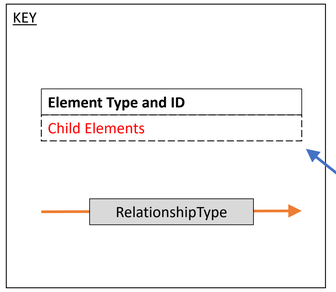
BuildingSync HVAC Systems Modeling Tutorial

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.

Table of Contents

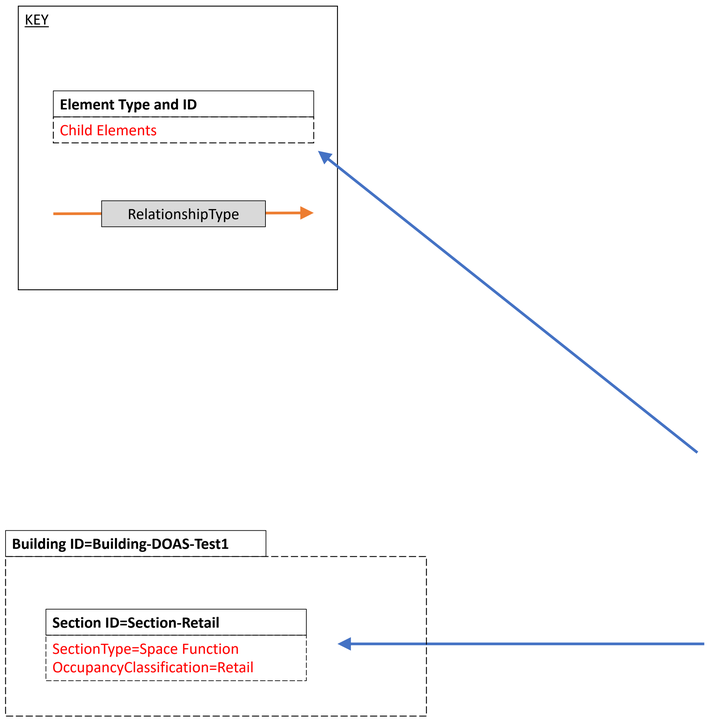
System Type[1]	Description	Status
PSZ-HP	Single stage heat pump, DX compressor, fan	Complete
PSZ-AC with gas coil	Two stages of heating, cooling, and fan	Complete
DOAS with fan coil air-cooled chiller with boiler	DOAS and FCU's fed by central chiller and boiler. The DOAS includes a thermal wheel. Three stages on Chiller and 3 stages on Boiler.	In Progress
VAV with reheat		Not Started
PVAV with PFP boxes		Not Started
VAV chiller with no reheat with zone heat pump		Not Started
Water source heat pumps cooling tower with boiler		Not Started
Fan coil chiller with district hot water		Not Started
Window AC with forced air furnace		Not Started
Direct evap coolers with gas unit heaters		Not Started

[1] The System Type definitions and systems modeled are intended to align with those from the create_typical_building_from_model enumerations, as well as provide significant overlap with ASHRAE 90.1 system types (90.1-2016 Table 11.5.2-1)



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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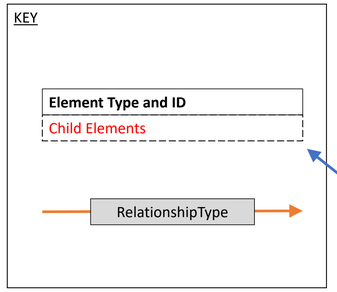
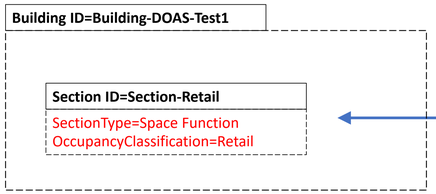
Nested components:

- 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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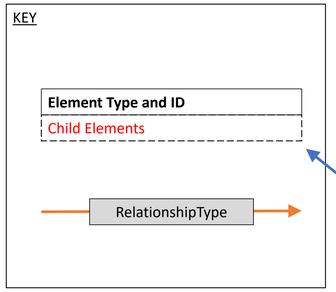

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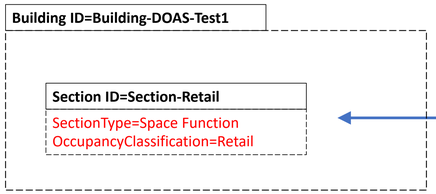

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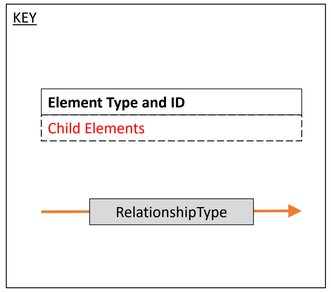
Example File:

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

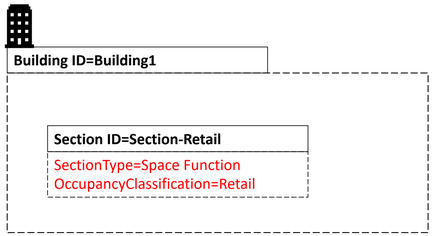
PSZ-HP System

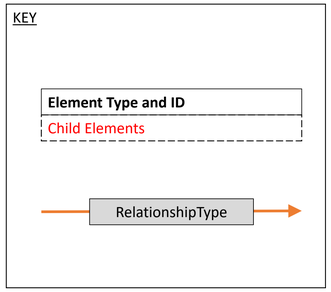
Modeling of a Single Zone Heat Pump System. Single stage heat pump, DX compressor, and fan.



This example will detail individual systems, elements, and the properties of the elements.

PSZ-HP
BuildingSync Recommended Implementation

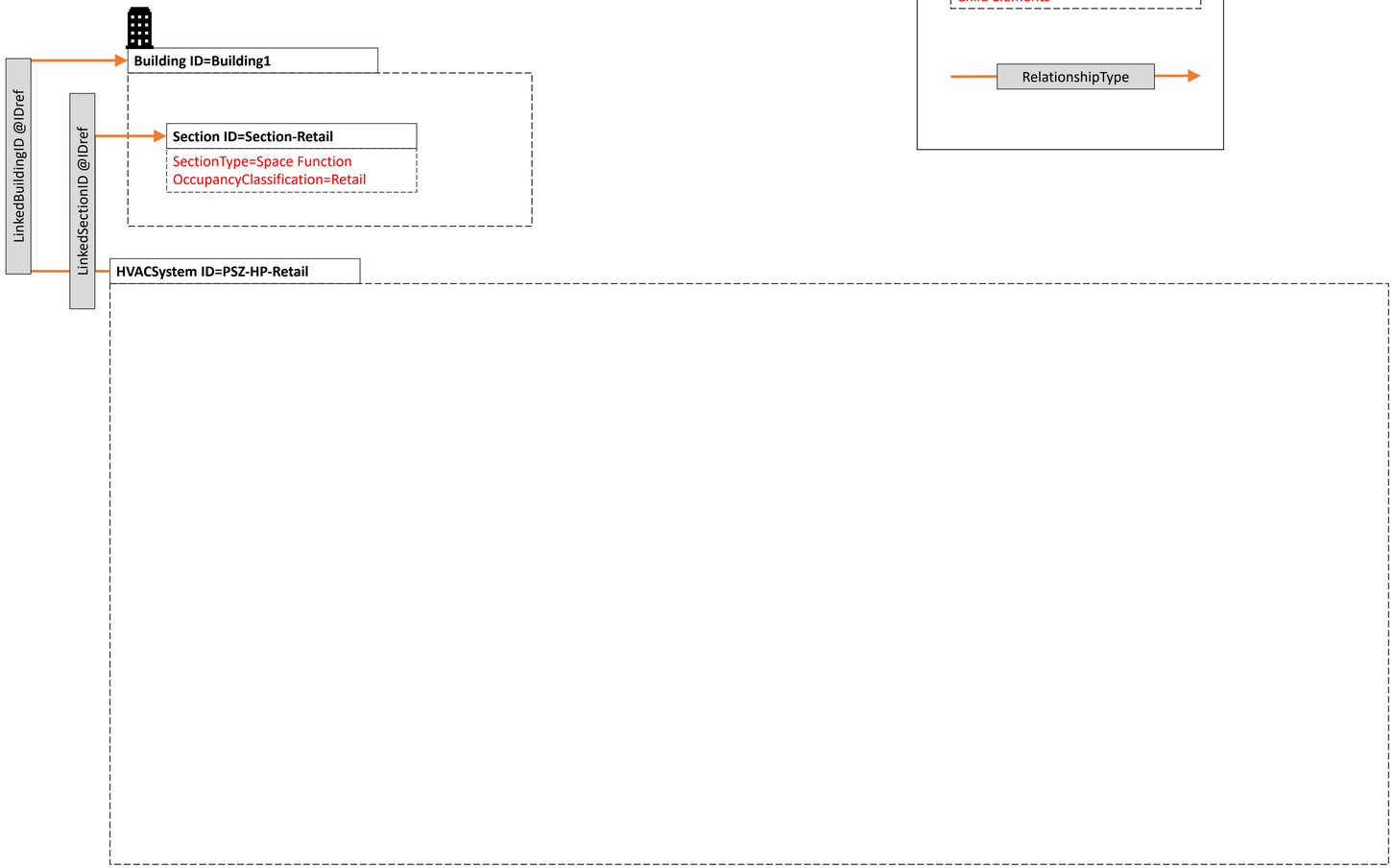


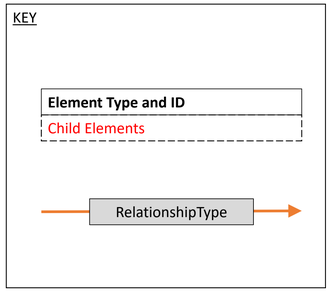


Building and Section

- 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

PSZ-HP
BuildingSync Recommended Implementation

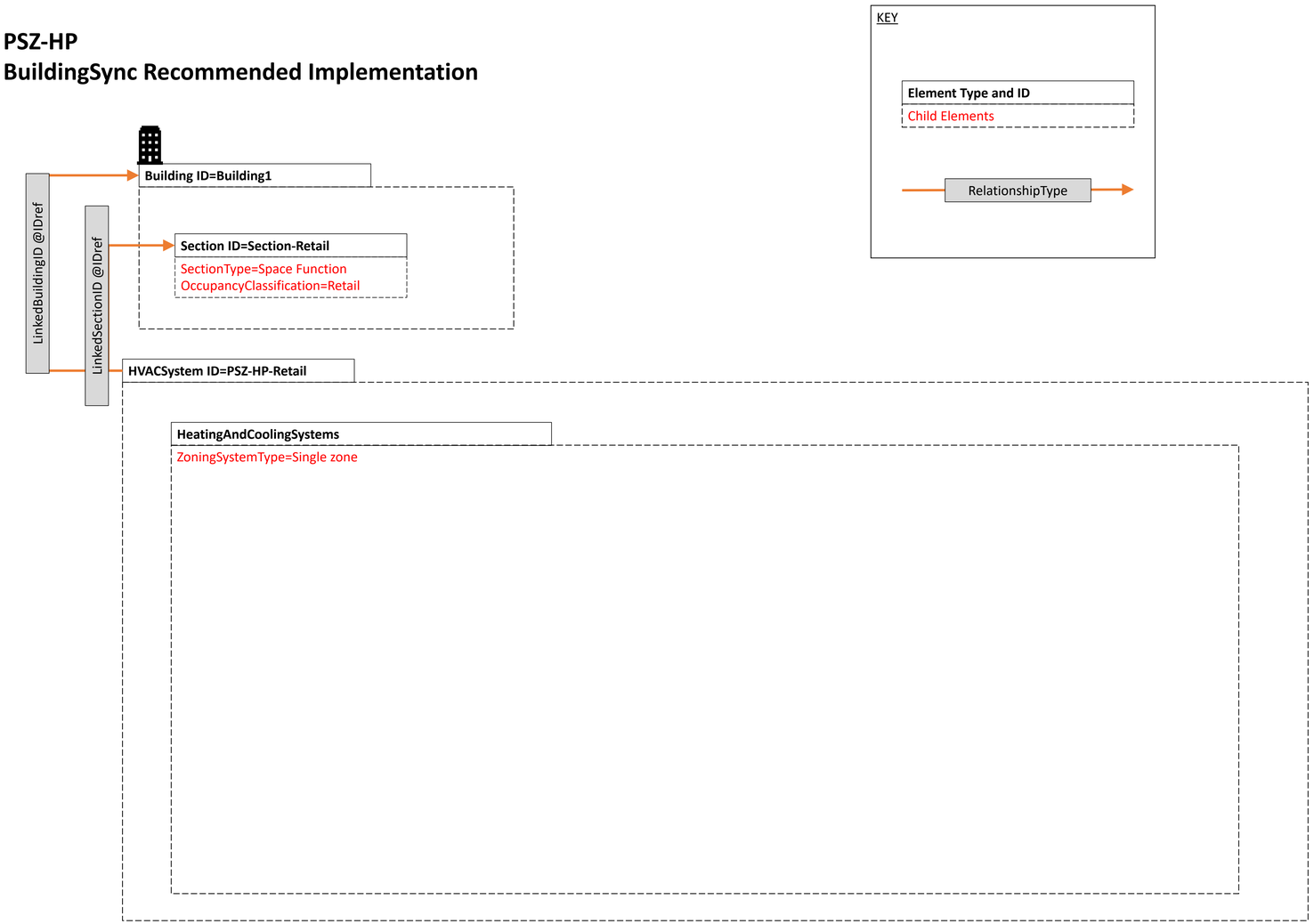




HVACSystem

- The HVACSystem element sits as a child element to:
  - Facility/Systems/HVACSystems
- This is the main wrapper element for things which will be performing space conditioning.
- For this example, we include just a single HVACSystem

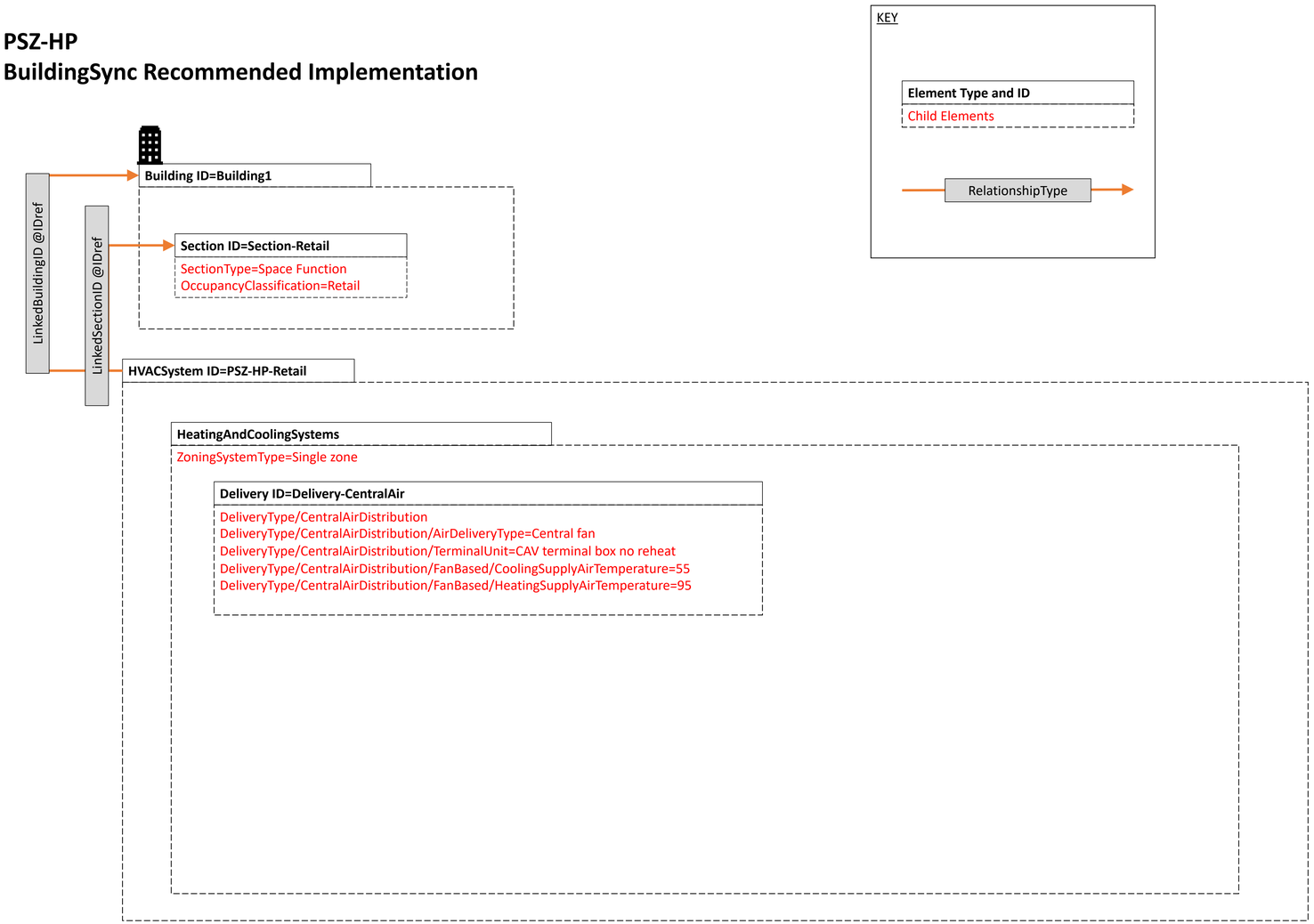
PSZ-HP
BuildingSync Recommended Implementation



HeatingAndCoolingSystems

- 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 HVACSystem serves 100% of the Gross Floor Area to which it is linked via the LinkedSectionID.

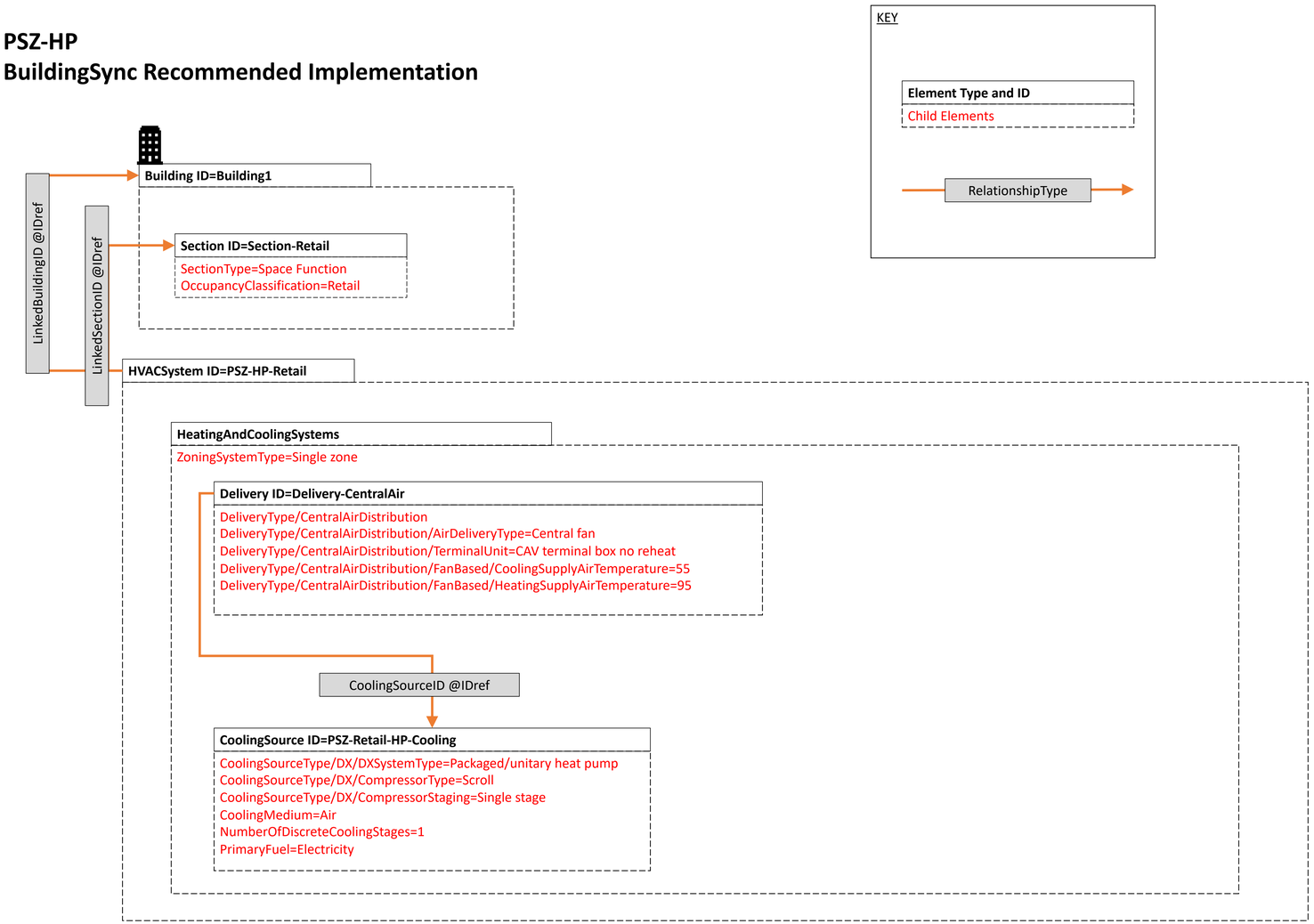
PSZ-HP
BuildingSync Recommended Implementation



Delivery

- 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.

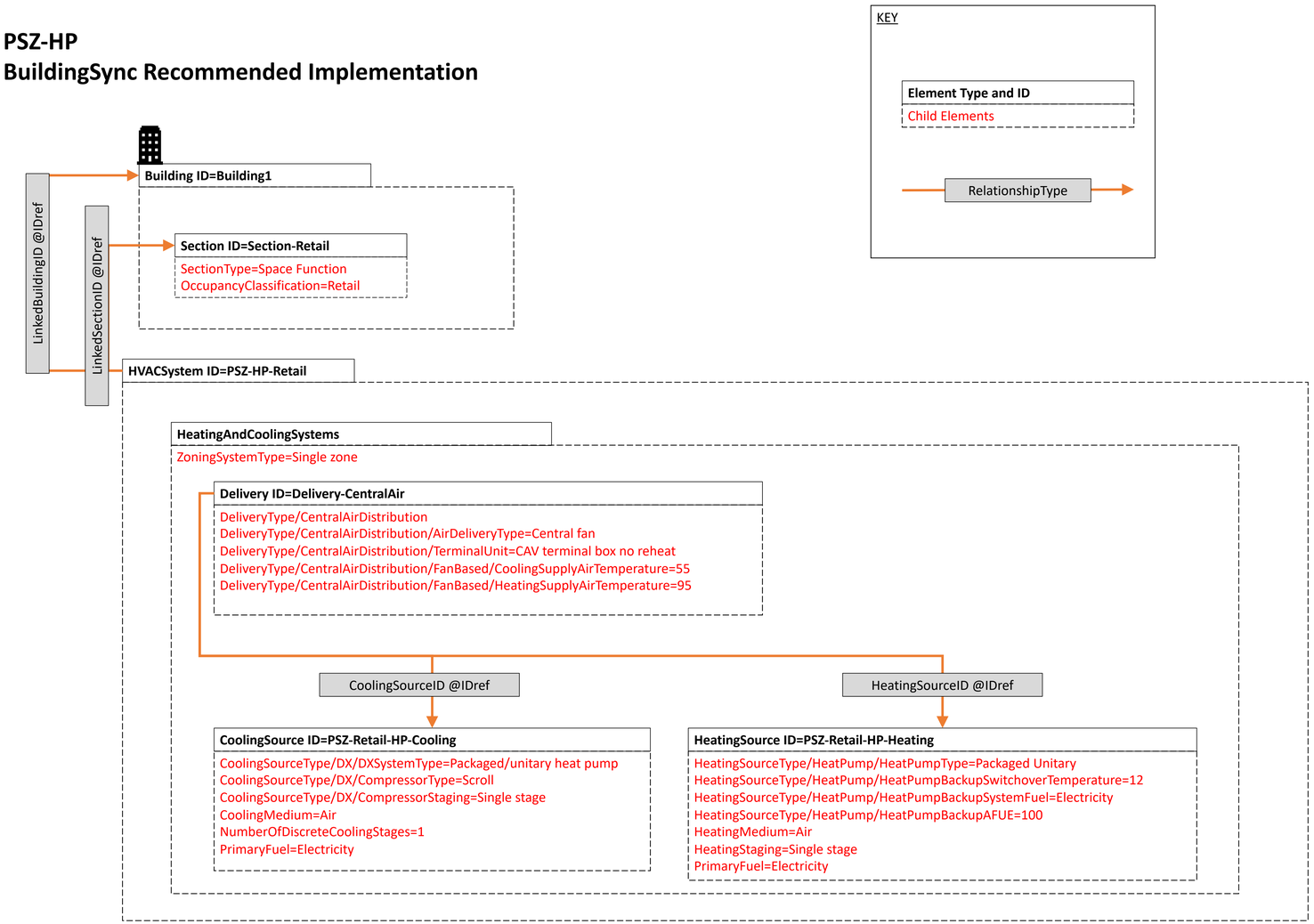
PSZ-HP
BuildingSync Recommended Implementation



<u>CoolingSource</u>

- Delivery is linked to a CoolingSource
- Here, the CoolingSourceType is specified as DX
- Specific information about the Compressor can be added, including number of stages and type

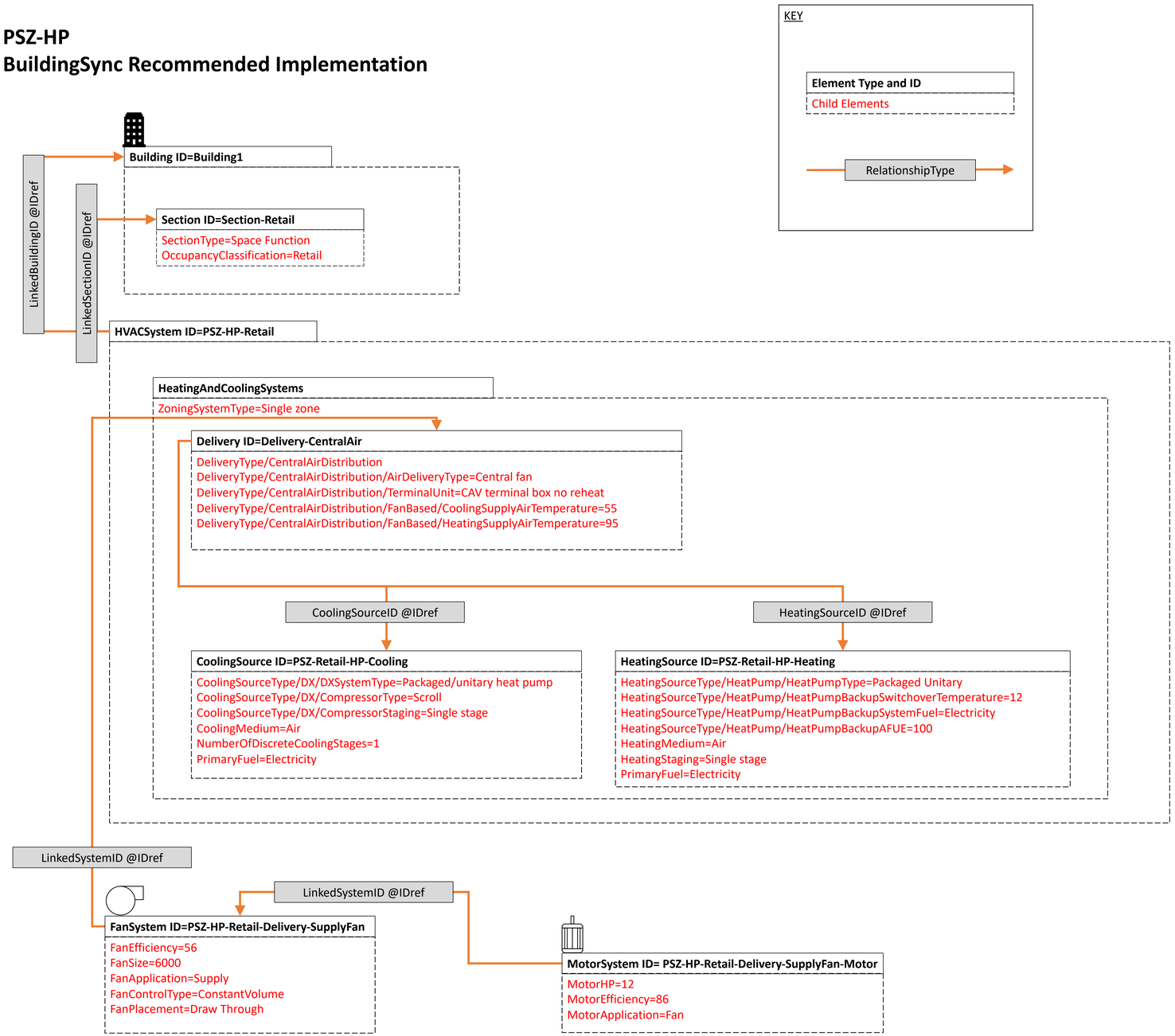
PSZ-HP
BuildingSync Recommended Implementation



HeatingSource

- Delivery is linked to a HeatingSource
- 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.

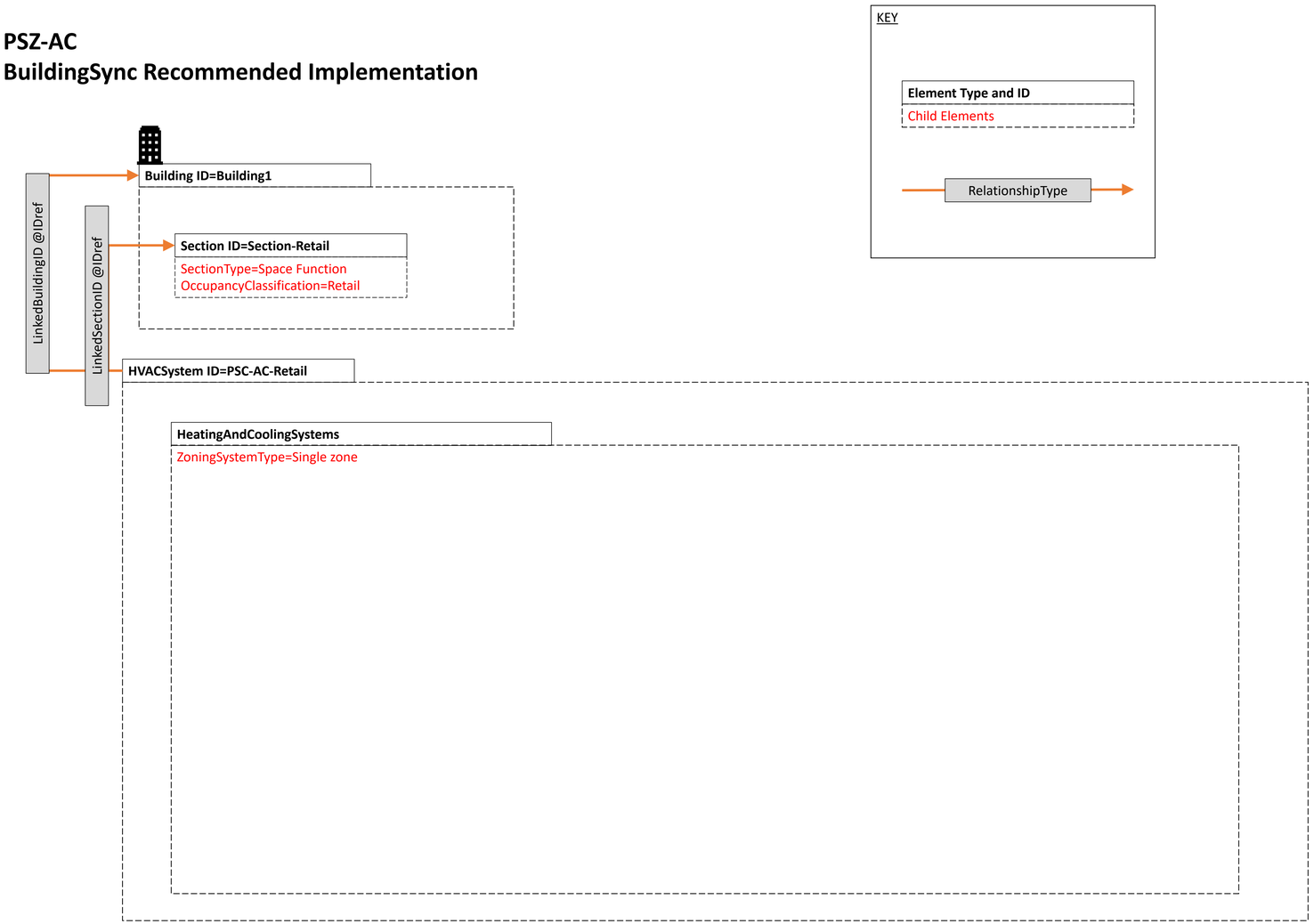
FanSystem

- 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 cooling both have two stages, with a two-stage fan as well.

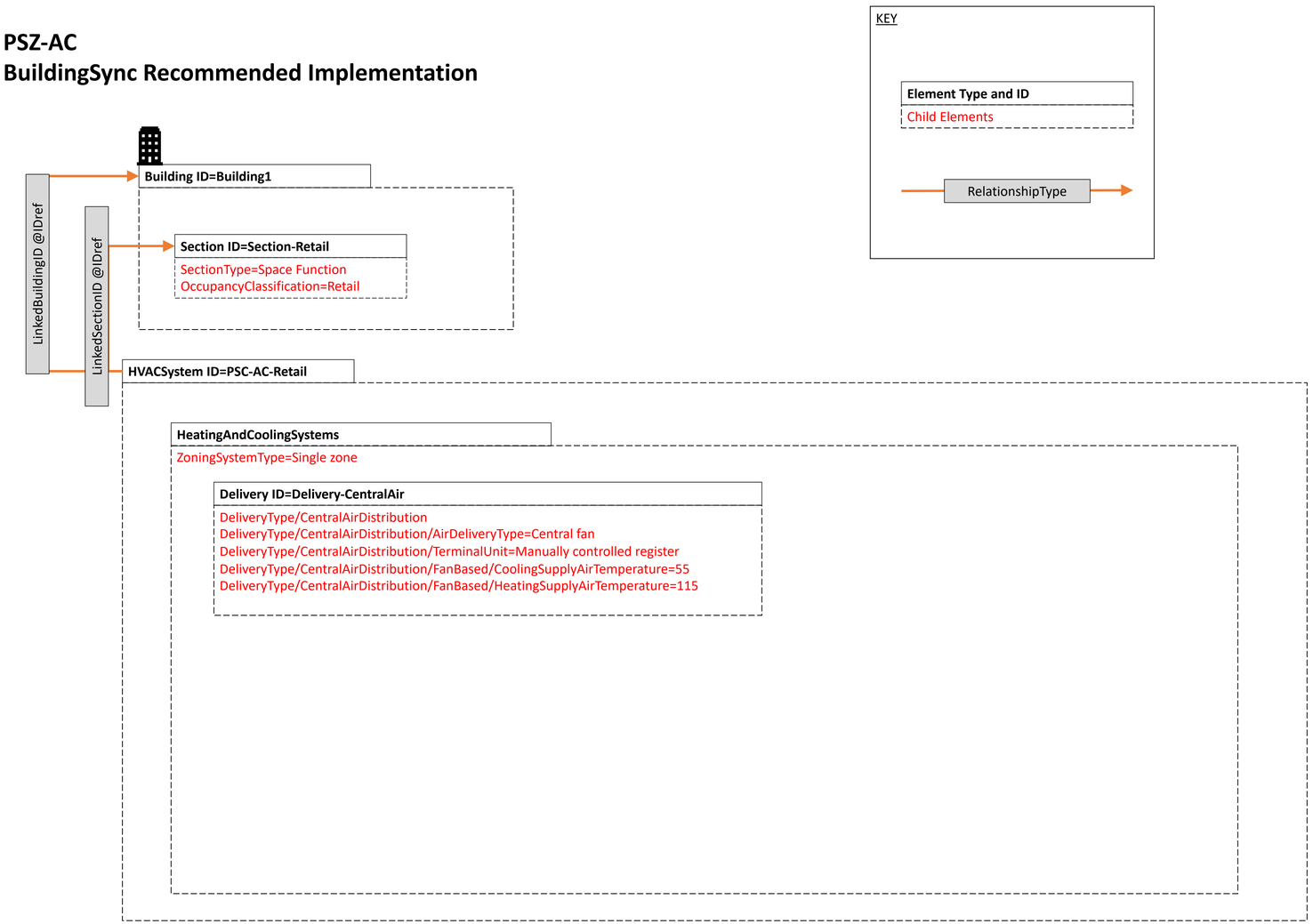
PSZ-AC
BuildingSync Recommended Implementation



Introduction

- We will start with the same Building, Section, and HVACSystem stub.
- The HeatingAndCoolingSystems element is also designated as a single zone via the:
  - ZoningSystemType=Single zone

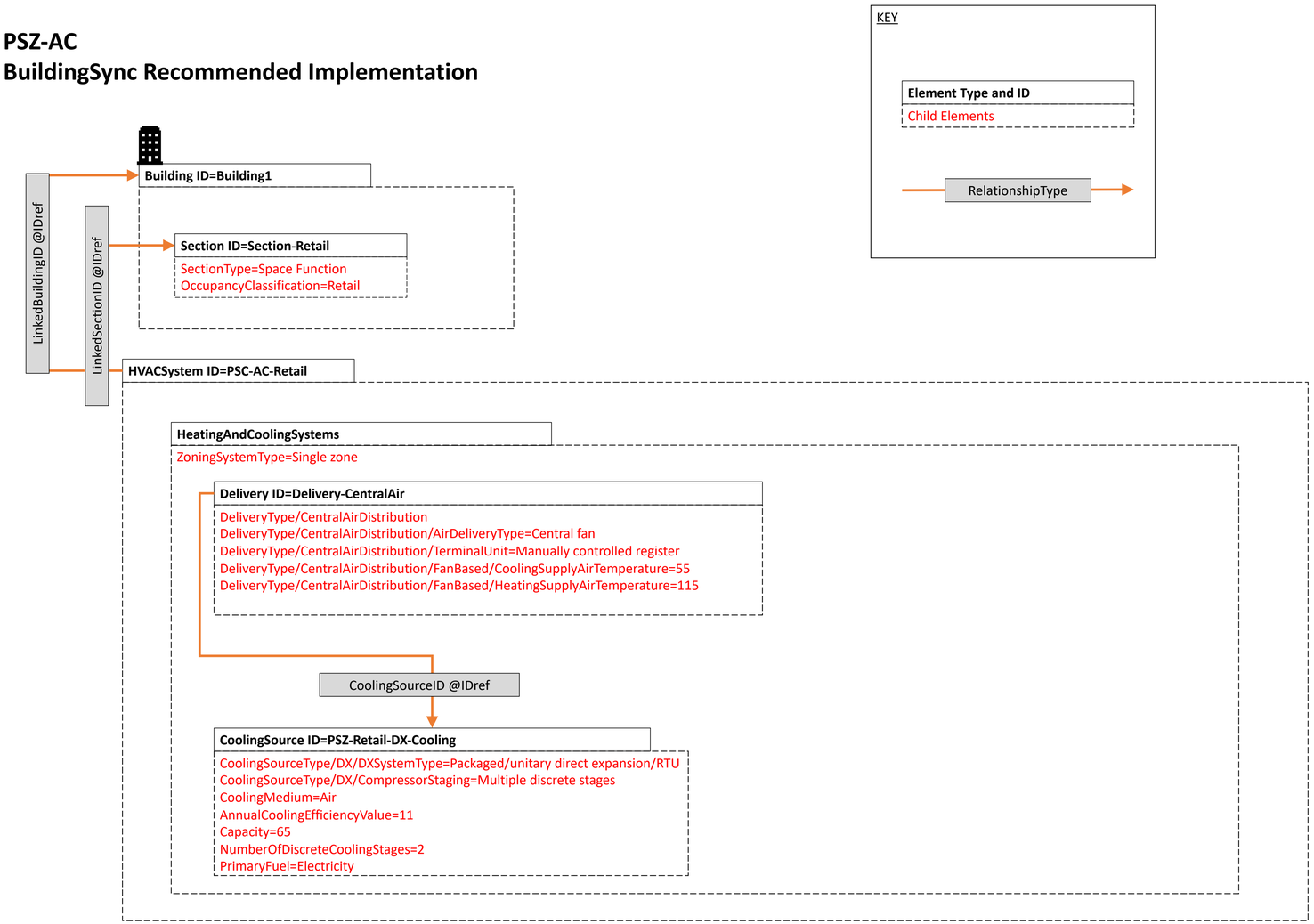
PSZ-AC
BuildingSync Recommended Implementation



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

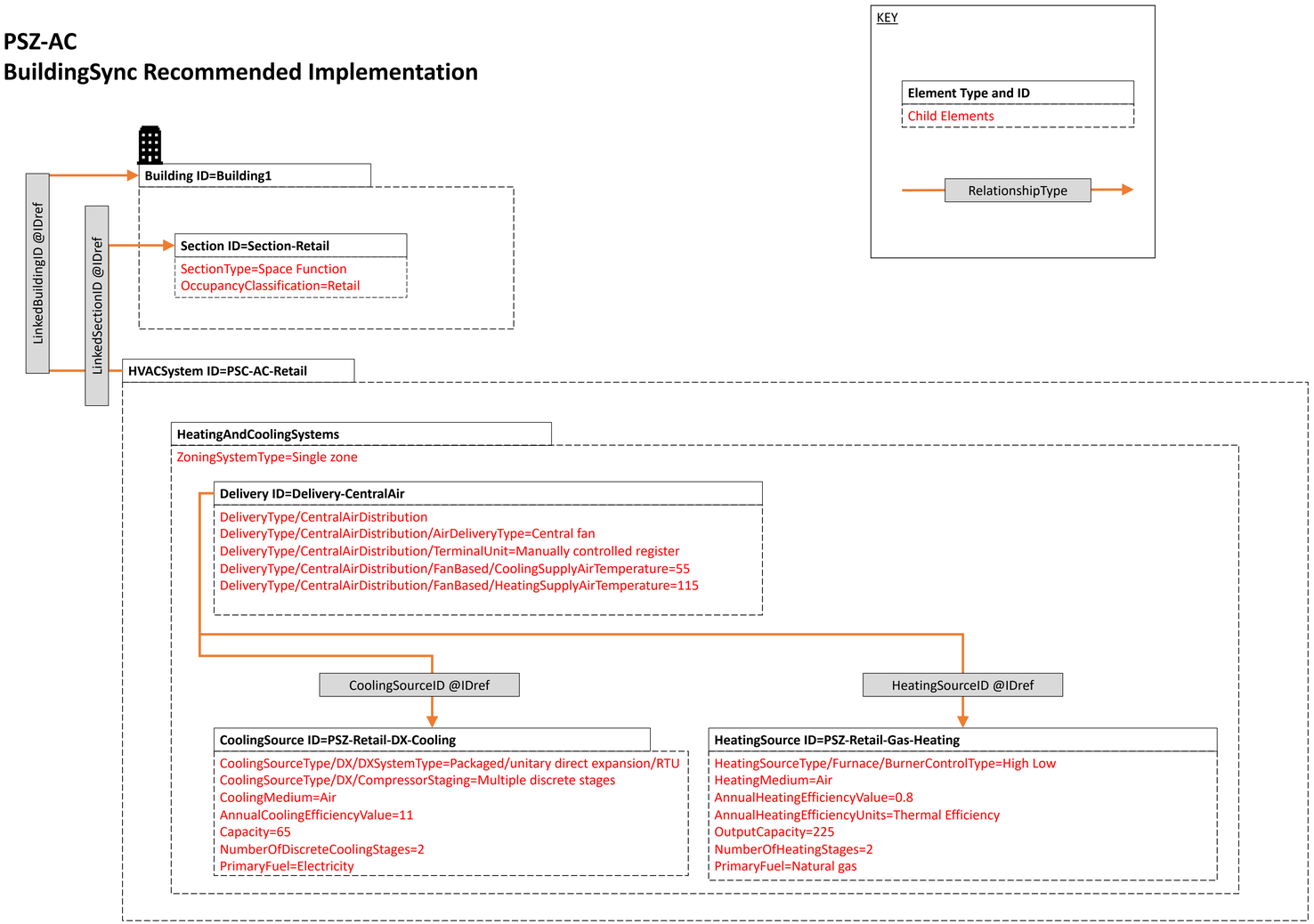
PSZ-AC
BuildingSync Recommended Implementation



CoolingSource

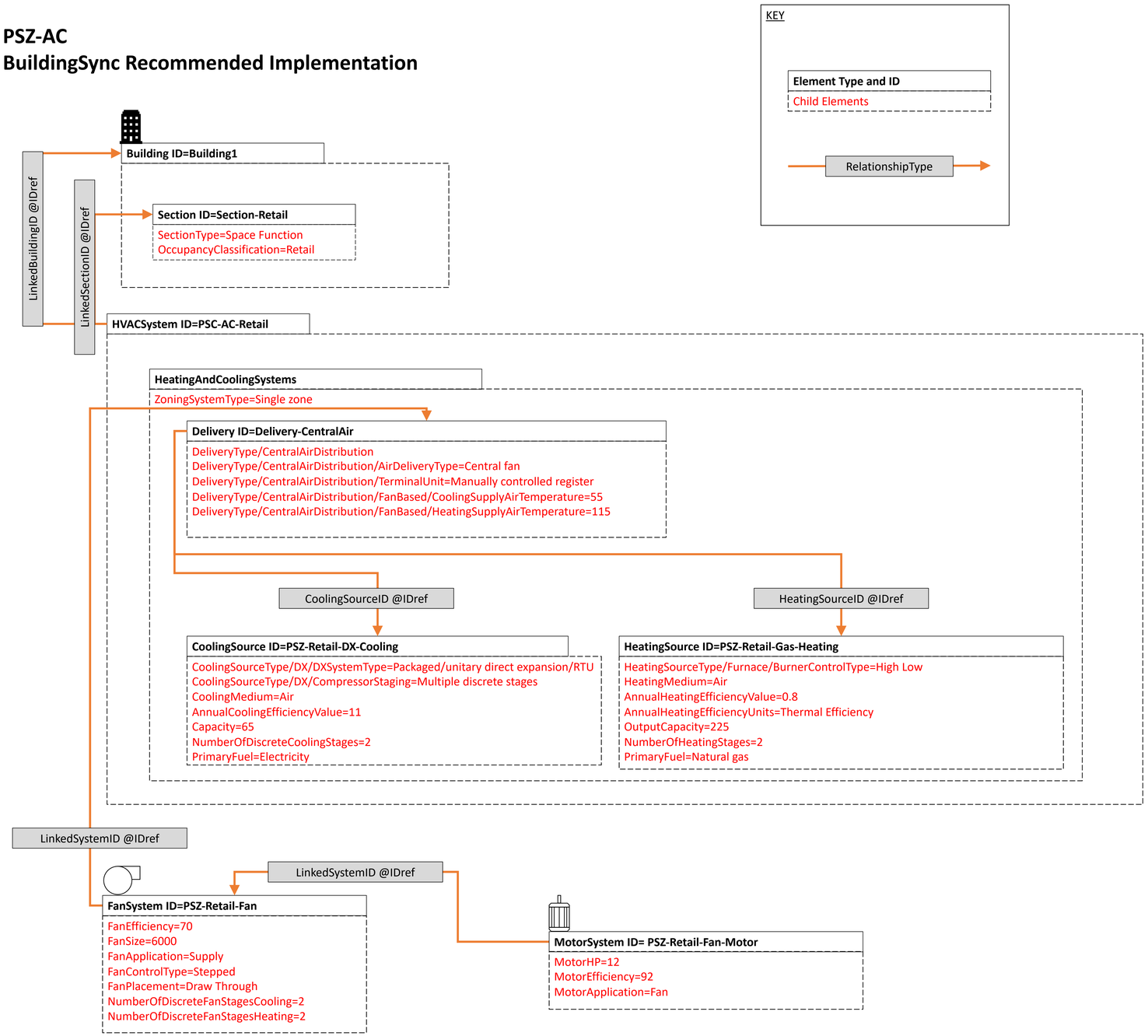
- Compressor staging can be specified
- Efficiency value and units specified
- OutputCapacity specified
- Cooling stages can be specified

PSZ-AC
BuildingSync Recommended Implementation



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

PSZ-AC
BuildingSync Recommended Implementation



FanSystem

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