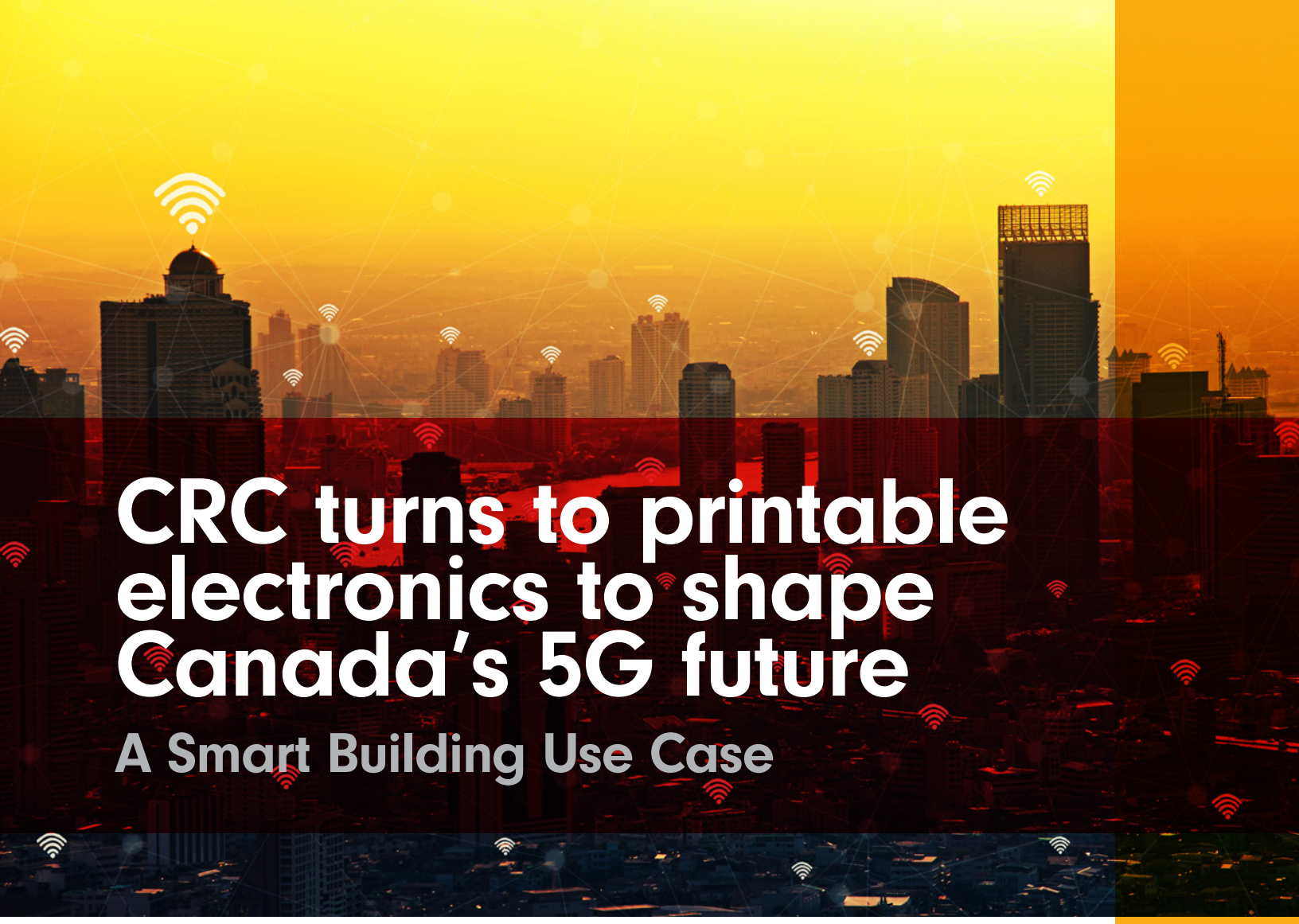

CRC turns to printable electronics to shape Canada's 5G future

A Smart Building Use Case

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Future wireless networks will use 5G or the fifth generation standard, which will enable more devices, faster reaction time, and higher speeds, and many new applications. 5G will see an unprecedented surge in mobile devices, machines and technologies communicating not just person to person, but device to device. However, 5G will need to use unoccupied, higher-frequency bands (26 GHz and above) to meet this demand.

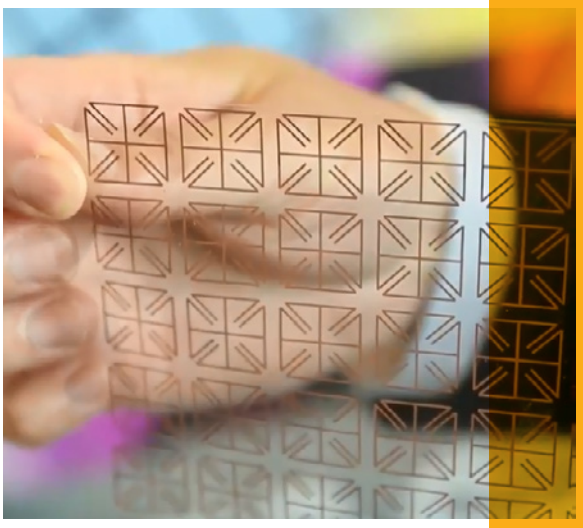
These frequencies have previously been considered unsuitable for mobile networks with challenges including the presence of dead zones due to hard shadowing and poor propagation characteristics. Engineered surfaces can be introduced in a communications environment to augment the propagation directly, thereby improving coverage and increasing capacity.

Engineered surfaces are a class of device that can be used to control electromagnetic waves. Typically consisting of a repeating metallized pattern, they are usually thin, sheet-like structures. The Communications Research Centre (CRC), Canada's advanced telecommunications research centre, is collaborating with fellow intelliFLEX Member organizations the National Research Council of Canada and GGI Solutions to advance the use of engineered surfaces with printed electronics in next-generation mobile wireless communications.

To improve wireless coverage engineered surfaces could be mass produced and deployed in a wide variety of contexts including:

- Interior and exterior of buildings
- Passive (unpowered) and active (powered for dynamic control)
- Incorporated in building materials such as wallpaper, window blinds, drywall, and concrete

Background and History



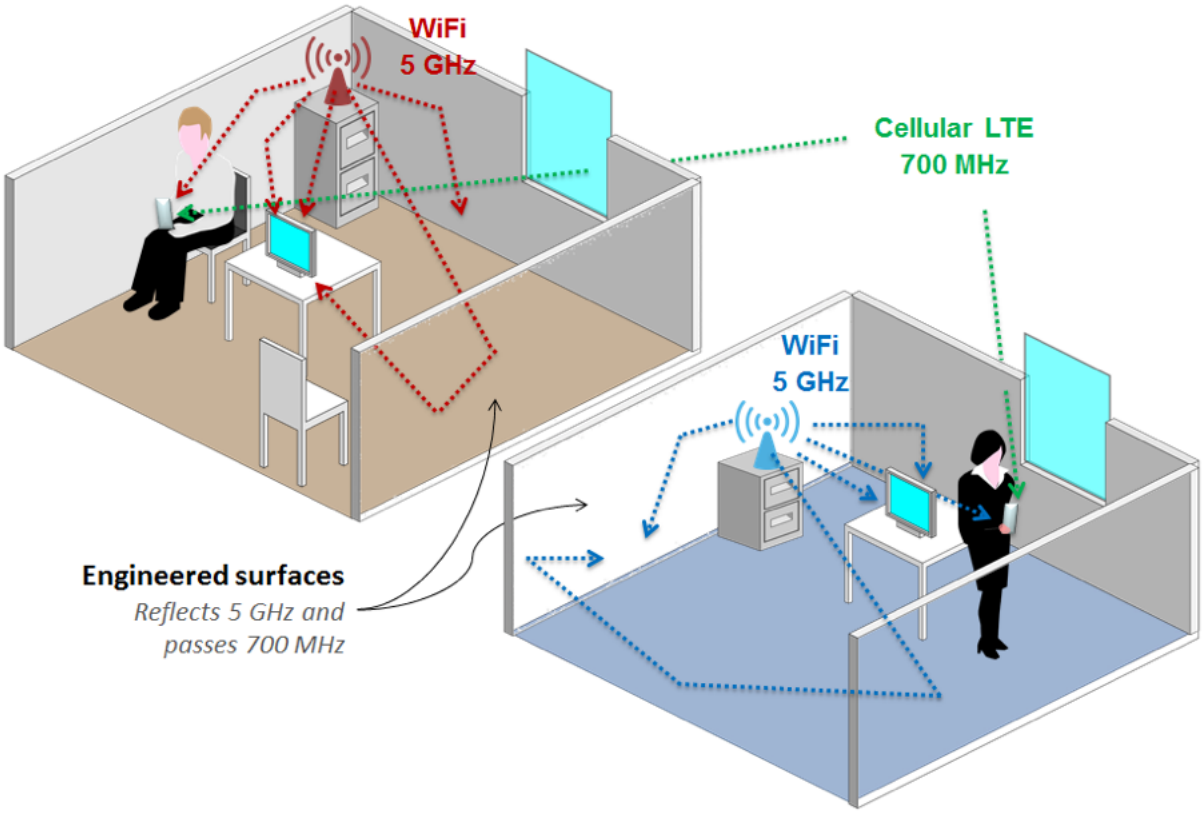
Engineered surfaces have been used extensively in military applications such as radome design and radio frequency (RF) shielding, as well as some limited use in the design of high gain antennas. There is also a similar surface in the window of a kitchen microwave: It keeps the microwaves in to heat your food, and lets the light waves out so you can see inside. Researchers at the CRC are using engineered surfaces to control the propagation of electromagnetic signals in a wireless communications environment: a paradigm shift in the telecommunications industry.

Fundamental Engineered Surface Capabilities

At the simplest level, an engineered surface can be used to selectively block and pass frequencies of interest. One possible application is for frequency re-use, where one portion of the RF spectrum is isolated between adjacent areas (or rooms) to reduce interference. Quite powerfully, this blocking can be designed for a single band while allowing other portions of the RF spectrum to pass. An example of a frequency re-use application is using engineered surfaces on the walls of rooms to enhance WiFi performance. Local WiFi signals can be cluttered and underperform, especially when many routers are using the same frequency. In this illustration, the WiFi signals at 5 GHz are blocked from escaping the room allowing for better performance and no interference from the adjacent room, but 700 MHz used for mobile phone use is allowed to pass through, allowing for the use of the phone. Similarly, the next room's WiFi signal is only from the router in that room. This is the advantage of an engineered surface over a simple solid or meshed metal surface – the ability to select which frequencies to block.

Advancing the Science

More advanced engineered surfaces have been devised by the CRC, allowing redirecting and shaping of the electromagnetic signals rather than simply blocking and passing. The RF control can go as far as shaping the multi-path of signals, allowing dynamic improvement of the spectral efficiency in the communications environment. While this is still experimental technology, the CRC's goal is to use engineered surfaces to provide improved wireless coverage, and prevent "dead zones" or areas where wireless reception is unreliable. For example, they could be used to direct wireless signals around corners, or bounce them off other surfaces to achieve maximum coverage in an office, our homes or our cities.



Fabrication Technologies

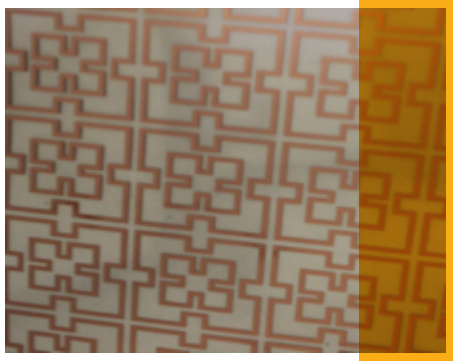
One of the enabling fabrication technologies is printed electronics. By printing metals and dielectrics (an additive fabrication process) engineered surfaces can be incorporated in existing building materials such as wallpaper, or drywall, in a low-cost, high-volume, and readily commercialized manner. Improving wireless coverage using these materials would be much cheaper than installing additional cell towers or repeaters. Eventually, this concept could be used in designing new buildings, or even in the building codes to plan for wireless coverage in a similar way as heating and cooling is today.

Powering IoT

Advances in engineered surfaces will support the deployment of 5G applications such as driverless cars and the Internet of Things. CRC wireless technology research helps improve and advance wireless telecommunications to benefit all Canadians.

About the Communications Research Centre

The Communications Research Centre (CRC)—a dedicated research arm of Innovation, Science and Economic Development Canada (ISED), Canada's spectrum regulator—is the federal government's laboratory dedicated to research and development in advanced wireless telecommunications. Researchers are pursuing some of the most progressive ideas in the world for managing spectrum, including big data, cloud analytics, artificial intelligence and state-of-the-art visualization. The focus of the research is about understanding how this critical resource is used today and finding innovative ways to use it even better.



About GGI Solutions

GGI Solutions has been operating in the field of human machine interface technologies for more than 30 years while continually diversifying its product and service offerings. The company is a trusted value-added partner in leading-edge technological solutions for its global aerospace, medical, industrial, transport and defense clients. GGI is also a leader in the emerging printed electronics industry, leveraging its partnership with the CNRC, CRC and global market leaders, to develop breakthrough applications of its scientific innovations.

About NRC

The National Research Council (NRC) is the Government of Canada's premier research and technology organization (RTO). NRC's Printable Electronics (PE) initiative coordinates research with industrial partners as a springboard for establishing a competitive, sustainable and large-scale PE sector in Canada. NRC has established a research and product demonstration capability to give Canadian designers and manufacturers a decisive competitive edge in producing PE products for world markets. NRC's current PE research priorities encompass functional materials, devices, security and printing technology.

About intelliBUILD BUSINESS NETWORK

intelliBUILD

intelliBUILD is an intelligent building and connected home innovation accelerator founded by intelliFLEX Innovation Alliance and supported by the Continental Automated Buildings Association (CABA).

intelliBUILD collaborates with supply chain stakeholders to create awareness, educate and facilitate the broad adoption of solutions enabled by printable, flexible or hybrid electronics for intelligent buildings and connected homes, to achieve benefits or functionality beyond what is possible with conventional electronics. intelliBUILD unites leading organizations across the commercial and residential building value chains, to collaboratively explore, evaluate and mobilize innovative solutions. intelliBUILD serves North America while sharing solutions globally. **Learn more at intelliflex.org/intellibuild**

intelliFLEX INNOVATION ALLIANCE

intelliFLEX

intelliFLEX, a not-for-profit industry alliance, is a vital partner for accelerating the growth of the printable, flexible, hybrid and related electronics sector in Canada. Our technologies add intelligence and connect ordinary objects to enable the Internet of Everything. We unite our 100+ members to build an effective ecosystem of supply chains for flexible, 3D printable electronics, 2D large area printable electronics, wearable electronics, smart textiles and hybrid electronics including related semiconductors, integrated circuits and software. Our programs accelerate the adoption of these innovations for Smart Packaging, Intelligent Buildings and Connected Homes, Aerospace and Defence, Automotive and Industrial Applications, Health and Wellness, Intelligent Documents, and Consumer Electronics.

Learn more at: intelliflex.org

CABA™

CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association dedicated to the advancement of intelligent home and intelligent building technologies. The organization is supported by an international membership of nearly 400 companies involved in the design, manufacture, installation and retailing of products relating to home automation and building automation. Public organizations, including utilities and government are also members. CABA's mandate includes providing its members with networking and market research opportunities. CABA also encourages the development of industry standards and protocols, and leads cross-industry initiatives.

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