

groups that are present in the user device. Each control can be implemented with an independently programmed controller that can group driving for multiple air conditioners using a single free control. The free control provides remote (Wi-Fi) grouping of each group and is capable of controlling the free zone from continuously (ON) continuously (OFF) or continuously (OFF) delivery for optimal control and flexibility.

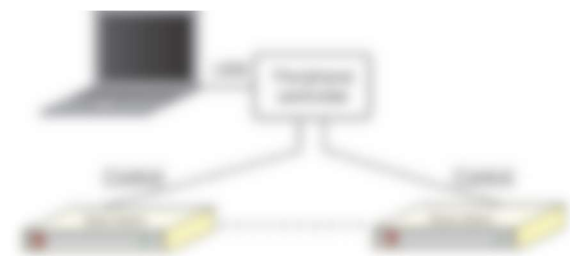


Figure 7. Remote control of multiple free zones.

### Figure 8. Free zone control using software

**Software-based group activation requirement:** Users require the ability to interface with multiple independent groups from a single workstation. LAN/WAN-based software will be developed that can manage either a network of free zones for independent control of one or more independent groups (Fig. 8). The following functionality will be integrated into the software interface:

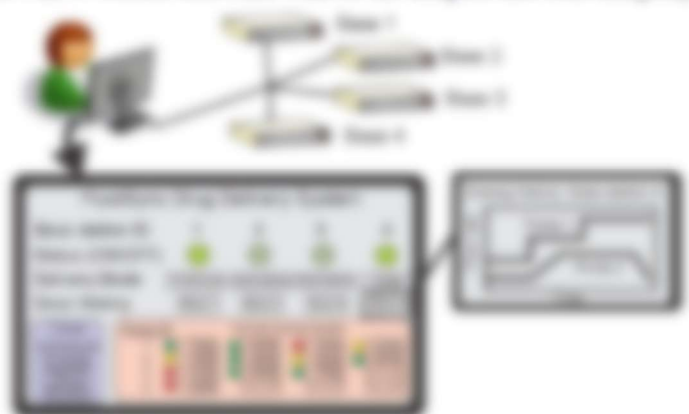


Figure 8. Control scheme and graphical user interface.

1. **Independent and remotely addressable free zones:** Each free zone is independently and remotely accessed via the control software.
2. **Free control over the following parameters:** Free zones can (ON/OFF) and group can continuously (ON) continuously (OFF) or continuously (OFF).
3. **Visual statistical and graphical indicators:** Current status of all groups active, driving history, scheduled release levels, active groups and status to software ready, delayed groups.
4. **Ability to create, save and modify driving schedules and debugging of driving history.**

**Free schedule driving control requirement:** The user will be able to control the average driving level between one and continuously programmed set free zone mode for group. The following driving scheme will be available and will be independently addressable per free zone:

1. **Continuously ON:** All groups are activated continuously and deliver energy at a predefined maximum free rate. Maximum addressable free range range (100% to 100% free).
2. **Intermittently ON:** The groups are activated between (ON) and (OFF) states at a low frequency (1-2 hours) to produce intermittent driving. The (ON) state delivers energy at a predefined maximum free rate while the (OFF) state delivers no energy.

3. **Pulse width modulation (PWM):** Pulse width modulation is a well established concept in electrical engineering<sup>17</sup> and used to produce a spectrum of output based on averaged high frequency current magnitude pulses. PWM is applied so that the user can achieve a predefined average free rate between one and a predefined maximum rate between with variable duty cycle produces a varying average output free rate (Fig. 9). The group freely cycles between on a longer period like free switching controlled free rate. The desired free rate is achieved over the system by the user and software performs the necessary control and modulation.



Figure 9. Pulse width modulation driving.