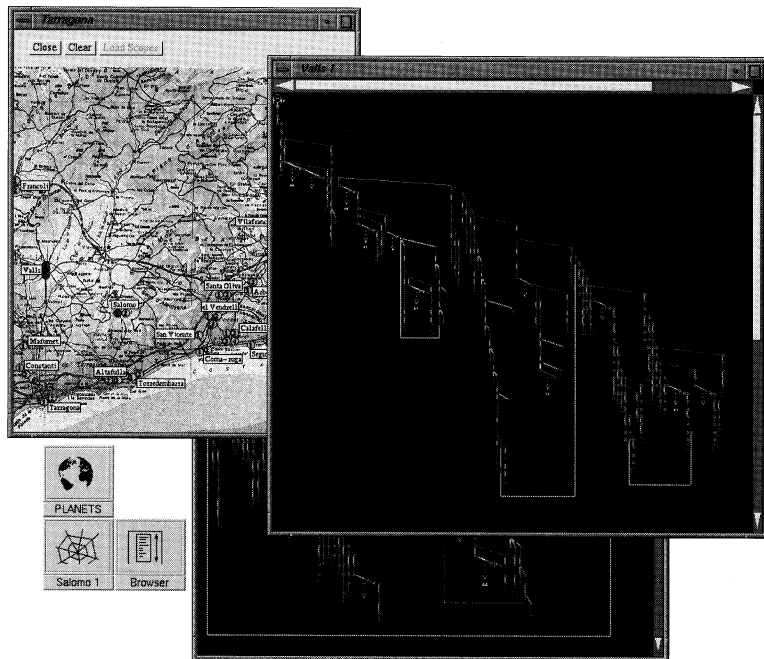


Newsletter

N° 4
July 1995

PlaNets ... a CHIP based scheduler from Spain !

This CHIP application schedules activities on an electrical power distribution network ... ensuring continuity of power supply, inspite of shutdowns in different parts of the network. This original application comes from our sun-blessed neighbours in Spain.



Networks and Maps in PLANETS

CHIP Applications at PAP'95 / PACT'95

Massive turn-out of CHIP users and CHIP applications at this international conference, which highlights innovative applications that are implemented in industrial sites.

Short CHIPS ...

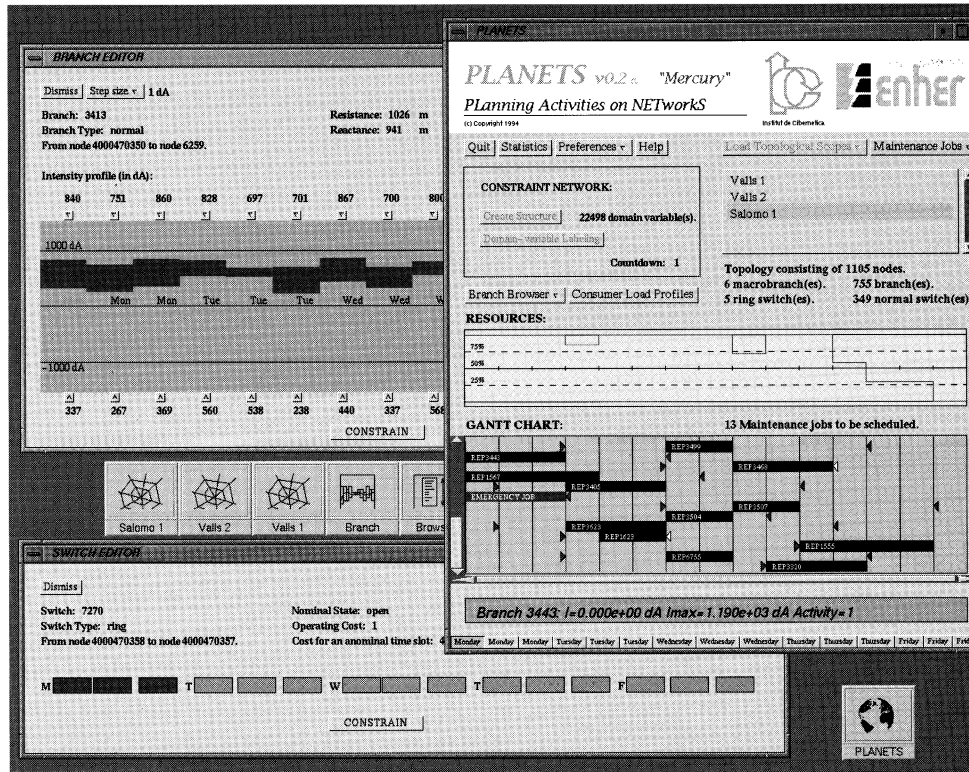
Solutions UNIX 1995, COSYTEC ... waltzes in Vienna !, COSYTEC in International Conferences, New Course Dates, Forth-coming Events.

Editorial

We will continue to supply our readers with information on practical applications built by CHIP users, that have become operational. This issue of COSYTEC *Newsletter* describes one that incorporates much domain-specific constraints that fall outside the scope of generic scheduler packages. This application is the result of successful technical cooperation between the Catalonia regional power utility ENHER S.A. and the Institut de Cibernètica (in Barcelona).

If you have (or know of) similar developments that you want to share with the CHIP community, do not hesitate to call us or email us at the address : "newsletter@cosytec.fr".

PlaNets: scheduling activities at Power Utilities



The Problem

The exploitation of a network for electricity distribution necessarily implies the planning and scheduling of activities to be carried out on it, within a certain time span. These activities basically fall into 4 categories:

- preventive maintenance
- modifications of the nominal topology
- reparation of malfunctions
- re-establishment of the nominal situation

The planning of these activities is not trivial: e.g. the area of the network involved needs to be isolated from the rest of the distribution network and connected to the ground. To continue supplying energy to other installations and consumers in the area, it is necessary to select and re-configure one of the alternative supply routings through the network, through opening and/or closing switches, without overloading any branch. In addition, various maintenance tasks would be scheduled, and certain switching operations might be shared among tasks. In some cases two tasks can never be carried out simultaneously if there are no viable network reconfiguration. Finally, activities require various resources of limited availability (manpower, vehicles, etc.), and are subject to due dates while task priorities must be respected.

PLANETS - the scheduler, a functional description

Given a collection of maintenance activities to be carried out within the weekly time span, characterized

by their network location, due date and resources consumption, given the network topology and the resource availability, PLANETS finds an optimal schedule with respect to the operation cost of realizing the necessary reconfigurations in every time slot.

The system now handles networks of up to 4000 nodes and 700 operable switches, and incorporates a network compression module. The scheduler takes about 3 minutes on a SuperSparc20 workstation.

In addition to gantt charts and resource views, PLANETS also offers graphical interfaces to manually operate the switches to reconfigure the network and see resulting load flows, to manipulate problem constraints using known consumer load profiles.

PLANETS - the technology

The PLANETS scheduler is entirely written in CHIP V4. Extensive use has been made of the CHIP++ object system and the XGIP X11 graphics system.

A complete problem of the before mentioned size, is represented by about 22000 domain variables. They are temporal (start dates), electric (current intensities) or topological (switch states). Due to the propagation characteristics of the resulting constraint network, the scheduling and reconfiguration subproblems can be solved efficiently. Optimization is done by a branch-and-bound process. A reconfiguration algorithm in a C library provided by ENHER S.A., for load balancing is incorporated, using CLIC. (see following page)

CHIP Applications at PAP'95 / PACT'95

The third international conference on the Practical Applications of Prolog PAP '95, held in Paris on 3-6 April 95, was more like a gathering for CHIP users, who came in force with 7 papers published. In addition, H. Simonis (COSYTEC) presented a tutorial on 'Planning and Scheduling', where he presented some lessons learnt from using CLP in operational applications, supported by the recent applications implemented by COSYTEC for the FINA refinery (B), for a food manufacturer in UK, and for the Monsanto herbicide complex in Antwerp (B).

Knowledge Engineering with CHIP: Application to a Production Scheduling Problem in the Wire-Drawing Industry, CRP Centre Univ.(L) & ENST Bretagne (F)

The industrial partner, TrefilARBED, an ARBED Steel subsidiary in Luxembourg, produces important quantities of drawn wire. This work enabled the development of a Knowledge Extraction methodology, allowing one to determine missing (unimplemented) constraints, and to progressively arrive at a system that behaves like experts.

DSS for Planning and Scheduling Aircraft Manufacturing, Dassault Aviation (F)

This paper describes work and experiences gained on 3 planning and scheduling systems for aircraft manufacturing, of which 2 are operational. It concludes that CHIP is adequate for solving *complex* problems where end-user interaction can play a role, that incremental development is important to match initial and evolving requirements.

Constraint-based maintenance scheduling on an electrical power distribution network, Institut de Cybernetica (E) and ENHER S.A. (E)

This system schedules maintenance activities taking into consideration various constraints arising from the power distribution business. When a part of the net work is closed, the affected customers must be given power using other parts of the network, without dangerously overloading them nor degrading tension. The system handles up to 4000 nodes in 3 minutes.

Building Industrial CHIP Applications from Reusable Software Components, COSYTEC

This paper shows how the CHIP V4 system components such as CHIP ++ and XGIP libraries, can be reused to build applications, reducing effort spent yet obtaining very high quality software. Reused code in typical applications can take up to 50% of the total application code.

Constraint based approach to design a DSS for Scheduling, LAAS-CNRS, Dassault Aviation & INSA (F)

This paper reports on a study of the processing-order release function in a flanging shop of Dassault Aviation, where parts are very diverse and different routings are possible. In addition to respecting time-windows, the parts to produce are assigned on the cutting machines, i.e. it simultaneously solves a 2D placement problem.

Solving school timetabling problems with CHIP, Ecole d'Ingénieurs en Informatique pour l'Industrie, Tours (F)

The importance of the graphical interface was stressed whereby end-users can see if the solution is acceptable and if constraints are left out. The conclusion was that CHIP allowed the resolution of very *difficult* problems without extensive mathematical training.

Applying constraint satisfaction techniques in timetable scheduling, Chinese Univ. of Hong Kong

This project was built in some 1500 lines, where 80% of the code handles graphical interaction. Compared with a C algorithmic approach which requires 8000 lines (50% being interface), the CHIP solution was 5 times faster (e.g. 4 seconds on Sun Sparc 10/30 for 5 departments with 72 courses).

PACT 95 in Paris, 7th April

This new conference is dedicated to the technical and business benefits of Constraint Programming Technology for solving real-world problems. There were 3 papers from CHIP users :

- H.Simonis, COSYTEC, "A Complex Transportation Problem solved with CHIP",
- I.Crabtree, British Telecom, "Resource scheduling-comparing simulated annealing with constraint programming"
- A. Chamard, Dassault Aviation, "CHIC Lessons on CLP Methodology".

(from preceding page)

PLANETS - the future

Before coming fully operational, PLANETS will be integrated with the other systems at the dispatching centre of the company using DEC alpha technology. Among these are systems for operational planning and the so-called orthogonal graphics system for on-line detailed visualization of the distribution network.

PLANETS results from ongoing technical cooperation between the Spanish power utility ENHER, S.A. (Empresa Nacional Hidroeléctrica del Ribagorzana) and the Institut de Cibernètica (UPC/CSIC).

Authors: Tom Creemers, Jordi Riera and Lluís Ros.

Short CHIPS

SOLUTIONS UNIX 1995

COSYTEC will be present at this annual show at Porte de Versailles, Paris, from 4 to 6 October 95. In addition to displaying operational industrial applications in Planning and Scheduling, COSYTEC will announce the *CHIP V4 Open Architecture*, including new C and C++ libraries, featuring new global constraints and more platforms.

Don't miss this occasion, call us for an invitation !

COSYTEC... waltzes in VIENNA !

ATTIS'95, the Airline Travel Transport Information Systems conference and exhibition was held at Vienna from 26 to 30 May 95.

There were two talks on air transportation applications based on CHIP:

- Crew rescheduling at SAS
- Day to Day Crew management at **Lufthansa**

COSYTEC also set up a booth to display related applications

Forth-coming Events

- ✓ First International Conference on Principles and Practices of Constraint Programming PPCP'95: 19-22 September 95 at Cassis, France.
Talks on CHIP include :
 - Modelling Producer/Consumer Constraints, by COSYTEC and Beyers&Partners
 - The CHIP System and its Applications, by H. Simonis
- ✓ Awareness Seminars 95: organized by the PMG
 - Birmingham 19-21 Sept on Manufacturing, in conjunction with CIM'95.
COSYTEC will be present at the exhibition

COSYTEC in International Conferences

- **Tokyo**, June: At the 12th International Conference on Logic Programming ICLP'95 in June, H.Simonis was invited to give a tutorial.
- **Singapore**, June: M.Dincbas gave a talk at the first international conference of INFORMS'95 (INstitute For Operational Research and the Management Sciences).
- **Jerusalem**, July : M.Dincbas gave a talk at the 14th European Conference on Operational Research EURO XIV.

New Course Dates

Two courses *Programming in CHIP* are scheduled

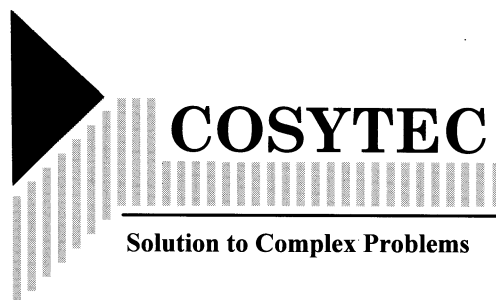
in Detroit (U.S.)	14-18/08/95
in Paris (F)	04-08/09/95

Personal Notes

New Personnel :

- Eric Bourreau has just joined COSYTEC and will broaden the ranks of the R & D team.

To receive the COSYTEC *Newsletter*, please send your name, job title, company and address to the editor at :



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