Building Automation...

How Do Parking Lot Controls Fit In?

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Why Power The Parking Lot?

Currently in Canada about 4.8 million vehicles need to plug in block heaters to ensure starting. In the near future a diversity of vehicles will require power from parking lots both in cold and warm regions. The new electric and hybrid vehicles will need to charge onboard battery systems and traditional gasoline and diesel engines still need to ensure starting. These current and uncertain future requirements demand parking lot control systems to be flexible and adaptable. With rising energy costs, building energy managers continue to feel the pressure to save all that they can. Parking lot control systems can help ease these pressures with electrical savings in the 40% to 65% range.

Parking lot control systems can be divided into two schemes, central or distributed.

Central control schemes have been around for over 50 years. These systems range from simple “flip-flop” systems where a half, third, or quarter of the parking lot is powered for 10 to 20 minutes at a time, to systems where the amount of time given to each zone is based on ambient temperature. These systems can be easily tied into EMS or Building Energy Management Systems for demand load shedding programs. Some with an ambient light sensor can control the parking lot’s lighting requirements for further savings and convenience. Power delivery schedules are set for the whole parking lot through the central control.

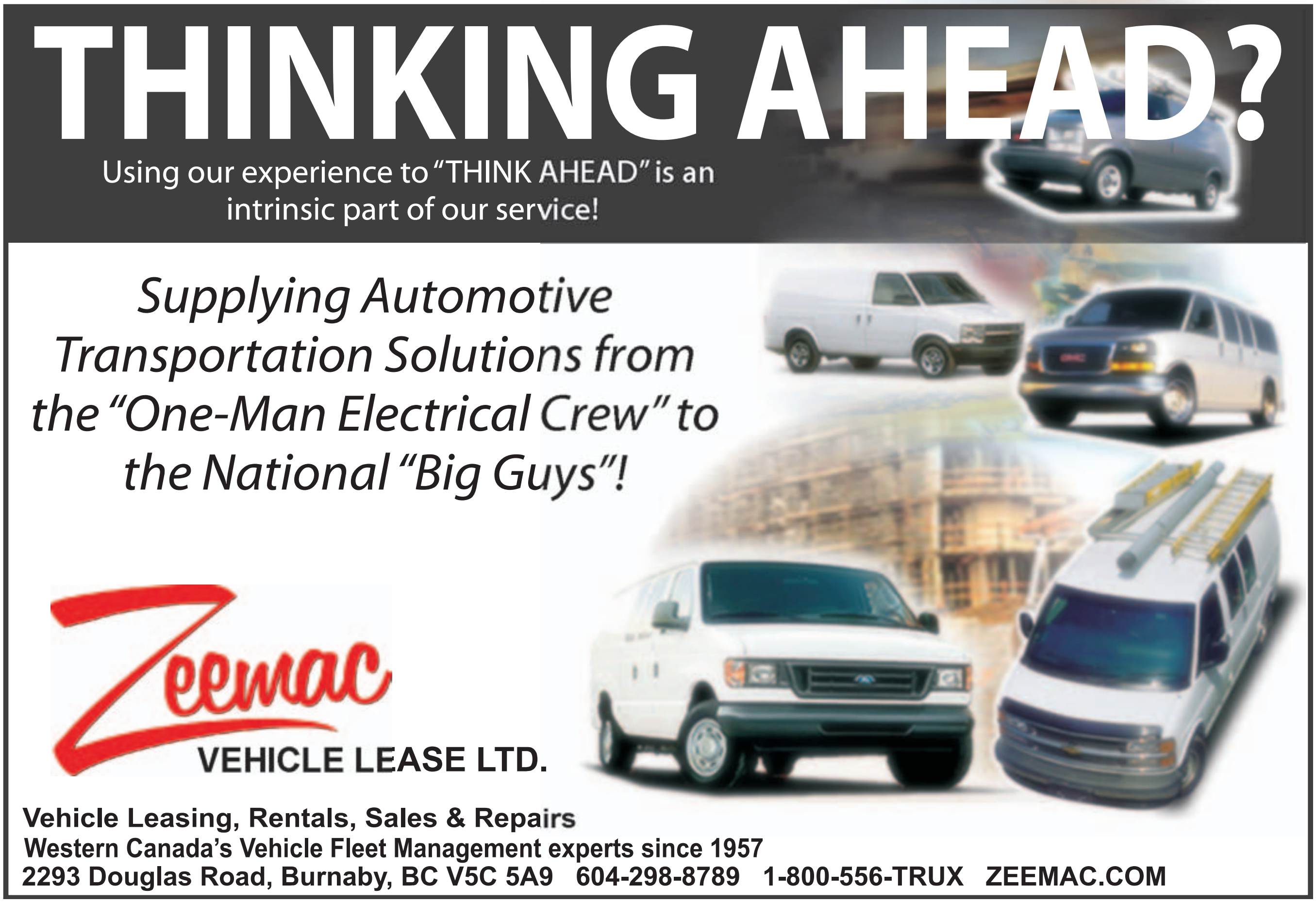
Distributed controls currently have over 10 years experience in the parking lot and are very different from their central control rivals. This system puts the control at each vehicle parking stall instead of at a central location. An increase in overall reliability and a dramatic increase in flexibility is realized. A vehicle's equipment can now be monitored for faults (no tripped breakers or service calls); usage information can be collected, such as amount of power delivered, number of times used and for how long, average load size, number overloads or short circuits, etc. Power delivery schedules for these controls are based on the current ambient temperature, wind-chill conditions, vehicle load size, and amount of time plugged in. Further, each stall in a parking lot can have a different power delivery schedule, giving parking management the maximum flexibility in satisfying current or emerging vehicle requirements.

Each scheme has advantages and disadvantages in ease of installation and site planning, maintenance, flexibility, potential savings, and user satisfaction.

Installation and Site Planning

Installation of central controls requires a fair amount of site planning. This includes placement and mounting of control, breaker, and contactor panels, load balancing between planned zones, sizing of contactors and conductors. Most central controls require a separate control for every service or remote breaker panel, increasing costs and complexity. Depending on whether the controls are mounted inside or outside they may require heater strips to keep them within operating temperature. Placement of any ambient temperature or light sensors requires special attention. After installation, a detailed inspection of the system is essential to ensure the system is configured to design and to avoid any unexpected problems.

Installation of distributed controls is simple for one stall or a thousand stalls. Use standard designs for wiring an uncontrolled parking lot, install a controller on each outlet box in the parking lot, and it's done. For retrofit jobs, simply replace each outlet in the parking lot with a controller. Distributed controls do not require any load balancing or zone planning. These controls, use their unique serial numbers to offset their



cycle times from each other. This provides an inherent average of the loads across the whole institution and in fact across the whole power grid. These controls do not require any special enclosures or considerations for installation and are rated for -55°C to 85°C conditions. A simple walk through the parking lot attaching a small load to each stall momentarily is all that is required for inspection and commissioning.

Maintenance

Maintenance of central controls requires checking the contactors on a regular basis. If the system employs a large contactor the contacts should be cleaned regularly to prevent contact carbon buildup. Breaker panels should be checked on a weekly basis throughout the season for any tripped breakers. The key to these systems is having a routine for checking breaker panels and contactors.

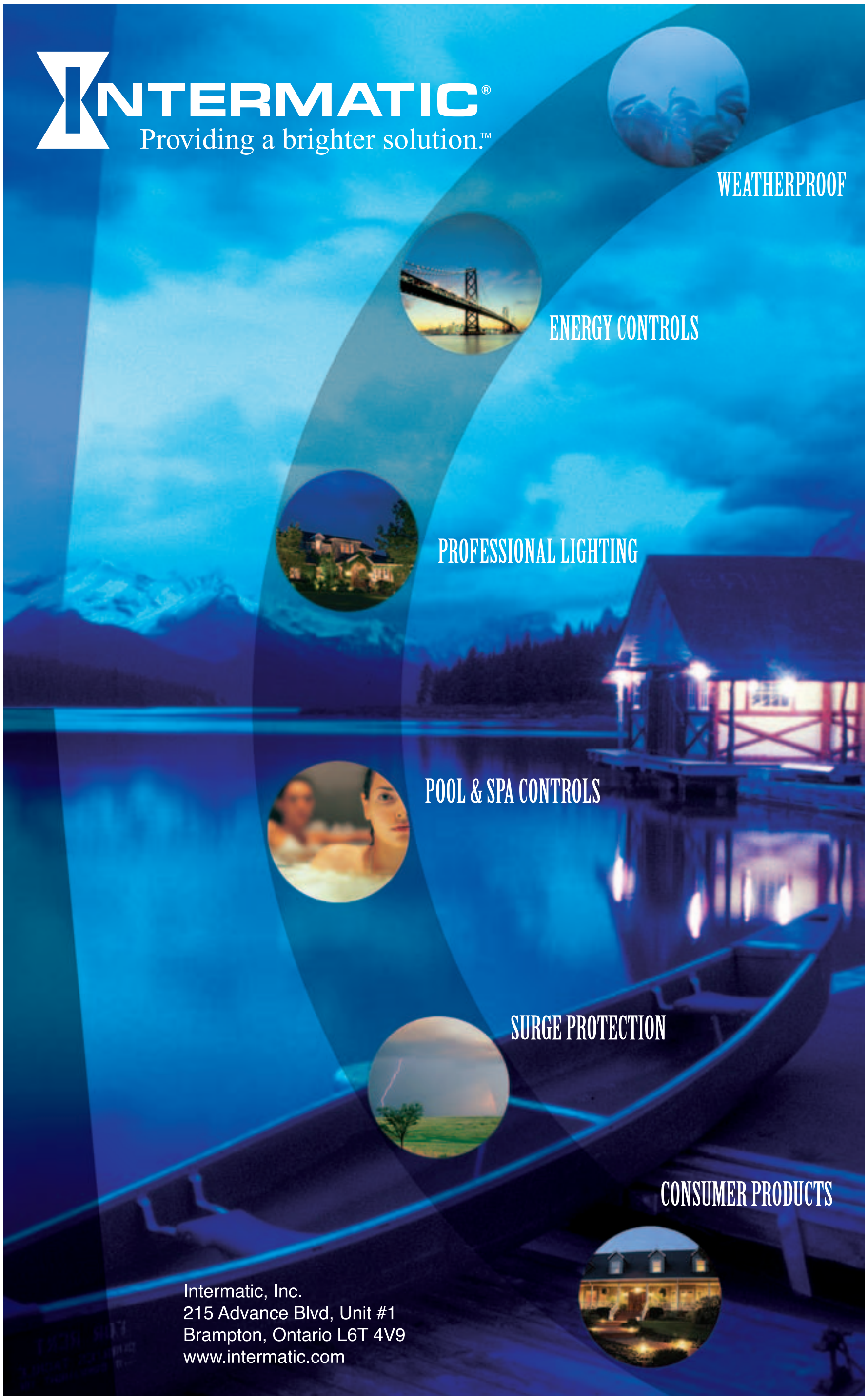
Distributed controls are by and large maintenance free. These systems are totally solid-state and have no contactors to maintain. And since they monitor the fault status of a vehicle's equipment (over 3600 times a second), faults are caught and shut-off before breakers have a chance to trip. This saves many unnecessary service calls by electrical staff to diagnose faulty user equipment and reset field breakers. Another unique feature is they have diagnostic lights for each stall. These lights let the parking patrons know the condition of their equipment indicating good, open faults, overload faults, and short-circuit faults. Again, this saves service calls by allowing service personnel to diagnose a user's problem over the phone.

Flexibility

Most current central control systems allow power delivery schedules to be based on temperature. Schedules are up to five steps or set points forming a staircase style of graph, power vs temperature. While most allow the temperature set points to be adjusted in 1°C increments, the power increments are usually fixed at a course of 25°. Controls with dual zones are smart enough to ensure the two zones are not on simultaneously when the command is for 50% power or less. And with commands greater than 50% the overlap is minimized. These efforts help to reduce the demand profile of the parking lot through load averaging, particularly in the shoulder or transition months. These demand gains can be hindered if the loads in the zones are not balanced and by the typical long zone cycle times (10 minutes or greater). Demand meters measure peaks over a 15-20 minute time frame and an imbalanced zone arrangement can lead to higher than expected demand readings.

Some allow the time of day to be included as part of the control program. Using this time clock feature, power to the parking lot can be removed during off business hours, saving unwanted power usage. The load-shed input (common on these systems) can be used to increase savings through load shedding as part of an existing building's EMS demand line management program.

While centralized systems provide a good measure of flexibility for saving



energy, it is done on a global scale. The idea with central systems are that one schedule suits all vehicles. This is clearly not true and with every exception implemented, more hardware or hard-wired solutions are made. These flexibility issues will grow with the eventual introduction of hybrid or electric vehicles.

The philosophy behind the power delivery schedules used in distributed controls is that people and their cars are one - where people go, their cars go. People take their car to work, home, shopping, etc. As an example, an apartment block has some tenants who work 9 to 5 others 4 to midnight, etc. If you based your power delivery on time of day some would be serviced and others would not. In the case of a distributed control the power delivery schedule begins from the time the vehicle is plugged in and is NOT determined from the actual time of day. So, in the above example each tenant's parking stall control would adapt to an individual's life schedule. Using this type of control scheme can yield significant benefits in satisfying user needs while minimizing management overhead.

Power delivery schedules begin with a power delay period followed by cycling based on one or more temperature vs power graphs. The initial power delay recognizes that the vehicle has just arrived and is warm and will not require power for some time. The initial power delay curve can be a flat time or can be temperature dependent (temperature vs time graph). Temperature is set in increments of 0.5°C and delay time in increments of 4.5 minutes. Power delivery schedules are a temperature vs power percentage graph. Power is measured in increments of 0.4% and again temperature is in increments of 0.5°C. Each graph can have up to 8 points and the actual result is a linear interpolation of power or time between temperature points. This yields a smooth transition between set points, unlike the central control staircase steps. One last unique feature of distributed control worth mentioning is its ability to limit an attached load size. These controls can set a load limit parameter such that if a vehicles load exceeds this limit power is stopped and a red light indicates this overload condition. This feature can be particularly useful to expand parking lot size without increasing the service size.

Each distributed control accepts a dual circuit and powers up to two stalls. No overlap occurs between these two stalls if the power delivery request is 50% or less. And above 50% this overlap is minimized. Loads are switched on/off on zero crossings of the AC line (sometimes called soft switching) and reduces power line switching noise to nil. The cycle time for these controls is a relatively short 4.55 minute period. This rapid cycle time coupled with the staggered cycle times of each unit (based on serial number) enhances load averaging as seen by demand meters. So whether parking loads are unbalanced or not they will always be balanced using a distributed control. Additional demand savings can also be realized without being tied into Building EMS systems, using the initial power delay feature. Most demand peaks occur within the first two hours of arriving at work or home, and with this initial power delay feature the parking lot can be prevented from contributing to these demand peaks.

The most dramatic difference between these two technologies is the flexibility afforded by distributed controls. Each individual stall's control can be tailored to the vehicle parked in the stall. This allows control profiles to be written for diesel, gasoline engines, emergency vehicles, or any other type of vehicle required current or future. Distributed control gives the maximum flexibility to building automation to meet customer and energy savings needs.

Potential Savings

Both central and distributed controls can achieve between 30% to 50% savings using the temperature cycling feature alone. Distributed control can achieve an additional 25% using its initial power delay feature. All in all both schemes have equal opportunities to save energy as a whole. The differences are in the way each system achieves these savings. Central systems make a global plan and implement it parking lot wide. Distributed controls use their flexibility advantage to achieve equal savings but provide better service and flexibility to parking patrons while significantly reducing installation, management, and maintenance costs.

User Satisfaction

Three groups will benefit from distributed controls: the building manager, parking patron, and power utility. The building manager enjoys equal energy savings while having reduced installation, maintenance, and customer support costs. The parking patron is happy to know his/her car is indeed plugged in (shown with feedback lights) and will start when asked to. And finally, the utility is happy with the clean power afforded with this soft switching control.

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