

UniCAP porting to Linux+RTLinux environment

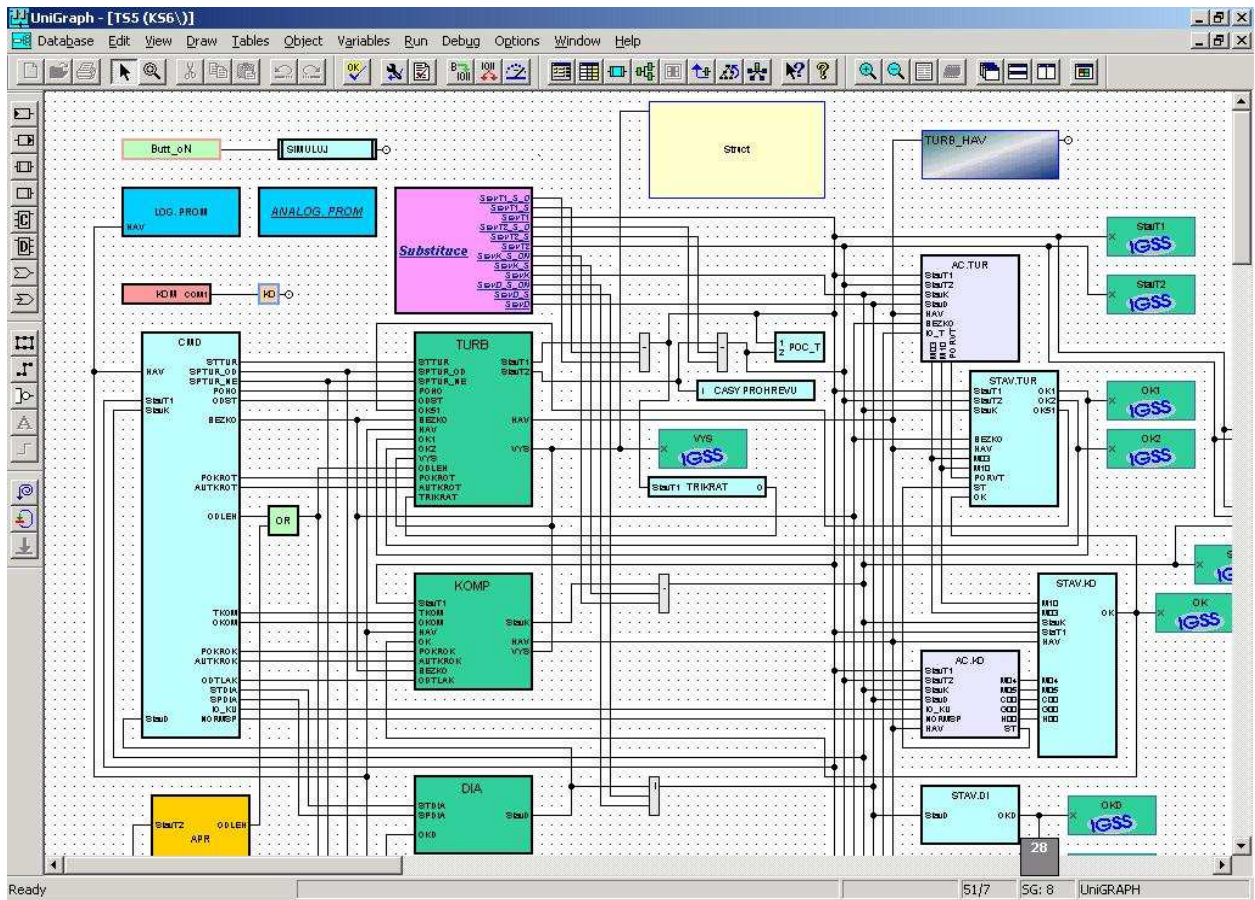
1. Introduction

UniCAP is a complex software tool for support of designing and application programming of distributed information and control systems.

It consists of two main parts:

1. Development environment for application programming.
Application programmer can use a graphic editor for design an application in FBD or SFC languages.

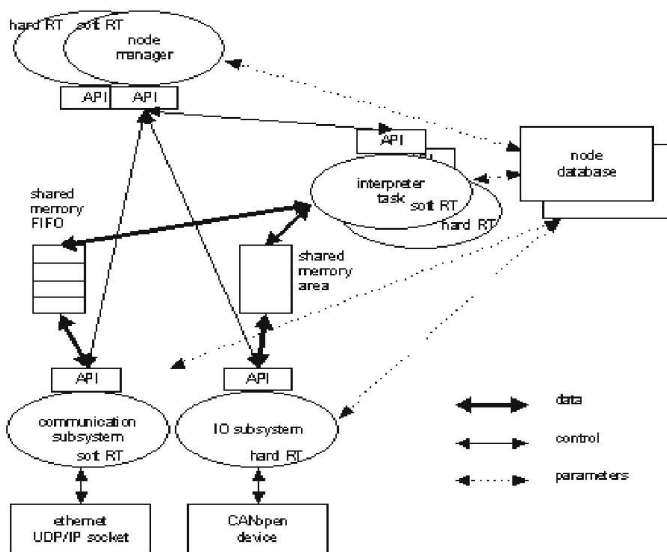
Main control algorithm of turbocompressor gas plant Kralice in FBD language:



2. Real-time environment in target process control stations

Control algorithms of process control applications are compiled, downloaded into process control stations (nodes of a distributed system) and executed in an environment of a real-time operating system. This part of UniCAP will be ported in frame of OCERA project from OS9 operating system to Linux+RTLinux operating system.

2. Software architecture of UniCAP in proces control stations



Node manager

Node manager maintains all information regarding node as control system subject. Node database with interpreted code is maintained here and algorithm interpreter is controlled in terms start, stop interpretation, attach/release IO subsystem and communication subsystem. Configuration/reconfiguration of IO subsystem and ethernet communication subsystem is controlled from here. Node manager will contain hard RT task responsible for accurate node timing and soft RT task responsible for node management.

Control algorithm interpreter

Control algorithm interpreter uses code, prepared in node database, and performs actions as specified by this interpreted code. Interpreted code is prepared offline in development and debugging tool running on host PC and downloaded into target system. Application control is described in languages according to IEC 61131 and then compiled. Download of interpreted code is controlled by node manager. Control algorithm interpreter contains IO subsystem interface and communication subsystem interface. Interpreted code is divided into interpreted "tasks", which are represented with Linux tasks. For critical control algorithms are these tasks placed in hard RT, the rest is placed in soft RT.

Ethernet communication subsystem

Ethernet communication subsystem transports messages via ethernet network using UDP/IP sockets. Subsystem take care for message confirmation, timeout evaluation and communication retries. Subsystem keeps and maintains net topology information, which is obtained with broadcast messages among nodes in topology.

IO subsystem with CANopen communication

IO subsystem connects algorithm interpreter with remote IO modules connected to node with CAN bus and protocol CANopen. IO modules provides direct technology control. CANopen protocol is realized by CANopen device and connected to the subsystem with its API library. CANopen subsystem is configured according to node database and can act as CANopen master or slave, as a master can manage several CANopen remote IO nets with attached modules. Used nets and modules with appropriate parameters are specified in database.

3. Plan of porting to Linux+RTLinux environment

Node manager

RT space placement: both hard RT and soft RT

SW interface: Node manager API

Control algorithm interpreter

RT space placement: both hard RT and soft RT

SW interface: API for interpretation control, Node databases with interpreted code

Ethernet communication subsystem

RT space placement: soft RT

SW interface: Communication subsystem API library

IO subsystem with CANopen communication

RT space placement: hard RT

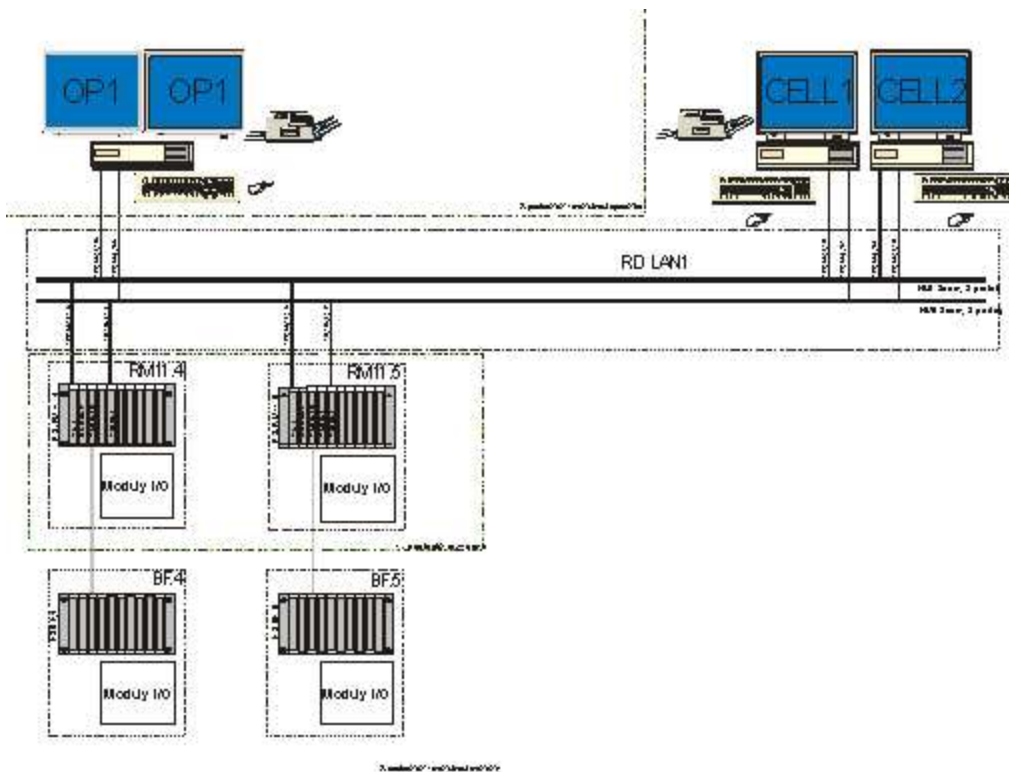
SW interface: IO subsystem API library

4. References

UniCAP was used as a design tool and as a real-time application in target process control stations in following applications:

1. The high-pressure Gas Turbocompressor Plant Kralice
technology: High pressure gas transport in the main gas pipe line from Russia to Germany
size of distributed system: 6 nodes
location: the Czech Republic, South Moravia
2. The high-pressure Gas Turbocompressor Plant Kourim
technology: High pressure gas transport in the main gas pipe line from Russia to Germany
size of distributed system: 6 nodes
location: the Czech Republic, Central Bohemia
3. The high-pressure Gas Compressor Plant Jablonov
technology: High pressure gas transport in the main gas pipe line from Russia to Germany
size of distributed system: 14 nodes
location: Slovakia
4. Underground Gas Storage Tvrdonice
technology: Seasoner natural underground gas storage
size of distributed system: 73 nodes
location: the Czech Republic, South Moravia

Turbocompressor gas plant Kralice is an example of a process control application developed with UniCAP and equipped with real-time part of UniCAP in target process control stations (RM11.4, RM11.5, BF4, BF5). OP1 is an operator station for long distance control of the technology via ethernet communications.



5. Plan of commercial exploitation

1. Operating systems Linux+RTLinux should completely replace OS9 as base RTOS in UniControls for applications in industry from 10/2004.
2. Savings are planned for development tools and for licence fees. Our estimations is to produce about 70 nodes per year and to save about 400 EUR per node for licence fees.
3. Linux+RTLinux enables to produce critical applications because source codes of the operating systems are available, which is usual requirement of certification authorities (Office for Avionics, Office for Rails, Office for nuclear safety...)
4. Better portability of applications (POSIX standard) should bring indirect savings.
5. UniControls plans to use UniCAP for applications in industry and to sell UniCAP including documetation and trainings as a complex tool for support of designing and application programming of distributed information and control systems.