



The Innovation Hub

for Affordable Heating and Cooling

Lesson Learnt Report

## Increasing the value of onsite renewables in Darwin through data driven analytics

Project DCH10

31 May 2022

Charles Darwin University



## About i-Hub

The Innovation Hub for Affordable Heating and Cooling (i-Hub) is an initiative led by the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) in conjunction with CSIRO, Queensland University of Technology (QUT), the University of Melbourne and the University of Wollongong and supported by Australian Renewable Energy Agency (ARENA) to facilitate the heating, ventilation, air conditioning and refrigeration (HVAC&R) industry's transition to a low emissions future, stimulate jobs growth, and showcase HVAC&R innovation in buildings.

The objective of i-Hub is to support the broader HVAC&R industry with knowledge dissemination, skills-development and capacity-building. By facilitating a collaborative approach to innovation, i-Hub brings together leading universities, researchers, consultants, building owners and equipment manufacturers to create a connected research and development community in Australia.

**This Project received funding from ARENA as part of ARENA's Advancing Renewables Program. The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.**



Primary Project Partner

Charles Darwin University

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## The i-Hub Initiatives



**SMART BUILDING  
DATA CLEARING HOUSE**



**LIVING LABORATORIES -  
GREEN PROVING GROUNDS**



**INTEGRATED  
DESIGN STUDIOS**



## i-Hub Lessons Learnt Report

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Sub-Project number	DCH10		
Sub-Project commencement date	December 2021	Completion date	June 2022
Report date	May 2022		
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## Lessons learnt

Lesson learnt #1 Opportunities to improve remote access to building management systems						
<b>Category</b>	Technical					
<i>Choose from:</i>	<i>Technical</i>	<i>Commercial</i>	<i>Social</i>	<i>Regulatory</i>	<i>Logistical</i>	<i>Other (specify)</i>
Describe what you learnt about this aspect of the Project.						
<p>Cybersecurity protocols within organisations can present a challenge in configuring the gateway to share data and applications between the DCH and the client's building management system (BMS). In this project, engineers at CSIRO were not able to directly access CDU or City of Darwin's VPN due to cybersecurity policies. Several solutions were tested, but in the end an off-the-shelf Microsoft Windows 10 license was purchased by CSIRO and installed on a virtual machine (VM). CSIRO's VPN was disabled, CDU and City of Darwin's VPN software were downloaded on the VM and network testing was done. A Niagara license was also purchased to be used on the VM. Ports tcp_4911 and tcp_5011 were opened for our VPN access, while UDP and tcp_8883 were opened for the Jace gateway itself. This allowed us to configure and maintain the Jace remotely and send the site data to the DCH MQTT broker.</p>						
Please describe what you would do differently next time and how this would help. What are the implications for future Projects?						
<p>This was the first project where CSIRO maintained the clients' gateways and this solution proved to be a scalable, secure and inexpensive method when working outside of an organisation's firewall to configure and maintain and send data to the DCH. IF the clients contract BMS or IoT providers, CSIRO is no longer providing JACE maintenance and onboarding would not require Cybersecurity risk mitigations and the JACE can be managed by the providers with access to the client's network.</p>						
If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.						
<p>Increasing focus of organisations on managing cybersecurity threats means that configuring and maintaining Jaces to transfer data across different networks is likely to remain a challenge that needs to be considered in project design and inception. There is the need to consider cross domain solutions that enable efficient sharing of data and information while considering cybersecurity protocols.</p>						



**Lesson learnt #2 Challenges in onboarding legacy buildings**

<b>Category</b>	Technical/social					
<i>Choose from:</i>	<i>Technical</i>	<i>Commercial</i>	<i>Social</i>	<i>Regulatory</i>	<i>Logistical</i>	<i>Other (specify)</i>

Describe what you learnt about this aspect of the Project.

Two of the BMSs onboarded related to legacy buildings (Civic Centre – City of Darwin, and Blue 1 – CDU). This has presented challenges in terms of the health of data that was ingested. Specific issues identified included:

- No firewall between buildings at CDU, which meant that tens of thousands of points were ingested – with unclear labelling of points this obscured access to relevant data
- Stale or faulty data points that provided no data or a single value with no temporal variation that did not reflect expected behaviour (e.g., energy demand profile for chillers). Further conversation with the BMS provider and facility managers at CDU is required to debug these issues and identify the correct HVAC and Plant points.
- The BMS device itself (which contains HVAC and Plant points) was completely hidden from the JACE. The BMS uses Schneider I/NET protocol instead of BACnet. JACE does not have an I/NET driver since it is a dedicated Schneider protocol. Software-based gateways or additional hardware is required to ingest the data from the BMS.
- BMS vs. EMS data at City of Darwin site: The only device exposed to the JACE gateway at the Civic Centre site, was the EMS which measured some 3-phase power and energy points. These points were not labelled properly and it was difficult to understand their origin.

Please describe what you would do differently next time and how this would help. What are the implications for future Projects?

There is the need for ongoing, effective coordination from the start of the project between BMS provider, IT team and facilities teams to ensure JACE can access relevant data and identify then address data quality issues. This is particularly critical for older buildings where knowledge of the system can be lacking with redundant points and inadequate documentation. Onboarding of legacy buildings presents a challenge as the understanding of the BMS is often fragmented across the organisation and the BMS service provider, while staff turnover can present challenges in knowledge retention given inadequate documentation and lack of data to ensure quality.

If the BMS is a Schneider product, we need to ensure the device is installed on the BACnet rather than I/NET.

Examples of issues encountered for onboarding is included below

📍 Bacnet Discover Devices

Discovered

Device Name	Device ID	Netwk	MAC Addr
BL1-AHU01-VAV14	device:10114	34	2
BL1-AHU01-VAV14	device:10114	34	2
BL1-AHU01-VAV15	device:10115	34	3
BL1-AHU01-VAV15	device:10115	34	3
BL1-AHU01-VAV16	device:10116	34	4
BL1-AHU01-VAV16	device:10116	34	4
BL1-AHU01-VAV17	device:10117	34	5
BL1-AHU01-VAV17	device:10117	34	5
BL1-AHU01-VAV18	device:10118	34	6
BL1-AHU01-VAV18	device:10118	34	6
BL1-AHU01-VAV19	device:10119	34	7
BL1-AHU01-VAV19	device:10119	34	7
BL1-AHU01-VAV20	device:10120	34	8
BL1-AHU01-VAV20	device:10120	34	8
BL1-AHU01-VAV22	device:10122	34	10

Figure 1: Blue 1 (CDU) – No proper MAC address to refer to

📍 Bacnet Discover Points

Discovered

Object Name	Object ID	Property ID	Index	Value
Stack:Unresolved device address:analogInput:101 [objectName]	analogInput:101	presentValue		Stack:Unresolved device address:analogInput:101 [presentValue]
Stack:Unresolved device address:analogInput:102 [objectName]	analogInput:102	presentValue		Stack:Unresolved device address:analogInput:102 [presentValue]
Stack:Unresolved device address:analogInput:103 [objectName]	analogInput:103	presentValue		Stack:Unresolved device address:analogInput:103 [presentValue]
Stack:Unresolved device address:analogInput:104 [objectName]	analogInput:104	presentValue		Stack:Unresolved device address:analogInput:104 [presentValue]
Stack:Unresolved device address:analogInput:105 [objectName]	analogInput:105	presentValue		Stack:Unresolved device address:analogInput:105 [presentValue]
Stack:Unresolved device address:analogInput:106 [objectName]	analogInput:106	presentValue		Stack:Unresolved device address:analogInput:106 [presentValue]
Stack:Unresolved device address:analogInput:107 [objectName]	analogInput:107	presentValue		Stack:Unresolved device address:analogInput:107 [presentValue]
Stack:Unresolved device address:analogInput:108 [objectName]	analogInput:108	presentValue		Stack:Unresolved device address:analogInput:108 [presentValue]
Stack:Unresolved device address:analogInput:109 [objectName]	analogInput:109	presentValue		Stack:Unresolved device address:analogInput:109 [presentValue]
Stack:Unresolved device address:analogInput:110 [objectName]	analogInput:110	presentValue		Stack:Unresolved device address:analogInput:110 [presentValue]
Stack:Unresolved device address:analogInput:112 [objectName]	analogInput:112	presentValue		Stack:Unresolved device address:analogInput:112 [presentValue]
Stack:Unresolved device address:analogInput:113 [objectName]	analogInput:113	presentValue		Stack:Unresolved device address:analogInput:113 [presentValue]
Stack:Unresolved device address:analogInput:114 [objectName]	analogInput:114	presentValue		Stack:Unresolved device address:analogInput:114 [presentValue]
Stack:Unresolved device address:analogInput:115 [objectName]	analogInput:115	presentValue		Stack:Unresolved device address:analogInput:115 [presentValue]
Stack:Unresolved device address:analogInput:116 [objectName]	analogInput:116	presentValue		Stack:Unresolved device address:analogInput:116 [presentValue]
Stack:Unresolved device address:analogInput:117 [objectName]	analogInput:117	presentValue		Stack:Unresolved device address:analogInput:117 [presentValue]
Stack:Unresolved device address:analogInput:118 [objectName]	analogInput:118	presentValue		Stack:Unresolved device address:analogInput:118 [presentValue]

Figure 2: Pink 9 (CDU) – Points are unresolved

Database						
Name	Exts	Device ID	Status	Netwk	MAC Addr	
Blue1						
Pink9						
BL1-AHU01-VAV14		device:10114	{ok}	34	2	
BL1-AHU01-VAV15		device:-1	{fault}	34	2	
BL1-AHU01-VAV16		device:10115	{ok}	34	3	
BL1-AHU01-VAV17		device:-1	{fault}	34	3	
BL1-AHU01-VAV18		device:10116	{ok}	34	4	
BL1-AHU01-VAV19		device:-1	{fault}	34	4	
BL1-AHU01-VAV20		device:10117	{ok}	34	5	
BL1-AHU01-VAV21		device:-1	{fault}	34	5	
BL1-AHU01-VAV22		device:10118	{ok}	34	6	
BL1-AHU01-VAV23		device:-1	{fault}	34	6	
BL1-AHU01-VAV24		device:10119	{ok}	34	7	
BL1-AHU01-VAV25		device:-1	{fault}	34	7	
BL1-AHU01-VAV26		device:10120	{ok}	34	8	
BL1-AHU01-VAV27		device:-1	{fault}	34	8	
BL1-AHU01-VAV28		device:10122	{ok}	34	10	
BL1-AHU01-VAV29		device:-1	{fault}	34	10	
BL1-AHU01-VAV30		device:10124	{ok}	34	12	
BL1-AHU01-VAV31		device:-1	{fault}	34	12	
BL1-AHU01-VAV32		device:-1	{fault}	34	12	
BL1-AHU01-VAV33		device:10125	{ok}	34	13	
BL1-AHU01-VAV34		device:-1	{fault}	34	13	

Figure 3: Blue 1 (CDU) – Faulty nodes



**Lesson learnt #3** Define focus of energy demand opportunities and renewables optimisation as bottom-up process that focuses onboarding

<b>Category</b>	Social					
<i>Choose from:</i>	<i>Technical</i>	<i>Commercial</i>	<i>Social</i>	<i>Regulatory</i>	<i>Logistical</i>	<i>Other (specify)</i>

Describe what you learnt about this aspect of the Project.

The project was initiated with several meetings between project partners to identify steps needed to onboard, which included:

- Identifying key personnel across facilities and IM&T
- Permissions needed to install Jace and access data
- Information on building plans
- Discussion on opportunities for using onboarded to identify opportunities for energy demand management and optimising building management operations

A presentation was organised for facility managers (City of Darwin and CDU) that highlighted applications of the DCH to optimise building management. However, ideas were being proposed by the project team rather than being elicited from the facilities team based on their needs, which meant there was perhaps sometimes a lack of clarity and engagement on the purpose of the onboarding.

Please describe what you would do differently next time and how this would help. What are the implications for future Projects?

The project should be initiated with a focussed workshop that involves all key parties to scope out a relevant and feasible focus for the onboarding that addresses an operational priority for the building. There is the need for a co-development process in identifying the intended optimisation of demand management and renewables strategies to ensure it can be supported by available applications and the sensors and information flows available through the BMS. Ensuring that specific strategy to be explored has high-level sign off and support in the organisation can motivate and engage staff, as well as ensure that BMS service providers are involved.

If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.