

PROGRAMMA "Futuro in Ricerca 2013"
Decreto del 28 dicembre 2012 prot. n. 956/Ric

PROPOSTA DI PROGETTO DI RICERCA TRIENNALE
Protocollo: RBF1375SF

1 - Linea d'intervento

LINEA 1 (starting)

2 - Principal Investigator

CASSARA'	Pietro	CSSPTR79C05G273U
(Family Name)	(Name)	(Tax Code)
Giovane ricercatore	05/03/1979	
(Qualification)	(Date of Birth)	
Consiglio Nazionale delle Ricerche		
(Institution where the research will be conducted)		
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3 - Research Project Title

A unified fRAMEwork for Social Smart sErVICES Provisioning (RAME.S.S.E)

4 - Main ERC field

PE - Physical Sciences and Engineering

4.1 - Possible other ERC field

4.2 - ERC (European Research Council) subsector research fields

PE Physical Sciences and Engineering

PE7 Systems and communication engineering: electronic, communication, optical and systems engineering

PE7_8 Networks (communication networks, sensor networks, networks of robots.....)

PE1 Mathematics: all areas of mathematics, pure and applied, plus mathematical foundations of computer science, mathematical physics and statistics

PE1_21 Application of mathematics in industry and society life

PE6 Computer science and informatics: informatics and information systems, computer science, scientific computing, intelligent systems

PE6_12 Scientific computing, simulation and modelling tools

5 - Keywords

n°	Description (english)
1.	SMART SERVICES
2.	SOCIAL NETWORK PROTOCOLS
3.	LIFE QUALITY
4.	NETWORK OPTIMIZATION
5.	NETWORKING

6 - List of the Research Units

n°	Associated Investigator	E-mail	University/Istitution	Date of Specialisation	Date of PhD	Post-doctoral experience (in months)	art. 3 comma 6	
							Childrens	
1.	CASSARA' Pietro	pietro.cassara@isti.cnr.it	Consiglio Nazionale delle Ricerche		26/04/2010			SI
2.	MILITANO Leonardo	leonardo.militano@unirc.it	Università degli Studi "Mediterranea" di REGGIO CALABRIA		01/04/2010			

7 - Scientific Publications of the participants in the research group in the last 5 years

n°	Publication	Name
1.	Cassara' P (2012). Pricing Schemes for Emerging Telecommunication Market. LAP Lambert Academic Publishing AG & Co KG	CASSARA' Pietro
2.	Cassara' P, Ala G, Francomano E, Ganci S (2012). Numerical solution of electric field integral equation for thin-wire piecewise antennas shape reconstruction. In: Proceedings of International Conference ICACM 2012.	CASSARA' Pietro
3.	Cassara' P, Tinnirello I, Di Bella G (2012). Performance Analysis in Spatially Correlated IEEE 802.11 Networks. In: Proceedings of IEEE International Conference ICTC 2012.	CASSARA' Pietro
4.	Cassara' P, Di Lisi Cosimo, Alcuri Luigi (2011). Correlation-Based Similarity Metric For Clustering In Multimedia Social Network. In: National Conference GTTI 2011.	CASSARA' Pietro
5.	CASSARA' P, LUIGI ALCURI, GIUSEPPE D'ACQUISTO (2009). An Innovative Pricing Method for Telecommunication Services Pricing through American Options. JOURNAL OF NETWORKS, vol. 4 Issue 1 2009, p. 00, ISSN: 1796-2056	CASSARA' Pietro
6.	CASSARA' P, LUIGI ALCURI, GIUSEPPE D'ACQUISTO (2008). American Options Based Service Pricing For Virtual Operators. In: IEEE NOMS. Salvador do Bahia, Brasile, Aprile, p. 00, ISBN: 978-1-4244-2066-7	CASSARA' Pietro
7.	Campolo C, Iera A, Militano L, Molinaro A (2012). Scenario-adaptive and gain-aware content sharing policies for cooperative wireless environments. COMPUTER COMMUNICATIONS, ISSN: 0140-3664	MILITANO Leonardo
8.	Militano L, Condoluci M, Araniti G, Iera A (2012). Bargaining Solutions for Multicast Subgroup Formation in LTE. In: IEEE Vehicular Technology Conference VTC2012-Fall. Quebec City, Canada, September 2012	MILITANO Leonardo
9.	Militano L, Iera A (2012). Adopting Bargaining Solutions for Bluetooth-based User Cooperation. In: IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC). Sydney, Australia, 9-12 September 2012	MILITANO Leonardo
10.	Iera A, Militano L, Romeo L, Scarcello F (2011). Fair cost allocation in cellular-bluetooth cooperation scenarios. IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, vol. 10, p. 2566-2576, ISSN: 1536-1276, doi: 10.1109/TWC.2011.052511.100749	MILITANO Leonardo
11.	Militano L, Fitzek F, Iera A, Molinaro A (2011). Group Interactions in Wireless Cooperative Networks. In: Wireless Access, IEEE Vehicular Technology Conference (VTC) - Spring 2011. Budapest, Hungary, May 2011	MILITANO Leonardo
12.	Militano L, Fitzek F, Iera A, Molinaro A (2010). A Genetic Algorithm for Source Election in Cooperative Clusters Implementing Network Coding. In: IEEE International Conference on Communications (ICC 2010) - CoCoNet Workshop. Cape Town, South Africa, 23-17 May	MILITANO Leonardo
13.	Militano L, Fitzek F, Iera A, Molinaro A (2010). Network coding and evolutionary theory for performance enhancement in wireless cooperative clusters. EUROPEAN TRANSACTIONS ON TELECOMMUNICATIONS, ISSN: 1124-318X, doi: 10.1002/ett.1435	MILITANO Leonardo
14.	HEIDE J, MILITANO L (2009). Introduction to Network Coding for Mobile Peer to Peer. In: FRANK FITZEK AND HASSAN CHARAF. Mobile Peer to Peer: A Tutorial Guide. John Wiley & Sons Ltd, Chichester, doi: 10.1002/9780470747889.ch8	MILITANO Leonardo
15.	CAMPOLO C, IERA A, MILITANO L, MOLINARO A (2008). Dynamic Bargaining of Content Shares in Wireless Cooperative Systems. In: IEEE INTERNATIONAL SYMPOSIUM ON PERSONAL, INDOOR AND MOBILE RADIO COMMUNICATIONS (PIMRC).. Cannes, Francia, 15-18 Settembre 2008	Leonardo
16.	MILITANO L, IERA A, MOLINARO A, FITZEK F.H.P (2008). Wireless peer-to-peer cooperation: when is it worth adopting this paradigm?. In: INTERNATIONAL SYMPOSIUM ON WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS(WPMC). Oulu Finlandia, 8-11 Settembre 2008	MILITANO Leonardo

7.1 - Scientific curricula

<p>1. CASSARA' Pietro DATE April/26/2010 Degree: PhD in Electronic and Telecommunication Engineering Research Interests: Stochastic models for the service pricing in the telecommunication networks PhD dissertation: Telecommunication pricing schemes Affiliation: Università degli Studi di PALERMO - P.zza della Marina, 61 Pal. Steri - PALERMO</p> <p>DATE: November/11/2005 Titolo conseguito: Master Degree Electronic Engineering Disseration: Detection of DDoS attacks in the SIP environment Affiliation: Università degli Studi di PALERMO - P.zza della Marina, 61 Pal. Steri - PALERMO</p> <p>Professional experience</p> <p>From June 08/2006 - To Day Teaching assistant for telecommunication network class Affiliation: Università degli Studi di PALERMO - P.zza della Marina, 61 Pal. Steri - PALERMO Department DIEETCAM (INGEGNERIA ELETTRICA, ELETTRONICA E DELLE TELECOMUNICAZIONI, DI TECNOLOGIE CHIMICHE, AUTOMATICA E MODELLI MATEMATICI)</p> <p>From November 01/2012 - oggi Post-Doc on Stochastic Models for localization algorithms Affiliation: Consiglio Nazionale delle Ricerche - Piazzale Aldo Moro, 7 - Roma Department: Istituto di scienza e tecnologie dell'informazione "Alessandro Faedo"</p> <p>From Agoust 01/2011 to October 31/2012 Post-Doc Affiliation: Università degli Studi di PALERMO - P.zza della Marina, 61 Pal. Steri - PALERMO Department: DIEETCAM (INGEGNERIA ELETTRICA, ELETTRONICA E DELLE TELECOMUNICAZIONI)</p>
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	From March 01/2011 - February 01/2012 Teaching: Optimization models class
2.	<p>MILITANO Leonardo Leonardo Militano was born on May 07, 1982, in Reggio Calabria - Italy.</p> <p>In November 2006 he received with full marks, a Ms. degree in Telecommunications Engineering from the University "Mediterranea" of Reggio Calabria, Italy, presenting a thesis work entitled "Implementation and Performance Evaluation for Power Saving Strategies in Cooperative Wireless Networking".</p> <p>From February 2006 to July 2006, within the Erasmus project, he developed his argument of research for his master thesis at the CTIF Department - Aalborg University (AAU), Denmark.</p> <p>In April 2010 he received the Ph.D. degree in "Informatics, Biomedical and Telecommunications Engineering" at University "Mediterranea" of Reggio Calabria defending a thesis entitled "Wireless Cooperative Networks: Methodologies and Algorithms for Performance Enhancement".</p> <p>In 2008 he has been a visiting Ph.D. student at the CTIF Department - Aalborg University (AAU), Denmark, for a five months period, where he developed his argument of research in the field of Wireless Cooperative Networks.</p> <p>From 2010 to 2012 he has been a postdoctoral researcher at University "Mediterranea" of Reggio Calabria.</p> <p>In 2012 he has been a visiting researcher for one month at the INRIA research center in Lille, France.</p> <p>In 2012 he taught the course of "Advanced Systems for Personal Communications" at the faculty of engineering of University "Mediterranea" of Reggio Calabria (Italy).</p> <p>Since 2013 he is a research fellow in Telecommunications (ING/INF 03) at the University "Mediterranea" of Reggio Calabria - Italy.</p> <p>His major research areas are the study of heterogeneous wireless networks, the study of resource allocation and energy saving solutions in cellular networks, the study of cooperative interactions among users and wireless networks.</p>

8 - Research Program Description

The world of telecommunication services contributes to substantial changes in the socio-economic habits of the population. In recent years especially, with the rise of Cloud Computing and Social Networking services, users can retrieve, share and update information and contents in real time. This has led to changes in both social and technological fields. In particular, the information flow speed and the rapidity with which information affects the society is increased. Furthermore, the required bandwidth for information exchange, the service reliability and quality have become more and more stringent constraints in the development of new network infrastructures.

The rapid growth of these services, together with the need of a high level of innovation technology to support the demands of users, have led to the development of inadequate service infrastructures. In fact, these infrastructures cause the inefficient circulation of information, the inefficient use of the network resources, which increases the service costs and decrease the system performance. Finally, some kinds of service allow to abuse of the shared contents and to make technological frauds. The RAMESSE research project aims at proposing a viable alternative to what observed. In fact, the first objective for the project is to study the behavior of agents as well as the resources typology involved in this kind of services, in order to subsequently propose possible optimizations of the service management and the available technological resources. In fact, more efficient service platforms can be developed using synergically the telecommunication systems and the user devices, during the information sharing.

For this reason, the RAMESSE research project aims at studying and characterizing the behavior of groups of users which follow social "laws", based on the exploitation of the contents or information related to the users' behavioral features. The characterization will be made through mathematical models. In addition, how the information flow and the contents are distributed in the network will be studied.

Once the behavior of users and the contents flow are characterized, new types of services will be studied to provide information and contents according to the user's habits. Or services able to suggest which other services might be of interest to the user in a given area, once detected its position through appropriate localization algorithms.

Based on the developed models and the nature of the services required by the user, we will study the technological solutions for the optimal management of network resources involved during the data exchange. Given the modern heterogeneous nature of networks, characterized by many communication segments and many devices, possible optimization solutions can arise adopting solutions based on Game Theory. In particular, the issues relating to the allocation resources, the definition of the costs and the management of the communications services of all the involved entities will be studied. In these network scenarios, better performance can be achieved through a cooperative and adaptive approaches, based on the interaction between users and the communication network.

The two research units (RUs) proposing the RAMESSE project have skills and expertise that well combine with each other and are mutually dependent, in order to successfully achieve the different objectives stated in the project through a unified framework for the provision of efficient and dynamic social services.

The protocols and algorithms proposed in the project will then be verified and validated by developing simulators able to replicate the features in the scenarios of interest referenced in the project.

Furthermore, the algorithms and protocols described above, will then be ready for integration in applications of simple use, enabling an improvement in the quality of life for the user, without adopting economically costly or complex solutions. At the same time the interests of the service providers will be safeguarded, who will be able to propose new business models and offer new services in an optimized platform, tailored on the social needs of the users.

9 - Working Programme of Research Units

The research activities of the RAMESSE project will be divided into different work units named Work Packages (WPs). The total number of WPs the project is composed of is five in total, they will be named from WP0 to WP4 and will cover all three years of the project duration.

The two Research Units (RUs) of the project, namely the "Istituto ISTI CNR of Pisa" and the "DIIES Department, Reggio Calabria University", will jointly participate to all activities within the WPs, with differentiated responsibilities based on the required expertise and the past experiences on the faced problems. In this way, the interdisciplinary cooperation among the two Research Units will be encouraged, while guaranteeing anyway the knowledge contribution, the required know-how for a successful outcome in the different aspects of the project which characterize the different WPs.

In particular, within the WP0, all the coordination activities for the project will be conducted, under the responsibility of the ISTI CNR of Pisa research unit. To this aim, monthly meetings involving the RUs are planned based on technological platforms.

Considering the specific problems studied in the WP1 and WP2, which are focused respectively on the modeling of users social behavior and on the specific optimization aspects and network resources management, and considering the experiences and expertise of the two RUs, the ISTI CNR of Pisa will have the coordinator role of WP1, while RU of Reggio Calabria will have the coordinator role of WP2.

In WP1 the most suitable models will be studied to represent the behavior of social groups when these are driven by the common objective to retrieve contents, using both cooperative and egoistic approaches.

Moreover, the most appropriate mobility models will be evaluated to represent users' migrations, given some contents sets of various interest and popularity.

The involved theories in this study phase will be based on Bayesian filters and Markov processes, to better characterize the user state in a network (number of available contents, number of users in the network) and the respective trend over the time (arrivals distribution, mean time to obtain the information or the contents, grade of similarity reached with other users). Classification and clustering techniques will be adopted based on Cross-Entropy to characterize which content type or information the user prefers. This allows to complete the definition of the network state and obtain information about, for instance, the number of contents with the highest grade of interest for the user. Moreover, for the analysis on the mobility distributions of the users, localization techniques will be considered to better investigate how the social aggregation laws and the locations influence such a mobility.

To complete the study in the time perspective of the processes analyzed in WP1, the theories of stochastic fluid models will be applied allowing to characterize the stochastic processes at the steady state, under certain stationary conditions.

Based on the characterizations performed in WP1, in WP2 the algorithms and protocols for a "Smart" content delivery to the users will be studied. It will be studied how to possibly meet the content requests from the user, according to an affinity logic between content and user as defined. This will be done by looking at the user's habits, the contents available in a given time instant and the available contents in the surroundings, after having defined its position.

In developing these algorithms and protocols, also the service provider point of view will be taken into consideration, in terms of use of its resources and the expected economical return.

Considering the heterogeneous network scenarios, due to the presence of user devices with various features, an architecture will be proposed based on the "Smart" interaction among the different network elements. In fact, given the conflicting interests between network/service provider and end-users, supported by Game Theory based tools, service models will be studied able to promote a good trade-off between efficiency and fairness in terms of resources management, monetary costs and/or energy consumption costs. Moreover, while with attention to the provider side, solutions will be studied to efficiently manage and allocate available resources, on the user side cooperative interaction models will be studied to maximize performance indexes like data throughput and energy efficiency in receiving the contents.

In WP3 software products, instrumentations and hardware already available at the involved research units will be used to implement simulators aiming at validating the models and the protocols defined in WP1 and WP2. With help of computing platforms such as MATLAB or MATEMATICA, the models, proposed to characterize the users state or in general the network and the interactions among them, will be tested and validated. Instead, based on simulators like nfsimulator or Evolutionary Environment Simulator (EVESIM) it will be possible to test the quality and the performances of the algorithms and protocols proposed to provide in a smart way the services to the users. In this same WP, when possible, we will try to validate the proposals based on real data obtained from service providers within the sector or from workgroups sharing their data, through scientific knowledge sharing networks (Planet-LAB network).

In WP4 the results obtained in the previously described analysis, will be published in international journals and conferences to enhance the promotion and spreading

of the proposed innovations.

10 - Aims and results of the research proposal

The world of telecommunications services is witness of the rapid expansion of content and information sharing services. The actors of this scenario are groups of users with common interests and habits. The rapid diffusion of this kind of services, has led to the development of service infrastructures that in an inefficient way spread the information, increasing the costs of the services and decreasing the network system performance. Moreover, many scenarios of abuse of the shared contents and possibility of technological frauds are arising.

Based on above considerations, the objective that the project RAMESSE aims to achieve is to provide analytical tools (analytical models and algorithms) of the issues that underlie these services. These tools will allow the development of new generations of social network applications overcoming the mentioned shortcomings, with attention to the network resources management and the interactions among users and between users and network.

This characterization will be performed developing mathematical models of the behavior of groups of users, which follow the social "law" based on the exploitation of contents and information meeting their needs. To this aim, in this phase the theoretical analysis based on Bayesian filters and Markov processes will be adopted, which allow to characterize the status of users in a network and its behavior over time. Furthermore, classification and clustering techniques based on the Cross-Entropy, will be considered to characterize what type of content or information the user prefers. Finally, localization techniques will be taken into account to investigate on how the surrounding environments influence the user's choices, jointly with the social laws. Finally, the distribution of the information and contents available in a network among users or between users and service providers will be studied over the time. For this purpose the fluids stochastic theory will be useful in characterizing the flows even in the presence of random processes, given the upper/lower bound of the process, for the steady state, under certain stationary conditions.

Once the behavior of users and the flow of contents are characterized, new types of services will be studied to provide information and contents to the users, in accordance with their habits. Similarly services will be studied able to suggest which other services can be of interest to the user in a given area, once identified its location. For this purpose the localization and robust optimization techniques will be useful for the selection of the user's contents, given the constraints about their habits and position. Instead, the consensus control theory will provide the support to develop services for distributed environments. The methods of resources optimization will be studied to develop methods for the service provider, to maximize the use of its resources, having identified the flow of users and their habits, the type of contents requested and the revenues that the provider expects.

Also the technological solutions for the management of the network resources, involved in the delivery of the contents of interest, will be studied. In fact, given the heterogeneous network scenarios due to the different kind of communication segments and user devices, optimized solutions are required to address resource allocation problems, meeting the constraints on the costs and the management of communications and services. For this aspect Game Theory based tools will be useful.

Algorithms and protocols developed in the first part of the project will then be implemented in a simple to use applications, which allow to improve the quality of life, avoiding the use of expensive and complex solutions.

Many application scenarios can be thought for the RAMESSE project, an example is in the field of care, especially for vulnerable people (disabled and elderly), which, including the user's needs and its geographical position, may be given information on the most useful services available for the user within a radius of a few hundred meters (services available in mobility). This is in line with the overall objective of improving the quality of life of the population on a large scale. The result of the project will be a library of models and protocols which describe the relationship among the network users, their needs and the available content or information. Moreover, a set of services will be developed, with attention to the needs of the service providers and the optimal management of their network technologies.

11 - Scientific and/or technologic and/or socio-economic impact of the research

The effects of the project on the scientific and technological fields will be related to the study of models of social processes, information flows, localization and allocation of the network resources techniques.

The development of new models for the characterization of the social processes and information flows can have effects not only in the field of telecommunications, but also in other fields such as the media communication and economics. From the study on the localization new technological solutions and new service infrastructures can arise, based on this novel techniques. These new types of services can encourage new technological and financial investments.

By the study of the architectures for "Intelligent" interaction among the network service entities, new models for the management and allocation of available resources can be developed. For this issue energy efficiency and economical aspects can be taken into account. Furthermore, the developed algorithms and protocols integrated in user applications can create new business opportunities in the field of service-applications. Finally, not to be underestimated is the impact of the project on the growth of the personal knowledge, due to the synergistic expertise exchange between the various technological fields involved in the project.

The impact in the social field are related to the synergy of the RAMESSE project with the Future Networks Work Program, and with the relevance of the addressed topics with the objectives in the Horizon 2020 program. These topics deal with the possibility to address the "big social challenges" of the demographic evolution and innovative and safe inclusive societies. The methodologies developed in RAMESSE represent a key step in the evolution of information and communication technologies (ICT), used as tools to address these challenges. Examples are the benefits arising from services for users in the sphere of socialization processes, especially in a time where the people isolation due to the daily routine is growing. Other effects can be identified in the possibility to create an infrastructure to support and help the elderly and people with disabilities.

The economical benefits concern new business opportunities arising from the new types of services provided, the possible investments made by the current service providers to improve the quality and variety of their services according to the indication given in our studies about the habits of users, content flows, network resources optimization and consequently on the energy resources/environmental optimization.

12 - Total cost of the research proposal, per single item

Cost item	Cost	Description (Italian)	Description (English)
A.1 - Permanent staff	109.600	Spese di personale di ruolo	Spese di personale di ruolo
A.2.1 - cost of contracts for managers of research units	300.000	Spese per contratti a tempo determinato per ri responsabili di unità	Costs for the contract fixed-term of the unit research supervisors
A.2.2 - Expenses for the personnel to be hired			
B - Overheads	245.760	Spese generali direttamente imputabili all'attività di ricerca	Spese generali direttamente imputabili all'attività di ricerca
C - Equipments costs, softwares			
D - Consulting costs			
E - Other costs	10.000	Spese per congressi e divulgazione dei risultati	Costs of the congress and dissemination of the results
TOTAL	665.360		

Cost item legend:

- ♦ **A:** Cost for staff (A.1 permanent staff; A.2.1 cost of contracts for managers of research units; A.2.2 Expenses for the personnel to be hired)
- ♦ **B:** Overhead (compulsory, 60% of total personell costs)
- ♦ **C:** Equipments costs, softwares
- ♦ **D:** Consulting costs
- ♦ **E:** Other costs

13 - Costs and fundings of the proposal

Total cost	Funding for the contracts for Unit Responsibles	MIUR funding (70%) on the remaining expenses	Total MIUR funding	University/Body (30%) funding on the remaining expenses
665.360	300.000	255.752	555.752	109.608

I dati contenuti nella domanda di finanziamento sono trattati esclusivamente per lo svolgimento delle funzioni istituzionali del MIUR. Incaricato del trattamento è il CINECA- Dipartimento Servizi per il MIUR. La consultazione è altresì riservata agli atenei e agli enti di ricerca (ciascuno per le parti di propria competenza), al MIUR - D.G. per il Coordinamento e lo Sviluppo della Ricerca - Ufficio V, al CNGR, ai CdS e ai revisori (peer review). Il MIUR potrà anche procedere alla diffusione dei principali dati economici e scientifici relativi ai progetti finanziati

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