

HVAC CONTROL SYSTEMS

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Background

A direct digital control (DDC) system consists of microprocessor based hardware used to control a building's mechanical and electrical systems, particularly the Heating, Ventilating and Air Conditioning (HVAC) system. While a DDC system can function independently (or standalone) at the building-level, it is usually combined with a Utility Monitoring Control System (UMCS) consisting of one or more operator workstation computers used to monitor and manage the connected DDC systems. Within the context of this document, the UMCS along with its connected DDC systems is referred to a building automation system (BAS).

A longstanding goal of most Army installations is to implement a single and cohesive post wide BAS as opposed to multiple separate and independent BASs. Unfortunately most Army Installations procure DDC systems on a case-by-case (building-by-building or system-by-system) basis where the controls are installed under separate contracts and by different contractors and without the planning, preparation and training needed to procure a successful post wide BAS. A successful BAS will:

- Provide a single user interface with a consistent "look and feel" even though it consists of DDC products from different manufacturers installed by different contractors. A key requirement is that the DDC systems must inter-operate with each other and with a UMCS through the use of an Open communications protocol.
- Be expandable without sole-source procurement and supportable over the long term without involvement of the original installing contractors.
- Use standardized and consistent control systems and strategies to achieve some commonality and familiarity for designers, construction quality verification staff, and O&M personnel.
- Support the needs of the building occupants, operations and maintenance (O&M) staff, and management. Therefore it must provide reliable environmental control, be useful to the O&M staff, and provide energy savings capability and functions.

Section 109 of the Energy Policy Act of 2005 sets the absolute minimum building control requirements for commercial buildings at the level of ANSI/ASHRAE/IESNA Standard 90.1-2004. However, Federal agencies are also required to achieve 30% lower energy consumption, if cost-effective, so the levels in Standard 90.1-2004 really only provide the basis for this calculation.

Requirements and Guidance

Two unified facilities guide specifications (UFGSSs) for BASs were released in 2004. The specifications are geared towards multi-vendor, interoperable, and energy efficient DDC systems that integrate with a UMCS (<http://www.wbdg.org/>):

- The DDC guide spec, UFGS 23 09 23 (previously UFGS 15951): Direct Digital Control for HVAC and Other Building Systems specifies controls at the building level.
- The UMCS guide spec, UFGS 25 10 10 (previously UFGS 13801): Utility Monitoring and Control System (UMCS) specifies the supervisory and post wide system.

These two specifications are intended to work together such that a single UMCS serves as a base wide interface to many building-level DDC systems, regardless of the manufacturer or installer of the building controls. Related design guidance, control system drawings and UMCS drawings are available at:

<https://eko.usace.army.mil/fa/bAS/>

Energy and Water Conservation Design Requirements for SRM Projects

The DDC and UMCS specifications are based on LONWORKS[®] technology¹ including the use of ANSI/CEA standards 709.1B and 852 (sometimes referred to as LonTalk[®]) for Open device communications and, LONWORKS[®] Network Services (LNS[®]) network operating system in support of Open network management and the LonMark Interoperability Guidelines. These elements and requirements lead to the procurement of an Open system - one where there is no future dependence on the original installing Contractor. For the purposes of procurement, this means that there is no sole source dependence on any Contractor for future system additions, upgrades, or modifications.

The specifications include energy savings requirements in line with the requirements defined in ANSI/ASHRAE/IESNA Standard 90.1-2004.

The goal of a single BAS translates directly into the one-time procurement of a single UMCS from a single vendor. The specifications require the UMCS to be installed and licensed to the Government such that it remains Open, and in concept all future integration of DDC systems into the UMCS can be competitively procured. In practice, however, the UMCS manufacturer/installer will be best able to perform the integration of DDC systems so in many cases installations will seek to procure integration services through the installing contractor. Regardless of who is performing the integration the building-level DDC systems can and should be procured competitively. A method for procuring and then expanding the UMCS must be identified and is discussed in ERDC/CERL Technical Report TR-07-16.

Figure 1 shows a UMCS/DDC system where multiple building DDC systems have been integrated into a single UMCS that provides multiple operator workstations ("UMCS Client"). Figure 2 also shows the UMCS/DDC system and further distinguishes between the UMCS and DDC elements specified by the two guide specifications.

Some of the benefits and capabilities of an Open multi-vendor BAS include:

- Competitive procurement, most notably at the building and sub-system level.
- Management of base-wide system operations such as: remote alarm reporting, remote scheduling (on/off control), remote set point override, data logging and reports, energy management including load shedding, utilities monitoring/measurement for the purpose of monitoring energy performance contracts, and initial diagnosis of service calls. Section 109 of the Energy Policy Act of 2005 sets the absolute minimum building control requirements for commercial buildings at the level of ANSI/ASHRAE/IESNA Standard 90.1-2004. However, Federal agencies are also required to achieve 30% lower energy consumption, if cost-effective, so the levels in Standard 90.1-2004 really only provide the basis for this calculation.
- A graphical user interface that provides for the same look and feel for monitoring and control regardless of which vendor's DDC system or sub-system an operator is viewing. As a result, system operators and managers need only become proficient with one user interface to efficiently and effectively manage base-wide operations..
- A "whole-building" or "intelligent-building" approach to systems integration where multiple building systems are integrated into one, including the efficient inter-connection of HVAC control sub-systems. For example, terminal unit equipment such as VAV boxes can be readily interfaced to the servicing air handler to turn the air handler on when needed. In addition, the whole-building approach provides the capability for integrating HVAC and non-HVAC systems such as lighting. For example, the same occupancy sensor that tells a VAV box to cool a room can also turn on the lights in the room.

¹ The term LONWORKS[®] is used to loosely describe a collection of technologies (including hardware, and software), vendors and installers relating to or based on the ANSI/CEA-709.1 communications protocol

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BACnet® is an alternative communications protocol that may be used where implementation planning has been completed and an implementation strategy has been documented. There is no Army-approved UFGS for BACnet, so design of BACnet systems should use the requirements found in the MILCON Transformation Model RFP and ERDC/CER TR-07-03 as described in ECB 2007-8.

Related BAS implementation guidance and information is available in Engineering Construction Bulletin (ECB) 2004-11, ECB 2005-17, ECB 2007-8, and ERDC/CERL Technical Reports TR-05-14 and TR-07-03, and TR-07-16.

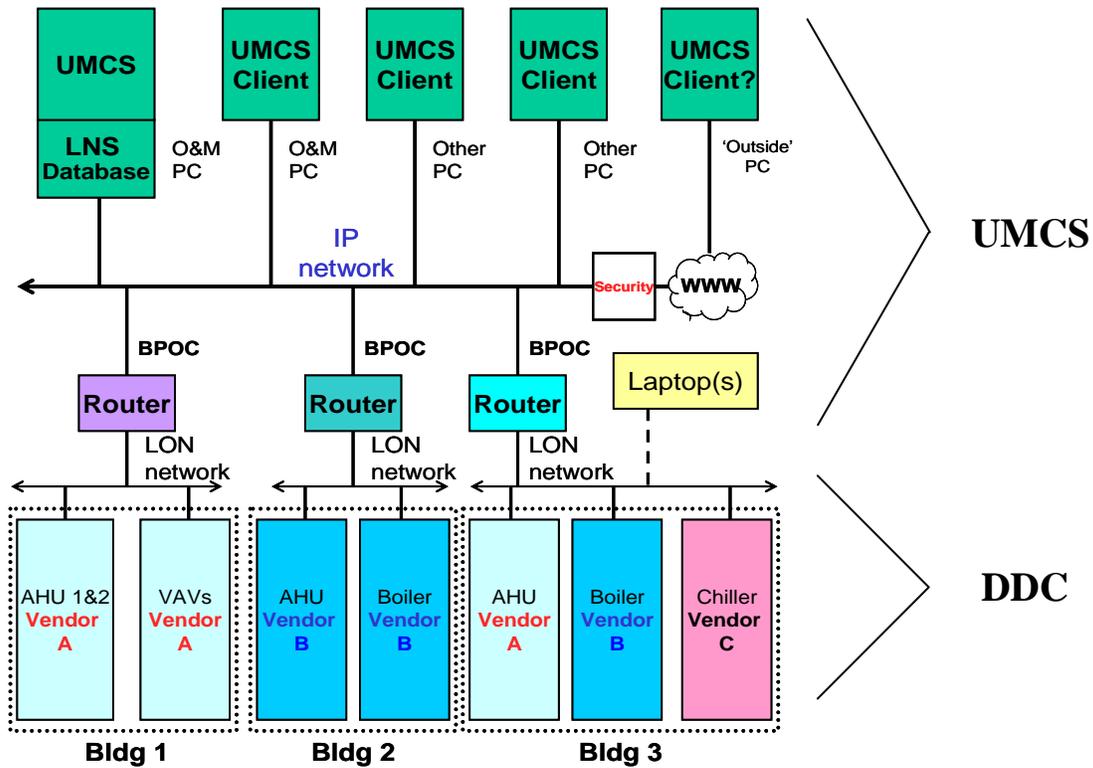


Figure 1. Basewide LONWORKS® BAS—including a UMCS and multiple-vendor DDC systems.

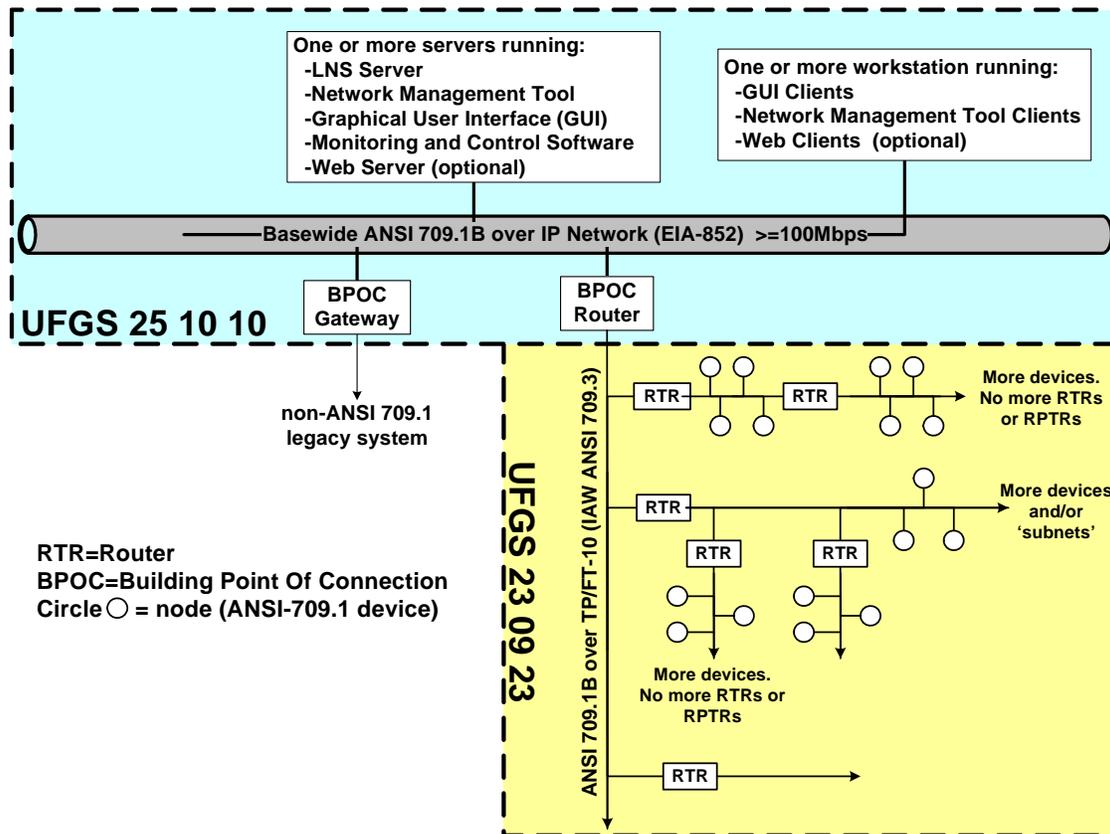


Figure 2. BAS comprised of UMCS and DDC systems.