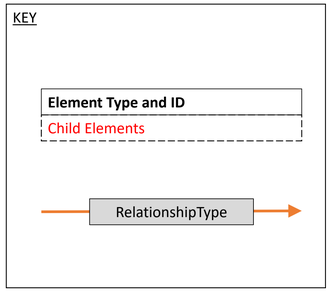
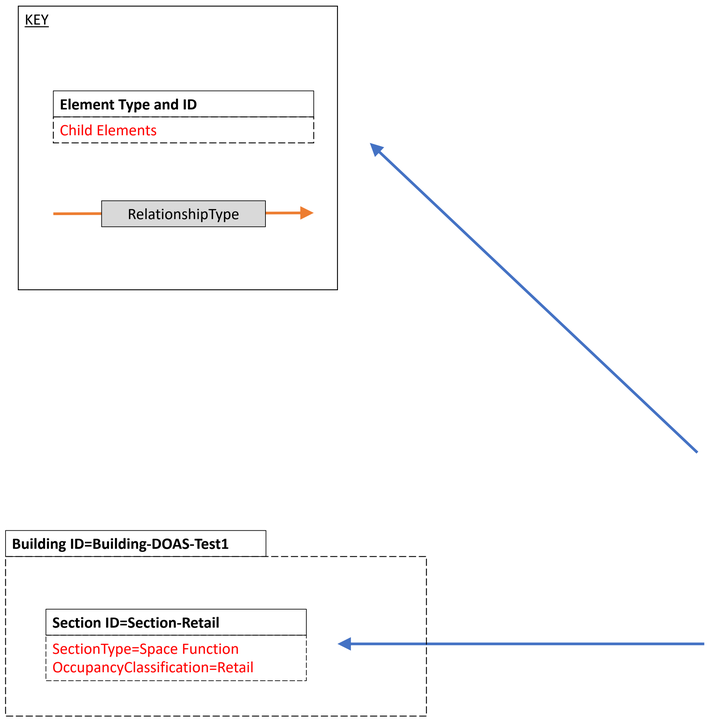
BuildingSync HVAC Systems Modeling Tutorial

The intended purpose of this document is to provide example implementations of some common HVAC systems and their auxiliary components that may be encountered. Auxiliary components include things such as Pumps, Fans, Motors, etc.



Primary Components:

- The primary components to be aware of when following along in these examples are the Element Type, as well as the child elements for that element



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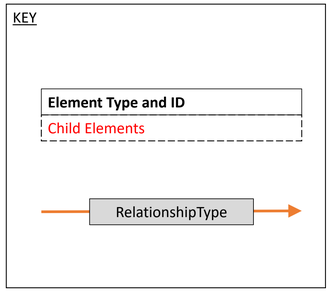
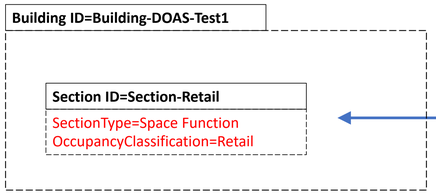
Nested components:

- These are used when additional information is desired about a child component
- Not all levels of the BuildingSync tree are shown within a nested component example to reduce verbosity. For example, to be verbose would require:
  - Building/Sections/Section
  - This may be left out at times when not critical



RelationshipType:

- Although designated as links between elements, they are ALWAYS modeled as child elements of the element they are connecting FROM (i.e. the starting point)
- This is just done for illustrative purposes in this diagram



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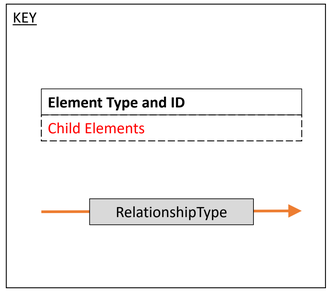

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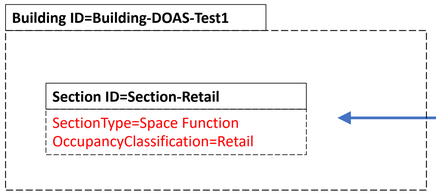

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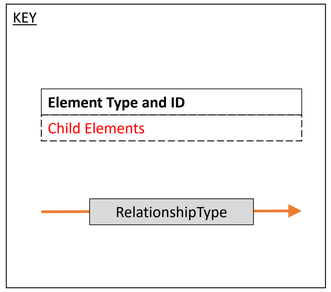
Example File:
- For each system, the accompanying XML file corresponding to the implementation of the example will be designated here

DOAS

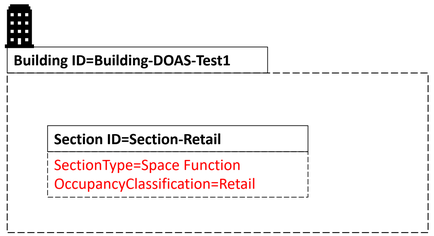
Modeling of a Designated Outdoor Air System with local Fan Coil Units for space conditioning. Both the DOAS and FCUs condition the air via chilled water from a Chiller and hot water from a Boiler.

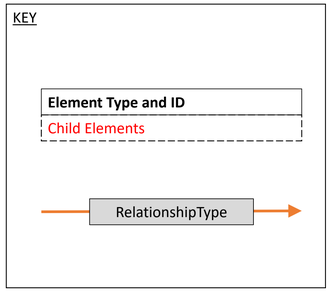


Introduction:

- For this example, we are going to look at connecting together high level elements in BuildingSync
- None of the elements will be provided with significant detail, we are mainly just looking at topology

DOAS with fan coil air-cooled chiller with boiler ATT Implementation

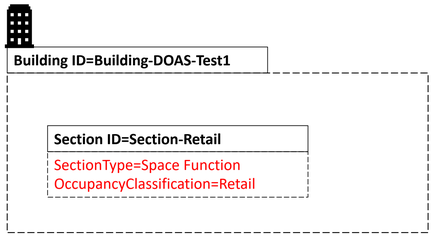


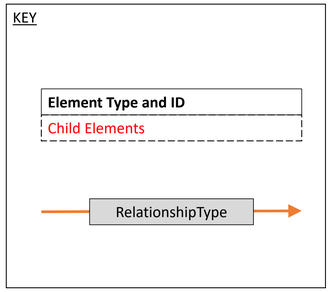


Building and Section

- We begin this example with a simple Building with a single Section.
- Note the SectionType is designated as Space Function – this is how we designate Sections in BuildingSync which map direcly from the ASHRAE 211 Normative Excel Document – ‘All – Space Functions’ sheet

DOAS with fan coil air-cooled chiller with boiler
ATT Implementation

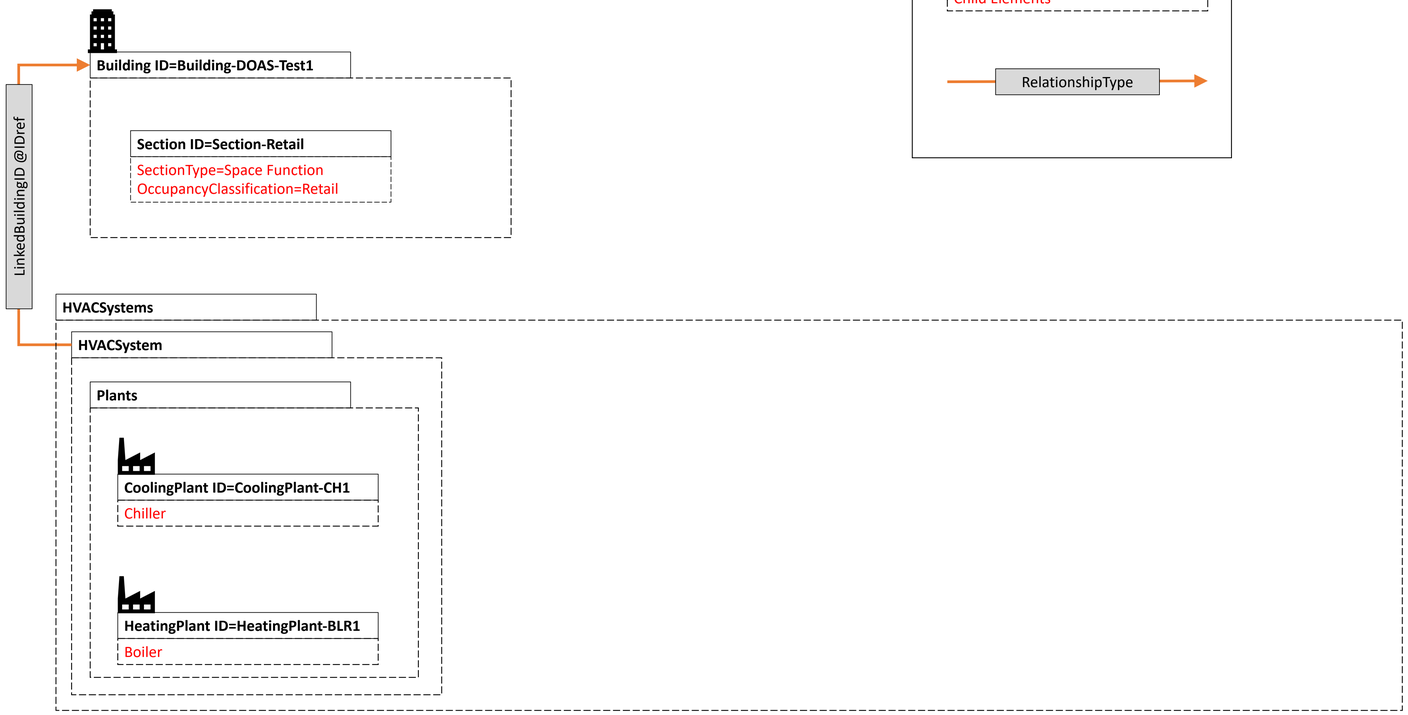




HVACSystems

- The HVACSystems element sits as a direct child element to:
  - Facility/Systems/
- This is the main wrapper element for things which will be performing space conditioning.

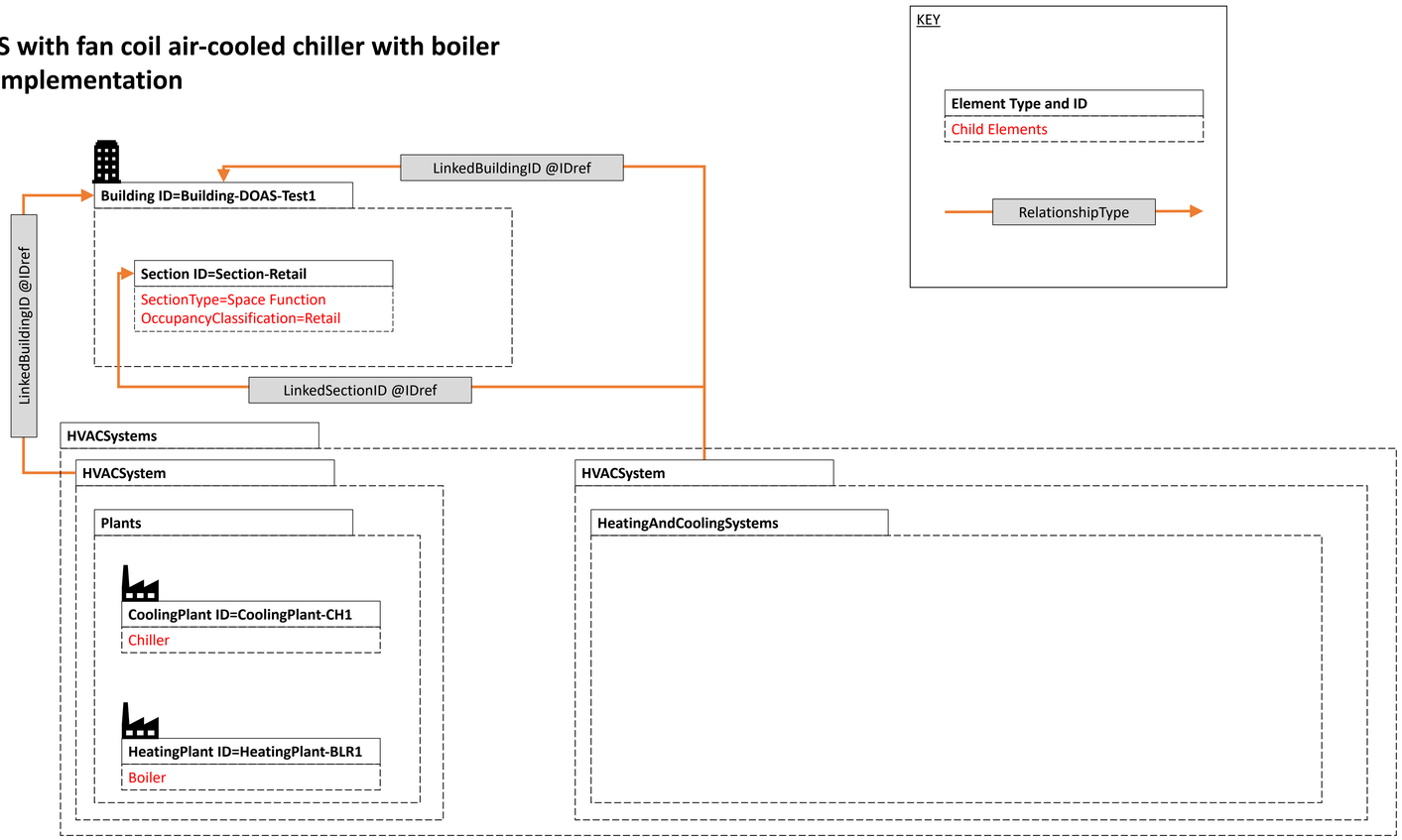
DOAS with fan coil air-cooled chiller with boiler
ATT Implementation



Plants

- Since Plants often can serve multiple Buildings, Sites, or Facilities, they can be linked to anyone of these higher level Premise entities
- In this case, an HVACSystem is created specifically for the Plants, since they will be used at the Building level and not specific to any Section.
- We create both a HeatingPlant and CoolingPlant
- Although not apparent here, the CoolingPlant consists of a single Chiller, and the HeatingPlant consists of a single Boiler

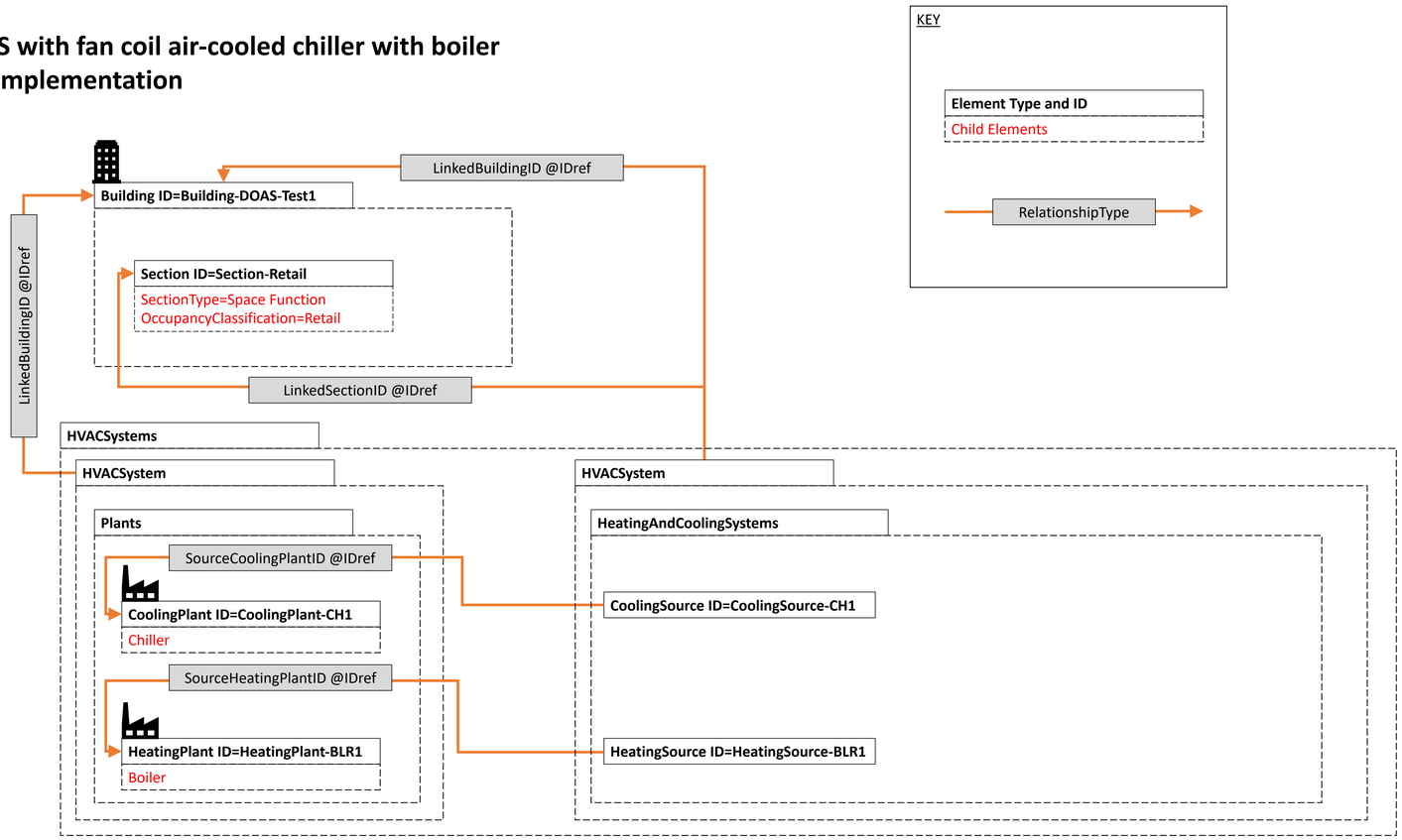
DOAS with fan coil air-cooled chiller with boiler
ATT Implementation



HeatingAndCoolingSystems

- These are designated as a separate HVACSystem since the children elements inside are designed to serve a specific Section within the Building
- It is linked to both the Building and Section for which it serves

DOAS with fan coil air-cooled chiller with boiler
ATT Implementation



HeatingSource and CoolingSource

- When connecting to plants, local HeatingSource and CoolingSource elements must be designated and connect to the plant

DOAS with fan coil air-cooled chiller with boiler
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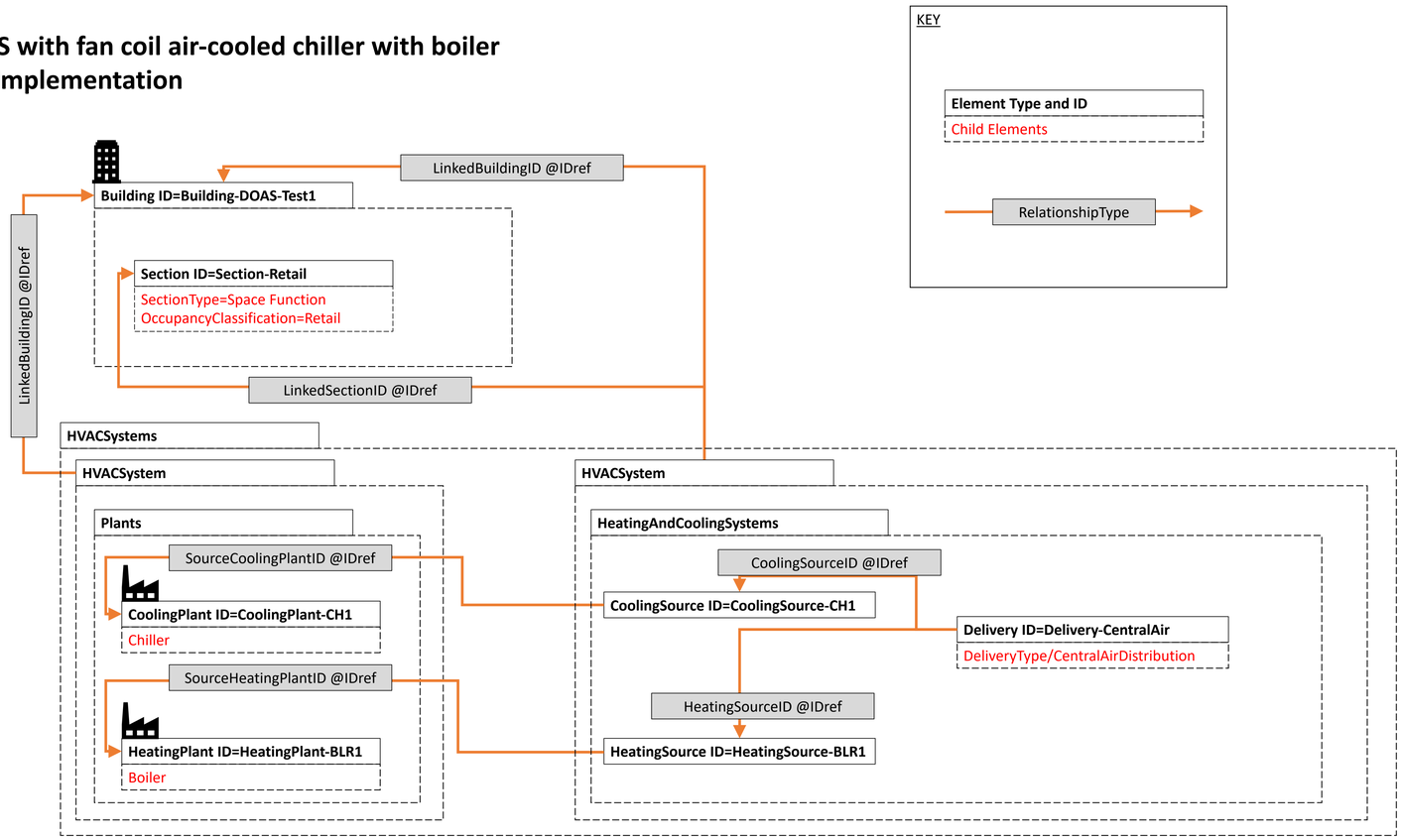
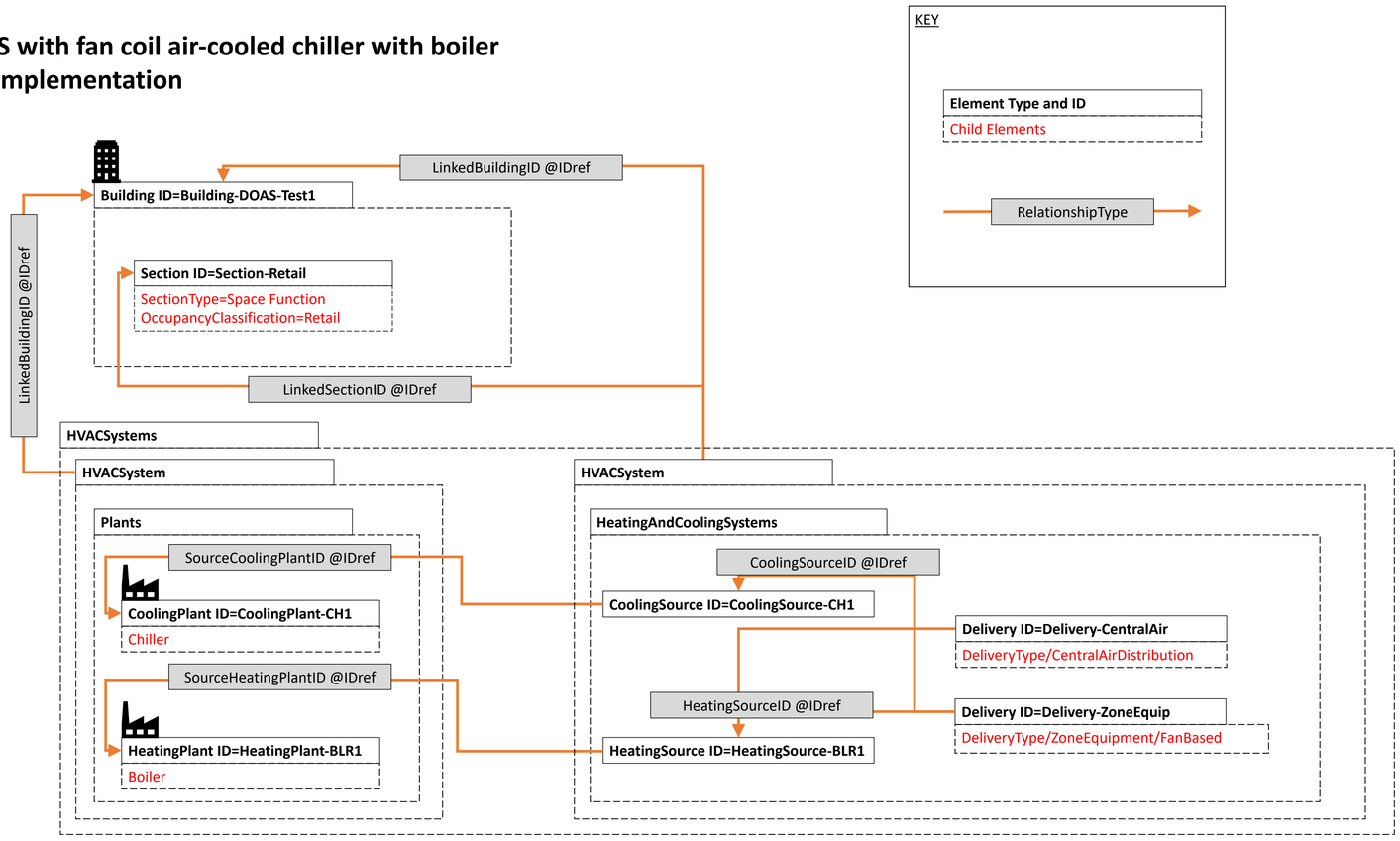


HeatingSource and CoolingSource

- When connecting to plants, local HeatingSource and CoolingSource elements must be designated and connect to the plant
- Deliveries then get connected to a plant through the CoolingSource or HeatingSource.
- Here, the CentralAirDistribution Delivery is connected to both the heating and cooling plants through the local HeatingSource and CoolingSource

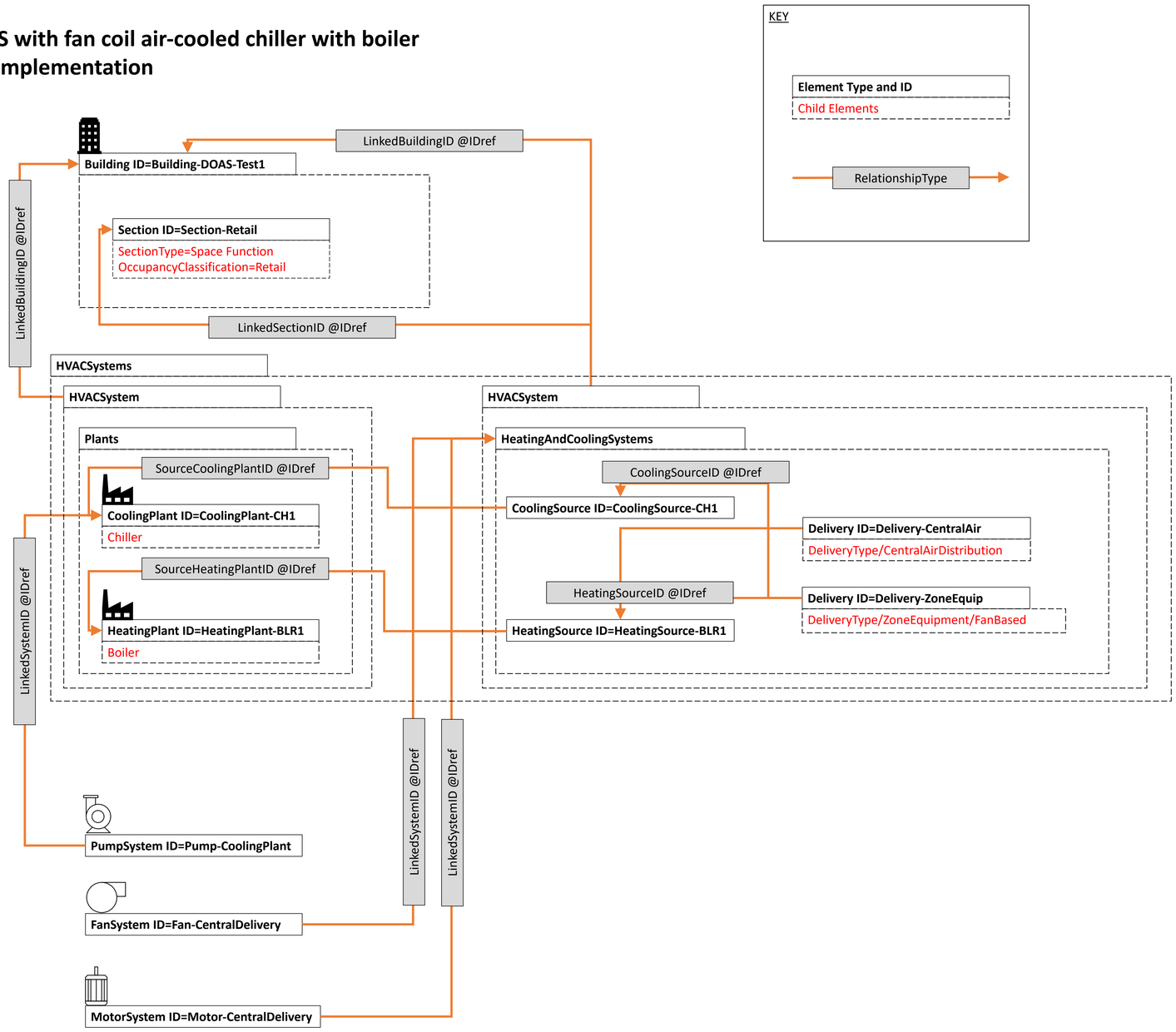
DOAS with fan coil air-cooled chiller with boiler
ATT Implementation



HeatingSource and CoolingSource

- When connecting to plants, local HeatingSource and CoolingSource elements must be designated and connect to the plant
- Deliveries then get connected to a plant through the CoolingSource or HeatingSource.
- Here, the CentralAirDistribution Delivery is connected to both the heating and cooling plants through the local HeatingSource and CoolingSource
- Additionally, the Zone Equipment is also connected to both the heating and cooling plants through the local HeatingSource and CoolingSource

DOAS with fan coil air-cooled chiller with boiler
ATT Implementation

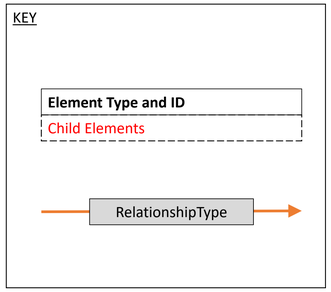


Auxiliary Systems
- PumpSystem
- FanSystem
- MotorSystem

- The above systems are considered auxiliary in the sense that, while part of a different system (HVACSystem), they are declared external to that system element
- They are then linked, through LinkedSystemID relationship elements

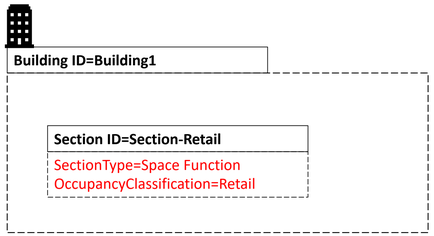
PSZ-HP System

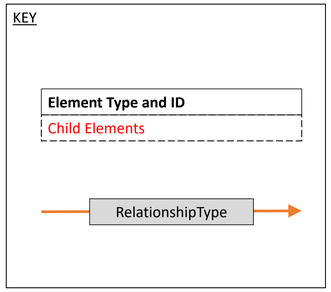
Modeling of a Single Zone Heat Pump System. Single stage heat pump, DX compressor, and fan.



- This example will go into more detail regarding individual systems, elements, and the properties of the elements

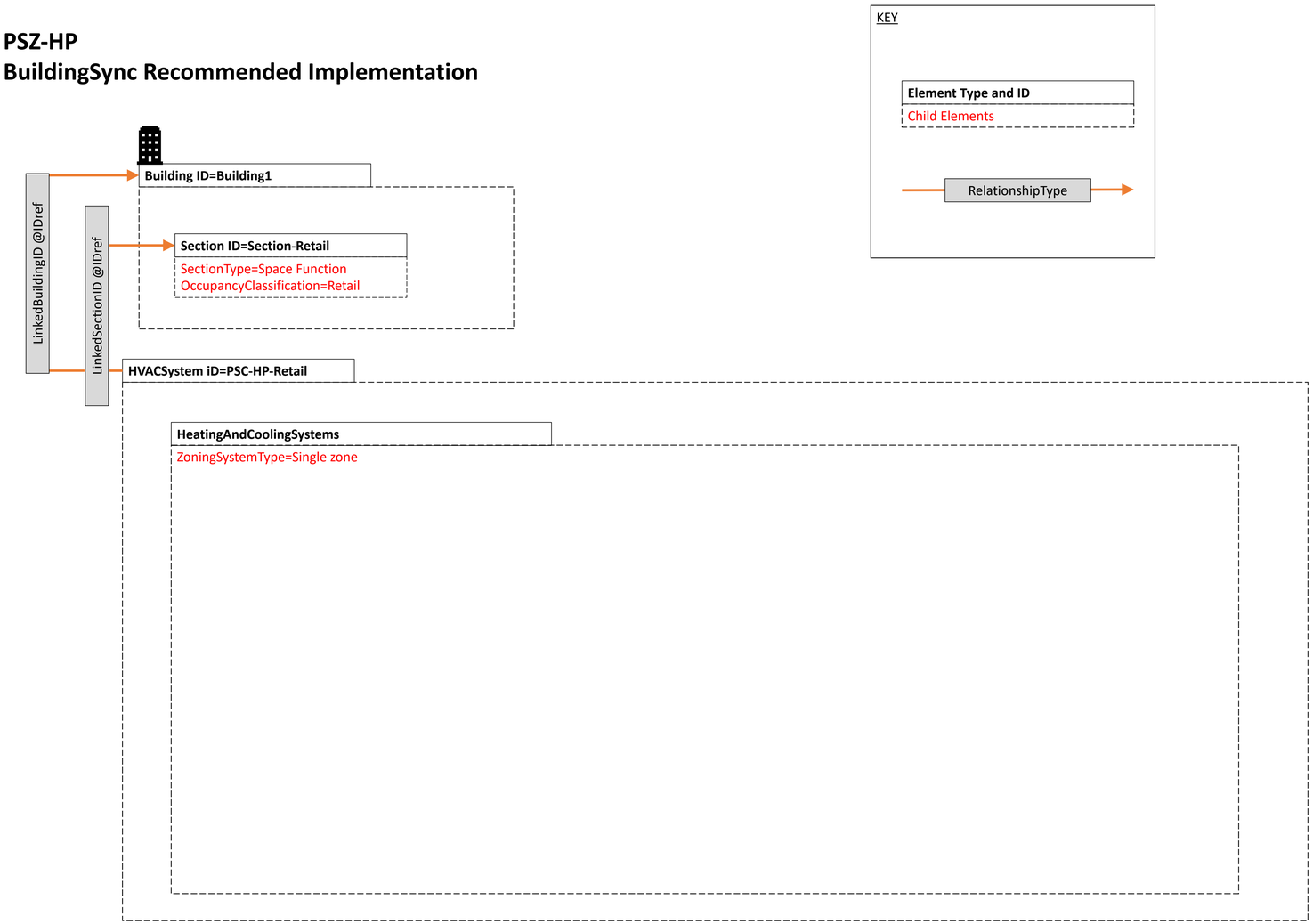
PSZ-HP
BuildingSync Recommended Implementation





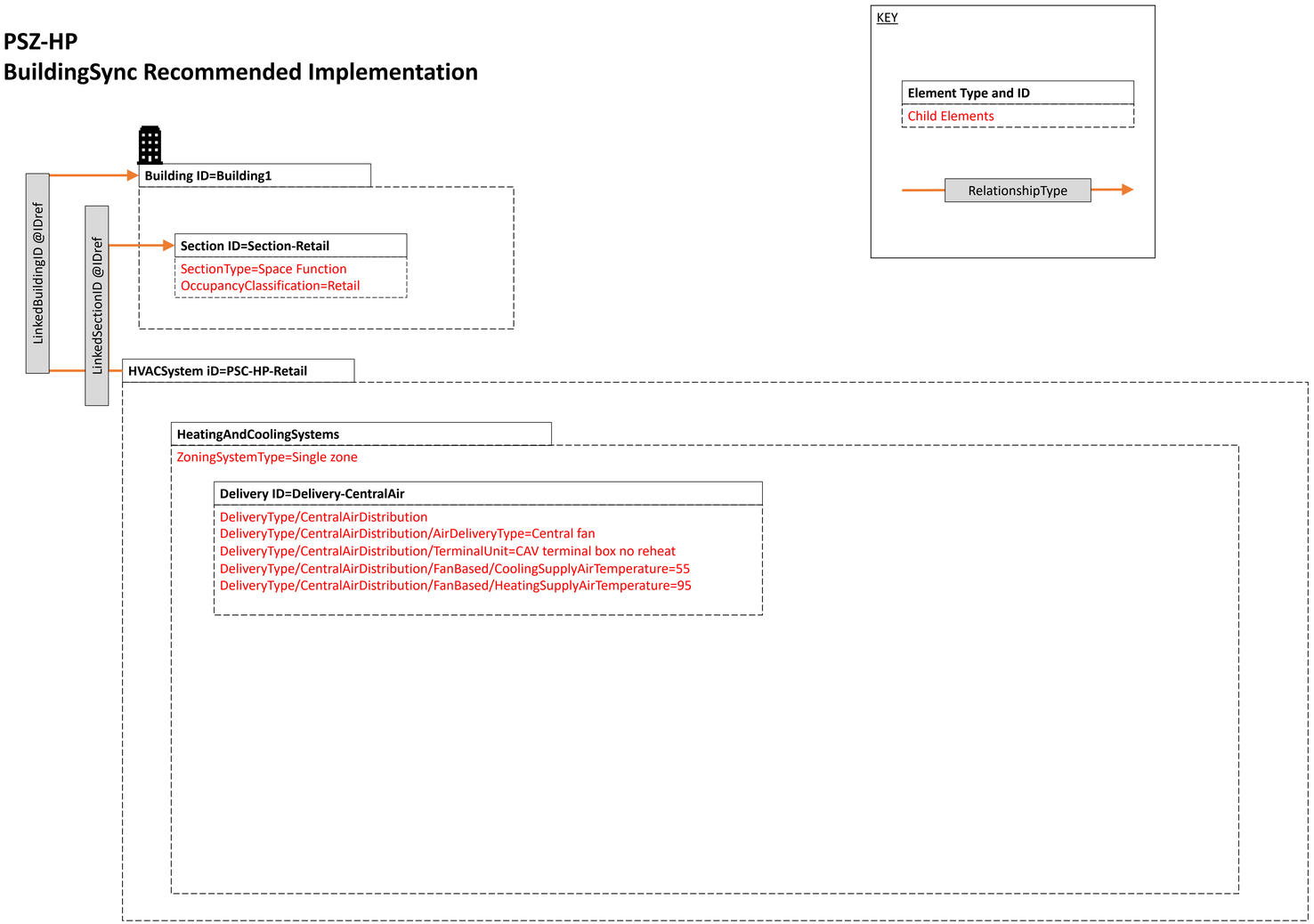
- We will start off with basically the same building as before, just a simple a retail store.

PSZ-HP
BuildingSync Recommended Implementation



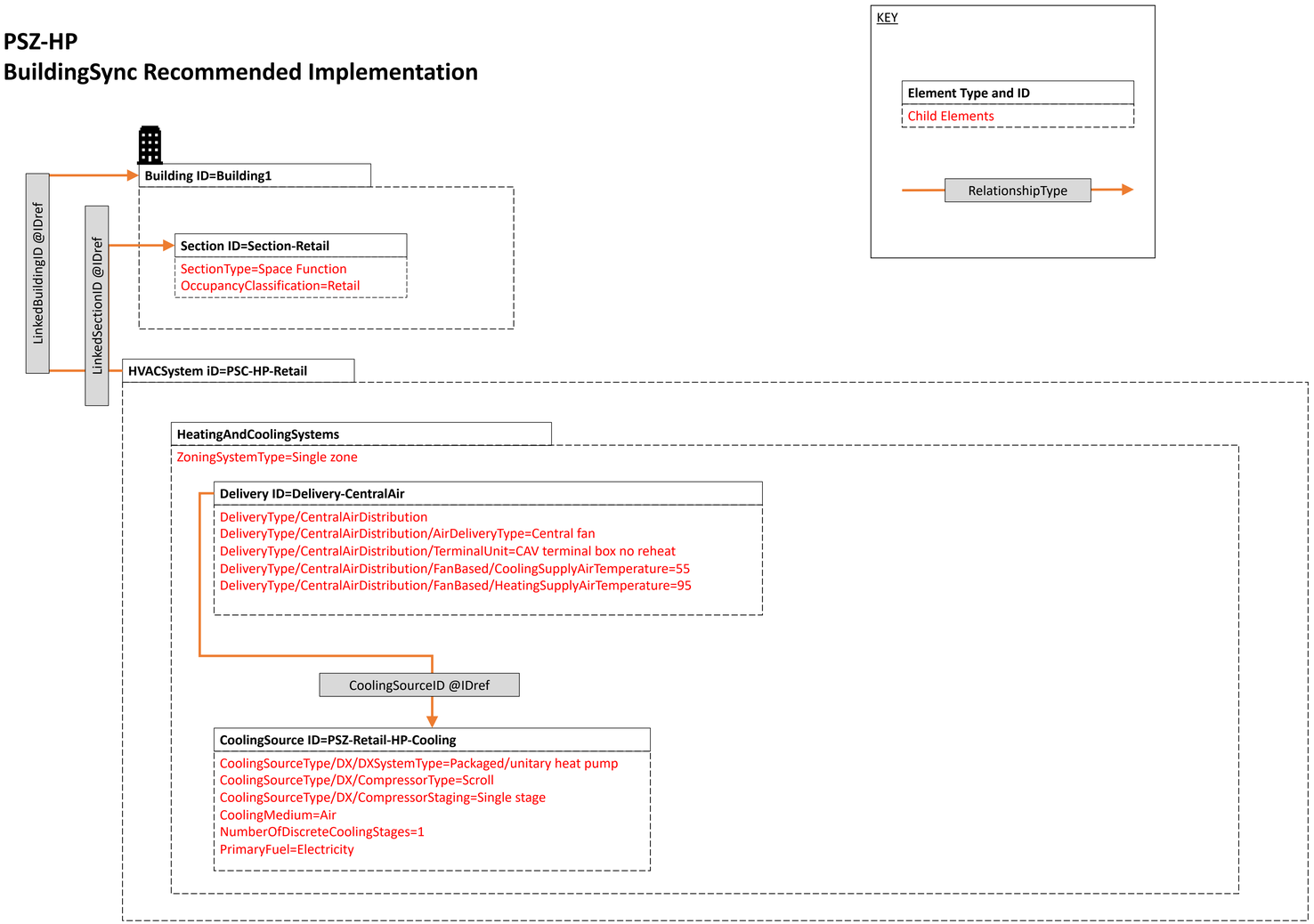
- Since there are no plants (which would typically tie ONLY to the Building level), we can create just a single HVACSystem to tie to both the Building and Section
- The type of ZoningSystem is defined at the HeatingAndCoolingSystems level
- The assumption when tying an HVACSystem to a particular Section is that it serves a portion of that section.
  - The percentage of the Section served by the HVACSystem can be specified via child elements of the LinkedSectionID:
    - FloorAreas/FloorArea/FloorAreaType=Gross
    - FloorAreas/FloorArea/FloorAreaPercentage=100
    - This specifies that the LinkedSection to which it is connected, this HVACSystem serves 100% of the Gross FloorArea of that Section.

PSZ-HP
BuildingSync Recommended Implementation



- A Delivery is a direct child element of the HeatingAndCoolingSystems element
- Notice that the type of TerminalUnit is specified as an element of the CentralAirDistribution. There can only be one type of TerminalUnit for a specific Delivery.
  - There is no way to specify N number of TerminalUnits
  - Although not shown for these levels of details, ThermalZone elements can be created as children of the Section element. Then, individual ThermalZone elements can be linked back to a Delivery
- Note that the Heating and Cooling temperature setpoints are designated within the FanBased element. These correspond to the setpoints for the delivery, i.e. discharge temperature setpoints.

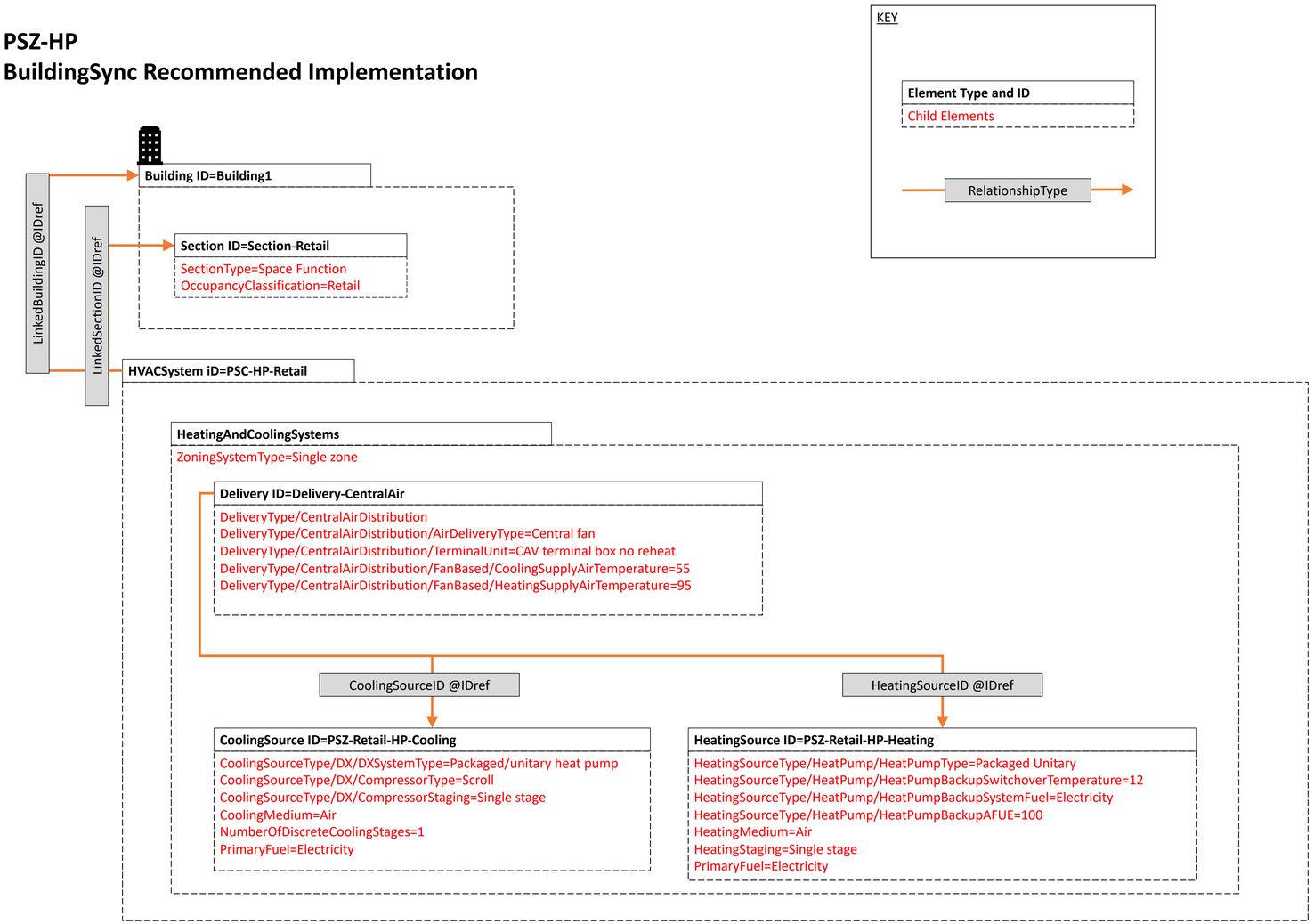
PSZ-HP
BuildingSync Recommended Implementation



- Delivery is linked to a CoolingSource

<u>CoolingSource</u>
- Here, the CoolingSourceType is specified as DX
- Specific information about the Compressor can be added, including number of stages and type

PSZ-HP
BuildingSync Recommended Implementation

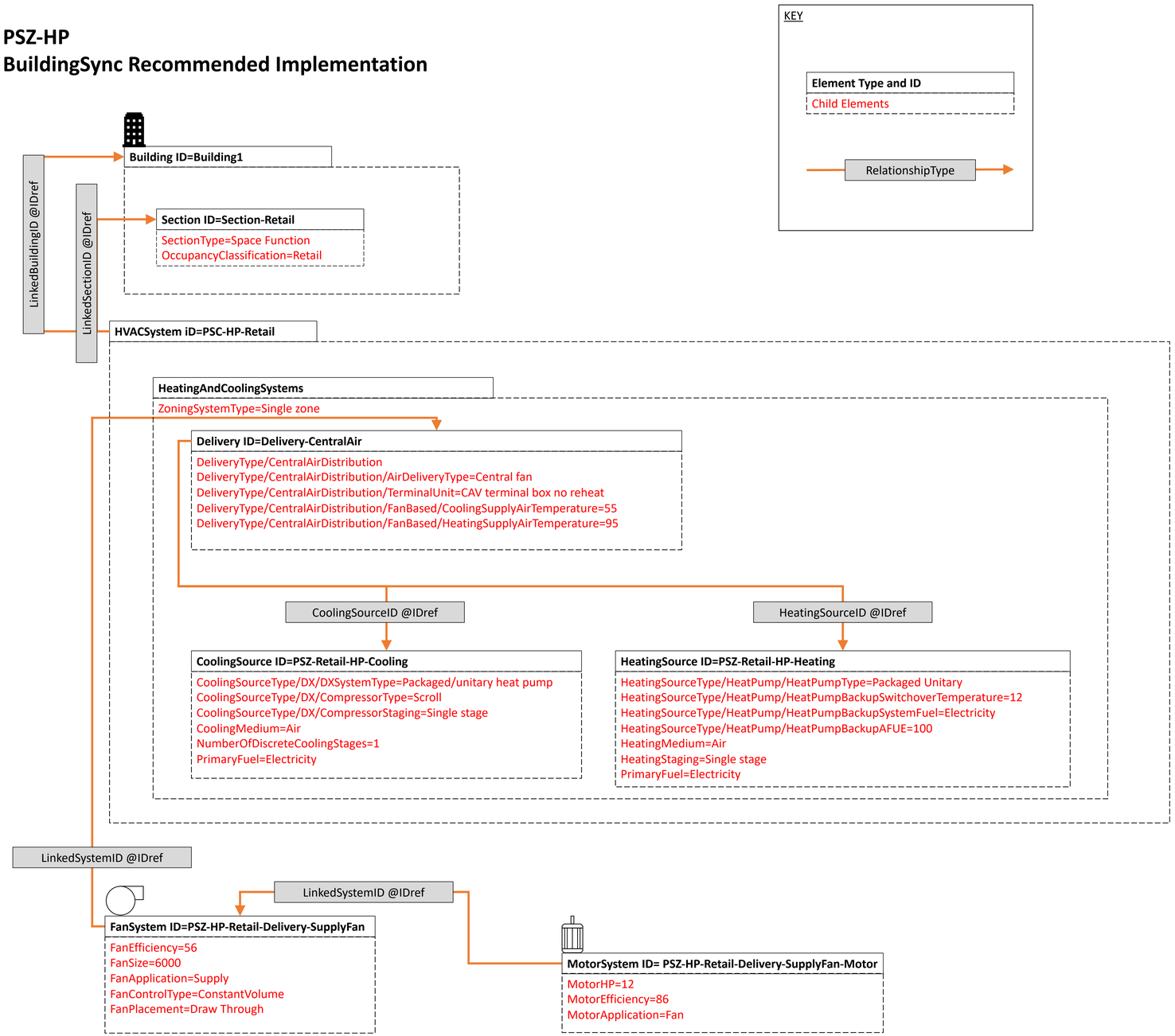


- Delivery is linked to a HeatingSource

<u>HeatingSource</u>

- Here, the HeatingSourceType is specified as a HeatPump
- Notice the capability to add in useful information about a BackupSystem for the heat pump, including fuel, AFUE, and switchover operation temperature
- Ability to identify the HeatingStaging

PSZ-HP
BuildingSync Recommended Implementation



MotorSystem

- As the motor is the general driver of the Fan, it is directly linked to it
- The MotorApplication can be specifed to specify the purpose of the motor without having to traverse relationships.

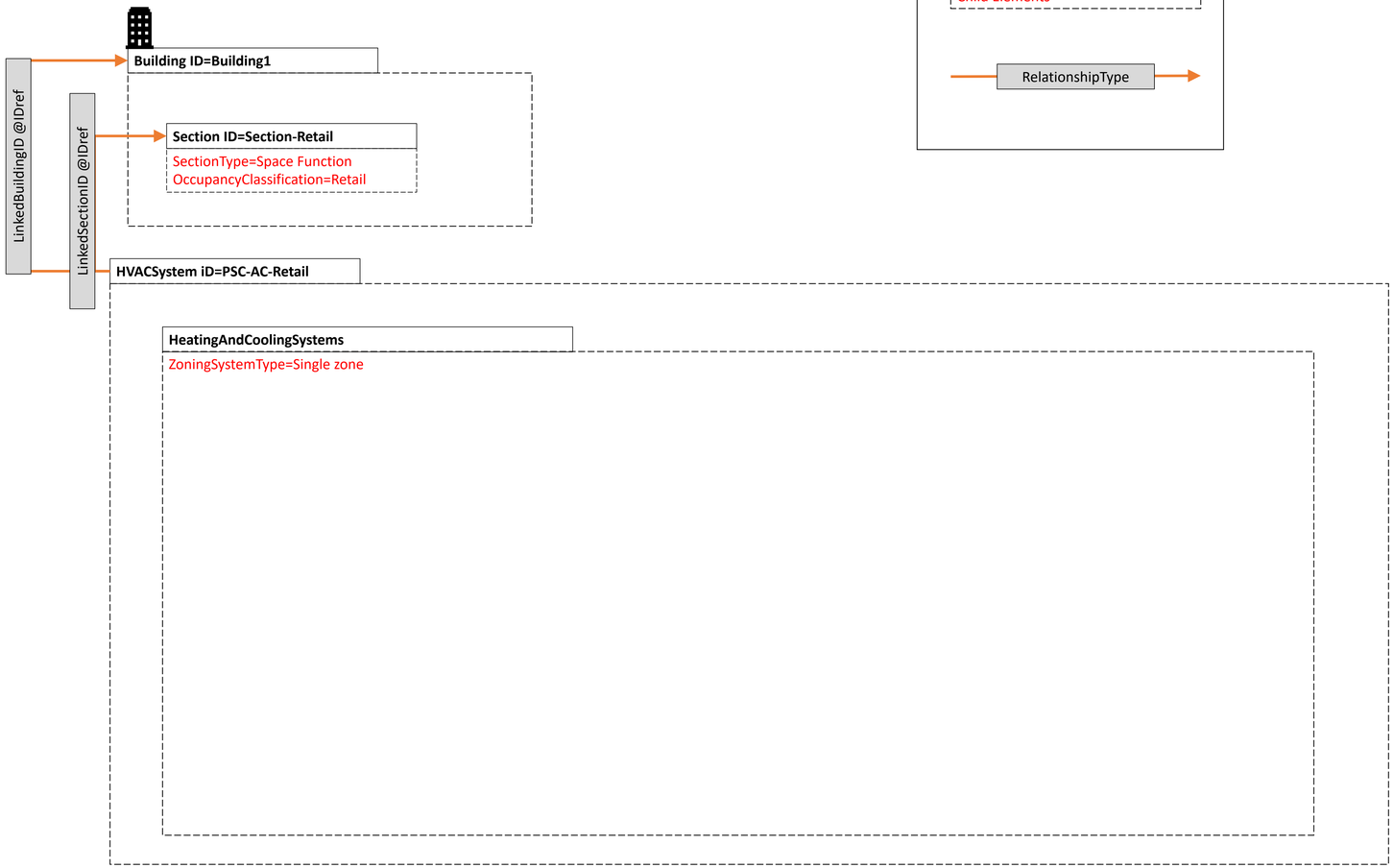
FanSystem

- The Fan corresponding to the Supply Fan of the Delivery system, it is directly linked to the Delivery
- FanControlType gets specified at the individual FanSystem level
- FanApplication can be specified in the event that multiple fans are directly linked to a Delivery. Allows for Supply, Exhaust, Return fans to be linked to same Delivery.

PSZ-AC System

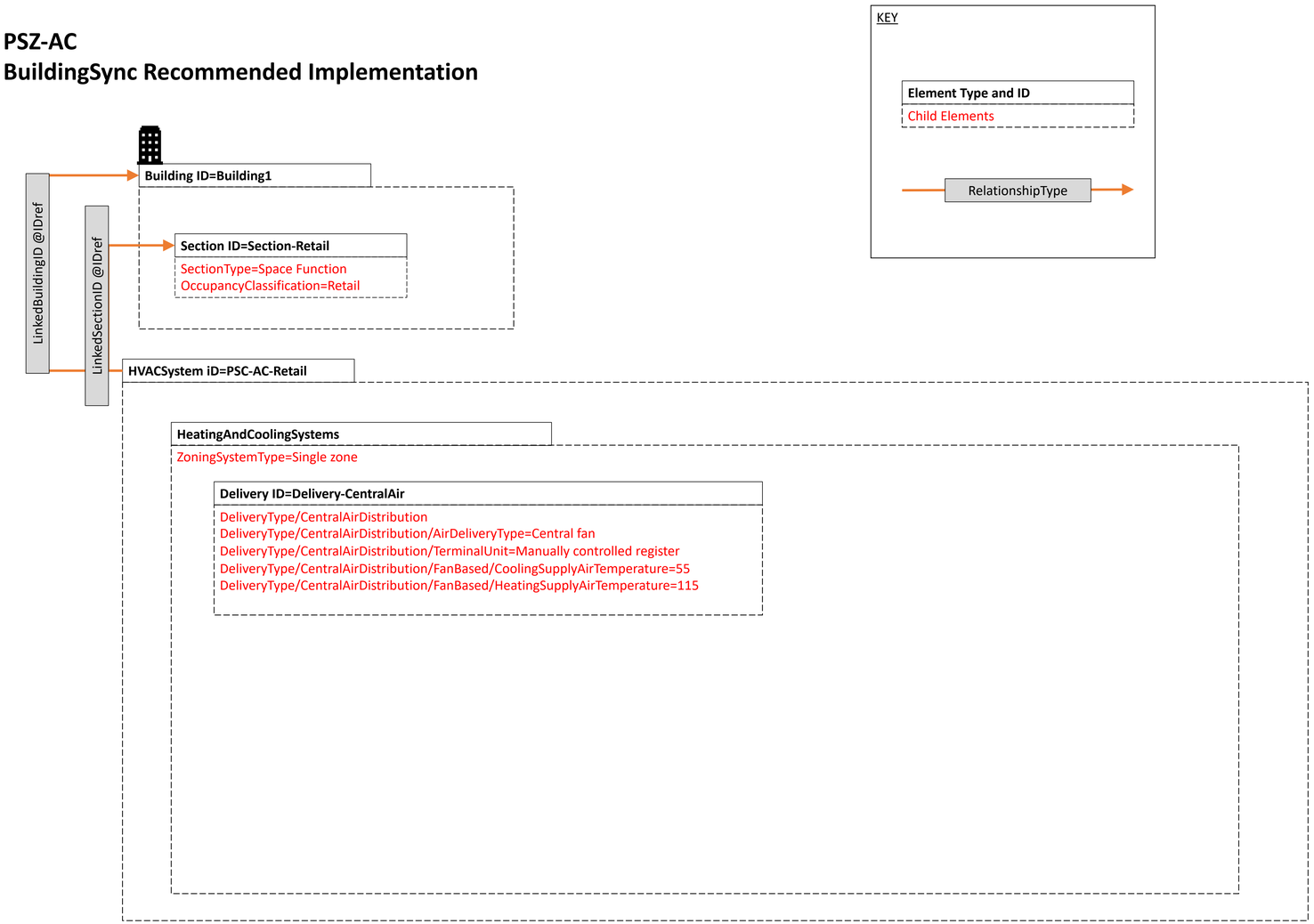
Modeling of a Packaged Single Zone AC System. Natural gas heating and DX cooling are used. Heating and coolinig both have two stages, with a two-stage fan as well.

PSZ-AC
BuildingSync Recommended Implementation



We will start with the same building and HVACSystem from last time, the main difference being there is only a single HVACSystem in this example

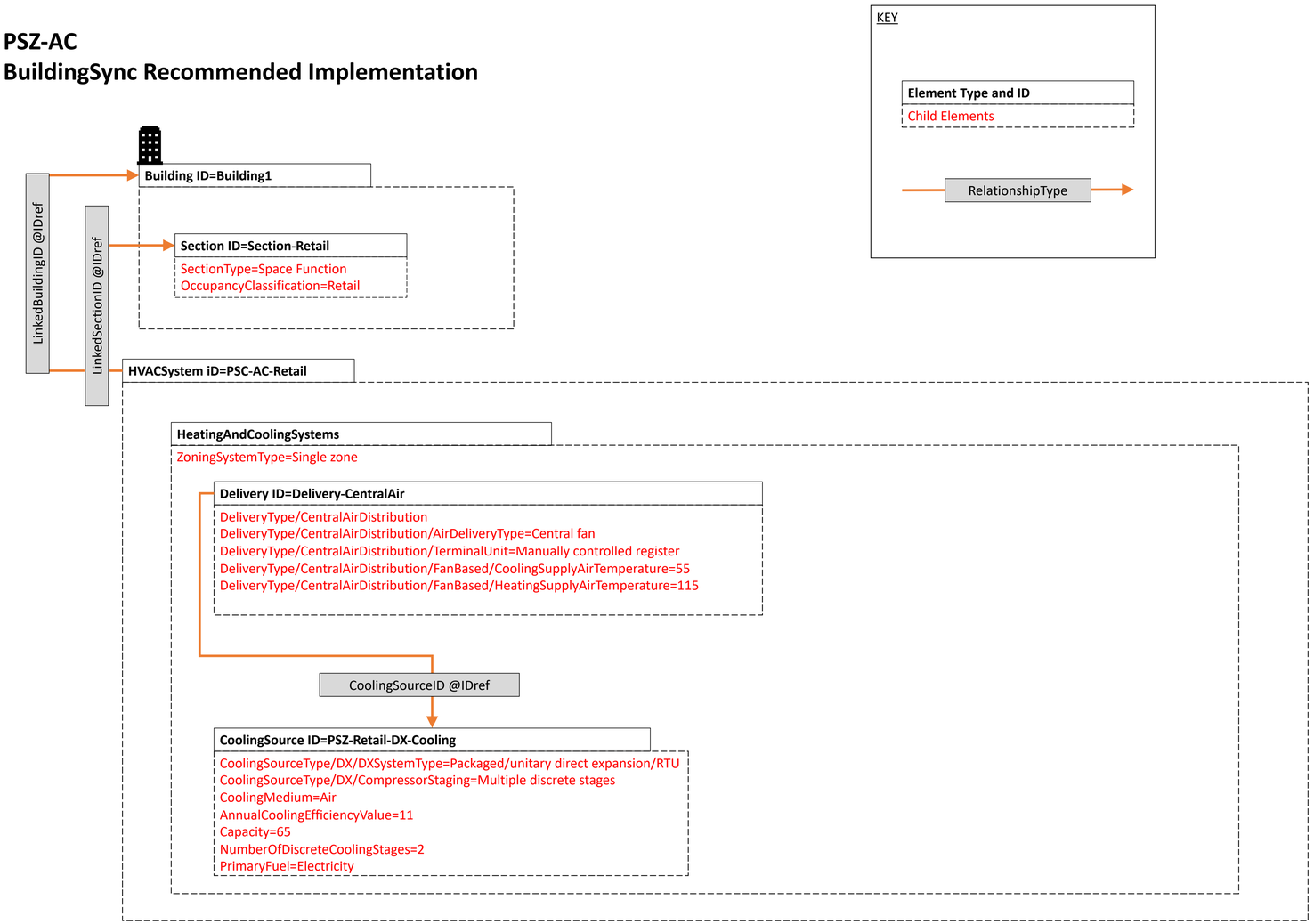
PSZ-AC
BuildingSync Recommended Implementation



Delivery

- The TerminalUnit is now specified as a Manually controlled register
- This is similar to a CAV terminal box with no reheat from last example

PSZ-AC
BuildingSync Recommended Implementation



CoolingSource

- Compressor staging can be specified
- Efficiency value and units specified
- OutputCapacity specified
- Cooling stages can be specified

PSZ-AC
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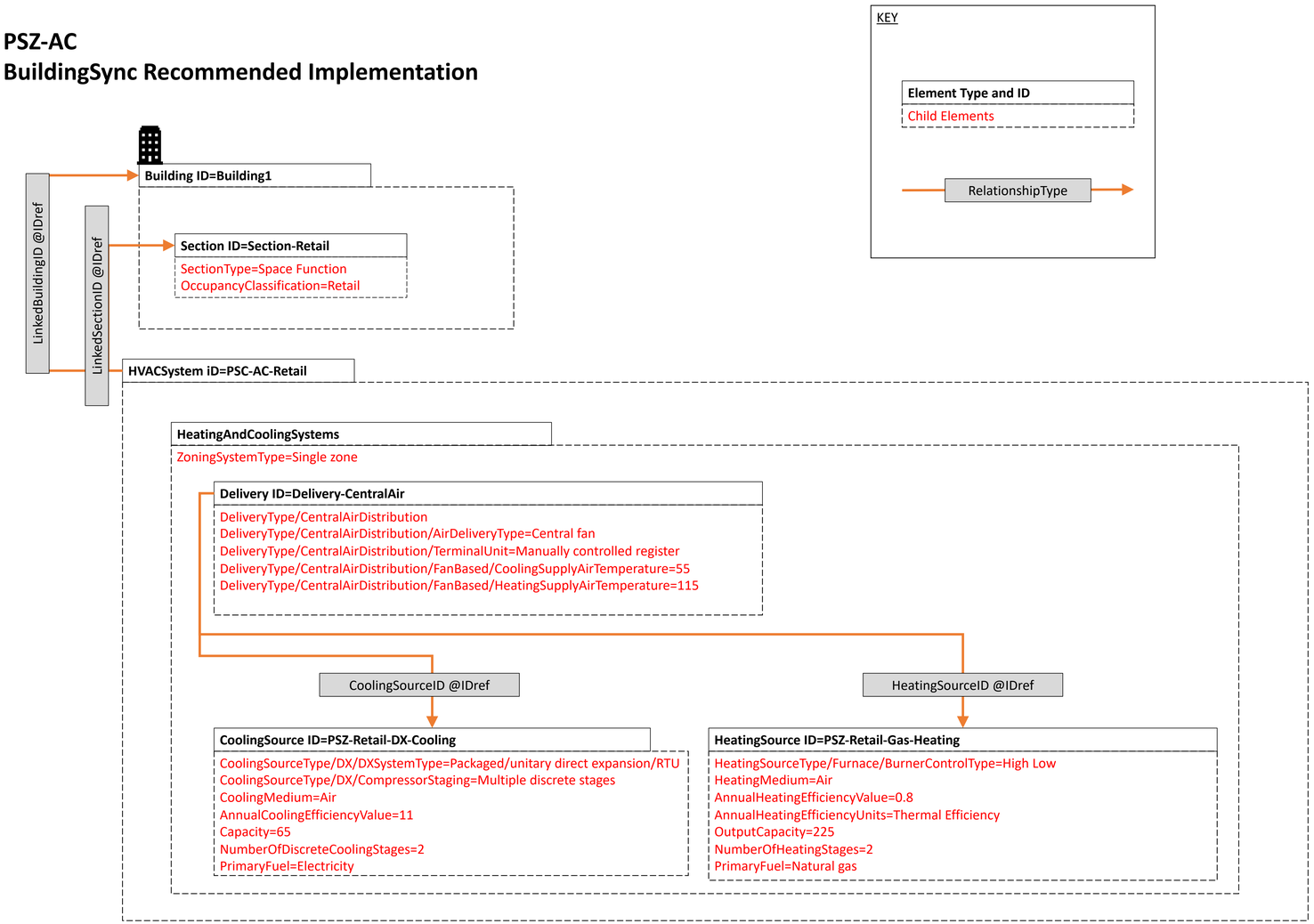

HeatingSource
- Efficiency value and units specified
- OutputCapacity specified
- Heating stages can be specified

PSZ-AC
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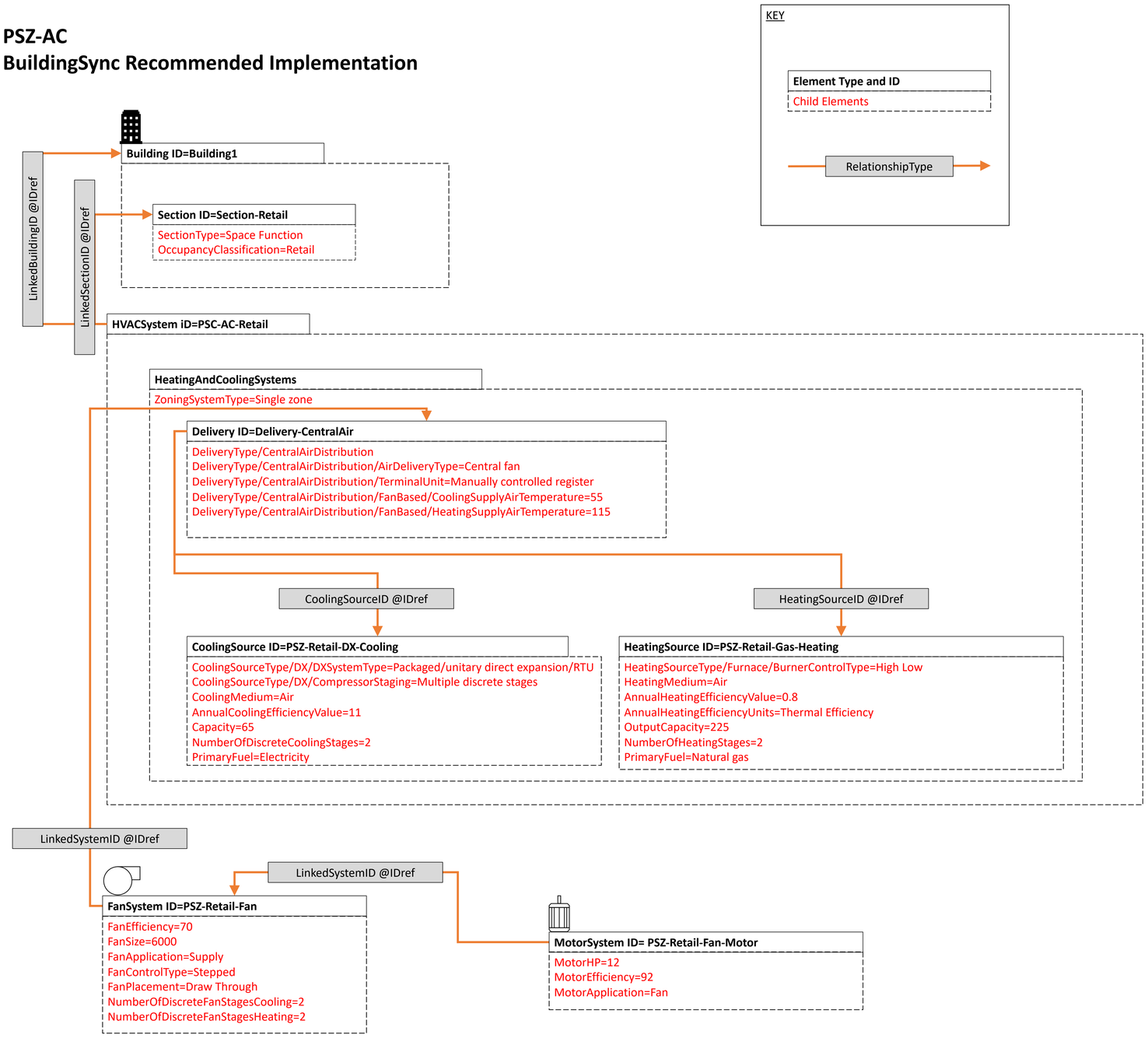

FanSystem

- Notice that fan staging can differ based on heating / cooling control type