

Energy Security Interface

Red Crater’s Energy Security Interface (ESI) utilizes physical security to provide intelligent control of lighting and air-conditioning for optimal energy efficiency.

ESI is a software system which uses the Cardax FT security platform and attached security devices to monitor security status of rooms and alarm zones, then intelligently instructs the building management system (BMS) to control air-conditioning and lighting. It uses motion sensors to detect actual room occupancy, security switches for contraindications (such as doors being left open) and alarm zones to determine arming status as input parameters for its energy control algorithm. It also comes with a SQL Server database which allows lighting and air-conditioning to be controlled via booking schedules to support preparatory room heating and lighting.

ESI will interface to any building management system which supports the BACnet control protocol. However, if there is no building management system, or the building management system does not control all of the lighting and air conditioning appliances, the ESI Solution can control lighting and air conditioning directly through power control relays.

Significant savings on electricity costs can be achieved with the added benefit of improved awareness among personnel of practical initiatives to reduce their electricity consumption and impact on the environment. For example, this solution has saved St Peter’s School 50% on their air-conditioning costs with return on investment in only 14 months whilst also raising environment awareness of staff and pupils.

How it works

ESI automatically turns lighting and air conditioning on and off based on whether rooms are scheduled to be used, or whether the rooms are actually occupied. It uses a variety of control methods ranging from simple schedule-only control to a combination of scheduled, occupation detection, manual override and alarm zone controlled.

Control Method	How it works
Scheduled Control	<p>The Scheduled Control method uses either the built-in SQL Server database or an external database to determine when rooms are to be used, and turns the air-conditioning and lighting on and off accordingly.</p> <p>This provides people who are using stand alone air-conditioners much more sophisticated control of when units operate, well beyond that which is possible through the air-conditioners’ own built-in timers. It also offers people who are using ducted systems more schedule control than they currently have available.</p> <p>The Scheduled Control method easily accommodates non-contiguous use (which is common in teaching environments), unusual usage patterns, as well as one off changes (such as weekend use of a facility).</p>
Manual Override	<p>This provides users with the ability to manually override the lighting and air-conditioning in their particular room through a easy to use desktop application. For example, if the air-conditioning has automatically come on but a user wants it turned off, this application gives a user the ability to do this through a one click operation.</p>

Control Method	How it works
Occupancy Control	<p>When Scheduled Control is not currently active (e.g. after hours), then Occupancy Control will automatically control lighting and air-conditioning in rooms.</p> <p>It uses door and motion detectors to determine when someone is present in a room and turns the air-conditioning and lighting on accordingly. It will also determine when a room is empty and turn the air-conditioners and lighting off automatically.</p>
Deactivate on Arming	<p>When alarm zones are armed it normally indicates that everyone is out of a room and that its use is no longer required. The ESI system uses arming to trigger turning off the air conditioners and lighting so these are not left on unnecessarily.</p>

Intelligent Control

While the ESI solution controls lighting in real-time (e.g. as soon as a door is open the lights come on), the following Intelligent Control Methods have been included specifically to reduce wear on the air-conditioners and to optimise heating and cooling effectiveness.

Count Down to Turn Off

The 'Count Down to Turn Off' feature is active during the Scheduled, Occupancy and Deactivate on Arming Control methods, so that when conditions are met to turn air-conditioners off (e.g. a door has been left open too long, the room is determined to be empty, or an alarm is set) the air-conditioners go into countdown mode rather than turning off immediately. Count-down is then cancelled when the air-conditioner is triggered to be on again.

This means that if someone leaves a room temporarily then re-enters a few minutes later, the air-conditioners will remain on. This prevents unnecessary temperature cycling, is more energy efficient (avoiding the higher power demand required for start-up), and reduces wear on the air-conditioners as they do not need to start and stop unnecessarily.

Persistent Activity Required

When the ESI solution is considering activating air-conditioners under Occupancy Control it includes a multiple detection algorithm so that it can distinguish between people staying in the room (air-conditioning required to be active) and when someone goes in and out of a room briefly (e.g. entering a room to pick something up off the desk).

Flexible Control: BMS and/or Direct Power Control

The ESI is able to control air conditioning and lighting through communicating directly to a BMS or through Direct Power Control. This ability to support both methods means ESI is a good option for improving energy efficiency regardless of the lighting and air conditioning systems already in place.

BMS Communication

The ESI can interface to a BMS in one of two ways.

The first method utilises the ESI's full support for BACnet which it uses to set BACnet devices into different control states based on whether the ESI control algorithm determines that a room is active. Because BACnet devices allow a range of options to be controlled in addition to On/Off (e.g. Fan Speed, disabling local operation etc) the ESI can be configured to apply different options for different rooms. For example, one room might require local control to be available at all times, whereas another room may require only local control to be available when a room is set to be active. In this way the ESI allows you to access the full flexibility of BACnet control supported by the BMS.

The second method is for the ESI to support direct hardwired relay connections to the building management control points either located in each room's control panel or located centrally on a master control unit. This is suitable for building management systems which are not BACnet capable or for situations where building managers prefer a physical wired approach to controlling energy.

Direct Power Control

The ESI controls stand-alone air conditioners and lighting circuits by direct control of power supply. It does this through a solid state power relay which is connected to Digital Outputs on Cardax FT security panels which effectively works in a similar way as controlling power at a switch. This allows smaller organisations (which only have stand-alone devices) to adopt effective energy management systems using ESI. It also allows for larger organisations which have a mixture of stand-alone and BMS based air-conditioning to apply an overarching control system using ESI. Furthermore, through its ability to control lighting through power supply you can effectively add lighting control to overall energy management regardless of whether an organization is already using a BMS.

Example situations where the ESI Solution is suitable

Red Crater's ESI Solution is a very flexible system that has wide applicability to control air-conditioning and lighting, therefore reducing electricity consumption. The following is a list of just some example situations where the ESI is suitable.

Education Facilities—Schools, Colleges, Universities

Rooms in education facilities provide an ideal environment for the ESI to regulate air-conditioning and make electricity savings. Rooms are often in use only some of the time, in which cases the system regulates the lighting, heating and cooling to only when it is needed.

Given students enter and exit rooms frequently there is an inherent risk that doors will be left open which will mitigate a room's heating/cooling. ESI monitors for this situation and when it determines a door has been left open, it turns off the air-conditioning and lighting to conserve power. Conversely, when air-conditioners are scheduled to be off ESI's Occupancy Control is smart enough to determine when people have only temporarily entered a room (e.g. to get something from a desk). It turns the lights on but leaves the air-conditioners off both to conserve power but also to prevent the air-conditioner going through an unnecessary on/off cycle.

Accommodation Blocks

Many high intensity work sites (such as mines and construction) have onsite accommodation blocks to house staff and contractors. Similarly educational facilities, military camps and homes for the elderly also house large numbers of people in accommodation blocks.

People in these environments want to keep the temperature at a pleasant level, in particular when the accommodation units are exposed to extremes of temperature outside. However, to ensure a pleasant temperature is maintained residents often leave the air-conditioners on when they are not in the accommodation block so that they can enjoy the correct temperature once they return.

This is an extremely wasteful practice which can easily be mitigated through the ESI's Scheduling function. This can be linked to a schedule so that heating/cooling automatically commences prior to the person occupying the room so at the time they return to their accommodation their room will be at the correct ambient temperature.

ESI also works effectively in any other similar accommodation situation (such as university halls of residence, homes for the elderly) where staff or residents have control over the air-conditioning units themselves or where the existing timetabling system is too rudimentary to operate efficiently.

Small Office Blocks and Retail

It is common for office blocks and retail stores to be fitted with stand-alone air-conditioners rather than a ducted air-conditioning system. However, these systems generally only have simple time control and no form of occupancy detection.

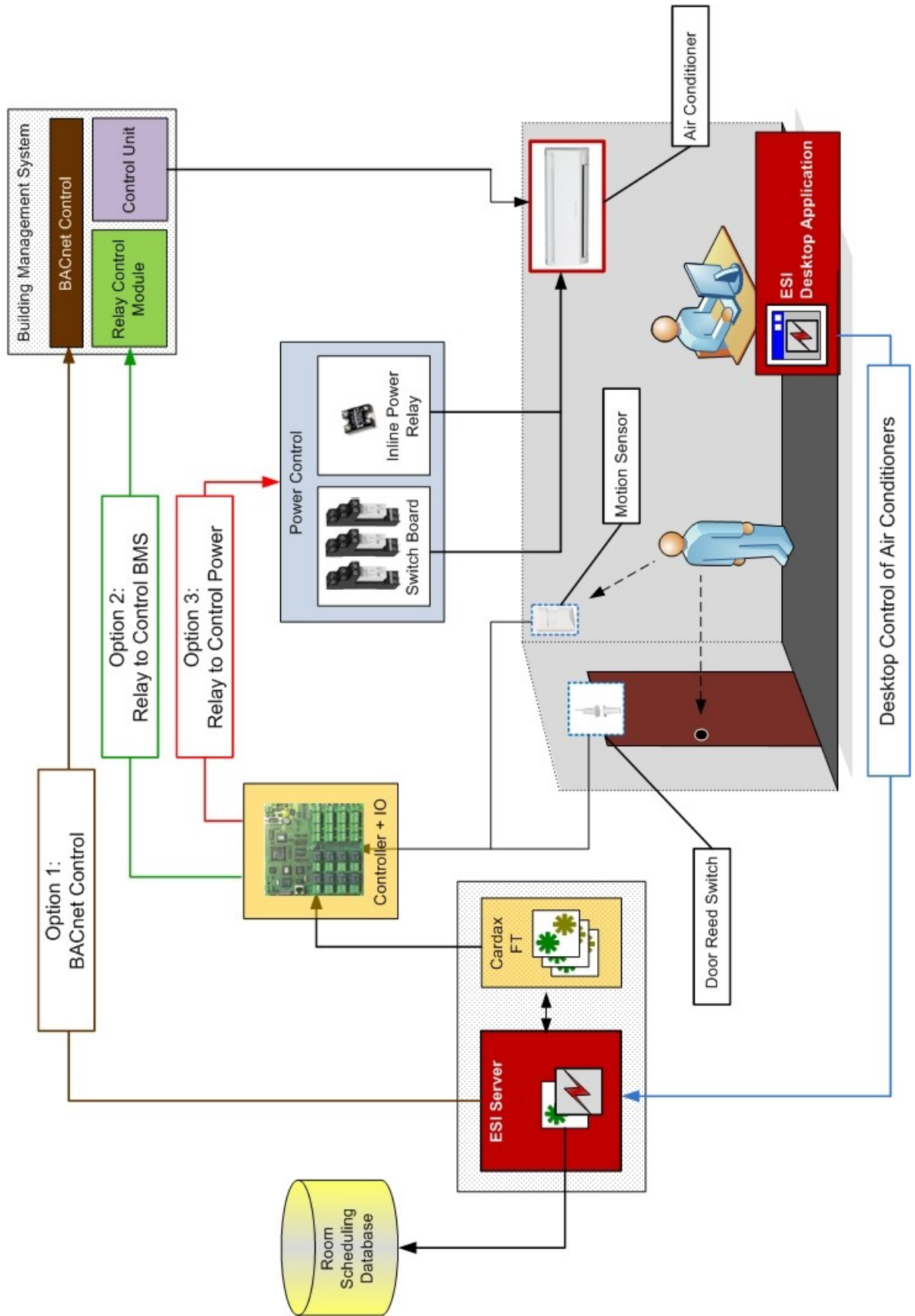
The ESI Solution provides the inherent benefits of the time based control features previously only available with large ducted air conditioning systems, but does so more cost effectively. This means employees arrive at work to a pleasant ambient temperature but have assurance that the air-conditioning and lighting will turn off as scheduled at the end of the day, thereby avoiding the risk of inefficient after hour operation. Furthermore, if more sophisticated air-conditioning control is desired then alarm based, occupancy detection and manual override options can also be implemented.

Corporate Buildings

Most corporate buildings will have some form of building management system as part of their air-conditioning system. While these system are generally very good at maintaining temperature in an efficient way, very few of these will control whether air-conditioning should be on or off based on whether rooms are actually occupied. For rooms which are used infrequently such as board rooms and meeting rooms this constitutes a huge opportunity for energy saving through turning air-conditioning off when not needed. Furthermore, most building management systems either are not set up to control lighting, and if they do it is controlled poorly (e.g. the lighting comes on only well after a person has entered a space).

Red Crater's ESI Solution addresses both of this situations. Firstly, the security devices can be used to determine when rooms are actually in use and automatically turn the air-conditioning and lighting on or off accordingly. Conversely, any room booking system can be linked to the ESI's SQL database to automatically control air-conditioning and lighting in those rooms.

Installation Topography



System Components

The following components are required for the Energy Security Interface Solution.

Red Crater Software Solutions	Description
ESI Server	This is a Windows Service which monitors room activity and scheduled occupancy, and controls air-conditioning devices accordingly.
ESI Desktop Application	This is a Windows application which allows computer users to override automatic control of air conditioners on a per room basis.
Cardax	Description
Cardax FT Server Software	The Windows based control software used for managing the Cardax devices. The RC Energy Control server communicates directly with the Cardax FT Server using the OPC Data Protocol.
Controller 3000 or 5000GL	This is the IP based security panel used for security access and alarm monitoring. Onboard Inputs are connected to Motion Detectors and Door Reed Switches, and Output Relays are used to control air-conditioning devices.
I/O Expansion Interface or High Density I/O Interface (Requirement depends on configuration of building and rooms)	The I/O Expansion units are used to provide more Inputs and Outputs to provide air-conditioning control to additional rooms.
Other Components	Description
Relay Power Control (Required if using power control rather than a Building Management System)	A Solid State Relay is recommended. This should have a control voltage of 40VDC, and a circuit voltage and amperage to meet the requirements of the air-conditioners in a room.
Motion Detectors (Optional)	'Standard' Security Passive Infrared Detectors (PIRs) are suitable for this purpose. While security PIRs are normally intended to prevent false activation and are therefore not suitable for room control applications, the ESI Server occupancy detection algorithm is designed to work with these detectors.
Door Reed Switch (Optional)	A standard Magnetic Reed Switch fitted to the door is suitable for the ESI application.

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