Application Descriptions

7

Hot Water Heating

11

Introduction

Summary

This document is for information only and gives an introduction and overview to the HVAC Application Interworking Standard for Hot Water Heating applications.

Version 01.00.01 is a KNX Approved Standard.

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

Document updates

Version	Date	Modifications
0.1	2001.12.15	BKY, document created
0.2	2002.02.22	BKY, editorial modifications, link to VAC and TU added, TFI approved, KNX Handbook 1.0
1.0	2002.09.12	BKY, editorial corrections, TFI approved, updated for KNX Handbook 1.1
1.0	2009.06.17	Update in view of publication in the KNX Specifications v2.0.
01.00.01	2013.10.29	Editorial updates for the publication of KNX Specifications 2.1.

References

[01] Chapter 7/10/1 “HVAC Sensor Functional Blocks”
[02] Chapter 7/10/2 “HVAC HMI Functional Blocks”
[03] Chapter 7/10/3 “HVAC Actuator Functional Blocks”
[04] Chapter 7/10/4 “HVAC Common Functional Blocks”
[05] Chapter 7/10/5 “HVAC Scheduler Functional Blocks”
[06] Chapter 7/11/1 “Heat Production”
[07] Chapter 7/11/9 “Property Identifiers”
[08] Part 7/12 “Direct Electric Heating”
[09] Part 7/13 “Terminal Unit Functional Blocks”
[10] Part 7/14 “Ventilation & Air Conditioning and Cold Water”
[11] Part 10/1 “Logical Tag Extended”

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1 Introduction

1.1 Scope

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

- Overall functionality of the HVAC Hot Water Heating System (Vol 7-11, see [06] – [07])
- Links between HWH and Terminal Unit (TU) systems (Vol 7-13, see [09])
- Links between HWH and Ventilation/Air-Conditioning and Cold Water (VAC) systems (Vol 7-12, see [10]).

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, MMI, Actuators, Common Controller Functions [01], [02], [03], [04] and [05]).

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 Hot Water Heating applications. This document intends to clarify the overall concept of the KNX HVAC system and dependencies of the different parts of the HWH 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)

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
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) [10]

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

Terminal Units (TU) [08]

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, MMI, Actuators - Common Controller Functions [01], [02], [03], [04] and [05]

Abbreviation	Description
AHSS	Air Humidity Setpoint Setting
AQSS	Air Quality Setpoint Setting
COS	Change over Status Sensor
DPS	Dew Point Status Sensor
FWTS	Flow Water Temperature Sensor
HVA	Heating Valve
OAD	Outside Air Damper
OAHS	Outside Air Humidity Sensor
OAQS	Outside Air Quality Sensor
OTS	Outside Air Temperature Sensor
PRD	Presence Detector
RAHS	Room Air Humidity Sensor
RAQS	Room Air Quality Sensor
RNAHS	Return Air Humidity Sensor
RNAQS	Return Air Quality Sensor
RNATS	Return Air Temperature Sensor
RNWTS	Return Water Temperature Sensor
RSMHD	Room Setpoint Manager HVAC Mode Driven
RSMT	Room Setpoint Manager Temperature Driven
RTS	Room Temperature Sensor
RTSA	Room Temperature Setpoint Absolute Setting
RTSR	Room Temperature Setpoint Relative Setting
SAHS	Supply Air 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 Humitdity
WOS	Window Switch
WSS	Wind Speed Sensor

General

Abbreviation	Description
cs	Company specific
NA	not allowed / not available
LTE	Logical Tag Extended Mode, see [11]
FB	Functional Block
DPT	Datapoint Type
IO	Interface Object

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 tightly integrated via a single manufacturers private network. They are installed by one or more installer and incremental add-on's require that the installer returns to the site. Also, there is little ability to intermix products from multiple manufacturers. This is illustrated in Figure 2-1.

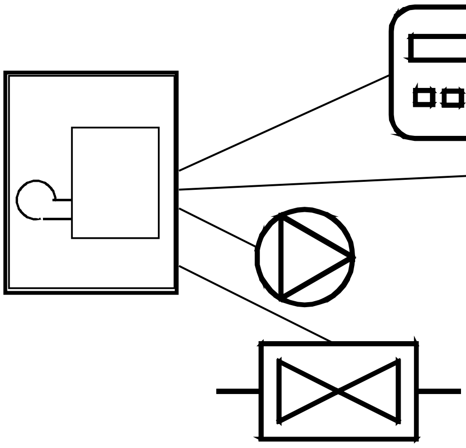


Figure 2-1 Tightly integrated single manufacturers HVAC system

The interworking concept of the KNX HVAC system allows interoperability among manufacturers products (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 a time that costs for bus connection can compete with direct wiring (even for simple low cost devices).

The long term vision provides most HVAC product to be connected to the KNX system. This is illustrated in Figure 2-2

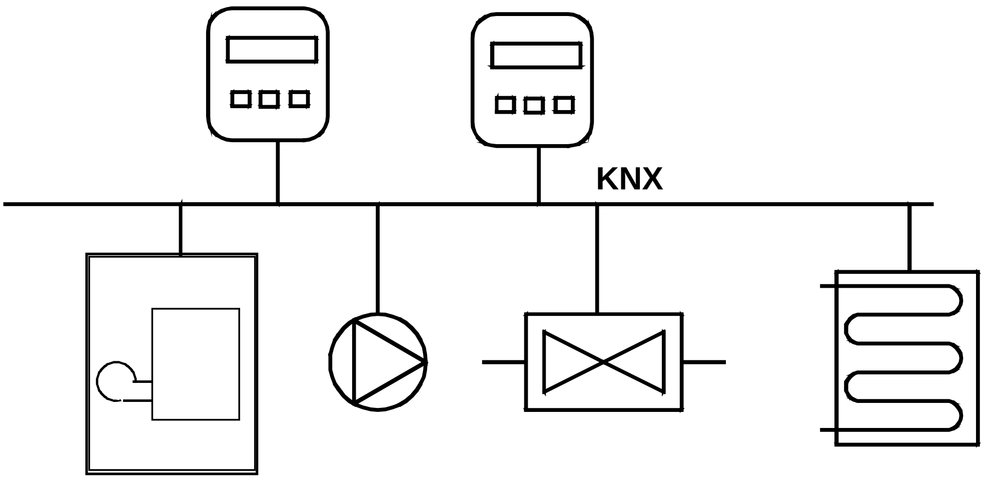


Figure 2-2 Long term view of Interoperable HVAC systems

Interworking with other application domains

HVAC systems in today’s residential or small commercial market have little or no provisions to interwork with other systems. Although conventional HVAC systems may maintain a 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 that “stand-alone” KNX HVAC systems (HVAC only) may be delivered as today and via HVAC distribution channels. However, these systems have the additional feature that they may be easily integrated into e.g. a single home control system that is harmonised with the activities of the occupants and other systems present in the home. This is made possible by standardised information that is shared among all systems. 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 available for the upscale market for many years, “intelligent” HVAC systems or home automation in the mass market is still evolving. New applications, features, and devices will evolve over the next years. Therefore, any attempt to provide an industry specification in this market must allow for manufacturer-specific extensions and evolution of the standard itself.

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

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

2.2 Application overview

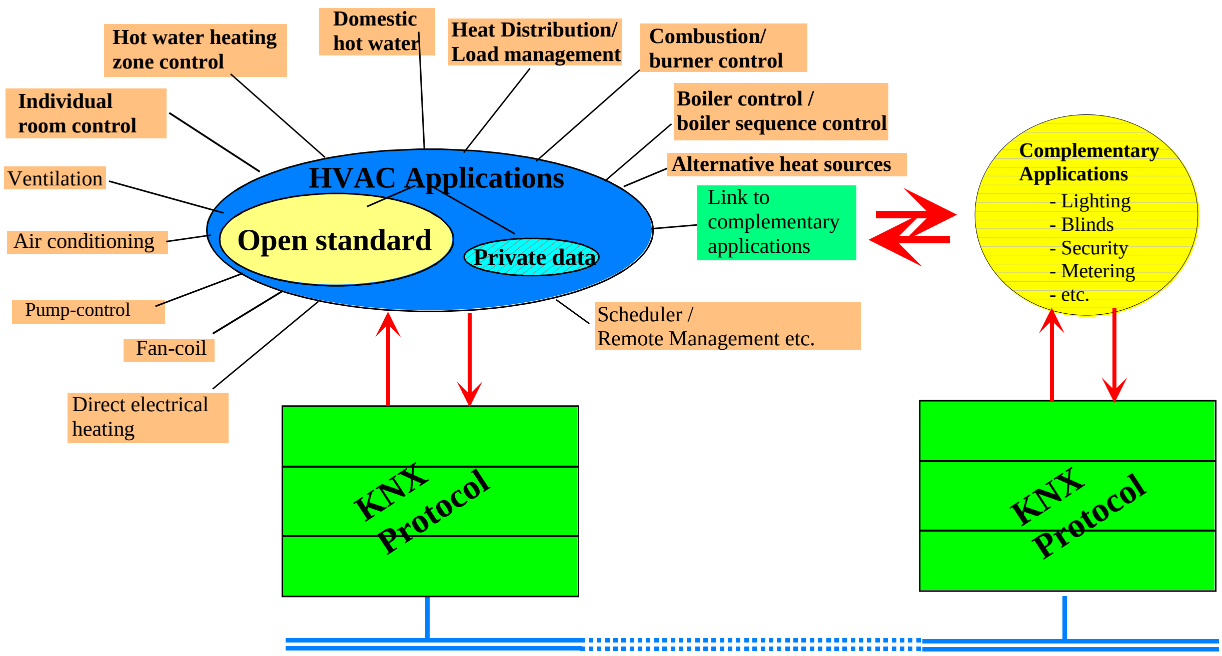


Figure 2-3 Field of Applications

2.3 Hot Water Heating system topology

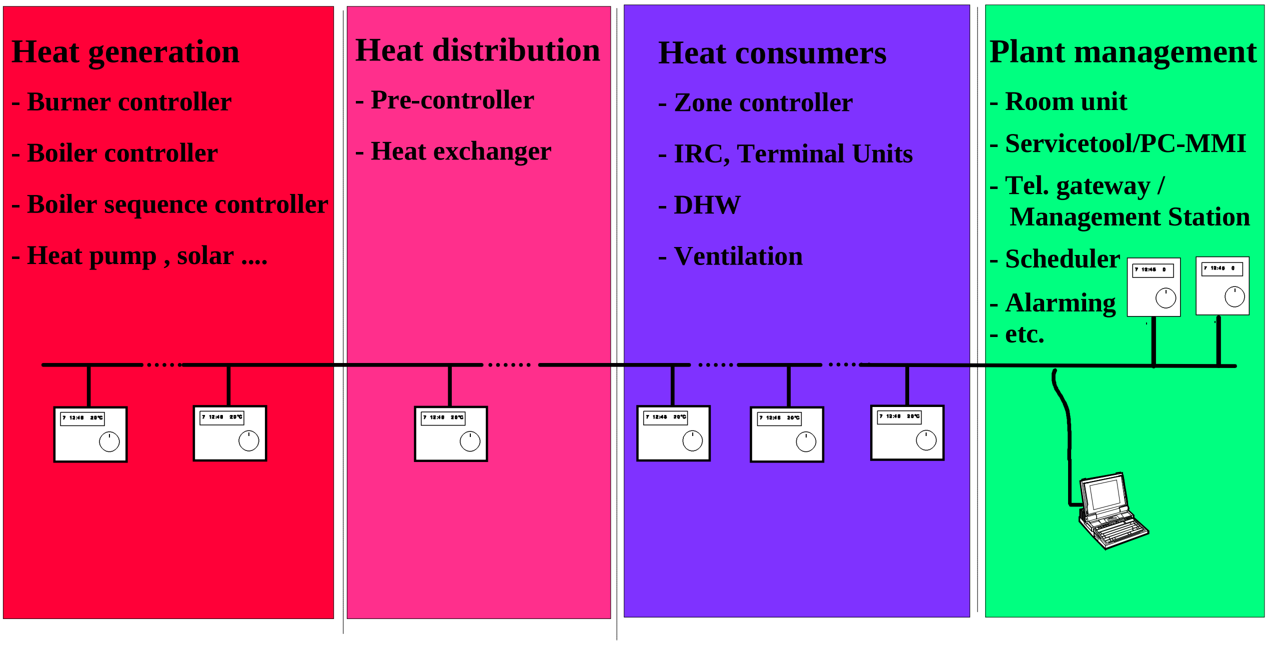


Figure 2-4 HWH system

The Figure 2-4 shows a distributed heating system that consists of :

- heat generation
- heat distribution
- heat 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 heat production and heat distribution => energy savings
- load management functions, load shedding, forced load
- optimisation of the operation of the plant, 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-MMI, Servicetool etc.)

Heat generation

Runtime interworking with the Heat Production part in a distributed heating system has mainly 2 targets:
– energy savings due to demand-dependent heat production
– load management / load shedding in case of boiler overload or boiler overheat conditions

A heat producer is usually a boiler which consists of a burner controller (BUC) and a boiler controller (BOC). There are different types of boilers with e.g. 1- or 2-stage or modulating oil or gas burners including burner control. Also e.g. wood fired boilers are used for heat production.

For higher power requirements boilers can be sequenced which gives special requirements (boiler sequence strategies) to the Heat Producer Manager (HPM) which controls the boilers according to the current heat demand.

Other heat generation types like solar energy or heat pumps or heat supply by district heating systems are taken into consideration too.

Heat distribution

In more complex systems the heat consumers are not directly connected to the boiler. Different levels of hot water distribution are possible (e.g. like high voltage - low voltage electrical distribution network). Each distribution level has its own hot water pipe and is managed by a Heat Flow Demand Manager (HFDM).

Heat distribution is done by hot water pipes and pumps with or without pre-control of the flow temperature for several heating zones or groups of them.

Heat consumers: room heating

In the today’s typical hot water heating systems room heating is done by radiators, under floor heating or a combination of both.

The water flow through these radiators or under floor heating pipes can be controlled by valves or variable speed pumps.

The flow temperature is controlled either directly by the boiler temperature or by mixing valves. For different groups of consumers there also can be a pre-control of the flow temperature per group and a final control for each consumer.

Two types of room heating principles are differentiated:

- each room is controlled individually by an Individual Room Controller (HIRC)
- multiple rooms or a part of a building are controlled together by a Heating Zone Controller (HZC)

Heat consumers: domestic hot water control

In the HWH application model those systems are considered, where the domestic hot water (DHW) preparation is done with the same heat production system used for the hot water room heating.

So the DHW and the hot water heating is interconnected and has to be handled in an proper way (e.g. time schedules; load management due to max. available power of the boilers etc.).

There are many types of DHW-plant schemes and it is not the scope of the HWH specification to describe all of these.

2.4 Typical application examples

2.4.1 Single family home, 1 zone heating

A typical single family home with several rooms has a boiler (oil or gas) for heat generation, a domestic hot water preparation and a hydronic heating system with radiators or/and under floor heating. There can also be valves for each radiator or room.

The heat demand for the hydronic heating is calculated by outside temperature compensation (OTC) with or without room temperature influence.

The boiler produces the requested hot water temperature by means of a 1- or 2-stage or modulating burner.

The example in Figure 2-5 shows a single family home with 1 zone heating, DHW-preparation and direct pump heating circuit

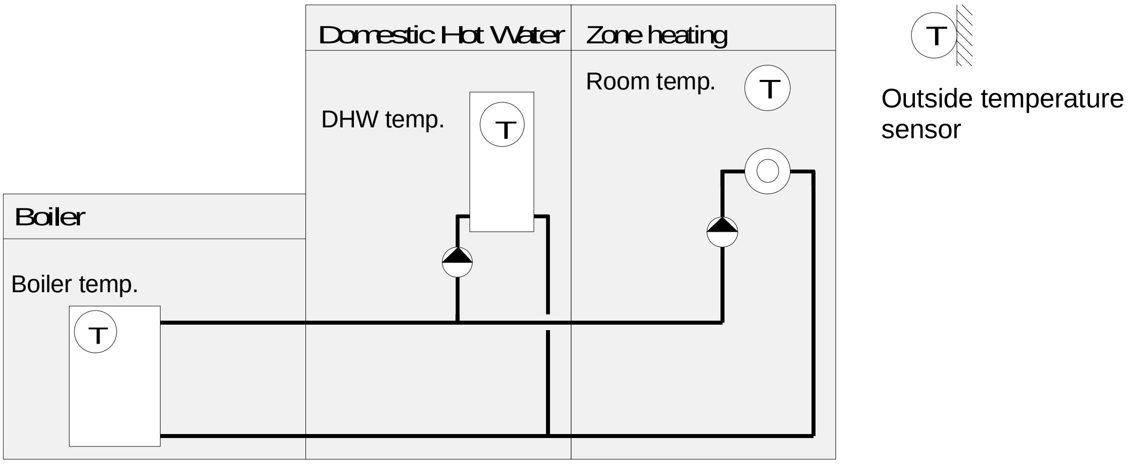


Figure 2-5 Single family home with 1 zone heating without mixing valve

The example in Figure 2-6 shows a single family home with 1 zone heating, DHW-preparation and a heating circuit with mixing valve

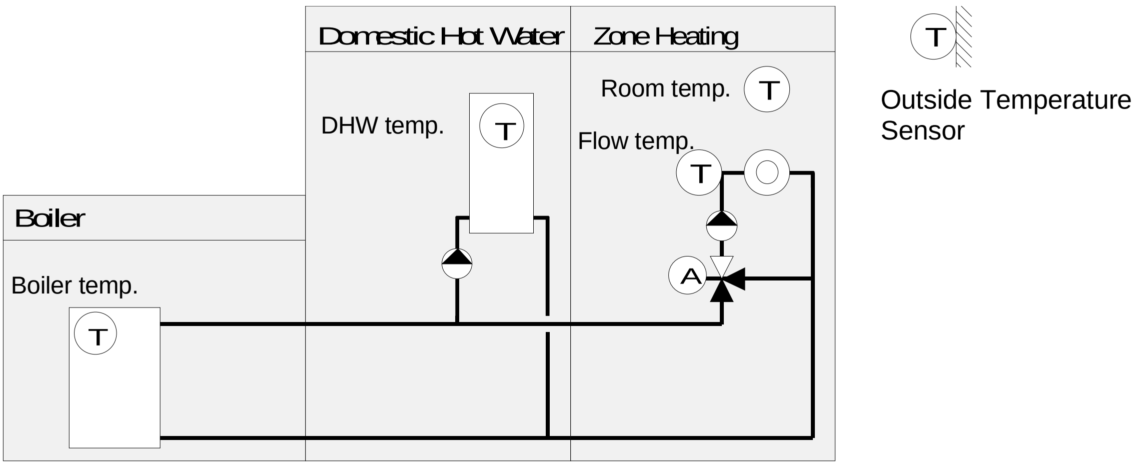


Figure 2-6 Single family home with 1 zone heating with mixing valve

The example in Figure 2-7 shows a single family home, with DHW-preparation and IRC (see also next chapter)

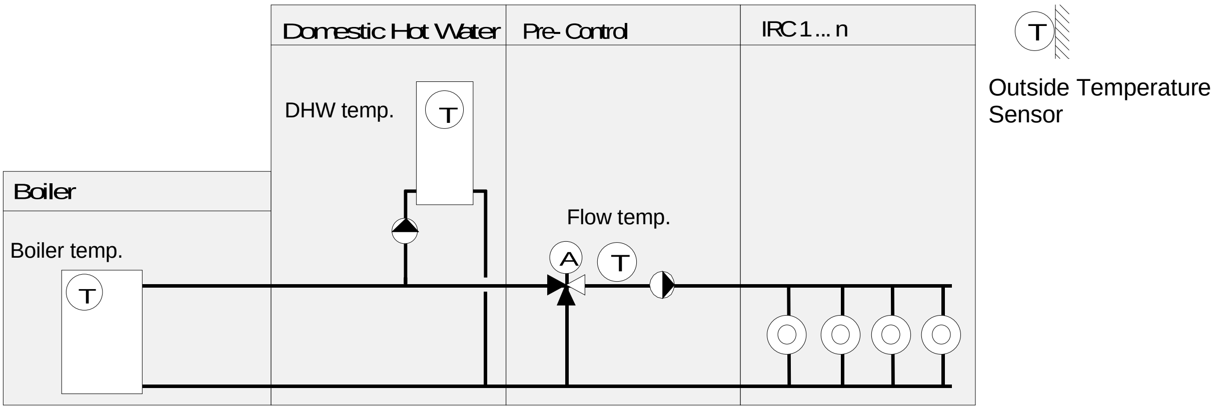


Figure 2-7 Single family home, with DHW-preparation and IRC

2.4.2 Single family home, IRC

A typical single-family home has 5 - 10 rooms with heating. Room heating is done with radiators or/and under floor heating. Each individual room has at least one radiator (or under floor heating pipe loop). Some larger rooms (e.g. dining room, living room) have 2 - 4 radiators. To control the hot water flow through the radiator a valve close to the radiator or in a central distribution box is used. For under floor heating control the valves are always in a distribution box. To drive the valves thermostatic actuators or motor actuators are used. In each room there is a room temperature sensor. To control the room temperature of an individual room there is typically a room unit with setpoint adjustment provided in each room and an individual setpoint time program in a central device. More comfortable systems do also have a presence sensor and a window open sensor in one or more rooms to save energy. Heat for the rooms is directly provided by the boiler or pre controlled via a three or four way mixing valve. For optimized on/off control the room temperature controller may need an outdoor temperature sensor.
Small systems have 1 - 2 devices including all functionality to control the room heating. The sensors , actuators and room units are directly wired or connected via bus. The room control devices and the heat-generation devices are communicating via bus.
Large systems have a control device for each room. There may also be separate devices for actuators, room units and sensors or combination of these functions in one device.

The example in Figure 2-9 shows a Single Family Home with 5 rooms, 2 rooms with Presence and Window Sensors and 1 room with 3 radiators.

The example in Figure 2-10 shows a Single Family Home with 6 rooms and 1 room with Presence and Window Sensors.

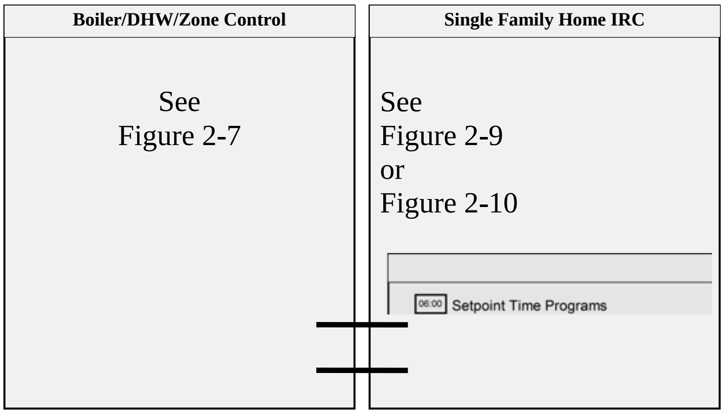


Figure 2-8 Single Family Home Heating with IRC

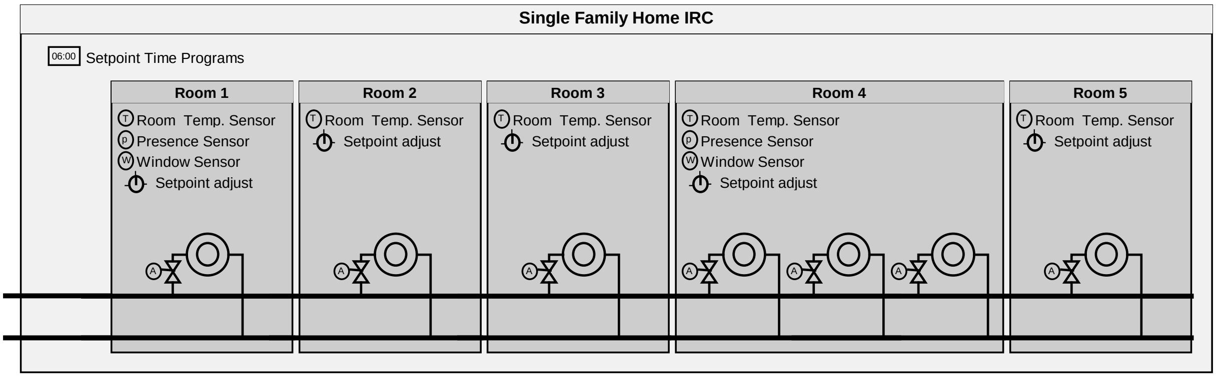


Figure 2-9 Single Family Home Heating with IRC

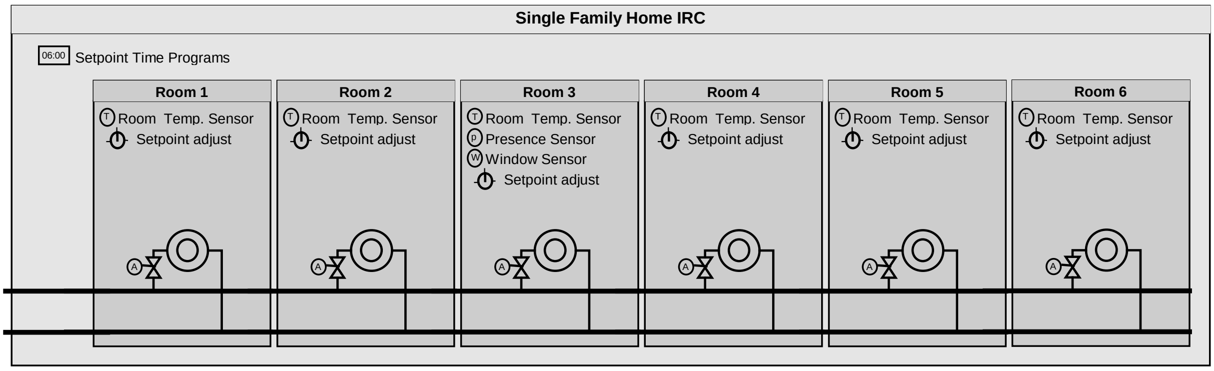


Figure 2-10 Single Family Home Heating with IRC

2.4.3 Multifamily home, apartment control

Most of the multifamily homes (multifamily means 2 to about 60 apartments) have a heating system which is very similar to the concepts of the single family home.

Typically there is a hot water heating system with radiators and/or under floor heating, DHW preparation and boilers with oil or gas burners for heat generation.

Room Heating Control:
In case of a Heating Zone Control System (HZC) the heat demand for each apartment is calculated by outside temperature compensation (OTC) with or without room temperature influence.

In case of Individual Room Control (HIRC) the heat demand for each apartment is calculated according to the current room temperature setpoint or valve position of each room temperature controller.

DHW Control
The domestic hot water is either prepared for all apartments together in one DHW zone with one big DHW storage tank or each apartment can have a separate DHW zone with and individual DHW storage tank and DHW controller.

Demand dependent Heat Production/Distribution
Out of all room heating demands of the apartments and the heat demands from all DHW zones the resulting heat demand for the boiler is calculated.

The heat generation is either done by one big boiler or by a sequence of smaller boilers.

The example in Figure 2-11 shows a multifamily home with apartments controlled by mixing valves, 1 DHW storage tank and 1 boiler

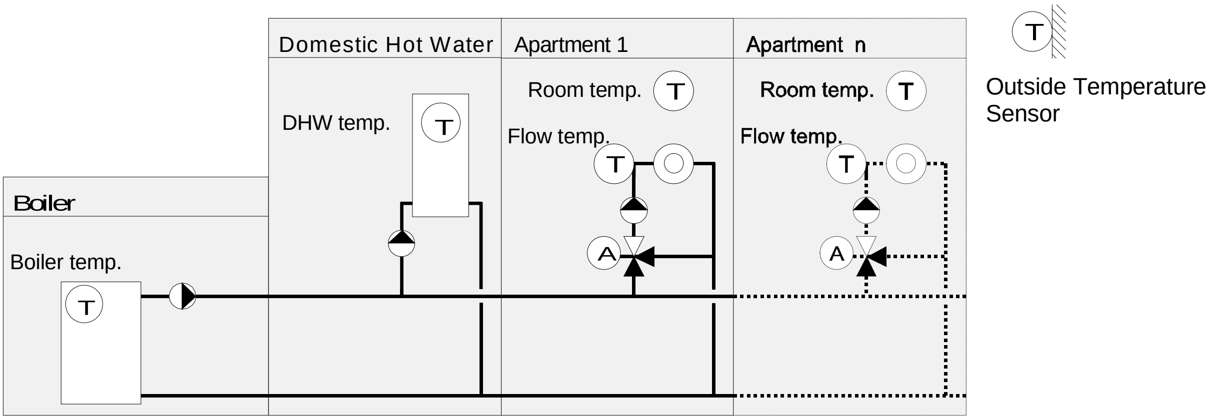


Figure 2-11 Multi family home, 1 boiler

The example in Figure 2-12 shows a multifamily home with apartments controlled by mixing valves, 1 DHW storage tank per apartment, pre-control for a group of apartments (heat distribution) and heat production by one boiler sequence

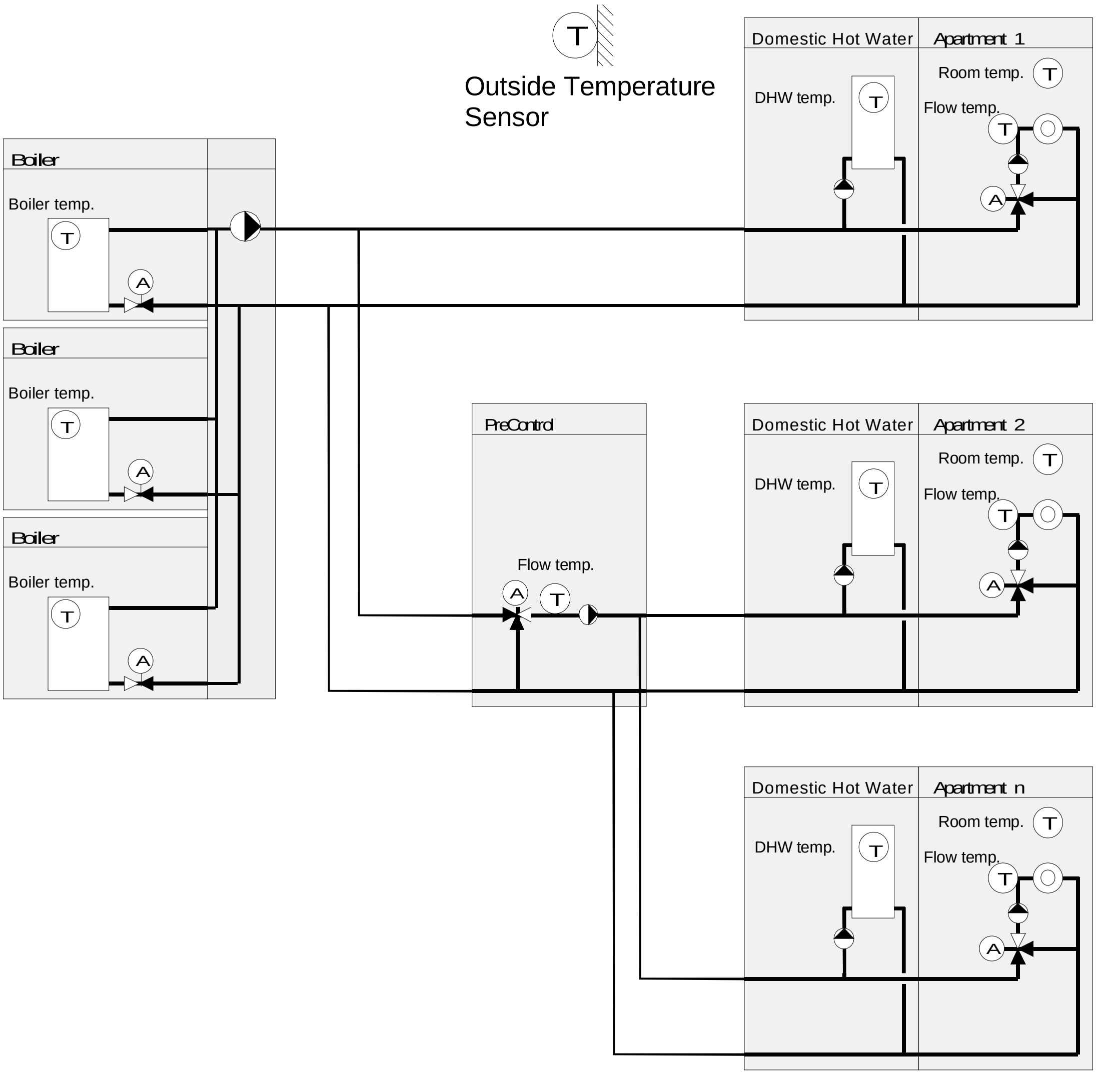


Figure 2-12 Multifamily home, boiler sequence

The example in Figure 2-13 shows a multifamily home with apartments controlled by IRC (see next chapter), 1 DHW common storage tank, pre-controls (heat distribution) for two apartments at a time and heat production by one boiler sequence

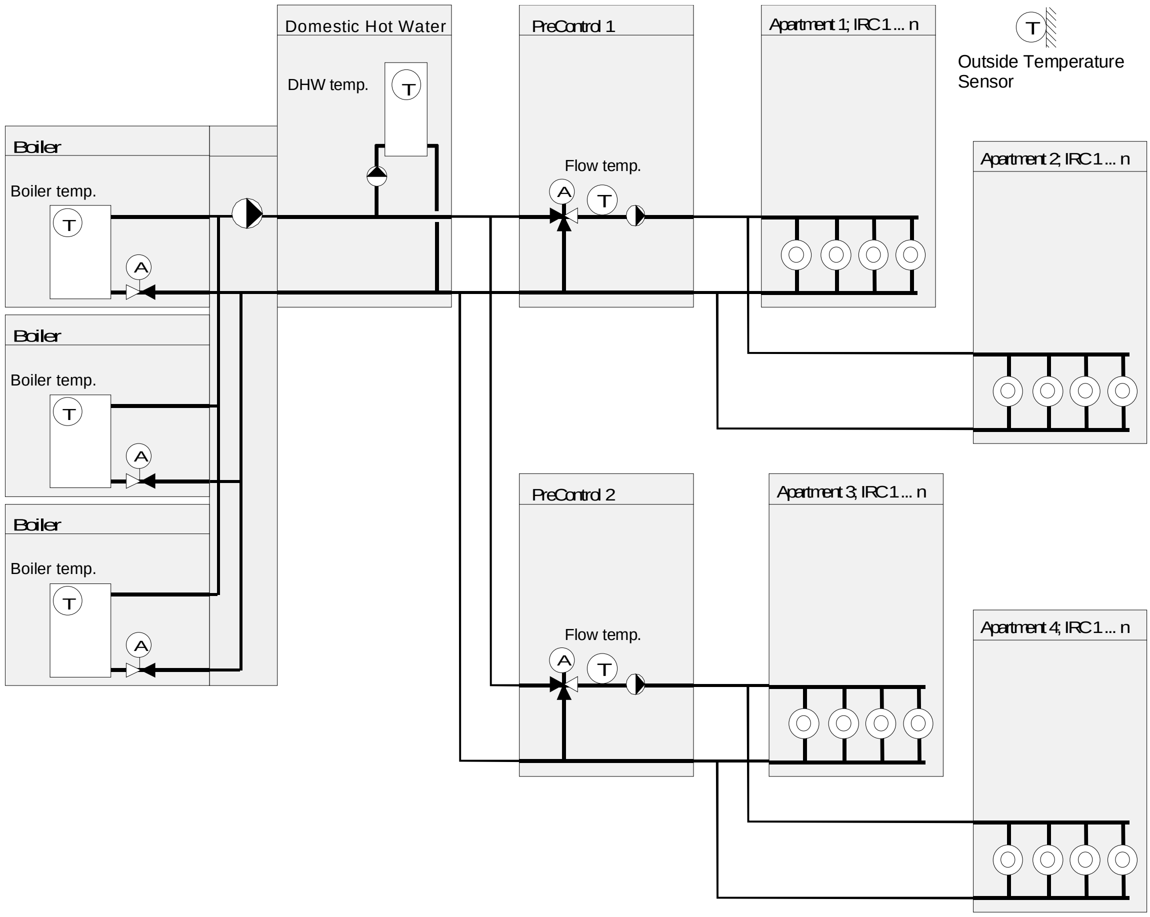


Figure 2-13 Multifamily home, boiler sequence, IRC

2.4.4 Multifamily home, apartment pre-control + IRC

The heating for a multifamily home is the same as for a single family home but with following differences:
Heat for the rooms is provided by a pre-controlled zone. Each apartment typically has a central device with time program functionality for all rooms of one apartment. In this device the room heat demands are collected and the resulting apartment heat demand is reported to the device with the pre-control function.

In this application, communication between devices of one apartment can be logically isolated from devices of an other apartment to guarantee privacy (e.g. by a Router device). If there is also a physical isolation between apartments the communication on the isolated bus segments will still work when there is an electrical problem on the bus in one apartment.

The example in Figure 2-14 and Figure 2-15 shows an Apartment Building IRC with 4 Apartments supplied by 2 pre controlled zones.

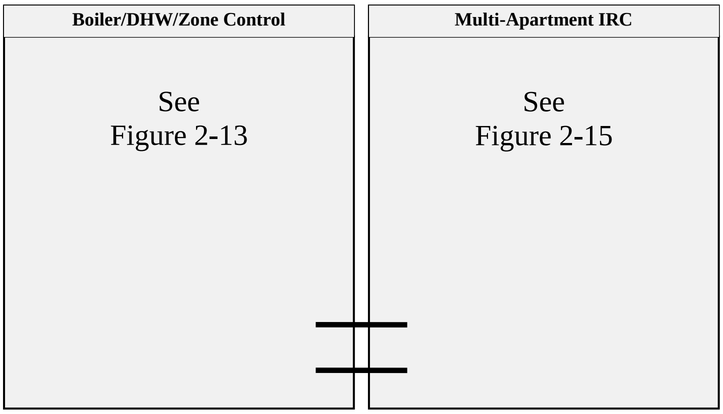
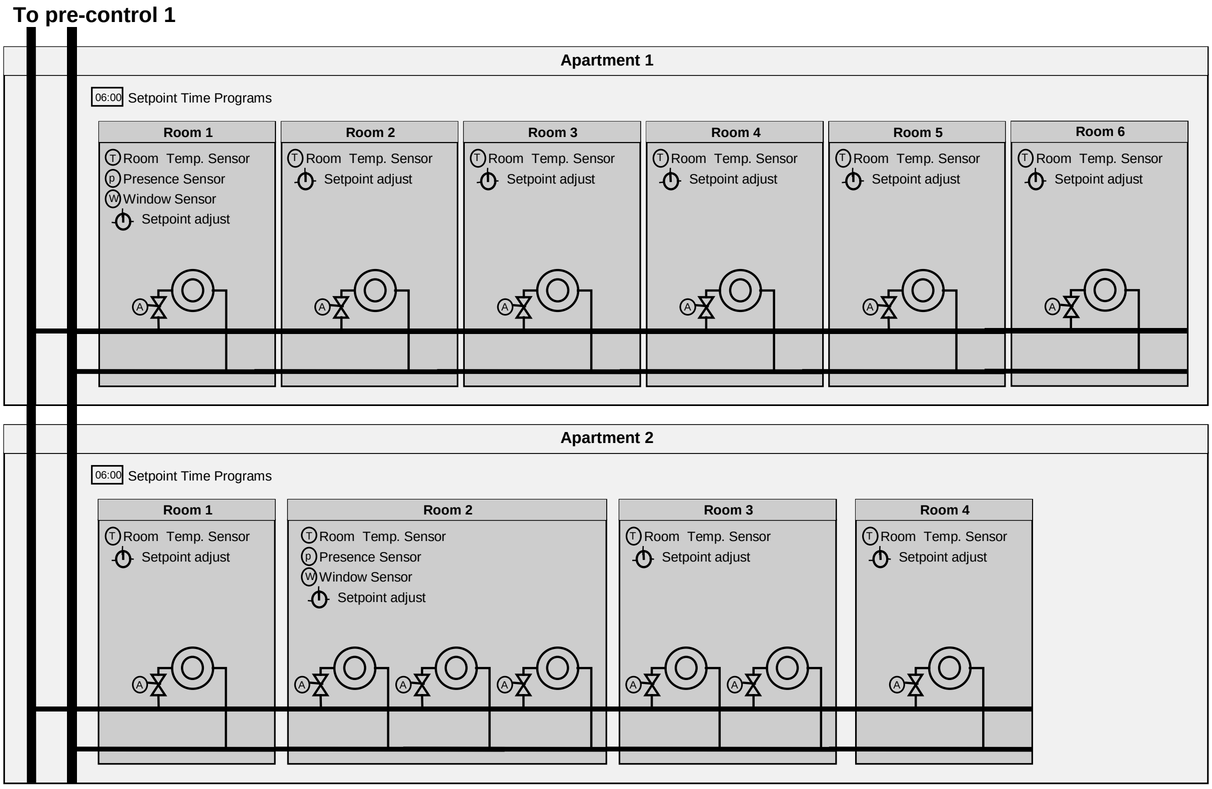


Figure 2-14 Apartment Building, IRC



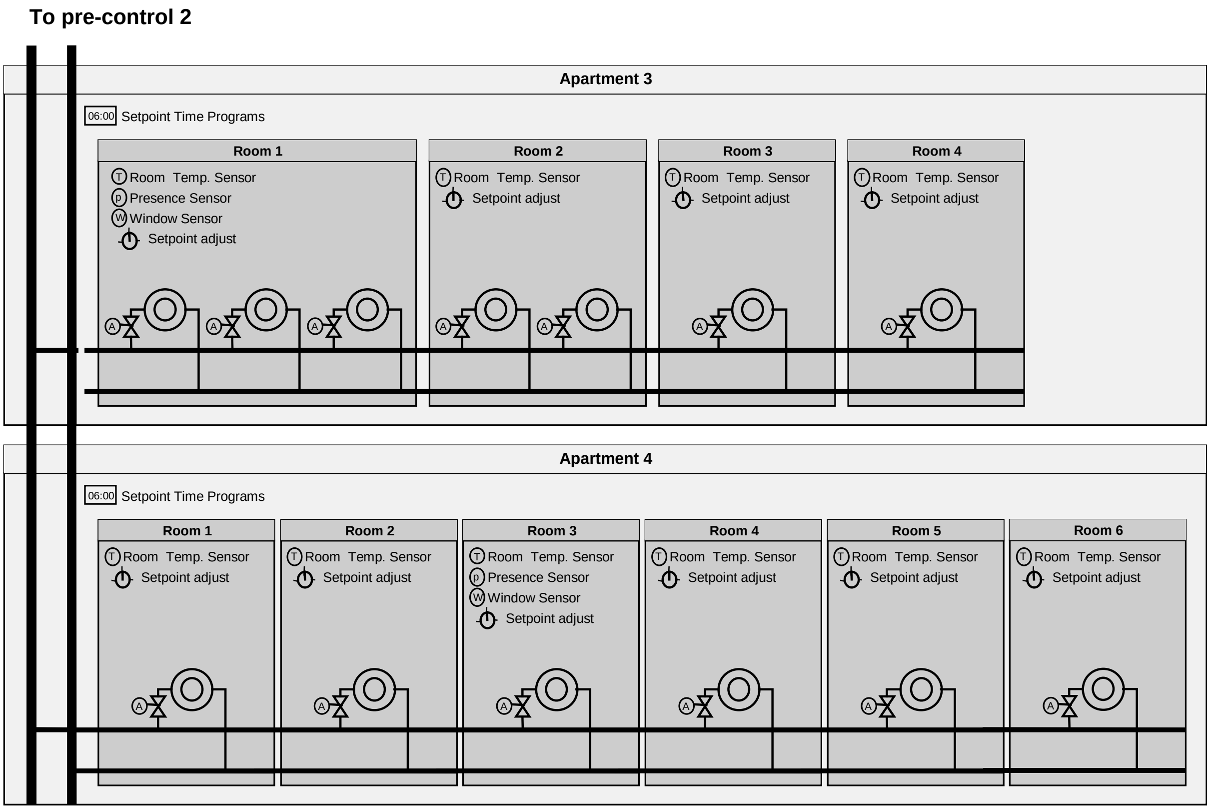


Figure 2-15 Apartment IRC

3 HWH System Model

In the following section some typical application examples and the corresponding KNX application model are described. The figures show the HVAC application diagram (simplified) and the mapping to functional blocks. In addition the grouping of functional blocks using LTE zoning is shown.

3.1 Multifamily home, apartment control

The **figure on the next page** shows a heating system for a multifamily home with **apartment zone control** (see also application scenario in chapter 2.4.3.). Remark: for reasons of simplicity Domestic Hot Water supply is not shown in this example.

The system in the example contains a heat production segment with multiple heat producers (boiler sequence) which are co-ordinated by the Heat Prod. Manager HPM. In a system with only one boiler, the HPM functionality would be reduced to a minimum. Each heat producer contains a Burner Controller BUC and a Boiler Controller BOC which have a 1:1 relationship. They are often integrated into one device – otherwise BUC and BOC are linked by the LTE group ProdSegmH_x.Producer_y.

The HPM receives the resulting overall heat flow demand in the heating system from the „first“ Flow Demand Manager HFDM in the primary Heat Distribution Segment. HPM and „first“ HFDM have always a 1:1 relationship and are usually located in the same device (and therefore data flow between HPM and HFDM is normally purely device-internal).

The HPM controls the heat producers according to the actual resulting overall heat flow demand (from HFDM) by sending the appropriate flow temperature demand or power demand to each Boiler Controller BOC which then controls the Burner Controller BUC accordingly.

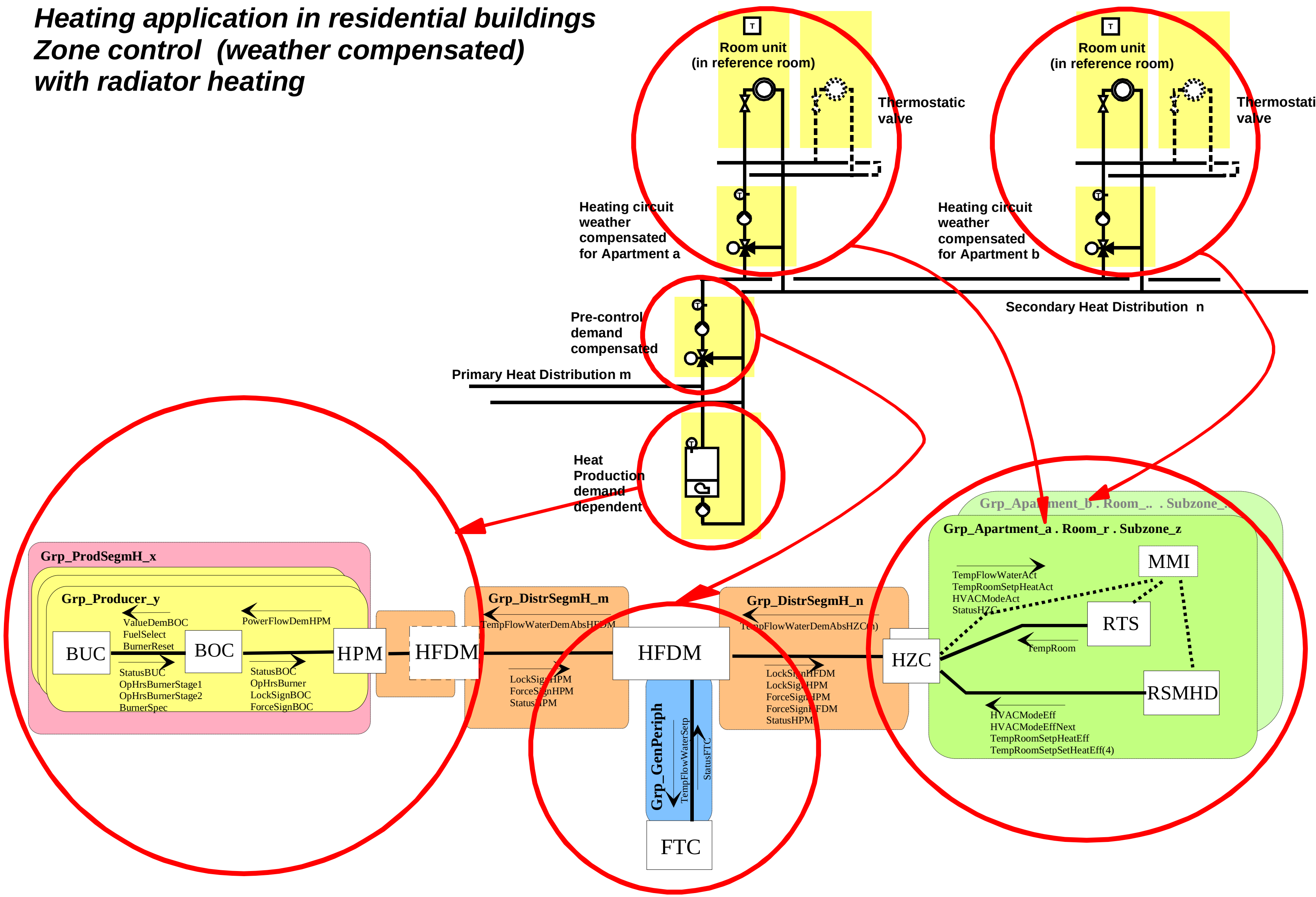
For boiler overheat protection or in case of oversupply the BOC can send a forcing signal to the HPM. Contrary, locking signals from BOC are used for boiler startup and overload protection. Forcing and locking signals from each BOC are collected in the HPM and the resulting forcing and locking signals for the heat production system are calculated. These resulting forcing and locking signals as well as HPM status information are distributed along the heat distribution system to the heat consumers (HZC) in the system. The heat consumers react accordingly by increasing or reducing of their energy consumption.

In more complex systems (like in this example) the heat consumers are not linked to the primary Heat Distribution Segment (directly connected to the boiler). Different levels of hot water distribution are possible. Each distribution level has its own hot water pipe which provides demand compensated hot water flow. In the LTE system functional blocks connected to one Heat Distribution Segment belong to the same LTE group DistrSegmH_..

In this example the HFDM collects the flow temperature demand signals from all apartments (i.e. heat consumers HZC) in the secondary Heat Distribution Segment, calculates the resulting heat demand and sends it to the preceding primary Heat Distribution Segment. In addition a demand compensated pre-controller (HFDM + FTC) provides the requested hot water flow in the secondary Heat Distribution Segment according to the resulting heat demand. The hot water flow temperature in the secondary Heat Distribution Segment is pre-controlled by the FTC. The FTC and the HFDM have a 1:1 relationship and are often located in the same device. Otherwise in LTE implementations the 1:1 functional binding is established by setting a specific 1:1 unassigned peripheral link GenPeripheral_x

The room temperature of one Apartment is controlled by one Heating Zone Controller (HZC) which calculates and controls the corresponding flow temperature of the zone. The apartment heating system does not comprise (bus connected) individual room controllers.

The flow temperature setpoint is calculated by the HZC according to the actual HVACMode and the corresponding room temperature setpoint. These information are provided by the Room Temperature Setpoint Manager (RSMHD). The HVACMode from RSMHD may depend on automatic time schedule, local user operation (MMI) presence detection, window status, Comfort Prolongation etc.


Heating application in residential buildings
Zone control (weather compensated)
with radiator heating
Room unit
(in reference room)
Thermostatic valve
Room unit
(in reference room)
Thermostatic valve
Heating circuit weather compensated for Apartment a
Heating circuit weather compensated for Apartment b
Secondary Heat Distribution n
Pre-control demand compensated
Primary Heat Distribution m
Heat Production demand dependent
Grp_ProdSegmH_x
Grp_Producer_y
BUC
BOC
HPM
HFDM
ValueDemBOC
FuelSelect
BurnerReset
StatusBUC
OpHrsBurnerStage1
OpHrsBurnerStage2
BurnerSpec
PowerFlowDemHPM
StatusBOC
OpHrsBurner
LockSignBOC
ForceSignBOC
Grp_DistrSegmH_m
TempFlowWaterDemAbsHFDM
HFDM
Grp_DistrSegmH_n
TempFlowWaterDemAbsHZC(n)
HZC
Grp_GenPeriph
TempFlowWaterSetp
StatusFTC
FTC
Grp_Apartment_b . Room_.. . Subzone_
Grp_Apartment_a . Room_r . Subzone_z
MMI
RTS
RSMHD
TempFlowWaterAct
TempRoomSetpHeatAct
HVACModeAct
StatusHZC
TempRoom
HVACModeEff
HVACModeEffNext
TempRoomSetpHeatEff
TempRoomSetpSetHeatEff(4)

3.2 Multifamily home, individual room control

The **figure on the next page** shows a heating system for a multifamily home with individual room control per apartment (see also application scenario in chapter 2.4.4.). Remark: for reasons of simplicity Domestic Hot Water supply is not shown in this example.

Heat Production and Heat Distribution are the same as in the preceding example in chapter 3.1

Each room (or subzone of a room) in an apartment is controlled individually by an heating controller HIRC according to the actual HVACMode and the corresponding room temperature setpoint. These information are provided by the Room Temperature Setpoint Manager (RSMHD).

The actual room temperature setpoint and the HVACMode in each room are calculated by the RSMHD. The HVACMode may depend on automatic time schedule, local user operation (MMI), presence detection, window status, Comfort Prolongation etc.

The HIRC calculates and controls the position of the valve(s) in the room (or subzone of a room). Within one room (or subzone of a room) all valves HVA are controlled together by the HIRC. The method of calculation of the valve position in the HIRC is company-specific.

The actual room temperature value (provided by RTS) is used for room temperature control loop mechanism. It is a mandatory input for HIRC.

All HIRC of the same Apartment are connected to one Heat Distribution Segment which provides demand dependent hot water flow.

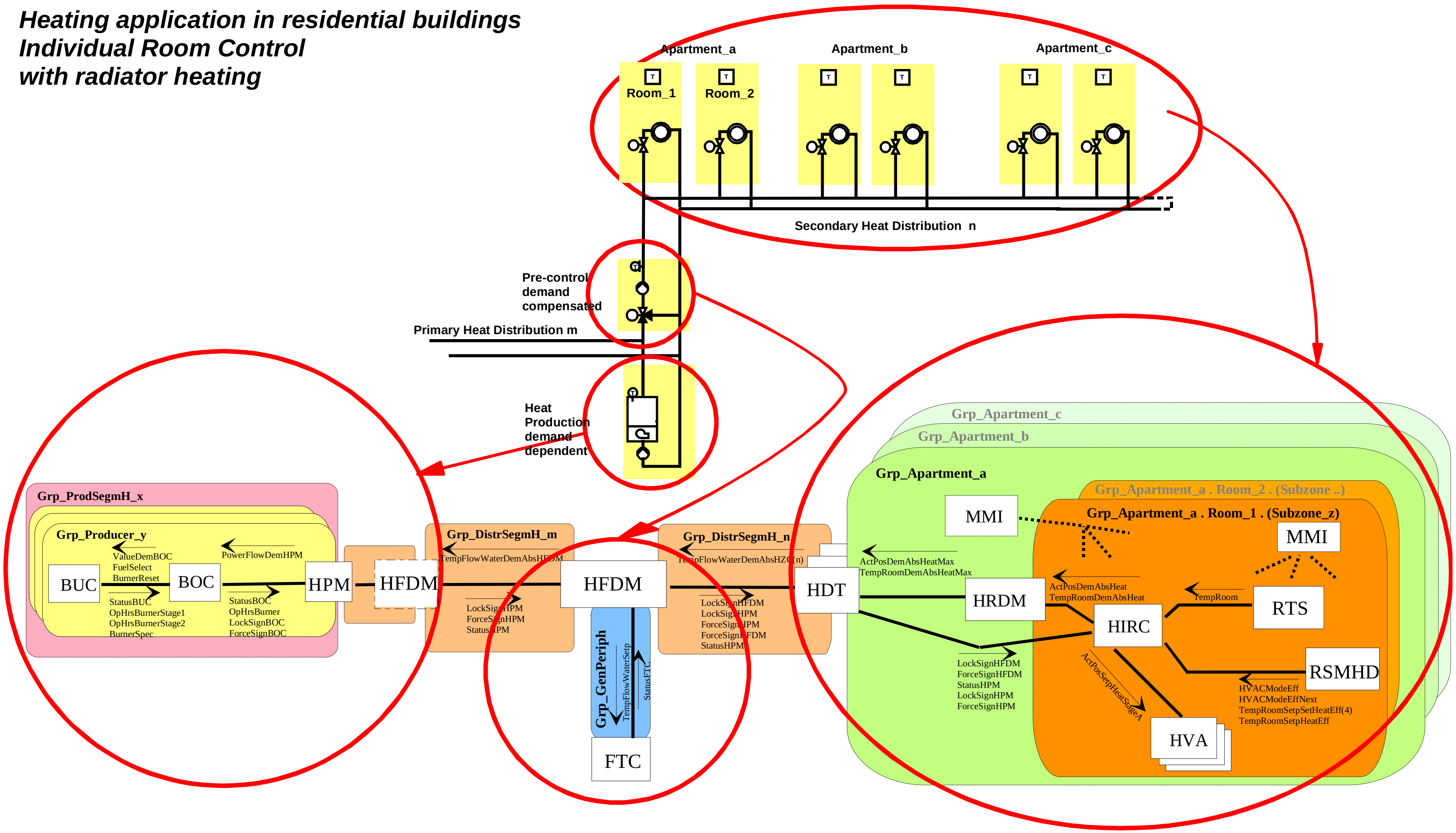
The HIRC calculates the room heating demand to enable demand-dependant heat production. The heat demand calculation is based on the same mechanisms as room temperature control (see above). The heat demand is either expressed as a (rated) room temperature setpoint or (rated) valve position setpoint.

The Heating Room Demand Manager (HRDM) collects the room demands from all HIRC’s in the same apartment and calculates the resulting heating room demand which is transmitted to the “Heating Demand Transformer” (HDT). The HDT translates the resulting heating room demand to the corresponding hot water heat demand (requested water flow temperature) which is then transmitted to the HFDM in the corresponding Heat Distribution Segment. HRDM and “HDT” functional blocks are often located in the same device.

A room MMI can be used for remote control of the HIRC and may also contain the RSMHD and the room temperature sensor RTS. A user interface in the apartment (apartment MMI) can be used for centralised remote control of the RSMHD‘s and HIRC‘s.

Constraints:
This Individual Room Control model is less suitable for large commercial applications because the hydraulic system may be different from the geographical structure of the building. The Rooms of one Floor could be connected to different Heat Distribution Segments. Therefore collection and management of the heat demand from all rooms within one floor can usually not be done centrally at the level of one Floor. The Terminal Unit (TU) application model is more flexible for IRC applications in commercial buildings but additional configuration of the Heat Distribution Segment per Individual Room Controller is necessary.

Heating application in residential buildings
Individual Room Control
with radiator heating



3.3 Multifamily home, domestic hot water control individual room control

The **figure on the next page** shows a heating system for a multifamily home with **apartment zone control** (same as in chapter 3.1) and centralised DHW preparation

Heat Production and Heat Distribution are the same as in the preceding example in chapter 3.1

A Domestic Hot Water circuit is controlled by a DHW Controller (DHWC) according to the current hot water temperature setpoint. The DHW setpoint depends on the actual DHW operating mode and a set of DHW temperature setpoints, each corresponding to one of the DHW operating modes. These information are inputs for the DHWC which are provided by the DHW Setpoint Manager (DHWSM). The DHW operating mode from DHWSM may depend on automatic time schedule or user operation (MMI).In simple systems the DHWSM may not support different DHW modes and will only provide the actual DHW setpoint

The current DHW temperature (normally a set of 2 different sensor values: DHWTS start/stop sensors) is also a mandatory for DHW control loop. DHW sensor(s) are usually hard-wired to the device containing the DHWC.

More sophisticated DHW applications may include solar DHW preparation (SDHWC) and optimized circulation pump control (DHWCPC). The DHW control system is composed of multiple functional blocks (some functional blocks are optional). Usually all of these functional blocks – except DHWSM or SDHWC - are located in the same device.

The DHWC is connected to one Heat Distribution Segment and sends its heat demand to the corresponding HFDM which provides demand dependent hot water flow.

DHW controls are often connected to the primary Distribution Segment or are located in a specific Distribution Segment.

Usually DHW load requests load priority:

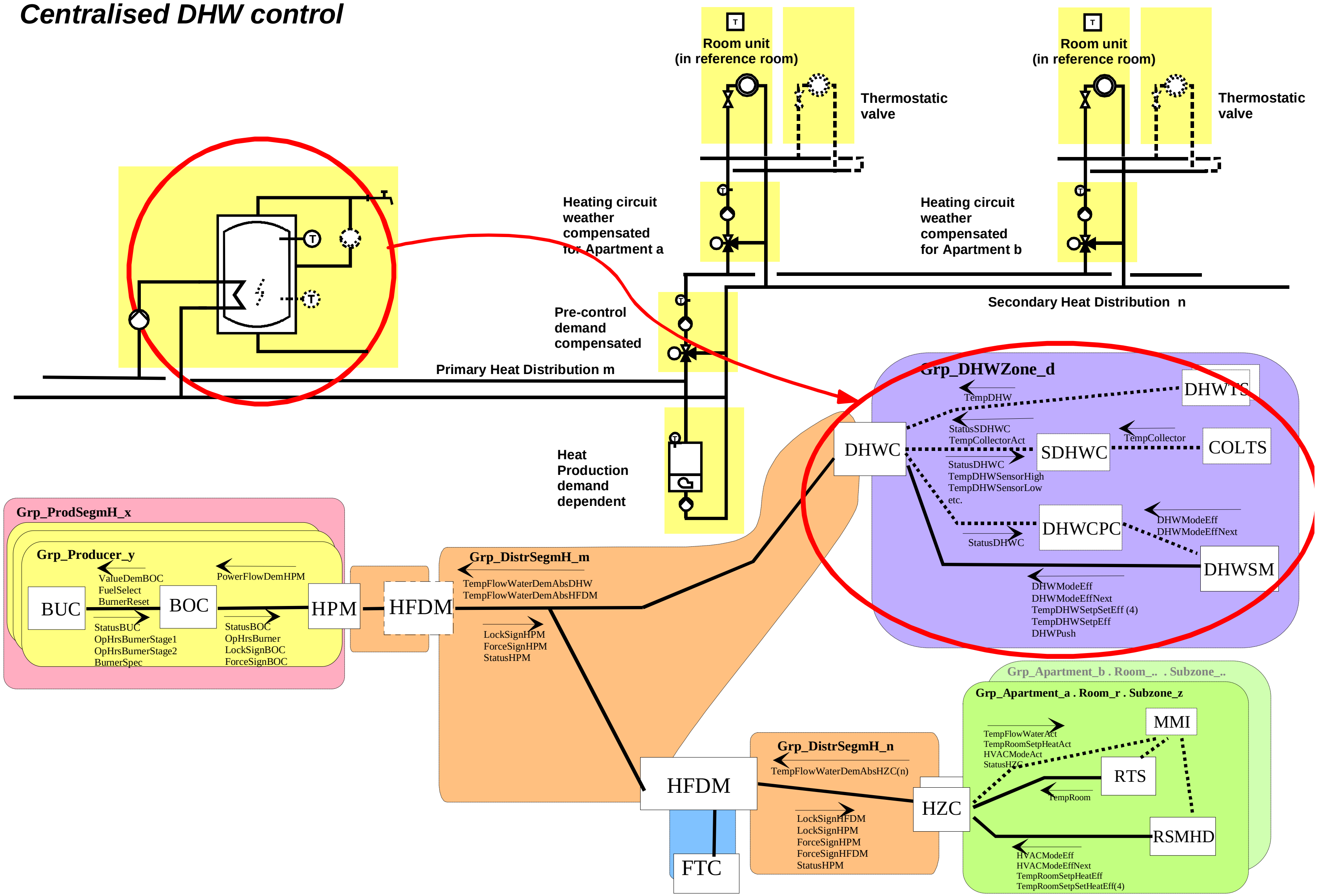
- „absolute load priority“: if DHW load requests all available power in the Distribution Segment
- „shifting load priority“: DHW load has priority in case of boiler overload

Load priority between DHWC and other consumers is controlled by the HFDM according to priority attributes in the heat demand signals. If load priority is requested by one or a class of consumers, the HFDM will send a locking signal to the consumers in the distribution segment.

Forcing signal must also be handled by the DHWC. In case of boiler overheat, DHW load will usually be activated first.

In LTE implementations of a DHW system all functional blocks used for DHW control are belonging to the specific group DWHZone. DHW zoning is completely independent of the building structure / geographical zones.

Centralised DHW control



4 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 Ventilation, Air Conditioning, and Cold Water and Terminal Units.

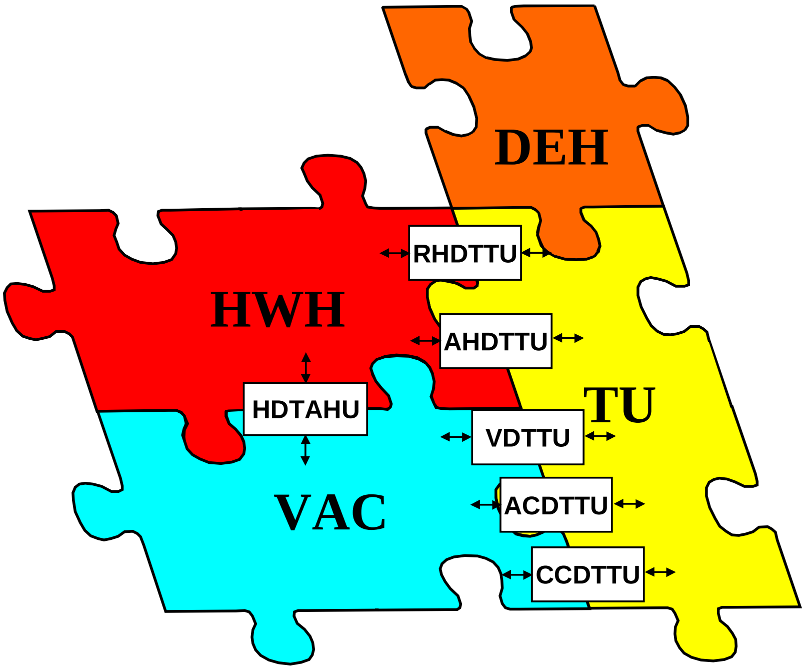
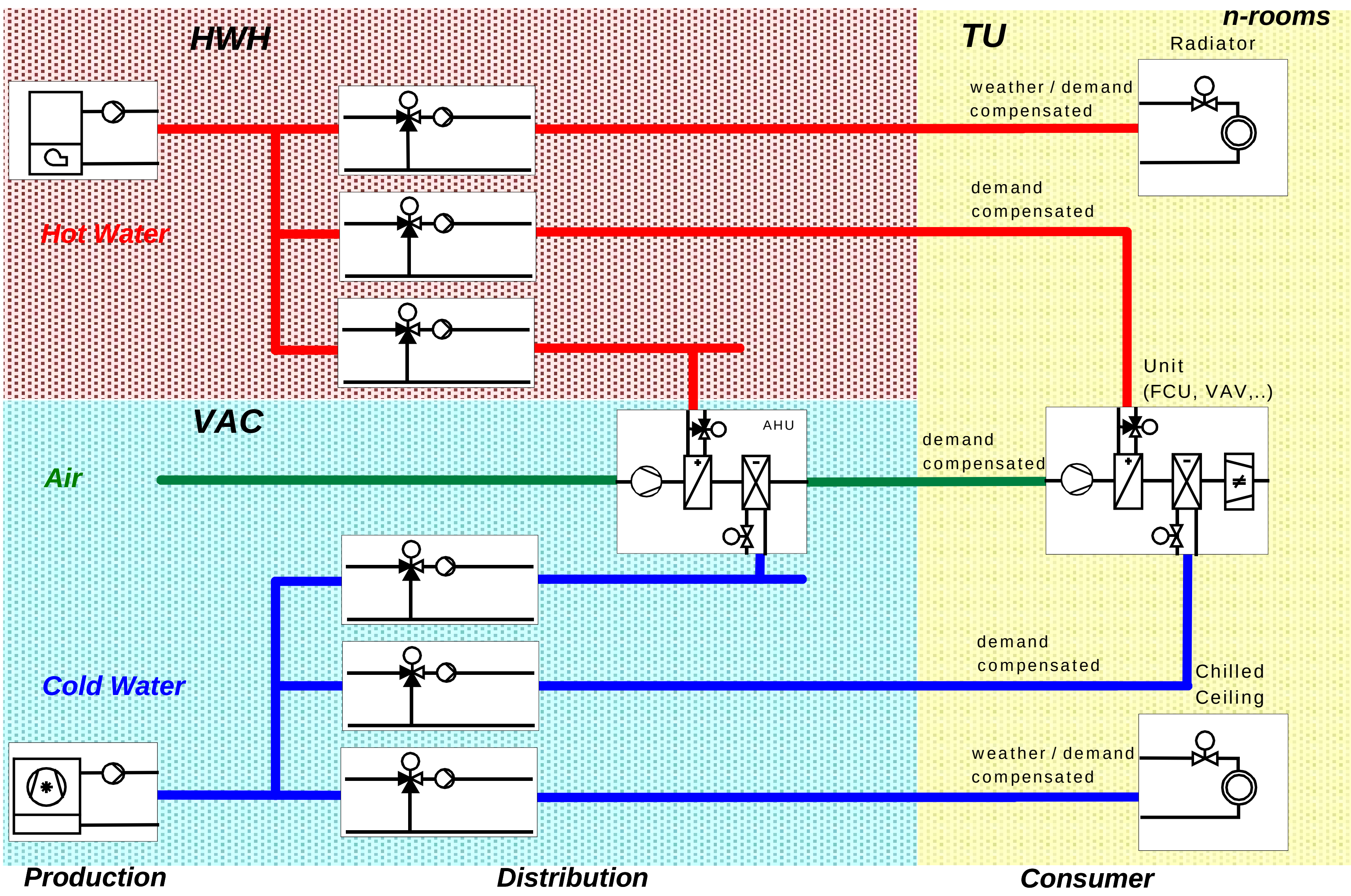


Figure 4-1 Interworking

The figure on the next page shows hot water and cold water consumers, distribution and production level.

Not on the pictures 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