ITU News MAGAZINE

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Women leading in radiocommunications and space

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Towards an equitable digital future

By Houlin Zhao, ITU Secretary-General

The COVID-19 pandemic has exacerbated global inequalities, and women often bear the brunt of it. Here at the International Telecommunication Union (ITU), while we promote equality in our own work, we must also strive to expand the opportunities for girls and women across the entire field of information and communication technologies (ICTs).

Ahead of the upcoming World Telecommunication Development Conference (WTDC), our newly formed Network of Women @WTDC encourages skilled female professionals to assume key roles. ITU also contributes to the EQUALS global partnership, which helps equip women for digital engagement. At the recent World Summit on the Information Society (WSIS) Forum 2021, we led virtual discussions on ICTs and gender mainstreaming.

To encourage more equitable participation at the next World Radiocommunication Conference (WRC), ITU's Radiocommunication Bureau recently launched the Network of Women for WRC-23 initiative. Our Radiocommunication Sector (ITU-R) is actively implementing the WRC-19 Gender Declaration, which commits us to gender equality as we advance radiocommunication systems and services.

This year, notably, marks the 10th Anniversary of International Girls in ICT Day – a worldwide celebration to inspire the next generation of women in tech. I am optimistic we will see more and more women in leadership and other key roles, both in ITU-led initiatives and throughout our exciting and diverse technical field.

As we build back better for the post-pandemic world, let's work together and keep strengthening our commitment for an equitable digital future.

> *"As we build back better for the post-pandemic world, let's work together and keep strengthening our commitment for an equitable digital future."*
>
> Houlin Zhao

Women leading in radiocommunications and space

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Celebrating women in radiocommunications and space

By Mario Maniewicz, Director of the ITU Radiocommunication Bureau

"The ITU Radiocommunication Bureau has undertaken several key initiatives to advance women's participation."

Mario Maniewicz

I am delighted to present this ITU News Magazine featuring women leading in radiocommunications and space.

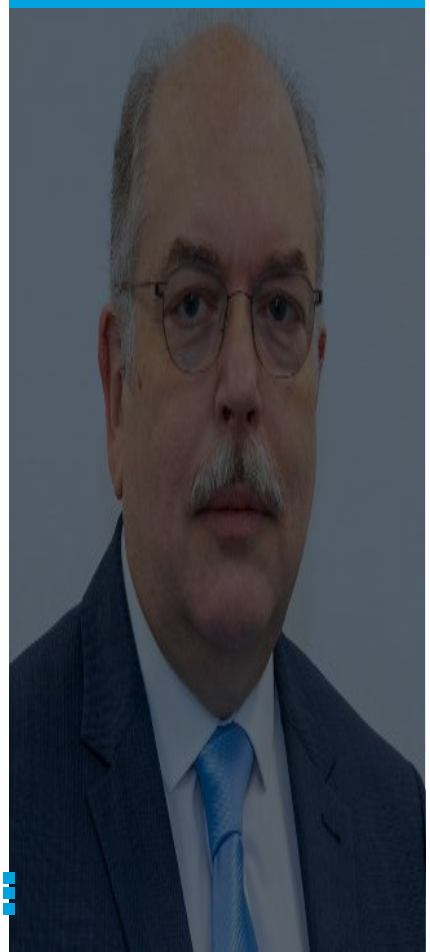
This special edition highlights women leaders across the radiocommunication and space domains, both in the public and private sectors. Our hope is that by sharing their stories, these change-makers and role models can inspire more young women and girls to consider careers in science, technology, engineering, arts, and mathematics (STEAM), including radiocommunications.

In this issue, you will find profiles and interviews dedicated to leaders in space exploration, spectrum management, standards development, research and development, science, and technology policy, etc. Our subjects are from public and private sector organizations, regulatory bodies and information and communication technology (ICT) ministries, including mobile, broadcasting, and satellite operators and suppliers, and more.

Highlighting these women and their achievements forms part of our ongoing efforts to implement the Declaration on Promoting Gender Equality, Equity and Parity in the ITU Radiocommunication Sector.

At the last World Radiocommunication Conference in 2019 (WRC-19), delegates recognized that while radiocommunication plays an important role in the development of information and communication technologies (ICTs), very few women, statistically, participate in key international processes. I firmly believe that our radiocommunication work – as the International Telecommunication Union (ITU) and in the public and private sectors – can be advanced more effectively through the active inclusion and participation of women.

Since WRC-19, the ITU Radiocommunication Bureau has undertaken several key initiatives to advance women's participation, whether in conferences, meetings, seminars, study groups or other engagement.



The Network of Women for WRC-23 (NOW4WRC23), an initiative launched in December 2020, aims to build capacity, and promote greater representation of women in key roles at the upcoming WRC, as well as in preparatory meetings and conferences as delegates, chairs, and vice-chairs.

NOW4WRC23 will go a long way to inspire a new generation of women to be involved in radiocommunications and contribute to our goal of more balanced gender participation in the work of the ITU Radiocommunication Sector (ITU-R) and in leadership roles. Also supporting this initiative, our Radiocommunication Advisory Group (RAG) includes a Correspondence Group on Gender that engages our membership in identifying ways and means for closing the gender parity gap.

ITU has made remarkable progress on gender issues over the past decade, increasing women's participation and contributions through mainstreaming policies and expanding efforts to empower women and girls.

Active inclusion of women and girls is consistent with our collective responsibility to ensure we leave no one behind. Together, we must turn the tide and continue to accelerate women's participation in the digital economy.

I hope you will enjoy reading this special edition of the ITU News Magazine.

> *"NOW4WRC23 will go a long way to inspire a new generation of women to be involved in radiocommunications."*

Network of Women for WRC-23

A forum for networking, mentoring and knowledge sharing

About NOW4WRC23 here.

Women of the Radio Regulations Board

The Radio Regulations Board (RRB) elected its first women members in 2006.

In 2021, a quarter of the RRB Board members are women. Twelve members are elected at the ITU Plenipotentiary Conference.

More about the RRB here.

Chantal Beaumier

Elected to the RRB: 2018
Vice-Chairman: 2019
Chairman: 2020

"Women with regulatory expertise in space radiocommunications are uniquely positioned to find solutions and build consensus on the RRB given our collaborative nature and different perspective on issues."

Sahiba Hasanova

Elected to the RRB: 2018

"It is vital to achieve gender equality in the RRB, as we need more women experts to find solutions to unresolved issues and to make decisions on difficult issues in applying the provisions of the Radio Regulations."

Lilian Jeanty

Elected to the RRB: 2014, 2018
Vice-Chairman: 2015
Chairman: 2016, 2019

"A large number of qualified women is active in the ITU Radiocommunication Sector, and therefore there is every reason to have more women in the RRB from all parts of the world."

Joanne Wilson

Elected to the RRB: 2014
Vice-Chairman: 2018

"I am a firm believer in equality in science. It can be achieved if future generations of scientists and technologists — whether researchers, practitioners, policy-makers, or educators — reflect our diverse global community."

Julie N. Zoller

Elected to the RRB: 2006, 2010
Vice-Chairman: 2007
Chairman: 2008, 2011

"Diversity and inclusivity produce healthier, more productive institutions. I encourage Member States to build a more inclusive Union by nominating women for the Radio Regulations Board and other elected positions."

Martine Limodin

Elected to the RRB: 2006

"It would be desirable to have more woman elected to the Board, as I believe in equality and the complementarity of skills."

WHEN WOMEN TAKE THE HELM

Wisdom from radiocommunication leaders

Although more than 25 years have passed since the Beijing Declaration, women still trail men by a long margin in many realms, including technology policy-making and leadership.

The governments that adopted the declaration at the fourth United Nations (UN) Conference on Women were convinced that "Women's empowerment and their full participation on the basis of equality in all spheres of society, including participation in the decision-making process and access to power, are fundamental for the achievement of equality, development and peace." In adopting the declaration, UN member states pledged to take action to "further the advancement and empowerment of women all over the world."

> Women's empowerment and their full participation on the basis of equality in all spheres of society, including participation in the decision-making process and access to power, are fundamental for the achievement of equality, development and peace.
>
> *Beijing Declaration and Platform for Action*

While progress remains uneven, the overall picture is improving. Slowly but surely, more women are taking the helm at major telecommunications, and information and communication technology (ICT) organizations, as well as in key international standards and policy-making bodies.

Last year, **Bernadette Lewis** became the first female **Secretary-General of the Commonwealth Telecommunications Organization**, an intergovernmental agency established more than 122 years ago. Previously, she was the first female Secretary-General of the Caribbean Telecommunications Union (CTU). "My time at CTU has certainly prepared me," she said upon making the move.

Many of the women interviewed here – all currently or recently active in the International Telecommunication Union (ITU) and its Radiocommunication Sector (ITU-R) – went through the experience of being the sole or first woman at the head of their organization, committee or standards body.

"I want every woman, every young girl to know that there is nothing to stop them from attaining such a position," Lewis added. "But it calls for a certain amount of dedication, discipline, and integrity to be able to navigate the many obstacles that will be thrown in their way."

"I want every woman, every young girl to know that there is nothing to stop them from attaining such a position."

Bernadette Lewis

The only woman in the room

There has been no shortage of obstacles. But supportive colleagues, management and role models, as well as fair working conditions, help outstanding women advance.

"When I started my career, people would come to a meeting who didn't know me, and automatically assume I was an administrative person," recalls **Veena Rawat, first woman to chair a World Radiocommunication Conference** (WRC-03), former Chair of ITU-R Study Group 4 on satellite services, and supported by Canada in 2010 as candidate for the position of Director of the ITU Radiocommunication Bureau.

"But I had such good support from my supervisors. They made sure to introduce me as an equal partner, part of the team. That kind of support is needed, especially when women are fewer in terms of numbers."

In a varied public- and private-sector career, Rawat recalls:

"I was the only woman for a long time. Right from the beginning when I did my PhD at Queen's University in Canada."

"That kind of support is needed, especially when women are fewer in terms of numbers."

Veena Rawat

There, a supportive thesis supervisor helped Rawat overcome obstacles she faced in her research: "I needed some data from copper mines because my work was on radiocommunications in difficult environments," she recounts. "At that time, women were not allowed in mines. But my supervisor helped me get the data by sending a male technician."

Chair of ITU-R Study Group 3 **(radio wave propagation) Carol Wilson** had a similar experience. Her thesis advisor, Charles Bostian, got her interested in radiocommunications and was a real mentor through her university years and beyond. But others were less supportive. "On the flip side, some of my fellow students, teachers, certainly some of my workplace managers were quite rude about women being engineers," admits Wilson. "I was motivated then to prove them wrong. I just put my heart into it and said, I can show you that I can do this. That in itself was a motivation."

Confidence in demonstrating your capabilities is crucial, agrees **Salma Jalife, former Chair of the Permanent Consultative Committee on Radiocommunications in the Inter-American Telecommunication Commission (**CITEL**)**. As one of the very few women engineering students, Jalife had a hard time dealing with male students who would treat her as less intelligent, or as if she needed help to do her work. "I started showing them that I was at the same level," she says. When she started helping male colleagues solve problems, they began to treat her as an equal. "Feel confident in what you do and show your colleagues that you are as capable as they are," she recommends.

Sometimes the obstacles women face can take a more abstract form. "In my career, I have hit the so-called glass ceiling," admits **Bettina Funk, Chair of the international special committee on radio interference (CISPR) at the International Electrotechnical Commission (**IEC**)**. "Sometimes you are in a position where you just can't develop anymore. Structural things prevent you from doing so, or it's the attitude or the culture saying: 'We don't want to have females higher up in the hierarchy.' You wonder why male colleagues are always getting ahead of you, even though you're doing exactly the same work, or sometimes even doing more."

If you can't influence the situation, move on, Funk advises.

As Wilson sums up: "It takes women putting themselves forward, men being willing to give women a seat at the table, and employers to be willing to support women employees and put them forward for positions and give them all the scope of opportunities."

"I just put my heart into it and said, I can show you that I can do this."

Carol Wilson

"Confidence in demonstrating your capabilities is crucial."

Salma Jalife

"In my career, I have hit the so-called glass ceiling."

Bettina Funk

Learning to lead

The women agreed that their struggles have given them an edge in certain leadership roles, despite doubts.

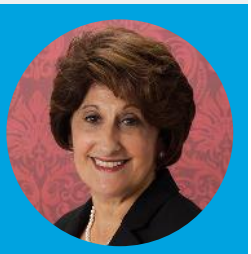
"I was one of the first women to chair the PCC III. Everybody was wondering what was going to happen with a woman carrying this group," recalls Jalife. "When you are chairing, you have to show your colleagues that you want to lead the group in a good direction. I was always open to listen and see if their opinions and comments were valuable for the group to have better positions. If you have an open mind and share knowledge with your colleagues, then you have an opportunity to be considered as an equal."

Overcoming challenges can bring out the best in people.

"Women who do succeed, in my experience, really are very extraordinary because they've had to battle against all the struggles," Wilson points out. "In addition to doing their regular engineering work, they've had to put up with a lot."

Even the proverbial female propensity to accept multi-tasking can be a positive thing, notes **Cheryl Blum, former Chair of the Telecommunications Industry Association (TIA) Engineering Committee on mobile and personal communications systems (TR45)**.

"By taking care of a home, taking care of a family, participating in various organizations, both at the community level as well as in other organizations, you learn a lot of skills which you bring to your career. You learn organizational skills and time management. You learn how to prioritize your activities, compromise, and negotiate."



"By taking care of a home... participating in various organizations, you learn a lot of skills..."

Cheryl Blum

The (long) way forward

At the last World Radiocommunication Conference (WRC), in 2019, ITU Member States unanimously adopted a declaration that promotes gender equality, equity and parity in the work of the ITU-R.

But there is still a long way to go, according to Rawat.

"Engineering was considered a profession with a hard hat, not a job for women. In that context, we have seen the increase in participation and leadership roles. But we are nowhere close to 50/50. So while we are improving, the rate of improvement is much lower than I would like."

Positive, successful role models are crucial to showing what is possible, she adds. "It improves confidence significantly in women. We have to continue to do what ITU is doing with the Network of Women."

NOW4WRC – the Network of Women for the World Radiocommunication Conferences – aims to boost women's participation and encourage them to take on leadership roles, including as committee and conference chairs.

"It is a serious responsibility for me to be a mentor and an example," adds Lewis.

Rawat personally attests to the success of this approach. "Under the NOW programme and even informally within the WRC, some women I have worked with have contacted me. I see their development, and that really gives me such pleasure that this thing works."

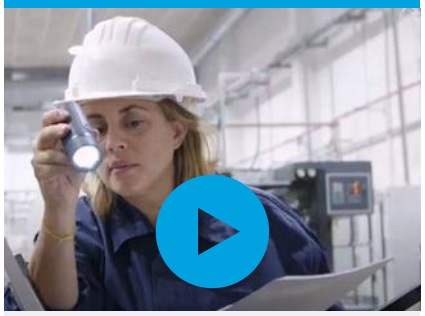
The focus on mentoring was inspired, in part, by the US-based We Lead (Women Empowered for Leadership Empowerment, Advancement and Development) initiative.

"The world needs more capable people, both men and women, to address the big problems of the future," Wilson notes. "If we don't have women going into engineering, we've lost half of the opportunities, half of the resources we have to solve problems."

Jalife agrees. "Decisions need to be made by both. We have a long history of women not participating in very important decisions. It is time for us to become part of these decisions that will lead us to a better, more inclusive world."

Empowering future women leaders

Listen to women leaders in the radiocommunication industry who share their personal experiences and inspiring advice, here.



Interview with Robyn Gatens

Director of the International Space Station for Human Exploration and Operations, NASA

Newly appointed Director of NASA's International Space Station for Human Exploration and Operations Robyn Gatens told ITU News about the past, present and future of the International Space Station (ISS), challenges and opportunities for space exploration, and what a bustling low-Earth orbit economy could look like.

These are exciting times for space exploration: more and more countries are establishing space programmes and announcing missions to the Moon, Mars and beyond. What role has the ISS played in advancing human space exploration?

Robyn Gatens: Not only are more countries interested in space, but more interest is coming from the private commercial space sector as well.

One of the key missions for the ISS is to be a test bed where we can learn about the systems and effects on the human body that is required to do these future missions beyond low-Earth orbit (LEO).

We need to develop those technologies and do that human research so that we know how to keep crews healthy.

Do you see the role of the ISS changing over time?

Robyn Gatens: We are entering our third decade on the ISS. Our first decade was all about assembly, which we completed in 2011. The last decade had us learning how to use and expand those capabilities on the space station to do research.

Additional crew members means that we can do more research.

We have more partners participating, both international and commercial. All that adds up to really maximizing its full potential.

"We need to develop those technologies and do that human research so that we know how to keep crews healthy."

Robyn Gatens


NASA/Roscosmos via Flickr

What challenges do you anticipate for the ISS as more countries and commercial operations head to space?

Robyn Gatens: We have limited flight opportunities, even with more vehicles and limited space on the space station to do things. But as we and other countries expand our commercial capabilities, there will be more opportunities.

One of the areas we are seeing promising markets for is tourism: flying astronauts from sovereign nations.

That's going to be a promising market for these private companies that want to have platforms in low-Earth orbit. So I think it's a challenge, but also an opportunity.

Does the ISS ever experience interference issues? Are you concerned about the growing number of LEO satellites that will be put in service in the next few years?

Robyn Gatens: With the growing number of commercial radio satellites and constellations, it does increase our efforts to ensure that there is no interference with the space station.

We work closely with the US Federal Aviation Administration (FAA) and satellite providers when they're doing their launches to ensure that we stay out of each other's way. We have had to do some avoidance manoeuvres occasionally to avoid some objects, but that's pretty rare.

"With the growing number of commercial radio satellites and constellations, it does increase our efforts to ensure that there is no interference with the space station."

What does a low-Earth orbit economy look like?

Robyn Gatens: One day we will retire the space station. It won't last forever.

So, we are doing all we can to enable a future where we have privately-owned and operated platforms from which NASA (the US National Aeronautics and Space Administration) and other countries and entities can purchase services for what we need to do in low-Earth orbit. We want to be one of many customers. Our vision for a low-Earth orbit economy is multiple human or human-tended, commercially-owned and operated platforms.

How has the COVID-19 pandemic affected human spaceflight over the past year?

Robyn Gatens: Initially our on-site work was restricted. The non-critical projects were delayed because we couldn't bring people on site to do hands-on work. Critical projects have been remarkably successful though. The teams have found a way to safely continue, with multiple mission control rooms: they work from one while cleaning the next one and do shifts that way. Now that people are really starting to get vaccinated, I think things will get easier.

In your new role, if you get a chance to go to space, would you like to?

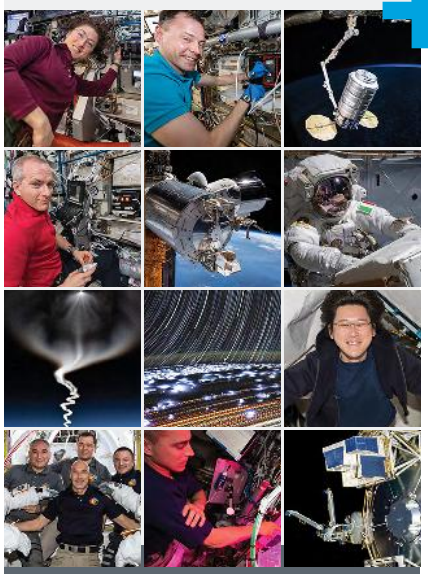
Robyn Gatens: I would love to, sure. But I'm also happy to enable others to go. At this point in my career, I'm probably destined to stay on the ground. But we've got a whole cadre of younger astronauts!

What role does international cooperation play in space services, and how do you see the contribution of organizations like ITU?

Robyn Gatens: No one country can do everything by themselves. If we're going to explore space, we need to do it together. Partnerships are very critical.

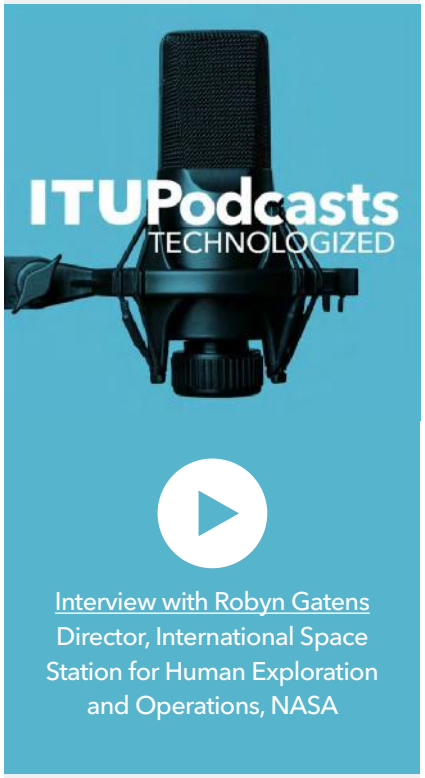
Groups like ITU not only provide collaboration opportunities, but also develop important interoperability standards.

Different countries bring contributions, and we know that they'll plug and play together. That's really important to enable everyone to participate, and it also drives global commercial partnerships.

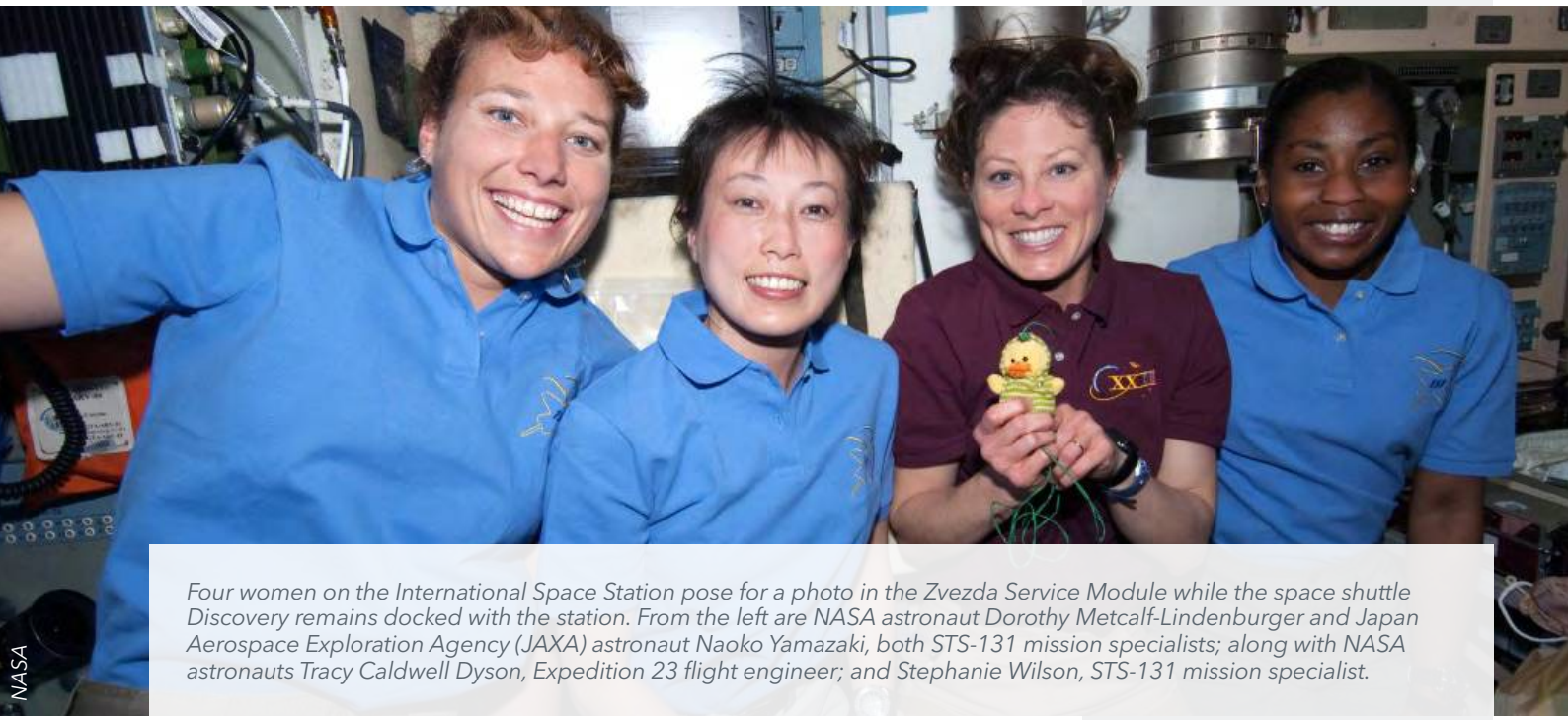


The Space Station 2021 Calendar

Download here.



Interview with Robyn Gatens
Director, International Space Station for Human Exploration and Operations, NASA



NASA

Four women on the International Space Station pose for a photo in the Zvezda Service Module while the space shuttle Discovery remains docked with the station. From the left are NASA astronaut Dorothy Metcalf-Lindenburger and Japan Aerospace Exploration Agency (JAXA) astronaut Naoko Yamazaki, both STS-131 mission specialists; along with NASA astronauts Tracy Caldwell Dyson, Expedition 23 flight engineer; and Stephanie Wilson, STS-131 mission specialist.

Meet the women who made history in space

"A bird cannot fly with one wing only. Human space flight cannot develop any further without the active participation of women." So said cosmonaut **Valentina Tereshkova**, who made history as the first woman in space aboard the then-Soviet Union's Vostok 6 spacecraft in 1963.

In the nearly six decades since Tereshkova first ventured into space, 64 more women have followed suit, albeit in fits and starts.

It took another 20 years after Tereshkova's flight before the former Soviet Union's Svetlana Savitskaya became the second woman in space in 1982. Two years later, she earned the spot of being the first woman to walk in space.

To date, women make up just over 10 per cent of human space travellers.

Although many more are preparing to explore what lies beyond Earth's orbit, human space flight has largely been made possible thanks to the scientific and technical contributions of women.

NASA

"A bird cannot fly with one wing only. Human space flight cannot develop any further without the active participation of women."

Valentina Tereshkova

More than astronauts

For decades, women have performed essential roles to enable the safe development of human space flight – often from the ground, and behind the scenes.

"Hidden Figure" mathematician **Katherine Johnson** of the US National Aeronautics and Space Administration (NASA) was instrumental in getting astronauts into orbit safely and helped put humans (all men, as it happens) on the Moon.

Computer scientist **Margaret Hamilton**'s software code was crucial to the safety of NASA's lunar missions. Mary Jackson, the first African American female engineer, for whom NASA's headquarters building was just renamed, performed years of research focusing on the behaviour of the boundary layer of air around airplanes. **Frances "Poppy" Northcutt** became the first female engineer to work at Mission Control during NASA's Apollo 8 mission.

This trend continues today and into the further reaches of space.

Computer scientist Katie Bouman helped develop the algorithm that created the first-ever image of a black hole. **Swati Mohan**, the engineer leading NASA mission guidance and control operations, became the face of the successful Mars landing of the Perseverance rover in early 2021. **Cathy Sham** of NASA's Johnson Space Flight Center, who also chairs a working party in the ITU Radiocommunication Sector (ITU-R), is the spectrum manager for the International Space Station as well as for NASA's activities on the lunar surface. Similarly, the Hope probe launched by the United Arab Emirates to study the Martian atmosphere, was led by **Sarah Al-Amiri** and included several women engineers.

But breakthroughs in human space flight have not come without considerable costs.

Christa McAuliffe was scheduled to become the first teacher in space. But on January 28, 1986,she, along with NASA astronaut **Judith Resnik**, an electrical engineer, software engineer, biomedical engineer and pilot along with their five male crew members died aboard the Space Shuttle Challenger when the shuttle broke apart just 73 seconds after the launch of mission STS-51-L.

Kalpana Chawla, who became the first Indian-born woman in space in 1997, was killed when returning from her second mission, along with medical doctor, US Navy captain, and space shuttle mission specialist **Laurel Clark** and the rest of the crew aboard the space shuttle Columbia in 2003.

Katherine Johnson

This trend continues today and into the further reaches of space.

But breakthroughs in human space flight have not come without considerable costs.

After the disaster, **Eileen Collins**, the first female pilot of a space shuttle mission and first-ever female shuttle commander, led NASA's poignant "Return to Flight" shuttle mission.

Astronauts Eileen M. Collins, mission commander, and Jeffrey S. Ashby, pilot, peruse checklists on Columbia's middeck.

Other notable pioneers

In recent years, human space flight has become increasingly frequent and multinational, and the role of women space travellers from around the world has grown in parallel.

1983
- The first American woman in space, **Sally Ride**, spent seven days aboard the space shuttle Challenger during its STS-7 mission in June 1983.

1984
- **Kathryn Sullivan**, who travelled to space the following year, became the first American woman to complete a spacewalk.

1991
- **Helen Sharman** holds the distinction of being the first British astronaut in space. During her sojourn in 1991, Sharman also became the first woman to visit Russian space station Mir.

1992
- Astronaut **Mae Jemison** became the first African American woman in space, serving as a mission specialist on the space shuttle Endeavour's STS-47 mission in 1992.

1992

- On another 1992 NASA-led mission, payload specialist **Roberta Bondar** became the first Canadian woman in space.

1994

- In 1994, Japan's **Chiaki Mukai** became the first Asian woman in space and the first Japanese national to complete two space flights.

1996

- **Claudie Haigneré** (formerly Claudie André-Deshays) was the first French woman in space, conducting life sciences and technology experiments in 1996. Later, she became the first woman to qualify as a commander of a Russian Soyuz capsule during re-entry.

2000

- The year 2000 saw astronaut **Peggy Whitson** become the first female International Space Station (ISS) Expedition Commander. Whitson and Yi So-yeon, the first South Korean in space, were part of a re-entry crew where the women outnumbered men for the first time ever.

  Whitson has a few more accolades under her belt, including the US record for cumulative time in space at a whopping 665 days. She also holds the record for the most spacewalk time by a female astronaut at 60 hours and 21 minutes over 10 spacewalks.

2001

- In a 2001 mission, NASA astronaut **Susan Helms** became the first female crew member aboard the International Space Station (ISS). She also jointly holds the world record for the longest single spacewalk at 8 hours and 56 minutes.

2006

- **Anousheh Ansari** became not only the first Iranian-born woman in space, but also the first self-funded woman to fly to the ISS in 2006.

2007

- NASA's **Sunita Williams** who first went to space in 2007 set the record at the time for the longest spaceflight by a woman and completed seven spacewalks.

2010

- 2010 marked the first and only time to date that four women were in space at the same time: **Tracy Caldwell Dyson**, **Dorothy Metcalf-Lindenburger**, **Stephanie Wilson** and Japan's **Naoko Yamazaki**.

2012

- **Liu Yang** became the first Chinese woman in space aboard the Shenzhou-9 spacecraft in 2012 and docking with the Tiangong-1 space station.

2013

- A year later, **Wang Yaping** became the second Chinese female space traveller, and taught schoolchildren live from the station.

2014

- **Samantha Cristoforetti**, the first Italian woman in space in 2014, supported biology, human physiology, radiation research. She also oversaw the undocking of the last Automated Transfer Vehicle of the European Space Agency.

2016

- In 2016, NASA astronaut **Kate Rubins** became the first person to sequence DNA in space aboard the ISS.

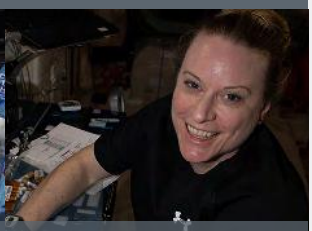
2019

- In 2019, NASA astronauts **Jessica Meir** and **Christina Koch** completed the first all-woman spacewalk to replace the space station's batteries – a feat delayed due to spacesuit sizes. The duo did two more spacewalks in 2020. At 328 consecutive days, Koch holds the record for the longest duration in space for a woman during a single mission.
- India's second Moon lander mission in 2019 was led (remotely) by **Muthayya Vanitha** and **Ritu Karidhal**, making it the Indian space agency's first-ever space mission to be headed by women.


Liu Yang 2012


Wang Yaping 2013


Samantha Cristoforetti 2014


Kate Rubins 2016


Jessica Meir and Christina Koch 2019



Muthayya Vanitha and Ritu Karidhal 2019

Bringing more women into space

The near future looks bright for aspiring women space travellers of the world.

Anna Kikina from Russia is scheduled to go into orbit in 2022. NASA has said it wants to land the first woman on the surface of the Earth's Moon in 2024. Last week, the United Arab Emirates announced that **Nora Al Matrooshi** would become the Arab world's first woman astronaut.

Two women are among the four passengers chosen to fly on aerospace manufacturer and space transportation company SpaceX's first-ever all-civilian space mission, Inspiration4.

Hayley Arceneaux, 29, would be the youngest American to fly into space and the first with a prosthetic body part.

"This mission is going to inspire people in so many ways," said Arceneaux, who is also a bone cancer survivor.

"Until this mission, I could have never been an astronaut. This mission is opening space travel to people who are not physically perfect."

> *"This mission is going to inspire people in so many ways."*
>
> Hayley Arceneaux

Interview with Simonetta Di Pippo

Director of the United Nations Office for Outer Space Affairs (UNOOSA)

Simonetta Di Pippo leads UNOOSA's strategic, policy and programmatic activities and advises the United Nations Secretary-General on space affairs. She has served as director of human spaceflight at the European Space Agency, and previously as director of the Observation of the Universe at the Italian Space Agency. She holds a Master's degree in Astrophysics and Space Physics, and honoris causa degrees in environmental studies and international affairs.

UNOOSA carries out an important mission regarding activities in space. What exactly does UNOOSA do, and how does this differ from the work of its sister UN agency, the International Telecommunication Union (ITU)?

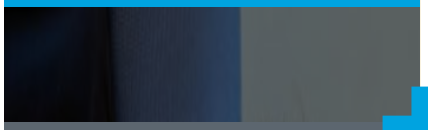
Simonetta Di Pippo: UNOOSA's mission is to promote the peaceful uses of outer space and ensure that everyone, everywhere, has access to the benefits of space technology and applications. ITU, on the other hand, is committed to connecting all the world's people, wherever they live and whatever their means, so that they can effectively communicate through radio and satellite technology. Therefore, our missions are closely aligned and interdependent.

Space exploration is the backbone of modern communication technologies: every time you make a phone call or access the Internet, you are benefiting from space technology, which also enables satellite navigation, remote financial transactions and many more of the activities that make our modern lives possible. UNOOSA's work, in ensuring strong international cooperation in space, the sustainability of space exploration, and inclusiveness for developing countries in benefiting from space, creates a strong foundation for ITU's work in leveraging the potential of communication technologies.

Would you describe yourself as a woman pushing space frontiers?

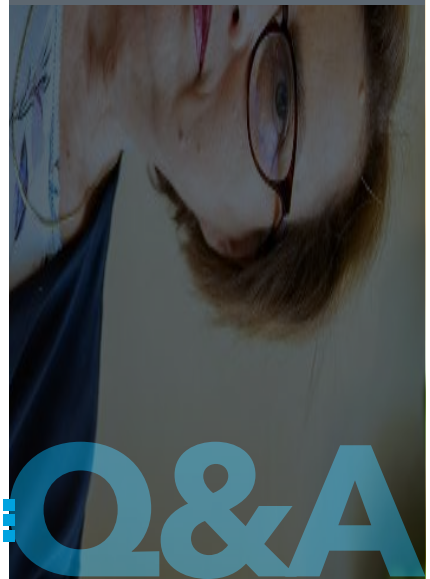
Simonetta Di Pippo: As an astrophysicist and someone who has worked in the space sector for decades, I certainly know well how it feels to be in a male-dominated sector. Throughout my career, I have always strived to help more women succeed in the space field.

> *"Role models are vital for empowering and educating women and girls."*
>
> Simonetta Di Pippo



Hubert Curien Award's first woman

Simonetta Di Pippo was the first woman to receive the Hubert Curien Award.



Role models are vital for empowering and educating women and girls – shedding light on opportunities, explaining different career paths, providing advice and connections, and showing that, if you are dedicated, you will succeed. I have always tried to provide this encouragement, support and inspiration to the women, and the men, around me.

What have been your most inspiring projects to date?

Simonetta Di Pippo: At UNOOSA, we are working to close not only the gender gap in accessing space, but also other kinds of gaps, for example, for countries to be able to leverage the benefits of space. Through our Access to Space for All Initiative, in collaboration with exceptional partners such as leading space agencies and private sector companies operating in space, we offer opportunities for teams from all over the world, particularly from developing countries, to acquire space capabilities. One of the flagship programmes under the Initiative, KiboCUBE, has already enabled two countries, Kenya and Guatemala, to deploy their first ever satellites. Other winners of the programme are expected to follow suit, with Mauritius likely next, so this is pretty exciting.

What made you decide to co-found Women in Aerospace Europe in 2009 and then, more recently, to become a United Nations International Gender Champion?

Simonetta Di Pippo: I have always believed in the power of association and networking to help women break glass ceilings. I co-founded Women in Aerospace Europe as an organization dedicated to increasing the leadership capabilities and visibility of women in the aerospace community, aiming to change things from within.

The contribution of senior leaders is also essential to drive change and empower women in all sectors. Through the UN International Gender Champions network, which I joined in 2017, high-level professionals commit to making a difference for women through their work. This is aligned with my long-time efforts and vision to help women reach their potential, so naturally I am delighted to be part of this network.

How is UNOOSA supporting girls and women and encouraging them to take up careers in the space industry?

Simonetta Di Pippo: In 2019, we launched Space4Women – an initiative to promote gender equality in the space and STEM (science, technology, engineering and mathematics) sectors.

"We offer opportunities for teams from all over the world, particularly from developing countries, to acquire space capabilities."

The Space4Women Mentorship Program

Apply to be a mentee here.

As research shows, the lack of mentors and women leaders in many scientific sectors is an important factor preventing more young women from pursuing, or even thinking of, education and career opportunities in these fields. To address this issue, Space4Women created a network of mentors through which space leaders from all over the world can help young women and men navigate education and careers in the space sector. Over the past year, we matched over 100 young people with our mentors, who provided them with career advice, support and inspiration.

The Space4Women website is also in the process of collecting capacity-building needs, from governments and institutions worldwide, to design the necessary support to strengthen gender equality in space and STEM.

Is the outlook for women and girls in the science community better today than when you began your career?

Simonetta Di Pippo: Things are changing, and many more girls and women today dare to dream about careers in "non-traditional" sectors that were out of bounds for previous generations of women. At UNOOSA, we often work with inspiring young women who are advancing the space sector in their own country, such as Pooja Lepcha from Bhutan, a beneficiary of our joint Kyutech (Kyusha Institute of Technology) fellowship with Japan to study nano-satellite technologies, who went on to be part of the team that created Bhutan's first satellite. Another example are the women scientists who were part of the team that developed Guatemala's first satellite.

Despite these inspiring examples, substantial obstacles remain for women. According to data from a UN report, women make up just over 35 per cent of STEM graduates worldwide.

According to a 2019 OECD Report, female employment in aerospace engineering hovers around 10–15 per cent in Europe and the US, and women account for slightly more than 20 per cent of space manufacturing employment.

Little has changed in these figures over the past thirty years. While the gender gap may now be narrowing, the share of women graduates in aerospace engineering remains low in many developed countries, despite government and private sector efforts.

We must do better. Every leader has a role to play to ensure equal opportunities – to unleash the talent of women in science and in all other sectors for the benefit of all.

Young women scientists and engineers help make Guatemala's first satellite in space, a success.

See video (in Spanish)

The Space Economy in Figures report

Chapter 3 is about remedying the gender gap in a dynamic space sector.

Read more in the OECD report here.

Interview with Julie N. Zoller

Head of Global Regulatory Affairs, Project Kuiper, Amazon

Julie Zoller oversees the key regulatory affairs portfolio for Amazon's Project Kuiper which aims to launch a constellation of low Earth orbit satellites to provide low-latency, high-quality broadband connectivity worldwide. She previously served as chief government affairs officer at Omnispace, and in tech-related policy roles at the US State Department, the National Telecommunications and Information Administration (NTIA), and at the US Department of Defense.

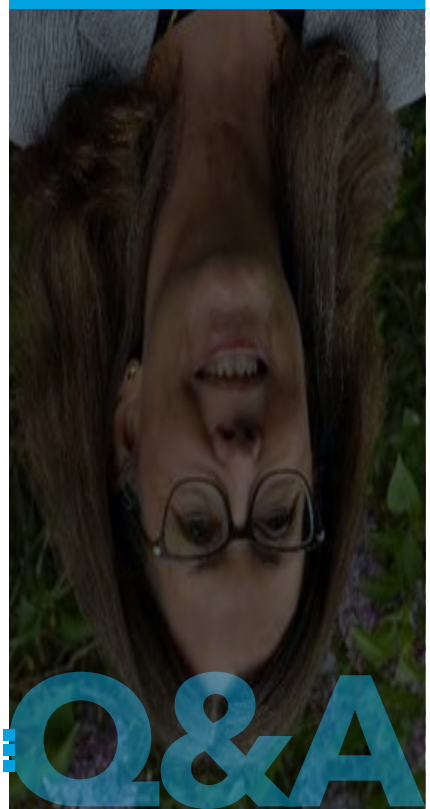
Prior to joining Amazon, you served as Senior Deputy Coordinator for International Communications and Information Policy in the State Department's Bureau of Economic and Business Affairs. You chaired the Council of the International Telecommunication Union (ITU) in 2016, and you were the first woman to chair ITU's Radio Regulations Board (RRB).

What can you tell us about your work as a member and chair of the RRB?

Julie Zoller: There is a common thread tying together my work at the State Department and chairing the Radio Regulations Board and ITU Council. I served for several years as a delegate, Board Member, and Counselor, building expertise and earning trust by listening to and appreciating the needs of others. This foundation of knowledge and trust prepared me to lead delegations and chair the Radio Regulations Board and Council. I really enjoyed the experience and working to find win-win outcomes.

Serving in a leadership capacity in government or a multilateral institution like ITU is a privilege and opportunity to do something for the common good. I'm proud to have been elected to the first Board with women members (2006–2010) and to have been the first woman to chair the Board. But the fact that women have been elected to the Board ever since, including serving as chair, is the real reward. Diversity and inclusion are good for institutions and businesses and are simply the right way to operate.

> *"We started Project Kuiper to provide high-speed, low-latency broadband to unserved and underserved communities around the world."*
>
> Julie Zoller



Can you offer some insights into Amazon's Project Kuiper and how it could improve people's lives?

Julie Zoller: We started Project Kuiper to provide high-speed, low-latency broadband to unserved and underserved communities around the world. In the midst of the COVID-19 pandemic, we have all had to shift our routine to learn, work, and access essential services from home. But there are still billions of people on Earth without reliable broadband.

Project Kuiper is an opportunity for us to address this need and help bridge the digital divide. To deliver service, we're building a constellation of 3236 satellites that will operate between 590 kilometres and 630 kilometres in altitude. Operating in low Earth orbit (LEO) has the dual benefit of lower latency and shorter de-orbit times, which is good for customers and space safety.

Describe your typical day as Head of Global Regulatory Affairs?

Julie Zoller: In a typical day, I'll have a staff meeting or attend a review, meet with my team to advance a particular regulatory matter, spend some time in one-on-one conversations with staff members, and read regulatory documents. Last July, the Federal Communications Commission (FCC) authorized us to deploy and operate the Kuiper NGSO (non-geostationary) system. Getting our license was a major milestone, but we still have lots of work to do.

We engage regularly in rule makings, and we're currently conducting technical studies in preparation for the 2023 ITU World Radiocommunication Conference (WRC-23). We've been fortunate to be able to meet via videoconference since last March, when we began working from home. Not everyone has this type of flexibility though, so I'm proud to be working on a project that will help connect the unconnected.

What is it about the space sector that particularly motivates you?

Julie Zoller: When I was a child, my entire school stopped our lessons to watch astronauts board space capsules and go to space, even to the Moon. My fascination continued with the space shuttle, which I got to see up close before it was retired. I was fortunate to become involved in communications satellites at the beginning of my career and have worked with systems in geostationary as well as low, medium, and highly elliptical Earth orbits.

"I'm proud to be working on a project that will help connect the unconnected."

Julie Zoller's work with ITU

Julie Zoller was the 2016 chair of the ITU Council and headed the US delegation to the 2016 ITU World Telecommunication Standardization Assembly. She served as deputy head of the US delegation to the 2016 OECD Ministerial on the Digital Economy, 2015 ITU World Radiocommunication Conference, and 2014 ITU Plenipotentiary and World Telecommunication Development Conferences, was elected to two terms on the ITU's Radio Regulations Board (2006–2014).

Satellite capabilities are expanding all the time, and the regulations have to enable that growth. Before there were personal computers, faxes, or cell phones. I sent teletype messages over satellite. Now we have a growing number of broadband satellite providers like Kuiper.
I'm excited to be a part of it.

Are investments in the space industry growing?

Julie Zoller: Absolutely. When we received our FCC license in July 2020, Amazon committed more than USD 10 billion to Project Kuiper. In April of this year, we announced an agreement with our first launch provider. These are just two examples, but I think they are a good indication of what's to come for the industry.

What advice can you give to women aspiring to take up space careers?

Julie Zoller: I highly recommend it. It's been an extremely rewarding journey filled with opportunity. My first job after I got my engineering degree was guiding the installation of large earth station complexes and testing the equipment after installation. That hands-on experience hooked me. I've served in the government and worked in private industry and managed large procurement and consulting contracts. I discovered I had an affinity for the regulatory side of space at the World Radiocommunication Conference in 1997 (WRC-97) and was elected to the Radio Regulations Board nine years later, stayed for two terms and became the first woman to chair it.

My advice is to embrace the opportunity in space. Do things you've never done before and dive deep to build your expertise. Say yes, and volunteer to do more. You will discover gifts you never knew you had and advance the use of space technology for the benefit of humankind.

Interview with Julie Zoller after the ITU Women in Standardization Expert (WISE) Group meeting.

See video

"Do things you've never done before and dive deep to build your expertise."

Julie Zoller chairing ITU Council, 2016

Interview with Rebecca Keiser

Chief of Research Security Strategy and Policy, National Science Foundation (NSF), and Chair of Women in Aerospace (WIA)

> *"I fell into science and technology policy work through a happy accident."*
>
> Rebecca Keiser

Rebecca Keiser joined the US National Science Foundation in 2015, initially heading the Office of International Science and Engineering. She previously worked at NASA as a special advisor on innovation and public-private partnerships, among other positions, and at the White House Office of Science and Technology Policy. She holds a PhD in International Studies, an MSc in Politics of the World Economy, and a BA in Japanese Studies.

Your bachelor's degree is in Japanese studies, and then you went on to an illustrious career working in science and technology policy in the White House, NASA and at the US National Science Foundation. That's quite a change of course.

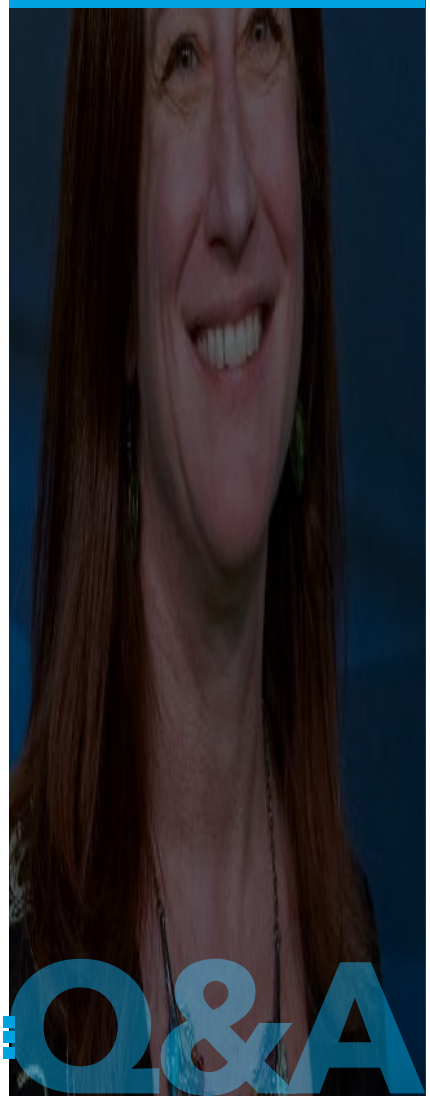
What excited you about science and technology policy?

Rebecca Keiser: I fell into science and technology policy work through a happy accident. When I was working on my PhD in international studies I received a fellowship from the US government to do my dissertation research in Japan. The fellowship required me to work for the federal government for a year after I received my PhD.

I began seeking federal employment in the late 1990s. It was an exciting time for the International Space Station as the international agreements were being negotiated. NASA was looking for a Japan specialist to assist with these agreement negotiations and other collaborations. It was the perfect fit, and NASA brought me on.

Even though my employment was initially for just a year, I fell in love with science and technology policy and remained at NASA for 16 years (for three of which I was on loan to the Office of Science and Technology Policy).

The happy accident changed my life, and I am so pleased that it did.



To the extent that you can, please tell us about the work you do as Chief of Research Security Strategy and Policy at National Science Foundation (NSF).

Rebecca Keiser: NSF created the Chief of Research Security Strategy and Policy (CRSSP) position in March 2020, and I am the first to fill the position.

NSF is concerned that there are some governments that are employing tactics that can destroy the research ecosystem, which is based on principles of research integrity such as transparency, openness, and merit-based competition.

Unfortunately, some governments have established programmes with contractual obligations that compel researchers to breach the principles of research integrity. The CRSSP's position works to develop policy to make NSF disclosure policies as clear as possible, to communicate the importance of research integrity to the research community, and to emphasize the importance of international collaborations that are based on such research integrity principles.

We seek to work with our international partners to foster research integrity and maintain our vibrant research ecosystem.

How is Women in Aerospace supporting more girls and women to take up careers in the space industry?

Rebecca Keiser: Women in Aerospace (WIA) focuses on many aspects to encourage more girls and women to enter a career in the space industry and to continue in the sector. WIA offers programmes that focus on career development at all levels including webinars on key issues such as negotiation, conflict resolution, and working in a virtual environment.

We hold programmes featuring women leaders in aerospace who talk about key aerospace issues as well as their own career paths. Additionally, we focus on creating and maintaining networks with other WIA members who can provide support and mentorship.

Through the WIA foundation, we provide scholarships to outstanding female college students to encourage them to enter careers in aerospace. Through the WIA awards, we acknowledge outstanding women in our industry.

There is always more that could and should be done, and WIA seeks continual input on additional ways in which we can serve the aerospace community to encourage more girls and women to enter and remain in aerospace positions.

Women in Aerospace

WIA provides programmes, professional development, conferences, networking opportunities and annual awards for the aerospace community.

Read more here.

How can governments and/or the private sector better foster gender equality and diversity and why do you think such goals matter?

Rebecca Keiser: I believe that gender equality and diversity need to be viewed as efforts that will improve a company or an organization rather than viewed as an obligation. Diversity brings fresh ideas and innovation. It brings a healthier work environment. It helps a company or an organization grow.

Right now, too many entities view gender diversity as something they have to do, rather than something they want or need to do for the benefit of the organization.

When employers see diversity as beneficial to the workplace, they can then focus on the infrastructure to encourage and maintain that diversity. This requires conscious effort, with a focus on aspects such as ensuring there are female role models throughout the organization, making sure that there are opportunities for women and men to participate in key projects and be part of teams, and that the performance assessment process is inclusive and equitable.

It takes a lot of work, but in the end, hopefully organizations will see the great value that diversity brings.

> *"I believe that gender equality and diversity need to be viewed as efforts that will improve a company or an organization, rather than viewed as an obligation."*

Women, ICT and emergency telecommunications

Opportunities and constraints

A 2020 report investigates how the digital divide is blocking women from becoming equal stakeholders in society, putting entire communities at greater risk during emergencies, and how information and communication technology (ICT) offers opportunities to close that gap.

Read more in a related article by Doreen Bogdan-Martin, Director of the ITU Telecommunication Development Bureau and Enrica Porcari, Chief Information Officer and Director of Technology for United Nations World Food Programme (WFP) and Chair of the Emergency Telecommunications Cluster (ETC).

Join ITU's online communities on your favourite channel

Inspiring women in government leadership

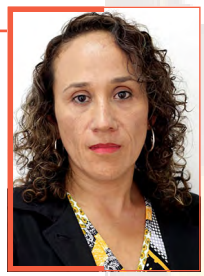
Meet some of the women in governmental information and communication technology (ICT) leadership positions. ITU News took a snapshot of their inspiring career paths.

Aminata Niang Diagne

Head, Radioelectrical Resources Office, Ministry of Digital Economy and Telecommunications, Senegal

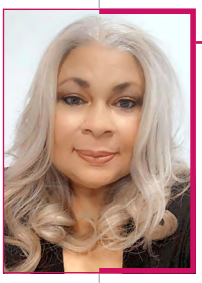
After graduating as a design engineer in telecommunications, Aminata Niang Diagne worked in the private sector before joining Senegal's telecommunications ministry in 2014. Participating actively in ITU Radiocommunication Sector (ITU-R) work since 2015, she also serves as Vice-Rapporteur for the ITU Telecommunication Development Sector (ITU-D). She has engaged in the work of ITU-R study groups, represented her government at meetings of the Economic Community of West African States (ECOWAS) and the African Telecommunications Union (ATU) and was Senegal's deputy head of delegation at the last World Radiocommunication Conference (WRC-19). She has joined the Network of Women for WRC-23 to encourage more African women to enter the field of radiocommunications.

Diana Paola Morales Mora



Deputy Director of Spectrum Management, National Spectrum Agency (ANE), Colombia

After starting her career in 2004 at Colombia's Ministry of Information and Communication Technologies, Diana Paola Morales Mora has held her current position as ANE's Deputy Director since 2019. Previously, she worked at the country's Communications Regulation Commission (CRC) as technical advisor on the *Best Practices Code for the Deployment of Communication Networks and Infrastructure, Quality of Telecommunication Services*, the country's broadband definition, and many other regulatory initiatives. In her time at the Commission between 2010 and 2018, she served as Infrastructure Regulation Manager and Data Governance and Data Analysis Manager. She holds a BSc in Electronic Engineering and an MSc in Information and Communication Technologies.



Maria Myers-Hamilton

Managing Director, Spectrum Management Authority (SMA), Jamaica

Prior to taking charge of national spectrum management in 2018, Maria Myers-Hamilton served as Director of Information Systems at the Jamaica Public Service (JPS) Company, where she oversaw the island nation's main telecommunications operations and led a team of over 70 technicians in delivering key ICT projects. Earlier, as Director of Records and Information Management at the Registrar General's Department, she and her team implemented the country's first e-payment and online application processing system for birth, death and marriage certificates. She holds an EdD in Instructional Technology and Distant Learning.

Irena Malolli

Director of Telecommunications and Post Strategy Development, Ministry of Infrastructure and Energy, Albania

Before taking over as the chief strategist for telecom and postal services Irena Malolli was Director of Infrastructure at Albania's Ministry of Infrastructure and Energy. Her previous positions included Director of the Electronic Communication, Postal and Integration Unit at Albania's Ministry of Innovation and Public Administration, Director of Electronic Communication at the National Agency on Information Society (NAIS), and Board Member of the Telecommunication Regulatory Entity (AKEP) in Albania during 2004–2008. She graduated with a PhD in Management, Information Systems in 2020, and holds an MSc in Communication Engineering and a Master of Business Administration (MBA), as well as an engineer's degree in telecommunications.

Kim Mallalieu

Senior lecturer, The University of the West Indies; Coordinator, Caribbean ICT Research Programme (CIRP); Deputy Chair, Telecommunications Authority of Trinidad and Tobago (TATT)

In a range of vital capacities, Kim Mallalieu is helping to shape digital development strategies for her island nation and across the Caribbean. She has led national, regional and international initiatives to build capacity in ICT policy, regulation, development, application and use, catering to executives through the international Master's degree programme in Telecommunications Regulation and Policy, and to small-scale fisherfolk through mobile apps, digital literacy and radio training. She is a licensed amateur radio and short-range Global Maritime Distress and Safety System (GMDSS) operator and a member of Radio Emergency Associated Communications Teams (REACT). Her credentials include a Bachelor of Science and a PhD.

Norizan Baharin

Former Chief Officer of Spectrum and Numbering, Licensing and Economic Regulation, Malaysian Communications and Multimedia Commission (MCMC)

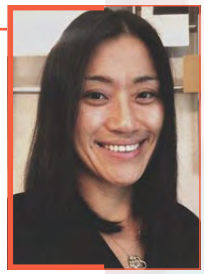
From 1999 until her retirement in January 2019, Norizan Baharin held various positions at Malaysia's national communications regulator, MCMC. She also led the country's satellite coordination team from 1993 until 2018. In 2014, she headed the ITU Standardization focus group on Aviation Applications of Cloud Computing for Flight Data Monitoring (FG AC) in response to discussions at the International Civil Aviation Organization (ICAO) on global aircraft flight tracking. FG AC, facilitated by ITU-experts on real-time monitoring of flight data, helped ICT experts and the industry identify key steps to standardize aviation applications.

Bolor-Erdene Battsengel

Chairwoman of Communications and Information Technology Authority (CITA), Mongolia

Responsible for Mongolia's digital policy development, Bolor-Erdene Battsengel has promoted transparent, prompt public services through the e-Mongolia governance programme, which digitized 516 key government services. Before becoming the youngest-ever chair at the national Communications and Information Technology Authority and making recent Forbes "Under 30", she implemented the "Nomads in the Digital Age" project with Gates Foundation-funded Pathways for Prosperity Commission, gained experience at the Asian Development Bank, the World Bank, the United Nations Food and Agriculture Organization, the European Bank for Reconstruction Development and various international development agencies. She holds a Bachelor's degree in International Relations, an MBA and a Master's in Public Policy.

Yoone Jeong



Senior Digital Technology Specialist (Digital Connectivity), Asian Development Bank (ADB)

A public policy and government affairs professional, Yoonee Jeong brings almost 20 years of experience in digital technology and development to her new position at ADB. She previously oversaw public and regulatory affairs across Asia at Telenor, a leading mobile operator in the region, and did consultancy work in Singapore for multiple private and public sector clients including the World Bank Group. Earlier, she worked at the Asian and Pacific Training Centre for ICT for Development (APCICT) a regional institute of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), as well as the Asia Pacific Women's Information Network Center (APWINC) focused on capacity building for policy-makers. She has a unique blend of experience in advisory, project management, research and stakeholder management and holds a Bachelor's degree in Interdisciplinary Studies and a Master's in International Development Policy.

Interview with Martha Suarez

President of the Dynamic Spectrum Alliance (DSA)

As head of the global, non-profit DSA, Martha Suarez advocates for laws and regulations to ensure more efficient and effective spectrum utilization. She previously led Colombia's National Spectrum Agency (ANE) and worked at Poland's Institute of Electron Technology (*Instytut Technologii Elektronowej – ITE*) through a fellowship with the European Partnership for Cognitive Radio (Par4CR) project. She is an electronics engineer, with a Master's degree in High Frequency Communication Systems and a PhD in Electronics, Optronics and Systems.

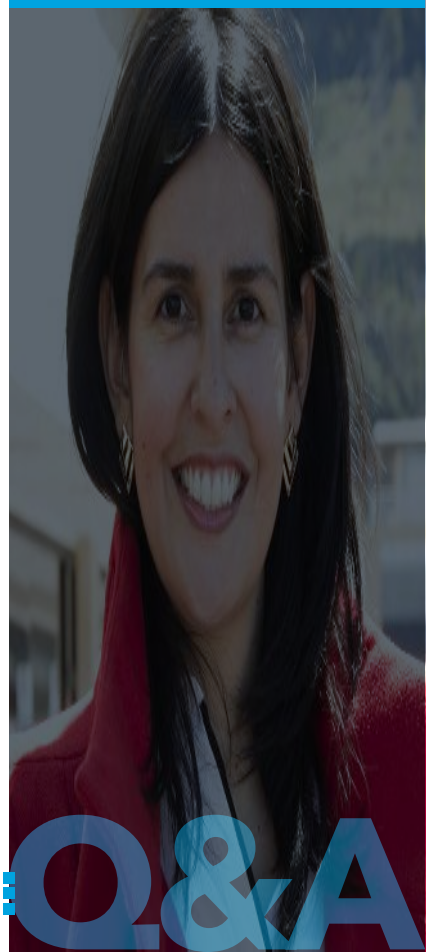
Why does spectrum matter and how is DSA helping to ensure efficient spectrum utilization?

Martha Suarez: Spectrum is a limited resource, but essential for wireless connectivity. The limited availability of suitable spectrum often presents an insurmountable barrier to entry for small telecom service providers and new entrants interested in offering affordable connectivity. Dynamic spectrum access tools and techniques enable more efficient use of limited spectrum resources by creating opportunities for different organizations to deploy more affordable and sustainable broadband networks, especially in communities that are without access or underserved.

The universal need for affordable online connectivity has never been more evident than during the past year. DSA aims to meet soaring broadband demand by enabling unlicensed access to the 6 gigahertz (GHz) band for wireless access systems and radio local area networks (WAS/RLANs). By adopting regulations for unlicensed access to this band, administrations such as Brazil, the Republic of Korea and Saudi Arabia are allowing efficient spectrum use, protecting current users of allocated services in the band and allowing support for applications like Wi-Fi.

Key focuses for DSA also include tiered spectrum-sharing models, like the Citizens Broadband Radio Service (CBRS) framework that was adopted in the US, or similar and simpler approaches in other countries. DSA also continues supporting dynamic access to spectrum in ultra-high frequency (UHF) bands and innovation in the mmWaves (high frequency, millimetre wavelengths) needed for high-speed Internet and 5G mobile services.

> *"The universal need for affordable online connectivity has never been more evident than during the past year."*
>
> Martha Suarez



How has your work changed with your move from leading a national spectrum regulatory agency to heading a global industry organization?

Martha Suarez: Even if the perspective and field of action have changed, my internal motivation to promote digital inclusion has remained the same. As a society, we need to work harder on this goal, and we need public-private collaboration to achieve sustainable results.

Before, as Director General of ANE in Colombia, I faced challenges in developing spectrum policies that extended beyond conventional approaches. For example, proposing long-term spectrum plans that focused not only on immediate economic gains, like spectrum auction proceeds, but also that considered broader and longer-lasting social and economic impacts. Spectrum policies must be formulated to attract long-term investment and facilitate the creation of local wireless ecosystems and infrastructure deployment.

Now, as President of DSA, I am constantly impressed by the technological expertise of our members. I can see how the industry has developed dynamic spectrum access tools and techniques that can make innovative spectrum-sharing frameworks a reality. I think that the industry could work closely with spectrum authorities to demonstrate state-of-the-art technologies and models that eventually, if adopted, could deliver inclusive economic growth and public benefit.

> *"Spectrum policies must be formulated to attract long-term investment and facilitate the creation of local wireless ecosystems and infrastructure deployment."*

What motivated you to enter the field of radiocommunications in the first place?

Martha Suarez: When I was studying to become an engineer, I was always attracted to telecoms and wireless networks. I still find the radiocommunication sector extremely interesting. It is constantly changing and, without a doubt, is transforming our society. But just as importantly, when studying for my Master's degree, I had female role models who inspired me. In fact, while conducting research in a male-dominated field, I was lucky to have two women as advisors for my PhD; one was an expert in signal treatment, and the other an expert in radio frequencies. They were both great mentors and an inspiration to me.

Being part of the radiocommunication environment, I understand the crucial necessity for us as women, first, to make sure that other women can also continue their careers and assume leadership roles, and second, to work on solutions for women's digital inclusion.

How easy was it, particularly as a woman, to get ahead in this area of work?

Martha Suarez: I studied for an undergraduate degree in electrical engineering, a Master's degree in High Frequency Communications Systems, and a PhD in Electronics, Optronics and Systems. I had the opportunity to study what I wanted, and I personally didn't experience any restrictions in that sense. However, my perception is that women continue to face a harder path to leadership roles, and in those cases, mentors – men or women – who can provide support and confidence are very valuable. I had the chance to work with many men and women who recognized my work and believed in me.

How might you inspire other young girls and women to follow in your footsteps?

Martha Suarez: Every action counts! Important tools are **coherence**, or preparing ourselves and demonstrating that it is possible; **visibility**, or promoting more women as role models and making them visible; and **sorority**, understood as women supporting other women. Along those lines, networks of women are very useful, because it is not only about a few women inspiring others, but about creating communities and long-term relationships. I will always recommend being part of networking groups for women in tech.

At the personal level, I am very excited to be part of a great project organized by the International Telecommunication Union (ITU) in the Americas Region and EQUALS, through the ITU Academy. The online course "Women's leadership in the telecommunications and ICT sector" (conducted in Spanish) has two components: a technical one that I deliver, and a leadership part provided by (Colombian women's empowerment speaker) Paola Rueda Lopez. The main objective of the course is to reduce the gender gap in the sector, providing the main concepts in a clear and simple way, with an overview of industry trends and emerging technologies.

I am really thrilled to see the results of this initiative, the high level of satisfaction from participants, and to be part of this effort aimed at creating new networks of female experts.

Inspiring women in broadcasting leadership

Meet some of the women in broadcasting leadership positions. ITU News took a snapshot of their inspiring career paths.

Cath Westcott

Senior Distribution Manager, BBC World Service

In her latest role at the British Broadcasting Corporation (BBC), Cath Westcott represents media operations reaching 468 million people worldwide each week. She chairs the Electromagnetic Interference and Compatibility (EIC) project group at the European Broadcasting Union (EBU) and has taken part in the UK delegations to four World Radio Communication conferences and two ITU Plenipotentiary Conferences. Representing the BBC at ITU meetings since 2006, she has also helped to organize successive International Girls in ICT Day celebrations. She holds a degree in English and later studied electronics. She first joined the BBC on an engineering training scheme in the 1980s and remains keen, as a founder-member of the BBC staff network for women in science and technology roles, to promote greater gender diversity in broadcasting.

Elena Puigrefagut

Senior Engineer, European Broadcasting Union (EBU)

Elena Puigrefagut conducts studies related to frequency planning and spectrum management, coordinates joint technical activities by EBU members and represents the organization on international committees. She is involved in discussions on the future of terrestrial broadcasting and preparations for the next World Radiocommunication Conference (WRC-23) and organized EBU's recent "Women in tech and engineering – realizing the potential" roundtable, which debated strategies to promote studies in the field among young girls, attractive career options, and ways to remove obstacles for female professionals. She previously worked for satellite operator Eutelsat, gaining experience in frequency planning and network engineering. She holds a Master's in Image Processing and an MSc in Telecommunication Engineering.

Ana Eliza Faria e Silva

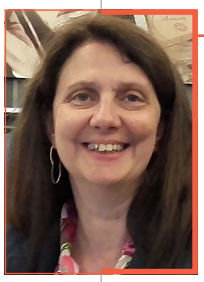
Senior Manager – Regulatory and Telecom, Globo, Brazil

In a career spanning more than 23 years, Ana Eliza has progressed from on-the-ground project engineering to overseeing wide-ranging regulatory issues and is currently senior regulatory manager at Latin America's largest media group, Globo, and is a board member of the Brazilian Forum for Digital Terrestrial Television. Amid her succession of roles, she held various management positions in the area of telecommunications. She has contributed to ITU activities for two decades and participated actively in World Radiocommunication Conferences since 2007. She co-chairs the Intersector Rapporteur Group on Integrated Broadcast-Broadband (IRG-BB). She holds a Master's degree in Video Compression, an MBA in Management and an MBA in Telecommunications.

Vittoria Mignone

Head, Fixed and Mobile Networks Department, Rai Centre for Research, Technological Innovation and Experimentation (CRITS), Italy

A fixture at Italian public broadcaster Rai since 1992, Vittoria Mignone first focused on advanced digital modulation and channel coding and now heads the team studying converged networks and systems. Active in European standardization bodies, she has helped to define digital video broadcasting (DVB) standards for satellite, cable, and terrestrial television channels. She chairs the DVB TM-S group, which develops technical specifications related to satellite broadcast, interactive services and professional links. She graduated from Turin Polytechnic in 1990 and is the author of patents and technical papers for leading international journals and conferences.



Lucia Luisa La Franceschina

Junior Executive, Rai Way, Italy

Since November 2019 Lucia Luisa La Franceschina has been Vice Chairman of the ITU Radiocommunication Advisory Group (RAG), whose work includes reviewing the priorities and strategies adopted in the ITU Radiocommunication Sector (ITU-R) and providing guidance to the Study Groups. She has worked at Rai Way for over 21 years, beginning her career as Technician in 2000, and working her way up to Junior Executive at Planning and Analysis of Networks and Services. A gender-equality advocate, Lucia Luisa is also Chair of the RAG Correspondence Group of Gender which is open to the ITU membership. In 1993 she graduated with a Master's Degree in Mathematics.

Philomena Gnanapragasam

Director, Asia-Pacific Institute for Broadcasting Development (AIBD)

As Director of the AIBD Secretariat, Philomena Gnanapragasam has set out to reinvigorate the institute's mandate as an intergovernmental body focused on media policies and pressing regional issues. AIBD – formed under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO) – has recently produced the *Health Communication Manual for Journalists* under her leadership. She sits on the board of several Malaysian universities as advisor for the media curriculum. A two-time recipient of Malaysia's prestigious Prime Minister's Award, she also holds 15 international awards for her work in radio and television, including the prestigious Golden Globe Award. She holds a double degree in Psychology and Political Science.

Building and nurturing women's digital leadership

By Doreen Bogdan-Martin, Director of the ITU Telecommunication Development Bureau

> *"ITU's roots as a highly technical agency have contributed to a marked gender imbalance."*
>
> Doreen Bogdan-Martin

Thinking back over my long career at the International Telecommunication Union (ITU), I remember arriving at my first-ever ITU Women's Breakfast at the 1993 Regional Telecommunication Development Conference for Asia and the Pacific in Singapore.

This popular initiative was pioneered by a dear friend and colleague, Walda Roseman, who has become a fixture at key ITU meetings in the over 25 years since then. Female delegates got to meet and network with other women in the information and communication technology (ICT) sector. It was especially valuable when we were much scarcer in number.

Today, after over a year without face-to-face meetings, those opportunities seem far away.

Yet this year's International Women's Day was all about women's leadership – the kind Walda showed. And leadership has been high on my own agenda, too, both in my previous role as head of Strategic Planning and Management, and now as Director of ITU's Telecommunication Development Bureau.

And because leadership has been identified as one of the connectivity enablers, it will take centre focus at the next Road2Addis event, Lead2Connect.

Building momentum

ITU's roots as a highly technical agency have contributed to a marked gender imbalance, both in our staff demographics and in the number of female delegates attending ITU events. That's changing – but we can and should take proactive steps to speed things along.

Noticing the chronic lack of women seeking leadership positions at ITU events (as chairs of committees, for example), we began organizing training sessions for female delegates as side-events to our conferences. Eventually, ITU partnered with the US Federal Communications Commission (FCC) to co-organize the WeLead mentoring programme for the 2015 World Radiocommunication Conference (WRC-15).

Network of Women (NoW)

Momentum grew, culminating in the first network of women (NoW) – for WRC-19 (NOW4WRC19), led by the ITU Radiocommunication Bureau. I want to build on the success of that initiative by bringing similar efforts to the ITU Development Sector.

That is why I launched NoW for the World Telecommunication Development Conference (NoW4WTDC) to encourage gender balance and women's leadership in the activities leading up to the WTDC.

A virtuous circle

Promoting women's leadership creates a virtuous circle, paving the way for more women and girls to embrace the exciting opportunities in the fast-growing technology space. As the actor, gender advocate and former ITU Envoy for Women and Girls, Geena Davis, said: "If she can see it, she can be it."

This year is the 10th anniversary of our Girls in ICT movement.

As has become increasingly clear over the last decade, female role models in science, technology, engineering and math (STEM) can inspire young girls and help women gain confidence in their own abilities and potential.

ITU co-founded the EQUALS Global Partnership with such empowerment in mind.

As part of the partnership, the EQUALS Leadership Coalition, led by the International Trade Centre and UN Women, is working to achieve gender equality in tech leadership by 2030. We are doing this by training and mentoring, facilitating better access to finance and funding, and identifying regulatory and policy barriers faced by women in ICTs.

Through Generation Equality and the work of the Action Coalition on Technology and Innovation led by ITU and other partners, I hope that more women and girls, in all their diversity, will receive equal opportunities to safely and meaningfully use, design and exercise leadership in technology and innovation.

The NoW platform enables women to share experiences, learn from one another, and gain the expertise and confidence to assume active leadership roles at key ITU events.

We launched a Network of Women in each ITU Region and I can already feel the excitement and passion women delegates are bringing to the process.

Building digital skills

In September 2020, ITU launched a project in partnership with the Enhanced Integrated Framework (EIF) and the United Nations Office for Project Services (UNOPS), to enhance the digital ecosystem and build digital skills for women entrepreneurs in least developed countries (LDCs), initially focusing on women in Burundi, Ethiopia and Haiti.

This year, recognizing the power of mentoring to bring about positive change, ITU launched the Women in Cybersecurity Mentorship programme. This new initiative encourages women to "dive in and thrive in" the fast-growing field of cybersecurity. It aims to give them knowledge, as well as courage, to take on challenging and exciting opportunities.

But mentorship must happen at all levels. The *Talking Tech: Girls and Women in ICT* interview series is an intergenerational interview project, in which girls and young women, aspiring for a career in the technology sector, get a chance to interview women in technology who are role models, leaders or further on in their careers.

Nurturing a community of leaders

Diversity and inclusivity will pay off with better decision making and better outcomes.

Let's make gender parity our benchmark – not just for ITU, but for a world where each and every person can fulfil their dreams and reach their potential.

Walda Roseman's efforts were instrumental in putting gender onto the digital industry's agenda. I look forward to being able to gather once again, when we can celebrate the power of community and the potential of ICTs to promote ever-greater global inclusiveness.

"Diversity and inclusivity will pay off with better decision making and better outcomes."

ITU is helping to close the gender digital divide by 2030 by leveraging and coordinating global initiatives such as Providing Opportunities for Women's Economic Rise (POWER), from the US Department of State's Bureau for Economic and Business Affairs, and EQUALS. This partnership will focus on implementing global projects and activities in advocacy, skills development, and economic empowerment, to maximize our effectiveness in building new opportunities for women at all stages of digital know-how.

About Doreen Bogdan-Martin

Doreen Bogdan-Martin was elected Director of the ITU Telecommunication Development Bureau in November 2018, taking office on 1 January 2019 — the first woman in ITU history to hold an elected management position.

She was an architect of the annual Global Symposium for Regulators, leads ITU's contribution to the EQUALS Global Partnership for Gender Equality in the Digital Age, has served for over 10 years as Executive Director of the ITU/UNESCO Broadband Commission for Sustainable Development and leads ITU's collaboration with UNICEF on the Giga project to connect all the world's schools.

She spearheads ITU's new Youth Strategy to more actively engage with the young people who are driving the next wave of digital transformation. She is an affiliate of the Harvard University Berkman Klein Center for Internet & Society, a Generation Unlimited Champion, a Champion of the EDISON Alliance and serves on a number of advisory bodies.

Be so good they can't ignore you: Women and girls in STEM

By Joanne Wilson, Deputy to the Director of the ITU Radiocommunication Bureau

> *"I am sharing these reflections in the hope that other girls and women across the world will consider careers in science, technology, engineering or math."*
>
> Joanne Wilson

Earlier this year, I was delighted to participate in Girl Up's Girl Talk, a virtual learning series featuring expert panels, youth-driven content, and community actions young change-makers can learn from while engaging with their peers across the globe. On 11 February, I had the privilege of addressing the 6th International Day of Women and Girls in Science Assembly, whose theme was "Equality in Science for Society".

Both events had me reflect on my 30+ year career in the technology industry, from earning an advanced degree in electrical engineering from Stanford University to leading standards development activities for a Silicon Valley technology pioneer, to supporting the Space Communications and Navigation (SCaN) Program at the United States National Aeronautics and Space Administration (NASA). I have also been a member of the Radio Regulations Board at the International Telecommunication Union (ITU).

Today, I am proud to have been appointed as Deputy to the Director of the ITU Radiocommunication Bureau, a position that had never been held by a woman engineer.

I am sharing these reflections in the hope that other girls and women across the world will consider careers in science, technology, engineering or math – the crucial collection of fields known as STEM – and to help them better understand how to do it.

Insights from a STEM career

Women often experience speaking up only to get ignored. A man might say the same thing, and suddenly it's a "brilliant idea". When that happens, know that the man who followed you heard your good idea, agreed with it, and wanted the idea captured. Don't let it get you down.

Move forward and do not let those things derail you.

I started my professional career at AT&T Bell Laboratories, a storied institution responsible for pioneering research and development in telecommunications. One time, while working at Bell Labs, I had to be late for an important meeting. Walking into the room I encountered a table full of men, all much older than me. I was the only African American, the only non-white, the only woman, and the youngest person in that room. When I sat at the table, they glanced at me and kept talking.

Then, an issue came up about a new project, and I happened to know the background. I asked for the floor and explained what was already done or being planned. Suddenly, the men whipped around and began to introduce themselves, one by one: now I had their attention. I was someone who knew what they needed to know.

And that project turned out to be one of the best I have ever worked on.

Joanne Wilson is the first woman engineer to have been appointed as Deputy to the Director of the ITU Radiocommunication Bureau.

Seize those opportunities

Decades ago, when I graduated from Stanford University with a Master's degree in electrical engineering, it was a different time. But several aspects remain very much the same: few women and people of colour in engineering, relatively speaking.

But I was blessed with having some very good role models when I was in school. One was my mother, who had worked at the US Census Bureau.

My mom was one of the many women who worked as editors of the Statistical Abstract of the United States, which has been published since 1878. Some guy would come in as their boss, and they would train him. Then he would go up the corporate ladder, so to speak, leaving them behind. Another guy would be hired again to be their boss, and the cycle would continue. Women did the hard work but were not given opportunities to advance.

"I was fortunate to never encounter the kind of teacher who suggested girls were worse at math than boys."

At the same time, I was fortunate to never encounter the kind of teacher who suggested girls were worse at math than boys. Math or science is not any more difficult or more challenging for a girl than a boy.

I also had the good fortune to attend a summer programme at the Massachusetts Institute of Technology (MIT) that aimed to make STEM fields more inclusive. If you're a high schooler in the US, check out the MIT Minority Introduction to Engineering and Science (MITES) programme, which aims to bring more kids from underrepresented communities into engineering and science.

Do your homework

Math and science are concrete. These are not subjective fields – you either know how to solve the problem or you don't. So dedicate yourself to being good: do your homework, go the extra mile, and do that bonus problem.

In the engineering world, it's all about competence. Knowing what you're talking about is the most important thing you can do as a scientist.

Explain what you know and what you don't know, be honest and then work to discover more. You must be credible. Once you pass that hurdle and know your stuff, people will line up to work with you.

Tackle problems together

You've got to work with others to solve big problems in science and technology. This is the reality for any STEM career. You will most likely be part of a collaborative effort.

During my undergraduate studies, my classmates and I would gather to work together on problem sets. In the evenings, groups would take over classrooms and work out how to tackle specific problems. Whoever knew how to solve a problem would work it out on the board and explain it to everyone else. Working through it together built confidence in each of us. Mutual support – with my friends – made the tough engineering curriculum much more endurable and fun.

I'd like to advise all young people going into STEM: form study groups, work things out together, and challenge each other in friendly competitions. It will prepare you well for your career later on.

Find your champion

In parallel, you should look out for allies and mentors. And for women in STEM, I should add: don't assume that your male colleagues and higher-ups or your professional contacts with different backgrounds than yours might not support you; they might actually turn out to be your best champions.

If not your direct supervisor, someone in your network might be ready to open a door for you.

I think everyone with a career has had someone else who stepped up and supported them, regardless of gender. Keep your focus on doing the best you can. Support will come.

Women in Tech Policy podcast

To explore the theme of ITU's 10th annual Girls in ICT Day: Connected Girls, Creating Brighter Futures, Joanne Wilson joined in a lively discussion with Access Partnership (an ITU Sector Member) about encouraging girls into STEM fields, as part of a Women in Tech Policy podcast series.

Listen to the conversation here.

Have fun with it

Doing something that really makes a difference is fun. Before joining ITU, I worked for ASRC Federal, a government contractor for NASA – where you have all kinds of people having a great time doing super cool science.

A good friend of mine, for example, is responsible for managing spectrum. Her job is to ensure all radio systems on the International Space Station can co-exist and don't interfere with each other. Today, she's responsible for spectrum management for all of NASA's activities on the Moon. Now that is a cool job!

When visiting the Jet Propulsion Lab in Pasadena (California, US), I saw more women doing amazing research, working on the Mars Rover and other activities. At every NASA Center, there are women doing cool science. Why let the guys have all the fun?

Equality and diversity in science

I am a firm believer in equality in science. It can be achieved if future generations of scientists and technologists – whether researchers, practitioners, policy-makers, or educators – reflect our diverse global community.

Our STEM workforce needs to be diverse, not only in terms of gender but also ethnicity and geographic and economic background.

Those who shape science and technology policy, who decide where research dollars flow, who perform research and develop new technologies, and who run companies that make critical infrastructure investments need to represent everyone. They must be from diverse backgrounds if all of society is to equally enjoy the benefits of science and technology.

If you like math and science and you want to do cool things with your career, then you should pursue an engineering degree. Find your speciality, whether in one of the various engineering disciplines or in the sciences or mathematics. There are so many interesting things to do and fascinating problems to solve.

The key to STEM is knowing your stuff.

Work hard and be competent. Then do more: be extraordinary. Put in the extra hours. And don't forget to have fun. In any of these fields, there are so many spectacular adventures waiting for you.

"Our STEM workforce needs to be diverse, not only in terms of gender but also ethnicity and geographic and economic background."

About Joanne Wilson

Joanne Wilson is Deputy to the Director of the ITU Radiocommunication Bureau and Chief of its Informatics, Administration and Publications Department.

She is an electrical engineer with more than 30 years of professional experience in telecommunications and radiocommunications, and a former member and Vice Chairman of the ITU Radio Regulations Board.

She holds Bachelor of Science and Master of Science degrees in electrical engineering from Southern University and Stanford University, respectively.

Nichelle Nichols as Uhura in the *Star Trek*: the original series episode "What Are Little Girls Made Of?" Season 1, Episode 7. Original air date, October 20, 1966. Image is a frame grab.

Why media matters: Images of women scientists and engineers

Despite global efforts to inspire and engage women and girls in science, women and girls in many countries remain excluded, held back by gender biases, social norms, and expectations, which influence the quality of female education as well as career options.

Gender inequalities not only exist in the real world, but also in film and television.

A study published by the Geena Davis Institute on female characters in popular films from around the world illustrates how gender stereotypes are reinforced by movie characterizations.

In movies screened in 11 countries, nearly 90 per cent of actors seen in science, technology, engineering, and mathematics (STEM) roles were male.

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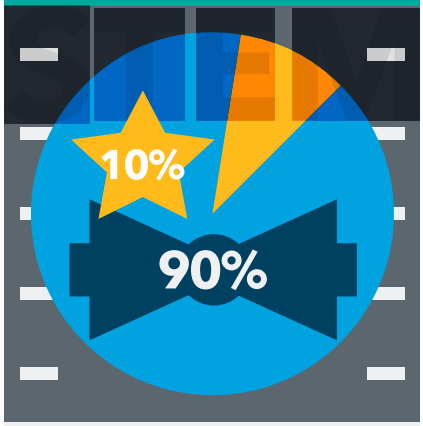

In 2012, Academy Award Winning Actor and advocate **Geena Davis** was appointed ITU's Special Envoy for Women and Girls in the field of technology, as part of a campaign highlighting the empowering role technology can play in the lives of women and girls. Davis was also recognized as a laureate at the 2012 World Telecommunication and Information Society Awards. More recently, Davis was honoured at the 2020 Governors Awards of the Academy of Motion Picture Arts and Sciences, where she received the Jean Hersholt Humanitarian Award for her work in promoting gender parity on screen.

"Media portrayals that emphasize cultural norms of femininity and traditional roles for women do little to encourage adolescent girls in engineering, science, and technology," notes communications scholar **Jocelyn Steinke**. She adds, "girls exposed to cultural representations that present engineering and science as masculine are likely to label these occupations as masculine, thus automatically excluding themselves from educational and professional opportunities."

"Media portrayals that emphasize cultural norms of femininity and traditional roles for women do little to encourage adolescent girls in engineering, science, and technology."

Jocelyn Steinke

Breaking STEM stereotypes

While female scientists may be relatively rare on the big screen or in our living rooms, several outstanding STEM performances helped break the stereotype.

One example is **Lieutenant Nyota Uhura**, played by Nichelle Nichols in the original *Star Trek* series, one of the first black women to be featured in a major US television series in a non-menial role. In the *Star Trek* universe, Uhura began as a communications chief aboard the USS Enterprise who specialized in linguistics, cryptography, and philology. In the show's fictitious year 2266, she moves to the operations division, where she proved to be a skilled technician and reliable bridge officer operating the helm, navigating the ship, and monitoring onboard scientific experiments.

In a 2019 interview, Nichols revealed that a chance meeting with Dr Martin Luther King Jr. convinced her to stay on the show because her character was the first TV image of a qualified, space-travelling woman of colour. After *Star Trek*, Nichols went on to play a key role in the efforts of the US National Aeronautics and Space Administration (NASA), to recruit both people of colour and the first female astronauts.

Role models

In *Contact* (1997), **Dr Eleanor "Ellie" Arroway** (Jodie Foster) is a Search for Extraterrestrial Intelligence (SETI) scientist who finds strong evidence of extraterrestrial life and is chosen to make the first contact.

The film features numerous real-life sites involved in space research and exploration, including the Very Large Array in New Mexico, the Arecibo Observatory in Puerto Rico, the Mir space station, and the Space Coast surrounding Cape Canaveral.

As a child, Ellie's father taught her to monitor shortwave radio frequencies. She later becomes a talented scientist who decodes a message that turns out to be the schematics of a mysterious machine to connect intelligent life across the galaxies. According to Washington Post culture columnist Alyssa Rosenberg, "Ellie herself is a character type that remains relatively rare: a brilliant scientist who is passionate, enthusiastic, occasionally girly. Contact is a movie that doesn't think female characters have to be only one thing."

In *Contagion* (2011), **Dr Erin Mears** (Kate Winslet) is a meticulous epidemic intelligence officer who works with the US Center for Disease Control – currently well-known as the CDC. Her tireless work to save the lives of those around her, along with deep knowledge and unwavering devotion to science make her a role model for women in STEM.

On-screen scientists

Gravity (2013) features **Dr Ryan Stone** (Sandra Bullock), a biomedical engineer who develops ground-breaking medical imaging technology approved for use in the Hubble Space Telescope. When disaster strikes on her first mission to space, she relies on her ingenuity to avoid a nearly lethal situation. Not only a leader and innovator in her field, but Dr Stone also adapts to every new challenge the mission throws at her.

In *Black Panther* (2018), **Shuri** (Letitia Wright) played an engineering mastermind. Her character has been lauded as an inspiration to young girls wanting to get into science and tech-related fields of study.

But women in space are not just science fiction.

The biographical drama *Hidden Figures* (2016) features the stories of real mathematicians who worked for NASA, making key contributions to US success in the Space Race.

Amid raging civil rights protests, all three were African American women. **Dorothy Vaughan** (Octavia Spencer) programmed early computers, **Mary Jackson** (Janelle Monáe) joined NASA as an engineer after a difficult battle to be allowed to study engineering, and **Katherine Johnson** (Taraji P Henson) calculated the trajectories of Apollo 11 and the Space Shuttle missions. They did so while dealing with racism and misogyny at every turn.

Contact
(1997)

Contagion
(2011)

Gravity
(2013)

Black Panther
(2018)

Hidden Figures
(2016)

Changing mindsets

Women's underrepresentation in STEM jobs remains one of the stumbling blocks to the attainment of gender equality everywhere, which is a key part of the United Nations 2030 Agenda for Sustainable Development.

Yet research confirms that media portrayals of women as science professionals can influence and inspire, as well as help to inform girls about future professional roles. Effecting change requires deliberate action. "The people who create and distribute media are part of the same culture, and prey to the same subconscious biases as the rest of us," observes a white paper from FEM Inc., *How media shapes perceptions of science and technology for girls and women*.

"Without conscious effort to change the environment, media is more likely to reinforce stereotypes surrounding STEM rather than break them."

Consequently, the white paper continues: "We need to inform content creators about the real effects of the underrepresentation of women in science. More importantly – we must demand to see more women in more diverse roles, both in STEM and other areas. If we direct our attention and our viewership to the existing TV shows, movies and online content that support and promote strong female characters and role models in STEM – then hopefully the supply will follow, to the benefit of us all."

"The media can shape people's perceptions on reality and construct and even change their mindsets on gender roles," observes **Arooba Javed** in a study entitled *The Media, the Women and STEM Fields*. "The way that women in STEM are portrayed in the media is important because it can either perpetuate stereotypes or help break them down."

> *"The media can shape people's perceptions on reality and construct and even change their mindsets on gender roles."*
>
> Arooba Javed

Further reading

- Adolescent Girls' STEM Identity Formation and Media Images of STEM Professionals: Considering the Influence of Contextual Cues – Read.
- Cultural Representations of Gender and Science: Portrayals of Female Scientists and Engineers in Popular Films – Read.
- What a scientist looks like: Portraying gender in the scientific media – Read.
- Media Depictions of Women in STEM Series – Read.
- Portrayals of Female Scientists in the Mass Media – Read.

List V – 2021

List of Ship Stations and Maritime Mobile Service Identity Assignments

List V enables mariners to identify ships in their vicinity. A ship's ID allows stations to contact or assist a ship in their navigation, or to pass on information.

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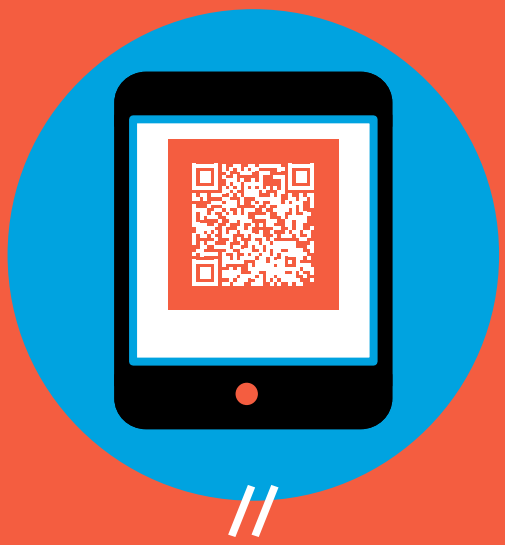

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