FINAL PUBLISHABLE REPORT

CONTRACT N°: COOP–2004–513029–SAFEPHONE

PROJECT N°: FP6-513029

ACRONYM: SAFEPHONE

TITLE: The development of an intelligent, physical condition monitoring, illuminated, self-powered emergency telephone casing for use in Hazardous, arduous or safety critical Situations.

PROJECT CO-ORDINATOR:

1. Pera (RTD Performer)

PARTNERS:

2. Arnesys
3. Profitek
4. Composites Integration
5. Information Management Systems
6. AG Electronic Systems Design Ltd

RTD PERFORMERS:

7. CRIC

PROJECT START DATE: 01/10/2004

DATE OF ISSUE: 30/01/2008

ABSTRACT

A Consortium of European SMEs has completed a successful Collective SME Project to develop a SafePhone system for European telemetics, composite and material science SME's. The Safephone project aims to improve the Pan-European road transport safety and the proliferation of vehicular telematics, exploiting the growing array of communications architectures technologies. Utilising the extensive networks of emergency telephone infrastructure already in existence, Safephone aims to support **a step-change in the personal safety** of the travelling public, **cost-effectively**, enhancing security and communications systems integrity.

The project has resulted in a system that will reduce the economic and environmental costs associated with increased disposal costs and tightening of pollution discharges.

PROJECT OVERVIEW

The Safephone project aimed to complement the corpus of recent research studies concerning Pan-European road transport safety and the proliferation of vehicular telematics, exploiting the growing array of communications architectures technologies. Utilising the extensive networks of emergency telephone infrastructure already in existence, Safephone aimed to support a step-change in the personal safety of the travelling public, cost-effectively, enhancing security and communications systems integrity.

Over the last 10 years there has been a steady rise in the number of accidents and incidents in tunnels across the EU, with 66 deaths recorded for road tunnel accidents and 31 recorded for metro fires. Many more civilians were affected by smoke inhalation and had to be evacuated through emergency procedures. The direct costs of the recent tunnel fires, such as those in the Tauern, Mont-Blanc and Gotthard incidents has been estimated to be about €210 million per year while the indirect costs to the economy resulting from tunnel closures are huge. In the case of the Mont-Blanc tunnel alone, these costs have been conservatively estimated at €300 - €450million per year for Italy alone.

The EU Commission proposed harmonisation measures on 30 December 2002 in the form of a new Directive aimed at improving the safety of the trans-European road network. A recent survey found that 4 of the UK's busiest road tunnels are among the worst in Europe and a recurring factor in these findings is the predominance of non-soundproofed emergency telephones.

The success of this project has addressed the EU transport safety needs and the interoperability requirements across multi – system architectures in line with the need for continuous feedback dialogue between safety communications systems stakeholders. This facilitated moves towards the recommendations outlined in the ERTICO project.
The technology developed under the Safephone proposal complements the research findings of the FP5 Safe Tunnel RTD project. The ***SAFE TUNNEL*** project is concerned primarily with vehicle telematics and aims to achieve a high integration of on-board vehicle devices and the relevant communication infrastructures. This vehicle-infrastructure integration shall be achieved at three levels: Check of on-board devices to detect/predict anomalies and the relevant information transmission to the control centre; Control of the access inside the tunnel and management of the communication vehicle-infrastructure; Control of the speed inside tunnels by

vehicle telecontrol and a moving spot light system.

A recent joint study carried out by the UK's leading motoring membership bodies and the Police, into road transport safety standards made a number of recommendations; including the need to upgrade emergency telephones. In Britain alone 250 people are killed or injured on Britain's hard shoulders, this is equivalent to 1 in 9 motorway deaths. Rebecca Rees, a spokesperson for the AA commented that 200,000 breakdowns are attended by their rescue teams on hard shoulders each year, putting their personnel at unnecessary risk. The European engineering sector is an essential pillar of the EU economy worth €300 billion pa with 375,000 companies, 90% of which are SMEs providing jobs for 20 million. 253,000 of these companies are SMEs involved in metal machining. The sector is under intense pressure from cheap imports from the Far-East where labour costs are much less. Further pressures have arisen from ever-tightening but essential environmental legislation in the EU resulting in increased disposal costs and tightening of pollution discharges. Consequently the number of engineering workshops has reduced by 20% in the last 5 years. This key SME sector must therefore respond if it is to survive.

Together the Consortium have successfully developed and disseminated a SafePhone system also known as an emergency telephone casing that is "intelligently" capable of detecting impacts and assessing damage. The casing is cost effective, resilient to damage and vandalism and also highly recyclable. In addition to this we have developed a low power lighting mechanism that can be moulded directly into the telephone casing along with the piezo electric sensor devices.

Scientific Objectives

To enhance the scientific understanding of the capability of a piezoelectric device, by building a working prototype device that demonstrates:

- Remote self-powered monitoring of a single composite component when encapsulated during the enclosure forming process
- The capability of the embedded piezo device to power low level component illumination provided by embedded fibre optics
- That a low-powered (approx 8mW), fieldbus compatible, electrical signal system to enable remote diagnosis monitoring of the piezo generated signal within the casing

Technological Objectives

Additionally, to research the possibilities of extending the use of piezoelectric devices into two other safety critical products e.g.:

- To develop a recyclable, single material composite for the manufacture of telecoms enclosures that meets IEC 60529 Standard IP 67 rating communications casing.
- To develop and embed, low-powered fibre-optics into the housing to provide in-case illumination.
- To develop and embed a piezoelectric impact monitoring device into the telephone casing, reducing by 100% the need for manual inspection of the enclosure.
- To develop a low power (minimally sub 2mA) signal-generation allowing for compatibility across the emerging digital telecoms infrastructure.
- To develop an electronics control system package that will manage signals from the piezo embedded enclosure via the Phone and landline system to a central control function, **improving system integrity by 20%**

Societal & Policy Objectives

- To reduce by 100% the unnecessary exposure of routine maintenance staff to hazards from passing traffic by eliminating the need to carry out routine inspection of the system
- To increase the reliability of emergency telephones by 50% through the introduction of remote routine monitoring of the telephone housing for damage
- To increase employment in the EU, by **creating approximately 2,000 jobs** through value added to the product functionality resulting in lower product lifetime costs and product differentiation from low-cost, non-EU sources
- To increase recyclability of the enclosure material by 70% and addressing the recent WEEE directives on waste production

Economic Objectives to Improve Competitiveness

- To reduce the end of life disposal cost through increased recycle-ability and increased life span of the product
- To incorporate the value added features of self illumination and self diagnosis to the emergency telephone housing system
- To develop a single material product for the casing that can be injection moulded to different levels of the IP standard at a reduced cost to current product materials
- To reduce the resources needed in operating routine preventative maintenance programmes for Highway Emergency Telephone Systems by focusing maintenance attention only on those Phones which need to be repaired

APPROACH

In order to achieve the objectives of the SafePhone project an ambitious programme of scientific and technological development, demonstration and dissemination activities was undertaken with the financial support of the Sixth Framework Programme.

The SME's in the Consortium recognised the importance of transnational co-operation throughout Europe considering the growing pressure on improving the safety of the trans-European road network, threats due to cheap imports from the Far-East and pressures from ever-tightening but essential environmental legislation in the EU resulting in increased disposal costs and tightening of pollution discharges. All the companies represented in the SAFEPHONE consortium have demonstrated the capability to innovate, however no single company has the pre-requisite scientific knowledge and expertise in every technology alone. Each partner brought unique expertise in their respective markets and together they provided a true supply chain that delivered the whole system effectively, and demonstrated their capacity to innovate and their ability to access the market. Furthermore, SMEs in consortium did not have the resources or capabilities to develop Safephone system alone. The SME association, therefore brought together a strong consortium including leading European research organisations who provides the required scientific knowledge and technology development capabilities, whilst at the same time allowing us to maintain the intellectual property of the developments. However, this could not have been achieved without financial support from the EC through the Collective funding mechanism. The following research and development work was required to achieve the technical objectives:

- Remote self-powered monitoring of a single composite component when encapsulated during the enclosure forming process
- The capability of the embedded piezo device to power low level component illumination provided by embedded fibre optics
- That a low-powered (approx 8mW), fieldbus compatible, electrical signal system to enable remote diagnosis monitoring of the piezo generated signal within the casing
- To develop a recyclable, single material composite for the manufacture of telecoms enclosures that meets IEC 60529 Standard IP 67 rating communications casing.
- To develop and embed, low-powered fibre-optics into the housing to provide in-case illumination.
- To develop and embed a piezoelectric impact monitoring device into the telephone casing, reducing by 100% the need for manual inspection of the enclosure.

- To develop a low power (minimally sub 2mA) signal-generation allowing for compatibility across the emerging digital telecoms infrastructure.
- To develop an electronics control system package that will manage signals from the piezo embedded enclosure via the Phone and landline system to a central control function, improving system integrity by 20%

Mainly SME consortium has drawn the expertise from two of Europe's leading Research & Development experts in the United Kingdom (Pera) and TI (Norway)).

The project was completed in the form of following work packages.

WP1: Scientific Characterisation: This work package combines the base information in providing the optimum type, number and locations of piezoelectric devices to be bonded to the telephone enclosure moulding which will enable effective remote diagnosis of the enclosure condition. The optimum sensor excitation signal parameter was evaluated along with the received signal processing requirements in order to perform diagnosis of the structure. Different options for the fabrication process for embedding the optical sub system into the casing material was also evaluated for optimisation.

WP2: Impact Sensor: In this work package the definition and development of an Impact Sensing algorithm capable of identifying the position (to within 3% in each axis of the object's surface area) and relative projected damage of an impact on a hollow object whose shell is of varying material strength, density and shape was undertaken. The Impact Sensing algorithm was made into a software package and then tested. The Wave Comparison algorithm for identifying major changes in sensor response to generated stimulus likely to represent a structurally damaging deformation in the target material was developed in this work package and Wave Comparison software package was implemented. Testing was then taken place of the software package.

WP3: Remote Diagnosis: In this work package it was proposed to develop the remote diagnosis and management communications module in association with a centralised control system. The remote diagnosis and management module was developed as a part of the phone unit, allowing it to be controlled, monitored and configured remotely by the centralised control system. The centralised control system was developed to remotely monitor, control and

configure multiple remote phone units, whilst being scalable to manage at minimum 1000 phone units in number.

WP4: Integrated Device Design: The objective of the work package was to develop the enclosure by specifying the requirements of the application. A robust method of holding the optical sub-system, developing a self-cleaning surface finish and selecting the components and lay-up of the composite bulk material will be developed. The work package was focusing in an enclosure specification for the bulk material and the surface gel coatings that meets the relevant European Regulations.

WP5: System Integration: In this work package we developed a design for an integrated system that has demonstrated the integrated functionality of the system. Prototype components were produced and an integrated prototype system was created. Test plans were devised to validate the robustness of the individual and system level operation. Tests were carried out and the faults rectified. Results were documented for later dissemination as appropriate. The work package has produce a report validating remote diagnosis and management performance capability

WP6: Innovation Related Activities: In this work package we formulated the project results into a protect table form and applying for protection on the innovative aspects of the product, by month 29 of the project. We are now transferring knowledge from the RTD performers to the SME participants and engage, through the supply chains within which our consortium resides, with up to 500 associated emergency and communication systems manufacturers and software development organisations, in order to proliferate the technology in its primary and tertiary applications through manufacturing and distribution licenses.

WP7: Coordination Management: In this work package the objectives are to ensure that all knowledge is created, managed and disseminated in a coordinated and coherent manner, along with all technical activities, legal aspects and other issues. A dissemination and use plan to aid the dissemination and exploitation process will be developed as part of the work package. Co-ordination between the EC and project consortium ensuring that all milestones, reports, and project financial administration is prepared in accordance with the contractual requirements. Integration of effort between R&D performers and partners. Monitoring of each of the partners and R&D performers to ensure effective use of their own resources through internal project

management and reporting through the task and work package leaders will be undertaken.
In short these tasks cover the scientific characterisation of piezo electric devices and low powered lighting technologies, the development of impact location and damage assessment algorithms followed by their implementation on board a dedicated processor, the design and implementation of a software toolset that is capable of monitoring and managing multiple SAFEPHONE devices and finally, the specification and creation of a resilient and recyclable emergency telephone casing.

PROJECT RESULTS

- Developed and embedded a low-powered lighting technology into the housing to provide in-case illumination that doesn't negatively affect the results of the damage location algorithms
- Developed a low-powered (approx 8mW), electrical signal system to enable remote diagnosis monitoring of the piezo generated signal within the casing
- Developed the capability of the entire system (including the low power illumination technology, the piezo devices and the additional logic and communications electronics) to be powered by current standard power inputs for VoIP emergency telephones
- Developed a recyclable, single material composite for the manufacture of telecoms enclosures that meets IEC 60529 Standard IP 66 rating communications casing
- Developed and embedded a piezoelectric impact monitoring device into the telephone casing, reducing by 100% the need for manual inspection of the enclosure.
- Developed a low power (minimally sub 2mA) signal-generation allowing for compatibility across the emerging digital telecoms infrastructure.
- Developed an electronics control system package that can manage signals from piezo sensors embedded into the enclosure via the phone and landline system to a central control function, improving system integrity by 20%
- Developed a system to reduce by 100% the need to perform routine manual maintenance on emergency telephones by embedding a piezoelectric impact monitoring device into the telephone casing and reporting any telephone issues to a centralised control station where actions to resolve the problem can be instigated.
- Allowed the automatic allocation and notification of emergency telephone problems to

maintenance engineers via SMS or email within a period of one hour from receiving the notification from a damaged phone.

MARKETING PLAN

In Europe over 10 million calls are made from emergency phones each year. It is estimated that there are currently 55,000 emergency telephone units installed on European roads[i] and this is set to increase significantly over the coming years. For example, the UK has committed to increase its emergency phone numbers by 27% over the next few years. Assuming this trend continues throughout Europe there will be nearly 70,000 phones by 2006. This number does not include the number of phones installed in Europe's tunnels, where they are installed at a greater frequency to increase safety in the tunnel. There are 440 road tunnels above 500 m in Europe, with an average of 5 emergency phones per tunnel. This equates to a further 2,200 emergency phones. This gives a total of around 72,000 emergency phones in the EU. It is estimated that these phones need to be replaced every 7-10 years, to ensure that systems remain in good working order. Therefore there are 10,300 emergency phones replaced each year. The current cost of these phones is €2,400 each, plus maintenance costs of 20%. This equates to a market size of around €31 M per year. The Safephone system will provide added value through the feedback mechanism and the illumination of the system. This added value will ensure the increased initial cost of €3,500 per system, plus 20% maintenance is acceptable to the customer.

In addition to emergency roadside phones, the system will be directly applicable to other hazardous environments, such as mining (providing a €30 M market), offshore (a €10 M market and), Chemical plant (an €81 M market), construction (a €50 M market), and food processing (a €50 M communications market).

Product Market Size

The proposed system will have the ability to replace existing emergency systems, and be installed during new road build, providing two access paths to the market. The total market accessible by the technology is estimated at €250 million per year.

Assuming market penetration of 20%, the effective market for the Safephone system is €70 million. This figure is for traditional installations, with no added value system monitoring. The addition of self monitoring of system status will increase the value of the market.

Number of emergency phones

In Europe, over 10 million calls are made from emergency phones each year. It is estimated that there are currently 55,000 emergency telephone units installed on European roads[1] and this is set to increase to 70,000 by 2006. At present there is no method of checking the physical condition of these installations remotely, and personnel therefore have to inspect the phones manually. Due to the nature of the locations (i.e. roadside, tunnels, processing plant, etc), puts that member of staff in a hazardous environment. In most cases therefore, the installations are checked infrequently, if at all.

Tunnel safety statistics

Over the last 10 years there has been a steady rise in the number of accidents and incidents in tunnels across the EU, with 66 deaths recorded for road tunnel accidents and 31 recorded for metro fires. Many more civilians were affected by smoke inhalation and had to be evacuated by the emergency services.

Financial Cost €

The direct costs of the recent tunnel fires, such as those in the Tauern, Mont-Blanc and Gotthard incidents has been estimated to be about **€210 million per year** while the indirect costs to the economy resulting from tunnel closures are huge. In the case of the Mont-Blanc tunnel alone, these costs have been conservatively estimated at **€300 - €450million** per year for Italy alone[2].

[1] UK National Audit Office Road User Satisfaction Survey, 2000

[2] http//:www.europa.eu.int/comm/transport/roadsafety/roadinfra/tunnels/index_en.htm

EU legislation

The EU Commission proposed harmonisation measures on 30 December 2002 in the form of a new Directive[3] aimed at improving the safety of the trans-European road network. A recent survey[4] found that 4 of the UK's busiest road tunnels are among the worst in Europe and a recurring factor in these findings is the predominance of non-soundproofed emergency telephones[5].

Benefits to SME Proposers

- Arnesys will gain additional volume for its assembly operation and a logical extension of its current product range into new and existing markets and a technology capable of being applied to adjacent products in those markets. This could generate additional €39.3M of revenue in Year 5 and Arnesys will need to consider sub-contracting manufacture to meet this demand.

- Profitek will gain expertise in the installation of new intelligent phone enclosures and the associated phone networks. In addition, they will gain maintenance and servicing experience of integrated Phone and Enclosure systems. In Year 5 after launch, this would generate an additional €50.5 M of revenue.

- IMS will gain experience in the design and manufacture of the electronic control systems for use in hazardous/rugged areas currently outside their traditional markets. In Year 5 post launch, additional revenues would be €29.3 M
- CI expects to add significant expertise to its injection moulding capability by the inclusion of the piezoelectric sensor in the moulds produced. Gross revenues in Year 5 are expected to be €16.3 M.

- ESDL will provide fibre optic technology to the system, gaining additional revenue of € 18.5M by Year 5 post launch

[3] http//: www.europa.eu.int/comm/transport/roadsafety/safety in European tunnels.

[4] http://195.167.162.28/aamotoringtrust/pdf/policy_tunnelTests_2003.pdf

[5] http://europa.eu.int/comm/transport/road/roadsafety/roadinfra/tunnels/index_en.htm

Exploitation Plans

Exploitable Knowledge (description)	Exploitable product(s) or measure(s)	Sector(s) of Application	Timetable for commercial use	Patents or other IPR protection	Owner & Other Partners Involved
A – Damage Location and Damage Assessment Algorithms	Intelligent, damage aware composite material	1. Emergency Telephones 2. Automotive & Aerospace	1. 2007 2. 2007	Copyrights relating to Damage Location and Assessment software planned for 2007	Arnesys & ESDL
B – SAFEPHONE telephone casing (recyclable & resilient)	New emergency telephone casing	1. Roadside Emergency Telephones 2. Railway & Off-shore Emergency Telephones	1. 2007 2. 2007	Patents relating to new use of composite material for casing planned for 2007	Arnesys & Composite Integration
C – Low powered embedded lighting mechanism	In mould lighting for emergency signs	1. Emergency Telephones 2. Street Signs 3. Emergency Signs for Large	1. 2007 2. 2008 3. 2008	Patents relating to low powered emergency signs planned for 2007	Arnesys
D – Low powered, piezo connected PCB for connection to networked	Intelligent, damage aware network devices	1. Emergency Telephones 2. Other SNMP capable network devices	1. 2007 2. 2007	Patents relating to a "black box" for sensing and communicating damage planned for 2007	Arnesys & IMS
E – Main SAFEPHONE communication and administration	Central Control System software	1. Emergency Telephones	1. 2007 2. 2007	Copyrights relating central control and administration software planned for 2007	Arnesys & IMS
F – Integrated SAFEPHONE Device	Integrated SAFEPHONE Device	1. Roadside Emergency Telephones 2. Railway & Off-Shore Emergency Telephones	1. 2007 2. 2007	Patents relating to SAFEPHONE Device, planned for 2007	All project partners

Result A – "Damage Location and Damage Assessment Algorithms"

CONCLUSIONS

A consortium of leading European SME Associations, innovation SME's and world-class Researchers have developed and produced an emergency telephone casing that is "intelligently" capable of detecting impacts and assessing damage. The casing is cost effective, resilient to damage and vandalism and also highly recyclable. In addition to this we developed a low power lighting mechanism that can be moulded directly into the telephone casing along with the piezo electric sensor devices.

The SAFEPHONE technology greatly improves the functionality of safety-critical communication systems, enhances durability, robustness and operational sustainability. Moreover, this new technology promises to increase overall reliability and systems integrity, thereby directly impacting on passenger safety. The technology also eliminated the requirement for routine, manual inspection and maintenance of communications equipment located in hazardous environments. Also, by embedding condition monitoring transducer technology into communication enclosures risk to maintenance personnel is minimised through a reduction in the number of routine and often unnecessary inspections.

.

The SAFEPHONE consortuim have collaborated on a TransEuropean Level with great success and are now committed to exploit the developed technologies by bringing the technology to the market.

ACKNOWLEDGEMENT

The partners wish to thank the European Commission for funding the project. Especially, they wish to thank the 'Specific Co-operative Research Projects for SMEs' Programme under the Sixth Framework Programme (2002 – 2006).

The partners would especially like to thank the Project's Scientific Officer and the Project's Financial Officer, for their help and guidance throughout the project.

CORRESPONDENCE

Please direct all correspondence relating to the exploitation and dissemination of the SAFEPHONE technology to mailto:wayne.kimberlin@pera.com.

PROJECT PARTNERS

	Name : Michaela Bitsakis **European Commission** Email: Michaela.BITSAKIS@ec.europa.eu
	Name : Robert MacArthur **Arnesys** Email: rmacarthur@arnesys.com
	Name : Tor Heggernes **Profitek** Email: tor@no.wmc-card.com
	Name : Stephen Leonard-Williams **Composites Integration** Email:slw@composite-integration.co.uk
	Name : Oscar Persano **Information Management Systems AG** E-Mail: ope@ims-info.ch
	Name: Michael Bonello **ESDL** Email: esdl@maltanet.net
	Name : Narcis Clavell **CRIC** E-Mail: narcis.clavell@cric.es
	Name: Wayne Kimberlin **Pera Technology** E-Mail : Wayne.Kimberlin@pera.com

GENERAL PROJECT INFORMATION: SAFEPHONE

Project Title:

The development of an intelligent, physical condition monitoring, Illuminated, self-powered emergency telephone casing for use in Hazardous, arduous or safety critical Situations.

For Information (co-ordinator contact details)
Wayne Kimberlin,
Project Manager, Pera Innovation Ltd,
Melton Mowbray, LE13 0PB, United Kingdom.
Tel.: +44 (0) 1664 501501;
Fax: +44 (0) 1664 501483;
mailto:wayne.kimberlin@pera.com
Web site: www.pera.com.

Proposers:

1. Arnesys
2. Profitek
3. Composites Integration
4. Information Management Systems AG
5. Electronic Systems Design Ltd

RTD PERFORMERS:

6. Pera
7. CRIC

Duration
01/10/2004 – 28/02/2007 (29 Months)

Reference:
COOP–2004–513029

Programme:

Sixth Framework Programme (2002 – 2006)

Project Cost:

€1363391

EC Funding:

€706281

---

[i] UK National Audit Office Road User Satisfaction Survey, 2000