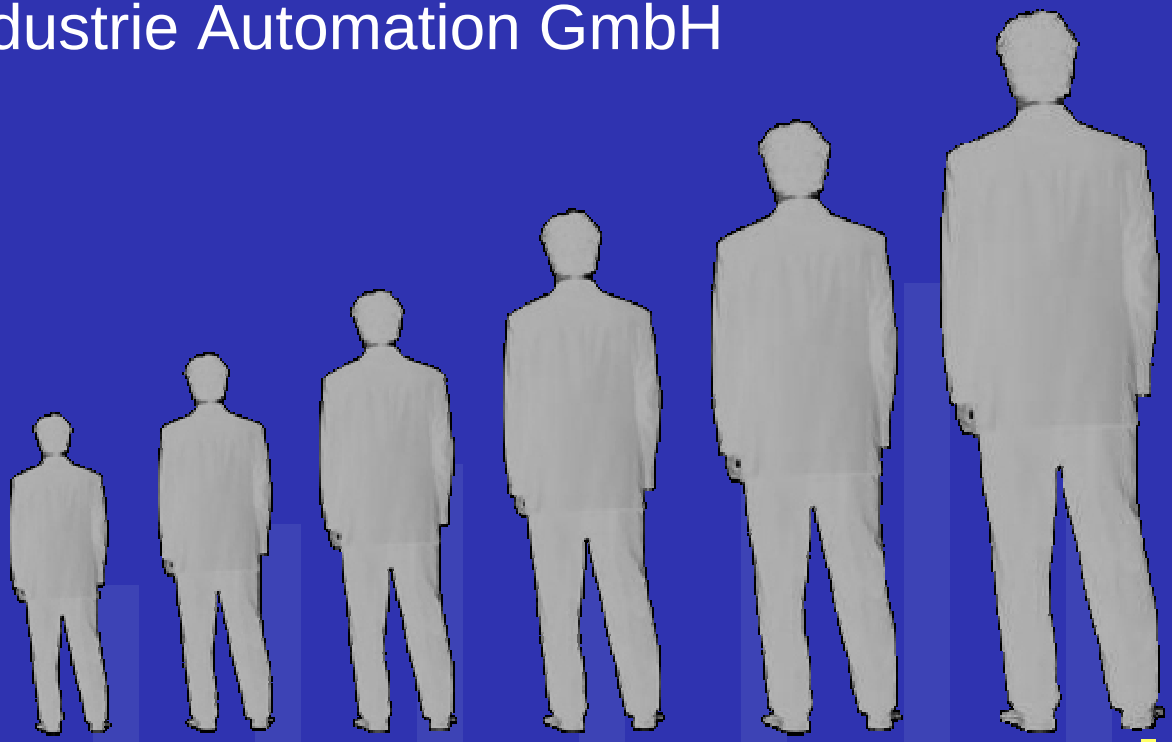
Hard Real-time in medical applications
Immense increase of programming efficiency with the GAMMA development tools

OS-9 Technology Day

Dipl.-Ing.(FH) Sascha Grewe
RST Industrie Automation GmbH



History

The experience of the company has its origin in the year 1987. This was the year where we started to develop object oriented real-time tools. 1989 we have presented one of the first window based process visualization.

-With this staff a new base was formed in 1993. The head office

-is located in Ottobrunn near Munich, the "heart of Bavaria". 1994 we started to develop the new real-time software product gamma. Since now we have developed nearly 200 different Systems from embedded Solutions to complete control Systems. At the moment 15 highly specialized people develop now solutions for our customers.

What is Gamma?

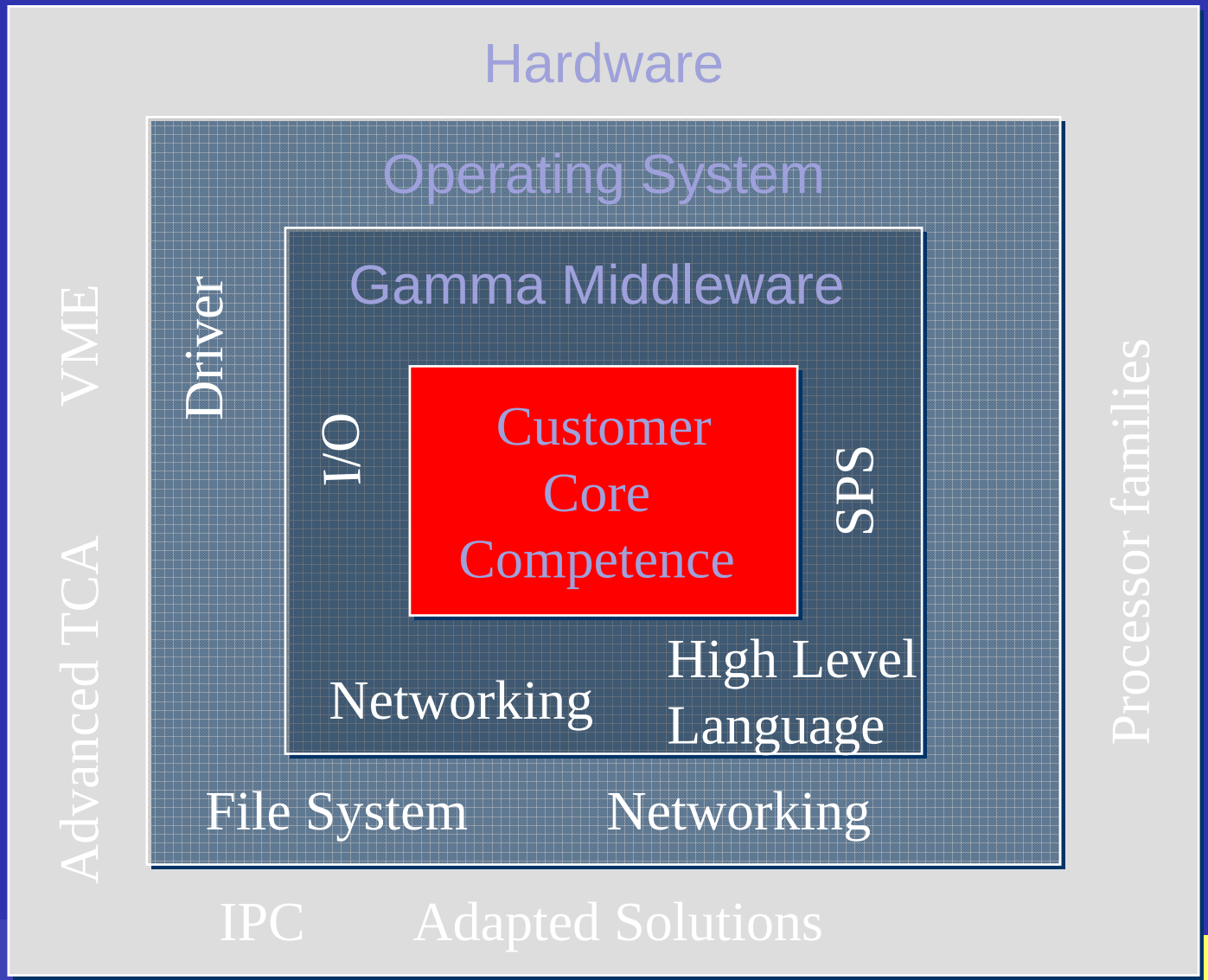
Gamma is a Cross development Tool for:

- Distributed applications
- Preferred in Real-time
- Platform independent
- Tool to develop control und testing systems in different structures
- Interfaces to PLC, IT and products like Mathlab Simulink, SPEC und LabView...

Our Advantages

- The hardware is much better than classic PLC‘s and standard PC’s
- There are innumerous platforms available
- Customers can change between different Hardware Developer
- No dependencies
- Embedded Hardware is mostly cheaper
- Real-time Operating Systems are more flexible
- Software can be transferred easily to new platforms
- Programming with Gamma can be much more effective

We optimize the customers work



Gamma combines the advantages of PLC and IT

Gamma could be the missing part to become a complete solution

- Easy, transparent and fast programmed like a PLC
- Flexible and powerful like IT Products

Gamma platform concept

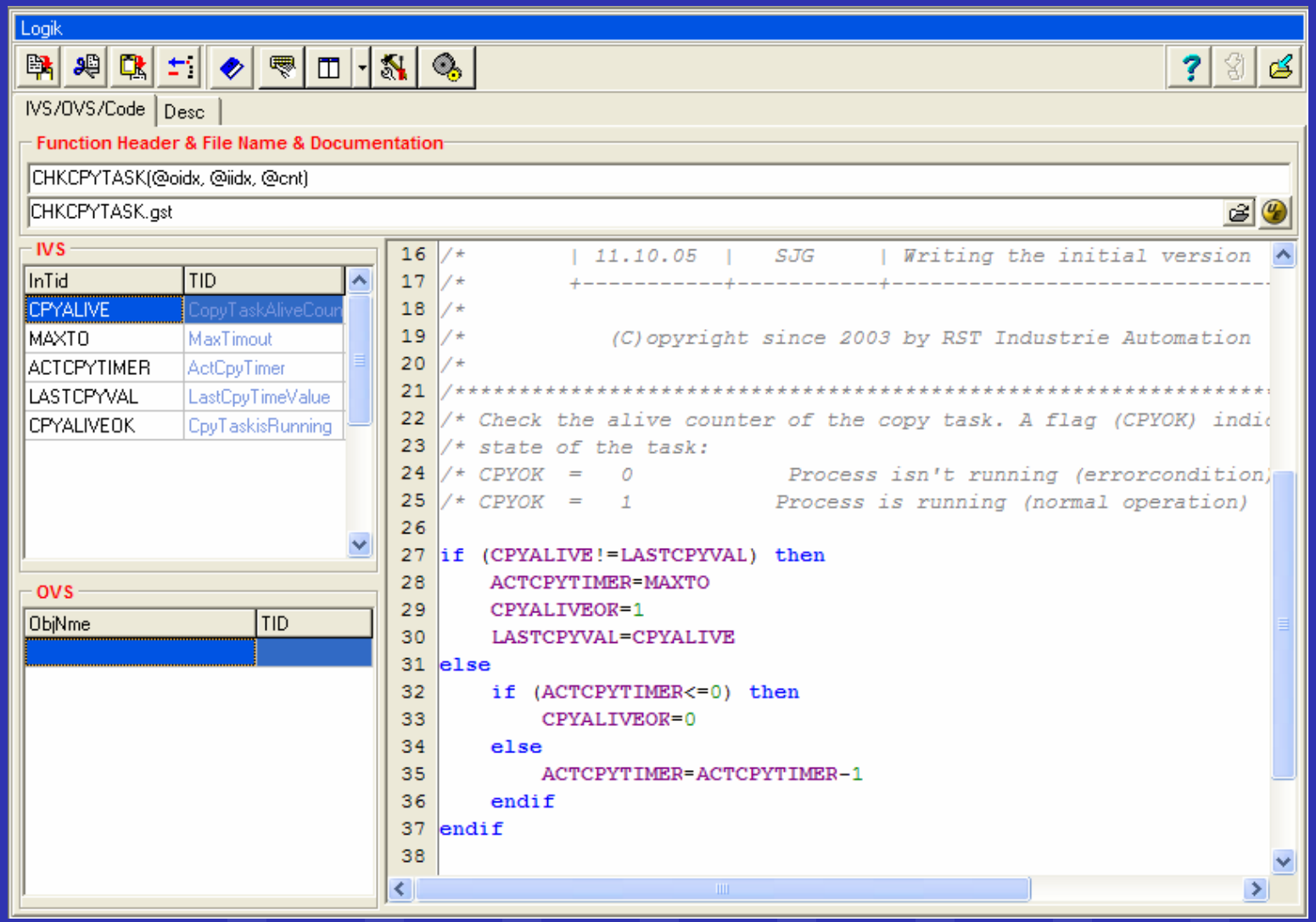
MICROWARE
OS9 / OS9000

LynxOS
FROM LYNUXWORKS

Microsoft Windows

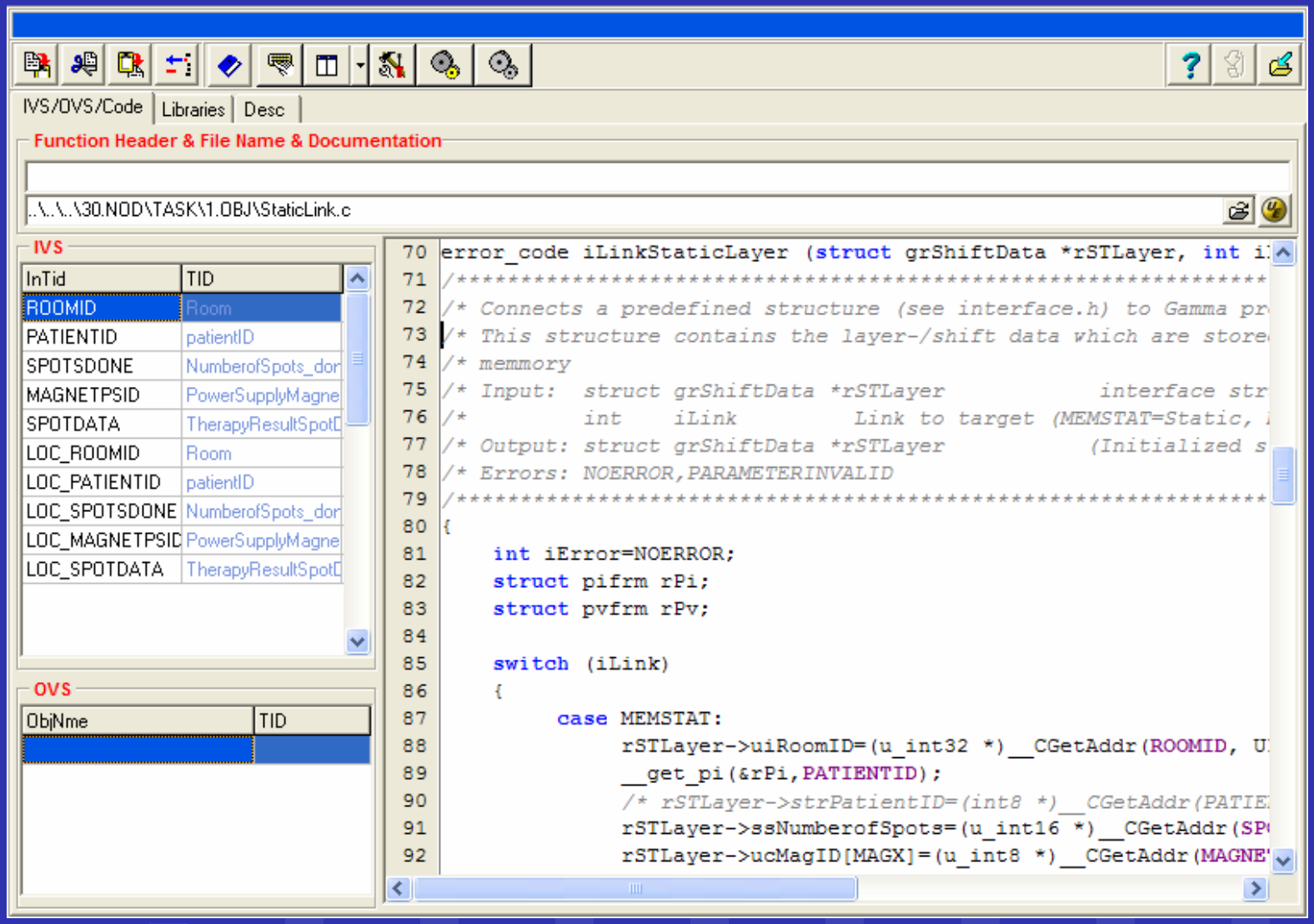
- Developing operatingsystem and Hardware independent
- Common maintenance
- Simple porting

Process development

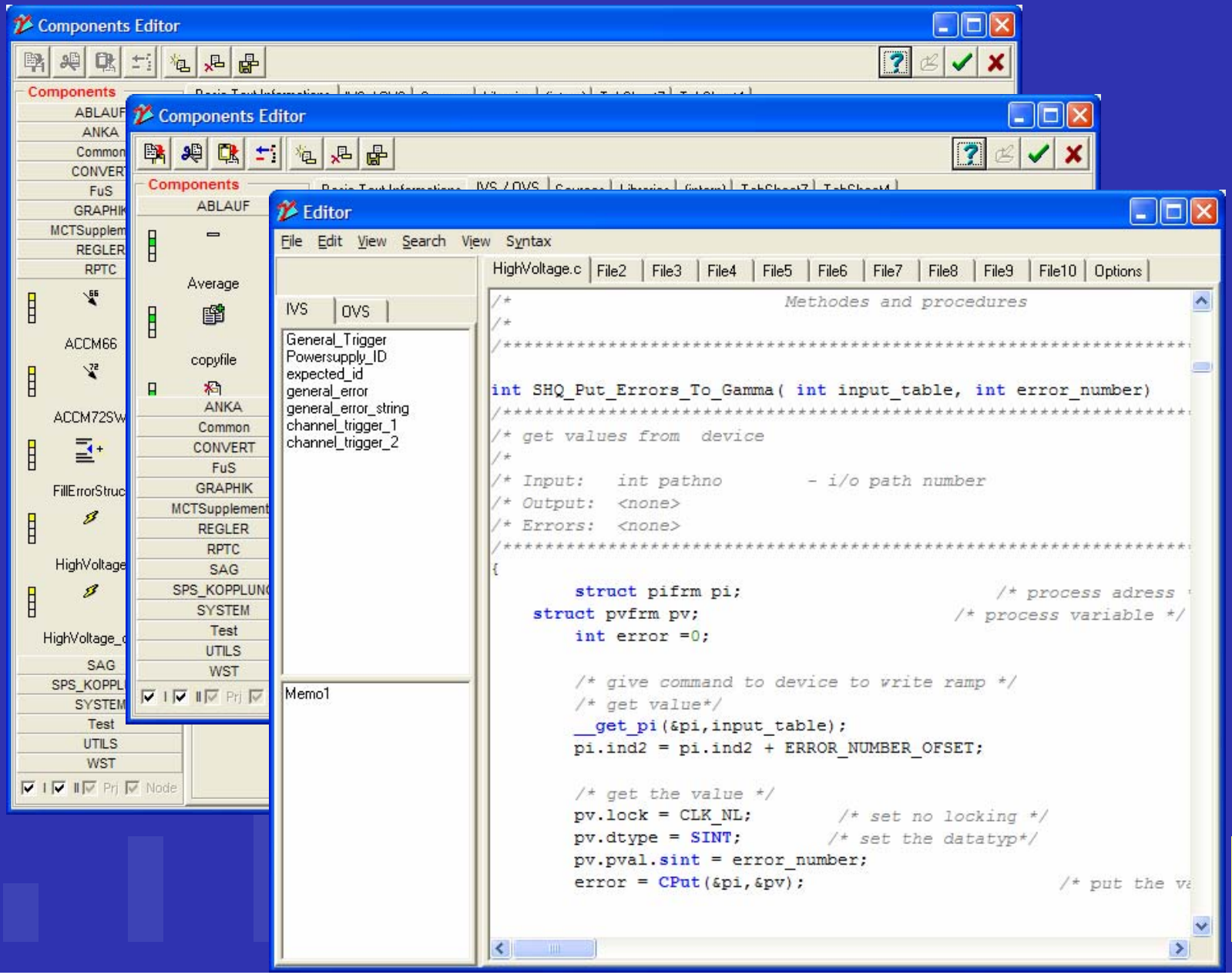


Structured Text for simple control sequences

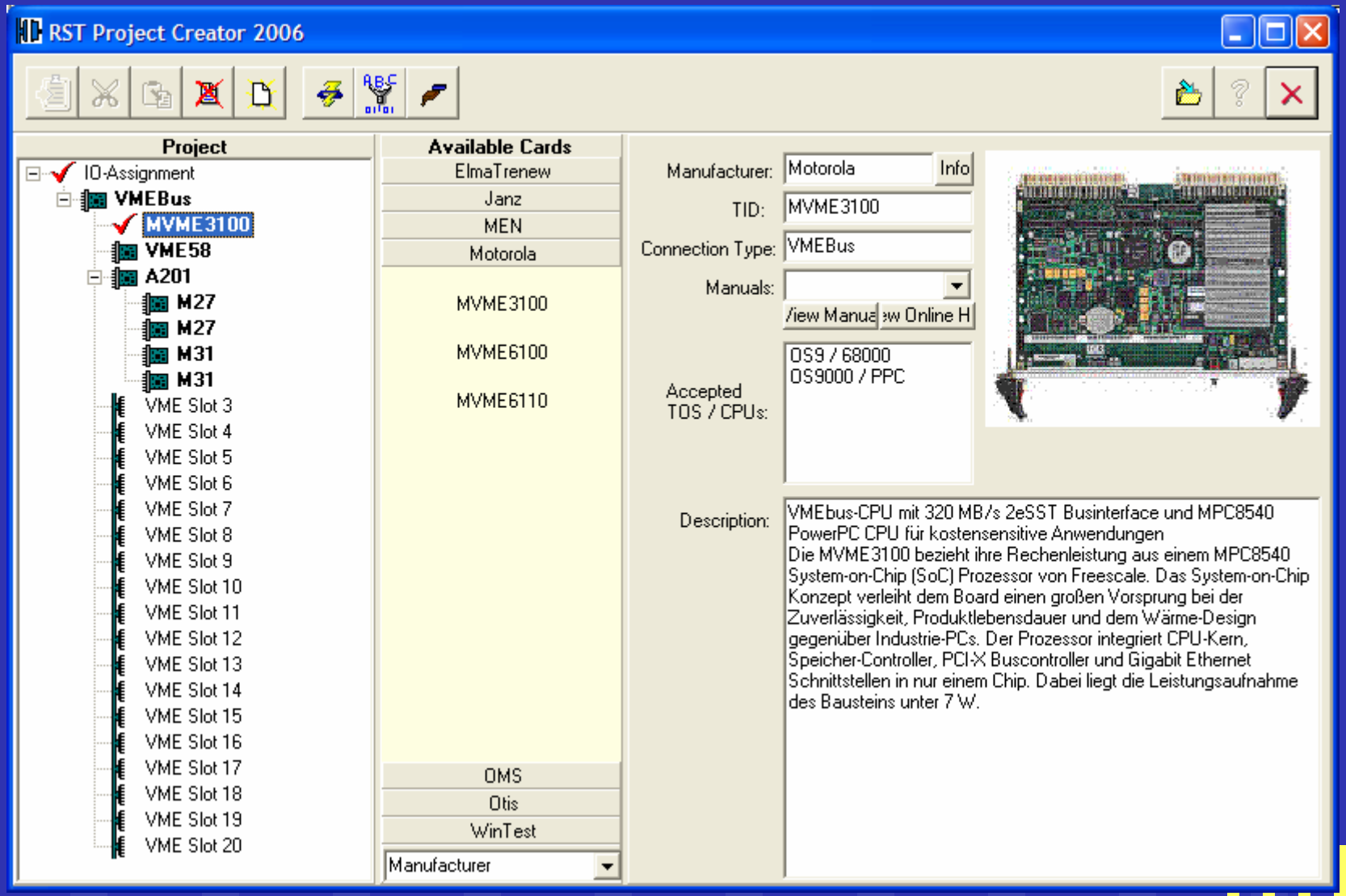
... Or „C“ / „C++“


IVS/OVS/Code
Libraries
Desc
Function Header & File Name & Documentation
..\..\..\30.NOD\TASK\1.OBJ\StaticLink.c
IVS
InTid
TID
ROOMID
Room
PATIENTID
patientID
SPOTSDONE
NumberofSpots_dor
MAGNETPSID
PowerSupplyMagne
SPOTDATA
TherapyResultSpotD
LOC_ROOMID
Room
LOC_PATIENTID
patientID
LOC_SPOTSDONE
NumberofSpots_dor
LOC_MAGNETPSID
PowerSupplyMagne
LOC_SPOTDATA
TherapyResultSpotD
OVS
ObjNme
TID
70 error_code iLinkStaticLayer (struct grShiftData *rSTLayer, int i
71 /***
72 /* Connects a predefined structure (see interface.h) to Gamma pr
73 /* This structure contains the layer-/shift data which are store
74 /* memmory
75 /* Input: struct grShiftData *rSTLayer interface str
76 /* int iLink Link to target (MEMSTAT=Static,
77 /* Output: struct grShiftData *rSTLayer (Initialized s
78 /* Errors: NOERROR,PARAMETERINVALID
79 /***
80 {
81 int iError=NOERROR;
82 struct pifrm rPi;
83 struct pvfrm rPv;
84
85 switch (iLink)
86 {
87 case MEMSTAT:
88 rSTLayer->uiRoomID=(u_int32 *)__CGetAddr(ROOMID, U
89 __get_pi(&rPi,PATIENTID);
90 /* rSTLayer->strPatientID=(int8 *)__CGetAddr(PATIE
91 rSTLayer->ssNumberofSpots=(u_int16 *)__CGetAddr(SP
92 rSTLayer->ucMagID[MAGX]=(u_int8 *)__CGetAddr(MAGNE

Component development



I/O Assignment – Device configuration



I/O Integration Management

RST Industrie-Automation

RST Card Integrator 2006

Card Information | IO Settings | Modules | Source Code | Variable Management

- ElmaTrenew
- Janz
- MEN
  - A12
  - A201
  - M27
  - M31
- Motorola
- OMS
- Otis
- WinTest

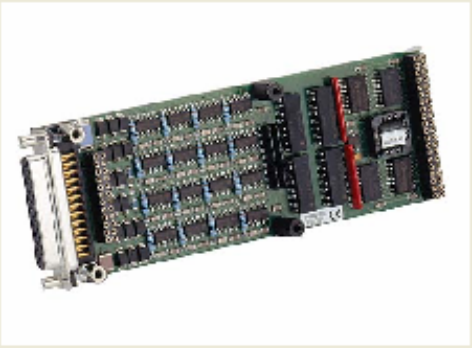
TID: M27

Online Help: http://www.men.de/products/

Connection Type: MModule

Manual: 04m027-.pdf

Add Manual | Delete Manual | ShowManual



TOS / CPU

OS9	68000	X
OS9000	PPC	X
LINUX	X86	
WINDOWS	X86	
LYNXOS	X86	

Description

16 outputs 8..36V
500mA output current per channel
Thermal and short-circuit protection
Load on supply voltage
Optical isolation

The M27 is based on the M-Module ANSI mezzanine standard. It can be used as an I/O extension in any type of bus system, i.e. CPCI, PXI, VME or on any type of stand-alone SBC. Appropriate M-Module carrier cards in 3U, 6U and other formats are available from MEN or other manufacturers.
The M27 with its open-collector outputs can be used in process I/O applications (cf. M28 with open-emitter outputs). If there are currents of above 500mA an intelligent power switch guarantees that the respective transistor is switched off. The M-Module is equipped with suppressor diodes for protection against overvoltage caused by inductive loads. The output registers can be read back.

Windows platform opportunities

RST Industrie-Automation

Borland® Delphi® 2006

The Ultimate I

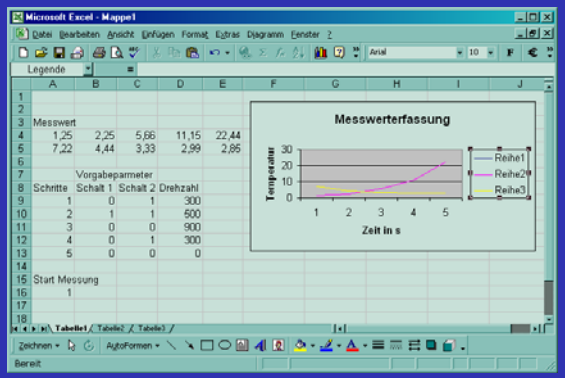
MAXIMIZE I
WITH TH

Borland® C++Builder® 2006

The Ultimate C++ IDE for Microsoft® Windows® Application Delivery

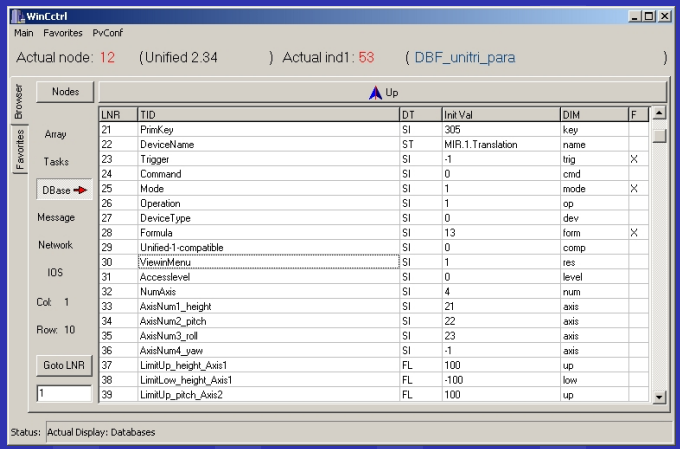
MAX

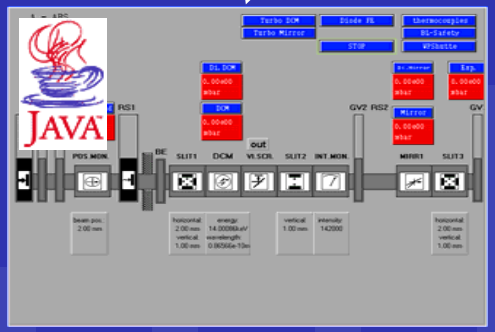
Microsoft Visual C++ 2005 Express Edition



Office/Excel

Gamma

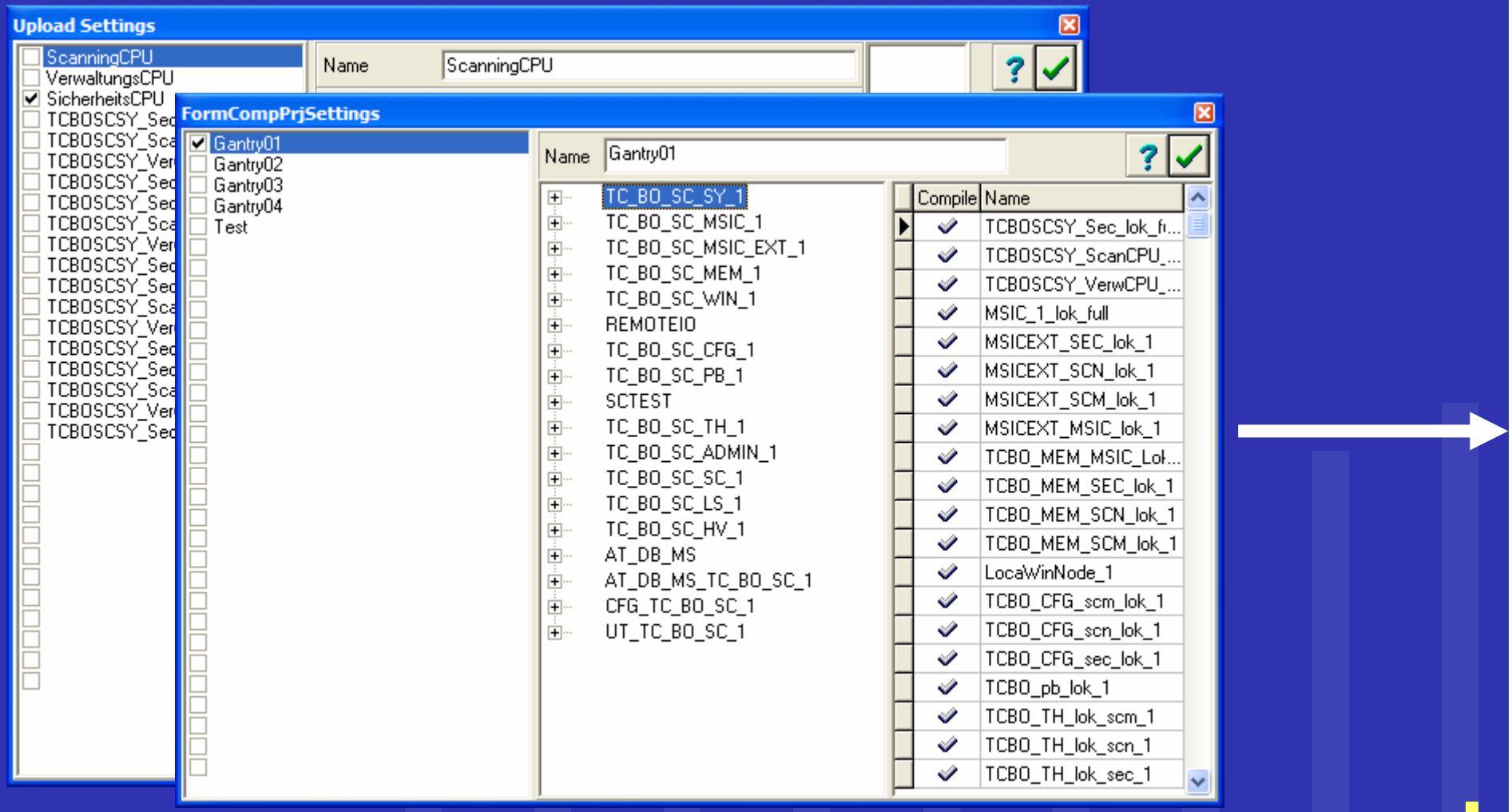




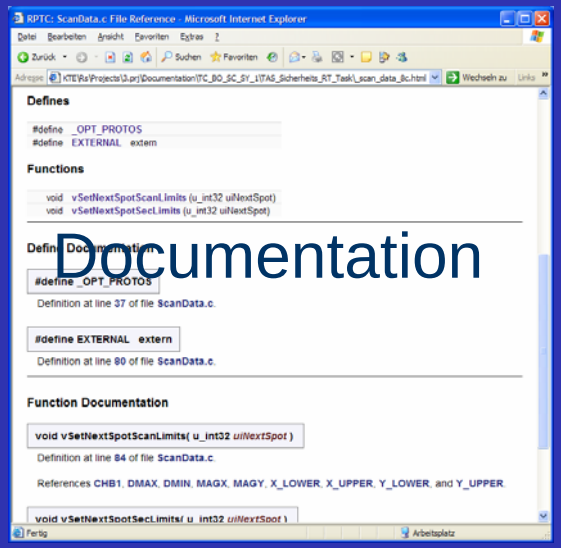
OPC OLE for Process Control

Test Interfaces

Project compilation

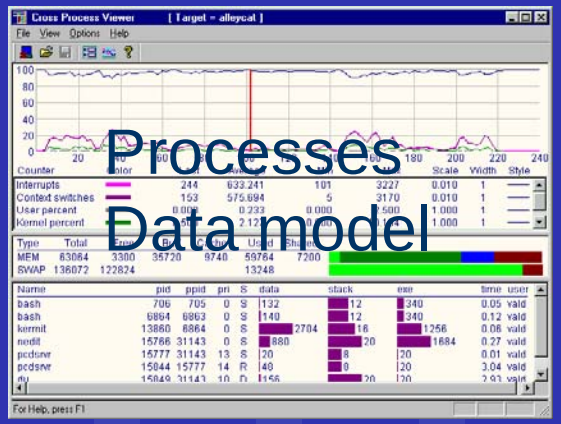


Fully automatic project compilation
Long time stable and effective

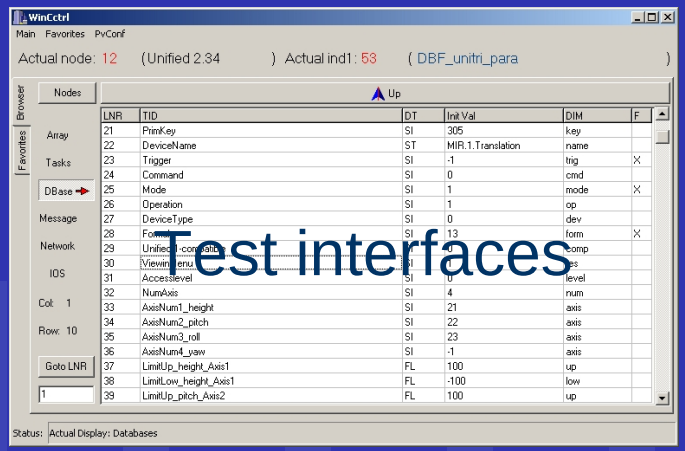


Documentation

Transfer demon



Processes
Data model

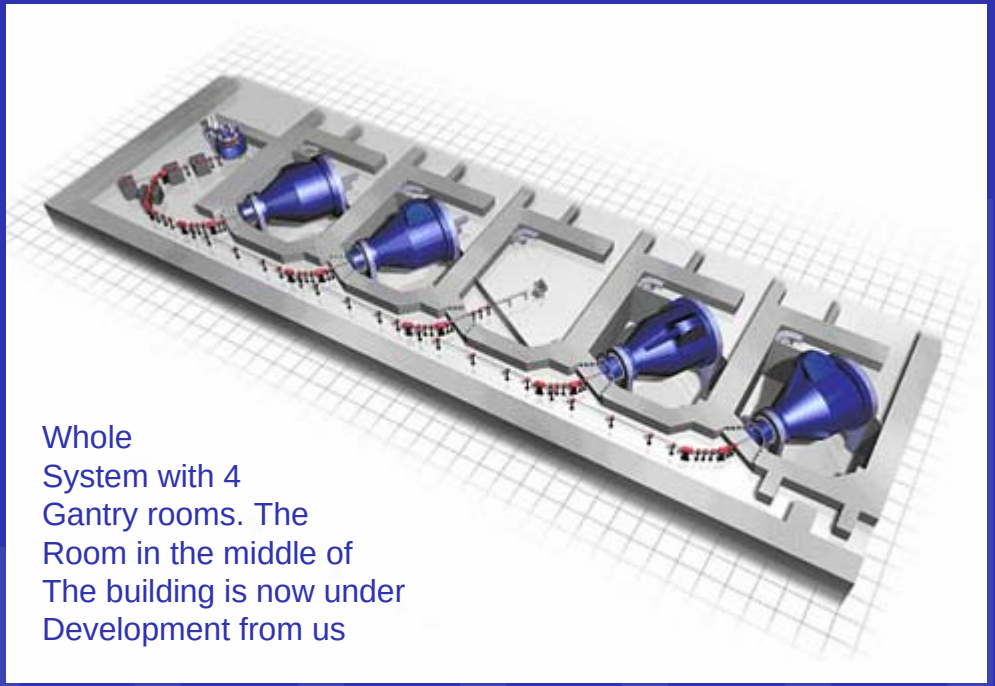


Test interfaces

The System

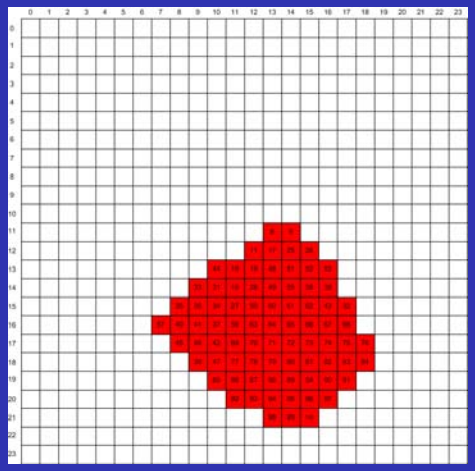
Proton therapy center for Rinnecker private clinic in Munich
Our job is beside others the beam control directly by the patient

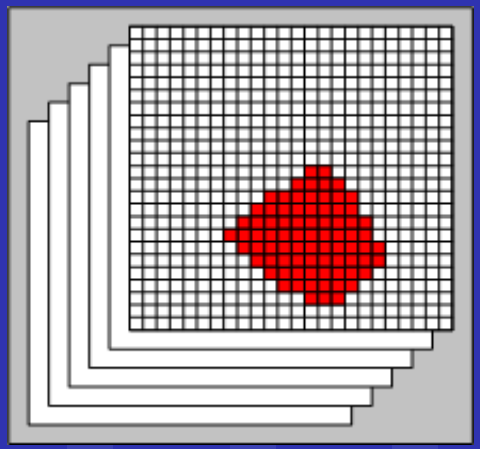
Gantry Control System



Whole
System with 4
Gantry rooms. The
Room in the middle of
The building is now under
Development from us

Scan principle



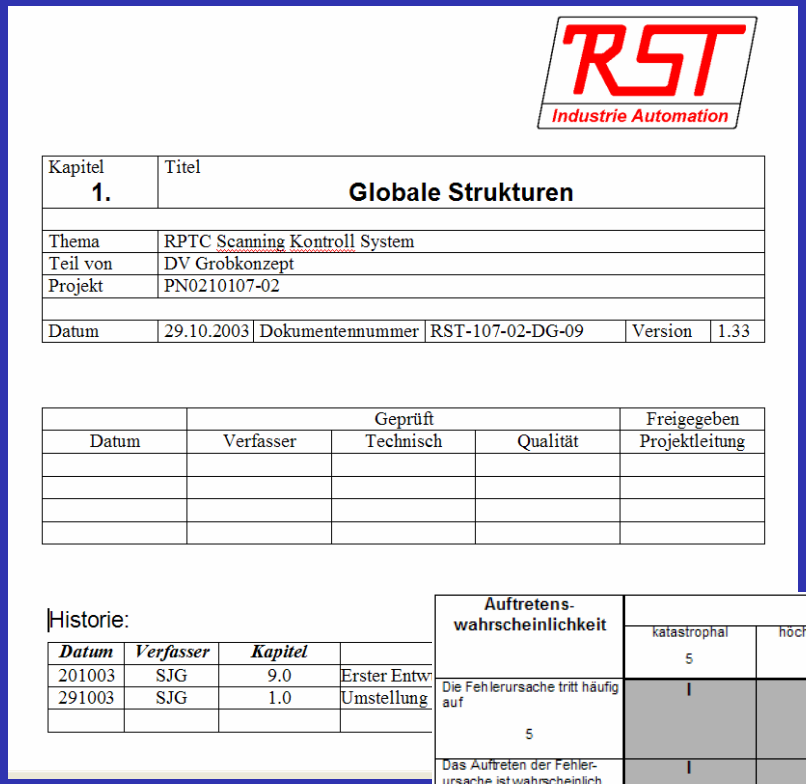


- A scan consists of a layer
- a treatment consists of several layers
- every layer has a different depth in the tissue
- using this method the tumor will be completely scanned.
- the surrounded tissue will be not irradiated and therefore not damaged

Requirements to the system

- Real-time cycle time up to 50µs
- Guaranteed beam switch off within 250µs
- redundant control of the beam and the beam control
- parallel working VME Systems
- High speed Networking
- Therapy control
- Communication to a Therapy control system
- Redundant data acquisition and analysis.
  - beam profile control
  - Magnet control and monitoring
  - Dose measuring and monitoring
  - additional I/O measuring and control

Design / Risk analysis



Kapitel	Titel
1.	**Globale Strukturen**
Thema	RPTC Scanning Kontroll System
Teil von	DV Grobkonzept
Projekt	PN0210107-02
Datum	29.10.2003

Dokumentennummer	RST-107-02-DG-09	Version	1.33

	Geprüft			Freigegeben
Datum	Verfasser	Technisch	Qualität	Projektleitung

Historie:

Datum	*Verfasser*	*Kapitel*	
201003	SJG	9.0	Erster Entw
291003	SJG	1.0	Umstellung

System design designed according to a Corresponding System requirement

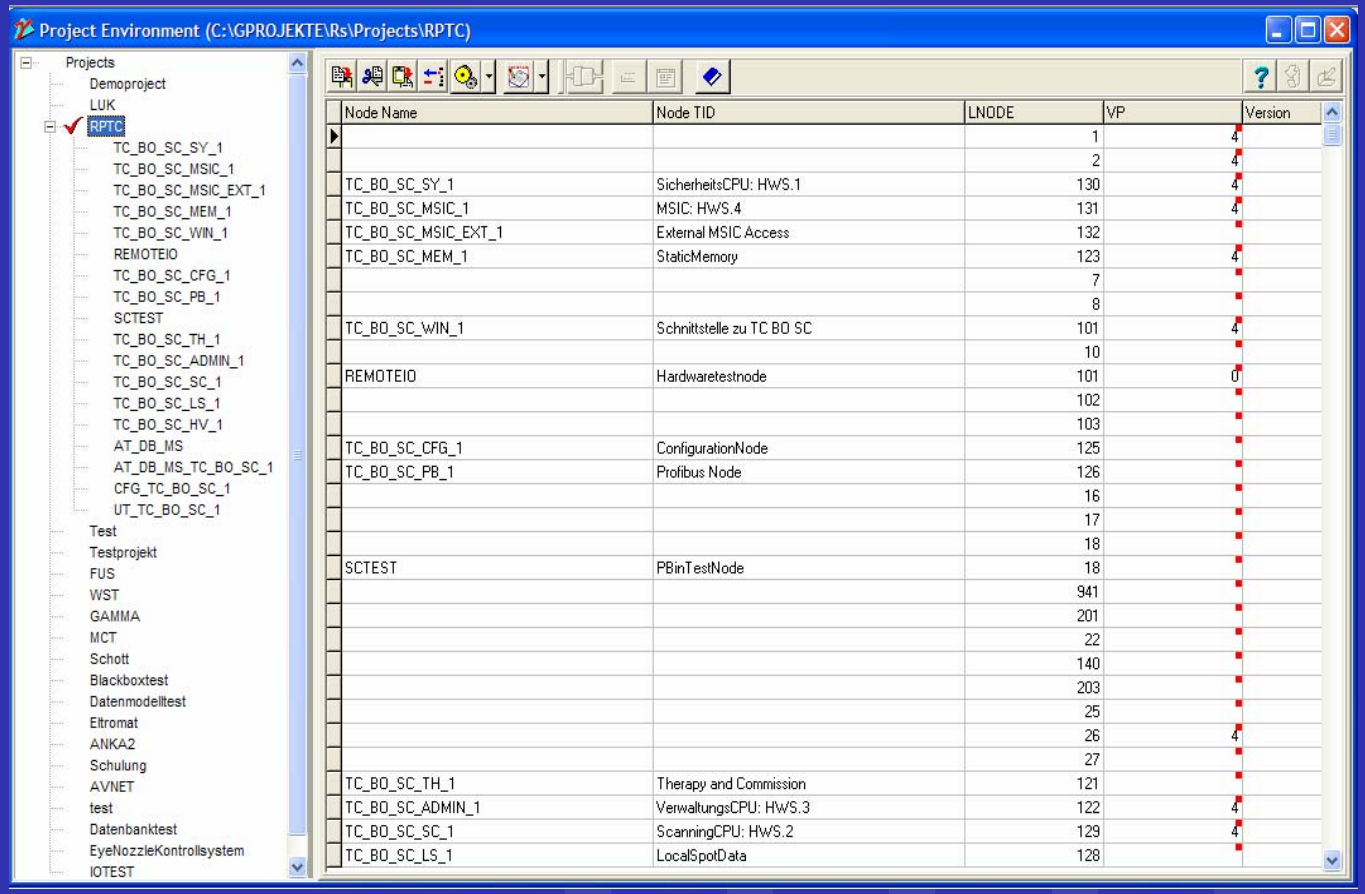
Risk analysis within a risk management

Auftretens-wahrscheinlichkeit	Schadensausmaß				
	katastrophal 5	höchst kritisch 4	kritisch 3	geringfügig 2	unwesentlich 1
Die Fehlerursache tritt häufig auf 5	I	I	I	II	III
Das Auftreten der Fehler-ursache ist wahrscheinlich 4	I	I	II	II	III
Die Fehlerursache tritt gele-gentlich auf 3	I	II	II	II	III
Das Auftreten der Fehlerur-sache ist unwahrscheinlich 2	II	II	II	III	III
Das Auftreten der Fehlerur-sache ist unvorstellbar 1	III	III	III	III	III

Anzahl der Risikobewertungen vor Berücksichtigung zusätzlicher Maßnahmen: XX

Anzahl der Risikobewertungen nach Berücksichtigung zusätzlicher Maßnahmen: XX

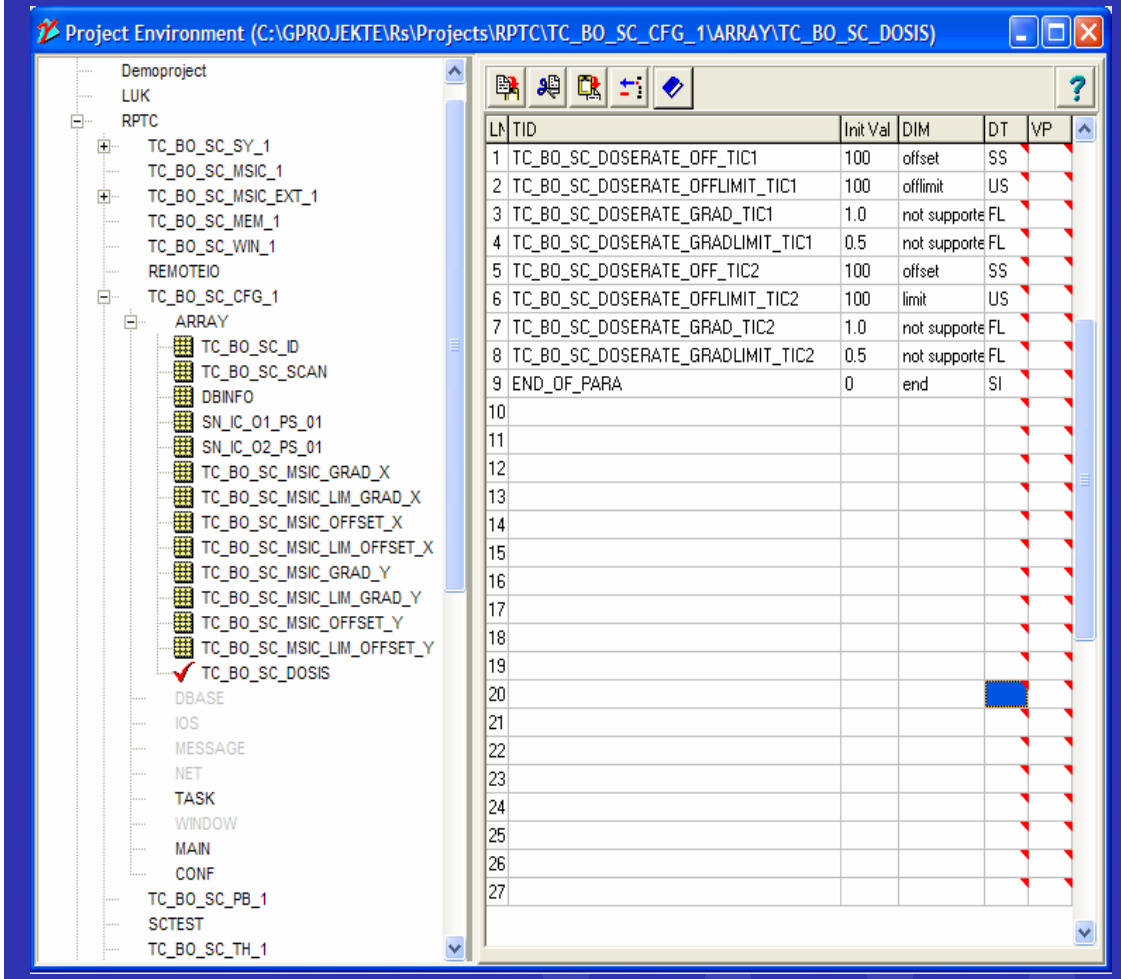
Project setup



Node Name	Node TID	LNODE	VP	Version
		1	4	
		2	4	
TC_BO_SC_SY_1	SicherheitsCPU: HWS.1	130	4	
TC_BO_SC_MSIC_1	MSIC: HWS.4	131	4	
TC_BO_SC_MSIC_EXT_1	External MSIC Access	132		
TC_BO_SC_MEM_1	StaticMemory	123	4	
		7		
		8		
TC_BO_SC_WIN_1	Schnittstelle zu TC BO SC	101	4	
		10		
REMOTEIO	Hardwaretestnode	101	0	
		102		
		103		
TC_BO_SC_CFG_1	ConfigurationNode	125		
TC_BO_SC_PB_1	Profibus Node	126		
		16		
		17		
		18		
SCTEST	PBinTestNode	18		
		941		
		201		
		22		
		140		
		203		
		25		
		26	4	
		27		
TC_BO_SC_TH_1	Therapy and Commission	121		
TC_BO_SC_ADMIN_1	VerwaltungsCPU: HWS.3	122	4	
TC_BO_SC_SC_1	ScanningCPU: HWS.2	129	4	
TC_BO_SC_LS_1	LocalSpotData	128		

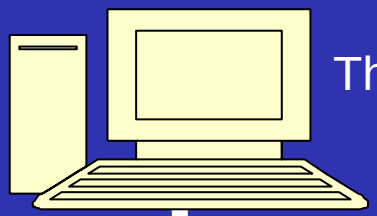
Setup of the project data and the system areas
Documentation of the system areas

Data model



- Setup a node
- Generation of data areas and variables
- Independent of the Operating system
- No specific computer assignment
- Defining the kind of communication
  - Networks
  - Shared Memory
  - Static Memory
  - Reflective Memory

System structure



Therapy planning

TCP/IP

Beam profile control

Reflective Memory

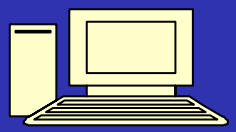
Management CPU

Scanning CPU

Safety CPU

VME-Bus

System structure over Gamma objects



Therapy planing

Therapy measured data

Management CPU

Scanning CPU

Safety CPU

Beam profile control

Therapy Parameter setting

Therapy treatment

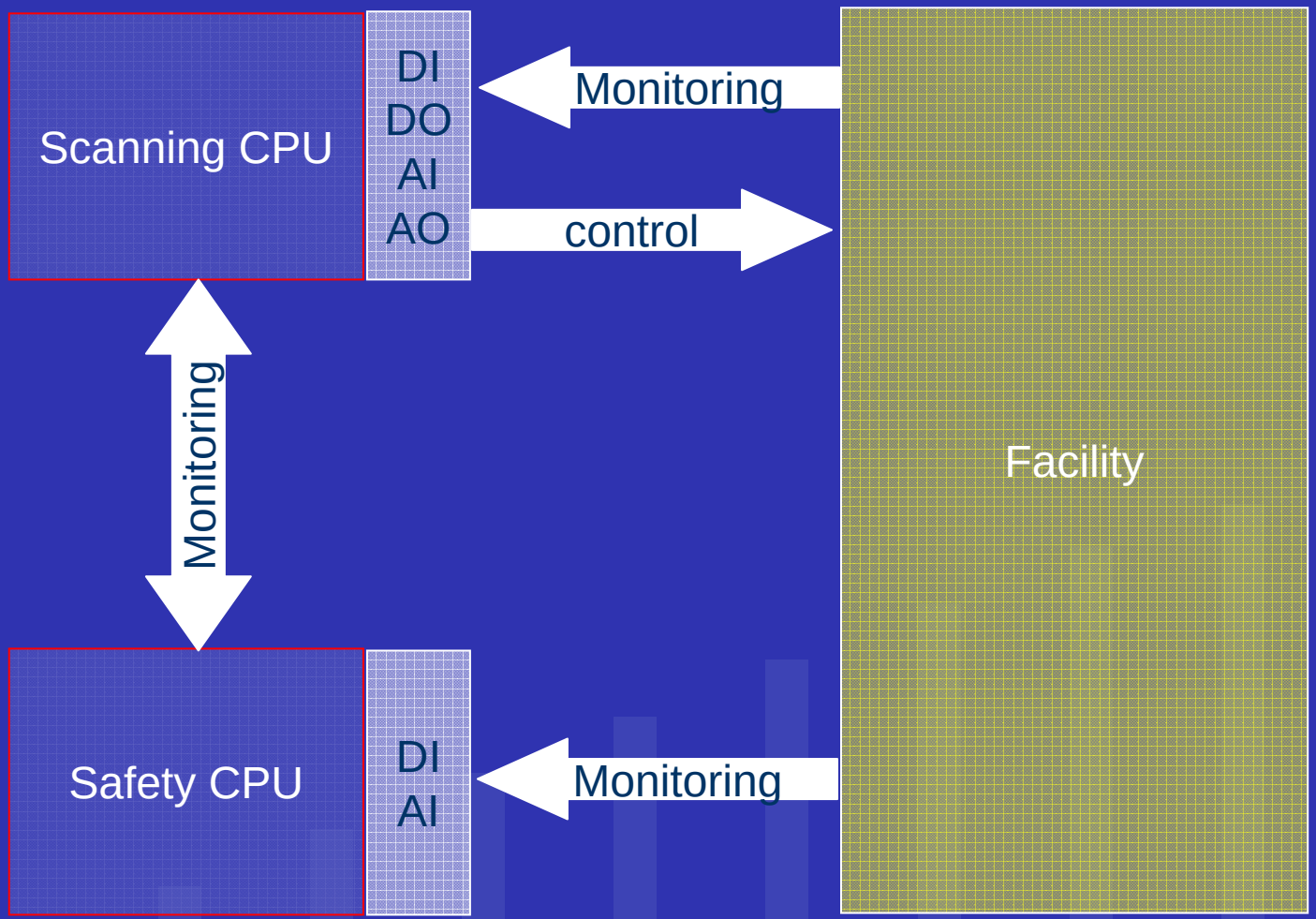
Irradiation

Monitoring

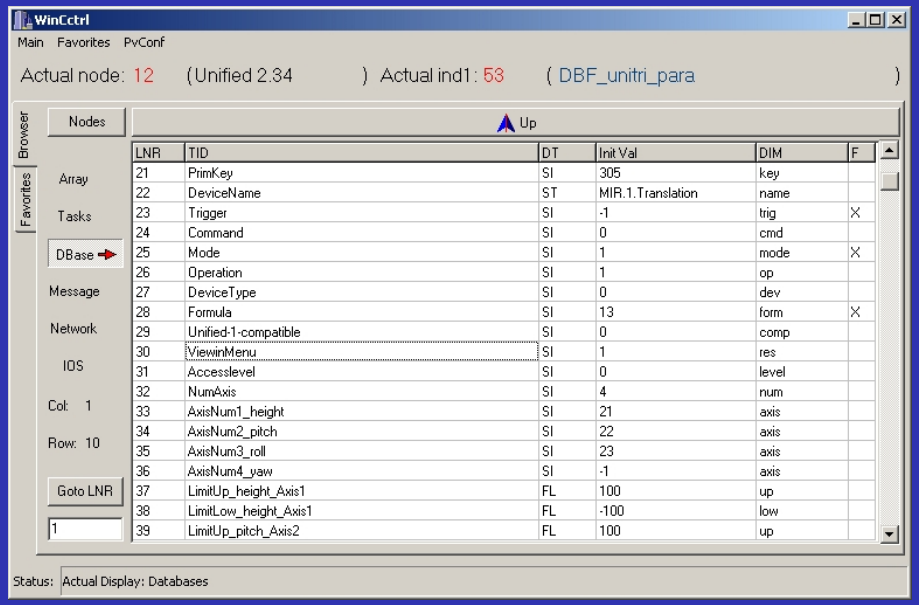
Beam profile measurement

Profibus Connection

Redundant acquisition



Testing

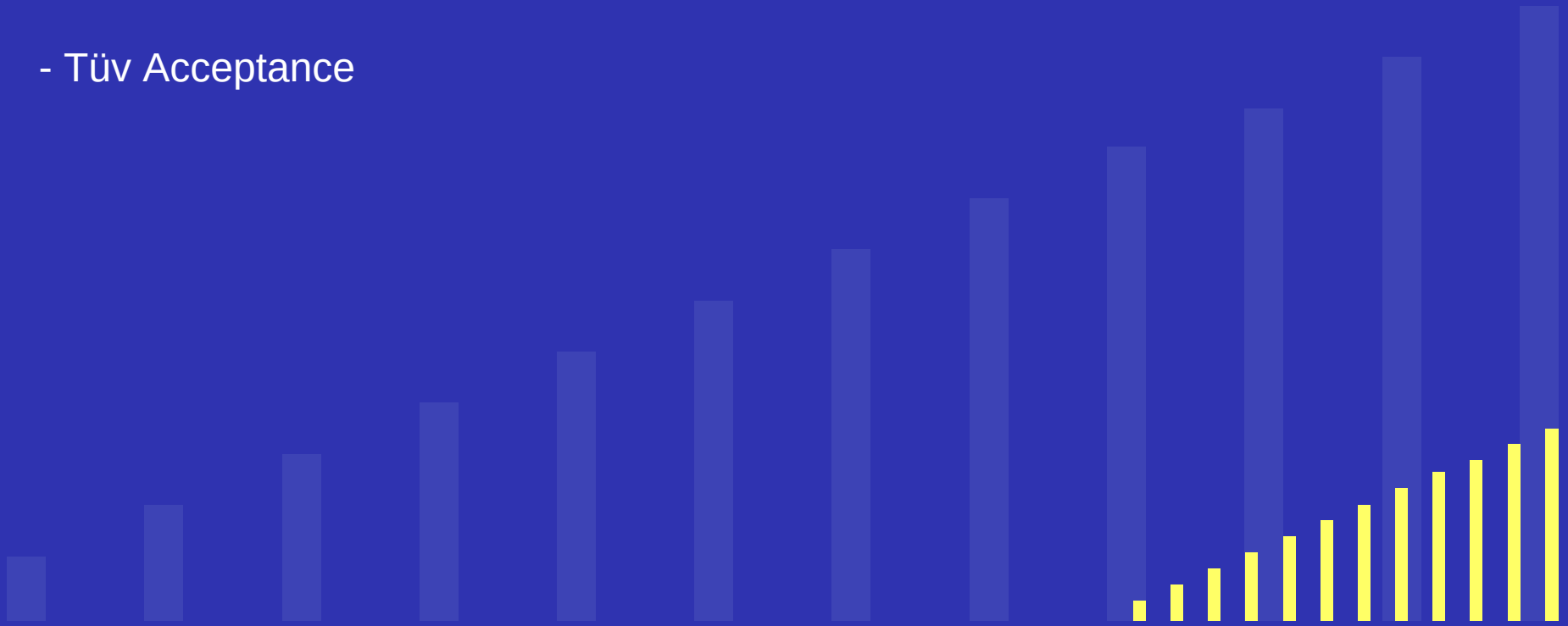


LNR	TID	DT	Init Val	DIM	F
21	PrimKey	SI	305	key	
22	DeviceName	ST	MIR.1.Translation	name	
23	Trigger	SI	-1	trig	X
24	Command	SI	0	cmd	
25	Mode	SI	1	mode	X
26	Operation	SI	1	op	
27	DeviceType	SI	0	dev	
28	Formula	SI	13	form	X
29	Unified-1-compatible	SI	0	comp	
30	ViewinMenu	SI	1	res	
31	Accesslevel	SI	0	level	
32	NumAxis	SI	4	num	
33	AxisNum1_height	SI	21	axis	
34	AxisNum2_pitch	SI	22	axis	
35	AxisNum3_roll	SI	23	axis	
36	AxisNum4_yaw	SI	-1	axis	
37	LimitUp_height_Axis1	FL	100	up	
38	LimitLow_height_Axis1	FL	-100	low	
39	LimitUp_pitch_Axis2	FL	100	up	

- Blackbox Test using the Data model
- Whitebox Test
- Test Drivers
- Code Review

Commissioning / Acceptance

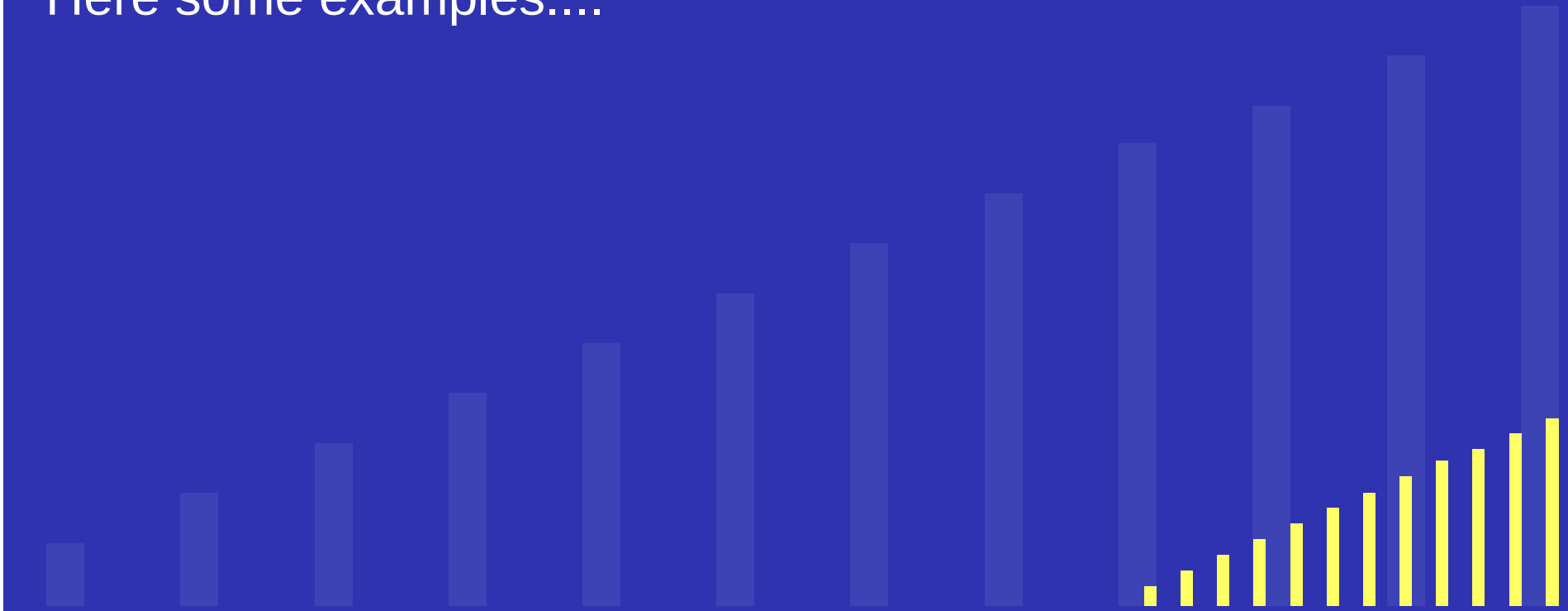
- Commisioning according to protocols
- Testing lists
- Timing Tests on the whole facility
- Formalized Acceptance protocoll
- Tüv Acceptance



Market Segments and Applications

In more than 150 different projects have we shown our competence:

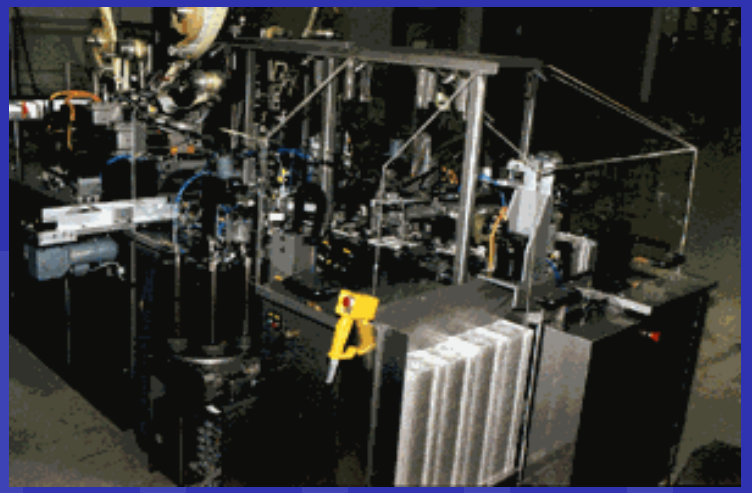
Here some examples....



Common

Surface control

Satelite programming aerospace



CD Packing machine

Beamline Control System

Hard- und Software based on VME and PC base.

Forschungszentrum Karlsruhe
Anka

National University of Singapore
SSLS

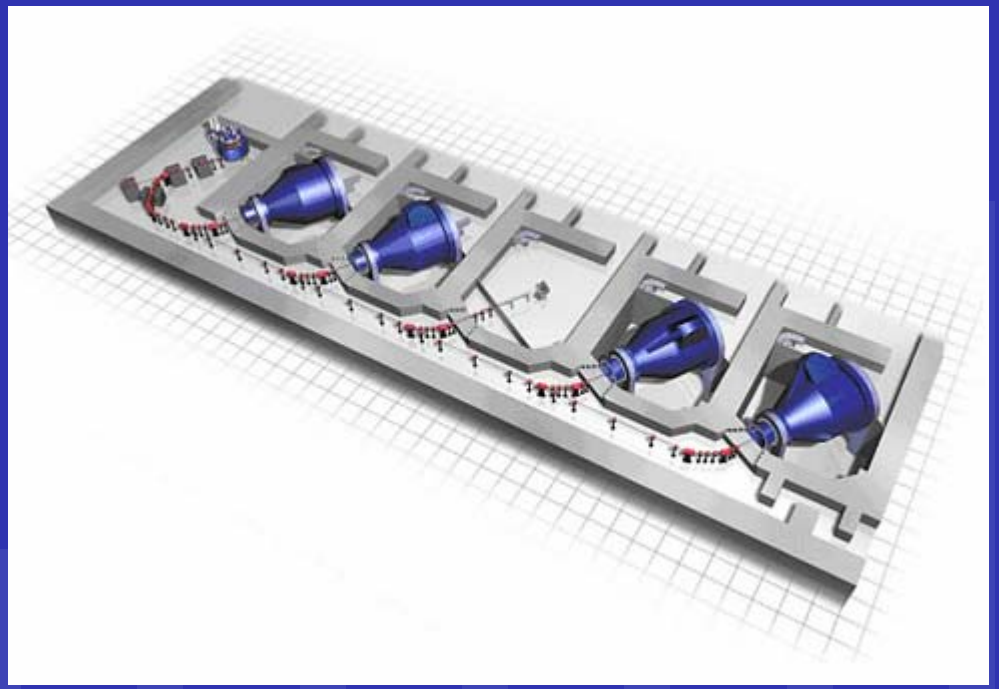
Singapore Synchotron Light Source SSLS

Medicine technology

RINECKER PROTON THERAPY CENTERs

München & Köln

Gantry Control System



Other Projects:

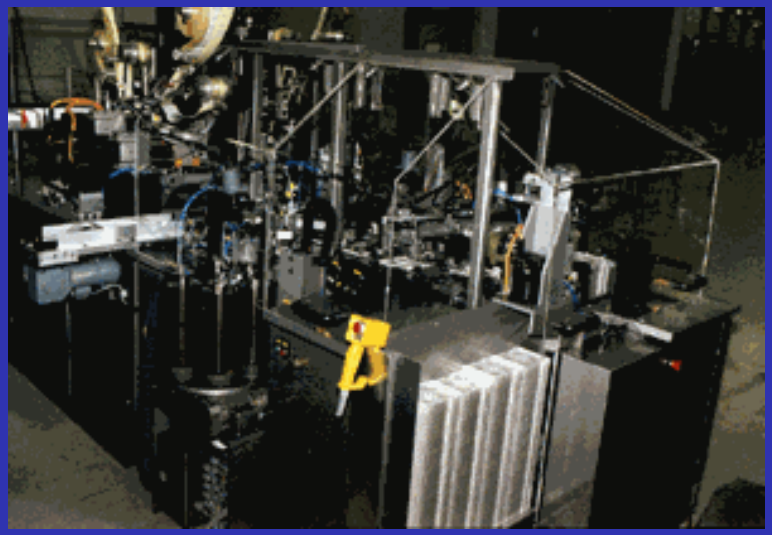
Laser control system to watch the platforms in underground stations

(General Electric)

Bicycle rent system with SMS, developed with Gamma Railway Netherland

Textile industry

Complete Solution spinning machine firm Suessen AG
130 embedded CPU‘s per machine connected via CANBus

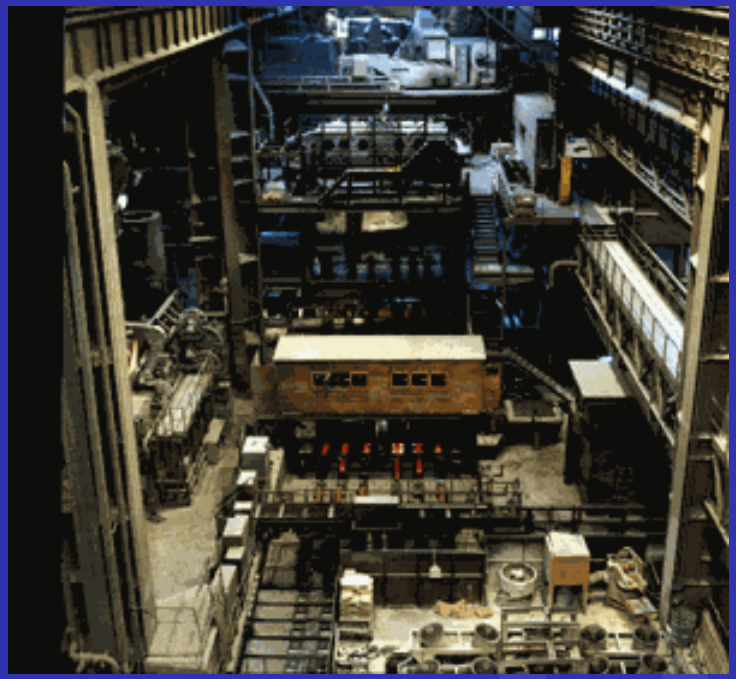


CD package system

Surface check system for varnish by cars (Daimler Chrysler)

Assisting the development of a x-ray satellite

Industrial bar-code control systems (Saarstahl AG)



Realisation of a Converter Control system for the steel factory Saarstahl AG

Printing industry

Industrial Drive Control firm Wiedeg

Portation from PSOS+ VME to OS9000

PowerPC Improvement in using Gamma Components

Printing machine for firm Aurentum

Complete gamma solution.

In working together, RST with its extensive experience and its national and international contacts could be a very interesting partner