



ACCENTURE LABS

DISTRIBUTED COMPUTING IN THE HUMAN-CENTERED ECONOMY

DISTRIBUTED COMPUTING TECHNOLOGY COULD BE A VITAL FACILITATOR OF THE COLLABORATIVE ECONOMIES OF THE FUTURE.

The shared economy has been growing in importance over the past decade, and is set to become an ever-more fundamental part of global commerce over the next ten years. This kind of economy puts the human at the center of its ecosystem. It's a socio-economic system built around collaboration and the sharing of human and physical resources. And, while it may appear in numerous forms and can take a variety of different names—the distributed economy, the peer-to-peer economy, the mesh economy, the collaborative economy, collaborative consumption—what draws each manifestation together are core ideas of collaborative creation, production, distribution, trade and consumption by both individuals and organizations.

The rise of the shared economy has been driven by a combination of societal and technological changes. Individuals are willing to share their time and underused assets and are prepared to openly interact and provide feedback to increase trust within a shared ecosystem. And, most importantly, access to assets is becoming more important than ownership, particularly where the assets concerned are used infrequently. Thus, individuals and businesses are content to share the use of vehicles via transportation services like Zipcar and Uber and share the use of their homes via Airbnb.

But this economy has only become possible—or, at least, practical—thanks to its leveraging of digital technology. Transactions in the shared economy most commonly take place through online marketplaces, peer-to-peer networks, mobile applications or other digital platforms, which have reduced transaction costs sufficiently to make them viable for all participants. The Internet, combined with location services such as GPS-enabled smartphones, means suppliers and consumers within the same geographical location can be brought together easily. And direct public feedback loops and social networks offer a means to validate reputations and build trust.

In this way, individuals, corporations, non-profit organizations and government agencies are empowered with the information they need to distribute, share and reuse excess capacity in goods and services. This is a core concept of the shared economy. It's a system that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility at all times, distinguishing between technological and biological cycles. And, when information about goods and services is shared, the value of those goods and those services can increase for individuals, for businesses and for wider communities.

CHALLENGES: SECURITY, TRUST AND EVOLVING NEEDS

But, for all the benefits the shared economy brings, there are risks and challenges associated with this kind of economic activity, and not just for traditional industry incumbents who may find their existing business models disrupted or bypassed by peer-to-peer networks.

The principal challenge is a question of trust and security. Trust is a cornerstone of the digital economy. But establishing trust in the shared economy can be more challenging for participants who lack the public recognition and goodwill that global, national or even local brands can bring. Collaborative or sharing ecosystems generally permit anonymity, giving untrustworthy or criminal participants greater opportunities to commit fraud. And the lack of a single dedicated party to assure quality or a single source of truth to guarantee correct information can make it more likely that sub-standard or inaccurately described products are purchased. Nor is there currently much engagement from established reputable financial organizations like banks or insurance companies in these networks.

Consumer expectations are changing, and becoming more demanding, too. The shared

economy of the future will be centered around meeting user needs, rather than offering pre-defined, siloed services. This kind of economy represents a shift towards human-centered ecosystems of partners, providers, friends and neighbors. In these ecosystems, which can exist on both a local and an international scale, consumers have new ways of formulating and declaring their needs. Those needs must, in turn, be matched with ultra-personalized offers and services, most likely aggregated from multiple participants in the ecosystem. This will mean seamlessly packaging together services, including services that consumers may not have initially considered, or may not even know anything about, in an optimal configuration to meet each individual's requirements. That configuration will include considerations like time savings (or right-on-time delivery), cost reduction, quality assurance, efficiency, and adaptation to individual circumstances.

But many of today's companies are ill-equipped for this vision of the shared economy. Most organizations' platforms are siloed, and many offer just a single service. Consumers must engage separately with retailers for retail purchases,

travel businesses for holidays, hotel companies for hotel transactions, and so on. This will likely be deemed unacceptable in the future, when packaged services designed to meet specific needs, potentially on a micro-scale, will become the norm. Businesses that want to play a role in the shared economy will therefore need to rethink how they deliver new, more sophisticated services in conjunction with their ecosystem partners. And to do that, they'll need to rethink how they rely on and share data within their ecosystems.

DISTRIBUTED COMPUTING: A ROUTE TO SECURE, SEAMLESS TRANSACTIONS

The solutions to these challenges will be technology driven. And fortunately, the technology is rapidly evolving to provide them. Advances in the structural design of data systems offer the promise of full immutability and traceability of data. And decentralized network architectures can make transactions easier, faster, and cheaper. These are key components in bringing trust to the shared economy and creating a seamless ecosystem.

Distributed computing technologies are at the heart of these solutions. And two technologies in particular will likely be essential elements in the evolved shared economy. These are distributed ledger platforms, which can bring trust and security to information and transactions within an ecosystem, and peer-to-peer networks, which offer the promise of instant querying across different partners for different interests. Seen together, they offer a revolutionary solution to the shared economy's key challenges.

SECURE TRANSACTIONS THROUGH DISTRIBUTED LEDGERS

Distributed ledger technology has huge potential across numerous domains. Indeed, it might even be said to represent a paradigm shift in sharing data with security and trust and developing new business models within a collaborative economy. A distributed ledger is a consensus of replicated, shared and synchronized digital data, spread across multiple geographies, sites or institutions. In this kind of data structure, there is no central administrator or centralized data storage to provide a single point of security vulnerability. Rather, data is replicated in multiple databases across a network of actors using consensus algorithms. Cryptographic techniques are used to preserve the integrity and privacy of data between different actors in the network, and a governance model defines each actor's role and access rights.

Blockchain is probably the most well-known example. This type of distributed ledger stores data in a linear chain of unchangeable packages (called 'blocks'). Each block contains a timestamp and a link to the previous block in the chain, thus making the Blockchain immutable. Participants in the system enforce the strength of the Blockchain themselves by validating new transactions (such as agreements or the movement of digital assets). By preventing retrospective changes to registered transactions and thus eliminating fraud and facilitating efficient and secure transactions for all participants, Blockchain is set to be a foundational technology for maintaining trust in the shared economy.

But Blockchain offers a further, potentially transformative, application. Self-executing pieces of computer code, called smart contracts, can be embedded in the chain. Just like traditional contracts, a smart contract is capable of facilitating, executing and enforcing the performance of an agreement between two or

more parties. But unlike a traditional contract, the entire process is automated: when pre-defined conditions set out in the smart contract are met, it will automatically execute whatever actions have been defined in the code. These actions can be varied: a payment of money, a transfer of ownership, the execution of a legal contract, or even the triggering of other smart contracts. And each action is self-executing, without the need for third parties or intermediaries.

SEAMLESS TRANSACTIONS THROUGH PEER-TO-PEER NETWORKS

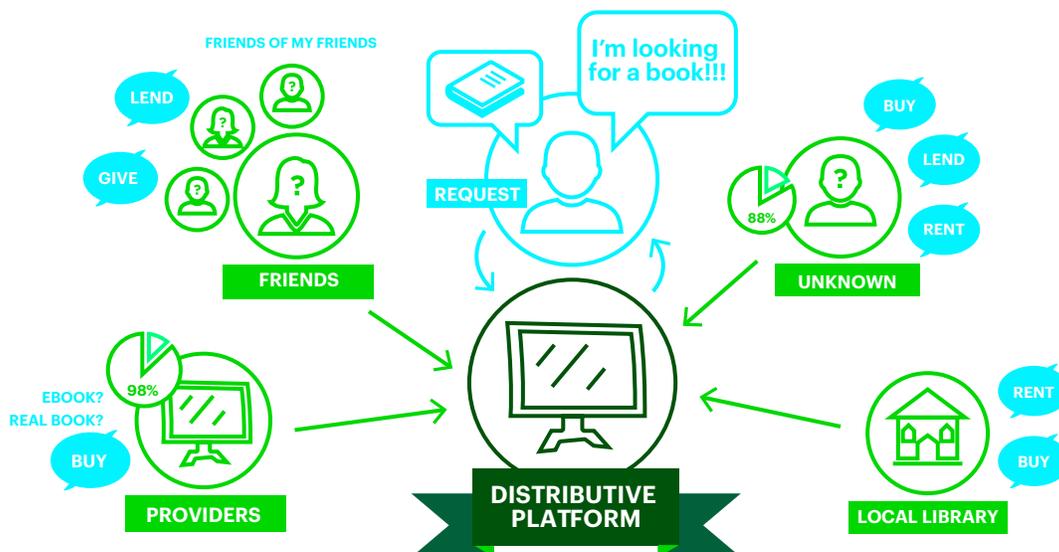
A peer-to-peer network is a form of distributed application architecture that partitions tasks or workloads between peers within a network. Each peer is an equally privileged, equally powerful participant – or node. In practice, this helps reduce the processing or computing time of the whole network. It also means there is very

little restriction on any participant accessing information from anywhere across the network, meaning data can be queried quickly at a lower cost. Participants are also able to join the network easily and experience near zero downtime.

In combining the best of these distributed ledger and peer-to-peer technologies, the future shared economy will offer instant, seamless, cheaper services to its participants. And it will do this while maintaining the trust, security and privacy essential for component processes like validating information, rating quality and making payments.

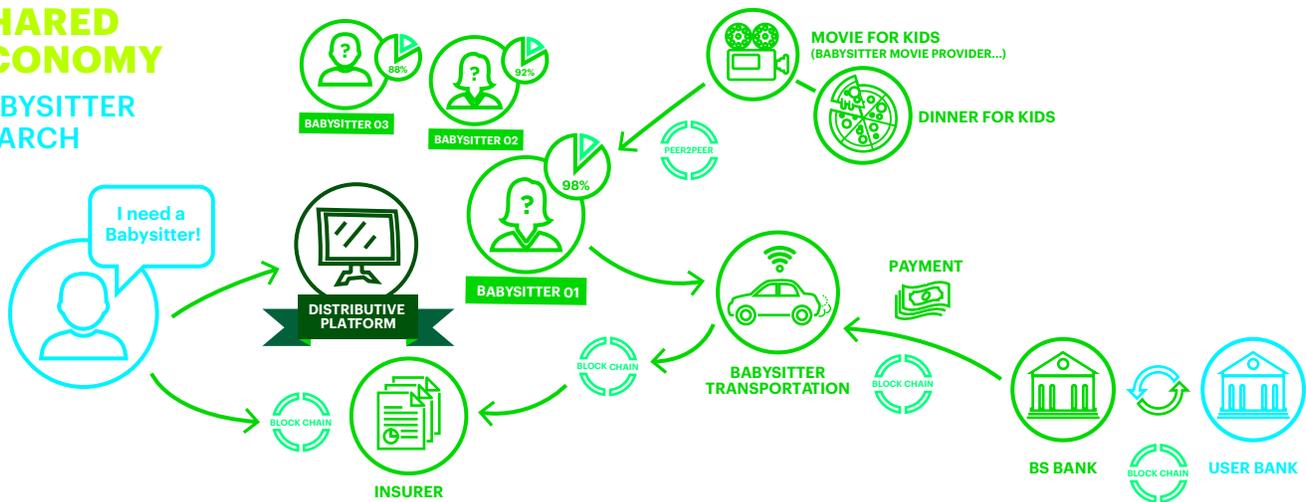
PUTTING THE HUMAN AT THE CENTER OF THE SHARED ECONOMY

These technologies could revolutionize any number of commercial or day-to-day activities. Take the example of an individual who is looking for a new book to read. This individual's need—something to read—could be decomposed into a set of component needs—title, genre, format, source, means of access—and met by a package of micro-services across a distributive platform. So, for example, a platform could recommend book titles based on the activity of the individual's friends and wider connections across its network. Numerous different providers within the ecosystem—commercial booksellers, local libraries, individuals looking to pass on used copies—could offer a chosen title along with ownership and format options—rent or buy, eBook or paper copy—and secure payment services, all as part of a seamless set of transactions within a single package.



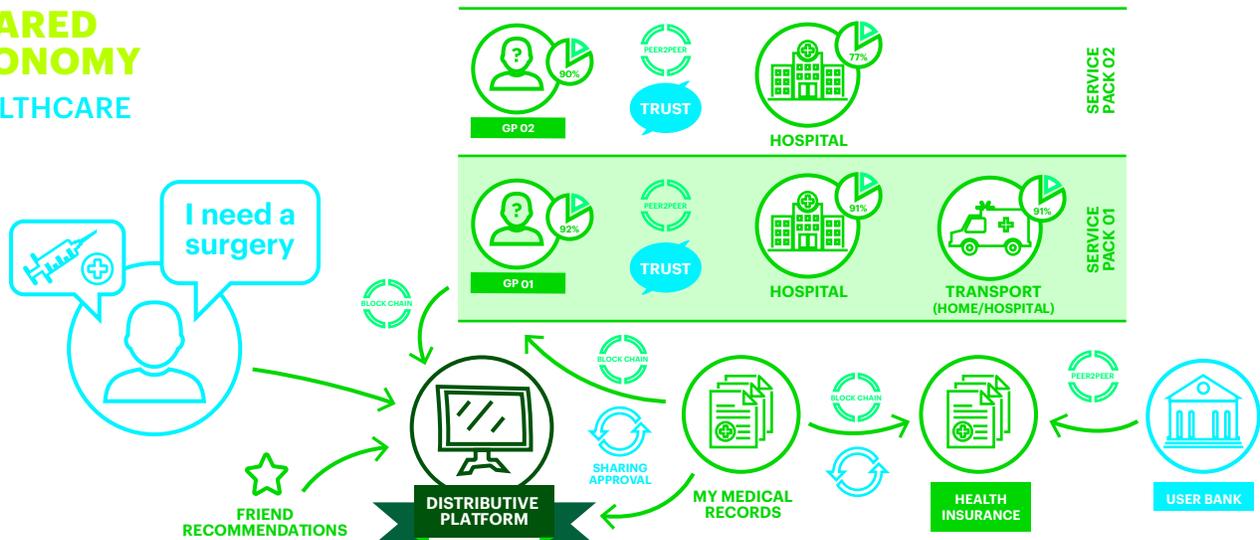
Consider, too, the possibilities for providing and accessing personal services within the shared economy. Take a parent's need to find a babysitter for a night out—an activity in which trust and reputation are especially important. The parent might select a babysitter based on immutable, traceable ratings on a distributive platform. Payment would be automatically transferred between the parent's bank and the babysitter's bank using smart contracts in a distributed ledger. The babysitter might select a movie or dinner for the parent's children from third parties over a peer-to-peer network. Transportation to the parent's place of residence could be arranged automatically, packaged with smart-contract-based insurance for the duration of the journey, however short. All of these actions would take place instantly, with the involvement of multiple participants in the ecosystem, using shared, secure data on which all parties can rely.

SHARED ECONOMY
BABYSITTER SEARCH



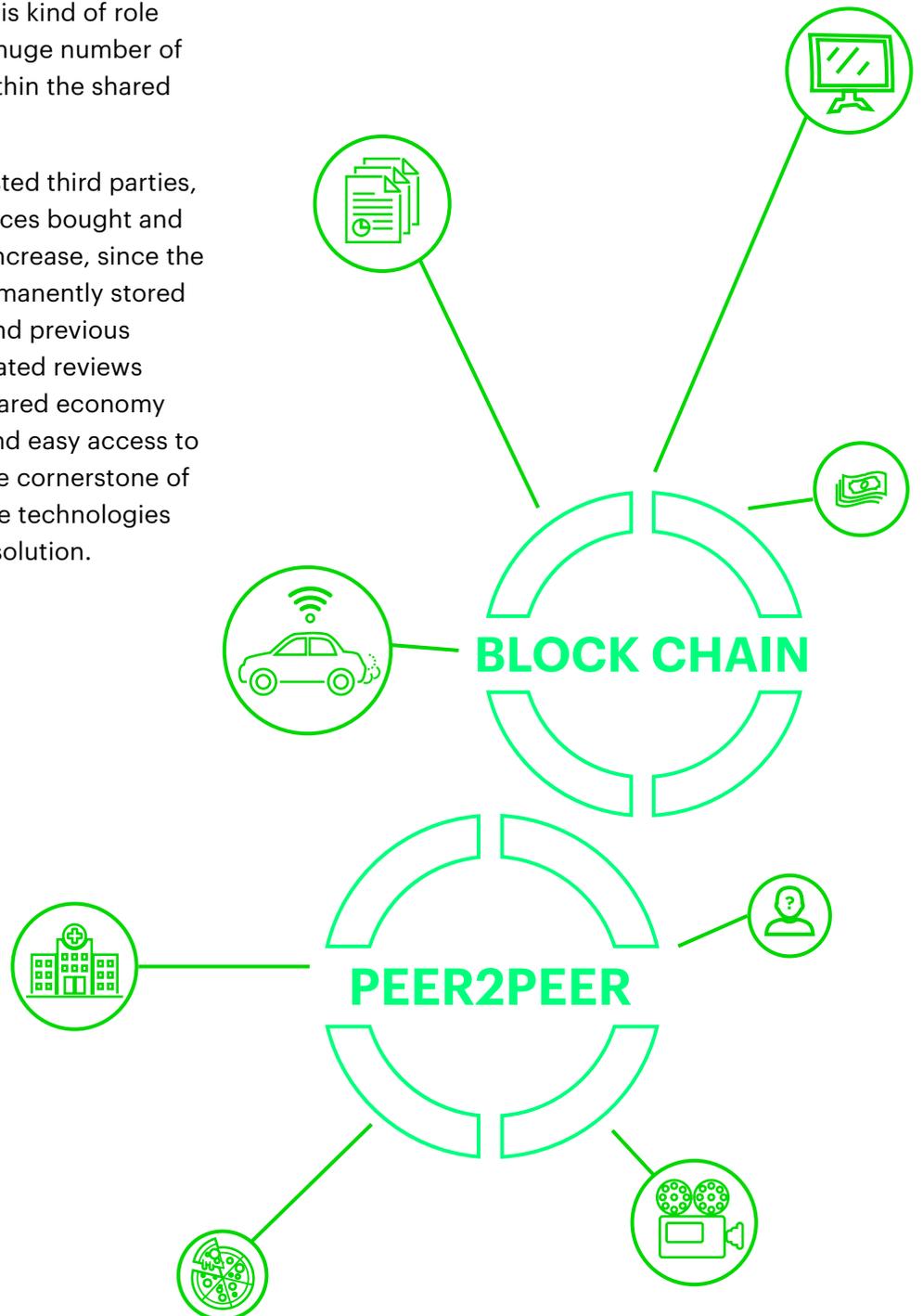
The sharing of sensitive data between healthcare professionals and other parties is another domain ripe for transformation in the shared economy. Blockchain-type technologies offer the possibility of creating a personalized health record for a patient that is immutable, secure and controlled by the individual concerned. Doctors, patients, insurers and state agencies can thus have access to an individual's validated healthcare data, subject to pre-defined limitations. And each would play a role in guaranteeing the validity of the information contained in the record at each stage. So, for example, a doctor's guarantee, added to a patient's record, that the patient is suffering from a particular medical condition and requires treatment, could be relied on by the patient's insurer as sufficiently validated to automatically authorize payment to the patient's bank via smart contracts embedded in the ledger.

SHARED ECONOMY
HEALTHCARE



So Blockchain and peer-to-peer technologies offer the promise of instant, seamless, secure transactions in the shared economy. They also offer a means for financial services providers, who might otherwise find themselves disrupted or disintermediated in these economies, to establish new, core roles as key providers of trust. These companies could, for example, provide services through distributed computing technologies in the form of loans, payments, or insurance, thus guaranteeing secure payments and transactions between participants. Indeed, this kind of role offers the potential to acquire a huge number of new financial services clients within the shared economy network.

And with the involvement of trusted third parties, the quality of products and services bought and sold within these networks will increase, since the identities of participants are permanently stored and can be accessed publicly, and previous activities are logged with associated reviews and reputation scores. As the shared economy continues to grow, and as fast and easy access to reliable shared data becomes the cornerstone of collaborative consumption, these technologies look set to offer a revolutionary solution.



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ABOUT ACCENTURE LABS

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