International digital standards

A case for the involvement of stakeholders in the ARIN region

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International digital standards: A case for the involvement of actors in the ARIN service region

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Introduction

Digital standards are all around us, telling our mobile phones how to connect to electronic communication networks, describing security procedures for internet of things (IoT) devices, and ensuring that we can exchange emails even if we use different email clients. Standards describe rules, requirements, and guidelines for how technologies, products, and services are developed and function. They outline repeatable ways of doing something and, as such, foster interoperability, while also enabling quality of service.

Standards are developed at the national, regional, and international levels. Of particular importance for the digital field – given the global nature of the digital economy – are international standards. These are developed within a broad range of organizations – such as the International Organization for Standardization (ISO) and the Internet Engineering Task Force (IETF) – typically through consensus-driven processes where various actors contribute their views and defend their interests (be they manufacturers, sellers, trade associations, governmental entities, etc.).

Although participation in international standards development organizations (SDOs) is generally open to anyone interested (either directly or through national SDOs), it is usually stakeholders from large and developed countries that are mostly present in this ecosystem. The so-called **standardization gap** – the imbalance in participation in international standardization, in particular between developed and developing countries – is a challenge recognized by SDOs themselves. And it is very visible if we look at how countries in the region serviced by the American Registry for Internet Numbers (ARIN) participate in the development of international standards. While stakeholders from the USA and Canada are highly active in standardization processes (even if with differing levels of engagement over the years, from one organization to another), there is very little (if any) participation from other countries in the region.

Against this background, the purpose of this paper is to help raise awareness about digital standards among the small, developing countries in the ARIN service region. In doing so, we start with an overview of what digital standards are and where they are developed at the international level. We then look briefly at the extent to which stakeholders from ARIN countries participate in several key international SDOs. Based on the findings, we argue in favor of more participation from these countries in international standard-setting.

As arguments, we explain that digital standards are relevant not only from a technical point of view; they also have broader economic, social, and political implications. As such, standards (should) matter, not only for those who develop them, but for the broader tech sector (the one developing, managing, and selling technologies/infrastructures), as well as governments and end users. Moreover, given the relevance of standards for the seamless functioning of digital technologies, products, and services when used by consumers around the world, it is important that the development of such standards reflects the views and interests of as many stakeholders as possible, from both developed and developing countries.

We end the paper with a series of recommendations that could lead to the more active engagement of developing countries and their stakeholders in the setting of international standards for digital technologies. These range from awareness raising and capacity development initiatives, to leveraging the role of regional SDOs in facilitating the participation of their members in international SDOs.

This paper is part of the *Raising awareness on digital standards for ARIN region countries* project run by Diplo US and funded by ARIN through its Community Grant Program. The project includes research, training, and awareness-building components dedicated to promoting a better understanding of the importance of international digital standards across the ARIN region, with a focus on developing countries. For regular updates on digital standards, consult the Digital Watch online observatory at dig.watch.

About digital standards

At first sight, standards are not the most engaging topic. But they do matter. From uniform brick sizes in Ancient Egypt and coinage in the Roman Empire (Barrios Villarreal, 2018), to today's protocols that make the internet work, standards function as agreed-upon rules or guidelines that tell us how to do something, fostering a coordinated approach.

There are various **definitions of standards**. ISO and the International Electrotechnical Commission (IEC) – two key SDOs – define a standard as a 'document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree or order in a given context' (ISO/IEC, 2004). Underlining the multistakeholder nature of standards development processes, ISO further notes that standards are 'the distilled wisdom of people with expertise in their subject matter and who know the needs of the organizations they represent – people such as manufacturers, sellers, buyers, customers, trade associations, users or regulators' (ISO, no date).

The European Committee for Standardization (CEN) describes a standard as a technical document 'designed to be used as a rule, guideline or definition. It is a consensus-built, repeatable way of doing something' (CEN, no date). According to the Standards Council of Canada (SCC), standards 'establish accepted practices, technical requirements, and terminologies for diverse fields' (SCC, no date).

Although invisible for most of us, standards exist in every field, including healthcare, aerospace, construction, and quality management. Standards for digital technologies – **digital standards** – are all around us, enabling devices to interact with each other, allowing us to connect to mobile networks, and facilitating the exchange of information.

Digital standards cover a wide range of technologies and related infrastructures, devices, applications, and services. For instance, **technical internet standards** form the infrastructure that makes the internet work. Examples include the Transmission Control Protocol/Internet Protocol (TCP/IP) – two protocols that enable the exchange of data via the internet; various standards related to the domain name system (DNS), such as DNSSEC – DNS security extensions that help secure data exchanges; and the secure sockets layer (SSL) and its successor, the transport layer security (TLS), dedicated to protecting the security of internet connections.

Web standards – related to the world wide web – provide specifications for the development and functioning of online content and applications to ensure that they are accessible across devices and configurations. Some of the most widely used web standards are HyperText Markup Language (HTML), a plain text language that uses tags to define the structure of documents; eXtensible Markup Language (XML), another type of language used for sharing structured information; and Cascading Style Sheets (CSS), a language used in conjunction with HTML to control the presentation of web pages (Geneva Internet Platform, no date).

Standards for networks and infrastructures cover technologies and architectures for mobile networks (e.g. 3G, 4G, 5G), broadband networks, and next-generation networks (e.g. cloud computing networks), to name just a few. **Standards for advanced technologies** are increasingly being developed in areas such as the IoT, artificial intelligence (AI), robotics, nanotechnologies, additive manufacturing, and quantum technologies. Other examples of digital standards include security standards, environment-related standards, and multimedia standards (e.g. standards for videoconferencing systems or internet protocol television (IPTV) services).

Standards are, in general, **voluntary**. Market players chose to adhere to certain standards depending on their goals and interests. For instance, WiFi standards are commonly integrated into mobile phones, tablets, and laptops; the producers of these devices are not

required to embed such standards, but they do so to ensure that their devices can connect to local networks. Depending on the extent to which they are used across the industry, some standards become highly successful, while others barely make it to the market (if at all). In addition, it is not uncommon to have multiple standards covering the same issue; in such cases, success is driven by market forces, competition, and consumer choice. Sometimes similar standards function in parallel; other times only one standard wins.

Companies are not always interested in the development or implementation of standards. This is the case, for instance, with certain apps for mobile devices. It is relatively easy for companies to develop their own solutions at a proprietary level and then put them on the market, without being interested in facilitating interoperability with similar solutions. The end result is the creation of walled gardens where users of certain apps cannot interact with users of similar apps.

There are instances when **standards can be made mandatory**. In China, for example, some standards are mandatory from the offset; companies are required to follow them. In other jurisdictions (e.g. EU countries, Canada, the USA), standards become mandatory when certain laws or regulations require compliance with them. Sometimes regulations refer to certain standards to be followed as a way to demonstrate compliance: although the standards are not mandatory as such, companies are encouraged to follow them as a way to comply with the regulation.

Another distinction is between de facto and de jure standards. **De facto standards** are not formally adopted by SDOs. They emerge through market uptake and become widely used usually because they are seen as the most efficient and/or reliable in their field (den Uijl, 2015). Some examples are the QWERTY keyboard and the MP3 format for audio files. **De jure standards** are developed and adopted within the framework of SDOs such as ISO or the Institute of Electrical and Electronics Engineers (IEEE). Over time, de facto standards can become de jure standards. This was the case with HTML and Adobe's Portable Document Format (PDF), initially accepted as de facto standards, and later adopted as de jure standards by ISO (Bryer et al., 2011).

Standards follow technological progress. While some standards may become completely obsolete, others evolve over time. Therefore most SDOs have review processes in place for the standards they develop. ISO and IEC standards, for instance, are reviewed every 3–5 years to ensure that they are still relevant.

International digital standards

Where and how international digital standards are developed

Standards are developed and adopted at national, regional, and international level. At the national level, SDOs usually bring together experts from various stakeholder groups (e.g. governmental agencies, private companies, research institutes, academia, consumer organizations) to elaborate standards in various fields.

Here an important role is played by the so-called **national SDOs**,[1] which either develop national standards themselves (examples include the British Standards Institution and the German Institute for Standardisation) or oversee the development of such standards by various accredited standards bodies (the American National Standards Institute (ANSI) and SCC function by this model). *See Annex 1 for a list of national SDOs in the ARIN service region.*

Regional SDOs are usually focused on the development of regional standards. CEN, the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunications Standards Institute (ETSI) develop standards for the EU region, while the CARICOM Regional Organisation for Standards and Quality (CROSQ) facilitates the development of regional standards across the Caribbean Community (CARICOM). Another goal of regional organizations is to facilitate cooperation between national SDOs, encourage the harmonization of national standards, and support their development; one example of such organization is the Pan American Standards Commission – COPANT.

Box 1. Regional SDOs in the ARIN region

There are two regional SDOs that involve participation from ARIN countries. COPANT includes 32 national SDOs, 9 of which belong to ARIN countries: Bahamas, Barbados, Canada, Grenada, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, and the USA. The organization is dedicated, among others, to (a) developing standards of interest to the region that have not been developed at the international level; (b) promoting the harmonization of standards among members; (c) supporting the increased application of international standards in the region; (d) serving as a coordinating and representative body for its members with other international and regional organizations; and (e) favoring the harmonization of policies and technical positions of its members within international standardization processes (COPANT, 2018). COPANT has concluded agreements with the IEC (1994) and ISO (2018) to promote international standards in the region and to increase the participation of its members in these organizations (COPANT, no date).

CROSQ members span 15 countries, 9 of them from the ARIN region: Antigua and Barbuda, Bahamas, Barbados, Dominica, Grenada, Jamaica, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines. The territory of Montserrat is also represented in the organization. As is the case with COPANT, members of CROSQ are national SDOs. Although the development and harmonization of regional standards is within the organization's mandate, there is less focus placed on this 'in light of international trade agreements'. Instead, standardization-related activities include providing support for the development of standards infrastructure at the national level; promoting and protecting the interests of members in regional and international SDOs; and promoting the awareness of standards and standards-related matters among governments, industry, and consumers (CROSQ, no date).

[1] Other terms used for national SDOs – which are typically mandated to participate in international SDOs, such as ISO and IEC – include national (standards) bodies and national (standards) committees.

Beyond national and regional standards, **international standards** are particularly important because they facilitate technological interoperability and international trade, key elements for the smooth functioning of the borderless digital economy. International digital standards are developed by a multitude of organizations.

Some are formal SDOs, recognized as such by national or international authorities (ITU, 2014). The **IEC** and **ISO** are included in this category. The IEC develops standards for electrical and electronic technologies, such as fiber optics and cables, smart energy, IoT, and AI, whereas ISO's much wider scope includes, among others, the development of standards for e-commerce, robotics, intelligent transport systems, and security. ISO and the IEC have a joint technical committee (JTC) focused on information technology – ISO/IEC JTC1. Within this JTC, 22 technical committees (TCs) – 20 serviced by ISO and 2 by the IEC – develop standards related to cybersecurity and privacy protection, data management and interchange, biometrics, cloud computing and distributed platforms, IoT and digital twins, and AI, among others.

The **International Telecommunication Union (ITU)** is another formal SDO. An intergovernmental organization at its core, ITU's work in standards development largely happens within its Telecommunication Standardization Sector (ITU-T). ITU-T focuses on standards for various fields of international telecommunications and ICTs, from telecommunication protocols and future networks to smart cities and security. The Radiocommunication Sector (ITU-R) also carries out some specific standardization work related to radiocommunication systems.

Quasi-formal SDOs are not officially recognized by national or supra-national authorities, but they are largely similar to formal SDOs in how they run and how they are organized. The best-known SDOs that develop digital standards and are usually included in this category are **IEEE**, which, through its **Standards Association (IEEE SA)** develops standards related to computer technology, consumer electronics, cybersecurity, green and clean technology, and wired and wireless communications, among other; the **IETF**, which develops standards for the internet; the **World Wide Web Consortium (W3C)**, which is dedicated to standards for the world wide web; and the **Third Generation Partnership Project (3GPP)**, which focuses on standards for cellular (mobile) telecommunications technologies, including radio access, core networks, and service capabilities.

These organizations have different membership structures, as well as their own rules and procedures for developing and approving standards (Table 1). There are, however, a series of principles that tend to be generally applied across these organizations, such as consensus,[2] transparency, openness, and due process.

The digital standardization landscape also includes a wide range of **industry forums and consortia**, usually formed by private sector entities interested in developing specific standards to meet their common needs. The industry sometimes prefers to work in such settings because they are seen as 'less bureaucratic and more efficient in reacting to market needs' (Pohlmann, 2014). Examples include the Broadband Forum (develops broadband network specifications); the LoRa Alliance (worked on the LoRaWan specification – a low-power, wide area networking protocol); the Connectivity Standards Alliance (focused on IoT technology standards); and the Organization for the Advancement of Structured Information Standards (OASIS) (works on various standards related to data exchange, cybersecurity, blockchain, etc.).[3]

[2] Although consensus tends to be the preferred rule for the adoption of standards, voting is usually also involved, especially when consensus cannot be reached.
[3] The portal consortiuminfo.org offers a comprehensive overview of the multitude of industry consortia involved in standardization work.

Table 1. Key SDOs involved in the development of digital standards

SDO	Membership	Examples of relevant ongoing work[4]
ISO	National standards bodies (one per country). Experts from industry, government, academic and research bodies, NGOs, etc., participate through their national body. It is also the responsibility of national bodies to organize consultations among stakeholders in their countries to develop common positions for ISO work (ISO, 2015).	Standards are developed within more than 250 technical committees (TCs) (plus many more associated sub-committees (SCs) and working groups (WGs)). Among them, at least 40 TCs deal with various digital technologies or related issues. Examples include: - TC 184 on automation systems and integration - TC 204 on intelligent transport system - TC 215 on health informatics - TC 261 on additive manufacturing - TC 268 on sustainable cities and communities - TC 276 on biotechnology - TC 299 on robotics - TC 307 on blockchain and distributed ledger technology - TC 321 on transaction assurance in e-commerce
IEC	National committees (one per country). Experts from various stakeholder groups participate through their national committees.	Over 100 TCs (plus related SCs and WGs) are involved in developing standards for various electrical and electronic technologies, such as fiber optics and cables, smart energy, IoT, and AI. Examples: - TC 86 on fiber optics - TC 100 on audio, video and multimedia systems and equipment - TC 108 on the safety of electronic equipment within the field of audio/video, information technology and communication technology - TC 110 on electronic displays - TC 124 on wearable electronic devices and technologies - TC 125 on e-transporters
ITU-T	In addition to member states,[5] ITU-T is also open to participation from industry, academia, and NGOs, as well as regional and international organizations. These can join ITU-T as sector members – with the right to participate across all activities of the Sector; associates – which can participate in one study group; or academia.	Standards related to ICTs are set in 11 study groups (SGs) (plus over 30 associated working parties (WPs)).[6] Examples include: - SG11 on protocols and test specifications - SG13 on future networks and cloud - SG15 on transport, access and home - SG16 on multimedia - SG17 on security - SG20 on IoT, smart cities and communities

[4] Valid for January 2022.
[5] The term usually refers to ministries, responsible telecommunication administrations (e.g. national regulatory authorities – NRAs) and organizations related to them, and permanent missions to the United Nations.
[6] This is valid for the 2017–2020 study period, which should have ended in 2020, but continues until spring 2022, due to the postponement of the World Telecommunication Standardization Assembly (WTSA). WTSA takes place every four years and within its scope are decisions regarding the overall ITU-T standardization programme of work (SG areas of work, leadership, etc).

IEEE SA	Individual and corporate members.	Standards are developed within numerous WGs dealing with issues such as AI, blockchain, computer technologies, consumer electronics, green and clean technology, healthcare IT, and wired and wireless communications. Examples include: - Digital representation WG - AI model representation, compression, distribution and management WG - Software-defined quantum communication WG - Vehicle-to-vehicle communications for unmanned aircraft systems WG - Wearables WG - 3D-based medical application WG
3GPP	Usually described as an industry association, it is open to individual entities (generally private companies) that are members of its seven organizational partners (telecom standardization bodies in China, the EU, India, the Republic of Korea, and the USA[7])	Standardization work happens within three technical specification groups (TSGs) on: - Radio access networks - Services and systems aspects - Core network and terminals Focus is currently placed on the so-called Releases 17 and 18, meant to bring enhancements to 5G systems. The precursor Releases 15 and 16 are now part of Recommendation ITU-R M.2150, which details radio interface specifications for 5G (ITU-R, 2021).
IETF	The IETF does not have a formal membership structure; participation is open to any interested individual.	Over 100 WGs are dealing with various internet-related issues such as routing, transport, security. Examples include: - Web transport and web packaging - IP version 6 (IPv6) maintenance - Home networking - DNS operations - Operational security capabilities for IP network infrastructure - Inter-domain routing
W3C	Open to individuals and organizations or all types (e.g. commercial, educational, governmental).	Over 40 WGs develop standards for various web-related issues. Examples include: - Accessible rich internet applications WG - Browser testing and tools WG - Dataset exchange WG - HTML WG - Immersive web WG - Web application security WG - Web payments WG

[7] Japan's Association of Radio Industries and Businesses and Telecommunication Technology Committee, the US Alliance for Telecommunications Industry Solutions, China Communications Standards Associations, the European Telecommunications Standards Institute, India's Telecommunications Standards Development Society, and the Republic of Korea's Telecommunications Technology Association.

Complexity and dynamism on the digital standardization landscape

Complexity

As shown before, the digital standardization landscape is a complex one, composed of a multitude of organizations and forums with diverse membership structures and working methods. Actors typically choose the SDOs to get involved in based on their interests, be they economic, geopolitical, etc.

Another element that adds to the complexity of the digital standardization landscape relates to the fact that there are sometimes **overlaps** in the work of SDOs, with efforts to standardize the same technology (or various aspects of it) carried out across multiple organizations. For instance, standards for various aspects of AI are currently being developed at ISO, IEEE, and ITU-T. Issues related to internet protocols and architectures are discussed not only at the IETF (where the TCP/IP suite originates), but also at ETSI (for instance, within an Industry Specification Group on Non-IP Networking) and ITU-T (one example being the heated debates around the proposal put forward by Chinese actors in 2019 that ITU-T takes up work on developing a new protocol – the now famous 'New IP' proposal[8]).

While such overlaps are somewhat natural, they also create the space for the so-called practice of **forum shopping**, when actors try to identify the places where their standard proposals stand a better chance of being approved. Sometimes this also means that the same actor puts forward the same proposal (or slightly different versions of it) within different SDOs. Other times different actors advance similar proposals in different SDOs, which often results in complaints about the duplication of work and efforts to block each other's proposals.

[8] For details about the *New IP* and related work, see the report *The geopolitics of digital standards: China's role in standard-setting organisations*, published in December 2021 by DiploFoundation/Geneva Internet Platforms and Multilateral Dialogue Konrad Adenauer Foundation Geneva (Teleanu, 2021).

SDOs typically try to address such challenges through various mechanisms. For instance, due process and strong consensus rules are meant to prevent actors from picking one organization over others because it might be easier to get a standard approved there. **Cooperation between SDOs** is another way to avoid overlaps. One example is the World Standards Cooperation – a framework under which the IEC, ISO, and ITU cooperate through mechanisms such as the Standards Programme Coordination Group, which enables some level of coordination of both existing and new fields of technical activities, to avoid conflicting requirements or overlaps (World Standards Cooperation, no date). Other examples of cooperation include liaisons and joint technical groups focused on the co-developed of standards (e.g. ISO/IEC JTC1 and ITU-T–IETF liaisons).

Dynamism

The dynamism of the digital standardization landscape is reflected both in what is being standardized and who is involved in standardization.

As digital technologies evolve, new standards are being developed to cover them. Keeping up with the fast pace of technological progress is often a challenge for standardization processes, as SDOs have to balance speed with the need to ensure due process and the integrity of the work.

New technologies being standardized also means that new actors constantly enter the standardization landscape, while other actors become less involved or exit the space completely. For instance, telecom operators like BT and AT&T, or vendors like Nortel, Siemens, and Sun – once very active in standardization processes – have reduced their participation over the years. Others, like Ericsson and Nokia, continue to be actively involved as they compete on the mobile network equipment markets with relatively newer actors like Huawei. And companies that were largely unheard of in the 1980s and 1990s – such as Apple, Amazon, Facebook, and Google – are now stepping up their participation in certain standardization processes.

State and non-state actors participate in international standardization driven by economic and/or geopolitical interests. As these interests change, so does their involvement in SDOs. Moreover, the international landscape for digital standardization also reflects the changing competition landscape in certain industries. This was illustrated by the growing involvement of Asian actors (initially from Japan and the Republic of Korea, and later from China) in SDOs starting the 1990s, when the region's technological and economic power began to grow. At the IETF, for instance, there were barely any documents authored by Chinese actors in early 2000, while most contributions came from the USA. Over the years, the number of document authors from China increased (from 1 in 2000 to 374 in 2021), while the number of document authors from the USA decreased (from 1036 in 2000 to 520 in 2021) (IETF, no date).

ARIN countries' participation in key SDOs

Status quo

The service region covered by ARIN includes Canada, the USA, and several countries and territories in the Caribbean and the North Atlantic.[9] A look at how the region is represented in several key SDOs shows that (a) Canada and the USA are very active in the development of international standards for digital technologies, and (b) there is very little (if any) representation from other ARIN countries.[10]

At ISO, Canada and the USA – through their national SDOs – are among the top 20 most active countries by the number of TCs and SCs they participate in fully (USA – 9th place, Canada – 18th place).

The USA also has the second-highest number of secretariat positions within TCs and SCs (12.8%) – after Germany (17.1%); Canada comes in 11th place (2.1%). An analysis of digital-related TCs and SCs (a total of 100 committees) shows that the USA also holds the highest number of secretariat positions – 24%; Canada comes in 10th place – 2%.[11]

The national SDOs of four other ARIN countries are full ISO members: Bahamas, Barbados, Jamaica, and Saint Lucia. The SDOs of Antigua and Barbuda and of Saint Vincent and the Grenadines have the status of subscriber member, while Dominica and Saint Kitts and Nevis are correspondent members (Figure 1).[12]

[9] A total of 11 countries and 18 territories.
[10] For this paper, the term 'ARIN country' denotes a country within the ARIN service region.

[11] Most of the statistical data included in this section is based on Teleanu, 2021.
[12] Full, correspondent, and subscriber members all have the right to participate in developing international standards. Differences appear when it comes to participating in developing policies, governing the organization, or selling ISO standards (ISO, 2015).

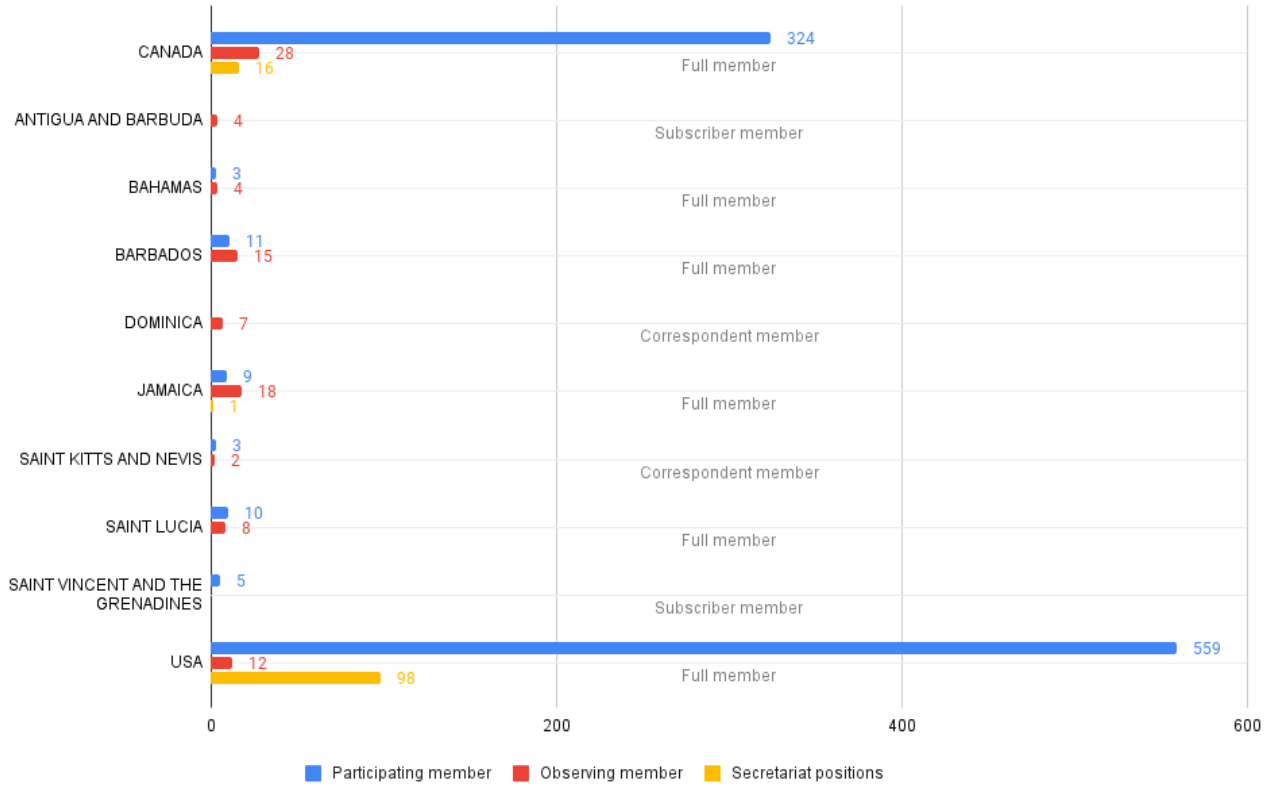

Figure 1. ARIN countries: Participation in ISO TCs and SCs, including Secretariat positions held (January 2022)

The only ARIN countries represented in the IEC are Canada and the USA. They both are among the top 20 most active countries by the number of TCs and SCs they participate in (USA – 5th place, Canada – 18th place). The USA also holds the second largest number of secretariat (13.9%) and chair (14.1%) positions for TCs and SCs, after Germany. Canada comes in 11th place for both secretariat and chair roles (2 each).

All ARIN countries have representation at ITU. In most cases, this representation is ensured by ministries with responsibilities for electronic communications/ICTs and/or regulatory authorities in the field. It is unclear though to what extent these state institutions participate in standardization work at ITU-T. Canada, Jamaica, and the USA are the only three countries with ITU-T members: 11 for Canada, 1 for Jamaica (Digicel Group), and 83 for the USA (Figure 2). Even though the USA has the largest number of ITU-T members, these entities are not particularly active in holding leadership positions within SGs/WPs: 1 SG chair, out of 11; 3 SG vice-chairs (3.1% of all such positions); 5% of all rapporteur roles (4th place).

Canada and the USA are the only ARIN countries with participation in the IETF, 3GPP, and W3C. IETF stats show that most document authors are from the USA, with Canada coming in 7th place. At 3GPP, the USA has the second largest number of individual members (95, 12.4%), after China (147, 19.2%); Canada occupies the 14th place (10 members, 1.3%). The USA is also the country with the largest number of W3C members (170, 37.3%); Canada occupies the 6th place (19, 4.2%).

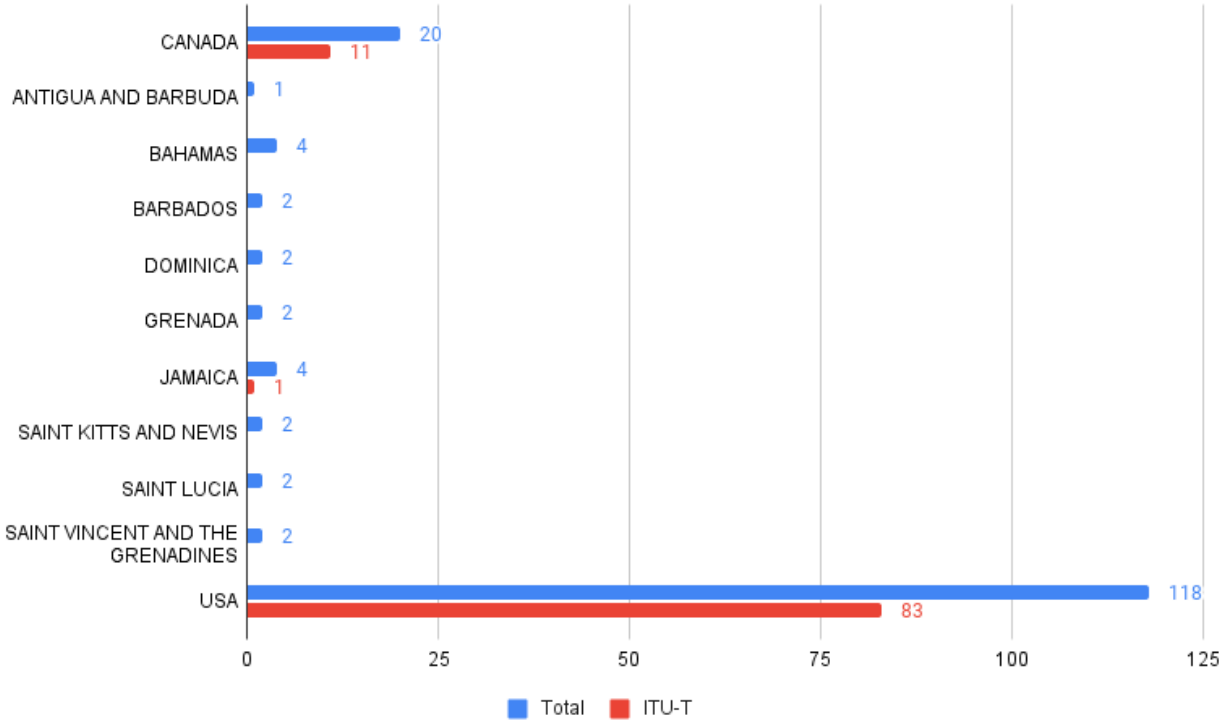

Figure 2. ITU members by ARIN country (January 2022)

Arguments for a more active involvement: Why standards matter

These findings are not necessarily surprising, given that most ARIN nations are small, developing countries, with multiple competing priorities when it comes to the allocation of financial resources. Some may also argue that there is little interest in international standardization because there is little digital industry active in or originating from those countries.

But digital standards are not and should not be relevant only for tech companies, or only for developed nations. Given the borderless nature of the digital space, and the fact that digital standards are reflected in products and services used around the world, it is important that the development of standards integrates views and interests from as many stakeholders as possible. Moreover, standards are not only about technology or about the competition between global market players. They also have relevance for public policy, geopolitics, and human rights. In this section, we look at the multiple implications of standards, give concrete examples, and list types of actors for which standards are relevant.

Technical implications

Standards provide a common language that facilitate interoperability, allowing technologies to interact with each other. They ensure that devices and applications are developed using the same rules and communication protocols, and that they can exchange data in compatible formats. Beyond interoperability, standards also foster quality of service and quality of experience, as well as safety and security.

◪	DNSSEC – developed at the IETF – helps secure data exchanged in the DNS. ISO/IEC 18033 standard series – developed at ISO/IEC JTC1 – provides specifications for encryption algorithms. Recommendation ITU-R M.2150 – adopted at ITU-R – details harmonized radio access requirements for 5G networks and devices.
⌘	Due to their technical implications, international standards are highly relevant for tech companies and the broader tech community. Their role in fostering quality of service, safety, security, and interoperability also makes standards relevant for all users of digital technologies (as well as state and non-state actors focused on protecting the rights and interests of end users).

Economic implications

Standards support innovation and help develop and sustain competitiveness, thus the ability to contribute to economic growth. When adopted and implemented at the international level, standards facilitate global trade by opening the doors for companies to new markets and helping avoid discrepancies between trade partners. Well-functioning global standards are therefore beneficial for both big players and smaller economies, allowing companies to export everywhere, under as fair competition terms as possible.

The relevance of international standards for trade was recognized by the World Trade Organization (WTO), whose Agreement on Technical Barriers to Trade (TBT Agreement) advises governments to use international standards as a basis for regulation (WTO, 1994). Although the WTO does not specify what is meant by international standards, the standards developed by the IEC, ISO, and ITU are generally understood as relevant in the context of the TBT Agreement.

What this means in practice is that countries should not place trade barriers on technologies that comply with such standards. This makes these standards particularly relevant for companies that want to export their products, as well as for governments that want to ensure their standards and regulations do not constitute technical barriers to trade.

Standards are also relevant from a competition point of view. For instance, if companies are able to have their technology reflected in international standards, this could give them a market advantage. In addition, the economic relevance of standards is reflected by the fact that many technologies that are essential parts of a standard are patented. Companies that own these standard-essential patents (SEPs) can request royalties/licensing fees for their use[13]; as such, the integration of SEPs into standards could generate significant revenues for the patent owner (Pohlmann and Blind, 2020).

[13] This usually happens under fair, reasonable, and non-discriminatory (FRAND) terms, a requirement that SDOs generally place on companies participating in standardization work.

◩	Mobile communications standards – developed at ITU-T, 3GPP, etc. – enable producers of network equipment to compete on international markets. 5G-related SEPs bring revenues to companies that own them. ISO, IEC, and ITU standards are generally recognized as not placing technical barriers to trade.
⌘	Due to their economic implications and relevance for international trade, international standards are highly relevant for tech companies and governments alike.

Sustainable development

International digital standards can help societies take advantage of the opportunities offered by digital technologies, including in terms of devising effective responses to global challenges (e.g. climate change) and advancing economic, social, and environmental sustainability (ISO, 2018). It is increasingly acknowledged that digital technologies that rely on international standards to function safely and efficiently 'can ensure a sustainable, equitable, and prosperous future' (ITU, 2021).

◩	Standards related to the circular economy – developed at ISO and ITU-T – can help drive progress toward environmental sustainability. Standards for sustainable cities and communities – developed at ISO and ITU-T – support multiple sustainable development goals (SDGs). Standards related to e-health services – developed at IEEE and ISO, for instance – can contribute to achieving good health and well-being (SDG 3).
⌘	Due to their potential to support sustainable development, international standards are highly relevant for all actors, from governments and tech companies to researchers and end users.

Human rights implications

Once they make their way onto the market – embedded in various technologies – standards can provide the context for promoting or abusing human rights. With digital technologies being part of our day-to-day reality, it becomes increasingly important to integrate a human rights approach to standards development processes.

Also important is to foster more links between the standards and the human rights communities, for instance by facilitating coordination between SDOs and international human rights processes – such as the Human Rights Council (HRC)[14] – and supporting the participation of civil society groups in standardization work.

[14] One important step in this direction was made by the HRC in July 2021, through a resolution that requests the Office of the High Commissioner to convene consultations on the relationships between human rights and technical standard-setting processes for new and emerging technologies, and to submit a report to the Council (HRC, 2021).

◩	Web accessibility standards help ensure that governmental digital services are available to people with certain disabilities. Internet protocol specifications, such as those developed at the IETF, can pose privacy risks if they do not embed sufficient protections to ensure the confidentiality of communications and the security of data (Cooper et al., 2013). Standards related to biometrics or surveillance systems – under development at ISO and ITU-T, for instance – can have implications for privacy, the right to non-discrimination, and other human rights.
⌘	Due to their potential impact on human rights, standards are relevant for end users and civil society groups, governments, and private companies and the tech community at large.

Public policy implication

Standards can help achieve certain public policy objectives, such as improving public services, advancing innovation and economic growth, driving competitiveness, protecting consumers' rights and interests, and ensuring the safe development of technologies (Ding, 2020).

◩	Data interchange standards can facilitate exchanges between various government systems while ensuring adequate levels of privacy and security of data. Information security and cybersecurity standards – developed, for instance, at JTC1 – can help protect critical infrastructures, ultimately contributing to national security (ITU, 2010). Standards for connected and autonomous vehicles – developed at ITU-T and ISO, for example – support public policy goals related to human safety and security.
⌘	Due to their potential to help advance public policy interests, standards are relevant for governmental entities, as well as for companies that provide services to governmental entities, operate public infrastructures, etc.

Geopolitical implications

Although standards and standardization processes have always had a (geo)political dimension,[15] this has become more visible in recent years in the context of the intensifying economic and technological competition between nations. Governments are increasingly aware that if a country's actors can influence standards in strategic industries, that country would likely obtain a significant advantage on the international stage. There are also concerns about the possibility of some actors advancing standard proposals that pose challenges to core values and principles upheld by some countries. These and similar concerns have brought standards to the forefront of several geopolitical forums, resulting in calls and proposals for strengthened cooperation between partner nations.

At the G7, a *Framework for Collaboration on Digital Technical Standards* outlines several areas of cooperation, from identifying shared interests in the development of digital standards, to upholding integrity in the development of standards and supporting the inclusion of international principles for digital technologies in standardization processes (G7, 2021). Within Quad, Australia, India, Japan, and the USA have agreed to establish a Critical and Emerging

[15] One example was the 1992 World Administrative Radio Conference, when European countries coalesced in a voting bloc to exert influence over the adoption of mobile telecommunication standards (Sung, 1992).

Technology Working Group to facilitate cooperation on international standards and innovative technologies (Quad, 2021). The EU-US Trade and Technology Council created in 2021 includes a WG on technology standards, dedicated to fostering transatlantic coordination and cooperation in standards for critical and emerging technologies (EU-US, 2021).

◩	The interest of certain actors in leading the development of standards for advanced technologies, where standardization processes are at an early stage – such as quantum technologies, additive manufacturing, biotechnology, AI – reflects the technological competition between nations.
⌘	Due to their geopolitical dimension, standards are highly relevant for governments.

Recommendations

Representation of the ARIN service region in international standardization is largely ensured by stakeholders from Canada and the USA. There is little representation from the rest of the region in ISO and ITU, and virtually no participation in several other SDOs we have looked at. Here we outline a series of recommendations that could contribute to increasing the participation in international SDOs of stakeholders from developing countries in the ARIN region.

For regional SDOs (COPANT & CROSQ)

- **Intensify capacity development initiatives** focused on (a) raising more awareness within the region on the importance of technical standards, in particular international ones, and (b) empowering stakeholders from across the region with the knowledge and skills needed to increase their participation in international SDOs. Such initiatives should be targeted not only at national SDOs, but also at individual stakeholders from across the region (governmental bodies, civil society, industry, academia, etc.).
    - This could be done in cooperation with/with the support of international SDOs such as ISO, the IEC, and ITU. COPANT, for instance, could leverage the agreements it has with ISO and the IEC to this aim.
- **Establish or strengthen relations with international SDOs.** Follow the work of these organizations closely so as to be able to provide regular updates to their members on SDOs activities, areas of particular interest, and modalities of participation.
- **Facilitate the coordination of common positions** on international standardization matters among members. Encourage member SDOs to engage other stakeholders from the national level. Where possible, act as the voice of member SDOs in international standardization processes.
- **Encourage the application of international standards** at national level.

For governments & national SDOs

- Governments and/or national SDOs to **develop national standardization strategies**, outlining priorities and goals related to both national and international standardization. Align these goals and priorities with broader industrial, technological, and economic policies.[16]
- Governments to **allocate more resources** to participation in international SDOs, in particular ISO, the IEC, and ITU.
- Governments to **make use of their presence in Geneva – through the permanent missions**[17] – to follow the work of Geneva-based SDOs and partner with other missions to support each other in following this work.
- Governments to **build on their representation at ITU through ministries and/or NRAs** and ensure that these entities also follow ITU-T standardization work.
    - Given the complexity of ITU-T standardization work, it is very difficult for any one country – including the developed ones – to follow all this work. **Joining efforts with other countries** – from the region and beyond – could enable a wider coverage of various activities and the exchange of information among partners.

[16] ISO's methodology for developing a national standardization strategy could be used as a starting point (ISO, 2020).

[17] Nine of the eleven countries in the ARIN region have permanent missions to the UN Office at Geneva: Antigua and Barbuda, Bahamas, Barbados, Canada, Dominica, Grenada, Jamaica, Saint Lucia, and the USA.
Missing are Saint Kitts and Nevis, and Saint Vincent and the Grenadines (UN Office at Geneva, no date).

- Governments and national SDOs to **engage other stakeholders** (businesses, the technical community, civil society, academia) in standardization-related activities and to encourage them to participate in international standardization processes.
    - This would also involve awareness raising and capacity development activities focused on issues such as explaining the multiple dimensions of standards (beyond their technical functions), the importance of transposing international standards at the national level, and the value of participating in international standard-setting.
- **National SDOs to join forces**, both directly and in the framework of regional SDOs, to increase their presence in international SDOs. This could start by identifying priority areas of common interest (e.g. international digital standards with relevance for climate change) and engaging in related work.

For international SDOs

- **Partner with national and regional SDOs** to raise awareness about their work within the region.
- **Support the inclusion of actors less represented** (be they nations or individual stakeholders). The standardization gap is a challenge that needs to be addressed if international standardization processes are to reflect the interests and needs of the global population.
- For Geneva-based SDOs: **Actively reach out to Geneva missions** and offer to support them in finding their way around standardization processes.

Annex 1: ARIN region

Countries and territories, national SDOs, participation in selected international SDOs

ARIN service region	National SDO	Repre-sentation in the IEC	Represen-tation in ISO	Representation in ITU	Repre-sentation in COPANT	Represen-tation in CROSQ	Represen-tation in other SDOs
Canada Sector							
Canada	Standards Council of Canada	Yes	Yes, full member	Yes 20 ITU members 11 ITU-T members[18]	Yes		3GPP, IEEE SA, IETF, W3C
Caribbean and North Atlantic Islands Sector							
Anguilla	n/a (British overseas territory)						
Antigua and Barbuda	Antigua & Barbuda Bureau of Standards		Yes, subscriber member	Yes 1 ITU member		Yes	
Bahamas	Bahamas Bureau of Standards and Quality		Yes, full member	Yes 4 ITU members	Yes	Yes	
Barbados	Barbados National Standards Institution		Yes, full member	Yes 2 ITU members	Yes	Yes	
Bermuda	n/a (British overseas territory)						
Cayman Islands	n/a (British overseas territory)						
Dominica	Dominica Bureau of Standards		Yes, correspondent member	Yes 2 ITU members		Yes	
Grenada	Grenada Bureau of Standards			Yes 2 ITU members	Yes	Yes	
Guadeloupe	n/a (French overseas department)						
Jamaica	Bureau of Standards Jamaica		Yes, full member	Yes 4 ITU members 1 ITU-T member	Yes	Yes	
Martinique	n/a (French overseas department)						
Montserrat	n/a (British overseas territory)					Participates through the Trade and Quality	

[18] As of January 2022

						Infrastructure Division Office of the Premier	
Saint Barthelemy	n/a (overseas collectivity of France)						
Saint Kitts And Nevis	Saint Kitts and Nevis Bureau of Standards		Yes, correspondent member	Yes 2 ITU members	Yes	Yes	
Saint Lucia	Saint Lucia Bureau of Standards		Yes, full member	Yes 2 ITU members	Yes	Yes	
St. Pierre and Miquelon	n/a (overseas collectivity of France)						
Saint Vincent and the Grenadines	Saint Vincent and the Grenadines Bureau of Standards		Yes, subscriber member	Yes 2 ITU members	Yes	Yes	
St. Martin	n/a (overseas collectivity of France)						
Turks and Caicos Islands	n/a (British overseas territory)						
Virgin Islands (British)	n/a (British overseas territory)						
United States Sector							
United States	American National Standards Institute	Yes	Yes, full member	Yes 118 ITU members 83 ITU-T members	Yes		3GPP, IEEE SA, IETF, W3C
Puerto Rico	n/a (unincorporated US territory)						
Virgin Islands (U.S.)	n/a (unincorporated US territory)						
United States Minor Outlying Islands	n/a (US islands)						
Outlying Areas Sector							
Antarctica	n/a						
Bouvet Island	n/a (dependency of Norway)						
Heard and McDonald Islands	n/a Australian external territory						
Saint Helena	n/a (British overseas territory)						

Annex 2: Abbreviations

3GPP	3rd Generation Partnership Project
AI	artificial intelligence
ANSI	American National Standards Institute
ARIN	American Registry for Internet Numbers
CARICOM	Caribbean Community
CEN	European Committee for Standardization (*Commission Européenne de Normalisation*)
CENELEC	European Committee for Electrotechnical Standardization (*Commission Européenne de Normalisation Électrique*)
COPANT	Pan American Standards Commission (*Comisión Panamericana de Normas Técnicas*)
CROSQ	CARICOM Regional Organisation for Standards and Quality
CSS	Cascading Style Sheets
DNS	domain name system
DNSSEC	DNS security extensions
ETSI	European Telecommunications Standards Institute
HTML	HyperText Markup Language
HRC	Human Rights Council
ICT	information and communication technologies
IEEE	Institute of Electrical and Electronics Engineers
IEEE SA	IEEE Standards Association
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
IoT	internet of things
IP	internet protocol
IPTV	internet protocol television

ISO	International Organization for Standardization
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunication Standardization Sector
JTC1	ISO/IEC Joint Technical Committee 1
NRA	national regulatory authority
OASIS	Organization for the Advancement of Structured Information Standards
SC	subcommittee
SCC	Standards Council of Canada
SDG	sustainable development goal
SDO	standards development organization
SEP	standard-essential patent
SG	study group
SSL	secure sockets layer
TBT	technical barrier to trade
TC	technical committee
TCP/IP	Transmission Control Protocol/Internet Protocol
W3C	World Wide Web Consortium
WP	working party
WG	working group
WTO	World Trade Organization
WTSA	World Telecommunication Standardization Assembly
XML	eXtensible Markup Language

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