Tools with foresight

Researchers from Aarhus have developed valuable tools from a thought that arose in the mind of a German researcher 42 years ago. In close collaboration with the industry and the military around the world, researchers in the IT City of Katrinebjerg are working on how to use the tools based on what is called Coloured Petri Nets

BY MALENE GROULEFF

Disastrous errors can be stopped in time when military operations are planned. Valuable time can be spared when developing and designing new mobile phones.

Coloured Petri Nets is not a fortune-teller. It is better than that. It is graphic tools based on thorough analysis rather than guessing and nonsense. And beyond this it is for free.

The modelling tools of Coloured Petri Nets, also called CPN, are so universal, that it might sound very abstract when explaining how the theories and tools can be used; it is all about simultaneity, communication and sharing resources, and it is about creating a solid overview of complicated processes.

More and more people all over the world have realized that the CPN provides concrete results. Different lines of business, as from working with traffic lights in Brasilia to handling atomic disposals in USA, use it.

Draw and insert information

An important part of the minds behind the CPN tools are to be found in the IT City of Katrinebjerg, where the CPN researchers are leading on an international level, and the tools they develop are unique all over the world. 1,400

PHOTO: LARS BROSLET

The researchers in the IT City hold a mouse in both hands when using the graphical tools, Coloured Petri Nets

researchers from all over the world are on the CPN mailing list that distributes news about CPN.

The CPN works like this; you line up a sequence or a system. You draw quadrangles, circles and lines. You connect the elements and feed with data and programming text on how the parts "talk together". In the CPN language the elements are called places and what connects them are called transitions. Then you simply click the play button and simulate what will happen, step by step. You may change the criteria and the order and see what this leads to.

Søren Christensen, researcher at the Department of Computer Science at the University of Aarhus, is one of the driving forces behind the CPN research in Denmark, which centre is in Aarhus. Together with a group of eight

researchers and six student programmers in the IT City of Katrinebjerg, the CPN group, he is working on developing the theories and the tools.

- The force of CPN is that it has not been developed for one specific purpose, but is very general. The weakness, however, is that you often have to tailor it to the application domain, Søren Christensen says.

In collaboration with Meta Software in Boston, USA, the Aarhus researchers developed the CPN tools in the eighties. Søren Christensen and Kurt Jensen went to Boston for two years. The Americans were in charge of sale and distribution, however, in the mid

nineties they chose to withdraw from the collaboration, due to a change in the company strategy. This led to a change for Søren Christensen and his colleagues in the CPN group. They were allowed to take over the tools, ten years old and a bit worn out.

- We chose to make the tools available for free in order to get as many as possible to use it and to avoid the use of resources for distribution and sale. In this way the researchers evaluated that it would develop the most.

And it did develop. I 1999 the CPN researchers decided to develop a new set of tools in collaboration with two other groups at the university; partly a group focussing on programming languages, partly a group with special expertise in user interfaces. The last is called HCI and stands for Human Computer Interaction. Its participation has made it possible to work with the tools in a very intuitive way, almost like with LEGO. You use neither menus nor dialogue boxes and you can even work with two mice at a time - one in each hand.

After a little more than three years the new set of tools was ready. Even though the theories of CPN are well on in years they are still of current interest and have even become more sophisticated. In a continuous process the researchers are working on the theories, the practice and the tools. This is a work in close collaboration with several institutions and companies, which have understood the point of using CPN in projects.

Pollution and slippery roads

The CPN is mostly used for protocols that are descriptions on how computers talk to each other. By these CPN can reveal communication and logistics on an invisible level. The standardization of protocols is common. However, on top of the protocols you build new pro-

tocols, to work with the specific type of machine or the specific type of usage. In these cases you can use CPN to develop the new protocols.

Søren Christensen and his colleagues are working on a three years project in collaboration with Ericsson Telebit. The project concerns so-called ad hoc networks with IPv6 protocols, where CPN plays an important part. It is called ad hoc because it is about communication between sensor units moving or landing in a place with no infrastructure. For example, in case of a serious pollution in a specific area you can drop down sensors from the air to supervise the situation.

An ISIS project in the IT City of Katrinebjerg is working on similar thoughts: Life WArnings Systems, LIWAS. In this case the sensors are attached to a car. The idea is that the car in front of you will warn the cars behind about spots of ice on the road. Instead of just driving carefully because of the warnings of the meteorologists about icy patches the cars exchange precise and relevant information. The following persons are behind the LIWAS project: Jørn Eskildsen, Amfitech ApS, Klaus Marius Hansen, ISIS Katrinebjerg Software, Lars M. Kristensen, Department of Computer Science, University of Aarhus and Ulrik Merrild, LIWAS ApS.

Simultaneous design of insides and package

When developing new mobile phones Nokia uses CPN to estimate the use of memory.

- It is of great importance that the designer, in an early state, is able to try out and test the "thing" before building it. When we develop a new Nokia-phone everything happens simultaneously. In fact the construction of the cover of the phone is initiated in a fabric at the same time as the software

is initiated somewhere else. This means that before starting the production of the phone they need to know how much memory and which processors are needed, explains Søren Christensen.

The CPN tools are very adequate for controlling this developing process. With the CPN tools you can reveal the problems most critical to the resources of the phone - that is for the memory, the calculation and communication. - An example of this could be that the phone rings at the same time as you are doing a video recording on the phone, says Søren Christensen.

The Australian defence ministry is also collaborating with the CPN group in Aarhus. The attention of the Australians was drawn to the tools when the Aarhus-researcher Lars Kristensen went to Adelaide for two years to do research. In this case it is about precise planning of military actions, about preventing communication failures and waist of resources.

- They use it when a lot of actions are to happen at the same time with a limited amount of resources. If they have to move something from one place to another, they need to use trucks of planes. When they do this others cannot use them at the same time. The order of the actions is therefore of great importance.

By describing all the elements our tools can help you find all the possibilities for putting a plan together. Taking our criteria in consideration they can choose the best plan. The best plan could be the fastest, cheapest or safest.

CPN would also be valuable for help organisations, where it is of great importance which things are done first, Søren Christensen explains.

Every autumn the CPN gather about 50 people from all over the world to a workshop in Aarhus. Here the industry, universities and authorities exchange experiences with the tools.