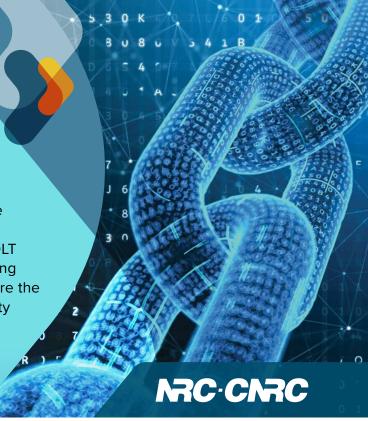# Distributed Ledger Technology (Blockchain)

Distributed ledger technology (DLT) such as blockchain – the system underpinning bitcoin – is projected to move beyond cryptocurrency applications and radically impact many industries in the coming years. For governments, DLT could help to streamline healthcare delivery, combat voting fraud, improve the collection of taxes and generally ensure the integrity of records and services. For defence and security organizations, the technology promises to make supply chains more secure and efficient, protect sensitive data and enable more effective identity management.

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Decentralization

The decentralized nature of DLT makes it potentially fairer, faster, and less costly than conventional, centralized systems. The bitcoin blockchain, for example, is a public, "permissionless" system, allowing anyone to participate and leaving the management of trust to complex algorithms. However, as the technology moves into the mainstream, other types of "permissioned" and hybrid systems are being considered and developed.

Consensus

Participants in a distributed ledger system must agree that all transactions occurring on the network are genuine. "Proof of work" (PoW) is a consensus technique used by cryptocurrency networks to verify transactions. Certain members of the blockchain ("miners") compete to decipher cryptographic puzzles. Once solved, the transactions are confirmed and a new block is added to the chain. However, due to the enormous amount of computing power required by PoW, several faster and more energy-efficient alternatives are being investigated.

Smart Contracts

Smart contracts are written in computer code and stored on a distributed ledger. They allow the exchange of anything with value in a transparent and seamless way without the need for a third party. The aim of smart contracts is to reduce costs, increase efficiency and provide security that is superior to traditional contracting processes. In the future, smart contracts may enable machines to interact with one another, autonomously identifying opportunities, negotiating agreements and settling payments.

Immutability

One of the biggest benefits of a DLT like blockchain is its security. By storing data across its network, a blockchain eliminates the risks that come with data being held centrally. There are no passwords to protect or centralized authorities to trust. In order to corrupt a blockchain, a hacker would need to break into not just one computer, but hundreds or possibly thousands.

> *The Internet is entering a Second Era. The first era was based on information being available anywhere and anytime. The second era – powered by blockchain technology – is bringing us the Internet of value: a new, distributed platform that will help us re-shape business and transform the world.*
>
> – **Tapscott D, Tapscott A.** How Canada can be a global leader in blockchain technology. *The Globe and Mail*. May 17, 2018.

National Research Council Canada   Conseil national de recherches Canada

Canada

Signals

Government

DARPA is funding efforts to discover if DLT could help protect highly sensitive data. The complexity of modern weaponry systems is such that vulnerabilities are both more likely and less detectable. With DLT, it would be theoretically possible to monitor every digital asset that constitutes a system needing protection.
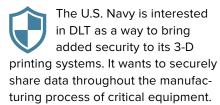
Collaboration

Shipping giant Maersk is working with IBM to test a blockchain-based approach for document management. The Port of Montréal and the Canada Border Services Agency have signed on to use the system.

Defence

The U.S. Navy is interested in DLT as a way to bring added security to its 3-D printing systems. It wants to securely share data throughout the manufacturing process of critical equipment.

Corporate

Artificial intelligence (AI) applications require a massive (and therefore expensive) amount of computing power. A start-up called Tatau has created a DLT-based platform that will allow the purchasing and selling of AI computational power.

> *Blockchain technology can be viewed as the fifth paradigm of computing technology following the mainframe, the personal computer, the Internet and finally the mobile and social network revolution.*

> – **Sudhan A, Nene MJ.,** Employability of blockchain technology in defence applications. 2017 *International Conference on Intelligent Sustainable Systems (ICISS). Proceedings.* 2017:630-637. http://dx.doi.org/10.1109/ISS1.2017.8389247.

Impact

Social

The core operational principles of DLT — decentralization, transparency, equality and accountability — could have far reaching social impacts, from ensuring the legitimacy of elections through more secure voting, to enabling entrepreneurs to do business and help communities in places where entrenched central institutions are corrupt or non-existent.

Policy

Given the sensitivity of some information (e.g. health records), many DLT applications in development require direct government involvement. This raises concerns about the degree to which private DLT networks can use personal data and how governments should engage with these networks.

Economic

For both governments and industry, distributed ledger technology has the potential to save money related to physical office space, identity verification, call centres and more. Blockchain could also reduce healthcare costs by streamlining patient administration and engaging consumers in self-care and health management at home.

Environmental

The proof-of-work method used to secure the bitcoin network uses a massive and ever-increasing amount of electricity, which is unsustainable and has significant negative impacts on the environment. According to the International Energy Agency, the entire bitcoin network now consumes more energy than several countries.

Defence

Rather than trying to prevent malicious actors from breaking in, blockchains assume that networks will be compromised by both adversaries and insiders. The goal is not to prevent intrusion, but to know where intruders have gone and what they have seen once inside.

> *Blockchain falls into the category of "foundational technologies" – and like the Internet or mobile devices before it, it could transform not just what we can do but how we do it, in fundamental ways.*

> – **Chew B, Henry W, Lora A, Chae H.,** *Assessing blockchain applications for the public sector.* Deloitte Insights. September 7, 2018. https://www2.deloitte.com/insights/us/en/industry/public-sector/blockchain-public-sector-applications.html.