MSX-Box

The system for networked control, regulation and acquisition of measurement data

MEASUREMENT SOLUTION EXTENDED Box

ADDI-DATA GmbH – Dieselstraße 3 – D-77833 Ottersweier
Phone: +49 7223/9493-0 – Fax: +49 7223/9493-92 – info@addi-data.com – www.addi-data.com

1 MSX-Box: Measurement Solution Extended Box

The MSX-Box is a PC alternative system for the networked control, regulation and acquisition of measurement data. The system offers you full machine time – only for your application – and is based on the open source philosophy for absolute programming freedom.

Fig. 1: MSX-Box (left side)

Fig. 2: MSX-Box (front side)

Fig. 3: MSX-Box (right side)

Fig. 4: MSX-Box (inside)

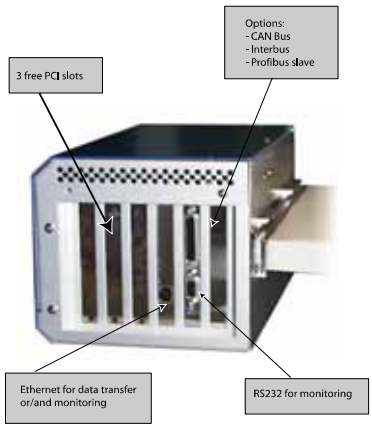


Fig. 5: Interfaces

2 Why did we develop the MSX-Box?

The MSX-Box is the answer to our customer's questions, remarks, requests, and critics that we collected over a few years time.

It closes the gap between the pure Embedded World and the PC – and combines the advantages of these two fields.

The MSX-Box has the following characteristics:

- Use and combination of standard technologies (= no proprietary system)
- Application is slim and clearly structured
- Scalable
- Available on a long-term basis

Furthermore, the use of open source technologies **leaves the vicious circle of forced operating system updates and periodical application portations**. The full development time is excludingly available for the application.

Fig. 6: Why the MSX-Box?

3 MSX-Box : The meeting point ...

The MSX-Box - the meeting point for:

Standard technologies in the **hardware** (PCI – boards) and **software** (GNU-C Compiler, HTML, etc...) fields

Real time Embedded Operating System: RTAI Linux
User comfort of an operating system and real time for time critical jobs.

Internet Technologies
http, TCP/IP, Socket, tiny webserver, etc.

Industrial fieldbus technologies
Optional CAN bus, interbus and profibus slave interfaces

Open Source Philosophy
Flexibility, customer freedom for updates

Software Concept
A software development framework with source codes and documentation is supplied with the delivery. Here possibilities are presented, how applications in the field of measurement, control and regulation can be realised with the MSX-Box.

4 Welcome to the MSX-Box world ...

4.1 Hardware components: Brief overview

A **controller board**, which is put on a **PCI backplane**, controls further standard PCI components (for example network board). A mains supply supplies the device with current. The whole is placed in a compact housing (L: 278 x H: 170 x W: 165 mm).

There are two mechanical mounting possibilities: Either on a DIN rail (option DIN rail mounting) or directly on a wall (option wall mounting)

Abb. 7: Wall mounting

Abb. 8: DIN rail mounting

5 LEDs are placed on the front side. One of them shows if there is voltage on the device. A further LED blinks during the TCP/IP data transfer and is wired up to the front from the supplied 10/100 MBps network board. The other three LEDs are freely programmable and are available for the application.

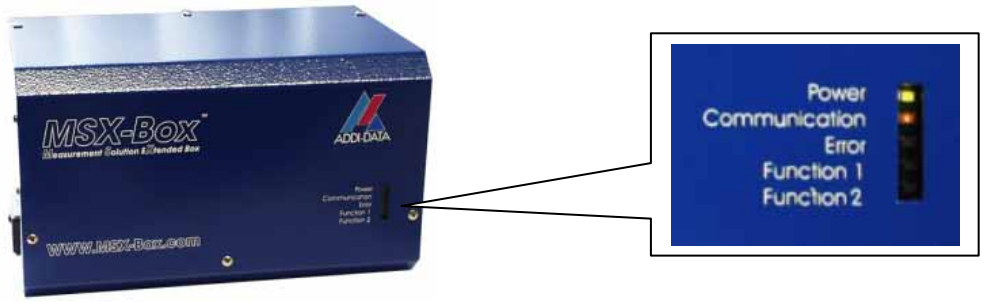


Abb. 9: MSX-Box LEDs

ADDI-DATA offers two versions of the MSX-Box:

The **MSX-Box 500** with 5 PCI slots**:** 2 slots for controller and Ethernet boards, and **further 3 slots free** for additional PCI Short Cards.

The **MSX-Box 800** with 8 PCI slots: 2 Slots for controller and Ethernet board, and **further 6 slots free** for additional PCI Short Cards.

4.2 The special characteristic of the MSX-Box is in its heart…

The special characteristic of the MSX-Box is crystallizing, when looking into the inner of the Box:

On the CPU board a **200 MHz, 64 Bit MIPS** micro controller is used. It is controlled through the preinstalled **Real time Embedded RTAI Linux** operating system.

The **16 MB Flash Memory**, which is on the controller board, is sufficient for the Embedded Linux (Kernel version 2.4.2x). Approx. 6 MB of this flash is still free and can be used as remanent memory for the application.

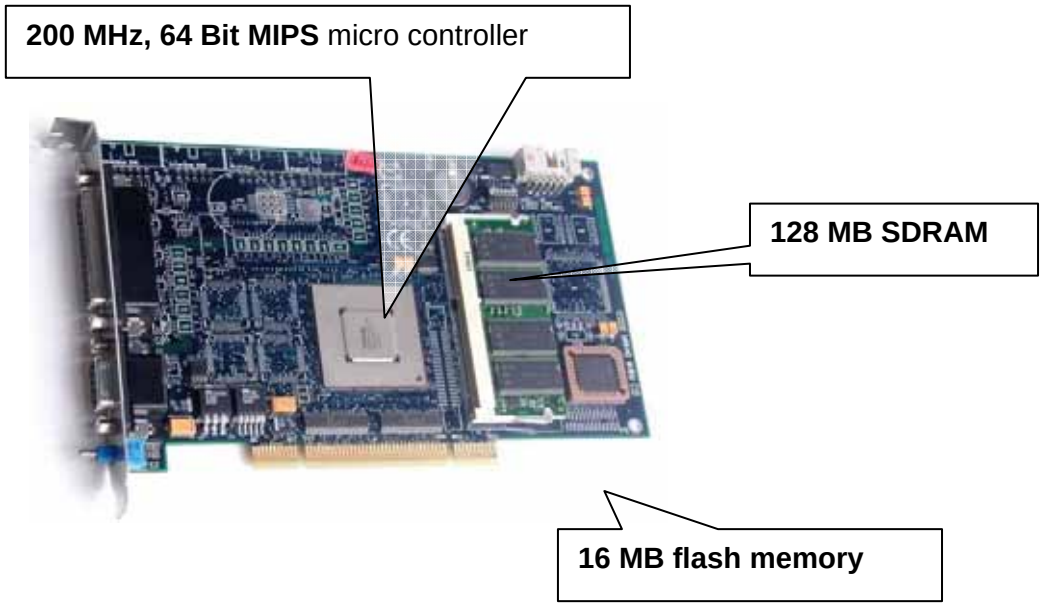


Abb. 10 : Controller board

4.3 Optimized for the industrial application...

The MSX-Box is the ideal design for the industrial application. The following additional functionalities support this statement:

4.3.1 No additional multimedia „trumpery", but useful functionalities for measurement, control and regulation jobs.

An integrated **"Watchdog"** can be programmed to **reset a present relay output** when the time was exceeded uncontrolled or to reboot the system **(Reset)**.

The 3 **timers**, which are available on the controller board, serve to provide clocks into the field of micro seconds.
These **timers**, combined with a **RTAI real time kernel,** are optimal in order to realize time critical process in a time clock, which is defined firmly, with minimal jitter.

Because of the applied **„Journal Flash File System"** (JFFS2) technique, the switching on and off of the MSX-Box can be realised with a power switch at any time without damaging the file system. This functionality, combined with an available 24 Volt digital **reset input**, makes it possible keeping the control about the MSX-Box.

It shall be emphasized that the standard MSX-Box can do **without wearing parts**. These are parts which fail firstly in permanent operation.

4.3.2 Optional fieldbus interfaces

The controller board can be equipped with up to **8 CAN** interfaces, **2 interbus** interfaces and one **profibus slave** interface.

The CAN interfaces are lead out on a 25 pin SUB connector of the controller board, the interbus and profibus slaves on the free slot plane.

Furthermore, it is possible to order the MSX-Box with an additional **RS232 or RS485** interface. A RS232 is installed basically on the MSX-Box. But it only serves for monitoring.

4.3.3 PCI: Tested and powerful standard bus technology

The bus clock of **33 MHz,** the data transfer over **32-bit databus**, the **automatic setting of IRQ and base address,** are obvious advantages of the PCI bus, in order to give the MSX-Box a further lead aver the usual embedded systems.

The combination of the PCI bus with the well-known embedded operating system Linux, makes the use of a lot of usual PCI boards possible, if these are supported by Linux: PCI network board, PCI USB board etc.

Normally, it is possible to use the most of the common PCI boards, if the driver is available as source code – for cross compiling.

In combination with the MSX-Box, the sarcastic "Plug and Pray" changes again into the **useful "Plug and Play"**.

4.3.4 Longterm availability

The **controller board** is, as it is usual at ADDI-DATA, **available on a longterm basis**. This contrasts with conventional motherboards that change at short notice and periodically in order to keep pace with the fast development of the addressed consumer market.

5 The first steps with the MSX-Box.

5.1 Monitoring with RS-232

The first contact with the MSX-Box is realized over a **RS-232 monitor interface**, which is placed on the controller board.

It is sufficient to start a **standard terminal program** (for example hyperterminal) with the corresponding parameterizing on the computer.

The preinstalled real time embedded RTAI Linux operating system (version 2.4.2x) is booted immediately after having switched on the MSX-Box. After inserting the user name and the corresponding password, you are in the heart of the MSX-Box. The user navigates in the file system with **standard Linux commands**.

Here, at the latest, the user sees that he has an easy and known Linux console environment. The experienced Linux user will cope with the environment easily and also Linux beginners will be surprised how fast they learn the few necessary Linux basic commands in order to operate the MSX-Box.

Here for example the IP address of the MSX-Box can be changed with the Linux standard command „ifconfig".

5.2 ... and through ethernet - TCP/IP.

The above mentioned monitoring also can be realised over a TCP/IP able terminal program (like PuTTY), with the advantage that the MSX-Box can be integrated directly into the internal network.

An easy „Peer to Peer"-connection with a crossed Ethernet cable also is possible.

6 Desktop with the internet browser

The tiny webserver, which is preinstalled in the MSX-Box, makes the saving of HTML pages on the system possible. With the additional CGI functionality dynamic websites can be created, which show process information or can provide a user interface for control tasks.

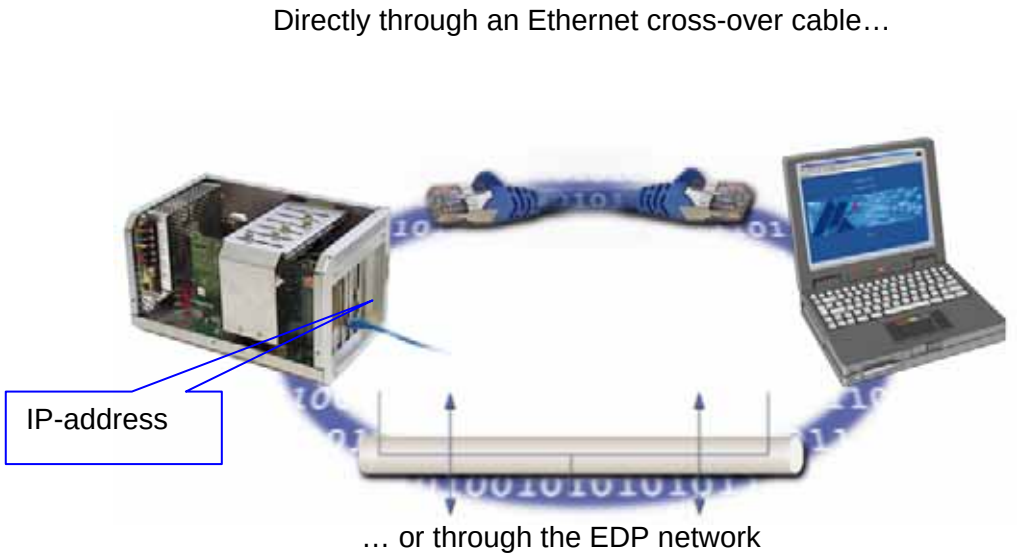


Fig. 11: Desktop with a web frontend

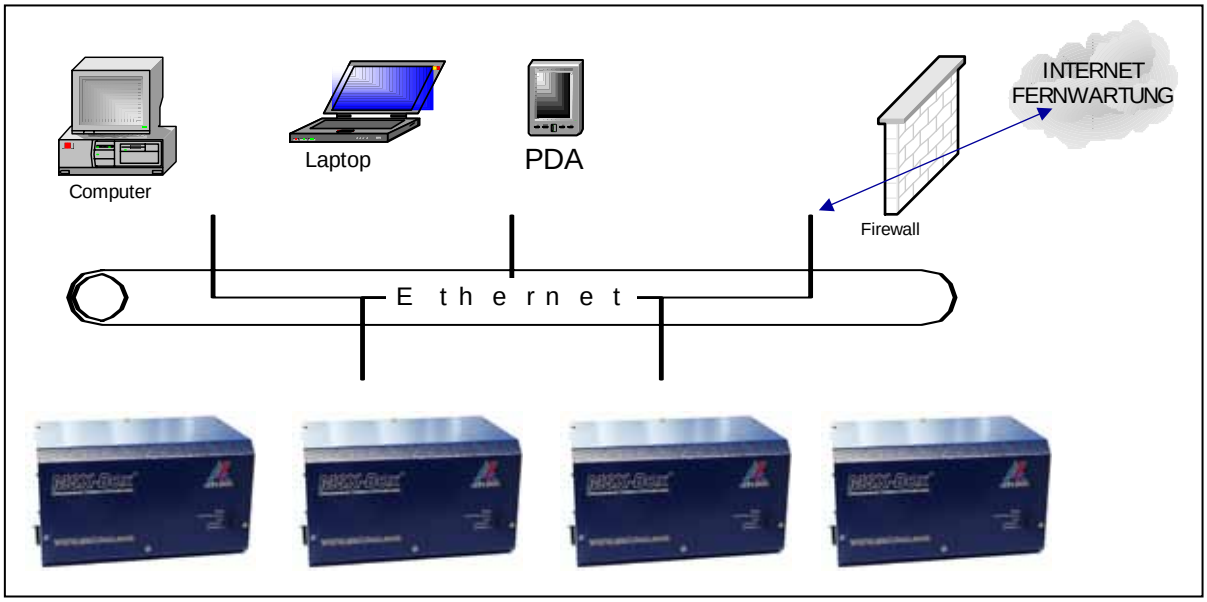
7 Flexible number of inputs and outputs

Very interesting is the possibility to adapt the number of the required inputs and outputs in a flexible way.

As already mentioned, ADDI-DATA offers two versions of the MSX-Box: One version with 3 free PCI slots (MSX-Box-500) and one with 6 free slots (MSX-Box-800). So, the number of required PCI boards can be selected according to application.

A further interesting functionality of the MSX-Box is the distribution of various devices in the EDP net. If the inputs and outputs of MSR application are distributed locally, then various MSX-Boxes with different IP addresses can be installed in order to administrate these I/Os.

Fig. 12: Flexibility in the EDP network



8 Software Framework

On the supplied CD different software components are available. This makes a fast and efficient application of the MSX-Box possible.

8.1 Operating system real time embedded RTAI Linux

The Linux version 2.4.2x with the RTAI Patch is preinstalled on the MSX-Box in compact format. The source code of this kernel is available on the CD and makes it possible to maintain over a few year time, a complete software revision standard (incl. the operating system).

8.2 COMEDI / IOCTL driver

COMEDI, the „**Co**ntrol and **Me**asurement **D**evices **I**nterface", was ported on to the MSX-Box. Via this interface input and output boards can be called in a unique manner.

IOCTL drivers also can be used after having been compiled with the supplied mipsel-linux-gcc Cross Compiler.

8.3 Jobs

The MSX-Box was designed in order to realise measurement, control and regulation jobs. These „Jobs"are software modules, whose source codes are disclosed and contained in the scope of delivery. They constitute a framework that can be used for individual customer needs.

8.4 TCP/IP Socket

A TCP/IP serversocket can be installed on a software port of the MSX-Box, so that a TCP/IP clientsocket, which is in the EDP network, can send or receive information to or from the MSX-Box.

8.5 Monitoring and visualization through internet technologies

The tiny webserver „thttpd" process is an embedded webserver. Herewith HTML pages and CGI programs can be installed on the MSX-Box, in order to provide a user interface: The web frontend. This can be called then in the EDP network with an internet browser through the IP address of the MSX-Box.

8.6 Open Source

From the operating system kernel to the application, the source code of the most software components is delivered.

The open source philosophy makes operating system updates and periodical application portations superfluous.

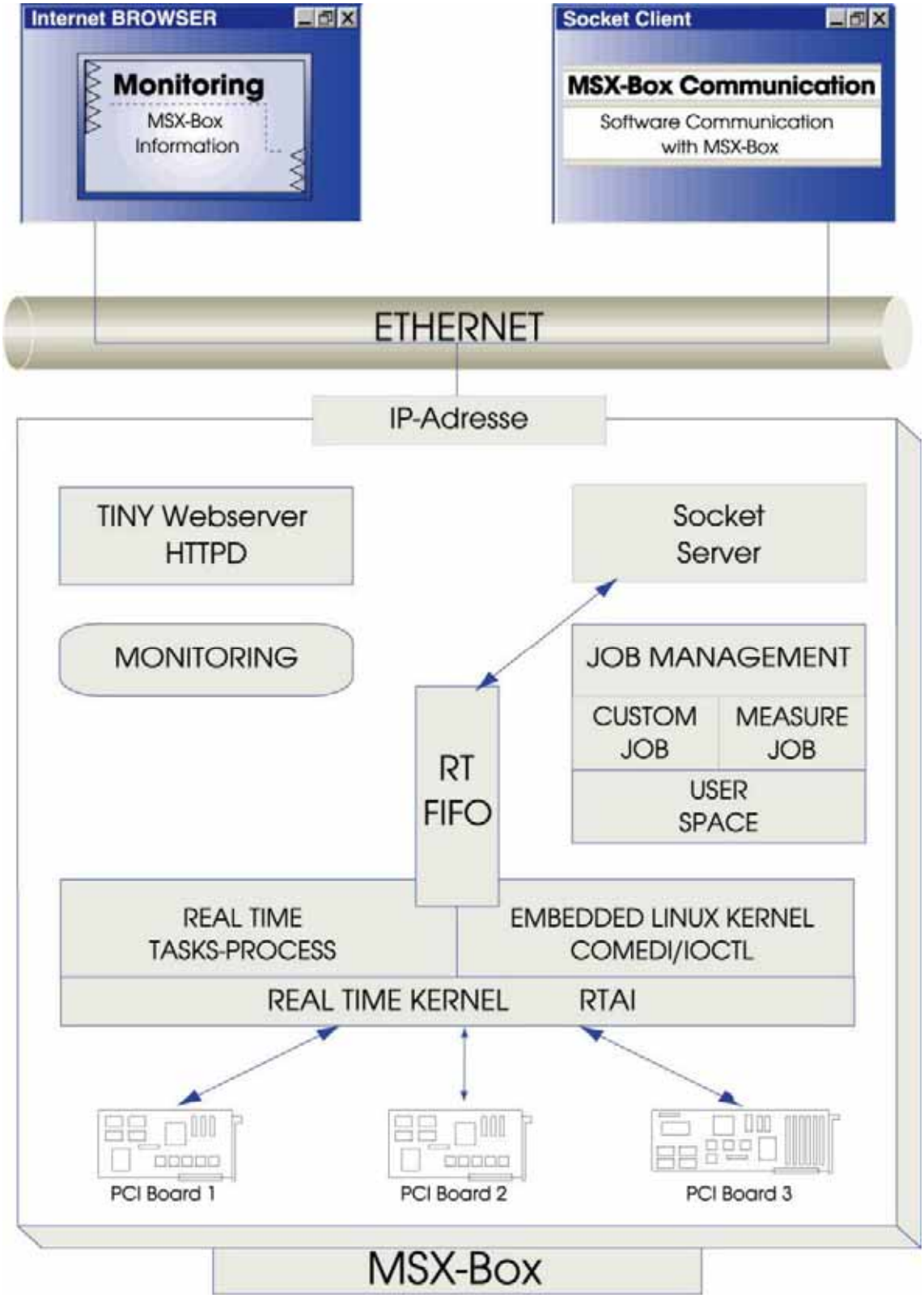


Abb. 13: Software Framework

9 Tools and models

For the use of the MSX-Box, three models were developed.

9.1 Model 1: Parameterization with the web frontend

In this model simple measurement jobs without programming are realized with the MSX-Box. The parameterization of the so called "Measure Jobs" is realized with the web frontend. After the activation, you can work independently on the MSX-Box.

9.2 Model 2: Framework for internet and C programming

In order to ease the process with the supplied Software Framework, own „Custom Jobs" can be developed in C.

9.3 Model 3: C Programming

In the software field, the programmer can learn the MSX-Box to 100%.

The use of the real time operating system Embedded RTAI Linux and the disclosure of the source codes make the creation of a complete tailor-made software application possible. Various C development are available, among other things the „MIPSEL-LINUX-GCC" GNU C Compiler.

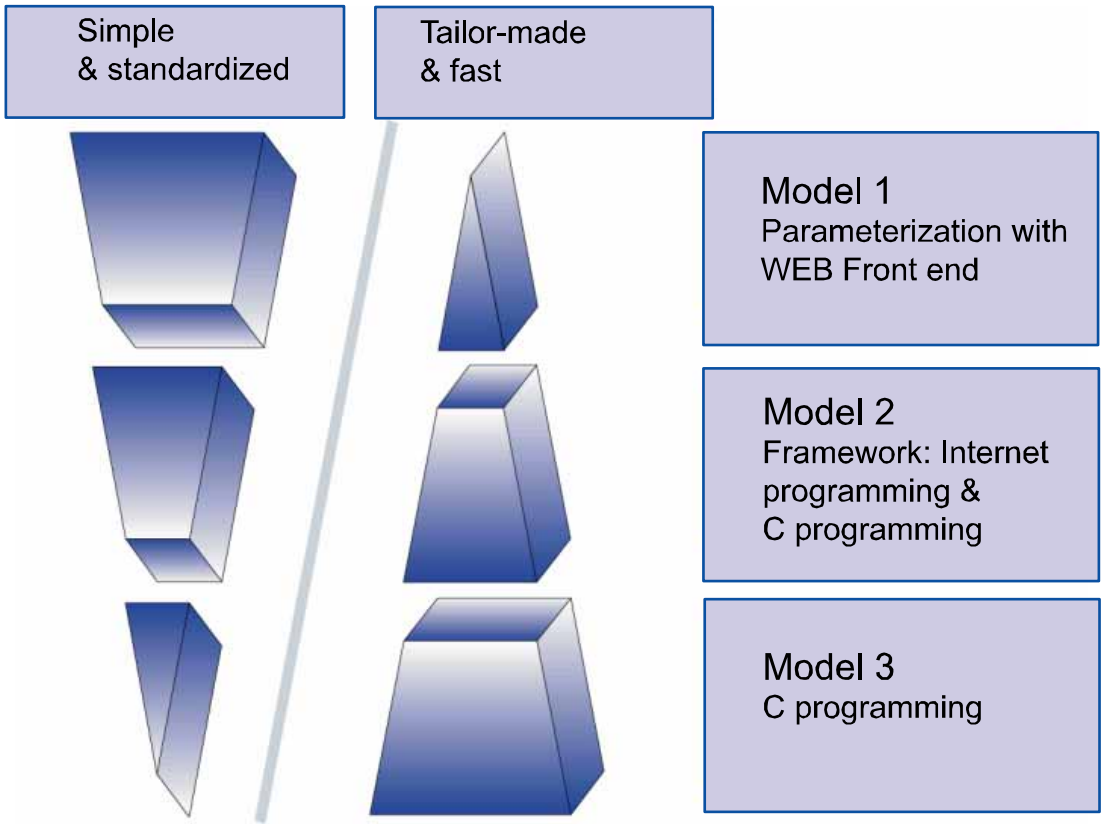


Fig. 14: Tools and models

10 Conclusion

With the MSX-Box, the company ADDI-DATA reached the development of a system that is optimized especially for the industrial application.

As the functionalities are concentrated in the field of measurement, control and regulation, the MSX-Box allows the creation of slim and clearly structured applications.

From the real time embedded operating RTAI Linux to the integrated webserver, through the optional field bus interfaces and the supplied software framework, the MSX-Box combines excellently technologies from different fields and therefore is an incomparable tool for the construction of decentralized MSR measurement applications.

By leaving the vicious circle of the forced system updates, the MSX-Box is the fundament for long-term current applications and herewith secures your invests over a few years time.

www.addi-data.com