Client Alert

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The Internet of Things: Evaluating the Interplay of Interoperability, Industry Standards, and Related IP Licensing Approaches (Part 2)

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We recently published a client alert on January 26, 2016 that addressed some of the more significant Internet of Things (“**IoT**”) -specific standards and initiatives and emphasized the importance of interoperability as central to the growth and success of the products and services that leverage the IoT. This Part 2 in a series of alerts on IoT provides a detailed update regarding one of the leading efforts around standardization, the Open Connectivity Forum (OCF). The alert also covers three additional industry standards that have particular potential when used in IoT: Bluetooth Low Energy, Wi-Fi (including 5G) and Blockchain.

“FRAGMENTATION IS THE ENEMY”

On February 19, 2016, the Open Connectivity Forum (“**OCF**”), a new standards effort for the IoT, was announced. Led by Intel, Qualcomm, ARRIS, CableLabs, Cisco, Electrolux, GE Digital, Microsoft and Samsung, the OCF reportedly seeks to merge the current efforts towards standards development in the IoT, uniting the former Open Interconnect Consortium with companies at all levels, and is “dedicated to providing this key interoperability element of an IoT solution.” The initiative hopes to circumvent the expenditure of time and resources in building consensus between multiple standards approaches, accelerating innovation and assisting developers create solutions that map to one open IoT interoperability specification. Emphasizing this point, Qualcomm recently published on its website that “fragmentation is the enemy of IoT”. The OCF sponsors the IoTivity open source project (covered in Part 1 of this Alert) which includes a reference implementation of the OCF specification licensed under the open source Apache 2.0 license.

OCF INTELLECTUAL PROPERTY POLICY

The Intellectual Property Policy adopted by the OCF shows a high level of attention to detail, thoroughness and nuance. Those considering joining would be well-advised to get some help in understanding how these terms will apply to their specific intellectual property portfolio, products, components and services. We have chosen to take a deeper dive into the intellectual property policy for this standard because the details of the policy reveal a number of areas of focus of the founding members.

While the policy imposes obligations on members as well as their affiliates to grant licenses under copyrights and patents, the scope and cost of those licenses will depend on a number of specifics that will vary depending on the precise contours of the final specifications. Members are required to represent that they are authorized to bind their affiliates to the terms of the policy, including parent and sister companies.

1. **Patent Claims Captured.** The patent claims captured by the policy are limited in a number of ways:

   - The only claims captured are those that would be necessarily infringed by implementing the mandatory portions of the specifications within the bounds of a tightly defined scope that ties specifically to enabling the compliant portions of products to interoperate, interconnect or communicate.

   - Necessary infringement is defined as there being no "commercially reasonable" non-infringing alternative for this enablement.

   The policy requires that any transfer of these necessary patent claims to unaffiliated third parties must be subject to the terms and conditions of the policy, and transfer or assignment agreements must explicitly address the fact that the transfer or assignment is subject to existing licenses and obligations imposed by standards bodies such as OCF. Those who practice in the merger and acquisition arena will want to take note of the potential issues for both sellers and acquirers in light of these requirements.

2. **Patent License Scope.** The license scope is also limited in similarly nuanced ways. The license under the above patent claims extends to only those portions of products and services that implement the protocols, functions, APIs and their adaptation layers, input parameters, data structures, services and firmware descriptors that fall within the mandatory portions of the final specification (including mandatory portions of optional components of the specification). Moreover, the policy goes to great lengths to ensure that, unless the final specification is explicit and describes in detail these items where the description's *sole purpose* is to enable interoperability, interconnection or communication, no license will apply. This would seem to place a heavy burden on the developers of the specification taking this into account in developing the details of the specifications.

3. **Opt-Out is not true Opt-Out.** Another interesting aspect of the policy is that while the policy allows for members to exclude specified patent claims from the royalty-free license, this opt-out mechanism is constrained. Most importantly, members cannot opt out entirely. The policy imposes a requirement to license those excluded patent claims on reasonable and necessary non-discriminatory terms – again, this applies even if patent claims are excluded in accordance with the opt-out framework. The opt-out mechanism also only can be exercised 4 times in any 60 month period.

4. **Copyright and Software.** While we have focused on patents here due to the policy's emphasis on the patent rights granted, the policy also imposes obligations to license copyrights. The policy only addresses rights under copyright to contributions made by members to the specification itself. The policy also includes a brief statement permitting members to contribute OCF open source that OCF deems acceptable and non-confidential as well as modifications and additions to such open source software to open source projects. It is not clear what will be considered "acceptable" and what software will be made non-confidential. The policy also appears to be limited to the following acknowledgment: members may license their software source code that implements the specification under open source licenses and may make contributions of such source code to open source projects. No limitations on which open source projects are permitted appear. This seems odd given that this could result in OCF open source software

ending up being contributed to projects that impose license terms that conflict with one another. It seems that OCF may have decided to defer these issues to the future once it has determined what is "acceptable" and what software OCF itself will make available.

5. **Rights on Termination.**

   Termination also raises issues for terminating as well as continuing members. Once members join, they may not terminate the licenses they have previously granted to other members prior to termination with respect to versions of the final specification that existed while they were members or contributions to draft specifications that they made which become part of subsequent versions of the specification after their termination. Continuing members are also required to provide more or less reciprocal grants.

STANDARDS WITH IOT APPLICABILITY (AND BEYOND)

Bluetooth Low Energy

1. **Technology.** Bluetooth is a short-range wireless connectivity standard that discovers and pairs devices together for the exchange of data. The Bluetooth Low Energy ("**BLE**") Standard, also called "Bluetooth Smart", is a subset of classic Bluetooth Basic Rate/Enhanced Data Rate (or "**Bluetooth Classic**") and was released as part of the core Bluetooth Version 4.0 Specification. Bluetooth Classic is connection orientated (i.e., when a device is connected, a link is maintained, even if there is no data flowing). Like Bluetooth Classic, BLE operates in the 2.4 GHz ISM band, but has a better range, lower power consumption requirements and lower data rates due to the fact that data is communicated in chunks rather than continuously. Bluetooth Classic faces significant challenges with fast battery draining and frequent loss of connection, requiring frequent repairing. Unlike Bluetooth Classic, which establishes a relatively short-range, continuous wireless connection, BLE has a range of about 30 to 50 feet but remains in sleep mode unless a connection is initiated, and allows for short bursts of long-range radio connection. Because BLE is designed for sending small chunks of data; it does not support streaming and is not optimized for file transfer. BLE's key features also include an industry-standard wireless protocol that facilitates multi-vendor interoperability including connectivity with the large volume of Bluetooth devices on the market; adaptive frequency hopping; fast connections; a standardized application development architecture that leads to low development and operational costs; and enhanced security with 128-bit AES data encryption.

   With all of these benefits, BLE is inexpensive and developer-friendly, allowing developers and OEMs to easily produce innovative new devices that are readily interoperable with billions of Bluetooth-enabled devices on the market.

2. **Standards.** The Bluetooth Specifications (including BLE), overseen by the Bluetooth Special Interest Group ("**SIG**"), defines the technology architecture that developers use to create Bluetooth-interoperable devices. According to the SIG website, the Bluetooth Specifications enable interoperability between systems by defining the protocol messages that are exchanged between equivalent layers.

3. **Licensing Approach.** The Bluetooth SIG requires members to agree to a Patent and Copyright License

Agreement that includes obligations to license necessary patent claims on royalty-free terms. The scope is similar to that imposed by the OCF, but there are some notable differences. First, the scope of the patent claims that are captured is somewhat different. The claims captured are those for which it is *not possible* to avoid infringement because there is *no reasonable technical alternative* for implementing those *protocols, data formats and electrical signaling characteristics* within the Bluetooth specifications that are disclosed with particularity and whose sole purpose is to enable interoperability, inter-connectivity or communication. The license is similarly scoped so that only those portions of products and services that implement the above portions of the specification are captured. There is no opt-out process, so all licenses are granted on royalty-free terms, unlike the OCF policy. The agreement does not address subsequent transfers or assignments of patents. And while rights granted by members who terminate their membership survive, the specifics of post-termination covenants and rights differ somewhat from the OCF policy.

The Bluetooth SIG also licenses software for its Smart Starter Kit under a separate end user license which provides limited rights to sample code and documentation behind BLE (the "**Software**").

4. **Applications**. Bluetooth Classic was originally designed for continuous, streaming data applications that enabled the exchange of large amounts of data at a close range (e.g., consumer products such as in wireless headsets, file transfers between devices, wireless speakers, wireless keyboards and printers). In contrast, BLE's features make it ideal for the IoT applications that don't require a continuous connection but only need to exchange small amounts of data periodically and depend on longer battery life, significantly reducing cost and extending battery power. IoT devices with BLE are seen throughout the market in wearable monitoring devices (e.g., fitness devices, smart watches and medical devices), other sensing applications (e.g., thermometers, proximity sensors, weight scales and tire pressure sensors), mobile operating systems (e.g., all major mobile operating systems now offer Bluetooth Smart APIs) and numerous other devices that use BLE to provide their smart functionality.

Wi-Fi

1. **Technology.** The universal Wi-Fi standard is a networking technology that uses radio waves to provide wireless high-speed Internet and network connections within a limited range. Developed by the Wi-Fi Alliance, Wi-Fi is defined as any wireless local area network ("**WLAN**") product that adheres to the Institute of Electrical and Electronics Engineers' ("**IEEE**") 802.11 standards. Distinct from the newer Wi-Fi HaLow standard discussed in Part 1 of this Alert, the traditional Wi-Fi standard is a WLAN technology that allows electronic devices to connect to a network, and data exchange between devices generally occurs over the 2.4 GHz UHF and 5 GHz SHF ISM radio bands. Most recently, the 2013 release of IEEE 802.11ac (employed in every major smartphone, laptop, and smart television) improves speed and performance in these frequency bands. However, proximity is key: Wi-Fi is limited insofar as range, but offers advantages in terms of speed and bandwidth.

2. **Standards.** The Wi-Fi Alliance lists Apple, Broadcom Ltd., Cisco Systems, Comcast, Dell Inc., Huawei Technologies Co. Ltd., Intel Corporation, LG Electronics, Microsoft Corporation, Nokia Corporation, Qualcomm, Samsung Electronics, Sony Corporation, T-Mobile USA Inc. and Texas Instruments as key

sponsors. Under the Wi-Fi Alliance's Intellectual Property Rights Policy, the stated purpose of the Wi-Fi Alliance is to "promote the IEEE 802.11 wireless networking standard by encouraging manufacturers of wireless networking products to achieve a high degree of interoperability among all products employing the standard and by promoting through a number of means the widespread adoption and use of products employing the IEEE 802.11 standard." The IEEE 802 Standard comprises a family of networking standards that cover the physical layer specifications of technologies from Ethernet to wireless.

3. **Licensing Approach.** Under the Wi-Fi Alliance's Intellectual Property Rights Policy, any member (or its affiliate) who makes a contribution to the Wi-Fi specification or participates by downloading the specification, must grant the other members (and their affiliates) and any implementers of the specification under reasonable and non-discriminatory terms (and on a royalty-free basis, if the member has so elected under the license) a non-exclusive and nontransferable, non-sublicensable, worldwide license under its affected patent claims to allow such members (and their affiliates) and their implementers to make, have made, use, use, import, offer to sell, lease, sell and otherwise distribute products compliant with the specification. Members grant to the Wi-Fi Alliance a worldwide, irrevocable, nonexclusive, nontransferable, sublicensable, royalty-free copyright license to reproduce, create derivative works, distribute, display and perform the member's contributions for the purposes of developing and distributing the specification and products based on it. The Wi-Fi Alliance owns the copyright in draft and published specifications.

   The scope of the patent claims captured by the Policy is again different from the OCF policy. The claims captured are those disclosed with particularity in the specification where the *sole purpose* of such disclosure is to define, implement and utilize products and services to interoperate, interconnect or communicate in wireless networking as defined within the specification. Unlike OCF, there is an opt-out mechanism under which a member may elect to not license its patents (but only if such patent claims are included in the specification *other than by that member's own contribution* and such member discloses its patent rights within a certain period). Any transfer by a member or its affiliates of captured patent claims remains subject to the Policy and the agreement to grant licenses by the transferors to other members, their affiliates and implementers of the specification. Like the OCF policy, dissolution of the Wi-Fi Alliance or a member's termination, expiration or withdrawal of its membership in the Wi-Fi Alliance has no impact on licenses granted to other members, their affiliates or implementers that existed prior to any such termination.

4. **Applications.** Traditional Wi-Fi is often not the first wireless networking technology to come to mind in the context of IoT. However, based on IoT's key requirements (i.e., low cost, low power, compact form factors, rapid connection setup times and scalable deployments), some argue it should be. Advantages inherent in the Wi-Fi standard underscore its potential for IoT applications. Wi-Fi is a solution for long-range connected devices in the home. Wi-Fi connects to a home router and has a broader wireless range than Bluetooth, offering power and costs savings. IoT devices that utilize the Wi-Fi standard may be packaged into smaller forms, are easily "on boarded" to a home network and are scalable. An IP-based communication standard, Wi-Fi is suited to IP addressing; IoT always requires such IP addressing to avoid the expense and complexity of implementing a separate IP-conversant gateway. Wi-Fi includes

security credentials in the form of WPA2, which has allowed Wi-Fi system vendors to develop reliable, mission-critical, large-scale infrastructure solutions for years. Wi-Fi is cost-effective in the IoT space, as it has the ability to leverage existing secure and reliable infrastructure. In addition, while most IoT devices do not require both long-range or high throughput, the Wi-Fi standard has the ability to scale to meet this need if IoT applications evolve to require such factors.

5G

1. **Technology.** 5G, the fifth generation of wireless communications technology, is a super-fast wireless network and the predicted next phase of mobile telecommunications standards. 5G network deployments are anticipated in the "low" frequency band (below 6GHz, alongside legacy technologies, 2-3G and 4G (LTE)); and in the "high" frequency band (above 6GHz, alongside Wi-Fi). 5G networks are expected to facilitate faster data rates for tens of thousands of simultaneous connections, enhanced coverage, spectral efficiency and signaling efficiency, and reduced latency (compared to 4G (LTE)). The capabilities of 5G far outstrip the previous standards: 2G networks were designed primarily for voice capabilities; 3G was designed for voice and data capabilities; 4G (LTE) was designed for improving capacity, user data rates, spectrum usage and latency in broadband internet applications. It is anticipated that 5G will be able to process 1000 times more mobile data than existing cellular systems. 5G networks will also be smarter, fusing computing capabilities with communications, allowing objects to connect independently from a specific available network infrastructure.

2. **Applications.** The applicability of high speed and low bandwidth capabilities, already available across 4G (LTE) networks, positions cellular solutions well for IoT. 4G (LTE) networks are already deployed in many countries, offer low speed, low power and cost-efficient capabilities that optimize 4G (LTE) networks for a range of IoT applications. However, security has proven a challenge for existing 4G (LTE) technology in the IoT, and the increasing demands of new IoT applications may exceed its capabilities in the future. In contrast, 5G shows potential, expected to cover both communications and broadcast-like services, and a range of new use cases (e.g., across a variety of applications, performance attributes and devices, such as in the IoT), providing a platform to simultaneously connect a massive number of devices to the Internet. 5G improves the data rate, coverage and reduces end-to-end latencies, supporting faster, smarter mobile broadband use. Such small latency is essential in emerging applications such as autonomous cars and intelligent transportation technologies, trends that 4G (LTE) may struggle to support.

3. **Standards.** Standardization activities are underway in 2016, as a range of standards organizations, industry players and academia work to identify the standards, licensing models and techniques to apply to the new 5G technology. 5G is still some time away from being commercially available, with commercial deployment of 5G widely expected to occur by 2020, and its implementation will require large-scale investment. Despite this, mobile network operators are already reporting trial implementations of 5G. In addition, on January 2016, Google announced its Project Skybender, a plan to project 5G internet from a network of solar-powered drones. Undoubtedly, there is enormous potential for 5G in the IoT, as well as in broader applications.

4. **Licensing Approach.** The licensing approaches adopted by standards organizations for this promising standard remain to be seen. The range of patents and key underlying technologies for 5G networks is expected to develop significantly in the next 5 years. Many companies are working to stay apace with these developments to capitalize upon the patent licensing opportunities. In the patent licensing space, revenues for 5G services are expected to exceed $65 billion by 2025.[1] In February 2016, Ericsson announced a virtual marketplace for patent licensing across potential IoT verticals, with the goal of simplifying access to standardized technology while expanding Ericsson's market strategy around intellectual property rights and 5G patent licensure. Handset makers are also working on 5G IP development in order to minimize their intellectual property licensing costs. The multiplicity of approaches reflects the familiar divide in the industry: on the one hand, strong protections for the underlying 5G patents creates an patent monetization opportunity for licensors, but also can create some barriers to broad implementation and adoption. On the other hand, weaker protections lower incentives for innovators to make their intellectual property available to competitors, creating the risk that high-quality technologies necessary to improve the standard will not be shared.

Blockchain

1. **Technology.** The significance of blockchain and other distributed ledger technologies ("**DLT**") in the IoT context is considerable. Recognized as the technology underpinning the Bitcoin digital currency, blockchain has gained more and more attention as various parties, including government authorities, financial institutions and firms across industries, examine its potential applications in a range of fields. Blockchain is emerging as a means to enable companies to make and verify transactions on a network simultaneously without a central authority, expediting transactions and cutting costs while lowering the risk of fraud.

   Simply put, a blockchain is an "append-only" database that makes it possible to create a digital ledger of transactions accessible to a distributed network of computers running on the same network protocol. A blockchain has three key elements: a network of computers, a network protocol and a consensus mechanism.

   - **Network of Computers.** A blockchain's network of computers may include everyone with a computer ("permissionless" networks, such as the Bitcoin blockchain), "permissioned" or private networks of entities that agree to participate (such as Hyperledger), and traditional databases. Each computer in a particular network is called a "node".

   - **Network Protocol.** Via an establish network protocol, each node coordinates with other nodes to maintain the integrity and consistency of the ledger. Cryptography is used to verify transactions and keep information on the blockchain private, allowing each participant on the network to securely verify the ledger, approving a transaction, without the need for a central authority to process, validate or authenticate transactions. The linked transactions on the digital ledger form an exact chain of title

[1] Pratap, R. and Vijh, R., *5G Mobile Networks: The Next Big Battleground,* IPWatchdog, March 31, 2016, http://www.ipwatchdog.com/2016/03/31/5g-mobile-networks-next-big-battleground/id=67632/.

over time. Once recorded, a data entry is extremely difficult to modify.

- **Consensus Mechanism.** The "consensus mechanism" is a set of rules by which the distributed computer network verifies each transaction and agrees on the current composition of the digital ledger. Each transaction in the blockchain must reference a balance in a digital ledger received from the previous transaction. The consensus mechanism in the permissionless Bitcoin blockchain is called "proof of work", requiring participants to expend resources using cryptography to verify the digital signatures attached to data blocks in each transaction. In "permissioned" blockchain networks, the consensus mechanism may be more flexible, as participants involved in the transactions are known. There is currently no universally accepted consensus mechanism. A range of blockchain configurations exist that use different consensus mechanisms, determined by such factors as the type and size of the network, transaction throughput capacity, privacy, resiliency, threat model, vendor dependency and the ability to meet regulatory requirements.

2. **Applications.** Despite the controversial reputation of Bitcoin due to its association with the contraband website, Silk Road, many companies view the underlying technology – the blockchain – as a significant opportunity. Various enterprises are experimenting with applications for different DLTs, from the underlying infrastructure to blockchain-based applications.

- **Internet of Things.** Blockchain has tremendous potential in the IoT. The current hub-and-spoke model, requiring a central authority, is expensive, less secure and has scalability issues. Some have proposed that blockchain technology as a solution to such issues. International Business Machines Corp. ("**IBM**") and Samsung have announced efforts to work on the Autonomous Decentralized Peer-to-Peer Telemetry ("**ADEPT**") platform, which proposes to demonstrate the benefits applying the decentralized approach of blockchain technology to the IoT. IBM's researchers have proposed that, if an IoT device is registered by manufacturer as a participant in the blockchain, the digital ledger becomes a valuable database of information (e.g., device history, product revisions, updates, and warranties). In a decentralized IoT, the blockchain framework facilitates the coordination and processing of transactions between interacting devices, eliminating the need for a central authority or point of failure, enabling trustless peer-to-peer messaging, securing distributed data sharing and a robust and scalable form of device coordination.

- **Smart Contracts**. Firms cite blockchain as presenting the opportunity to securely track assets through their supply chains or electronically initiate and enforce "smart contracts". A smart contract is an agreement that is automatically executed by a node once pre-coded conditions are satisfied. The projected impact of smart contracts on the global economy is considerable. In September 2015, the World Economic Forum released a report that predicted that, by 2027, 10% of global gross domestic product will be stored on blockchain technology,[2] largely through the shift to smart contracts secured in the blockchain as "self-executing contractual states, which eliminate the risk of relying on others to

[2] Global Agenda Council on the Future of Software and Society, *Deep Shift: Technology Tipping Points and Societal Impacts, Survey Report,* World Economic Forum, September 2015, p. 24, http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf.

follow through on their commitments". As an example, the dynamics of the media industry could be transformed by the use of blockchain to implement "smart contracts". A smart contract could ensure that a song won't play unless payment has been transferred, preventing piracy by verifying the legitimate chain of custody. The same model would apply to movies and other digital content. An example is Artist Imogen Heap, who released a single in October 2015 on Ujo, a music blockchain built on the Ethereum Protocol.

- **Financial Services.** Financial services companies represent a first mover in the space: blockchain is perceived as a means to address the shortcomings in the existing financial infrastructure. The legacy system is expensive, inefficient and vulnerable to operational failure and attack, based on a centralized, unencrypted, hub-and-spoke database model that requires multiple participants to maintain records to ensure consistency, making reconciliation processes cumbersome. Regulatory demands for increased transparency and expedited settlement times generate issues in the trade-processing and record-keeping phases of a transaction, generating added costs and counterparty, operational, and security risks. For example, in financial services, trades are often verified by a central clearinghouse that maintains its own ledger, a process that may require days and expense for a transaction to settle. In contrast, blockchain technology eliminates the clearinghouse, banks maintain their own copy of the ledger and participants may communicate with one another via a common network protocol and consensus mechanism, allowing transactions to be approved automatically within minutes, saving time and cost. In the past year, more than 40 financial institutions reported that they were working with blockchain, experimenting with different implementations of the technology to settle trades, making cross-border payments and other transactions, and reducing transaction time and risk. The Wall Street Journal recently reported that the use of blockchain technology could cut $20 billion in annual costs in global banking.[3] Industry groups perceive the potential of DLT to address limitations of the post-trade process in the financial industry by "modernizing, simplifying and streamlining the siloed design of the financial industry with a shared fabric of common information".[4] The R3 CEV LTD consortium ("**R3**"), a group of 42 banks working on blockchain standards, recently conducted a pilot test among 11 banks on a private blockchain using a private open-source blockchain from Ethereum. Nasdaq reported in December 2015 that it had conducted its first securities transaction on its blockchain-based product, Nasdaq Linq.

- **Other Industries.** In other industries, a range of startups and industry groups are exploring the potential applications of DLT, from creating certification mechanisms for the trade of precious goods to the media business.

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[3] Vigna, Paul. *Nasdaq's Blockchain-Based Securities Platform Records First Transaction,* The Wall Street Journal, December 30, 2015, http://blogs.wsj.com/moneybeat/2015/12/30/nasdaqs-blockchain-based-securities-platform-records-first-transaction/.

[4] *Embracing Disruption: Tapping the Potential of Distributed Ledgers to Improve the Post-Trade Landscape*, Depository Trust & Clearing Corporation, January 2016. p. 11, http://dtcc.com/news/2016/february/03/dtcc-sharpens-distributed-ledger-focus-with-white-paper.

3. **Challenges.** Despite the media coverage and apparent potential of blockchain technology, key challenges need to be overcome before it sees broad adoption. Notwithstanding the number of new partnerships, new developments and new test cases underway, currently there is no standardized DLT tools or interfaces and no large-scale blockchain application operating in production due, in part, to technology challenges related to security, unproven scalability, latency, performance and uncertainties about where regulators stand on the technology. Collaboration across all interested parties, including regulators, is required. A recent report released by Depository Trust & Clearing Corporation ("**DTCC**") argued that "[a] sustainable distributed ledger platform that is capable of serving markets broadly should require central industry coordination and governance, whether through industry associations, open consortia or industry utilities whose mission is to serve the industry."[5] These efforts remain in early stages. In addition, a range of legal and regulatory issues remain to be addressed, such as concerns around accountability, the enforceability of smart contracts, consumer protection, privacy and security, competition and antitrust and the regulation of decentralized organizations. It's clear that blockchain technology has significant potential in a range of sectors. However, given the unresolved issues, while a useful new tool, the technology is not a panacea. Some transactions may benefit from decentralization; others will still require an intermediary and centralized database.

4. **Industry Standards.** What, then, is the current state of play with respect to the standards governing blockchain and DLT? Blockchain is not the subject of the kinds of industry standards seen for IoT in general. The technical standard, ISO 20022, operates as an ISO standard for electronic data interchange between financial institutions. However, industry standards adopting the technical standard are in their infancy, and the market is beginning to see the same kind of multiplicity of initiatives evident in the IoT standards reviewed in Part 1. Presently, there are no commonly accepted interoperability standards governing the operation of DLT across enterprise. Recently, Saket Sharma, CIO of BNY Mellon's Treasury Services unit, emphasized that the lack of consensus on standards for blockchain technology in the industry was hindering the industry, as without a standard financial firms would not be able to interoperate.

   Several competing initiatives exist in the space including, without limitation, those supported by R3 (an R3-managed private peer-to-peer distributed ledger, underpinned by Ethereum technology and hosted on a virtual private network in Microsoft Azure, the public cloud platform offering Blockchain as a Service ("**BaaS**")), the SWIFT Consortium ("**SWIFT**"), the Stellar Development Foundation's open source Stellar Protocol, the Ethereum Foundation's open source Ethereum Core Protocol (licensed under the GNU Lesser General Public License) and the Interledger Protocol promoted by Ripple and licensed under the terms of a W3C Community Contributor License Agreement, among many others. However, the Linux Foundation's Hyperledger project is posed to lead the definition of industry standards for blockchain technology. In December 2015, the Linux Foundation announced plans to collaborate with other technology and banking players to create an enterprise-grade open-source distributed ledger framework utilizing blockchain technology called "Hyperledger". According to a press release, '[t]he project will develop an enterprise grade, open source distributed ledger framework and free developers to focus on

[5] See DTCC, op cit 2, p. 11.

building robust, industry-specific applications, platforms and hardware systems to support business transactions."[6] Participants in the group reportedly include R3, SWIFT, Cisco Systems, Inc., IBM, Intel Corporation, Accenture, ANZ Banking Group, CLS, Deutsche Borse, Digital Asset Holdings, DTCC, Fujitsu, IC3, JP Morgan, the London Stock Exchange Group, Mitsubishi UFJ Financial Group, State Street, VMWare, Inc. and Wells Fargo. The group reports that it hopes that the Hyperledger standard will become the de facto standard in the space. The collaboration will seek to identify and address important features and currently missing requirements for a cross-industry open standard for distributed ledgers.

5. **Licensing Approach.** The Linux Foundation released the Hyperledger source code under the open source Apache License (Version 2.0). Under that license, a contributor must grant to a licensee (e.g., someone accessing the Hyperledger standard) a royalty-free copyright license as well as a royalty-free patent license of limited scope.

   The scope of the Apache license has been written about extensively elsewhere, so we focus here on a few issues of particular import to IoT. The patent license grant leaves open important questions as to scope, particularly in the interoperability context. The scope of the license grant is broad, as it extends to the manufacture, use sale, offer for sale, import and other transfer of the entire work that is licensed by Apache (this is defined as the "Work"), not just the specific contribution that the licensor itself made. The patent claims captured under the license, however, are narrower: the grant is only under those claims that are necessarily infringed by the specific "contributions," (works of authorship intentionally submitted by the licensor for inclusion in the Work) *or their combination with the Work* [emphasis added]. This language is somewhat vague and may lead to questions of interpretation as to whether the patent licenses capture particular claims of patents. By comparison, the OCF and Bluetooth patent license grants, while arguably narrower, are more specific and may be subject to clearer interpretive guidance.

CONCLUSIONS

The development of standards to govern technologies such as 5G and DLT will undoubtedly have a significant influence in shaping how the IoT industry evolves and the broader application of the technologies. The involvement of companies other than financial institutions in the Hyperledger project emphasizes blockchain technology's broader relevance and potential. However, as with the "standards war" seen in the IoT context, resolution of the current multiplicity of efforts will require resources and time. The development of these technologies will undoubtedly be accompanied by new regulatory hurdles requiring resolution. The treatment of intellectual property within this process will merit careful consideration. As with the IoT-specific context, the open source model underlying the original blockchain model undoubtedly promotes a broad and cross-industry approach to collaboration, but must be balanced with the range of interests inherent in the landscape of proprietary vendor solutions.

[6] Linux Foundation Unites Industry Leaders to Advance Blockchain Technology, Linux Foundation, December 17, 2015. http://www.linuxfoundation.org/news-media/announcements/2015/12/linux-foundation-unites-industry-leaders-advance-blockchain

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