Modern lifestyles depend daily on wireless communications and smart chip-enabled services, and these are a source of constant electromagnetic radiation. Growing awareness of their possible impact on health and data security is driving new developments in textiles.

On the safe side

The invisible forces that have become intrinsic to modern living, the smart phones, Wi-Fi networks, Bluetooth connectivity, the Radiofrequency Identification (RFID) and Near Field Communication (NFC) chips used daily all emit or use some form of electromagnetic radiation. While people for the most part enjoy these technologies, and wouldn't want to live without them, they do raise concerns as to their possible effects on health and on the need to protect personal data.

This is the thinking behind new generation brands offering hacker-proof and electromagnetic shielding clothing and accessories. Upstart French brands The Faraday Project, which lines its products with silver-laced materials, and Duoo Hopeful, which makes boxer shorts designed to protect men's fertility, have even made it their speciality. UK travelwear brand Craghoppers has introduced cyber-crime protecting features into its main range and its upscale label Ultimate Travel Collection.

The method employed to block electromagnetic signals relies on conductive textiles that are plated with a metal, in yarn form or as a coating, and specially constructed to create a Faraday Cage effect. Named after the English scientist Michael Faraday, who invented it in 1836, a Faraday cage or shield is an enclosure designed to block electromagnetic fields. A conductive textile creates a resistive surface that reflects the radio signals, at certain frequencies. It must also block radiation mechanically by having very small pores, and this requires tightly woven or knit constructions. A three-dimensional textile is considered the more effective, though flat fabrics are also said to do the job.



UK travel brand Craghoppers has introduced RFID-protection to its range to minimise the risk of data theft for travellers carrying 'contactless' bank cards and passports.

Craghoppers UTC

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Protecting equipment from electromagnetic interference (EMI) is by far the biggest market for shielding fabrics, says Noble Biomaterial's senior VP of conductive products Bennett Fisher. It represents upwards of 90% of the company's sales in the category. "Textiles are commonly used in electronics as their flexibility and lightness make them easy to integrate."

Japanese textile manufacturer Amaike's Super Organza was first developed as a liner for flat-screen televisions. The very fine 7-denier polyester weighs only 5 grams per square metre and has been adopted by fashion designers for its delicate sheen and striking immaterial texture.

Based in Scranton, PA, Noble Biomaterials manufactures silver-laced yarns and textiles. Its legacy product is a 30-denier nylon ripstop fabric that attenuates radiation in the 50-60 decibels (dB) range, a scale corresponding to common frequencies emitted by electronics, by 99.9%. "This fabric has 200 ends per inch," says Mr Fisher. To effectively block radiation, conductive Velcro is used to "allow continuous conductivity, thereby closing the Faraday Cage."

Munich-based interlining specialist Kufner also makes EMI shielding fabrics. Its key products are a silver-plated knit and a copper-plated woven fabric. These are used to make garments designed to protect people who wear pacemakers as well as hacker-proof wallets. At a press conference the company organised at Techtextil, in Frankfurt, it showed what it is calling "the most secure wallet in the world."

At the show, Kufner also presented its newest safety concept, Criftex, which is a dispatch bag offering traceability functions and cutting resistance thanks to a sensor-embedded stainless-steel mesh. The high-tech textile is made on a machine specially designed for that purpose. "When someone tries to cut the fabric, an alarm will sound or be sent to a smartphone," said Kufner general manager Martin Dinter.

The power of the mobile phone

EMI shielding materials were once used mainly to protect people working in high radiation environments, be they electrical powerlines or cell phone towers. But as technologies evolve, the range of applications is expanding. "We are seeing a rise in the use of RFID chips and each new generation of cell phones is more powerful," says Rolf Schumacher, a technical consultant for Kufner. He says today's phones can increase their power up to 1,000-fold to send a signal. Phoning in certain conditions, particularly in a vehicle (whether moving or not), will induce the device to amp up its power to connect to a relay station.

To address today's high-powered smartphones, Noble Biomaterials has created new solutions such as multi-metal fabrics combining silver and copper.



XShield, a textile made by Kufner, offers protection from electromagnetic radiation and unauthorised access to RFID data.

Kufner

Several layers of its standard shielding textiles would be another option. "Three years ago, our standard 60 dB fabric offered the requisite level of protection for most needs," says Mr Fisher. "With today's phones, one would need a fabric shielding in the 80 to 100 dB range, which is much more difficult to achieve with a textile."

Safe unmentionables

Though there is no clear consensus on the effect electromagnetic radiation has on human health, a growing body of research suggests that protection is recommended. The most clearly identified risks are children under the age of 15, pregnant women and masculine fertility as exposure to radiation is suspected to affect sperm.

This has inspired Duoo Hopeful, founded in 2015, to develop Faraday Cage-effect boxer shorts. It has developed a fabric it calls SilverShell Technology made in 30% silver yarn, 45% cotton, 20% polyester and 5% elastane, and manufactured in France. "The knit structure has been designed to guarantee conductivity throughout the fabric," says Antoine Serouille, one of the three co-founders.

The company's two products include a boxer short made in 100% SilverShell fabric and one with the fabric placed only on the relevant section of the male anatomy, and which is sold at a lower price (€30 instead of €45). The shielding properties have been tested by a third-party laboratory on a mannequin whose absorption features mimic those of the human body and in a series of frequencies ranging from 800 to 2500 MHz. Results have shown that the boxer shorts block 99.9% of radiation. Instead of raising fear about electromagnetic radiation, Duoo Hopeful prefers to market itself as "a solution to prevent risks without changing our habits with regards to technology", says Mr Serouille.

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French brand Duoo Hopeful bets on its brightly coloured boxer shorts and its playful take on protecting what's most precious, Précieux being the name of its key product.

DUOO Hopeful

Launched in 2016, French menswear brand The Faraday Project has decided to radically modernise the masculine wardrobe. It intends to launch an innovative textile every year, and began with a tightly woven silver-based 3D-structured fabric. It lines certain sections of what the brand is calling hack-proof clothing. "The silver is applied via sputtering," co-founder and CEO Thomas Fayon told *WSA*.

With the development of passports and payment cards equipped with RFID and NFC chips, the need to protect against cybercrime is seen as a serious issue. People interviewed for this article say that a basic RFID hacking device, or cloner as it is also called, can be bought on Amazon for less than $30. A Google search has confirmed this, with many online websites offering both the device and the blank RFID cards.

The impact of legislation

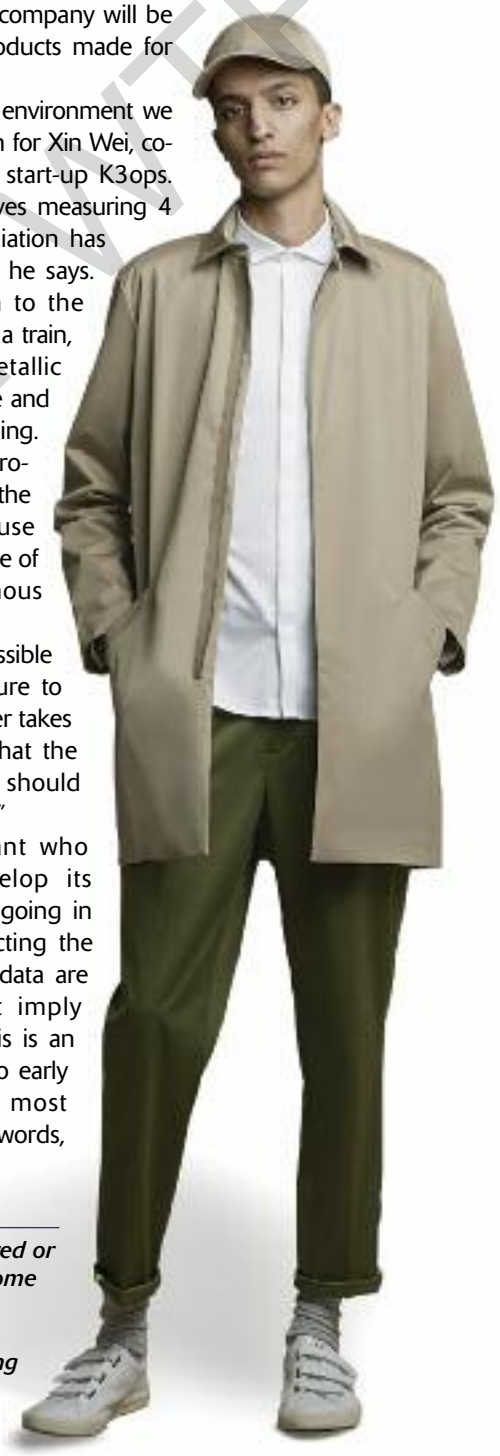
In addition to the risk of having one's identity or money stolen, the market for shielding apparel may also see growth with the implementation in Europe of a work environment directive (2013/35/EU). It lays down minimum safety requirements regarding the exposure of workers to electromagnetic fields (EMF) and was to be transposed into national law by all EU member states by July 2016. It covers the direct and indirect effects of exposure to electromagnetic radiation, based on scientifically proven data, though how this is transposed to workers remains unclear. "The research and science are still in development," says Mr Fisher.

The directive has contributed to raising awareness says Mr Serouille at Duoo Hopeful. "Our experience with customers indicates that they are interested in clothing that protects from electromagnetic radiation, but they don't want to change their style." The young company will be expanding its offering with products made for women and the home.

The ambient electromagnetic environment we live in every day is a key concern for Xin Wei, co-founder of French technology start-up K3ops. "The human brain absorbs waves measuring 4 Hertz and electromagnetic radiation has been found to disorient bees," he says. "Having constant connection to the internet, even when traveling in a train, can be dangerous as the metallic structure creates a Faraday Cage and keeps the radiation from escaping. K3ops has developed an electro-magnetic shielding fabric, but the company's main focus is to use radiofrequency signals as a source of electricity to power autonomous chargers and lightbulbs.

When questioned on the possible health issues related to exposure to electromagnetic radiation, Kufner takes a neutral stance, but admits that the "possibility exists and people should protect themselves, just in case."

Valérie Caillez, a consultant who helped Duoo Hopeful develop its collection, sees this market as going in two distinct directions. "Protecting the body and protecting personal data are two separate functions that imply different types of products. This is an area that will evolve, but it's too early to say which will be the most important," she says. In other words, it's still up in the air.



Mineral nano-fibres and sputtered or sprayed silver microfibres are some of the innovative fabrics French start-up The Faraday Project features in its hack-proof clothing for men.

The Faraday Project

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