Application Descriptions

7

Ventilation, Air Conditioning, and Cold Water

14

Introduction

Summary

This document is for information only and gives an introduction and overview to the HVAC Application Interworking Standard for Ventilation, Air Conditioning and Cold Water applications.

Version 01.01.01 is a KNX Approved Standard.

This document is part of the KNX Specifications v2.1.

Document updates

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1.1	2009.06.18	Update in view of publication in the KNX Specifications v2.0.
01.01.01	2013.10.29	Editorial updates for the publication of KNX Specifications 2.1.

References

[01] Part 7/10 "HVAC General Functional Blocks" [01]
[02] Chapter 7/11/1 "HWH Production" [02]
[03] Chapter 7/11/2 "HWH Distribution" [03]
[04] Chapter 7/11/3 "HWH Domestic Hot Water Control" [04]
[05] Chapter 7/11/4 "HWH Room Heating Control" [05]
[06] Chapter 7/11/5 "HWH Load Management" [06]
[07] Chapter 7/11/9 "HWH Property Identifiers" [07]
[08] Part 7/12 "Direct Electric Heating" [08]
[09] Part 7/13 "Terminal Unit Functional Blocks" [09]
[10] Chapter 7/14/1 "VAC Ventilation, Air Conditioning" [10]
[11] Chapter 7/14/2 "VAC Cold Water" [11]
[12] Chapter 7/14/9 "VAC Property Identifiers" [12]
[13] Part 10/1 "Logical Tag Extended" [13]

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Contents

1 Introduction

1.1 Scope

This document is an informative part of the KNX HVAC Application Interworking Standard. It illustrates the following:

- Overall function of the HVAC Ventilation, Air Conditioning and Cold Water (Vol 7-14, see [10] – [12])
- Links between VAC and Terminal Unit (TU) systems (Vol. 7-13, see [09])
- Links between VAC and Hot Water Heating (HWH) systems (Vol. 7-11, see [02] – [06]).

General purpose Functional Blocks used for HVAC applications such as sensors, actuators, HMI, and common HVAC Functional Blocks are described in Vol. 7-10 (HVAC Specification Functional Blocks, Sensors, HMI, Actuators, Common Controller Functions [01]).

The target market for the KNX HVAC system is mainly (European) residential and small commercial buildings.

1.2 Objectives

This document is for information only and gives a short introduction and overview to the HVAC Application Interworking Standard for Ventilation, Air Conditioning, and Cold Water applications. This document intends to clarify the overall concept of the KNX HVAC system and codependencies of the different parts of the VAC system.

The document also contains descriptions of typical application examples (scenarios).

The content of this document is not normative.

1.3 Abbreviations

Functional Blocks:

Hot Water Heating (HWH) [02] - [06]

Abbreviation	Description
BUC	Burner Controller
BOC	Boiler Controller
HPM	Heat Production Manager
BST	Buffer Storage Tank
HFDM	Heating Flow Demand Manager
FTC	Flow Temperature Controller
HPM	Heat Production Manager
HZC	Heating Zone Controller
HIRC	Heating Individual Room Controller
HRDM	Heating Room Demand Manager
HDAUX	Auxiliary Heating Demand
HDTACT	Heat Demand Transformer Actuator Position
HDTRT	Heat Demand Transformer Room Temperature
DHWC	Domestic Hot Water Controller
DHWS	Domestic Hot Water Scheduler
DHWCPS	Domestic Hot Water Circulation Pump Scheduler
SDHWC	Solar Domestic Hot Water Controller
DHWSM	Domestic Hot Water Setpoint Manager
DHWCPC	Domestic Hot Water Circulation Pump Controller
UDHWSET	DHW User Settings

Ventilation, Air Conditioning, and Cold Water (VAC) [11] - [12]

Abbreviation	Description
AHUC	Air Handling Unit Controller
CC	Chiller Control
CDAUX	Auxiliary Cooling Demand
CDAUXPER	Auxiliary Cooling Demand Percent
CDTAHU	Cooling Demand Transformer Air Handling Unit
CFDM	Cooling Flow Demand Manager
CPM	Cold Water Production Manager
CRC	Re-Cooling Controller
CZC	Cooling Zone Controller
HDAUXPER	Auxiliary Heating Demand Percent
HDTAHU	Heating Demand Transformer Air Handling Unit
SATC	Supply Air Temperature Controller

Terminal Units (TU) [09]

Abbreviation	Description
ACDTTU	Air Cooler Energy Demand Transformer Terminal Unit
AHDTTU	Air Heater Energy Demand Transformer Terminal Unit
CCDTTU	Chilled Ceiling Energy Demand Transformer Terminal Unit
FCC	Fan Coil Unit Controller
RCC	Radiator and Chilled Ceiling Control
RHDTTU	Radiator Heating Energy Demand Transformer Terminal Unit
SPUC	Split Unit Control
VAVC	Variable Air Volume Control
VDTTU	Ventilation Demand Transformer Terminal Unit
WHPC	Water Heat Pump Control

Sensor, HMI, Actuators - Common Controller Functions [01]

Abbreviation	Description
CFWTS	Condenser Flow Temperature Sensor
CRNWTS	Condenser Return Water Temperature Sensor
DPS	Dew Point Status Sensor
FWTS	Flow Water Temperature Sensor
HVA	HVAC Valve
HVACOPT	HVAC Optimiser
HVACEMS	HVAC Emergency Source
OAD	Outside Air Damper
ORHS	Outside Relative Humidity Sensor
OAQS	Outside Air Quality Sensor
OTS	Outside Air Temperature Sensor
PRD	Presence Detector
RRHS	Room Relative Humidity Sensor
RAQS	Room Air Quality Sensor
RNARHS	Return Air Relative Humidity Sensor
RNAQS	Return Air Quality Sensor
RNATS	Return Air Temperature Sensor
RNWTS	Return Water Temperature Sensor
RSMHD	Room Setpoint Manager HVAC-Mode Driven
RSMTD	Room Setpoint Manager Temperature Driven
RTS	Room Temperature Sensor
SARHS	Supply Air Relative Humidity Sensor
SAQS	Supply Air Quality Sensor
SATS	Supply Air Temperature Sensor
SIS	Sun Intensity Sensor
SMAQ	Setpoint Manager Air Quality
SMRH	Setpoint Manager relative Humidity
UAQSS	Air Quality Setpoint Setting
URHSS	Air Relative Humidity Setpoint Setting
UHRS	User HVAC Room Setting
UHD	User HVAC Display
WCOS	Water Change over Status Sensor
WOS	Window Switch
WSS	Wind Speed Sensor

General

Abbreviation	Description
cs	Company-Specific
DPT	Datapoint Type
FB	Functional Block
GO	Group Object
IO	Interface Object
IR	LTE-Service InfoReport
LTE	Logical Tag Extended Mode, see [13] Volume 10, LTE Specification
NA	Not Available
M	Mandatory
W	LTE-Service Write

2 Overview

2.1 KNX HVAC interworking vision

Interworking of HVAC devices

In today's European residential or small commercial buildings market, HVAC systems are either stand-alone, hard-wired, or fully integrated via a single manufacturer private network. They are installed by one or more installers, and add-ons require that the installer return to the site. Also, mixing products from multiple manufacturers as illustrated in Figure 2.1-1 is not possible for the most part.

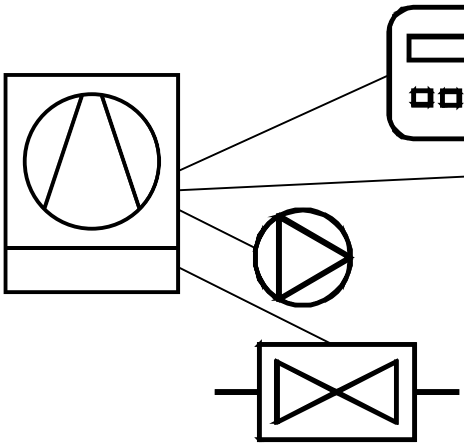


Figure 2.1-1 Tightly integrated single manufacturers HVAC system

The interworking concept of the KNX HVAC system allows for interoperability among products of different manufacturers (multi-vendor systems). The KNX HVAC system model also permits easy installation of entire HVAC systems or subsequent add-on of HVAC products. It also recognises the need for evolutionary solutions in the market until such time that costs for bus connection can compete with direct wiring (even for simple low-cost devices).
The long-term vision provides for most HVAC products to be connected to the KNX system as illustrated in Figure 2.1-2.

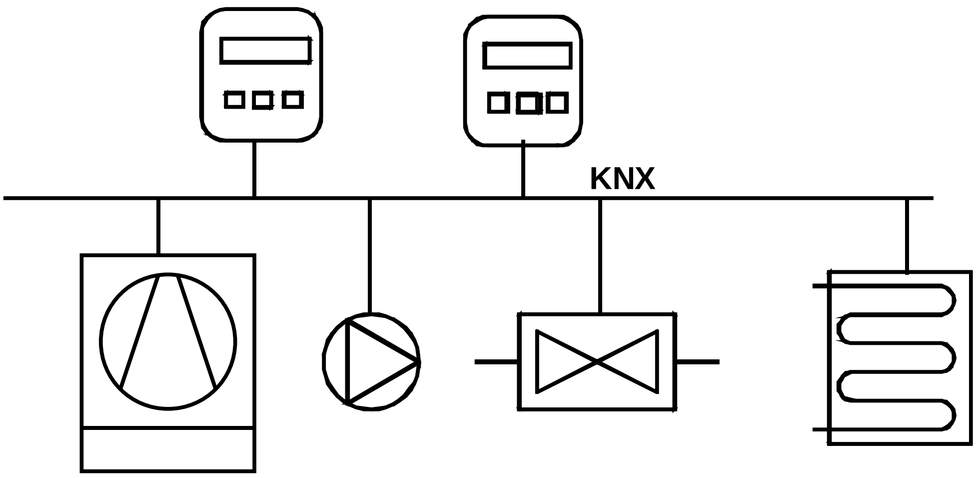


Figure 2.1-2 Long-term view of interoperable HVAC systems

Interworking with other application domains

HVAC systems in today's residential or small commercial market feature little or no provisions to interwork with other systems. Although conventional HVAC systems may maintain an operating mode for "occupied and unoccupied", and a lighting or shutter & blinds system may have the ability to provide for a "lived-in-look" when the home is unoccupied, conventional systems of different application domains do not communicate.

One of the visions of the KNX HVAC model is to deliver stand-alone KNX HVAC systems (HVAC only) as practised today as well as via HVAC distribution channels. In addition, these systems can easily be integrated into e.g. a single home control system customised to the occupants' activities and other systems present in the home. Standardised information shared among all systems makes this possible. The KNX model provides data interfaces to exchange information of common interest with other application domains.

This level of interworking among subsystems (functions of common interest) provides a basic level of integration. It offers benefits to the user in the form of convenience, peace of mind, and savings. Interworking between application domains can be expanded using a professional installation tool (ETS).

Manufacturer-specific features

Although in upscale market for many years, "intelligent" HVAC systems or home automation in the mass market is still an evolving market. New applications, features, and devices will be developed over the next few years. Therefore, any attempt to provide an industry standard in this market must allow for manufacturer-specific extensions and further development of the standard itself.

It is important for each manufacturer to be able to provide features that differentiate their products in the marketplace.

The KNX HVAC interworking model only defines today's state-of-the-art functions and enables manufacturers to add vendor-specific information for unique functions.

2.2 Application overview

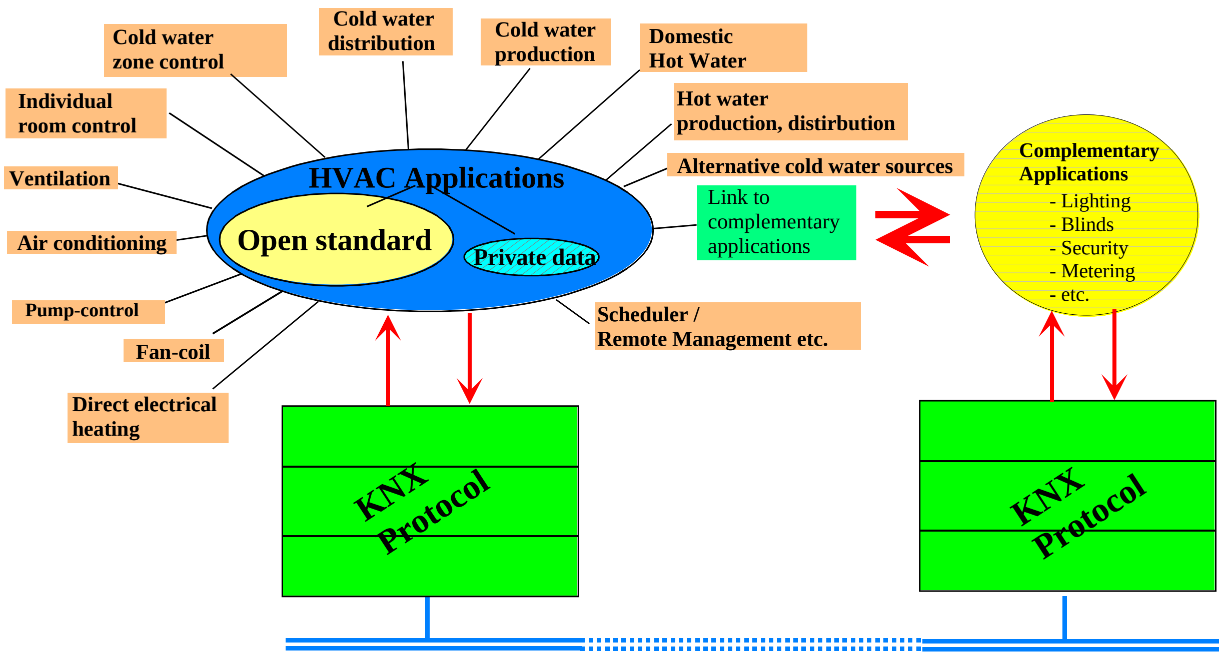


Figure 2.2-1 Field of applications

3 Ventilation and Air Conditioning

3.1 Ventilation and Air Conditioning system topology

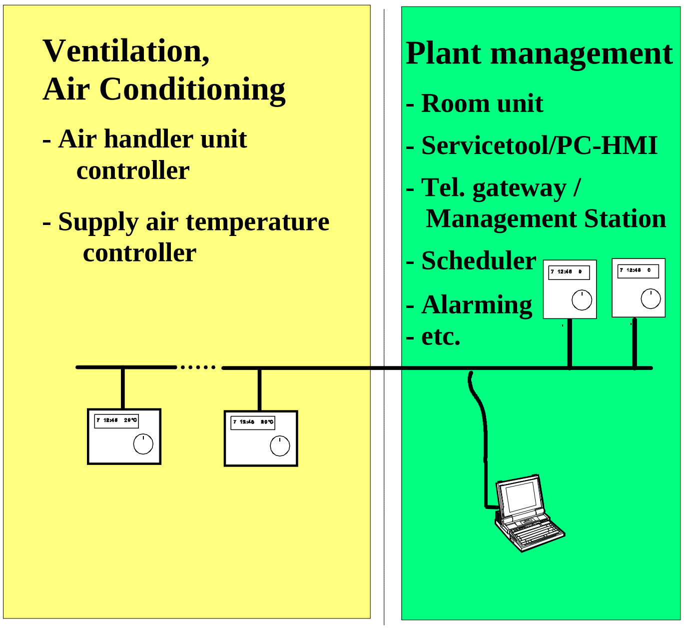


Figure 3-1 VAC system Ventilation, Air Conditioning

Figure 3-1 shows a distributed heating system that consists of:

- Ventilation and air conditioning
- and a part for plant management / remote control

HVAC devices connected to the KNX system will work as a distributed system. Runtime interworking data is exchanged between the devices for higher functionality and more comfort. Example:

- Energy demand-dependent cold / hot water signals => energy savings
- Load management functions, load shedding, forced load
- Optimisation of plant operation, automation of repetitive processes
- Sharing of common sensors
- Connection of intelligent actuators
- Visualisation of status information (e.g. on a Room Unit)
- Management and remote control functions of the HVAC system (Room Unit, Scheduler, PC-HMI, Servicetool, etc.)

Ventilation and Air Conditioning

Ventilation and air conditioning systems are:

- Stand-alone (independent) temperature and/or humidity and/or air quality controller applications (AHUC), which control a single room or a reference room.
- Demand controlled air handler (SATC), supply air temperature controller in connection with terminal units (variable air volume systems, etc).

3.2 Typical application examples and mapping in KNX-Function Blocks

3.2.1 Residential apartment ventilation

A single-family home with ventilation system (residential apartment ventilation) with air heat exchanger. This stand-alone system has an outside air intake system, a heat exchanger (energy recovery system), electrical heating, supply air fan, exhaust air fan and air relief. The temperature is controlled.

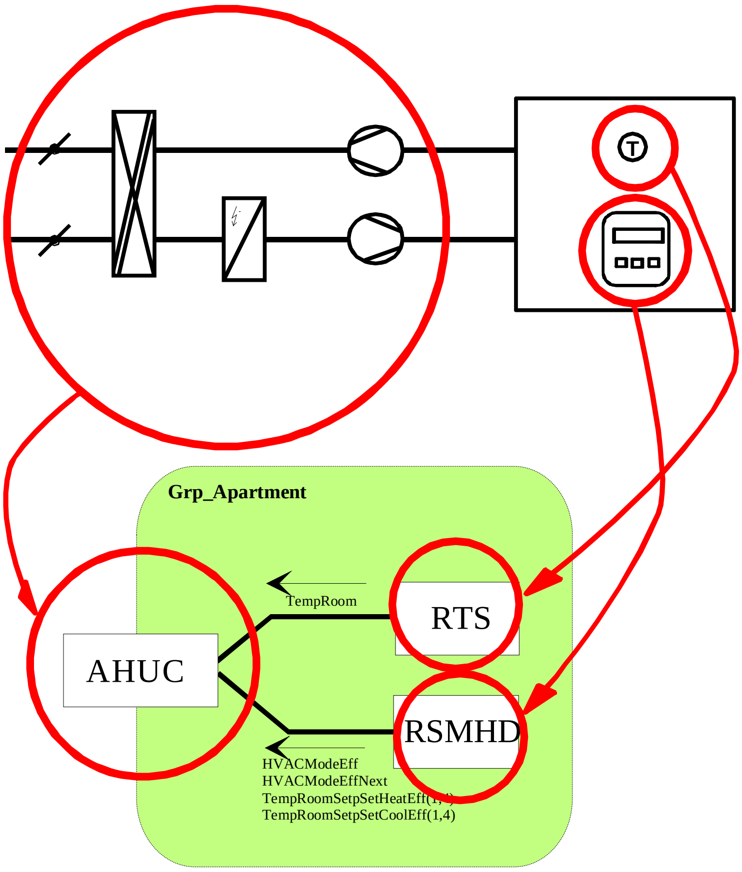


Figure 3.2-1 Residential apartment ventilation

The air handling unit is represented by the Functional Block Air Handling Unit Controller (AHUC), with temperature control algorithm. The value of the room temperature (RTS) is transmitted via KNX to the air handling unit temperature controller. The Room Setpoint Manager (RSMHD), which may be part of a room unit, sends its HVACMode and setpoints via KNX-signals to the AHUC.

3.2.2 Stand-alone air handling unit with hot water heating and cold water cooling

Stand-alone temperature and/or humidity control using heating and cooling coils for air treatment.

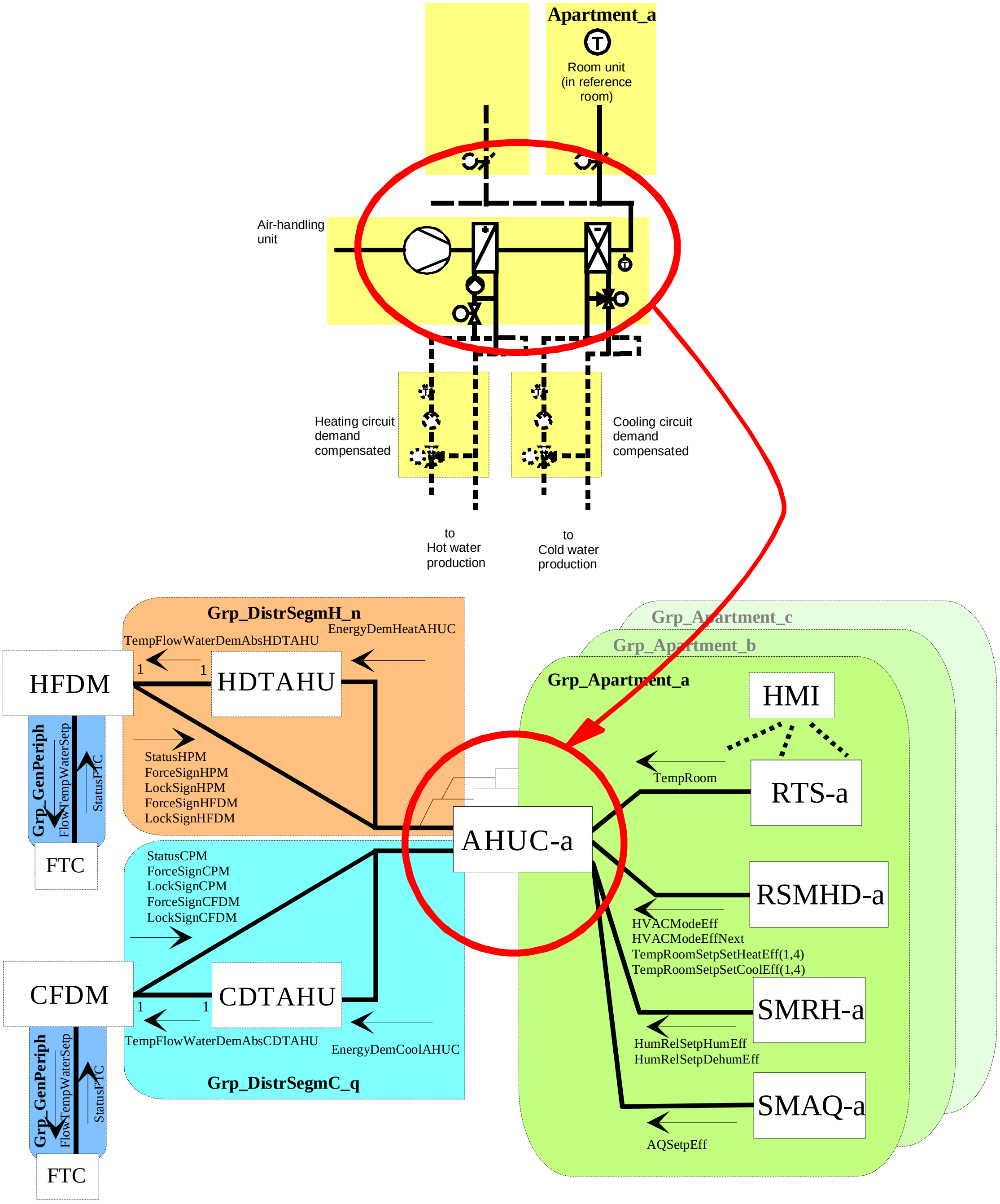


Figure 3.2-2 Stand-alone air handling unit

The air handling unit is represented by the Functional Block AHUC. Depending on the requirements, this air handling unit controls:

- temperature
- humidity
- air quality

Therefore are the different setpoint managers: RSMHD for temperature, SMRH for humidity, SMAQ for air quality requirements.
The room temperature (RTS) value may be transmitted via KNX to the air handling unit temperature controller and to the additional display (HMI) functions.

Hot water and cold water demands as a percentage value are transformed into temperature demand signals in the Heating Demand Transformer Air Handling Unit (HDTAHU) or in the Cooling Demand Transformer Air Handling Unit (CDTAHU) respectively. The demand from the different consumers (refer to chapter 5) are collected in the Heating Flow Demand Manager (HFDM) or Cooling Flow Demand Manager (CFDM) respectively, and control a pre-controller.

As shown in the example for the Functional Blocks (Figure 3.2-2), it is possible to connect 3 (or n) Air Handling Units Controllers (AHUC) to the transformer(s), whereby each transformer represents a hydraulic circuit of a pre-controller and therefore a 1 : 1 connection between HDTAHU and HFDM as well as between CDTAHU and CFDM.

Demand-controlled air handling units

Demand-controlled air handlers (SATC), supply air temperature controllers in connection with terminal units (variable air volume systems, etc).

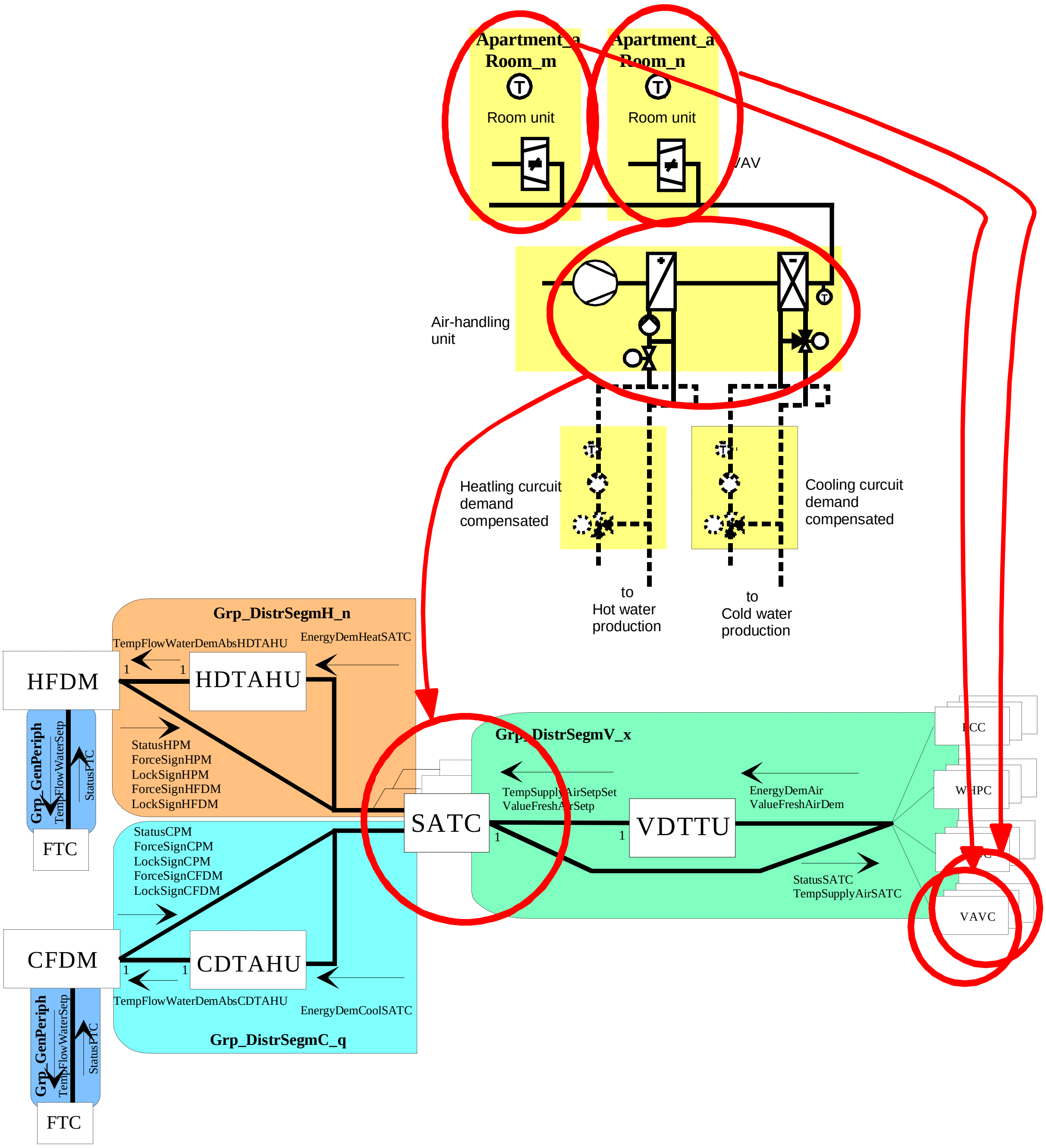


Figure 3.2-3 Air handling unit with terminal units

A number of Terminal Unit Controllers (e.g. variable air volume controllers (VAV), refer to [09]) are connected via Ventilation Demand Transformer (VDDTU) to the Supply Air Temperature Controller (SATC).

The supply air handling unit is represented by the Functional Block SATC. Depending on the requirements, this air handling unit controls:

- temperature
- humidity
- air quality

The supply air temperature setpoint is calculated by the Ventilation Demand Transformer (VDTTU). Air quality setpoints are determined via ValueFreshAirDem by the VDTTU. SMRH for humidity.

Hot water and cold water demands as a percentage value are transformed into temperature demand signals in the Heating Demand Transformer Air Handling Unit (HDTAHU) or in the Cooling Demand Transformer Air Handling Unit (CDTAHU) respectively. The demand from the different consumers (refer to chapter 5) are collected in the Heating Flow Demand Manager (HFDM) or Cooling Flow Demand Manager (CFDM) respectively, and control a pre-controller.

As shown in the example of the Functional Blocks (Figure 3.2-3), it is possible to connect 3 (or n) Supply Air Temperature Controllers (SATC) to the transformer(s), whereby each transformer represents a hydraulic circuit of a pre-controller and therefore a 1 : 1 connection between HDTAHU and HFDM as well as between CDTAHU and CFDM.

4 Cold Water

4.1 Cold Water system topology

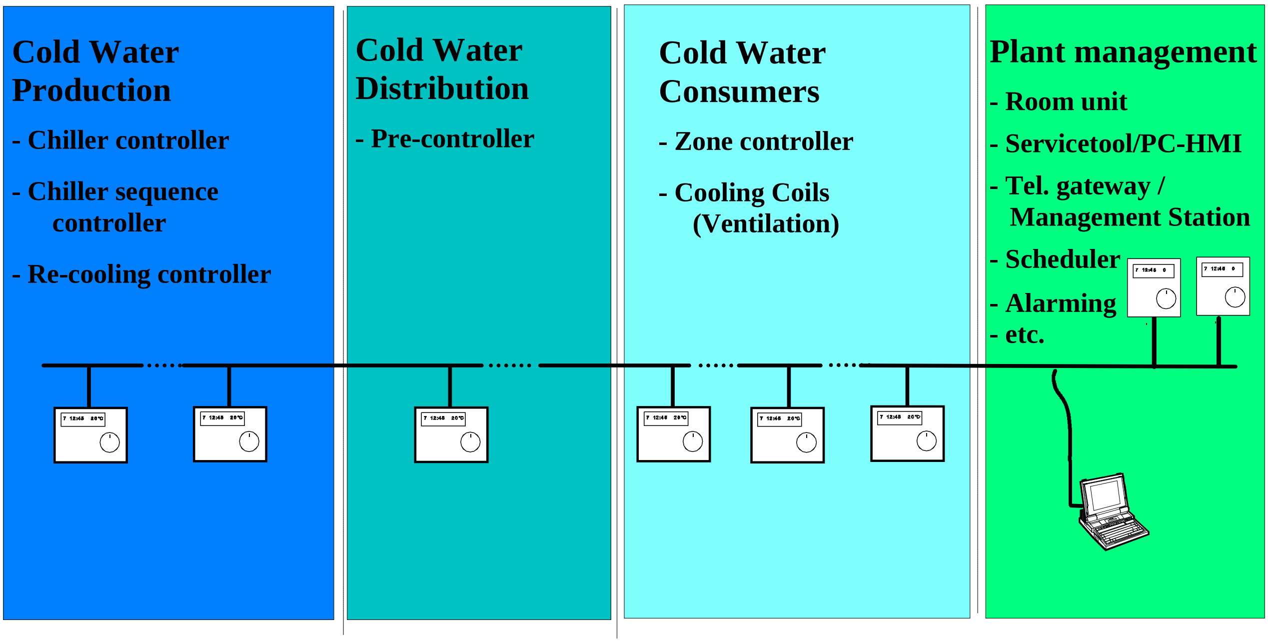


Figure 4-1 VAC system Cold Water

Figure 4-1 shows a distributed cold water system that consists of:

- cold water production
- cold water distribution
- cold water consumption
- and a part for plant management / remote control

HVAC devices connected to the KNX system will work as a distributed system. Runtime-interworking data is exchanged between the devices for higher functionality and more comfort. Example:

- Demand-dependent cold water production and cold water distribution => energy savings
- Load management functions, load shedding, forced load
- Optimisation of plant operation, automation of repetitive processes
- Sharing of common sensors
- Connection of intelligent actuators
- Visualisation of status information (e.g. on a Room Unit)
- Management and remote control functions of the HVAC system (Room Unit, Scheduler, PC-HMI, Servicetool etc.)

Cold Water Production

A cold water producer usually is a chiller, consisting of a chiller controller (CC) and a re-cooling controller (CRC). There are different types of chillers with e.g. 1-stage or n-stages, or modulating. For higher power requirements, chillers can be sequenced which gives special requirements (chiller sequence strategies) to the Cold Water Producer Manager (CPM), which controls the chillers according to the current cold water demand.

Cold Water Distribution

In more complex systems, the cold water consumers are not directly connected to the chiller. Different levels of cold water distribution are possible (e.g. like high voltage - low voltage electrical distribution network). Each distribution level has its own cold water pipe and is managed by a Cold Water Flow Demand Manager (CFDM).

Cold water distribution is implemented by using cold water pipes and pumps with or without pre-control of the flow temperature for several cooling zones or groups of zones.

Cold Water Consumers

Different types of cold water consumers:

- Cold water coils of ventilation and air conditioning systems
- Chilled ceiling cold water consumers, fixed setpoint, dew point or weather-compensated systems

All the consumers are connected via hydraulic cold water pipes to a pre-controller (cold water distribution) or directly to a chiller unit.

The water flow through these consumers can be controlled by valves or variable speed pumps.

4.2 Typical application examples and mapping in KNX-Function Blocks

4.2.1 Chilled ceiling zone controller

A chilled ceiling controller calculates the cold water flow temperature according to the room conditions.

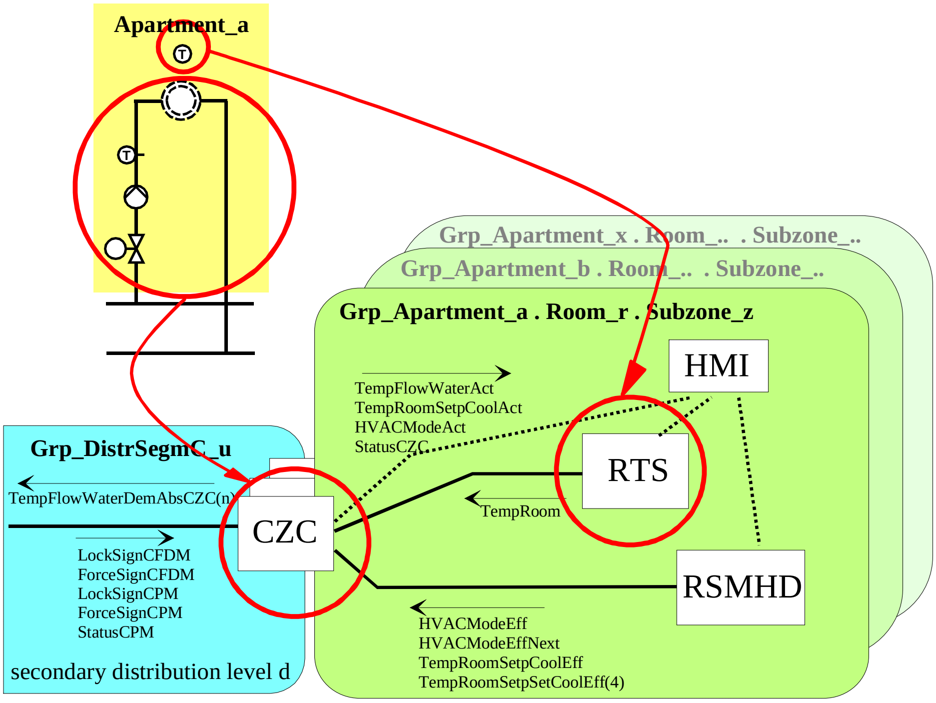


Figure 4.2-1 Chilled ceiling zone controller

The Functional Block Cooling Zone Controller (CZC) represents the chilled ceiling with temperature control algorithm. The room temperature (RTS) value is transmitted via KNX to the Cooling Zone Controller (CZC). The Room Setpoint Manager (RSMHD), which may be part of a room unit, sends its HVACMode and setpoints via KNX-signals to the CZC.

4.2.2 Cold water pre-controller

A pre-controller calculates the required cold water flow temperature according to the consumers. These may be chilled ceiling controllers, air handling units (AHUC, SATC), or terminal unit controllers (VAV, etc).

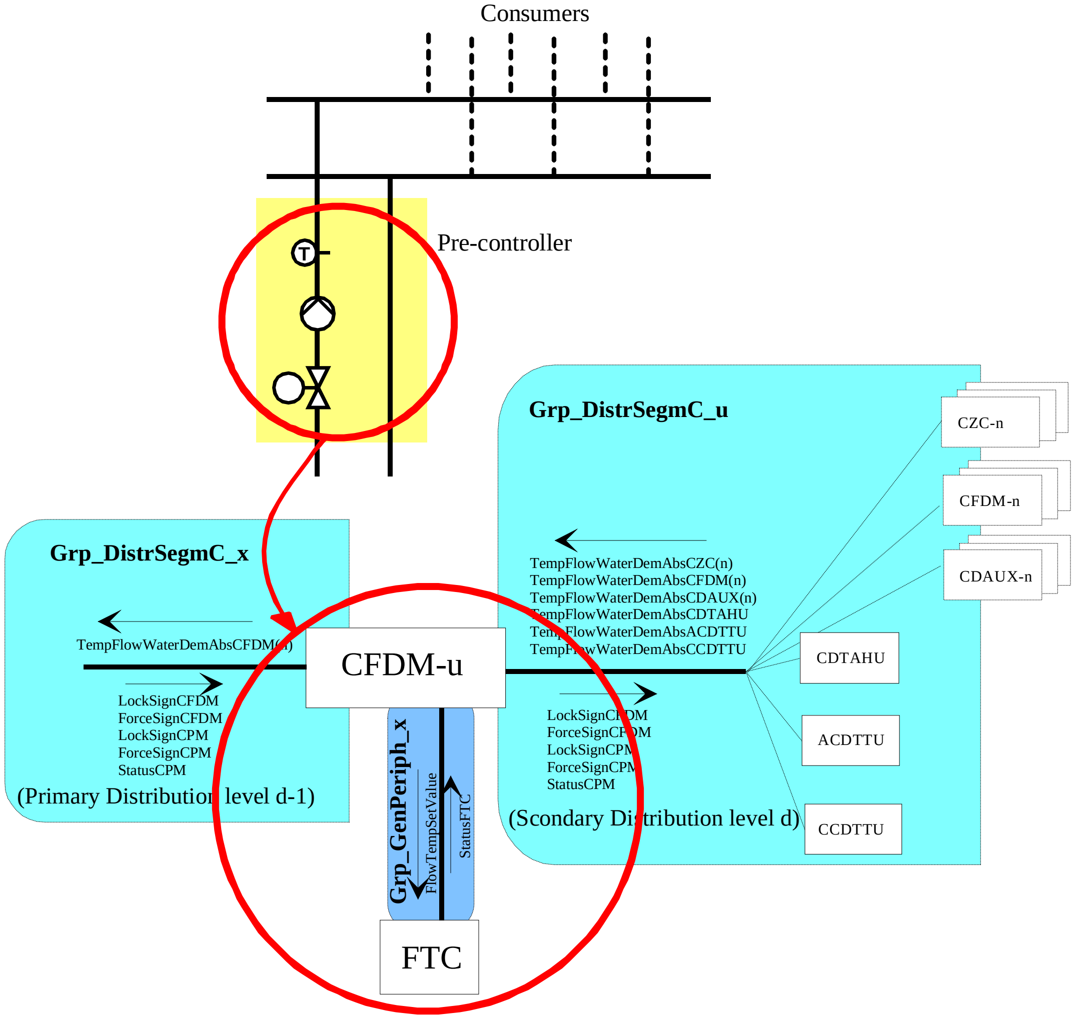


Figure 4.2-2 Cold water pre-controller

The Cooling Flow Demand Manager (CFDM) collects the cooling demand in the Secondary Cold Water Distribution Segment. This may be:

- Chilled ceiling zone controllers (CZC)
- Other pre-controllers (CFDM)
- Auxiliary cooling demands, like process cooling devices (CDAUX)
- Ventilation cooling demand from air handling units (CDTAHU)
- Air cooling demand from terminal units (ACDTTU)
- Chilled ceiling cooling demand from terminal units (CCDTTU)

And controls to the calculated flow temperature setpoint by Functional Block Flow Temperature Controller (FTC).

Additionally, cooling demand of the Primary Cold Water Distribution Segment is sent to the Cold Water Production Manager (CPM).

4.2.3 Chiller controller

Chilled sequence control system with two chillers and a common cooling tower system with two wet cooling towers.

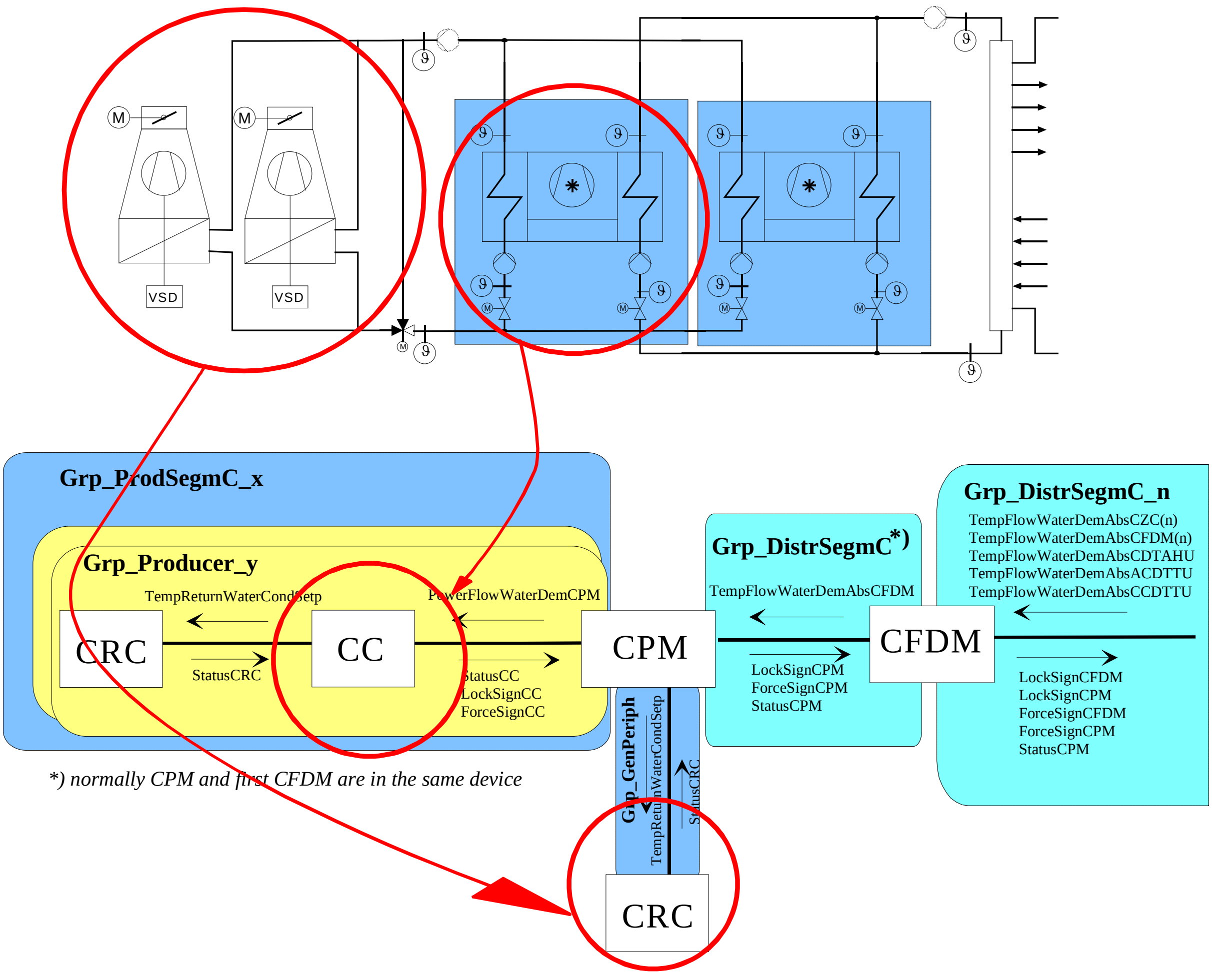


Figure 4.2-3 Chiller controller

The Functional Block Cold Water Flow Demand Manager CFDM collects all cold water requirements and sends the calculated demand to the Cold Water Production Manager CPM. The CPM is controlling/scheduling one or more Chiller Controllers CC. A Chiller Controller CC is a stand-alone chilled water production unit. Control of the condensed water circuit may be implemented via:

- Package unit (within the Chiller Controller CC)
- Split unit, remote location from the Chiller Controller CC (on the roof). For this scenario, a Re-Cooling Controller CRC is connected to the Chiller Controller CC.
- With a common Re-Cooling Controller, e.g. cooling tower (wet, dry) or seawater re-cooling. For this scenario a Re-Cooling Controller CRC is connected directly to the Cold Water Production Manager CPM. (refer to Figure 4.2-3)

The functions of a cold water system with buffer storage tanks are incorporated in the Cold Water Production Manager CPM.

5 HVAC System Model

The **figures on the following pages** represent HVAC applications and the corresponding KNX application model

They show interworking between different HVAC application areas such as Hot Water Heating [02] – [06], Ventilation, Air Conditioning, and Cold Water [10] – [11] and Terminal Units [09].

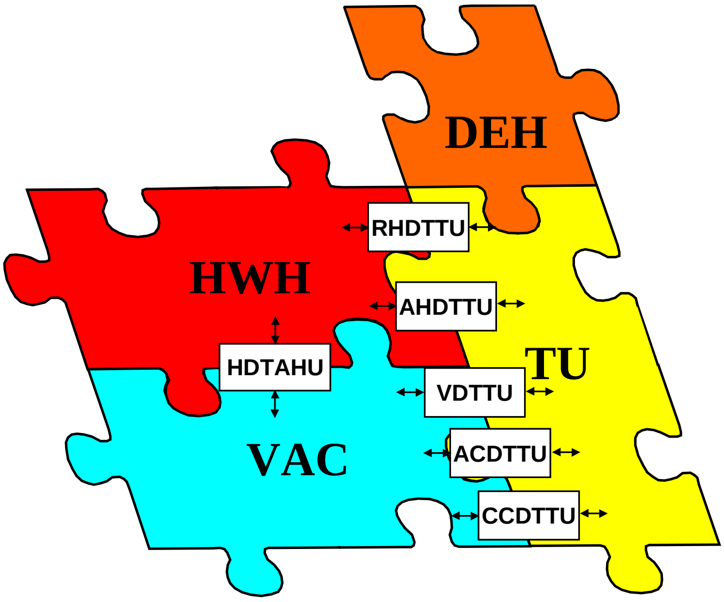
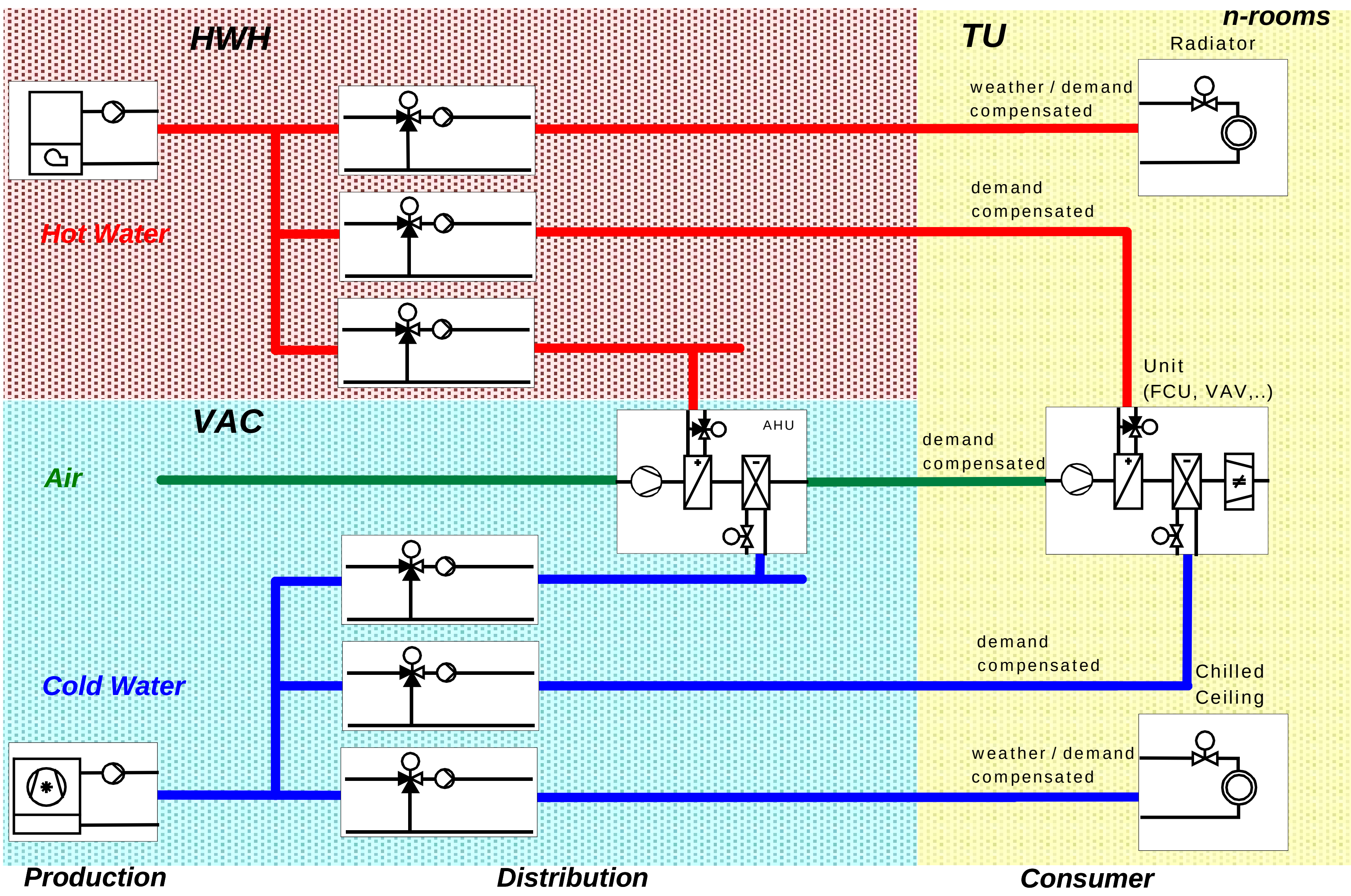


Figure 5-1 Interworking

The figures on the next pages show hot water and cold water consumers, distribution and production level.

Not on the figures are the stand alone heating zone controllers (HZC), chilled ceiling controllers (CZC), and stand alone air handling units (AHUC) as well as domestic hot water Functional Blocks.

HVAC Architecture



HVAC Functional Blocks