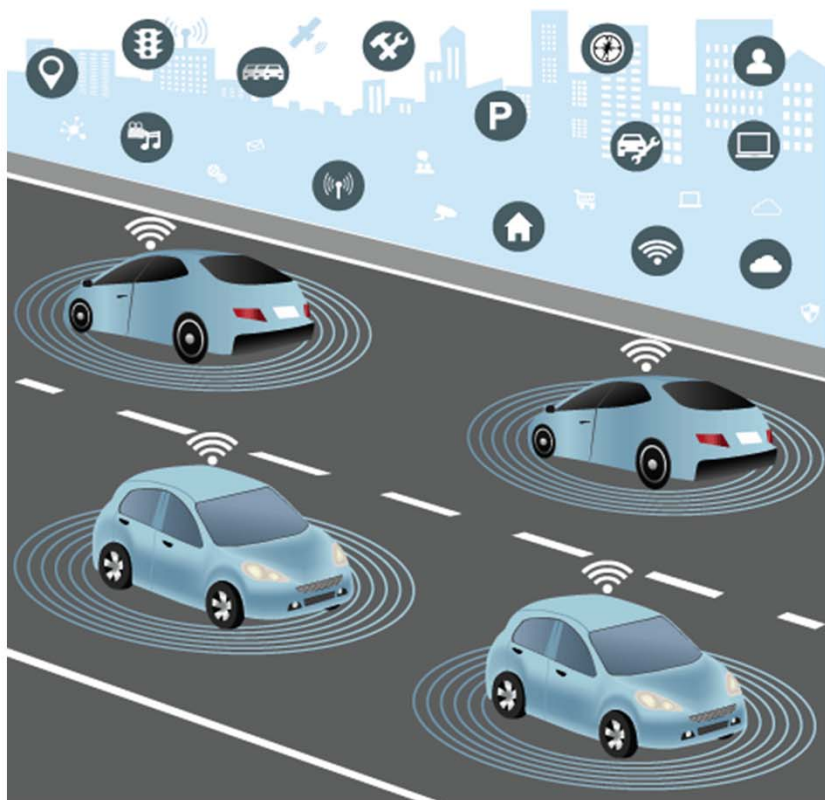




**WIRELESS WORLD**  
**RESEARCH FORUM®**

# **WWRF Connected Vehicle WG Update**

**Presented**

**By**

**WWRF VIP CV WG Chair Dr. Seshadri Mohan,  
Professor, University of Arkansas at Little Rock  
at**

**ITU-CITS Meeting, MARCH17 23, 2022**



# WWRF Role and principles of operation

WIRELESS WORLD  
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- 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  
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- Manufacturer
- Network operator
- Industry organization
- Academic institute



- Africa
- Americas
- Asia
- Europe



# How does WWRF work?

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- 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

## 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.

## 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.

## 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 efficient train 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.

## 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.

## 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 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 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?

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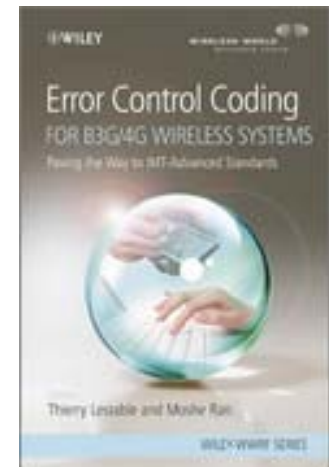
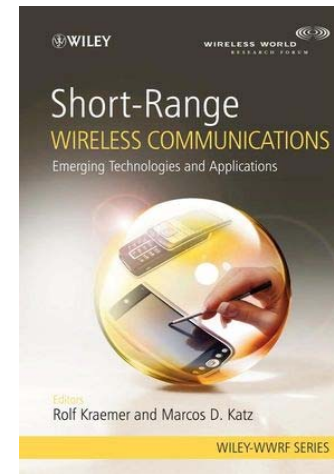
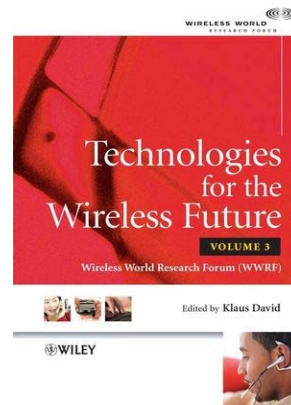
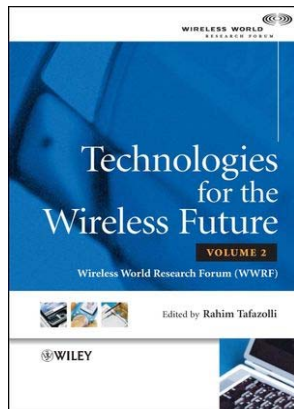
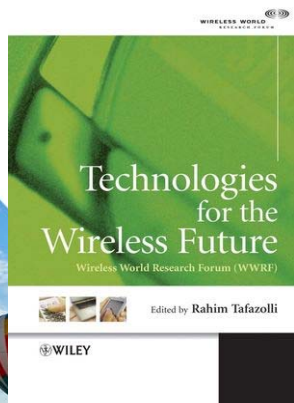
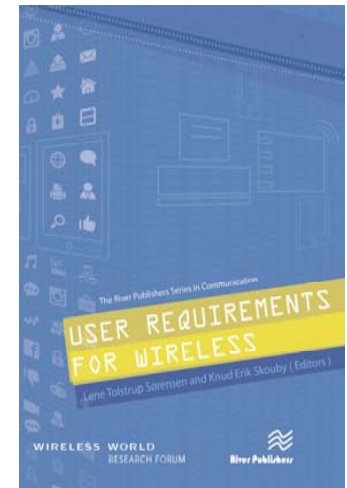
- Founded in 2001
  - Through WSI, an EU-funded research landscaping project
- Based in Switzerland
- Independent and owned by its members
- Promoting visions of the wireless future



# WWRF outputs

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



# Outlooks to look out for

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- 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  
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- 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



- Manufacturer
- Network operator
- Industry organization
- Academic institute
- Research organization



- Africa
- Americas
- Asia
- Europe



## VIP CV WG: The Connected Vehicle

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### 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.



# Summary of VIP CV Activities

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- The CV White Paper (WWRF Outlook 25), already published, is being considered for possible inclusion as a book chapter in a suitable publication.
- A second white paper on connected vehicles is underway on the topic of 'The Role of AI/Machine Learning in Connected Vehicles.' Members of Telecommunications Standards Development Society, India (TSDSI), and other organizations have formed a team to partner with WWRF CV VIP working group to develop the white paper.
- Connected Vehicles Sessions were organized at the following meetings:
  - In conjunction with WWRF 5G Huddle in Ottawa, Canada, May 12, 2022
  - As part of WWRF 47 in Bristol, UK, during June 21-23, 2022
  - As part of WWRF 48 in Abu Dhabi, UAE, November 7-9, 2022
  - A workshop on connected vehicles as part of 2022 IEEE ANTS



# WWRF 5G HUDDLE 2022, OTTAWA, CANADA

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- A CV WORKSHOP WAS HELD AT U OTTAWA, KANATA-NORTH; THE FOLLOWING PAPERS WERE PRESENTED:
- **9:00 am – 9:10 am – Introduction** to the workshop and participants– Seshadri Mohan, Chair of Connected Vehicles Working Group – WWRF
- **9:10 am – 9:20 am – Introduction to WWRF**, Nigel Jefferies, Chair WWRF
- **9:20 – 9:35 am - Opening Remarks and CAV at University of Ottawa** – Guy Levesque, Associate Vice-President for Research and Innovation, University of Ottawa
- **9:35 am – 10:05 - AI-enabled Autonomous Vehicles-Driven Services for Secure, Sustainable and Healthy Communities** – Burak Kantarci, Director, Smart Connected Vehicles Innovation (SCVI) Centre with Ottawa University, Canada
- **10:05 am – 10:35 am - Safety of Vulnerable Roadside Users** – Klaus David, Kassel University, Germany



# WWRF 5G HUDDLE 2022, OTTAWA, CANADA

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- **10:50 am – 11:20 am - Connecting Autonomous Systems -**  
Vishnu Ram, OV, TSDSI, India
- **11:20 am – 11:50 am - Real-time 3D Digital Twin for Autonomous Vehicle Safety,** Mahbubul Alam, Chief Marketing Officer & Chief Business Development Officer at Dimaag-AI. CA, USA
- **11:50 am – 12:20 pm - 5G & Cybersecurity in Vehicles: Challenges & opportunities -** Ravi Puvvala, CEO, Founder and CEO of Savari (a Silicon Valley startup now acquired by Harman International),
- **12:20 pm – 12:50 pm – Addressing the Sensor Challenges for Self-Driving vehicles –** Dr. Andre Burgess, NPL, UK



## WWRF'47 VIP CV BRISTOL, UK, June 21 – 23, 2022

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- Two sessions were held
- Eight papers were presented; received four full paper submissions and four invited talks
- CV Session 1 on 6/22/2022 and CV Session 2 on 6/23/2022 included the papers listed in the next two slides



# CV SESSION 1

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| Time  | Speaker                                                                    | Title                                                                                       | Affiliation                                                                                 | In-Person or Virtual |
|-------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------|
| 16:00 | Yaser Awadh Bakhuraisa,                                                    | Analysis of Millimeter-Wave Propagation Paths in Urban Environment for vehicle Localization | Faculty of Engineering and Technology (FET), Multimedia University, Malacca, Malaysia       | In-Person            |
| 16:20 | Abhishek Mukherjee, Pradipta Biswas                                        | ADAS for Indian Road Situations                                                             | Professor, IISc, Bangalore, India                                                           | Virtual              |
| 16:40 | Adrian Kliks, Łukasz Kułacz, Paweł Sroka, Paweł Kryszkiewicz, Michał Sybis | Initial evaluation of the could-based Vehicular Dynamic Spectrum Access                     | Deputy-director at Institute of Radiocommunications associate professor, Poznan University, | In-Person            |
| 17:00 | Mahbubul Alam                                                              | Security of Connected Vehicles                                                              | Chief Marketing & Business Development Officer, DIMAAG-AI, Inc.                             | Virtual              |



# CV SESSION 2

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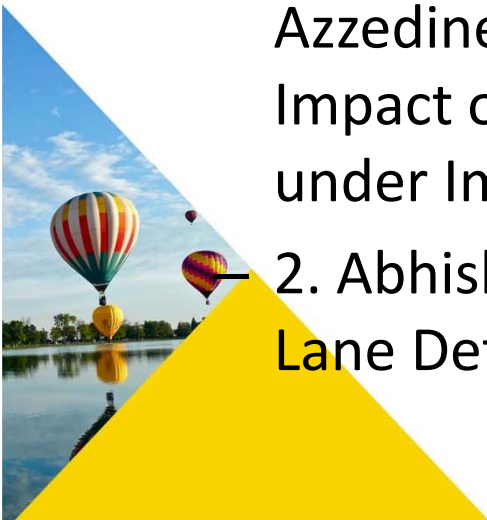
| Time  | Speaker                                                                        | Title                                                                                                  | Affiliation                                      | In-Person or Virtual |
|-------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------|
| 14:00 | Tathagat Pal, Gurinder Singh, Vivek Ashok Bohara, Anand Srivastava             | On the Performance of Optical-RIS Aided Vehicular Communication Systems                                | Dept. Electrical Engineering, IIIT Delhi, India  | In-Person            |
| 14:20 | Bhavani Shankar                                                                | Interference: The new frontier for autonomous driving?                                                 | Professor, University of Luxemborg               | Virtual              |
| 14:40 | Samhita Kuili, Kareem Dabbour, Irtiza Hasan, Andrea Herscovich, Burak Kantarci | Adversarial Machine Learning-Enabled Anonymization of OpenWiFi Data                                    | University of Ottawa, Ontario, Canada            | Virtual              |
| 15:00 | Ravi Puvvala                                                                   | Balancing act between 5G enabled in-vehicle and cloud computing power to prevent cybersecurity attacks | Vice President of Strategic Partnerships, Harman | Virtual              |



# WWRF'48, Abu Dhabi, VIP CV ACTIVITY

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- Four contributed papers were presented; received one full paper
- White paper 2 proposal was presented, titled “The Role of AI/Machine Learning in the Evolution of Connected Vehicles”
  - 1. Omer Melih Gul, Michel Kulhandjian, Burak Kantarci, Azzedine Touazi, Cliff Ellement, Claude D’Amours “On the Impact of CDL and TDL Augmentation for RF Fingerprinting under Impaired Channels”
  - 2. Abhishek Mukhopadhyay, Pradipta Biswas, “A Hybrid Lane Detection Model for Wild Road Conditions”



# WWRF'48, Abu Dhabi, VIP CV ACTIVITY

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- 3. Sayon Karmakar, Amit Kumar, Seshadri Mohan, “Optimal Control in Connected and Automated Vehicles: A review”
- 4. Yaser Awadh Bakhuraissa, Azlan Bin Abd Aziz, “Statistical Analysis of mm-Wave Features for V2V Scenario in Urban Environment.”
- 5. Seshadri Mohan, Discussion on CV White Paper 2: The Role of AI/ML in the Evolution of Connected and Autonomous Vehicles



# ONGOING/FUTURE VIP CV ACTIVITIES

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- Our liaison activity with ITU-T CITS is ongoing; an update regarding VIP CV activity was presented at the ITU-T CITS meeting on September 23, 2022.
- A second white paper on connected vehicles is under way
- A Connected Vehicles panel was organized at 2022 IEEE ANTS
- A special issue of Wireless Personal Communications journal is being scheduled on the topic of “Wireless Communication in Optical Imaging and Sensing for Connected and Autonomous Vehicles”
- A special issue of Wireless Personal Communications journal will be published consisting selected papers from IEEE ANTS 2022
- A proposal is being developed for a third white paper on connected vehicles concerning the impact of 6G on Connected Vehicles
- Those interested in contributing to the white paper, please contact VIP CV Chair Seshadri Mohan at [sxmohan@ualr.edu](mailto:sxmohan@ualr.edu).



# Panel at IEEE ANTS 2022

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## **IEEE International Conference on Advanced Networks and Telecommunications Systems**

18-21 December 2022 // Gandhinagar, Gujarat, India

Scalable, Secure, and Sustainable Connectivity for All

### **Panel on AI/Machine Learning-Enabled (CAV) in the Era of 5G, 6G, and Beyond**

**Sponsored by Wireless World Research Forum (WWRF)**

#### **Panel Chair and Panelists**

Dr. Seshadri Mohan, University of Arkansas at Little Rock, [sxmohan@ualr.edu](mailto:sxmohan@ualr.edu)

Prof. Dr.-Ing. Klaus David, University of Kassel, Germany, [david@uni-kassel.de](mailto:david@uni-kassel.de)

Dr. Burak Kantarci, University of Ottawa, ON, Canada, [Burak.Kantarci@uottawa.ca](mailto:Burak.Kantarci@uottawa.ca)

Dr. Bhavani Shankar, University of Luxemborg, [Bhavani.Shankar@uni.lu](mailto:Bhavani.Shankar@uni.lu)  
(mailto:Bhavani.Shankar@uni.lu)

Dr. Pradipta Biswas, IISc, [pradipta@iisc.ac.in](mailto:pradipta@iisc.ac.in)



## Contact

WIRELESS WORLD  
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- Dr. Nigel Jefferies, Chair WWRF, [chair@wwrf.ch](mailto:chair@wwrf.ch)
- Prof. Seshadri Mohan, UA Little Rock, [sxmohan@ualr.edu](mailto:sxmohan@ualr.edu)

