



University of Stuttgart
Germany



2021

ICSA

IEEE International Conference
on Software Architecture 2021



International Conference on Software Architecture

22. – 26.03.2021, Stuttgart (held virtually)

PREMIUM SPONSORS



Content

22. – 26.3.2021

Stuttgart

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Foreword

The IEEE International Conference on Software Architecture is the premier gathering of practitioners and researchers interested in software architecture, component-based software engineering, and quality aspects of complex software systems. ICSA continues the tradition of a working conference, where researchers meet practitioners and where software architects can explain the problems they face in their day-to-day work and try to influence the future of the field. Interactive working sessions are the place where researchers meet practitioners to identify opportunities to create the future. The 18th IEEE International Conference on Software Architecture (ICSA 2021) continues this long history of establishing and supporting the software architecture research and practice community. This conference looks at what can be learned from our software architecture history, experience, studies, and best practices.

The year 2020 has been a very difficult year for all, including the software architecture community. The COVID-19 situation challenges systems and their software architectures in different ways: the way we are collaboratively creating software architectures without the typical in-person activities such as workshops, brainstorming sessions, reviews; the challenges facing our systems in terms of new usage patterns and business opportunities; and the impact they are having on our social and economic well being. This is why we have selected the theme “Software Architecture in the COVID-19 Reality” for ICSA 2021.

ICSA 2021 is run as a fully-virtual conference, which creates many organizational challenges, but also provides an opportunity for people from all over the world to more easily attend. Given that people did not have to travel, we have also done our small part in decreasing the carbon footprint of our conference. However, we will miss the face-to-face interaction with colleagues and the impromptu discussions that have always characterized this conference. Whether future ICSA versions will be hybrid so that we can get “the best of both worlds” is something that we will need to consider, while at the same recognizing the many challenges of running a conference in hybrid mode.

ICSA 2021 was planned to be held in Stuttgart, Germany. It is one of the

vibrant German regions shaped by large industries, such as automotive and insurance. Its picturesque landscape is surrounded by small hills, but also has significant environmental challenges to be addressed in the near future. During the virtual conference we will try to connect to the planned venue via a virtual city tour, participation of local research and industry partners, and virtual social events.

The General Chair and Technical Track Chairs would like to thank all members of the ICSA 2021 organizing committee, who made the event possible, and quickly adapted to a very challenging virtual version of the conference. We would also like to give special thanks to the Technical Track program committee members whom dedicated a large amount of time not only to reviewing their assigned papers, but also actively participating in the discussions. Their very thorough feedback was very valuable to all authors, whether the paper was accepted or rejected. We would also like to thank all our sponsors and supporters as they made the conference easy to organize, in particular our conference hosts, the IEEE Computer Society and infos e.V. Thank you!

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Keynotes

Workshop



Jay Gambetta

IBM Fellow,
VP of Quantum Computing

Quantum circuits, and the future
of quantum computing in the cloud

Beyond Architecture



Birgit Penzenstadler
Chalmers University

The not-so-subtle art of taking a deep
breath: Live-wiring yourself for better
output and experience

Academic



Nenad Medvidovic
University of Southern California, USA

Human Archipelagos Have Been Induced
by COVID, but Architectural Archipelagos
Are All Our Own Doing

Industry



Vijayananda (Vijay)
Philips, India

Transforming care @ scale and speed
with Philips Architecture in COVID-19
times

The abstracts and further info can be found here:

<https://icsa-conferences.org/2021/attending/keynotes/>



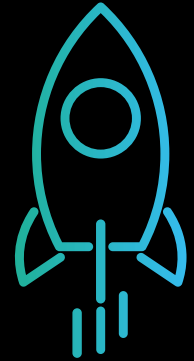
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Workshops

QSA – 1st Workshop on Quantum Software Architecture

Organizers:

Johanna Barzen, University of Stuttgart, Germany
Sebastian Feld, Delft University of Technology, The Netherlands
Frank Leymann, University of Stuttgart, Germany
Karoline Wild, University of Stuttgart, Germany

Mo. 22. March 2021, 08:50 – 15:00

Quantum computing is becoming real: Several vendors offer quantum computers in the cloud or on premise, companies invest to become familiar with this technology and its potentials, several software companies build corresponding tools, and consulting companies offer services to build solutions. Many applications will benefit from quantum technologies because a lot of intractable problems (in the sense of complexity classes) may realize up to exponential speedups on quantum computers.

However, software to be run on a quantum computer is quite different from software for classical computers. Thus, the current state of the art is that solutions are hand-crafted in an ad-hoc manner and a solid foundation for building and integrating quantum software is missing.

The goal of the QSA workshop is to bring together researchers and practitioners from different areas of quantum computing and (classical) software architecture to strengthen the quantum software community and discuss architectural styles and best practices of quantum software as well as other aspects of the quantum software development lifecycle.

The workshop offers a platform for the presentation of novel scientific ideas as well as practical experiences and enables the exchange with experts from different areas of quantum computing.

<https://icsa-conferences.org/2021/workshops/qa/> 

Workshops

WASA – 7th International Workshop on Automotive System/Software Architectures

Organizers:

Stefan Kugele, Technische Hochschule Ingolstadt, Germany
Darko Durisic, Volvo Car Corporation, Sweden
Yanja Dajsuren, Eindhoven University of Technology, The Netherlands
Mirosław Staron, Chalmers | University of Gothenburg, Sweden

Mo. 22. March 2021, 14:00 – 17:30

With the advent of software and electronics, automotive companies are enabling innovation to improve safety, security, driver experience, and driving automation. Moreover, the complexity and size of software keep growing because of future innovations, such as lane-keeping, self-learning algorithms, and automated driving, which all lead to the ultimate goal of autonomous driving. Consequently, increasing use of software over the years introduced the paradigm shift by requiring automotive companies to develop their systems using architecture and model-based techniques. Although model-based techniques using e.g. MATLAB/Simulink and Stateflow are being accepted in the automotive industry as standard languages and tooling for developing automotive control software, the techniques for system and software architecture are still far from being widely accepted. This is excluding the AUTOSAR standard (Classic and Adaptive), which defines the language for designing and configuring automotive software architectures and identifies major architectural components of automotive systems.

The goal of this workshop is to address issues related to the appropriate automotive system/software architecture and engineering techniques, which can be accepted by the automotive industry. Therefore, to bring together researchers and practitioners in the area of automotive system/software architecture and engineering, the International Workshop on Automotive System/Software Architectures (WASA) is being organized with the International Conference on Software Architecture (ICSA 2021), the premier international software architecture conference.

<https://icsa-conferences.org/2021/workshops/wasa/> 

Workshops

BlockArch – Second International Workshop on Blockchain-Based Architecture

Organizers:

Mohamad Kassab, Penn State University, Malvern, United States

Valdemar Vicente Graciano Neto, Federal University of Goiás, Goiânia, Brazil

Mo. 22. March 2021, 13:00 – 19:00

Blockchain is an emerging technology that comprises a set of nodes without a pre-existing trust relationship and connected through a peer-to-peer topology. The five essential characteristics of blockchain tech-

nologies; namely, decentralization, consensus, immutability, provenance, and finality, enable new forms of distributed software architectures, where agreement on shared states can be established without trusting a central integration point. A major difficulty for architects designing applications based on blockchain is that technology has many configurations and variants. Since blockchains are at an early stage, there is little scientific evidence, product data or reliable technology evaluation available to compare different blockchain-based architectural designs.

The goal of this workshop is to shed the light on

<http://www2.inf.ufg.br/~insight/blockarch2021/index.html>



architectural issues, concerns, and solutions that emerge with the blockchains technologies.

Sponsor Talks

Thomas Eisenbarth

Axivion

Architecture Verification

Slot: Tue Mar 23, 17:00-17:20 UTC

Matthias Eschhold & Steve Walter

Novatec

Package structure of software systems

Slot: Wed Mar 24, 17:50-18:10 UTC

Ivan Greguric Ortolan

Mimacom

Event Driven Architecture on Apache Kafka

Slot: Wed Mar 24, 09:45-10:05 UTC



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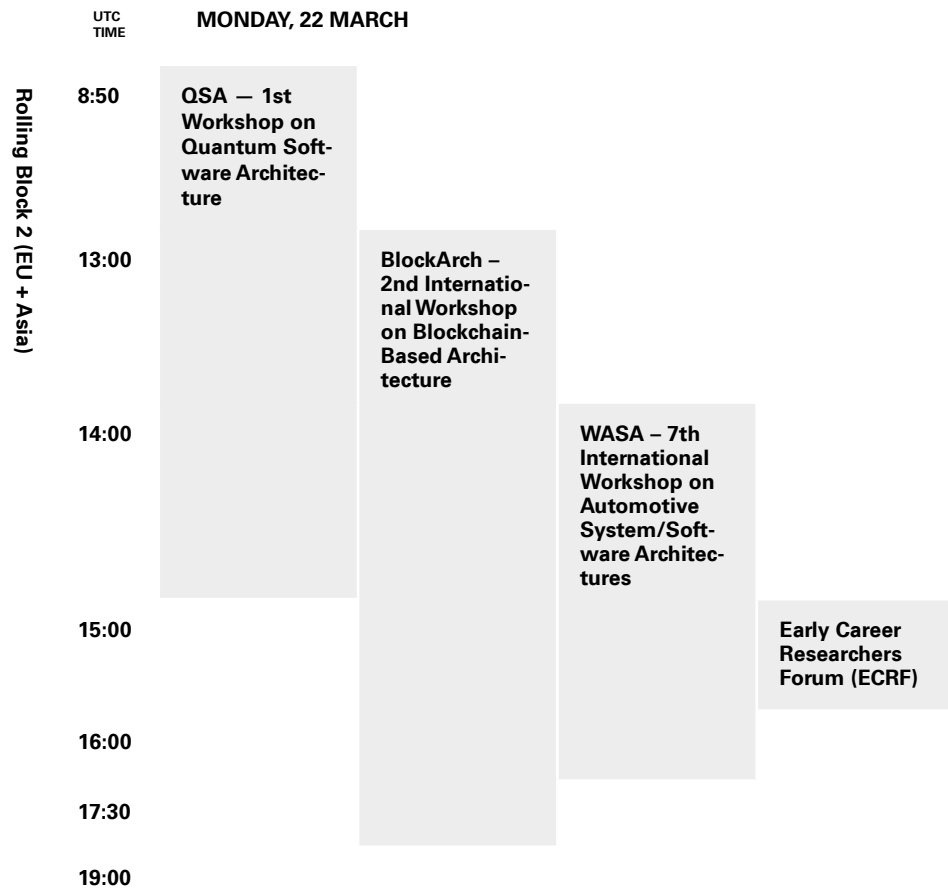
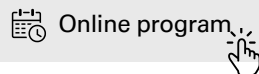
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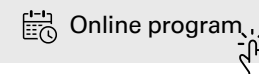
Program overview



- Open Research Object (ORO)
- Research Object Reviewed (ROR)
- Candidate for Best Paper Award

Note: All mentioned times / days are UTC (24h)

Program overview



UTC TIME	TUESDAY, 23 MARCH
0:00	Opening
0:20	Session 1: Quality Attributes and Emerging Technologies Quantum Computing Platforms: Assessing Impact on Quality Attributes and SDLC Activities Architectural Decay as Predictor of Issue- and Change-Proneness A Decision Model for Choosing Patterns in Blockchain-Based Applications
1:05	Break
1:15	Session 2: Infrastructure and Platforms Long Live The Image: Container-Native Data Persistence in Production Designing a Security Platform for Collaborating Autonomous Systems - An Experience Report Constructing a Shared Infrastructure for Software Architecture Analysis and Maintenance
2:00	Break
2:10	Keynote 1: Transforming care @ scale and speed with Philips Architecture in COVID-19 times Vijayananda (Philips, India)

TUESDAY







- Open Research Object (ORO)
- Research Object Reviewed (ROR)
- Candidate for Best Paper Award

Note: All mentioned times / days are UTC (24h)

UTC
TIME

TUESDAY, 23 MARCH

Rolling Block 2 (EU + Asia)

8:00	Opening	
8:20	Keynote 1: Transforming care @ scale and speed with Philips Architecture in COVID-19 times Vijayananda (Philips, India)	
9:10	Break	
9:20	Session 3: Architectures for Emerging Technologies Quantum Computing Platforms: Assessing Impact on Quality Attributes and SDLC Activities Towards Resilient IoT Messaging: An Experience Report Analyzing MQTT Brokers  A Decision Model for Choosing Patterns in Blockchain-Based Applications	Session 5: Microservices A Process Model for Microservices Design and Identification Microservices for Continuous Deployment, Monitoring and Validation in Cyber-Physical Systems: an Industrial Case Study for Elevators Systems Semi-automatic Feedback for Improving Architecture Conformance to Microservice Patterns and Practices
10:05	Break	
10:15	Session 4: Security and Privacy φcomp: An Architecture for Monitoring and Enforcing Security Compliance in Sensitive Health Data Environment Designing a Security Platform for Collaborating Autonomous Systems – An Experience Report Modeling Data Flow Constraints for Design-Time Confidentiality Analyses	Session 6: Microservices and Performance Practitioner Views on the Interrelation of Microservice APIs and Domain-Driven Design: A Grey Literature Study Based on Grounded Theory    Monolith Modularization Towards Microservices: Refactoring and Performance Trade-offs Model-based Performance Analysis for Architecting Cyber-Physical Dynamic Spaces  



Open Research Object (ORO)



Research Object Reviewed (ROR)



Candidate for Best Paper Award






Note: All mentioned times / days are UTC (24h)

UTC
TIME

TUESDAY, 23 MARCH

Rolling Block 1 (Americas + EU)

17:00	Sponsor Talk: Architecture Verification – Thomas Eisenbarth (Axivion)	
17:20	Session 7: Quality Attributes Architectural Decay as Predictor of Issue- and Change-Proneness Towards Resilient IoT Messaging: An Experience Report Analyzing MQTT Brokers  Model-based Performance Analysis for Architecting Cyber-Physical Dynamic Spaces  	Session 9: Microservices 2 A Process Model for Microservices Design and Identification Monolith Modularization Towards Microservices: Refactoring and Performance Trade-offs Semi-automatic Feedback for Improving Architecture Conformance to Microservice Patterns and Practices
18:05	Break	
18:15	Session 8: Security and Maintainability φcomp: An Architecture for Monitoring and Enforcing Security Compliance in Sensitive Health Data Environment Constructing a Shared Infrastructure for Software Architecture Analysis and Maintenance Modeling Data Flow Constraints for Design-Time Confidentiality Analyses	Session 10: Microservices 3 Practitioner Views on the Interrelation of Microservice APIs and Domain-Driven Design: A Grey Literature Study Based on Grounded Theory    Monolith Modularization Towards Microservices: Refactoring and Performance Trade-offs Model-based Performance Analysis for Architecting Cyber-Physical Dynamic Spaces
19:00	Break	
19:10	Working Session: Architecture Technical Debt - Part 1	Working Session: Software Architecture Problems in the Next 5-10 Years - Part 1



Open Research Object (ORO)



Research Object Reviewed (ROR)

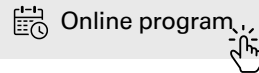


Candidate for Best Paper Award



Note: All mentioned times / days are UTC (24h)

Program overview



WEDNESDAY

UTC TIME	WEDNESDAY, 24 MARCH	
Rolling Block 3 (Asia + Americas)	0:00	Keynote 2: Human Archipelagos Have Been Induced by COVID, but Architectural Archipelagos Are All Our Own Doing Nenad Medvidovic (University of Southern California)
	0:50	Session 11: Assessment and Design Techniques 1 Facilitating Connector Evolution With Architecture-Centric Development PPTAM: What, Where and How of Scalability Assessment ArCode: Facilitating the Use of Application Frameworks to Implement Tactic and Patterns
	1:35	Break
	1:45	Working Session: Software Architecture for Machine Learning Systems - Part 1
		Working Session: Software Architecture Design Reasoning and Thinking - Part 1

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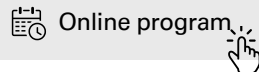
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WEDNESDAY




UTC TIME	WEDNESDAY, 24 MARCH	
Rolling Block 2 (EU + Asia)	8:00	Keynote 3: The Not-So-Subtle Art of Taking a Deep Breath: Live-Wiring Yourself for Better Output and Experience Birgit Penzenstadler (Chalmers University)
	8:50	Session 12: Business Impact and Analysis Aligning Architecture with Business Goals in the Automotive Domain The Influence of Cognitive Biases on Architectural Technical Debt Contrasting Big Bang with Continuous Integration through Defect Reports
	9:35	Break
	9:45	Sponsor Talk: Event Driven Architecture on Apache Kafka - Ivan Greguric
	10:05	Working Sessions: Architecting for Sustainability - Part 1
Rolling Block 1 (Americas + EU)	11:05	Social Event 1
	17:00	Keynote 3: The Not-So-Subtle Art of Taking a Deep Breath: Live-Wiring Yourself for Better Output and Experience Birgit Penzenstadler (Chalmers University)
	17:50	Sponsor Talk: Package Structure of Software Systems – Matthias Eschhold & Steve Walter (Novatec)
	18:10	<div> Session 13: Assessment and Design Techniques 2 ArCode: Facilitating the Use of Application Frameworks to Implement Tactic and Patterns Aligning Architecture with Business Goals in the Automotive Domain PPTAM: What, Where and How of Scalability Assessment </div> <div> Session 14: Architecture Evolution The Influence of Cognitive Biases on Architectural Technical Debt Facilitating Connector Evolution With Architecture-Centric Development Contrasting Big Bang with Continuous Integration through Defect Reports </div>
	18:55	Break
	19:00	<div>Working Session: Architecture Technical Debt - Part 2</div> <div>Working Session: Soft. Arch. Problems in the Next 5-10 Years - Part 2</div>
	20:30	Social Event 2

Program overview







UTC TIME		THURSDAY, 25 MARCH	
RB3	0:00	Working Session: Software Architecture for Machine Learning Systems - Part 2	Working Session: Software Architecture Design Reasoning and Thinking - Part 2
	8:00	Session 15: Traceability and Decomposition 1 InMap: Automated Interactive Code-to-Architecture Mapping Recommendations    Automatic Class Decomposition using Clustering Why and How Your Traceability Should Evolve: Insights from an Automotive Supplier	Session 16: Architectural Knowledge System- and Software-level Architecting Harmonization Practices for Systems-of-Systems – An exploratory case study on a long-running large-scale scientific instrument Knowledge-based Adequacy assessment Approach to support AI adoption Exploring Web Search Engines to Capture Architectural Knowledge
Rolling Block 2 (EU + Asia)	8:45	Break	
	8:55	Working Session: Architecting for Sustainability - Part 2	
	10:40	Social Event 3	

Rolling Block 1 (Americas + EU)




UTC TIME	THURSDAY, 25 MARCH	
17:00	Keynote 2: Human Archipelagos Have Been Induced by COVID, but Architectural Archipelagos Are All Our Own Doing Nenad Medvidovic (University of Southern California)	
17:50	Session 17: Traceability and Decomposition 2 System- and Software-level Architecting Harmonization Practices for Systems-of-Systems – An exploratory case study on a long-running large-scale scientific instrument Automatic Class Decomposition using Clustering InMap: Automated Interactive Code-to-Architecture Mapping Recommendations   	Session 18: Architectural Knowledge and Traceability Why and How Your Traceability Should Evolve: Insights from an Automotive Supplier Knowledge-based Adequacy assessment Approach to support AI adoption Exploring Web Search Engines to Capture Architectural Knowledge
18:35	Break	
18:45	New and Emerging Ideas Panel: Software Architecture in the COVID-19 Reality	
19:45	Social Event 4 - Among Us	


THURSDAY

-  Open Research Object (ORO)
-  Research Object Reviewed (ROR)
-  Candidate for Best Paper Award

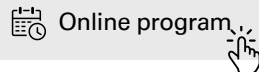
 Note: All mentioned times / days are UTC (24h)

THURSDAY

-  Open Research Object (ORO)
-  Research Object Reviewed (ROR)
-  Candidate for Best Paper Award

 Note: All mentioned times / days are UTC (24h)

Program overview



UTC TIME	FRIDAY, 26 MARCH
Rolling Block 2 (EU + Asia)	8:00 Session 19: Sustainability and Evolution 1 A Framework of Software Architecture Principles for Sustainability-driven Design and Measurement Enabling Consistency between Software Artefacts for Software Adaption and Evolution Continuous API Evolution in Heterogenous Enterprise Software Systems The Tao way to anti-fragile software architectures: the case of mobile applications
	8:55 Awards Ceremony
	9:15 Break
	9:25 Most Influential Paper Presentation PerOptryx: automated application of tactics in multi-objective software architecture optimization . Anne Kozirolek, Heiko Kozirolek, Ralf H. Reussner
	10:15 Closing
Rolling Block 1 (Americas + EU)	18:00 Session 20: Sustainability and Evolution 2 A Framework of Software Architecture Principles for Sustainability-driven Design and Measurement Enabling Consistency between Software Artefacts for Software Adaption and Evolution Continuous API Evolution in Heterogenous Enterprise Software Systems The Tao way to anti-fragile software architectures: the case of mobile applications
	18:55 Break
	19:05 Most Influential Paper Presentation PerOptryx: automated application of tactics in multi-objective software architecture optimization . Anne Kozirolek, Heiko Kozirolek, Ralf H. Reussner
	19:55 Awards Ceremony
	20:15 Closing

Social events

Games

skribbl.io



Kahoot



Do you have the courage to test your drawing skills? Skribbl.io is a simple multiplayer game where you have to draw a chosen word, and others need to guess it. Your drawing skills will make you either a winner or a loser. Either way, you will have a lot of fun!

Slot: Wed Mar 24, 11:05 UTC

How well do you know trivia? Kahoot! is a simple multiplayer quiz game. The challenge is not only to provide the correct answer but also to be as fast as possible. Exploit all the knowledge you never thought to be of any use and test your computer science knowledge.

Slot: Wed Mar 24, 20:30 UTC

Codenames

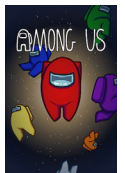
Have you ever wanted to be a spy like James Bond? Codenames is a simple premise and challenging game which allows you to enter the world of spies. You can have a lot of fun guessing which cards may fit the clues given by your spymaster. But be aware not to catch the other team's cards or even the black one.

Slot: Thur Mar 25, 10:40 UTC



Among Us

Have you ever wanted to downright lie to your colleagues or find out who the imposter in your group is? Then, Among Us is the right game for you. As a crewmate, you get a set of tasks to solve, while the ones in the role of imposters aim to sabotage the tasks and eliminate the crew. You need to install the app for playing the game, which is available for iOS and Android for free. Alternatively, you can buy the game via Steam or Epic game stores for playing it on your PC.



Source: Wikipedia

Slot: Thur Mar 25, 19:45 UTC

City Tour

Socializing during a virtual conference is a difficult task. We will nevertheless try to compensate for lack of personal interaction as much as possible. During all socializing slots, we will present a pre-recorded Stuttgart city tour.

Slots:

Wed Mar 24, 11:05 & 20:30 UTC

Thur Mar 25, 10:40 & 19:45 UTC



Overall information

Due to the Covid-19 pandemic, ICSA 2021 made an early, and as it turned out, wise decision to move to a full virtual conference.

Therefore, ICSA 2021 has all advantages (cheap registration, easy to attend, no travel and corresponding climate footprint, ...) and disadvantages (less interaction, harder socializing, ...) of being a virtual event.

On this page we provide some information on the conference's organization as virtual event.



Prerecorded Talks

ICSA 2021 will not use live talks for most of the main event. Authors will be asked to provide pre-recorded, 10-minute videos of their talks. We will share the talks over YouTube and link them in the virtual conference management system. Discussion sessions during the conference will then provide summaries of submitted papers (<= 5min) and we will have Questions and Answers (Q&A) session. Discussions will be prepared upfront in the virtual conference management system.

Virtual Conference Management System

The conference will be managed and operated under the hood of the Whova conference management system. You can find [ICSA's Whova page here](#). The ICSA agenda in Whova embeds your prerecorded YouTube videos and Zoom meetings for all live sessions. This means all information you need is centralized inside of Whova. Channels per session and for all types of socializing or networking activities will be provided in addition by Whova.



Whova

iOS

Android

Multi-Time-Zone Mode

All discussion sessions of ICSA 2021 will be scheduled to take place twice with the objective that in each of the three major time zones (Europe, Asia, America) people can attend their preferred sessions during mostly business hours. The few live sessions, like the keynote presentations, conference opening, etc. will be played back or shared via video recording. Q&As will be done in this case in an asynchronous fashion via Whova.

Further information you can find on the following link:

<https://icsa-conferences.org/2021/attending/virtual-attendance/>

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