

make every plug talk!

Revolutionize the world – one plug at a time.

Written by **Ron Dembo** January 2010 (Original Version)

**REVOLUTIONS
OFTEN
COME FROM
UNEXPECTED
PLACES**

→ The moment in July 1969 when Neil Armstrong stepped onto the moon's surface is etched in our collective memory. Just three months later, Charley Kline, a student programmer at the University of California, Los Angeles, sent the first electronic message over a computer network. Unfortunately, the system crashed after only two letters had been transmitted. While Armstrong's first step on the moon was a great leap for mankind, Kline's two letters had a more profound effect on our day-to-day lives.

Sometimes it is not the headline-grabbing events that have the most impact, but these seemingly small developments that in time transform our lives. Often, developments take advantage of a wider environment of advances, linking them in a way that is greater than the sum of all parts, unleashing whole new realms of possibility.

We are about to witness a transformation in our relationship to electricity. Electricity will become a commodity and we will be the traders. With the advent of “talking plugs” - devices that can send information over the Internet showing what each and every appliance is consuming in real time - we will shift from being passive users of electricity to active managers. As with the Internet, the world is about to be transformed once more.

TALKING PLUGS → Almost none of our appliances, buildings and infrastructure have the built-in capability for intelligence or interaction. It would take many years and would be too costly to replace our TVs, refrigerators, washing machines, water heaters and air conditioners with a new generation of smart appliances. So we propose another possibility: insert intelligence and communications capabilities and integrate software at the point where our standard appliances meet the power supply - at the plug.

These new devices - called ‘talking plugs’ (www.talkingplug.com) - use a combination of radio frequency chips and sensors to identify the appliances plugged into sockets and monitor their power consumption. Wireless communications and the Internet allow this information to be sent wherever we like - to a dashboard that displays our energy consumption, to software that can figure out the optimal operation of the appliances, or even to those operating the electricity grid. We can use this same communications channel to send instructions back to the appliances from the grid operator to turn them off and reduce peak loads.

There are a number of applications of this new technology that we can implement right now that will immediately reduce our electricity consumption, save on our energy bills and cut the carbon our power generation plants are dumping into the atmosphere. Saving electricity is a sweet spot in fighting climate change. It is the least expensive form of increasing supply. It is where everybody wins - the consumer, the producer and the world.

Our electrical grid was designed over a hundred years ago on a simple supply and demand model that assumes that users will demand electricity and the grid will supply it. As a consequence, in Britain grid operators dread the ad breaks in soap operas or sports events because millions of people turn on their kettles and the operators have to scramble to provide them with power. They send water pouring over hydroelectric dams in Scotland, pull electricity in from France - all because of the disconnect between users and suppliers. Consumers have no information about their impact on the power generation infrastructure, and no incentive to behave any differently. The price of a kilowatt of electricity in most jurisdictions is the same whether it is scarce or abundant.

That was OK when there were two billion people on the planet, with only a relative handful having access to electricity and just a few appliances in our homes. But the demand for power is growing, and will continue to grow exponentially.

Not only do homes in the developed world have many more gadgets than before, but in the developing world electricity means lighting, a water supply, heating, cell-phones, cooling and communications - all the things we associate with progress.

We cannot support this growth in demand with business-as-usual power consumption. Our environment won't tolerate it. We need to see what we are consuming to understand our impact. To do this, we need more sophisticated controls than just the on/off switch. Talking plug technology gives us just this flexibility - it makes our appliances "intelligent" by inserting software between the appliance and the plug.

A SMART NEW WORLD

→ Picture a world where every plug and light switch is able to report via Internet connection exactly what appliance is attached to it, whether it is on or off, and how much energy it is using. At the same time, we are able to talk back to all the plugs and switches via the same connections, and monitor and control their operation.

Now, imagine what could happen.

You would walk into your office, house or apartment and know exactly what energy was being consumed and where. The talking plugs would be monitoring every appliance and piece of equipment, and reporting back on a display on your computer. You could take advantage of the talking plugs' two-way communication and pre-program them to cut down your energy spend. You could instruct all appliances plugged in but not in use to be switched firmly off, so there would be no wasteful leakage of electricity into TV set-top boxes or idle phone chargers. And you could tell your water heater and air-conditioning not to come on unless you were there or were close to home, and same thing with the lights. The talking plugs would know you were home because you could program them to pick up your cell phone signal based on your GPS coordinates.

Just taking the simple step of turning off appliances not in use could save a significant amount of electricity. Experiments in North Carolina and elsewhere have demonstrated that when people are made aware of the phantom consumption of energy in their homes they take action that helps cut their bills by 15 percent on average.

Imagine if we applied these same techniques to offices, shops, hospitals, universities and other large buildings. Buildings account for 40 percent of carbon emissions in North America, and the figure is similar for many other countries. Just using talking plugs to eliminate phantom consumption and reduce total building emissions by 15 percent in the US alone would have a staggering impact. The US currently emits just under 6 billion metric tons of carbon per year. A 15 percent reduction in US building emissions would be the equivalent of eliminating the carbon emissions for the whole country of Spain.

AN INTELLIGENT GRID

→ Now picture an intelligent grid where the grid operator could price electricity according to demand. We are moving in this direction in some places where there is now real-time commercial electricity pricing and tiered pricing for retail consumers. With real-time pricing, the grid operator can raise the price up at peak times and lower it when demand falls. We could program our hot water heaters, washing machines, dryers and dishwashers to only operate at the most economical times or when we absolutely need them. This would shave even more off our energy bills. Experiments have shown that savings of up to 40 percent can be achieved in this way. This would also give utilities the tools to manage incentive programs that reduce their costs.

Spikes in electricity demand are far more costly and polluting than off-peak operation of the grid. This is because the oldest, dirtiest and least efficient power plants are brought on-stream last to meet peak demands. To give you an idea of the impact of this, in Ontario, Canada, a 10 percent increase in peak demand can mean a 40 percent increase in the cost of power generation. If we can smooth the peaks in demand, we can significantly reduce costs and carbon emissions.

Electricity demand can spike when there is a cold snap or a sudden rise in temperature, or when everyone wants to run appliances at the same time. With an intelligent grid, the operators could reflect electricity demand in the price, raising it steeply when there is a threat of a spike. Talking plugs would monitor the price, and as it rose they would begin to switch off non-essential appliances, and turn others down - for example, lowering the temperature of a thermostat on a heating system. All these responses can be simply pre-programmed into the plugs via control software. In Ontario today, users pay just over 5 cents per kilowatt-hour (kWh) at midday on a sunny summer day, with all their air conditioning systems going, while the grid operator has to buy electricity from Ohio, produced with polluting coal-based generators, for over 50 cents per kWh to meet the demand. Clearly, there would be tremendous benefit in giving users incentives to change their behavior in a way that would smooth out the load demand on our utilities.

We are moving to a world where renewable energy will form a much bigger part of our energy mix. This poses a new and interesting problem. The wind might blow or the sun might shine just when we don't need the excess power - a problem Denmark has today. So what do we do with the excess electricity? With the right pricing signals and the controls afforded by talking plugs we will be able to offload the excess into our homes. Our hot water tanks and car batteries will store this excess energy to reduce the pressure on the electrical system when electricity is scarce. Our homes, offices and cars will become one large, distributed storage device. This will change our relationship to electricity entirely. We will all become efficient traders of electricity enabled by talking plugs.

TALKING PLUGS AND SMART PHONES

→ Talking plugs leverage the ubiquity of smart phones and the connectivity of the Internet. Because the control mechanism between the user and the plug is software, nearly any action could be programmed in. The plugs could be programmed to apply rules to the appliances attached to them. For example, they could be told how much current an appliance was expected to draw, so that if someone fitted a 100-watt bulb to a lamp that could only take a maximum of 60 watts, the plug could turn the lamp off until the correct bulb was fitted. Or the plug could check whether a warranty had been approved before turning a new appliance on.

Talking plugs give every appliance a unique identifier. With appliances communicating with the Internet via the talking plug, manufacturers can keep track of their products in the same way computer manufacturers and software developers keep track of their products now. This can have many benefits both for the manufacturers and the users. The Coca Cola Company could monitor all its vending machines remotely and devise ways of reducing their electricity consumption and cost. Maytag could alert owners when their washing machines need servicing.

Talking plugs could also be used to achieve the old Popular Science vision of the intelligent home that knows when you are about to arrive and gets everything ready for you. Your talking plug control system could monitor your cell phone signal, and when you were a certain distance from home, switch on those appliances - heating or air conditioning, coffee machine, etc. - that you need when you arrive. With today's iPhones and Blackberrys equipped with GPS, it is a simple matter to tell a talking plug where you are located.

YOU WILL BE TRADING ELECTRICITY

→ The problem with green energy sources such as wind, solar and wave power is that they can vary with the weather. Until now there has been no effective way of storing excess electricity generated under ideal conditions for distribution when the conditions are less favorable.

Imagine you are on holiday - your car is at home. It is three in the morning. The wind is blowing hard. Your car communicates with the grid and takes in cheap excess electricity, filling its battery at two cents per kWh. Through its talking plug, since you are away, your car offers electricity back to the grid at midday the next day for eight cents a kWh. The utility is happy - it has reduced peak load and has sold excess energy. You are happy - you've made some money while on holiday. And the environment is better off. Who would have thought you would become a trader of electricity?

Talking plugs could be a key agent in facilitating this new market. You could program your talking plug to trade with the grid, while ensuring your battery was topped up when you needed it. Measures such as these begin to turn electricity into a commodity that is traded between the homeowner (or business, university, department store, etc.) and the grid operator. Electricity will become like a liquid stock with a market price, with individuals able to arbitrage and buy and sell to the market. Ultimately, this should smooth the demand curve, and enable much more efficient use of our energy resources.

CONCLUSION → Talking plug technology has the potential to transform our environment and provide us with tools to eliminate energy waste, use electricity more efficiently and significantly cut damaging carbon emissions. They can link consumers and producers to arbitrage energy costs for the benefit of everyone.

Talking plugs are not a mad scientist's dream. They are here today, and are already being applied to real world problems and the challenge of climate change. To find out more contact info@talkingplug.com or info@zerofootprint.net .

ABOUT ZEROFOOTPRINT → Zerofootprint is a socially responsible enterprise whose mission is to apply technology, design and risk management to the massive reduction of our environmental footprint. We operate both in the for-profit and charitable domains through two entities, Zerofootprint Software and Zerofootprint Foundation using shared technology.