

About the 21st International Conference on Cyber Warfare and Security, 2026

The International Conference on Cyber Warfare and Security (ICCWS) is a prominent academic conference that has been held annually for 21 years, bringing together researchers, practitioners, and scholars from around the globe to discuss and advance the field of cyber warfare and security. The conference proceedings are published each year, contributing to the body of knowledge in this rapidly evolving domain.

The Proceedings of the 21st International Conference on Cyber Warfare and Security, 2026 includes Academic research papers, PhD research papers, Master's Research papers and work-in-progress papers which have been presented and discussed at the conference. The proceedings are of an academic level appropriate to a professional research audience including graduates, post-graduates, doctoral and post-doctoral researchers. All papers have been double-blind peer reviewed by members of the Review Committee.

Aims and Scope

The ICCWS serves as a crucial platform for the exchange of ideas and the dissemination of cutting-edge research in cyber warfare and security. By having a broad scope and covering a wide range of topics, the conference aims to facilitate interdisciplinary dialogue and collaboration, driving forward innovations and improvements in how nations, organizations, and individuals address cyber threats. The conference proceedings provide valuable insights and are frequently cited by academics, policymakers, and industry professionals, underscoring the conference's role in shaping the future of cyber warfare and security.

Topics Covered

The call for papers for the ICCWS 2026 conference asked for contributions that considered the following topics. In addition to this the committee welcomed papers on a number of specialist mini-tracks which can be seen at the end of this list.

Cyber Warfare Strategies and Tactics

- Examination of state-sponsored cyber operations.
- Analysis of cyber deterrence and defence mechanisms.
- Offensive and defensive cyber strategies used in modern conflicts.
- Case studies of significant cyber-attacks and their geopolitical implications.

Cyber Security Technologies and Techniques

- Development and deployment of advanced cybersecurity tools and technologies.
- Network security protocols and architecture, including intrusion detection and prevention systems.
- Cryptographic methods and their application in securing communications.
- Penetration testing or pentesting techniques
- What AI means for Cyber Security and Cyber Warfare now and in the future

Cyber Threat Intelligence

- Methods for gathering and analysing cyber threat intelligence.
- Role of artificial intelligence and machine learning in predicting cyber threats.
- Techniques for identifying and mitigating insider threats.
- Analysis of cyber threat actors, including nation-states, terrorist groups, and cybercriminal organizations.

Information Warfare and Psychological Operations

- Strategies for psychological operations in the cyber domain.
- Use of social media and other digital platforms for information warfare.
- Techniques for combating misinformation and disinformation.
- Impact of information warfare on public opinion and national security.

Legal and Ethical Issues in Cyber Warfare

- Legal frameworks governing cyber warfare and security.
- Ethical considerations in offensive and defensive cyber operations.
- Compliance with international laws and norms.
- Privacy issues and the balance between security and civil liberties.

Cyber Defence and Critical Infrastructure Protection

- Strategies for protecting critical infrastructure from cyber attacks.
- Resilience and recovery planning for cyber incidents.
- Sector-specific challenges in industries such as energy, finance, and healthcare.
- Collaboration between public and private sectors for enhanced cybersecurity.

Emerging Technologies and Future Trends

- Impact of emerging technologies like quantum computing on cybersecurity.
- Future trends in cyber warfare and security.
- Role of the Internet of Things (IoT) in expanding the cyber threat landscape.
- Predictions for the evolution of cyber conflict and defence mechanisms.
- The impact of AI on Security issues

Human Factors in Cyber Security

- Role of human behaviour and psychology in cybersecurity.
- Training and awareness programs for improving cybersecurity culture including Cybersecurity Education in both formal and informal settings
- Strategies for mitigating human error and insider threats.
- Social engineering tactics and countermeasures.
- Introducing AI into previously human driven systems.

In addition to the main call for papers the committee invited submissions on the following specialist Mini Tracks:

- **Cybersecurity at the Digital Frontlines: Strategy, Conflict, and Resilience**
Mini Track Chair: Dr. Zakariya Belkhamza, Ahmed Bin Mohammed Military College, Qatar
- **AI for Network Security**
Mini Track Chair: Christoph Lipps, German Research Center for Artificial Intelligence, Kaiserslautern, Germany
- **Cyber Resilience and Innovation Across the Maritime Ecosystem**
Mini Track Chair: Dr. Kasey Miller, UNC-Wilmington, USA
- **Interdisciplinary Research in Cybersecurity**
Mini Track Chair: Dr. Char Sample, Marshall University, USA

The programme from the 2026 conference can be downloaded from [here](#) and full details about the conference can be seen from the conference website <https://www.academic-conferences.org/conferences/icws/>

ICCWS Preface

These proceedings present the collective work of contributors to the *21st International Conference on Cyber Warfare and Security (ICCWS 2026)*, hosted by the University of North Carolina Wilmington (UNCW) in Wilmington, NC, USA, on 5–6 March 2026. The Conference Co-Chairs are Dr. Ulku Clark and Dr. Toni Pence, and the Program Chair is Dr. Bilge Karabacak, all from UNCW.

ICCWS is a long-standing and respected event on the academic research calendar. Now in its 21st year, the conference continues to offer a valuable platform for scholars, practitioners, and experts to exchange ideas and engage with peers who are shaping the evolving field of cyber warfare and security.

The breadth of topics represented in these proceedings reflects the diversity and growing importance of research in this domain. We are confident that the papers presented will contribute to stimulating discussions and an engaging two days of academic dialogue.

The opening keynote presentation is given by Jeff Crume, NC State University, USA and his talk is titled: *AI: The New Attack Surface*. The second day of the conference will open with an address by Joe Evangelisto, NetSPI, USA on the topic of *CTEM: Mastering Continuous Threat Exposure Management*.

With an initial submission of 178 abstracts, after the double blind, peer review process there are 72 Academic research papers, 4 PhD research papers, 3 Masters Research papers, 3 Non-Academic Paper and 3 work-in-progress papers published in these Conference Proceedings. These papers represent research from Austria, Brasil, Canada, Finland, France, Germany, Ghana, Italy, Latvia, Malaysia, Netherlands, Nigeria, Norway, Pakistan, Qatar, Saudi Arabia, South Africa, Turkey, UK and USA.

We hope you enjoy the conference.

Dr. Ulku Clark and Dr. Toni Pence
Wilmington, USA
March 2026

Biographies of Chairs and Keynote Speakers

Conference and Programme Chairs



Dr. Ulku Clark is a Professor of Cybersecurity and Information Systems at the University of North Carolina Wilmington (UNCW) and the Director of the Center for Cyber Defense Education (CCDE). She is also the principal investigator of a maritime cybersecurity research group. With extensive experience in cybersecurity education, research, and industry collaboration, Dr. Clark plays a critical role in shaping the next generation of cybersecurity professionals. She has organized numerous cybersecurity conferences, workshops, and research initiatives, emphasizing the importance of cyber resilience, analytics, and defense strategies. As a co-chair of ICCWS 2026, Dr. Clark is dedicated to fostering global discussions on emerging cybersecurity threats and innovations.



Dr. Toni Pence is the Department Chair of Computer Science and an Associate Professor at the University of North Carolina Wilmington and has been on faculty since 2015. She earned her M.S. and Ph.D. from Clemson University and her B.S. from Winthrop University. Her research focuses on human computer interaction, user interface design, usability design and experimentation, virtual and augmented reality, and simulation training. With over a decade of experience in academia, she has built a strong reputation in the field of extended reality in education. Her work has received funding from the National Science Foundation. In 2016, she was a recipient of UNCW's Discere Aude Award for outstanding mentorship of undergraduate students and has continued to make a positive impact in the lives of those around her.



Dr. Bilge Karabacak is an assistant professor at the Cameron School of Business at the University of North Carolina Wilmington, with over 25 years of experience in cybersecurity across academia, industry, and government. He holds an M.S. in Computer Science and a Ph.D. in Information Systems with a specialization in cybersecurity. Before transitioning to academia in 2020, Dr. Karabacak co-founded a cybersecurity startup in Silicon Valley, managed cloud-based security products, and worked as an information security analyst at a multinational bank. He later chaired the Master's in Cybersecurity program at Franklin University before joining UNCW. His research focuses on information security risk analysis, cybersecurity maturity assessment, and maritime cybersecurity.

Keynote Speakers



Rob Main is a veteran IT professional with over 35 years of leadership experience, who joined the US Department of Homeland Security's Cybersecurity & Infrastructure Security Agency (CISA) in June 2023 and presently serves as CISA Region 4's Cybersecurity State Coordinator for North Carolina. In that role, he offers cybersecurity assistance to critical infrastructure owners and operators and state, local, tribal, and territorial (SLTT) governments in North Carolina. Prior to his current role, Rob held several positions within North Carolina state government since 1998, including State Chief Risk Officer for the State of North Carolina and Chief Information Officer (CIO) for three Executive Branch Agencies. Additionally, Rob is an U.S. Air Force veteran, having served a combined 25 years on active duty and with the North Carolina Air National Guard. He retired from military service in 2015 as a Major in the Air Logistics specialty. Rob earned his associate's degree in Computer Science from the Community College of the Air Force in 1996, his bachelor's degree in Computer Science/Business Administration from Troy State University in 1998, his Master of Business Administration degree from East Carolina University in 2008, his Certified Government Chief Information Officer certification from the University of North Carolina at Chapel Hill in 2015, and his Certified Information Security Manager certification from ISACA in 2025.



Jeff Crume is an IBM Distinguished Engineer and Master Inventor with more than 40 years' experience in the IT industry. He has a PhD in Cybersecurity and serves as an Adjunct Professor at NC State University. Jeff's YouTube videos have been viewed more than 20 million times and he is the author of a book entitled "Inside Internet Security: What Hackers Don't Want You To Know" as well as a contributing author to the "Information Security Management Handbook." He is a member of the inaugural class of the NC State University Computer Science Alumni Hall of Fame and serves on the editorial board for the "Information and Computer Security" research journal. Jeff lived in Beijing on assignment in 2006 and has worked with clients in 50 countries.

Mini Track Chairs



Dr. Zakariya Belkhamza is a faculty member at Ahmed Bin Mohammed Military College in Doha, Qatar. His research interests include information systems and strategic management with a focus on cybersecurity, digital governance, and policy innovation. He holds a PhD in Management Information Systems and has extensive experience in academic research, curriculum development, and statistical modelling. His work explores the intersection of emerging technologies, digital transformation, and cognitive strategy. Dr. Belkhamza has contributed to leadership education and digital transformation initiatives, and has presented at international conferences on cyberwarfare, development policy, and digital society, and published several books and peer-reviewed journal articles.



Christoph Lipps, graduated in Electrical and Computer Engineering at the University of Kaiserslautern, where he meanwhile lectures as well. He is a Senior Researcher at the German Research Center for Artificial Intelligence (DFKI) in Kaiserslautern, Germany, heading the Cyber Resilience & Security Team of the Intelligent Networks Research Department. His research focuses on Physical Layer Security (PhySec), Physically Unclonable Functions (PUFs), Artificial Intelligence (AI) Methods, Security and Trust in the Sixth Generation (6G) Wireless Systems and all aspects of network and cyber security. He is the author of numerous scientific publications, member of the IEEE, ACM and VDE, as well as of the scientific advisory boards and technical program committees of multiple international conferences and journals.



Prof. Topside E. Mathonsi is an Associate Professor and Head of the Department of IT at Tshwane University of Technology (TUT), South Africa. Holding a Doctor of Computing, his research spans cybersecurity, wireless communication systems, 5G, IoT, and smart agriculture. He has authored over 100 peer-reviewed publications and is deeply involved in academic leadership, mentoring numerous master's and doctoral students. Prof. Mathonsi also serves as an examiner for various universities. His significant contributions have earned him several accolades, including TUT's Institutional Award for Research in Training (Male), Younger Researcher of the Year, and the Huawei Future Star Award. A member of IEEE and IACSIT, he continues to advance ICT in South Africa.



Dr. Kasey Miller is an assistant professor at UNCW's Congdon School and a retired Marine Major with expertise in cybersecurity and information systems. He holds a Ph.D. in Information Sciences from the Naval Postgraduate School and certifications including CISSP, PMP, CKM, and CQRM. Dr. Miller previously served at the U.S. Naval Academy and led cybersecurity programs for the Marine Corps, Navy, and CSIAC. His civilian roles included HIPAA compliance and automation for the II MEF, as well as program leadership at NAVAIR. A published author and speaker, he brings deep technical, academic, and operational experience to the cybersecurity field.



Dr. Char Sample is an assistant professor of cybersecurity at Marshall University. Dr. Sample has 40 years of industry experience beginning in software development, through product test and integration, and finally as a researcher (both applied and academic). Dr. Sample's research areas are all cybersecurity related with an interest toward decision-making in cybersecurity.

Pre-Conference Workshops



Dr Armistead, CISSP is the President of Peregrine Technical Solutions, a small business that focuses on Maritime Cybersecurity as well as Facility Related Control Systems. He leads a number of different contracts where his team locks down these Operational Technology requirements, plus Peregrine has developed a number of playbooks to exercise cyber security incidents at sea.

ICCWS Reviewer Committee

ICCWS is fortunate to have a significant number of international experts in the field willing to review papers. Care is taken to ensure that a fully double-blind peer review process is followed and reviewers are not selected if they have any research or organisational connection to the author/s.

Dr Bulent Acma, Anadolu University, Eskisehir, Turkey; Dr William ("Joe") Adams, Univ of Michigan/Merit Network, USA; Brandon Adcock, Coalition, Inc., USA; Dr Maamoun Ahmed, Military Technological College, Oman; Ayokunle Akinsanya, Bowie State University, USA; Prof Hamid AL-Asadi, University of Basrah , Iraq; Dr Elie Alhajjar, USMA, USA; Prof Todd Andel, University of South Alabama, USA; Prof Antonios Andreatos, Hellenic Air Force Academy, Greece; Leigh Armistead, Oak Ridge National Laboratory, USA; Danielle Badenhorst, CSIR, South Africa; Prof Richard Baskerville, Georgia State University, USA; Dr Zakariya Belkhamza, Ahmed Bin Mohammed Military College, Qatar; Dr Kyle Bester, University of South Africa, South Africa; Dr Ujas Bhadani, Northeastern University, USA; Dr Mustafa Canan, Naval Postgraduate School, USA; Dr Jim Chen, U.S. National Defense University, USA; Dr Sabarathinam Chockalingam, Institute for Energy Technology, Norway; Dr Nathan Clarke, University of Plymouth, UK; Dr Henry Collier, Thomas Edison State University, USA; Edwin Covert, Bowhead Speciality Underwriters, USA; Dr Paul Crocker, University of Beira Interior, Portugal; Prof Rabelani Dagada, University of South Africa, South Africa; Dr Rishabh Das, Ohio University, USA; Dr Amir Djenna, University of Constantine, Algeria; Dr Geoffrey Dobson, , USA; Prof Eric Filiol, ENSIBS, Vannes, France & CNAM, Paris, France; Dr Jonathan Fuller, United States Military Academy, USA; Dr Ahmad Ghafarian, University of North Georgia, USA; Prof Dr Tim Grant, Retired But Active Researcher, The Netherlands; Dr John Gray, Nova Southeastern University, USA; Virginia Greiman, Boston University, USA; Dr Michael Grimaila, Air Force Institute of Technology, USA; Dr George Grispos, University of Nebraska at Omaha, USA; Mr Raymond André Hagen, IIK @NTNU.no, Norway; Prof Bill Hutchinson, Edith Cowan University, Australia; Ramkumar Jaganathan, VLB Janakiammal College of Arts and Science (affiliated to Bharathiar University), India; Dr Awan Jawad Hussain, Iqra University, Karachi, Pakistan, Pakistan; Dr Richard Jones, University of Edinburgh, UK; Dr Saltuk Karahan, Old Dominion University, USA; Prof Jesuk Ko, Universidad Mayor de San Andres, Bolivia; Dr Robert Koch, University of the Federal Armed Forces, Germany; Dr Ahmet Koltuksuz, Yasar University, Turkey; Prof Thamizhmaran Krishnamoorthy, Government College of Engineering, Bodinayakkanur, Tamilnadu, India; Mr Mahendra Krishnapatnam, Sri Krishnadevaraya University, India; Dr Goksel Kucukkaya, University of Cincinnati, USA; Dr sanjeev kumar, Career Point University Hamirpur HP India , India; Prof Shreyas Kumar, Texas A&M University , USA; Peter Kunz, Hexagon Geosystems, Germany; Dr Gregory Laidlaw, University of Detroit Mercy, USA; Dr Sylvain (Sly) Leblanc, Royal Military College of Canada, Canada; Louise Leenen, CSIR, Pretoria, South Africa; Prof Martti Lehto, University of Jyväskylä, Finland; Dr Antoine Lemay, CYDEF, Canada; Chelsea Levesque, SENEDIA, USA; Dr Andrew Liaropoulos, University of Piraeus, Greece; Christoph Lipps, German Research Center for Artificial Intelligence, Germany; Volodymyr Lysenko, University of Washington, USA; Dr Clara Maathuis, Open University, Netherlands; Dr Bill Mahoney, University of Nebraska, Omaha, USA; Arun Mamgai, Red Hat Inc, USA; Dr Alexander Master, Army Cyber Institute, USA; Assc Topside Mathonsi, Tshwane University of Technology, South Africa; Dr Stephanos Mavromoustakos, Indiana Institute of Technology, USA; Dr Paul Maxwell, Army Cyber Institute, USA; Dr Andre McDonald, Council for Scientific and Industrial Research, South Africa; Dr Terry Merz, Government Women Engineering college Ajmer , USA; Dr Kasey Miller, University of North Carolina Wilmington, United States; Akhil Mittal, Synopsys, USA; Mrs Nthabiseng modiba, Sol Plaatje University, South Africa; Dr Michael Moeti, Tshwane University of Technology , South Africa; Assc Noluntu Mpekoa, University of Johannesburg, South Africa; Prof Antonio Muñoz, University of Málaga, Spain; Director of Engineering Rahul Nagraj, Purdue University, USA; Ikuomor Ogiriki, Rowan University, USA; Kelly Onu, Ernst & Young, United States; Prof Tim Pappa, Capitol Technology University, USA; Wadduwage Shanika Perera, Sam Houston State University, Texas, United States; Andy Pettigrew, George Washington University, USA; Dr Jackie Phahlamohlaka, Council for Scientific and Industrial Research, Petoria, South Africa; Heloise Pieterse, CSIR, South Africa; Dr Ajeet Singh Poonia, Bikaner Technical University, India; Assc Chaitanya Rahalkar, Georgia Institute of

Technology, USA; Dr Jyri Rajamäki, Laurea University of Applied Sciences, Finland; Dr Trishana Ramluckan, University of KwaZulu-Nata, South Africa; Dr Mark Reith, Air Force Institute of Technology, USA; Assistant Professor GOLLA BALA RENUKA, MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, india; Dr Neil Rowe, US Naval Postgraduate School, Monterey, USA; Prof Lili Saghafi, Canadian International College, Montreal, Canada; Dr Char Sample, US Army Research Laboratory, USA; Mr. Gustavo Sanchez, Karlsruhe Institute of Technology (KIT), Germany; Ramanamurthy Saripalli, Pragati Engineering College, India; Dr Yilun Shang, Singapore University of Technology and Design, Singapore; Dr Pankaj Kumar Sharma, Government Women Engineering college Ajmer , India; Dr Dan Shoemaker, Centre for Assurance Studies, USA; Mr Avinash Singh, University of Pretoria, South Africa; Nakul Singh, Righ Inc., USA; Dr Siphesihle Sithungu, University of Johannesburg, South Africa; Prof Jill Slay, University of South Australia, Australia; Dr William Spring, University of Hertfordshire, UK; Baror Stacey, University of Pretoria, South Africa; Ms Sneha Sudhakaran, Louisiana State University, USA; Dr Sneha Sudhakaran , Florida Institute of Technology , USA; Unal Tatar, University at Albany - SUNY, USA; Dr Manonmani Thayanithi, Mepco Schlenk Engineering College , India; Dr Le Thi-Thu-Huong, Pusan National University, Korea; Dr Antonio Jorge Tomeu-Hardasmal, University of Cadiz, Spain; Dr Eric Trias, Air Force Institute of Technology, USA; Dr Nuray Turan, Karamanoglu Mehmetbey Üniversity, Türkiye; Dr Namosha Veerasamy, Council for Scientific and Industrial Research, South Africa; Prof Murdoch Watney, University of Johannesburg, South Africa; Richard Wilson, Towson University, USA; Enes Yurtoglu, Turkish Air War College, Turkey; Dr Zehai Zhou, University of Houston-Downtown, USA.