Real-time AI Optimisation for AHU/VAV System

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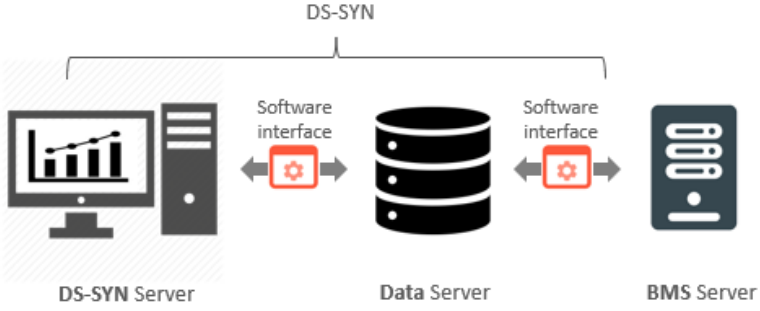
Most building HVAC systems operate in an open-loop fashion when it comes to the relationship between cooling demand and supply. When tenants require cooling, the Building Management System (BMS) calculates set points for the chiller plant and air handling units (AHUs) or variable air volume (VAV) systems based on instantaneous readings from the air and water sides of the system. This straightforward demand-and-supply approach, however, takes no account of airside thermal dynamics or the energy consumption characteristics of the waterside equipment. The result is that even a chiller system with a high efficiency rating can end up operating wastefully, simply because it is being used in ways that do not align with its optimal operating range.

The DS-SYN technology addresses this by replacing the conventional open-loop approach with a real-time, closed-loop demand-supply synchronisation solution. Rather than reacting to instantaneous readings, DS-SYN uses advanced data-driven models to understand and anticipate airside cooling needs alongside the waterside system's supply capability, then applies optimisation techniques to determine the best possible AHU and VAV set points at any given moment. Importantly, the solution does not directly alter waterside set points — instead, it influences waterside efficiency indirectly through smarter airside control. This makes the technology largely brand-agnostic, meaning it can be applied to HVAC systems regardless of the chiller brand in use.

The technology was validated in a Green Mark Platinum office building spanning more than 30,000 square metres across over 12 floors, with 20 AHUs and 500 VAVs. Without any additional hardware, sensors, or actuators — relying solely on the existing VAV control mechanisms within the BMS — DS-SYN delivered energy savings of more than 20%.

DS-SYN is applicable across a broad range of building types, including offices, shopping malls, hotels, and institutional buildings, provided they have a centralised BMS. While the solution is primarily software-based, it also offers proprietary sensor suites to supplement airside measurements in buildings where existing instrumentation is insufficient. The one key system requirement is that the BMS must be capable of controlling air supply rates in AHUs and VAVs through adjustable damper feedback or temperature set points — a condition met by most modern centralised systems, and one that enables DS-SYN to be deployed in a plug-and-play manner.



Applications:

- Scalable and smart HVAC control with brand-agnostic deployment

Capabilities:

- Real-time data-driven model learning and updating and performance prediction.
- Scalable real-time optimization to determine best AHU/VAV setpoints that meet airside cooling needs and lower waterside energy consumption waste.
- Fast response (in a few minutes) to each individual tenant's cooling needs.
- Brand-agnostic deployment, ensuring fast installation and low cost. In addition, any subsequent chiller system upgrade will not affect an existing DS-SYN system.

Benefits:

- Reduce building energy consumption by 20% in a large commercial building. In principle, the larger the building, the more VAVs, the higher the energy saving.
- Guaranteed satisfaction of thermal comfort stated by building owners.
- Fast and low-cost deployment, causing minimum interruption, and facilitating simple system maintenance and upgrade.
- Automatically identify operational status of VAVs and ambient sensors that can help users lower the HVAC maintenance cost and improve system responsiveness.

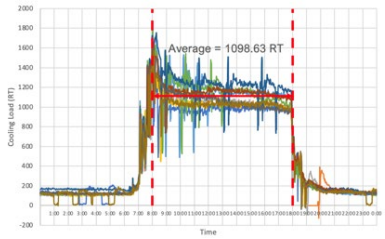
Estimated Energy Savings:

- 15 - 20% overall annually

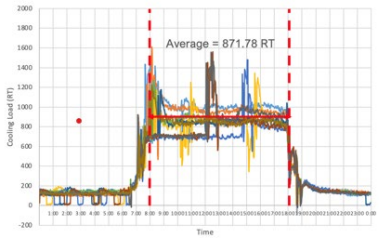
Estimated Payback Period:

- $\leq$ 1 year with the current Singapore electricity rate

In this deployment architecture, all learning and optimisation modules reside on the DS-SYN Server. A Data Server acts as an intermediary, periodically pulling real-time data from the BMS Server and storing it in a database accessible to the DS-SYN Server, while transmitting optimised VAV temperature set points back to the BMS Server via standard protocols such as BACnet or OPC UA. Once connected, the system begins delivering energy savings with minimal setup. The impact of this is illustrated in the cooling load comparison shown above, contrasting baseline performance in October 2023 with the reduced cooling load achieved after DS-SYN was deployed.



Baseline Daily Cooling Loads



DS-SYN Incurred Daily Cooling Loads

Adopted in Projects:

- Local operational office building.

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