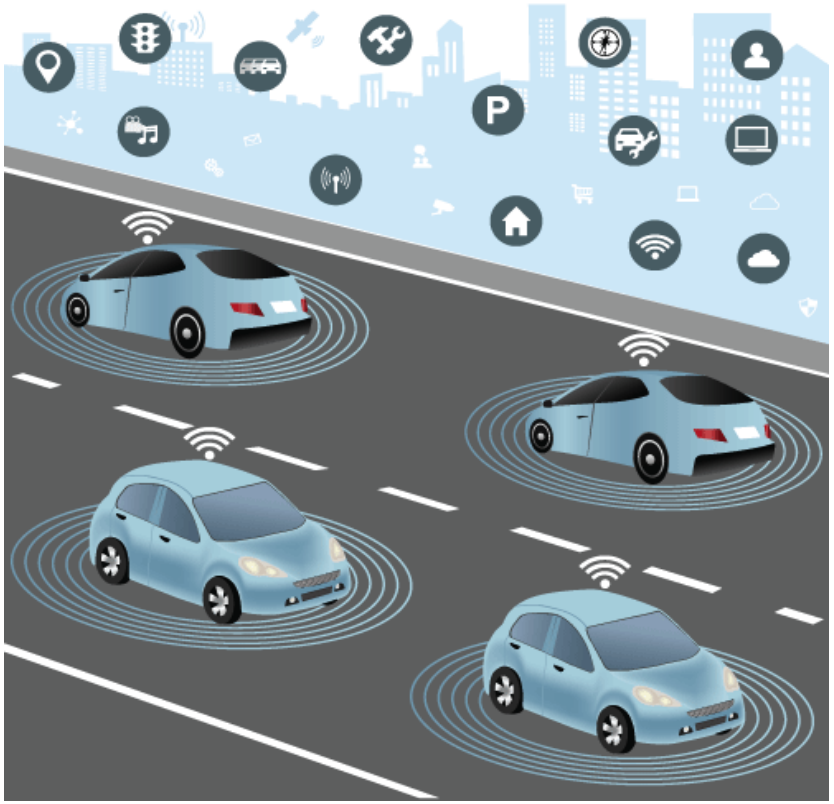

WIRELESS WORLD
RESEARCH FORUM®

The Connected Vehicle

Presented
By
(WWRF VIP CV WG Chair Seshadri Mohan)
at
ITU-CITS Meeting, September 10, 2021

WWRF Role and principles of operation

WIRELESS WORLD RESEARCH FORUM®

- Develop future vision of the wireless world
- Inform and educate on trends and developments
- Enable and facilitate the translation of the vision into reality
- Bring a wide range of parties together to identify and overcome significant roadblocks to the vision

- Global
- Open to all
- Covers every platform
- Not
  - standards body
  - research funding body
  - A typical research conference
- Based on membership
- All can attend meetings and make contributions

Membership

WIRELESS WORLD RESEARCH FORUM®

How does WWRF work?

WIRELESS WORLD RESEARCH FORUM®

- Hold two meeting per year
  - as well as the WWRF 5G Huddle and other special and invited sessions
- Take input from our members and meeting participants
- Put the results together and bring out a vision of the future research challenges
- Promote the vision through publication and working with global and regional partners

WORKING GROUPS

WGC
New directions in communication architectures and Technologies

Guiding the mobile industry in the use of software, virtualization and cloud computing in future networks (both wireless and wired) by developing end-to-end network architectures, identifying the specific requirements and issues and addressing them by providing solutions that are practical and business driven.

WGA/B
User Needs & Requirements; Services, and Devices, in a Wireless World.

Promoting a secure communications environment across multiple Socio-Economic settings based on user needs and requirements.

WGD
Radio Communication Technologies

Advanced radio technologies and spectrum issues are investigated, to optimise the design of the air interface, medium access and heterogeneous multi-user, multi-RAT systems and identify trends and impact the wireless evolution towards 5g and beyond.

WG HF
High Frequencies (mmWAVE and THz) Radio Communications Technologies

Higher frequency radio communication technologies are expected to enable the vision of wireless transmissions towards the region of 1 Tbit/s. Improved channel modelling and the design of appropriate waveforms, baseband processing, medium access control (MAC) schemes and antenna array configurations are addressed.

WG WAI
AI for Wireless Communications

Artificial Intelligence applied to the wireless communications domain is referred to as Wireless Intelligence (WI). This will be in all sub-systems within the wireless ecosystem. WI is expected by the market to not only reduce operational expenditures (OPEX), but also to increase user quality of experience (QoE) as well as help the introduction of new value chains in an increasingly competitive and complex business environment.

VIP RAIL
Track-to-Train communications

The focus identifying the potential benefits and hurdles for the future adoption of what today is known as 5G by rail transport systems worldwide Security, reliability, IoT and dependability are playing a focal role in future radio communication systems for efficienttrain operations and safety.

VIP Water
Vertical Industry Platform - 5G for smart water management

A discussion platform about water management and study of the communication requirements, to assess whether 5G can take us faster and further than existing ICTs.

VIP CV
Connected vehicles

Focuses on research that looks five to ten years ahead in order to meet the requirements of the automotive and transport industries based on the next generation wireless technology.

VIP EMW
Ehealth, mobile health and wearables

Developing an e/m-Health and wearables vertical industry paradigm to expose the requirements of such systems to be 5G-enabled

What is WWRF?

WIRELESS WORLD RESEARCH FORUM®

- Founded in 2001
  - Through WSI, an EU-funded research landscaping project
- Based in Switzerland
- Independent and owned by its members
- Promoting visions of the wireless future

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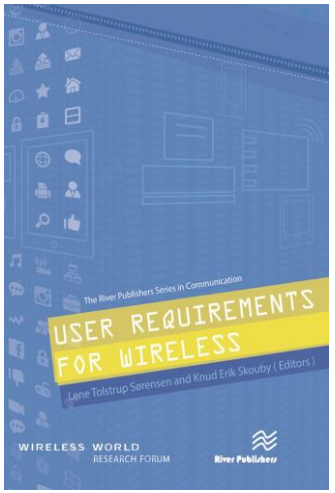
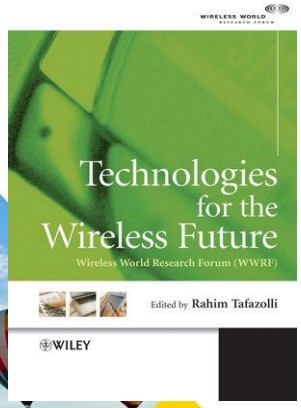
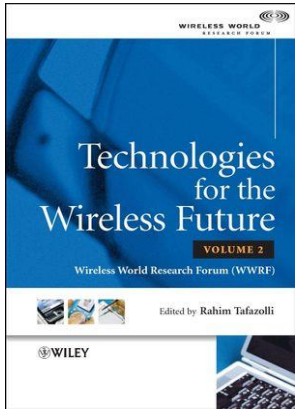
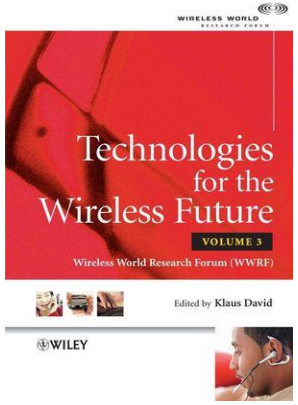
WWRF outputs

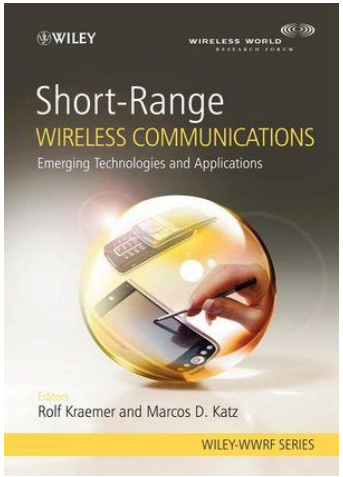
- WWRF Outlook – published version of White Paper
- WWRF Library – proceedings of each meeting
- WWRF – Wiley and River book series











Outlooks to look out for

WIRELESS WORLD RESEARCH FORUM®

- WWRF Outlook
  - WWRF Outlook 24 - Artificial Intelligence in the Wireless Arena
  - WWRF Outlook 25 - Connected vehicles (2019); revised 2021
- In development
  - 5G business models
  - 5G and the water industry
  - Millennial users in a 5G context
  - Cybersecurity challenges in the Wireless World
  - Ehealth enabled by 5G and machine learning
  - Network slicing
  - High speed rail services and 5G
  - Thz communications and system architectures
  - 6G/Beyond 5G
  - AI/ML-enabled Connected Vehicles

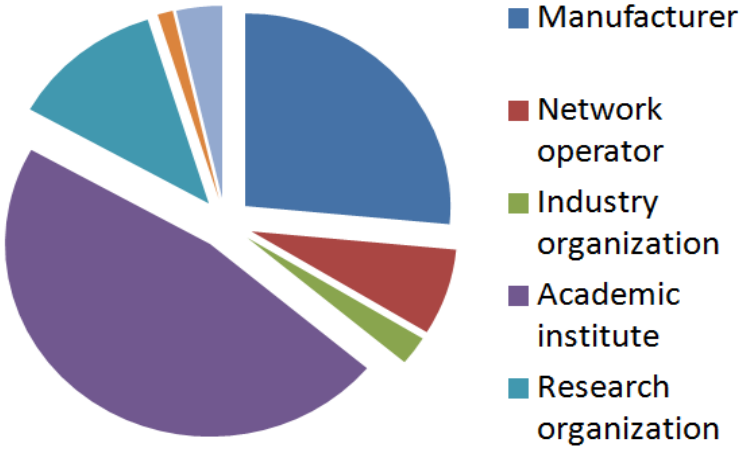
WWRF Overview

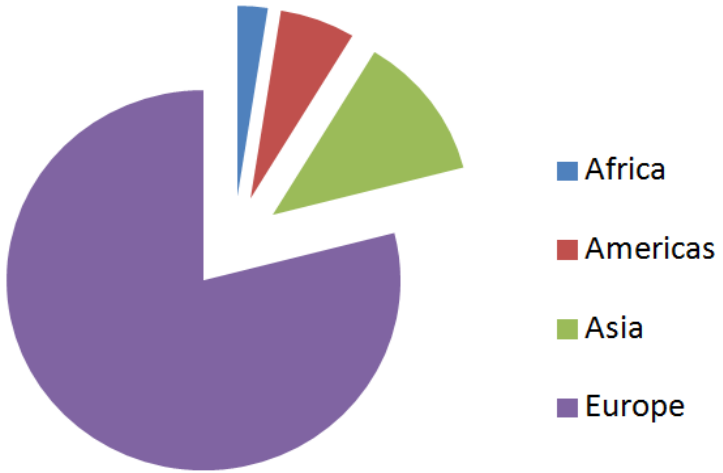
WIRELESS WORLD RESEARCH FORUM®

- Develop future vision of the wireless world
- Enable and facilitate the translation of the vision into reality
- Bring a wide range of parties together to identify and overcome significant roadblocks to the vision
- Inform and educate on trends and developments

- Global operation
- Covers every technical field of wireless communications and mobile networking
- Open to all
- Based on membership

60 member organizations





VIP CV WG: The Connected Vehicle

WIRELESS WORLD RESEARCH FORUM®

Scope

The VIP CV WG focuses on research that looks five to ten years ahead in order to meet the requirements of the automotive and transport industries based on the next generation wireless technology. It also is aimed at the identification of use cases for these industries.

Objectives

WIRELESS WORLD RESEARCH FORUM®

- Leverage academic research to develop technologies for connected vehicles (CV) that complement developments in standards bodies.
- Provide relevant input to government in order to maximize the advantages of CV technologies while addressing concerns with respect to security and privacy.
- Develop WWRF as a bridge between the automotive industries and industry organizations such as 5GAA and the wireless standards organizations (such as 3GPP) to provide input to help prepare for standardization.
- Create a better understanding in the automotive industries of the potential and capabilities of future wireless technologies.
- Enable the telecom and automotive industries to jointly discuss the vision, usage scenarios, requirements and enabling technologies to achieve the targets of future vertical industry communications in 5G and beyond.
- Develop use cases and study any gaps that may need to be addressed with respect to existing and evolving standards (e.g., DSRC) for the support of connected car and associated industries
- Develop use cases and technical requirements for 5G and beyond support of the connected car and associated industries.

Participation

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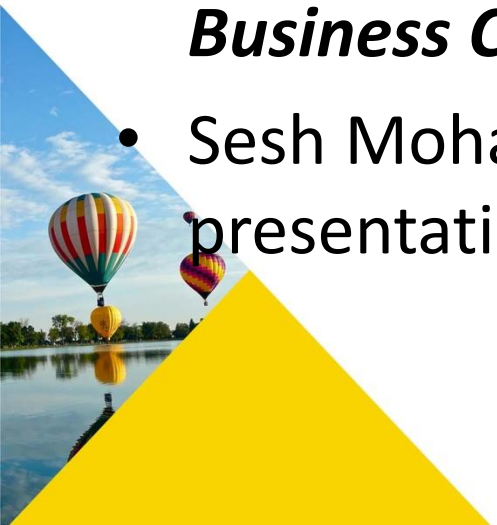
- The major companies, universities and organizations active in the area of V2X, including China Mobile, Intel, the Society of Motor Manufacturers & Traders (SMMT), ITU CITS, King's College London, UA Little Rock, USA, and Huawei.
- Many telecom operators, vendors and car manufacturers have shown interest and some of them are expected to join and contribute.

VIP CV Activities

17th CTIF Global Capsule (CGC) Annual Workshop

WIRELESS WORLD RESEARCH FORUM®

- Organized by Prof. Ramjee Prasad
- Focus on '***innovation and its commercialization through a strong partnership between industries and academia as well as on modern practices and methodologies in cross-/multi-/interdisciplinary areas such as social science, technology, and Business Canvas.'***
- Sesh Mohan represented WWRF VIP CV with a presentation on 'AI/ML-Enabled Connected Vehicles'



Workshop at 2021 IEEE ANTS, December 2021

WIRELESS WORLD RESEARCH FORUM®

- A workshop on ‘AI/Machine Learning-Enabled Connected Vehicles’ will be organized as part of 2021 IEEE Advanced Networks and Telecommunications Symposium (ANTS) to be held during December 13-16, 2021 in Hyderabad, India.
- Workshop Organizers:
  - Seshadri Mohan, UA Little Rock, USA
  - Klaus David, University of Kessel, Germany
  - Sachin Sharma, Graphic Era University, Dehradun, India

IEEE ANTS 2021
CV Workshop

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- Channel estimation, especially with high-mobility vehicles with rapidly changing environment and channel conditions; machine learning can adapt to the environmental dynamics and estimate and even predict the channel characteristics;
- Prediction of traffic flow by applying machine learning to the vast amount opast traffic flow information, history of accidents, congestion, roadworks, detours, and other traffic incidents possibly due to weather;
- Resource allocation in wireless networks of connected vehicles by exploiting machine learning, utilizing information gathered from the previously mentioned aspects of channel estimation and traffic flow prediction, to efficiently allocate the scarce radio and network resources to connected vehicles; and
- Predicting the driving behaviors of drivers, the physical and emotional status, alert the drivers of possible corrective actions to take to avoid accidents.
- Application of machine learning to determine and even predict security threats to connected vehicles and ensuring privacy and security.
- Machine learning to protect VRUs and enhance their safety.

5G System Design Solutions for Wireless Personal Applications

WIRELESS WORLD RESEARCH FORUM®

Wireless Personal Communications
https://doi.org/10.1007/s11277-021-08753-0

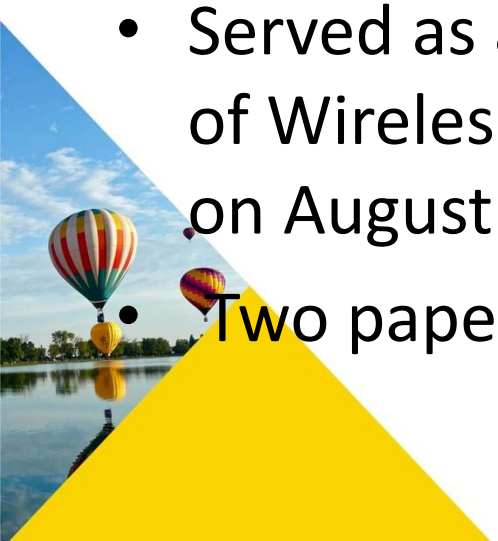
GUEST EDITORIAL

Check for updates

5G System Design Solutions for Wireless Personal Applications

Pavlos I. Lazaridis[1] · J. N. Swaminathan[2] · Seshadri Mohan[3]

- Served as a co-guest editor of the above special issue of Wireless Personal Communications that appeared on August 30, 2021.
- Two papers on connected vehicles were published.



5G System Design Solutions for Wireless Personal Applications

- In the study by Le et al., the authors propose a scheme that combines NOMA with cognitive radio (CR) for vehicle-to-everything (V2X) as a promising application with high spectrum efficiency. Simulation results exhibit the advantages of the proposed CR-NOMA assisted V2X system with respect to outage probability and bit error rate.
- The paper by Anandpushparaj et al. studies the system performance of UAV-assisted relay systems. Simulation results provide some interesting insights on the impact of self-interference and the fading parameter.

Summary of VIP CV Activities

WIRELESS WORLD RESEARCH FORUM®

- The CV White Paper (WWRF Outlook 25) to be included as a book chapter in a publication by River Publishers.
- A second white paper on connected vehicles on the topic of 'The Role of AI/Machine Learning in Connected Vehicles' is under development.
- Those interested in contributing to the white paper and/or IEEE ANTS Workshop please contact VIP CV Chair Seshadri Mohan at sxmohan@ualr.edu.

Future 2021 - 2022 Events

WIRELESS WORLD RESEARCH FORUM®

- VIP CV will meet at the forthcoming WWRF meetings:
  - WWRF 5G Huddle, May 12, 2022, Ottawa, Canada.
  - WWRF46 in December 2021, Paris, France
  - 2021 IEEE ANTS Workshop on AI/ML-Enabled Connected Vehicles
- Contributions to WWRF Meetings
  - Open calls are advertised on the website www.wwrf.ch
  - Full papers will be published in IEEE VT Magazine (if successfully reviewed)
  - Contributions can be made by all including non-members

Contact

WIRELESS WORLD RESEARCH FORUM®

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- Prof. Seshadri Mohan, UA Little Rock, sxmohan@ualr.edu