

Research Strategies, Tactics and Paradigms Relevant to a Specific PhD Thesis in MAP-I Program

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Abstract. This paper discusses research strategies, tactics and paradigms relevant to Computer Science in general. Also in this paper, the methodologies which will be applied for a defined PhD thesis under the title of “*Secure and Reliable Communication Infrastructure for IP-Based Emergency Applications*” assigned to Vahid Nazari Talooki (PhD student in MAP-I program) are explained. The main idea of PhD thesis and the steps that are needed to do it will be explained. After that we have a section about methodology definition and research strategies, tactics and methodologies that are useful for this PhD thesis are discussing.

Keywords: Methodology, PhD Thesis Plan, Scientific Modelling, Problem Solving, Simulation

1 Introduction

Methodology is “The analysis of the principles of methods, rules, and postulates employed by a discipline” or “the systematic study of methods that are, can be, or have been applied within a discipline” [1].

There are a number of questions that can help to choose which methodology is best suited to the topic of your study. These can be grouped into questions about the methodology itself, about the techniques it uses for gathering data, and about how these data are analysed. Each methodology represents a different approach to evaluation. The fact that there are so many approaches in common use simply reflects the fact that no single methodology is 'the best'. Which one will be most appropriate for us depends on the type of questions we are asking.

In this paper, after introduction, we will see a definition for methodology, and then will explain methodology term, then a very short introduction to author's PhD thesis, choosing a methodology section, discussing the research strategies, tactics and paradigms in this thesis and a conclusion part will be at the end.

2 Methodology

A methodology is a system of organising principles underlying an area of study. It is a form of standardisation or framework, allows things to be compared on a like-for-like basis, and allows findings to be replicated so as to validate them. Methodology also ensures that findings are as true to reality and it is the framework that allows the body of human knowledge to progress. Through using a standard approach to creating new information, all people working within a given field can continually review, refine and validate (or invalidate) previous findings, until knowledge that is as accurate as possible is found.

Methodology includes all of the things that are crucial to a piece of research being carried out effectively and includes philosophical approaches, theoretical models, rules for creating hypotheses and rules about designing and conducting meaningful experiments and how to collect and analyse data, and rules for writing up results. A methodology includes sub-methodologies, or subordinate organising principles, which integrate into the hierarchy of the overall methodology.

Methodology and method shouldn't be confused to each other. As an example while we make survey, if we ask questions to the instructors instead of students because the instructors have more knowledge about the subject, method about gathering data changes but methodology (asking someone) doesn't change.

Methodology refers to more than a simple set of methods; rather it refers to the rationale and the philosophical assumptions that underlie a particular study relative to the scientific method. This is why scholarly literature often includes a section on the methodology of the researchers.

3 PhD Thesis Plan

Author's thesis topic is "*Secure and Reliable Communication Infrastructure for IP-Based Emergency Applications*" under the supervision of Prof Jonathan Rodriguezjonathan@av.it.pt. The whole work can be summarized like below:

Discussions about emergency services usually diverge into discussions about most prominent catastrophes and terrorist attacks. Such events tend to create crisis and panic over the society. For this reason, it is important to define an appropriate crisis handling management. This strategy will coordinate all the available resources in terms of public services (police, authorities, hospital, fire-brigade, and so on) so that this crisis is resolved smoothly. While these extreme events surely represent some of the most demanding scenarios for emergency services, in order to fulfill the requirements of modern societies, research and development in the area of emergency services need to address a much broader scope.

With the increased reliance of our modern societies on communication infrastructures and the migration towards IMS and all-IP next generation networks, research and development activities must aim at providing stable and reliable communication infrastructures even under extreme situations as well as integrating and migrating the current emergency service infrastructure.

This includes not only replicating current emergency services in an IMS and all-IP environment but also enabling new forms of high-quality and secure communication infrastructure for emergency workers. Moreover providing robust and reliable broadband networking infrastructures for emergency services and investigating and realizing some mechanisms for providing reliable services in IP networks in general and ad-hoc networks in particular are the others research challenges which will be addressed in the scope of this doctorate program.

I planned some general steps for this PhD program which is summarized below:

3.1 Literature Survey

As a first step, the requirements for emergency systems from a regulatory and operational view will be collected and analyzed. This information will be used to develop the appropriate mechanisms and framework for providing emergency services based on IMS for daily and extreme emergency situations as well as integrating this framework with legacy systems. In the context of the specified framework, special attention will be dedicated to aspects of high availability of the system and its secure operation.

State of the Art and Requirement Analysis:

- As a first step, the requirements of emergency systems and state-of-the art will be analyzed to provide the requirements of the emergency architecture to be developed.
- State-of-the-art review on wireless mobile ad-hoc networking.
- State-of-the-art review on security aspects for ad-hoc networking.
- State-of-the-art review on reliable and secure service provisioning.

3.2 Design and Specification of IP-based Daily Emergency Systems using mobile Ad-Hoc networking

This will consist of the following activities:

Design and Specification of IP-based Daily Emergency Systems: This part of the work will address issues of supporting daily emergency using wireless ad-hoc. This will include issues of user localization, QoS provisioning, routing, and security aspects.

3.3 Design and specification of IP-based services for Catastrophe situations

Design and specification of IP-based System for Catastrophe situations: Using concepts of ad-hoc communication integrated with links to fixed networks this task will address issues of providing a reliable and communication infrastructure for emergency services. In this context issue of QoS control, secure communication and integration of ad-hoc and fixed networks will be addressed.

3.4 Emergency System Integration and Validation

Emergency System Integration: This part of the work will involve the integration of the complete system and evaluating its correctness, performance and applicability. The integration will be done in steps allowing a step-by-step verification of the complete system. The system will be evaluated from different points of view, including:

- Performance: this involves determining the speed of establishing secure communication
- Between ad-hoc emergency workers, time needed to react to sudden events and accuracy of detecting failures and denial of service attacks.

- Availability: This involves mainly the ability of the system to withstand sudden event leading to the failure of a server, network connection or a complete subsystem.
- Scalability: Investigate the ability of the system to cope with large numbers of calls for example.
- Writing Doctoral thesis and Journal Publication

4 Choosing a Methodology

The fact that there are so many approaches in common use simply reflects the fact that no single methodology is 'the best'. Which one will be most appropriate for us depends on the type of questions we are asking. By specifying some futures and specification of thesis we will be able to find some appropriate methodology for our work. In this specific case (this PhD thesis), there are some properties which should be considered in choosing a proper methodology.

First of all, because of we cannot apply our theories on the real system (mobile network), so we should have a small sample of mobile network for applying our theories, running some programs, doing some tests and so on. Scientific modelling which is discussing in next section (5.1) can help us to achieve that goal.

This work should prepare some novel ideas about “Secure and Reliable Communication Infrastructure for IP-Based Emergency Applications”. To achieving this purpose we need a methodology that can help us as a tool of thinking and solving the problem.”Problem Solving” approach which can satisfies this requirement is discussing in next section (5.2).

After previous two steps we will have some possible models and solutions for our project. In this stage we should examine these possible solutions to find a final and best answer which can satisfy all requirements of thesis. A powerful tool for examining and monitoring all possible solutions (when accessing to real system is hard or impossible) is “simulation” tactic which is discussing in next section (5.3).

5 Research Strategies, Tactics and Paradigms in This Thesis

Most scientists and researchers have their own specific scientific methods, research strategies, tactics and paradigms which are supported by methodologies. This PhD work will be a loop of design, implementation and evaluation (Figure 1). There are a wide range of these methodologies and strategies based on this thesis which some of them can be better for applying in this thesis. This section summarizes these useful tactics for this thesis.

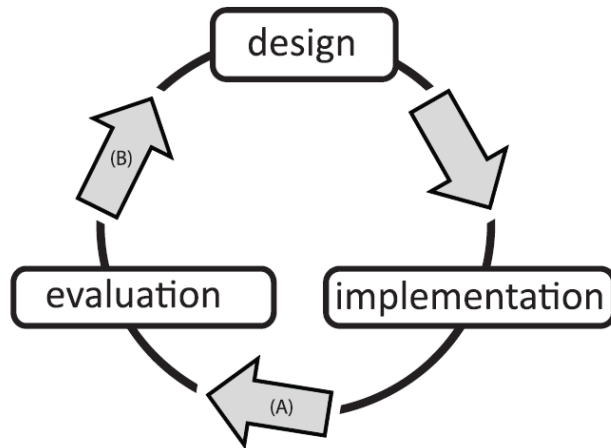


Fig. 1. Three essential elements in this PhD plan and their relation

5.1 Scientific modelling

Because of we cannot apply our theories on the real system (mobile network), so we should have a small sample of mobile network for applying our theories, running some programs, doing some tests and so on. Scientific modelling which is discussing in this section can help us to achieve that goal.

Scientific modelling is the process of generating abstract, conceptual, graphical and or mathematical models. Science offers a growing collection of methods, techniques and theory about all kinds of specialized scientific modelling.

Modelling is an essential and inseparable part of all scientific activity, and many scientific disciplines have their own ideas about specific types of modelling. It has some essential part: [2], [3]

5.1.1 Model

A model in science is a physical, mathematical, or logical representation of a system of entities, phenomena, or processes. Basically a model is a simplified abstract view of the complex reality.

5.1.2 Modelling language

A modelling language is any artificial language that can be used to express information or knowledge or systems in a structure that is defined by a consistent set of rules.

5.1.3 Scientific method

Scientific method refers to the body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge.

5.1.4 Simulation

A simulation is the implementation of a model over time. A simulation brings a model to life and shows how a particular object or phenomenon will behave.

5.1.5 Structure

Structure is a fundamental and sometimes intangible notion covering the recognition, observation, nature, and stability of patterns and relationships of entities.

5.1.6 Systems

A system is a set of interacting or interdependent entities, real or abstract, forming an integrated whole.

5.1.7 The process of generating a model

Modelling refers to the process of generating a model as a conceptual representation of some phenomenon.].

5.1.8 The process of evaluating a model

A model is evaluated first and foremost by its consistency to empirical data; any model inconsistent with reproducible observations must be modified or rejected.

5.2 Problem solving

This work should prepare some novel ideas about “Secure and Reliable Communication Infrastructure for IP-Based Emergency Applications”. To achieving this purpose we need a methodology that can help us as a tool of thinking and solving the problem.”Problem Solving” approach which can satisfies this requirement is discussing in this section.

Problem solving forms part of thinking. Considered the most complex of all intellectual functions, problem solving has been defined as higher-order cognitive process that requires the modulation and control of more routine or fundamental skills (Goldstein & Levin, 1987). It occurs if an organism or an artificial intelligence system does not know how to proceed from a given state to a desired goal state. It is part of the larger problem process that includes problem finding and problem shaping. Some problem-solving techniques are [4]:

- Divide and conquer: break down a large, complex problem into smaller, solvable problems.
- Hill-climbing strategy, attempting at every step to move closer to the goal situation. The problem with this approach is that many challenges require that you temporarily move farther away from the goal state.
- Trial-and-error
- Working Backwards

5.3 Simulation

After previous two steps we will have some possible models and solutions for our project. In this stage we should examine these possible solutions to find a final and best answer which can satisfy all requirements of thesis. A powerful tool for examining and monitoring all possible solutions (when accessing to real system is hard or impossible) is “simulation” tactic which is discussing in this section.

Simulation is the imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviours of a selected physical or abstract system.

Key issues in simulation include acquisition of valid source information about the referent, selection of key characteristics and behaviours, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes [5].

6 Conclusion

There are a wide range of these methodologies, strategies and based on each specific PhD thesis and for this specific PhD Thesis (“*Secure and Reliable Communication Infrastructure for IP-Based Emergency Applications*”), best methodologies which are completely applicable and apply able were discussing in this paper.

We discussed that the real system (mobile network) which we are dealing with in this PhD work is so big and therefore we cannot apply our theories on the real system. Scientific modelling can help us to solve this problem. This work should prepare some novel ideas so we need a methodology that can help us as a tool of thinking and solving the problem which “Problem Solving” can satisfy this requirement. We should be able to examine all possible solutions and answer models to find a final and the best answer which “simulation” can handle it for us as a powerful tool for examining and monitoring all possible solutions.

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