Application of the building automation and control system function list (BACS FL), ISO 16484-3

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Building automation and control plays a significant role in the reasonable use of natural resources, building efficiency and user flexibility while guaranteeing economical and easy operation. Only manufacturers with competent employees can ensure — at adequate prices — optimum deployment of building automation and control including investment protection along with the required serviceability and functionality. Adequate pricing is only possible when invitations to tender are legally certain. Unfortunately, this has not been a priority for numerous investors as sufficiently underscored by the number of bankruptcies, mergers and incomplete building automation and control projects over the past decade. In general, invitations to tender must support the unambiguous exchange of information to secure free and fair competition, avoid unnecessary cost risks and take advantage of the potential for innovation.
Generally recognized standards and standardized methods are required to control today's complex technical building automation and control systems and plants.
This paper shows the reader how to apply the internationally standardized building automation and control function list and explains the basic principle of building automation and control functions. The paper also describes their relevance for system integration projects while using official and current building automation and control terms from global standardization.

Abbreviations used:
AS – Automation station (controller)
ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
BAC – Building automation and control
BACS - Building automation and control system
BACS FL – Building automation and control system function list
CEN – European Committee for Standardization
DP – Data point
EDE – Engineering Data Exchange
HVAC – Heating, ventilating, air-conditioning
HSI – Human system interface
I/O – Input/Output
ISO – International Organization for Standardization
VDI (Association of Engineers in Germany)

Open specifications of works for open systems?

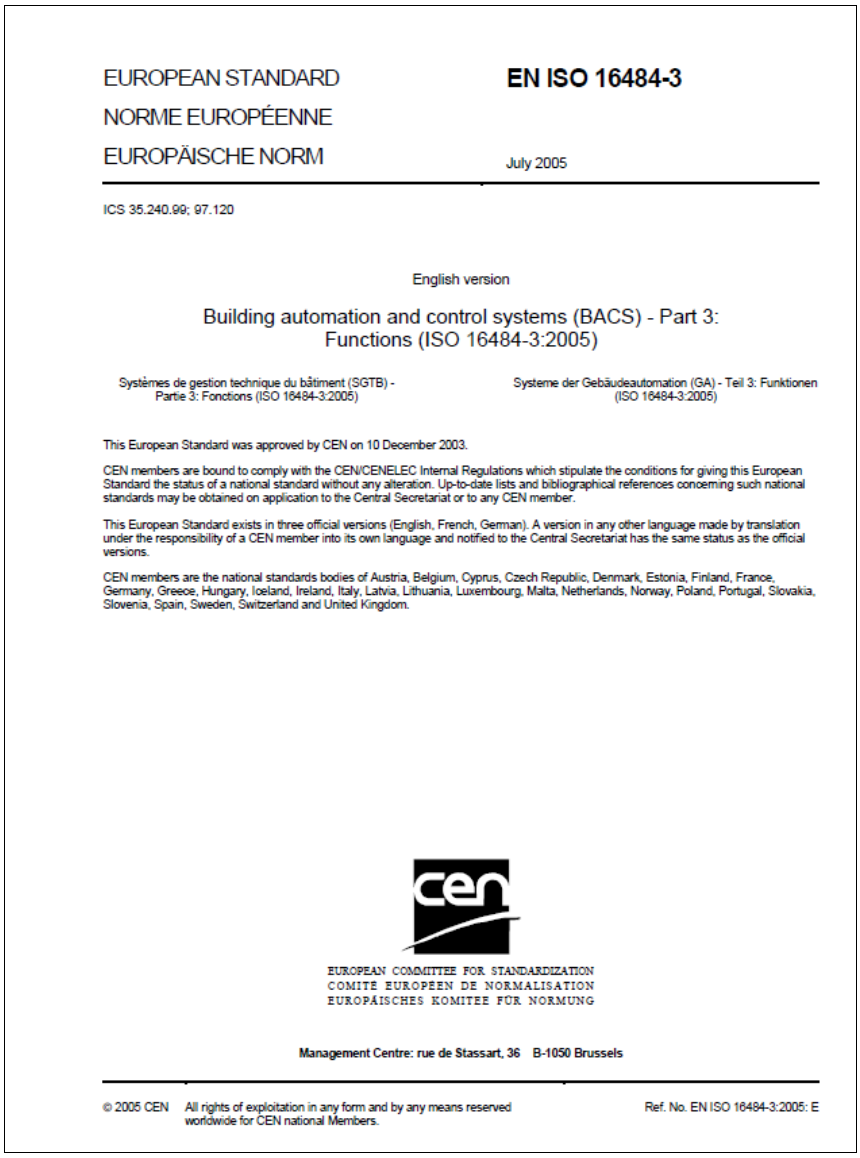
Specification of works remains open when descriptions are ambiguous or have multiple meanings as to how building automation and control should ultimately operate. The result is a lack of a concrete subject of the contract, i.e. no contract at all. Many players in our business are unaware of this fact. Courts have found that a purchase agreement or contract for work and services does not enter into force until everything is agreed to in concrete form (e.g. Municipal Court Frankfurt, November 22, 2002, AZ 32 C 1677/02 – 48).

Many countries rely on standard wording for construction contracts such as DIN 18386 for “General technical specifications for building works” which specify BAC functions per “ISO 16484-3” as the applicable billing units. (Each BAC Function in this case is understood as a fully complete engineering service including the programming, implementing, testing, commissioning, documenting and user instruction). BAC bidding documents or specifications must contain all documents in detailed form deemed essential and required for a comprehensive interpretation of overall functionality to even allow for comparable and well considered submissions. These types of general determinations help reduce the cost risk for all participants by avoiding misunderstandings or incorrect

calculations. Conversely, standardized determinations make it possible to review the quality of the completed work.

It should be possible to separate pricing of hardware and calculable engineering services in the specification of works. Of course, each party is free to agree to individual invitations to tender and contract forms as well as choice of wording with the ordering party. We should note at this point, however, that any court is likely to rely on relevant, applicable standards and other generally recognized technical rules when deciding a dispute.

Regardless of the considerations, significant expense will apply for the technical processing required to implement a BACS in a concrete plant. These expenses are directly related to the number and type of required BAC functions per ISO 16484-3.



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 16484-3

July 2005

ICS 35.240.99; 97.120

English version

Building automation and control systems (BACS) - Part 3:
Functions (ISO 16484-3:2005)

Systèmes de gestion technique du bâtiment (SGTB) - Partie 3: Fonctions (ISO 16484-3:2005)

Systeme der Gebäudeautomation (GA) - Teil 3: Funktionen (ISO 16484-3:2005)

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Ref. No. EN ISO 16484-3:2005: E

Fig 1 – The global BACS Standard Part 3 “Functions”

A “measurable” rule shall exist for changes — typical of construction projects — to the type and scope of contractual performance. As a rule, a change has to be agreed to by the ordering party and contractor prior to execution. For BAC, the internationally recognized BACS Function List represents the best means of documentation to this end. As a consequence, the specification of works must include these functions among its items.

Pricing

The function positions in a specification truly render the performance of the consultant BAC engineer transparent. Builders' representatives clearly see the functions and performance they receive for given plants and what the real costs are. No one feels fleeced. It is possible to estimate the costs during pre-planning quickly and easily using static values by counting the number of sensors and actuators (roughly the number of data points in HVAC). The introduction of BAC functions per ISO16484-3 and growing experience with them as well as increasing use of computers means that "fast calculations" will soon migrate from hardware data points toward standardized functions.
Naturally, a price for the total number of functions can be set as a lumpsum as part of the bidding process to avoid itemized pricing – yet for potential sizing changes, the BACS FL provides a solid basis for calculating fees. We recommend setting a flat rate for these BAC functions for billing purposes to the extent that at this time no computer-supported tools exists for creating measurements from system documentation.

Disadvantages of data point calculation

When services are solicited for bidding in the form of hardware data points, the performance content of the data points – and thus the entire function of the plants – is not set by the planner meaning that any offer can be individually interpreted and evaluated. One data point contains a varying amount of information, often dependent on the system, that is not known and always subject to differing interpretations unless otherwise set per ISO 16484-3 (BAC Functions) and if open communication is required per ISO 16484-5 (BACnet).
Precise pricing and serious calculations are simply not possible using data points. Bids are thus not comparable, yet the practice is customary within the industry. The data point in this sense represents a fixed performance, which everyone can consider in a different manner. The party that does the least amount of "considering" wins the bid – and often runs a deficit that is ultimately compensated with supplemental charges. The project heads are "pressured" accordingly. Unpredictable supplemental charges are unavoidable when the specification of works does not provide a pricing basis. Of course calls for "open communications", in other words, changing manufacturers by the party feeling cheated, follow without delay.

From data point list to ISO BACS Function List (BACS FL)

Over the past 30 years, different forms of data point lists were the only and dominant tools for consultant BAC engineers. The “old” data point list, expanded by the BAC functions and their definitions, represents an essential basis to define plant functionality aimed at replacing free flowing and barely interpretable and calculable text descriptions in the individual specification of works items. The most important prerequisite for efficient BAC systems is project requirements derived from proper, competent measuring, control and BAC planning as documented in the ISO BACS FL. Furthermore, verbal or graphical descriptions of control functions and operating modes are included. For determining the number of the functions to be engineered, it is important that all required information – “properties” under BACnet – and the performance limits are clearly established.

Figure 1 – BAC functions (per HAK)

BAC functions

BAC functions were originally developed and specified as items under the German master specification developed by representatives from the global BAC industry. All BACS manufacturers, some HVAC companies and a number of consulting planners in Germany participated in the project. The VDI (Association of Engineers in Germany) adopted these functions in its Guideline VDI 3814. These were then integrated into the global BACS standard at CEN and ISO and have been valid worldwide together with the BACS FL since December 2004.
BAC functions, created with the agreement of all market participants in the BAC sector, represent a new approach to displaying uniform service-oriented construction services – in particular for system integration. The BAC functions help “determine quantity” of functions (the “functionality”) when setting up plants. Each operational function includes the entire gamut of required technical processing and engineering and renders flat rate, incalculable items such as “1 each engineering work” superfluous. Specification of works remains thin since the drafter can simply refer to the ISO standard when describing BAC function items.

BAC planning

The four essential components to documenting BAC planning are:

1. The control diagram for each plant as per ISO 16484-3;
2. The BACS Function List as per ISO 16484-3;
3. Closed and open-loop control description as free flow text and/or as specification language for sequential function charts e.g. as a state machine as per IEC 60848;
4. Specification text with items for the solicitation of bids (for public bidding, relying on neutral texts).

The BAC planner naturally creates additional documents for quantity and explanation purposes:

- System topology,
- floor plan to include the location of the control devices,
- panel list,
- addressing scheme,
- list of electrical consumers,
- list of sensors (measured values and contact transmitters),
- list of valves, dampers and fire dampers,
- cabling list,
- commissioning requirements,
- etc.

The plant automation and control diagram shows the data points, the processing of analog values and communication functions as well as local human system interface(s) for operation, energy and maintenance management as a basis for the BACS FL.

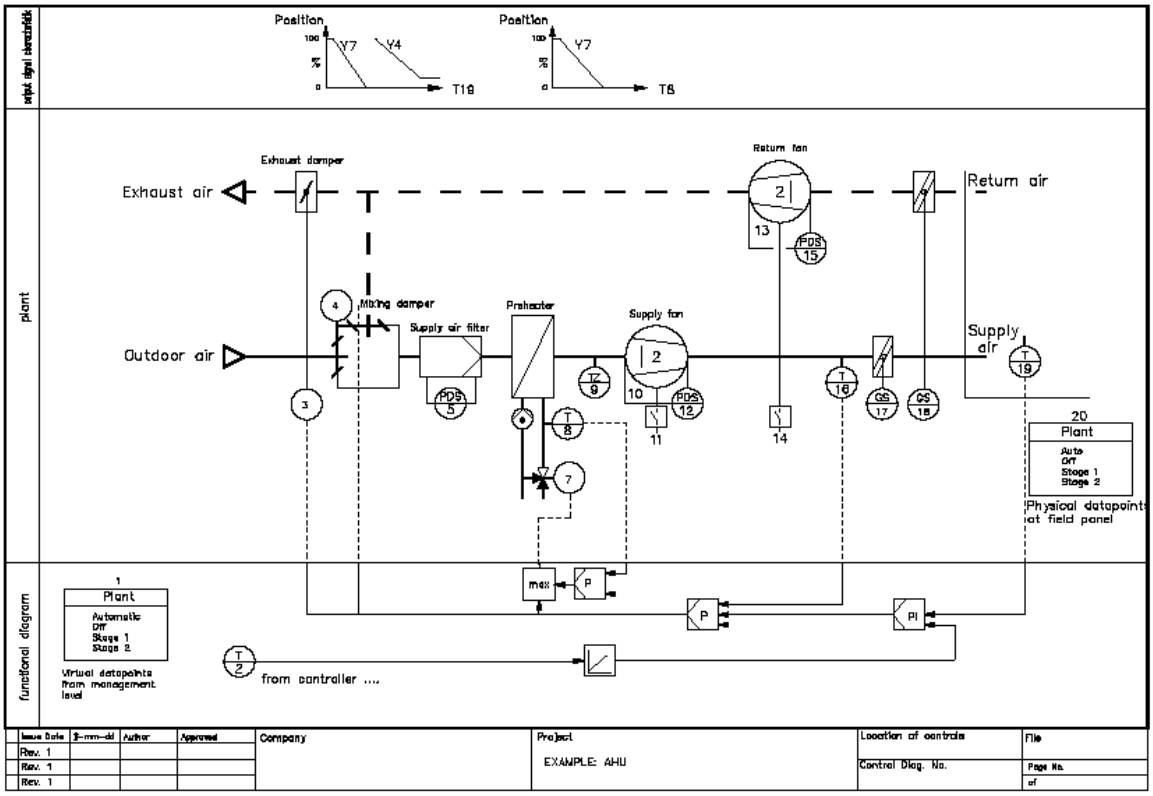

Figure 2 – Example of an air treatment control diagram (as per ISO 16484-3)
Comment: The new global standard for BACS moves away from the depiction of square contact transmitters and round analog sensors, the internationally applicable Letter ID in the symbol (ISO 3511/DIN 19227) replaces graphical differentiation. The number in the measuring location circle corresponds to the line number for the BACS FL.
Virtual or communicative I/O functions are displayed below the lower separating line in the control diagram.

Rationalizing BACS planning

CAD tools exist to create views or design diagrams for control and automation technology, measuring and control technology, hydraulics, pneumatics, electronics, panel views as well as other areas.
BACS manufacture-neutral computer programs, such as “TRIC” (www.tric.de) automatically generate the BACS FL as an Excel table from the control diagram for the electrical and mechanical installations. Motor, field device, cable lists and other lists are also created from the generated BACS FL. In other words, changes to electrical and mechanical plants no longer represent a big problem. The sum total of BAC functions is always correct – with a click of the mouse. The sum is integrated as quantity in the specification of works sorted by spatial focal points, e.g. mechanical equipment rooms. Requirements for the associated hardware are described separately.

BAC functions

Building automation and control are grouped into the BAC functions input/output, processing, management and operator functions. They are documented in the BACS FL (see example fig. 3). The BACS FL is already referred to as the “ISO Function List” in day-to-day language and was previously referred to within the industry as the information list or data point list. The wording of the official requirements for the BAC functions as set forth in ISO 16484-3 applies as a matter of principle.
The global standard describes how to handle the BACS FL. It is important to establish the informational content for an entry in the list for communication, operating and management functions specific to the project, since many

of the properties (information) are identified as "optional" for communication objects per the BACnet standard. The number of individual pieces of information for each data point, i.e. the informational depth, is determined by the data of the object properties to be transmitted (and displayed) in the BACS FL.

BACS FL functions

The BACS FL is used as a calculation worksheet to document and add up building automation and control functions. They are an integral part of complex programs that process information of assigned physical or shared, communicative data points.
The project-specific compilation of BAC functions in a specification of works includes turn-key operational services for each data point and the associated, predefined plant function. In other words, BAC functions include all activities of a vendor such as:
- technical clarification of tasks from implementation planning (user requirements specification),
- engineering – creating mounting and shop planning (specifications),
- establish addresses, parameters, interfaces and functions for each data point,
- technical processing and entry of addresses, characteristic curves, measuring ranges, sizing, SI units and entry of program parts/programs and associated parameters; they include time and control logic functions, commissioning, setting and function test, operator instructions and documentation for the BAC plant.
As a consequence, no additional flat-rate "engineering services" are allowed in the specification of works. Specified, standardized BAC functions can naturally be flat-rated when awarding the bid. Added to this are itemized, required hardware and user rights for software programs.

BACS FL structure

In the BACS FL, the planner's data point designation is provided for in the first line of the first column, in text form or as a designation in the structure for the planned addressing system. A corresponding comment should be entered in the "remarks" column for additional data – on a special sheet as required. The remaining columns contain functions assigned to this data point. For data points with output functions (switching and positioning), a reference of the assigned processing function can be added in the remarks column. Data point is a term developed over time that once referred to only one physical process value or state. The first standardized definition is found in ISO 16484-2.
A communication object can also be displayed as a data point in the BACS FL, in homogenous projects as physical input/output only, in heterogeneous projects as "shared" I/Os.
The BACS FL is divided into four primary sections that establish the plant-specific assignment of BAC functions:

1) Input and output functions are divided into physical I/O and shared, communicative I/Os;
2) Processing functions, divided into monitoring, controlling, calculating and plant or cross-system optimization;
3) Management functions, divided into communication (e.g. for shared data points) and operational data storage (management function programs are described in the global BACS standard, Part 3);
4) Operator functions, divided into visual display and additional reporting functions.

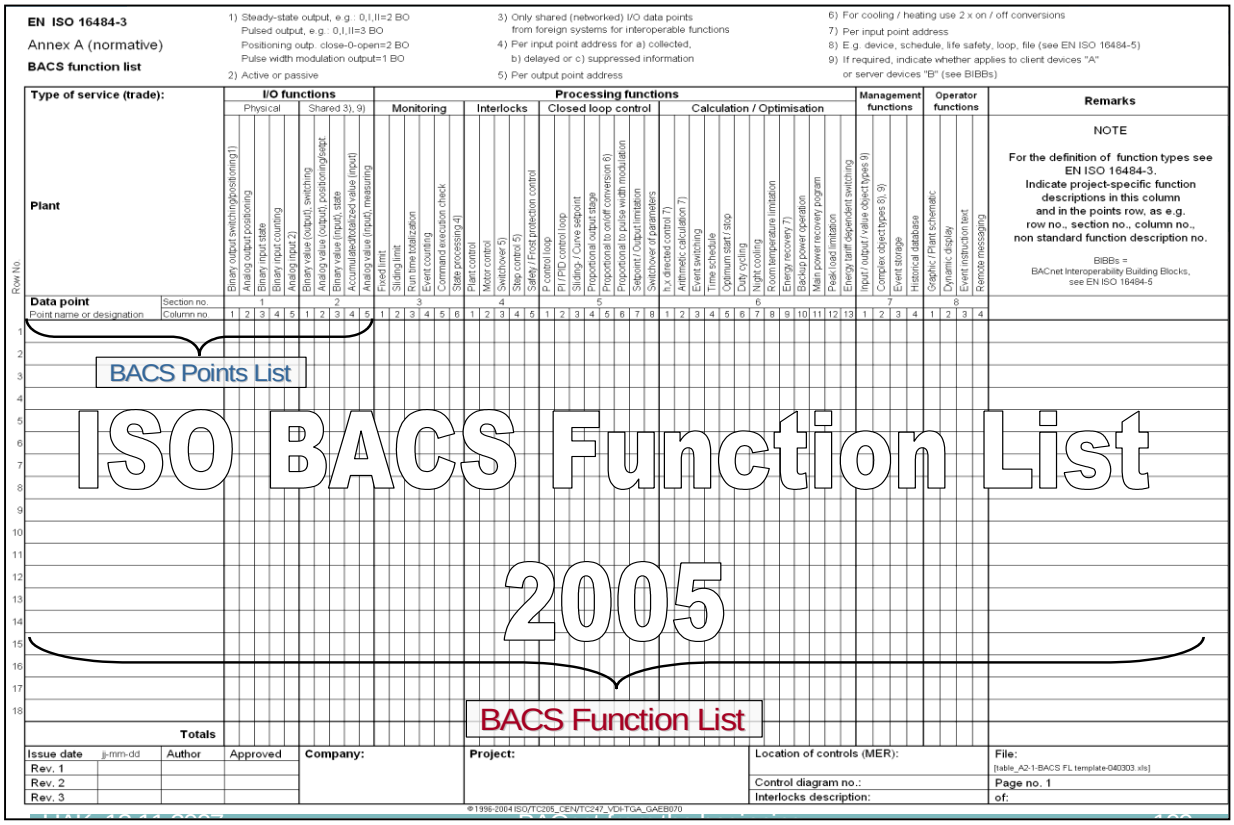

Figure 3 – BACS FL, ISO 16484-3

Functions for heterogeneous systems

Management communication functions are planned when data exchange among automation equipment with third-party operating facilities is required. Operator functions in this case are only contained for the information of the controls installer. This must be clearly explained in a BACS specification of works; additional (non third party) "homogenous operator functions" may be required. The human system interface (HSI) installer receives this list in reverse order. If management functions for logs, statistics, etc., are required, the management equipment installer also receives the corresponding BACS FL and, of course, the number of management/operator function items in his specification of works.

The required communication functions for shared data points must be calculated on both sides.

Working with the BACS Function List

The control diagram forms the basis for working with the BACS FL and, as required, a logic interlocks description or function chart.

Each field device is entered as a data point and every shared, communicative function (with a third-party system) is entered to its dedicated point name. There are also virtual data points derived from processing functions (e.g. calculations). The functions are then assigned to the data points per the rules under ISO 16484-3 for the data points to specify required automation tasks. Documentation can also be created on the implemented plant for operational and calculation purposes.

When not using a CAD program, such as TRIC, to generate the BACS FL, the recommended procedure is to follow the flow of the primary medium (air, water) in the plan and to enter, in the lines of a spreadsheet table, the automation-related plant parts for inputs and outputs (sensors, actuators) as data points. General data points such as overall plant control, e.g. automatic on/off and cross-system data points should be entered at the beginning of the list. This also includes typical panel data points such as mains or control voltage monitoring.

We recommend using object orientation (e.g. preheater, supply air fans, control, etc.) and the principle of causation when assigning functions to the data points, to the extent not otherwise required by the standard. Comply with the notes above on the BACS FL.

Processing functions in terms of a function block display are combined to describe plant automation by entering the number of required functions in the corresponding column and line on the BACS FL. The functionality of individual data points is determined by the type and amount of assigned functions. A suitable computer tool to generate the list (e.g. in Excel) is highly recommended.

Example:

Establishing cascade control in the BACS FL: The requirements for cascade control can be displayed by providing a line for each input value. The (P or PI/PID) master control function and one or more sequential control functions can be entered in the line for the associated data points. We recommend using the "remarks" column for additional explanations. The output value for the master control function is assigned as the function setpoint compensation to the sequential controller(s). The master controller – normally – does not have additional output functions, but can be supplemented with the functions setpoint characteristic curve, limitation setpoint/manipulated variable, parameter changeover as well as management communication and operator functions (see example in Figure 4). The figure 5 then explaines the use of communicative data points within homogeneous BACS.

VDI 3814-1
BACS Funktion List
(DIN EN ISO 16484-3)

1) Steady-state output, e.g.: 0,I,II=2 BO
Pulsed output, e.g.: 0,I,II=3 BO
Positioning outp. close-0-open=2 BO
Pulse width modulation output=1 BO
2) Active or passive
3) Only shared (networked) I/O data points from foreign systems for interoperable functions
4) Per input point address for a) collected, b) delayed or c) suppressed information
5) Per output point address
6) For cooling / heating use 2 x on / off conversions
7) Per input point address
8) E.g. device, schedule, life safety, loop, file (see EN ISO 16484-5)
9) If required, indicate whether applies to client devices "A" or server devices "B" (see BIBBs)

Type of service (trade): Ventilating
Plant **Room x**

Row No.	Data point: Point name or designation	Binary output switching/positioning1)	Analog output positioning	Binary input state	Binary input counting	Analog input 2)	Binary value (output), switching	Analog value (output), positioning/setpt.	Binary value (input), state	Accumulated/totalized value (input)	Analog value (input), measuring	Fixed limit	Sliding / Floating limit	Run time totalization	Event counting	Command execution check	State processing 4)
		I/O functions – Physical					**I/O functions** – Shared 3), 9)					**Processing functions** – Monitoring					
	Section no.	1					2					3					
	Column no.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6
2	outdoor air temperature											1					
19	room temperature					1							1				
16	supply air temperature					1						1					
17	supply fire damper			1													
	Totals																

Row No.	Data point: Point name or designation	Plant control	Motor control	Switchover 5)	Step control 5)	Safety / Frost protection control	P control loop	PI / PID control loop	Sliding / Floating / Curve setpoint	Proportional output stage	Proportional to on/off conversion 6)	Proportional to pulse width modulation	Setpoint / Output limitation	Switchover of parameters
		Processing functions – Interlocks					**Processing functions** – Closed loop control							
	Section no.	4					5							
	Column no.	1	2	3	4	5	1	2	3	4	5	6	7	8
2	outdoor air temperature						1		1					
19	room temperature							1	1					
16	supply air temperature						1		1	2				
17	supply fire damper													
	Totals													

Row No.	Data point: Point name or designation	h,x directed control 7)	Arithmetic calculation 7)	Event switching	Time schedule	Optimum start / stop	Duty cycling	Night cooling	Room temperature limitation	Energy recovery 7)	Backup power operation	Mains power recovery pogram	Peak load limitation	Energy tariff dependent switching
		Processing functions – Calculation / Optimization												
	Section no.	6												
	Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13
2	outdoor air temperature													
19	room temperature													
16	supply air temperature													
17	supply fire damper													
	Totals													

Row No.	Data point: Point name or designation	Input / output / value object types 9)	Complex object types 8), 9)	Event storage	Historical database	Graphic / static plant schematic	Dynamic display	Event instruction text	Remote messaging	**Remarks**
		Management functions				**Operator functions**				NOTE For the definition of function types see VDI 3814-1 : 2005 (DIN EN ISO 16484-3). Indicate project-specific function descriptions in this column and in the points row, as e.g. row no., section no., column no., non standard function description no. BIBBs = BACnet Interoperability Building Blocks, see DIN EN ISO 16484-5
	Section no.	7				8				
	Column no.	1	2	3	4	1	2	3	4	
2	outdoor air temperature	2	1				3			virtual datapoint (A) from controller ..... 3.1) switching preheater pump
19	room temperature	2	1				3			7.1) value + limits 7.2) loop
16	supply air temperature	2	1				3			5.4) sequence damper-preheater 7.2) loop
17	supply fire damper	1					1			3.1) switch off plant
	Totals									

Issue date	jj-mm-dd	Author	Approved	**Company:**	**Project:**	Location of controls (MER):	File: [table_A1-1-BACS FL-xpl-AHU-050308.xls]
Rev. 1		VDI	HAK		EXAMPLE: AHU	Control diagram no.: A1	Page no. 1
Rev. 2						Interlocks description: no	of: 2
Rev. 3							

Figure 4 – BACS FL excerpt for air treatment cascade controller – homogenous system (from ISO 16484-3)
Comment: The management communication functions in this case are used solely to clarify the type of functions for the dynamic display – there is no "shared data point" for a third party system involved. Those functions may be left out as items in the specification of works.

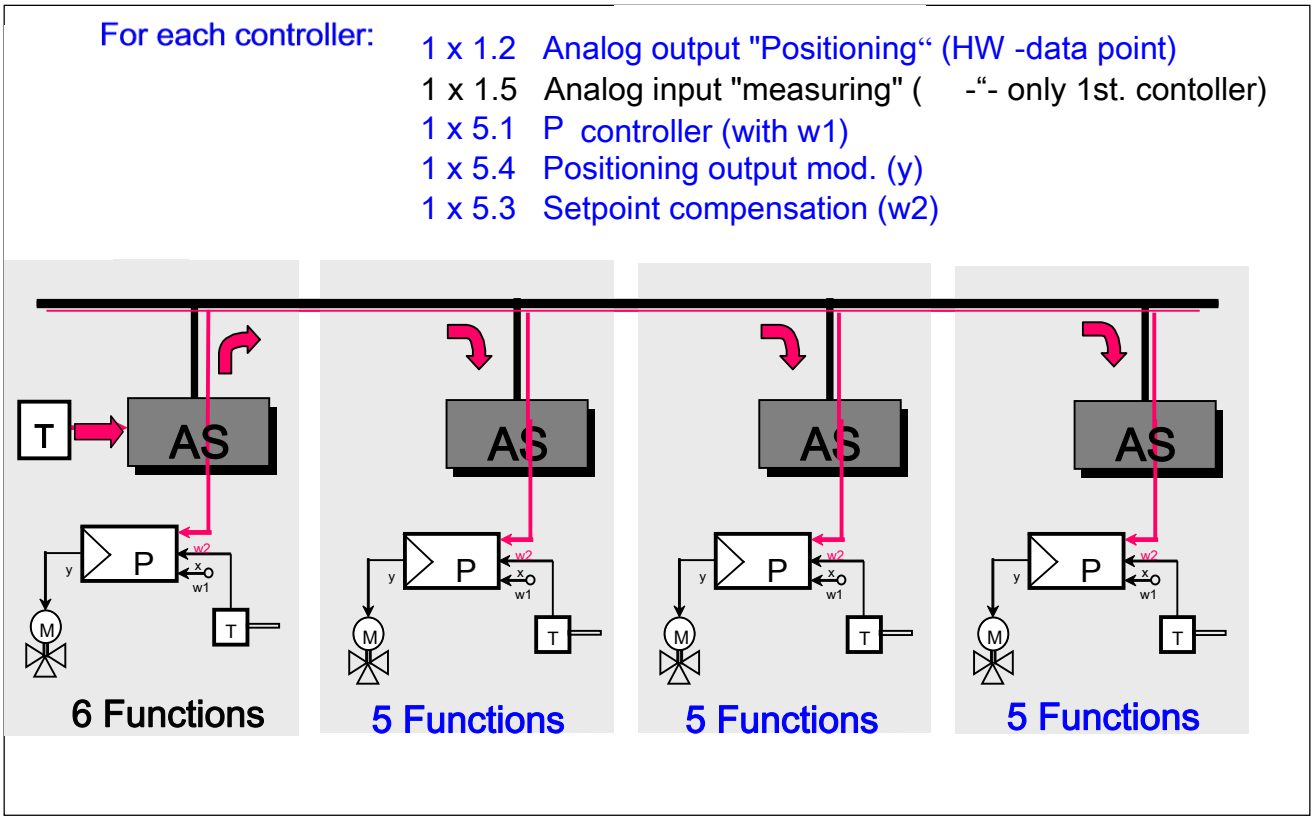

Figure 5 – Calculable functions (example from A. Lezius, VDI course, Planning using BAC functions)

Notes on the application of a few special functions in the BACS FL

General

System-internal and supplier-specific functions were not added to the BACS FL, e.g. system self-monitoring and additional information on system states (except for heterogeneous systems), since they are not project/plant or application-related. BAC function requirements per ISO 16484-3:2005 apply for the application of the BACS FL.

Input and output functions (Section 1)

I/O function information is available for additional processing by all other BAC functions. Among the parameters considered I/O functions are data point addresses, characteristic curves and sensor ranges, SI units, state and associated status descriptions, text and parameter assignments, that are also found in the properties for BACnet objects (refer to communicative I/Os below).
The physical input and output functions serve to monitor states and values from measured values and contact inputs, and to output switching and positioning commands for physical data points directly linked to the system in question. The hardware determination for each required function is entered in the BACS FL for multistate input/output data points. Take note of steady-state or pulsed contact outputs, see note number 1 on the BACS FL, as well as monitoring functions for local override (e.g. H-0-A).

Plant control function (column 4.1)

As a rule, a series of functions are executed, e.g. "Open dampers", "Start pumps and fans" and "Release controller" after switching on a plant using this function. Changes to the command sequence may be initiated automatically depending on certain variables. For example, the preheater pump ramps up and heating control is activated prior to opening the air dampers when the outside air temperature drops below a limit value.
All complex command sequences for plant control and all operating modes are set down in writing, as well as in the control diagram and/or function charts, as required.

Motor control function (column 4.2)

Includes all internal control logic functions for the controlled aggregate. Example: Start up control provides the input to switch on the motor. The state input indicates that the motor is operating. Motor control is switched off when a signal reports a motor failure; antiblocking protection for water pumps is included. Multistate actuators have only one motor control BAC function, but several physical output functions. The star-triangle changeover does not belong to this function in the ISO standard. This motor control function is not used for actuators.

Calculating/optimization functions

The calculation functions “h,x-directed control” and “arithmetic calculation” generate values for other functions and for the HSI.
Optimization functions (6.3 – 6.13) do not replace "normal" monitoring and control functions such as plant or motor control. They are used for plant or cross-system energy and operation management to reduce energy consumption and operating costs, or to increase operational security. Each optimization requires special, additional commissioning of the automated plants at the proper time – this fact must be considered in the contract accordingly and for acceptance as well.

Event-driven switching function (column 6.3)

Serves cross-plant optimization of operation by events beyond the automated plant/system in question, e.g. changeover of the operating mode after a message of a defined event such as an alarm from a fire detection system. A reference to the triggering data point can be entered in the remarks column for the controlled data point. Whenever possible, include the data point to be controlled as a reaction on the triggering data point.

Additional descriptions

Additional documents are created when the required automation process cannot be sufficiently described using the BACS FL, which is especially the case for highly developed optimizations and functions that go above and beyond the standard. Enter this information in the BACS FL on the associated data point in the "remarks" column. In the event of supplemental functionality within a function type, the description should refer to the section and column number of the standardized function.
Example: 6.1a (a = Designation for the supplement),
Here for the h,x-directed control strategy (Section 6, column 1).
But be aware, those non-standard amendments do not allow computer based tendering and bidding as used in some countries.

Application of the BACS Function List for system integration

When connecting various systems for interoperability the globally applicable communications protocol BACnet (ISO 16484-5) is recommended, i.e. for building a heterogeneous system. Other variants result in a loss of "openness" as a matter of principle. Standardized interfaces are necessary for reasonable interaction, but are not enough. Heterogeneous BAC projects among various manufacturers demand clear and unique determinations of supplier limitations and responsibilities.
The BACS Function List per ISO 16484-3 is particularly well suited for assigning engineering services for "shared data points", helping to prevent overlapping services and system components. This also impacts hardware and licenses for software.

BACS FL for various partial systems

For planned heterogeneous systems, the functionality provided as a service must come from the BACS Function List per ISO 16484-3 for each partial system. Common are only the data point names, communication functions (as server or as client, or both) and operator functions, as required. Physical input and output functions can only occur once in a linked overall system. The processing functions should occur just once.

Shared data points

It may be necessary for system integration using shared data points to determine clients and servers for the data. To this end, use the BACnet Interoperability Building Blocks (BIBBs). Clients (Requester of data or services) are indentified by "A" and servers (Maintainer of data or services) with "B". This assignment can be entered in the BACS FL, as required. Note that client and server describe only software functions and not, as is often incorrectly assumed, dedicated devices or equipment – equipment facility can be both client and server simultaneously. In the example for client (A) and server (B), the services Read Property (RP) and Write Property (WP) are displayed from the Interoperability Area (IA) "Data Sharing" (DS), (refer to Figure 6).

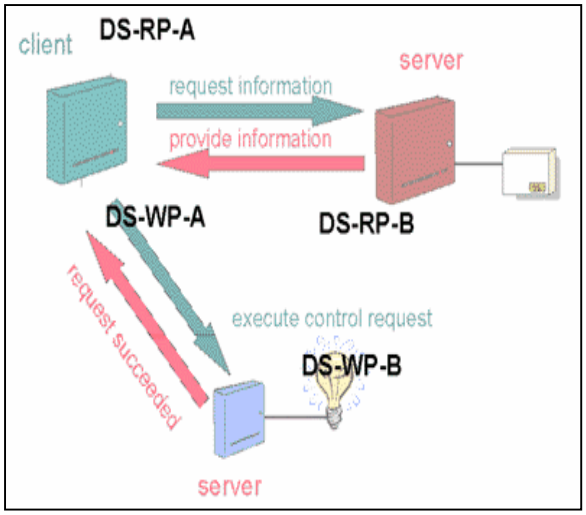

Figure 6 – Client "A"; server "B" (Source David Fisher, Pittsburgh, PA)

Assign BACnet object types to BAC function types

The BACnet object types with their properties and BACnet procedures are the most important semantic elements of the BACnet protocol, as they describe the meaning of the data, thus becoming information. This represents a principle difference between BACnet and most other communication protocols.
It is important for BAC projects to clearly specify the required information.

Table 1 below displays BACnet object types with a reference to the data point types and to the BAC functions of the ISO standard.

The BACnet communication objects

In the context of building automation and control, a BACnet communication object type provides in one set of clearly named and structured data elements, the so-called properties, all information required for a program-supported interpretation of the data. This occurs by setting the corresponding data types, limitations and functions. Only the properties required for a minimum degree of interoperability within BACS are specified in the standard as mandatory and optional. Most of the optional properties expand the open functionality and so the range of interoperability, if implemented in roughly the same manner by the participating communication partners.
By 2007, 28 various BACnet object types were already defined in the ISO standard 16484-5. The term "object type" refers to the assignment of numerous (differing) communications objects (e.g. data points) required in a project to a class. Special communications objects used in a project are referred to as "objects" with an assignment of class designations such as device or binary inputs.
Data elements are transmitted using services established in the BACnet standard.
The design consultant for integration is responsible for specifying (overall) system functionality resulting from interoperability. System functionality includes all project-required interoperability (as per ISO 16484-5) and the required resulting BACnet interoperability building blocks (BIBBs) for the various BAC devices.

EN ISO 16484 – VDI 3814-1			
	BACnet-Object type **Original language, Abbreviation, German translation**	**Data point / Function type,** **BACS Function list (Section.Column)** **English translation, original Language**	**Relevance und Entry in the BACS FL** **English translation, original language**
1.	Accumulator ACC Zählwerteingabe	Counting (binary input), 1.4 In case of system integration as common communicative function 2.4, resp. 7.1. Zählen (Binäreingabe, 1.4 Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.4, bzw. 7.1.	For measuring sensors with pulse output for counting and totalization of values over time. With exact adoption to the displayed value of the physical counter and with corresponding pre-adjustment for the accuracy. Für Messgeräte mit Impulsausgabe zum Zählen und Aufsummieren der Werte über die Zeit. Mit genauer Anpassung an den angezeigten Wert im physikalischen Zähler und entsprechender Voreinstellung für die Genauigkeit.
2.	Analog Input AI Analogeingabe	Measuring, 1.5 In case of system integration as common communicative function 2.5 bzw. 7.1. Messen, 1.5 Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.5 bzw. 7.1.	e. g. measuring temperature z. B. Temperaturmessung.
3.	Analog Output AO Analogausgabe	Positioning, 1.2 In case of system intgration as common communicative function 2.2 bzw. 7.1. Stellen, 1.2 Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.2 bzw. 7.1.	e. g. positioning command or actuating signal for control valve z. B. Stellbefehl für Regelventil.
4.	Analog Value AV Analogwert	Virtual analog DP In case of system integration as common communicative function 2.2, 2.5, bzw. 7.1. Virtueller analoger DP Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.2, 2.5, bzw. 7.1.	Digital presented analog value, e.g. the result of a calculation Digital dargestellter Analogwert, z. B. das Ergebnis einer Rechenoperation.
5.	Averaging AVG Mittelwert	Virtual analog DP In case of system integration as common communicative function 2.2, 2.5, bzw. 7.1. Virtueller analoger DP Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.2, 2.5, bzw.	Digital presented analog value as the result of a statistical function with mean, minimum, maximum and variance Digital dargestellter Wert aus Statistikfunktion als Mittelwert mit Minimum, Maximum und Varianz.

EN ISO 16484 – VDI 3814-1			
	BACnet-Object type **Original language, Abbreviation, German translation**	**Data point / Function type,** **BACS Function list (Section.Column)** **English translation, original Language**	**Relevance und Entry in the BACS FL** **English translation, original language**
		7.1.	
6.	Binary Input BI Binäreingabe	Notification (binary input state), 1.3 In case of system integration as common communicative function 2.3 bzw. 7.1. Melden, 1.3 Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.3 bzw. 7.1.	e.g. plant state, status, alarm z. B. Betriebszustands- Störungs- oder Alarmmeldung.
7.	Binary Output BO Binärausgabe	Switching, positioning, 1.1 In case of system integration as common communicative function 2.1 bzw. 7.1. Schalten, Stellen, 1.1 Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.1 bzw. 7.1.	e. g. command on/off, open/close z. B. Schaltbefehl Ein/Aus, Stellbefehl Auf/Zu.
8.	Binary Value BV Binärwert	Virtual binary DP In case of system integration as common communicative function 2.1, 2.3, bzw. 7.1. Virtueller binärer DP Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.1, 2.3, bzw. 7.1.	Notification, binary state, e.g. 0/1 of a logic interlock function Melden, Binärzustand, z. B. 0/1 aus einer logischen Verknüpfung.
9.	Calendar CAL Betriebskalender	System parameter Systemparameter	Holiday list, not a BACS function, included in 6.4 Time schedule Feiertags- und Ferienliste, keine GA-Funktion, in 6.4 "Zeitabhängiges Schalten" enthalten.
10.	Command CMD Gruppenauftrag	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP, bei Fremdkopplung als Management-Kommunikationsfunktion 7.2.	Command for execution of several predefined activities, e.g. from optimization functions 6.3 to 6.13 and operator function 8.2; Auftrag (Kommando) zur Ausführung (mehrerer) vordefinierter Aktivitäten (z. B. beauftragt von Optimierungsfunktionen 6.3 bis 6.13 und ggf. Bedienfunktion 8.2.
11.	Device DEV Device	Basic system parameter, in case of system integration as virtual DP 7.2., e.g. for watchdog-functions System-Grundparameter, bei Fremdsystemkopplung als virtueller DP 7.2, z. B. für Watchdog-Funktionen	Properties of nodes with BACnet objects; Properties von Netzwerk-Teilnehmern (Geräte, Stationen und andere Einrichtungen), in denen BACnet-Objekte repräsentiert werden.
12.	Event Enrollment EE Ereigniskategorie	Basic system parameter, to specify in a standard description for the entire project. System-Grundparameter, in einer Standardbeschreibung für das Gesamtprojekt festzulegen.	Specification of event types for fixed reactions on events/alarms, included in the standard BACS functions; Festlegung von Ereignisarten für spezifizierte Reaktionen auf Ereignisse/Alarme, in den GA-Funktionen enthalten.
13.	Event Log ELOG Ereignis-Aufzeichnung	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Ggf. virtueller DP, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Transmission of a list with event states and time stamps, 7.3, may also be used for BACS function 7.4; Übertragen einer Liste mit Zuständen und Zeitstempel, 7.3, darf auch für GA-Funktion 7.4 genutzt werden.
14.	File FIL Datei	System functionr Systeminterne Funktion	File transfer, e.g. for configuration data, programs or backup (archiving); is part of BACS-software; Dateiübertragung, z. B. für Konfigurationsdaten, Programme oder für Datensicherung (Archivieren), in GA-Software enthalten.
15.	Global Group GGRP Globale Gruppeneingabe	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP, bei Fremdkopplung mit Management-Kommunikationsfunktion 7.2.	Grouping of input values from various objects in the BACS network; is part of BACS functions 3.6, 6.1, 6.2, 7.3, 7.4, 8.2. Gruppierung von Eingabewerten beliebiger Objekte im GA-Netzwerk, ist enthalten in den GA-Funktionen 3.6, 6.1, 6.2, 7.3, 7.4, 8.2.
16.	Group GRP Gruppeneingabe	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Grouping of input values from various objects in the same device; is part of BACS functions 3.6, 6.1, 6.2, 7.3, 7.4, 8.2. Gruppierung der Eingabewerte beliebiger Objekte im selben Device, ist enthalten in den GA-Funktionen 3.6, 6.1, 6.2, 7.3, 7.4, 8.2.

EN ISO 16484 – VDI 3814-1			
	BACnet-Object type **Original language, Abbreviation, German translation**	**Data point / Function type,** **BACS Function list (Section.Column)** **English translation, original Language**	**Relevance und Entry in the BACS FL** **English translation, original language**
17.	Life Safety Point LSP Gefahrenmelder	complex input object type as common management-communication function 7.2. Komplexes Eingabe-Objekt Bei Fremdkopplung als Management-Kommunikationsfunktion 7.2	Information about the properties for life safety applications in the network. Derived actions are corresponding BACS functions. Informationen über die Properties für Gefahrenmelde-Anwendungen im Netzwerk. Abgeleitete Aktionen sind entsprechende GA-Funktionen.
18.	Life Safety Zone LSZ Sicherheitsbereich	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2	Combination of life safety objects, e.g. for fire alarming loops, fire sections, alarming devices. Application for e.g. 7.3, 7.4 (reports), 8.2 dynamic insertion in user interfaces, Derived actions are corresponding BACS functions. Zusammenfassung von Gefahrenmelder-Objekten, z. B. für Brandmeldelinien, Brandabschnitte, Nebenmeldezentralen etc. Anwendung für z. B. für 7.3, 7.4 (Protokolle), 8.2 dyn. Einblendung etc. Abgeleitete Aktionen sind entsprechende GA-Funktionen.
19.	Loop LP Regler	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Properties (attributes and parameters) of control loop functions; as part of BACS functions 5.1-5-8, 7.3, 7.4, 8.2. Properties (Attribute und Parameter) von Regelfunktionen, enthalten in den GA-Funktionen z. B. 5.1-5.8, 7.3, 7.4, 8.2.
20.	Multi-state Input MI Mehrstufige Eingabe	Multi state notification, 1.3; in case of system integration as common communicative function per stage, 2.3 resp. 7.1. Melden, 1.3, bei Fremdkopplung als gemeinsame, kommunikative Funktion je Stufe, 2.3 bzw. 7.1.	Logic input state coded as a figure, e.g. for notification off, slow, fast. Each stage counts as a BACS function in the BACS FL. Logische Meldezustände als Zahl kodiert, z. B. Meldung: aus, langsam, schnell. Je Stufe ist eine GA-Funktion einzutragen.
21.	Multi-state Output MO Mehrstufige Ausgabe	Multi state command, 1.1, in case of system integration as common communicative function per stage, 2.1 resp. 7.1. Schalten, Stellen, 1.1; bei Fremdkopplung als gemeinsame, kommunikative Funktion je Stufe, 2.1 bzw. 7.1.	Logic output state coded as a figure, e.g. for commands off, slow, fast,… Each stage counts as a BACS function in the BACS FL. Logische Ausgabezustände als Zahl kodiert, z. B. Schaltbefehl: Aus, Stufe 1, Stufe 2, ... Je Stufe ist eine GA-Funktion einzutragen.
22.	Multi-state Value MV Mehrstufiger Wert	Virtual multy state DP, iIn case of system integration as common communicative function 2.1, 2.3, bzw. 7.1. Virtueller mehrstufiger DP, bei Fremdkopplung als gemeinsame, kommunikative Funktion je Stufe, 2.1, 2.3, bzw. 7.1.	Logic state coded as a figure, e.g. state definition 1,2,3,… Each stage counts as a BACS function in the BACS FL. Logische Zustände als Zahl kodiert, z. B. Zustands definition 1,2,3, … Je Stufe ist eine GA-Funktion einzutragen.
23.	Notification Class NC Meldungsklasse	Basic system parameter, to specify in a standard description for the entire project. System-Grundparameter, in einer Standardbeschreibung für das Gesamtprojekt festzulegen.	Time and destination depending dedication of alarm and event notifications, included in the corresponding BACS functions; Zeit- und Empfängerbezogene Zuordnung von Alarm- und Ereignismeldungen, in den betreffenden GA-Funktionen enthalten.
24.	Program PR Programm	Complex object, in case of system integration as common management-communication function for complex object types 7.2. Komplexes Objekt, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Access to a program in a BACnet device, e.g. to load and start this. The program is to be described. Zugriff auf ein Programm in einem BACnet-Device, z. B. um dieses zu laden und zu starten. Das Programm muss zusätzlich beschrieben werden.
25.	Pulse Converter PC Impulszähler Eingabe	Mass/quantity counting, 1.4 In case of system integration as common communicative function 2.4, resp. 7.1. Mengenzählung, 1.4, alternativ zu Zählwert-Eingabe. Bei Fremdkopplung als gemeinsame, kommunikative Funktion 2.4, bzw. 7.1.	For counting a quantity over a given time interval, e.g. for cars, water quantity. Also for periodic power measuring as for load shedding, not for tenant billing (see Nr. 1 Accumulator). Für Mengenzählung über ein gegebenes Zeitintervall, z. B. für Automobile, Wassermenge. Auch für periodische Leistungserfassung z. B. für Höchstlastbegrenzung, nicht jedoch für Abrechnungszwecke. Für Eich- bzw. Abrechnungszwecke siehe Nr. 1 Zählwert-Eingabe-Objekt.
26.	Schedule SCHED Zeitplan	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP Bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Schedule for execution of repeating activities and specification of exceptions, is part of the BACS function 6.3, is required for 6.5 to 6.7 and 6.12/6.13. Zeitplan zur Ausführung wiederkehrender Aktivitäten und Festlegung einmaliger Ausnahmen, enthalten in der GA-Funktion 6.3, wird benötigt für 6.5 bis 6.7 und ggf. 6.12/6.13.
27.	Trend Log TLOG	Virtual DP, in case of system integration as common management-communication	Subscription to a value for COV reporting to report a trend 7.3, may also be used for historical data base 7.4.

EN ISO 16484 – VDI 3814-1			
	BACnet-Object type **Original language, Abbreviation, German translation**	**Data point / Function type,** **BACS Function list (Section.Column)** **English translation, original Language**	**Relevance und Entry in the BACS FL** **English translation, original language**
	Trendaufzeichnung	function for complex object types 7.2. Ggf. virtueller DP, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Abonnement auf einen Wert für zeitweise ereignisorientierte Übertragung (COV-Reporting) für Trendaufzeichnung 7.3, darf auch für Historisierung in Datenbank 7.4 genutzt werden.
28.	Trend Log Multiple TLOGM Mehrfachtrendauf-zeich-nung	Virtual DP, in case of system integration as common management-communication function for complex object types 7.2. Virtueller DP, bei Fremdkopplung als virtueller DP mit Management-Kommunikationsfunktion 7.2.	Subscription to multiple values from various objects in the BACS network for COV reporting to report trends 7.3, may also be used for historical data base 7.4. Abonnement auf mehrere Werte für zeitweise ereignisorientierte Übertragung (COV-Reporting) oder "Lesen" von Werten für z. B. netzwerkübergreifende Trendaufzeichnung 7.3, darf auch für Historisierung in Datenbank 7.4 genutzt werden.

Table 1 – Mapping BACnet object types and BAC function types

Information depth

The information depth per data point is derived from the number and type of properties transmitted with a BACnet object. It is important to clearly specify required information when determining the number of functions to be engineered. The number of individual items of information per data point, the information depth, is determined by the object properties to be transmitted (and displayed). The optional properties responsible for meeting the required functions must be specified in detail (and reviewed) since many of the properties (BAC information) are identified as just optional in the standard for BACnet object types. The known BACS FL serves as a tool in this regard.

Dynamic displays

The dynamic displays BAC function displays the current state and current value or operation for the required functions, e.g. in a plant graphic. Of course, operator dialogs without graphics are also considered operator functions. The number of dynamic displays and operating information must be specified for each data point. Some BAC functions as a matter of principle should include operations such as scheduling or limit value parameters.
ISO 16484-3 provides an example of the dynamic displays BAC function (BACS FL section 8, column 2, see Table 2 and 3).
Unless further functions are planned, e.g. for “historical data base” and “remote messaging”, at a minimum, the same number of functions selected for display in another system must be defined for “management communication” functions in heterogeneous systems as well.
The question as to what information should be included often arises for communications, operater and management functions. The principle applies whereby system internal messages (wire break, short circuit, other defects) for homogenous systems do not belong to project-specific BAC functions – they normally are specified for the system in question in a so called “standard description”.

	Data point type and BAC functions	**Number of I/O and processing functions**	**Selected for dynamic display (example)**	**Number of dynamic display functions**
1.	**Two-stage plant switching command:**			
	Operating mode switching (0)-automatic-I-II;	3	3	
	Command execution check back (0-autom.)-I-II;	2	2	
	Run time monitoring;	1	1	
	Run time limit;	1	1	
	Logic control, plant control;	1	0	
	Optimization, e. g.:			
	Time schedule;	2	0	
	Optimum start - stop;	1	1	
	Night cooling;	1	0	
	Mains power recovery program;	1	0	
	Peak load limitation	1	1	
	Back up power operation.	1	1	
	Total			10
2.	**Temperature measured value**	1	1	
	with 2 limit values	2	2	
	Total			3

	Data point type and BAC functions	Number of I/O and processing functions	Selected for dynamic display (example)	Number of dynamic display functions
3.	**Two-speed fan:**			
	Motor control;	1	0	
	Steady state output (0)-I-II;	2	2	
	Check back per each switching stage;	2	2	
	Run time;	1	1	
	Run time limit value;	1	1	
	Command execution check;	1	1	
	Motor fault (overcurrent)	1	1	
	Total			8
4.	**Cascade control**:			
	Room temperature measured value;	1	1	
	P reference controller (complex object type);	1	1	
	Supply air temperature measured value;	1	1	
	Lower sliding limit value;	1	1	
	PI secondary controller (complex object type);	1	0	
	Secondary controller setpoint compensation;	1	0	
	Setpoint limitation;	1	0	
	Output limitation;	1	0	
	2 proportional output stages.	2	0	
	Total			4

Table 2 — Example for assigning dynamic display functions (ISO 16484-3), also see Table 3a and 3b

Shared, communicative I/O functions

The BACnet input and output object types as well as the value object types can be used as input/output functions for “data points”. The I/O functions for shared, communicative data points compile information available to the user **for networked equipment from various system builders** for the user. These "virtual" I/O data points possess a unique data point and user address as communication objects to identify assigned information; they are otherwise not considered a data point. The I/O functions as services for shared, communicative data points make it possible, with the help of the BACS FL, to define assignments of functions from different, third-party systems. This avoids the common practice of double engineering processing functions and problems associated with billing. Only communication functions are required in each participating system for interoperable, heterogeneous systems; for both server and client systems, i.e. at least twice. A price for these functions essentially represents technical clarifications and coordination with the communications partner, who as a rule is not a party to the agreement.

The shared, communicative I/O functions only include the described engineering services for shared data points and not user rights to software for the communications protocol.

BAC management functions

Management functions are established for each project to make data available for storage, statistical evaluation and display in logs (e.g. trend log), unless of course the owner assumes the service. As a rule, setting up BACnet trend functions or trend objects is an operational activity**.**

Management communication functions

A price for these functions essentially represents technical clarifications and coordination with the communications partner, who as a rule is not a party to the agreement. It further serves to document a selection of functions

or information from data points for storage, processing or operating by a third-party system. The entry of a function applies for the planned communications direction in the context of the data point as client and/or server (if, for example, check back state can be displayed in its own line, it still belongs to the data point). An additional description is required in the specification of works. These mgmt.-communication functions are considered internal system functions for homogeneous systems and do not need to be displayed for the purposes of bid calculation. Generally, there is no extra engineering service for management communication functions – from the customer‘s point of view; they are already defined in the BACS FL together with the actual management and operator functions. The same rules apply to input/output functions in a homogenous system.
Object types used for management communication functions differ with regard to the complexity of the data. They are listed separately in two columns within section 7 (management functions) of the BACS FL:
- Input/output and value object type and
- Complex object type.

To couple heterogeneous systems, ISO 16484-3 requires special consultation among the individual system builders for all object types, that extend beyond I/O objects (7.1), e.g. complex communications objects (7.2). Furthermore, special attention must be paid to documentation of this consultation in the event of warranty claims or assigning liability, e.g. for messaging failures. The goal of the consultation is to ensure consistent application in a project for these special and often optional object properties. An EDE datasheet (Engineering Data Exchange File) developed by contractors within the BACnet Interest Group Europe (B.I.G.-EU), can serve as the necessary tool.

Management communication functions – Input/output and value object type

This type of I/O object transmits data and information to (or from) third-party system(s) for management or operator functions. This includes information from analog, binary or multi-state I/O functions with their state information, values, and further attributes and properties describing I/O functions for shared data points as well as information from monitoring functions per Section 3 of the BACS FL. The two object types, counter value input and/or pulse counter input, also belong to this group and must be defined accordingly; the counter value can be a virtual DP. The information depth for the given data point shall be established on a project-specific basis in the BACS FL.

Management communications function – Complex object type

Complex object types transmit data and information to (or from) third-party system(s) for management or operator functions.
We distinguish among three variants of complex object types:

1. Object types for BAC functions with assignment to data points for each project (including homogeneous ones),
2. Object types for planned, heterogeneous projects, and
3. Object type for superposed system functions.

Table 2 provides an overview of these object types. In the list below, the numbers in parenthesis refer to the assigned section/column on the BACS FL.

The following (complex) object types (7.2) can be assigned to independent (virtual) data points:
- Command object as virtual DP, e.g. data point "Room operating mode", for optimization functions (6.3 through 6.13);
- Life safety point object as physical data point with complex entry functions requiring specification;
- Life safety zone object as virtual DP, e.g. for a detector line.

For networked, heterogeneous systems, the following (complex) object types (7.2) can be assigned independent (virtual) data points:

- Device object (per ISO 16484-2: hardware object); as system basic parameter (system-internal function). An additional virtual shared data point per 7.2 for cross-system watchdog must be set up for heterogeneous systems.
- Event log object, e.g. contained in the following functions: Event long-term storage (7.3), histories in the database (7.4). It is entered as a virtual DP for heterogeneous system, if required; generally set up by the operator.
- Global group object, e.g. contained in the following functions: Message processing (3.6) (common message), calculating functions (6.1, 6.2), management functions (7.3, 7.4), and operator function (8.2). It is entered as virtual DP with functions per 7.2 for heterogeneous systems.
- Group object, see global group object.
- Loop object is, e.g., specified by the following functions: Control functions (5.1 to 5.8), management functions 7.3, 7.4, and operating function "dynamic display" (8.2). It is entered as virtual DP with function per 7.2 for heterogeneous systems.
- Program object, entered as virtual DP as required for heterogeneous systems. The program itself must also be described as a separate item.
- Schedule object, included in the BAC function, “Scheduled switching" (6.4). It is used for BAC functions 6.5 through 6.7 and 6.12/6.13 as required. The schedule object can be entered as a virtual DP for heterogeneous systems.
- Trend log object, e.g. included in the following functions: Event long-term storage (7.3), histories in database (7.4). It is entered as a virtual DP for heterogeneous system; generally set up by the operator.
- Trend log multiple object, see trend log object.

The following object types, specifying interoperable system parameters, are not directly assigned to BAC management functions for the BACS FL:

- Calendar object: System parameters together with the schedule object. Services for the initial entry is included in the BAC function "scheduled switching" (6.4). This service must be clearly assigned for heterogeneous systems.
- Event enrollment object as basical system-internal function; not a function for the BACS FL. Event enrollment categories can be set in the system standard description as required.
- File object as system basic parameter or system-internal function; not a function for BACS FL. File objects must be individually specified in a specification of works for heterogeneous systems.
- Notification class object as system basic parameter or system-internal function; not a function for BACS FL. Notification classes can be set in a system standard description as required.

Final comments

This paper presented the new ISO BACS Function List in its basic structure while explaining some of its unique features. At this point, we would like to once again warn against independently interpreting the titles on the BAC list. As a matter of principle, the definitions as per ISO 16484-3 apply. For BACnet and its planning, refer to the official websites such as www.BACnet.org and www.BIG-EU.org.

The author, Dipl.-Ing. Hans R. Kranz (HAK) was project leader for the global BACS standard 16484 within CEN and ISO.

Example for heterogeneous Systems

BACS Function List

ISO 16484-3

1) Steady-state output, e.g.: 0,I,II=2 BO
Pulsed output, e.g.: 0,I,II=3 BO
Positioning outp. close-0-open=2 BO
Pulse width modulation output=1 BO

2) Active or passive

3) Only shared (networked) I/O data points from foreign systems for interoperable functions

4) Per input point address for a) collected,
b) delayed or c) suppressed information

5) Per output point address

6) For cooling / heating use 2 x on / off conversions

7) Per input point address

8) E.g. device, schedule, life safety, loop, file (see EN ISO 16484-5)

9) If required, indicate whether applies to client devices "A" or server devices "B" (see BIBBs)

Row No.	Type of service (trade): Ventilating Plant SYSTEM X Room x		I/O functions: Physical					I/O functions: Shared 3), 9)					Processing functions: Monitoring						Processing functions: Interlocks					Processing functions: Closed loop control								Processing functions: Calculation / Optimization																			Management functions				Operator functions				Remarks
			Binary output switching/positioning1)	Analog output positioning	Binary input state	Binary input counting	Analog input 2)	Binary value (output), switching	Analog value (output), positioning/setpt.	Binary value (input), state	Accumulated/totalized value (input)	Analog value (input), measuring	Fixed limit	Sliding / Floating limit	Run time totalization	Event counting	Command execution check	State processing 4)	Plant control	Motor control	Switchover 5)	Step control 5)	Safety / Frost protection control	P control loop	PI / PID control loop	Sliding / Floating / Curve setpoint	Proportional output stage	Proportional to on/off conversion 6)	Proportional to pulse width modulation	Setpoint / Output limitation	Switchover of parameters	h,x directed control 7)	Arithmetic calculation 7)	Event switching	Time schedule	Optimum start / stop	Duty cycling	Night cooling	Room temperature limitation	Energy recovery 7)	Backup power operation	Mains power recovery pogram	Peak load limitation	Energy tariff dependent switching	Input / output / value object types 9)	Complex object types 8), 9)	Event storage	Historical database	Graphic / static plant schematic	Dynamic display	Event instruction text	Remote messaging	NOTE For the definition of function types see VDI 3814-1 : 2005 (DIN EN ISO 16484-3). Indicate project-specific function descriptions in this column and in the points row, as e.g. row no., section no., column no., non standard function description no. BIBBs = BACnet Interoperability Building Blocks, see DIN EN ISO 16484-5
	Data point Section no.		1					2					3						4					5								6																7				8				
	Point name or designation Column no.		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4	1	2	3	4	
1	plant st.1/st.2/off/auto														1				1															2	1		1					1	1		4					2			A 4.1) off by rep.swi., fire damper, frost; 8.2) Step B 7.1) switching + operating mode;
2	outdoor air temperature												1											1		1																												B virtual datapoint (A) from controller ..... 3.1) switching preheater pump
3	exhaust damper			1	3												1												1																		4					2			B 1.3)+8.2) position indicating; 7.1) from 3.5
4	mixing damper			1	3												1												1																		4					2			B 1.3)+7.1) position indicating; 7.1) from 3.5 5.7) minimum fresh air
5	supply air filter				1													1																													1					1			B 3.6) delayed
6	preheater pump (on/off + fault)		1		3										1		1			1																												5					2			A 1.3) state+fault; fct.3.1 out-temp-lim; B 4.2) incl. pump stall protection; 8.2 On-Off/Fault
7	preheater valve			1	1								1																																		2					1			B 3.1) <3% preheater pump off 8.2) position indicating, state
8	preheater temperature						1											1				1	1			1																						2	1							A B 5.1) frost protection by ph-water
9	preheater frost protection				1													1				1																										1					1			B

Table 3a - BACS-FL Example for System X (only Field and Automation Functions, limited local operating)

	Data point; SYSTEM Z Section no.	1					2					3						4					5								6																7				8				
	Point name or designation Column no.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4	1	2	3	4	
1	plant st.1/st.2/off/auto																																														4		2	2	1	4			A B 7.1) 8.2) switching + operating mode + Step;
2	outdoor air temperature																																														1			1		3			A virtual datapoint (A) from controller ..... in Syst. Y see also System, X
3	exhaust damper																																														4		4			4			A 1.3)+7.1) position indicating +7.1) from 3.5 Sys X.
4	mixing damper																																														4		4			4			A 1.3)+7.1) position indicating +7.1) from 3.5 Sys X.
5	supply air filter																																														1		1			1			A
6	preheater pump (on/off + fault)																																														5		5			5			A 1.3) state+fault; fct.3.1 out-temp-lim; B from Sys. X
7	preheater valve																																														2		1	1		2			A 7.1) position indicating, state
8	preheater temperature																																														2	1	1	1		3			A 5.1) frost protection by PH-frost (water) Sys. X
9	preheater frost protection																																														1		1			1			A

Table 3b - BACS-FL Example for System X (only Management and Operator Functions, extract)