WIRELESS WORLD
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The Connected Vehicle

**Presented
By
(WWRF VIP CV WG Chair Seshadri Mohan)
at
ICITS Meeting
Geneva, Switzerland (6 March2020)**
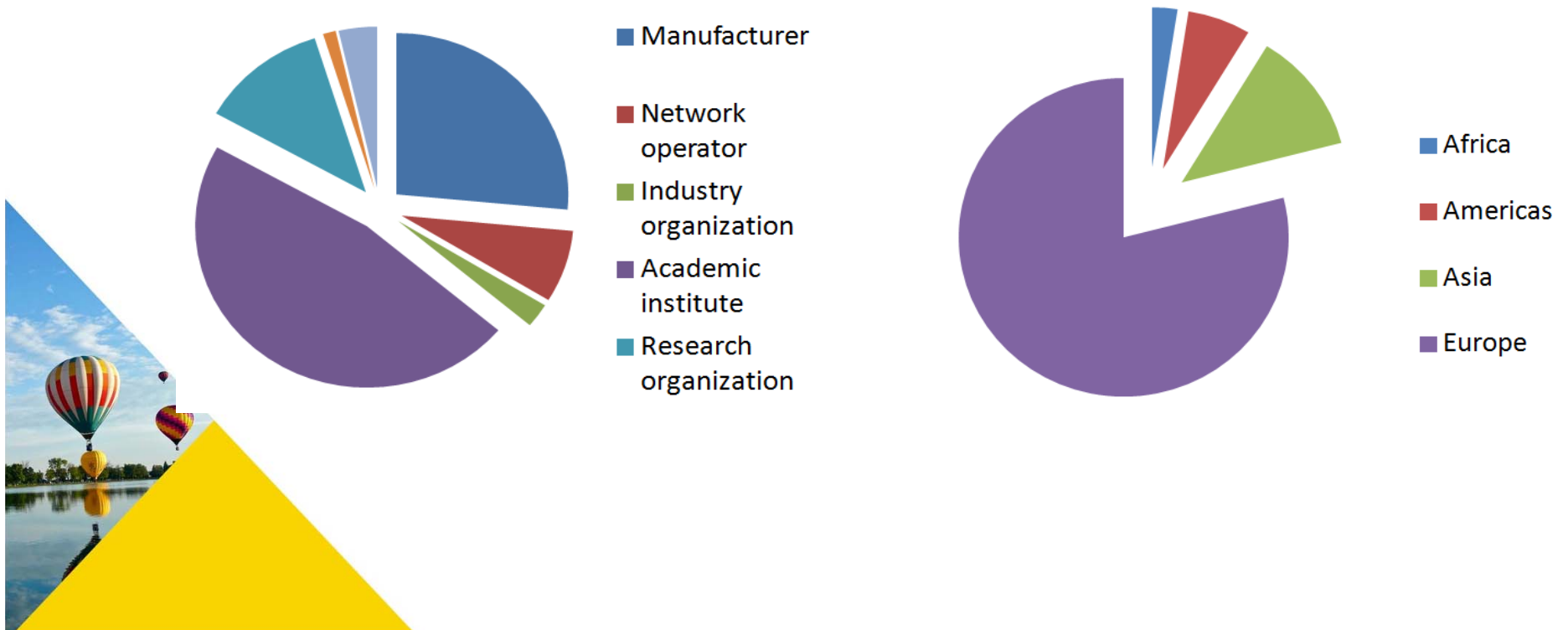
WWRF Overview

- 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

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

- Africa
- Americas
- Asia
- Europe

VIP (Vertical Industry Platform): Bringing IoT into 5G

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Contributions to international standardizations are from member organizations

SDOs

VIP-WGs

WWRF

Use cases, Requirements, Tech Analysis Service / Applications

ORGs

Visions, Scenarios & Technologies

Telecom Industry

Vertical Industries

Academia

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 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.

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

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.

Objectives

- 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.
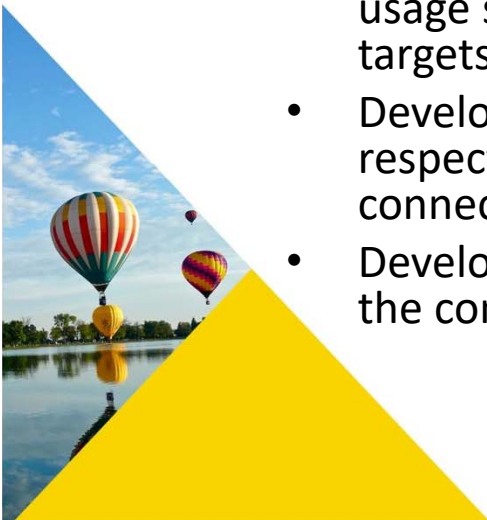
Milestones and deliverables

- Outputs include white papers and technical proposals which will be submitted to major standardization bodies of 5G, including ITU and 3GPP, as well as industry organizations such as 5GAA
  - Launch of working group at WWRF39 meeting in Barcelona (October 2017)
  - Generate a white paper outline for soliciting contributions at WWRF40 in Durban, South Africa on the research status of 5G and other wireless technologies in the road transport environment (Done)
  - White paper was completed – WWRF Outlook 25: Connected Vehicles, and distributed to participants at WWRF Meeting 43 held in London in October 2019.

Participation

- 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.

WWRF'43 London, UK

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- VIP CV White Paper was completed and distributed to the participants at the meeting

- Sesh Mohan delivered a plenary talk titled "The Impact of Emerging Standards, 5G and Beyond, and Machine Learning on Connected Vehicles."

- Three papers were presented in the VIP CV session
  - M. Wong, "Security of V2X"
  - AntoniosLalas, Konstantinos Votis, DimitriosTzovaras, "Cybersecurity Aspects of 5G Connectivity in Smart Cities Ecosystem via Connected and Autonomous Vehicles Use Cases"
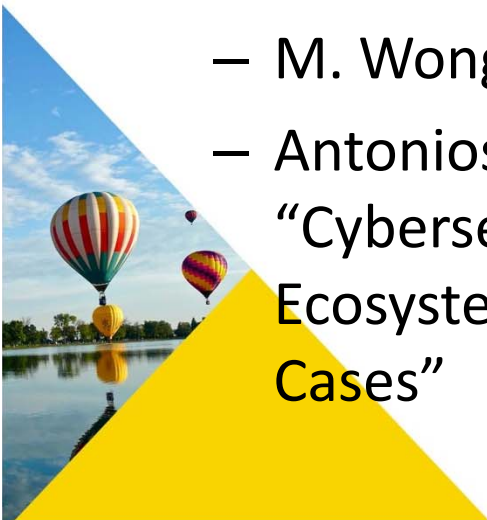
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– Ahmed Y. Awad, Akshay Yewale, Dattaji Gosavi, Akshat Shah, Dipesh Narayankar, Vaibhav Tiwari, Arwa Mohammed Taqi, Mariofanna Milanova, Seshadri Mohan, "Real-Time V2V Communication with a Machine Learning-based System for Detecting Drowsiness of Drivers"

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- **A Workshop titled "Impact of Emerging Standards, 5G and Beyond, and Machine Learning on Connected Vehicles," was organized on Dec. 16, 2019.**

- **The following papers were presented at the Workshop**
  - Seshadri Mohan, "Impact of Emerging Standards, 5G and Beyond, and Machine Learning on Connected Vehicles,"
  - Ashok Chandra, "Spectrum issues related to connected vehicles."
  - Ravi Puvvala, "How V2X will complement existing on board sensors for connected & autonomous vehicles?"
  - Akshay Yuwale, "Real-Time V2V communication with a Machine Learning-based System for Detecting Drowsiness of Drivers."
  - Purnima Lala, "Drone-based mesh network for traffic congestion control"
  - Vimala Mathew, "Person re-identification through face detection from videos using Deep Learning"
  - Open panel discussion with audience participation

WWRF 5G Huddle, Feb. 2020

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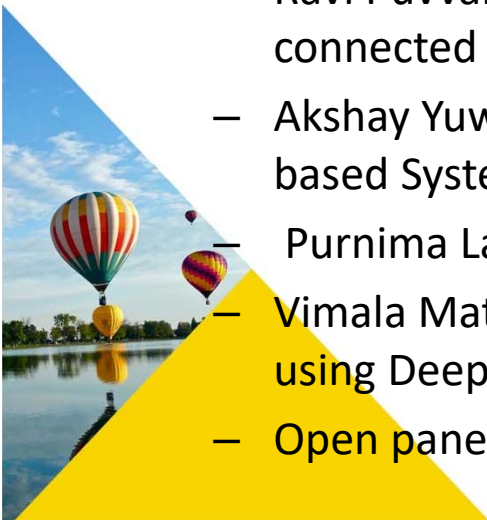
- WWRF 5G Huddle in New Delhi, Feb. 5-6, 2020

  - A panel session was organized on the topic of "Driving digital transformation in urban environments" in which the following papers and panel were organized.

  - Bipin Pradeep Kumar, "Case Study: 5G & Smart Cities"

  - Seshadri Mohan, "The Impact of Emerging Standards, 5G and Beyond, and Machine Learning on Connected Vehicles."

  - A Panel Discussion ensued following the above two papers.

Future 2020 Events

- Two Workshops are planned on Connected Vehicles
  - One on April 8, 2020 at IEEE 6th World Forum on IoT, New Orleans, Louisiana. (See https://wfiot2020.iot.ieee.org/program/technical-program/special-sessions-and-workshops/#WS3)
  - Another on "Evolution of Connected Vehicles: The Role of AI/Machine Learning, Emerging Standards, and 5G and Beyond," (see https://ieee-wf-5g.org/workshop-on-evolution-of-connected-vehicles-the-role-of-ai-machine-learning-emerging-standards-and-5g-and-beyond/) at IEEE 5G World Forum, Bengaluru, India, Sep. 10-12, 2020.

Future 2020 Events

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- VIP CV will meet at the forthcoming WWRF meetings:
  - WWRF44 at Aarhus Universiy, Copenhagen, Denmark in May (www.wwrf42.ch)
  - WWRF45 in Malaysis, in October (www.wwrf43.ch)
- 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

White Paper on Connected Vehicles Published as Outlook 25

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OUTLOOK

Visions and research directions for the Wireless World
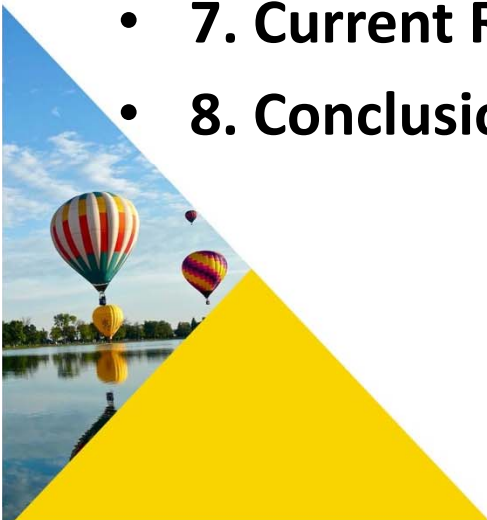
Connected Vehicles

October 2019, No 25

Outlook 25 Connected Vehicles

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- **1. Introduction**
- **2. Relevant Standards**
- **3. Heterogeneous Connectivity and Requirements of CV**
- **4. Spectrum Issues**
- **5. Security and Privacy in Connected Vehicles**
- **6. Cyber Security Issues Relevant to Connected Vehicles**
- **7. Current Research Relevant to IoV**
- **8. Conclusions**

CV White Paper II

- Another White Paper is being planned the topic of which is
  - **"Role of AI/Machine Learning in Connected Vehicles."**

Contact

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