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IMPLICATIONS OF RECENT TRENDS IN TELECOMMUNICATIONS ON MODELING AND SIMULATION FOR THE TELECOMMUNICATION INDUSTRY

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Abstract: With this paper we would like to trigger a discussion on future needs of modeling and simulation techniques and tools for the telecommunication industry. We claim that the telecommunication market has undergone severe changes that affect the need for and type of simulations in industrial research. We suggest some approaches how to address these new challenges. We believe that there is need for intensive research in the area.

Keywords: Telecommunications, Market Evolution, Modeling and Simulation Challenges.

ACM Classification Keywords: D.2.2 Design Tools and Techniques; K.6.1 Project and People Management.

Introduction

Models and simulations in telecommunications fulfill a number of tasks. We build models and run simulations to check the design of emerging products, we model the environment in which such a product is employed and we evaluate and optimize the performance of telecommunication equipment.

In the telecommunications industry the ultimate goals behind these tasks is to save costs and to make money by better or faster design and efficient development support.

We claim that the world of telecommunication has lately undergone severe changes that affect the need for and type of simulations in industrial research. In the course of this paper, we will outline the main trends we observe and discuss the implications on modeling and simulations.

1. Fractalization of the "old" incumbent telecommunication market.

2. Shift of operators' interest from providing a network to providing services and applications.

3. Shortening of development cycles.

4. Telecommunication and telecommunication problems pervade other sectors of private and business life.

Evolution of the Telecommunication Market

2.1. Fractal markets: We observe that a large part of the market has become fractal as opposed to monolithic in the past. The large state owned companies have been replaced by private enterprises. This is true for both, the Western industries, where the telecommunication business has been privatized and the former Soviet block where telecommunication has been denationalized.

This means that a large number of companies are producing and offering new - often small - products, services and devices, among which the customers, operators and consumers, may choose. Often these products complement each other enhancing each other's value. This means that there are no longer single solutions out of one hand.

An example might be the offering of ring-tones that enlivens the world of mobile communications as a complementary business. Another one is the home entertainment sector where networks are closely intertwined with the services, such as TV over broadband, that are offered through the networks and even the content that is offered.

2.2. Enlarged value chain: Operators and manufacturers seek to get a bigger portion of the value chain by offering applications and services or at least middleware to enable applications and services. This can be observed, for example, in the home entertainment market. Broadband internet access opens a new channel to the end consumers of content, e.g. movies, and thus offers an opportunity for direct cooperation between content manufacturers and operators such as the big national telecommunication providers. We may, at some point, see a merger of network provisioning and services.

2.3. Shortened development cycles: Industrial research is always coupled with a certain product that the company wishes to launch. When products become smaller and follow, to a certain extend, the fashion of the day, development cycles shorten and design becomes more volatile. In industry, we need to cope with these shortened development cycles. Otherwise people may cease to use simulations as a decision basis. As a matter of fact, we have the impression that there is already a decline in the use of simulations. We think, that there is a need for "rapid modeling", may be even accepting a degradation of simulation quality.

2.4. Telecommunication pervades other industrial and private sectors: Telecommunication, at the very beginning, dealt with the communication between two people at some distance. Today not only people communicate, but people with devices and devices with devices. We see, for example, that the control units in a truck (for motor, breaks, gearing) exchange information across a mini communication system. Tags are attached to new cloths that communicate with the security system of a store through a small radio system. Infotainment systems in cars communicate with some traffic control network outside the car or with other cars.

There are many more examples. But do we carry over the knowledge of how to build a good telecommunication system to these areas?

3. State of the Modeling and Simulation Art in Industry

3.1. Adaptive development processes: In “old” product design, requirements were supposed to be complete and clear before product development began. With today’s explorative technology and rapidly changing markets (e.g. in telecommunications today), modeling and simulation targets are difficult to fix. A new development process must enable quick requirement adaptation, often without sufficient prior modeling and simulation. Some of the changes in the telecommunication market are discussed in Andersen (2002).

3.2. Volatility of modeling requirements: The lack of stable modeling and simulation requirements makes it difficult to validate and verify product models. Product "verification" usually refers to testing whether a product meets certain specifications. "Validation" seeks to ensure that the customer is satisfied and that the correct specifications were incorporated into the product.

3.3. Availability of software tools: The design and manufacturing processes may be presented as activities, both series and parallel, at several levels of detail over time during the development of a product. As depicted in NRC (2004), software tools are not available for 60% of the required product development activities. For other activities software tools may be emerging or even commonly available. However they rarely interoperate and their use is often inefficient.

3.4. Tool interoperability: Only when tools are available and fully interoperable, designers and engineers can use and link various data and models for a given activity as well as across different activities required for product design and realization. It yet needs to be demonstrated whether modeling and simulations tools can be integrated across multiple domains including geometric modeling, performance analysis, life-cycle analysis, cost analysis, and manufacturing.

3.5. Need for econometric evaluation of modeling and simulation: The critical decisions in the design and manufacturing of a product are taken in the early stages of its life cycle, based on the products’ modeling and

simulation. But the economic usefulness of product modeling and simulation is still difficult to judge. We need methods and tools for the econometric evaluation of product modeling and simulation (Sargent et al 2000). The usefulness of models is also discussed in (Andersen 2002) also.

3.6. Multilayer modeling merging the product, management and market levels: Modeling and simulation play an important role on the product design level, on the management level (Ericsson AB 2005) and on the market level (Andersen 2002). Merging these levels implies multilayer modeling, incorporating different paradigms, languages and methods. Such a methodology is emerging in physics (Fishwick et al. 1992) but a modeling methodology that integrates the languages of physics, management and economics is still a matter of the future.

4. Challenges and Conclusion

On the one hand, the incumbent telecommunication market seems to undergo severe changes towards a fast-living volatile world and on the other hand "classic" telecommunications modeling and simulation problems pop up in new and unexpected areas of life.

We think that modeling and simulation can respond to these changes by tackling the following challenges:

- Develop new paradigms for modeling and simulating emerging New Generation Networks, applications and services that take into account the volatility of product requirements.
- Integrate dynamic models with different levels of abstraction, different paradigms, and different modeling languages.
- Development of meta-modeling methodology and tools to evaluate the technical and econometric usefulness of modeling and simulation in every stage of product life cycle.
- Establish sets of clear criteria for modeling and simulation needs for industrial applications, such as the necessary levels of sensitivity and accuracy and the ability to adapt to requirement changes.
- Establish suitable methods and criteria to verify, validate, and certify model trustworthiness for emerging systems, devices and their environments, especially when we develop adaptable methods.
- Increase the reusability of model components as well as of data of the real systems measurements and of simulation results.
- Integrate the methods and tools for design, creation, management and control of telecommunication products and systems (for a preliminary approach see Caughlin 2000).

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