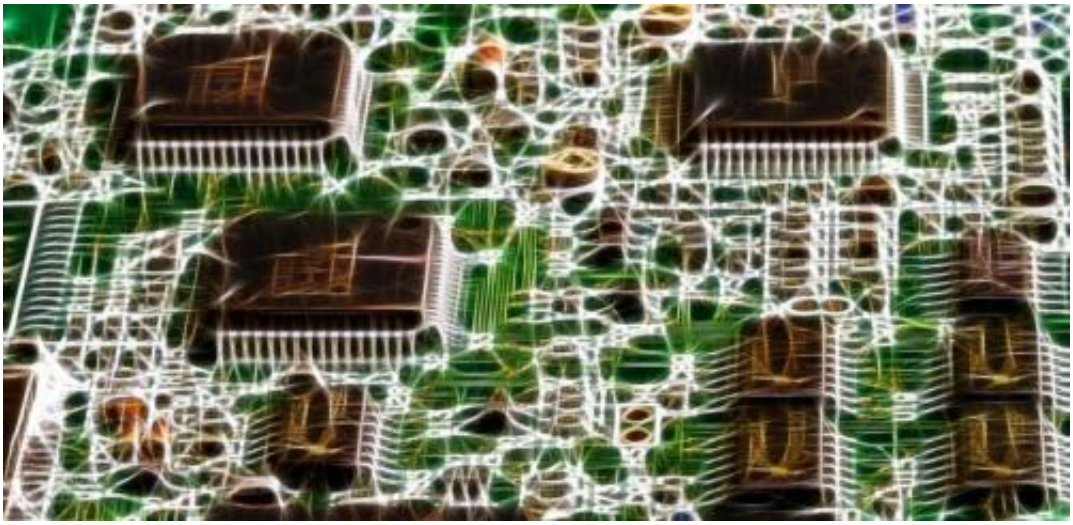
Electromagnetic disaster could cost trillions and affect millions. We need to be prepared

August 11 2014, by Anders Sandberg



Roasted by a pulse. Credit: arbyreed, CC BY-NC-SA

Predicting or worrying about disasters is a popular pastime. But we tend to take notice when somebody with money at stake becomes concerned.

Financial people likely sat up when Paul Singer, manager of the Elliott Management hedge fund, warned in his latest newsletter that:

Even horrendous nuclear war, except in its most extreme form, can be a relatively localised issue, and the threat from asteroids can possibly be mitigated. The risks associated with an electromagnetic pulse, or EMP, represent another story entirely.

How right is he to worry about this?

A force of nature

Electricity and magnetism are tightly linked. Change an electric field – for example by moving charge – and a magnetic field appears. Change a magnetic field – for example by rotating a magnet – and electric fields appear. This is why electromagnets, generators and antennas work. Electromagnetic waves, whether radio, light or X-rays, are just oscillating fields.

The Earth has a vast natural magnetic field, courtesy of currents inside its core. As long as it is stable it is not noticeable except for turning compass needles. But what if something forced it to move? The change would produce currents in long conductors such as power lines or telecoms cables. The field is weak, but a shift across kilometres of cable can induce powerful currents, strong enough to burn out fuses or damage transformers and other electronics.

A sharper push – such as generated by a nuclear explosion – can produce currents that disrupt smaller devices. In fact, microchips are easily burned out by a few volts in the wrong place.

What worries Singer is either naturally occurring geomagnetic storms, caused by the solar wind interacting with the Earth's magnetic field, or deliberately produced electromagnetic pulses (EMPs) by nuclear weapons, or so-called e-weapons, devices that have been developed to disrupt enemy electronics. If something causes widespread and persistent black-outs and equipment damage the economic damage – and human problems – would be enormous.

Stormy sunlit days

Could something like this happen? In 1859 a solar storm, the "Carrington event", named after an amateur astronomer, caused auroras down to the Caribbean, making telegraph systems across the world fail – pylons threw sparks and operators got electric shocks. It is worth noting that telegraphs are simple, sturdy systems compared to today's fine electronics.

In 1989, a solar storm blacked out the power grid in Quebec. Small storms, a recent study shows, can cause noticeable bumps in insurance claims for industrial electrical equipment.

More recently, a near-miss was reported in July 2012, where Earth dodged a plasma cloud ejected by the sun only by a few degrees. Had it hit, the consequences would be dire.

A report from Lloyds emerging risk group has reviewed the evidence. They find that a Carrington-level geomagnetic storm is almost inevitable: one about every 150 years.

This poses a threat to regions dependent on electricity: such storms could cause outages lasting from two weeks to two years. The main problem is the availability of spare transformers.

When hurricane Sandy hit New York in 2012, the main reason power could not be restored on lower Manhattan – despite the obvious wealth of the place – was that ordering replacement transformers takes months.

Sandy's worst effects were in a single location. In the case of a big storm, replacements would be needed in hundreds of locations at the same time. The cost of a Carrington-like event to the US economy would likely be in the range of US$500m to US$2.6 trillion. A report by the US National Academies was even more pessimistic, guessing at a higher range and a multi-year recovery. Besides disrupting electricity such storms can also

destroy satellites, disrupt GPS navigation and make other parts of the infrastructure fail.

The risk is real

Singer is probably right to worry about solar storms. Estimates are that there is a 12% risk over the next decade for a storm bad enough. Fortunately, we can improve our infrastructure when we recognise there is a problem. We can build more resilient systems, have a few back-up transformers in storage and harden devices. This costs money, but it is cheaper than a few weeks without power.

What is probably more worrying is the use of electromagnetic pulses created by weapons. This is a real threat, which was was discovered the hard way in 1962, when a high-altitude Pacific nuclear test caused electrical damage 1,400 km away in Hawaii.

In fact, deliberate destruction of enemy power grids using high-altitude detonations soon became part of the strategy of the superpowers. In the case of nuclear war there will no doubt be more things to worry about than just the power grid, but it is worth recognising the threat posed to nearby nations. Electromagnetic fields know no boundaries.

Electromagnetic pulses from non-nuclear devices are a real possibility, either based on an explosion compressing a magnetic coil or strong microwave fields. They have so far not been used for terrorism – presumably they are not bloody enough – but several countries have researched it.

Do we need to protect ourselves against e-weapons in the future? They are not lethal, the principles to build them are well known and it is not hard to imagine some people thinking they have good reasons for disrupting centres of power, finance or data. So, yes, defence against

them would be a good idea.

That there are back-up copies and that data centres can be hardened might be less helpful than it looks if everybody needs new computers, networks, phones, cars and printers simultaneously – the disruption could be quite profound. Building more resilient gadgets would be to our advantage.

In the end, an electromagnetic disaster might cost trillions, harm millions of people and weaken society – perhaps on a global scale. It is a global catastrophic risk worth reducing. But it does not represent an existential risk just yet. But we are rapidly becoming more dependent on our fragile and vast electrical infrastructure. Some insulation is needed.

Source: The Conversation