



D18 BMS HARDWARE AND SOFTWARE REPORT

**Sustainable Architecture Applied to
Replicable Public-Access Buildings.
Contract:**

TREN/ 04/FP6EN/SO7.31838/503183

Date: 31/11/2004

Work Package 7.1

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Doc ref: SARA D18 - BMS hard & soft
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1) INTERNET COMMUNICATION

The planned monitoring and simulation activities within the SARA Project require the exchange of measured data gained within the building management systems of each demonstration site with other locations like e.g. zafh.net or HESPUL via internet. To realize this objective the building management systems of all demonstrations sites will be equipped with several data acquisition devices and with a connection to the internet. Either internet interfaces or at least dialup modems can be used for the internet connection. Online data sharing as well as the exchange of data-files containing collected historical data will be necessary for the planned online simulation activities and the long term analysis of the building energy performance. The requirements for the two different types of necessary data exchange are discussed in the following paragraphs 1.1 - 1.3 .

1.1) SOFTWARE SOLUTIONS FOR ONLINE DATA SHARING:

For online data sharing the actual measured data from the data acquisition devices of the BMS are shared by requirement (e.g. simulation program) or by fixed time steps for actualisation (e.g. monitoring). There are several software solutions like OPC or DataSocket available to realize the necessary communication for online data sharing. To enable the online communication the OPC or DataSocket server is installed on the PC of the building management system and the OPC or DataSocket clients (reader and writer) are installed on the PCs of the communication counterparts (e.g. zafh.net PC in Stuttgart). With the OPC or data socket client-reader running on the PC of e.g. zafh.net, the measured data can be read from the OPC or data socket server running on the PC of the building management system. These data can then be used as input of a simulation program running on the PC of zafh.net. For advanced fault detection it is possible to write back the calculated outputs of the simulation programs on the OPC or DataSocket server of the building management system or on a website using the OPC or DataSocket client-writer. The principle of this communication is shown in Fig. 1.

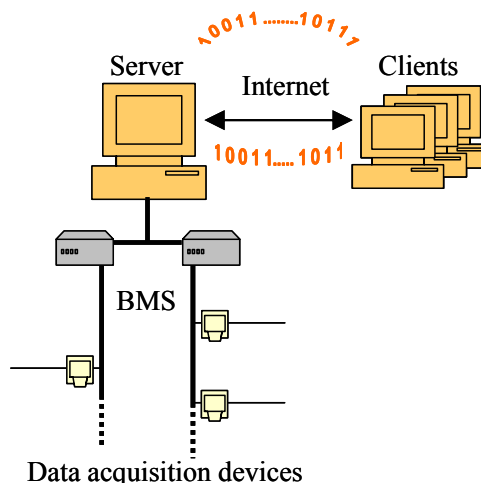


Fig. 1: Applications for online data sharing

OPC or DataSocket servers are the best choice for online communication, as they provide access to the numerical data in the computer's random access memory. Webservers are not very useful for online data sharing, as data are only transmitted in HTML format and numerical data can only be extracted by elaborate parsing software. Furthermore webservers must be specially programmed to provide the data for example in XML format. As the transmission speed and actualisation of data depends strongly on the performance of the webserver, data exchange via webserver is not equal to the online connection described above. Under these circumstances a webserver solution should always be the second quality.

1.2) SOFTWARE SOLUTIONS FOR DATA-FILE EXCHANGE:

Despite of the online data exchange used for monitoring and online simulations, for long term analysis the exchange of data-files containing the collected historical measurement data from the data acquisition devices of the building management system is necessary. The most open and most simple solution is the utilisation of FTP "File Transfer Protocol". To enable the exchange of data-files the FTP server is installed on the PC of the building management system and the FTP clients (reader) are installed on the PCs of the communication counterparts (e.g. zafh.net PC in Stuttgart). Since the data-files are exchanged only once a day / week / month or year for this type of data exchange there is no need for a permanent connection to the internet. The principle of this communication is shown in Fig. 2.

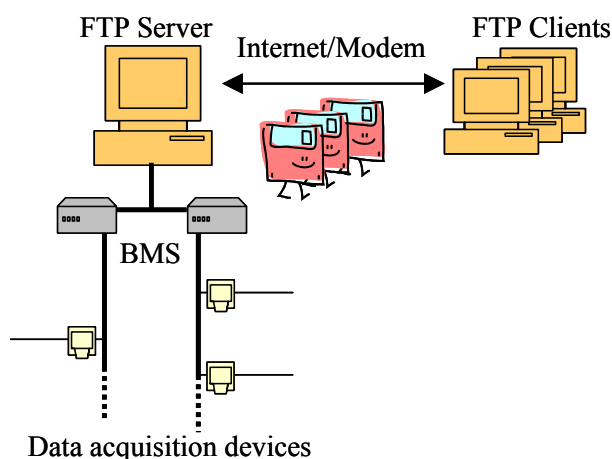


Fig. 2: Applications for online data sharing

1.3) COMBINED SOFTWARE AND HARDWARE SOLUTIONS

The software solutions for online data exchange or data-file exchange described in paragraph 1.1 and 1.2 require a PC connected to the building management system of the demonstration sites. Direct access to this PC is necessary for data exchange. However, especially the smaller demonstration sites will not necessarily be equipped with a PC and in other case a direct access to the PC of the building management system may not be wanted. In these circumstances small network controllers with integrated web user interface (e.g. systems from ECHELON, Johnson Controls or Carrier) may offer a practicable solution.

These small network controllers are equipped with the following features:

- Compact embedded processor platforms that provide integrated control supervision and network management solutions
- Installed FTP server for data exchange
- Provided with web user interfaces and modem for stand-alone application
- Enabling communication and data sharing between multiple communication standards (e.g. LonWorks, BACnet, CCN)

Possible applications of the small network controllers are shown in Fig. 3:

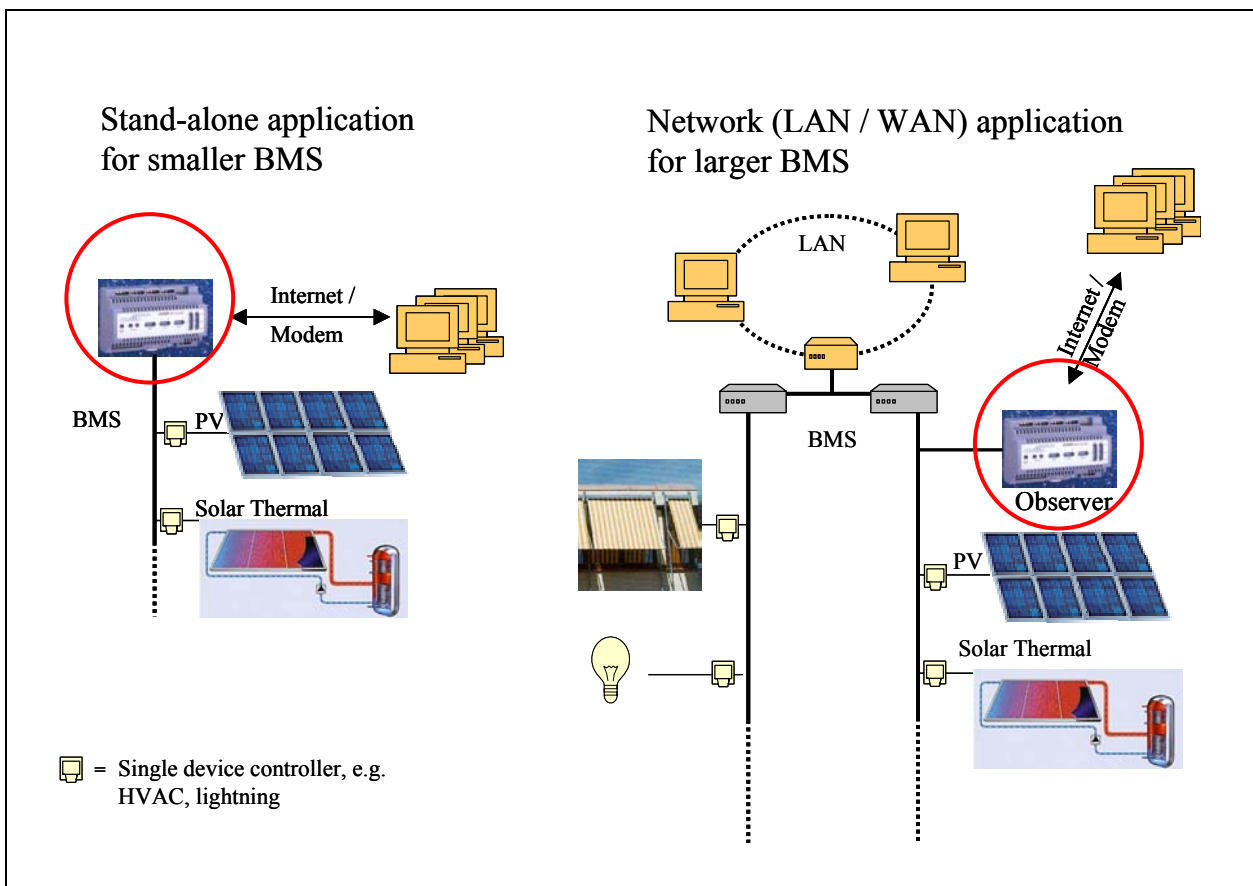


Fig. 2: Possible applications of the small network controllers

2) NECESSARY DATA POINTS IN THE BMS FOR MONITORING AND ONLINE SIMULATION

To specify the necessary data points in the building management systems for monitoring and online simulation a list accounting to EN ISO 16484 (VDI 3814) has been developed and appended to this report.

This list includes the minimum requirement of data points necessary for the planned monitoring of the building energy consumption for heating, ventilation, cooling and lighting. These data points should be integrated in all demonstration sites if the described equipment exists. For online simulation activities this list will be enlarged in some parts as soon as the necessary information are available. This will probably concern only some of the buildings.

At least hourly mean values of the measured data from the defined data points should be stored on the server of the BMS to enable long term analyses of historical data.

For online simulation only actual mean values in time steps of 2 to 5 minutes should be delivered from the defined data points and stored on the server.

Control

The following devices should be controlled through BMS:

- heating system, e.g.
 - boiler / heat pump / solar thermal system / district heating
 - earth tubes / collectors
 - storage tank
 - distribution system
 - temperature regulation in selected spaces
- cooling system, e.g.
 - refrigerator / chiller
 - distribution system
 - temperature regulation in selected spaces
- ventilation system, e.g.
 - air conditioning
 - recuperation
 - distribution system
 - temperature regulation in selected spaces
 - air change rate regulation (volume, CO₂)
 - lighting (daylighting)
 - daylight/artificial light ratio harmonisation

- Necessary additional features of the BMS:

- Connection to the internet (as specified in Paragraph 1)
- Data access for online simulation (as specified in Paragraph 1)
- Visualisation on site (in addition to BMS computer)

WP 7.1: Definition of necessary data points in the BMS for monitoring and online simulation

D18: BMS, Monitoring and Online Simulation Minimum Equipment for Data Acquisition							Table 1
Num.	Trade	Plant	Description Data Points / Objects	Unit	I/O Functions Physical	Recommended Type of Sensor	Sensor Signal
1.	Climate data	<u>meteorological station</u>					
			temperature ambient air	°C	analog input	NTC – Sensor	resistance
			relative humidity ambient air	%	analog input	capacity sensor	voltage
			global solar irradiation on horizontal level	W/m ²	analog input	pyranometer	voltage
			wind speed	m/s	analog input	anemometer	voltage
2.	Room control	at least two reference rooms (north/south)					
			temperature room air	°C	analog input	NTC – Sensor	resistance
			relative humidity room air	%	analog input	capacity sensor	voltage
			lighting (e.g. workplace)	Lux	analog input	light sensor luxmeter	voltage

Accounting to EN ISO 16484 (VDI 3814)

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Num.	Trade	Plant	Description Data Points / Objects	Unit	I/O Functions Physical	Recommended Type of Sensor	Sensor Signal
3.	Heating	Heat source e.g. boiler plant					
			<u>delivered energy</u> (electricity, gas, oil, wood chips,...) if possible with digital counters	kWh; l/h; m ³ /h; ...	binary input, counting	energy- / mass counter	binary
			otherwise: read once per week and type it in a data sheet (consumption of gas, oil, wood chips,...)	l/ week; m ³ / week;	----	----	----
		building heating system e.g. boiler plant					
			<u>net energy</u> energy consumption	kWh	binary input, counting	energy counter	binary if possible M-Bus
			supply temperature heating medium	°C	analog input	NTC – Sensor	resistance
			return temperature heating medium	°C	analog input	NTC – Sensor	resistance

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Num.	Trade	Plant	Description Data Points / Objects	Unit	I/O Functions Physical	Recommended Type of Sensor	Sensor Signal
		domestic hot water (only central supply)					
			<u>energy input storage</u> energy quantity	kWh	binary input, counting	energy counter	binary if possible M-Bus
			supply temperature medium from boiler	°C	analog input	NTC – Sensor	resistance
			return temperature medium from storage	°C	analog input	NTC – Sensor	resistance
		room heating and domestic hot water					
			consumption of electricity (pumps and all heating devices)	kWh	binary input, counting	energy counter	binary

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Num.	Trade	Plant	Description Data Points / Objects	Unit	I/O Functions Physical	Recommended Type of Sensor	Sensor Signal
4.	Ventilation	air-conditioning plant					
			temperature outside air (at inlet ventilation system)	°C	analog input	NTC – Sensor	resistance
			relative humidity outside air (at inlet ventilation system)	%	analog input	capacity sensor	voltage
			temperature supply air	°C	analog input	NTC – Sensor	resistance
			relative humidity supply air	%	analog input	capacity sensor	voltage
			volume flow rate supply air	m ³ /h	analog input	differential pressure measurement	voltage
			volume flow rate fresh air	m ³ /h	analog input	differential pressure measurement	voltage
			temperature extracted room air	°C	analog input	NTC – Sensor	resistance
			relative humidity extracted room air	%	analog input	capacity sensor	voltage

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Num.	Trade	Plant	Description Data Points / Objects	Unit	I/O Functions Physical	Recommended Type of Sensor	Sensor Signal
			temperature exhaust air (after heat recovery)	°C	analog input	NTC – Sensor	resistance
			relative humidity exhaust air	%	analog input	capacity sensor	voltage
			volume flow rate exhaust air	m ³ /h	analog input	differential pressure measurement	voltage
			consumption of electricity (ventilators and all other ventilating devices)	kWh	binary input, counting	energy counter	binary
		heat exchanger / air cooler					
		- preheater	<u>energy preheater</u> energy consumption	kWh	binary input, counting	energy counter	binary if possible M-Bus
			supply temperature medium from boiler	°C	analog input	NTC – Sensor	resistance
			return temperature medium from preheater	°C	analog input	NTC – Sensor	resistance
		- air cooler	<u>energy air cooler</u> energy consumption	kWh	binary input, counting	energy counter	binary if possible M-Bus

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			supply temperature medium from cooling system	°C	analog input	NTC – Sensor	resistance
			return temperature medium from air cooler	°C	analog input	NTC – Sensor	resistance
		Heat recovery (air to air heat exchanger)					
			temperature supply air after heat recovery	°C	analog input	NTC – Sensor	resistance
4.	Refrigeration	refrigeration system					
		- standard electrically driven system	<u>delivered energy</u> (consumption of electricity of all devices)	kWh	binary input, counting	energy counter	binary
		- thermal cooling system	<u>delivered thermal energy</u> (gas, oil, wood chips, ...) if possible with mass counter	kWh; l/h; m ³ /h; ...	binary input, counting	energy / mass counters	binary

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			otherwise: read once per week and type it in a data sheet (consumption of gas, oil, wood chips,...)	l/ week; m ³ / week;	----	----	----
			<u>delivered electricity</u> (consumption of electricity of all devices, like pumps	kWh	binary input, counting	energy counter	binary
		- standard or thermal cooling system	<u>net energy</u> energy consumption	kWh	binary input, counting	energy counter	binary if possible M-Bus
			supply temperature cooling medium	°C	analog input	NTC – Sensor	resistance
			return temperature cooling medium	°C	analog input	NTC – Sensor	resistance
4.	Electrical engineering	lighting system					
			consumption of electricity (separate electricity counter for lighting)	kWh	binary input, counting	energy counter	binary

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5.	Renewable energy systems	photovoltaic					
			produced electricity	kWh	binary input, counting	energy counter	binary
		solar thermal					
			<u>solar thermal energy</u> energy consumption	kWh	binary input, counting	energy counter (2 temperatures + mass flow)	binary if possible M-Bus
			supply temperature medium from collector	°C	analog input	NTC – Sensor	resistance
			return temperature medium from heat exchanger	°C	analog input	NTC – Sensor	resistance
		geothermal					
		- liquid driven systems	<u>geothermal energy</u> energy consumption	kWh	binary input, counting	energy counter (2 temperatures + mass flow)	binary if possible M-Bus
			supply temperature medium from earth tube / earth collector	°C	analog input	NTC – Sensor	resistance

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			return temperature medium from heat exchanger	°C	analog input	NTC – Sensor	resistance
		- air driven systems	temperature supply air after earth tube	°C	analog input	NTC – Sensor	resistance
			relative humidity supply air after earth tube	%	analog input	capacity sensor	voltage
			volume flow rate supply air	m ³ /h	analog input	differential pressure measurement	voltage