Access Control, Energy and the Environment

Borer White Paper – October 2007

When an organization looks for a new or replacement access control system, the purchase price is often a principle factor when deciding on which system to purchase.

Purchase price alone is not an accurate measure as to the true costs of a system. When evaluating the products offered by different vendors, the purchaser should take into consideration: purchase cost of equipment and software; cost of installing the infrastructure including data cable and mains power outlet and power cables; cost of installation; cost of maintenance; cost of energy used over the projected life of the system; cost of disposal at the end of the products life cycle. It is only after costs associated with all of the above have been determined that the true cost of a system can be arrived at.

It is very difficult for the purchaser of a system to determine the true cost of a the system and its environmental and energy impact, because the purchaser will need to have a detailed technical understanding of the application, the products offered and the manner in which they are integrated. Energy costs will, without doubt, continue to escalate. Consequently, the cost of energy used by a system over its useful lifespan of say 7 years may be considerable. Users often consider the energy costs of lighting; heating and ventilation but almost without exception these are ignored when making a purchase of a CCTV, intruder or access control system.

Choice of Locks, Key to Reducing Lifetime Energy Cost

The choice of locks and power supplies (PSU) will significantly impact on the cost of energy used over the system's lifetime. The following table gives a comparison of the energy used by the more common electric locking mechanisms tested:-

Type of lock	Current at 12 Volts DC
Mini Magnetic lock (single magnet)	500 mA
Magnetic Lock (single magnet)	486 mA
Electric Strike	330 mA 370 mA Peak
Magnetic Shear Lock (single magnet)	500 mA 1.5 Amp for 2 seconds peak

A magnetic lock will draw energy to keep a door locked. Many electric strikes also work in fail safe mode, continuously drawing power while the door is locked. Consequently, many locks used in access control applications are constantly using energy. Electric strikes used in a fail secure mode only use energy when unlocked; hence they are more energy efficient as they only draw power while access is being made.

Power Supplies, a Hidden Opportunity for Saving Energy

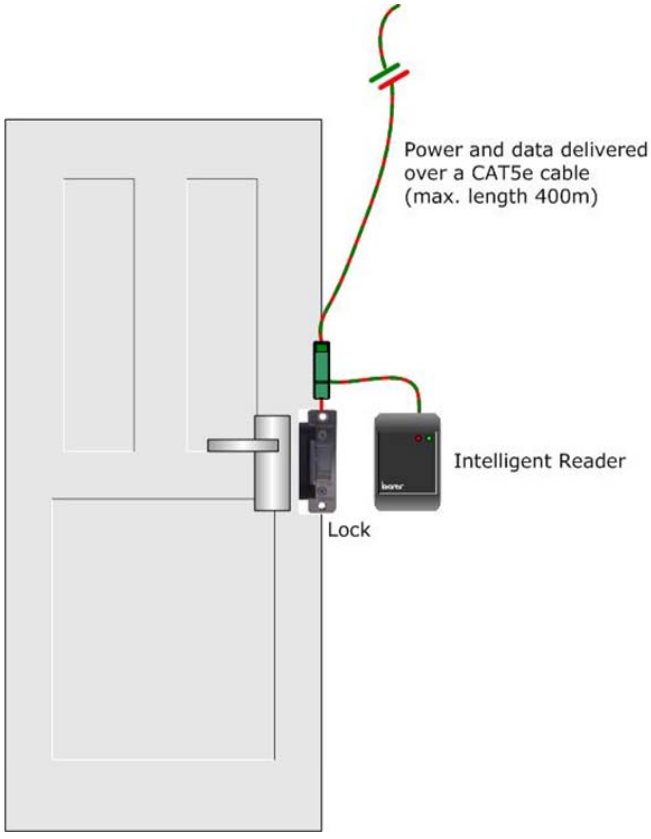
Power supplies are one of the crucial building blocks of modern system, converting high-voltage alternating current (AC) into low-voltage direct current (DC) for use by the electronic circuits in office equipment, telecommunications, and consumer electronics.

Between 6 and 9 billion AC/DC power supplies are currently in use worldwide. Power supplies not only convert energy – they also consume it. While the best power supplies are more than 90% efficient, some are only 20% to 40% efficient, wasting the most of the electricity that pass through them.

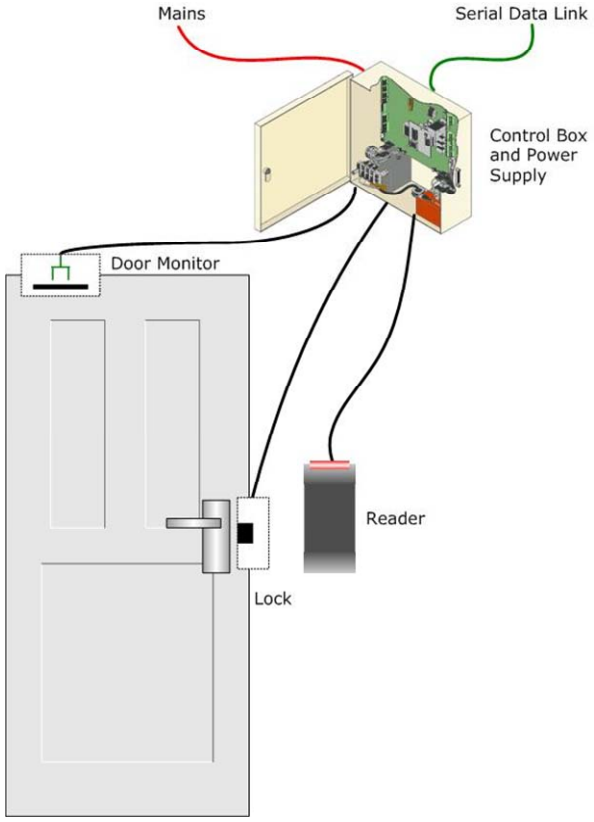
It has been estimated* that today's power supplies consume at least 2% of all electricity generated. Assuming there are 7.5 billion power supplies deployed worldwide, the application of more efficient power supplies could annually save nearly $9 billion in energy cost and reduce carbon dioxide emissions 72 million tons.

Linear power supplies, because they cost less to manufacture, are the most widely used power supplies in access control applications. Switched Mode power supplies work at much higher frequencies and are manufactured using solid state components. They are more expensive to produce, more compact and are substantially more energy efficient. A switching power supply will consume up to 50% less energy and also produce substantially less heat than an equivalent linear power supply. The energy efficiency of a power supply is determined by dividing the output power by the input power.

Typical energy efficiencies under load are in the range 25% to 60% for linear power supplies and from 50% to 90% for switched mode power supplies. This means that a door access system using a switched mode power supply could consume 50% less energy than an identical configuration using a linear power supply.



Borer Solution
Less than 3 Watts consumed by a Borer intelligent reader and electric release combination



Typical Competitor Solution
15 – 20 Watts to control a single door equipped with a fail safe electrical strike

Building an Energy Efficient Access Control System

When planning an access control system, the correct choice of lock and power supply technology can make a significant impact on energy efficiency, cost of ownership and environmental carbon emissions. Borer Data Systems have, over the last 5 years applied "clean design" concepts to reduce the energy consumption of our products and systems.

The following tables compare the energy usage of a Borer 'Fusion' system against a typical system produced by one of our competitors (Legacy system). The Borer system employs a central switched mode power supply to eight doors with energy. The energy delivered is managed and monitored to limit the delivery of power to each door according to its individual needs (lock and card access reader). Most Legacy systems employ linear power supplies, one at each door, which do not monitor or manage the delivery of power to the door's electric release and attached equipment.

Securing Double doors using magnetic locks with in and out access control using a CONVENTIONAL access control system		
Item Description	**Standby**	**Duty cycle**
Access Control Panel	400 mA	450 mA
Card Access Reader Heads IN and OUT	240 mA	360 mA
Double Magnetic Locks	1 Amp	0 Amp
Load Power Out	19.68 Watts	9.72 Watts
Total power input linear PSU @ 50% efficiency	39.36 Watts	19.44 Watts
Energy consumed over 1 year assuming 5% duty cycle	336 kilowatts hours	
Cost of Energy for 1 year assuming energy cost at £0.10 per kilowatt hour	£34	

Securing Double doors using magnetic locks with in and out access control using a BORER system with "PowerWise" Technology		
Item Description	**Standby**	**Duty cycle**
Access Control Panel	N/A	N/A
Card Access Reader Heads IN and OUT	130 mA	180 mA
Double Magnetic Locks using "PowerWise" managed power	500 mA	0 Amp
Load Power Out	7.56 Watts	2.16 Watts
Total power input Switch Mode PSU @ 80% efficiency	9.45 Watts	2.70 Watts
Energy consumed over 1 year assuming 5% duty cycle	79.8 kilowatts hours	
Cost of Energy for 1 year assuming energy cost at £0.10 per kilowatt hour	£7.98	

Securing Single / Double door(s) using a fail safe electric strike with in and out access control using a CONVENTIONAL access control system		
Item Description	**Standby**	**Duty cycle**
Access Control Panel	400 mA	450 mA
Card Access Reader Heads IN and OUT	240 mA	360 mA
Electric Strike	350 mA	0 Amp
Load Power Out	11.88 Watts	9.72 Watts
Total power input linear PSU @ 50% efficiency	23.76 Watts	19.42 Watts
Energy consumed over 1 year assuming 5% duty cycle	206.24 kilowatts hours	
Cost of Energy for 1 year assuming energy cost at £0.10 per kilowatt hour	£20.62	

Securing Single / Double door(s) using a fail safe electric with in and out access control using a BORER system with "PowerWise" Technology		
Item Description	**Standby**	**Duty cycle**
Access Control Panel	N/A	N/A
Card Access Reader Heads IN and OUT	130 mA	180 mA
Double Magnetic Locks using "PowerWise" managed power	40 mA	0 Amp
Load Power Out	2.04 Watts	2.16 Watts
Total power input Switch Mode PSU @ 80% efficiency	2.55 Watts	2.70 Watts
Energy consumed over 1 year assuming 5% duty cycle	22.3 kilowatts hours	
Cost of Energy for 1 year assuming energy cost at £0.10 per kilowatt hour	£2.23	

The standby column lists the energy, based up on a 12 Volt supply, used while the door is locked, the duty Cycle column shows the energy used during an access event.

Life Cycle Costs at the Door

The comparison following table offers a comparison between a Borer Fusion system and a low end, low price competitors system. The comparison is made over a period of 7 years and is based upon the provision of access control for a single leaf wooden door equipped with an electric strike, push to exit button with in and out card access readers. This comparison uses the list price of the equipment with no attempt to compare the features and benefits of the two solutions. It is simply to demonstrate the difference in life time costs for a standard installation using a competitors system and one using the Borer Fusion system.

		Fusion		**Legacy**	
	Units		**£**		**£**
Equipment Requirements **Borer Fusion:** Intelligent Proximity Reader with keypad (£350), Intelligent Proximity Reader (£300), Lock Manager (£70) **Legacy Technology Alternative System:** Proximity reader Head with keypad (£120), Proximity reader Head (£99), Control Panel (£220), Power Supply and Housing (£85.50)			£720		£524
Battery (£22) assuming battery replacement every 3 years	Count	-	-	3	£66
Exit Switch (£30), monitored Trimec electric (£180) strike, tamper switch			£210		£210
Cable Ends to be terminated	Count	32		66	
Installation of Main Power fused spur	Count	-	-	1	£180
Installation Time (@ £60 ph)	HH:MM	2:30	£150	5	£300
Commissioning Time (@£60 ph)	HH:MM	0:15	£15	1:00	£60
Energy Consumed / Costs over 7 years assuming 6% energy price inflation PA	Kilowatt hours	156	£19	14437	£181
Total			**£1114**		**£1521**

The table demonstrates that the cost price of the equipment alone does not truly reflect upon the installed cost or the cost of ownership.

Life Cycle Costs for a Small System

The following table compares the total cost of ownership over a seven year period for a small system using 'legacy' and 'Fusion' architecture equipped as follows:

- Secure eight single leaf wooden doors using a medium quality 'fail safe' electric strike;
- Control of both access and egress at each door using proximity (125 kHz) card access readers;

		Fusion		Legacy	
	Units		**£**		**£**
Software Borer Fusion SE / Competitors Software			FoC		FoC
Borer Midspan Bridge / Ethernet Adapter			£1000		£250
Central PSU 48 Volt, 160 Watt, 86% efficient. Note: the power loss due to the efficiency of the PSU has been included in the calculation of energy consumed at the door.			£350		-
Battery for central PSU, battery replacement every 3 years	Qty	12	£264	24	-
Cost of an 8 door access control with IN and OUT control over 7 years			£8912		£12,168
Total			**£10,526**		**£12,418**

The above clearly demonstrates that a Borer Fusion access control system is competitively priced even when bench marked against a low cost 'legacy' access control system aimed at the small company / SME market. This comparison has not taken into account intangible benefits including:

- The Borer Fusion system uses fewer components and is less than 20% of the mass of typical legacy solutions – less energy and raw materials used during manufacture, less waste / less to dispose of at the end of the products life;
- Fusions offers energy management with remote diagnostics – many problems can be diagnosed and resolved remotely, over the internet, reducing the number of service calls;
- Fusion is easier to accommodate and easier to maintain – it does not require the installation of a metal box, to house a control panel and power supply, at every door. Fusion allows for equipment to be conveniently located and accessible at working height (in a 19" rack in a communications cabinet) and at the point of access adjacent to the door handle;
- Fusion is scalable – it can grow from a small system for one site into a very large system encompassing many sites, accommodating thousands of access points and tens of thousands of card holders.

Potential cost savings are even greater when a Fusion system is bench marked with systems which are functionally comparable and have scalable architectures.

Managing the Distribution of Power

A unique feature of the Borer's Fusion access control system is that the power being delivered to each door over CAT5 cable is being constantly monitored and managed. The energy usage profile for each door is recorded and can be displayed graphically by the Fusion software. This information is very useful in detecting equipment problems at an early stage. This allows maintenance personnel to identify and deal with problems during routine maintenance visits, and before a problem becomes a fault requiring an engineer to be called out to repair it.

The Benefits of a Borer Access Control Solution

Energy Savings of up to 80%

Substantial energy savings can be made using Borer's power management and energy delivery systems. For example alternative door access systems typically consume between 12 to 15 Watts to control a single door equipped with a fail safe electrical release. Compare this with the *less than 3 Watts required* by a Borer intelligent reader and electric release combination using Borer's "***PowerWise***" power delivery system and energy saving technology.

Reduced the Amount of Infrastructure to Deploy

The delivery of both power and data over CAT5e structured cabling means that you don't need to install a mains spur at every door. With the provision of a mains spur typically costing between £50 and £80 on a new build and from £150 on a retro-fit, *considerable savings can be made.*

Less Equipment to Deploy

Typical alternative systems require a reader head, lock, data cable and mains power spur as well as a control box and power supply installed at every door. Borer only need a CAT5e cable, electric lock and Borer's intelligent reader to ensure maximum security. Consequently, there is by mass up to **80% less equipment to install,** resulting in more rapid installation, lower maintenance charges and less to recycle at the end of the system's life.

Easier and Faster to Install

With less equipment to install and all installation work undertaken at door handle height, health and safety restrictions associated with installation engineers ***working at heights*** can be avoided, resulting in faster installation and easier maintenance.

Reduced Maintenance Overhead

Sophisticated power status reporting assists in the remote diagnosis of equipment faults and their swift rectification. This can significantly ***reduce the need for remedial maintenance visits and engineering time on site***. It is estimated that eighty percent of reported faults relating to equipment in the field are resolved by simply power resetting the equipment. Often this requires a field service engineer to visit the customer's sites and simply to remove and reconnect power to the faulty piece of equipment. The results are wasted travel (fuel miles) and time and effort. The technology pioneered by Borer allows all but real equipment failures to be resolved by sending a command via email, web cast or mobile text message to a Midspan Bridge, instructing it to remove and reconnect power to the port hosting the failed device. The Midspan Bridge will power reset the relevant port thereby resetting all devices connected to it; often this is all that is needed to resolve a reported fault.

Life time Savings in the Cost of Energy and Emissions

Cost savings of up to £260 per door can be made over a system 10 year lifespan when comparing the Borer access control system with an alternative system.

Aesthetically more Pleasing

The Borer intelligent reader provides a complete door access control solution in one reader head. You need minimal wall space as there is **no requirement for *unsightly control boxes*** or mains power spurs. The Borer intelligent readers have a minimalist design with a small footprint which will discreetly fit in with most surroundings.

Environmental Benefits of Clean Design

Borer Data Systems consistently strive to innovate and have applied the disciplines of "Clean Design" which is about asking the following "smart" questions early in the product design cycle.

- Can we make products smaller and lighter - reduce the quantity of raw materials needed to manufacture them?
- Can we make it run on less power?
- Can we build it with fewer parts?
- Can we use less packaging?
- Can we design out the need for hazardous materials?
- Can we make our systems easier to maintain?
- Can we design equipment to be upgraded rather than replaced?
- What will happen at the end of a products life?

Good solutions to any of these questions make a cleaner product. Many of them also make it easier and/or cheaper to build. Ultimately, a business will benefit from clean design and will be able to respond quickly to real pressure from consumers and suppliers, rising taxes on waste and the increased cost of raw material.

The Clean Design Objectives we set ourselves together with our choice of technology have enabled us to integrate the best of mainstream technologies such as the Mifare Smart Cards, Power over Ethernet, TCP/IP and Controller Area Network into our products. This has allowed us to reduce the cost of ownership over the products total life cycle. Our design objectives, which are in line with the EU EuP directive 2005/32/EC, are as follows: -

- By designing our products to be smaller more compact, the quantity of raw materials by mass and consequently the energy required to manufacture them is reduced.
- Smaller and more compact products use less packaging therefore the cost of shipping and the amount of packaging to ship the products is reduced
- By reducing the complexity of systems the amount and complexity of the infrastructure (data and power cables, mains outlets, batteries and consequently enclosure to house the equipment) and amount of time required to deploy / install the product is reduced
- By designing products to use the available energy more efficiently, the amount of energy consumed is reduced
- By providing monitoring and control tools which enable remedial tasks to be undertaken remotely, the number of post installation service calls (fuel miles) required to service and repair equipment is reduced
- By using less raw materials to manufacture the product and designing in ease of disassembly more of the product can be recycled and the volume of waste to dispose of at the end of its life cycle is reduced

Borer has aimed for high levels of product integration to achieve the above objectives, reducing the number of devices and the size of the devices deployed. Borer's product designers and development engineers have taken leading edge technologies from both the automotive and communications industries (the largest single users of electronic components). As a result we have reduced product mass (the quantity of raw materials used in the manufacture and deployment of our products) and reduced energy demands in line with the requirements of and in advance of the introduction of the EuP directive.

Borer produce systems and equipment that are considerably smaller and more power frugal than competitive systems. By designing equipment with lower power demands, Borer is able to take advantage of technologies such as "Power over Ethernet" (PoE), to deliver power to a network of devices down CAT5 cable. Borer provides systems that deliver power across CAT5e data cables from a single central monitored power supply. This eliminates the need, at every door, for a local power supply, enclosure, transformer, battery, controller and AC power outlet and cable.

The result is a system that is not only easier to install and maintain but also uses less energy and reduces the volume equipment deployed. (Note current WEEE directive 2002/96/EC and the proposed EU battery directive will greatly increase costs associated with the disposal of used electronic equipment and batteries).

Our research has enabled us to take advantage of improved power management technology such as PoE. Using Power over Ethernet (PoE) design features and components, we have developed systems with predictive fault diagnostics that remotely monitor devices for communication, power consumption and temperature anomalies thereby improving fault diagnosis and enabling the systems administrator to reset devices over the network. Consequently reducing the number of service engineer site visits with associated travelling costs (fuel miles).

Summary

It is evident that the energy demands of equipment in the field have ramifications for the entire system. If these demands can be reduced then:

- Fewer batteries, which power the system when mains power is lost, are required – less toxic waste, less to recycle;
- The gauge of the cables carrying power can be reduced - less copper used in the manufacture of the conductors thereby saving on raw materials;
- One central (dual if redundancy is needed) energy effiecient switch mode power supply can be emplyed – saving on the number of power supplies deployed and reducing the energy loss converting for AC to DC;
- The mass of the equipment deployed can be significantly reduced – less packaging, less to stock, less to install and maintain, less to dispose of at the end of the product life cycle.

It can be clearly seen that the 'clean design' process not only delivers environmental benefits but can also provide cost savings.

References

EU environmental directives: RoHS (2002/95/EC), WEEE (2002/96/EC), EuP Directive (2005/32/EC).

**NRDC report prepared by Ecos Consulting titled* "Power Supplies, a hidden opportunity for saving energy"

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