

6G Market Development A North American Perspective

A hand wearing a blue and purple glove is shown on the left side of the page. The hand is pointing towards the right, with a small white object on the index finger. The background is a dark blue gradient.

The Next G Alliance (NGA) is a bold new initiative to advance North American mobile technology leadership over the next decade through private sector-led efforts.

With a strong emphasis on technology commercialization, NGA's scope of activities encompasses the full 6G lifecycle from research to realization.

NGA's growing membership reflects support from stakeholders in academia, government, and industry.

This Perspective outlines the strategic importance of 6G and the imperatives that will shape North America's competitiveness, economy, and global leadership.

North America and the 6G Market

Compared to prior generations, 6G is different

Earlier “Gs” focused on technology. They delivered near-ubiquitous networks and affordable communications while providing the foundations for messaging services and mobile broadband connectivity, designed for personal users.

Subsequent Gs widened the technology envelope to enable massive, machine-type connectivity and ultra-low-latency communications. These Gs facilitated industrial applications, where users can capitalize on artificial intelligence (AI) technologies and data from internet-of-things (IoT) sensors. As a result, businesses can manage mission-critical equipment and monitor supply chain performance in real time and over great distances. They can also deliver high-quality entertainment and

gaming services to consumers. The application opportunities are limitless.

6G’s differences include advances in computing, communications, and sensing. Looking to the future, these capabilities will improve the comingling of physical and digital worlds. The availability of more and higher quality data will make it feasible to build digital twins of the real world with many practical benefits. This allows, for example, engineers to perform maintenance tasks without interrupting factory operations. Municipalities could simulate how best to manage smart city assets. At the human level, extended reality (XR) and haptic interfaces will redefine the “look and feel” of digital world experiences, significantly enriching student

learning and workforce training activities.

Because of its deeper integration into society, 6G also differs in non-technical ways. Its scope encompasses economic ambitions, societal needs, and sustainability priorities. Additionally, the global movement toward 6G magnifies geopolitical, secure supply chain and technology leadership considerations. These differences will lead to additive requirements with a broader set of technical and non-technical stakeholders shaping 6G than has historically been the case.

Against this changing backdrop, this Perspective outlines North America’s 6G imperatives for the coming decade. It examines the future of 6G opportunities, market determinants, and North America’s levers of influence across a wide spectrum of stakeholders. It concludes with immediate and action-oriented imperatives for public and private sectors across North America.

6G Market:
What the
Future Holds



What
Factors Are
Shaping the
Future



North
America’s
Levers of
Influence



Imperatives
for
North
America

6G Market: What the Future Holds

Prospects that will excite society and boost the Digital Economy

6G is North America’s first “G” where a private sector-led alliance brings national experts and resources together to influence new mobile technologies and their impact on the economy. Through the Next G Alliance (NGA), academia, public, and private

sectors are cooperating to define and represent North American interests.

The prospects for 6G are exciting. Through a wide-ranging analysis of 6G application use cases, NGA members highlight four areas for

innovation. First, enhance the quality of **everyday living**. Second, improve customer **experiences** and interfaces with technology via a dynamic and expanded range of applications. Third, play a **critical role** in applications spanning healthcare, manufacturing, agriculture, transportation, and public safety domains, among others. Finally, attain **societal goals** and increase public safety.



6G applications will enhance the quality of everyday living



Dynamic and expanded 6G applications will enhance customer experiences and technology interfaces



Advances in 6G technology will enhance critical functions in multiple industry sectors



6G applications will help to attain high-level societal goals and increase public safety

Figure 1: Industry Trends and Market Expectations for 6G

In practice, 6G is likely to have a far more profound economic impact. Beyond technical advances, 6G innovation will stimulate novel ways of tackling economic ambitions, societal needs, and sustainability priorities. In effect, 6G will unleash several waves of innovation, significantly boosting the “digital” quotient of the overall economy.

The Rise of the Digital Economy

6G’s innovation potential is closely tied to the “Digital Economy” which ranks as a “Top-5” component of the overall economy according to the [US Bureau of Economic Affairs \(BEA\)](#); Statistics Canada, the national agency, paints a similar picture.

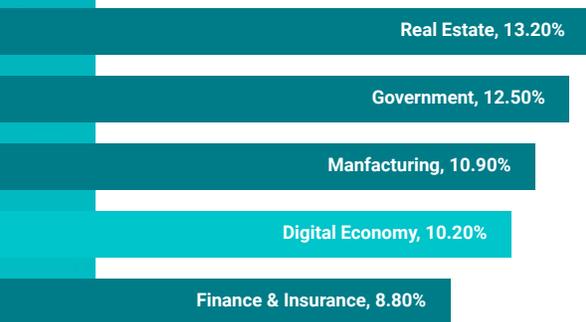


Figure 2: Digital Economy as a Share of US GDP in 2020 (Source: US BEA (2022))

The BEA reports that the digital economy’s annual growth rate for real gross output averaged 4.8% between 2012 and 2020. That is over three times faster than the overall economy’s growth of 1.5% over the same period. For 2020, average annual compensation rates of about \$88k per job in the overall economy compare with a figure of \$139k in the digital sector. While the overall

economy contracted in 2020, the BEA’s statistics suggest that the growing digital economy was mostly insulated from pandemic effects.

Defining the reach and size of the digital economy remains a work in progress. As Figure 3 illustrates, the BEA defines the constituent parts of “infrastructure,” “e-commerce,” and, “priced digital services” and provides

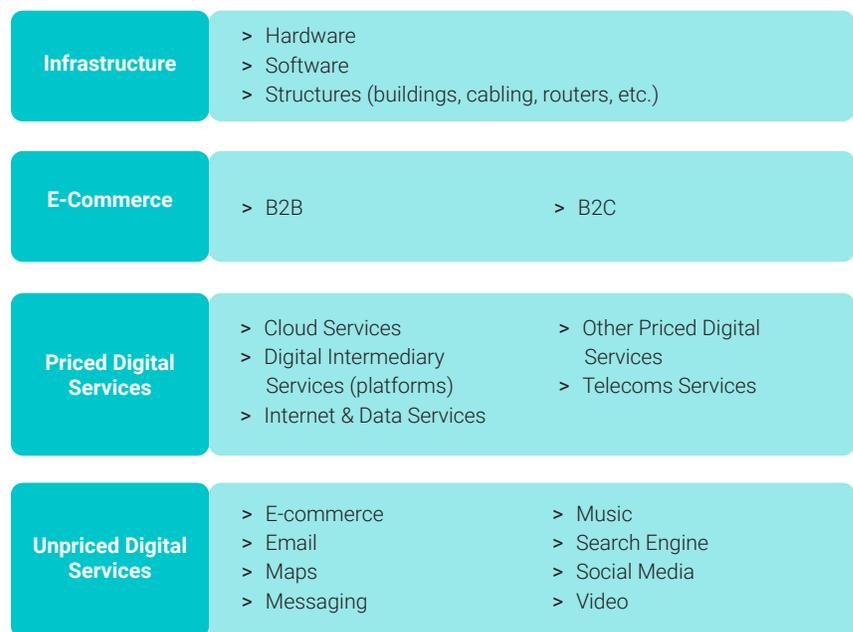


Figure 3: Elements of the Digital Economy (Sources: US BEA (2021), Brynjolfsson et al. (2017))

partial estimates for the size of each category. In future updates, it aims to report on structural investments (e.g., buildings, data centers, cable installations), the services component of e-commerce, and certain priced digital services.

Economists are also exploring how to quantify “unpriced digital services” such as email, maps, and search engines. In addition to being highly valued, they are integral to everyday life. In the commercial sector, these digital tools can be the lifeblood of small, medium, and large enterprises.

6G’s Role in the Digital Economy

With its linkages to complementary technologies, 6G is likely to accelerate these digital economy dynamics and disrupt established industry models. Seamless connectivity, multi-sensory interfaces and immersive content will enable novel, physical, and digital world interactions with immense potential to transform various parts of the economy. Realtors and retailers will reimagine home-buying and shopping experiences, for

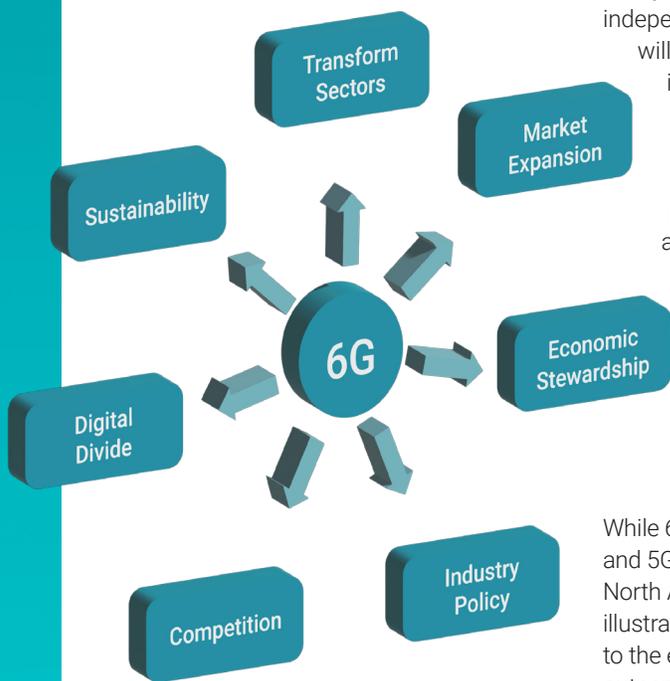


Figure 4: 6G Will Affect Many Parts of the Economy

example. New education providers will improve learning processes and access to multi-sensory knowledge. Across the defense sector, there will be opportunities to work with high-fidelity tactical simulators and to deploy more secure communications networks.

6G will also expand opportunities for many sectors of the North American economy. The research, intellectual property, and investor communities will have more frontiers to explore. 6G’s software paradigm will expand the addressable market for the wider software sector. There will be opportunities to take advantage of 6G capabilities and foster new industries in areas such as content development and collaborative working, among others. The market for new classes of 6G devices and sensors also provides an opportunity to grow North America’s manufacturing base.

It is also important to recognize that technology is a cornerstone for economic and national security. In the past, for example, proficiency in shipbuilding technologies helped nations rule the seas. In the future, a nation’s security will depend on its ability to access and use technology independently. Exercising sovereignty will occur in a world where 6G is the universal fabric for computing, communications, and sensing. This makes it even more important for public and private sector agencies to collaborate on 6G initiatives that promote North American innovation, economic models, and strategic policies.

The Wow! of Wireless

While 6G is less than a decade away and 5G adoption is in its early years, North America’s 4G track record illustrates the sector’s contribution to the economy and its potential to outperform over the long term. [CTIA studies of the 4G-era projected the U.S. wireless sector growing from](#)

[\\$196 billion in 2011 to \\$442 billion in 2019.](#) This forecast, equating to a 10% annual growth rate, would see the US wireless sector expanding from 1.25% of GDP in 2011 to 2.06% in 2019. The scale of 5G promises to be as substantial as 4G. [By 2030, CTIA research projects that 5G will add somewhere in the region of \\$271-to-325 billion to the wireless sector’s GDP.](#) It bears repeating that 4G and 5G are significant engines for job creation.

These 4G and 5G data points reflect current ways of thinking. They leave scope for innovative uses and positive economic surprises. Consider 4G which has a lengthy market record. CTIA valued it at \$691 billion for 2019, an almost \$250 billion surprise over its initial \$442 billion projection.

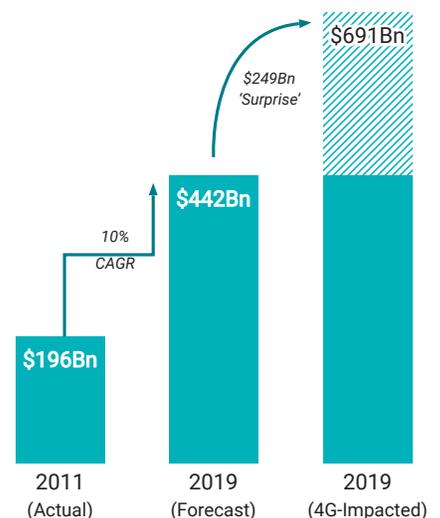


Figure 5: The Impact of 4G on Wireless GDP (Source: CTIA)

How 6G’s long-term GDP impact and cross-industry multiplier effects play out depends on factors such as market demand, the timing of commercialization strategies, and measures to smooth the path to adoption. In the short term, however, timely action, effective policy, and stakeholder collaboration will have a significant bearing on how North America molds its 6G future and the associated economy and job market consequences.

What Factors are Shaping the Future

The emerging role of new stakeholders and societal goals

The 3rd Generation Partnership Project (3GPP) is the global entity for standardizing mobile communications systems. It is backed by the most important regional standards development organizations (SDOs) across the globe. 3GPP's work began in 1998. Its standardization roadmap since then accommodates continuous innovation, with planned releases every few years to incorporate new requirements.

Standardizing Gs in the Mobile Industry

Previous Gs established a global consensus on the process to develop detailed technical standards. The process starts with the International Telecommunication Union's Radiocommunication Sector (ITU-R) defining an overall scope and key performance requirements based on inputs from academia, government, and industry. The ITU-R's International Mobile Telecommunications (IMT) Vision for 2020 defined 5G. The IMT Vision for 2030, which corresponds to 6G, is currently in development.

Other standards groups respond to the ITU-R Vision by creating technical specifications for technologies that

can fulfill the requirements. Candidate standards are submitted to the ITU-R for evaluation against the defined criteria. Standards that meet the G's goals are endorsed as part of the G. While each G attracts several ITU-R submissions, the specifications developed by 3GPP and endorsed by 3GPP's partners such as ATIS are the most commercially important.

This process is likely to be adopted for 6G. Expectations for commercial 6G systems are aiming for 2030, although leading nations and vendors are targeting prototypes from around 2026.

The Growing Impact of External Drivers

The mobile industry's well-ordered and linear picture is, however, changing. This is driven by many factors, some governed by industry participants, with a growing number determined externally.

The mobile industry will introduce changes in addressing a broader scope of drivers that include economic, societal, and sustainability goals for 6G. Commercial drivers are creating pressure to improve the industry's technology development processes. That involves engaging

end users and injecting demand-side requirements earlier in the standardization cycle. Industrial users that view cloud computing and communications as strategic enablers are likely to want a greater say in how 6G addresses their needs.

Other parts of the ICT sector will also drive change from the innovation that 6G

unleashes. Based on past evidence, changes might alter commercial models and encourage new market entrants, much as touch-sensitive glass, iPhone ergonomics, and the app economy shaped the 3G and 4G markets. Changes might also be forced by upstream industry decisions. Design and manufacturing tolerance choices in the semiconductor industry are one such example. Others might arise from net-zero carbon-emissions targets for communications networks and resource scarcity in the battery sector.

At the same time, external factors are likely to change the boundaries and rules by which the mobile industry operates. One of these factors is geopolitical as governments now view 6G as a vehicle to exercise market leadership. Governments are also concerned about technology sourcing, supply chain security, and dependencies on a limited supplier base. Digital sovereignty policies could easily intrude on established business practices and 6G standardization in the future.

The 6G industry needs to be alert to cross-vertical and geographic changes that might spill over from adjacent industries or foreign jurisdictions. An example is the EU's GDPR regulation, which requires local and foreign organizations to safeguard personal data and uphold the privacy rights of anyone in EU territory. 6G's greater intensity of data and personalization of user experiences might lead to future legal and regulatory changes around data and digital-world rights.

Compared to the past, the balance of influences suggests that a growing body of external actors and non-technology issues might shape 6G and North America's destiny. In practice, much depends on how well local stakeholders lead the global mobile industry in leveraging their levers of influence and international heft to greatest effect.

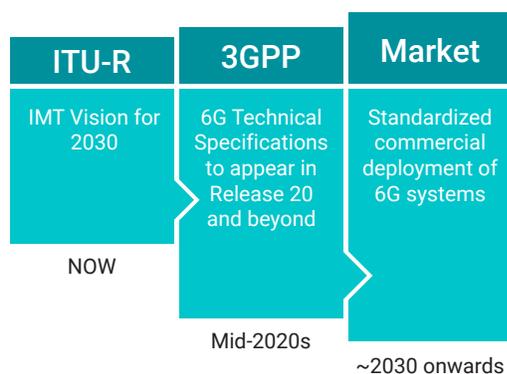


Figure 6: Timeline to 6G

North America's Levers of Influence

The power of free-market innovation and industry-transforming strengths

Technology is the prime driver of the economy and plays an increasingly key role in defining each nation's sovereignty. It should therefore come as no surprise to see corporations and governments launching 6G initiatives to gain an early advantage. North America can be just as forward acting by playing to its free-market, innovation, and industry-transforming strengths.



Within the ICT sector, app stores and touchscreens are examples of major innovations. They emerged from North America's market economy independently of 3G and 4G technology roadmap developments. They show how North America's powers of entrepreneurship and innovation can influence global markets in parallel with industry planning and global standardization approaches. The scale and purchasing power of North American consumers and infrastructure providers are other contributors to this dynamism. These innovations are valuable complements to North America's start-up ecosystem across sectors that span finance, medical sciences, services, and technology. Large and vibrant capital markets ensure that promising ideas can be nurtured and funded to a viable scale. Collaboration, industry alliances, and professional networking tools play an important part in this process.

The U.S. government carries considerable weight in the overall economy through its research funding, procurement, rule-setting, and ICT-usage activities. Looking specifically at 5G, the U.S. government's Secure 5G and Beyond Act of 2020 fostered a raft of initiatives across agencies including the Department of Defense, the Department of Energy, and the National Science Foundation. Now is the opportunity to make an



earlier start in resourcing the R&D initiatives that will lay the foundations for 6G. These can build on groundbreaking public-private partnership models such as the National Science Foundation's Platforms for Advanced Wireless Research (PAWR) and the Resilient & Intelligent NextG Systems (RINGS) programs. The scope for ambition and government leverage is considerable. The Defense Advanced Research Projects Agency's (DARPA) projects, for example, spawned the internet, autonomous vehicles, and GPS technologies. Today, DARPA is leading on Open Source Secure 5G, which has direct relevance to 6G.



North American universities account for half of the world's top 100 institutions. Their scope for influence is twofold beginning with their function as research pathfinders. World-renowned institutions set priorities and construct the overall research agendas across multiple disciplines. Secondly, by attracting international students and researchers, they constantly refresh the diversity and quality of North America's talent pool.

The pace of technical innovation over the past decade has nurtured several new industries in areas related to 6G. Over-the-top (OTT) service providers are an example of a whole category whose existence was enabled by ubiquitous broadband connectivity. As a result, North America leads the world in terms of the value generated by e-commerce, online content, and app-enabled services. OTT business model breakthroughs are the basis for innovation in other industries along with the rise of open-source offerings and information-service intermediaries.



Innovation and influence are just as evident in North America's



communications ecosystem. At the hardware level, expertise in chip design translates into even higher smartphone processing capacity. Similar expertise helped to miniaturize modules and extend the power life of IoT devices. Growth in open-source software, flourishing developer communities and entrepreneurship in cloud computing are other examples of North America's expertise and international leadership.

Hollywood is the tip of a much larger entertainment sector that includes the media, gaming, and creative industries. There is an obvious fit between them and 6G's digital-world experiences. Gamification and immersive rendering of workplace settings are examples where the creative industries can transform educational programs and boost industrial productivity, not just within North America.



The connected, autonomous, and electric vehicles industry is another beacon of North America's influence. Many of its sensing and AI advances depend on access to plentiful and real-time data. Requirements such as these will affect 6G expectations for connectivity, edge processing of data, autonomous learning, and miniaturized electronics, among others. Their spillover effects will also benefit other applications and industries.

These examples of North America's strengths and leverage have significant potential to cross sector boundaries. Relative to prior Gs, the vision for 6G's integrated fabric of computing, communications, and sensing offers an opportunity to unleash cross-industry synergies by linking disparate resources and pockets of expertise. North America's stakeholders face several imperatives to mobilize and scale the continent's capabilities quickly while smoothing the path from research to realization.



Imperatives for North America

Strategic importance of aligning common interests

The first imperative is for North America's stakeholders to align common interests and act on 6G immediately. This might seem too early given that 2030 is eight years away. It might also seem early as 6G standardization is due to begin a few years from now. But delaying

1. Launch Multi-Stakeholder Action Immediately

action until after standardization carries significant risks. This is evident from the need

to pass the U.S. Secure 5G and Beyond Act of 2020 to defend national priorities over 5G technology and related geopolitical concerns.

There are several justifications for immediate action on 6G. In light of lead-time considerations, now is the time to prepare for R&D leadership by coordinating research and pre-commercialization partnering models among North America's public- and private-sector stakeholders. An immediate start will be valuable for the massively parallel task of capturing user and industry requirements across technical, societal, and economic dimensions. Exploration of new service concepts and groundbreaking technologies will foster quicker innovation, all the better to inform 3GPP standardization.

The ITU-R Vision process is one opportunity for North America to shape international thinking. It takes place against a backdrop of other nations making unprecedented policy commitments and investing strategically in 6G. On the ground, researchers are pushing the bounds of physics and deploying long-lead-time 6G demonstrator projects and test beds. This is the international landscape of public- and private-sector initiatives that reinforces the need for an immediate start across North America.

Success for North America depends on overlaying a bottom-up vision, led by the private sector, with top-down political action. Alignment and

coordinated action over common interests between academia, the private sector and different branches of government can magnify North America's capabilities and mitigate the risk of narrow outcomes.

Among large economies, North America's free-market principles give full rein to its market scale, purchasing power and economic dynamism. There is a culture of risk-taking and entrepreneurship among the general population and its continuous influx of international talent. North America's second

2. Invest in Collaboration & Reduce Sources of Friction

imperative is to unleash these characteristics on the yet to

be imagined opportunities that 6G promises. Lower-friction engagement models can lift performance expectations between academia and industry, between the ICT and neighboring industries, and with different government agencies. One way to advance the innovation process, for example, is to shorten the time to discover and secure research funding.

Beyond foundational research topics, interactions with industry can expose academia to challenges associated with large-scale deployment and market-adoption issues. Over a longer horizon, industry has an opportunity to inform the academic curriculum and the kinds of software and engineering disciplines required in the future STEM workforce. Academia and industry can also work together on inspiring young students to pursue careers in STEM fields related to 6G.

Outreach to non-ICT sectors is vital because of the essential role that wireless communications will play in every part of the economy. Information gaps can be closed through two-way collaborations. That way, vertical industries can prepare for digital economy solutions while the ICT sector learns about emerging industry needs.

In parallel with industry initiatives, federal and local governments can signal their commitment to 6G and shape market sentiment toward societal and sustainability issues. This can be through their procurement practices and use of modern technology to manage energy consumption and the use of scarce resources. Other opportunities for

3. Leverage the Weight of Government Agencies & Resources

government involve systematic investment in 6G R&D, improved regulatory permitting,

and spectrum policies that enable affordable access to 6G communications systems.

Access to additional spectrum is a recurring theme in the communications sector. 6G will be no different. Proactive research into the 6G spectrum landscape can only help North American regulators and industry in preparing to deploy market-ready spectrum.

The central role of 6G's digital-world experiences raises new challenges in areas such as digital property rights, the responsible use of data, and technology as a means of oppression. Examples of negative externalities include information misuse and systems that ignore sustainable design principles. 6G will intensify these concerns because of the increased availability and volume of data. Measures that encourage human-centric solutions and safeguards to protect the general population are likely to fall to government legislators and policymakers. A proactive path forward to address new requirements will benefit from multi-stakeholder expertise, including coordination with like-minded nations that share common values.

These imperatives cover a wide range of topics and diverse sector interests, many coming from outside the ICT industry. Lasting and market-leading outcomes call for greater stakeholder coordination across public and private sectors. This is the context for launching the NGA.

NGA's Role in Changing the 6G Paradigm for North America

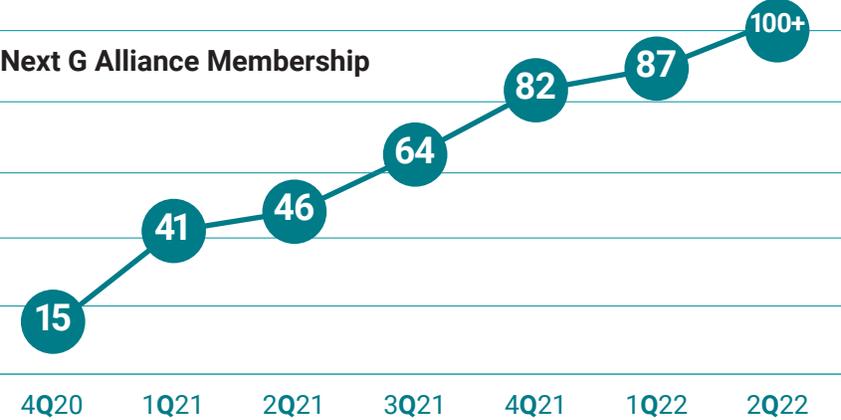


Figure 7: Over 100 Members and 800 Experts

NGA is a bold new initiative to advance North American mobile technology leadership over the next decade through private sector-led efforts. With a strong emphasis on technology commercialization, NGA's scope of activities encompasses the full 6G lifecycle from research to realization.

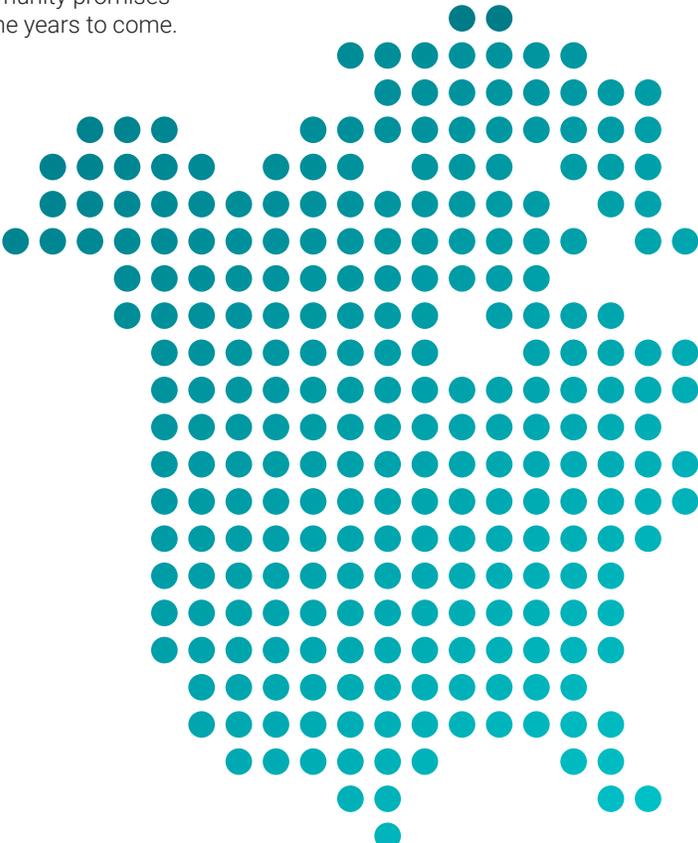
The NGA's working group (WG) structure reflects the broad nature of 6G. The National 6G Roadmap WG laid the foundation for North America's roadmap and early contributions to the ITU-T Vision process. The Green G WG addressed sustainability issues while the Societal and Economic Needs WG focuses on the broader market and international contexts that will shape 6G. The core business model, services, and technology aspects of 6G are covered by the Applications WG, the Spectrum WG, and the Technology WG.

Over 800 individuals participate in NGA, making it the forum for coordinating 6G in North America. Their involvement denotes a commitment to a dedicated 6G coalition for North America. The opportunities to form partnerships, from research to market development, are unique in North America's 6G landscape.

There have been early successes

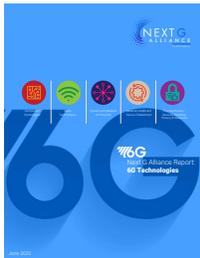
in NGA's brief existence. NGA members have prioritized the pre-standardization research agenda and published influential 6G white papers. NGA has established liaisons with leading international groups. The NGA Research Council will funnel expertise sharing and partnering between academia and industry to influence research outcomes with government and 6G research communities.

Excitement and engagement within NGA's growing community promises greater rewards in the years to come.



As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of and major U.S. contributor to the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL). **For more information, visit www.atis.org.**

Next G Alliance Reports



6G Technologies



6G Applications and Use Cases



Roadmap to 6G



Green G: The Path Toward Sustainable 6G

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