuring the communication of sensors in a tunnel could be reused to ensure communication in an industrial environment or in a hospital. On the other side it would be very interesting for the u-2010 project to reuse communication components for sensors to ensure the communication between the emergency services. The RUNES component based model will make this reuse possible and will help in reducing development and testing times.

**CK3.** What key opportunities do you see for reconfigurable embedded systems in the domain your organisation operates? Any killer-apps in sight?

**SK3.** SAP delivers a comprehensive range of solutions that empower every aspect of business operations. Among other emerging technologies, we deal with “smart items” which are reconfigurable embedded devices that are able to provide data about themselves or the object(s) they are associated with and can communicate this information to other devices. Smart-item technology can provide accurate data about business operations in a timely fashion, as well as help streamline and automate operations. Therefore it can help towards bridging the gap between the physical and digital world; this requires a flexible and scalable system architecture to integrate automatic data acquisition with existing business processes and to make ubiquitous computing a reality. At SAP Research we are working towards creating a holistic, service-oriented architecture for the seamless integration of real-world data and events into enterprise software that efficiently exploits the capabilities of ubiquitous-computing technologies, to provide organizations with a significant competitive advantage. Key focus is on peer-to-peer communication and business logic on the item. As you can see the future of reconfigurable embedded systems in business domain is promising. Although several enhancements can be made in existing business processes and new solutions not possible before can be realized, I believe that creating an infrastructure that will couple the physical, virtual and business process world in a service-oriented manner will be itself the next big-thing to watch out for.

**HL3.** My organisation HITEC Luxembourg S.A. is active in the area of traffic control and supervision. In this area reconfigurable embedded systems are very promising. In the traffic control area access to sensor and video information is essential. Reconfigurable embedded systems can add to the reliability and availability of the access network, while allowing the reconfiguration of the network in case of a failure. This will greatly increase the dependability, resilience and survivability of the networks. Another area of HITEC’s activities is monitoring and control solutions, especially but not limited to Satellite Ground stations. Also in this area we will look into the opportunities that reconfigurable embedded systems could provide. As we just started this investigation it is too early to talk about the final applications, but we see opportunities in integrating the RUNES concepts in our solutions.
In each issue of the newsletter we will present profiles of the RUNES partners that bring together their world class skills into the consortium. In the current issue CRC is presented.

Communications Research Centre

An Agency of Industry Canada, the Communications Research Centre Canada (CRC) is the Canadian government's primary laboratory for research and development (R&D) in advanced telecommunications. The R&D coming out of CRC is used for public policy purposes and to strengthen the Canadian economy through technology and knowledge transfer.

CRC has a strong tradition of technology transfer to industry and has been responsible for the creation of more than 60 companies. It runs the CRC Innovation Centre to provide small and medium-sized high-tech companies with access to CRC’s technologies, research expertise and unique laboratories. CRC also provides selected services to Industry Canada and to other federal government departments and agencies, provincial governments, academia, and the private sector.

With 200 research staff, CRC has exceptional talent and R&D expertise in a wide range of communications fields. Numerous researchers are internationally recognized in their respective disciplines. Many possess specialised scientific knowledge and skills that are unique in Canada. CRC’s reputation for excellence is what prompts private companies, universities and other organizations from Canada and abroad to seek collaboration opportunities. Under its four main research branches (Terrestrial Wireless, Satellite Communications and Radio Propagation Research, Broadband Network Technologies and Broadcast Technology), CRC specialises in taking an interdisciplinary approach to longer-term R&D in wireless systems, radio fundamentals, communication networks, photonics and interactive multimedia.

Louise Lamont is the Research Manager of the Ad hoc and Sensor Network Systems Group, and the contact point for RUNES at CRC.

A team of the Ad hoc and Sensor Network Systems Group, within the Broadband Network Technologies Branch participates in RUNES. The Group is managed by Louise Lamont who is responsible for assessing mobile and sensor ad hoc communication network issues and requirements, as well as defining, developing and participating in R&D programs to meet those needs. The group's major projects involve: the convergence of mobile wireless networks and the Internet; inter-layer protocol interaction; auto-configuration; routing mechanisms; service discovery; geo-location and tracking; improved security; QoS and power consumption mechanisms within wireless ad hoc/sensor networks. The resulting R&D is used to support CRC's Major Program initiatives, Industry Canada, National Defence, and Canadian industrial development in the execution of their mandates and R&D programs as well as to support international R&D collaboration undertakings.

CRC is involved in a Technology Demonstrator Project called Self-healing Autonomous Sensor Network (SASNet). The aim of the project is to develop an integrated, land-based, self-healing, ad hoc wireless network of heterogeneous sensors that provides improved surveillance capability to land based forces in support of both mission planning and force protection.

The objective is to demonstrate a networked sensor system that can be easily deployed, operated and managed within the Canadian land operations context to enhance the effectiveness of individuals, small teams and sub-units in collecting timely, relevant, and accurate situational awareness information in a contemporary operational environment. The domains of application of the SASNet technology and concept extend beyond military operations such as rescue/emergency services and planning authority to name a few.

The SASNet project may use some of the software that was developed within RUNES as a base to improve and adapt further into the SASNet specific scenarios. The security aspects, network formation, routing, localization and tracking, NEMO and 6lowpan are all components that can be very useful to exploit.

More information about the Mobile Ad hoc and Sensor Network Systems group is available at:
http://www.crc.ca/manet-sensor
RUNES Events

IST 2006
The RUNES consortium had a strong presence at the IST2006 in Helsinki where it gave a very successful demonstration (recipient of Honourable Mention by the organisers), generating a great deal of interest at the exhibition and also many positive comments concerning how the potential realistic deployment of wireless motes was shown in such a practical way. The demonstration was based around a scale model of a road tunnel. Six TMote Sky motes were used to act as the fixed infrastructural temperature sensors within the tunnel and a further four motes represented mobile temperature sensors deployed by the authorities during the course of the emergency. Two screens were also used, one to show portions of the RUNES video which explains the scenario in some detail, and one to demonstrate the status of the networks via a user interface.

ITEA2 Symposium
The ITEA2 (Information Technology for European Advancement) programme organised their 2006 Symposium in Paris during 5-6 October. ITEA2 stimulates and supports projects that will give European industry a leading edge in systems and services in which software represents a significant segment in terms of system functionality, system development cost & risk and system development time. RUNES was among the 5 IST projects invited to participate in this year's Symposium. The project's stand attracted significant interest from the participants who were interested to find out about the recent developments in technology and its applications and demonstrations. The Fire in a Road Tunnel DVD was instrumental in communicating the vision of the project in emergency response cases.

SCAR Demo at SenSyS 06
The demo of ‘SCAR: context-aware adaptive routing in delay tolerant mobile sensor networks’ attracted considerable interest among the participants of SenSys'06 in conference in Boulder, Colorado. In order to show the performance protocol to the attendees, various sensors were deployed in the conference room. Messages containing temperature readings were asynchronously delivered to the sink (a desktop connected to a sensor node) in the demo area of the conference, also by means of a mobile robot built using Lego Mindstorms running SCAR.

Privacy and WSN
While the widespread adoption of wireless sensor network technology promises tremendous benefits for everyone, there are also some potential drawbacks. One of these is the possible loss of privacy. The technology represented by wireless sensor networks is non-obvious to most people. If they do not understand it, they may not be in a position to make balanced judgements concerning the extent to which it may have a negative impact on their own standards of privacy. In a move to address this issue, members of the RUNES consortium took part in an event in London: ‘A Fine Balance - Encouraging technology and protecting privacy’ which brought together experts from a wide range of perspectives to share their understanding of the issues involved. The RUNES technical co-ordinator, Stephen Hailes (UCL), gave a keynote presentation which set the tone for later discussion in the workshop. The initiative is seen as an ongoing process, but a RUNES perspective on the issues involved can be found on the RUNES website http://www.ist-runes.org/docs/articles/privacy_and_WSN.pdf

EWSN07
RUNES had a very strong presence in this year’s European Conference on Wireless Sensor Networks (EWSN) which took place in Delft, The Netherlands last January. Four papers outlining work undertaken as part of RUNES by SICS, KTH, Politecnico di Milano and University of Trento were featured in the technical programme addressing diverse topics such as lightweight protocol stacks, efficient routing, decentralised scattering of wake-up times and energy consumption in sensor networks.

WiSIG Meeting
UCL delivered a presentation entitled ‘Challenges of Resource Constrained Networked Embedded Systems’ as well as a demonstration related to the RUNES ‘fire in a road tunnel’ scenario at the 2nd meeting of the Wireless Sensing Interest Group (WiSIG). Both attracted significant attention by the members of the group which was established to explore the opportunities, applications and successful deployment of wireless technologies and subsequently inform and advise the UK sensing community on its uses and benefits.
RUNES Partners

**Industry**
- connectBlue AB
  - [www.connectblue.se](http://www.connectblue.se)
- Ericsson AB
  - [www.ericsson.com](http://www.ericsson.com)
- Ericsson Magyarország
  - [www.ericsson.hu](http://www.ericsson.hu)
- Industrieanlagen-Betriebsgesellschaft mbH
  - [www.iabg.de](http://www.iabg.de)
- Kodak Ltd.
  - [www.kodak.co.uk](http://www.kodak.co.uk)
- LiPPERT Automationstechnik GmbH
  - [www.lippert-at.com](http://www.lippert-at.com)

**Non-profit research institutes**
- National ICT Australia
- Swedish Institute of Computer Science
  - [www.sics.se](http://www.sics.se)
- Communications Research Centre Canada
  - [www.crc.ca](http://www.crc.ca)

RUNES Future Events

**10th Int. Conf. on Hybrid Systems: Computation and Control (HSCC’07)**
- 3-5 April 2007 | Pisa, Italy
The conference is dedicated to research in embedded reactive systems involving the interplay between symbolic/switching and continuous dynamical behaviors. Emphasis is on the latest developments of applications with particular attention to embedded and networked control systems.
For more information on this conference, visit: [http://hscc07.dii.unisi.it/](http://hscc07.dii.unisi.it/)

**Design, Automation and Test in Europe**
- 16-20 April | Nice, France
András Toth (Ericsson) will give a talk entitled ‘Adaptive and Intelligently Self-organising Middleware Systems’, while Anton Cervin (Lund University) will present Truetime, a tool for Simulation of Networked Embedded Control Systems.
Truetime allows co-simulation, including the physical nodes and their environment, the software inside the nodes, and the wired/wireless network communication.
For more information on this conference, visit: [http://www.date-conference.com/](http://www.date-conference.com/)

**RUNES Summer School**
- 9-11 July 2007 | London, UK
The first two days of the RUNES Summer School comprise technical lectures and related hands-on programming seminars, while the third is self-contained and structured around the RUNES applications and the demonstrator. The aim is to broaden the students’ appreciation for and interest in the field of networked embedded systems, while also extending their technical skills.
For more information on this event, visit: [http://www.ist-runes.org/summer_school/](http://www.ist-runes.org/summer_school/)

**1st Contiki OS Workshop**
- 26-27 March 2007 | Stockholm, Sweden
The program features hands-on tutorials on Contiki programming, presentations about Contiki components, plans for future development, demonstrations, and a poster session. Software for the tutorials and hands-on sessions will be distributed in advance.

**European Control Conference 2007**
- 2-5 July 2007 | Kos, Greece
Karl H. Johansson (KTH) and John Lygeros (ETH) are organising a mini tutorial entitled ‘Toward a component-based framework for networked control’. The programme comprises 5 papers, all of which have been co-authored by members of the RUNES Advanced Control work package. In connection with the session, an invited journal article will be published in the European Journal of Control.
For more information on this conferene, visit: [http://www.ecc07.ntua.gr/](http://www.ecc07.ntua.gr/)

**RUNES Final Public Dissemination Day**
- 27 July 2007 | Stockholm, Sweden
The Final Public Dissemination day has been scheduled for 27 July 2007, immediately after the Final Review/Demo (25-26 July) in Stockholm, Kista. Kistagången 26. The demonstrations will be accompanied by a technology seminar, and details for companies wishing to adopt the technologies developed in the project.
More information on this event will be published on [www.ist-runes.org](http://www.ist-runes.org)

Feedback
Please email your feedback, news and views to newsletter@ist-runes.org.

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