

Telecom & AI : The Emperor's New Clothes?

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Abstract

The telecommunications industry has been a fruitful field for AI applications. Looking from the present to the future we must ask ourselves whether or not the potential in this field is still available or even growing. For this reason we focus our interest on current state of the art techniques and applications and also on future aspects. We will address the following topics : current state of the art of AI in telecom; existing AI techniques and TMN (Telecommunication Management Networks); difficulties and obstacles in using new techniques; open issues and new directions for AI.

1 Introduction

In R&D the telecommunications industry employs worldwide more than 500 000 engineers. Whereas in the past most of their efforts were directed at hardware, current trends show the increasing importance of software technologies. Most of the well-known research laboratories support AI divisions working at the cutting edge of this technology. The reasons for conducting research in AI are manifold.

Public switching systems are among the most complex machines ever built. Despite their deterministic local behavior, we need powerful and proper AI techniques in order to fulfill demands for the relevant services in an optimal way.

Most telecom companies are actively involved in developing telecommunication management platforms as a step in addressing global fault, performance, security and configuration problems. Work is under way to incorporate AI techniques into these platforms. However, the panelists currently identify a gap between promising AI research results and their application in telecommunications.

2 Current State of the Art in Telecom

Greg Vessonder

It is fitting that the state of AI and Telecom be reviewed since it has been ten years since the first AI and telecom paper was presented at IJCAI-83 in Karlsruhe, Germany. At that time we introduced ACE, a diagnostic expert system for pinpointing problems in the local loop. The last ten years has shown a flurry of activity in AI and in telecom. There have been con-

ferences on AI and telecom and an edited book, "Expert systems applications to telecommunications" has been published.

The road to applying AI techniques to telecom has not been smooth and has paralleled the application of the technology in other areas. Initially much of the work was done with academically derived tools and methodologies which resulted in a moderate degree of success. This then evolved to using more sophisticated tools on specialized hardware which did not fare as well for a variety of reasons including the need of telecom applications to be connected to the rest of the telecom network. Finally shells and tools based on more standard hardware and languages resulted in strong growth of applications.

The applications in telecom have primarily been diagnostic expert systems. In particular switch diagnostic systems have been popular including COMPASS, AMF, MAD and SMART. Less frequent applications for expert systems have involved provisioning and design. In the next few years, as other AI technologies and methods in addition to rule-based expert systems become popular, we should see explosive growth in these areas.

As AI becomes more ubiquitous in telecom, the systems will become less of a technical curiosity and more just one of many techniques used by telecom application developers. This anonymity-through-acceptance is one criteria for measuring the future success of the technology. Therefore the Emperor's New Clothes (with apologies to Penrose) existence will not be an issue. What is the issue is that the Emperor will need the clothes to survive.

3 Advanced AI Techniques in Telecom

Fumio Hattori

A survey of advanced AI techniques used and useful for telecom applications is presented. New research results are addressed from its applicability, necessity and its limitations point of view. Merits and draw-backs by using new techniques for different telecom areas are discussed. The following candidate techniques will be discussed more deeply:

- Real-time AI for real-time network control
- Distributed AI for network resource allocation
- Neural networks for autonomous network control

- Fuzzy systems for network management
- Very large knowledge bases

It will be shown that all these techniques are necessary and partially effective in certain areas. Finally the following question will be addressed: "Are these techniques the most important ones for next generation telecommunication network management?"

3 Difficulties and Obstacles in Applying Existing AI Technologies

Werner Remmele

Siemens AG is a major supplier within the telecommunication market for both public and private communications systems. With DM 18.6 Bill. in 91/92 almost 25% of Siemens sales were within the two communication groups of the company. Obviously, there is a strong necessity for ongoing innovation of their technologies.

Some of this R&D work is carried out in the company's corporate department for Research and Development (ZFE), which is responsible for innovative technologies, and their transfer into the different groups. There are strong links between the communication groups and the department for Knowledge Based Systems within ZFE, and some projects have been completed jointly.

We describe briefly two expert systems that Siemens is using in the telecommunication area, one for support of human interface design and one for configuration of switches.

Hicom, the Siemens private communication system, is a highly flexible system which can be configured customer-specifically to meet a wide range of different needs, depending on the customers language and country, number of extensions and many add-on features. Consisting of approximately 300 different hardware boards and vast amounts of software, its configuration requires substantial knowledge on the interaction and dependencies of the various components.

Siemens is using an expert system, XPS-configurator, to support engineers in selecting the customer specific components and check the resulting layout for consistency. The system is well integrated into the engineering process from tender formulation to hardware assembly and has been in routine use for several years.

The Siemens digital telecommunication system, EWSD is in world-wide use at PTT administrations. Its operator interface is the Man Machine Language (MML) according to a CCITT recommendation. Siemens MML currently comprises about 2000 commands and 4000 output masks. The language is continually adapted to technical innovations in EWSD. To ensure user-friendliness, new or changed commands need to conform to well defined standards of consistency and quality.

We developed an expert system, CODEX, to support the design of MML commands and enforce the relevant regulations. Consisting of an MML-checker and an MML-advisor, which contain knowledge of the relevant design regulations, it interactively helps language designers to meet all requirements. Ultimately, the system contributes to the high MML

quality which in turn makes the operators work smoothly and efficiently.

While in the 80s AI techniques were expected to penetrate all areas of computer applications, their actual deployment has happened more slowly.

Despite the examples cited, the tremendous potential in telecommunication for such engineering tasks as design, diagnosis, monitoring, but also image processing has not been matched by a corresponding record of installed AI solutions. Indeed, we are far from a routine use of knowledge based systems as a standard technique of software engineering. From our perspective, we found the following issues as most significant for the wide usage of AI:

- Integration of AI-techniques into traditional systems
- Request for high availability of telecom systems
- Usage of common platforms
- Heuristic approaches

One difficulty in integrating AI-techniques lies in the very high engineering investment represented by a modern telecommunication system. The hardware and software development effort invested makes it impossible to completely redesign a whole system using the latest technology; instead one always has to live with large portions of existing code, and any AI solution has to fit in with it. Thus, although substantial knowledge is incorporated in any telecom system design and implementation, it is seldom in a form useable by a knowledge-based system.

For this very reason, most real projects have chosen the obvious approach of starting with a small prototype, e.g. diagnosis of one particular version of one component of a switch. This did work, but for a practically useful system a more complete solution is needed, and when it comes to scaling up the effort in knowledge acquisition gets so high that it cannot be justified economically.

A different obstacle derives from the extremely high standards for system availability; these have always made fail-safeness a requirement in telecom systems, and solutions like redundant hardware have been provided that leave little space for additional improvement by, e.g. knowledge based diagnosis.

Another obstacle that was relevant in the early days has been largely overcome recently – it is the isolation of AI systems in terms of the hardware and software platforms available. Indeed, in the old days of the Lisp machine it was as easy to create an interesting prototype as it was hard to transfer it to the real world computing environment of the telecom switch. Meanwhile, the problem has been addressed from both sides, i.e. AI has learned to run on standard hardware and integrate with standard languages, and telecom has adopted modern software concepts, like object oriented languages that make it easy to create advanced applications.

Another difficulty has been described by the term "first generation expert systems". The fact that simple prototypes can be built with just about any tool obstructed our view for the difficulties of scaling up to large systems. Telecom systems are inevitably so complex and so rich in customer specific

ic variations that only a model-based approach can make the effort in knowledge acquisition manageable. What we need is a principled method for using design knowledge consistently as the basis for different applications. Instead of developing a knowledge base a posteriori it has to evolve from the general engineering process.

Several ongoing developments in the AI area promise solutions to the problems stated above. In particular, the field of model-based diagnosis has produced encouraging results in building expert systems in a more systematic way from a library of component models for a technical domain. Techniques of non-monotonic reasoning and qualitative models are applied here successfully.

Progress in knowledge acquisition has been made, especially in the KADS projects. Using a standardized approach to knowledge based system development such as Common-KADS enhances both the predictability of the results and the integration with conventional and existing software.

Finally, the effort to standardize knowledge representation formats and allow the re-use and exchange of knowledge bases between different applications, is expected to yield significant progress toward the economics and large-scale application of AI techniques.

4 State, Difficulties and Future Directions Concerning AI in TMN

Franz Barachini, Georg Pauthner

Alcatel concentrated its AI efforts at the beginning towards the development of expert system shells such as SPOKE and PAMELA. The latter is especially oriented towards easy integration of expert systems into existing process control systems. Real-time features as interruptability and the implementation of a high performance inference engine have been realized within PAMELA.

Subsequently, expert systems for fault management (SAMPAN, ALAMOS) and automated generation of routing tables (ARX) of public switching systems have been implemented. We made the experience that e.g. ALAMOS was perfectly shaped towards the problem. Nevertheless reusability, generality, knowledge maintenance and acquisition was still a problem.

Concerning the current state of network management systems we identify the following situation :

- The introduction of central network management facilities based on proprietary, vendor dependant approaches is finished

- The upgrade from proprietary solutions to TMN compliant ones is ongoing
- The most relevant features of network management systems today deal with the immediate operating and maintenance of a network, like alarm collection or remote operation

For the features mentioned above there is no need for the usage of AI technologies. This is justified by the fact that from the experimental prototypes, exploring the possible benefits of AI techniques, very few of them have really been fielded. In addition some of them were used as marketing arguments only.

In contrast to the past, the future of AI technologies in telecom systems can be drawn in rather bright colors. Since the size and complexity of networks is increasing, provisioning of powerful support systems for planning and maintenance of networks will require the handling of large amounts of information being partly incomplete and inconsistent. According to the application areas of TMN the use of AI can be forecasted in the following areas :

- Fault management : diagnosis support by e.g. correlation of alarms or reasoning of the cause based on a model of the network
- Configuration management : population of routing tables based on rule sets or e.g. planning support for new networks
- Performance management : evaluation of test results and simulation of the network behavior
- Security management : detection of security bottlenecks or diagnosis support for security alarms
- Accounting management : no need for AI

Currently the Alcatel-Austria Research Centre is developing FAMAP, a generic alarm and fault management package. During our investigations we recognized that there is a need to modify a knowledge base not only by telecom suppliers but also by operators. For this reason mechanisms are provided, so that existing core knowledge can only be modified to a certain extend.

The main purpose of FAMAP is to allow the implementation of expert systems which are improving network availability by providing mechanisms for fast fault identification and by reducing the load on the operators. Moreover FAMAP components can be reused for different equipment and network structures. A first expert system based on FAMAP is under test in an operation and maintenance center for mobile radio.