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SECURING WESTERN LEADERSHIP IN GLOBAL 5G STANDARDS AND PATENTS

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Introduction

Without a cohesive, coordinated U.S.-led standards development strategy, the U.S. and Western, like-minded nations stand to lose leadership on more than just 5G wireless communications technologies. If the West loses the capability to shape the standards to define 5G, China could win 6G and nG (any future G). Whichever country, or collection of like-minded countries, leads in the development and deployment of the latest technology will see more economic growth from that technology, which translates into not just technological and economic power, but also geopolitical power.

4G, the predecessor to 5G, offers a glimpse of the economic growth, geopolitical power, and influence a first-mover country gains from shaping and dominating bleeding-edge technology. 5G is the foundation for next-generation technologies. Allowing China to dominate and influence 5G threatens long-term national security and economic growth for the West.

In March 2020, the White House announced the *National Strategy for Securing 5G* as a response to the threat posed by China. The strategy includes an intent to "promote United States leadership in international standards development and adoption."[1] MITRE assessed the current landscape of global 5G standards setting and identified opportunities for the U.S. to attain leadership and influence the adoption of international standards that do not favor only China.

In this paper, MITRE explores the dynamics between global standards engagement, patent development, and market influence in the 5G industry. By applying a data-driven approach to understand Huawei and ZTE behaviors in standards setting, we challenge the assertion that China currently has dominance in global 5G standards. However, China *is* pursuing a very aggressive strategy to gain that dominance. If it is allowed to do so, it could significantly progress toward a national objective to dictate global 5G standards. The impact would be profound and the dominance would affect U.S. government and industry engagement, commitment, and behavior in 5G standards. A U.S.-led coalition of like-minded organizations and partners needs to counter and change Chinese market leaders' behavior to enable the West to secure 5G standards leadership.[2]

Why Standards Matter

Over the past two decades, the global telecommunications manufacturing base has shifted to Europe as North American firms have been acquired and consolidated into European players. In addition, North American firms began sharpening their focus on higher margin software and services. The absence of U.S. leadership in the industry coincided with a ramping up of China's national strategy to become an economic superpower through licit and illicit behaviors. By the rollout of 4G, China emerged as a contender in the wireless technology space at the lower end of the market mostly building and selling to the late-adopter, budget-constrained segments of the world. 5G represents a significant shift for China from global contender to leader and the first time China sits at the bleeding edge. 5G will usher in a new wave of transformative technology fueling advances across both government and commercial sectors, and China has committed early investment to lead global deployments.

U.S. companies that maintain a strong investment in research and engineering will advance the next generations of mobile telephony (6G and beyond). A strong research and engineering presence will avail companies of the patent process to protect their intellectual property and to participate aggressively in the voluntary industry standards process. This is done through the U.S. affiliates of international

standards organizations and other international standards development organizations (SDOs) where the parameters of these future generations of mobile telephony will be defined.

The U.S. recognizes the importance of standards and has taken actions to increase standards engagement. The *National Strategy for Securing 5G* calls for stronger alliances and public-private partnerships to adopt standards promoting market diversity and reliable technology to develop 5G infrastructure.[3] The *Department of Defense (DoD) 5G Strategy* includes objectives to influence 5G standards and policies to enhance U.S. competitiveness.[4] Further, the DoD Chief Information Officer has established a cross-department team engaging various SDOs with an emphasis on securing the supply chain through uniform international standards and requirements.

The U.S. government knows that 5G standards matter, evident from the national strategies and initiatives to accelerate engagement with SDOs, yet the government cannot effectively guide these standards without cooperation from industry. U.S. industry is heavily invested in standards development but can still benefit significantly and influence standards globally through proper U.S. government policies and coalition building.

The Critical Standards Bodies

Currently, the following standards-settings bodies and regional consortiums determine the requirements and technical standards that define the global 5G market: International Telecommunications Union (ITU), Internet Engineering Task Force, European Telecommunications Standards Initiative (ETSI), 3rd Generation Partnership Alliance (3GPP), International Standards Organization, and International Electrotechnical Organization. Each of the global standards organizations and bodies are influenced by efforts of regional SDOs such as Alliance for Telecommunications Industry Solutions (ATIS) in North America.

3GPP is a consortium of market leaders that includes seven regional SDOs and manages and defines the international standards for 5G development. This has led to carriers falling uniformly in line under the leadership of 3GPP.

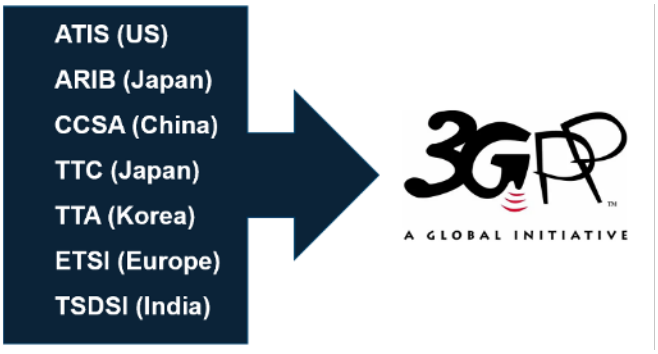

Figure 1 provides an overview of the structure of 3GPP and its 7 global SDOs.

The primary focus on U.S. 5G standards development strategy rests in engagement with 3GPP, the global industry consortium standards-setting body, and ATIS, the North American regional standards development organization that is a member of 3GPP.

ATIS presents an opportunity for the U.S. to drive technical proposals to influence international standards. Leveraging and partnering with ATIS is a critical component of a cohesive and coordinated U.S.-led standards engagement strategy.

Influence of Standards Engagement

A primary goal of each member in 3GPP is to ensure that the published standards contain as many of their technical proposals as possible. Technical contributions lead to an advantage in intellectual property (IP) rights. Technical contributions include company IP, which if incorporated into the standards must then be adopted

by all market competitors deploying 5G. Moreover, 3GPP requires individual members to declare to their organizational partners any IP rights (IPRs) that they believe to be essential, or potentially essential, to any work being conducted within 3GPP. This leads to the creation of standard essential patents (SEPs).[5] International standards can determine which companies receive billions of dollars in equipment sales and licensing royalties for years to come, which increases their market influence and reputation.[6] It is important to note that not all SEPs are created equal nor are all SEPs implemented as applicable requirements for licensing. The value and technical criticality of SEPs are determined by market forces and not standards bodies or consortiums.

Incentivizing U.S. engagement through the 5G standards development process presents an opportunity to drive market share and shift the global competitive landscape.

The China 5G Standards Threat

China has fully recognized the impact of 5G technological standards setting and has backed state-coordinated policy and strategy to influence leadership in 5G SDOs. And allowing China to dictate the international technical standards for 5G has repercussions far beyond 5G.

Beijing is preparing to release China Standards 2035, a 15-year blueprint on its strategy and intentions to dominate global technical standards for the next generation of technologies. China is influencing how the next generation of technologies will operate including telecommunications, artificial intelligence, cloud computing, internet of things, and big data. If China continues to define international technology standards, the associated data that flows through the infrastructure and networks operating from the adopted requirements are potentially subject to Chinese government access.[7]

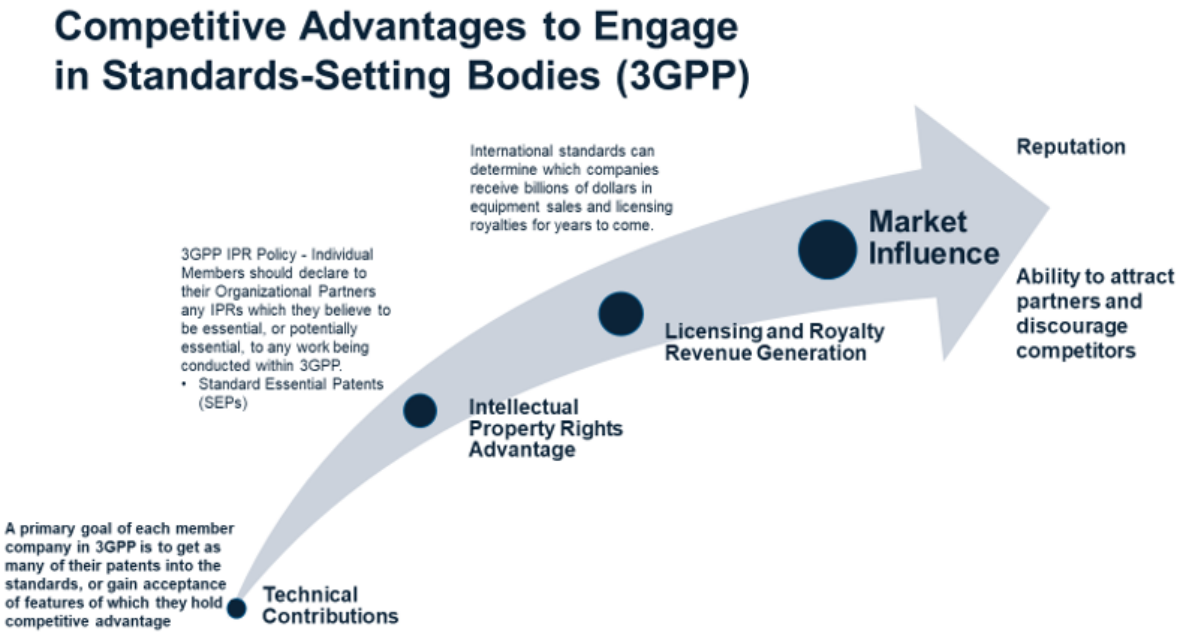

Figure 2 provides an overview of the lifecycle of standards influence, demonstrating that a single technical contribution can lead to competitive advantage and market influence.

China has the power and influence to continue to dominate the proposal, lobbying, and adoption of international standards dependent on Chinese technology strengths. To defend the West's long-term strategic interests, the U.S. must build and develop global partnerships and coalitions to drive standards away from China's technical strengths and influence adoption of international standards that promote market diversity and infrastructure security and resilience.

China's Coordinated Competitive Advantage

Beijing's current standardization five-year plan, separate and distinct from China Standards 2035, includes the goal of promoting advantageous and special Chinese technology standards to become international standards to serve Chinese enterprises and industry going global. Beijing's standards policies can amplify the market-distorting effects of its broader industrial policies like Made in China 2025, which provides disproportionate government support for Chinese companies in an effort to create globally competitive national champions.

Incentives are driven by government policy, support, and industry championing. In China, Huawei is the state-sponsored champion in telecom. Huawei is provided special state-backed loans at low rates through state-owned banks,[8] and Huawei invests capital in research and development (R&D) and innovation, leading the global 5G market players in total R&D investment.[9] China also operates a $100 billion direct government subsidy fund, of which Huawei is a significant beneficiary.[10] In addition to low-cost government loans and government subsidies, Huawei employees travel internationally under diplomatic passports and enjoy special lavish standards far superior to and differentiated from other global telecom entities.[11]

The investment in R&D enables Huawei and ZTE to grow their engagement and presence in regional and global standards development bodies. In addition to enabling Chinese entities to fund standards development, local and state governments provide individual incentives to company employees across the standards development process: technical proposal (through working groups, regional bodies, global bodies), proposal acceptance, and standards adoption. The incentives provided by the state encourage individuals to actively engage, contribute, and influence standards development.

	Employee Participation in 3GPP Standards-Setting Body	5G Standards Contributions
HUAWEI TECHNOLOGIES CO., LTD.	3,098	19,473
TELEFONAKTIEBOLAGET LM ERICSSON	2,193	15,072
SAMSUNG ELECTRONICS CO.,LTD.	2,142	4,573
QUALCOMM INC	1,701	5,994
NOKIA OYJ	1,618	11,555
ZTE CORPORATION	1,128	4,692

Figure 3 shows the coordinated advantage Huawei holds over other 5G competitors: highest employee participation in 3GPP, most technical contributions to 3GPP.

A direct driving factor for China's push to set international standards may rest in the royalties and licensing fees generated from declared 5G patents. China simply does not want to pay licensing and royalty fees to foreign countries and has established national champions (Huawei) and provided government support to commit resources to R&D programs and acquisitions, specifically 5G.[12]

Huawei has a clear advantage in employee participation and contributions across 3GPP, and MITRE has developed additional insights into Huawei's (and China's) advantage and behavior across standards organizations.

China's Anti-Competitive Behavior in Standards

Illicit behavior and actions occur at the country/regional business level. For instance, in Costa Rica, South America, and Africa, Huawei won contracts because of additional promises and incentives often considered unethical or illegal by other market competitors including building a hospital for free. It should be noted that a U.S. competitor can be held to different standards of behavior under U.S. law, but it is not illegal in every country and for every competitor. At a country and regional business level, these additional incentives are a part of normal business with 5G providers, representing a significant competitive advantage to countries such as China that engage in this behavior.

From the outset, China established a presence in 5G standards development. China has adopted an aggressive engagement strategy across 5G international standards. China's initial engagement behavior included hiring retired or unemployed telecom veterans to lead China's strategy and offering financial incentives to employees for contributing to working groups, proposals, and adopted standards.

China's tactical actions are part of the greater 2035 Standards strategy to steer technology towards Chinese industry strengths and advantages. Through aggressive action, China is executing its strategy through 1) attaining leadership positions across standards bodies and 2) designated authoring and editing authority for contributions.

Chinese companies have attempted to gain influence through the standards process in several ways:

- Twisting the arm of (i.e., threatening) a nominee board's businesses to gain leadership positions
- Pressing working groups of SDOs into bringing in Chinese nationals as co-authors and co-editors of technical contributions and studies
- Inserting language in proposals and standards that mandate conformity versus providing options to market competitors (using "shall" versus "should")
- Promoting written language of standards to be in Chinese versus English
- Eliminating items and components in standards that do not serve China's best interests through quorum by dominating presence in meetings and standards bodies
- Establishing subsidiaries in multiple countries to gain influence through voting across various regional SDOs (ensures Chinese presence and vote in every SDO)

China is still learning the culture and adapting to the norms of standards organizations but already recognizes that the actions, behaviors, and tactics that work in China do not necessarily work in standards bodies. China has attempted to gain influence with below board and potentially anti-competitive behaviors and has been met with pushback from standards bodies.

Challenging China's Global 5G Leadership

It is apparent that China (mainly via Huawei) is heavily engaged and invested across the 5G standards development community through state-coordinated strategy, policies, and preferential treatment. Various published standards and patents news articles and studies have deemed Huawei and China as 5G leaders.[13]

A variety of published 5G standards and patents leadership studies have reached misleading conclusions, detailed in a paper released by Bird & Bird LLP.[14] The important findings from the paper that MITRE used as guardrails to execute its study of 5G leadership are listed below:

- Existing assessments of declaration leadership are inaccurate[15]
- Using patent counts to assess leadership is misleading
- Impact of standards and validity of patent data must be replicable by secondary sources
- Declaration of patents does not weigh essentiality of the patents

MITRE leveraged data from various sources included in the Bird & Bird study to compile a holistic global patents landscape but did not rely exclusively on this data. MITRE used patent data integrated with standards data to apply a unique and innovative methodology to assess 5G leadership.

	Employee Participation in 3GPP Standards-Setting Body	5G Standards Contributions	5G Approved Contributions	5G Standards Favorabiity Ratio (Approved % to Contributions)
HUAWEI TECHNOLOGIES CO., LTD.	3,098	19,473	5,855	30%
TELEFONAKTIEBOLAGET LM ERICSSON	2,193	15,072	5,114	34%
SAMSUNG ELECTRONICS CO.,LTD.	2,142	4,573	1,239	27%
QUALCOMM INC	1,701	5,994	1,994	33%
NOKIA OYJ	1,618	11,555	3,804	33%
ZTE CORPORATION	1,128	4,692	1,188	25%

Figure 4 shows employee resources committed to engage in 5G standards development through 3GPP and the correlation between a company's engagement, proposed contributions, and approved contributions. Notably, within 3GPP, there is no one country or company that is favored over another. Huawei clearly dominates in 3GPP participation despite a lower approval rate than Ericsson, Nokia, and Qualcomm.

By analyzing and aggregating standards engagement, contributions, accepted contributions, and patents data, it becomes apparent that China's 5G global standards leadership is partially founded on global perception.

The favorability ratio signifies that standards organizations such as 3GPP are fairly resistant to country and company influence.[16] Nevertheless, greater participation, engagement, and contribution certainly results in a higher volume of approved contributions and ultimately, competitive advantage across the standards process.

Huawei operates and executes a standards engagement strategy driven by volume, leading to a perception of global leadership across these areas:

- 5G SEPs
- R&D investment
- 5G submitted and approved contributions in 3GPP
- Individual employee participation in 3GPP

Declaring essential patents does not accurately define or characterize technology leadership. There is no denying the fact that Huawei has the most declared 5G patents but breaking down the essentiality of those patents reveals their true innovation, value, and technical contribution to the 5G market. Similar to Huawei's technical standards proposals and contributions, only

	5G Standards Contributions	5G SEPs	5G SEPs Per Total 5G Standards Contributions
HUAWEI TECHNOLOGIES CO., LTD.	19,473	3,325	17%
TELEFONAKTIEBOLAGET LM ERICSSON	15,072	1,423	9%
NOKIA OYJ	11,555	2,308	20%
SAMSUNG ELECTRONICS CO.,LTD.	4,573	2,846	62%
ZTE CORPORATION	4,692	2,204	47%
QUALCOMM INC	5,994	1,330	22%

Figure 5 demonstrates the correlation between 3GPP employee participation, contributions, and declared 5G SEPs. The assessment starts to demonstrate the differentiated strategies of market competitors in 5G standards development. Technical leadership and excellence appear to be an objective of companies such as Samsung, ZTE, and Qualcomm. Volume appears to be a strategy across Huawei, Nokia, and Ericsson.

a small percentage of Huawei's declared essential patents meet international standards and hold value to competitors.

Huawei's business relies heavily on access to other companies' patents to make equipment that meets global standards.[17] Richard Windsor, a global technology analyst, applies an airplane analogy to the 5G standard essential patent scenario. To build a commercial airliner, the essential components are the engine, ailerons, and wings—but the aircraft also needs seats and beverage carts. Qualcomm, Ericsson, and Nokia hold the essential parts in 5G, while Huawei's and other's patents are closer, borrowing from the analogy, to beverage carts and seats.[18]

Huawei does not hold a technical advantage or leadership position in 5G SEPs. The global perception emanating from volume of declared essential patents compels competitors to believe that Huawei's patents are valuable, and Huawei is influential in driving international standards, creating a competitive technical advantage and position of standards leadership. Coordinated messaging and global partnerships with Huawei competitors are critical steps to counter China's efforts to influence the 5G market.

Perceived technical leadership (5G patent volume, 5G SEPs, R&D investment, contributions) does not equate to technical excellence (accepted proposals, applicable SEPs, quality contributions), but it does enable market influence through growing market share and discouraging competition.

China's strategy promotes advantageous and special Chinese technology standards in order to increase the likelihood of the market shifting to a strategy in their favor. Even as *perceived* leaders in 5G, China can influence the competitive investment strategies of rival companies such as Nokia, Ericsson, and Samsung.

This strategy potentially signifies that Huawei and other China SDO participants may not truly care whether their SEP's control standards issuances are adopted across the board as long as they are not diverted into complying with the patented technologies of other competitors within the standards framework.

Anticipating the Great Divide

China has encountered significant pushback and restrictions advancing and deploying 5G across the globe. The U.S. has effectively banned American telecom carriers from investing in Huawei infrastructure, and the U.S. has led a campaign to persuade foreign partners to take similar actions and positions against China. A consequence of dividing 5G deployment between U.S. allies and China allies presents the possibility of two competing global 5G ecosystems or consolidation and emergence of competing SDOs that will alter the global standards development landscape.

3GPP governs a single global standards framework and represents a consortium of global SDOs. 3GPP sets the global standards that industry players must follow to operate in global markets. A scenario could exist where 3GPP is absorbed by China, and North America and Europe form a joint SDO consolidating ATIS and ETSI. The 3GPP members and regional SDOs must choose between China and the West.

This scenario could cause a dramatic shift in global competition as industry players that influence and drive standards through regional bodies will be forced to choose between conforming to the standards of the West or the standards of 3GPP and China. It is difficult to assess the draw and attraction of two global forces (U.S. and Europe) acting in unity to create an industry-conforming SDO that competes directly with 3GPP and China.

Regardless, this scenario requires the same set of actions: the U.S. must focus on coalition building as well as engaging and working with the private sector to counter China's influence.

How the U.S. Responds to China's 5G Standards Threat

Based on our analysis, China clearly engages in aggressive competition within the rules and norms of the international standards organizations and is primarily influential through the volume of its active participation. The U.S. can promote and advance Western global leadership through coordinated legislative action and engagement with U.S.-based, standards-setting bodies.

There are a number of 5G-related legislative measures that have been introduced in the 116th Congress, but these are primarily focused on securing 5G infrastructure and deployment, the 5G supply chain, the transfer and export of critical technologies, and open radio access network (OpenRAN) initiatives.

Two bills were introduced, however, specifically involving standards engagement. The first of these, the Secure 5G and Beyond Act of 2020 (PL 116-129), was enacted into law in March 2020. It requires the President to develop a strategy to secure and protect U.S. 5G and follow-on systems, including these provisions:

- Ensure the security of 5G wireless communications systems and infrastructure within the U.S.
- Assist mutual defense treaty allies and partners to maximize the security of their 5G systems and infrastructure
- Protect the competitiveness of U.S. companies, the privacy of U.S. consumers, and the integrity of standards-setting bodies

The other bill, the Promoting United States International Leadership in 5G Act of 2019 (HR 3763), has passed the House but, as of this writing, awaits Senate action. It would direct the President to establish an interagency working group to enhance U.S. leadership in international bodies (e.g., ITU) that set standards for 5G and future technologies. The group would report to Congress on the items delineated below:

- A strategy to promote U.S. leadership in standards-setting bodies
- A strategy for diplomatic engagement with allies and partners to share security-risk information related to 5G
- China's activities in 5G standards-setting bodies
- A strategy for engaging with the private sector, academia, and federally funded research and development centers to develop secure 5G standards

If both bills are enacted into law, these measures offer an opportunity to build on legislative momentum to craft policy to significantly close the 5G standards engagement gap between the U.S. and China. Such a U.S. 5G standards development strategy must be built on the foundation of incentivizing U.S. industry partners to actively participate in the standards debates ongoing in the relevant SDOs. While the legislative vehicles described above address some important aspects of the problem, neither of them offers the kinds of financial incentives necessary to induce private industry to actively work to advance and secure U.S. 5G leadership. The incentives required here are modest but critically important.

MITRE outlines the following elements for executing a U.S. 5G standards development strategy and providing avenues to secure U.S. 5G standards leadership.

Dedicated Federal Funding Tied Directly to Standards Development

Legislation such as HR 3763 promotes standards-setting integrity, security, and leadership by establishing an interagency working group funded from participating agencies. Designating a federal agency as the dedicated

lead of this effort would necessarily require augmented funding through an appropriations bill.

ATIS, the North American regional telecommunications SDO, includes members outside of industry, specifically the federal government including these agencies: DoD, National Security Agency, National Telecommunications and Information Administration, Department of Transportation, Department of Justice, and Cybersecurity and Infrastructure Security Agency (Department of Homeland Security). Identifying and funding one of these federal agencies to lead an SDO effort offers an alternative approach to incentivizing industry players and provides a direct channel to drive and influence standards.

Recognizing the criticality of the standards development process, the federal government can direct and drive U.S. engagement, participation, contribution, and leadership across regional SDOs (ATIS) and then to global SDOs (i.e., 3GPP, ITU).

Advancing U.S. Innovation and R&D Through Tax Policy

U.S. telecom companies currently receive a 7% tax credit on R&D for qualified expenses, which are listed below:

- Developing custom communication networks
- Developing new programming models, algorithms, and parameterized data traffic
- Developing or improving functional integration for mobile computing, media, and network processes
- Integrating new materials to improve product performance and manufacturing processes and testing of prototypes
- Implementing new production standards and quality assurance processes
- Improving product quality, durability, or safety of networks and processes

In addition to expanding the list of qualified 5G R&D expenses, another option for stimulating American leadership here would be to increase the R&D tax credit for 5G-related expenditures from 7% to 15% or up to 25%. Such a move could incentivize industry's investment in 5G technologies and advance America's technical leadership in the area. In addition to driving patent development and protection efforts, it would also create natural interest on the part of U.S. industry in pursuing greater involvement in requirements and standards development.

U.S.-Funded Patent Protection Costs

The patent process includes filing a patent application, prosecuting the patent application, granting the patent, and maintaining a patent. Costs to maintain a patent include patent protection components such as official fees, attorney charges, and translation costs. Over the life of a patent, those costs are high. In the U.S., 5G startups, entrepreneurs, and individual inventors are stymied by the high costs of patents, especially patents intended for license.

Directing the National Science Foundation to fund patent protection for U.S. 5G innovators would likely provide important incentives to advance R&D, file patents, declare SEPs, and influence standards development without fear of potentially engaging in international intellectual property law disputes with entities that intend to drive U.S. competitors out of the 5G market. Federally funded university research IPRs and technology transfer are governed by the 1980 Bayh Dole Act. Providing an avenue to better protect IP for universities and institutions represents a significant and transformative extension of the 1980 act. U.S.-coordinated and funded patent protection could thus provide an avenue to advance 5G technical global leadership.

ATIS Engagement

As discussed above, ATIS is the North American regional SDO that strategically drives industry and government engagement and represents the platform for the U.S. to influence global SDOs and the global standards process.

ATIS is one of the 5G vehicles that the U.S. can directly leverage and influence through government action. The U.S. could advance a systematic effort to collaborate and use ATIS to its highest potential and utilize ATIS to drive standards to the 3GPP and global SDOs that are favorable to the U.S.

With ATIS, the U.S. can achieve influence similar to the European Union (EU) and ETSI. ETSI is now a successful global actor that the EU has leveraged to further its interests in the global arena of trade and markets. Specifically, ETSI has incorporated preferences and values of private and data protection in technical standards that are reflective of the EU's aspiration to balance non-economic and economic aims.[19]

The U.S. can also work with ATIS to build coalitions with like-minded companies in response to a possible division of the world telecom infrastructure to participate, engage, and counter China's volume and influence. By working through industry, the U.S. can avoid the perception of directly engaging with China and risking retaliation. Across 3GPP, there is pushback against government involvement because it is seen as politicization versus focusing on standards.

OpenRAN is still in the early stages and potentially represents the West's best play in 5G standards engagement. OpenRAN is an emerging disruptor that breaks up the radio access network into interoperable components to promote compatibility and vendor agnostic solutions for consumers. ETSI has not been involved in OpenRAN, and there is an opportunity for ATIS take the mantle. Formal engagement with ATIS to influence studies and proposals focused on OpenRAN provides opportunity for the U.S. to strategically build standards and open the door to U.S. technical leadership in areas such as edge cloud, virtualization, and software.

Formal engagement in OpenRAN brings in another critical U.S. organization, ORAN Alliance. Collaborating between ATIS and ORAN Alliance provides significant U.S. industry participation and coalition-building opportunities and a chance to exert influence through a regional body and the global standards process to push U.S. leadership in key areas such as satellites, drones, and unmanned aircraft systems.

Advancing and Securing Western 5G Technical Leadership

The U.S. is currently falling short in the global 5G race and could succumb to Chinese influence and domination of 5G and future generation wireless network technologies. It is critical to recognize product development and standards setting as two areas where the U.S. trails. A well-coordinated U.S. strategy is the first essential building block for creating an opportunity to shift the balance of global power away from China and back towards the U.S.

The perception of power and leadership has enabled China to take hold of 5G, across the standards-setting bodies and through market share. The threat is clear. The U.S. must do more to counter China's 5G global influence, which is built on the foundation of its perceived standards-setting dominance. China's threat in standards setting extends beyond 5G to next-generation technologies that will influence U.S. and global ways of life. The U.S. must take concerted action now to properly influence and drive international standards adoption to shift the balance of power for 5G and beyond.

China is not dominating essential 5G standards and patents yet, but Beijing has the potential to shift from the beverage carts of 5G to the steering and avionics. The U.S. has an opportunity

to take control of 5G and beyond through proper investment, commitment, and funding to advance U.S. 5G competition, starting with standards development initiatives. At the very least, the U.S. needs to build coalitions and partners across the globe to prevent China from seizing complete control of 5G and shaping standards that define the incremental technologies the U.S. and rest of the world will depend on in the future.

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About the Center for Technology & National Security

MITRE launched the Center for Technology & National Security (CTNS) to provide national security leaders with the data-driven analysis and technologically informed insights needed to succeed in today's hyper-competitive strategic environment.

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MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our public-private partnerships and federally funded R&D centers, we work across government and in partnership with industry to tackle challenges to the safety, stability, and well-being of our nation.

MITRE | SOLVING PROBLEMS FOR A SAFER WORLD™

Endnotes

1. https://www.whitehouse.gov/wp-content/uploads/2020/03/National-Strategy-5G-Final.pdf
2. MITRE relied on data provided and validated by both commercial sources (Bureau Van Dijk) and open sources (cited). MITRE limited its analyses and based its assertions for this paper on one international standards-setting consortium, the 3rd Generation Partnership Project (3GPP), the designated global 5G industry-conforming standards body.
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9. https://www.gizmochina.com/2019/04/29/huawei-spent-15-3-billion-on-rd-last-year-comes-in-top-5/ It should be noted that "total R&D" is not exclusive to 5G R&D and includes all R&D across all company operations.
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